



## DCC OPERATION

PLEASE READ BEFORE USE AND SAVE

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## **CAUTION: ELECTRICALLY OPERATED PRODUCT:**

**Recommended for Ages 14 and up. Not recommended for children under 14 years of age without adult supervision. As with all electric products, precautions should be observed during handling and use to prevent electric shock.**

**WARNING:** When using electrical products, basic safety precautions should be observed, including the following:

- Read this manual thoroughly before using this device.
- M.T.H. recommends that all users and persons supervising use examine the hobby transformer and other electronic equipment periodically for conditions that may result in the risk of fire, electric shock, or injury to persons, such as damage to the primary cord, plug blades, housing, output jacks or other parts. In the event such conditions exist, the train set should not be used until properly repaired.
- Do not operate your layout unattended. Obstructed accessories or stalled trains may overheat, resulting in damage to your layout.
- This train set is intended for indoor use. Do not use if water is present. Serious injury or fatality may result.
- Do not operate the hobby transformer with damaged cord, plug, switches, buttons or case.
- The transformer was designed to operate on regular US household current (120 volt, 50-60 Hertz). Do not connect to any other source of power.
- To avoid the risk of electrical shock, do not disassemble the transformer unit. There are no user-serviceable parts inside. If the unit is damaged contact M.T.H. Service for instructions.
- The transformer is equipped with an internal circuit protector. If the circuit protector trips, unplug the power cord from the electrical wall outlet, check your layout for any short circuits. The circuit breaker will reset automatically when the short is removed from the circuit.
- Unplug the transformer from the electrical wall outlet when not in use.
- Do not use this transformer for other than its intended purpose.

**Transformer Ratings:** Input: 120 VAC, 60 Hz Only, Output: 15 VDC, 56.3 VA

## DCC - Digital Command Control

DCC is a popular digital command scheme wherein the track power is also a digital control signal. That is, using a DCC controller, you can communicate with multiple engines and have all of them moving at different speeds and in varying directions on the same track at the same time. The power/command signal remains constant and engines are commanded to perform as desired. Your MTH PS3.0-equipped engine has the ability to decode and respond to these DCC commands. This allows you to mix and match MTH PS3-equipped engines as well as operate them with any other manufacturer's DCC-decoder equipped engine. The best part about your MTH PS3.0-equipped engine is that the decoder is built right in. No need to remove the hood and install speakers or boards. It's all done for you at the factory. Each PS3.0-equipped engine has a full complement of lights, sounds, smoke (if equipped). Just set the model on the rails, apply DCC power and hit F3 on your DCC handheld controller and you're off and running.

### Activating DCC Mode

Even though your locomotive is equipped with a DCC decoder, you will notice that there is no switch to select it. We found that when the switch was present, it was confusing to those who are not familiar with DCC operations. In order to operate in DCC you will need to remove the tender body and then carefully remove the jumper block (be careful not to damage the Signal Transformer) on the Printed Circuit Board as shown here.

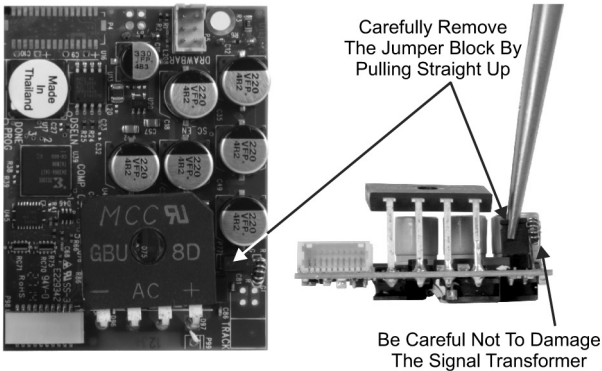


Figure: Printed Circuit Board

When the jumper block is installed, the engine will respond to DCS signals. When the jumper block is removed, the engine will respond to DCC signals. After removing the jumper block keep it in a safe place in case you decide to operate with DCS in the future.

#### CAUTION:

- Do not apply DCS signals and DCC signals to the same track simultaneously. The signals are not compatible, mixing the DCS and DCC signals will damage the DCS TIU unit.
- Do not operate the engine with a DCC without removing the jumper block. Damage to the PS 3.0 board will occur.
- If attempting to control the engine with DCS when the jumper block is removed, the engine will not respond to commands.

## Basic DCC Operation

Your MTH PS3.0-equipped engine takes full advantage of DCC's capabilities. Below are the basic commands you'll want to know to get started running quickly. Please refer to the Advanced DCC Operation section of the manual if you want to dig into the full capability of DCC.

Each engine type may have a slightly different F Function list. This depends upon whether it's steam, diesel, or electric and whether it has smoke or not. Please refer to the table of Default CV Values for your particular engine's F Functions. A note about enabling/disabling F Functions in DCC - Depending upon the DCC system you have you may need to toggle a particular F Function on then off to actually get it to enable. Some DCC systems do this for you automatically and others allow you to set particular F Function buttons to either be set for momentary or toggle. Please refer to your DCC control station manufacturer's manual for more information on how they handle F Function buttons.

Your MTH PS3.0-equipped engine's default short address is 3. So all you have to do is power up your DCC system and call up Locomotive 3 to begin.

## Start-Up/Shut-Down

### F3 – Start-Up/Shut-Down

Pressing this twice (toggle on then off) will start up your engine. When you apply DCC power your MTH PS3.0-equipped engine will remain dark and quiet. Since you likely don't want to run the engine this way, simply press F3 twice to start your engine. The lights, sound and smoke (if equipped) will come on.

**NOTE:** Now your engine will start up just by advancing the throttle. But for the F3 functions (Start Up and Shut Down) to operate, the engine not be moving.

To shut your engine down, press the F3 button twice. This will play the shut down sounds and then turn the lights and smoke and sounds off. As long as there is DCC power still on the track the engine can be started up again by pressing the F3 button twice.

## Sounds

### Bell/Whistle (Horn)

#### F1 – Bell

To activate the Bell press F1. To deactivate it, hit F1 again

#### F2 – Whistle (Horn)

To activate the Whistle/Horn, press F2. To shut it off either let off the F2 button or press and release it

## **PFA**

### **F4 – PFA**

PFA in MTH lingo stands for Passenger/Freight Announcements. Your engine is pre-programmed for the appropriate type of sounds based upon the type of service the real-life engine used in daily operation.

There are five sound sequences or segments in the PFA feature. Each segment is advanced by you, the operator.

You hit the F4 button twice on the DCC controller to let the engine know you want it to advance (this toggles the PFA function on then off to clear the remote for the next sequence). In most PFA sequences there is a minimum wait time of about 20-30 seconds before it will advance. So, here is how a typical PFA sequence operates:

1. Press the F4 button twice (toggle F4 on then off) to start the PFA sequence on the engine. You'll hear "Now arriving..." for passenger sound sets and cab chatter for freight sound sets. The bell will then begin ringing.
2. Slowly reduce the throttle until the train stops at the desired location and speed reaches zero. Press the F4 button twice (toggle F4 on then off) again and the bell will stop ringing. You will hear the engine sounds switch from the cab to the station or yard with all the ambient sounds you'd hear in the real thing.
3. Press the F4 button twice (toggle F4 on then off) again to advance the sequence. You'll hear "Now boarding..." for passenger sound sets and freight yard sounds for freight sound sets.
4. Press the F4 button twice (toggle F4 on then off) again to advance the sequence. You'll hear "Now departing..." for passenger sound sets and more freight yard sounds for freight sound sets.
5. Press the F4 button twice (toggle F4 on then off) the last time to advance the sequence. You'll hear "All aboard..." for passenger sound sets and more freight yard sounds for freight sound sets. The engine sounds will switch over to the cab again. When the bell begins to ring, advance the throttle to move the engine out of the station or yard. The bell will shut off automatically.

## **Lights**

### **F0 – Headlight/Taillight**

This toggles your headlight/taillight on and off.

### **F5 – Lights**

This toggles your firebox and cab interior light on and off.

## **Master Volume**

### **F6 – Master Volume**

When you activate F6, the Master Volume will begin increasing. If you are at 0 (no volume), the first time you turn on F6 it will take approximately 3 seconds to get to 100% volume. When you get to your desired volume level, turn F6 off.

The next time you toggle F6 on it will drive the Master Volume to 0. If you are at 100% it will take approximately 3 seconds to get to 0. When you arrive at your desired level turn F6 off.

It works like a volume slider – the first time you enable F6 it goes up and stops at 100%. Toggle F6 off and then back on and it will go down to 0 and stop.

## Couplers

Your MTH PS3.0-equipped engine comes with remotely controlled Proto-Couplers. They can be fired using your DCC handheld.

### F7 – Front Coupler

Pressing F7 twice (toggling on then off) will fire your Front Coupler

### F8 – Rear Coupler

Pressing F8 twice (toggling on then off) will fire your Rear Coupler

## Forward/Reverse Signal

Just like a real engine, you can announce the direction of intended movement using your DCC handheld and F9 and F10.

### F9 – Forward Signal

Pressing F9 twice (toggling on then off) will sound the Forward Signal. This is two whistle/horn blasts

### F10 – Reverse Signal

Pressing F10 twice (toggling on then off) will sound the Reverse Signal. This is three whistle/horn blasts

## Grade Crossing Signal

Again, just like a real engine, you can trigger the Grade Crossing Signal on your engine. This is two long, one short, one long whistle/horn blast.

### F11 – Grade Crossing Signal

Pressing F11 twice (toggling on then off) will sound your Crossing Signal.

## Smoke (if equipped)

### F12 – Smoke On/Off

Enabling F12 will turn the smoke unit on. Disabling F12 will turn your smoke unit off.

### F13 – Smoke Volume

There are three smoke volume levels in your MTH PS3.0-equipped engine – Low/Med/High. The default for this is set to High. You can adjust the smoke output (amount of smoke the generator puts out) by pressing the F13 button twice. This sets the level to the next step. For example, if you are currently at the High smoke output level, pressing F13 twice (toggling it on then off) will set the smoke volume to Low. Pressing F13 twice again will set it to Medium and so on.

## Engine Sounds

### F25 – Engine Sounds

You can turn the Engine Sounds On/Off by pressing the F25 button. Pressing it once (enabling F25) will cause the Engine Sounds to shut off. The Whistle/Horn and Bell sounds will still be active, however. To turn the engine sounds back on press the F25 button again (disable F25).

## Additional F Functions

**NOTE:** The engine must be sitting still in order to trigger F-Functions F14 through F18

### F14-F16 – Idle Sequence

Pressing F14, F15, or F16 twice (toggling on then off) will trigger an Idle Sequence if the engine is not moving. These vary from engine to engine and may include things like checking the coal load, checking the water level, using the Alemite grease gun on the drivers, etc. When triggered, these will run through the sequence that varies in duration.

### **F17 – Extended Start-Up**

If your engine is shut down or you've just applied DCC power pressing F17 twice (toggling it on then off) will start the Extended Start-Up sounds. This is very similar to F3 except you will hear the crew talking back and forth about getting the engine ready to run.

### **F18 – Extended Shut-Down.**

If your engine is already up and running you can play the Extended Shut Down sounds by pressing F18 twice (toggling on then off). The Extended Shut Down is very similar to F3 in that the engine will ultimately shut down, but in the case of Extended Shut Down you will hear the crew talking back and forth about how the engine ran, time schedules, etc.

### **F19 – Labor Chuff**

To force the Labor Chuff sound in a steam engine, press the F19 button once (enable F19). As long as F19 is enabled the engine will play its Labor Chuff sounds. To set the sound back to Normal Chuff press the F19 button again (disable F19).

### **F20 – Drift Chuff**

To force the Drift Chuff sound in a steam engine, press the F20 button once (enable F20). As long as F20 is enabled the engine will play its Drift Chuff sounds. To set the sound back to Normal Chuff press the F20 button again (disable F20).

### **F21 – One Shot Doppler**

You can set your MTH PS3.0-equipped engine to simulate the actual Doppler Effect sound a real engine makes as it passes you. To do this, press the F21 button once (enable F21) and then listen as the engine makes that pitch shift that mimics the Doppler Effect perfectly. Press the F21 button again (disable F21) to shut off the Doppler Effect. With a little practice in timing and speed you can make this happen right in front of you.

### **F22 – Coupler Slack**

When an engine couples to a train and pulls out, it has to take up the coupler slack. You can play this sound by pressing F22 twice (toggling on then off). This feature works two ways – While the engine is sitting still, press F22 twice to enable it. Then, when you move the engine, it will play the Coupler Slack sound.

The second way is to simply force the sound while the engine is moving. To do this, simply press F22 twice (toggling it on then off). The sound will play.

### **F23 – Coupler Close**

To play the Coupler Close sound press the F23 button twice (toggling it on then off). You can play this sound as you're coupling cars together to add realism.

### **F24 – Single Whistle/Horn Blast**

To play a Single Horn Blast press the F24 button twice (toggling in on then off). This plays a single, short horn blast.

### **F26 – Brake Sounds**

Pressing the F26 button (enable F26) will disable the Brake Sounds for your engine. The Brake Sounds occur when you reduce the speed of your engine rapidly. To enable the Brake Sounds press the F26 button (disable F26). Brake Sounds are On by default.

### **F27 – Cab Chatter**

Cab Chatter occurs when the engine is sitting at idle. There are various times when the crew will talk to each other when the engine is sitting at idle. Pressing the F27 button (enable F27) will disable the Cab Chatter. Pressing the F27 button again (disable F27) will enable Cab Chatter. Cab Chatter is On by default.

### **F28 – Feature Reset**

Resets Features to defaults.

# FUNCTION CHART

<b>F Key</b>	<b>Description</b>
F0	Head/Tail light
F1	Bell
F2	Horn
F3	Start-Up/Shut Down
F4	PFA
F5	Lights (except head/tail)
F6	Master Volume
F7	Front Coupler
F8	Rear Coupler
F9	Forward Signal
F10	Reverse Signal
F11	Grade Crossing
F12	Smoke (On/Off)
F13	Smoke Volume
F14	Idle Sequence 3
F15	Idle Sequence 2
F16	Idle Sequence 1
F17	Extended Start-Up
F18	Extended Shut-Down
F19	Labor Chuff
F20	Drift Chuff
F21	One Shot Doppler
F22	Coupler Slack
F23	Coupler Close
F24	Single Horn Blast
F25	Engine Sounds
F26	Brake Sounds (On/Off)
F27	Cab Chatter (On/Off)
F28	Feature Reset



## CV29

CV29 is the basic decoder setup CV that is used by all DCC decoder manufactures.

So, if you are familiar with CV29 from other manufacturer's decoders M.T.H.'s is no different. The most important part of CV29 is the ability to switch between long and short addressing. By default, CV29 on your M.T.H. PS3.0-equipped engine is set to 2.

### Long and Short Addressing

Like most DCC Decoders, your M.T.H. PS3.0-equipped engine can be programmed with both Long and Short Address. Short addresses are those from 1-127 and Long addresses are those from 128-9999. You can program the engine address either with Programming on the Main (PoM) or using a Programming Track. Since it's easiest, in most cases, to PoM the instructions will show you how to do it this way. By default, your M.T.H. PS3.0-equipped engine comes programmed with both a long and short DCC address. The default Short address is always 3. The default Long address will be 3333.

#### To change your engine's Short Address using PoM:

1. Call up the engine's current address on your DCC handheld
2. Enter Programming on the Main on your DCC handheld
3. Enter the new address you want. Remember, you can only use address 1-127 for Short Addressing
4. Once you hit Enter the engine will give you a two whistle/horn blast response
5. Call up the engine on its new address and away you go.

**NOTE:** If you have elected to use PoM and did not start-up the sounds of your locomotive, you will not hear the two-whistle/horn blast response.

Alternatively, depending upon the type of DCC system you have, you can enter PoM and then write the new address in the Address Menu. This only works for short addressing. For example, on an MRC Prodigy Advance2 system, you would:

1. Call up the engine's current address on your DCC handheld
2. Hit the PROG button twice to enter PoM mode
3. Hit Enter twice so the LCD displays "Adr"
4. Type in the new Short Address (1-127) that you want and hit Enter
5. The engine will give you a two whistle/horn blast response

**NOTE:** If you have elected to use PoM and did not start-up the sounds of your locomotive, you will not hear the two-whistle/horn blast response.

#### To change your engine's Long Address using PoM:

1. Call up the current engine's address on your DCC handheld
2. Enter Programming on the Main on your DCC handheld
3. In the following steps you will need to write values to CV17 and CV18 to tell the engine what the long address should be

In order to determine your required values for CV17 and CV18 you will need to go to

[http://extranet.M.T.H.-railking.com/pdfapp/pdfs/instruction/HO%20DCC%20addressCV17\\_18%20Converter.xls](http://extranet.M.T.H.-railking.com/pdfapp/pdfs/instruction/HO%20DCC%20addressCV17_18%20Converter.xls)

Enter in the long address you want then click anywhere else in the spreadsheet and it will return the values for CV17 and CV18 (it will also return the hex conversion of the CV17 and CV18 values if your DCC system requires this).

Below is an example for extended address 2011:

### CV 17 and CV 18 Conversion Tool

Desired 4-Digit Engine Address	Hex Conversion	C17 Value to Enter	C18 Value to Enter
2011	07DB	199	219

4. Call up CV17 and enter the value required for CV17. You will get a two whistle/horn blast response
5. Call up CV18 and enter the value required for CV18. You will get a two whistle/horn blast response
6. In this step you have to tell the M.T.H. engine that you want it to start looking at long addresses. You do this in CV29:
  - a. Bring up the CV menu on your DCC handheld
  - b. Enter "29" to edit CV29
  - c. Enter "38" to change the value of CV29 and hit Enter
  - d. The engine will give you a two-whistle/horn blast response.

**NOTE:** If you have elected to use PoM and did not start-up the sounds of your locomotive, you will not hear the two-whistle/horn blast response.

### Feature/Factory Resetting

Please note, when making setting changes in DCS or DCC, such as address, please wait a minimum of 5 seconds after removing power to insure the settings are stored in the engines memory. Reapplying power in less than 5 seconds may result in losing the setting changes. If all else fails and you aren't sure of something, never fear. You can always get your engine back to a known state by either performing a Feature or Factory Reset.

There are a couple of ways to reset your M.T.H. PS3.0-equipped engine:

**Factory Resets:** Clears everything (makes engine just like it was when you bought it new)

- Send a decimal 08 to CV8 to reset everything entirely back to factory default
- Send a decimal 192 to reset everything except user speed tables

**Feature Resets:** There are a couple of Feature Resets that you can use

- Press F28 twice (toggling on then off). This resets the smoke, volume and lights back to their defaults
- Send a decimal 64 for a Feature Reset. This resets volumes, smoke and light settings.
- Send a decimal 128 to reset only address values back to factory default
  - This is the same as writing 55 to CV55 to engine address 55

**NOTE:** The engine address has to be something other than address 55

## Lost or Unknown Engine Address and the 55-55-55 Address Reset

In some cases you may not remember or have somehow lost the engine address. Following the above Feature or Factory Resets will allow you to recover an engine. The limitation to this is that for most resets you must know the engine address. If you are unsure of the engine address you can apply the 55-55-55 reset (send a value of 55 to CV55 to engine address 55). In order for this to work correctly the engine's address must NOT be 55. The engine will need to be sitting at some address other than 55.

Below is the method (55-55-55 Reset) you can employ to return an engine to its factory default short address of 3 (it will also set the engine's long address back to its default – usually 3333 or the cab number on some models) if you're unsure of the engine's current address:

- Check first to see if the engine happens to be sitting at address 55. Call up engine 55 on your DCC handheld and hit F3 to start the engine up. If it starts up then you can change the address to whatever you want using CV1 (short address) or CV17 and CV18 (long address)
- If the engine doesn't start up at address 55 then you can use the 55-55-55 reset. To perform this follow the instructions below:
  - Ensure the DCC system is powered up and power is on the rails
  - Call up engine address 55. NOTE: you are NOT changing the engine's address to 55 you are just telling the DCC system to start talking to engine address 55. You will want to make sure that no other M.T.H. engines are on the rails or any other manufacturer's engines with an address of 55 are on the rails. M.T.H. engines will listen for commands coming to engine address 55 when the 55-55-55 reset is enabled even though they are not programmed as address 55
  - Enter PoM mode on your DCC handheld and write a value of 55 to CV55. Again, even though your M.T.H. engine is NOT on address 55 it will still listen for this reset command
  - Call up address 3 on your DCC handheld and hit F3. The engine should now start-up

If you have performed the 55-55-55 reset and the engine still doesn't respond then place the engine on the programming track output of your DCC system and program a value of 3 to CV1. This will set the engine's short address to 3. However, as long as the engine is NOT programmed as address 55 then the 55-55-55 reset will always set the engine's long and short addresses back to their factory defaults. It will also set the engine's addressing back to short (if you happened to have CV29 set to long addressing)

The 55-55-55 Reset can be confusing at first but the main point to note is that you are NOT setting the engine's address to 55 to perform the reset, you are just calling up engine address 55 on your DCC handheld and sending a value of 55 to CV55. Again, M.T.H. engine's will listen to the 55-55-55 reset command even though the engine's address isn't actually 55 (and it can't be for the 55-55-55 reset to work).

# MTH PS3.0 Expanded DCC Functionality

## Advanced DCC Operation

This section of the manual provides more in-depth detail on how to set up and configure your MTH PS3.0-equipped engine using the NMRA-standard CV's as well as the manufacturer-specific CV's. It also explains some of the other F Functions not covered in the Basic DCC Operation section.

## Configuration Variables (CV)

Configuration Variables used on MTH PS3.0-equipped engines.

CV1	Short Address: 1-127 are the valid addresses
CV2	Start Voltage <sup>1</sup>
CV3	Acceleration Rate <sup>1</sup>
CV4	Deceleration Rate <sup>1</sup>
CV5	Max Voltage <sup>1</sup>
CV8	MFG ID. MTH =27 (Also used for various resets)
CV11	Packet Timeout
CV17	High Byte of Extended Address
CV18	Low Byte of Extended Address
CV19	Consist Address (bit 7=1 on an engine will tell the engine it's reversed in a consist)
CV21	Defines active Function F1-F8 for the active consist
CV22	Defines active functions for FL and F9-F12 for the active consist (bit 0=1 will tell an engine that you want it's FL control to operate under the consist address – bit1-0/bit2=1 will configure the FL control for a reversed engine in a consist)
CV23	Consist Acceleration Rate
CV24	Consist Deceleration Adjustment
CV25	Speed Table Select
CV29	Decoder Configuration
CV49	Short Address (controllers that prohibit PoM)
CV50	Extended Addr High Byte (controllers that prohibit PoM)
CV51	Extended Addr Low Byte (controllers that prohibit PoM)
CV52	MTH/PWM Mode Configuration
CV53	MTH Acceleration (1/8 *sMPH/s) (For example - a Value of 8 written would give you 1sMPH/s acceleration)
CV54	MTH Deceleration Rate (1/8*sMPH/s)
CV55	Factory Address Reset Alternate method. Send a value of 55 to CV55 on address 55 and the model will go back to the Factory Default Address. <b>NOTE: The engine address has to be something other than address 55</b>
CV56	Marklin Configuration
CV57	Anti-Jackrabbit Toggle. A value of 7 disables the feature, a value of 0 enables the feature.
CV63	MTH Consist Acceleration Rate (1/8*sMPH/s)
CV64	MTH Consist Deceleration Rate (1/8*sMPH/s)
CV66	Forward Trim <sup>1</sup>
CV67- CV94	Speed Table Selection (CV29 bit 4 must be set to 1 then CV25 must be set to 0 or 1)
CV95	Reverse Trim <sup>1</sup>
CV105	User ID #1 – General Purpose use for customer
CV106	User ID #2 – General Purpose use for customer
CV115- CV170	MTH Function Assignments – See table of supported CV's and manual section on how to re-arrange them for further information

**1. CV52, bit0 must = 1. This will enable PWM Mode.**

## Factory Default Values for MTH PS3.0 DCC Configuration Variables (CV's)

Default Value	Range	Description	CV	F-Key	Description	CV
3	0-127	Short Address	1	1	Function - Bell High Byte	115
16	0-255	Start Voltage (Cv52 bit 0 must =1)	2	1	Function - Bell Low Byte	116
0	0-255	Accel Adjustment	3	2	Horn High Byte	117
0	0-255	Decel Adjustment	4	2	Horn Low Byte	118
0	0-255	Max Voltage (Cv52 bit 0 must =1)	5	3	Start-Up/Shut Down High Byte	119
0	-	NMRA Mfg Version	7	3	Start-Up/Shut Down Low Byte	120
27	-	NMRA Mfg ID	8	4	PFA High Byte	121
0	0-255	Packet Timeout	11	4	PFA Low Byte	122
205	192-231	Extended Address High Byte	17	5	Lights High Byte	123
5	0-255	Extended Address Low Byte	18	5	Lights Low Byte	124
0	0-255	Consist Address	19	6	Master Volume High Byte	125
0	0-255	Consist Functions F1-F8	21	6	Master Volume Low Byte	126
0	0-255	Consist Functions F9-F12	22	7	Front Coupler High Byte	127
0	0-255	Consist Acceleration Adjustment	23	7	Front Coupler Low Byte	128
0	0-255	Consist Deceleration Adjustment	24	8	Rear Coupler High Byte	129
0	0-127	Speed Table Select	25	8	Rear Coupler Low Byte	130
2	0-255	Decoder Configuration	29	9	Forward Signal High Byte	131
-	0-127	Short Address (controllers that prohibit PoM)	49	9	Forward Signal Low Byte	132
-	192-231	Extended Addr High Byte (controllers that prohibit PoM)	50	10	Reverse Signal High Byte	133
-	0-255	Extended Addr Low Byte (controllers that prohibit PoM)	51	10	Reverse Signal Low Byte	134
0	0-255	MTH/PWM Mode Configuration	52	11	Grade Crossing High Byte	135
128	0-255	MTH Acceleration Rate	53	11	Grade Crossing Low Byte	136
64	0-255	MTH Deceleration Rate	54	12	Smoke On/Off High Byte	137
0	0-255	Marklin Configuration	56	12	Smoke On/Off Low Byte	138
0	0-255	Anti-Jackrabbit	57	13	Smoke Volume High Byte	139
0	0-255	MTH Consist Acceleration Rate	63	13	Smoke Volume Low Byte	140
0	0-255	MTH Consist Deceleration Rate	64	14	Idle Sequence 3 High Byte	141
0	0-255	Forward Trim	66	14	Idle Sequence 3 Low Byte	142
0	0-255	Alternate Speed Curve Step 1	67	15	Idle Sequence 2 High Byte	143
9	0-255	Alternate Speed Curve Step 2	68	15	Idle Sequence 2 Low Byte	144
19	0-255	Alternate Speed Curve Step 3	69	16	Idle Sequence 1 High Byte	145
28	0-255?	Alternate Speed Curve Step 4	70	16	Idle Sequence 1 Low Byte	146
38	0-255	Alternate Speed Curve Step 5	71	17	Extended Start-Up High Byte	147
47	0-255	Alternate Speed Curve Step 6	72	17	Extended Start-Up Low Byte	148
57	0-255	Alternate Speed Curve Step 7	73	18	Extended Shut Down High Byte	149
66	0-255	Alternate Speed Curve Step 8	74	18	Extended Shut Down Low Byte	150
76	0-255	Alternate Speed Curve Step 9	75	19	Rev Up High Byte	151
85	0-255	Alternate Speed Curve Step 10	76	19	Rev Up Low Byte	152
94	0-255	Alternate Speed Curve Step 11	77	20	Rev Down High Byte	153
104	0-255	Alternate Speed Curve Step 12	78	20	Rev Down Low Byte	154
113	0-255	Alternate Speed Curve Step 13	79	21	One Shot Doppler High Byte	155
123	0-255?	Alternate Speed Curve Step 14	80	21	One Shot Doppler Low Byte	156
132	0-255	Alternate Speed Curve Step 15	81	22	Coupler Slack High Byte	157
142	0-255	Alternate Speed Curve Step 16	82	22	Coupler Slack Low Byte	158
151	0-255	Alternate Speed Curve Step 17	83	23	Coupler Close High Byte	159
161	0-255	Alternate Speed Curve Step 18	84	23	Coupler Close Low Byte	160
170	0-255	Alternate Speed Curve Step 19	85	24	Single Horn Blast High Byte	161
179	0-255	Alternate Speed Curve Step 20	86	24	Single Horn Blast Low Byte	162
189	0-255	Alternate Speed Curve Step 21	87	25	Engine Sounds High Byte	163
198	0-255	Alternate Speed Curve Step 22	88	25	Engine Sounds Low Byte	164
208	0-255?	Alternate Speed Curve Step 23	89	26	Brake Sounds On/Off High Byte	165
217	0-255	Alternate Speed Curve Step 24	90	26	Brake Sounds On/Off Low Byte	166
227	0-255	Alternate Speed Curve Step 25	91	27	Cab Chatter On/Off High Byte	167
236	0-255	Alternate Speed Curve Step 26	92	27	Cab Chatter On/Off Low Byte	168
246	0-255	Alternate Speed Curve Step 27	93	28	Feature Reset High Byte	169
255	0-255	Alternate Speed Curve Step 28	94	28	Feature Reset Low Byte	170
0	0-255	Reverse Trim	95			
0	0-255	User ID #1	105			
0	0-255	User ID #2	106			

## User-Settable F-Function List

This feature allows you to take the 28 F-Functions that currently reside in each MTH Proto-Sound 3.0-equipped O-Gauge Engine and change the location of that function. For example: F4 is currently PFA and you'd like that placed down to F28 which is Feature Reset. The below instructions explain how you can do this.

**NOTE:** When you set a particular F-Function to a numeric location you are overwriting that existing number's function. Further, you are leaving the location where the previous function was moved from empty, which means that F-Function no longer has any function associated with it

In order to move the F-Functions around you will need to refer to the below table.

**NOTE:** The Function Identification number IS NOT the F Function number you would use on your DCC handheld. It is used internally in the engine.

### Function Identification Chart

SOUNDS	FUNCTION IDENTIFICATION	OTHER FUNCTIONS	FUNCTION IDENTIFICATION
Bell	1	Feature Reset	29
Brake Sounds	2	Front Coupler	30
Cab Chatter	3	Front Pantograph	
Clickety Clack	4	Up/Down	31
Coupler Close	5	Pantograph	
Coupler Slack	6	Auto/Manual	32
Drift Chuff	7	Rear Coupler	33
Engine Sounds	8	Rear Pantograph	
Forward Signal	9	Up/Down	34
Grade Crossing Signal	10	Rev Down	35
Horn	11	Rev Up	36
Idle Sequence 1	12	Smoke On/Off	37
Idle Sequence 2	13	Smoke Volume	38
Idle Sequence 3	14	Disable Momentum (Motorola)	40
Idle Sequence 4	15	Half-Speed (Motorola)	41
Labor Chuff	16	Switching (combination of	
Master Volume	17	Momentum and Half-Speed)	42
Short Horn	18		
One Shot Doppler	19	<b>LIGHTS</b>	
Reverse Signal	20	Lights	39
		Marker (Train/No Train)	43
		Beacon (Alt Lighting/Country)	44
<b>SCRIPTS</b>			
Extended Shut Down	21		
Extended Start Up	22	<b>ELECTRIC SMOKE</b>	
PFA	23	Electric Boiler Start-Up	45
Start Up/Shut Down	24	Electric Pressure Release	46
Train Wreck	25		
Trolley Manual Mode	26	Trolley Random Stops	47
Trolley Learn Mode	27		
Trolley Auto Mode	28		

The above list includes ALL F functions that an MTH PS3 engine could have. You are free to change any of the above listed items to any F function position, 1-28. For example, if you your engine came from the factory without a smoke unit but you added one at a later date you could swap out any of the F functions, 1-28, for the Smoke On/Off and the Smoke Volume.

So, using the example above of moving F4 to F28 here are the steps:

1. Refer the MTH Supported CV table to see what CV the destination Function is assigned to. In doing so, you are looking only for the Low Byte CV location. In this case it's CV170
2. Using your DCC system, bring up CV programming for CV170
3. Now tell the engine which F-Function you want to write at CV170. So, looking at the Function ID table above you can see that PFA is a value of 23
4. Using your DCC system, enter a value of 23 for CV170 and hit Enter. You have just re-assigned the PFA sound to F28 on your DCC controller. The engine will give you a two horn blast indication. **NOTE:** You've also left an empty location where PFA used to be (F4)
5. Now you can fill that location with whichever CV you'd like. For this example we are just going to move the Feature Reset up to F4 (we're just swapping F4 and F28)
6. Since F4's Low Byte is CV122 then bring up CV programming for CV122
7. Now tell the engine which F-Function you want to write at CV122. So, looking at the Function ID table above you can see that Feature Reset is a value of 29
8. Using your DCC system, enter a value of 29 for CV122 and hit Enter. Your engine will give you a two horn blast indication

## CV57 - Anti-Jackrabbit

- This either enables or disables the feature whereby in Conventional DC one has to lower the track voltage below approx 9VDC and then raise it again to get the engine to move
- The only method to enable/disable this feature is through DCC
- This feature is ONLY utilized in Conventional DC. It does not have support for DCS, Conventional AC, or DCC
- CV57 is the CV used to toggle this. Writing a value of 7 to CV57 will disable the feature. Writing a value of 0 to CV57 will re-enable the feature
- This feature was borne out of the request for those with automated systems that shut down the track power to avoid collisions and for traffic management.

**Operational Note:** If you are running in Conventional and you have antijackrabbit disabled, your engine will not play any start-up sounds or shut down sounds. Once the charge light goes out it will just be at the engine's normal idle sounds. Likewise, when you remove track power there will be no shut down sounds. It will just be idle sounds until the super caps shut the board off

By default anti-jackrabbit is enabled at the factory.

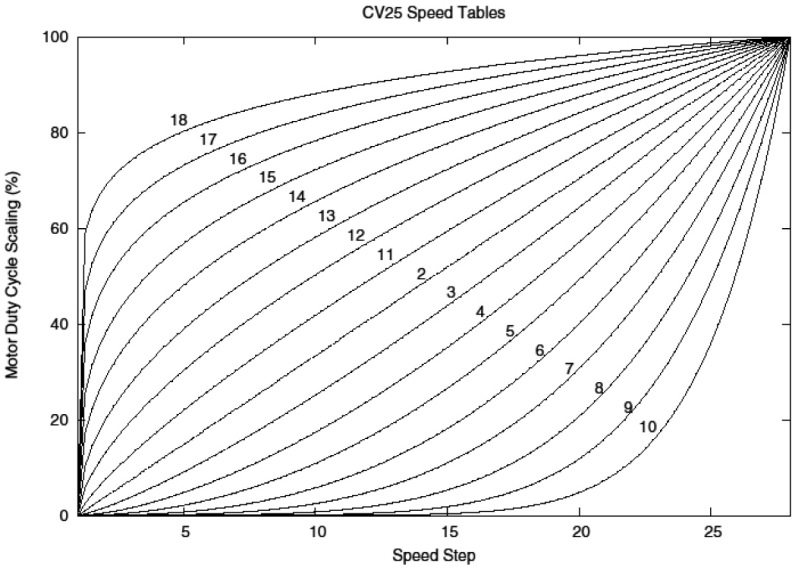
1. To disable anti-jackrabbit ensure the engine is running in DCC
2. Connect the DCC system to the engine and power on the DCC system
3. Hit F3 or scroll the speed up to get the engine started up
4. Enter Programming on the Main (PoM)
5. Select CV57 and write a value of 7
6. The engine will give you a two honk response
7. This setting will now be saved and the engine will now operate with anti-jackrabbit deactivated.

**NOTE:** Again, Anti-Jackrabbit operation only applies to Conventional DC 8. To re-activate anti-jackrabbit repeat the above steps except write a value of 0 to Cv57

## Custom Speed Tables

Below is a table that shows the value to write to CV25 to achieve the desired speed curve. For example, if you would like to use speed curve 18 then:

1. Write a value of 1 to CV52 to enable PWM Mode
2. Write a value of 1 to bit 4 of CV29
3. Write a value of 18 to CV25. Your engine will now use the speed curve #18 below
4. If you want to create your own speed table using CV's 67-94 then write a value of 0 or 1 to CV25

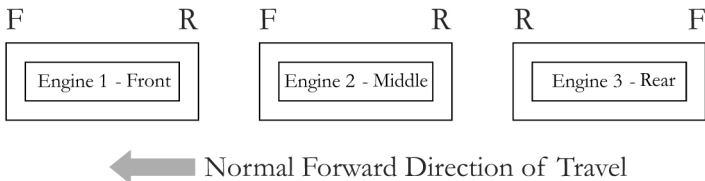


## Advanced Consisting

Advanced Consisting follows the NMRA standards. Any values assigned to CV's 21-24 are ignored once the consist is removed (CV19 set to 0).

- Setting the MSB (Bit 7) of CV19 tells the engine that it is facing reverse in the consist
- Setting CV21 and CV22 determine which F Functions the consist responds to

See diagram below for example





### To set this consists up so that:

- The Headlight is ON in the Front engine when going Forward, OFF when the consist is in Reverse
- The Reverse light and headlight is OFF in the Rear engine when the consist is going Forward, headlight is ON, reverse light is OFF when the consist is in Reverse
- The Middle engine has no lights in either direction

### Perform the following:

1. Build the consist using your DCC system per the DCC system's manufacturer's instructions. In many newer systems you have the ability to tell the system which engine is reversed. Remember the consist address you told the DCC system to be built at as you'll need to come back to that address to actually run the consist. The instructions assume only CV19 gets the consists address and nothing more
2. Call up the Front engine on your DCC handheld; address 1 in this example
3. Select CV22 and write a value of 1. This tells the engine that it's a forward facing engine and that you want F0 to control the FL function at the consist address. The engine will give you two horn blasts to announce that it received the CV change
4. Ensure F0 is deactivated at the Front engine's address. Most systems have a light bulb icon to indicate whether F0 is active or not. Ensure that it is OFF
5. Call up the Rear engine on your DCC handheld; address 3 in this example
6. Set CV19 to 128 + the value of your consist address
  - So, if your consist address is 4 you would add  $128+4=132$ . You would write 132 to CV19. This tells the Rear engine that it's reversed in the consist. You will get two horn blasts to announce that it received the CV change. Some DCC systems may already do this for you but the instructions assume your system does not. If you are in doubt then go ahead and follow step 5 as it will do no harm
7. Set CV22 to a value of 2 to the Rear engine's address to tell the Rear engine that you want to control its FL control with the F0 button at the consist address. The engine will give you two horn blasts to announce that it received the CV change
8. Ensure F0 is deactivated at the Rear engine's address. Most systems have a light bulb icon to indicate whether F0 is active or not. Ensure that it is OFF
9. Call up the Middle engine on your DCC handheld; address 2 in this example
10. Ensure F5 and F0 are toggled OFF. You may have to toggle F5 on/off a couple times to get the lights in sync with the DCC command station. This will depend upon your DCC system

11. Call up the consist address (address 4 in this example)

12. Press the F0 button to ensure the FL is toggled on. Most systems have a light bulb icon to indicate whether F0 is active or not. Ensure that it is ON

**NOTE:** The convenient thing about setting up the consist as described above is that it allows you flexibility in the orientation of an engine in a consist; particularly the head and tail engines where the FL control is integral. For example, if you wanted to flip the Rear engine around and make it face forward in the consist all you'd have to do is go into the Rear engine's address (address 3 in the example) and clear bit 7 of CV19. In other words, just write the consist's address to CV19. The FL control will automatically understand what you've done so there is no need to go in and change CV22.

Below is a table that outlines which bits correspond to what F Functions F0, F9-F12 are used in a consist:

Bit (Decimal Value)	7 (128) Not Used	6 (64) Not Used	5 (32)	4 (16)	3 (8)	2 (4)	1 (2)	0 (1)
F Function	Not Used	Not Used	F12	F11	F10	F9	F0 (Engine Facing Rev)	F0 (Engine Facing Fwd)

## Setting Up CV21 for a Consist

CV21 allows you to set which F Functions you want the consist address to control. For example, you will likely want all of your MTH consist engines to respond to Start-Up/Shut Down (F3). Also, you'll likely want at your Front engine to respond to the Bell and Horn commands (F1 and F2, respectively) and the Front Coupler (F7 on most MTH models). Likewise, you'll want your Rear engine to respond to the Rear Coupler command (F8 on most MTH models).

Please refer to the table below to see which bits have what decimal value and which F Function they correspond to.

### To do this:

1. Call up the Front engine on your DCC system
2. To set the Front engine to respond to the Bell (F1), Horn (F2), Start-Up/Shut Down (F3) and Front Coupler (F7) you will want to write a value of 71 to CV21. This is setting bits 0, 1, 2, and 6 ON.
  - a. CV21's bits are shown in the table below – the decimal value is shown in parenthesis:

Bit (Decimal Value)	7 (128)	6 (64)	5 (32)	4 (16)	3 (8)	2 (4)	1 (2)	0 (1)
F Function	F8	F7	F6	F5	F4	F3	F2	F1

**NOTE:** CV21 is ONLY used when you have some value other than 0 written to CV19. If CV19 = 0 then the values of CV21, CV22, CV23, and CV24 are not used

3. Call up your Middle engine (address 2 in the example)
4. Since you want to have the Middle engine respond to F3 only then write a value of 4 (CV21, bit 2 = ON)
5. Call up your Rear engine (address 3 in the example)
6. Since you want to have the Rear engine respond to the Start-Up/Shut Down (F3) and Rear Coupler (F8) functions you want to write a value of 132 to CV21

Your engines are now set up according to the example above.

You will note that there is no F0 in CV21. This is because that function (FL) is controlled by CV22. Please refer to the Advanced Consisting section for more information regarding CV22.

## Programming Track

Your MTH Proto-Sound 3.0-equipped locomotive does not program well on Programming tracks due to the inclusion of super capacitors utilized in the locomotive's electronic package. The super capacitors provide backup power to the electronics, allowing the locomotive to better negotiate track sections suffering from poor electrical conductivity. This ensures that sounds continue to play, the locomotive continues to move forward and lighting remains lit. During power shutdowns, the super capacitors provide power to allow the locomotive shutdown sounds to continue playing through their conclusion. Unfortunately, the super capacitors require that operators ONLY program engine CV's using Programming on the Main (PoM).

## DCC Bit Value Decoder

Example Value (bit 7 -> bit 0) 11011001								
Bit (Decimal Value)	7 (128)	6 (64)	5 (32)	4 (16)	3 (8)	2 (4)	1 (2)	0 (1)
Binary Example	1 (on)	1 (on)	0 (off)	1 (on)	1 (on)	0 (off)	0 (off)	1 (on)
Decimal Value	128	64	0	16	8	0	0	1

So, in the above example you simply add up the values in the "Decimal Value" row – 128+64+0+16+8+0+0+1 = 217. You would write 217 to the CV you were altering.

The above applies to any CV. Also, if you have a CV that already has a value assigned that you do not want to alter but need to make additions to it, for example CV29, you would simply add the additional bits you enabled to the existing value to obtain the new CV value.

For example, if you had a consist address (CV19) set to 5 and you wanted to alter this to show an engine reversed in the consist you would need to set bit 7 (decimal value = 128) for the engine you want to reverse. To do this - take 128 (the new bit you want to set) + 5 (the existing bit that you do not want to alter) = 133. You would then write a value of 133 to CV19.