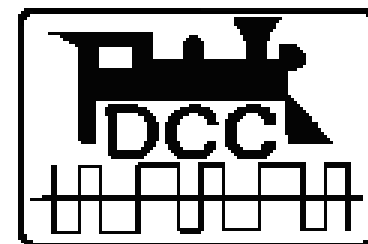# DCC Locomotive Speed Matching

by
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Introduction – Why do we need Speed Matching?

- Prototype railroads operate long trains by:

  - Adding more diesel locomotives

  - Provides power needed to move train at desired speed over track route to be followed

- This locomotive lash up is called a Consist

  - Several locomotives being run together as a single locomotive (MU)

  - Prototype locomotives have equipment to synchronize members of consist for efficient aggregated tractive effort
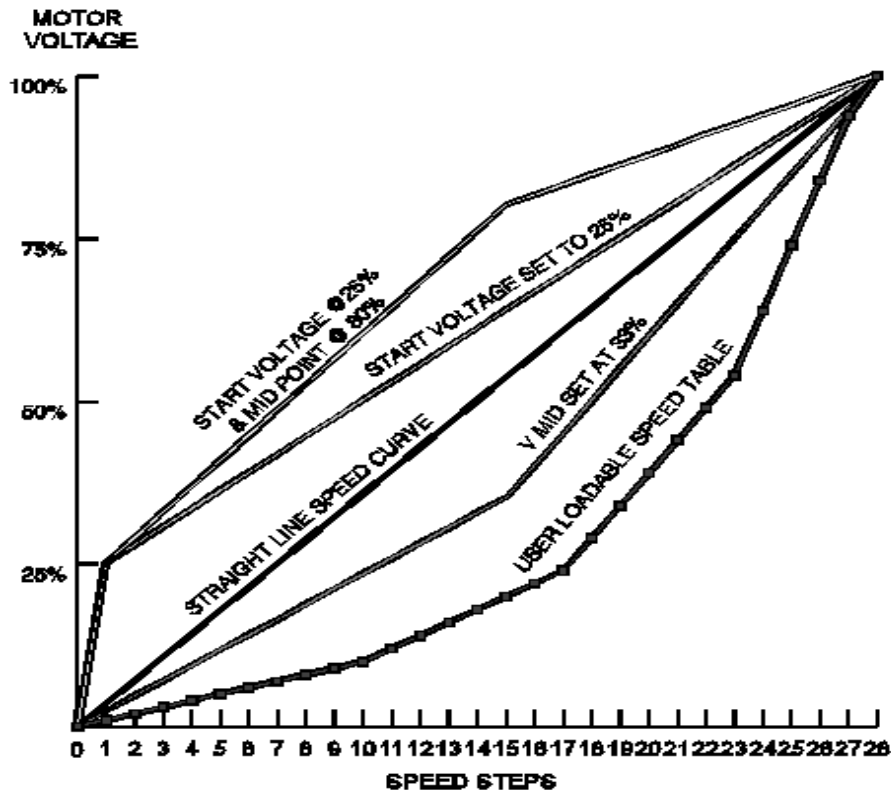
Introduction – Why do we need Speed Matching?

• N Scale model locomotives from different manufacturers do not run at the same speed for the same throttle setting

• Different locomotive models from the same manufacturer do not run at the same speed for the same throttle setting

• Thus, we cannot consist (MU) locomotives of different types/manufacturers as freely as prototype railroads can.

• Essentially we are limited to the same locomotive models from the same manufacturer, e.g. 2 x Atlas GP9.

DCC Speed Matching Theory

LOCOMOTIVE SPEED/VOLTAGE CURVE
OPTIONS WITH DCC

MOTOR VOLTAGE

100%

75%

50%

25%

START VOLTAGE @ 25% & MID POINT @ 80%

START VOLTAGE SET TO 25%

STRAIGHT LINE SPEED CURVE

V MID SET AT 50%

USER LOADABLE SPEED TABLE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

SPEED STEPS

- Utilizing capabilities of DCC decoders in two ways, we can speed match various locomotives:
  - **1st method**....Use Vstart, Vmidpoint and Vmaximum settings in decoder Configuration Variables (CV).
    - **This is an easy way to get close, especially with two locos of same type and manufacture.**
    - **Does require loco owner to be familiar with CV tables & settings for various decoders**
    - **Does require loco owner to be familiar with JMRI Decoder Pro**
    - **May require some "tweaking"**
    - **Close is often not good enough!**

DCC Speed Matching Theory

- **Utilizing capabilities of DCC decoders in two ways, we can speed match various locomotives:**
  - **2nd method…Use the 28-step speed table built into most DCC decoders**
  - **Using special Speed Matching Script with JMRI software and the speed match layout**
  - **Allows for easy method of setting the 28-step speed table to speed match our model locomotives so we have same freedom as the prototype in consisting locomotives.**

Look Up Table Method

The look up table below shows the effects of different CV values that you can program into CV29. CV values are shown in both decimal & hex. The factory default value for CV29 is 06.

CV Value For CV29 Hex or Dec		Speed Steps/ Speed Table	Analog Mode Conv	Normal Direction Of Travel	2 or 4 Digit Adr
x00	000	14	OFF	Forward	2
x01	001	14	OFF	Reverse	2
x02	002	28/128	OFF	Forward	2
x03	003	28/128	OFF	Reverse	2
x04	004	14	ON	Forward	2
x05	005	14	ON	Reverse	2
x06	006	28/128	ON	Forward	2
x07	007	28/128	ON	Reverse	2
x10	016	14 Speed Table	OFF	Forward	2
x11	017	14 Speed Table	OFF	Reverse	2
x12	018	28/128 Speed Tbl	OFF	Forward	2
x13	019	28/128 Speed Tbl	OFF	Reverse	2
x14	020	14 Speed Table	ON	Forward	2
x15	021	14 Speed Table	ON	Reverse	2
x16	022	28/128 Speed Tbl	ON	Forward	2
x17	023	28/128 Speed Tbl	ON	Reverse	2
x20	032	14	OFF	Forward	4
x21	033	14	OFF	Reverse	4
x22	034	28/128	OFF	Forward	4
x23	035	28/128	OFF	Reverse	4
x24	036	14	ON	Forward	4
x25	037	14	ON	Reverse	4
x26	038	28/128	ON	Forward	4
x27	039	28/128	ON	Reverse	4
x30	048	14 Speed Table	OFF	Forward	4
x31	049	14 Speed Table	OFF	Reverse	4
x32	050	28/128 Speed Tbl	OFF	Forward	4
x33	051	28/128 Speed Tbl	OFF	Reverse	4
x34	052	14 Speed Table	ON	Forward	4
x35	053	14 Speed Table	ON	Reverse	4
x36	054	28/128 Speed Tbl	ON	Forward	4
x37	055	28/128 Speed Tbl	ON	Reverse	4

DCC Speed Matching Theory

– **The individual owner can choose the speeds in which to match his/her locomotives.**

– **One suggestion for matching different locomotives is provided in the table below for diesel locomotives:**
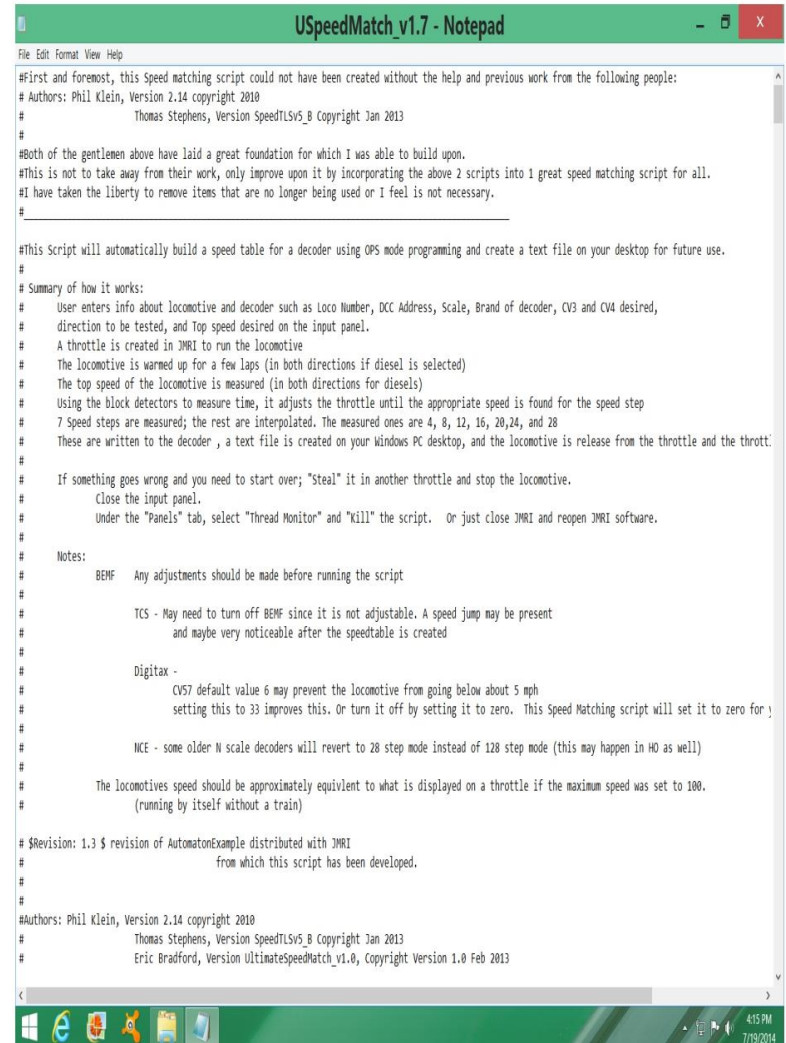
Diesel Locomotives	
Type of Locomotive	**Speed**
Freight	70
Passenger	100
Switcher	50

DCC Speed Matching Theory

- **Note: Check the maximum speeds of locomotives in your roster to ensure the selected speed for matching is within the capability of the locomotives in the class.**

  - For example, do not choose 80 mph as the maximum speed for your freight locomotives if some of them cannot go that fast.

- **Choosing a speed for matching steam locomotives is not as easy, as maximum speeds for steam locomotives are almost totally dependent on their wheel diameter, steaming capabilities and vintage.**

  - You may have to check prototype information to determine the maximum prototype speed for the particular locomotive.

DCC Speed Matching Operation

- **The speed matching script will automatically build a speed table for a decoder using OPS mode programming and create a text file on the computer desktop for future use.**

DCC Speed Matching Operation

- **The user enters information about the locomotive into the "Speed Matching Table Input Panel." (shown below)**
  - Locomotive road number
  - Decoder DCC address
  - Type of Locomotive (steam,diesel,etc.)
  - Scale (defaults to "N")
  - Brand of Decoder (defaults to "Digitrax")
  - Acceleration (CV3) and deceleration (CV4) desired (disabled while script is running)
  - Direction to be tested (defaults to "Forward")
 - Top speed desired.
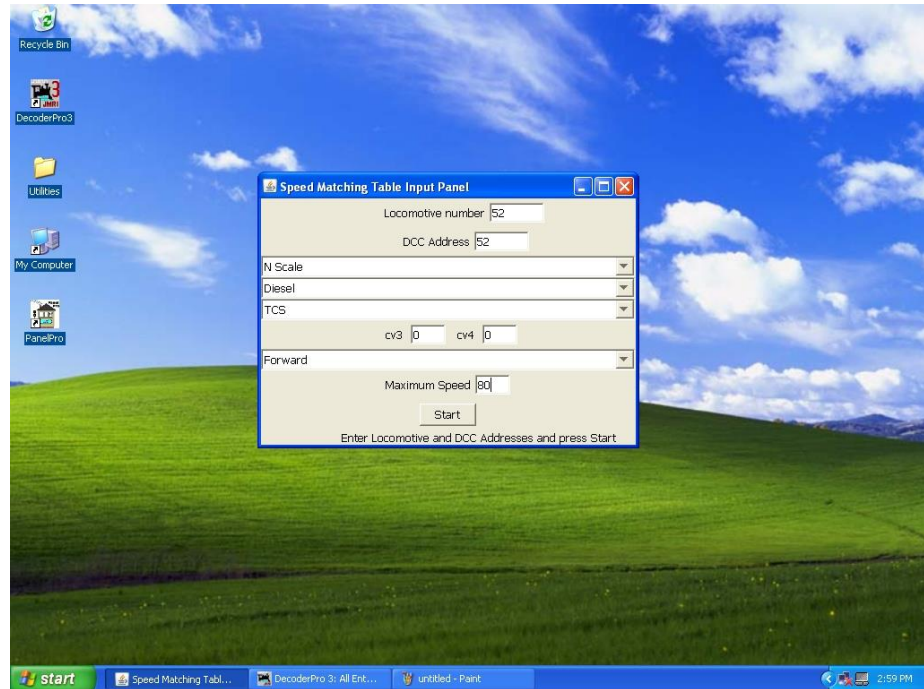
DCC Speed Matching Operation

- **Connect the computer to the Command Station using a LocoBuffer or PR3/4 with appropriate cables and then turn it on**

- **Allow the computer to boot to its desktop.**

- **Boot DecoderPro and run the Speed Matching script.**

- **A throttle is created in JMRI to run the locomotive**

DCC Speed Matching Operation

- **Do an OpSw #39 reset of the Command Station to ensure a clean running command station.**

- **Both the locomotive and speed matching layout must be in top shape to ensure the best possible speed match results**
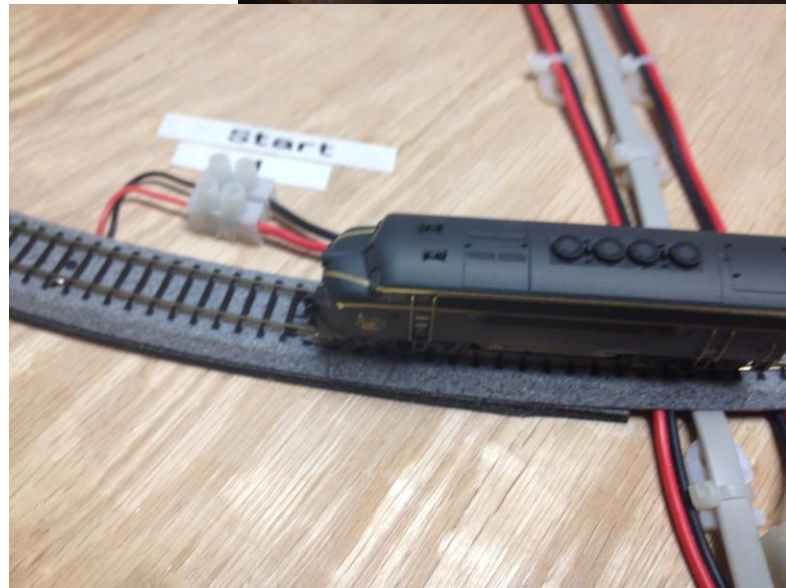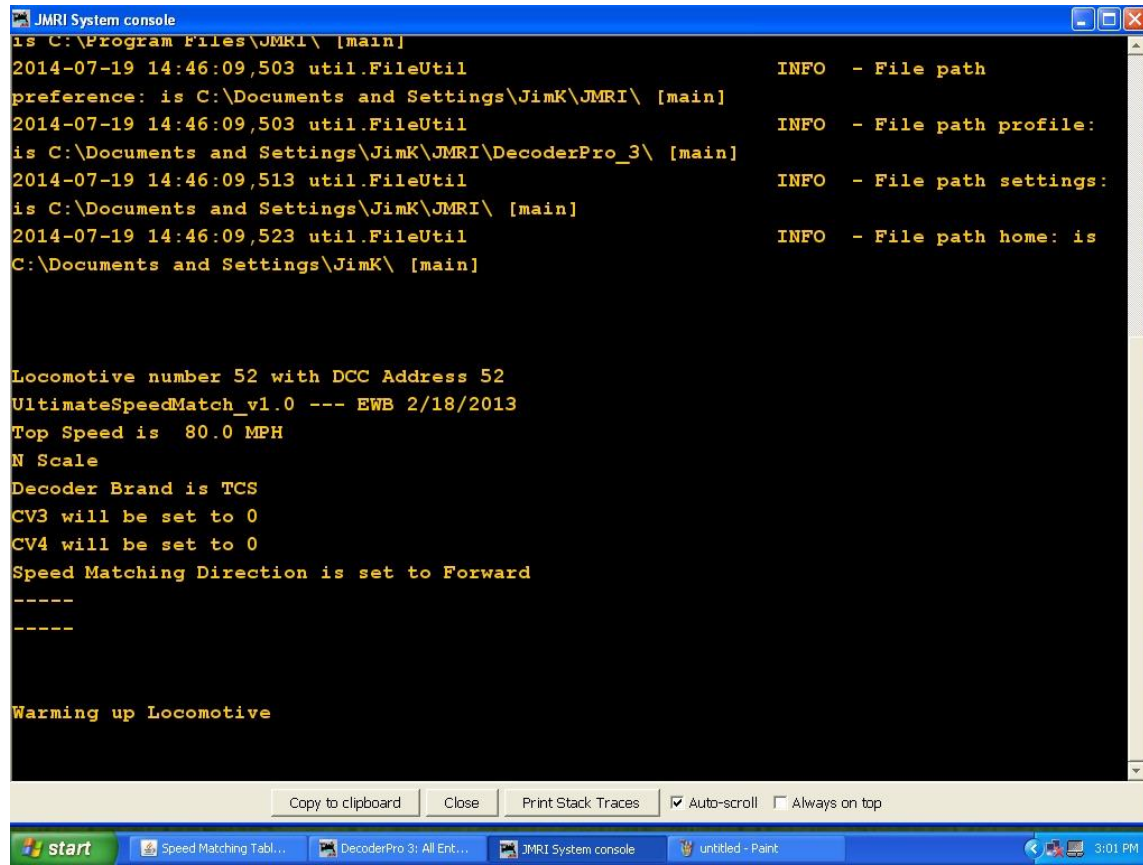
DCC Speed Matching Operation

- **Locomotive is placed at Start location**
- **The locomotive is warmed up for a few laps around the layout (in both directions if diesel; in forward direction only if steam)**
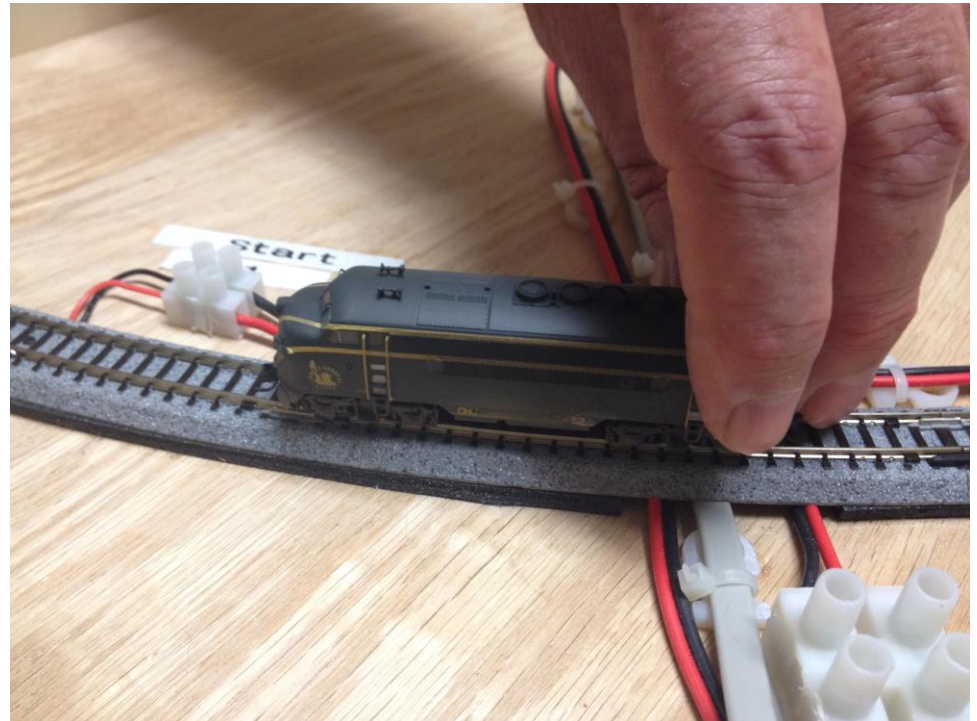
DCC Speed Matching Operation

- **JMRI System Console messages seen during warm up**

- **The top speed of the locomotive is measured (in both directions for diesels)**

DCC Speed Matching Operation

- **The Speedometer can be used to verify speeds detected by the script**
- **You may notice a slight difference between the script speed and the speedometer reading**
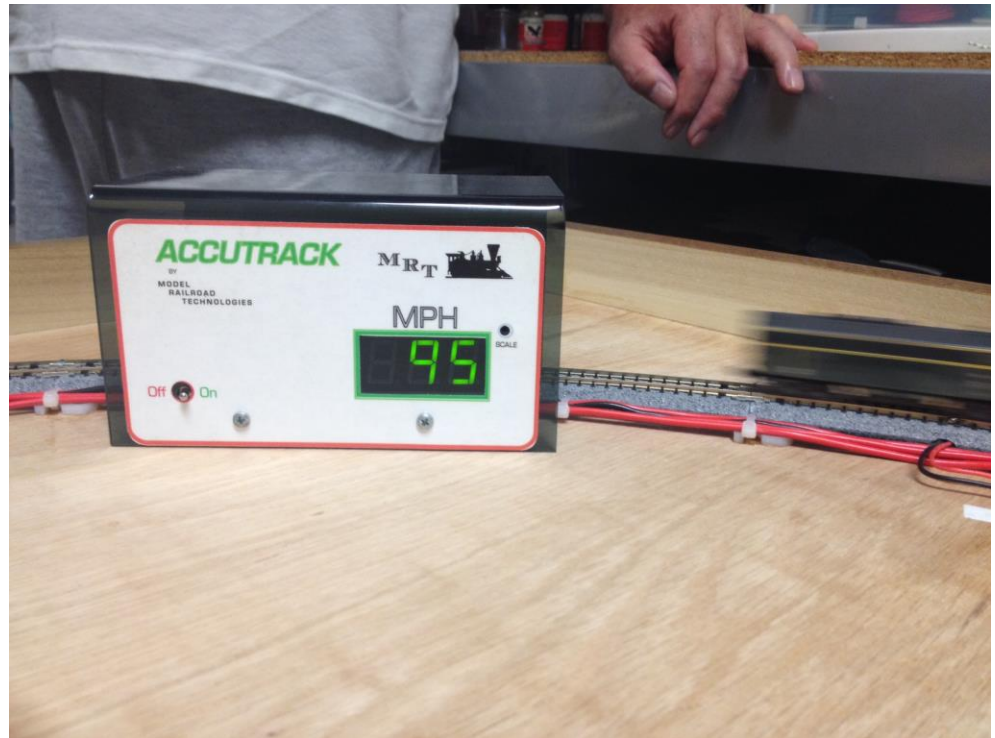
DCC Speed Matching Operation

- **Using the block detectors to measure time, the script adjusts the throttle until the appropriate speed is found for the speed step.**
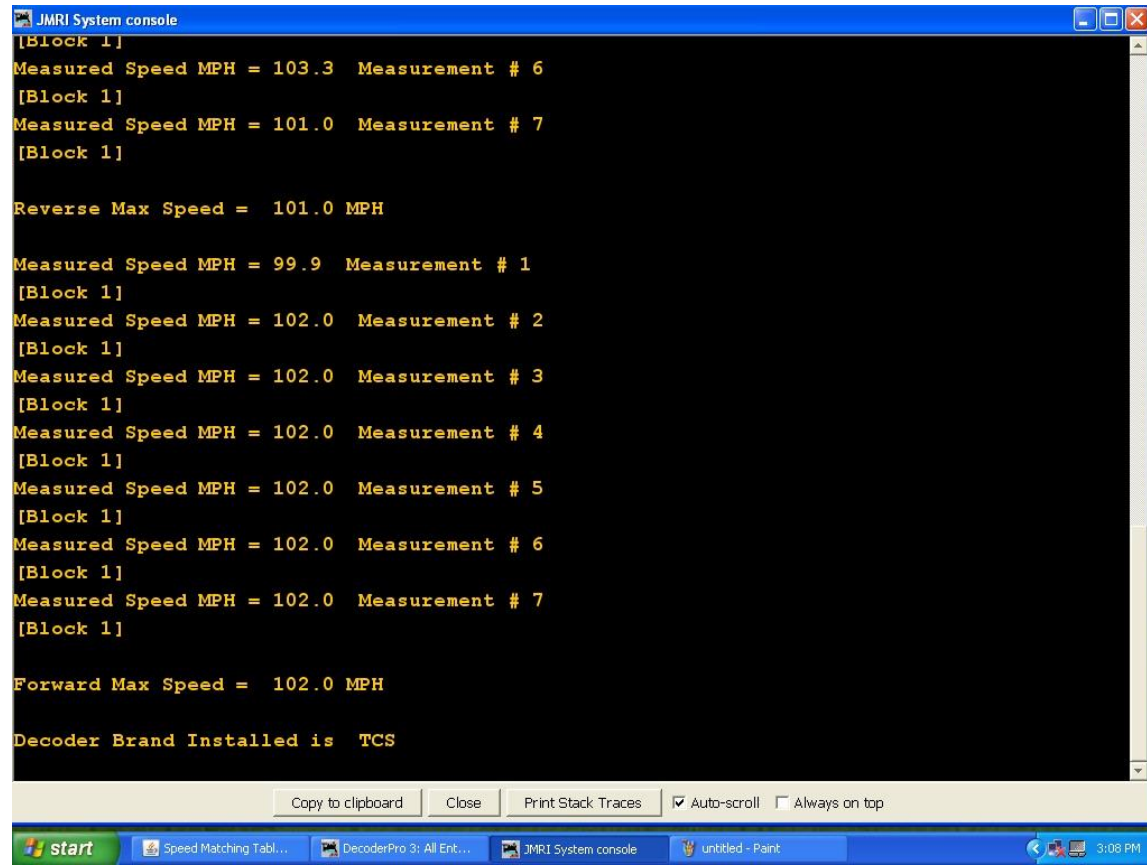
- **Seven speed steps are measured, and the rest interpolated. The measured speed steps are 4, 8, 12, 16, 20, 24 and 28**


```
JMRI System console

[Block 1]
Measured Speed MPH = 103.3  Measurement # 6
[Block 1]
Measured Speed MPH = 101.0  Measurement # 7
[Block 1]

Reverse Max Speed =  101.0 MPH

Measured Speed MPH = 99.9  Measurement # 1
[Block 1]
Measured Speed MPH = 102.0  Measurement # 2
[Block 1]
Measured Speed MPH = 102.0  Measurement # 3
[Block 1]
Measured Speed MPH = 102.0  Measurement # 4
[Block 1]
Measured Speed MPH = 102.0  Measurement # 5
[Block 1]
Measured Speed MPH = 102.0  Measurement # 6
[Block 1]
Measured Speed MPH = 102.0  Measurement # 7
[Block 1]

Forward Max Speed =  102.0 MPH

Decoder Brand Installed is  TCS
```
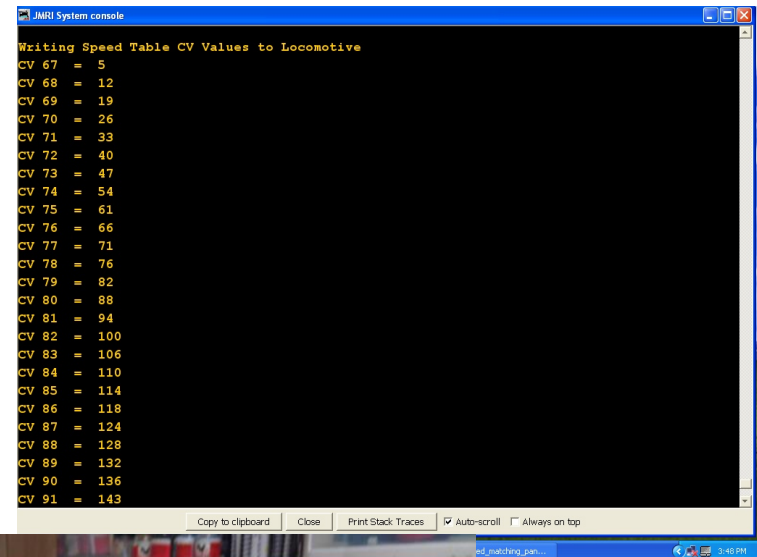
DCC Speed Matching Operation

- **The values determined for the speed steps are written to the decoder, and a text file is created on the computer containing the speed step values and other appropriate information for the decoder**

- **The locomotive is released from the JMRI throttle, and the throttle is discarded**


```
JMRI System console

Writing Speed Table CV Values to Locomotive
CV 67  =  5
CV 68  =  12
CV 69  =  19
CV 70  =  26
CV 71  =  33
CV 72  =  40
CV 73  =  47
CV 74  =  54
CV 75  =  61
CV 76  =  66
CV 77  =  71
CV 78  =  76
CV 79  =  82
CV 80  =  88
CV 81  =  94
CV 82  =  100
CV 83  =  106
CV 84  =  110
CV 85  =  114
CV 86  =  118
CV 87  =  124
CV 88  =  128
CV 89  =  132
CV 90  =  136
CV 91  =  143
```
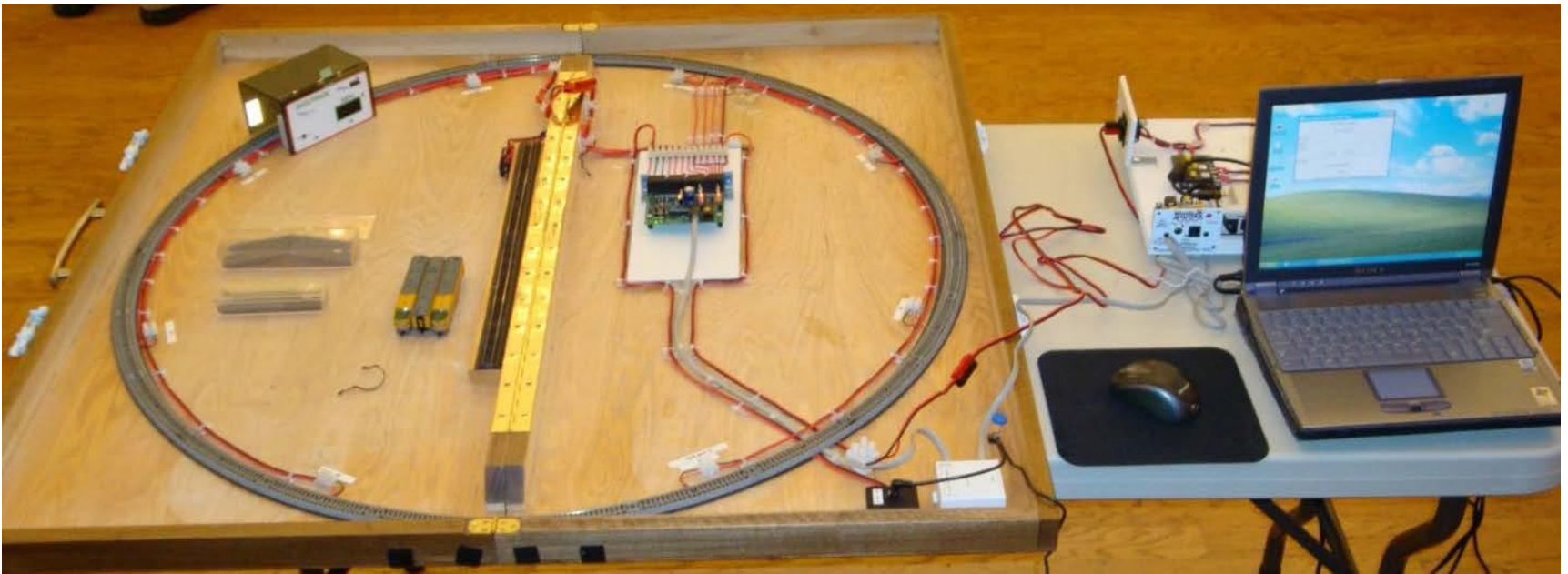
Copy to clipboard   Close   Print Stack Traces   Auto-scroll   Always on top

Folding Layout for Speed Matching

Circle of Kato Unitrack 19" radius (24 sections), divided into 8 electrical sections.

Folding layout dimensions 42" x 42", folded 42" x 21"

Layout for Speed Matching

Circle of Kato Unitrack 19" radius (24 sections), divided into 12 electrical sections.

Layout dimensions 40.5" x 40.5"

Rail A & B /Ground — LocoNet — Power In

Digitrax BDL168 Occupancy Detector

Layout Wiring Detail

- **BDL168 "Home Run" wiring diagram includes:**
  - **LocoNet**
  - **Power Supply**
  - **Detection Sections**
  - **Zone wiring**
- **Full BDL168 install details available on pdf**
  - **Download from Digitrax web site**
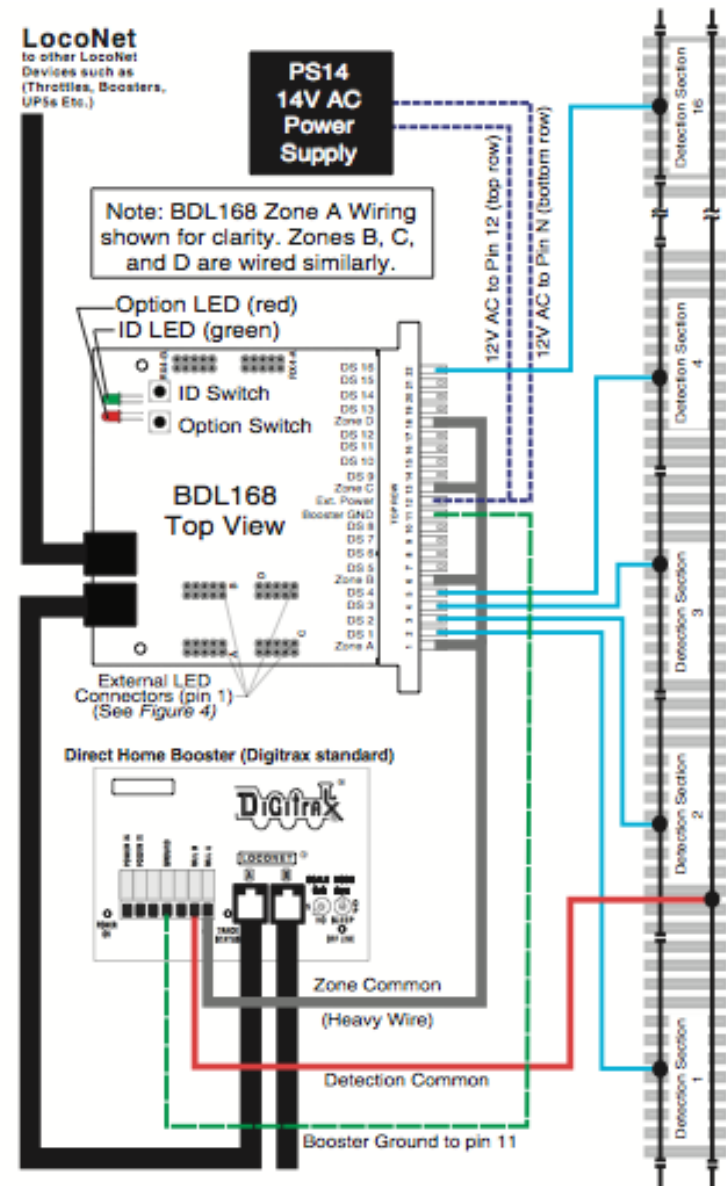
Caution

- **Use command station for programming with the same voltage as the command station which controls the layout.**
  - **DCS100/200/210/240 = 12V (N), 14.5V (HO)**
  - **DCS50/51/52 = 14.5V**
  - **Difference is about 17%, results in different end voltage for low-speed gearing (Atlas) and high-speed gearing (Kato)**
  - **Locos speed matching using a 14.5V command station will probably not still be matched when powered by a 12V command Station**

Software
Speed Matching Script

- **Current version of the speed matching script is:**

    Ultimate_Speed_Match_v2.0-2.py

- **Not yet tested with 4.99.x series of JMRI or JAVA 11.**

- **On first use open the script in Notepad and read the enclosed instructions.**

- **To obtain email at president@nrail.org; wallisjm@att.net .**

DCC Locomotive Speed Matching