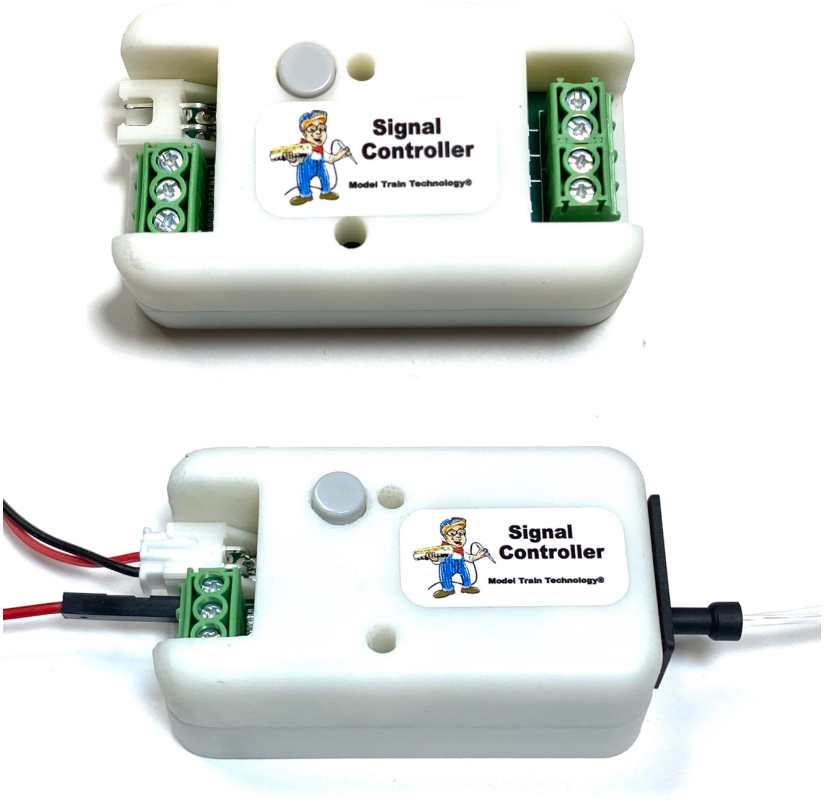
Model Train™ TECHNOLOGY

Signal Controller™

OPERATIONS MANUAL

LED & Fiber Versions

Version 1.28a



INTRODUCTION

The Model Train Technology™ ***Signal Controller™*** provides an extremely simple plug-and-play system for lighting and animating layout block signals and RR Crossing Flashers.

After years of running block signaling from the computer via train software, I decided that for my 4x8’ demo layout I wanted a very simple system that gives the appearance of a much more sophisticated operation – without all the work. And I wanted a lot less wiring.

- No Soldering
- No Computer
- No Programming

Our simplified system will provide great animation in just a few minutes of installation time, not days or years and at a fraction of the cost of elaborate CTC systems and no programming is involved. Very few if any of the visitors to your layout will know the difference!

OVERVIEW

Each ***MTT Signal Controller*** ("***Controller"***) stands on its own and is triggered by a sensor, mounted either under or on the side of the track. Our ***Precision Detector™*** series is a great choice since it is not based on typical IR (infrared) and is therefore not impacted by difficult lighting conditions. The ***Controller*** has an optional magnetic base and can be mounted upside-down under the layout so that the Controller can be removed easily when needed.

The ***Controller*** also has a built in DCC decoder that will allow your block signals to change automatically when you switch a turnout or route. No software, computer or programming is necessary. And there is no complicated wiring. <u>You don't need DCC to run the Signal Controller</u> but it's there if you need it.

When the ***Controller*** is tripped by a sensor, it starts a display (aspect) cycle that begins with red. While the sensor shows occupied, the ***Controller*** will stay red. Once the block (detector) is cleared, the ***Controller*** will start a change of light sequence based on one of the options shown below. The time between stages can be adjusted on the ***Controller.***

The ***Controller*** has three outputs that are synchronized to a behavior. You can adjust the brightness of each of the output individually. This lets you set the brightness appropriate to your layout. You can also individually adjust each of the different colored LEDS. The typical colors of the LEDS (Red, Yellow and Green) do not glow at the same brightness with the same voltage. The ***Controller*** allows you to adjust them to your liking. No resistors are needed! The ***Controller*** supports both common anode and cathode.

The ***Controller*** allows you to set the speed by which the Aspect (colors) shifts from Red to Yellow to Green after the train has passed and the block is unoccupied. You can make it occur almost immediately, or you can set it up to 30 seconds. Each ***Controller*** has its own speed adjustment

The ***Controller*** has eight distinct behaviors that are set with the single push button. The time between stages is set with the screwdriver(provided) and trim screw. They are:

- Red, Green
- Red, Yellow, Green
- Red, Yellow, Yellow flash, Green
- R, R&Y, G&Y, Green

- R, R&Y, R&Y-Flash, G&Y-flash, Green
- Red, fade to Yellow, fade to Green
- Alternate flash (speed adjustable) *
- Alternate flash with fade (speed adjustable) *

**For use with gate crossings*.

There are three types of controllers:

1. 3-Light LED
2. 3-Light FIBER
3. 4-Light FIBER (for PRR and LIRR type Signals)

Shown on page 11 is our ***MTT Power Module*** and our ***Precision Detector™*** connected to the ***Controller***. Two wires power the ***Controller,*** and a single trigger wire connects the detector to the ***Controller***.

The ***Controller*** for LEDs should be power by 12VDC or DCC and the output will either be ~5V or ~12v depending on how you set the ***Step Down*** mode. To light 2-5V LEDs, use the 5V (Step Down mode ON) setting on the controller.

The ***Controller*** can light at least two LED block signals each with three 2-5v LEDS or 12V or up to four Crossing Flashers. The Fiber version can light 2 HO or N scale block signal using

the special 2-core pin. Thus, you can have two 3-light or 4-light fiber signals controlled by a single controller. Fiber block signals lights are available in O/S. We also have G scale versions available. For O and S scale usually only one Signal can be operated by a single Signal Controller.

LATCHING (Clear-to-Proceed)

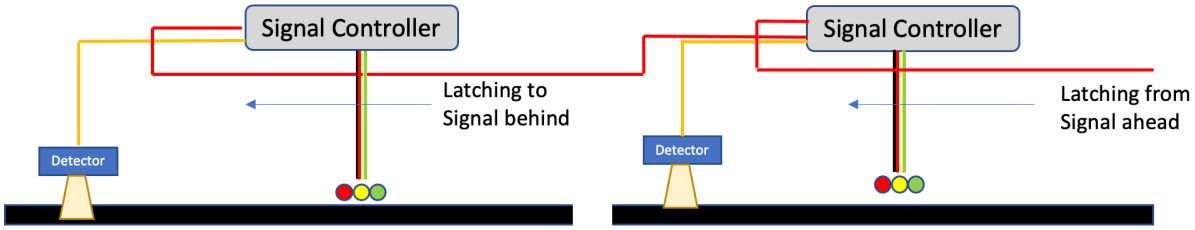
While not a true CTC signaling system, there is one feature that will give the appearance of one – without the complexity.

In short, if you connect the Signal wire of the Signal controller from the block ahead to the LATCH terminal of the Signal Controller of the block behind, while the block ahead is occupied the block behind will wait at the last aspect before green. Once the block ahead is clear, the Signal Controller of the block behind is “released” and will turn green.

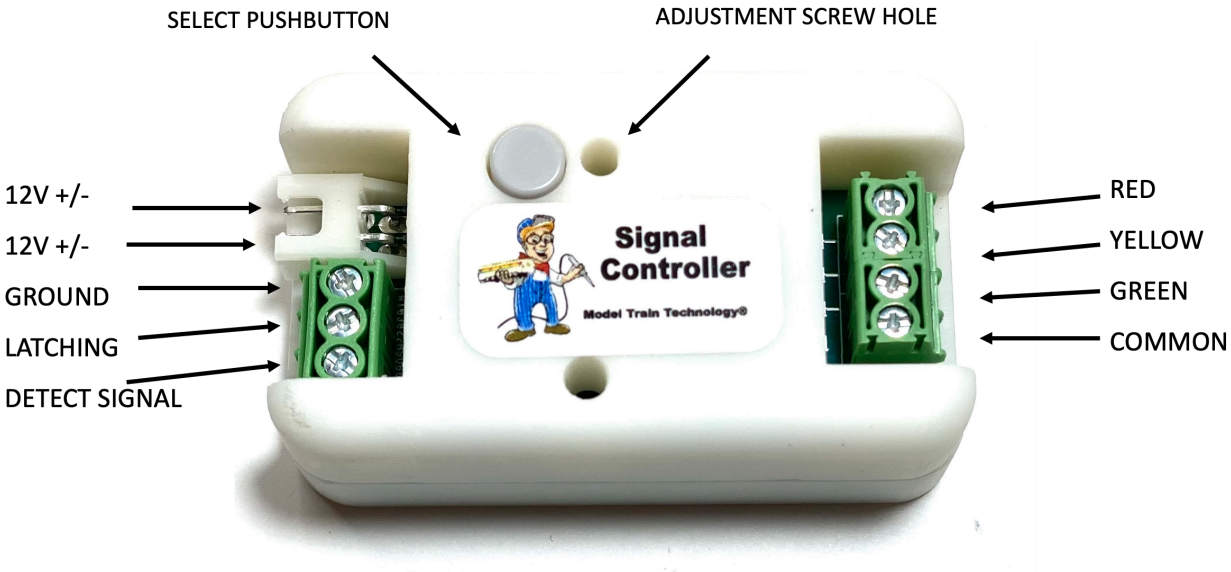
You can daisy-chain as many latching connections as you like.

Here is the wiring for Latching:

Signal Latching Example



SETUP AND OPERATION



When you plug in power the blue internal LED will light. The green LED or FIBER output will light.

The Controller setup is simple. Connect to a 12VDC power source (or DCC power) to the topmost JST terminals as shown above. Connect your Signal LEDs as shown on the right. The LEDs can be common Cathode or Common Anode. Common Cathode means the COMMON is negative (usually the black wire, but not always). Common Anode means the COMMON is VCC+, or POSITIVE voltages and usually a red wire.

To Switch the Controller between common cathode (-) and common anode (+) see page 15.

The Detect Signal input is an OPEN DRAIN (GROUND) connection. That means that the signal it's looking for is a ***digital LOW***.

NOTE: this Open Drain low is NOT the same as a LOW/HIGH from an Arduino. DO NOT connect an Arduino GPIO pin directly to the Signal Controller.

If you use our ***MTT Power Module*** to power your detectors and the ***Controller*** you only need the single yellow SIGNAL wire to connect the trigger wire.

If you have another kind of sensor system you can either have them share the same power supply or use the GROUND terminal. You may also "short" the ground and the signal to create the same result. In other words, a simple mechanical switch between SIGNAL and GROUND will trip the Controller. Very simple.

The Signal Controller also has a manual STEP mode. You can use this if you want to push a button and manually step through the aspect changes. The STEPs go in order and then back to the first aspect. So, typically Green to Reds, to Yellow, to Green. However, if you want the

defaults to be Red, simply reverse the Red and Green Fibers or LED wires. Then the default will be Red. When you push the button the aspect will change to Green and then Yellow (and flashing yellow if you have aspect 5 or 6 selected.

SELECTING A SIGNAL BEHAVIOR (ASPECTS)

You push the Select Pushbutton the number times needed to select an option according to the table below. Once you stop pushing the button the Controller will wait 2 seconds and then all the LEDs will turn off. One second later the green signal LED will blink the number count matching the button pushes.

PUSHES	SIGNAL BEHAVIOR
2	Red, Green
3	Red, Yellow, Green
4	Red, Yellow, Yellow flash, Green
5	R, R&Y, G&Y, Green
6	R, R&Y, R&Y-Flash, G&Y-flash, Green
7	Red, fade to Yellow, fade to Green
8	Alternate flash (speed adjustable) *
9	Alternate flash with fade (speed adjustable) *

** For use with Gate Crossing Flasher*

The default setting is 3.

SELECTING THE ASPECT SPEED

The behavior speed adjustment screw is inside the Controller. You access it with the provided 2mm screwdriver. Gently turn the screw inside from zero to about 300 degrees. It does not turn 360 degrees. Left or counterclockwise is faster (less time between stages), right or clockwise increases the time between stages. You can make the adjustment at any time since the Controller reads the setting at the beginning of each detector trip event.

SETTING THE BIGHTNESS (LED OR FIBER)

Setting the brightness for each output is accomplished through a series of SINGLE pushes to the select button. In an idle state, with no triggers active, press the select button once. This will START the sequence to adjust ALL the LED outputs one at a time.

After the first press all the LEDs will light, and the RED led will be ***active*** for the adjustment. You may not see any visible change. Gently Insert the screwdriver into the adjustment screw hole and turn the insider screw clockwise and counterclockwise to reach the desired brightness for the red LED.

When you are happy with the setting, press the select button once. This will save the Red LED setting; the Red LED will blink and cycle the adjustment to the Yellow LED. Adjust as needed. Then press the button once again. The Yellow LED will blink and then set the mode for adjustment to the Green LED. Once you are set with the Green LED brightness setting, press the select button one final time.

After the final press, all three LEDs will flash and turn off. After that and depending on the behavior setting, one of two things will happen:

1. If you have set the aspect behavior between 2 and 7, the Green LED will light, and the system will be ready to receive a Block Occupied trip signal.

2. If you have selected either behavior 8 or 9, which are the crossing gate alternate flash modes, all the LEDs will remain off until a block occupied trip signal is received.

NOTE: after you have adjusted the brightness, remember to RE-SET the adjustment screw to the timeout setting you want. Most of the time when you set the brightness of the LEDs the adjustment screw will be toward the "high" side, meaning all the way clockwise. This is also the LONGER time setting for the aspect changes.

CROSSING GATE LIGHT SETTINGS (Aspects 8 & 9)

The speed of the alternate flashing can be adjusted by turning the speed adjustment screw. It adjusts the time between stages just as before but in this case, it is the speed of the back and forth of the two output ports (red and green). There is no timeout delay option for the Alternate Flashing modes. Instead, you use the timeout function on the ***Precision Sensor*** (or other sensing system) to decide when to turn off the alternate flashing LEDs.

FORWARD LATCHING FEATURE

The way standard latching works is the Signal Controller in the forward block “holds” the Signal Controller behind it at the YELLOW stage until the train is clear of the forward block. Once clear the train is clear of the forward block, it releases the latch and the block behind it is cleared to Green.

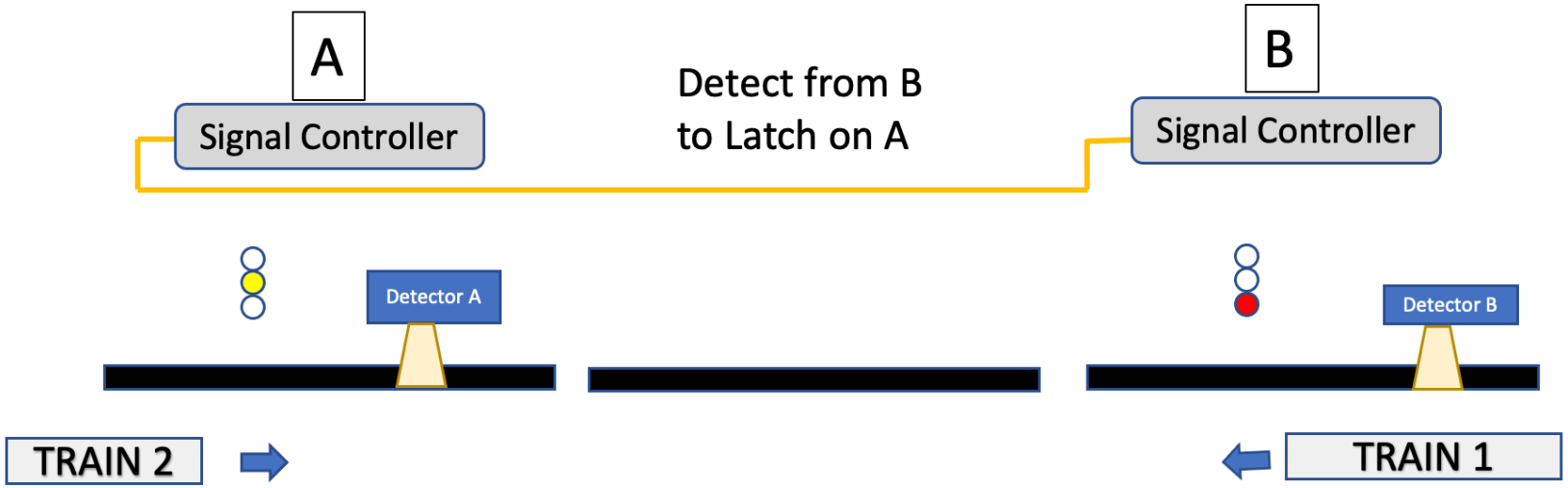
This all assumes that the trains are on the same track heading in the same direction. This also means that the blocks have been tripped by detection.

<u>FORWARD Latching allows a Signal Controller (via Detection) to cause a “Non-tripped” Signal Controller to instantly show Yellow.</u>

This would normally be caused by two trains approaching each other with a passing siding nearby. Reverse latching tells the “second” train to slow down (via the yellow indication). It could also be set to red by connecting another detector that is in the closer block.

You DO NOT have to configure Forward Latching. It happens automatically if the latching wire is connected, and the conditions explained happen.

Here is an example:



Train #1 traveling West trips detector B for Signal Controller B. As normal, the block signal changes to RED as shown. Train#2 is approaching Block A but has not tripped its detector. HOWEVER, Signal Control B, via reverse latching, causes Signal Controller A to show a yellow condition. It will stay yellow while Detector B is active OR Train 2 trips Detector A – at which point it will cause Signal A to change to red.

SWITCHING POLARITY

All Model Train Technology LED Block Signals are common cathode (GND-), and the ***Controller*** default is common cathode – so you don't have to do anything. However, if you are connecting the ***Controller*** to another signal you purchased from China, or some US manufactures the common wire may be PLUS (VCC+). That means you must reverse the polarity of the ***Controller*** to common anode (+). Here is how to do that:

1. Press and hold the select button on top of the Controller. The blue light will go off. Continue to hold the button until the blue light starts blinking.

2. Release the Select button. The blue LED will continue to blink

3. Then, press the Select button Three (3) times (CATHODE MODE) or Four times (4) for ANODED MODE.

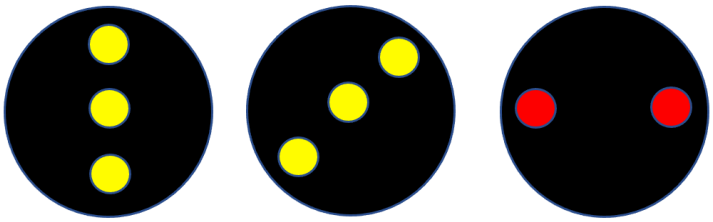
   See the chart on page 25.

4. The Blue light bill blink either 3 times or four times depending on which mode you selected.

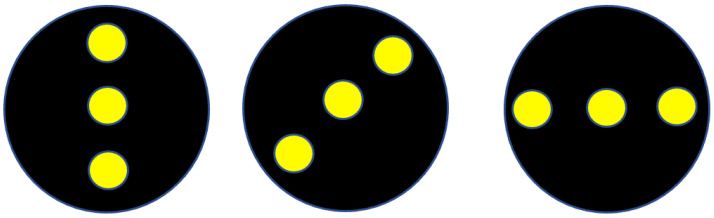
SEVEN LIGHT SIGNALS

If your Signal Controller has four outputs, the fourth output is used to light the center light on a round 7 light signal. We currently support two behaviors: Pennsylvania Railroad (PRR) and Long Island Railroad (LIRR).

For the PRR the signals will look like this:



For the LIRR the signals will look like this:

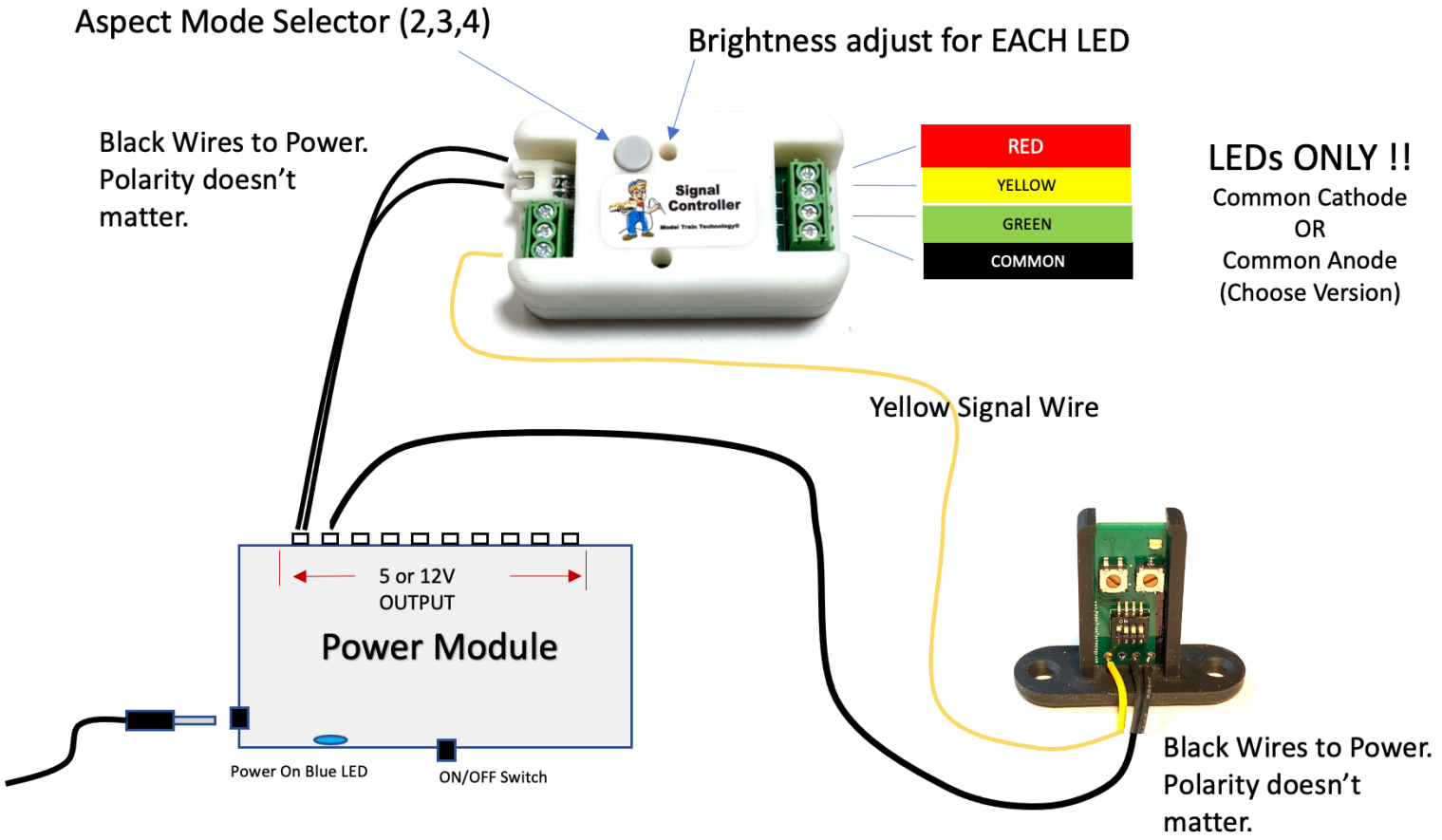


NOTE: typically, the PRR STOP is two Reds horizontal with the middle light off. There are some variations, but this is what this controller will show. If you want green and yellow signals, we can do that.

The LIRR signals are typically all white with the center light on all the time. We kept to this except when the lights are flashing and then the center light flashes with the other lights. That is NOT a prototypical behavior but we kept that mode in the controller so you could implement it if you like.

Model Train TECHNOLOGY

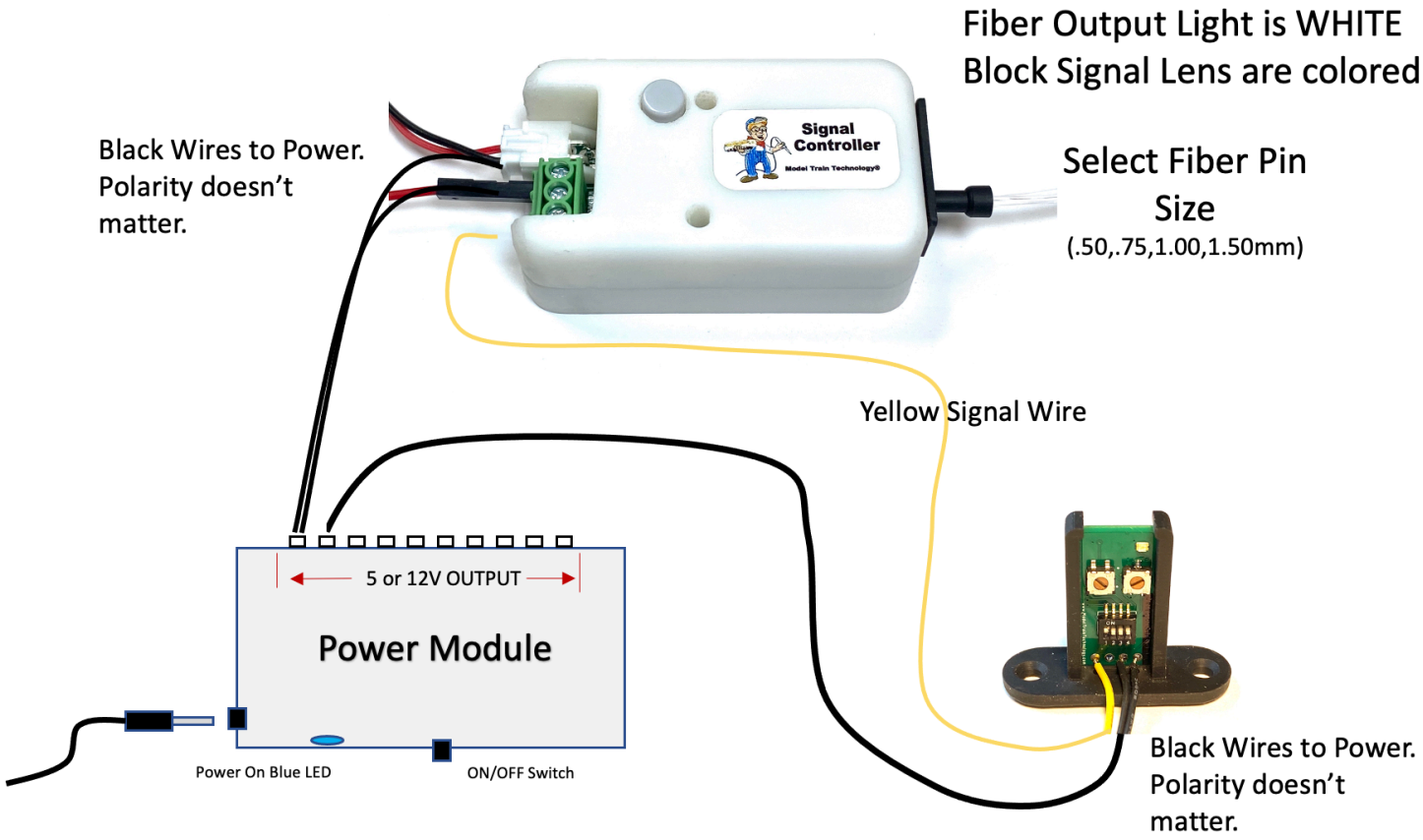
MTT Precision Detector™
LED SIGNAL CONTROLLER HOOKUP



Model Train TECHNOLOGY

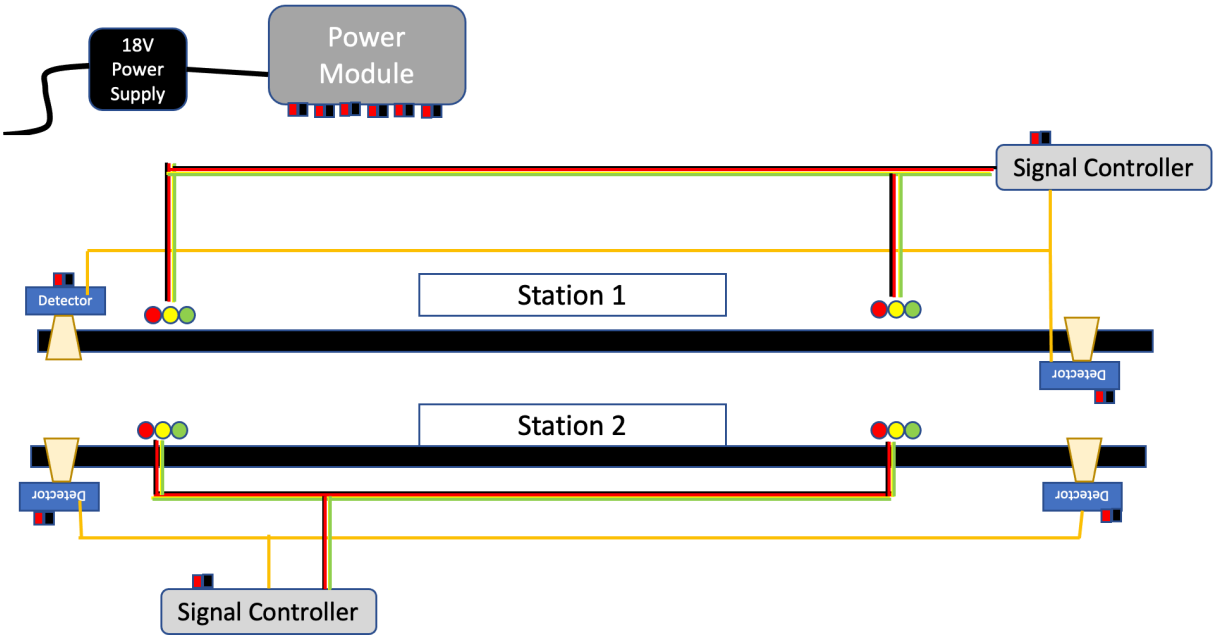
MTT Precision Detector™

FIBER SIGNAL CONTROLLER HOOKUP



Model Train TECHNOLOGY

Detection/Signaling Example



* Includes power supply

For clarity, power to each component is represented by:

DCC OPERATIONS

The ***Controller*** can respond DCC Accessory messages just like your turnout controllers. You can set the ***Controller*** to the SAME address as a turnout so that when you change the turnout, the ***Controller*** automatically changes the color of the signal. You can also configure several Controllers to the same switch address so that multiple but different signal lights will light according to your layout design. Since ***routes*** are a combination of turnout commands, the ***Controller*** can align the signal lights accordingly.

You can use any valid accessory switch address between 1 and 2044. When the ***Controller*** receives a DCC turnout command (thrown or closed) that matches the ***Controller*** address, it will activate the trip function of the ***Controller*** and start the aspect animation.

- Closed means that the siding is closed, and the switch aligns with the Main Line – meaning the switch should be straight.

- Thrown means that the switch is set to divert the train to the siding or wherever else it might go, but not straight.

  The ***Controller*** uses the THROWN direction as a tripped condition.

  Since there are only two conditions for a turnout, it makes the most sense to set the ***Controller*** to 2 aspect mode – Red and Green only.

  If you find that the Thrown and Closed states are backward to the way you want to display the signal, simply reverse the wires and/or fiber cable connections to the ***Controller.***

To operate the ***Controller*** with DCC you must power and connect your DCC rails A & B to the ***Controller***. For small and medium sized layouts this should not be a problem since the ***Controller*** and LED require about 30ma each to run. For larger layouts or layouts with a lot of signals connected to you DCC track we suggest you create a separate Booster zone. This way, no current will be taken away from the rails to run the engines.

SETTING THE CONTROLLER ADDRESS

With the Controller in the non-tripped state, press and hold the select button for about 10 seconds. Within 1 second of beginning to press the button, all the signal lights will go out. Usually, it's just the green light that goes out since it's the only one on.

Continue to hold the select button until the light comes back on. Then release the button. The green light and the blue power light will begin to flash on and off. This indicates that the ***Controller*** is ready to accept a new address.

To set a new address, select the Accessory/Turnout number that you want to use on your DCC hand controller. This can be a number from 1-2044. Using your DCC hand controller, enter the number and then press the appropriate command to set a CLOSED or THROWN switch event. Either closed or thrown will work. This will be slightly different depending on the brand of DCC system that you are using.

To exit setting the address mode WITHOUT changing it, press the select button once. The Controller will return to its ready state.

As soon as you select CLOSED or THROWN, the ***Controller*** will flash 4 times and the lights will go off. The ***Controller*** is now set to the new address.

Lastly, the ***Controller*** will enter the unoccupied/un-triggered state which usually means that the green light will go on.

While DCC is connected and active, DCC commands will override the input signal and latching functions. In other words, you can use detectors OR DCC to trigger the *Controller* but not at the same time.

DCC to non-DCC Controller Linking

When the Signal Controller is operating in DCC mode, as mentioned above, the ***Inputs*** to Detect and Latching will not activate. However, the Latching terminal will automatically switch to act as a ***Trigger Output*** in sync with the DCC signals. In other words, if you give a Controller under DCC a Thrown command, it will trip that Controller AND trip that Controllers Latching circuit. You can then connect a wire from the Latch terminal to the Detect of another Controller NOT under DCC control.

Since the two controllers will be on different power supplies (DCC and some other DC power source) you will also need to establish a common GROUND between the Controller. Conveniently, there is a GROUND terminal on all Signal Controllers. Simply run a wire to connect the ground terminals of the two Controllers.

SETTING THE OUTPUT VOLTAGE (STEP DOWN)

The Signal Controller should typically be powered with 12VDC. As mentioned earlier, the output will follow the input.

To use most LEDs which are 2-5v, you want to set the Controller into ***STEP DOWN*** mode so the output voltage to roughly 5VDC.

5VDC (#5 Step Down) is the DEFAULT SETTING.

To use pass through voltage up to 10vDC us #6

The procedure to activate 5 VDC Step Down is like setting the Controller DCC Address.

1. With the Controller in the non-tripped state, press and hold the select button for about 10 seconds. Within 1 second of beginning to press the button, all the signal lights will go out.
2. Press the select button 5 times.
3. The blue LED will flash 5 times to indicate the Step-Down mode has been set.

BLUE LIGHT TIMEOUT

If set, the BLUE indicator light will go out after 60 seconds of startup or if the Select button is not pushed. Each time you press the Select button, the light will come back on and start its 60 second timeout clock. In Address setting mode, press the SELECT button 12 times to toggle between On and Off. After being set, if the mode is ON, the blue light will flash 10 times. If off, it will flash once.

SETTING THE STEP MODE & PRR & LIRR SETTINGS

With the Controller in the non-tripped state, press and hold the select button for about 10 seconds. Within 1 second of beginning to press the button, all the signal lights will go out. Wait until the light begins to blink and then release the button.

Then, press the select button the desired number of times as shown below:

USE THE HOLD-SELECT MODE TO CHANGE:

Cathode mode	3
Anode mode	4

Voltage set to 5V Max.	5
Voltage Pass Through	6

PRR Mode**	7
LIRR Mode**	8
Button STEP Mode	9 (toggle)

RESET - Cathode Mode	10
RESET - Anode Mode	11
Blue LED On/Off	12

**** Four Output Controller Only**

ELECTRONICS AND STATIC ELECTRICITY

The ***MTT PRECISION DETECTOR™ - Trackside*** circuit board and components are exposed when the cover is off. Electricity can be dangerous. Static electricity can cause component failure. Scuffing along a carpet and then touching one of the component connectors can cause a static spark. These components are fairly rugged – some designed for the automotive industry. Just be mindful of the risk. The current on the board will not harm you if the board is powered and operated as per the instructions.

ONE YEAR MANUFACTURER WARRANTY: We warrant this product to be free from defects in workmanship and materials, under normal residential use and conditions, for a period of one (1) year for the original invoice date. Shipping and handling fees are to be paid for by the customer.

LIMITATION OF LIABILITY

UNDER NO CIRCUMSTANCE SHALL COMPANY OR ITS AFFILIATES, PARTNERS, SUPPLIERS OR LICENSORS BE LIABLE FOR ANY INDIRECT, INCIDENTAL, CONSEQUENCIAL, SPECIAL OR EXEMPLARY DAMAGES ARRISING OUT OF OR IN CONNECTION WITH YOUR USE, OR INABILITY TO USE THE PRODUCT, WHETHER OR NOT THE DAMAGES WERE FORESEEABLE AND WHETHER OR NOT COMPANY WAS ADVISED OF THE POSSIBLITY OF SUCH DAMAGES. WITHOUT LIMITING THE GENERALITY OF THE FOREGOING, COMPANY'S AGGREGATE LIABILITY TO YOU SHALL NOT EXCEED THE AMOUNT OF THE PRODUCT. THE FOREGOING LIMITATION WILL APPLY EVEN IF THE ABOVE STATED REMEDY FAILS OF ITS ESSENTIAL PURPOSE.

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