Digitrax
Command
Control

DS54

Quad Stationary Decoder
for Digital Command Control
with Programmable
LocoNet Inputs & Outputs

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DS54 Quad Stationary Decoder Users Manual

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1.0 Introduction

The DS54 is a DCC stationary decoder that can control multiple items that are fixed around the layout. Things like turnouts, lights, signals, sound and other immobile devices can be controlled with the DS54. The DS54 comes from the factory already programmed to operate solenoid turnouts. If you don't want to use any of the advanced functions, then you are set to go!

The DS54 has LocoNet messaging capabilities that let you send information back to the system. This information can be used to expand the capabilities of your layout. It can be used for animation or even for occupancy detection when used with BD1s and the DS54's capabilities don't stop there.

2.0 DS54 Features & Specifications

Four outputs that can control slow motion and/or solenoid turnout machines, lights, sound modules, DC motors, etc.

Eight inputs that can be set up for turnout control, occupancy detection, signaling systems and animation control.

DS54 is **completely programmable**. Each of DS54's 4 outputs can be set up independently to run solenoid turnout machines, slow motion turnout machine, lamps, animation devices or other stationary devices on the layout. This means that you could control a Tortoise, a Snap Switch, a blinking light, and a rotating windmill with one DS54.

It can handle **over 2000 switch (or stationary) addresses.** The stationary address range is separate from the DCC mobile address range that controls locomotives. This means that a locomotive with mobile decoder address 15 and a turnout with switch address 15 are controlled completely separate from each other.

DS54 can handle **over 4000 sensors** on a layout.

3.0 Terminology

The DS54 is a quad stationary decoder. Each DS54 has a **stationary decoder address**: 01-511. Each DS54 has four independent **function cells**: A, B, C & D. Each function cell has both output and input wires. Each cell has its own **switch address** that controls the device attached to the function cell. This means that each DS54 has 4 switch addresses available for each stationary decoder address.

SWITCH commands are sent by **throttles** via the command station to the switch addresses to control each function cell.

Each DS54 function cell A, B, C, & D can be set up with one of 3 different output types:

1. **Pulse** for solenoid turnout machine operation
2. **Steady** for slow motion turnout machine operation
3. **Blinking** for lamp operation.

Each DS54 function cell A, B, C, & D also has 8 inputs called Auxiliary inputs & Switch inputs. AuxA input & SwitchA input, AuxB input & SwitchB input, AuxC input & SwitchC input and AuxD input & SwitchD input. These inputs can be used for feedback like reporting turnout position or occupancy. In this manual, the DS54's inputs (that could be function cell A, B, C, or D) are referred to as follows: **Aux_ input** or **Switch_ input**. For example, AuxA input or SwitchD input. where you see the notation Aux_ input or Switch_ input this means that any function cell A, B, C, or D may be inserted.

Stationary decoders, like the DS54, have their own **configuration variables or CVs,** that are used to set up the outputs and inputs described above. CVs are used to set the decoder's stationary address, control whether the output is static, pulsed or blinking, set up how the decoder reacts to various triggers, control local routes and cascaded routes. Stationary decoders are most often used to control turnouts and routes.

Turnout position: Closed and Thrown Turnouts are called **closed** where the routing is through the straight leg or set for the mainline. Turnouts are called **thrown** when the routing is through the curved leg or set for the diverging route. On the throttle this is displayed as "c" (closed) & "t" (thrown).

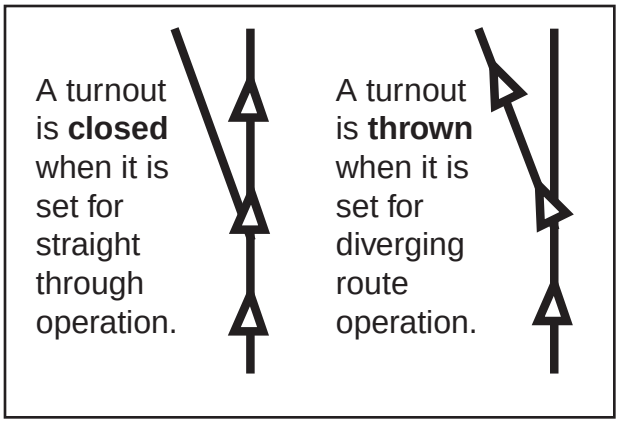


Figure 1: Turnout Position, Closed & Thrown

Turnout position reporting is done two ways with the DS54 & LocoNet:

The first is the **standard position reporting** method. With this method an external microswitch is attached to the red wire on the DS54 output cable and the output is programmed to send a message when the turnout position is closed. With this method of reporting, LocoNet uses the turnout position information to infer when the turnout position is thrown.

The other is **exact turnout position reporting**. With this method, the DS54 is hooked up to two turnout reporting microswitches and the DS54 is programmed to send the information to the LocoNet system. Using this information, the command station always knows the exact position of the turnout, even if it was changed manually.

A **Task** is the action performed by a function cell when it receives a valid trigger. A **Trigger** is an event detected on the layout that causes a function cell to execute a task. A trigger can be set up several different ways. A trigger can be set up to happen based on whether either an input or and output is ON or OFF. A **level** trigger set up will cause a trigger when the input changes from OFF to ON & ON to OFF. A **negative edge** trigger occurs when there is a change from ON to OFF. A **positive edge** trigger occurs when the input is off and there is a change from OFF to ON.

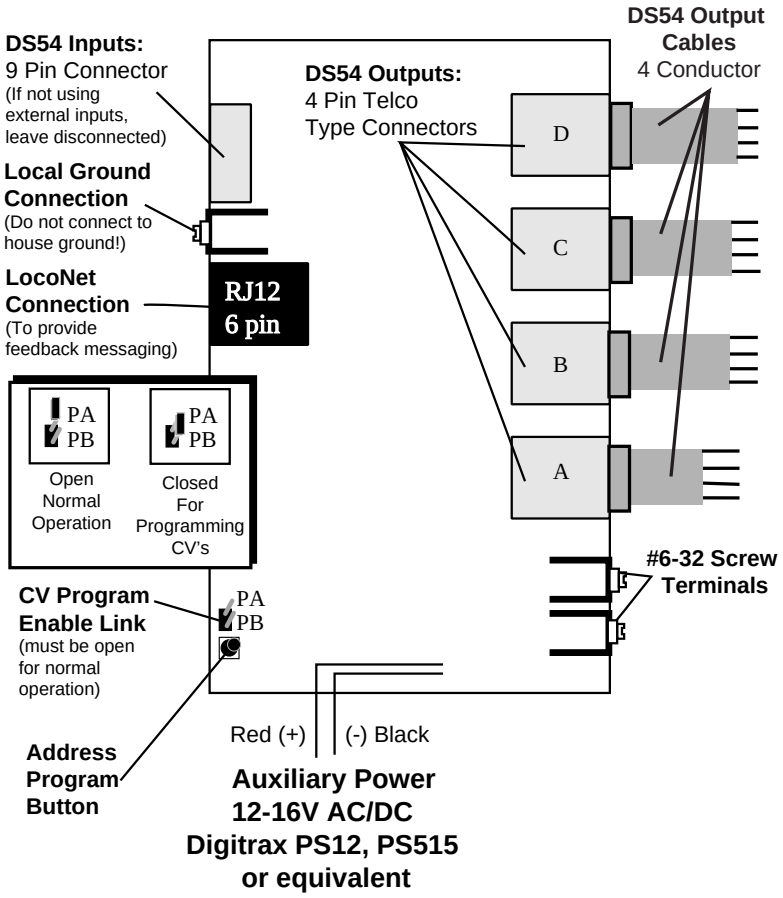
Function cells can be set up to handle triggers in two ways: **non-retriggerable** means that the current output action must be completed before a new trigger is accepted. **Re-triggerable** means that the DS54 function cell will accept a new trigger and begin a new action before it completes its current output action.

A **Route** is set up by linking stationary decoders together so that they perform several operations based on a single command sent from the command station. It is sort of like “consisting” turnouts. A **Local Route** is one that is handled by a single DS54 without intervention from the command station. A **Cascaded route** is the operation of one or more function cells on more than one DS54 to operate a specific route. **Nested route** is a route that is part of another route.

Hexadecimal and decimal notation: In this manual CVs are shown as decimal numbers and CV values are shown as hexadecimal and decimal numbers in the following format x##/###. For example x20/032 means hex 20 or decimal 032. When using a Digitrax DT100 or DT200 throttle to program CVs, the CV values will be displayed on the throttle as hexadecimal numbers. With a DT300 or DT400, CV values can be displayed as either hex or decimal numbers. When the numbers are decimal, three digits appear in the display. When the number displayed is hexadecimal an “x” is displayed before two hex digits. Please consult the hex to decimal conversion table at the end of this manual to translate the hex digits to decimal.

4.0 DS54 Connections & Specifications

Figure 3: DS54 Board Layout

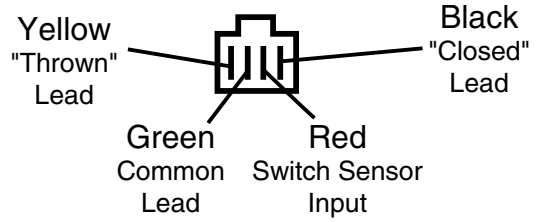


DS54 Outputs: The four outputs for the DS54 are four telephone type connectors labeled A, B, C & D. These are 4 pin connectors and are used to link the DS54 to the turnout machines or other layout devices controlled by the DS54.

DS54 Output Cables: DS54 output cables are included with each DS54. These cables can also be purchased from DigiKey & other TelCo suppliers. These cables are shipped with a 4 pin telco handset type plug at both ends. To make 2 output cables, cut the cable at a location that makes the cut ends reach the turnouts or other devices you want to hook up. Plug the connector end into the DS54's outputs and hook the other end to the turnouts or other devices you wish to control.

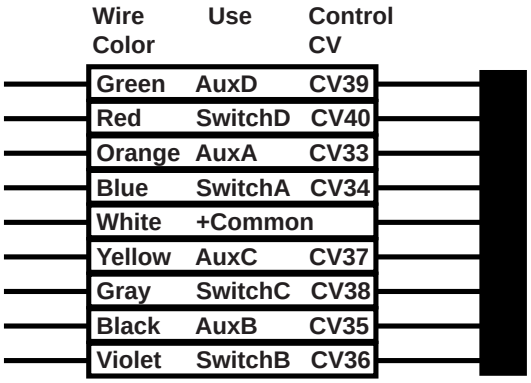
DS54 Output Wire Colors: As you plug the DS54 output cables into the DS54, note that the wire colors are from left to right yellow, green, red & black. Yellow is the thrown lead. Green is the common lead. Red is the switch sensor input lead. Black is the closed lead.

Figure 2: DS54 Output Connector Color Code



DS54 Inputs: The 9 pin Digitrax connector is used on the DS54 for inputs from devices on the layout. These inputs can be from things like momentary contact switches for determining turnout position, from BD1 occupancy detectors or other devices. Each function cell has a pair of input wires available.

Figure 4: DS54 Input Connector Color Code



Digitrax standard 9 pin connector

Note that the 4 SwitchA, SwitchB, SwitchC & SwitchD inputs are available on both the DS54 input cable and the DS54 output cable. If a Switch_ input is being used via the DS54 output cable, you should not connect it on the DS54 input connector. In other words, only one Switch_ input should be hooked up for each function cell.

LocoNet Connection lets you use the DS54's LocoNet messaging abilities to communicate with the system via LocoNet. Simply plug in a LocoNet 6 conductor cable to gain access to the rest of the LocoNet system.

CV Program Enable Link is used to program the DS54. It must be in the open position with one pin uncovered for regular operation. To program the DS54, move the link so that it is closed with both pins covered to enable programming. Be sure to put the Programming Enable Link back in the open position when programming is completed.

Address Program Button is used to program the DS54's stationary address and 4 associated switch addresses.

Local Ground: the screw terminal next to the LocoNet connector is the local DS54 ground for connecting devices to the the DS54. If using the DS54 only for switch control, LocoNet and system ground are not required. Connecting the DS54 to the booster via LocoNet for feedback messaging will provide any necessary system ground. DO NOT connect this to a house ground (water pipe, electrical ground connection, etc) or it may result in damage to the DS54.

Auxiliary Power 12-16V AC/DC connections: red (+) & black (-) wires are used to connect an auxiliary 12-16 volt AC/DC power source. Digitrax recommends use of auxiliary power for all turnout machine types to achieve optimal operation. Digitrax PS12 Power Supply is excellent for this purpose.

#6-32 Screw Terminals are for connecting the DS54 to the local section of DCC powered track. The DS54 normally gets its power via these terminals.

5.0 Installing A DS54 Under The Layout

Refer to ***Figure 5: Install the DS54 Under the Layout***.
To Install the DS54 under the layout:

1. DS54s can be programmed either before or after they are installed on the layout. If you are installing your first DS54 and will use switch addresses 01, 02, 03 & 04 only for operating solenoid type turnout machines you can proceed with the installation.
   a) For slow motion turnout machines see Section 6.1.2.
   b) To change the switch addresses or other CVs see the Programming Section below before proceeding with the installation.
   c) To set up feedback or other intermediate and advance features, see Sections 13 & 14 and program the DS54 before proceeding with the installation
2. Mount the DS54 under the layout using the four mounting holes in the corners of the unit.
3. Allow a minimum of 1/2" spacing all around for air circulation.
4. Be sure that no metallic objects or wires are touching the board that could create a short circuit.

5. The DS54 board can be physically located anywhere that is convenient to the turnouts under its control.
6. To connect to LocoNet, simply run a LocoNet cable from the closest LocoNet device that is already hooked up and plug it in to the LocoNet port on the DS54. Remember to test the LocoNet cables with the LT1 tester that came with your starter set. *If you are not using the feedback features built in to the DS54 you do not need to connect to the RJ12 LocoNet Connection.*
7. Power the DS54 by connecting the #6-32 screw terminals to a local section of DCC powered track. Connect one wire to each DCC powered rail (polarity does not matter). 20 to 22AWG wire is recommended for this connection.

5.1 Auxiliary Power

To provide enough power to the DS54 to avoid power drops on the system when multiple turnout machines are operated simultaneously or if you want slow motion turnouts to operate faster, provide additional power to the DS54.

Digitrax recommends using auxiliary power for all turnout machine types.

This auxiliary power can be from any transformer with a voltage between 12V & 16V AC/DC. The transformer should be overload protected and **only** be used with DS54s. Digitrax PS12 12V AC Adapter is excellent for providing auxiliary power for DS54s. The red auxiliary power input is positive (+) and the black is negative (-). See ***Figures 3 & 5.***

When using more than one DS54, make sure that the polarity is the same for all auxiliary power inputs.

Figure 5: Install the DS54 Under the Layout

Install the DS54 under the layout. Allow 1/2" clearance on all sides for air circulation. Be sure that nothing, like wires or metallic objects, that could cause a short on the board is touching the DS54.

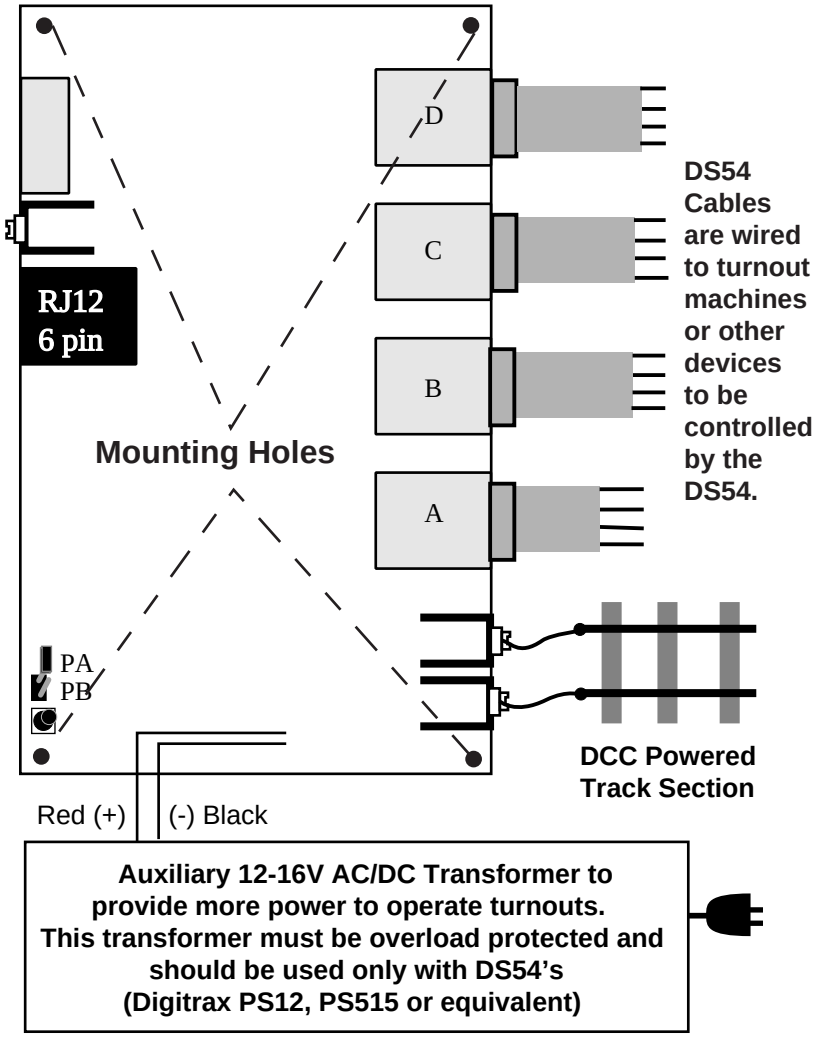
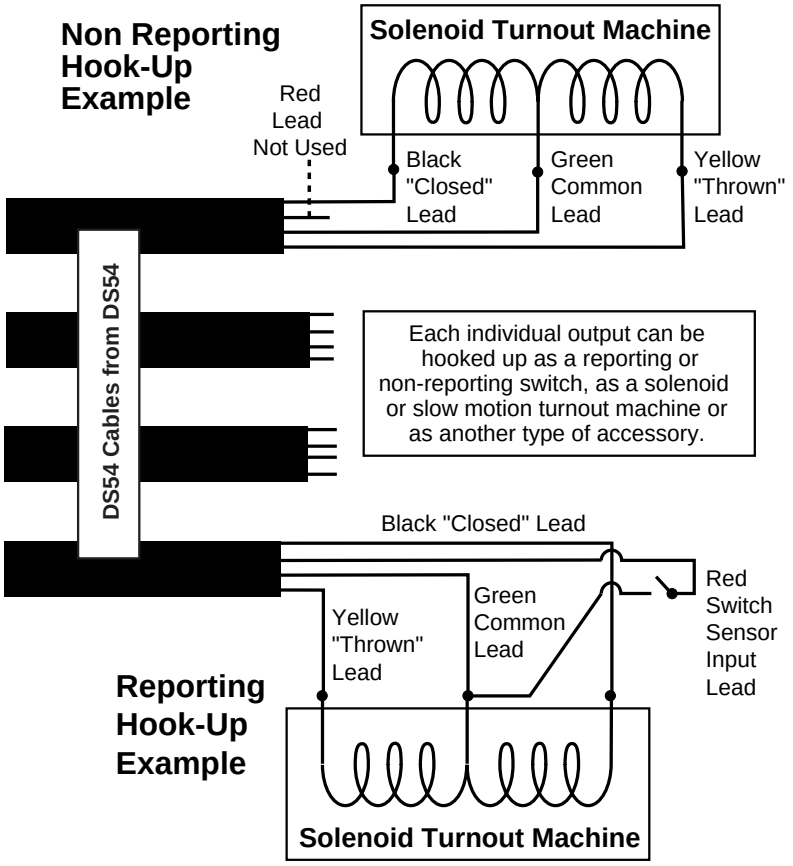


Figure 6: Hooking up solenoid turnout machines.
Non-reporting and reporting examples



If you are not using reporting, simply leave the red switch sensor input lead unconnected.

To use turnout reporting, connect switches as shown so contacts are closed when the turnout is closed, & connect the DS54 to LocoNet with a LocoNet 6 conductor cable via the 6 pin RJ12 connector on the DS54.

6.0 Using the DS54's Outputs

Each of the DS54's outputs can be set up to run solenoid (snap) turnout machines, slow motion (Tortoise type) turnout machines, bi-polar turnout machines, DC motors and lamps on the layout. More than one type of output may be combined on each DS54 to control different types of turnout machines, DC motors and/or lamps, all controlled by one DS54!

6.1 Turnout Machines

Most DS54s are used to control turnout machines on the layouts. The following Sections illustrate how to hook up each kind of turnout machine.

6.1.1 Solenoid Turnout Machines

A solenoid turnout machine is operated by a pulse of current that operates the turnout. Atlas and Peco snap switches are examples of this type of turnout machine. The DS54 comes from the factory programmed for operating solenoid turnout machines. When using only solenoid turnouts, simply hook up the DS54 according to ***Figure 6***.

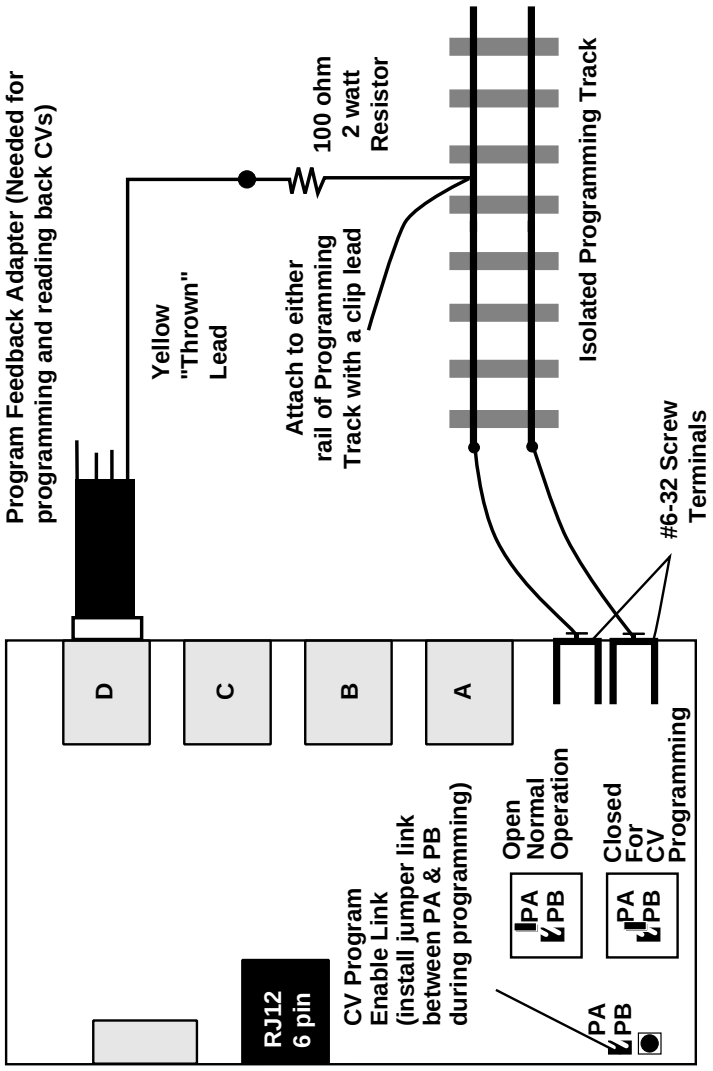
As it comes from the factory, the DS54 is set up for pulse retriggerable operation with a duration of about .125 seconds. This means that each time a turnout is activated, the DS54 sends a pulse of current to the appropriate solenoid for about 1/8th of a second. Retriggerable means that if another command is sent to the DS54 before the first action is completed, the DS54 will ignore the first command and execute the new one immediately.

CAUTION: <u>Controlling more than one solenoid turnout with a single DS54 output is not recommended.</u>

To hook up solenoid turnout machines:

1. Disconnect or turn off DCC track power and any auxiliary power supplies installed on the layout.
2. Install the DS54 under the layout and provide power for it as described in Section 5.0.
3. The DS54 is programmed at the factory to stationary decoder address 01 so that the Outputs A, B, C, & D correspond to switch address numbers 01, 02, 03, and 04 respectively.
4. Connect each turnout machine to the DS54 using the four-pin cables provided.
5. Connect the black wire to the closed lead on the turnout machine
6. Connect the green wire to the "common" lead on the turnout machine

Figure 7 : Programming DS54 CVs and Reading back CVs



7. Connect the yellow wire to the thrown lead on the turnout machine
8. Connect the heavy red and black auxiliary power wires to the dedicated DS54 auxiliary power supply (Digitrax PS12 or equivalent).
9. (Optional) Connect the red wire in the DS54 output cable as shown to a switch sensor input for standard turnout position reporting. Exact turnout position reporting is discussed in detail in Section 10.
10. Turn on the DCC track power and auxiliary DS54 power supply.
11. Issue a SWITCH command to switch address 01 from a throttle. (To do this, put the throttle in SWITCH mode, select switch address 01 and press the c or t button on the throttle to operate the turnout.) OutputA of the DS54 will send a pulse to the turnout machine connected to it each time the turnout is commanded to change from closed to thrown & vice-versa.
12. Send commands to switch address 02 and OutputB will operate the turnout connected to it. Continue with switch address 03 & 04 to check Outputs C & D.

6.1.2 Slow Motion Turnout Machines

A slow motion turnout machine uses a steady stream of current to move the turnout. Examples of slow motion turnout machines are Tortoise (made by Circuitron) and SwitchMaster. Since the DS54 comes from the factory set for operation of solenoid turnout machines, CVs 03, 04, 05, & 06 will have to be reprogrammed to set up the DS54 for slow motion operation of one or more outputs. CV programming will be covered in more detail shortly.

How to set up a DS54 for Slow Motion Turnout Operation:

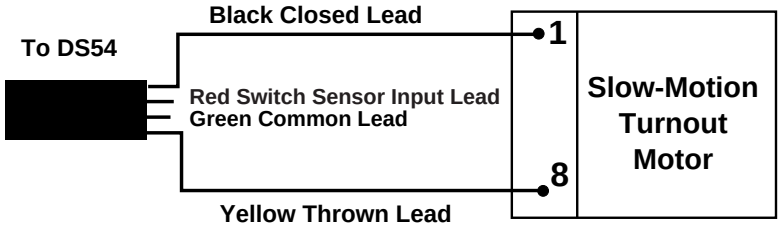
1. Move the CV Program Enable Link so that both pins PA & PB are covered to enable programming.
2. Connect the DS54 to the programming track as shown in ***Figure 7***. You can use the 100ohm 2 watt resistor that came with your starter set test kit to protect the DS54 from being damaged if track power is applied accidentally during programming.
3. Put the system into programming mode.
4. Program CV03 to the value of x20/032 (20 hex or 32 decimal).
5. Repeat step 4 to program CV04 to x20/032, CV05 to x20/032 & CV06 to x20/032 to set up all four outputs on the DS54 for operating slow motion turnout machines.

The chart below shows you which CV and which CV value to program for each of the DS54's outputs and their corresponding values.

CV#	Usage	Solenoid	Slow Motion
CV03	OutputA	x00/000	x20/032
CV04	OutputB	x00/000	x20/032
CV05	OutputC	x00/000	x20/032
CV06	OutputD	x00/000	x20/032

6. When you are finished entering values for each of the DS54's Outputs, exit programming mode.
7. Move the CV Program Enable Link so that only one pin is covered to disable programming mode on the DS54.
8. Proceed with connecting the DS54 to slow motion turnout machines on the layout as shown in ***Figure 8***.

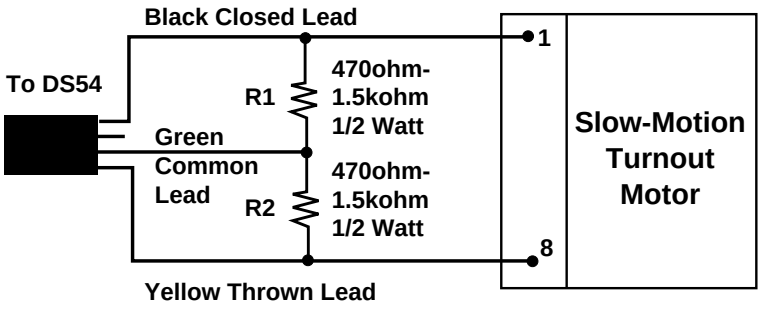
Figure 8: Hook up for Slow Motion Turnout Machine



6.1.3 Adjusting Slow Motion Speed

If your slow motion turnout machine operates too slowly, add resistors as shown in ***Figure 9*** to increase the speed. Lower resistances will increase speed. A practical lower limit would be 470 ohm 1/2 watt resistors.

Figure 9: Adjusting Single Slow Motion Turnout Machine Operation Speed

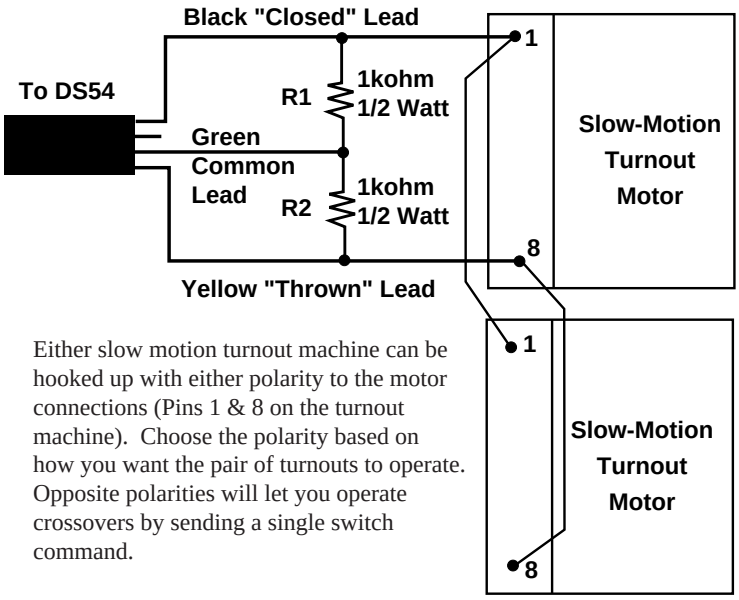


6.1.4 Using two slow motion machines on one output

The DS54 can operate two slow motion turnout machines from each DS54 Output. To use two slow motion turnout machines on one DS54 output hook them up according to ***Figure 10***. The two resistors allow more stall current to the turnout machines being operated as a pair. Either slow motion turnout machine can be hooked up with either polarity to the motor connections (Pins 1 & 8 on the turnout machine). Choose the polarity based on how you want the pair of turnouts to operate. You can have one turnout move to the closed position while the other moves to the thrown position. This is useful for cross overs and other track arrangements.

If you choose not to use an auxiliary power source for the DS54, we recommend resistors be installed on all individually operated slow motion turnout machines on the layout. This will increase the power output and insure that the slow motion turnout machines operate reliably and completely. A resistor value of 1.5 k ohm, 1/2 watt is recommended for single slow motion turnout machines. If two slow motion turnout machines are paralleled as shown in ***Figure 10***, 1k ohm, 1/2 watt resistors are recommended. Lower resistor values may be used if track power is set to the N-scale setting on the booster. When paralleling two slow motion turnout machines, always connect the resistors as shown even if you are also using an auxiliary power supply to be sure that both turnouts will operate reliably.

Figure 10: Using One DS54 Output to Control Two Slow Motion Turnout Machines



Either slow motion turnout machine can be hooked up with either polarity to the motor connections (Pins 1 & 8 on the turnout machine). Choose the polarity based on how you want the pair of turnouts to operate. Opposite polarities will let you operate crossovers by sending a single switch command.

6.2 Using Bi-polar Turnout Machines and DC Motors with DS54

To operate properly, bi-polar turnout machines like Kato UniTrack and LGB turnouts require more voltage that the DS54 alone can provide. The DM1 DC Motor Adapter provides a voltage doubler to allow operation of these devices.

DC motors with a current draw of up to 1/2 amp can be run on the layout by using the DM1 and the same steady output that is used for slow motion turnout machines.

To make bi-polar turnouts and DC motors work:

1. Set up one of the DS54's outputs to operate a slow motion turnout machine as described above.
2. Plug a Digitrax DM1 DC Motor Adapter into the DS54 output you set up in step 1. The DM1 acts as a voltage doubler to give enough voltage to operate the bi-polar turnout or DC motor.
3. If you wish to draw the full 1/2 amp load current, connect a 12 to 16V AC/DC transformer to the DS54's auxiliary AC power input. This will provide enough power to run the bi-polar turnout or DC motor.

6.3 Controlling Stationary Lamps with the DS54

The DS54's outputs can control lamps on the layout, too. Each lamp can be set up to be on steady when activated by the throttle or they can be set to blink at a range of rates. For lamp control, program the output type CV for the function cell you are using to a value of x20/032 to x27/039. See **Table II** for the blinking effect caused by each different CV value.

For operating lamps a closed command ("c") turns the lamp ON and a thrown command ("t") turns the lamp OFF.

7.0 Issuing SWITCH Commands With A Digitrax Throttle

Digitrax produces many different throttles that can be used with LocoNet systems. The following instructions will help you learn to operate your DS54s with most Digitrax throttles. If the throttle you are using is not detailed here, please consult your Starter Set Manual or Throttle Manual for complete instructions.

7.1 DT400 Series Throttle

To change the position of a switch or turnout

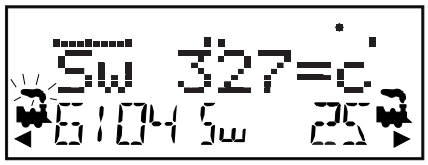
1. Press the SWCH key 

to enter switch mode. When you enter Switch mode, the throttle knobs & direction keys will continue to control the loco addresses running on the throttle. Loco speed will be displayed on the bar graph and loco direction will be displayed on the direction indicators for each throttle. The numeric keypad will be used to enter switch numbers and the OPTN t 

and CLOC c 

Keys are used to tell the switch or turnout in which direction it should operate.
2. The last switch decoder address selected by the throttle is displayed on the text line followed by a "c" or a "t".
3. The LCD indicates the switch position using the c or t as follows:
   "t" indicates that the switch is "thrown" (for a turnout, the diverging route is set)
   "c" indicates that the switch is "closed" (for a turnout, the mainline route is set)

If the "t" or "c" indicator is flashing it means that the LocoNet Command Station does not know the current switch position. A steady "t" or "c" indicates that the command station knows the position of the switch.



This LCD shows a DT400 in Switch Mode

1. **Sw**=Switch Mode
2. **Switch 327** is selected and is in the c (closed) position. .
3. Address **6104 is active** (blinking smoke) on the L throttle
4. Address 6104 is running at **50% speed** (bar graph) in the reverse direction.
5. Address 25 is running on the R throttle at 0% speed in the forward direction.

4. Use the numeric keypad to enter the switch address you want to change
5. Once the desired switch address appears in the text area of the throttle, you will see either “c” or “t” on the right side of the = sign in the display. If the “c” or “t” is flashing, the command station does not know the position for this turnout. Press the OPTN t Key 

to move the switch to the “thrown” position **OR** the CLOC c Key 

to move it to the “closed” position.
6. If the switch selected is a turnout connected to an accessory decoder, it will change position from closed to thrown or vice-versa. If the switch selected is an op switch setting for the command station, the software switch inside the command station will be changed.
7. After commanding the switch “closed” or “thrown” the switch position display will stop flashing, since the command station now knows the current switch position.

Note that the accessory decoders in the system are accessible to all throttles or control devices with switch control capabilities & are not reserved in-use to a single throttle like locomotive decoders.

8. When you have finished Sw (switch) operations, return to Fn (Normal Operating Mode) by pressing the EXIT Key 

or the FUNC Key 

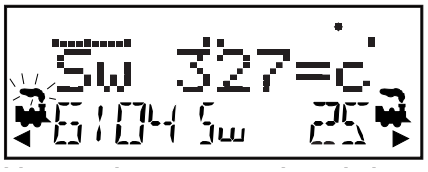
9. The next time you enter Sw mode , the DT400 will remember where you left off & start at the last switch address & position you used.

7.2 DT300 Series Throttle

To change the position of a turnout using a DT300 Series Throttle:

1. Press the MODE Key  until the mode indicator in the center of the bottom line of the DT300's LCD shows Sw.
2. The last switch decoder address selected on the throttle is displayed on the text line followed by a "c" or a "t".
3. The LCD indicates the switch position using the c or t as follows:
   "t" indicates that the switch is "thrown" (for a turnout, the diverging route is set)
   "c" indicates that the switch is "closed" (for a turnout, the mainline route is set)

If the "t" or "c" indicator is flashing it means that the LocoNet Command Station does not know the current switch position.



This display example shows Switch Address Number 327 is in the closed position.

4. Dial up the switch address you want to change by using either throttle knob or the Y +  and N -  Keys. You can also use the L throttle knob to set the 100s and the R throttle knob to set the 1s.
5. Once the desired switch address appears in the test area of the throttle, you will see either "c" or "t" on the right side of the = sign in the display. If the "c" or "t" is flashing, the command station does not know the position for this turnout. Press either the L Reverse Key  to move the switch to the "thrown" position or the R Reverse Key  to move it to the "closed" position.
6. If the switch you selected is a turnout connected to an accessory decoder, it will change position from closed to thrown or vice-versa. If the switch selected in an op switch setting for the DB150 command station, the software switch will be changed.
7. After commanding the switch "closed" or "thrown" the switch position display will stop flashing, since the command station now knows the current switch position.

Note that the accessory decoders in the system are accessible to all throttles or

control devices with switch control capabilities & are not reserved in-use to a single throttle like locomotive decoders.

When Sw (switch) operations are complete, return to Lo (Loco) mode by:

1. Pressing the MODE Key  twice (skipping past MU mode),
2. Pressing down on either throttle knob or
3. Wait for the 6 second no-input inactivity time-out to return the DT300 to the Lo (Loco) default mode.

The next time you enter Sw mode , the DT300 will remember where you left off & start at the last switch address & position you accessed.

7.3 UT Series Throttle

To change the position of a turnout using a UT Series Throttle:

1. Press the "RUN/STOP" and the "OpSw" buttons at the same time to activate "SWITCH" Mode.
2. Use the two rotary selectors on the UT2 to select the turnout address to throw or close (With the UT2 you are limited to a two digit turnout address).
3. The "c" LED will light if the last known state of the turnout selected is the "closed" position.
4. Press "ACQ" to throw or close the turnout.
5. The "c" LED will be dark if the last known state of the turnout selected is the "thrown" position.
6. If the "c" LED flashes on and off, the turnout state is unknown.
7. Return the rotary selector switches to the locomotive address before exiting "Switch Mode". If the locomotive address is not correct the locomotive will be released.
8. Press "RUN/STOP" and "OPSW" at the same time to return to normal operation.

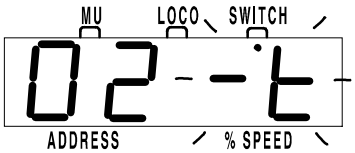
While in "Switch" Mode, you can still control the speed and direction of your locomotive. Functions will also operate normally while in SWITCH Mode.

7.4 DT100 & DT200 Series Throttles

To change the position of a turnout using a D100 or DT200 Series Throttle:

1. Press the **MODE/DISP** key until the **SWITCH** mode indicator is lit in the LCD.
2. The display shows the switch address in the left hand side of the display and the turnout position in the left hand side of the display. You will see a two digit switch address followed by a **-t** or **-c** for thrown

or closed. If this **t** or **c** indicator is flashing it means that the LocoNet command station does not know the current turnout position. This DT 100/200 throttle display example shows switch address 02 is in an unknown position



3. Use either throttle knob or the up and down arrow keys to scan to the switch address that you want to change. DT100s use the three left digits to display the switch address and DT200 throttles use the two left digits to display the switch address.
4. Once you have the desired switch address in the left side of the display, on DT 100/200 throttle you can choose which way to move the turnout by pressing the "**c**" or "**t**" arrow key.
5. After sending the command, turnout closed or thrown, the turnout position display will stop flashing, since the throttle now knows the current turnout position.

When a DCS100 command station is used, the DT100 can read back turnout states. The DT200 & DT100s cannot read back these positions when operating with a DT200 as the command station (Big Boy Set).

Note that the turnouts in the system are accessible to all throttles or control devices with turnout control capabilities & are not reserved *in-use* to a single throttle the way locomotives are.

When you have completed turnout operations, return to **LOCO** mode by pressing the **MODE/DISP** key twice (skipping past MU mode), pressing the **FUNC/FO** key or waiting for the 6 second *no input time out* to return the throttle to the **LOCO** default mode. The next time the **SWITCH** mode is selected, the display will remember & display the last switch address & position selected.

7.5 DT300 & DT400 Series Throttles

To change the position of a switch or turnout

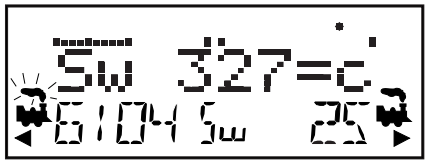
1. Press the SWCH key 

to enter switch mode. When you enter Switch mode, the throttle knobs & direction keys will continue to control the loco addresses running on the throttle. Loco speed will be displayed on the bar graph and loco direction will be displayed on the direction indicators for each throttle. The numeric keypad will

be used to enter switch numbers and the OPTN t  and CLOC c  Keys are used to tell the switch in which direction it should operate.

2. The last switch decoder address selected by your throttle is displayed on the text line followed by a “c” or a “t”.
3. The LCD indicates the switch position using the c or t as follows:
   “t” indicates that the switch is “thrown” (for a turnout, the diverging route is set)
   “c” indicates that the switch is “closed” (for a turnout, the mainline route is set)

If the “t” or “c” indicator is flashing it means that the LocoNet Command Station does not know the current switch position. A steady “t” or “c” indicates that the command station knows the position of the switch.



This LCD shows a DT400 in Switch Mode

1. **Sw**=Switch Mode
2. **Switch 327** is selected and is in the c (closed) position. .
3. Address **6104 is active** (blinking smoke) on the L throttle
4. Address 6104 is running at **50% speed** (bar graph) in the reverse direction.
5. Address 25 is running on the R throttle at 0% speed in the forward direction.

4. Use the numeric keypad or throttle knobs to enter the switch address you want to change
5. Once the desired switch address appears in the text area of the throttle, you will see either “c” or “t” on the right side of the = sign in the display. If the “c” or “t” is flashing, the command station does not know the position for this turnout. Press the OPTN t Key  to move the switch to the “thrown” position **OR** the CLOC c Key  to move it to the “closed” position.
6. If the switch you selected is a turnout connected to an accessory

decoder, it will change position from closed to thrown or vice-versa. If the switch you selected is an op switch setting for your command station, the software switch inside the command station will be changed.

7. After commanding the switch “closed” or “thrown” the switch position display will stop flashing, since the command station now knows the current switch position.

Note that the accessory decoders in the system are accessible to all throttles or control devices with switch control capabilities & are not reserved in-use to a single throttle like locomotive decoders.

8. When you have finished your Sw (switch) operations you can return to Fn (Normal Operating Mode) by pressing the EXIT Key 

or the FUNC Key 

.

9. The next time you enter Sw mode , the throttle will remember where you left off & start at the last switch address & position you accessed.

8.0 Troubleshooting Turnout Operation Problems

Solenoid turnout machine will not operate

Check for incorrect output wiring

1. ***Are the wires in the DS54 cables in the correct order?*** Looking down at the plug you should see yellow, green, red, black from left to right.

2. ***Are the wires connected correctly to the turnout machine?***
   Yellow to the thrown lead
   Green to the common lead
   Red to switch sensor input
   Black to the closed lead.

Slow motion turnout machine operates backwards

See “Solenoid turnout machine will not operate” above

Turnouts don’t have enough power when I issue several commands in sequence.

Add auxiliary AC for better turnout response. This auxiliary AC/DC can be from any transformer with a voltage between 12V & 16V AC/DC. This transformer should be overload protected & only be used with DS54s & not shared with boosters in the system. If you are only sending commands to one solenoid at a time, wait for about 1/2 second between commands and you probably won't need to use the auxiliary AC/DC input. Digitrax PS12 & PS515 are great for this purpose.

Balky solenoid turnouts

If the turnout is balky & does not operate reliably, ***check for mechanical friction or jamming problems***. These mechanical problems must be remedied, for proper operation. If you are still having problems after correcting mechanical issues, a higher voltage might help the solenoid turnout work more reliably. See above info on ***adding auxiliary AC/DC input***.

Turnout position does not correspond to command issued

If the system shows the turnout should be thrown, but the solenoid actually closes the turnout, ***reverse the wiring*** for the solenoid turnout machine. Simply disconnect the plug output lead from the DS54, & reverse the solenoid connections to the black & yellow (outer 2 wires in the flat cable) leads that activate the solenoid. Plug in again & recheck that the turnout position matches that reported by the system.

9.0 DS54 Addresses

Each DS54 can be programmed to access 4 of the 2044 switch addresses accessible with the DS54. Each DS54 has a stationary decoder address (there are 511 stationary decoder addresses). Each stationary decoder address has four consecutive switch addresses associated with the DS54's four outputs. This means that DS54 switch addresses come in groups of 4.

511 Stationary decoder addresses
x 4 Switch addresses
Equals 2044 switch addresses.

For each DS54, OutputA corresponds to the first switch address in an stationary decoder address group. For example, if you program the DS54 to stationary decoder address 02, it will respond to the group of switch addresses 05, 06, 07, & 08, OutputA will be switch address 05, OutputB will be 06, OutputC will be 07, & OutputD will be 08.

Note: The Stationary Decoder Address is actually programmed into CV513.

Since this CV is not accessible by all DCC systems, the DS54 is set up so that lower CVs, starting with CV01 can be used for programming. If you are using a system that does access high CVs, simply add 512 to the CV numbers you see in this manual.

Address Set Up for DS54 BEFORE Installation on Layout:

1. If you are using this method of programming, be sure that the DS54 is not connected to the rest of your layout. It should only be connected to the programming output of the DCS100 or DCS50. If using a DB150, be sure the DS54 is isolated from the rest of the layout.
2. Start with the command station in PROGRAM mode.
3. Move the DS54's CV Program Enable Link so that both pins PA & PB are covered to enable programming.
4. Connect the yellow wire of one of the outputs through a 100ohm resistor to one of the rail terminals on the DS54. *See Figure 7.*
5. Press the address program button on the DS54 you to set up and hold for about 2 seconds.
6. Go into PROGRAM Mode with your throttle. Select PAGED PROGRAMMING. Send a SWITCH command from the throttle using any address in the range of 4 addresses you want to set up for the DS54. The address of the SWITCH command sent will automatically be programmed into your DS54.
7. When you are finished, exit programming mode on your throttle and open the DS54's programming link.

Switch address groups do not have to be used in order. So, if you have just 2 DS54s on your layout, you could program them as follows: DS54 stationary decoder address 07 with switch addresses 25, 26, 27, 28 and DS54 stationary decoder address 15 with switch addresses 53, 54, 55, 56 on the layout.

These examples will get you started:

DS54 outputs & corresponding switch addresses

DS54's 4 function cells respond to DCC commands for these switch addresses

DS54 Stationary Decoder Address	Switch Address-Function Cell A	Switch Address-Function Cell B	Switch Address-Function Cell C	Switch Address-Function Cell D
01	01	02	03	04
02	05	06	07	08
03	09	10	11	12
04	13	14	15	16
05	17	18	19	20

9.1 Changing the Address of a DS54 Installed on the Layout

This procedure lets you change the DS54's stationary decoder addresses and associated group of four switch addresses only. For information about programming other CVs see Section 12 below. This procedure can be used for decoders installed on the layout. Using this procedure, you can change addresses without having to remove the decoder from the layout.

For Switch Addresses 01-252:

1. Turn on DCC track power.
2. Press & hold the **Address Program Button** on the DS54 for 1 second then release it. This will cause the DS54 to accept the next SWITCH command sent from the command station and re-program the DS54's stationary decoder address and its four related switch addresses.
3. Use a throttle to send a SWITCH command to any switch address in the group of four switch addresses that you want to program the DS54 to respond to. You can send either a c or t command.
4. Once the SWITCH command is received, the DS54 decoder returns to normal operating mode.

For Switch Addresses 253 & above:

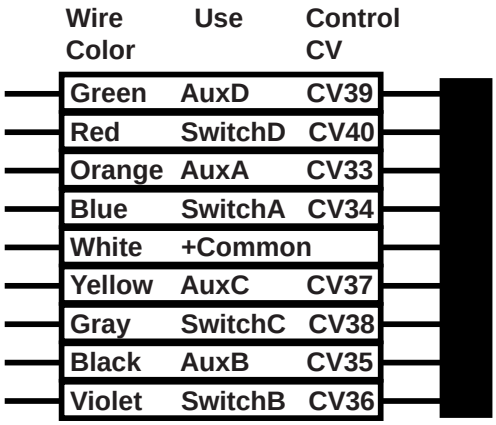
After completing steps 1-4 above,

5. Turn track power off for about 10 seconds, then turn track power back on to complete updating the programming in the DS54. Do this step if you are changing the address of a decoder either to or from an address higher than 252.

10.0 Using DS54 Inputs

The DS54 has 8 inputs that can be used for turnout position reporting, layout automation, occupancy detection, etc. ***Figure 11*** shows how the wires on the Digitrax Standard 9 pin wire harness are used as DS54 inputs. Notice that each function cell A, B, C, & D has two input wires. The 2 input wires for function cell A are called SwitchA input and AuxA input. The 2 input wires for function cell B are called SwitchB input and AuxB input and so on. The white wire on the connector provides the +Common power connection.

Figure 11: DS54 Inputs use Digitrax Standard 9 pin harness as shown here.



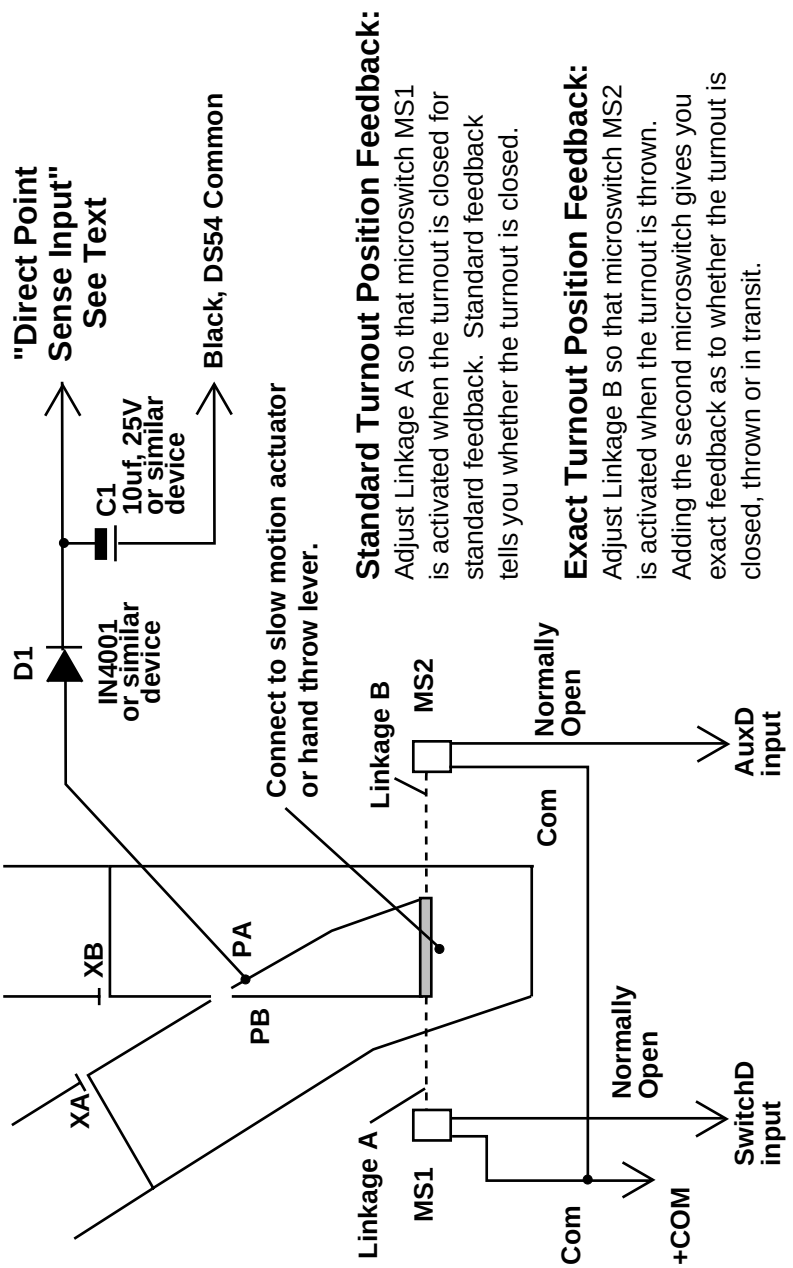
10.1 Standard Turnout Position Reporting

With standard turnout position reporting, the system is set up to report when a turnout is closed. If the turnout is not reporting closed then the system infers that the turnout is thrown.

10.1.1 Wiring for Standard Turnout Position Reporting

Figure 12 shows an example of hooking up standard turnout position reporting with a single microswitch on the red input sensor wire on the DS54 output cable. You could also use the Switch_ input wire from the DS54 9 pin Input connector for this purpose. Do not hook up both the Switch_ input wire and the red sensor input wire at the same time.

Figure 12: Turnout position reporting with DS54



10.1.2 Program DS54 for Standard Turnout Position Reporting

To set up standard turnout position reporting, program the Switch_ input type CV and the Switch_ message type CV.

10.2 Exact Turnout Position Reporting

Exact turnout position reporting uses LocoNet messages that tell the system whether the turnout is thrown, closed, or unsafe/in transit. When using exact turnout position reporting, the system reports that the turnout is unsafe/in transit during the interval between closed and thrown messages.

10.2.1 Wiring for Exact Turnout Position Reporting

Figure 12 shows how to set up a turnout for exact turnout position reporting. In this diagram two microswitches, MS1 and MS2, are used to determine the position of the turnout that is reported to the system. The microswitches are connected to the throw bar of the turnout or to the actuator of the turnout machine. When the turnout is closed, MS1 is in contact with the actuator and the message that the turnout is actually closed is sent to the system. This message can be used to display the turnout position in handheld throttles, on computer throttles or even on LEDs mounted on a layout fascia panel. When the turnout is operated, the second microswitch, MS2, makes contact and another message is sent indicating that the turnout is in the thrown position. While the turnout is in transit, the system will report that the turnout position is not known (and therefor unsafe/in transit)..

When hooking up a DS54 for exact turnout position reporting, follow the convention of using the Switch_ input wire for reporting closed and the Aux_ input wire to report thrown. The message for closed and thrown is sent when the input is activated.

10.2.2 Programming the DS54 for Exact Turnout Position Reporting

To implement exact turnout position reporting, program the Aux_ input message type for exact feedback. The default for the Aux_ input line tells the system that it is not being used for exact feedback reporting. So, you will need to program that information into the DS54. Choose the appropriate Message Type CV for the function cell you are using from **Table V**. From **Table VI**, determine that the CV value for exact position reporting is x8A/138. Program the DS54 to those values.

Note that the SwitchA input associated with OutputA is used & not the AuxA input, *which could have been programmed for the same task*, since both AuxA input & SwitchA input can cause changes to OutputA.

Figure 13: DS54 Hook-Up Example

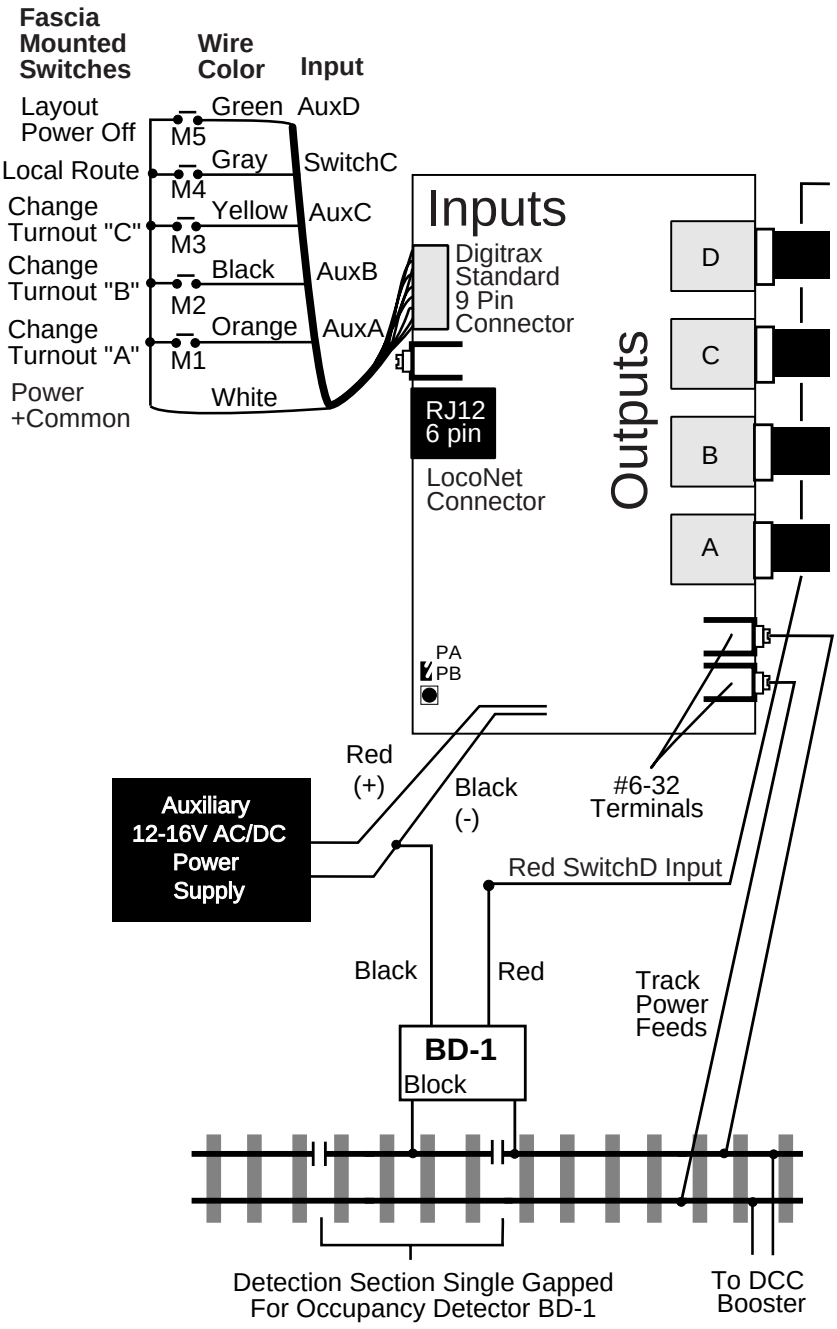
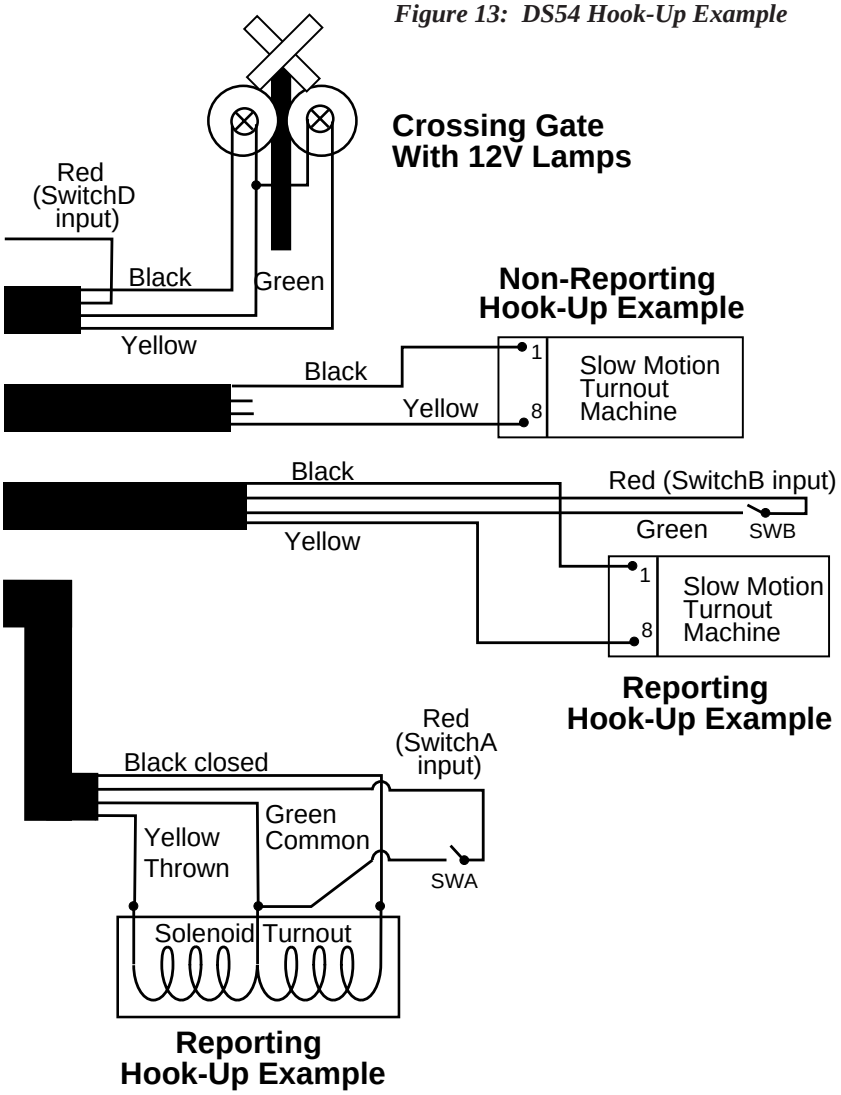


Figure 13: DS54 Hook-Up Example



This DS54 hook up example shows:

OutputD: Automatic crossing gate with BD-1 detector & alternately flashing 12V lamps,

OutputC: Non-reporting slow motion turnout machine,

OutputB: Standard reporting slow motion turnout machine,

OutputA: Standard reporting solenoid turnout machine.

The SwitchA input was used because it is wired into the same 4 wire cable going to the turnout, & is readily available at the solenoid turnout being set up for feedback.

SwitchA input is being used solely to generate a turnout feedback message to LocoNet & is not causing any changes to OutputA. This feedback message will be sent any time SwitchA input sees a change, because a LEVEL type of triggering is used for SwitchA input. Level triggering will cause a trigger on both OFF to ON & ON to OFF input changes. In this way the DS54 will report any time the turnout change from closed to thrown or vice-versa.

Note that this single feedback microswitch, SWA, can only positively report that the turnout is closed & will not report that the turnout is jammed, unsafe or in transit. You can arrange the AuxA input (being used in this example just to toggle OutputA, as a local turnout control) to positively report the thrown position of the turnout.

An example of this *exact* turnout feedback reporting is given in ***Figure 12***. In this case the system can tell that the turnout is positively closed, positively thrown or is "unsafe/in-transit". If you *need* this level of feedback certainty, you can achieve it by using both inputs as shown in ***Figure 12***. When using *exact* position reporting, the system controller or any device on LocoNet can assume the turnout is unsafe in the period between a feedback message saying one of the inputs has changed to OFF (the turnout is moving from a known safe state) & the next feedback message from this switch address showing a positive ON or exact thrown or closed position is seen.

The LocoNet convention for turnout feedback message reporting is that the Switch_ input ON reports a turnout is positively closed. The Aux_ input can be used either as the thrown indicator when ON, or could be used to report the position of a different manual turnout or other device. If you want to use the Aux_ input type for this thrown or exact position reporting, you will need to setup the Aux_ message type for exact feedback. The system controller can infer from this DS54 setting to interpret this meaning, since the default meaning for the Aux_ input is that it is NOT being used as a for exact thrown feedback indication, but is available for independent use, such as reporting on a hand-operated turnout setting or local turnout control.

Figure 12 shows using external turnout contacts (e.g., a microswitch) to indicate to the DS54 the turnout position. It is also possible to place direct contacts on the turnout so that when the points are in the correct position they connect the *Track Power* (DCC packets) via a diode (D1) & capacitor (C1) to the DS54 Switch_ input or Aux_ input line, as a "direct point sense input." This avoids the friction & use of an external microswitch, if a contact is readily made. As also shown in ***Figure 12***, it is possible to isolate the turnout points, PA &

PB and use their connection to either of the powered rails to signal the turnout position. In this method you will need to isolate the two points PA & PB with gaps at XA & XB so the turnout is "non power-routing" (always best with DCC) to the rest of the powered rails. *Be very careful with this method*, since the rail sections PA & PB when set, are only being powered via a small low pressure contact area to the adjacent rail & may not be able to carry the full DCC load current when being jostled by wheels rolling over them.

11.0 DS54 CV Programming Steps

The DS54 can be programmed using a programming track or on the layout after it is installed. **If you choose to program the DS54 after it is installed on the layout, you must remove all DCC equipped locomotives, remove DS54 auxiliary power, disconnect the 9 pin DS54 input plug and all 4 DS54 outputs before you program DS54s.** Because of this, Digitrax strongly recommends that the DS54 be programmed and tested before installation on the layout.

1. Plan how you want to use the DS54. Determine which CVs and CV values you want to program using the tables in this manual. At the end of this manual there are four blank forms that detail all CVs used to control each of the DS54's function cells. Make copies for each DS54 on the layout & use them in planning the CV settings for setting up each function cell of the DS54. Once you know what you want a particular DS54 to do, use the charts provided in this manual to look up the CVs and determine which CV values need to programmed to accomplish your goal. Write them down on the forms and proceed to steps 2-8 below to program the DS54.
2. Move the CV Program Enable Link so that both pins PA & PB are covered to enable programming.
3. Connect the DS54 to the programming track as shown in ***Figure 7*** or if the DS54 is already installed on the layout and you want to program it directly on the layout, remove all DCC equipped locomotives, remove DS54 auxiliary power, disconnect the 9 pin DS54 input plug and all 4 DS54 outputs before programming DS54s.
4. Put the system into programming mode.
5. Follow the instructions for the throttle you are using to select the CV and CV Value to program
6. Repeat step 5 for as many CVs and their CV values as you want to program.
7. When you are finished programming, exit the programming mode.
8. Move the CV Program Enable Link so that only one pin is covered to disable programming mode on the DS54.

12.0 DS54 Basic Configuration Variables and Values

The DS54 has several kinds of configuration variables or CVs that let you set up how the DS54 will operate.

Hexadecimal and decimal notation: In this manual CVs are shown as decimal numbers and CV values are shown as hexadecimal and decimal numbers in the following format x##/###. For example x20/032 means hex 20 or decimal 032. When you use a Digitrax DT100 or DT200 throttle to program CVs the CV values will be displayed on the throttle as hexadecimal numbers. If you are using a DT300 or DT100 you can display the CV values as either hex or decimal numbers. When the numbers are decimal, you will see three digits in the display, when the number displayed is hexadecimal you will see an "x" before the two digits displayed. Please consult the hex to decimal conversion table (**Table XI**)at the end of this manual to translate the hex digits to decimal.

12.1 DS54 Output Type CVs

DS54 Output type CVs determine how the output from each function cell on the DS54 will work. These are the CV numbers associated with each output.

Table I: Output Type CVs: CV03, CV04, CV05, CV06

CV#	Usage	Value range (default x00/000)	Defined by
CV03	Output Type for A	x00-x27/000-039	Table II
CV04	Output Type for B	x00-x27/000-039	Table II
CV05	Output Type for C	x00-x27/000-039	Table II
CV06	Output Type for D	x00-x27/000-039	Table II

Output Type CV Values: The following tables list the CV values that are used to set up the DS54's output types. Decide the type of output you need, find the correct CV number for the output you want to program from **Table I** and the correct CV value for the type you want to set up in **Table II** and program the chosen CV number to the chosen CV value.

Table II: CV03, CV04, CV05, & CV06 Values for setting up the type of output and the duration of the pulse or blink rate for lamps for each function cell A, B, C, & D on the DS54.

CV Value	Output Type	Duration	Use With
x00 (default)	Pulse retriggerable	0.125 sec	Solenoid
x01/001	Pulse retriggerable	0.25 sec	Solenoid
x02/002	Pulse retriggerable	0.35 sec	Solenoid
x03/003	Pulse retriggerable	0.5 sec	Solenoid
x04/004	Pulse retriggerable	0.625 sec	Solenoid
x05/005	Pulse retriggerable	0.75 sec	Solenoid
x06/006	Pulse retriggerable	0.9 sec	Solenoid
x07/007	Pulse retriggerable	1 sec	Solenoid
x08/008	Pulse retriggerable	2 secs	Solenoid
x09/009	Pulse retriggerable	3 secs	Solenoid
x0A/010	Pulse retriggerable	4 secs	Solenoid
x0B/011	Pulse retriggerable	5 secs	Solenoid
x0C/012	Pulse retriggerable	6 secs	Solenoid
x0D/013	Pulse retriggerable	7.5 secs	Solenoid
x0E/014	Pulse retriggerable	10 secs	Solenoid
x0F/015	Pulse retriggerable	12 secs	Solenoid

CV Value	Output Type	Duration	Use With
x10/016	Pulse no-retrigger	0.125 sec	Solenoid
x11/017	Pulse no-retrigger	0.25 sec	Solenoid
x12/018	Pulse no-retrigger	0.35 sec	Solenoid
x13/019	Pulse no-retrigger	0.5 sec	Solenoid
x14/020	Pulse no-retrigger	0.625 sec	Solenoid
x15/021	Pulse no-retrigger	0.75 sec	Solenoid
x16/022	Pulse no-retrigger	0.9 sec	Solenoid
x17/023	Pulse no-retrigger	1 sec	Solenoid
x18/024	Pulse no-retrigger	2 secs	Solenoid
x19/025	Pulse no-retrigger	3 secs	Solenoid
x1A/026	Pulse no-retrigger	4 secs	Solenoid

Table II (continued):

CV Value	Output Type	Duration	Use With
x1B/027	Pulse no-retrigger	5 secs	Solenoid
x1C/028	Pulse no-retrigger	6 secs	Solenoid
x1D/029	Pulse no-retrigger	7.5 secs	Solenoid
x1E/030	Pulse no-retrigger	10 secs	Solenoid
x1F/031	Pulse no-retrigger	12 secs	Solenoid

CV Value	Output Type	Duration	Use With
x20/032	Static	Steady	Slow motion

CV Value	Output Type	Duration	Use With
x21/033	Blinking	0.125 sec	Lamp
x22/034	Blinking	0.25 sec	Lamp
x23/035	Blinking	0.5 sec	Lamp
x24/036	Blinking	1 sec	Lamp
x25/037	Blinking	2 secs	Lamp
x26/038	Blinking	4 secs	Lamp
x27/039	Blinking	8 secs	Lamp
x28/040 through xFF/255	Reserved for future features		

12.2 DS54 Basic CV Programming Example

Set up DS54 Outputs for 1 Solenoid Turnout Machine, 2 Slow Motion Turnout Machines & 1 Crossing Gate with Detector

1. Determine which CVs and CV values you want to program using the tables in this manual.
2. Move the CV Program Enable Link so that both pins PA & PB are covered to enable programming.
3. Connect the DS54 to the programming track or if the DS54 is already installed on the layout and you want to program it directly on the layout, remove all DCC equipped locomotives, remove DS54 auxiliary power, disconnect the 9 pin DS54 input plug and all 4 DS54

outputs before you program DS54s.

4. Put the system into programming mode.
5. Using a throttle, select the CV you want to program.
6. Select the CV value you want to program for the CV.
7. Press the appropriate keys on the throttle to program the CV you selected to the CV value you have chosen.
8. Repeat steps 5 through 7 for as many CVs and their CV values as you want to program.
9. When you are finished programming, exit the programming mode.
10. Move the CV Program Enable Link so that only one pin is covered to disable programming mode on the DS54.
11. Install or reconnect the DS54 on the layout and wire the turnout machines, crossing gate and fascia mounted switches as shown in ***Figure 13***.

Program the DS54's outputs for this example as follows:

A. Set up OutputA as a solenoid with a 1/4 second non-retriggerable output. Table I lists the CVs that determine the output type for each function cell. **Table I** shows that the CV value programmed into CV03 determines the output type for function cell A.
Table II lists the possible CV values and their effects. From **Table II**, a CV value of x11/017 will operate a solenoid turnout machine with a 1/4 second non-retriggerable pulse. Follow the programming steps above to program CV03 to a value of x11/017.

B. Set up OutputB to operate a slow motion turnout machine.
Refer to **Table I** to determine that the output type CV for OutputB is CV04. Refer to **Table II** to determine that CV value that will give the result desired. In this case the CV value is x20/032. Again, follow the steps outlined above to **program CV04 to a value of x20/032**.

C. Set up OutputC to operate a slow motion turnout machine. Refer to Refer to **Table I** to determine that the output type CV for OutputC is CV05. Refer to **Table II** to determine that CV value that will give the result desired. In this case the CV value is x20/032.
Again, follow the steps outlined above to **program CV05 to a value of x20/032.**

D. Set up OutputD to operate a lamp that is blinking with a 1 second duration when the output is turned ON (closed=ON). Refer to **Table I** to determine that the output type CV for OutputC is CV06. Refer to **Table II** to determine that CV value that will give the result desired. In this case the CV value is x24/036.

Again, follow the steps outlined above to **program CV06 to a value of x24/036**.

By programming the 4 Output type CVs (CV03, CV04, CV05 or CV06) you have set up the output types needed for each of the DS54's outputs for this example.

This example is continued in Section 13.3 where programming the inputs on the DS54 is covered.

13.0 Intermediate DS54 CVs

13.1 Trigger/Task Configuration Variables

Each of the 8 DS54 inputs have a CV number that controls how they respond to input signals. The response is defined by a trigger and a task. An input is ON if it is connected to greater than +6 Volts with respect to DS54 negative common line up to a maximum of 20Volts. A voltage from 0 to less than +6 Volts is considered OFF. If an input line is left disconnected it is by definition OFF.

Digitrax recommends programming these CV values in hex as shown here. To program in decimal, compute the hex number and convert it using the conversion table (**Table XI**) at the end of this manual.

Table III: DS54 Input Trigger/Task CV's, CV value ranges & associated wire colors

CV #	Input	Values (00 default)	Input wire color	Pin
CV33	AuxA	x00-xFF	Orange	3
CV34	SwitchA	x00-xFF	Blue	4
CV35	AuxB	x00-xFF	Black	8
CV36	SwitchB	x00-xFF	Violet	9
CV37	AuxC	x00-xFF	Yellow	6
CV38	SwitchC	x00-xFF	Gray	7
CV39	AuxD	x00-xFF	Green	1
CV40	SwitchD	x00-xFF	Red	2
Common Lead			White	5

The trigger/task CV values in hex are made up of two digits. The left digit sets up the trigger conditions that must occur to initiate a task specified by the right digit of the CV value in hex. The right digit sets up the task that will occur when the trigger conditions are met. Once you determine this two digit hex CV

value, program it in to the CV number that controls the input you want to set up.
A negative edge trigger happens when an input changes from OFF to ON. A positive edge trigger happens when an input changes from ON to OFF. A level trigger happens when the input changes from either OFF to ON or from ON to OFF. Triggers can also be set up to be based on the state of the output.

The "#" shown below is a place holder for the other digit of the hex number

TABLE IVA : DS54 Trigger Task CV - Left Digit-Trigger Codes.

Left Digit Trigger Code	Activation	Trigger Event(s)	Type
0#	Input ON	When OFF to ON	Positive Edge
8#	Input OFF	When ON to OFF	Negative Edge
1#	Input ON	Any Input change	Positive Level
9#	Input OFF	Any Input change	Negative Level
2#	Qualified by current Output		Output ON - Positive Edge Output OFF - Negative Edge
3#	Qualified by current Output		If Output ON - Positive Edge If Output OFF - Negative Edge
4#-7#, A#-F#	Reserved		

Trigger values 2# and 3# let you set up conditions where the input trigger polarity depends on the current output direction. This allows a self-indexing turntable to index to a contact switch input point and take account of the direction it is traveling when the index signal is generated. In this case one input can trigger turntable indexing by starting a steady output ON and the other input is used to stop the turntable when it is aligned, by turning *both* steady outputs OFF.

The following task digits are combined with the trigger digit to create the Trigger/Task CV.

TABLE IVB: DS54 Trigger/Task CV – Right Digit-Task Codes

Right Digit Task Code	Task-Meaning	Example Usage
#0	Output Toggle	Manual local turnout control
#1	NO output change	Inputs don't affect output
#2	Output thrown (OFF)	Force output thrown
#3	Output closed (ON)	Force output closed
#4	Both outputs OFF (clear)	Turn OFF DC motor for self indexing turntable
#5	Restore both Outputs to last state	Continue
#6	Execute local route	Make local route manually
#7	Output follows Input, with Output polarity set by trigger polarity	Use for input level following, either polarity
#8-#F	Digitrax reserved	Task expansion

For example, to set up any input for using a BD1 for feedback only, program its associated Input Trigger/Task CV to a value of x91.

13.2 Message Type CVs

When the input Trigger conditions are met, the DS54 can send a number of different messages to LocoNet. These messages are set up by programming Message type CVs. If LocoNet is not operating or disconnected, the DS54 will continue with all its normal tasks and queue all messages till the LocoNet connection is reestablished. A DCC RESET will clear all pending messages. Note that the DS54 device messages are a higher priority than any throttle update, so sensors are always guaranteed fastest access to LocoNet.

Table V: DS54 Message Type CV's

CV #	USAGE: Message Type	Default Code	Defined by
CV41	AuxA Input message	00	Table VI
CV42	SwitchA Input & OutputA change messages	00	Table VI
CV43	AuxB Input message	00	Table VI
CV44	SwitchB Input & OutputB change msgs	00	Table VI
CV45	AuxC Input message	00	Table VI
CV46	SwitchC Input & OutputC change msgs	00	Table VI
CV47	AuxD Input message	00	Table VI
CV48	SwitchD Input and OutputD change messages	00	Table VI

Table VI: DS54 Message Type CV Values

CV Val (hex)	LocoNet Message Sent	Result
x00	Sensor input message	Input treated as general sensor
x01	No LocoNet messages this cell	No messages at all
x02	Turnout feedback message	Inupt is turnout position feedback
x03	Cascaded turnout request	Send cascade turnout request message
x04	System Power ON/Off	Send ON/OFF based on trigger
x05	System STOP/RUN	Send STOP/RUN based on trigger
x06-x09	Digitrax reserved	
x0A**	Exact turnout feedback message	AUX input is exact feedback
x0B-x7F	Digitrax reserved	
x80*	Output state & sensor input message	Output message on output change
x81*	Output state message	Send output message, output changed
x82*	Output state & turnout feedback message	As well as message type defined by lower digit code
x83*	Output state & cascaded turnout request	
x84-x89	Digitrax reserved	
x8A	Exact turnout feedback message	AUX input is exact feedback
x8B-xFF	Digitrax reserved	

Notes for Message type CV Values:
*Note that the output on change message can only be enabled in the CV entry for the Switch_ Input message CV for a particular cell. For example, CV44 can use these x81-x83 CV values to allow output on change messages for cell B (OutputB). For the Aux input lines, message type CV values x80-x83 will not allow output change messages for their cell. *Output on change messages will only be generated if a local input condition within the DS54 has changed the output.*

** The Exact feedback message type only applies to Aux_ inputs (not Switch_ inputs). There is no exact status effect for Switch_ inputs.

The Cascaded Turnout requests refer to an associated pair of CVs, in the range CV57 to CV72, that define a turnout change request to be sent via LocoNet to the system master command station when this input is triggered. This will result in a turnout command being generated and sent to the DCC rails, based on the turnout's switch address and position set up in the input's associated Cascade Turnout request CVs. Note that this switch address could be defined, for example in a command station, as a chain of MU'ed turnouts (or a route) that would then be executed by this "cascade" type message.

Message type CV values x04 and x05 are special codes. Messages type CV values of x04 and x05 can be used to create various system control buttons or external switches, like emergency STOP, POWER ON or POWER OFF, connected via a DS54. They send messages based on the state of the input when the trigger conditions are met.

Message Type x04:
If the Input is ON at trigger, the message will be Power ON
If the Input is OFF at trigger, the message will be Power OFF.

In this case, if the Trigger to be Positive edge (Trig/Task=x0#) is chosen, the Power ON message will be sent if a momentary switch is used on the input to an ON voltage level. In the case of LEVEL trigger input (Trig/Task=x1#) Power On will be sent when the input is ON, and Power OFF will be sent when the input is OFF (unconnected)

Message Type x05:
If the Input is ON at trigger, the message will be STOP (IDLE the layout)
If the Input is OFF at trigger, the message will be START (actually Power ON)

Note that the Task codes that operate on local Outputs and the Message Type codes are independent in operation but are executed by the same input trigger conditions.

LocoNet messages distinguish between Output state message, Feedback message and Sensor Message types. In all cases the DS54 stationary decoder address and 4 related switch addresses of the output or input are contained in the message to uniquely identify the source of the message.

13.3 Programming Example: Trigger/Task & Message Type CVs

Refer to *Figure 13.*

A. Function Cell A

OutputA is used to control a solenoid turnout machine and the associated feedback line is used with a microswitch (SwitchA input) linked to the turnout for reporting (feedback) of the actual turnout position to LocoNet.

SwitchA Input The COM contact on the microswitch is connected to the normally open (N.O.) contact when the turnout is straight-through or closed. The DS54 sees the SwitchA input ON when the turnout is closed. Set up this input so that when the input changes it will trigger a turnout feedback message to be sent to LocoNet.

A Digitrax DCS100 Command Station or computer running LocoNet compatible software can process this LocoNet message and report the turnout position to throttles attached to LocoNet.

AuxA Input Is used with a manual switch M1 which is mounted in the fascia of the layout. When M1 is pressed OutputA will operate the turnout and the SwitchA input line will report the change in turnout position to LocoNet.

To make function cell A work this way, you will need to program the following CVs to the CV Values detailed in the list below. Note that in the first part of this example, you already programmed CV03 to 11 so you can skip to CV33 and begin programming. CV03 is included in this table for completeness.

Set up function cell A to control a solenoid turnout machine with standard turnout position reporting and fascia mounted turnout control button.

CV#	CV Val hex/dec	Usage	Effect	Comment
CV03	x11/017	Output type for A	Non-retriggerable 0.25 second pulse for solenoid	Setup for solenoid turnout on OutputA
CV33	x00/000	AuxA input Trig/task	Change OutputA when switch M1 pressed	Local OutputA control
CV34	x11/017	SwitchA input Trig/task	Trigger on level, no output task-message only	OutputA feedback
CV41	x01/001	AuxA input message type	No messages sent	SwitchA input reports feedback
CV42	x02/002	SwitchA message type	Send OutputA feedback message	OutputA feedback message

In this example, the SwitchA input associated with OutputA is used instead of the AuxA input. The AuxA input *could have been programmed for the same task*, since both AuxA input & SwitchA input can cause changes to OutputA. The SwitchA input was used in this example because it is wired into the 4 wire cable going to the turnout and is readily available at the solenoid turnout being set up for feedback.

In this example the SwitchA input is used only to generate a turnout feedback message to LocoNet & is not set up to cause any changes to OutputA. This feedback message will be sent any time SwitchA input sees a change, because a level type of triggering for SwitchA input has been chosen. Level triggering will cause a trigger when either OFF to ON or ON to OFF input changes occur. With level triggering the DS54 will report any time the turnout change from closed to thrown or vice-versa.

This single feedback sensor switch, SWA, can only positively report that the turnout is closed. It can not report that the turnout is jammed, unsafe or in transit.

In this example the AuxA input is used to operate the turnout attached to OutputA from a manual switch mounted in the fascia panel. This allows for the turnout to be operated either from the manual switch or from the throttle.

B. Function Cell B

OutputB is used to control a slow motion turnout machine with a turnout feedback sensor microswitch, SWB.

SwitchB Input The COM contact on the microswitch is connected to the normally open (N.O.) contact when the turnout is straight-through or closed. The DS54 sees the SwitchB input line ON when the turnout is closed. Set up this input so that when the input changes it will trigger a turnout feedback message to be sent to LocoNet.

AuxB Input Is used with a manual switch M2 which is mounted in the fascia of the layout. When manual switch M2 is pressed Output B will operate the turnout and the SwitchB input line will report the change in turnout position to LocoNet.

To make function cell B work this way, program the following CVs to the CV Values detailed in the list below. Note that in the first part of this example, you already programmed CV04 to x20/032 so you can skip to CV35 and begin programming. CV04 is included in this table for completeness.

Set up function cell B to control a slow motion turnout machine with standard turnout position reporting and fascia mounted turnout control button.

CV#	CV Val hex/dec	Usage	Effect	Comment
CV04	x20/032	Output type for B	Steady output type	Setup for slow motion OutputB
CV35	x00/000	AuxB input Trig/task	Change OutputB when switch M2 pressed	Local OutputB control
CV36	x11/017	SwitchB input Trig/task	Trigger on level, no output task - message only	OutputB feedback
CV43	x01/001	AuxB input message type	No messages sent	SwitchB input reports feedback
CV44	x02/002	SwitchB message type	Send OutputB feedback message	OutputB feedback message

C. Function Cell C

OutputC is set up to control a slow motion turnout machine without turnout feedback.

SwitchC Input the red wire in the DS54 output cable is not connected

AuxC Input is used with a manual switch M3 which is mounted in the fascia of the layout. When M3 is pressed OutputC will operate the turnout.

Set up function cell C to control slow motion turnout machine with no turnout position reporting and a fascia mounted turnout control button.

CV#	CV Val hex/dec	Usage	Effect	Comment
CV05	x20/032	Output type for C	Steady output	Setup for OutputC Slow Motion type
CV37	x00/000	AuxC input Trig/task	Change OutputC when switch M3 pressed	Local OutputC control
CV38	x06/006	SwitchC input Trig/task	Trigger on edge, generate local route	Local Route from switch M4
CV45	x01/001	AuxC message type	No messages sent	No feedback
CV46	x81/129	SwitchC message type	Output change message only	Update turnout output state only

For OutputC, a positive feedback turnout input is not being used, but a message can still be sent to LocoNet indicating that OutputC has changed state. This can be done with either the AuxC local control input or if the Local Route triggered (on SwitchC input) changes OutputC. In this case, the LocoNet device tracking turnout states will mark the turnout in a known Output state, but *without positive feedback*. If there is a command over the DCC rails that changes OutputC, there will be NO messages triggered, since it is NOT a Local input event & the

LocoNet Master Command station issued the request & hence knows the intended turnout position. Note that with CV54, OutputD was not included in the local route and A was set to closed and B & C were set to thrown when manual switch M4 is pressed. To make this work, program the following CVs and CV Values.

CV#	CV Val hex/dec	Usage	Effect	Comment
CV53	x00/000	AuxC Local Route	None	Not used for Route
CV54	x71/113	Switch C Input	Include Outputs Route A+B+C, Not D	OutputA Local closed, B+C thrown

D. Function Cell D

OutputD is used as an automatic crossing gate controller with occupancy detection.

SwitchD Input is used to monitor a Digitrax BD1 occupancy detector.

AuxD Input is used with a fascia mounted manual switch M5 that is set up to shut off layout power.

Set up function cell D as an automatic crossing gate controller with block detection and a fascia mounted manual switch to shut layout power off.

CV#	CV Val hex/dec	Usage	Effect	Comment
CV06	x24/036	Output type for D	Blinking (alternating) output at 1 second period	Setup for lights for crossing gate
CV39	x80/128	AuxD input Trig/task	Power OFF when M5 pressed, Negative Edge	Emergency Power OFF
CV40	x17/023	SwitchD input Trig/task	Trigger on level, have output D ON if BD1 is ON	Block detector link to crossing gate lights
CV47	x04/004	AuxD message type	Send power off message when AuxD goes OFF	Press & release M5 for power OFF
CV48	x00/000	SwitchD message type	Send sensor message from block detector	For signal system & CTC panels

The D output type is configured to operate as a blinking output when the output is ON (closed). The Trigger/Task configuration for the SwitchD input is setup to turn OutputD ON (lights blink) when the occupancy detector is ON, showing a locomotive is occupying the protected detection section. If OutputD should be OFF (non-blinking) when SwitchD input is ON (BD1 detection section occupied), change the Trigger to Negative Level, i.e., CV40=x97/151, to give the output sense a reversed meaning.
In this example, a DCC command for OutputD to be closed or ON will remote-

ly start the signal lights flashing & the thrown or OFF command will turn OFF the signal lights.

Set up the SwitchD input to generate a LocoNet sensor message when it detects that the detection section is occupied (ON) & *also* when the detection section becomes unoccupied (OFF), this results from the Trigger being set for level type (both changes). This ensures the system will be updated as to the current state, occupied or not-occupied, of the occupancy detector.

13.4 Using a Digitrax BD1 Occupancy Detector

The Digitrax BD1 has internal "anti-chatter filtering" to ensure that when the locomotive *crosses the gap* into the detected section, the uncertainties of where it is picking up track power from are filtered out. The occupancy detector will only operate (ON) when the locomotive (or current load) *is inside the detected section and there are no shorts across the isolation gaps.*

The BD1 is a high sensitivity occupancy detector designed for DCC operations, and needs a maximum resistance across the tracks of 15 K ohms to operate ON properly. Naturally, you should NOT connect any other devices or loads *across the detection section that you wish the BD1 to report occupancy status of*, otherwise the BD1 will not be able to report OFF or “clear”.

The thin black wire on the BD1 be attached only to the heavy black DS54 common wire. The thin red wire from the BD1 should be attached to the DS54 input lead chosen for the task. The short heavy leads of the BD1 are connected to carry the track current from a powered track section INTO the detection section where the detection rail has been *gapped at both ends of just one of the rails*. For correct operation it is important that the heavy lead marked "Block" be connected to the isolated rail of the detection section. To lower the sensitivity of the BD1 occupancy detector, you can connect a 1/4 watt resistor in the range of 47 ohms to 1K ohms across the BD1's heavy input leads, the exact value can be determined by trial for the sensitivity you desire. The output of the BD1 can be checked with a regular DC voltmeter. If the BD1 red wire is over +6 volts with respect to the black wire, the detection section will be reported as occupied or "ON". You can put a 10K 1/4 watt resistor across the detection section to verify that it is working correctly, when the voltmeter is connected and the BD1 black and red leads are correctly connected to a DS54.

Figure 14 shows how multiple detection sections can be handled by a single BD1 to automate a more complex version of an automatic crossing gate. In this example, red LEDs are used as the crossing gate lights. Two diodes, D1 and D2, are used to energize a solenoid to operate the gate and operate a sound module from the output voltage when the lights are flashing.

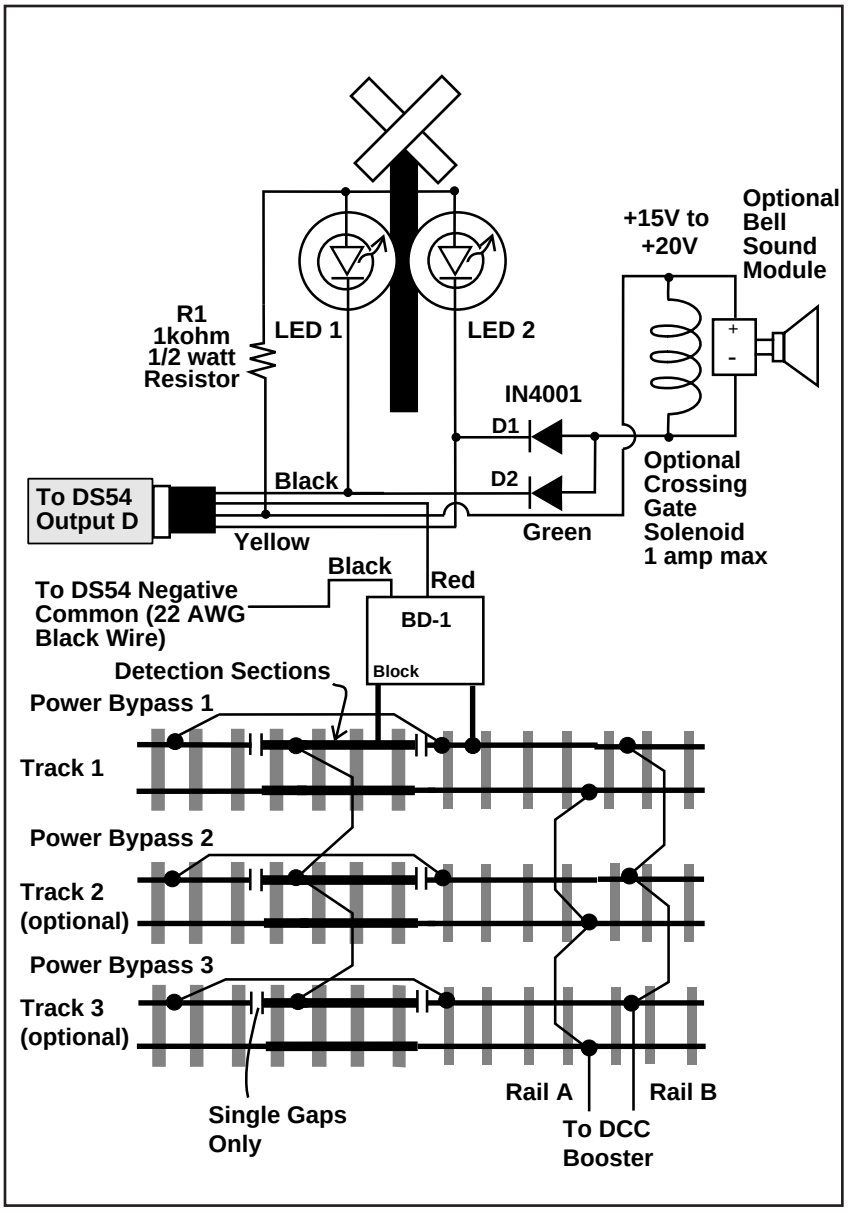


Figure 14: Automatic crossing gate with multiple detection sections

14.0 Route Control CVs (Advanced)

14.1 Local Route Control CVs

A **Route** can be set up by linking stationary decoders together so that they perform several operations based on a single command sent from the command station. It is sort of like “consisting” turnouts. A **Local Route** is one that is handled by a single DS54 without intervention from the command station.

Any DS54 input can be set up to generate a local route. A local route is a task that can include any or all of a particular DS54’s 4 function cells and define the settings these function cell outputs will have when that route is operated.

Table VII: DS54 Local Route CV's

CV#	Local Route Set up for
CV49	AuxA input
CV50	SwitchA input
CV51	AuxB input
CV52	SwitchB input
CV53	AuxC input
CV54	SwitchC input
CV55	AuxD input
CV56	SwitchD input

The outputs that are included in a local route are set up in the left digit of the CV value programmed into the Local Route Set up CV. For any cell or cells that are included in the route by the left digit, the right digit of the CV value controls whether the output will be in the closed (ON) or thrown (OFF) position when the route is activated. The left (inclusion) and right (position) digits are combined to form the CV value in hex to program into the Local Route Set up CV.

The local route will be executed when the trigger condition for this input line has been met. It is sensible to only trigger a local route on an edge and not a level trigger condition since the route is executed as a fixed predefined pattern, and having 2 successive activations on a single momentary key press is redundant.

When programming these values, Digitrax recommends that you use hex numbers. Alternately, you can compute the hex number and use the conversion table (**Table XI**) to determine the decimal value to program.

Table VIIIA: DS54 Local Route Set up
CV Value: Left Digit Function
Cells Included in Local Route

Left Digit	Function Cells/Outputs included in Local Route
0#	none
1#	A
2#	B
3#	A+B
4#	C
5#	A+C
6#	C+B
7#	A+B+C
8#	D
9#	D+A
A#	D+B
B#	D+A+B
C#	D+C
D#	D+C+A
E#	D+B+C
F#	D+C+B+A

In **Table VIIIA** the "#" is a place holder that will be filled in with the right digit that determines turnout position from **Table VIIIB**.

Table VIIIB: DS54 Local Route Set Up CV
Right Digit Turnout Position Control

Right Digit	Enabled Cells/Outputs in Route to Set ON/CLOSED. (Un-named are made OFF/THROWN)
#0	none (all OFF/THROWN)
#1	A
#2	B
#3	A+B
#4	C
#5	A+C
#6	C+B
#7	A+B+C
#8	D
#9	D+A
#A	D+B
#B	D+A+B
#C	D+C
#D	D+C+A
#E	D+B+C
#F	D+C+B+A (all ON/CLOSED)

In **Table VIIIB** the "#" is a place holder that will be filled in with the left digit that determines turnout position from **Table VIIIA**.

Table IX: Cascade Turnout Request Message CV's

CV Number	Use	Default	Range (hex)
CV57	AuxA Cascade Control	00	xB0 or x90 or x00
CV58	AuxA Cascade Address	00	x00-x7F
CV59	SwitchA Cascade Control	00	xB0 or x90 or x00
CV60	SwitchA Cascade Address	00	x00-x7F
CV61	AuxB Cascade Control	00	xB0 or x90 or x00
CV62	AuxB Cascade Address	00	x00-x7F
CV63	SwitchB Cascade Control	00	xB0 or x90 or x00
CV64	SwitchB Cascade Address	00	x00-x7F
CV65	AuxC Cascade Control	00	xB0 or x90 or x00
CV66	AuxC Cascade Address	00	x00-x7F
CV67	SwitchC Cascade Control	00	xB0 or x90 or x00
CV68	SwitchC Cascade Address	00	x00-x7F
CV69	AuxD Cascade Control	00	xB0 or x90 or x00
CV70	AuxD Cascade Address	00	x00-x7F
CV71	SwitchD Cascade Control	00	xB0 or x90 or x00
CV72	SwitchD Cascade Address	00	x00-x7F

14.2 Cascade Turnout Control Messages

A **Cascaded route** is the operation of one or more turnouts by a function cell when it sends a request for the command station to initiate the required action.

Cascade turnout control messages can be set up to be sent to LocoNet when the input trigger condition is met for any of the DS54's 8 input lines. These messages are controlled by a pair of CVs, the Cascade Control CV and the Cascade Address CV as follows:

Cascade Control CV: this CV has 3 valid CV values-xB0, x90, or x00. All other values are reserved by Digitrax for future expansion.

Table X: Cascade Control CV's

Value	Meaning
x00/000	Cascade Turnout message disabled (default)
xB0/176	Change Cascade turnout number to CLOSED (ON)
x90/144	Change Cascade turnout number to THROWN (OFF)

Cascade Address CV: This CV has a valid range of x00 to x7F. This number is the hexadecimal value of the (Turnout number -1). e.g Turnout number 1 would have a Cascade address of x00. See **Table XI** for Decimal to hexadecimal conversions

15.0 Reading Back CVs and CV Values

If you use a programming track and device, like a DCS100 or PR1, that can read back CVs and their values, you can place the Program Enable Link in the closed position and hook up a Program Read Back Adapter as shown in ***Figure 7***. The Program Read Back Adapter consists of a 120 ohm 2 watt resistor connected to the yellow and black leads of one of the DS54's outputs. The other end of the resistor is connected to one of the programming track rails; it doesn't matter which one. (If you still have the resistor from the test kit that was included in your starter set, you can use it for this purpose. You can also use a 12V 5W automotive lamp instead of the resistor.)

Follow your system manual's instructions for reading back CVs and their values.

16.0 DS54 Troubleshooting Instructions

Be sure you understand how to do CV programming with the throttle you are using. CV values shown are 00 or 000 for decimal and x00 for hex. Read your manual carefully to be sure you are using the appropriate values when programming the DS54.

DT100 & DT200 throttles do not support decimal.

DT300 & DT400 throttles default to decimal but you can toggle between decimal and hex by clicking the right knob. You know you are in hex mode if the display shows the value with an "x" prefix like "x00". As you click the right hand knob, it toggles the value displayed as hex and decimal.

Before you contact our tech support department or send your DS54 back to be repaired, please do the following to make sure your DS54 is not functioning properly.

1. Reset your DS54 to the default values

2. If you command station supports CV readback, you can check the CV values programmed but simply reading back CV values does not reset the values. Note: reading CV03-06 will display two different values depending weather the switch is closed or thrown. Closed "default" is 00/x00 for solenoids and 32/x20 for static output. The thrown value is 128/x80 for solenoids and 160/xA0 for static output.

CV01(Ad):01	The value is the address and is always decimal.(only DT100 and DT200 use hex for address 100 to 127)
03:00 to 06:00	Configured default value for solenoids. For slow switch-motor operation use a value of 32/x20
33:00 to 40:00	These CVs are used for Input Trigger/Task configuration
41:00 to 48:00	These CVs are used for Message Type configuration
49:00 to 56:00	These CVs are used for Local Route configuration
57:00 to 72:00	These CVs are used for Cascade Turnout Request Message configuration

Once all of these CVs are reset to the default CV values, the DS54 should operate as a new one out of the box.

If you need to reset your DS54 and know which group of CVs you actually used, a reset of these CVs might be sufficient to recover the DS54. In any case to be absolutely sure, reset them all.

If you are able to get your DS54 back to defaults and it is operating properly, you can begin customizing the DS54 again by programming its CVs. Be sure to review the CVs and values programmed before you begin to avoid problems.

Table XI: Decimal to Hexadecimal Conversion Chart

DEC	HEX	DEC	HEX	DEC	HEX	DEC	HEX	DEC	HEX	DEC	HEX	DEC	HEX
00	00	39	27	78	4E	117	75	156	9c	195	c3	234	EA
01	01	40	28	79	4F	118	76	157	9d	196	c4	235	Eb
02	02	41	29	80	50	119	77	158	9E	197	c5	236	Ec
03	03	42	2A	81	51	120	78	159	9F	198	c6	237	Ed
04	04	43	2b	82	52	121	79	160	A0	199	c7	238	EE
05	05	44	2c	83	53	122	7A	161	A1	200	c8	239	EF
06	06	45	2d	84	54	123	7b	162	A2	201	c9	240	F0
07	07	46	2E	85	55	124	7c	163	A3	202	cA	241	F1
08	08	47	2F	86	56	125	7d	164	A4	203	cb	242	F2
09	09	48	30	87	57	126	7E	165	A5	204	cc	243	F3
10	0A	49	31	88	58	127	7F	166	A6	205	cd	244	F4
11	0b	50	32	89	59	128	80	167	A7	206	cE	245	F5
12	0c	51	33	90	5A	129	81	168	A8	207	cF	246	F6
13	0d	52	34	91	5b	130	82	169	A9	208	d0	247	F7
14	0E	53	35	92	5c	131	83	170	AA	209	d1	248	F8
15	0F	54	36	93	5d	132	84	171	Ab	210	d2	249	F9
16	10	55	37	94	5E	133	85	172	Ac	211	d3	250	FA
17	11	56	38	95	5F	134	86	173	Ad	212	d4	251	Fb
18	12	57	39	96	60	135	87	174	AE	213	d5	252	Fc
19	13	58	3A	97	61	136	88	175	AF	214	d6	253	Fd
20	14	59	3b	98	62	137	89	176	b0	215	d7	254	FE
21	15	60	3c	99	63	138	8A	177	b1	216	d8	255	FF
22	16	61	3d	100	64	139	8b	178	b2	217	d9		
23	17	62	3E	101	65	140	8c	179	b3	218	dA		
24	18	63	3F	102	66	141	8d	180	b4	219	db		
25	19	64	40	103	67	142	8E	181	b5	220	dc		
26	1A	65	41	104	68	143	8F	182	b6	221	dd		
27	1b	66	42	105	69	144	90	183	b7	222	dE		
28	1c	67	43	106	6A	145	91	184	b8	223	dF		
29	1d	68	44	107	6b	146	92	185	b9	224	E0		
30	1E	69	45	108	6c	147	93	186	bA	225	E1		
31	1F	70	46	109	6d	148	94	187	bb	226	E2		
32	20	71	47	110	6E	149	95	188	bc	227	E3		
33	21	72	48	111	6F	150	96	189	bd	228	E4		
34	22	73	49	112	70	151	97	190	bE	229	E5		
35	23	74	4A	113	71	152	98	191	bF	230	E6		
36	24	75	4b	114	72	153	99	192	c0	231	E7		
37	25	76	4c	115	73	154	9A	193	c1	232	E8		
38	26	77	4d	116	74	155	9b	194	c2	233	E9		

The following four forms detail all CVs used to control each of the DS54's function cells. Use them in planning the CV settings for setting up each function cell of the DS54. Once you know what you want the DS54 to do, look up the CVs and their values that you need to program in this manual. Write them down here, program the decoder on the programming track, test the decoder and then install the decoder on the layout.

DS54#_____ Function Cell A Turnout Address_____
Description of set-up:

_____
_____
_____

CV#	CV Value	Use	Desired Effect/Comments
CV03		Output type	
CV33		AuxA input Trigger/task	Trig
			Task
CV34		SwitchA Trigger/task	Trig
			Task
CV41		AuxA message type	Msg type
			Output msg?
CV42		SwitchA message type	Msg type
			Output msg?
CV49		AuxA	Local route in A
			ON/Closed A
CV50		SwitchA	Local route set up in A
			On/Closed A
CV57		AuxA Cascade Control	Cascade effect
CV58		AuxA Cascade Address	Turnout # (hex value is #-1)
CV59		SwitchA Cascade Control	Cascade effect
CV60		SwitchA Cascade Address	Turnout # (hex value is #-1)

DS54#_____ Function Cell B Turnout Address_____
Description of set-up:

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CV#	CV Value	Use	Desired Effect/Comments
CV04		Output type	
CV35		AuxB input Trigger/task	Trig
			Task
CV36		SwitchB Trigger/task	Trig
			Task
CV43		AuxB message type	Msg type
			Output msg?
CV44		SwitchB message type	Msg type
			Output msg?
CV51		AuxB	Local route in B
			ON/Closed B
CV52		SwitchB	Local route set up in B
			On/Closed B
CV61		AuxB Cascade Control	Cascade effect
CV62		Aux B Cascade Address	Turnout # (hex value is #-1)
CV63		Switch B Cascade Control	Cascade effect
CV64		Switch B Cascade Address	Turnout # (hex value is #-1)

DS54#_____ Function Cell C Turnout Address_____
Description of set-up:

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_____

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CV#	CV Value	Use	Desired Effect/Comments
CV05		Output type	
CV37		AuxC input Trigger/task	Trig
			Task
CV38		SwitchC Trigger/task	Trig
			Task
CV45		AuxC message type	Msg type
			Output msg?
CV46		SwitchC message type	Msg type
			Output msg?
CV53		AuxC	Local route in C
			ON/Closed C
CV54		SwitchC	Local route set up in C
			On/Closed C
CV65		AuxC Cascade Control	Cascade effect
CV66		AuxC Cascade Address	Turnout # (hex value is #-1)
CV67		SwitchC Cascade Control	Cascade effect
CV68		SwitchC Cascade Address	Turnout # (hex value is #-1)

DS54#_____ Function Cell D Turnout Address_____
Description of set-up:

_____
_____
_____

CV#	CV Value	Use	Desired Effect/Comments
CV06		Output type	
CV39		AuxD input Trigger/task	Trig
			Task
CV40		SwitchD Trigger/task	Trig
			Task
CV47		AuxD message type	Msg type
			Output msg?
CV48		SwitchD message type	Msg type
			Output msg?
CV55		AuxD	Local route in D
			ON/Closed D
CV56		SwitchD	Local route set up in D
			On/Closed D
CV69		AuxD Cascade Control	Cascade effect
CV70		AuxD Cascade Address	Turnout # (hex value is #-1)
CV71		SwitchD Cascade Control	Cascade effect
CV72		SwitchD Cascade Address	Turnout # (hex value is #-1)

17.0 Warranty and Repair Information

DS54

One year guarantee on DS54. See www.digitrax.com for current warranty policies and procedures. These units are not user serviceable. If a defect occurs, return the unit to Digitrax for service. Digitrax will repair or replace DS54s at our discretion at no charge to you for one year from purchase date. This warranty excludes damage due to abuse, such as failure to properly protect against input over current with a fuse or circuit breaker or applying excessive input voltage to the unit. We will make any repair needed because of physical damage or electrical abuse at fair and reasonable rates.

All warranties on Digitrax products are limited to refund of purchase price or repair or replacement of Digitrax products at the sole discretion of Digitrax. In the event that Digitrax products are not installed or used in accordance with the manufacturer's specifications, any and all warranties either expressed or implied are void. Except to the extent expressly stated in this section, there are no warranties, express or implied, including but not limited to any warranties of merchantability or fitness for a particular purpose.

Digitrax, Inc. reserves the right to make changes in design and specifications and/or to make additions or improvements in its products without imposing any obligations upon itself to install these changes, additions or improvements on products previously manufactured.

FCC Information

Radio or TV Interference: (this information is MANDATED by the FCC)

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

-Reorient or relocate the receiving antenna.
-Increase the separation between the equipment and the receiver.
-Connect the equipment into an outlet on a circuit different form that to which the receiver is connected.
-Consult the dealer or an experienced radio/TV technician for help.

Note that any modifications to the equipment not expressly approved by Digitrax voids the user's authority to operate under and be in compliance with CFR 47 rules, as administered by the Federal Communication Commission. Digitrax believes any conscientiously installed equipment following guidelines in this manual would be unlikely to experience RFI problems.