

## Speed Matching Technique

### Always Test Speeds At The Same Throttle Setting

If using the T9000 throttle, make your tests with the throttle set to speed step 14 out of 28. Use SHOW 0 to view the current speed step setting. If using the RF1300 throttle, set the speed knob marker to about the 1 o'clock position.

### Using CV6 - Mid Point Speed Setting and Factory Setting

Speed matching is done using CV6 which sets the locomotive speed when the throttle is at one half of full speed.

The factory setting for CV6 sets the motor voltage to exactly half of full voltage when the throttle is at half speed. For reference, there are 255 equal voltage steps from 0 motor voltage to full motor voltage. Half voltage at half throttle is a value of 128.

### A Perfect Match Is Not The Best Match

A perfect match is not desired. The best performance is when there is always a small amount of tension on the couplers. The preferred match is when the lead locomotive is slightly pulling the trailing units. The couplers stay together better on rough track and when the units crest a hill.

### How Much Of A Change?

Since this locomotive is running too fast, the CV6 value needs to decrease. If it is only a little fast, then make only a small decrease in the CV6 value. For example, a 5% decrease in mid point speed is a value of about 115. If you need a major slow down of the mid point speed, a 25% decrease is a value of about 64.

### Program CV6 To The New Value - Make Sure The Locomotives To Be Changed Are Unlocked

Bring the locomotives to a stop. Now use OPS programming to send CV6's new value - 115 - for this example. Here's the key sequence to do this. Press OPS, then SEL then \*,6,\* followed by #,1,1,5,#. The locomotive will jump and chirp. Press OPS to exit programming.

Test the matching of the locomotives at the same speed step. If the locomotive is still too fast, then try a lower value for CV6. If the locomotive is now too slow, increase the value of CV6. Continue playing with the value of CV6 until you are happy with the matching.

### Additional Methods To Tune Locomotive Performance

Don't forget to check the operation of the motor bumping CVs described in the Users Guide. These CVs allow very fine adjustments of the motor starting voltages.

You may decide that a custom speed table is what you want. This is a set of entries that describe how fast the motor goes for a given speed step. A custom speed table replaces CV5 and CV6 but does allow the use of motor bumping. Experiment with all of these options and select what works for your locomotive fleet and your railroad.

If you find some interesting and useful methods and tips for fine tuning your Drop-In equipped locomotives, send them to us. Write an email describing how you get the best performance matching. We'd like to share them with our other users.

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## Drop-In Slave Decoder Addendum

### This Addendum Is A Companion Booklet

This addendum contains extra instructions and components that are used along with the appropriate Drop-In installation manual for your locomotive.

### Differences Between Master and Slave

There is only one significant difference between the Master and Slave Drop-In decoders. Only the Master decoder has the radio receiver. It connects to the slave using the extra hookup cable supplied with the Slave decoder. Otherwise, the two decoders have the same software, features and capabilities.

### Not Using The Sound Module

It is very common to use only one sound module, usually in the Master. If this is your choice, then skip all of the P8 installation instructions found in the Drop-In Decoder installation manual.

### Install The Slave Decoder - Don't Close Up Loco Yet

Disassemble the locomotive and install the Slave Drop-In following the appropriate installation manual.

### Determine Hookup Wire Locations

Included with the Slave Drop-In decoder are a set of extra hookup connectors and cables. These hookup cables are used to join the Master and the Slave decoders.

### Cut Cables To Length and Splice Together

Once the length has been determined, the cables can be cut and spliced together. Insulate all splices with heatshrink tubing.

### Perform Preliminary Master-Slave Checkout

Once the Slave Drop-In has been installed, connect it to the Master and follow the checkout and setup instructions contained in this addendum.

Heatshrink tubing may be ordered from Mouser Electronics. Use 0.25 inch diameter tubing with part number 5174-1141. It sells for about \$2 and comes in a 4 foot length. [www.mouser.com](http://www.mouser.com)

The F3 B unit uses a high voltage bulb for the backup light. This is different from the F3-A unit which uses a low voltage bulb. If you wish your trailing B unit to have a backup light, change the original incandescent lamp for a 5 volt lamp. Or use a white LED with a 100 ohm resistor in series with the LED.

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### Slave Decoder Extras

These items only come with a Slave Drop-In decoder. They are not included with regular (Master) Drop-In Decoders.

- 2 KK 2-pin headers + wire
- 1 Small black socket + wire
- 1 Large black plug + wire
- 1 Addendum booklet

## Master and Slave Pigtails and Connection Headers

### Master and Slave Drop-In Connection Points

All Master Drop-Ins have a two pin white header labeled TOSL. This abbreviation stands for TO-SLAVE. Likewise, all Slave Drop-Ins have a two pin white header labeled FRMS. This abbreviation stands for FROM-MASTER. This is where the connection cable is plugged in. The picture in the installation manual points out the TOSL header. If you look in the same location on your Slave Decoder, you will see the FRMS header.

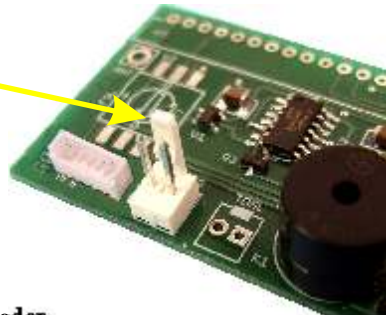
#### TOSL Header On Master

The recommended cable to connect from the Master's TOSL header over to the Slave is below.



#### FRMSL Header On Slave

The recommended cable to connect from the Slave's FRMS header back to the Master is below.



### You Must Have One and Only One Master Drop-In Decoder

Only one Master is allowed. The Master can be connected to one or more Slave Drop-In decoders (max is 3).

### Master Does Not Have To Be Same Type or Model

You may use any model of a Master Drop-In decoder to feed any model of a Slave Drop-In decoder. The two units do not have to be the same model. A Master SD70 Drop-In can feed a Slave GP30. The Master/Slave connections for each Drop-In decoder are the same.

### Using Your Own Plugs and Sockets

You are certainly free to use your own favorite plugs and sockets between the Master and Slave locomotives. Be sure to maintain correct polarity. Also make sure that the selected socket does not short out the two signals when the plug is removed from the socket. If this occurs, the Master decoder will be damaged.

The signals going through the pigtails do not contain any high power. Therefore you can use small diameter wire for your own plugs and sockets.

**A smart person reads instructions.  
A genius follows instructions.**

## More Setup Options and Speed Matching

### Option #3 - Step By Step Sequence

Step 1 - Turn on the power to the lead locomotive. Turn **OFF** the power switch on the **trailing** locomotive. Only the lead locomotive is to be powered on at this time.

Step 2 - Send the lock command using OPS programming and setting CV16 to a value of 1.

Push OPS and SEL. Then push \*,1,6,\* . Then push #,1,#. The lead locomotive will beep. Push OPS to exit programming mode. The lead locomotive is now locked and can not be programmed.

Step 3 - Turn **ON** the power to the **trailing** locomotive. Both the lead and the trailing locomotives must have their power turned on. Program the trailing locomotive for reverse operation.

Push OPS and SEL. Now push \*,2,9,\* . Next, if your locomotive address is less than 100, enter #,3,#. But, if your locomotive address is 100 or higher, enter #,3,5,#. Push OPS to exit programming mode.

Use the throttle to verify that both locomotives now operate in the correct direction.

### More Than 2 Locomotives

You may use any of the techniques previously described to reverse the orientation of the other locomotives. For option 3, simply plug in each trailing locomotive, one at a time, and repeat the procedure.

For sheer simplicity, you can't beat the reversal of the motor leads. There is no programming needed and the locomotive can be easily returned to its original orientation.

### How To Speed Match Locomotives

Speed matching of locomotives is easy if they are the same brand and model. In nearly all cases, they run at the same speed, forward or reverse, when set to the same speed. Speed matching locomotives of different ages or models is a bit more involved but it is relatively easy.

The first task is to watch how the a set of locos perform when not coupled together. Determine which locomotive is running the slowest of the set. Since it easier to slow down a fast locomotive, the slow one becomes the one to which the others are matched.

Once you have figured out the slow unit, it will be locked so programming commands will not affect the locomotive. Once locked, programming commands sent to the other locomotives will have no affect on the slow locomotive.

The procedure to lock the slow locomotive depends on the type of decoder in the slow locomotive.

**If the "slow" loco contains a Master Decoder**, lock the slow loco following these steps.

Step 1 - Turn **OFF** the power switch on the other locomotives. Only the slow locomotive is to be powered on at this time.

Step 2 - Send the lock command using OPS programming and setting CV16 to a value of 1.

Push OPS and SEL. Then push \*,1,6,\* . Then push #,1,#. The lead locomotive will beep. Push OPS to exit programming mode. The slow locomotive is now locked and can not be programmed.

**If the "slow" locomotive contains a Slave Decoder**, lock the slow loco following these steps.

Step 1 - First lock both locomotives, the faster Master equipped locomotive and the slower Slave locomotive. Make sure power is on for both locos and are connected together.

Step 2 - Send the lock command using OPS programming and setting CV16 to a value of 1. Push OPS and SEL. Then push \*,1,6,\* . Then push #,1,#. Both locos will beep.

Step 3 - Turn off the Slave locomotive's power switch so it will remain locked.

Step 4 - Unlock the Master locomotive. Push OPS and SEL. Then push \*,1,6,\* . Then push #,0,#. This permanently unlocks the Master locomotive.

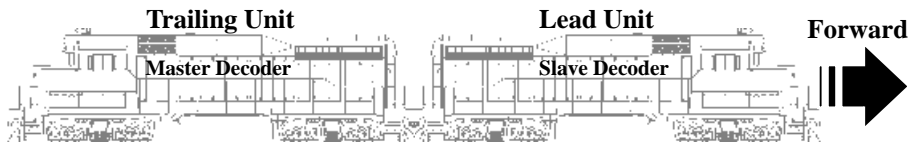
Programming commands for better speed matching can now be sent to the locomotive set but only those that are unlocked will respond.

## Other Options For Changing Loco Direction Orientation

### Option #2 - Program Master Loco For Reverse Operation

Back-to-back diesels require one loco, usually called the lead locomotive to go in the forward direction with the throttle set for forward, and the other locomotive to run in reverse. So, pick the lead loco which is usually the locomotive who's address is used to select and run the pair.

*Tip: it is easier to have the slave unit be the lead unit especially when the locomotives are back to back. There are fewer steps required to change the trailing unit's direction when the Master Drop-In decoder is in the trailing unit.*



To force the trailing locomotive to run backwards when the throttle is set to forward, requires setting a configuration variable, CV29, in the trailing locomotive's decoder. If this is new to you, please see the Drop-In Users Guide. Follow this sequence to change CV29 in the trailing locomotive. The slave is the lead locomotive for this key sequence. This sequence requires the Master and Slave decoders be oriented as shown in the above drawing.

**Turn off the Slave power switch.** Doing so prevents the Slave decoder from hearing the command you are about to send.

**Push OPS and then SEL for OPS mode programming.** Enter \*,2,9,\*. Next, If your locomotive address is less than 100, enter #,3,#. But, if your locomotive address is 100 or higher, enter #,3,5,#. Push OPS to exit programming mode. The command tells the locomotive to run in the reverse direction when the forward speed command is received. No other changes occur.

Turn on the Lead locomotive's power switch and verify that both locos now run in the proper direction.

### Option #3 - Program Slave Loco For Reverse Operation

Although seemingly the same as option #2, it isn't. In this case, the Master's radio receiver needs to stay on so it can send data to the Slave decoder. With this option, you will use lock and key CVs to prevent or "lockout" changes to the Master decoder while unlocking and allowing changes to the Slave decoder. This technique is also used when fine tuning the performance of a specific locomotive.

*continued on the next page*



## Creating Master And Slave Pigtails

### Terminology Used In This Section

Each Drop-In Slave Decoder comes with 4 sets of connectors with attached wires (A, B, and C). These are used to create the Master-Slave connecting cable.

The picture below shows the two sets of pigtails that need to be created; one for the master unit (A and B) and one for the slave unit (C and A). Note that there are two A connectors. The only difference in the picture is that one of the A connectors is turned upside down.

The gray rectangles are the locations for the splices joining the set to make the pigtail.

### Maintain Color Match To Maintain Polarity

The two wires are color coded because the polarity is important. Accidentally reversing the wire will probably damage either one or both decoders. So be careful.

As the picture shows, red always connects to red. Black always connects to black. Since each connector has the wires already attached, there is little chance for error. Be careful and make sure you are connecting matching colors. If you are color-blind, seek assistance from someone before making the splices.



### Locating The Master/Slave Connection

There is no hard rule where to place the plug and socket that joins the Master and Slave unit. Most users place them off to one side of the coupler. Make sure they don't hang too low or they might snag something on your roadbed.

### Which Pigtail To Use On Locomotives

There is no requirement to use the C connector on the Master locomotive. You can use the B connector. It doesn't matter. However, the Master is always sending a signal to the Slave unit. Thus we selected the C connector because it has the pins hidden and protected.

### Pigtail Length Considerations

Temporarily couple the two locomotives together. Plug the two black connectors together and route their wires approximately where you want them to be when the cable is completed. Now plug in the two white header sockets. There will be more than enough wire and it is best to trim off any excess.

As a rule don't have too much slack between the two locomotives. Likewise, don't make them too tight. Both conditions will cause problems when the locomotives are placed into service. It is better to have the cable too long versus too short - you can always coil up the excess wire inside the locomotive.

Cut the wire lengths leaving just enough slack to allow the locomotives to go through a tight radius curve.

### Strip and Tin The Trimmed Wires

Strip about 1/2 inch of insulation from each wire. Twist the strands together. Heat up the end of the wire and apply a small amount of solder. This is called tinning and keeps the strands together. Do this to each of the 4 sets of wires.

### Slip On Heatshrink Tubing

Slip a piece of heatshrink tubing, one piece over each wire, coming from the A connectors. The tubing must be long enough to cover the splice. The heatshrink tubing needs to be long enough to cover the entire splice.

## Creating Master And Slave Pigtails And Checkout

### Join Wire Ends and Solder Splices

Lay each wire on top of the other and solder together. Twisting is not needed. However, be sure the two wires are lying on top of each other and securely joined together. Let the joint cool before moving to the next step.

### Slide Heatshrink Tubing Over Splice And Heat

Move the tubing over the splice and heat with an iron, match or lighter. Don't allow the tubing to shift during heating. All bare wire must be covered. This concludes the cable building.

### Preliminary Checkout

Plug in the cables to connect the Master Drop-In and the Slave Drop-In. For this test, it is assumed that the decoders have not be changed from their factory settings and are still on address 3 and frequency 0.

Turn on power to both locomotives. Turn on the throttle, set it to frequency 0 and address 3. Look on both decoders and verify both red GP LEDs are on steady. If not, check the following items.

- **Master red GP off** - either address or frequency or both are not matched between the Master and the throttle.

- **Master red GP on, Slave red GP off** - verify Slave decoder's green power LED is on. If the green LED is on then suspect a problem with the connecting cables. There may be a bad splice or something as simple as not being plugged into the proper header on the master or on the slave. There are a lot of similar looking connectors on some decoders. Look for the marking on the board to confirm you have plugged the cables into the correct headers.

### Select the Master Decoder Frequency and Set The Locomotive Addresses

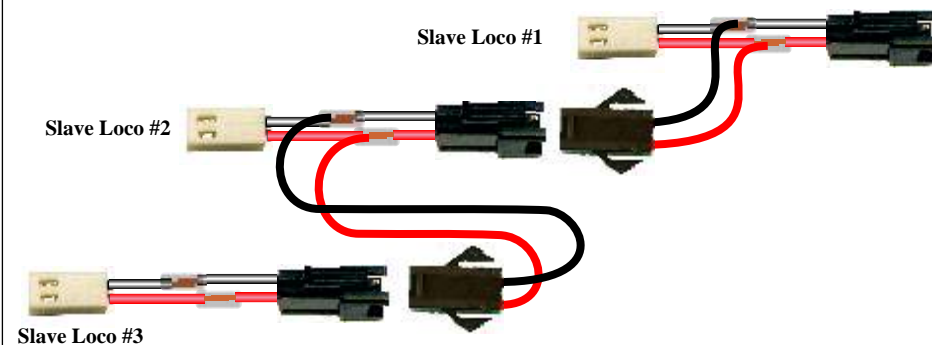
Make sure the power is on for both locomotives. Decide what frequency will be used. Dial it into the Master. Change the throttle frequency to match and verify both locos move. Next, change the locomotive address. Both addresses are changed at the same time. Program the new address. See the Drop-In user guide for specific details on how to do this. Change the throttle to the new address and verify that both locos move.

At this time, installation is complete. You may close up both master and slave decoder equipped locomotives. However, if you have multiple slaves, be sure to check them out, one at a time, before reassembling them. Be sure and refer to the installation instructions for reassembly tips.

### Multiple Slave Units Attached To Master

The image below shows how multiple slaves attach to the Master. A second connection pigtail exits the slave and is connected to the pigtail on the next slave. Take care not to reverse the colors. Red always goes to red and black always goes to black.

The maximum number of slave locomotives fed by one Master is 3.



## Changing Trailing Locomotive Direction Orientation

### Setting Direction Orientation

If both locomotives face forward, whether they are two diesel cab units or an A and B set, their forward direction is correct without any other changes. When set for forward, both locomotives move in the forward direction relative to the cab.

However, when the two locomotives are back to back, then the rear locomotive will head off in opposite directions when the throttle is set to forward. You will need to set the trailing locomotive such that it actually runs in reverse when the forward or lead unit is running forward. As a result both locomotives move in the same direction.

### First Step - Determine The Lead Locomotive

The lead locomotive is the locomotive that moves in the forward direction when the throttle is set for forward. This is usually, the first locomotive and the locomotive number is the address usually assigned to the set of locomotives. The lead locomotive can be either a Master Drop-In or a Slave Drop-In. In a later section, you'll see where this is an advantage.

Although there are lots of options for changing a trailing locomotive's direction orientation, there is actually only one very simple method and it is called option #1. It requires no programming of the decoder. Just flip the motor wires where they go into the truck.

### Option #1 - The EASY Method - Simply Reverse The Motor Wires

This is the easiest of all the methods and the best one to use when the locomotives will be permanently coupled. Turn the locomotive upside down and swap the two motor wires where they enter the truck. **Do this on both trucks.**

The motor connections are small sockets that slide onto the pins sticking out from the truck. Just swap left for right and right for left. Use a pair of needle nose pliers to gently slide the socket off the pin. The motor wires are the outside set of pins. The inside set of pins goes to the wheel wipers and can be ignored or removed.

