This Recommended Practice received approval from the NMRA Board of Trustees in July 1995 and March 1997.

Fail-Safe Operating Characteristics For Digital Command Control, All Scales

Revised March, 1997	RP 9.2.4

The purpose of this RECOMMENDED PRACTICE is to insure that Digital Command Stations and Digital Decoders operate together in known, predictable, and compatible ways for certain key events. These events are:

A: initialization of the DCC system
B: conversion between different power modes
C: occurrence of error conditions

The definition of the operation during these three key events is especially important given that the Digital Command Stations and Digital Decoders may be provided by different manufacturers.

This RECOMMENDED PRACTICE is designed to be used in conjunction with the other relevant NMRA documents which relate to DCC.

A: Initialization of the DCC system

Upon initialization of the DCC system two possible conditions exist:

- the *Digital Command Station* has retained information about the previous state of the system
- the *Digital Command Station* has no information about the previous state of the system

In the case where there is no information about the previous state of the system, the *Digital Command Station* shall send a minimum of twenty (20) digital decoder reset packets to the layout followed by a minimum of ten (10) idle packets. These packets shall be sent prior to sending any packets which contain operating instructions to the layout. The ten idle packets are required to insure that the *Digital Decoders* exit service mode. For further details on reset packets and idle packets refer to NMRA Standard S-9.2. For further information on Service Mode refer to RP-9.2.3.

Upon receiving power, *Digital Decoders* enter normal digital operations mode[1]. If this follows only a minor interruption in power such that the *Digital Decoder* has valid speed and direction information, it is permissible for the *Digital Decoder* to resume operation. Otherwise, the *Digital Decoder* shall bring the device being controlled to its initial defined state (which for locomotives is a complete stop).

B: Converting Between Different Power Modes

When a *Multi Function Digital Decoder* that has automatic conversion enabled detects the absence of the NMRA digital signal for more than 30 milliseconds, it is permissible for the decoder to convert to an alternate power source. If the decoder converts to analog mode, it shall accelerate (decelerate) the locomotive at the programmed acceleration (deceleration) rate in the direction specified by S9 (to the best of its ability) until the available analog power level is reached.

When the *Multi Function Digital Decoder* is not in digital mode and detects the presence of the NMRA digital signal, it shall return to digital operations mode and at its option: 1) continue to operate at the same speed as it was operating under the alternate power source, 2) operate at the last known digital speed, or 3) come to a stop until a proper digital instruction is received.

[1] *Digital Decoders* must be in digital operations mode in order to interpret NMRA digital packets for the purpose of operating the railroad and its trains.

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When converting between alternate power sources, if the new direction information is such that it would cause the locomotive to reverse direction, the *Multi Function Digital Decoder* will decelerate the locomotive (to a complete stop if necessary) until such time as either 1) the direction information is the same, 2) a command control packet is received that tells the *Multi Function Digital Decoder* to stop, 3) a reset packet is received or 4) the track voltage drops to "0" volts for 500 milliseconds.

C: Occurrence of Error Conditions

While in digital operations mode each *Multi Function Digital Decoder* shall have a Packet Update time-out value. While in digital operations mode, if the packet time-out value is exceeded, the *Multi Function Digital Decoder* will bring to a stop all controlled devices. The purpose of this time-out is to insure that each *Multi Function Digital Decoder* receives a periodic update from the *Digital Command Station* and thereby help prevent runaway conditions. The user should be able to define the value for this time-out within these restrictions:

- a value of 0 disables the time-out (i.e., the user has chosen not to have a time-out)
- a value range of 1 through TIMEOUT_MAX sets the time-out to the chosen value. The minimum value of TIMEOUT_MAX will be 20 seconds. It may be longer at the manufacturer's discretion.

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