

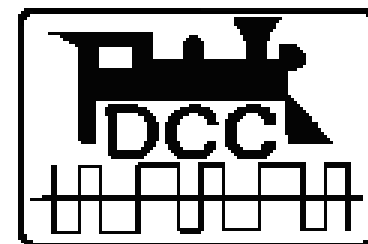
DCC Locomotive Speed Matching

by

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Eastern N Lines Partnership**



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**



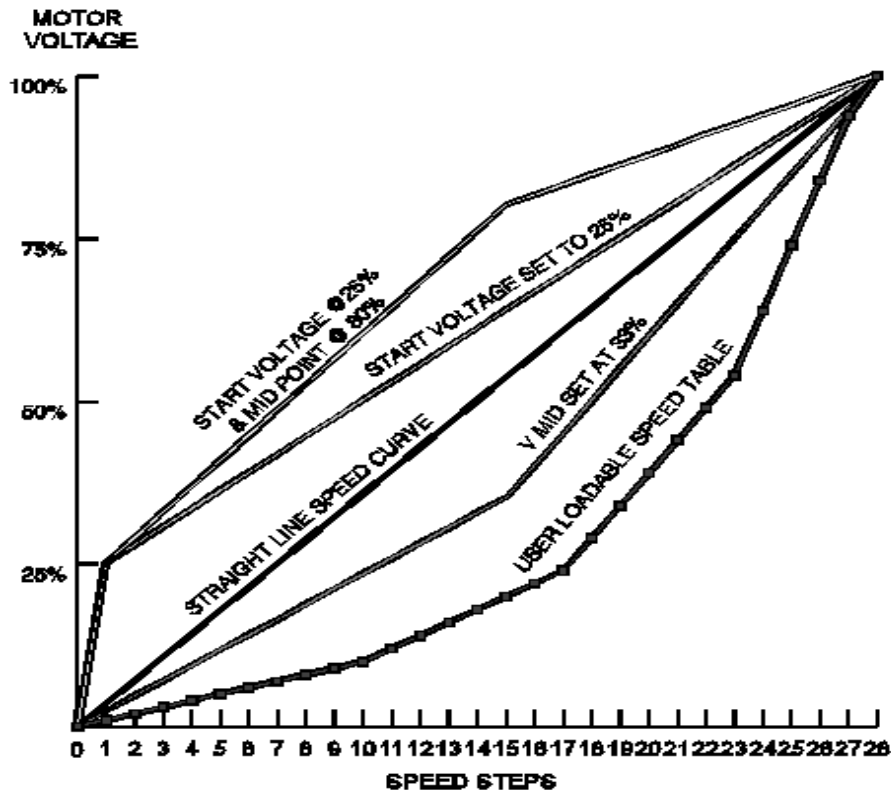
Introduction – Why do we need Speed Matching?

- 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



- 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:

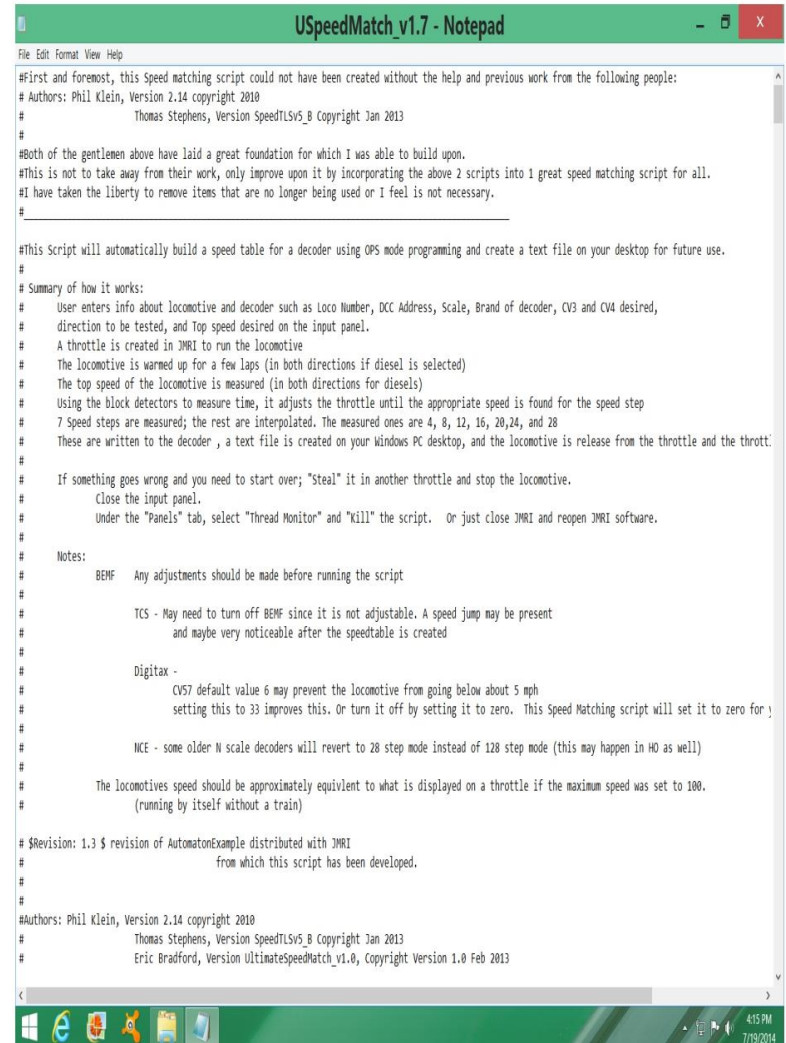
Diesel Locomotives	
Type of Locomotive	Speed
Freight	70
Passenger	100
Switcher	50

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.

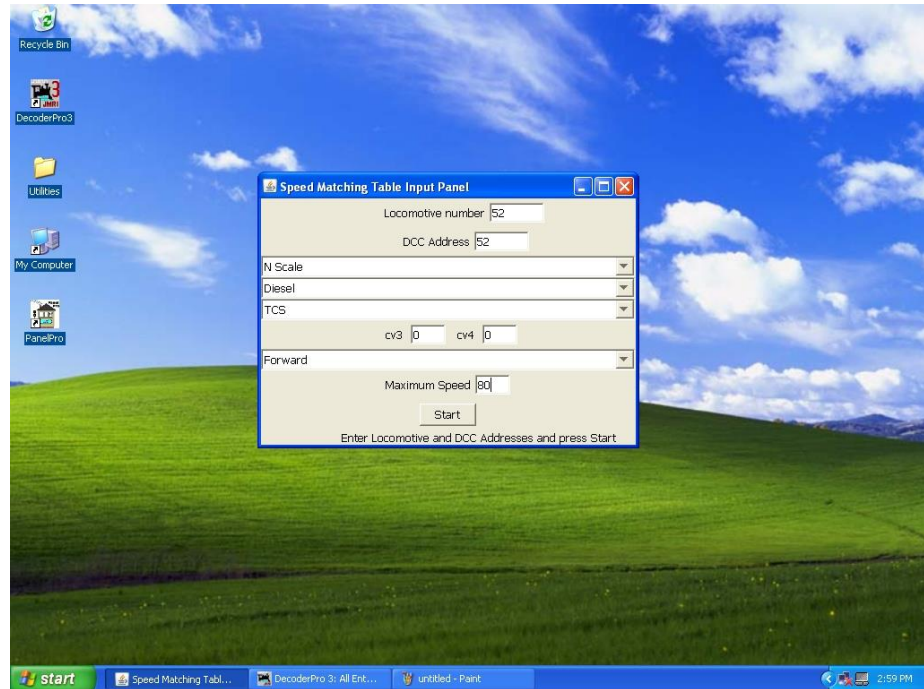


```
USpeedMatch_v1.7 - Notepad
File Edit Format View Help

#First and foremost, this speed matching script could not have been created without the help and previous work from the following people:
# Authors: Phil Klein, Version 2.14 copyright 2010
#           Thomas Stephens, Version SpeedT5V5_B Copyright Jan 2013
#
#Both of the gentlemen above have laid a great foundation for which I was able to build upon.
#This is not to take away from their work, only improve upon it by incorporating the above 2 scripts into 1 great speed matching script for all.
#I have taken the liberty to remove items that are no longer being used or I feel is not necessary.
#
#
#This Script will automatically build a speed table for a decoder using OPS mode programming and create a text file on your desktop for future use.
#
# Summary of how it works:
#   User enters info about locomotive and decoder such as Loco Number, DCC Address, Scale, Brand of decoder, CV3 and CV4 desired,
#   direction to be tested, and Top speed desired on the input panel.
#   A throttle is created in JMRI to run the locomotive
#   The locomotive is warmed up for a few Laps (in both directions if diesel is selected)
#   The top speed of the locomotive is measured (in both directions for diesels)
#   Using the block detectors to measure time, it adjusts the throttle until the appropriate speed is found for the speed step
#   7 Speed steps are measured; the rest are interpolated. The measured ones are 4, 8, 12, 16, 20, 24, and 28
#   These are written to the decoder, a text file is created on your Windows PC desktop, and the locomotive is release from the throttle and the thrott
#
# If something goes wrong and you need to start over; "Steal" it in another throttle and stop the locomotive.
#   Close the input panel.
#   Under the "Panels" tab, select "Thread Monitor" and "Kill" the script. Or just close JMRI and reopen JMRI software.
#
# Notes:
#   BEMF - Any adjustments should be made before running the script
#
#   TCS - May need to turn off BEMF since it is not adjustable. A speed jump may be present
#         and maybe very noticeable after the speedtable is created
#
#   Digitax -
#             CV57 default value 6 may prevent the locomotive from going below about 5 mph
#             setting this to 33 improves this. Or turn it off by setting it to zero. This Speed Matching script will set it to zero for
#
#   MCE - some older N scale decoders will revert to 28 step mode instead of 128 step mode (this may happen in HO as well)
#
#   The locomotives speed should be approximately equivalent to what is displayed on a throttle if the maximum speed was set to 100.
#   (running by itself without a train)
#
# $Revision: 1.3 $ revision of AutomatonExample distributed with JMRI
#           from which this script has been developed.
#
#
#Authors: Phil Klein, Version 2.14 copyright 2010
#           Thomas Stephens, Version SpeedT5V5_B Copyright Jan 2013
#           Eric Bradford, Version UltimateSpeedMatch_v1.0, Copyright Version 1.0 Feb 2013
```


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.



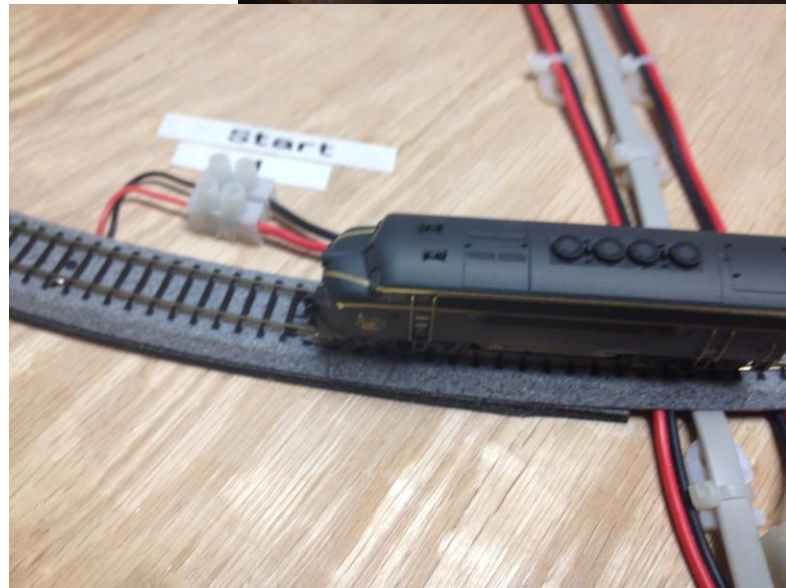
DCC Speed Matching Operation

- 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



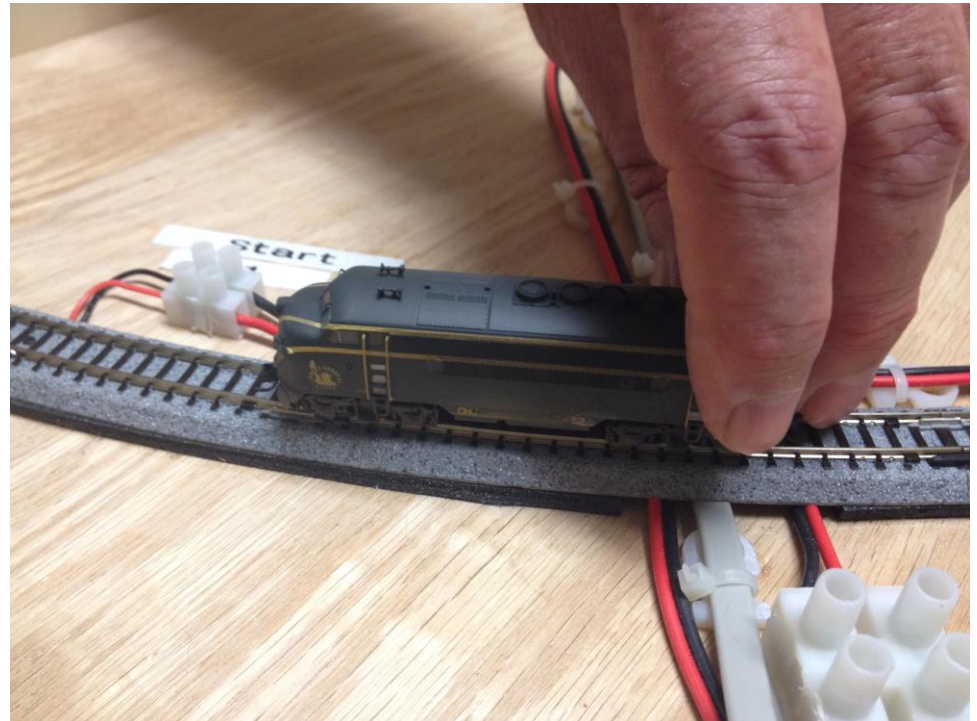
DCC Speed Matching Operation

- 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



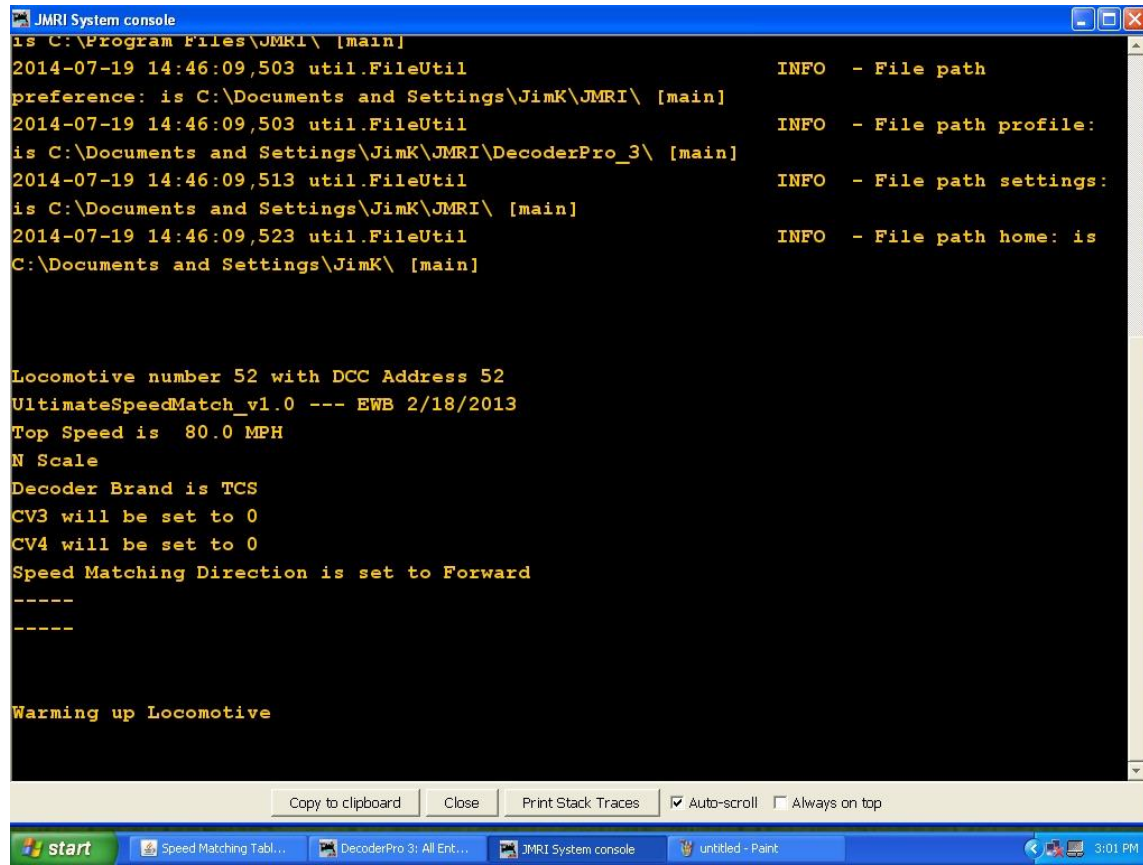
DCC Speed Matching Operation

- 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)



```
is C:\Program Files\JMRI\ [main]
2014-07-19 14:46:09,503 util.FileUtil          INFO - File path
preference: is C:\Documents and Settings\JimK\JMRI\ [main]
2014-07-19 14:46:09,503 util.FileUtil          INFO - File path profile:
is C:\Documents and Settings\JimK\JMRI\DecoderPro_3\ [main]
2014-07-19 14:46:09,513 util.FileUtil          INFO - File path settings:
is C:\Documents and Settings\JimK\JMRI\ [main]
2014-07-19 14:46:09,523 util.FileUtil          INFO - File path home: is
C:\Documents and Settings\JimK\ [main]

Locomotive number 52 with DCC Address 52
UltimateSpeedMatch_v1.0 --- EWB 2/18/2013
Top Speed is 80.0 MPH
N Scale
Decoder Brand is TCS
CV3 will be set to 0
CV4 will be set to 0
Speed Matching Direction is set to Forward
-----
-----

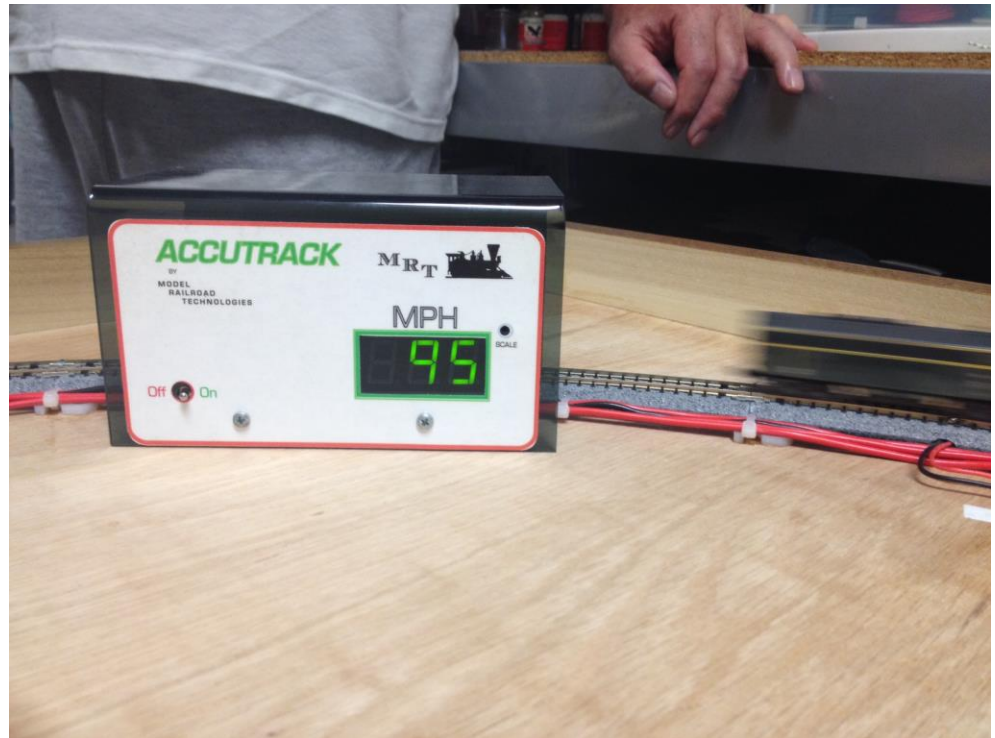
Warming up Locomotive
```

Copy to clipboard Close Print Stack Traces ☒ Auto-scroll ☐ Always on top

start Speed Matching Tabl... DecoderPro 3: All Ent... JMRI System console untitled - Paint 3:01 PM

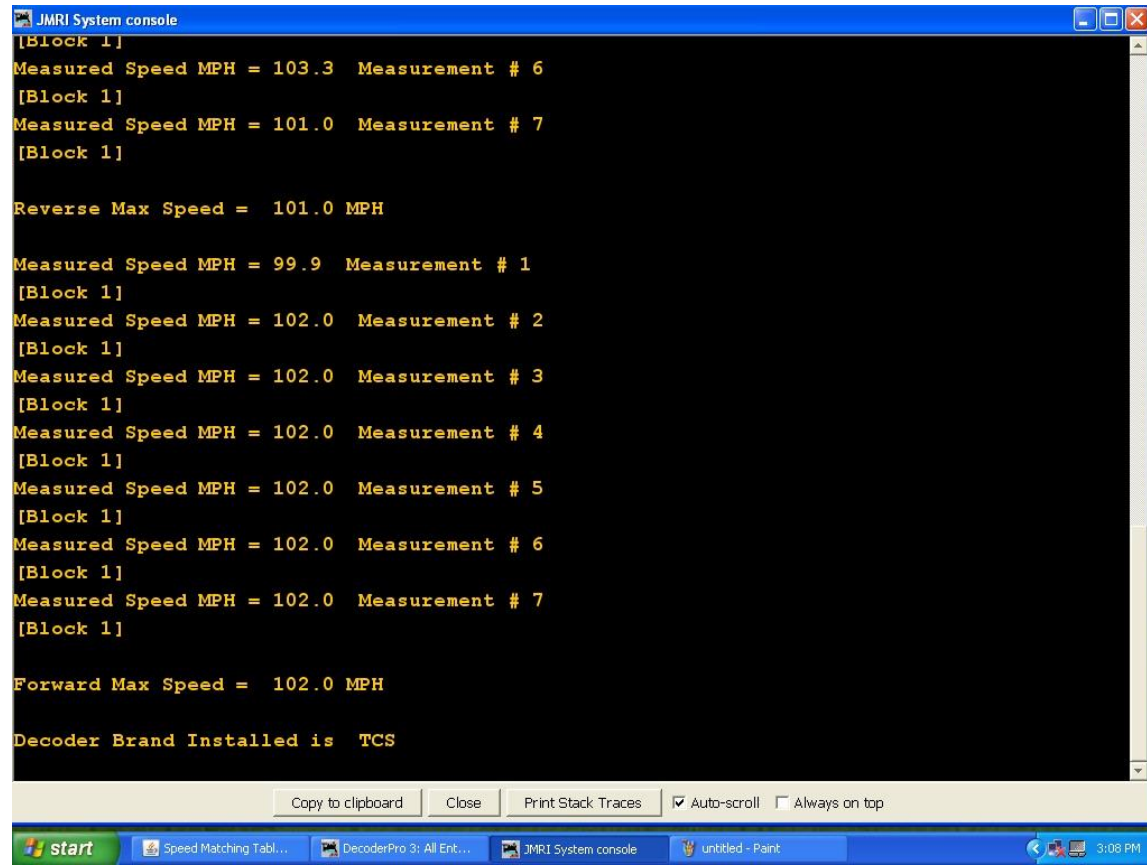
DCC Speed Matching Operation

- 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

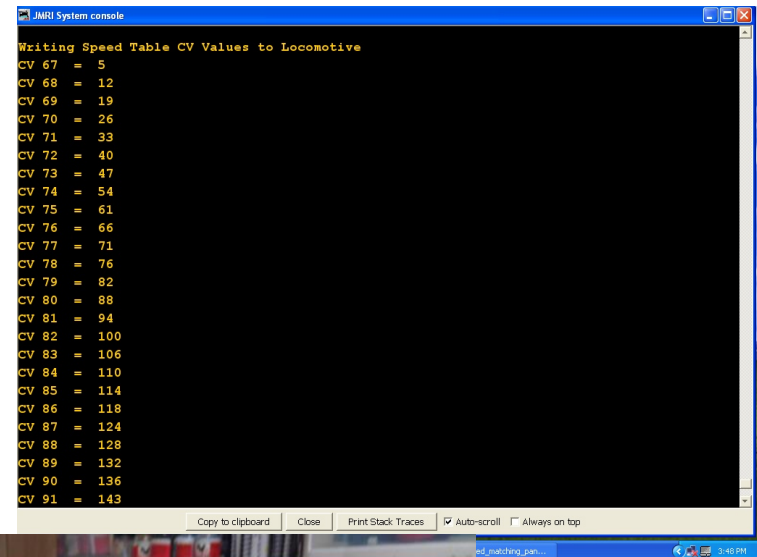
Decoder Brand Installed is TCS
```

Copy to clipboard Close Print Stack Traces ☒ Auto-scroll ☐ Always on top

start Speed Matching Tabl... DecoderPro 3: All Ent... JMRI System console untitled - Paint 3:08 PM

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



```
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
```

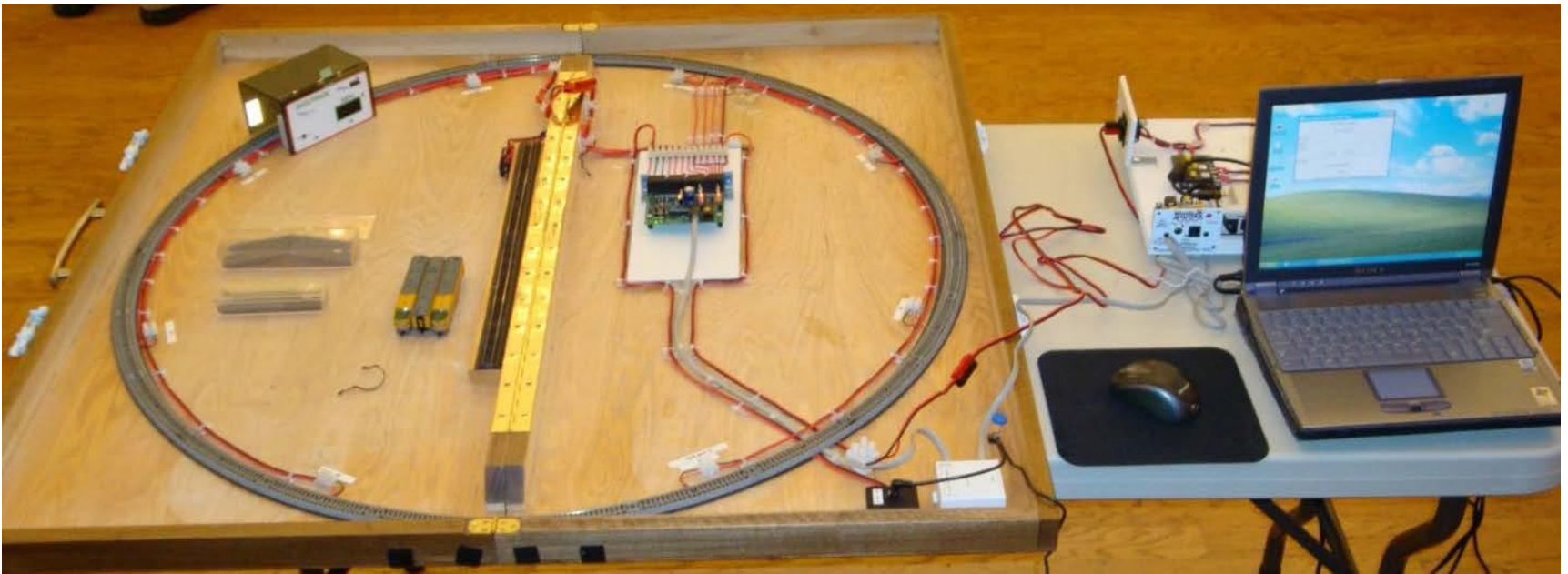
The screenshot shows a window titled "JMRI System console" with a black background and yellow text. It displays a list of CV values being written to a locomotive, ranging from CV 67 to CV 91. The window has standard Windows controls at the top and a status bar at the bottom with options like "Copy to clipboard", "Close", "Print Stack Traces", "Auto-scroll", and "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

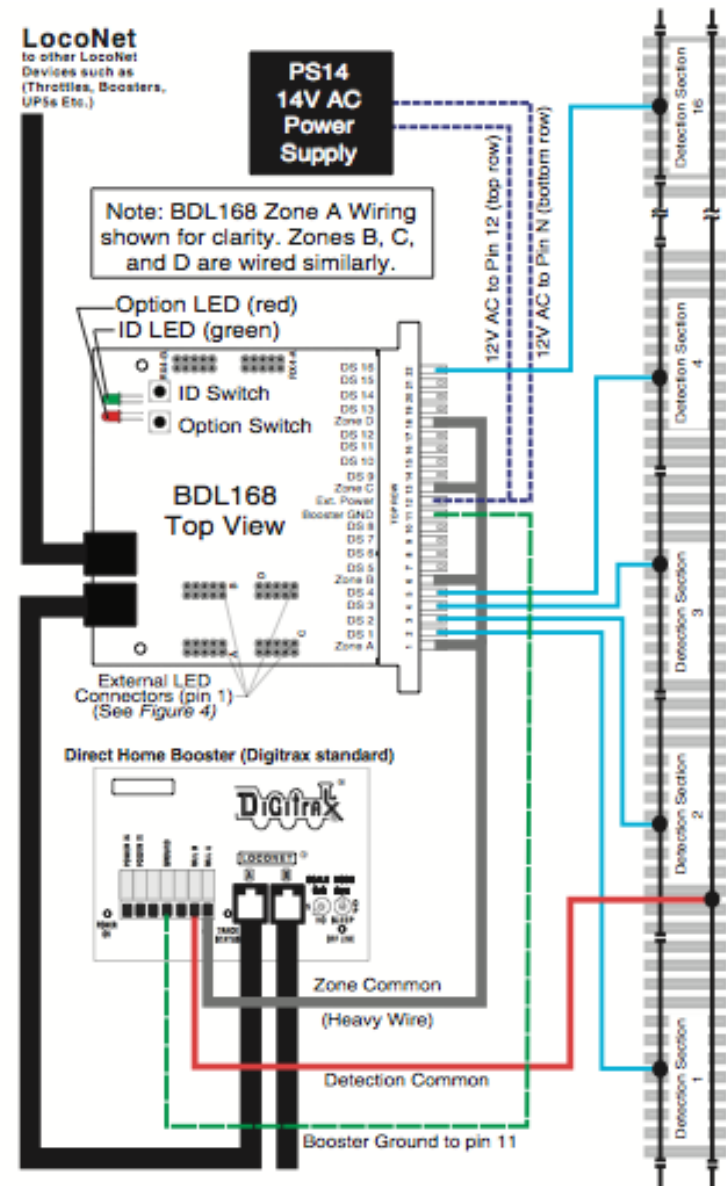
Circle of Kato Unitrack 19" radius (24 sections), divided into 12 electrical sections.

Layout dimensions 40.5" x 40.5"



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