MTH DCS and DCC Compatibility

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Abstract

MTH (Mike's Train House) has recently entered the HO market with a quality line of HO locomotives. The first of these models was the PRR K-4. Although new to the HO market, MTH is a leading producer of O gauge model railroad equipment. Since entry into HO, MTH has released several steam engines and has announced a line of diesel locomotives which includes BNSF and the UP Heritage fleet of SD70ACe diesels. We know these are of great interest.

DCC is not used as the digital control system in MTH O scale locomotives; MTH locomotives use a digital control system called DCS that was developed by MTH; DCS stands for Digital Command System. When MTH entered the HO Market, they decided to support DCS in their HO locomotives as well as DCC. However, the primary emphasis is on DCS, with limited DCC compatibility. MTH trains do operate well in DCC but there are many caveats that the purchaser should be aware of.

MTH locomotives are exciting; the line of steam locomotives introduced so far have great sound and bellows operated smoke units. There is no reason to believe the diesel line will be anything but a quality line which includes some exciting, innovative features. One announced feature of great interest is the automatic coupler. However, since MTH locomotives have limited DCC compatibility there are some issues. The significance of these issues depends on the intended use. For some the DCC issues will be significant and for others they will be no problem at all.

It is the purpose of this document to inform the reader about the idiosyncrasies of MTH's DCC system and also give and overview of DCS. It is important for purchasers to make an informed decision when spending two hundred dollars or more on a locomotive purchase.

MTH DCC

DCC (Digital Command and Control) is the system used in the HO market to control locomotives digitally. It has many great features which support small and large layouts alike. When DCC is combined with sound, locomotives come alive. Using DCC control systems, the operator can control multiple trains on the same track, ring the bell, blow the horn, control lighting, consist locomotives and even operate a large prototypical layout. DCC is a great enhancement to model railroading.

DCC controlled locomotives operate by converting digital codes, transmitted on the rails, to commands. The received commands perform the desired functions such as turning on the headlight or sounding the horn. DCC is also used to configure locomotive features such as locomotive address, speed curves, top speed, momentum, sound levels, function key assignments and advance consisting. This configuration information is saved in registers called CVs (control values).

It is the CV support where the main difference lies between MTH DCC locomotives and the normal HO, DCC locomotive. It is not the purpose of this document to be a tutorial on DCC but to concentrate on DCC compatibility issues between MTH DCC and normal DCC HO. We will release a DCC Primer in the future as time permits.

MTH DCC locomotives, as released to-date, only support ten CVs while other DCC Locomotives support many more CVs. Sound and DCC locomotives have even more CVs than DCC non- sound decoders. Some CVs are standard and are defined by a NMRA specification while other CVs are manufacturer specific. Also, there are variations between DCC manufacturers in the values used to configure some of the Standard CVs; please consult your DCC decoder documentation for detailed information.

Some of the standard DCC, CVs are documented in detail here because they are important in understanding basic DCC compatibility issues. Other CVs are discussed as a group. Others are not discussed at all.

Some of the Standard CVS

Address CVs – Used to set the long or short address of the locomotive. The configuration of these CVs is standard on all DCC decoders.

CV 1 *Engine Address* – The CV where the short engine address is set. The address is usually set to 3 for new locomotives. The maximum address is 127. To set a lcomotive address above 127, the long address CVs must be used.

CV 29 *Configuration CV* – Contains several configuration settings. This CV is usually set at the bit level and is one of the most difficult CVs to understand. Bit 5 controls the selection of the long address or short address. Many DCC systems take care of setting this bit automatically when a long address is selected. If bit 5 is set, the long address is used. If it is not set, the short address is used. This CV contains also contains other configuration data such as the direction bit, and speed curve selection.

CV 17-18 *Long Address* – Contains the long address of locomotive, the high half is in CV 17 and low part in CV 18. It takes two CVs to make a long address.

Momentum CVs

CV 3 *Acceleration* – Sets the momentum for acceleration. Increasing the value of this CV makes the locomotive accelerate slower. The higher the value, the longer it takes to get to the selected speed.

CV4 *Deceleration* – Sets the momentum for deceleration. Increasing the value of this CV makes the locomotive decelerate slower. The higher the value, the longer it takes to get to a lower speed or stop.

Speed CVs – Speed CVs are used as a simple method of creating a three point speed curve. These values can be used to speed match locomotives for consisting or to a set prototypical top speed. DCC decoders also contain user modifiable speed tables that give more intricate control but are more complicated to set.

CV 2 *VStart* – Contains an offset value that lowers the throttle setting for getting a locomotive moving from neutral (stopped). Modify this CV to get the locomotive moving on speed step one.

CV 5 *Vmid* - Contains the value that sets the mid range speed of the locomotive.

CV 6 *Vmax* – Contains the value that sets the top speed of the locomotive. Usually this value is used to decrease the top speed since default is always max speed.

Advance Consisting CVs

These CVs are used to setup hardware consisting. Hardware consisting allows consists of locomotives to be defined in the locomotive's DCC decoder; an advance consist is preserved outside of the DCC system. In other words, the consist address is a part of the locomotive. The consist will exist no matter when or where the locomotives are run. You can take a set of advance consisted locomotives to the club layout and run them without additional configuration.

Using advance consisting, the operation of function keys can be configured on a per locomotive basis allowing prototypical consist operation. For example, the headlight, horn and bell can be disabled on all locomotives except the lead locomotive.

CV 19 Consist Address - This CV sets the digital address of the consist. Consist addresses can be 1-127. If the same address is stored in CV 19 in three locomotives, all three locomotives will respond to commands sent to the consist address. If the locomotive needs to run in reverse, then bit 8 must also be set along with the address. The easiest way to set bit 8 is to add 128 to the locomotive address. For example 129 would be address 1 in reverse.

CV 21 Consist Functions F1–F8 – Bits in this CV enable or disable function keys F1 – F8.

CV22 Consist Functions F0, F9-F12 – Bits in this CV enable or disable function keys F0 (headlight) and F9 through F12.

Lighting Effects CVs

All advance DCC decoders support CVs to configure lighting effects. These CVs and capabilities vary between DCC manufacturers. Generally, they are used to configure headlight, reverse light, mars light and other lighting behavior, intensity and effects.

Sound CVs

These CVs vary by manufacturer in location and capability. Generally, they support setting sound volumes and effects. All DCC sound decoders allow the setting of horn/whistle max volume and chuff/engine sound max volume. Some decoders have many, many individual volume configuration CVs, others have only a few, but all sound decoders have some.

MTH DCC Overview

The MTH locomotives are designed primarily for MTH DCS but support DCC compatibility. Although the MTH locomotives operate well in DCC, only a few CVs are available for configuration. In place of CVs, MTH uses function keys to control DCC functions and parameters. This approach limits DCC capabilities. These limitations are addressed in the text that follows.

MTH Supported Standard CVs

CV 1	Short Address
CV 3	Acceleration Rate
CV 4	Deceleration Rate
CV 17-18	Extended Address (upper bits must be set to 1)
CV29	Bits 5 = ext. address; bit 1 = Direction bit (only features supported in CV 29)

MTH Extended CVs

49	Short Address (controllers that prohibit address POM)
50 & 51	MTH only CV - Extended Address (controllers that prohibit address POM)
55 Reset	Send value = 55 to CV 55 to reset the decoder.

MTH DCC Compatibility Issues

The following significant DCC features are not supported in MTH locomotives.

- Advance Consisting – Consisting must be done using the DCC system's consist capability which does not support enabling or disabling function keys on a per locomotive basis. Also the consist is not portable.
- CV min, mid, and max for sitting a three point speed curve and matching locomotive speeds for consisting. It is not possible to speed match your MTH locomotive to a DCC locomotive. You may be able to match your DCC locomotive to your MTH locomotive.
- Speed Tables – No custom speed tables.
- Individual sound volumes – master sound can be set to three levels with F7
- Function key remapping
- Modification of lighting operation

MTH DCC Function Keys

MTH DCC supports the following function keys. However, function keys above 12 are generally inaccessible when using DCC systems. Most DCC throttles and command systems only support twelve function keys.

Function Key	Function
F0	Headlight on/off
F1	Bell on/off
F2	Whistle/Horn on/off
F3	Start-up/Shut-down
F4	PFA initiate and advance
F5	Cab Light on/off
F6	Engine Sounds on/off
F7	Volume low, med, high, off
F8	Smoke on/off
F9	Forward Signal Sound
F10	Reverse Signal Sound
F11	Coupler Slack Sound
F12	One-Shot Doppler on/off
F13	Extended Start Up
F14	Extended Shut Down
F15	Labor Chuff
F16	Drift Chuff
F17	Smoke Volume low, med, high
F18	Single short whistle toot
F19	Coupler Close
F20	Feature Reset
F21	Idle Sequence 1
F22	Idle Sequence 2
F23	Idle Sequence 3
F24	Idle Sequence 4
F25	Brakes auto/off
F26	Cab Chatter auto/off
F27	Clickety-Clack (track sound) auto/off
F28	Train Wreck

Configuring MTH DCC Systems in DCS

MTH configuration parameters can be set using an MTH DCS controller. Using DCS, there is a full complement of configuration variables that can be set. Once set in DCS, they will remain set when using DCC. Therefore it is possible to configure an MTH locomotive on a DCS program track and then use the locomotive in DCC with the modified configuration.

Some of the configuration variables are as follows:

- Maximum sound levels for whistle/horn, chuff, and bell
- Smoke volume
- Lighting operation and effects
- Maximum speed
- Enabling and disabling various sounds

There is no help for DCC advance consisting because DCS consisting is completely different than DCC consisting. In DCS, when you consist locomotives, the system keeps the consist information and speed matching between locomotives is automatic. When operating in DCS, there is robust consisting support.

DCC Compatibility Conclusions

The suitability of MTH DCC compatibility is up to the individual. Only you know how your trains are operated. This document is meant to provide you with enough information to make an informed purchasing decision. I have contacted MTH about these compatibility issues and they have shown no interest in enhancing them. They are marketing DCS command controllers to the HO market and are promoting DCS as an alternative to DCC.

Is DCS an alternative to DCC? I will attempt to answer that question with some detail in the remainder of the document. In short though, it is an alternative for some. If you wish to run only MTH locomotives, DCS is a fully contained, capable system that is easier to use than DCC and you will never need to know what a CV, bit, byte or hexadecimal is. MTH DCS uses English menus to do the locomotive configuration and much of the operation.

MTH is producing more, high quality locomotives all the time. If you are content to purchase only MTH locomotives, then it is worth looking at DCS. However, if you have a significant investment in DCC or you wish to operate locomotives from Broadway Limited, Walthers, Atlas, Intermountain, Athearn, and others, it is not a choice.

Personally, I do not understand the reluctance on the part of MTH to add more DCC support; greater DCC support would make their locomotives more versatile and open greater sales opportunities.

I have purchased a DCS system to configure my MTH locomotives because I desire control over such things as individual sound volumes, smoke level and maximum speed. However, I am someone who uses advance consisting and the lack of advance consisting in MTH locomotives will be a significant factor in my purchase decisions. My MTH K-4 is a wonderful locomotive and I enjoy seeing and hearing it run. I only wish it had greater DCC compatibility.

MTH Digital Command and Control

Overview

The MTH DCS (Digital Command System), is quite different from the HO DCC (Digital Command and Control System). For one, DCS is a proprietary system designed by MTH for use with their locomotives. DCC is an open architecture built to a NMRA standard. It is used by many manufacturers. Using DCC you can run equipment from numerous sources while DCS is restricted to MTH. There are advantages to both approaches.

Since DCS is a complete system that is highly integrated, it presents a more consistent interface to its users. Every DCS locomotive is built by MTH to play in the DCS environment. Therefore, the DCS system can depend on each locomotive responding the same to all control and configuration commands.

For example, to change the system volume level in DCS, you select the *Sound Menu*, go *to Engine Sounds Volume* and then set the maximum volume level. This is all done in natural language using menus. There is no way to standardize this function in DCC. Since sound volumes are not a part of the NMRA standard, each decoder manufacturer has implemented a different CV number for master volume and also use different range levels. To further complicate this picture, the DCC control system itself is manufactured by yet another manufacturer. You may be running a locomotive built by Atlas with a QSI sound decoder and Digitrax DCC system.

The advantage of DCC is the number of choices available for equipment and features. The disadvantage is the lack of high level integration due to non-standard hardware. You cannot have a DCC controller that has a function to set master sound level because there is no standard for master sound level configuration. A DCC controller can implement an easy way to set locomotive addresses because DCC address configuration is controlled by the standard.

The advantage of DCS is due to its proprietary nature. Everything is standard because it is all made by the same company. The disadvantage is that DCS does not play with anything else. You cannot run an Atlas HO engine on a DCS system; you can only run MTH locomotives. DCS has additional capabilities beyond running your locomotives; it supports the capability to have knowledge of your layout and to operate switches and accessories. It can even store routes.

Electrically both systems are also different. DCC uses an alternating voltage of approximately 14 volts to operate equipment. DCS is a DC system of approximately 18 volts. In fact, in DCS, you can use your old analog transformer as a power supply as long as it supplies non-pulsed DC.
Another disadvantage of DCS is lack of DCS decoders to install into older locomotives; there are none. You must buy a DCS locomotive or nothing.

This document is not meant as a tutorial on DCS but I will go through some of the functions to give you a feel for the system.

DCS Function and Configuration examples

DCS uses a throttle or hand controller that is similar in appearance to a DCC controller (throttle, cab, etc). However, where DCC hand controllers are limited to dedicated buttons for speed, direction horn/whistle and Bell, the DCS hand controller has many more functions. This is due to the high degree of integration possible in a proprietary system. See next page for illustration.

DCS Remote Throttle

Running a locomotive

In DCC, to run a locomotive, you place it on the track, select its address, and increase the throttle to make it go.

In a DCS system, you must make the system aware that the locomotive exists to run it. Here is how you accomplish this task.

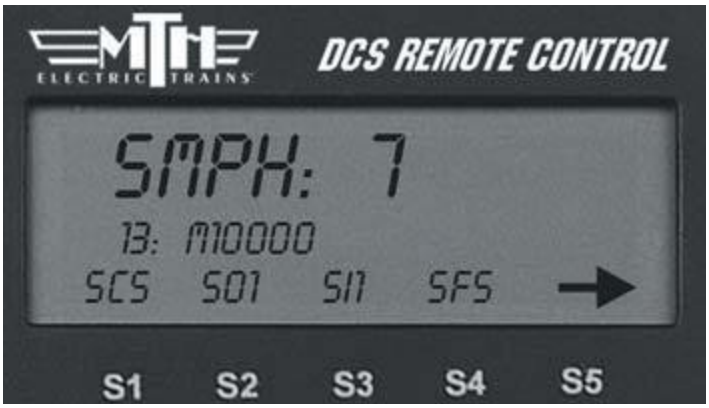
1. Place an MTH locomotive on the track

2. Press Menu and select SYSTEM

3. Select ADD Engine – The DCS system will do an inquiry and find the engine on the track. It will notify you when it has seen the engine and stored its information. When you look at the engine display, you will see the engine is identified and assigned the next available number. For example, *1. PRR K4 #518.* You do this once for each engine you want the system to remember. After that, the DCS system will see the engine anytime it is on the track. All you

do is make it active to run it.

4. To accelerate the locomotive, roll the throttle thumbwheel downward. To slow the locomotive, roll the throttle thumbwheel upward. DCS locomotives run in scale miles per hour therefore the display will show you actual scale speed.



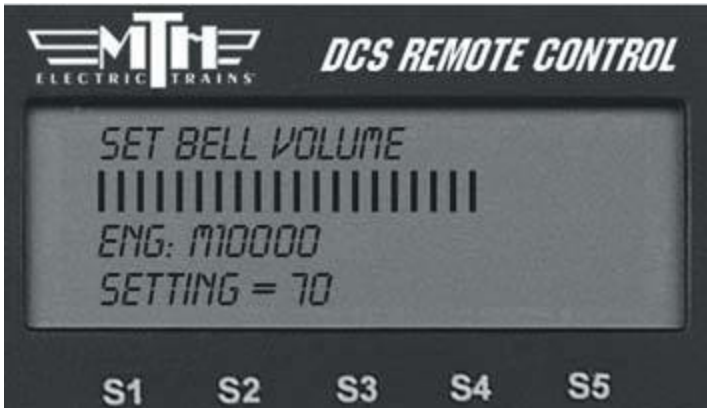
DCS display showing scale speed for locomotive 13

DCC locomotives run at a speed set to by a digital level. Speed level 20 does not indicate the DCC locomotive's speed only the speed setting. Since DCS locomotives run in scale miles per hour, 1 MPH is the same speed for every locomotive being run.

You can quickly set a DCS locomotive to a scale speed using Quickset. Press down on the thumbwheel while the control is in run mode. The menu will ask you to enter the Quickset speed. Enter the speed using the keypad and then press the Thumbwheel again. The locomotive will change speeds to the new speed entered.

Setting the DCS Whistle/ Horn Maximum Volume.

1. Press Menu
2. Select SOUND
3. Select HORN VOLUME – the display will show a horizontal graph of the maximum level along with the engine ID. Also, the horn/whistle will be playing so you can hear the changes.



4. Use the thumbwheel to increase or decrease the sound volume.
5. Press the thumbwheel to set the desired level.

Final Remarks

This document is not intended as a DCS operator's manual but is meant to give the reader a feeling for DCS operation. You can see the entire manual and some presentations on DCS at the MTH HO website: http://www.mthhotrains.com. There are many DCS features that have not been addressed in this document. They are explained in the DCS manual.

There are many more differences between DCS and DCC especially in layout configuration. In DCS all track and switch data is entered into the DCS system. Accessories are operated by a DCS accessory controller.

In DCC switches are operated by stationary decoders with DCC addresses. Track is only entered into the system if you are using a computer based layout control program. DCC systems can be interfaced to personal computers for computerized layout control. The list of possibilities is too vast to discuss in this document.

In summary, DCC is an open architecture, heterogeneous system that supports products from many manufacturers. This gives great flexibility and choice but at the expense of more complicated operation and configuration.

DCS is a proprietary, homogeneous system that is highly integrated and easy to use. The sacrifice, for ease of use and great integration, is flexibility. It has great capabilities when used with MTH DCS equipment but it cannot operate equipment from other manufacturers which includes hundreds of HO, DCC locomotives.

If you are in a position to only purchase MTH locomotives, DCS is worth looking at. You will save yourself the frustration of learning about CVs and how to configure all the different DCC decoders available. However, if you have an existing DCC fleet and/or wish to run locomotives and equipment from many manufacturers, DCS will not fit your requirements.

I hope this document has given you a feeling for MTH DCC compatibility as well as a feel for the MTH DCS system.