

How To

Speed Matching the Locomotive Fleet

By John Deery

This article is about DCC controlled layouts. If you run DC, this will not work for you.

We all want our layout to run smoothly. Part of this smooth running involves adjusting how locomotives respond to throttle input by speed matching the locomotives. Speed matching is adjusting the locomotives in the fleet to run at the same speed for a given throttle setting. This is helpful if you want to run a consist (multiple locomotives running in the same train) or just want your engine fleet to respond the same way to a given throttle input. Many engines run fast out of the box with scale top speeds exceeding 100 MPH. You can slow these engines down to a more prototypical speed. All of this is easy with DecoderPro (part of the JMRI software suite) running on a computer connected to your layout's DCC command station.

Warning: New to JMRI DecoderPro or speed matching? Ask for help before proceeding.

I model in N scale. There are three brands of locomotives running on my layout: Atlas, Kato and Bachmann. Atlas engines are my preferred brand. The newer Atlas engines are good runners at all speeds and very quiet. Kato are a *very close* second (second based on the fact that I usually have to replace the Kato couplers). I have noticed the Kato may be a little bit noisier than the Atlas locos but they are also good runners. Bachmann engines are okay, but they are not the silky smooth runners like the Atlas and have poor slow speed control when switching (this may be a decoder issue). The decoders I run are NCE in the Atlas and Kato engines (installed either by me or OEM decoders). There are OEM wired decoders in the Bachmann (unknown brand, I looked), and an OEM Lenz decoder in one Atlas engine (not happy with it - no speed table function). All engines are speed matched unless the decoder does not allow simple speed profiles (V_{min} - V_{mid} - V_{max}) or a speed curve (like the Bachmann locos or the Lenz decoder). Then I just let it go (and I plan to replace these decoders in the future).

First try at Speed Matching – Using DecoderPro and a Circle of Track

I used this method the first time through the speed matching process. You choose one of locomotives to be the “standard locomotive” (also called the “golden loco”) and match the other locomotives against this one engine. Using DecoderPro, you set the V_{min} - V_{mid} - V_{max} values that allow the loco to mimic your “golden locomotive” (your standard). Watch a video that explains the process:

https://www.youtube.com/watch?v=9_XFU_YuNJQ

The V_{min} - V_{mid} - V_{max} method means you set the starting power, a top end power and a midpoint power. It is basic and easy to do. What you are actually doing is changing the values for several configuration variables that control locomotive speed. For some engines, this is all you can do (depending on your decoder, of course).

The process uses a loop of track hooked up to the layout power and a train controller. The JMRI Decoder Pro software runs on a PC connected to your layout (or in this case a loop of track) in Program on Main mode. You run your “golden loco” and the engine you are matching on the track loop at the same time. You adjust the power values at the Minimum, Midpoint and Maximum throttle settings for your new loco using DecoderPro. Then you write these values to your engine’s decoder on the fly. This changes the specific CV’s values in the decoder that control the power values at a given throttle setting. Shift the power up or down at a given throttle setting to match speeds with the standard locomotive. Take your time, make moderate adjustments and run several laps to check the speeds.

You spend a lot of time running your engines around a small test track. I found the process to be time consuming. I also did not get the results I wanted. The locomotives were close but not really speed matched. **If you do not plan to run locomotives in a consist, this method may be good enough to give you a similar throttle response across your engine fleet.**

HINT - If you are adding a new decoder to a locomotive, before you buy, be sure it will support full speed tables (not just V_{min} - V_{mid} - V_{max}) and has a trim function (adjusts forward vs. reverse speeds). Most mid-range (or better) decoders should have these functions. Not all OEM decoders have these functions. Know before you buy. This will prevent heartache later.

Second Try at Speed Matching – using DecoderPro, a Speedometer and my Layout

I found that the simple method was just that. Yes, it is easy, but it really does not work well across different manufacturers and decoders. For the next round of speed matching, I bought a Model Train Technologies Accutrack II speedometer (**Figure 1**). I use the speedometer to set all locomotives to run at the same scale speed for a given controller setting. This video shows the process using this speedometer:

<https://www.youtube.com/watch?v=g0HyUdH0dq8>

I went through and did the speed matching. I modified the process in the video a bit since I wanted to have only low speeds and simple controls. **On my layout, whatever the control is set at, the scale speed in MPH is the control setting divided by 2.** If the controller is set at 60, you are at a scale speed of 30 MPH.



Figure 1.

JMRI had good, clear directions on just how to set up the full speed curve. Print out their directions and follow them. There are some quirks with some decoder brands or types (none that I used had the quirks), but these issues are mentioned and a workaround is presented for these specific decoders. The article is here:

https://www.jmri.org/help/en/manual/DecoderPro3/Comp_Speed_Talble.shtml

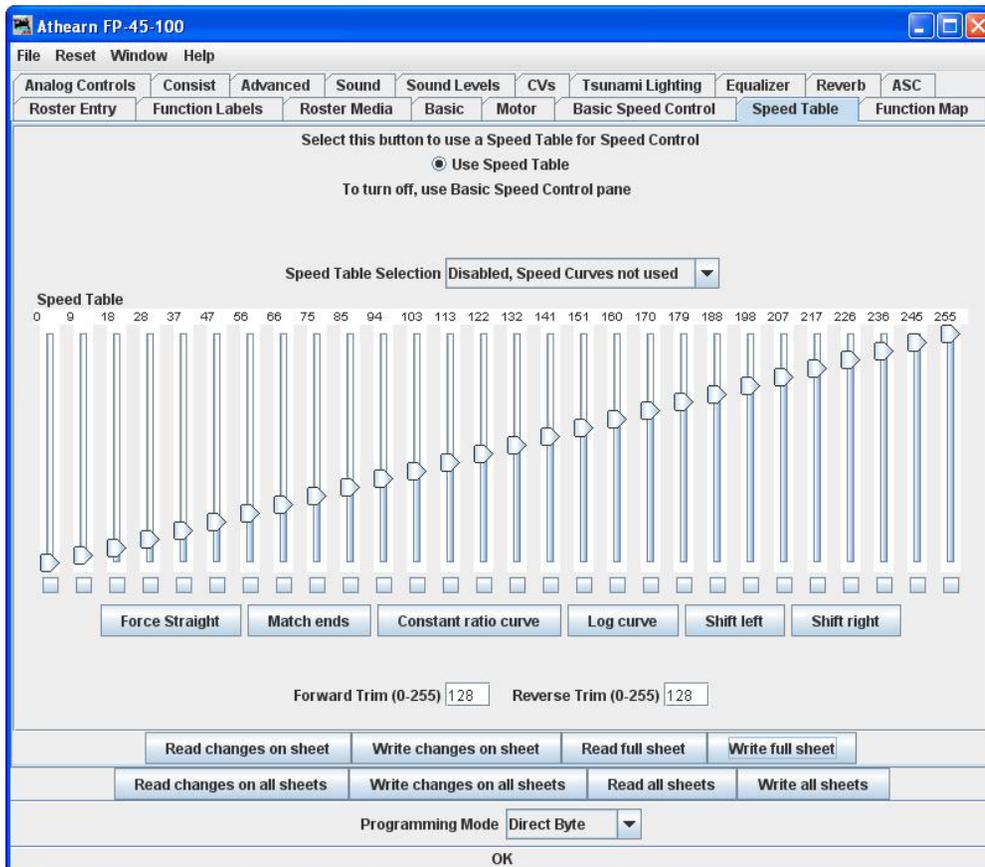


Figure 2.

adjust by a half step on your speed table to get that last 1 mph speed change. Since a half-step adjustment is impossible, be happy if your speed is within 1 mph of the intended speed. Example: you get 33 mph at a controller setting instead of 32 mph. That is good enough. Consisting will still work well.

My worksheets and process notes from speed matching my engine fleet are below. The process is to adjust the power using Decoder Pro for each step of the speed curves (steps 1, 126, 64, 32, 96 in that order) on each locomotive. I noticed that even the same brand and loco models could have different power settings to maintain a certain speed. The trim function helps you to ensure the forward and reverse speed of a given locomotive are the same at a given throttle setting. Recording these power values in a table serves as a good backup of your work. It also gives you some starting values for a similar locomotive.

For my process you run the loco through the speedometer. I have a laptop running DecoderPro connected to my layout (powered by an NCE Power Pro 5-amp). Adjust the power settings on the speed table pane with DecoderPro in Program on the Main mode (**Figure 2**). Write these values back to the loco decoder while you are running until the speeds you see on the speedometer match the speeds you want for a given throttle setting. This process changes the CV's values in the decoder that control the speed curve power values at a given throttle setting. Using the speedometer made it easy to adjust and get good results quickly. It took me an afternoon to do eight locos, including a beverage break and the occasional train running with the newly speed matched locomotives. It all worked very well and I am very happy with the results.

HINT – Be sure to break in any new locomotives first. New locomotives will perform differently as they break in, usually running a bit faster at a given throttle setting. Warm up the loco before running the speed trap. I run only the loco with no cars coupled. This way you will get consistent results for all locomotives. Be sure to check the forward versus reverse speeds for a given throttle setting. Most locomotives will need a trim adjustment so they run at the same speed in different directions. Some decoders do not support this adjustment. Yes – this is another item to check before buying a decoder.

ANOTHER HINT – When speed matching a loco, if you get within +/- 1 mph of your intended speed at a given controller setting, that is good enough. Sometimes you really need to

The tables below show the power settings for a given speed for some locomotives. This method uses the whole throttle range from 1 to 126. **Scale Speed in MPH = 1/2 * throttle setting.** So 1/2 throttle is about 30 MPH (scale speed) which is just right for my branch line layout.

This first table shows the desired results I want after speed matching.

Throttle settings and resulting power and speeds				Top speed is 64 MPH
Speed MPH	Throttle %	Speed Step	Speed table Index	Throttle Setting
Barely rolling	1	1	1	Setting of 1
16	25	32	7	1 quarter
32	50	64	14	Half
48	75	96	21	3 quarters
63	100	126	28	Full

Below is part of my speed matching worksheet. Power values (in milliamps) are from the speed curves.

Speed step	1	126	64	32	96	
Speed (MPH)	Barely rolling	63	32	16	48	Comments
Loco #						
120	29	130	76	48	103	
122	16	124	78	47	100	Trim +2 reverse
1111	N/A	Top speed 56	N/A	N/A	N/A	No speed table available
1859	30	79	54	44	63	No trim function. Reverse too slow by 7MPH
2137	N/A	Top speed 120	N/A	N/A	N/A	No speed table available
2150	44	148	91	65	117	
2152	43	139	88	62	112	Trim +2 forward

I recorded the power value for each engine and each setting in the table. Remember to adjust the power in the following order of steps: 1, 126, 64, 32, 96:

- Speed step 1 = Loco barely rolling with no hesitation. Value could be different for each loco.

- Speed step 126 = 63 scale mph at some power setting (adjust power to obtain proper speed)
- Speed step 64 = 32 scale mph at some power (adjust power to obtain proper speed)

These first three entries set the V_{\min} - V_{mid} - V_{\max} values. But keep going.

- Speed step 32 = 16 scale mph at some power (adjust power to obtain proper speed)
- Speed step 96 = 48 scale mph at some power (adjust power to obtain proper speed)

The last two steps fill in the curve. I found that many of my engines' speed curves are not a straight line, but are a curve. The factory setting is usually a straight line with V_{\min} - V_{mid} - V_{\max} values defining that line.

Use the Trim Function if needed. Trim is a forward vs. reverse speed adjustment that changes the power for the given direction (either forward or reverse). Many engines run at different speeds in forward versus reverse at a throttle setting. You want the engine to have the same speed at a throttle setting in either forward or reverse (helpful in a consist). I set the Trim at the top speed (63 mph). Differences between forward and reverse speeds were more apparent at this higher speed.

That is it. Once you have the locos speed matched, you can set up an engine consist with any speed matched locomotives you want. Add power to the front, mid-train or the end and group them into the same consist. They all work together very well. Remember to warm up a locomotive before consisting for best performance.

One unexpected benefit of speed matching: My 5 year old granddaughter likes to run trains fast with the throttle set to full speed (usually the passenger consist). Speed matching helps alleviate that issue a little bit. She still runs at full throttle much of the time, but now it is slower. I tried giving her a switcher, which is geared to run at slow speeds. She noticed that quickly saying, "Papa, can I please have one of the good engines? This one is slow." Come on! She is five, for crying out loud. How does she....never mind.

Let's run some trains.