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| TITLE**DCC Decoder Test System** **Design Specification - Sender 4** | | | | | | | | |
| Brian Barnt 33959 Gloria Avenue  North Ridgeville, OH 44039  216.496.6750 | | | | | **DWG NO.**  93-0147-002 | | | **Rev.**  **A** |
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# Overview & History

This project is a major revision of the National Model Railroad Association’s (NMRA) Digital Command Control Decoder Test Board. This document assumes that the reader is already familiar with Digital Command Control (DCC) specified in the NMRA Standards and Recommended Practices[[1]](#endnote-1), specifically S-9.1, S-9.2, and RP-9.1.1 through RP-9.3.2.

The original DCC Decoder Test board, designed in 1994, generated DCC packets of varying bit times to establish the timing range that a DCC Decoder under test would accept. This was accomplished using PC software and a custom ISA timing card installed in the PC. This combination worked well for the basic signal timing specified in Standard S-9.1.

In 1998, the growing number of DCC manufacturers had purchased all of the ISA timing circuit cards built. Realizing that the ISA bus was being phased out, the second-generation cards were built with an additional 8-bit input port, and a PC/104 connector as well as the ISA connector.

The operation of both the original timing board (called a “sender board”) and the follow-up board (“send2” or “sender2”) are well documented in the “NMRA Conformance Test DCC Signal Generator – Theory of Operation” by Ken West.

This project involves revision of the sender board hardware as well as it’s associated PC software. To make the scope more manageable, it has been broken down into two phases. Phase 1 will create a new hardware design using a USB interface to the test hardware and the associated PC software. Phase 2 will add new hardware to address needs not anticipated in the original design.

# Design Specification

The Product Design Specification details the requirements and inner workings of the product’s hardware, software, packaging, and so forth. Figuratively speaking, it provides the high level design from which all detail work will be based on.

# Hardware Architecture

Insert diagram of hardware here.

Figure : Block Diagram of Device

Now describe each block, what it does, etc.

# Software Architecture

### Language

The software for this project will be written in **C**, using the encapsulation concepts from C++ as far as possible, per Coding Standards (Dwg. 94-012-000).

### Development Tools

This project uses the ??? Compiler for ???, and associated tools.

### System Inputs

|  |  |
| --- | --- |
| **Signal** | **Source and Range** |
|  |  |
|  |  |
|  |  |

### System Outputs

|  |  |
| --- | --- |
| **Signal** | **Destination** |
|  |  |
|  |  |
|  |  |

### Error Handling

….

## Top-Level Architecture

….

### Interrupt Service Routines

…

#### ISR\_Routine\_1

Description of ISR\_Routine\_1

#### ISR\_Routine\_2

Description of ISR\_Routine\_2.

#### ISR\_Routine\_3

Description of ISR\_Routine\_3.

### State Machine

Description of states.

## Low-Cost Version Software Modules

The following modules and public functions make up the program.

Module Drawing

### Module A

|  |  |
| --- | --- |
| Description | Simple description of function of file. |
| Notes | Other help for reader, including references. |

#### Procedure Foo

|  |  |
| --- | --- |
| Name | Type FuncionFoo (Param1, Param2) |
| Description | Sinple description of function of the function Foo(). |
| On Entry |  |
|  | Type Param1 – description of use |
|  | Type Param2 – description of use |
| On Exit |  |
|  | Type Param1 – description of use |
|  | Type Param2 – description of use |
| Globals |  |
|  | Type variableName – description of use |
| Returns |  |
|  | Type – description o fvalue |

# Test Methodology

## Compatibility Testing

….

## Distortion Testing

## Environmental Testing

## FCC & CE Testing

A prototype unit will be tested for emissions as soon as is practical.

# Manufacturing Requirements

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1. "NMRA - Introduction to Standards" National Model Railroad Association. 23 Feb 2009 <http://www.nmra.org/standards/standards.html>. [↑](#endnote-ref-1)