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The Hare REV A
An Intelligent, Plug n Play, Accessory Decoder for the Tortoise Switch Machine
Patent Pending

Designed by Larry Maier, Developed by DCC Specialties

The need for a more flexible accessory decoder for the Tortoise has inspired this smart DCC accessory decoder for the Tortoise called "The Hare". Unlike the slow Tortoise, The Hare is a high speed solid state electronic device with built in smart features, intelligent control and is compatible with all DCC Systems that support Accessory control.

Plugs Directly on to Tortoise, simplifies wiring, reduces failures.

Auto Throw™, feature automatically throws points when a train is approaching against the points!

Smart Route™, feature sets up to 13 routes by simple address programming in addition to the primary decoder address.

Smart Default Ops™, allows all Hare controlled turnouts to move to a pre-determined position when layout is powered up or remain as last thrown.

Operate Signals, or Panel LED Indicators also Manual Push Button Control Option.

System Reset, by simple programming, resets to defaults.

DC, Direct Current Ops, the Hare will operate on DC using Manual Push Button Control Option
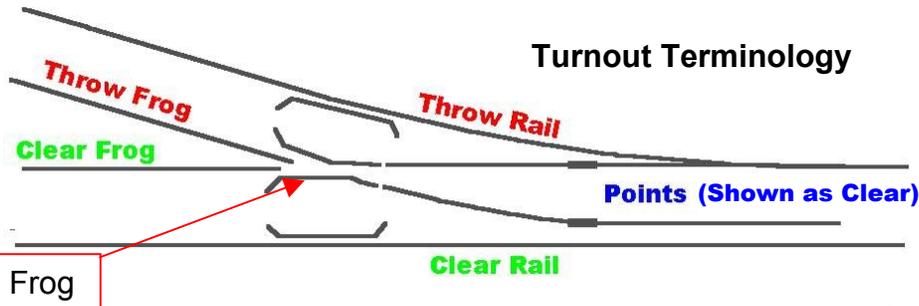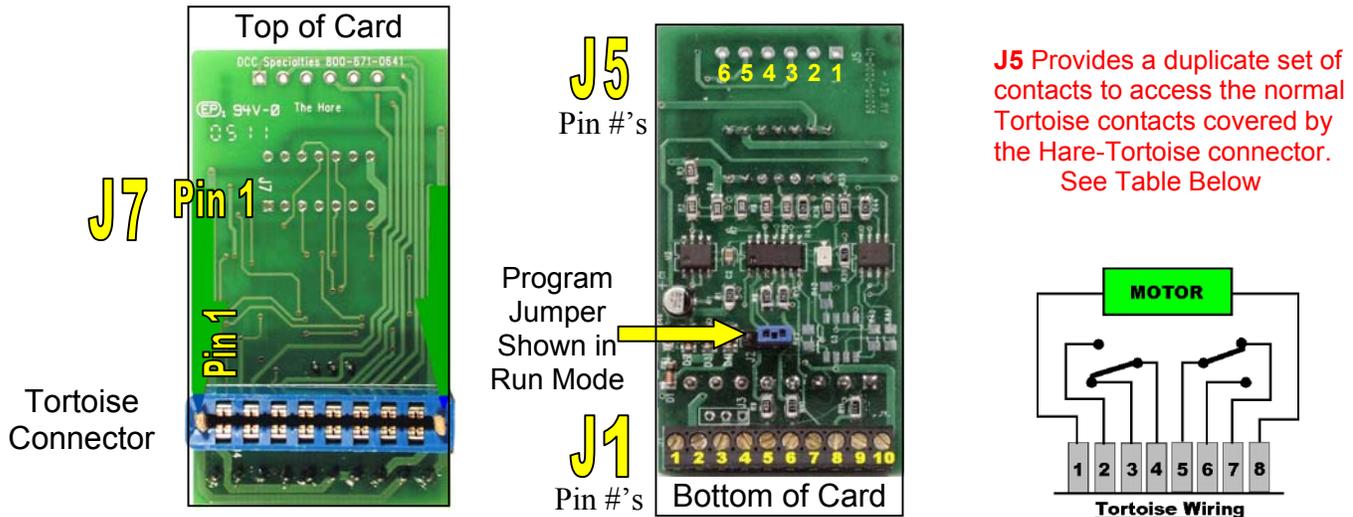
Automates Reverse Loop Turnouts.

A) Quick Start:

You can proceed directly to Step (1)-(3), below for a "Quick Test" of Operation.
This will show you how simple it is to install the *Hare* and operate on DCC!

1) Install the *Hare* on the Tortoise: See Pg-6, Fig-1

2) Connect DCC Power to screw terminals, 1, 2 of J1. Caution, connecting power to other terminals will damage HARE!

3) Test your DCC setup by operating, use default address, 1 for this test.

B) The Hare at a Glance:

Top of Card

J5

Pin #'s

J7 Pin 1

Pin 1

Tortoise Connector

Program Jumper Shown in Run Mode

J1

Pin #'s

Bottom of Card

J5 Provides a duplicate set of contacts to access the normal Tortoise contacts covered by the Hare-Tortoise connector. See Table Below

MOTOR

1 2 3 4 5 6 7 8

Tortoise Wiring

Turnout Terminology

Throw Frog

Throw Rail

Clear Frog

Points (Shown as Clear)

Clear Rail

Frog

Normally Plugged

Tortoise Pin # Normally	Hare J5 Pin #	Tortoise Pin # Reversed
2	6	7
3	5	6
4	4	5
5	3	4
6	2	3
7	1	2

Normally and Reverse plugged define the respective *Hare* JP5 pin numbers corresponding to the Tortoise contacts.   See Pg-6

Reverse Plugged

It is OK to mate The Hare to The Tortoise with the card edge connector mounted in the reverse direction (i.e. Tortoise pin 8 to Hare pin 1) if this is required due to space limitations. We recommend that you avoid this if possible, but if it is necessary you must then reverse all of the programming directions for CV49.

C1) Basic, Run on DCC using only DCC Throttle Control:

1) Before starting you need to understand and determine the following to use all the *Hare's* features.

A   Switch Position: Which way is the **Clear** route thru the turnout? The Hare has to know how it is plugged into the Tortoise and how theTortoise is oriented to the Turnout. For the primary address CV49 determines this, see Tortoise pictures and Switch Positions below.
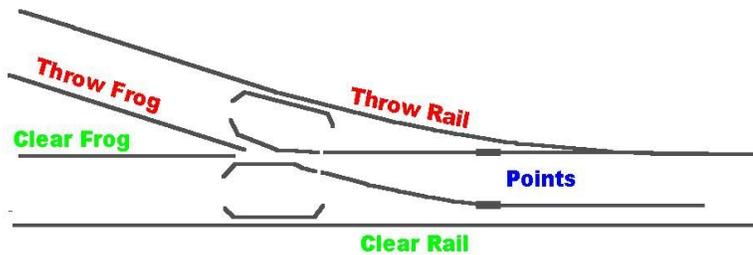
Turnout Terminology

Points shown are for **Clear** route

B Turnout Frog Type: Is the turnout Frog an **Insulated** type, (sometimes called Insul-Frog) or a **Solid** Frog (also known as Electro Frog). The Frog Types have different connections for the **Auto Throw** feature.

C Turnout Address: What will the turnout address be when programmed? Range 2-2044, do not use 1. It is the Default Address and all un-programmed *Hares* will respond to one (1)

Switch Positions and CV49

Determine which direction the Tortoise actuator arm is positioned when the path is set for the **Clear** operating path, see picture below. The chart on page 9-10 can be used as an aid in setting up the primary and route addresses when you determine the switch positions you want. If you make a mistake, don't worry, the turnout will work opposite to the command you have issued and is easy to re-program CV49. See also, Pg 7

The Two Switch Positions are Clear, the other position is Thrown.
We will use **Clear** or **Thrown** for these instructions.

The Table below shows how the DCC Manufactures identify Clear and Thrown

System	Clear (Hare)	Thrown (Hare)
Digitrax	**c** or Closed	**t** or Thrown
Lenz	**+**	**-**
MRC	ON	OFF
NCE	Normal/ON/ **1**	Reverse/OFF/ **2**

2) Install the *Hare* on the Tortoise: See Pg-6, Fig-1

3) Connect DCC Power to screw terminals, 1, 2 of J1.
Caution, connecting power to other terminals will damage HARE!

4) Test your DCC setup by operating, use default address, 1

5) Program Primary Address and CV49 See, Pg 7-8

If CV 49 is programmed incorrectly the turnout will work opposite to the command you have issued and is easy to re-program. See also, Pg 7

Determine CV49 values only when your Turnout is set for the Clear Route,

There are two possible positions for the Tortoise actuator Arm. If your Tortoise Arm is positioned as shown in the **right** picture below then set **CV49 to 0**   (factory default).

Arm

1   **1**
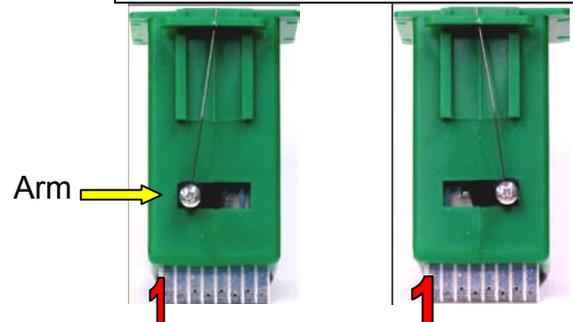
If your Tortoise Arm is positioned as shown above **left** then set **CV49 to 1**

# C2) Basic + Panel / Signal Indicator LEDs + Momentary Push Button.

Follow instructions for the **Basic** setup prior to installing LEDs and Momentary Push Buttons on Pg-3.

Wire LED's and momentary push buttons as shown below for **Insul Frog** or **Electro Frog**.
You can use one or more LEDS. Turn off track power prior to making connections.

Insul-Frog and Electro-Frog :

**Pin-out Connections for *Hare*
Connector JI, (10 Connections)**

1. Throw Rail (DCC power)
2. Clear Rail (DCC power)
3. Throw Frog rail (Insul-frog)
4. Clear Frog rail (Insul-frog)
5. Not Used
6. LED Cathode Red (Throw)
7. LED Common (Anodes)
8. LED Cathode Green (Clear)
9. Push Button Switch A
10. Push Button Switch B
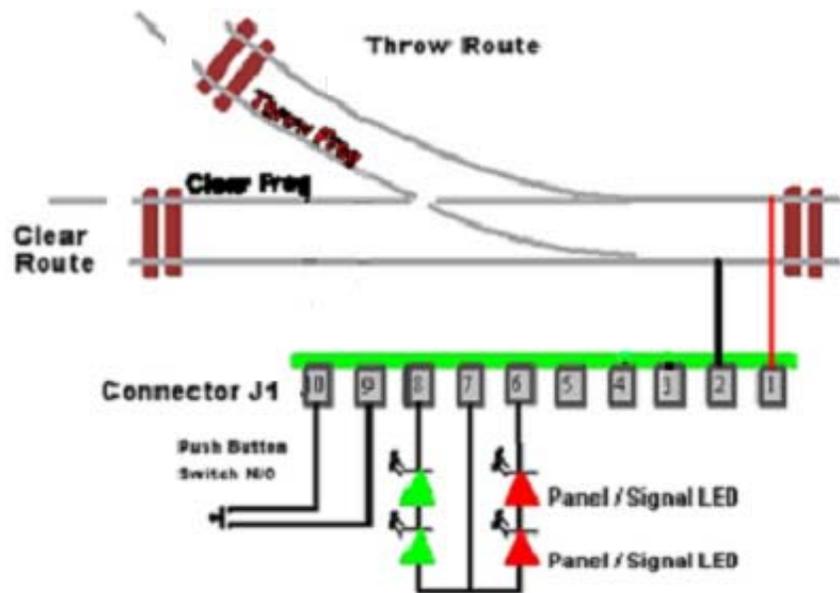
Note: To power the Frog for an Electro-Frog Turnout see Pg-5. Ignore the connections for Auto Throw.

C3) Implement Auto Throw:

We have designed the *HARE* so you do not have to make any alterations to your turnouts unless you choose to do so for space or performance reasons.

The Auto Throw feature uses an isolated rail section called a **Trigger Rail** to activate the *HARE*. You can make the **Trigger Rails** by creating two Gaps on the frog rails either outside or within the Turnout. You can use insulated joiners or cut thru the rails, see 2A and 2B below and Pg-5

There are two steps to implementing the Auto Throw:

1) Installing jumpers on the HARE from J5 to J7. There are two options that are dictated by the relative position of the Tortoise Arm to the Clear route as shown, Pg-6

2) Creating the **Trigger Rail** gaps and wiring to JI as shown, see Pg-5

A) For an Insul-Frog the 1st Gap is created by the Insul-Frog itself and the 2nd gap could be an insulated rail joiner on the frog rails where the turnout connects to main tracks. The 2nd gap may be moved further away from the Turnout as you choose for timing

B) For an Electro-Frog the 1st Gap may be created by using an insulated rail joiner on the frog rails where the turnout connects to main tracks and the 2nd gap is cut in the same rail that has the insulator, at least several inches away from insulator. Also, The 1st and 2nd gaps can be spaced about ¼" to create a short Trigger Section (For Sound Units) and may be moved further away from the Turnout as you choose for timing.
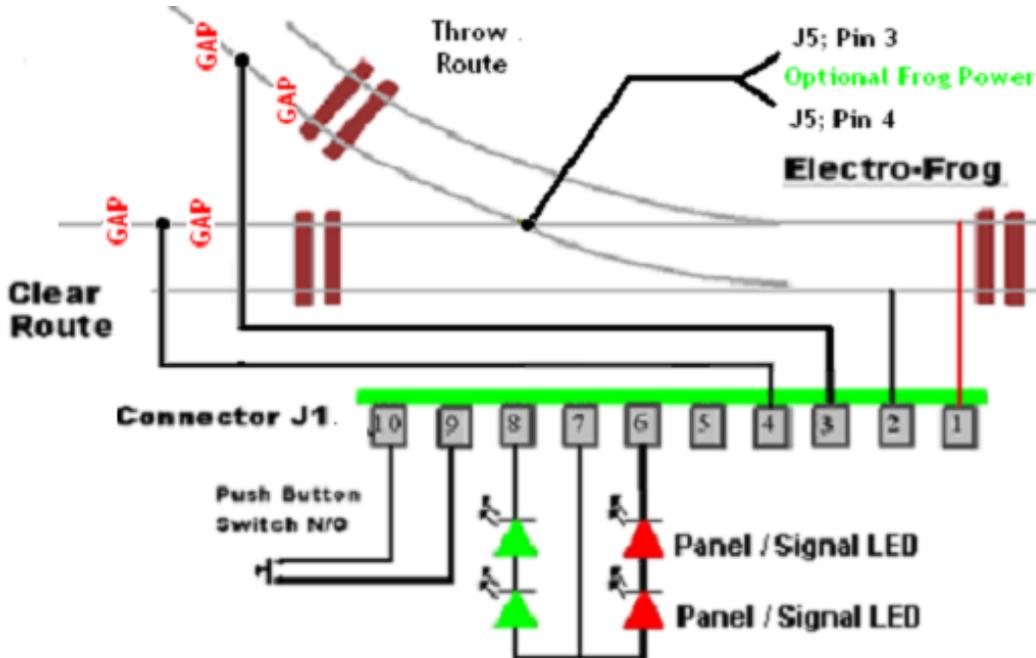
C3) Implement Auto Throw: (Continued)

Insul-Frog:

Note: Terminals 3 & 4 show connections for Insul-Frog auto throw. An Insulator or a **Gap** must be created shown above as **Gap** on each frog rail. The further the **Gap** is moved away from the turnout the more time will be available to auto throw for an approaching locomotive.
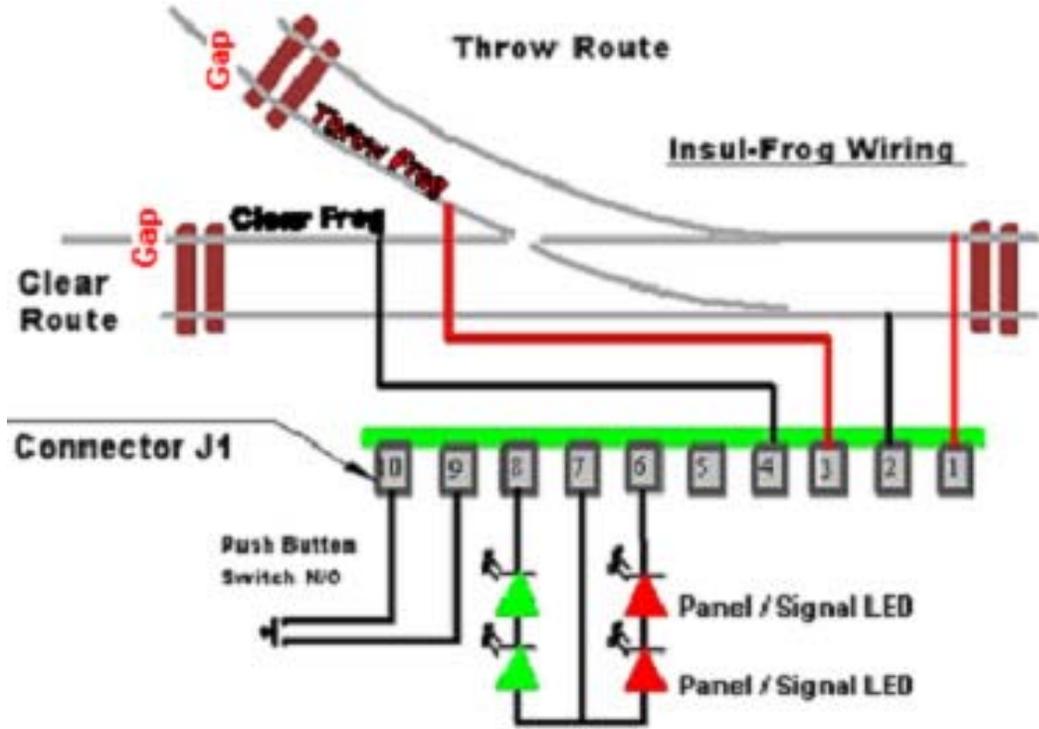
Electro-Frog

Note: Terminals 3 & 4 show connections for the Electro-Frog auto throw. Insulators or a **Gaps** must be created shown above as **Gap** on each frog rail. The further the **Gaps** are moved away from the turnout the more time will be available to auto throw for an approaching locomotive.

D) Wiring and Installation Info:

It may be easier to program the *Hare* first and then wire it to the layout and Tortoise. Make a chart of the switch number and the **Clear** positions for programming and future reference. (Sample chart see Pg-9-10)

When the *Hare* is plugged into the Tortoise there may be too much clearance between the Tortoise Connector and the Hare plug, shims like a flat toothpick can be added. You can also visually align when installing.   **Fig-1**

Shim added to connector on both ends to keep Tortoise Aligned to contacts
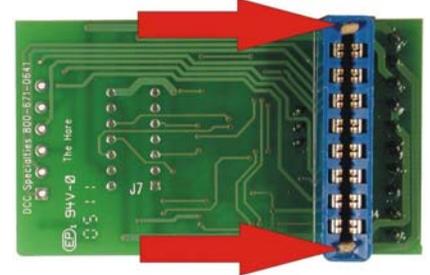
If you are using block detecting that senses current on the rails you need to wire the *Hare* power connection to a source of power before the detector.
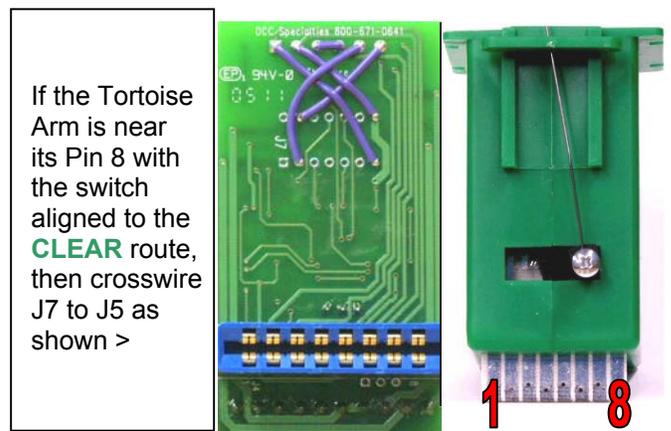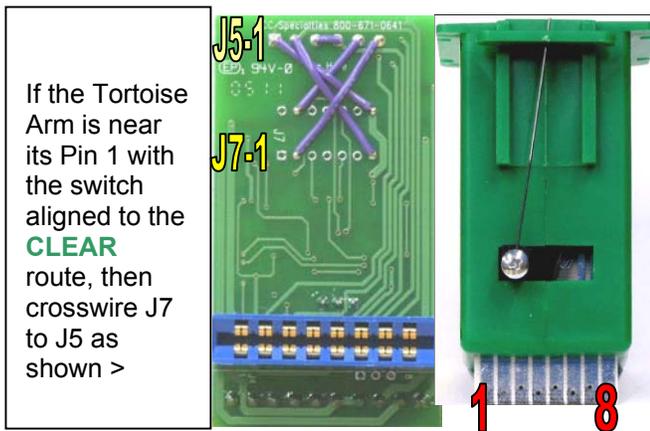
If you are not using **Auto Throw** the power should connect to a source that will not shut down with a short. Otherwise the short will cut the power to the *Hare* and you cannot operate the switch.

Contacts from The Tortoise
The switch contacts in The Tortoise are brought out to connector J5 on the *Hare.* If you want access to these contacts for point power routing or other secondary functions, you can either solder wires directly to the printed wiring board, or purchase a six-position connector similar to J1. The holes have been designed to accept a Digikey part number ED1518-ND connector, available from your *Hare* dealer. The table, Pg-2, shows the relationship between J5 and The Tortoise card edge connector. The chart also shows the pin numbers when the *Hare* is installed in reverse

Wiring the Hare Jumpers, J5 to J7, for Auto Throw: Caution, there are two options

It is important to do this correctly as a track short will occur.

If the Tortoise Arm is near its Pin 1 with the switch aligned to the **CLEAR** route, then crosswire J7 to J5 as shown >

If the Tortoise Arm is near its Pin 8 with the switch aligned to the **CLEAR** route, then crosswire J7 to J5 as shown >

Actuator near Pin 1 for Clear	
From J7	**To J5**
13	5
8	1
7	2
2	6

Actuator near Pin 8 for Clear	
From J7	**To J5**
13	6
8	2
7	1
2	5

E) Programming: **Do Not Use Program Track**

CV-63 has two functions. It is used as an index to point to primary address and the 13 route addresses during programming A value of 0 points to the primary address and 1 to 13 point to the **Smart Route** addresses. A value of 42 will reset the *Hare* to factory default settings. (See the chart in back for more details, Pg-9)

CV-50 to CV-62 are used to indicate the Clear or Thrown Switch Positions of the **Smart Route** turnouts. CV-50 to CV-62 are either a **0,** (Follow Route Command Direction) or a **1,** (Reverse Route Command Direction). Route Command is the Throttle Instruction you want to issue, Clear or Thrown to activate the **Smart Route** The route Switch Position can either follow or reverse this Command for a specific **Smart Route** turnout.

To visualize this assume that your route is set to activate on the Clear Command. Any turnouts in the route that would require a Thrown position would be the Reverse of the Clear Command and require the Switch Position CV for that route to be programmed to: 1. See Pg-9

CV-64 is to setup the **Smart Default OPS,** see Pg-8

Programming The *Hare:*

Before programming the Hare, first remove power. The Hare is set into the programming mode by moving the programming jumper to the program position and then applying power to the Hare. The program position of the blue programming jumper is shown in the picture above. It should cover the center pin and the pin next to the J2 label to select the programming mode at power on. For programming, the Hare is connected to the normal track output of your command station, not the programming track connections. Temporarily two jumpers can be run between connector J1 pins 1 &2 on the board and track power. Once in the programming mode, the Hare will remain in the program mode until power is removed and the programming jumper is returned to the normal operation position.

J5 Pin #'s

Program Jumper Shown in Run Mode

J1 Pin #'s | Bottom of Card
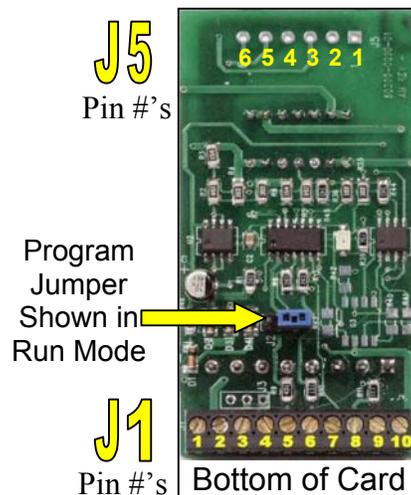
Setting Accessory Addresses: See also **Smart Routes** Pg-9

On entering the program mode, CV 63 is automatically set to 0 so that it is pointing to the primary address of the ***Hare***. The next accessory address issued by the Command Station will be stored as the primary address. To issue an accessory address, you must select the address on your command station then issue a clear or throw command (see your command station directions for specific instructions on controlling accessories). You may continue issuing accessory addresses up to a total of 14 (one primary and 13 **Smart Routes**). Once you have issued the maximum number of accessory addresses, the Hare will no longer store addresses, even if more are received. In the programming mode you will see LED D10 flash briefly each time an accessory address is issued. This indicates that the address has been correctly received and stored. While the primary address of the Hare is always the first address, the other addresses for **Smart Routes** can be issued in any order. You do not have to enter **Smart Route**™ addresses in any particular order, but you need to record the position in which you entered each address so that you can set the associated switch direction CV correctly. There are no provisions to read back values in CVs.

Setting the Switch Position CV's:

CV 49 to 64 values are also programmed by setting the Hare to the programming mode as discussed above. These CVs are programmed using the Program-on-the-Main (or OPS mode) function of your command station. Follow the command station instructions for entering the Program-on-the-Main (P o M) mode or OPS mode. Once in the OPS mode, the Command Station will ask for an address of the "engine" to be programmed. Since the ***Hare*** is an accessory decoder, it does not use mobile decoder (engine) addresses, so enter any value for the address since it is not used by the ***Hare***. Pick any address that is not currently in use on the layout. A good choice might be 9999, or 9984 for Digitrax

The Command Station will then ask for which CV to program. Enter the CV number (49 to 64) to be programmed. Then enter the value to be programmed into the CV. For CV49, valid values are 0, 1, 2, or 3 to tell the Hare the configuration of the switch. CV50 through CV62 have valid values of 0 or 1 depending on whether you want the points to follow the command station commands (0) or reverse the command station commands (1) for the associated route address. CV63 has valid values of 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 42. 0 through 13 will point to the primary (0) address or one of the route addresses (Smart Route™ 1-13). A value of 42 will reset all addresses and CV values to the factory default.

E) Programming: (Continued)

If you make a mistake, don't worry, the turnout will work opposite to the command you have issued and is easy to re-program CV49. See also, Pg-7

Setting Smart Default OPS:

When power is restored to a layout the **Smart Default OPS**™ can be programmed to:

(A) Return a turnout to the position it was in when power was removed or

(B) Have turnout set to the position of your choice regardless of the power off position.

Valid values for CV 64 are 0 (restore points to the position present at power off), 2 (always set the points to the clear route at power on), and 3 (always set the points to the throw route at power on). Each time a valid CV value is received and stored, D10 will flash indicating a successful programming operation. Once the Hare is in the programming mode, CV values and address values may be programmed in any order

Exit the Program-on-the-Main (OPS) mode to restore the commands station to normal operation. Once you have finished programming the Hare, remove power from the unit and <u>return the programming jumper to the normal operation position.</u> The Hare is now ready to go.
.

Implement Smart Route feature: See Setting Accessory Addresses, Pg 7 and 9
Any un-programmed Smart Route turnouts will respond to ADD 1

The Hare has a normal DCC address that can be programmed with a DCC system. Added to this are 13 additional addresses that can be used to setup **Routes** with a feature called **Smart Routes**™ This allows setting up multiple switch machines with the same addresses so you could send out one command and have as many switches operate as needed to set a route.
If you are setting up multiple machines you should also determine the addresses for the routes that include this switch. If you do not have any routes setup yet, these route numbers can be programmed later. Along with the route number you will need to know which way to position the switch points, See Pg-3

Special Programming Instructions: (Not Needed for NCE)
Some DCC Command Stations need to follow special programming sequences to ensure that you can reliably program the *Hare* with them. **These special instructions are for Digirax and Lenz**

Digitrax:
The Digitrax command station sends out up to eight accessory addresses every time you turn track power on. If you connect the Hare to the Digitrax system with the *Hare* set to the programming mode, these eight addresses will be stored. One solution is to turn on the command station and wait a minute before connecting the *Hare* so that the *Hare* will not see these addresses. The better solution is to follow the directions above for setting the *Hare* to the programming mode and then turn on the Digitrax system. The eight addresses will be stored. Simply use the OPS mode programming to set CV63 to 0, and the *Hare* is ready to program normally. This does mean that you want to be careful if you have already programmed some addresses. These can be over-written by the Digitrax system. Your best bet is to keep a list of
the address set in each Hare, when you want to add addresses, you will have to set CV63 to 0 and then re-program the original addresses before adding the new ones.

Lenz:
The Lenz system sends repeat accessory commands as long as you hold down the 1 or 4 command key. This ensures that the accessory decoder sees the message, but can result in the same address stored multiple times while programming the *Hare*. The solution is simple. Hold the 1 or 4 key down for only a short time. Once you see D10 flash indicating an address has been stored, release the control key. If you see multiple flashes, you have stored the same address more than once. Since the *Hare* will flash D10 each time you send it an accessory address, you can easily get a feel for the timing involved. Select an accessory address that has not been programmed into the *Hare*. Send an accessory command to this address and hold down the 1 or 4 control key. D10 will flash each time the command station repeats the accessory address. This will give you a feel of how long to hold the control key while you are programming to avoid multiple address storage.

F) Forms for Address and Configuration Assignments

Be sure to keep a record of the setting for the Hare. You may remember them today, but it is easy to forget. If this is in a club there should be a record as reference for other members. There is also a PDF online, DCCSpecialties.com

Chart for Switch Address _____   Location or Turnout _____   Date _____

Primary Address	Programmed Address Number	Smart Route Command Clear or Thrown	Follow (0) or Reverse (1) the Smart Route Command	Switch Position CV	CV Values used
Primary Address			na	49	0,1
#1 Route Address				50	0,1
#2 Route Address				51	0,1
#3 Route Address				52	0,1
#4 Route Address				53	0,1
#5 Route Address				54	0,1
#6 Route Address				55	0,1
#7 Route Address				56	0,1
#8 Route Address				57	0,1
#9 Route Address				58	0,1
#10 Route Address				59	0,1
#11 Route Address				60	0,1
#12 Route Address				61	0,1
#13 Route Address				62	0,1
Pointer and Reset*				63	0-13, 42
Power up Position*				64	0,2,3

Determine CV49 values only when your turnout is set for the Clear Route

CV-50 to CV-62 are used to indicate the **Clear** or **Thrown** positions of the switch in a route.
  CV-50 to CV-62 are either a **0,** (Follow Route Command Direction) or a **1,**
  (Reverse Route Command Direction). Route Command is the Throttle Instruction you want to issue
  Clear or **Thrown** to activate the route. The route address can either follow or reverse this instruction for specific turnout.

To visualize this assume that your Smart Route is set to activate on the Clear Command. Any turnouts in the Smart Route that would require a Thrown position would be the Reverse of the Clear Command and require the Switch Position CV for that route to be programmed to: 1. See Steps below

    Step 1:   Select the desired *Smart Route* address.
    Step 2:   Select the command you want to use to activate the *Smart Route* (i.e. clear or throw)
    Step 3:   For each turnout in the *Smart Route*, decide if you want the switch position to follow the route command or
                 reverse the route command to form the desired *Smart Route*.
    Step 4:   For each switch in the *Smart Route*, program the switch position CV associated with the route address to 0
                 (follow the route command) or 1 (reverse the route command)

***CV-63** Automatically advances from 0 to 13 as the addresses are programmed. Programming a 42 to this CV will result in a reset of all CV and Addresses to factory settings.
**** CV-64** Sets Status of switch when power is turned on. 0= return to power off setting. 2 = move to **Clear** position with power up, = 3 move to **Thrown** position on power up.

Route Planning and Programming Example:

Shown below are three switches. In the first set, all switches are aligned to clear and allow travel on parallel mainline tracks. The second arrangement shows a route from the lower main, across the adjacent main, and onto a divergent route from the second main. The third arrangement shows a cross-over from one main to the other.
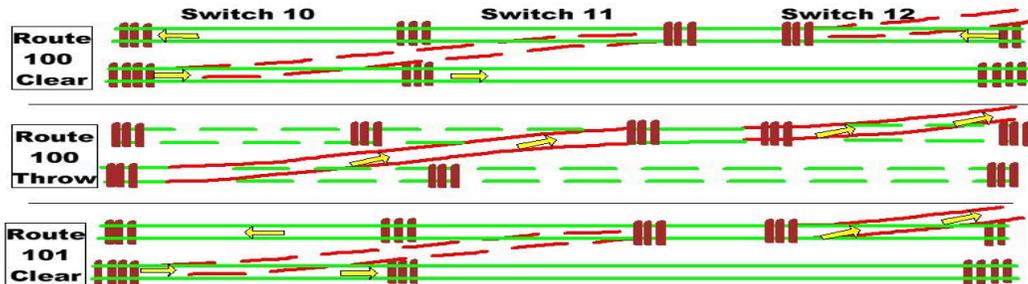
Assume the primary address of the left-most switch is 10, the middle primary address is 11, and the right-most switch primary address is 12. All three switch arrangements can be accessed by programming two routes. Assume the first route has address 100 and the such as address 101. The programming tables for each switch are shown below.

Address	Programmed Address	Route Command	Follow or Reverse Command	RoutrSwitch PositionCV	Programmed CV Value
Primary	10			49	
#1 Route	100	Clear	Follow	50	0
#2 Route	101	Throw	Follow	51	0

Address	Programmed Address	Route Command	Follow or Reverse Command	RoutrSwitch PositionCV	Programmed CV Value
Primary	11			49	
#1 Route	100	Clear	Follow	50	0
#2 Route	101	Throw	Follow	51	0

Address	Programmed Address	Route Command	Follow or Reverse Command	RoutrSwitch PositionCV	Programmed CV Value
Primary	12			49	
#1 Route	100	Clear	Follow	50	0
#2 Route	101	Throw	Reverse	51	1

For each switch, the switch points will follow the accessory command any time that the primary address is accessed. To align the switches as shown in the first configuration, issue a Clear command to address 100. All three switches will align to the clear position. To align the switches as shown in the middle (second) configuration, issue a Throw command to address 100. All switches will move to the throw position. To align the switches as shown in the final (third) configuration, issue a Throw command to address 101. Switches primary address 10 and primary address 11 will move to the throw position, while switch primary address 12 will move to the clear position. Note that if a Clear command is issued to address 101, primary address 10 and primary address 11 will move to the clear position, while switch primary address 12 will move to the throw position. This may or may not be a useful route. This illustrates that you will normally set your routes to operate on either a Clear or Throw command, not both. The example for address 100 illustrates that under some conditions, both the route Throw and route Clear commands may be useful.