



M.T.H. HO ES44AC Diesel Engine

(PS3E+)

Engineer's Guide

Congratulations! You've just purchased the most feature-rich and technically advanced HO diesel locomotive ever produced! This highly detailed model includes a broader range of features than you'll find on any other HO scale diesel, including smooth performance from a three-scale-mile-per-hour crawl to full throttle; "cruise control" for steady speeds regardless of curves, switches and grades; built-in decoders for DCC and the M.T.H. Digital Command System (DCS); and a full range of prototypical sounds. If you're looking for motive power that's accurately detailed, smooth running, and a great deal of fun to operate, it doesn't get any better than this.

Operates on R1 - 360.0 mm (14 3/16 in) radius curves with Code 70, Code 83 or Code 100 rails.



PFA
Passenger/Freight
Announcements

PLEASE READ THE MANUAL BEFORE USE AND SAVE
WWW.MTHHOTRAINS.COM

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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.

This product may be protected by one or more of the following patents: 6,019,289; 6,280,278; 6,281,606; 6,291,263; 6,457,681; 6,491,263; 6,604,641; 6,619,594; 6,624,537; 6,655,640.

Rev: _80dl19548i_HO ES44 Diesel P33E+ 10/9/14

QUICK START GUIDE

Of course, you should read your manual over before running your engine. But if you just can't wait, choose how you want to run below and enjoy! Now, after a few minutes, shut her down and read through your engineer's guide.

CAUTION: M.T.H. PS3E+ HO engines **OPERATE ON AC VOLTAGE** and are designed to operate on HO 3-Rail Stud-rail track.

I USE AN AC SUPPLY...

- Step 1: Unpack your Engine. (refer to unpacking instruction on pg 4)
- Step 2: Set the engine on the track
- Step 3: Apply increasing **AC** voltage until she starts up and pulls out!

I USE A REGULAR DC SUPPLY...

- Step 1: Unpack your Engine. (refer to unpacking instruction on pg 4)
- Step 2: Set the engine on the track
- Step 3: Apply increasing **DC** voltage until she starts up and pulls out!

I'M A DCC/MOTOROLA OPERATOR...

- Step 1: Unpack your Engine. (refer to unpacking instructions on pg 4)
- Step 2: Set the engine on the track
- Step 3: Power up your DCC system
- Step 4: Select engine address 3 and press "F3" to start her up
- Step 5: Turn the throttle and head on down the pike

I RUN DCS...

- Step 1: Unpack your Engine. (refer to unpacking instructions on pg 4)
- Step 2: Set the engine on the track
- Step 3: Power up your DCS system
- Step 4: Add the engine to your system and start her up
- Step 5: Turn the throttle and move out

* 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.

WHAT IS 'MOTOROLA?'

You will see the term Motorola when referring to DCC a lot in this manual, because...well Motorola is essentially 99% DCC (**there are only really a few functions that are specific to motorola**). Motorola is primarily used for DCC functions on 3-Rail Engines in Europe, and is most frequently used with a Marklin controller. Chances are, if you are using Motorola you already know it. Otherwise just stick to DCC if that is what you are operating!

UNPACKING YOUR ENGINE

Removing and Unwrapping Your Engine

Carefully remove and unwrap the model on a soft surface. By nature, models with high levels of detail have some small fragile parts.

Carefully remove any foam packing pieces that may be surrounding the model.

What Else is in the Box?

The following items are packed with your engine.

Engineer's Guide (1)

Replacement Traction Tires (4)

Your locomotive is equipped with two neoprene rubber traction tires on each powered truck block. While these tires are extremely durable, you may need to replace them at some point.

PRODUCT OVERVIEW

Getting to Know Your M.T.H. HO Locomotive

Key Features

Your new HO Diesel Engine is equipped with the exclusive M.T.H. Proto-Sound® 3.0E+ digital sound and control system. In plain English, this means your locomotive contains state-of-the-art electronics providing realistic digital sounds, precisely controlled speed in increments of 1 scale mile per hour and much more.

Compatibility

The Proto-Sound 3E+ system is universally compatible with track power and/or signal combinations including analog AC, analog DC (regular DC power pack), DCC/Motorola (NMRA Digital Command Control), or DCS (MTH Digital Command System). Simply set your Engine on the rails, flip the DCS/DCC switch to the mode you want to run, apply any one of these power/signal sources, and move out! A vast array of realistic operation is automatic when the Engine is run on analog AC or analog DC. You can expand access to features in a DCC environment. Experience the most your new locomotive has to offer in the simple to use yet powerful world of DCS. To be clear, DCS is NOT a proprietary version of DCC, as some other manufacturers offer. DCS is a comprehensive layout control system designed with one primary goal: make model trains do amazingly realistic things using a simple and intuitive controller. We put the complexity on the inside, and the fun in your hands!

Digital Sound

Your Proto-Sound 3.0E+ (PS3E+) equipped engine contains over 100 individual recordings. These recordings are played back dynamically at appropriate times to create a symphony of realism for your ears. Hear the diesel roar automatically intensify or lighten when speeding up or slowing down, listen to the sounds of brakes squeaking and squealing as you come to a stop, or enjoy the random conversations of railmen working as your model sits at idle. It's all there and it's incredible.

Your HO diesel includes built-in realistic horn sound effects, including forward (two blasts) and reverse (three blasts) signaling and crossing signal sounds, all available with one-touch control from a DCS controller or through any DCC controller capable of accessing up to F28.

Digital Control

In standard analog AC or analog DC mode, your model still operates under digital control. The PS 3E+ advance speed control system converts track voltage into digital speed commands. Your model will run smoothly and consistently at any speed regardless of load, hills, or curves. If you are a DCC/Motorola user, you'll quickly learn to appreciate the precision of our speed control and linear speed curve. DCS users will enjoy the added benefits of controlling speeds in increments of 1 scale mile per hour displayed on DCS controllers or easily changing acceleration and deceleration rates independently without any discussion of bits or bytes. **To be clear, DCS is NOT DCC.**

Lights

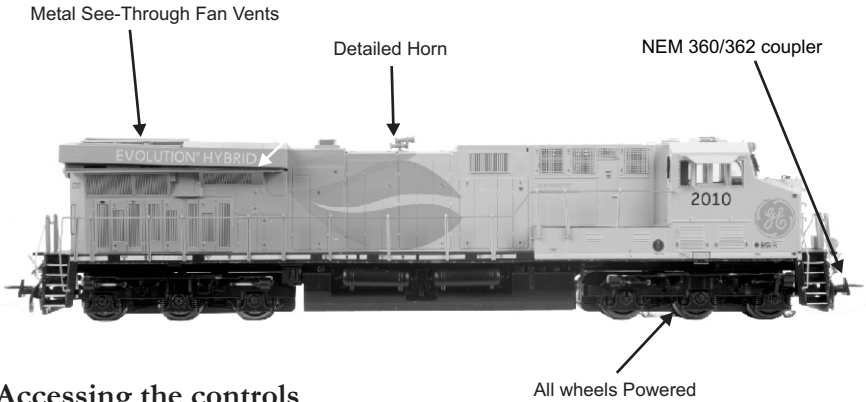
As you read on, you'll notice there are no instructions for replacing light bulbs in your diesel. That's because there aren't any. We use specially designed and controlled LEDs to create realistic lighting effects that occur automatically. Again, **NO PROGRAMMING!!** Just come to a stop and watch as the headlight dims automatically in accordance with rule 17. Of course, as you pull away, the headlight returns to it's fully bright, yet warm, glow. We even included a light in the cab so the engineers can see to do their jobs!

More...

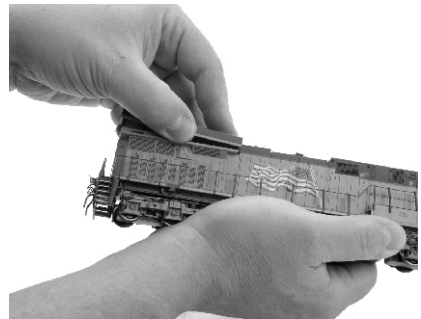
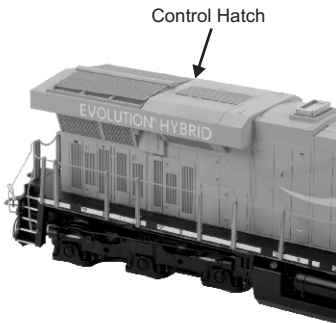
In analog DC operation, just flip the track polarity or direction switch at any speed and watch your Engine gradually come to stop, turn on the appropriate directional lighting, and smoothly accelerate back up to speed. No other HO locomotive has features like these. There are so many more things to learn and enjoy about M.T.H. HO Engines, we could write a book. But, that's no fun. So, if you haven't already done so, flip to the Quick Start Guide and let's run your new engine!!

ENGINE DIAGRAM

Locomotive



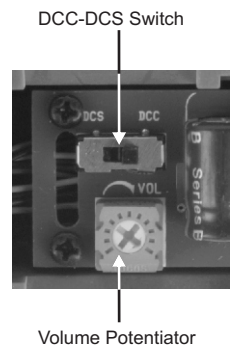
Accessing the controls



To remove the Control Hatch, gently pull it outward and lift it off from the side.

DCC-DCS Switch

If you remove the fan vent at the rear of the engine (as shown above), you will find your DCC-DCS Switch, and volume Potentiator. As a factory default, the switch is set to the DCC position. To operate the engine in DCS mode, ensure the switch is set to DCS. If you wish to run the engine in DCC mode, ensure the switch is set to DCC. If you inadvertently leave the switch in DCC it won't hurt anything, you just won't be able to communicate with your engine with your DCS system. Likewise, if you leave the switch in DCS and try to operate the engine under DCC you may notice a humming coming from your engine and you will likely notice that your DCC system's overload light will be on.



SET-UP

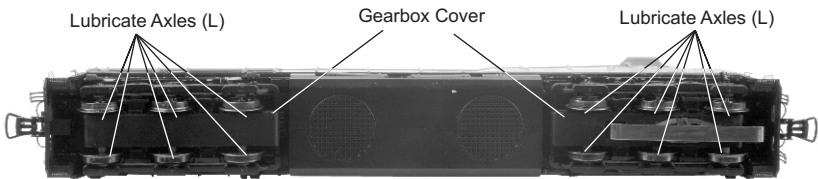
Couplers

This engine comes equipped with a NEM 362 coupler pocket and NEM 360 couplers. If you do not wish to use the NEM 360 coupler you can use any coupler that fits the standard NEM 362 coupler pocket.

Lubrication

Using light machine or household oil, apply a very small amount to all axles points as shown.

Your gearbox is properly greased at the factory and probably never needs service however, if you run excessive hours pulling heavy loads, it's a good idea to remove the gearbox cover and re-grease using M.T.H. gear grease or equivalent. To remove the gearbox cover, snap it off from one of the ends.

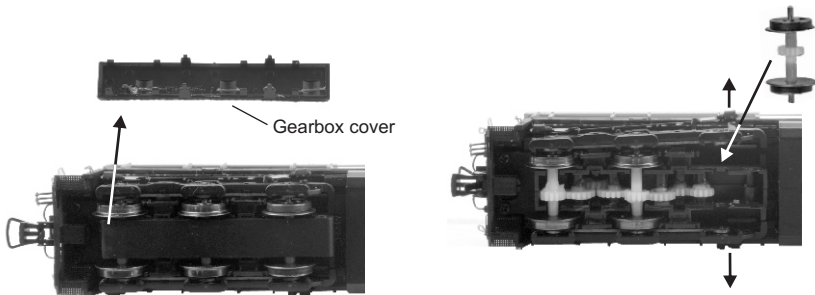


SET-UP

Traction Tire Replacement

Your locomotive is equipped with two neoprene rubber traction tires on each powered truck block. While these tires are extremely durable, you may need to replace them at some point.

1. First, remove the gearbox cover from the truck block. To do this, turn your engine upside down and snap it off from one of the ends.



*Separate the truck sides
in order to free the drive wheel*

2. Pull apart the truck sides from the truck block in order to remove the drive wheel (*see photo above*).

3. Make sure the old tire has been completely removed from the groove in the drive wheel, using a razor blade or small flathead screwdriver to pry away any remains.

4. Slip the new tire onto the wheel. You may find it useful to use two small flathead screwdrivers to stretch the tire over the wheel.

5. If you twist the tire while stretching it over the wheel, you will need to remove and reinstall the tire. Otherwise your engine will wobble while operating.

6. Make sure the tire is fully seated inside the groove. Use a razor blade to trim away any excess tire that doesn't seat itself inside the groove properly.

7. Reassemble in reverse order.

One set of replacement tires is packaged with the model. Additional tires are available directly from the M.T.H. Parts Department.

Order online: www.mthtrains.com

E-mail: parts@mth-railking.com

Phone: 410-381-2580

Fax: 410-423-0009

Mail: 7020 Columbia Gateway Drive, Columbia MD 21046-1532

MODES OF OPERATION

There are 4 modes of operation with different levels of features accessible in each. We refer to them as Conventional AC, DC, DCS, and DCC/Motorola. Here's a little more explanation before we get into the features of each mode.

Conventional AC

When using conventional AC power, the engine will respond to changes in track voltage. An increase in track voltage will increase the locomotive speed and a reduction in track voltage will reduce the engine speed.

Analog DC

This is when there is nothing connected to the rails except a conventional DC power pack. These power packs generally have at least one variable output controlled by a throttle of some sort and a means of reversing DC polarity on the track to change the direction of your engine.

DCS or Digital Control System

While the acronyms are close, this is about where the similarities between DCS and DCC end. Yes, they are both digital control systems, however, M.T.H. DCS is NOT DCC. There are several proprietary versions of DCC on the market, but this is NOT one of them. M.T.H.'s DCS system is proven technology in the O and One gauge markets and now, we've brought its power and simplicity to you.

First, the power signal in DCS is NOT the command signal. Next, DCS employs a fully functional bi-directional communication scheme opening a vast range of advanced features and yet, is so simple and intuitive, you can enjoy them! No programming tracks, bits and bytes, or conversion of binary to hexadecimal numbers here! To add an engine in DCS, just press "ADD ENGINE." After that, If you want to start your engine, just press "START UP" or, to turn the sound on or off, just press "SOUND." No combinations of letters or numbers to remember! We think you're really going to like this!

Please note, when making setting changes in DCS or DCC, such as address, please wait a minimum of 5 Seconds after removing power to ensure the settings are stored in the engines memory. Reapplying power in less than 5 seconds may result in losing the setting changes.

DCC/Motorola or Digital Command Control

DCC/Motorola is a popular digital command control scheme wherein the track power is also a digital control signal. That is, using a DCC/Motorola controller, you can communicate with multiple engines and have them all moving at different speeds or moving in opposite directions on the same track at the same time. The power/command signal remains constant and engines are "commanded" to perform as desired. M.T.H. is new to DCC/Motorola but, we recognize it's importance to many HO operators. So, we loaded our engine with more DCC features easily accessible to the operator than any HO engine ever built previously. You DCC/Motorola guys are in for a real treat!

Please note, when making setting changes in DCS or DCC,/Motorola such as address, please wait a minimum of 5 seconds after removing power to ensure the settings are stored in the engines memory. Reapplying power in less than 5 seconds may result in losing the setting changes.

FEATURES AND OPERATION

Now, for the fun stuff! Your new M.T.H. HO Diesel Engine has more features and operating capabilities than any HO engine ever built by any manufacturer. We're going to walk you through everything she does in general, but you'll probably find a few we forgot to mention on your own.

Conventional AC

When using conventional AC power, the engine will respond to changes in track voltage. An increase in track voltage will increase the locomotive speed and a reduction in track voltage will reduce the engine speed. *(see pages 26-28 for specifics on the Marklin controller)*

Changing Direction (AC)

When power is first applied to the track, the locomotive will be silent for 1-20 seconds and the headlight will be on, indicating the super capacitors are charging (The super capacitors provide power to the sound system during direction changes or intermittent drops in track power due to dirty track or on switches, when operating in conventional mode). When the super capacitors are charged, all the lights will come on and the engine sounds will start up. There should be no movement, turning the throttle knob on the transformer counterclockwise past zero and quickly back up again will bring the engine to a forward motion state, then increasing the throttle will begin to move the engine forward, and speed will increase as the throttle is advanced. To change direction, turn the throttle knob on the transformer counterclockwise past zero and quickly back up again. Then adjust the throttle knob to control the speed of the locomotive.

Analog DC

Not much explanation is required here, and that's exactly why you run your trains this way! Here's the good news, even if you like to keep it simple, your MTH HO engine is packed with cool sounds, lights, and operating features, that you're going to love.

Running the Engine

Set the engine on the rails, and apply DC power. Refer to the Set-Up section of this guide for instructions on how to lubricate the chassis.

As you increase power, at about 6 volts, the lights and sounds will come on. Keep going on up to about 8 and she'll move out! About 16 volts DC is adequate for prototypical speeds however, your engine can handle up to 24 volts DC if you feel the need for speed!

Changing Direction

If you flip the direction (polarity) switch on your power pack while the engine is moving, it will gradually slow to a stop, and slowly accelerate back up to speed in the opposite direction. This is an exclusive feature of MTH engines that we're sure you'll enjoy. You can also change direction the old fashioned way by reducing throttle until the engine stops, flip the direction switch, and then increase throttle again. Either way is OK, we just thought a graceful transition from any speed would be cool.

If you switch track polarity too slowly, the engine may stop abruptly and not move in the reverse direction. This is normal. There is a feature we call “anti- jack rabbit” that prevents the engine from taking off at high speeds when high voltage is applied to the track instantly. Some direction switches have a “dead” spot where the power is completely off during polarity changes. This can invoke the anti-jack rabbit feature. The solution is to flip the direction switch more quickly. Don't worry you won't hurt the engine.

Speed Control

Your engine is equipped with speed control. This feature is always active, even in analog AC or DC mode. Basically, your engine constantly measures track voltage and converts this to a digital speed command. You should notice the speed remains constant up and down grades, around curves, and with varying loads. This is no accident. You've got the most precise speed control system available today.

Sounds

In this mode, sounds are pretty much automatic. If you're moving, you'll hear diesel sounds.

When your sitting at idle, there may be some maintenance done. You could hear someone calling for help on the radio. Don't worry, all of this and more is just a normal part of everyday operations.

When you're moving at a pretty good clip and you reduce the throttle quickly, you may hear the brakes squeak and squeal as the engineer applies them. Of course, they'll stop when the engine does.

If things get too noisy, just locate the sound volume pot under the rear roof, adjust the volume from maximum down to off, whatever suits you. Turn it counterclockwise to reduce the volume or clockwise to increase it. Refer to page 7 for volume pot location.

Lighting

Now, this is an illuminating section (we couldn't resist). Your model is equipped with a headlight, number board lights and ditch lights (where applicable).

The first thing to know about the lighting is there aren't any bulbs. It's all LEDs, so you should never have to replace them. As with sounds, in analog DC mode, lighting operation is fully automatic. They're always on and behave appropriately.

Lighting (continued)

The headlight functions under rule 17 and dims when stopped for a time or while backing up. Of course, just as you begin to move forward, it goes bright to show the way.

By default your ditch lights are set to ON. That means they are ON as soon as the engine starts moving in forward. When you sound the horn they will alternately flash and will continue to flash for 5 seconds after the horn button has been released. When you set the ditch lights to OFF they will stay off regardless of movement or horn sounds. **NOTE** – The Ditch Lights follow Rule 17 lighting. That means when your engine is stopped the ditch lights will go off. Once you start moving again in forward (when the headlight goes from dim to bright) they will come back ON, provided you have them set to ON.

On the GE Evolution version of the ES-44 there is a new lighting feature that existed on the Demonstrator model - Charge Lights. These lights showcase GE's hybrid dynamic braking. At idle and during braking these lights chase in towards the center of the body. When moving the lights chase out towards the traction motors. The LMK softkey in DCS controls this lighting effect.

DCS Digital Control System

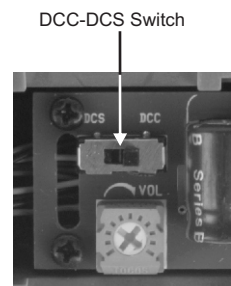
As you may have gathered by now, DCS is an M.T.H. exclusive Digital Control System that provides easy access to dozens and dozens of features in our models. We developed DCS to provide a powerful and advanced model train control system that was simple and enjoyable to use. We've accomplished that goal. DCS further expands the features available far beyond that of DCC. After all, in DCC, we only had a limited number of “F” commands to fill.

As with DCC, we'll leave the detailed “how-to” system explanations to the DCS system manuals. What you should know are all the cool features your engine has built-in, waiting for you to experience.

Don't forget to switch your engine to DCS MODE!

Running the Engine

Once the DCS system is connected to your track and powered up by an AC or DC Power Supply (even though DCS can be controlled by AC and DC power supplies, your M.T.H. HO locomotive will **ONLY** run on DC power), you simply place your engine on the rails, press “ADD ENG” and the system will scan the track and automatically upload your engine into the controller. At this point, you can press “START UP”, roll the throttle and pull out! That's it!



Speed Control

DCS engines are controlled in scale miles per hour (smph) and increments of one. So, that means if you dial up 10, your engine will smoothly accelerate to 10 smph. There is no need to select a speed step setting, there's only one precise linear control at scale speeds. See, powerful yet simple.

Sounds

Independent Volume Settings

Using DCS, you independently adjust the bell, horn, engine, and accent sounds volume. This is like a mixer so you can set up the engine to fit your specific tastes and sense of realism. They all move relatively up or down with the master volume settings.

Doppler Loop

You can either press the Doppler button on the remote to activate what we refer to as “one-shot” Doppler, or, using DCS, you can program a Doppler loop that will peak at the same point on your layout, over and over.

Custom Sounds

You can fire any of 10 individual sound bites pre-loaded into your engine. These are typically, diesel idling sounds. Each one at the press of a single button. You can also make voice or other audio recordings and play them back on command with ease.

Proto-Dispatch

Press the “MIC” (microphone) button on your DCS remote and speak. Your voice will be digitized and played out of the model in real-time. Talk about station announcements!

Proto-Cast

Another MTH exclusive, you can connect any audio source with a line output to the DCS TIU and send music, train sounds, or anything you like down the rails to be played through the engine as it moves along the track. Your holidays may never be the same!

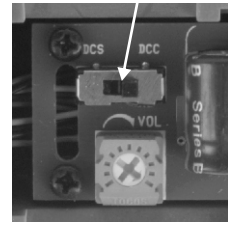
Lighting

As with everything in DCS, this becomes a little more than obvious. Pressing the “HEADLIGHT” button turns off the directional headlight and reverse light (if equipped).

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

DCC-DCS switch



PS3.0E+-equipped engine has the ability to decode and respond to these DCC commands. This allows you to mix and match MTH PS3E+—equipped engines as well as operate them with any other manufacturer's DCC-decoder equipped engine. The best part about your MTH PS3.0E+-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 PS3.0E+-equipped engine has a full complement of lights, sounds, and smoke (if equipped). **JUST SWITCH THE MODEL TO DCC MODE**, set it on the rails, apply DCC power and hit F3 on your DCC handheld controller and you're off and running.

*As mentioned before, 99% of DCC functionality is the same as Motorola. For the few **Motorola Specific** functions, refer to page (26).

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 PS3.0E+-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 PS3.0E+-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 – You are actually able to move the engine in DCC without starting it up. Just increasing the throttle will cause the engine to move. In order for F3 to function correctly the engine must 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.

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

F5 – Lights

This toggles all your lights (except the headlight) on and off

Master Volume

F6 – Master Volume

There are 10 volume levels. Pressing F6 twice (toggling on then off) raises the Master Volume one level. The Master Volume loops. That is, if you go past the 10th level it will loop back around to the 1st or lowest volume level.

Forward/Reverse Signal

Just like a real engine, you can announce the direction of travel 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

Crossing Signal

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

F11 – Crossing Signal

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

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

Idle Sequence - F13, F14, F15 and F16

Pressing F13, 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 a sequence that varies in duration.

Note – The engine must be sitting still in order to trigger these

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 – Rev Up

This will force the engine to Rev Up. Press the F19 button twice (toggling on then off) to Rev Up one notch. There are eight rev levels in a Diesel/Electric.

F20 –Rev Down

This will force the engine to Rev Down. Press the F20 button twice (toggling on then off) to Rev Down one notch. There are eight rev levels in a Diesel/Electric.

For example, if you set the rev level on a Diesel to notch 6 and start increasing the speed of the engine it will stay at that rev level until the engine's speed calls for a higher rev level. Once the engine has gone past that rev level, notch 6 in this example, the engine will then rev down normally, all the way to idle, as you decrease the speed.

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 hooks up and pulls a train 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 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

This resets features to default.

Function Chart

Function	Description
F0	Headlight
F1	Bell
F2	Horn
F3	Start-Up/Shut Down
F4	PFA
F5	Lights
F6	Master Volume
F7	Front Coupler (Sound Only)
F8	Rear Coupler (Sound Only)
F9	Forward Signal
F10	Reverse Signal
F11	Grade Crossing
F12	Clickety Clack
F13	Idle Sequence 4
F14	Idle Sequence 3
F15	Idle Sequence 2
F16	Idle Sequence 1
F17	Extended Start-Up
F18	Extended Shut Down
F19	Rev Up
F20	Rev Down
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

***Refer to pages 23, 24 & 25
for CV Data and Function ID**

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 MTH'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 MTH PS3.0-equipped engine is set to 2.

Long and Short Addressing

Like most DCC Decoders, your MTH 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 MTH 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 is 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

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

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 this step you have to tell the MTH 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

4. In the following steps you will now need to write values to CV17 and CV18 to tell the engine what the long address should be. Call up CV17 and enter the value required for CV17. You will get a two whistle/horn blast response
6. Call up CV18 and enter the value required for CV18. You will get a two whistle/horn blast response

In order to determine your required values for CV17 and CV18 you will need to go to [http://extranet.mth-](http://extranet.mth-railking.com/pdfapp/pdfs/instruction/HO%20DCC%20addressCV17_18%20Converter.xls)

[railking.com/pdfapp/pdfs/instruction/HO%20DCC%20addressCV17_18%20Converter.xls](http://extranet.mth-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

Feature/Factory Resetting

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 MTH PS3.0E+ equipped engine:

- Factory Resets – Clears everything – takes engine to just like it was when you got it brand new
 - Send a decimal 08 to CV 8 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

Advanced DCC Operation:

This section of the manual provides more in-depth detail on how to set up and configure your MTH PS3.0E+ 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. Please refer to the CV Data Table on page 25.

Configuration Variables (CV)

Configuration Variables used on MTH PS3.0E+ equipped engines.

CV1	Short Address: 1-127 are the valid addresses
CV2	Start Voltage (CV52, bit0 must = 1. This will enable PWM Mode)
CV3	Acceleration Rate (CV52, bit0 must = 1. This will enable PWM Mode)
CV4	Deceleration Rate (CV52, bit0 must = 1. This will enable PWM Mode)
CV5	Max Voltage (CV52, bit0 must = 1. This will enable PWM Mode)
CV8	MFG ID. MTH =27. Also used for various resets.
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
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. Note: The engine address has to be something other than address 55
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(CV52, bit0 must = 1. This will enable PWM Mode)
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 (CV52, bit0 must = 1. This will enable PWM Mode)
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

Below is the table of Factory Default MTH supported DCC CV's. This table is specific to the engine in the title of this manual:

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

Function Key	Decimal	Hex	Description	CV	Function Key	Description	CV
-	3	03	Short Address	1	1	Function - Bell Low Byte	116
-	16	10	Start Voltage (Cv52 bit 0 must =1)	2	2	Horn High Byte	117
-	0	0	Accel Adjustment	3	2	Horn Low Byte	118
-	0	0	Decel Adjustment	4	3	Start-Up/Shut Down High Byte	119
-	0	0	Max Voltage (Cv52 bit 0 must =1)	5	3	Start-Up/Shut Down Low Byte	120
-	0	0	NMRA Mfg Version	7	4	PFA High Byte	121
-	0	0	NMRA Mfg ID	8	4	PFA Low Byte	122
-	192	C0	Extended Address High Byte	17	5	Lights High Byte	123
-	0	00	Extended Address Low Byte	18	5	Lights Low Byte	124
-	0	00	Consist Address	19	6	Master Volume High Byte	125
-	0	00	Consist Functions F1-F8	21	6	Master Volume Low Byte	126
-	0	00	Consist Functions F9-F12	22	7	Front Coupler High Byte	127
-	0	00	Consist Acceleration Adjustment	23	7	Front Coupler Low Byte	128
-	0	00	Consist Deceleration Adjustment	24	8	Rear Coupler High Byte	129
-	0	00	Speed Table Select	25	8	Rear Coupler Low Byte	130
-	2	02	Decoder Configuration	29	9	Forward Signal High Byte	131
-	0	00	MTH PWM Motor Configuration	52	9	Forward Signal Low Byte	132
-	128	80	MTH Acceleration Rate	53	10	Reverse Signal High Byte	133
-	64	40	MTH Deceleration Rate	54	10	Reverse Signal Low Byte	134
-	0	00	Anti-Jackrabbit	57	11	Grade Crossing High Byte	135
-	0	00	MTH Consist Acceleration Rate	63	11	Grade Crossing Low Byte	136
-	0	00	MTH Consist Deceleration Rate	64	12	Smoke On/Off High Byte	137
-	0	00	Forward Trim	66	12	Smoke On/Off Low Byte	138
-	0	0	Alternate Speed Curve Step 1	67	13	Smoke Volume High Byte	139
-	9	9	Alternate Speed Curve Step 2	68	13	Smoke Volume Low Byte	140
-	19	13	Alternate Speed Curve Step 3	69	14	Idle Sequence 3 High Byte	141
-	28	1C	Alternate Speed Curve Step 4	70	14	Idle Sequence 3 Low Byte	142
-	38	26	Alternate Speed Curve Step 5	71	15	Idle Sequence 2 High Byte	143
-	47	2F	Alternate Speed Curve Step 6	72	15	Idle Sequence 2 Low Byte	144
-	57	39	Alternate Speed Curve Step 7	73	16	Idle Sequence 1 High Byte	145
-	66	42	Alternate Speed Curve Step 8	74	16	Idle Sequence 1 Low Byte	146
-	76	4C	Alternate Speed Curve Step 9	75	17	Extended Start-Up High Byte	147
-	85	55	Alternate Speed Curve Step 10	76	17	Extended Start-Up Low Byte	148
-	94	60	Alternate Speed Curve Step 11	77	18	Extended Shut Down High Byte	149
-	104	68	Alternate Speed Curve Step 12	78	18	Extended Shut Down Low Byte	150
-	113	71	Alternate Speed Curve Step 13	79	19	Rev Up High Byte	151
-	123	7B	Alternate Speed Curve Step 14	80	19	Rev Up Low Byte	152
-	132	84	Alternate Speed Curve Step 15	81	20	Rev Down High Byte	153
-	142	8E	Alternate Speed Curve Step 16	82	20	Rev Down Low Byte	154
-	151	97	Alternate Speed Curve Step 17	83	21	One Shot Doppler High Byte	155
-	161	A1	Alternate Speed Curve Step 18	84	21	One Shot Doppler Low Byte	156
-	170	AA	Alternate Speed Curve Step 19	85	22	Coupler Slack High Byte	157
-	179	B3	Alternate Speed Curve Step 20	86	22	Coupler Slack Low Byte	158
-	189	BD	Alternate Speed Curve Step 21	87	23	Coupler Close High Byte	159
-	198	C6	Alternate Speed Curve Step 22	88	23	Coupler Close Low Byte	160
-	208	D0	Alternate Speed Curve Step 23	89	24	Single Horn Blast High Byte	161
-	217	D9	Alternate Speed Curve Step 24	90	24	Single Horn Blast Low Byte	162
-	227	E3	Alternate Speed Curve Step 25	91	25	Engine Sounds High Byte	163
-	236	EC	Alternate Speed Curve Step 26	92	25	Engine Sounds Low Byte	164
-	246	F6	Alternate Speed Curve Step 27	93	26	Brake Sounds On/Off High Byte	165
-	255	FF	Alternate Speed Curve Step 28	94	26	Brake Sounds On/Off Low Byte	166
-	0	0	Reverse Trim	95	27	Cab Chatter On/Off High Byte	167
-			User ID #1	105	27	Cab Chatter On/Off Low Byte	168
-			User ID #2	106	28	Feature Reset High Byte	169
1			Function - Bell High Byte	115	28	Feature Reset Low Byte	170

CV Programming – Marklin 6021 Controller

Note: There are 4 DIP switches on the back of the Marklin 6021 Controller. For MTH engines you will want the DIP switches set to the following:

- 1 - OFF**
- 2 - ON**
- 3 - OFF**
- 4 - OFF**

To enter programming mode using a Marklin 6021 controller, perform the following steps:

1. Press and hold the stop and go buttons simultaneously until the two digit LED display flashes 99.
2. Ensure that track power is off by pressing the stop button.
3. Enter the engine address or 80 on the keypad. 80 will match any engine address.
4. Turn the speed knob counter clockwise to the direction change position and hold it there.
5. Press the go button. The headlight should start to flash. This indicates that the engine is waiting for the CV number to be entered.
6. Release the speed control knob.

To program a CV, perform the following steps:

1. If the desired CV number is less than 80, enter the CV number on the keypad, confirm that the function LED is off (pressing the off key if necessary), and go directly to the next step.
 1. If the desired CV number is equal or greater than 80, enter the hundreds and tens digits of the CV number on the keypad. For example, to program CV 94, enter 09 on the keypad then press the function key to tell the engine that a CV number greater than 79 is being entered
 2. Briefly turn the speed knob counter clockwise to the direction change position. The headlight should shift to a long-short flash pattern
 3. Enter the unit's digit of the CV number preceded by a zero. For the example of CV 94, enter 04. The state of the function LED does not matter. Note: use 80 for 00.
2. Briefly turn the speed knob counter clockwise to the direction change position. The headlight should shift to a single short flash pattern.
3. If the desired CV contents is less than 80, enter the CV contents on the keypad, confirm that the function LED is off (pressing the off key if necessary), and go directly to Step 4
 1. If the desired CV content is equal or greater than 80, enter the hundreds and tens digits of the CV contents on the keypad. For example, to program a CV with the value 128, enter 12 on the keypad then press the function key to tell the engine that a number greater than 79 is being entered

2. Briefly turn the speed knob counter clockwise to the direction change position. The headlight should shift to a short-short flash pattern.
3. Enter the units digit of the CV contents preceded by a zero. For the example of 128, enter 08. The state of the function LED does not matter. Note: use 80 for 00.
4. Briefly turn the speed knob counter clockwise to the direction change position. The headlight illuminates continuously for ~1.5 seconds to confirm successful programming. If programming was unsuccessful, the headlight will rapidly flash for ~1.5 seconds. The headlight then returns to the long flash pattern that indicates that the engine is waiting for the next CV number to be entered.
5. To program more CVs, return to Step 1. To exit programming mode, turn off track power by pressing the stop button

Note: When entering values greater than 79, the two entries are actually added together. This applies to both the CV number and contents. Thus it is theoretically possible to program a CV number as high as 869 (790 + 79).

Operation

Until the engine receives a packet that is addressed to it that uses the new Märklin format, the single function key directly controls startup and shutdown. If the function key is on, the engine will run the startup script. If the function key is off, the engine will run the shutdown script. This allows the engine to be used with controllers that only have a single function key, such as the Märklin 6020, or a Märklin 6021 with DIP switch 2 in the off position.

When the engine receives a packet that is addressed to it using the new Märklin format, the normal function mapping is used, with the function key corresponding to function 0(head/tail light).

Bit	Function
0	Enable 27 speed step mode
1	Enable 28 speed step mode
2	Enable extra functions at engine address + 1 and consist address + 1
3-7	Reserved

MTH engines support both New and Old Motorola formats. For the Old Motorola format the Function/Off button on the Märklin 6021 controller toggles Start-up/Shut-Down. For the New Motorola format the Function/Off button on the Märklin 6021 Controller toggles the Headlight/Taillight and F1-F4 are supported. Please see page XX for the engine's F-Function List.

27 Speed Step Mode maps directly to the 28 speed steps used in DCC but does not use the 28th speed step. It uses the odd steps on acceleration and the even steps on deceleration.

28 Speed Step Mode maps directly to the 28 speed steps used in DCC

When the New Motorola format is used (DIP switch 2 in the ON position on the Marklin 6021 Controller), you can re-map F1-F4 using CV115-CV122. When Bit 2 of CV56 is set you now have functionality of F5-F9 at the current engine address + 1. For example, if you are controlling engine address 5 you would need to call up engine address 6 and then you can use Function/Off and F1-F4 to control functions F5-F9. The same applies to consists as they would be consist address + 1. Also, you can re-map F5-F9 via CV123-CV130.

User-Settable F-Function List

This feature allows you to take the 28 F-Functions that currently reside in each MTH Protosound 3.0E+ equipped HO Engine and change the location of that function. For example: F18 is currently Extended Shut Down 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'd 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	40
Idle Sequence 4	15	(Motorola)	
Labor Chuff	16	Half-Speed (Motorola)	41
Master Volume	17		
Short Horn	18	Switch—Half-Speed/ Momentum Disable	42
One Shot Doppler	19	(Motorola)	
Reverse Signal	20		
SCRIPTS		Electric Boiler Start-Up	45
Extended Shut Down	21	Electric Pressure Release	46
Extended Start Up	22		
PFA	23	LIGHTS	
Start Up/Shut Down	24	Lights	39
Train Wreck	25	Marker (Train/No Train)	43
Trolley Manual Mode	26	Beacon	
Trolley Learn Mode	27	(Alt Lighting/Country)	44
Trolley Auto Mode	28		

The above list includes ALL F functions that an MTH PS3.0E+ 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 of moving F18 (Extended Shut Down) to F28 (Feature Reset) here are the steps:

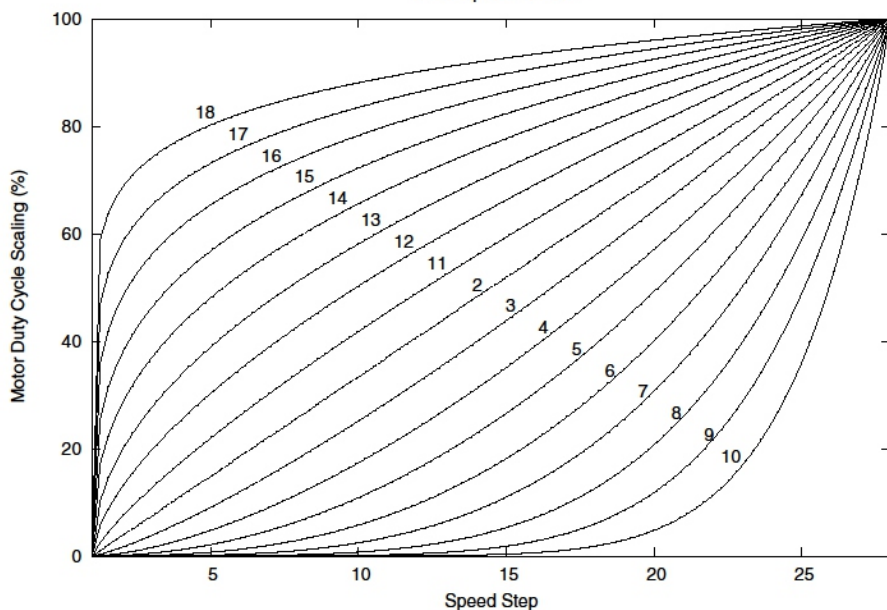
1. Refer the MTH Supported CV table to see what CV the destination Function is assigned to. In doing so, you are looking only for the Low Byte CV location. In this case it's CV170
2. Using your DCC system, bring up CV programming for CV170
3. Now tell the engine which F-Function you want to write at CV170. So, looking at the Function ID table above you can see that Extended Shut Down is a value of 21
4. Using your DCC system, enter a value of 21 for CV170 and hit Enter. You have just re-assigned the Extended Shut Down 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 Extended Shut Down used to be (F13)
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 F18 (we're just swapping F18 and F28)
6. Since F18's Low Byte is CV150 then bring up CV programming for CV150
7. Now tell the engine which F-Function you want to write at CV150. So, looking at the Function ID table above you can see that Cab Chatter is a value of 29
8. Using your DCC system, enter a value of 29 for CV150 and hit Enter. Your engine will give you a two horn blast indication

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

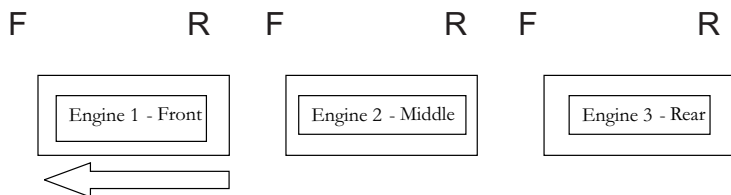
CV25 Speed Tables



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



Normal Forward Direction of Travel

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
 - a. 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)

Programming Track

Your MTH PS3.0E+ equipped HO engine can function on Programming Track outputs from DCC systems. Because each DCC system manufacturer's output capabilities on the Programming Track differ it is recommended that you use a DCC Programming Track Booster to perform functions on the programming track. Simply put – try to program or read back the address of an MTH engine on a programming track. If you can read/write the address then you won't need a Programming Track Booster. If your DCC system can't read/write then you will likely need a Programming Track booster. There are a few different manufacturers of these boosters. Your local dealer can provide you with more information on these boosters. MTH has used the DCC Specialties Power Pax with some success. Note – An alternative to writing on a Programming Track is to simply Program on the Main (PoM). MTH engines support PoM to write any CV on the main. However, read back is not supported on the main. Check with your DCC system's manufacturer to see about any limitations they may have to 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.

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

1. Call up your Middle engine (address 2 in the example)
2. Since you want to have the Middle engine respond to F3 only then write a value of 4 (CV21, bit 2 = ON)
3. Call up your Rear engine (address 3 in the example)
4. 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 (F0) is controlled by CV22. Please refer to the Advanced Consisting section for more information regarding CV22.

SPECIFICATIONS

Electrical	Input Voltage	0-24 VDC
	Current Draw (lights, sounds)	~230 - 650mA
	Lighting	LED - Rule 17
Operating Modes	Analog DC	Yes
	DCC - Digital Command Control	Yes
	Motorola	Yes
	DCS - Digital Control System	Yes
Default Addresses	DCS	1
	DCC short	3
	DCC extended	3333

US PATENTS

US 6,457,681	Oct. 2, 2002
US 6,619,594	Sept. 16, 2003
US 6,655,640	Dec. 2, 2003

CARE AND MAINTENANCE

HO Troubleshooting Guide

The following Guide will help you trouble shoot your M.T.H. HO engine. This guide is broken up into the four operating modes of the engine: Analog AC, Analog DC, DCC, and DCS.

Analog AC

Start-Up	Solution
When I apply power to the track my engine doesn't do anything. No lights, no sound, nothing.	Check to see if that section of track has power. Use a voltmeter or a lit passenger car.
	Slide the engine a couple of feet in either direction, you may have a bad track section.
	Have you got that section electrically isolated with a toggle switch or other device?
Sound	Solution
I have no sound from my engine, but my lights are on and it moves just fine.	Check the volume pot on your locomotive. Full CW = Max Volume
There's a crackling sound from my engine	Check to see if a screw or some other material hasn't lodged itself in the underside of the
Lights	Solution
One of my lights is out.	Most likely you had been running the engine in DCC or DCS mode and toggled that light off. Put it back into one of those modes and turn that light back on. The engine will remember that when you run it again in Conventional AC.
None of my lights are on.	Could be the same reason as "One of my lights is out"
	Is the engine getting power? Check to see if there is voltage on the track or move the engine a few feet in either direction.
Motion	Solution
When I apply power to the track my engine starts up (lights and sound) but it won't move	Lower the track voltage then raise it again. The engine should start moving. If you apply greater than 9VAC quickly the engine will just sit there. Lowering it below 9VAC then raising it will get the engine moving.
My engine hesitates at slow speeds.	An engine may do this right out of the box if it has not been lubricated. Follow the lubrication instructions. Now go ahead and run it.
	New engines even after they are lubricated may take a little bit to get everything run in. Be a little patient and let it run for a bit. It should clear up shortly after lubricating and running.

CARE AND MAINTENANCE

HO Troubleshooting Guide

The following Guide will help you trouble shoot your M.T.H. HO engine. This guide is broken up into the three operating modes of the engine Analog DC, DCC, and DCS

Analog DC

Start-up	Solution
When I apply power to the track my engine doesn't do anything. No lights, no sound, no nothing.	Check to see if that section of track has power. Use a voltmeter or a lit passenger car.
	Slide the engine a couple of feet in either direction, you may have a bad track section
	Have you got that section electrically isolated with a toggle switch or other device?
Sound	Solution
I have no sound from my engine, but my lights are on and it moves just fine.	Check the volume pot on your locomotive. Full CW = Max volume
There's a crackling sound from my engine	Check to see if a screw or some other material hasn't lodged itself in the underside of the engine body.

Analog DC

Lights	Solution
One of my lights is out	Most likely you had been running the engine in DCC or DCS mode and toggled that light off. Put it back into one of those modes and turn that light back on. The engine will remember that when you run it again in Conventional DC.
None of my lights are on	Could be the same reason as “One of my lights is out”
	Is the engine getting power? Check to see if there is voltage on the track or move the engine a few feet in either direction.
Motion	Solution
When I apply power to the track my engine starts up (lights and sound) but it won't move	Lower the track voltage then raise it again. The engine should start moving. If you apply greater than 9VDC quickly the engine will just set there. Lowering it below 9VDC then raising it will get the engine moving
My engine hesitates at slow speeds	An engine may do this right out of the box if it has not been lubricated. Follow the lubrication instructions. Now go ahead and run it.
	New engines even after they are lubricated may take a little bit to get everything run in. Be a little patient and let it run for a bit. It should clear up shortly after lubricating and

DCC/MOTOROLA

Start-up	Solution
When I apply power to the track my engine doesn't do anything. No lights, no sound, no nothing.	Did you press F3 yet? F3 on your DCC handheld will start your engine up.
	Check to see if that section of track has power. Use a voltmeter or a lit passenger car, not your tongue.
	Slide the engine a couple of feet in either direction, you may have a bad track section
	Have you got that section electrically isolated with a toggle switch or other device?
Sound	Solution
I have no sound on my engine, but my lights are on and it moves just fine	You may have it turned off. Repeatedly press F7 to cycle through the volume levels (there are 9 levels, 0-max)
When I run Doppler I can hear the Doppler shift but then the engine sounds fade out and I can't get them back	This is normal. You will need to press the F12 button again to turn Doppler off. Your engine sounds will now return to normal

DCC/MOTOROLA

Lights	Solution
One of my lights is out.	Check your F keys. F0 is the headlight (also controls the Back-up light) and F5 will toggle the Cab light and firebox light.
None of my lights are on.	Could be the same reason as "One of my lights is out"
	Is the engine getting power? Check to see if there is voltage on the track or move the engine a few feet in either direction.
Motion	Solution
When I apply power and hit F3, my engine powers up but it won't move.	This is normal, dial up the speed on your DCC controller to make your engine move.
My engine hesitates at slow speeds.	An engine may do this right out of the box if it has not been lubricated. Follow the lubrication instructions. Now go ahead and run it.
	New engines even after they are lubricated may take a little bit to get everything run in. Be a little patient and let it run for a bit. It should clear up shortly after lubricating and running.
PFA	Solution
I hit F4 to start the PFA but the engine just keeps ringing its bell, that's all it'll do.	Bring the engine speed to 0. Now press F4. You will now hear the station or yard arrival sounds (pretty cool, huh?). Pressing F4 will cycle through the PFA sequence (check out the PFA section of the manual for more)
Shut Down	Solution
Okay, I give up. What do I have to do to shut it down?	Well, you can either remove power from the track or press F3 again.
Lost or Unknown Address	Solution
I can't call up my engine on the address I believe it to be set at	Perform the 55-55-55 Reset instructions on page 25
	If you are trying to talk to an engine on its short address you may have set CV29 to activate long addressing. Try to get a hold of the engine on its last known long address
	Place the engine on the Programming Track output on your DCC system and write a value of 3 to CV1

DCS (Remember, it's NOT DCC)

Start-up	Solution
When I apply power to the track my engine doesn't do anything. No lights, no sound, no nothing.	This is normal. You have to hit the Start-Up button.
	Check to see if that section of track has power. Use a voltmeter or a lit passenger car, not your tongue.
	Slide the engine a couple of feet in either direction, you may have a bad track section
	Have you got that section electrically isolated with a toggle switch or other device?
I get an error when I hit Start-Up	Have you recently changed the engine address?
	Check if there is power on that section of track the engine is sitting on (there has to be power for the signal to get to the engine and for the engine to be able to hear it)
	If you have two engines on the track they both may have the same address. Take one of them off the rails and try it again
DCS is polarity sensitive when powered by a DC power supply.	Check the polarity of the DC power supply connected to the Fixed 1 or Fixed 2 Inputs. Shut down power, reverse the inputs and repower DCS. Hitting the startup button the DCS remote should start up the locomotive.
Sound	Solution
I have no sound on my engine, but my lights are on and it moves just fine	You may have it turned off. Repeatedly press VOL + to bring the Master Volume up
	Did you turn off the ENG Sounds? Press the ENG SND button on your DCS controller.
	Check that you haven't lowered any of the independent engine volumes (Eng Sounds, Bell, Whistle, or Accent)
When I run Doppler I can hear the Doppler shift but then the engine sounds fade out and I can't get them back	This is normal. You will need to press the Doppler button again to turn Doppler off. Your engine sounds will now return to normal

DCS (Remember, it's NOT DCC)

Lights	Solution
One of my lights is out.	Check that you haven't turned it off with the DCS controller. You have independent control over lights on your engine
None of my lights are on.	Could be the same reason as "One of my lights is out"
	Is the engine getting power? Check to see if there is voltage on the track or move the engine a few feet in either direction.
Motion	Solution
When I apply power and hit Start-up, my engine powers up but it won't move.	This is normal, dial up the speed on your DCS Remote to make your engine move.
My engine hesitates at slow speeds.	An engine may do this right out of the box if it has not been lubricated. Follow the lubrication instructions. Now go ahead and run it.
	New engines even after they are lubricated may take a little bit to get everything run in. Be a little patient and let it run for a bit. It should clear up shortly after lubricating and running.
PFA	Solution
When I enter PFA all that happens is the bell rings. What do I do?	Press the DIR button. Your engine will stop and begins the arrival sequence. Pressing the DIR button will cycle you through the next 3 PFA sequences
Why does my engine run away all by itself after the PFA is over?	This is normal. The engine will leave the station at the same speed it entered (when hit the PFA button). The speed setting can be changed after the bell stops ringing.
Shut Down	Solution
Okay, I give up. What do I have to do to shut it down?	Well, you can either remove power from the track or press or press Shut-Down. Button on the DCS Remote
Lost or Unknown Address	Solution
I can't call up my engine on the address I believe it to be set at	Delete the engine from your DCS remote, and attempt to re-add it.
	On the DCS Remote, hit Menu → System → Engine Setup → Recover Engine

HOW TO ORDER PARTS:

Replacement parts are available directly from the M.T.H. Parts Department (Order online: www.mthtrains.com, e-mail: parts@mth-railking.com, Fax: 410-423-0009, Phone: 410-381-2580, Mail: 7020 Columbia Gateway Drive, Columbia MD 21046-1532).

Recommended Transformers

AC Power Supply Chart

RECOMMENDED AC TRANSFORMERS					
Transformer Model	Center Rail	Outside Rail	Min/Max. Voltage	Power Rating	Transformer Type
Marklin 6646 (Or Equivalent)	Red Terminal	Black Terminal	0-17v	32-VA	Standard

DC Power Supply Chart

RECOMMENDED DC TRANSFORMERS				
Transformer Model	Min/Max. Voltage	Power Rating	Notes On Use	Transformer Type
MRC 6200	0-18.5v	60-Watt	Not Recommended For #70-3001-1 J3a	Electronic
MRC Controlmaster 20	0-20v	100-Watt		Electronic
PH Hobbies PS5	0-20v	100-Watt		Electronic
PH Hobbies PS10G	0-20v	180-Watt		Electronic
Bridgeworks Magnum 15	0-24v *	300-Watt		Electronic
Bridgeworks Magnum 200	0-24v *	300-Watt		Electronic
Bridgeworks Magnum 400	0-24v *	300-Watt		Electronic
Bridgeworks Magnum 1000	0-24v *	300-Watt		Electronic
LGB Jumbo #50101	0-24v *	240-Watt	Not recommended for #70-3001-1 J3a	Electronic
Crest CRE-55460 Power Supply w/ CRE-55401 Controller	18VDC on Supply, 0-18VDC at Controller	180-Watt	FOR ANALOG DC OPERATION ONLY Controller has PWM Output from Fixed DC Input DO NOT Use with the DCS System (TIU) PWM Output from this power supply Will DAMAGE the TIU	Electronic

* Use 22 volts maximum track voltage when operating a MTH locomotive equipped with Proto-Sound, Loco-Sound, Proto-Sound 2.0, or Proto-Sound 3.0

Service & Warranty Information

How to Get Service Under the Terms of the Limited One-Year Warranty

When you suspect an item is defective, please check the operator's manual for standard operation and troubleshooting techniques that may correct the problem. Additional information may be found on the M.T.H. Website. Should you still require service, follow the instructions below to obtain warranty service. First, e-mail, write, call or fax a M.T.H. Authorized Service Center (ASC) in your area to obtain Repair Authorization. You can find the list of ASCs on the M.T.H. Website, www.mthtrains.com. Authorized Service Centers are required to make warranty repairs on items sold only from that store; all other repairs may-- or may not be done at the store's own discretion. If you did not purchase the item directly from the ASC, you will need to select a National Authorized Service Center (NASC). These centers are compensated by M.T.H. to perform warranty service for any customer whose repair qualifies for warranty service. A list of NASC retailers can be located on the M.T.H. Website or by calling 410-381-2580. Should the warranty no longer apply, you may choose either an ASC or NASC retailer to service your M.T.H. Product. A reasonable service fee will be charged.

CAUTION: Make sure the product is packed in its original factory packaging including its foam and plastic wrapping material to prevent damage to the merchandise. There is no need to return the entire set if only one of the components is in need of repair unless otherwise instructed by the Service Center. The shipment must be prepaid and we recommend that it be insured. A cover letter including your name, address, daytime phone number, e-mail address (if available), Return Authorization number (if required by the service center, a copy of your sales receipt and a full description of the problem must be included to facilitate the repairs. Please include the description regardless of whether you discussed the problem with a service technician when contacting the Service Center for your Return Authorization.

Please make sure you have followed the instructions carefully before returning any merchandise for service. Authorized M.T.H. Service Centers are independently owned and operated and are not agents or representatives of M.T.H. Electric Trains. M.T.H. assumes no responsibility, financial or otherwise, for material left in their possession, or work done, by privately owned M.T.H. Authorized Service Centers.

If you need assistance at any time email MTH Service at service@mth-railking.com, or call 410 381-2580.

Limited One-Year Warranty

All M.T.H. products purchased from an M.T.H. Authorized Retailer are covered by this warranty provided the product was manufactured within five years of the date of purchase. This warranty is for the original purchaser and is non-transferable.

See our website www.mthtrains.com to identify an M.T.H. Authorized Retailer near you.

M.T.H. products may be registered online in advance of warranty work at www.mthtrains.com/warranty. The original sales receipt and the conditions below must be met regardless of whether the product is registered on the M.T.H. website in order to obtain warranty service.

M.T.H. products manufactured within five years from the date of purchase are warrantied for one year against defects in material or workmanship, excluding wear items such as light bulbs, pick-up rollers, batteries, smoke unit wicks, and traction tires. We will repair, replace, or credit (at our option) the defective part without charge for the parts or labor if the following conditions are met: (1) the item is returned to an M.T.H. Authorized Service Center* (ASC) or M.T.H. National Authorized Service Center (NASC) or M.T.H. Electric Trains Service Department, (2) was manufactured within the previous five years and (3) was purchased within one year of the original date of purchase from an M.T.H. Authorized Retailer. Products manufactured after the five year cutoff from the date of purchase are not covered under any warranty by M.T.H. Electric Trains. The manufacture date of an item can be verified on the item's detail page "shipping date field" on the M.T.H. website (www.mthtrains.com). This warranty does not cover damages caused by improper care, handling, or use. Transportation costs incurred by the customer are not covered under this warranty.

Items sent for repair must be accompanied by a return authorization number, a description of the problem, and a **copy of the original sales receipt from an M.T.H. Authorized Retailer**, which gives the date of purchase. If you are sending this product to an Authorized Service Center, contact that Center for their return authorization.

This warranty gives you specific legal rights, and you may have other rights that vary from state to state. Specific questions regarding the warranty may be forwarded to M.T.H. Directly.

* Authorized Service Centers (ASC) are only obligated to provide warranty service for any consumer who has purchased the specific M.T.H. item from them that requires service work.

Service Department:
M.T.H. Electric Trains
7020 Columbia Gateway Drive
Columbia MD 21046-1532