The Hare™ REV J, 5/20/2011
An Intelligent, Plug n Play, Accessory Decoder for the Tortoise™ Switch Machine
US Patent 7,810,760 and 7,810,761

Version 1

Designed by Larry Maier, Instructions by Don Fiehmann

Plugs Directly on to Tortoise: **Simplifies wiring, eliminates 16 wire connections and reduces failures.**

Auto Throw™ **Automatically throws points when a train is approaching against the points!**

Auto Throw™ Timer: **Provides for timing the auto throw function to prevent two trains from colliding.**

Auto Return™ : **Automatically returns the points after a preset interval for any/all operational events.**

Smart Route ™ **Sets up to 28 routes by simple address programming in addition to the primary address.**

Dispatcher Over-Ride ™: **Allows the Dispatcher to lock out any or all other switch commands.**

Lock Block Protection: ™ **Overrides the HARES operation if a designated block is occupied.**

Locked Route Control ™: **Provides for only one route direction response for either a Throw or Clear command.**

Switch Speed Control ™: **Allows you to control the Tortoise motor speed.**

Smart Default Ops™: **Upon Power-up, HARES return to either last thrown position or a programmed default.**

Smart Power Routing: **Selectively directs switch point power by using a dip-switch.**

Operate Switch Signals **or Panel LED Indicators.**

Manual Pushbutton or Toggle Switch: **Allows single button or toggle switch manual control of the points.**

System Reset: **A single CV, CV63=42 sets all Addresses and CVs to original factory values.**

Direct Current Ops: **The Hare will operate on DC using Manual Push Button Control Option.**

Semaphore/Gate Ops: **Uses a Tortoise for triggered control of a semaphore or crossing gate.**

Automates Reverse Loop Turnouts. **Using Auto Throw feature.**

Version II, all the above + Feed Back

*Feed Back, Turnout Position Reporting to:* **Digitrax (LocoNet), Lenz (ExprssNet) and NCE (CabBus)**
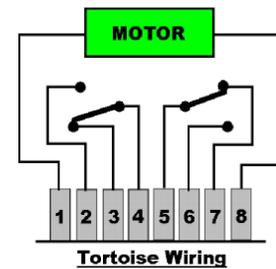
A) Quick Start:

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-9, Fig-1
2) Connect DCC Power to screw terminals, 1 and 2 of J1.
   Caution, connecting power to other terminals will damage HARE!
3) Test your DCC setup by operating, use primary default address, 1 for this test.

4) Digitrax users should review the configuration of the Digitrax DCS-100 prior to operating/ programming a HARE. It is important that the DCS-100 has the switching (Turnout) control enabled, otherwise it will not to operate Stationery Decoders

B) The Hare at a Glance:
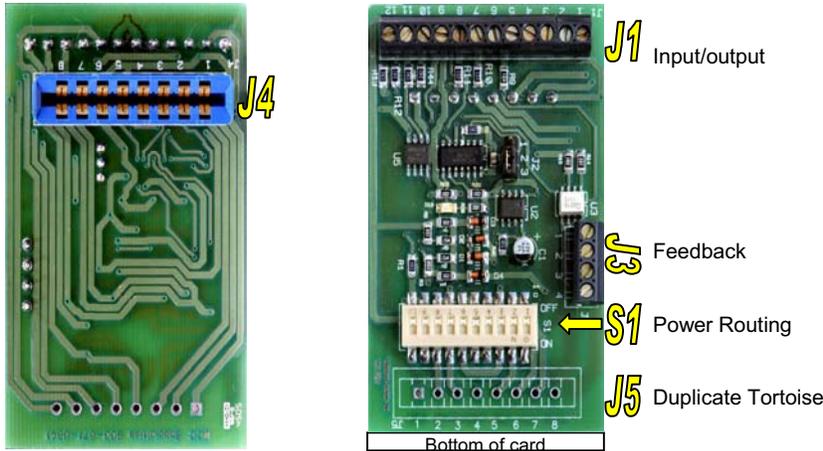
J5 Provides a duplicate set of contacts to access the normal Tortoise™ contacts covered by the Hare-Tortoise™ connector. See Table Below

J4

J1 Input/output
J3 Feedback
S1 Power Routing
J5 Duplicate Tortoise
Bottom of card

MOTOR

Tortoise Wiring

Screw terminals for J3 & J5 are an optional accessory. You may either purchase screw terminals or solder directly to the circuit board.

Turnout Terminology

Throw Frog
Clear Frog
Throw Rail
Points
Clear Rail
Frog

(Shown a(Clear)
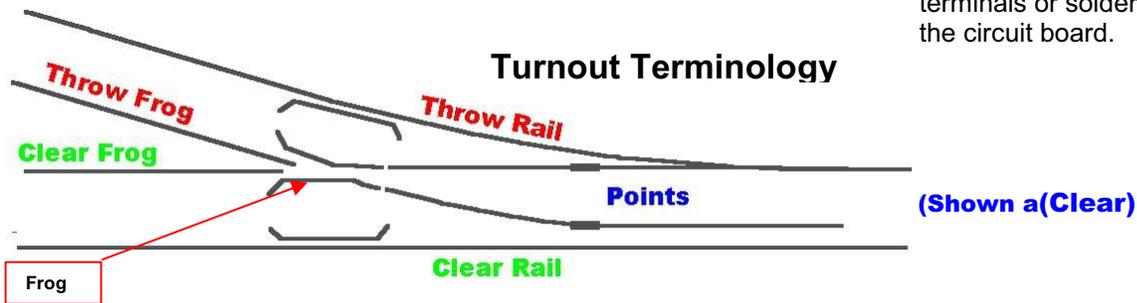
Normally

Tortoise Pin #	Hare J5	Tortoise Pin #
1	1	8
2	2	7
3	3	6
4	4	5
5	5	4
6	6	3
7	7	2
8	8	1

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

**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 terms 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 the Tortoise is oriented to the Turnout. For the primary address CV49 determines this, see Tortoise pictures and Switch Positions below. At this point, make sure that all switches in **S1** are OFF.
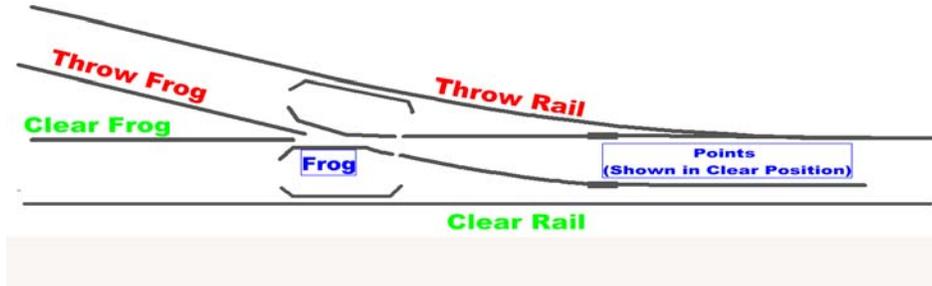
B   Turnout Frog Type: Is the turnout **Frog** an **Insulated** type, Insulfrog or a **Solid** Frog, Electrofrog?

C   Turnout Address: What will the turnout address be when installed? Range 2-2044. Do not use (1). It is the Default Address and all un-programmed *Hares* will respond to one (1). All Smart Route Default Addresses are 2044.

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 it is easy to re-program CV49. See also, Pg 10.

The Two Switch Positions are Clear and 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**

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).
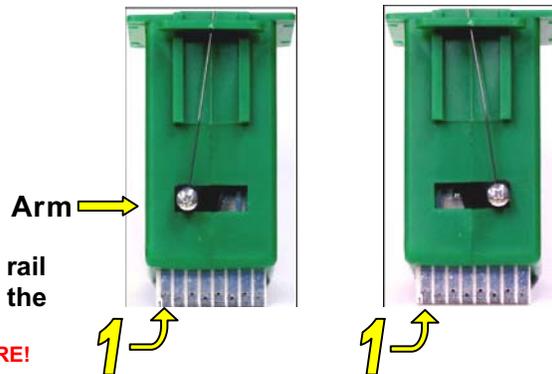
2) Install the *Hare* on the Tortoise: See Pg-9, Fig-1

3) Connect DCC Power to J1. The DCC polarity on the throw rail should go to screw terminal 1 of J1 and the DCC polarity on the clear rail should go to screw terminal 2 of J1.
Caution, connecting DCC power to other terminals will damage the HARE!

Arm

4) Test your DCC setup by following the switch operation directions

for your system. Use the default address 1.

5) Program Primary Address and CV49 See, Pg 10-13

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 10.

If your Tortoise™ arm is positioned as above **Left** when the points are aligned to the **Clear** route, then set **CV49 to 1.**

C2) Basic + Panel / Signal Indicator LEDs and Manual Control

Follow instructions for the **Basic** setup prior to installing LEDs. See Pg-3
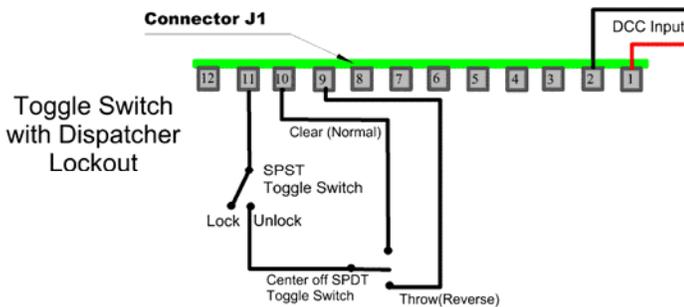
Wire LED's as shown below. The type of switch (**Insul-Frog** or **Electro-Frog**) does not make any difference**.** You can use one or more LEDS. Turn off track power prior to making connections.

Optional Hare LED Wiring

Connector J1 — DCC Input

One or two LEDs can be wired in series

Bi-Color LED
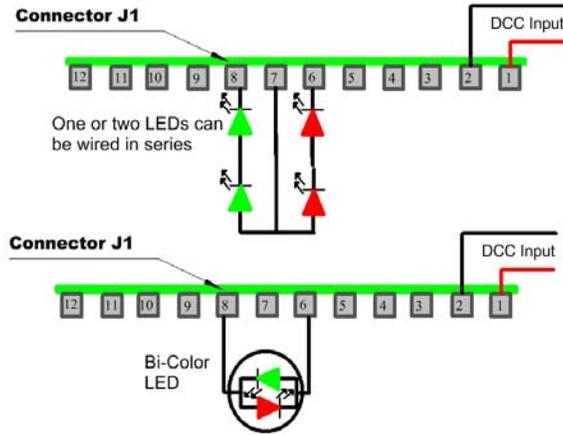
There are two manual control options with the Hare. One mode uses a single momentary contact **Push Button,** the simplest method. With this method, the points will change position every time the pushbutton is operated. The other method, **Dispatcher Mode** uses either a **Single Pole Double Throw (SPDT-Center Off)** switch or a **Single Pole Double Throw (SPDT)** switch in conjunction with **Single Pole Single Throw (SPST)** switch connected in series with the common lead of the **SPDT**. This method enables the **Dispatcher Mode** and the points will always follow the position of the SPDT or the (Center Off) switch. While the SPDT or the (Center Off) switch has an active connection, the Hare **will selectively respond to and/or inhibit DCC commands**, see, **CV66**. This allows a dispatcher to take over-riding control of the switch. To enable all contol options, simply center the (Center Off) switch, or turn off the SPST switch in series with the common of SPDT switch terminal. Use the **(SPDT-Center Off)** to retain local control at the panel and the override switch **SPST** for Dispatcher control.

Optional Hare Switch Wiring

Toggle Switch with Dispatcher Lockout

Connector J1 — DCC Input

Clear (Normal)
SPST Toggle Switch
Lock | Unlock
Center off SPDT Toggle Switch
Throw(Reverse)

Center off toggle switch will allow the operator to lock the switch in one position or allow normal operation when in the center position. The single pole switch allows the dispatcher to turn off or lockout the other double pole switch.

Toggle Switch

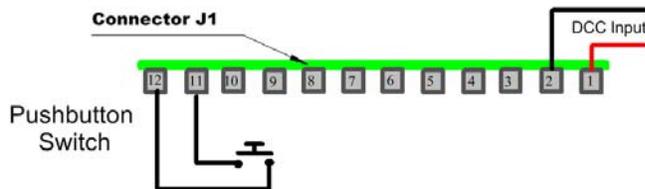Connector J1 — DCC Input

Clear (Normal)
Throw(Reverse)
Center off SPTD Toggle Switch
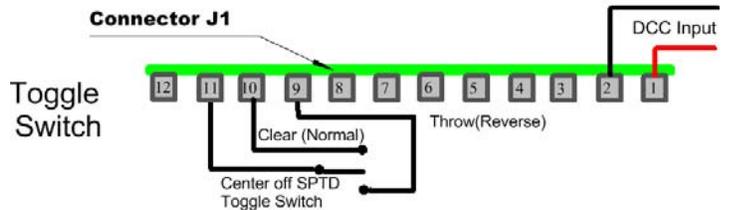
Center off toggle switch will allow the dispatcher to lock the switch in one position or allow normal operation when in the center position.

Pushbutton Switch

Connector J1 — DCC Input

Each operation of the pushbutton reverses the point position.

C3) Using the Hare to Route Switch Point Power

Power routing with the Hare is easy. If you are using an Electro-Frog switch, connect the frog to J1-5. If you are using an Insul-Frog switch, connect the throw frog rail to J1-3 and the clear frog rail to J1-4 (see page 3 for picture of frog rails). Simply setting the switches in the switch block **S1** enables power routing. Note that one side of the switch has the switch positions numbered, and the other side shows the "ON" legend. Refer to page 3 and the position of the Tortoise arm when the points are in the clear position. Refer to the table below for the correct **S1** positions.

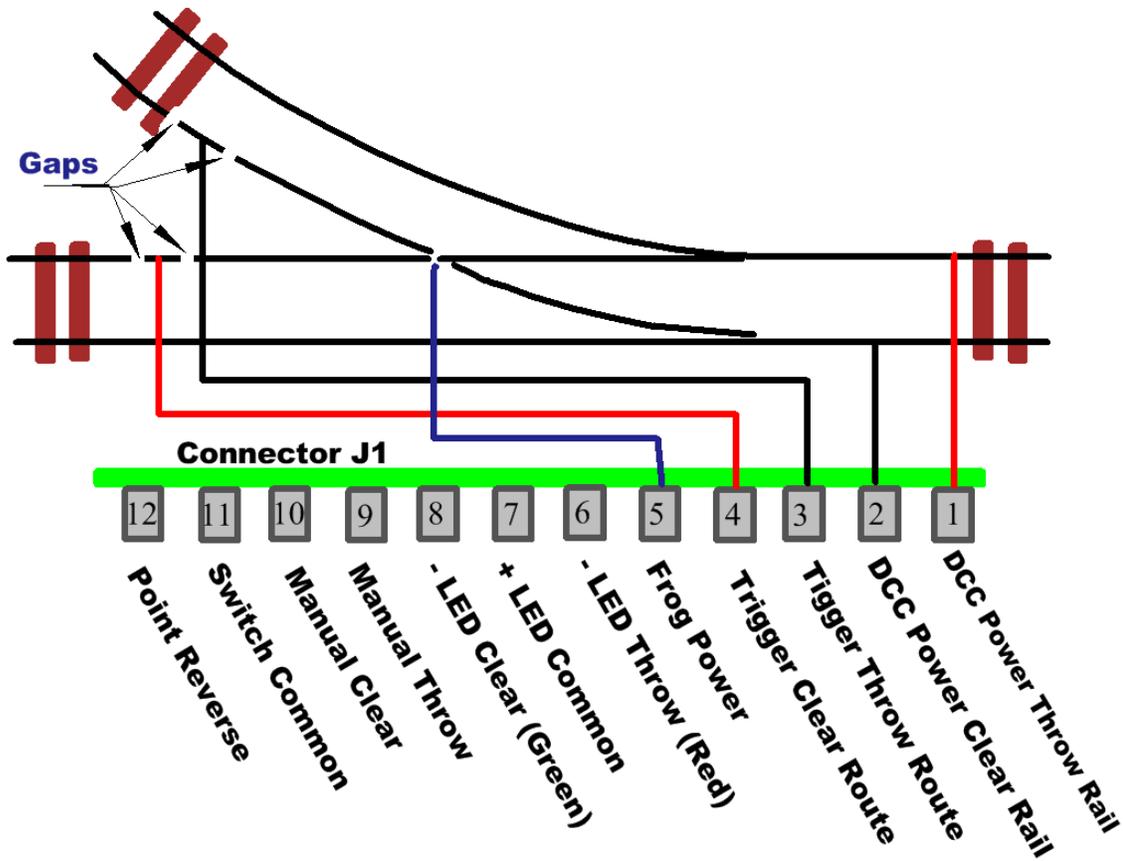| S1, Switch Number	Tortoise Arm with points clear matches **Left Picture**	Tortoise Arm with points clear matches R**ight** Picture
1	ON	ON
2	ON	ON
3	ON	OFF
4	OFF	ON
5	ON	OFF
6	OFF	ON
7	ON	OFF
8	OFF	ON
9	ON	OFF
10	OFF	ON

C4) Implement Auto Throw™:

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

The auto throw feature works by using two isolated sections of track called **Trigger Rails**. The trigger rails have power routed to them by the Hare as discussed above. This is necessary so that you don't have a dead section of track. Normally, the trigger rail that is aligned with the point position has power routed to it (so a train passing through the points will continue operating) through the Tortoise and S1. The trigger rail on the mis-aligned point direction is turned off. If trains enter and leave the switch in the correct direction, then all is well. If a train approaches from the mis-aligned direction, the engine wheels will bridge the gap to the trigger rail applying power to the trigger rail through the engine. The Hare senses this condition and moves the points and the power routing to allow the incoming train to move through the points without an accident.

If you have an Insul-Frog switch, the two frog rails are already insulated from the frog. You can use this gap as one of the trigger rail gaps. The other gap would be away from the switch by a distance determined by operating considerations (discussed later). In this case, you do not need to power the frog, so you do not need a connection from J1 pin 5. If you are using an Electro-Frog switch, the first trigger rail gap can be the insulated rail joiner normally used on each frog rail to prevent shorts. As with the Insul-Frog, the other insulated gap is set in the track a distance away from the switch that is determined by desired operating conditions. In the case of an Electro-Frog switch, J1-5 is connected to the switch frog in addition to the trigger rail wiring. In either case, the throw frog trigger rail is connected to J1-3 and the clear frog trigger rail is connected to J1-4.

The figure below, Pg-6, shows the connections for auto throw to operate. Insul-Frog and Electro-Frog switches are connected as shown except that the Insul-Frog does not require the blue wire shown connected to J1-5. While the trigger rails are shown as short sections, they may be any desired length. It takes about 2 seconds to move the points during an auto throw, and the ends of the trigger rails (or the trigger rails themselves if they are short) should be located at least the two second travel distance of your train away from the points. This will prevent the train from crossing moving points during auto throw. Remember that the trigger rail is **not powered** when the approach is mis-aligned. If your train fully enters the isolated section, it will stop until the points have finished moving. For this reason, you may want to make the trigger rail length less than the distance between the pick-ups of your smallest engine. Then, compute the distance that your fastest moving train will move in two seconds. This is the minimum distance between the short trigger rail and the points of the switch.

C4) Implement Auto Throw (Continued)

Gaps

Connector J1

12 11 10 9 8 7 6 5 4 3 2 1

Point Reverse
Switch Common
Manual Clear
Manual Throw
- LED Clear (Green)
+ LED Common
- LED Throw (Red)
Frog Power
Trigger Clear Route
Tigger Throw Route
DCC Power Clear Rail
DCC Power Throw Rail

Generic auto throw installation;
Note that the blue wire is not used with Insul-Frog switches. The right end of the trigger rail gaps can be part of the switch if desired.

Once the switch is wired according to the figure, remember to set the 10 power routing switches as shown in section C3. Our customers have come up with many novel ways to apply the auto throw feature. The following sections show how to install the Hare with the auto throw feature in several different situations.

Auto Throw with Auto Reversing
In order to successfully use the Hare on the end of a reverse loop it is recommended that you have the Trigger Rails not be directly adjacent to the reversing section. Having a short section of track powered from outside of the reversing section ensures that the auto-reversing module will work properly and the Hare will not short out due to the reverser not having swapped the polarity in time. This arrangement does take up more space than would be ideal, but it ensures that the Hare and the auto-reverser will not interfere with one another. It is important that all trigger rails be powered from the associated switch clear or throw rail and that intervening rails be the same polarity as the trigger rails. Otherwise, auto throw may not work or you may end up with a short circuit.

Reversing Loop   Trigger Rails
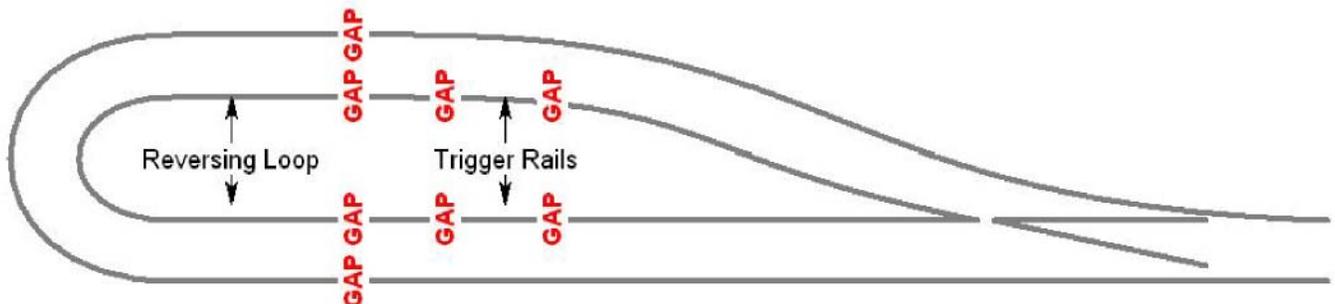
C4) Implement Auto Throw (Continued)

Auto Throw can set Automatic Entry Direction to a Reverse Loop

The figure below shows how to extend the clear trigger rail ahead of the switch into a reverse loop. When the train approaches, it will always trigger the clear route, resulting in a consistent entry direction into the reverse loop. The distance must be at least the train length, otherwise the switch will auto throw under the train leaving the reverse loop. If you cannot get a long enough distance between the switch and the incoming trigger rail, you can use the auto throw timer to inhibit the auto throw function for a specified number of seconds after the train enters the reverse loop. In this way, the auto throw can be disabled after lining the points for the entry into the reverse loop. As long as it remains disabled until the train clears the points, auto throw will not throw the points under the exiting train. This method can also be used to always align a spur with the main to prevent unexpected freight deliveries if a switch is accidentally left aligned with the spur. To access the spur, the switch is thrown after the train clears the main line trigger rail one train length from the switch.
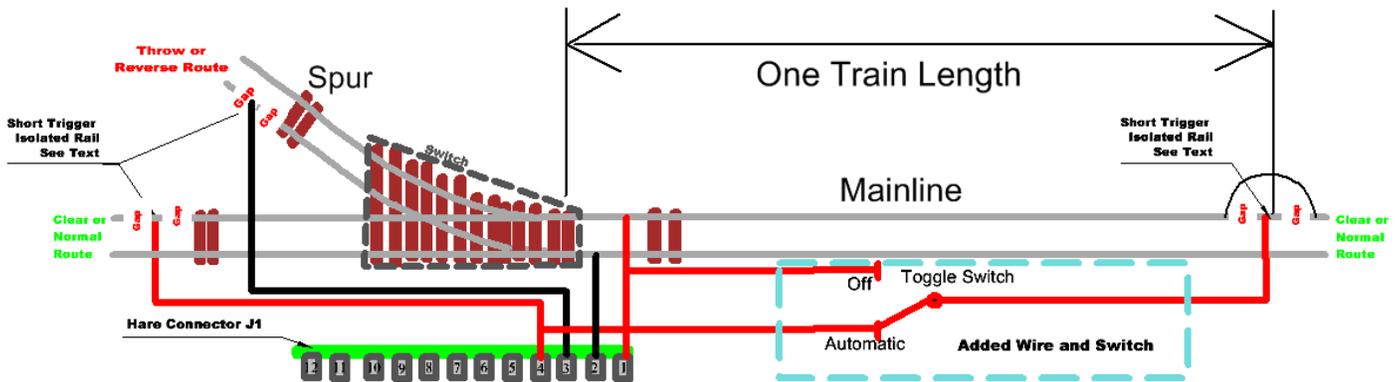
Extending Auto Throw Trigger Rail Distances

In some track configurations, it is difficult to separate the trigger rails from the switch points. The figure below shows one possible solution. This gives the switch points more time to move before a train enters the switch. At 60 scale miles per hour, your train will move about 2 feet in the time it takes the Tortoise to completely move the points from one position to the other.
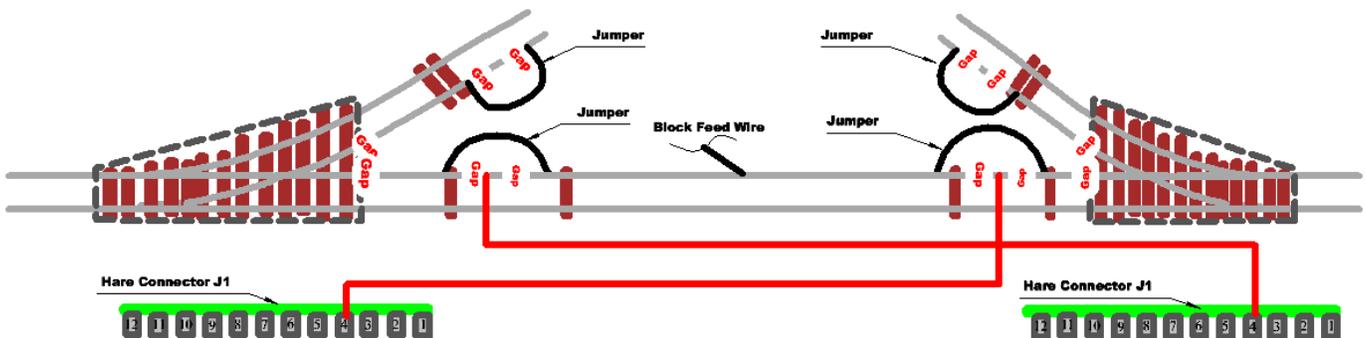
Connections with limited distance

7

C4) Implement Auto Throw (Continued)

Using Auto Throw with Layout Block Detectors Present:

The Hare does draw some power from block in which it is connected. Some block detectors may sense this current and identify the block as occupied even when it is clear. The following figures show how to maintain proper block detection operation with the Hare installed and configured for auto throw. One figure shows Insul-Frog connections, while the other shows Electro-Frog connections.
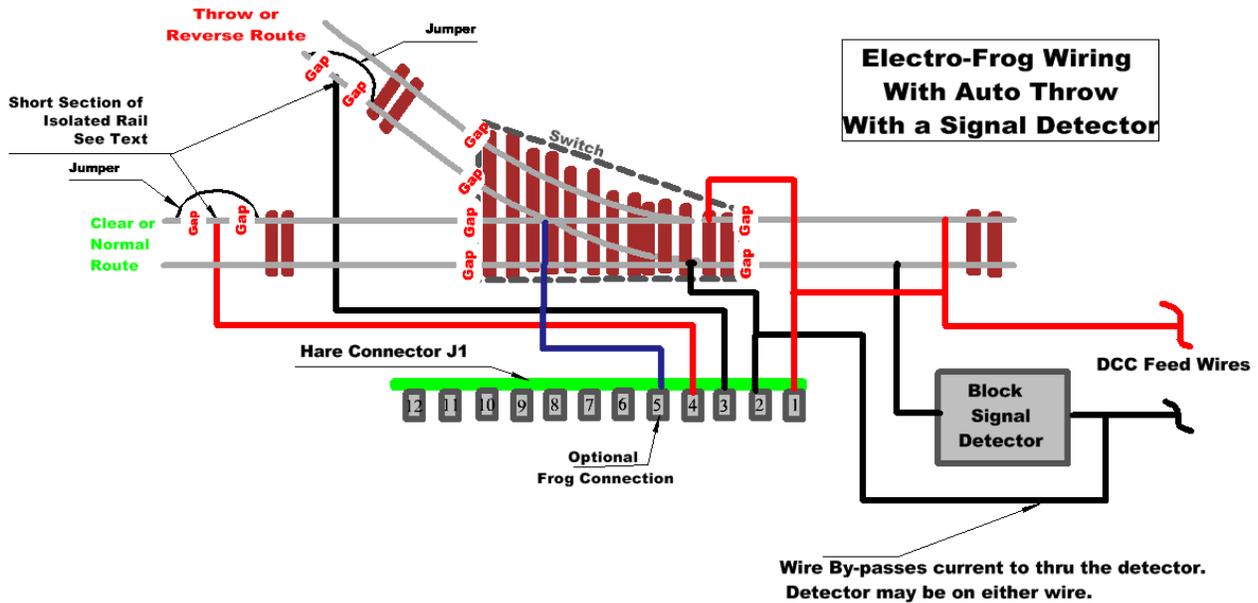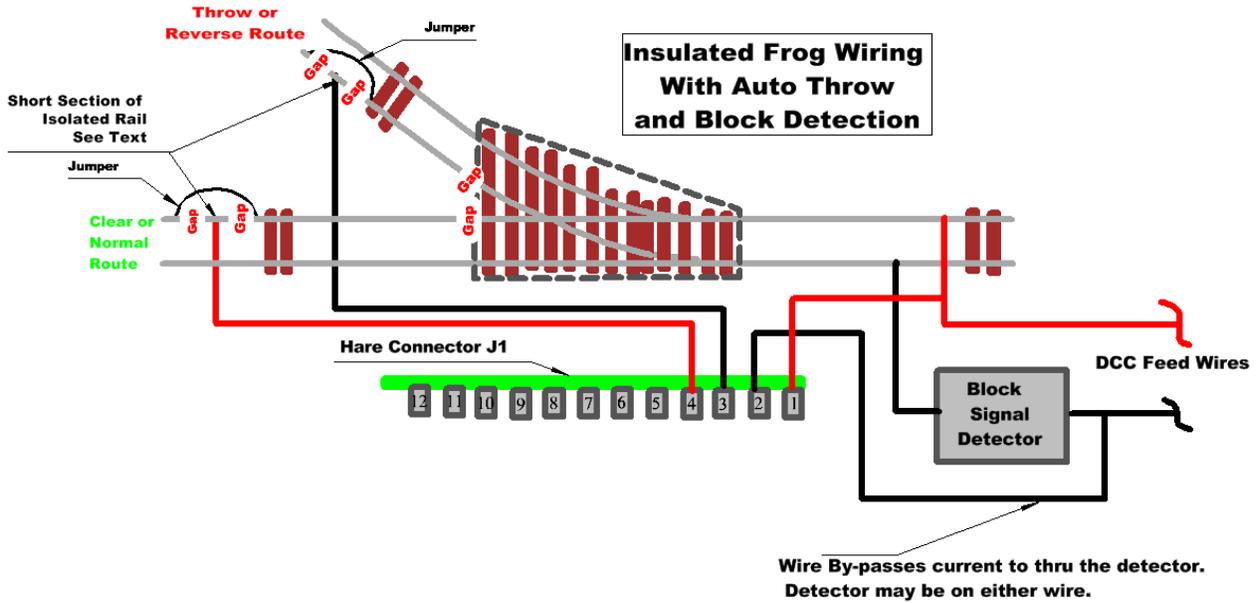
D) Wiring, Installation, Lock Block and Feed Back Info:

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 such as a flat toothpick can be added or you can visually align the contacts. In any case, ensure that the contacts in the Hare connector align with the contact surfaces of the Tortoise connector. The figure to the right shows how to add shims to the Hare connector to reduce the amount of play when the Hare is mated to the Tortoise.
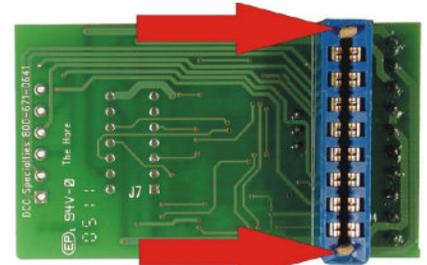
Fig-1

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 your own secondary functions, you can solder the wires directly to the printed wiring board. The table on page 2 shows the relationship between J5 connections and the Tortoise connector numbers. If you are using the Tortoise contacts for your own purposes, make sure that all switches on S1 are turned OFF, or you may end up with a short circuit to track power.

Lock Block Protection

Use of a Block Detector to Inhibit Hare Operation when the Block is Occupied

Under some conditions, you may want to prevent auto-throw or some other Hare function when a train is occupying a track block. One example might be that a train from a diverging route is inhibited from tripping the auto-throw if a train is occupying the mainline near the switch. This prevents the lower priority train from moving the points under the mainline train.
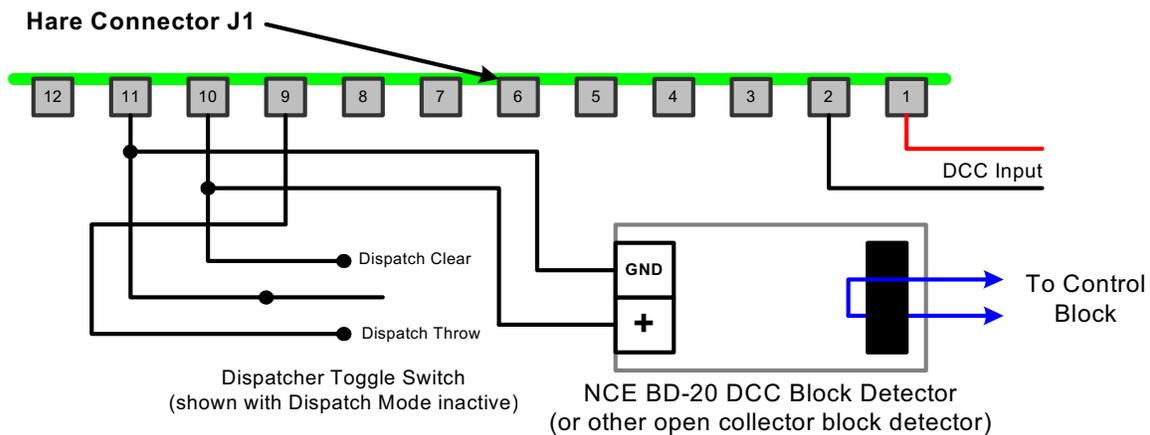
This function can be accomplished by using a block detector with an open collector output. A suitable device is the NCE BD-20, although any unit with an open collector output that is isolated from the track power can be used. The ground of the output is connected to Hare J1 pin 11. The open collector is connected to Hare J1 pin 10. Any time a train occupies the detected block, the Hare will enter the Dispatch Mode and move the switch points to the clear position. In the Dispatch Mode, CV66 specifies which functions are inhibited. Setting bit 0 inhibits DCC operation, bit 1 inhibits auto-throw, and bit 2 inhibits manual throw. The default is that all functions are inhibited during the Dispatch Mode. While the connections shown will force the switch to clear when the block is occupied, moving the wire from J1 pin 10 to J1 pin 9 will force the points to the throw position when the block is occupied with the same Dispatch Mode lockouts as for the wiring shown.

The diagram shows the dispatcher's switch in the center off position, indicating that the dispatcher is not in control. If the dispatcher's switch is active, then the dispatcher's switch will control the position of the points regardless of the status of the block detector. Triggering the block detector while the dispatcher's switch is active may result in any attached signal lights turning off then on, but the position of the points will follow the dispatcher's switch. If you don't want any interaction between the block detector and the dispatcher's switch, simply use a switch (or a set of switch contacts on the dispatcher's switch) to open the GND lead of the block detector when the dispatcher's switch is active.

Feed Back:

Interfacing to Digitax Loco Net, NCE Cab Bus and Lens XpressNet

The **Hare II** has optional outputs that allow you to convey the clear (normal) or throw (reverse) status of the Hare to your NCE Cab Bus, your Lenz XpressNet, or your Digitrax Loconet. These connections are made using hardware available from the respective system manufacturers. The diagrams below show you these connections. Follow your manufacturers directions for use of the data. The Team Digital, SRC8 is a lower cost Digitrax option.

Switch Position Indication For NCE AIU

Switch Position Indication For Digitrax DS54 & DS64

Switch Position Indication For Lenz LR101

Switch Position Indication for Team Digital SRC8
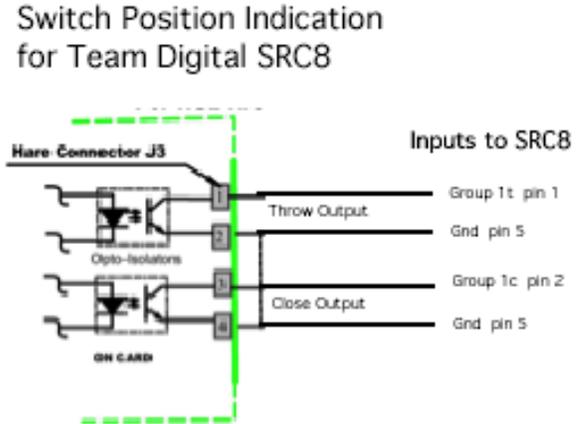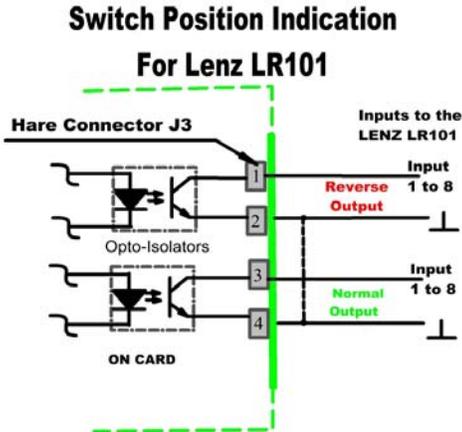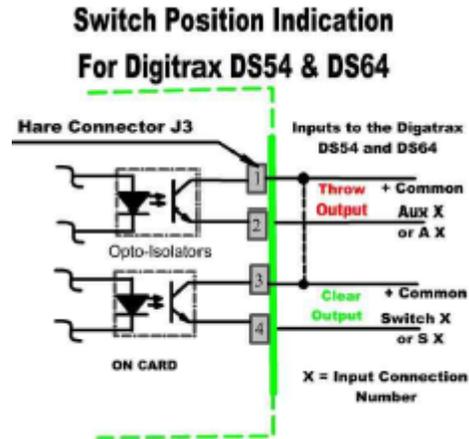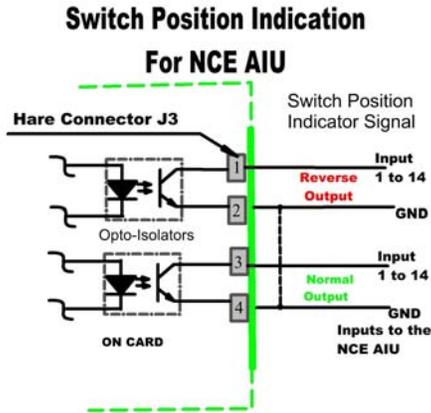
E) Setting Addresses and Programming CV's:

(1) **Do Not Use Program Track!**

(2) **The HARE addresses are SET by moving the program jumper as described below and issuing Accessory Commands.......operating the turn-out by using your DCC Throttle. Pg-12**

(3) **Configuration CV's are Programmed in Ops Mode, "on the main", also by moving the programming jumper as described below. Pg-12**

It is important to remember that **Addresses are Set** and **CV's are Programmed!**

Special Programming Instructions:

Specific DCC Systems need to follow specific programming sequences to reliably program the *Hare.* **See Also Pg 16-15**

NCE and MRC: Do not use the Accessory Programming Mode only use Ops Mode. **See also, Pg-15, 16**

Digitrax: See also, Pg-15

The Digitrax command station sends out up to eight accessory addresses every time you use your throttle to turn track power on and/or you reboot the system and have track power set for auto turn on. If you connect the Hare to the Digitrax system with the *Hare jumpers* set to the programming mode, these eight addresses will be stored. It is recommended for Digitrax that the Setting of Addresses and Programming of CV's be done at the same time to avoid the accidental Setting of Addresses as described above. See pg 19-20.

(a) 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.

(b) 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 OPS mode programming to set CV63 to 0, which resets to default settings, 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.

(c) Also, Digitrax users should review the configuration of the Digitrax, DCS-100 prior to programming a HARE. It is important that the DCS-100 has the switching control enabled otherwise, it will not to operate, Stationery Decoders.

Lenz: See also, Pg-16

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. In the normal operating mode (not programming mode), 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.

E) Setting Address and Programming (Continued)

Moving the programming Jumper for Setting Addresses and Programming CV's.

The right figure shows the location of the program jumper on the Hare. When the jumper is connecting J2-2 to J2-3, the Hare will operate normally. To program the Hare, remove power, move the jumper so that it connects J2-1 to J2-2 (terminal numbers are indicated on the board), and then restore power. Note, the Digitrax caution above The Hare is now in the programming mode. It will remain in the programming mode until power is removed, the jumper is returned to J2-2 to J2-3, and then power is restored. In the programming mode, you can Set Address and Routes, and Program CV values. Below are the specific CVs that can be programmed, acceptable values to program, and what each value does.

Program Jumper

Setting Addresses: Do not use Ops Mode,

See also **Smart Routes** Pg-13

The default primary address of the Hare is 1. The default route address of all 28 routes is 2044. This means that out of the box, the Hare should respond to addresses 1 and 2044. Upon moving the Jumper to enter the address setting mode CV63 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 via your throttle will be stored as the primary address. To issue an accessory address you must select the address on your throttle then issue a clear or throw command (see your throttle directions for specific instructions on controlling accessories). You may continue issuing accessory addresses up to a total of 28 (one primary and 28 **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 the 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. If you want to set a specific route address without having to step through the primary and all the other route addresses, simply set CV63 to point to the address (0 though 28) that you want to program and then issue an accessory command at the desired address.

Programming CVs: Use Ops Mode

CVs 49 to 68 are also programmed by moving the Hare's programming jumper as discussed above. These CVs are programmed using the **Program-on-the-Main** (Pom or OPS mode) function of your command station. Follow your command station instructions for entering the Program-on-the-Main 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 68) to be programmed. Then enter the value to be programmed into the CV. **If you make a mistake, don't worry, just go back and program the CV to the desired value. If you are hopelessly lost, set CV63 to 42 and you can start over again with factory default values.** You may **Set Address** values and **Program CV** values in any order. For CVs use the OPS mode programming, and for addresses, use normal train running mode and issue accessory addresses. Exit the Program-on-the-Main (OPS) mode to restore the command station to normal operation. Once you have finished programming the Hare, remove power from the unit and return the programming jumper to the normal operation position. The Hare is now ready to go.

E) Setting Address and Programming (Continued)

CV49 is used to control which direction the Hare sees as the **Clear** and **Thrown** switch positions. It will accept a value of 0 (default) or 1. A value of 0 will cause the hare to operate as normal (right hand picture on page 3), and a value of 1 will cause the hare to respond in reverse of default operation (left hand picture on page 3). Make sure you determine values for CV49 only when the switch points are in the **Clear** position.

CV50 to CV62 and CV73 to CV87 are used to indicate the **Clear** or **Thrown** Switch Positions for the **Smart Route** turnouts. They will accept values of **0** (default), **1**, **2**, or **3**. A value of **0** will cause the points to move in the same direction of the DCC Accessory Command. A value of **1** will cause the points to move in the opposite direction the of the DCC Accessory Command. A value of **2** will cause the points to always go the **Thrown** position regardless of the commanded direction of the DCC Accessory Command. A value of **3** will cause the points to always go to the **Clear** position regardless of the direction of the DCC Accessory Command. This allows you to have Routes that either can be activated in both directions, or you can have a route that throws only in one direction to eliminate the need to remember which route takes which command. Note that if you are using the feature (Locked Route Control), you will need to use the primary address of the Hare to change the points from the route commanded position or you must define a different route that moves the points to the opposite position.
Caution: Smart Routes can only be implemented by programming CV 72. CV72=number of smart route addresses to enable. Default =0 (primary address only), Maximum=28

*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 or 2**. 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).

Address Setting CV63 has two functions. It is used indirectly to set the **Primary** address and the **28** route addresses during Address Setting. It is also used in CV programming to reset all addresses and CVs to their factory default values. It defaults to 0 when you move the program jumper to enter the address setting mode and automatically advances from 0 to 28 as the route addresses are entered by Accessory Commands. A value of 0 points to the primary address and 1 to 28 points to the **Smart Route** addresses. If you have already programmed some route addresses and don't want to disturb them, then set CV63 to point to the next available address that you want to program and you can access it directly. Programming CV63 to a value of 42 will reset the *Hare* to factory default settings. (See the chart in back for more details, Pg 17-18.

CV64 Smart Default sets the position of the switch points when power is turned on/off. It will accept values of **0** (default), **2**, and **3**. A value of **0** will cause the Hare to ensure that the points are in the same position as the last point movement command before power was removed from the layout. Note that auto throw is not considered a commanded position, so the points may not return to the last position if it was caused by an auto throw operation. A value of **2** will cause the Hare always to move to the **Clear** position when power is applied. A value of **3** will cause the Hare always to move to the **Thrown** position when power is applied. **Note: Digitrax users please follow the specific programming instructions on Pg-12, 17,**

CV64, (CV69 Auto Return Enable) and (CV70 Auto Return Delay) returns the points to a defined position after a fixed time interval. It is controlled by three CVs. **CV64** determines the **"home" position** of the points. This is the position to which the Hare will return the points after the desired waiting period following a point movement. **0** (the default) will return the points to the Clear position. A value of **2** will return to the Clear position and set the points to clear at power on. A value of **3** will return the points to the Throw position and set the points to Throw at power on. **CV70** sets the **Auto Return Delay** time between the start of the point movement and the time that the Hare automatically returns the points to the programmed position. The value to enter into the CV is the desired delay in seconds. Values of,**1** –**255** are valid, the default is **15**. **CV69 is Auto Return Enable** control. It sets which functions will activate. **1** enables Auto Return after a DCC command, **2** enables Auto Return after an Auto Throw, **4** enables Auto Return after a manual pushbutton operation, and **8** enables Auto Return in the Semaphore Ops mode. You can enable multiple Auto Returns by adding the individual numbers together to get the final CV value (e.g. 15 will enable Auto Return after any points movement).

E) Address Setting and Programming (Continued)

CV65 Switch Speed Control. Valid values for CV65 are **0** to **15** (default)**.** A value of **15** will cause the points to move at normal full speed (about 2 seconds Tortoise transit time). A value of **0** will result in the slowest speed (about 12 seconds Tortoise transit time). Values in between will result in proportionally faster or slower transit times. The very slow speed may show some loss of torque while the points are moving. At the end of the movement, full holding torque is applied to the Tortoise.

CV66 Dispatcher Override is for disabling the Auto-Throw feature when **Dispatcher Over-Ride**™ has been activated. You may select which functions are inhibited during the Dispatch Mode. This is controlled by CV66. A value of **1** will inhibit DCC operation during Dispatch Mode, **2** will inhibit Auto Throw during Dispatch Mode, and **4** will inhibit the manual pushbutton during Dispatch Mode. For multiple inhibits, simply add the individual values together (i.e. a value of 7 will inhibit all functions during dispatch mode – this is the default). If you have a control function enabled during Dispatch Mode and it moves the points (e.g. Auto Throw), the points will be out of position with respect to the Dispatcher switch. This situation is corrected by disabling/enabling the dispatcher switch, or simply toggling the Dispatcher switch to the opposite position and then returning it to the desired position. Auto throw is always enabled, regardless of CV66 value, when the Hare is not in the Dispatcher mode.

CV67 Auto Throw Timer allows you to set a variable time after an auto throw event during which the auto throw function is inhibited. This feature is designed for situations in which a train could bridge two auto throw trigger sections (or an approaching train could move the points under a train already occupying the switch). The first auto throw would align the points correctly, but the second one could throw the points under the train causing a wreck. The auto throw inhibit allows you to set a variable time from **0 to 255** seconds after the points have moved in response to an auto throw trigger during which neither trigger rail will activate the auto throw function. At the end of the programmed time period, auto throw is enabled and operates normally. Valid values for CV67 are **0** (default) through **255**. **0** will allow auto throw to function any time the auto throw is enabled (see CV66). Any other value is the time in seconds that auto throw is inhibited after auto throw has moved the points.

CV68 is used to enable **Semaphore** (crossing gate) operations. Valid values are **0** (default) and **1**. When CV68 = 0, all normal Hare switch control functions are active. Some modelers use the Tortoise to control the motion of semaphore signals or crossing gates. The Tortoise does an excellent job of moving these accessories due to its low speed operation. If CV68 is set to **1**, then the semaphore mode is activated. In this mode, the Throw trigger rail, when tripped, will move the Tortoise to the Throw position and turn on the red LED output. If the Clear trigger rail is tripped, the Tortoise will move to the Clear position and turn on the green LED output. In this mode, you **DO NOT** route power to the trigger rail sections. **MAKE SURE THAT ALL S1 SWITCHES ARE TURNED OFF!** The trigger rails are short sections of rail completely isolated from the layout power (that is, a short section of rail with an isolating gap at each end). The trigger rail should be no longer than half the length of your shortest engine. The trigger rails are placed an appropriate distance from the signal or crossing gate to give the appropriate time response to an approaching train. The trigger rails may be in either leg of the track, but both should be in the same leg of the track. Note that once the Hare is triggered, it will remain in the new position until the opposite trigger rail is activated by a metal wheel shorting the trigger rail to the adjacent layout power rail. Power on defaults (CV64) are still active in this mode, and accessory DCC signals can be used to change the position of the signal or crossing gate in the same manner as moving the points of a Turnout. Auto Return is available for use in this mode.

Implement Smart Route feature: See Setting Accessory Addresses above.

Caution: Smart Routes can only be implemented by programming CV 72. CV72=number of smart route addresses to enable. Default =0 (primary address only), Maximum=28

Any un-programmed Smart Route turnouts will respond to ADD 2044. The *Hare* has a normal DCC address that can be programmed with a DCC system. Added to this are 28 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 address so you can 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

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	Address Number	Smart Route Command **Clear** or **Thrown**	Follow or Reverse Smart Route Command, Always **Thrown,** or Always **Clear**	CV Value	CV	CV Values used
Primary Address			N/A		49	0,1
#1 Route Address					50	0,1,2,3
#2 Route Address					51	0,1,2,3
#3 Route Address					52	0,1,2,3
#4 Route Address					53	0,1,2,3
#5 Route Address					54	0,1,2,3
#6 Route Address					55	0,1,2,3
#7 Route Address					56	0,1,2,3
#8 Route Address					57	0,1,2,3
#9 Route Address					58	0,1,2,3
#10 Route Address					59	0,1,2,3
#11 Route Address					60	0,1,2,3
#12 Route Address					61	0,1,2,3
#13 Route Address					62	0,1,2,3
#14 Route Address					73	0,1,2,3
#15 Route Address					74	0,1,2,3
#16 Route Address					75	0,1,2,3
#17 Route Address					76	0,1,2,3
#18 Route Address					77	0,1,2,3
#19 Route Address					78	0,1,2,3
#20 Route Address					79	0,1,2,3
#21 Route Address					80	0,1,2,3
#22 Route Address					81	0,1,2,3
#23 Route Address					82	0,1,2,3
#24 Route Address					83	0,1,2,3
#25 Route Address					84	0,1,2,3
#26 Route Address					85	0,1,2,3
#27 Route Address					86	0,1,2,3
#28 Route Address					87	0,1,2,3

	CV	CV Values used
Pointer and Reset	63	0-28,42
Power up Position (Smart Default)	64	0,2,3
Programmable Point Speed	65	0-15
Dispatcher Over-Ride (Auto-Throw Lock-Out)	66	0,1,2,4
Auto Throw Timer (auto throw inhibit time)	67	0-255
Semaphore OPS mode	68	0,1
Auto Return Enable	69	0,1,2,4,8
Auto Return Delay	70	0-255

Caution: Smart Routes can only be implemented by programming CV 72. CV72=number of smart route addresses to enable. Default =0 (primary address only), Maximum=28

G) 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.
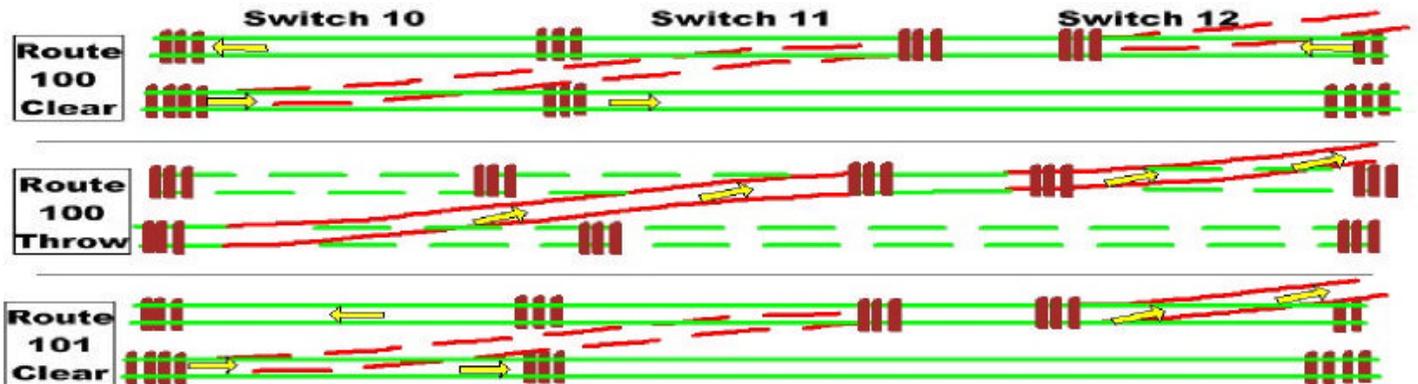
Assume the primary address of the left-most switch is 10, the middle primary address is 11, and the right-most switch primary address is 12. All three switch arrangements can be accessed by programming two routes. Assume the first route has address 100 and the such as address 101. The programming tables for each switch are shown below.

Address	Programmed Address	Route Command	Follow or Reverse Command	Route/ Switch Position CV	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	Route/ Switch Position CV	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	Route/ Switch Position CV	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. At other times, only a throw or clear command may make sense.

H) Sequential Programming Instruction for Setting the Address and Programming CV's

Digitrax: Using the DT-400/402

Setting HARE Addresses:
1. Disconnect HARE from DCC power
2. Move HARE Jumper to Program Position
3. Turn DCC power on "PWR"+ " Y+"
4. After 30 seconds, reconnect DCC power Program CV's at this time (see below)
First, In CV 63, enter a value of 42 to reset. Then set any other CV's needed. Do not
 Move Programming jumper or turn off power. .Exit program mode and go to step 5.
5. Press "SWCH" key to enter Switch Mode
6. Select the switch number to be set using the keypad or RH knob.
7. Press either the "OPTN" or "CLOC" key to set address.
8. Repeat steps 6 and 7 until all addresses set.
9. Press "EXIT" key to return to LOCO mode.
10. Turn DCC power off "PWR" " N –".
11. Move HARE Jumper to Run Position
12. Turn track power on. Test the switch address setting by using the
 "SWCH" key 000000000and switch addresses.
13. Turn power off and put the program jumper into the Run position.
14. Turn DCC power on. Test the HARE using the switch commands.

Programming HARE CVs: Do Setting Addresses First, See Above
1. Disconnect the HARE from DCC power.
2. Move HARE Jumper to Program Position
3. Turn DCC power on "PWR" " Y+"
4. After a few seconds, connect DCC power to the HARE
5. Select an unused locomotive number with the keypad or RH knob.
6. Press "PROG " key until you get from Pg to Po
7. Use LH throttle to set, dial the CV number and the RH throttle for the CV value.
8. Press, "ENTER"
9. Repeat steps 7 & 8 until all the CV values are set.
10. Press "EXIT"

NCE: Using the Pro Cab or Power Cab

Setting HARE Addresses:
1. Turn DCC Power off
2. Move HARE Jumper to Program Position
3. Turn DCC Power on
4. Press SELECT ACCY
5. Then use the keypad to enter the new switch number.
6. Press ENTER then press either 1 or 2 to set the address.
7. Repeat steps 4 thru 6 until all of the switch addresses are set.
8. Turn DCC Power off.
9. Move HARE Jumper to Run Position.
10. Turn DCC Power on
Test the switch setting using the SELECT ACCY key

Programming HARE CVs:
1. Turn DCC Power off
2. Move HARE Jumper to Program Position
3. Turn DCC Power on
4. Use SELECT LOCO to address an unused locomotive number
5. Press PROG/ESC key to enter PROGRAM ON MAIN mode.
6. Key ENTER to select the unused locomotive number, then ENTER again.
7. Key 2 to enter PROG CV NUM
8. Enter CV number then ENTER
9. Enter value to be stored then ENTER.
10. Repeat steps 8 and 9 until finished.
11. Press PROG/ESC to return to normal operation.
12. Turn power off and put the HARE Program Jumper into the Run position.
13. Turn power on
Test the HARE using the SELECT ACCY key.

H) Sequential Programming Instruction for Setting the Address and Programming CV's

Lenz: Using the LH100:

Setting HARE Addresses:

1. Turn DCC power off.
2. Move HARE Jumper to Program Position
3. Turn DCC power on
4. Press "F5" key to select "SW" mode.
5. Enter the switch number to be set using the keypad, then press ENTER.
6. Press either the "+" or " – " key to set the address. Let LED blink once.
7. To enter another address press the "CI" key.
8. Repeat steps 5-7 until all addresses are set.
9. Press "ESC" key to return to normal.
10. Turn DCC power off.
11. Move HARE Jumper to Run Position
12. Turn track power on.
13. Test the switch address setting using "SW" mode and the new switch address(es).

Programming HARE CVs:

1. Turn DCC power off.
2. Move HARE Jumper to Program Position
3. Turn DCC power on.
4. Select a locomotive number with the keypad that is unused on your layout.
5. Press the "F" keys and the "+" or "– " key to select "PoM" mode then hit "Enter".
6. Press "+" or "–" until "CV" is displayed then press "Enter".
7. Key in the desired CV number then press "Enter"
8. Enter the CV value to change, then press "Enter".
9. The display will show the CV number and value to be programmed.
10. Hit "Enter" to program the CV, note the LED on the HARE flashes when the key is released
11. Press "Esc" key to return to Step 7) or press "Esc" three times to exit CV programming
12. Turn power off and put the Program jumper into the Run position.
13. Turn DCC power on.
Test the HARE using the switch commands.

MRC: Using the Prodigy Advance Cab:

Setting HARE Addresses:

1. Turn DCC Power off
2. Move HARE Jumper to Program Position
3. Turn DCC Power on
4. Press ACCY key
5. Then use the keypad to enter the new switch number.
6. Press ENTER then press either 1 or 2 to set the address.
7. Repeat steps 4 thru 6 until all of the CV values are set.
8. Turn DCC Power off
9. Move HARE Jumper to Run Position.
10. Turn DCC Power on
Test the switch setting using the ACCY key.

Programming HARE CVs:

1. Turn DCC Power off
2. Move HARE Jumper to Program Position
3. Turn DCC Power on
4. Press LOCO to address and key in an unused locomotive number.
5. Press PROG key to enter PROG MAIN TRACK mode, then press ENTER.
6. Continue to press ENTER until CV# is in the display.
7. Enter the CV number then ENTER
8. Enter the value to be stored in the CV then ENTER.
9. Repeat steps 8 and 9 until finished.
10. Press ENTER to return to normal operation.
11. Turn power off and put the HARE Program Jumper into the Run position.
12. Turn DCC power on.
Test the HARE using the ACCY key.