



Combined Manual for Chief Starter Set, DCS100 Command Station/Booster & DT100IR Throttle

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1.0 Introduction

Congratulations on your purchase of a Digitrax Chief Starter Set, DCS100 Command Station/Booster and/or DT100IR Throttle! The overall design of the Digitrax Command Control system allows you to create a working layout by connecting various system components in the configuration that best meets your needs. The Digitrax system drastically reduces & simplifies layout wiring; you probably won't need to rewire your existing system. To create a DCC system you will need a Command Station, a Booster, a Throttle & several mobile decoders for your locomotives. LocoNet is the communications network Digitrax products use to put it all together.

- Each system has one Command Station that generates the DCC packets that tell the decoders what to do & produces Rail Sync so that all the devices you attach to LocoNet work together. With the Digitrax System you have a choice of several command stations to allow you to tailor your system to meet your needs. In an effort to keep the price down, we have chosen to combine command station functionality with other system hardware components. The DB150 Command Station/Booster is the command station for Genesis and Empire Builder sets. The DCS100 Command Station/Booster is the command station for the Chief Starter Set.
- Boosters receive the DCC signal from the Command Station, amplify it & put it on the track as the power that runs the layout. You can have several boosters on a system, each driving its own track section. You can have both regular or auto reversing boosters depending on your needs.
- Throttles are input devices that tell the Command Station what you want the decoders to do. You can have many throttles on your system. The number is determined by the capabilities of the Command Station you are using.
- The Decoders in the locomotives or under the switches or other accessories receive the signal from the track, decode it & tell the locomotive or switch/accessory what to do.
- There are many different combinations of Digitrax products that you can use to set up a system that is just right for your application. You can also combine Digitrax products with DCC compatible decoders, boosters & computer software made by other manufacturers.

Your success with & enjoyment of our products are very important to us. After all, this is a hobby & it is FUN!!! Please read this manual carefully before you install your DCS100 & DT100IR. We have included lots of hints & operating ideas based on our experience with the Digitrax system. If you

have questions not covered by this manual please contact your dealer or call us directly.



1.1 LocoNet: The Digitrax Difference!

LocoNet is a powerful communications network especially designed for model railroad operation. It is engineered for rapid response even when many throttles & other devices are connected to the network.

To engineer LocoNet, we used all of the best features of the powerful Ethernet CSMA/CD Local Area Network, the most universal worldwide hookup standard for computer networks. We ensured that LocoNet's protocol was Peer-to-Peer, which any LAN expert will confirm, gives the most powerful & expandable software architecture.

LocoNet offers you a powerful yet SIMPLE "plug & play" connection scheme for wiring a high performance Digital Command Control railroad layout. LocoNet is cost-effective & easy to maintain, & gives excellent high speed total system performance. In particular, the system is designed to be sure that as 100 or more throttles & hundreds of sensors & other devices are added to the system, there will be no operator perceptible delays as the LocoNet **system** executes all the operators' requests. Only a Peer-to-Peer type technology on a true two-way Multiple Access network can meet these performance & expandability targets.

Your LocoNet network allows very simple, "free form" wiring & has passed the stringent Radio Interference rules of FCC Part 15 Class B, as required for home installations. This makes adding extra devices & features simple- **no complex Bus connection & terminator rules to worry about.** We have even run throttles & sensors on a LocoNet system over 2,000 feet long using "vanilla" telephone wire!

LocoNet is expandable so that as new features are added you can simply connect & "overlay" these capabilities to your existing working LocoNet system *with minimal disruption or changes to existing hardware & software.* Only a carefully crafted & smart Peer-to-Peer network can offer this unique & open-ended expandability.

So, LocoNet is more than just hardware, it is a number of operating system, hardware, wiring, communications architecture & software innovations that are synthesized together to create the total LocoNet system concept.

To the average user this means **Sophistication without Complexity**. You have a system that is easy to hook up, run & expand in the future. You don't need to worry about the high-tech details; Digitrax has already sweated them out for you. Just enjoy operating your layout- it's that simple & powerful!

2.0 DCS100 Command Station/Booster Features

- **The DCS100 is a combination DCC Command Station & Booster.** The DCS100 operates as the command station & main system booster on a Digitrax LocoNet system. It can also be used in conjunction with your computer if you choose to do so.
- **The DCS100 accepts throttle input from any LocoNet throttle** (DT100IR, DT100IR, DT200, BT2, UT1, UT2, Computer throttle & new Digitrax & LocoNet Certified throttles of the future.)
- **Control over 9,000 locomotive addresses.**
- **Aliasing** capability gives you four digit addressing for ALL DCC decoders.
- **Roster capability** lets you set up the locomotives you operate most often in an easily accessible list.
- **Built in read/write programmer & separate service mode programming output** allows you to program each individual decoder's acceleration, deceleration, start-voltage, mid-point voltage, loadable speed table, etc., without shutting down the layout.
- **Operations mode programming** lets you program expanded packet format (EPF) decoders “on the fly” while they are on the mainline.
- **128 speed step operation!** You can select 14, 28, or 128 speed step operation for each individual decoder so you don't have to sacrifice performance if you have some decoders that have 128 speed steps & some that don't.
- **Basic, Advanced or UniVersal Consisting** lets you choose how you handle consists.
- **Function Control.** Control directional lighting & additional function outputs from the keypad.
- **Control up to 999 switch addresses** from the DT100IR keypad.
- **Absolute switch position control** with the DT100IR keypad. Press  for closed and  for thrown.
- **Route** capability to simplify complex yard operations.
- **Switch Feedback memory.** The DCS100 automatically handles switch feedback reporting if you have LocoNet Certified switch feedback modules programmed & attached to the system.
- **Compatible with the NMRA Baseline DCC standard & RP's.**
- **Customizable System Options** let you set up how *you* want your system to run. You can have “beeps” on or off, you can set time outs, set up purge options, enable Motorola trinary modes, enable automated decoder

consisting & much more. A large range of customizable options. Defaults are values that will work for most layouts.

- **Motorola format compatibility mode** lets you run DCC & Motorola format trinary decoders at the same time.
- **DCS100 Booster Capabilities** give you a 5 amp High Efficiency booster along with your command station.

A powerful 5 Amp Digital Command Control Booster Rated at 96VA Accepts either 50/60Hz AC or DC input from your existing power supply. Minimum input voltage: 12.6V AC or DC, Maximum input voltage: 22V AC or 28V DC. The power supply you use should be within this range & should be overload protected for its rated output, up to a maximum of 5 amps.

Auto resetting over temperature & short circuit protection. Unique smart protection will not "weld" derailed locomotives to the track.

Multi Scale selectable voltage for N through G scale operations.

User adjustable voltage trim.

Track Status indicator shows voltage & signal type (DCC or "Zero Stretch" Analog Signal for conventional operation.)

Stabilized Track Drive Output. .

LocoNet Expansion Network for easy reliable system hook up & future system expansion.

High impedance balanced signal input receivers on the LocoNet Interface allow reliable boosting of several different types of command control signals in large wiring plans.

Auto shutdown if command control drive signal is lost so that the layout will not convert to DC operation if a cable or connection is broken. The trains won't just "take-off" if they are not getting the DCC signal.

- **DT200 Compatibility Mode.** All DT200's in the system become walkaround throttles & will be able to perform all the same functions as before if you use a DCS100 as the system command station. The DT200's will still be limited to 127 locomotive & switch addresses.
- **Brake Section Generator,** the DCS100 can be configured to generate DCC Broadcast Stop or "Brake Section signals" when the Programmer is not in use. Simply add a second DB100a booster & some simple relays, ballasts & wiring to create automatic signal-controlled STOP sections.

3.0 DT100IR Advanced Digital Throttle Features

- The DT100IR is a full featured advanced DCC throttle. It works as an advanced throttle on LocoNet when another device such as a DCS100, DB150, DT200 or a computer is acting as the command station.
- The DT100IR's display is a large easy to read LCD with four digits & other indicators. It also uses several LED's to indicate status.
- The DT100IR is different from most throttles you have ever used because it has two sets of throttle controls on a single hand held. The left hand throttle knob & the left hand direction arrow key work together to control the speed & direction of one train while the right hand side can control another train at the same time. This arrangement is particularly useful if you are operating alone & want to have two trains under your control. The **dual throttle** arrangement makes consisting & helper operations simple & much more prototypical.
- The DT100IR's throttle knobs are **encoders** rather than potentiometers. When you turn the throttle knob, it rotates more than one turn from 0 to full speed. These knobs give you incredibly fine speed control & when you select another loco, the throttle knob position does not change the speed of the new loco selected. No more rushing to adjust the throttle to match the loco's current speed! (Note: If you prefer push-button operation, just use the up & down arrow keys.)
- The DT100IR requires no battery for normal operation allowing the throttle to be unplugged from the network and moved to the next location, for full walk around capability.
- With a compatible Infra-red receiver, such as a Digitrax UR90 or 91, the DT100IR is capable of full infrared tetherless operation by just adding a 9 volt battery.
- Displays aliased addresses for baseline 2-digit DCC decoders
- Supports 4 digit addressing with 14 bit or long address expanded packet format (EPF) decoders
- Function Control. Control directional lighting & up to 8 additional function outputs from the keypad.
- Displays switch position & can also show actual switch feedback.
- Access to three service mode programming methods
- Access to operations mode programming (programming on the mainline).
- The DT100IR operates as an advanced throttle on a DT200 (Big Boy) Command Station, too!
- Fully networked user configurable Fast clock, with Editor.
- Individual Throttle 24 hr Fast clock Alarm setting
- Editor to create & modify Routes
- Advanced locomotive sharing capability to allow supervised operation & future advanced system features

- Customizable for user throttle preferences. You choose whether the throttle knobs have straight line or ballistic tracking, set up default mode for new decoder address set up & more.

4.0 QUICK INSTALLATION GUIDE

These simple instructions will get your Chief starter set up & running quickly. You can investigate the specifics later but, for now let's get your trains running. A full description of all controls & technical reference information are included later in this manual.

Before you begin your installation be aware that the addition of DCC to your layout will not correct existing wiring problems. Usually, if you can run an analog engine smoothly on your railroad, you won't have a problem hooking up DCC. If you do have concerns about your existing wiring, start by running the Chief on a separate loop of temporary track.

4.1 Making Track & Booster Connections

See the "Chief Set Quick Start Hook Up Diagram," Diagram 1.

A) Start with the DCS100 & your conventional power pack or other suitable transformer. See section 5.0 for information on how to choose an appropriate power supply.

B) Set the  SCALE switch on the DCS100 to the scale you are running N, HO, O/G(also used for S). To get the best low speed performance, we recommend using the DCS100 in the "N" scale setting (even if you are running HO). *When running analog locomotives (without decoders) we strongly suggest that you use the "N" scale setting to give quieter operation & generate less heat build up in the analog engines.*

C) Set the  MODE switch on the DCS100 to the "RUN" position.

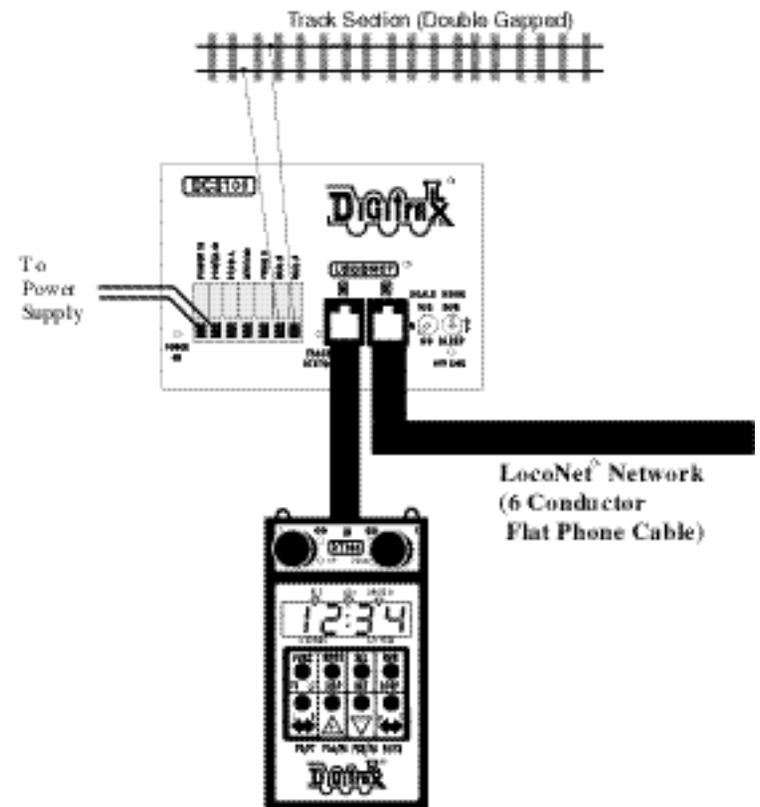
D) The GROUND terminal on the front of the DCS100 provides electrical safety features and an RF ground reference for minimum radiated noise. It should be the ONLY point of any installation that is connected to the AC safety ground pin provided on most 3 pin 110V AC power sockets. If the power outlet is a 2 pin ungrounded unit, this ground terminal can be connected with a GREEN 14 AWG multi-stranded conductor to a cold metallic water pipe ground, as defined in the National Electrical Code. This is a safety precaution that should not be ignored.

E) Connect the two POWER IN terminals to the output of your transformer or power supply source. Turn on your power supply to send power to the DCS100.

F) The DCS100 will "beep" & the "Power ON" indicator **ON** ○ will light up GREEN. Also, the _{NET} ○ indicator will glow steady RED, showing that the unit is in "RUN" mode & that the LocoNet network is OK. If the unit has been configured the _{CONFIG} ○ indicator will be GREEN with a single brief "wink" off about every 4 seconds. The red "OVER TEMP" light will also be lit. The full meanings of these indicators are covered in section 8.2.

G) The "Track Status" indicator should be off at this point. This is the normal system default after input power is applied to the DCS100. Now that the DCS100 is ready to go, we can connect a throttle and start running the layout.

Diagram 1: Chief Set Quick Start Hook Up



Notes:

1. You can plug into either the A or B port on the DCS100 because they are wired in parallel and are interchangeable.
2. The DT100R throttle that comes with your Chief Set does not have to be plugged directly into the DCS100. It can be plugged in any LocoNet jack on the system. All throttles are walk around when you use the DCS100 as the system command station.
3. Expand your LocoNet Network by "daisy chaining" components as shown in Diagram 2 on the next page.

See Section 7.2 for information about Auto Reversing Operation.

Diagram 2: Expanded LocoNet Connection Example

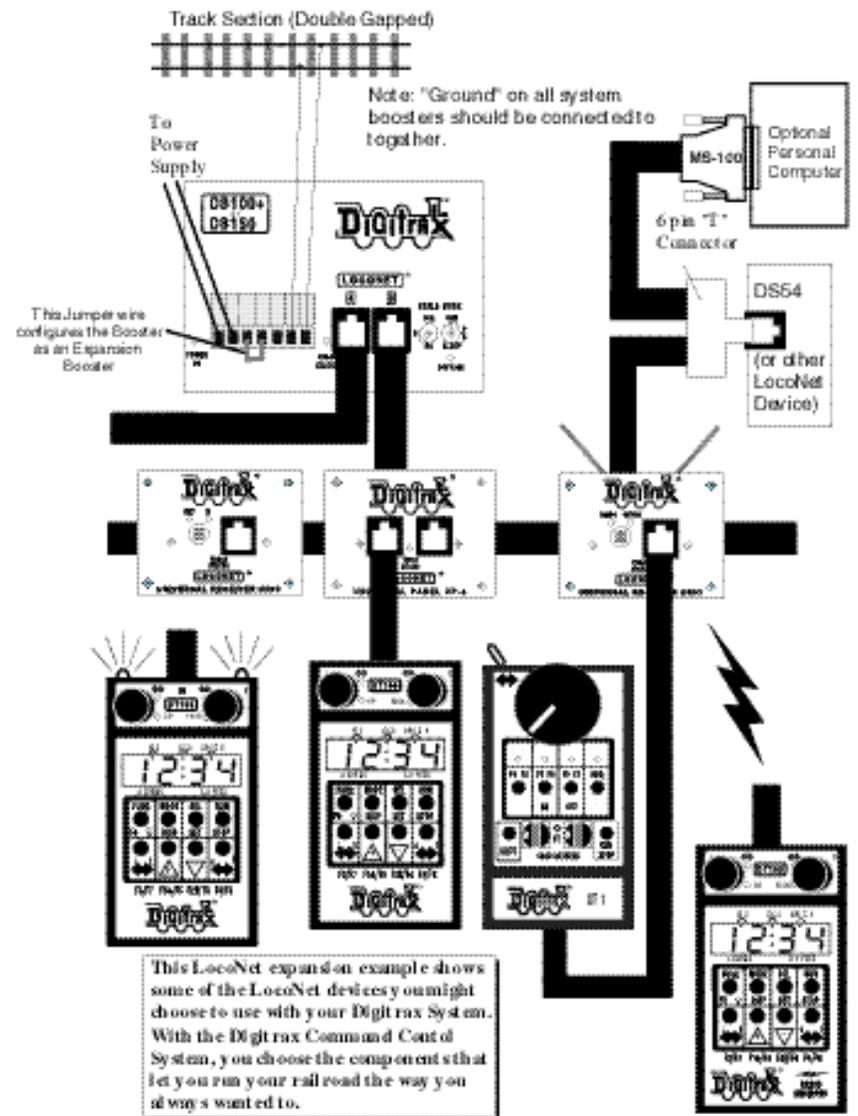
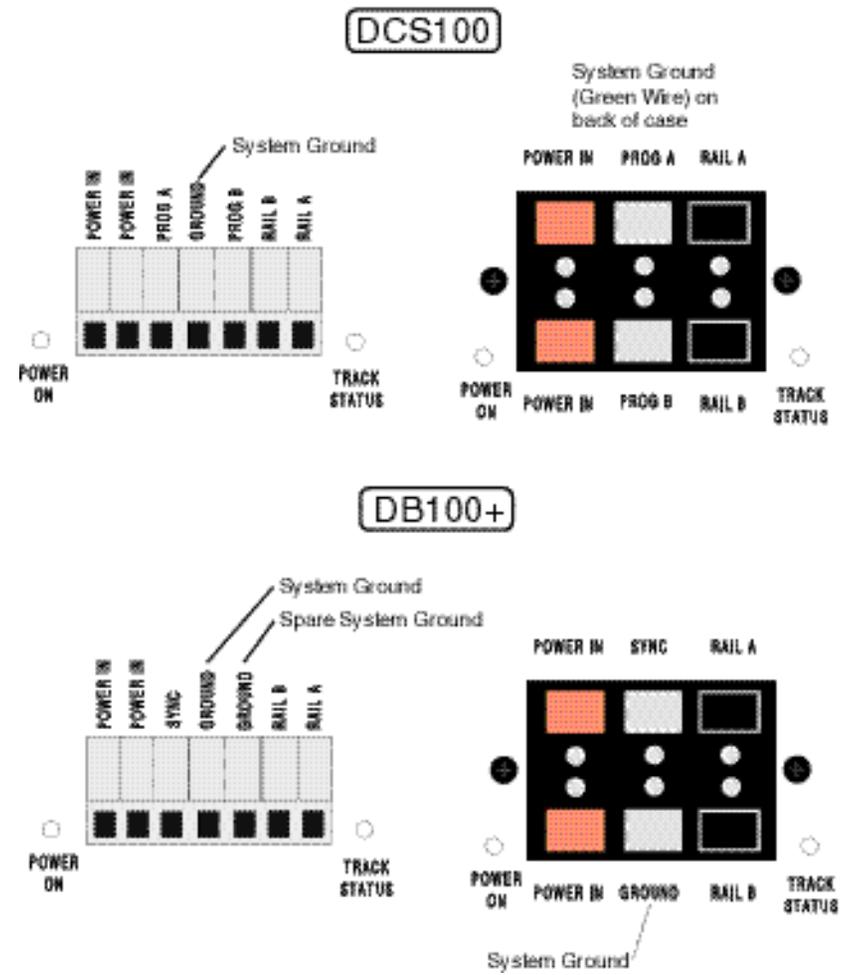


DIAGRAM 3:

DCS100 /DB100 CONNECTOR DIFFERENCES

Your DCS100/ DB100 may have one of two different connectors. Either style will work with the other. To avoid any confusion regarding how to wire your Booster please refer to the following drawing.



4.2 Plugging In Your DT100IR Throttle

The DT100IR comes from the factory with the most common features set as the default. We recommend that you start with these default settings, You can still change them later if you choose.

Logging Onto The LocoNet System

1. For normal operation the DT100IR does not need a battery. When it is unplugged from the network the display will be blank.
2. Plug the DT100IR into either LocoNet Jack on the DCS100
3. The DT100IR will beep & the LCD display will display either "idLE" or "SE:L". If the DCS100 Booster section is not supplying track power to the rails, both the DT100IR's direction indicators  will be steady ORANGE, the DCS100's Track Status indicator will be off and DCS100's "OFF LINE" Indicator will be on. If you already have more than one booster on your layout, the DCS100 is commanding all other boosters to have their track power OFF, also.

Turn On Track Power

1. Press down & hold the  key then also press the  key. This commands the system to turn on Track power.
2. The combination  &  will turn off all system track power.

Turn Off the track power

With the DT100IR plugged into LocoNet, turn off the track power by pressing and holding the "RUN/STOP" button, then simultaneously pressing the "-" MINUS button. The unit will beep once and the "TRACK STATUS" light on the DCS100 will go out. Note: While track power is off, BOTH direction indicator LEDS on the DT100IR will be a steady YELLOW.

Checking For Run State

1. The DT100IR's direction indicators  will be *flashing* ORANGE if the track is powered but is in "Stop" where all mobile decoders are powered but commanded to stop. The DCS100's "OFF LINE" indicator will be lit.
2. To change from "Stop" to "Run," press down & hold the  key then also press the  key. The direction indicators  will no longer be ORANGE but will show the direction of the decoder assigned to the adjacent throttle knob. GREEN for Forward, RED for Reverse & OFF for no address selected. The DCS100's "OFF LINE" indicator will no longer be lit. Each time you hold the  &  keys down the system will toggle between "Run" & "Stop" with track power on.

Connect The Layout To Chief

1. The DCS100 track status indicator should now glow ORANGE, indicating that the track is powered.
2. Connect the Rail A/B terminals to your track.

Note: During your initial installation, we recommend that you make these connections after powering up the DCS100 & DT100IR so that you will be able to determine that your DCC equipment is working properly prior to introducing any potential outside wiring problems. If your layout has any short circuits & you connect it to the DCS100's RAIL A/B terminals, when you power up the DCS100 it will beep up to 5 times & shut down the RAIL A/B terminals until the fault is cleared.

Once your track is powered without any faults, you can proceed to select & run DCC and analog locomotives. We recommend that you run an analog locomotive first.

4.3 Run An Analog Loco on Address "00"

How to Select Address "00":

Note: With the DT100IR you can control two different addresses at the same time, one on the Left Throttle and another on the Right Throttle. Because only one throttle can be displayed on the DT100IR's LCD screen at a time, we use the direction indicator  to indicate which side is currently "display active". The "display active" throttle is the one with the flashing RED or GREEN direction indicator .

1. Turn the Right Throttle Knob "R" a 1/4 turn in either direction to activate the Right Throttle. The display will show **SE:L-**, indicating that no Locomotive is selected on the Right Throttle & *prompting you that the  key must be pressed to activate a selection in this throttle.*



2. Press the  key to select an address. The display will typically show **00:03**, with the 2 digits in the "Address" side (left hand side) of the display flashing to let you know that you need to select an address. The "LOCO" flag on the screen will also flash during address "browsing" or selection.

Note: During 2 digit loco address selection, the right hand side of the display shows complete status information of any locomotive address in the display. Section 15.0 gives details of locomotive status codes & what they mean and how you can use them in your operations.

3. Turn either throttle knob, or use the   keys, to scan or "browse" through the addresses until you reach the address number "00". Notice, turning the knob clockwise increases the loco address number & turning the knob counterclockwise reduces the loco address number. When you

have scanned to the address you want, '00' in this example, press the  key again to SET this address *active* in the Right throttle. The display will stop flashing & the direction indicator  next to the Right throttle will flash GREEN indicating the Right throttle is the "active display" throttle & the system assumes that the locomotive is going forward. Note: Since this is an analog loco the actual direction is determined by the orientation of the track feeds and how the loco is placed on the track. In the case of an analog loco, the direction indicator  may or may not match the physical direction of the loco. In the case of a correctly wired DCC loco the direction indicator  will always match the actual loco direction. If you press the  (right arrow) key to change direction, the direction indicator  will flash RED indicating that the loco has changed direction.

Checking Analog Mode

Before placing an analog locomotive on the track you should

1. Turn the Right Throttle knob "R" clockwise slowly to 99% or full speed. The DCS100 "TRACK STATUS" indicator should change from ORANGE to more RED or GREEN indicating that we will be able to control the analog locomotive on the layout.
2. Press the reverse  direction key for the right throttle. The right direction indicator  will change from blinking GREEN to blinking RED. Also the TRACK STATUS indicator on the DCS100 will change from RED to GREEN or vice-versa.
3. Once you observe these "track status" indications, turn the Right Throttle counter clockwise down to 0% speed.
4. Place an analog locomotive on the track fed from the DCS100 Rail A/B terminals. Remember, that we recommend that you use the "N scale" setting when using an analog locomotive on your layout. The locomotive should not be moving on the layout and you will hear the locomotive "sing" slightly due to the DCC track signal. Once the analog loco is moving, this sound will change and be less noticeable.
5. Use the Right Throttle knob to run the analog locomotive. As the value in the % SPEED display increases, the locomotive on the track will begin to move.
6. Once you have successfully run an analog locomotive, then you can add a second locomotive that is equipped with a decoder. Follow the instructions in your Decoder User's Manual to complete the decoder installation and proceed to the next step.

4.4 How To Select & Run A DCC Equipped Loco

In order to select a DCC locomotive to run on either throttle, you must know its address. All Digitrax decoders are factory programmed to the default 2

digit address "03." If your decoder has not been re-programmed then select "03" as the address for the Left Throttle knob "L." If you do not know the address of the DCC locomotive you want to run, you have two options: You can read back the actual address of the decoder using the programming track as outlined in section 21.2, OR you can re program the decoder as outlined in section 21.2 or 21.3.

Selecting A 2 Digit "Short" DCC Locomotive Address

This Quick Installation only deals with DCC locomotives equipped with the decoder that came with your Chief Set. These decoders are factory programmed to use 2 digit addresses and are capable of 128 speed step operation. If you wish to use other decoders during the Quick Installation procedure please see the notes below.

1. Turn the Left Throttle Knob about 1/4 turn to activate the left hand throttle.
2. The display will change to **SE:L-** to let you know that the Left throttle is display active but has no loco address selected.
3. Press the  (Select/Set) key. SE:L- will begin to flash.
4. Use either the throttle knob or the   keys to scan for the locomotive address you want to run. Address "03" in this example. When the address you want to run is in the left side of the display, press  (Select/Set) to SET this address as the active address in the Left Throttle.
5. The left throttle direction indicator  will flash GREEN indicating that the Left throttle information is currently displayed & that the DCC locomotive's direction is forward.
6. Now use the Left Throttle Knob to run the DCC loco you have selected and set to the Left throttle.
7. Since the display can only show information for one throttle at a time, the throttle direction indicator  shows which throttle is on display by flashing. Notice *when we started working with the Left throttle* that the Right direction indicator  stopped flashing & became a steady color indicating the direction of the Right throttle's locomotive. To display the Right throttle address & % speed all you have to do is move the throttle knob or change the locomotive's direction.

By now you are running two locomotives (one analog and one DCC) and you have learned some of the key concepts of using the DT100IR!! Please read the following sections for more in depth information about other features & capabilities of the Chief set. ENJOY!

QUICK INSTALLATION Notes for Users of Non-default Digitrax Decoders and Decoders Made by Other DCC Manufacturers:

1. The DCS100 command station defaults to 128 speed step operation so, if you are using a DCC locomotive with a decoder that does not have 128 step capability, please refer to section 15.1 - 15.2 for instructions to modify or Status Edit the speed step mode that the system will use for this locomotive address. OR see section 24.0 to change the global System default from 128 Steps to something else.
2. If you can't control the operation of the lights in your locomotive with the DT100IR (in default 128, or 28 speed step mode), be sure that the decoder itself is programmed in advanced 28 speed step mode. Please refer to section 26.5 "Strange Lights" for corrective measures.

4.5 Shutting Down the System

When you are finished, there are two different ways to shut down your system.

1. When using current production "Tethered" throttles such as the DT100IR, UT1 or UT2, we recommend that all locomotives speed be set to zero and then be released back to the system. Now turn off track power by pressing  &  on any DT100IR, then turn off the power to the system.

To resume your session where you left off, simply turn the power back on. Any throttles plugged into LocoNet will beep within a couple of seconds to indicate that LocoNet is active again. The throttles will display whatever was active in the display at shut down.

If the track status indicator did not come on when you switched the DCS100 back on, then press the  &  on any DT100IR to restore track power.

2. If you are using throttles that use a battery such as the DT100, DT200 or BT2, you can shut down the Chief & LocoNet by simply switching the DCS100 "Mode" switch to the "Sleep" position . At this point all attached throttles will go to "idLE" indicating that they are powered down and in the "sleep" state. It is fine to leave the power to the **DCS100 on all the time**. It consumes less energy than a 20th of a normal household lamp and in this state the DCS100 provides keep alive power to all throttles that are connected properly to LocoNet. This conserves throttle battery life.

When you are ready to resume your session exactly where you left off, simply switch the DCS100 "Mode" switch back to the "Run" position . The attached DT100IR's and DT200's will beep within a couple of seconds to indicate that LocoNet is active again and the "idLE" displays on the throttles will change.

If the track status indicator did not come on when you switched the DCS100 back to "RUN" mode, then press the  &  on any DT100IR to restore track power.

That's all there is!

At this point you have placed your Chief set in service & can now continue to add to the layout, LocoNet system & operations as *you* desire. See diagram 2 to get an idea of how to add a host of other Digitrax & other vendors' LocoNet Certified components & expand on the Chief set as the core of a very powerful & expandable networked system!

If you had problems at any step in this Quick Installation section, we suggest you try backing up a step until you get correct results. We carefully set up the installation procedure so that if you follow them carefully, any problems you encounter will be easy to isolate & debug.

If you have any questions or problems, we encourage you to call, fax or e-mail us or your favorite Digitrax dealer. We have a lot of experience at helping a diverse range of customers with successful installations. We have staff available to help during normal business hours, so if you are "spinning your wheels" we would be very glad to help.

5.0 Power Supply Considerations For Boosters

The DCS100 accepts a minimum input voltage of either 12.6V AC (50/60 Hz) or DC. Maximum input voltage is 22V AC or 28 V DC. You can use either AC or DC from a model railroad power pack or you can use a generic transformer. The power pack must be overload protected for its rated output up to a maximum of 5 amps.

The DCS100 contains a high efficiency DCC booster section that stabilizes the track drive voltage to be related to the scale setting selected. It trims any excess input voltage as heat into its large capacity heatsink. For maximum current drive capacity select the lowest input voltage possible for the particular scale. For N scale you can use 12.6VAC transformers of sufficient current capacity. The optimal input voltage for use with the HO setting is a 12.6V AC to 16V AC transformer, & the O/G setting works well with an 18VAC transformer.

You can use other values, but the values recommended above will give maximum sustained drive power. If you have DC power use the same voltage as the AC values given here.

The DCS100 booster section has a max. output current limit of 5 amps. This means that when the booster sees a 5 amp or greater load, it regards this as a short circuit and will shut down until the load is removed or reduced below the 5-amp threshold.

Actual continuous output current depends on several factors.

- 1) Input supply voltage
- 2) Room temperature / airflow over booster heat sink

Higher input voltages increase the amount of heat that must be dissipated by the booster heat sink. If the heat sink does not get sufficient airflow or the heat sink is blocked, the booster will eventually reach an OVERTEMP state and shut down.

A small fan blowing cooling air on the DCS100's heatsink will also help to maximize the sustained current capacity.

5.1 Transformers

There are many transformers & power packs that can supply the input power for the DCS100 &/or DB100. Most regular DC train control packs do not have enough power to supply the full power potential of the DCS100 &/or DB100 booster, since they were typically designed to only run 1 locomotive in a blocked system. You could temporarily use these lower capacity power

packs to test the system & demonstrate operations with a limited locomotive count. To get the full power potential you will probably need to hook up a suitable transformer with a higher power rating.

You should be very careful in hooking up a transformer to be sure that you do not create a shock or fire hazard. Many modelers have safely hooked up line transformers when creating their own conventional DC throttles, from one of the many "do it yourself" project articles.

If you are not trained to safely work with 110 Volt input wiring, we strongly suggest you consult with an electrician.

In particular you must be certain to fully isolate the Primary power supply input to the transformer from the Secondary or low voltage side. A Primary fuse is needed to ensure that if a fault develops that the user is forced to check the unit carefully before returning it to service.

The following is an example list of components for building your own low cost power supply for use with the DCS100 &/or DB100 using 110V/60Hz AC line power

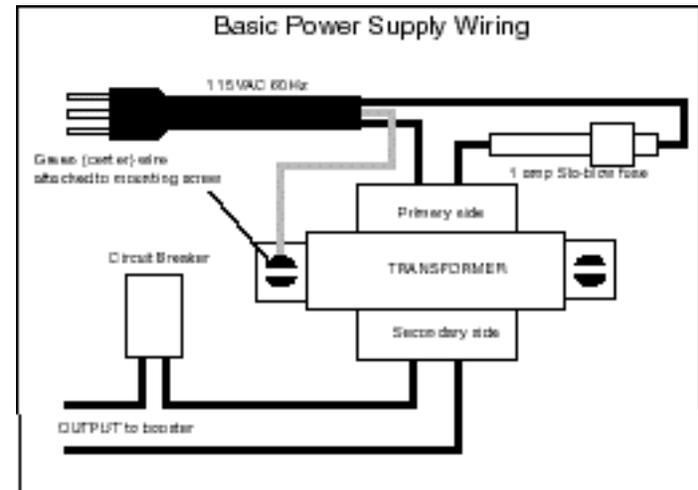
Description	Part #	Est Cost	Supplier
16V AC 6.25 Amp Transformer	4-06-8016	\$19.95	MCI Trans
Line Cord	Q112-ND	\$ 5.58	DigiKey
1 Amp 3AG Slo-Blo Fuse	F319-ND	\$ 4.20 per 5	DigiKey
3AG In Line Fuse Holder 150145	F049-ND	\$ 2.90	DigiKey
5 Amp Fuse holder-type Circuit Breaker	PB186-ND	\$ 2.42	DigiKey
Heat Shrink Sleeving			DigiKey

The Phone Number for MCI Transformers is 1-800-MCI-TRAN (In NY dial (516)587-0510)

The Phone Number for DigiKey is 1-800-DIGIKEY (DigiKey is also an excellent source for 6 conductor phone wiring supplies needed for the LocoNet network connections described later.)

Consult your local dealer to help you find an appropriate power supply.

Many dealers offer their own power supplies.



- 1) Most important is to be sure the 110V input voltage is **safely isolated from the low voltage secondary of the transformer**. A properly installed safety ground connected to the DCC equipment will ensure that the layout cannot become a shock hazard if there is mis-wiring or insulation failure. If you are not certain of your wiring & checking it, do not connect a newly wired transformer to any booster or command station until you have verified with a voltmeter that the voltages are within the specified limits. You should also check that both of the transformer or power supply leads have no voltages exceeding the UL safety extra low voltage (SELV) limits with respect to the safety ground and DCS100 case. If you measure a voltage greater than the output voltage from either output lead to safety ground, have your installation checked by an expert before proceeding.
- 2) **You must protect the primary & secondary windings of the transformer from overload**. A typical primary (input side) protection for a transformer rated 80 VA to 100 VA would be a 1 amp "slow-blow" fuse (in an appropriate fuse holder) wired in the primary 110V line circuit. Be sure to use the correct fuse rating for the exact transformer you select. For the secondary (output side) we recommend a circuit breaker rated no more

than the *minimum* of either the transformer secondary current rating or the DB100 or DCS100 output current rating. Typical components have about 10% rating tolerances.

- 3) If you are hooking up 220V or 240V line supply transformers, select appropriate Primary circuit fuse & circuit breaker ratings. The secondary (low voltage) side will have the same nominal 4.5 or 5 amp current rating, as for 110V installations. If your AC supply is 50Hz be sure the transformer selected is designed for operation at this frequency. The DB100 & DCS100 are designed to accept either 50Hz or 60Hz AC low voltage input power as well as DC.

6.0 Track Wiring Considerations

Early proponents of DCC touted the fact that you can hook up your railroad with just two wires. While this is technically correct, there are some issues that need clarification. You should have feeders to each rail approximately every 6 feet or so from the power bus. The general rule is, "If your trains will run on your track with regular DC then they will run on DCC." Unless you need to section your layout for added power, the only gaps you need are for hard shorts like reverse loops & uninsulated frogs. If you are already wired for block control, you probably don't need to rewire. Just open all your blocks so that the entire track has power & you are ready to go. If you are using common rail wiring & need to section your layout, you will need double gaps to separate the sections.

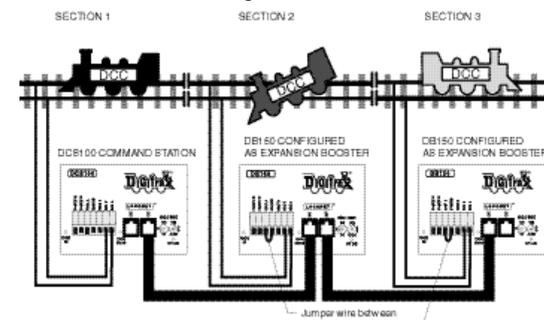
*Remember, no matter how you control your trains, you should always use safe wiring practices. In particular be aware that the multiple locomotive capability of Command Control means that you can have many locomotives running in a single area of the layout. For this reason, to fully upgrade your wiring for maximum locomotive operations, you will need to **ensure that all your power busses & feeders are capable of carrying the continuous full load current of a booster to any connected area of the layout.***

Once you have checked out your wiring for its current capacity be sure to test that you can reliably shut down the booster with any short circuit fault at any location on the track work. With Digitrax boosters audio warnings or beeps were included to make this very easy. Simply move around the layout & place a short across the tracks, & be sure that you hear the booster beep & shutdown every time the short is sustained for at least 1/2 second. If the booster does not reliably see the short you need to review the wiring & connections until this is true.

6.1 Sectioning the Layout

Even though blocking is not required for train operation with DCC, sectioning the layout may be indicated:

1. To provide additional power to operate more locomotives than one power supply can handle. For example a 5 amp booster & power supply will operate between 6 & 10 average N-scale locos & between 4 & 6 HO



locos.

2. To prevent total layout shutdown when shorts occur in any given section. If a short occurs in one section, only that section shuts down, the rest of the layout keeps operating.

To section the layout you will connect additional boosters & power supplies. To do this, connect the DB100's SYNC & GROUND terminals, with a short

length of wire & set the  Mode switch to RUN to set up the DB100 as a booster when it is initially powered up. Connect to other DB100's on LocoNet via either LocoNet Port A or B using regular 6 conductor RJ12 extension cables. **Note that the "Grounds" of all Boosters should be connected together with 18 gauge wire.**

Note: The DCS100 is not designed for current sharing and should not be used in parallel with any other DCC booster.

6.2 Reverse Section Wiring

You can operate reverse loops manually or automatically with Digitrax. You must double gap (completely isolate) both ends of the reversing section.

If you choose manual operation use a DPDT toggle switch or relay to handle the polarity change as the loco enters & leaves the reversing section.

If you choose to use an additional DB100 or DB150 series auto reversing booster to completely automate the reversing section, power the reverse loop with a separate booster & transformer. Set up the reversing section as follows:

When using DB100, DB100a and some early DB100+ expansion boosters, we recommend using the DCS100 to power the reversing section and use the DB100 series booster to power the non-reversing section. Set up the boosters as follows. DB150's can be used as autoreversing boosters in any combination with a DCS100.

DCS100

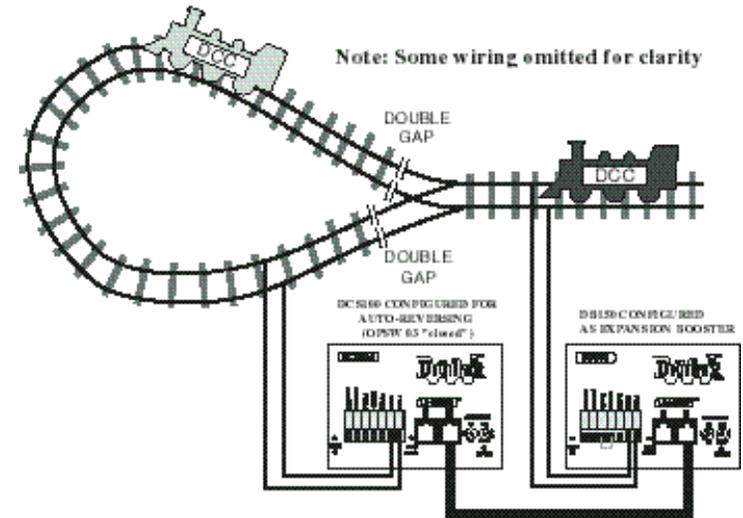
Configure the DCS100's booster as the auto reversing booster by setting the Option switch OPSW03 to "closed," as per section 24.0. In this configuration you are using the DCS100's booster configured for auto reversing to power the reverse section & the DB100 to power the main line. This will avoid any booster problems that could occur because of the DCS100's improved automatic shutdown capabilities.

Note: If the booster section of the DCS100 has a short circuit or over temperature fault, the DCS100 will continue to operate as a command station on LocoNet.

DB150

Configure a DB150 as autoreversing by connecting the CONFIG A, CONFIG B and GROUND with 2 short lengths of wire. This forces the DB150 to the auto reverse mode when the unit is initially powered up. Connect to other boosters on LocoNet via either LocoNet Port A or B using 6 conductor RJ12 extension cables.

Reverse Loop wiring for Auto-Reverse



DB100 Series

To use a DB100 series booster as an auto reversing booster, connect the DB100's , SYNC & GROUND terminals, with a short length of wire & set the  Mode switch to P/R to select the auto reverse mode when the unit is initially powered up. Connect to other DB100's on LocoNet via either LocoNet Port A or B using 6 conductor RJ12 extension cables.

Note that when the polarity change occurs, DCC equipped locos will continue at the speed & in the direction commanded but any analog engines running will reverse direction because they see the polarity change & respond to it. Two boosters are needed to perform the auto reverse function. One booster acts as the master system phase reference & the other handles the polarity reversal for the reversing section.

One booster can be used to handle more than one reverse section at a time however, the unit can only fix one gap at a time. If more than one train is entering or leaving the reverse sections connected to a single booster at the same time, a short will occur. More than one train can be in the reverse section/s at any time but, only one can cross the double gaps at a time.

6.3 Bi color Track Indicators

Hooking up Bi-color LED indicators around the layout is a convenient way to see the power status of sections of the layout at a glance. The LED indicates whether a track section is powered up, if "Zero-stretching" Analog mode is being used & its local direction, & can even be used to indicate if the GAPS in a reverse section are matched or not.

You will need:

One 2 lead bi-color LED (Radio Shack #276-012)

One "ballast" or "current setting" resistor. We recommend a 1K 1/4 watt resistor (Radio Shack #271-1321) for reasonable brightness & current levels.

- Connect the 1K resistor in series with either one of the LED leads to make a "ballasted" LED.
- With the 2 lead bi-color LED there is no strict polarity to observe, the emitted color will depend on how the LED leads are connected to the track.
- Simply connect the "ballasted" LED across the track to indicate the track is powered. If you connect a "ballasted" LED across one of the double gaps of a reverse section the LED will be OFF (not lit) when the gap polarity is matched.

Digitrax Universal Panels, UP1, UP2 & UP3 incorporate bi-color LED's to make it simple to see the power status of individual track sections.

7.0 LocoNet Wiring Components

SOURCE OF RJ12 COMPONENTS

Many Digitrax Authorized Dealers carry the RJ12 components you need for hooking up your LocoNet wiring. You can also check with the local telephone supply company or Radio Shack. If you can't find the components you need locally, we recommend DIGIKEY. The RJ12 is the 6 pin version of the RJ11 connector with all 6 pins loaded with conductors. This is the connector Digitrax uses for LocoNet & the Challenger throttle bus.

DIGIKEY Phone #1(800) DigiKey (1(800)344-4539).
 They accept VISA/MASTERCARD, & will ship UPS/FEDEX.
 Suggested parts & Digikey part #'s

Cable Couplers & Wall plates

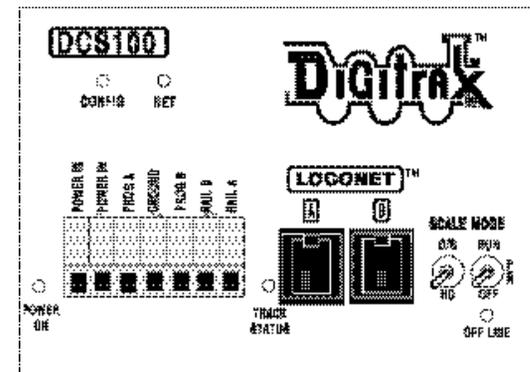
Part Number	Description
048-0051-ND	6 Wire Adapter (1M-2F)
048-0056-ND	Fem Coupler, Crossed
048-0060-ND	Dual RJ12 Wall Plate

CABLES with RJ12 plugs already on both ends

Part Number	Description
H2662-07-ND	7' CABLE W/PLUGS, BLACK
H2662-14-ND	14' CABLE W/PLUGS, BLACK
H2662-25-ND	25' CABLE W/PLUGS, BLACK.

Be sure that all pins are connected in the same order at both ends of the cable. The Digitrax Universal Panels UP-1, UP-2 & UP-3 provide simple plug & play alternatives to wiring RJ12 phone jacks around the layout. The UP-3 is shown in the Chief Hook Up Diagram, (Diagram2). This fascia mounted panel provides two RJ12 jacks & a "Track Status" indicator. The back of the panel provides 2 RJ12 jacks for daisy chaining from one Universal Panel to the next & keep alive jack capability. Rather than wiring each outlet you simply use 6 conductor phone wire with male plugs on each end to make the connection from one Universal panel to the next. UP-2 provides two 1/4" stereo jacks in front & two RJ12 jacks in back. UP-1 provides two RJ12's, one 5 pin DIN & one 1/4" stereo jack in front & three RJ12's, back. Other LocoNet devices such as the DS54 can also be plugged into LocoNet via the Universal Panels. For more information, contact your local dealer.

8.0 DCS100 Command Station/Booster



8.1 DCS100 Connections & Configuration Controls

The diagram above shows the front panel of the DCS100 combined LocoNet Command Station & Booster.

POWER IN, PROG A/B, RAIL A/B Connections: The left side terminal block has 3 sets of connections:

- a) The two “**POWER IN**” terminals should be connected to the power supply or transformer you are using. See section 5.1 for information about suitable power sources.
- b) The two “**PROG A/B**” terminals are connected to a separate programming track for service mode decoder programming. This can also be connected to the "Rail Sync" lines on another DB100 booster if you wish to use the Brake Generator feature. If you are interested in this feature, contact Digitrax for an application note that covers this.
- c) The two “**RAIL A/B**” terminals should be connected to the section of the layout that you wish to drive with the DCS100's booster section.

LocoNet A/B Connections: The center section of the DCS100 has two RJ12 style Telco jacks for connections to LocoNet™ devices such as throttles, sensors, extra boosters, computers and other LocoNet devices. You can use either or both of the LocoNet A or B ports, since they are wired in parallel.



Scale Switch: This controls the nominal track voltage that the DCS100 booster section puts on the rails. We recommend using the N scale setting for most operations. The typical factory settings for scale voltages are approximately: N=12V, HO=14V, O/G=20V. The DCS100 also has an internal user adjustment for these track voltages, see following.

DCS100 track voltage fine tuning: Small YELLOW trimmer/adjuster behind the LocoNet B port & Scale switch can be used to fine tune the booster track voltage. You will need to open the DCS100 case & use a small phillips or 3/32" blade screwdriver to turn this potentiometer. See section 8.4 for how to open the DCS100's case. When working inside the DCS100's case, be careful to avoid disturbing any components other than the ones you are working on. Measure the DC voltage (unloaded) from either track terminal to the GREEN ground wire on the case. This measured DC voltage multiplied by 2 is approximately the digital track voltage when the analog channel "00" is at 0 speed. Turn the trimmer pot clockwise to increase the scale setting voltage & counter clockwise to decrease the voltage.

We recommend that you use the lowest voltage setting that will do the job for your application.



Mode Switch: This is a primary control for the running & configuration of the DCS100. The 3 settings are:

- RUN position is for normal operations.
- OP position can be selected to allow a DT100IR or DT200 throttle access to the Option Switches for unit customization. see section 24.0
- SLEEP position is used to shutdown the system and to power down the attached throttles and generate keep alive power for the throttles.

8.2 DCS100 Indicators

The DCS100 has a number of LEDs that give a visible indication of how it is operating.

ON ○ "POWER ON"

This GREEN indicator is ON when Input power is applied to the DCS100.



TRACK STATUS ○ "TRACK STATUS"

This Bi-colored indicator is lit when there is voltage on the Rail A & Rail B terminals of the DCS100. The shade of color is typically ORANGE for normal DCC operations.



OVER TEMP ○ "OVERTEMP" or "SHUTDOWN"

This RED indicator shows that the DCS100 Booster is shutdown & is not driving the rails. This can be caused by several situations: the track output may have been turned off by a user, the track may be shorted, or the DCS100 may be overheating,. On some DCS100's this indicator is labeled "OVERTEMP" and on others it is labeled "SHUT DOWN."



NET ○ "NET"

This is a diagnostic RED indicator that gives information about what the DCS100 is seeing on LocoNet & how it is related to operations. In a correctly wired operating layout this indicator will be ON and it will flicker off any time a good LocoNet message is seen by the DCS100. Look for the following characteristic blinking patterns on the NET indicator when you are using your DCS100.

- A) Solid RED=LocoNet OK
- B) RED with Blink off=DCS100 has a valid LocoNet message
- C) Steady OFF=DCS100 sees a short circuit on LocoNet
- D) OFF pulsing on every 1/2 second=DCS100 is in "option" mode see section 24.0.



CONFIG ○ "CONFIG"

This green indicator is used to indicate the Primary operating mode of the DCS100. This indicator should be steady green winking *off* briefly once every 4 seconds. This indicates Config setup OPSW05 is correct. If you see 8 winks every 4 seconds, then we recommend that you change OPSW05 to "closed." The DCS100 will operate correctly in either case.

If this green indicator is mainly off then OPSW01 is incorrectly set to "closed" and OPSW01 must be changed back to the default "thrown." See 24.0 for more information about Config Set up.

8.3 DCS100 Audible Sounds & Their Meanings

The DCS100 emits a number of beeps & clicks as warnings and diagnostic tools that allow you to de-bug a number of conditions.

Any group of less than 3 closely spaced beeps are not used as a specific warning. The meanings of the various sounds your DCS100 might make are outlined on the following page.

Audible Feedback	What the sounds mean to you.
3 Beeps	A loco address has just been purged due to non-use. This is informational only. Refer to the DCS100 Option setup, section 24.0, to customize the loco purging operation.
4 Beeps	Booster short circuit shutdown
6 Beeps	Command station already present in system (bad master) condition detected. This indicates the DCS100 is being powered up into an active LocoNet that already has an active Command Station operating. The DCS100 will simply become a booster in this situation.
7 Beeps	DCS100 CMOS Battery low condition. Battery needs to be replaced soon. See section 8.4 below for battery change instructions.
8 Beeps	Memory ECC/ checksum fail. This indicates that the local CMOS memory has been corrupted & has been reset automatically.
9 Beeps	Transmit failure of DCS100. This indicates that there is a device blocking proper message action on LocoNet.
16 Beeps	Software time-out failure. This indicates that the DCS100 has had a hiccup. No action is required, the unit will resume operation.
Continuous soft clicks	Low input power supply voltage. If the DCS100 input voltage falls below about 9.5V DC or 8V AC when it is operating, the unit will emit a series of continuous soft clicks until the low voltage condition corrected.

8.4 DCS100 CMOS Battery Warning & Replacement

If you get 7 beeps when power is first applied you need a new CMOS memory backup battery. While this beeping indicates that the battery should be replaced, your memory integrity is still fine. *The DCS100 will still operate, even if this battery is not present*, but all your memory settings & option switch settings will not be remembered when the DCS100 is powered down.

To replace CMOS battery without losing any memory settings

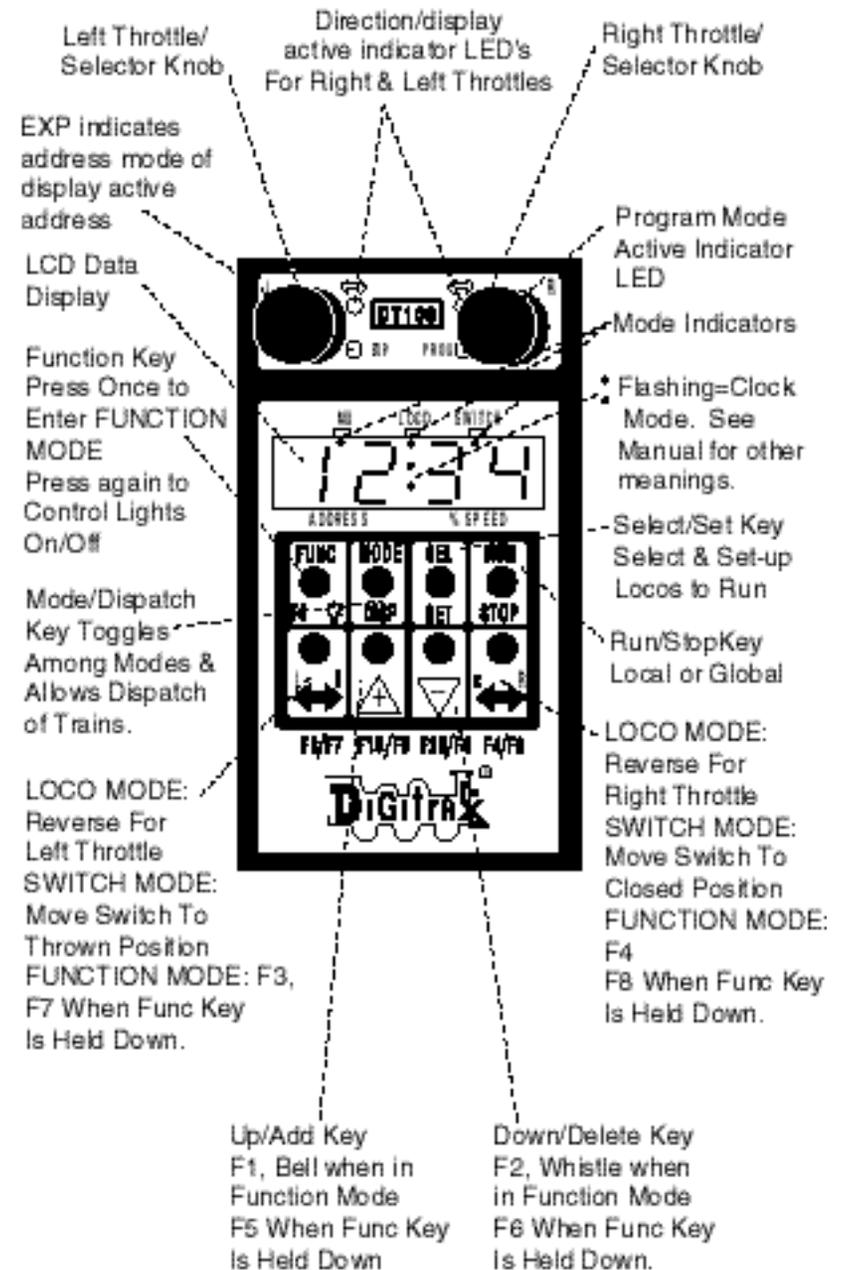
- 1) Remove the DCS100 input power & disconnect all DCS100 leads.
- 2) To open the DCS100 case: Remove the two screws on the top & bottom of each side of the case. Slide the gray front panel off the DCS100. As long as you do not make any modifications or leave any loose parts inside the DCS100 you will not affect your warranty coverage!

- 3) Locate the **empty** coin cell holder on the upper PC board at the top left of the unit. There are 2 battery holders & it does not matter which holder has a good battery in it.
- 4) Slide a NEW CR2032 style 20mm diameter 3V lithium coin cell in EMPTY holder. This will ensure the 100% continuity of memory, since this allows a "hot swap" even without any external power applied. Note that the coin cell battery + terminal will be visible on the upper side when it is in the holder correctly. The unit has reverse polarity rotation & the two coin cells are isolated from each other.
- 5) Remove the old battery from the other holder & discard it. *Be sure not to short the +ve arm at the top of the holder to the metal case or any PC board connection.*
- 6) Reassemble the DCS100 case. Be sure that you don't leave any loose parts inside.
- 7) Reconnect the DCS100 & be sure that you do not get 7 beeps when external power is restored.

Sustained track short circuits on the track section connected to the DCS100 Rail A/B terminals, will cause the unit to beep 4 times & turn off its *local* Booster track output. The RED "SHUT DOWN" or "OVER TEMP" light will be on to indicate this. Note you can lengthen the short circuit duration needed to shutdown the DCS100, by making OPSW#18 to the "closed" or "c" position (refer to section 24.0). This will make the DCS100 booster tolerate longer shorts, like those caused by pilot trucks crossing live switch frogs. Be sure that your layout wiring & locomotives can handle these longer short circuits and only use this adjustment if you are satisfied it will work properly on your layout and not cause damage to your locos or wiring.

Diagram 4: DT100IR Throttle Diagram

Diagram 4: DT100 Control Panel



9.0 DT100IR LocoNet Throttle Control Panel

9.1 General Color Codes

The DT100IR control panel is color coded according to how the keys are used.

GREEN keys & indicators are for loco speed & direction control.

RED key is "Run/Stop." This is so you can't miss it in case of emergency.

BLUE keys are related to function control. When the function mode is active, the GREEN keys in the bottom row take on the BLUE meanings F3/F7, F1 /F5, F2 /F6, F4/F8.

9.2 The Left & Right Throttle Knobs

The Throttle Knobs on the DT100IR are actually "encoders." They give very smooth, fine speed control. In 128 speed step mode it takes several complete turns of the knob to go from stop to full speed. When you select a locomotive that is moving & set it on a Throttle Knob, the Throttle continues to run the locomotive regardless of the position of the Knob.

You can customize the tracking characteristics of these knobs for either "straight line" or "ballistic" tracking. With "straight line" tracking each movement of the knob causes a fixed rate of change in the display. With "ballistic" tracking, the faster you move the throttle knob, the faster the data changes in the throttle. Your DT100IR was shipped with "ballistic tracking" as the default setting. To change your throttle to "straight line" tracking see DT100IR option setup in section 19.0.

9.3 Direction Indicators

RED=Loco in Reverse

GREEN=Loco in Forward

Flashing=Throttle Active in Display

Both Flashing ORANGE= System is in "Stop" with track power ON

Both Solid ORANGE = System Track power is OFF.

9.4 Program Mode Indicator

Indicates that this DT100IR throttle is in the programming mode. When this mode is active the throttle knobs & keys will not control any selected locomotives but allow you to use either the Service mode programmer in the DCS100 or perform operations mode programming on the mainline. See section 21.0 for complete programming instructions.

9.5 ○ EXP Address Mode Indicator

OFF	Indicates that the display active throttle in the DT100IR is controlling a 2 digit address.
Blinking RED	Indicates that the display active throttle is controlling an aliased address.
Steady RED	Indicates that the display active throttle is controlling a 4 digit address (or EPF or 14 bit address).

9.6 LCD Display

The DT100IR's LCD display is used to display several different types of information to the operator.

Current Operational Mode of the DT100IR: The three small mode indicators across the top of the LCD indicate whether you are in MU  (multiple unit or consist mode), LOCO  (regular locomotive operations mode) or SWITCH  (turnout control mode). Only one of these indicators will be lit at any time. The DT100IR automatically defaults to the LOCO mode & will return to this mode if you change to another operational mode & don't do anything within about 6 seconds. Use the  key to toggle among these operational modes



The numbers & letters in the LCD screen have different meanings depending on the mode the DT100IR is in & the functions you are executing. They may be flashing or not. A flashing display is usually a prompt. All of these displays & their meanings are described later in this manual.

The colon  in the middle of the display is flashing when the Fast clock is being displayed. No colon  will be displayed when you are working with 4 digit addresses. A steady colon  will be displayed when you are working with 2 digit addresses and when you are status editing.

9.7 Run/Stop

When this key is used by *itself* it can be set up to operate in one of two ways. This set up is part of your throttle option set up when you initially power up each throttle and each DT100IR throttle can be set up differently.

- The default Local Run/Stop allows you to stop *only the addresses under control of your throttle* when just  is pressed for 1 sec.
- Global Run/Stop allows you to stop the entire layout by pressing just  for about 1 second. Press again to toggle between STOP & RUN.

Other special uses for Run/Stop when used in *conjunction* with other keys are described in other sections of this manual. This is the same way that DT200's operate.

9.8 Select/Set

Used for selecting & setting loco addresses to the throttles. *When the DT100IR is address selecting or in "browse" mode the LOCO mode indicator will be blinking.* If there are steady 4 digits in the display with no colon  on you are selecting a 4 digit address. The EXP indicator  will also be lit & indicate which type of 4 digit address is being selected. A steady EXP  in this case means 4 digit addressing and a blinking EXP  means aliased addressing.

If the left 2 digits are flashing along with the LOCO indicator & there is a colon  in the middle of the display then a 2 digit address is being browsed. This key is also used in other modes to select or complete an operation.

9.9 Mode/Dispatch/Display

Mode: Press  to move from one operational mode to another. LOCO is the DT100IR's default mode since most of the time you are running locos.

Press  to change to SWITCH then to MU then back to LOCO.

Dispatch: To Dispatch or offer a locomotive you have set up on a DT100IR to another throttle, press this key while in Select Address mode.

Display: In programming mode this also can be used to read back or "DISPlay" a CV value from a decoder on the DCS100's Service mode programming track. See section 21.2 for details.

9.10 Function/F0/Light Control

Press once to enter Function Mode. The display shows "Fn:oo" with the oo flashing to indicate that you must choose which function you wish to toggle. Press  again to toggle the directional lights on or off. OR, press the key above F1, F2, F3 or F4 to toggle any of those functions that are available in your loco.

Function 2 is a special key because it is non latching, this allows you to activate a function while the key is held down & deactivate it when the key is released. This makes it easy to simulate blowing a horn. If you wish to latch the F2 key on simply turn the throttle knob while holding down the F2 key. After you have latched F2, you can turn it off by pressing the FUNC key followed by the F2 key.

Function 3 is a regular latching function key that can be set up as a non-latching function key during throttle set up.

Press & hold the  key while pressing the key above F5, F6, F7, F8 to toggle functions 5-8 on & off.

In Edit & Programming modes  is also used to cycle among several choices.

9.11 Function 1-8 Keys

Active when in function mode. Use the keys above these designations to access the various decoder functions. F2 is non latching. See section 10.10 for more information about using these keys.

9.12 & Left & Right Throttle Direction Change Arrows

Changes the direction of the loco on the related throttle. The  key changes direction of the address on the "R" or Right Throttle. The  key changes direction of the address on the "L" or Left Throttle.

Also used to select the position to which you want to set a switch or turnout:

 t=thrown  c=closed

These keys are also used by the various system editors to control data entries.

9.13 Up/Add & Down/Delete Arrows

Use to browse addresses & increase/decrease speed. Use to MU-Link & MU-Unlink locos from consists. These keys are also used when you are using various system editors.

These +/- keys can be configured to be repeating so that if you hold a key down it will repeat until you release the key. This is the normal default when the "ballistic knob" mode is selected as the Option setup for this throttle, see section 20.0.

10.0 DT100IR: Major System Modes

The DT100IR's MAJOR mode changes are controlled when the DT100IR is connected to LocoNet by using the  key in conjunction with other keys as described below.

10.1 Track Power On Mode

When track power is off, press the  &  keys simultaneously to have the DCS100 or master command station turn on the track power & go through power up sequencing. Once track power is on, then pressing  &  will cause the system toggle between RUN and STOP.

10.2 Track Power Off Mode

When track power is on, press the  &  keys simultaneously to have the DCS100 or master Command station turn OFF track power & stop generating DCC packets. This will turn off the track power from all boosters.

10.3 Stop Mode

If the track power is on and trains are running the keys  &  will make the system go to STOP, and all trains will stop. Pressing  &  while the layout is in STOP will change it back to RUN.

Section 9.7 discusses the operation of the  key when used alone.

When the system is in STOP Mode both of the direction indicators  will blink ORANGE. In this state there is power to the track but all locomotives are stopped.

10.4 Programming Mode

Any DT100IR can program locomotive decoders by accessing the network programmer of the DCS100. To enter Programming Mode, press the  &  keys simultaneously. Section 21.2 gives complete programming instructions.

Note: DT200's are not designed to access the Network programming of the DCS100.

10.5 DT100IR Unit Reset

Press ,  &  keys simultaneously. This three key-stroke input will force the DT100IR to reset itself and will allow you to redefine the Primary & Secondary Options for the throttle. Removing & replacing the battery also causes the DT100IR to reset. If you are using RESET to reconfigure the DT100IR throttle options it is best to first release any addresses being controlled by this throttle.

11.0 LOCO Mode: Running Trains

LOCO mode is the default mode for the DT100IR because it is the mode you use to run the trains. If you change to SWITCH or MU mode & don't do anything, the unit will default back to LOCO mode in about 6 seconds.

If a throttle has a locomotive selected & under its control, its associated direction indicator  will be GREEN if the loco's direction is forward & RED if its direction is reverse. In addition, if the direction indicator  is flashing it means the associated throttle's locomotive information is currently showing in the display, meaning the Address & Speed in the display are related to this throttle. For example: if the  on the right side of the DT100IR is flashing RED, this means that the ADDRESS & % SPEED in the display are for the loco that is currently being run by the Right Throttle Knob & that locomotive's direction is reverse.

The RED EXP indicator  shows whether the locomotive address this throttle is controlling is a 2 digit address, an aliased address or a 4 digit address.

To display the information for the throttle not currently in the display, turn the Throttle Knob not currently in the display. If you change the direction of the loco not currently displayed, the display will also change to that Throttle Knob & make it's display active.

11.1 The Select Message

If a Throttle Knob does NOT have a locomotive selected when you try to make it display its information with its knob or direction change arrow, the display will show "SE:L-". This means that there is no active loco on the throttle you tried to display & that you need to press, browse to the loco address you want to run & set it to that throttle by pressing  again before you can use it.

11.2 Two digit address & % Speed Display

When you have a loco with a 2 digit address the EXP indicator  is off & the numbers to the left of the colon  & above the word "ADDRESS," are the address of the locomotive & the numbers to the right of the : & above the words "% SPEED" are the % speed for the throttle currently displayed. The speed is shown as a % of full speed & is NOT actual speed step codes sent to the decoders in the locomotives. Note: For addresses above 99 please refer to Table I below to translate the mixed mode hexadecimal value that shows in the display for addresses above 99.

Table I: Translation Table for Decimal to Mixed Mode Hexadecimal Numbers for Loco & Switch Addresses Above 99.

DEC	MM	DEC	MM	DEC	MM
0-99	0-99				
100	A0	110	b0	120	c0
101	A1	111	b1	121	c1
102	A2	112	b2	122	c2
103	A3	113	b3	123	c3
104	A4	114	b4	124	c4
105	A5	115	b5	125	c5
106	A6	116	b6	126	c6
107	A7	117	b7	127	c7
108	A8	118	b8		
109	A9	119	b9		

11.3 Locomotive Speed Control

To control the speed of a locomotive, just turn the throttle knob that is set to the locomotive whose speed you want to change. If the throttle was not already active in the display it will now become "display active" & the display will show its address & current speed commanded. Alternately, speed can be increased & decreased by using the  and  keys.

A 2 digit address will show the address on the left side & the current speed on the right side, separated by a steady colon .

If you change the speed of a 4 digit address loco, then the new speed, xx will flash up on the display as "SP:xx" & the display will return to the steady 4 digit address with no colon & the LOCO flag on.

If a sub-element in a consist with a 2 digit address, aa, is selected in a throttle & you try to change its speed the display will change to "aa:cn" & the "cn" digits in the speed side show that you cannot directly change the speed or direction of this loco since it is in a consist. You can however go ahead & modify its functions such as lights, etc.

If the consisted loco has a 4 digit address, the EXP indicator  will not light up, but the display will flash up "-cn-" & then return to the 4 digit address display.

11.4 Locomotive Direction Control

To change the direction of a locomotive, just press the direction arrow  for the address set to the Right Throttle Knob or  for the address set to the Left Hand Throttle. The direction indicator  beside that throttle will change color to indicate the new direction (RED for reverse or GREEN for forward). If the throttle was not "display active" when you changed direction, its information will also now appear in the display.

If you change direction while a loco is moving it will slow down to 0 speed and then speed up to the commanded speed according to the decoder's programmed deceleration and acceleration characteristics. Since it is more prototypical to stop the loco before changing directions you will probably want to close the throttle to 0 speed & stop the loco before commanding a direction change but, it's up to you.

If you have programmed the decoder with a non-zero deceleration rate that matches the scale effect of braking the train, then you can simply command an instant reverse of direction, and the system and decoder will simulate braking by causing the locomotive slow down at the programmed deceleration rate, stop & accelerate again at the programmed acceleration rate.

11.5 Selecting the Locomotives You Want To Run

With the DCS100 there are four options for addressing and programming locomotives. You can use these four addressing modes at any time in any combination you choose.

Address "00" Analog Address: For locos without decoders

2 digit addressing: Also called 7-bit or short addressing can be used with any DCC decoder

Aliased Addressing: Assigns a 4 digit alias to a 2 digit address decoder. Gives you 4 digit addressing with all DCC decoders

4 Digit Addressing: Also called 14-bit, EPF, or long addressing can be used with any DCC EPF decoder that supports this feature.

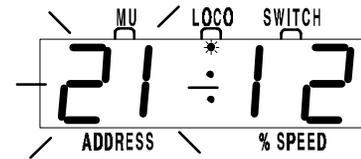
The DCS100 address range looks like this:

Address in DT100IR Display	EXP indicator	What these addresses represent
0001 to 9980	RED flash	Alias Roster for Aliased 2 digit addresses
00:	off	Analog Address
01: to c7: (127)	off	2 digit address Range
0128 to 9980	RED steady	4 digit address Range

This addressing scheme provides complete backward compatibility with all existing DCC decoders & does not force you to replace any decoders while allowing four digit addressing for any decoder on the layout.

11.5.1 Selecting A 2 digit address

1. Turn the throttle knob you wish to use about 1/8 turn to make it the "display active" throttle. Press the  key to enter "address select" mode. The left hand side of the display that shows the short address 2 digits will flash to prompt you to choose an address. The right-hand side of the display shows various status codes as you "browse" 2 digit addresses. The meanings of these codes are detailed in the section 15.0 status edit section. Generally you don't need to worry about these codes since the system automatically uses them transparently to most users. They give you a convenient & valuable insight as to how locomotives are operating on the layout.



This display shows locomotive address 21 selected but not set, since the address 2 digits are flashing. Notice the status "12" indicates this address is common, 14 speed step mode.

2. Turn either throttle knob or use the & keys to browse through the addresses to the one you want to run.
3. Press the key again to SET that 2 digit address. If the address request is successful, the display will show the locomotive information at the speed & direction the system has remembered it.

If you try to access a loco address that is active on another throttle, when you press to set the address, the display will change back to **SE:L-** & the throttle direction indicator will **not** light up. The address SET request failed because the LocoNet system does not allow you to select a locomotive address that is active or "in-use" on another throttle *anywhere* else on the system. This is true even if the loco address is being used by a completely different throttle or even a remote computer hooked up to the system! At this point just press again & scan for a different loco address that is not "in use."

In certain cases you can override this security interlock & "steal" an "in-use" locomotive. See section 12.1 for details, & use this facility wisely.

When you request "address select" on a "display active" throttle by pressing , the current displayed locomotive will immediately be made *common* or released to the system for anyone to select. Once you have entered "address select," you can browse for another locomotive that is *common*, *idle* or *new* & SET this locomotive on the throttle with another press of the key.

Obviously, you can simply re-select the locomotive you just released when you started "browsing," provided someone else did not select it on their throttle in the meantime.

When you press the key the second time to SET a locomotive address the system makes the locomotive in-use & only your throttle has control of it. See section 12.1 and 12.2 for notes on locomotive stealing & DT100IR slot following capability.

A *new* locomotive address once set on the throttle becomes *in-use* at speed 0, forward direction & all functions off.

The only way to modify the speed & direction of consisted or MU'd locomotives is to select the address of the TOP of the consist. We call the "key" locomotive that other locomotives are consisted TO, the TOP locomotive because it does not need to be in any particular physical order in the consist. The TOP locomotive address controls the speed & direction of all locomotives consisted to it by the MU function. See section 18.0.

If during "address select" mode there is no input for the 6 second time-out time, the DT100IR will abort the selection process & default back to LOCO mode with the throttle now inactive. This clears the locomotive that was in the throttle & makes it common or accessible to the rest of the system.

Note: If the right hand side of the status display shows "FF" during address selection, this means that the command station has reached the limit of *in-use* & *common* locomotives that it can refresh at one time. The DCS100 is shipped with OPSW#44 at its default setting of "t" & 22 slots, since refresh frequency is improved if you are not using more than 22 running locos.

When you see the "FF" message you have two options

1. Free up some refresh slots by making sure any locomotives you are not using are not selected on any throttle ("*common*" at speed 0).
2. If you need to use more than 22 slots you can change the DCS100 OPSW#44 to "c." This increases the DCS100's slot refresh capacity to approximately 120 active locos with any available address. If you use the expanded 120 slots, note that some Trinary mobile decoders may behave sluggishly. See section 24.0 for setting up the DCS100 options.

11.5.2 Selecting An Aliased Address From the Alias Roster

For accessing the aliased address mode refer to lower section of Diagram 5.

Aliased address mode is a very powerful way for the system to allow 2 digit address decoders to be selected from the system Alias Roster & then operated as 4 digit addresses. This allows any decoder to run with 4 digit address, even if it does not support the 4 digit address format. You can even assign the Analog (Conventional address 00) to a 4 digit number. Motorola Trinary format "AC digital" decoders can also be aliased and run with a 4 digit address!

The Alias Roster is a database of 4 digit numbers that are matched to 2 digit addresses. The Alias roster defines all the power units you choose to operate this way. The Roster is stored in the DCS100. The DCS100 remembers the Alias Roster even if the system is powered down between sessions. It is very

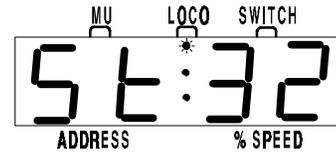
easy to update or edit this Roster. The Roster is conveniently sorted in numerical order, which makes browsing for an address very easy. Because only the active aliased addresses are included in the Roster it is an uncluttered way to remind yourself of the actual current locomotives usable on the layout.

To view the current Alias Roster press  and turn either throttle knob to the left and once you browse below address "00" you will see the aliased addresses that are active in the system. When you enter this Alias address area, the DT100IR will check that the system supports Aliases. If the system supports aliases, the EXP indicator  will start blinking & the DT100IR will beep and allow you to browse the aliased address roster (below address 00). If there are no current aliased addresses in the Alias roster you will see "- - -" in your display as you browse the roster.

To access the Alias Roster on your DT100IR:

- 1) Press the  key to enter browse mode. The LOCO indicator  will begin to blink.
- 2) Turn either throttle knob counter-clockwise or use the  or  keys until you get to 2 digit address 00. Continue one more step below "00" and the DT100IR will beep & the RED EXP indicator  will begin to flash to indicate that you have entered the alias roster. The LCD screen will show a 4 digit number without a colon. The blinking LOCO indicator  lets you know that you are browsing through the aliased 4-digit addresses already set up in the Roster.
- 3) Browse through the Alias roster until you find the aliased address you want to run. The aliased addresses set up in the roster will appear in descending order with the largest one first.
- 4) Press the  key to select this aliased address to your throttle. The LOCO indicator  will stop blinking and become steady. The EXP indicator  will be blinking RED to show the 4 digit number in the display is actually an aliased address linked to a 2 digit address.

If you pause at an Alias address entry for longer than about 1 second then the DT100IR screen will change to display the Loco's status code "cc" in the display as "St:cc". This status number is the same as used in the 2 digit address mode (see 15.0 for status code list) & can be status edited in the same manner by pressing the  key.



In this example the 3 means the Loco is in-use and the DT100IR will not allow you to select this normally. The 2 means that this loco is being handled by the system as a 14 step decoder on the track.

If you browse down the Alias roster or list & come to an empty Alias entry, the display will show a line of 4 dashes "----" to indicate this entry is empty.

When you reach the end of the Alias entries, the display will show "-end".

11.5.3 Editing Aliased Address Roster Entries

To read back the actual 2 digit address assigned to the aliased address, simply press the  key to toggle to the 2 digit address "aa". This will be displayed flashing as "AL:aa" (ALias: 2 digit address). To return to the aliased address simply press the  key again. The aliased address will now be flashing to indicate that it is now able to be edited.

You can swap the display between the two digit address and aliased four digit address as often as you wish. When you have finished reading back and/or modifying the aliased address or the 2 digit address for this entry simply press the  key to close the entry and save your changes. The DT100IR will resume browsing the alias roster.

Creating a new aliased address:

1. Browse to any aliased 4-digit address or an empty alias roster entry "- - - -".
2. Press the  key to toggle to the 2 digit address that is currently assigned to the aliased address. The 2 digit address will be flashing.
3. Press the  key to toggle back to the aliased address that will now be flashing.
4. To edit the aliased address, use the left throttle knob ("L") to change the two left hand digits in increments of 100 and the right throttle knob ("R") to change the right two digits by increments of 1.
5. When you have chosen a new aliased address press the  key again to toggle to the 2 digit address.
6. Use the throttle knobs to change the 2 digit address as desired
7. Press the  key to close the entry and save your changes. The DT100IR will resume browsing the alias roster again.

NOTE: The aliased address entry you started with will not be altered since it will not match the modified aliased address when you closed the edit and saved the changes.

Changing the 2 digit address aliased to an existing aliased four digit address.

1. Browse to the aliased 4-digit address you wish to change.
2. Press the  key to toggle to the 2 digit address that is currently assigned to the aliased address. The 2 digit address "aa" will be flashing "AL:aa".
3. Change the 2 digit address by using the throttle knobs
4. When you have finished editing, press the  key. The display will flash "good" (GOOD) to indicate that the DCS100 accepted the changes and saved them to the Alias Roster. If you get "FULL" (FULL) message instead it means that the Alias roster in the command station is full. You can make room for another entry by deleting an existing Alias address (see below).

Deleting an Alias address:

- 1) Browse to the aliased address that you wish to delete.
- 2) Press the  key to toggle to the 2 digit address "aa", flashing as "AL:aa" (Aliased to 2 digit address)
- 3) Press the  key to toggle to go back to the flashing aliased address
- 4) Use the Left or right throttle to dial the aliased address down to "0000" which is invalid and marks the current roster entry for deletion.
- 5) Press the  key to "close" the edit mode & write back this "0000" address which will erase the Alias address entry you started with. The Alias roster will now be sorted again to remove this "gap" in its entries.
- 6) If you were freeing up an entry because a previous addition failed because the Roster was "FULL", you can now regenerate a new alias entry since the deletion has created room in the Roster

Note that it is permissible to have more than one aliased addresses with the same 2 digit address. If you try to select an aliased address and the 2 digit address is already "in-use" in the system then it will not be selectable & its status will typically flash up as "St:3x". Where the "3" means the decoder address is already in use & the "x" indicates what speed step mode the command station is sending to the decoder.

If you start the address selection process by pressing the  key on an active throttle that currently contains an aliased address, the associated 2 digit address will be released & marked in the system as having the 4 digit alias "embedded." (This embedded Alias will be recovered if selected by a DT100IR using 2 digit address browsing.) If an aliased address is released,

your DT100IR will automatically return to browsing the Alias roster for a new address to select. In this case, you won't need to re-enter the Alias Roster by "going below 00."

If you are "browsing" 2 digit addresses & the EXP indicator  EXP begins to flash RED, this means that the 2 digit address currently in the display has an embedded aliased address. If you press  the aliased address will be selected to run the locomotive.

'Zapping' The Embedded Alias Address When Browsing 2 digit addresses:

If you choose to use the 2 digit address to run the locomotive, you can "zap" (clear) a previously embedded aliased address information by pressing the  key. The EXP indicator  EXP will stop blinking & you will be able to select the 2 digit address with no embedded 4 digit alias information by pressing . Zapping an embedded alias does not make *any changes to the alias Roster*. You are simply removing the embedded alias information that was referenced earlier from the alias Roster.

11.5.4 Selecting A 4 Digit Address Loco

To use 4 digit addressing you must use decoders like Digitrax FX Series decoders that support this Extended Packet Format feature. In order to run your FX decoders in 4 digit address mode you must program CV17 & CV18 to contain the 4 digit address, & also enable the 4 digit address mode in the decoder by programming CV29 to a value of 26. This is somewhat more involved than using the aliased address mode with 2 digit address decoders. Refer to the Programming section 21.0 for information on this.

Note that you cannot use 2 digit address decoders in the 4 digit address mode since they do not support this particular NMRA Recommended Practice for the Extended Packet Format. Digitrax created the aliased 2 digit address mode to allow 4 digit access to these decoders.

Decoders that support 4 digit address mode also support 2 digit address mode. Be sure that your 4 digit address mode decoders are programmed appropriately for the command station you will be using to run them. If you take a locomotive from a layout where it is being run in 4 digit address mode, it must have its 2 digit address (CV1) reprogrammed to turn off the usage of CV17 & CV18 as 4 digit address decoder. You can also reprogram CV29 to achieve the same effect without modifying CV1.

As you browse above 2 digit address "c7" (127) the DT100IR changes automatically to 4 digit address mode & the EXP indicator  EXP will change

from off to steady RED. In order to make it easier to select four digit addresses on your throttle, once you enter the four digit address mode, the left throttle knob will increment the left hand digits of the address number by 100's (from 100 up to 9900) and the right throttle knob will increment the right hand two digits of the address by 1's (from 0 to 99). For example, if you want to browse to 4 digit address 6587 you would use the Left Hand Throttle Knob to dial up 65 in the left hand two digits and the Right Hand Throttle Knob to dial up 87 in the right hand two digits in the display.

If you pause on a Long Address for more than about second, the status for this locomotive, "xy", will flash up on the display "St:xy" (Status:status code)

Long Address Selection shortcut:

If you press down & HOLD the  key to release a loco or start the address selection process & then turn one of the throttle knobs, the DT100IR will immediately enter the 4 digit address range. The RED EXP indicator  will glow steady to let you know that you are in the 4 digit address range. You can then release the  key & browse for the 4 digit address you wish to select. When the 4 digit address you wish to use is in the display, simply press the  key to select it into the throttle.

To quickly get back to 2 digit address mode, simply turn the left hand knob counter clockwise until the red "EXP" led goes out.

You can status edit a 4 digit address decoder the same way as a 2 digit address or aliased address is status edited by pressing the  key before "setting" the address to the throttle. See section 15.0 for information about status editing.

12.0 Walkaround Operation On LocoNet

The DT100IR does not need a battery while being used as a "Tethered" throttle. When a DT100IR detects that it is NOT connected to a powered-up LocoNet, it will enter the power saving idLE mode and the display will go blank. This occurs when you unplug a throttle to walk around the layout. When you reconnect a DT100IR to a powered LocoNet, it automatically logs back on to the network & verifies that the command station has an exactly matching state for any of its throttles that were active when the DT100IR was disconnected. If there is any discrepancy, the associated throttle will not be reactivated automatically. When your throttle is reactivated the direction indicator  will be lit & the display will show the state of the last "active display" throttle.

Note: See section 20.0 for "Infrared Tetherless Operation of the DT100IR".

If a DT100IR with selected in-use locomotives is disconnected from LocoNet for more than the system purge time (about 200 seconds), the Command Station will purge these in-use locomotives to the common state so that other throttles can access these locomotives. If the original DT100IR is reconnected after a purge of its last in-use locomotives, it will recognize this. If the previously in-use locomotives that are now common locomotives have not been selected by other LocoNet throttles, the original DT100IR will automatically re-log on to these purged locomotives.

If the this is not the case, simply reselect the purged locomotives by pressing the  key for the appropriate throttle, i.e., the DT100IR throttles still remember the locomotive that was last selected. The SET operation will reactivate the throttle & make the locomotive in-use in exactly the state the system remembers it. The designation of locomotives as in-use or common ensures orderly sharing of locomotives on the layout & increases the system's ability to run more locomotives at a time

12.1 Forcing A Selection, or "Stealing" A "Lost" Locomotive

You won't be able to select a locomotive to a throttle if the DCS100 realizes it is already "in-use." It is possible to override this interlock & force the DT100IR to select an already "in-use" loco. This is called locomotive "stealing" & can result in two throttles logged onto a single locomotive. Because of this multiple-throttle interaction you should be careful when you use stealing. It is useful to use to gain control of "lost" locomotive before the system actually purges it.

To Steal a Locomotive Using a DT100IR:

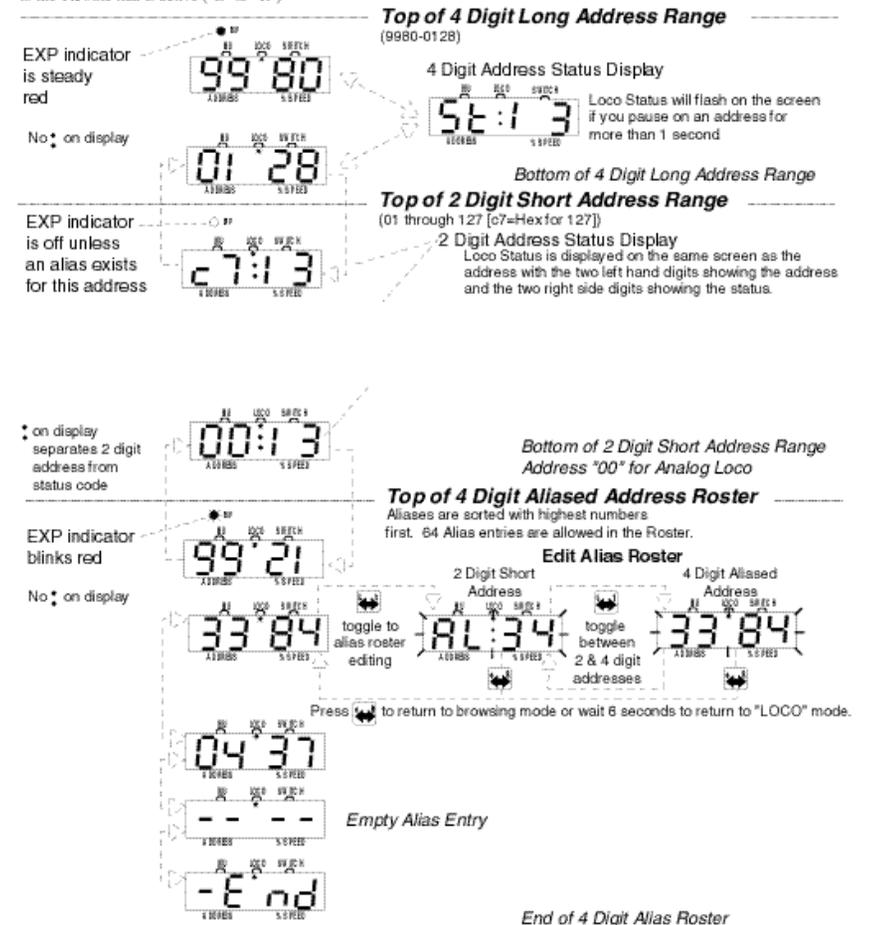
1. Use either throttle knob to browse to the address of the DCC locomotive you want to steal. In 2 digit address mode the DCC locomotive status digits on the right will typically show "3x" indicating this address is "in-use" & not normally selectable.
2. If you are in a 4 digit address display mode the Loco status will flash up "St:3y" after your browsing address has been stable for at least a second.
3. Before you time-out of "browse" mode & while you still have the loco you want to steal showing in the display, press "SEL/SET" if the locomotive is not available the display will show "SE:L".
4. Now disconnect the DT100IR from LocoNet. The display should immediately go blank .
5. Press & hold the direction arrow for the throttle side (either  or ) you were using in step (1) & plug the DT100IR back into LocoNet.

After the DT100IR beeps you can release the direction key and the throttle you are using should be logged onto the "stolen" locomotive address. Note that a throttles' direction key being depressed when it is plugged into LocoNet is the authorization for only that throttle to steal.

6. Once a throttle has "stolen" a loco the slot following mode becomes active and both throttles will update speed and direction information for the address.

Diagram 5: Address Selection Flow Chart

1. Press SEL/SET  key to Select an Address. (The "LOCO" indicator  blinks indicating that you are in address browsing.)
2. Use the "L" or "R" throttle knob to browse through the available addresses. The DT100 offers three different address ranges to choose from:
 - 4 Digit Long Addresses are in the range from 9980 down to 0128.
 - 2 Digit Short Addresses are in the range from 127 (c7 in hex) to 01. Address 00 is the analog address.
 - 4 Digit Aliased Addresses are stored in the alias roster "below" 00 in descending order.
 As you use the throttle knobs to browse the addresses you will notice that when you are using 4 digit addresses that the Left Hand Throttle Knob increases and decreases the 100's and the Right Hand Throttle Knob handles the 1's. This makes 4 digit address browsing faster. When you are in 2 digit addresses, you can use either Throttle Knob to browse the addresses by 1's.
3. When the address you wish to select in your DT100 display, press SEL/SET  Key again to "Set" the Address Selected to the Throttle that is active ("L" or "R")



12.2 DT100IR Slot Following -"Training Mode"

When a DT100IR detects that a loco address that is "in-use" on one of its throttles is being changed by another throttle or computer, it will "click" every time it sees a remote throttle change its locomotive settings. If that locomotive is in the display active throttle, its speed display will also show the changes. This is called slot following. This allows two DT100IR's to run a single locomotive with either throttle being able to send commands to the loco. Both throttle displays will reflect the exact state of the locomotive. You can use slot following as a "training mode."

A supervisor can "steal" a locomotive that is in a trainee's throttle & be able to "look over the trainee's shoulder" or closely supervise that locomotive's control. The supervisor can gain instant override control without having to physically "grab" the trainee's throttle. This allows you to have unskilled visitors operating on your layout and lets you allow them to participate and enjoy operations without undue anxiety for either party.

Slot following also allows a PC on LocoNet to run sophisticated CTC & routing control programs that permit the system to have automated control over locos. The computer would be able to control speed and stop engines automatically while letting the engineer with the throttle in his hand know what is happening.

12.3 DCS100 Loco Purging Strategy or Time Out!

Sometimes when I plug my DT100IR back in it doesn't log back on to the engine (or engines) I was running before I unplugged. What should I do? The DCS100 will automatically release or "Purge" locomotives from "in-use" to "common" that are not under the control of a throttle connected to LocoNet after about 200 seconds. This is a safety feature that allows other throttles in the system to gain control of engines that may have been left running unattended by an engineer.

Once a loco has been purged by the DCS100 to "common," other throttles in the system will be able to select & control it. If this occurs & the original DT100IR is plugged back in again, it will *not* log back on to the purged loco since it sees that another throttle now has that loco "in-use." If the purged loco has not been placed "in-use" by another throttle then the original DT100IR will automatically recover the purged loco when it is reconnected to LocoNet.

By setting some of the DCS100's option switches, you have several purging options available:

1. The default is purge time=200 seconds.
 2. Purge time can be increased to 600 seconds (OPSW13=closed)
 3. Purged locos can be set to stop when purged (OPSW15=closed)
 4. Purging action can be disabled completely (OPSW14=closed)
- See section 24.0 for information about setting DCS100 option switches.

13.0 Controlling Lights & Functions

1. Press the  key once to enter the Light/Function control mode for the "display active" locomotive. The display will show "Fn:oo" with the "n" flashing to indicate that the function number of the function you wish to change needs to be selected.
2. Once you are in the "Fn:oo" mode, use one of the 5 BLUE keys to choose which function you want to change.  key will now select & change the Light or "F0" function. Each time the  key is pressed while in the "Fn:oo" mode, the Light/F0 will change from OFF to ON or vice-versa. The display will show "F0:on" (Function 0:on) for light ON & show "F0:off" (Function 0: off) for light OFF. This is the same for the other functions F1, F2, F3, F4.
3. To access functions F5 through F8, press and hold the  key while pressing the BLUE F5, F6, F7 or F8 key to toggle between on and off for the function you choose.

You can "mix & match" & change any of the functions F0 - F8 while you are in the "Fn:oo" mode until you are satisfied with the settings & return to LOCO mode.

To make it easier to control sound features, F2 is a non-latching function. This means that if F2 is used to control a whistle or horn sound from the decoder, it will only sound when F2 is held down in the "Fn:oo" mode.

To return to LOCO mode you have three options:

1. Adjust either throttle knob,
2. Press the  or  key, or
3. Wait for the 6 second no-input time-out to elapse

Note that for proper light operation, you must be sure that the operating mode (Standard 14 or Advanced 28/128 speed steps) of the decoder matches the operating mode sent by the Command Station to that decoder. If you are using a Digitrax or other DCC decoder that can access Advanced mode, we recommend it be programmed to the Advanced mode, and that you run your DT100IR in the Advanced 28/128 speed step (default) mode. For other DCC Baseline-only decoders you will need to status edit the decoder to Standard

14 speed step mode to have correct motor & light operation. See also Status Edit in section 15.0-15.3.

13.1 Controlling Functions On Consisted Locos

Even though a locomotive is part of a consist, you can still access its function outputs independently as follows

1. Press  and browse to the address of a locomotive that is a part of consist.
2. Press  again to set the loco to your throttle.
 - 2a. **Consisted 2 digit address.** If the loco you want to change the functions on is a 2 digit address, the display will show "aa:cn" (Address number:consisted) to show that locomotive address aa is part of a consist & can't have its speed or direction changed. The throttle knob will NOT operate & the direction indicator will be unlit. However, the functions on this locomotive address can be modified by pressing  and proceeding with the normal function control keystrokes outlined above!
 - 2b. **Consisted 4 Digit Address.** In the case of a loco with a 4 digit address, when you press the  the second time, the throttle will display "Se:L" (it will appear to reject the address selection). Move either throttle knob or press either direction arrow key and "-cn-" will be displayed in the first screen followed by a second screen with the consisted 4 digit loco address to let you know that the loco selected is part of a consist. Press the  key & proceed with the normal function control keystrokes outlined above.

14.0 Dispatching Locomotives

Dispatching is a special feature incorporated in the LocoNet "language" to meet the needs of operators that wish to enforce a strict discipline in how engineers access locomotives during an operating session.

Dispatching allows you to run consists with some basic throttles that can't make their own consists. Dispatching also allows you to have newcomers run trains on the layout without giving them access to the entire operation.

To dispatch a locomotive using a the DT100IR, press  to enter "address select," browse to the address you want to dispatch & press  to dispatch it, that's all there is to it! The dispatched train can be a single locomotive or a consist that was set up by the DT100IR. Note that you cannot dispatch a loco that is currently *in-use*.

Any LocoNet throttle with dispatch capability can take a locomotive setup in a throttle & release it to the system as common & also specially marked as the dispatch locomotive.

This specially marked Dispatch locomotive can be requested & acquired by any throttle in the system.

Acquiring a "Dispatched" locomotive using a UT1 or UT2

Set the address selector switches to address "99" then press the "ACQ" button. The Status LED should light green showing that you now have control of the dispatched locomotive. (See Users Manual for UT1 or UT2 for complete instructions)

Acquiring a "Dispatched" locomotive using a BT2 "Buddy Throttle"

BT2 "Buddy Throttles" have no address selection capability of their own. This is similar to how real engineers are "assigned" trains in the prototype world. The first BT2 in the system to press  and the  or  will take command of (or acquire) the dispatched loco on either the Left or Right Throttle of that BT2.

The throttle that acquires the dispatched locomotive/consist will pick-up the train in exactly the state it was in when it was initially dispatched. If the unit was moving with lights on, it will be acquired with no speed change & continue with lights on until the acquiring throttle commands a new setting.

The TOP locomotive in a consist or MU lashup can be Dispatched to pass control of the entire consist to any other throttle connected to the system.

Dispatching a locomotive is also a fast & convenient way to clear a throttle for another address selection, without having to wait for the unit time-out back to LOCO mode. This happens when you want to swap locomotive addresses for convenience, from one throttle side of a DT100IR to the other.

There is only one Dispatch marked locomotive in the system at a time. The Dispatch marked locomotive will be acquired by the first throttle to request it.

15.0 Decoder Status

The Digitrax system assigns various status codes to each locomotive in the system at any given time. Status codes are made up of two digits and display in the form "aa:xy" for 2 digit addresses and "St:xy" for 4 digit addresses.

The left status digit "x" tells us the whether the decoder is *new* to the system, *common*, *idle*, or *in-use*. This digit is reserved for system usage and is not normally user modified.

The "x" status digit **determines whether a particular address is selectable by throttles and whether it is currently having its data refreshed by the command station**. This controls the interlocking or sharing of locomotives between throttles. "Refreshed" means that the Command station is constantly repeating the last command sent on the rails to a *mobile* decoder. This ensures that a mobile decoder will be able to recover smoothly even if it has power interruptions due to for example, dirty track.

Table II: Loco STATUS Codes Left Digit ("x")

Status Digit Value	State	Selectable?	Refreshed?
0y	<i>New</i>	selectable (default)	not refreshed
1y	<i>Common</i>	selectable	refreshed
2y	<i>Idle</i>	selectable	not refreshed
3y	<i>In-use</i>	not selectable	refreshed
5y	Common	not selectable	consisted/refreshed
7y	In-use	not selectable	consisted/refreshed

The right status digit "y" tells us how many speed steps the decoder is using, whether it is an FX or not and whether it is a consist TOP. Refer to the table below for the specifics. This "y" digit is the value that you can modify to select the speed step mode for a decoder.

Table IIa: Loco STATUS Codes Right Digit ("y")

Status Digit Value	Meaning
x0	Normal 28 step
x1	Motorola Trinary/ AC Digital type decoder
x2	Baseline 14 step
x3	128 step
x4	28 step FX decoder (enable advanced consisting)
x7	128 step FX decoder (enable advanced consisting)
xb	128 step & Consist TOP

Examples: If a loco's status code is 03, it is new, selectable, refreshed & 128 speed step operation. If a loco's status code is 52, it is part of a consist, common, not selectable because it is not the TOP of the consist & operating in baseline 14 speed step mode.

15.1 Status Editing a Decoder

When you begin the address selection process by pressing  the DT100IR's LCD screen will show the address selected and the decoder status. If you wish to "status edit" the loco selected you must do so BEFORE pressing  again and setting the loco selected to the throttle.

2 Digit Address Status Display: The decoder status will display in the right hand side of the display for 2 digit addresses

4 Digit Address or Aliased Address Status Display: Since we only have 4 digits in the display, the data will be displayed in two screens. First you will see the for about 1 second then you will see "St:xy" which means Status Code=xy (where x & y are the two digits of the status code as detailed in section 15.0).

Once you have the status code in the throttle display, you can status edit both 2 and 4 digit addresses as follows:

1. Press  and the status code "xy will begin to flash.
2. Use either throttle knob or the  or  keys to change the status value. This value will be displayed in the right hand side of the display or on the second screen as described above.
3. Once the status code number you want is displayed in the right hand two digits of the display, press  to change the status code of the locomotive and to set it to the display active throttle.

If the loco was originally in-use, the throttle will become inactive with SE:L- in the display. A DT100IR throttle will not be able to edit the status of an in-

use locomotive, it can only edit the status of a loco that is available for it to select. If the loco was common, idle or new at the start of editing, the new status value will be loaded & the throttle will be activated on this locomotive when the  key is pressed.

A consisted loco address cannot have its status edited. To edit the status for a consisted locomotive, the unit must be un-linked from the consist.

15.2 Notes For Users of Non-Digitrax Decoders

If you have a decoder that does not understand Advanced 28/128 speed step mode, you will need to "status edit" that locomotive to Standard 14 speed step mode before running it with the DT100IR & the system. This tells the system to handle this decoder as a 14 step decoder. It does not reprogram anything in the locomotive. You will need to change the status code to a value of "x2", for example "12", so that the DT100IR will operate those decoders in Standard 14 speed step mode.

16.0 Switch Mode

To change the position of a switch, press  key until the SWITCH mode indicator  at the top of the LCD screen is on. The switch decoder address is displayed in the 3 right hand digits on the LCD screen. The right character in the LCD screen indicates the switch position as follows:

"t" indicates that the switch is "thrown" (diverging track selected)

"c" indicates that the switch is "closed" (not turning out or diverging).

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 #2 is in an unknown position.

1. Use either Throttle Knob or  or  keys to browse to the address of the switch you want to change. You can also use the left throttle knob to set the 100's and the right knob to set the 1's.
2. Once the desired switch address appears in the left 3 digits of the LCD, you will see either "c" or "t" on the right digit of the display. If the "c" or "t" is flashing the command station does not have a known position for this turnout. Press either the "thrown"  key or the "closed"  key to select the turnout position you want.

NOTE: When Operating a DT100IR on Big Boy system, if your DT100IR detects that it is connected to system using a DT200 as the

command station (Big Boy Starter Set) it will use the same 2 digit switch display mode as the DT200. Both left & right throttle knobs will only change the switch by 1 count to a maximum of 128 or "c8."

3. The switch you selected will change position from closed to thrown or vice-versa.
4. 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 switch 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 are.

When you have finished your switch operations you can return to LOCO mode LOCO by

1. Pressing the MODE/DISP key twice (skipping past MU mode MU) or
2. Wait for the 6 second no-input inactivity time-out to return the DT100IR to the LOCO default mode.

The next time you enter SWITCH mode SWITCH , the DT100IR will remember where you left off & start at the last switch address & position you accessed.

17.0 Routes

The DCS100 lets you set up routes that are triggered by the activation of a single switch. To trigger a route, all you need to do is use Switch mode to select the TOP switch number and move the switch to the position that you set up in the route list. The TOP switch does not need to be physically present on the layout, it can be a "phantom" switch address. You might want to distinguish these types of addresses by using a particular range of switch numbers as phantoms. For convenience we suggest that you select a range of "Top" switch numbers that are allocated to be routes as distinct from the normal switch numbers. For example, switches 1 to 49 are for "real" switches on the layout and switches 50 to 99 are route Top switches. The DCS100 supports up to 32 routes. Each route consists of a list that contains a TOP Switch and its position and up to 7 other switches and their positions. Routes are stored in a memory array in the DCS100 in battery backed CMOS memory and can be triggered by any throttle in the system that has switch capabilities. Each of these 32 routes is triggered by setting the TOP switch to the position saved in the route list. When a route is triggered, a route can include a switch that is the Top of another route and all the entries in the second route will be added to the string of switch

commands the initial route request generates. The second route called is a "nested" route.

From the initial route you can "nest" up to 3 levels deep. Note that a route that itself does not contain another Top switch (i.e., another route) will not increase the nest depth. Knowing this, you can assemble up to 120 switch commands in a single route if you are careful in your nesting and expansion.

If the DCS100 evaluates a route that exceeds 3 nest levels above the current evaluation, or a cumulative total exceeding 120 switch commands it will abort the assembly of the total route and beep 4 times to alert you that there is a route problem. Note that if a route contains the same switch command more than once and this causes the route to "loop back" on itself, this will also generate a 4 beep Route error indication and no switch commands will be issued to the layout. In this case you will need to edit the route and correct the errors in the list before trying the command again.

Note that to use routes in the DCS100 you must set OPSW#26 to "closed." If OPSW#26 is the default "thrown," then routes will not be available in the DCS100.

A DT100IR can trigger and edit routes above the 32 supported by the DCS100. Future PC applications software will be able to go beyond the 32 Route capability of the DCS100 and add up to 100 routes in the system. You can erase all current routes in the DCS100 by setting OPSW#37 to "closed."

DS54 Cascaded Routes:

Because the DS54 can generate cascade switch message commands, it can be used to augment the DS54 "local routes" with any LocoNet route that is in the system. Even if you do not use the internal or local routes of the DS54, you can trigger up to 8 different route requests to the system from small push buttons attached to the DS54. Remember to select the correct Cascade control value from Table X of the DS54 manual so that the "Thrown" [90] or "closed" [B0] state matches that of the Top switch number of the Route you wish to trigger. Also be sure to connect the DS54 to LocoNet by the black 6 pin RJ12 jack so it can "talk" to LocoNet!

See section 17.0-17.2 for information on editing or setting up routes. Note that you will not often need to edit your routes once you have selected and tested the range of routes that you want on your layout.

17.1 DT100IR Route Editing

Diagram 5 shows the DT100IR key strokes to allow you to create & edit routes. The matrix shows an array of 32 routes each with an initial TOP switch entry, and up to 7 more switches in that route. Note that the diagram shows a dashed box display that is flashed up to indicate which entry you are working on. After this flashed display, the DT100IR will display the actual switch information that is "behind" or stored in this entry. This is depicted as the solid display box behind, and related to, the dashed display.

Entering Switch Editor & Selecting A Route To Review or Edit:

1. If you are currently in LOCO mode LOCO , press the MODE DISP key to change to SWITCH mode SWITCH . Note that you have a 6 second inactivity time-out, and if you do not make an entry within 6 seconds, the DT100IR will return to LOCO mode LOCO .
2. Press the FUNC key to change from SWITCH mode and enter Route/Signal/Clock Editor mode.
- 3a. If routes are enabled in the DCS100, by OPSW# 26 being made "c" or closed, then the display will flash "rt:01" (Route:01) to indicate you have entered the Route Editor.
- 3b. If routes are not enabled then this editor mode will be skipped and the DT100IR will attempt to edit Signal module information. Since the Signal modules are not yet installed, the unit will then skip to the Clock editor. Section 22.0 describes the steps for changing the Fast Clock, Rate and Alarm setting using these editors.
4. Select the route number you wish to edit by browsing through the 32 available routes. This route number, "nn" is simply a reference for editing and transcribing route information in the Route memory array. You will not trigger routes with the Route number but will do so by selecting the TOP switch in the route and changing its position to match the position set up at the Top of a particular route.
As you assemble your routes, we recommend that you keep a list of switches in each route (this will make it much easier to find problems with nesting). The following page is a blank route list table to help you keep up with the switches you set up in each route.
- 4a. The DT100IR will display "rt:nn" (route:route number) to indicate that you are at the TOP switch of route number "nn". After this ID has flashed up, the display will change to the 3 digit switch number of the TOP switch and the last digit will show either "t" or "c" to indicate the position of the TOP switch that will trigger the route.
5. After the "rt:nn" display has flashed up the switch number of this Top switch can be reviewed and changed if necessary. Use the following keys to make changes as needed:

- The Left throttle knob will change the switch# in increments of 100
 - The Right throttle knob will change the switch# in increments of 1
 - The  key will trigger the switch to move to the thrown position and the display will show "t" in the last digit
 - The  key will trigger the switch to move to the closed position and the display will show "c" in the last digit
 - The  key will update the route memory array for any changes you have made or will move to the next route number and display its TOP switch if no changes were made. To update the information and move to the next route number press  twice.
 - The  key will update the route memory array for any changes you have made or will move back to the previous route and display its TOP switch if no changes were made. To update the information and move to the next route number press  twice.
6. Editing The Other Switches in the Route. After reviewing the TOP switch in a Route you can edit the other 7 entries in the route by pressing the  key. The display will flash up the Entry number "ss" as "En:ss". The  key allows you to cycle between Route TOP display "rt:nn" and the Entry display "En:ss" for the other 7 switches in the route at any time during editing.
 7. Once you are in the Route Entry section after "En:ss" has flashed up, you can edit the Switch information for each entry in the route, using the same keystrokes detailed in step 5 above.
 8. After making & documenting all the changes you want to the Routes, you can exit the Route editor by letting the DT100IR time-out after 6 seconds of inactivity, or you can use the  key to cycle through the other 4 editors and back to LOCO mode. See section 22.0 for information on Fast Clock editing.

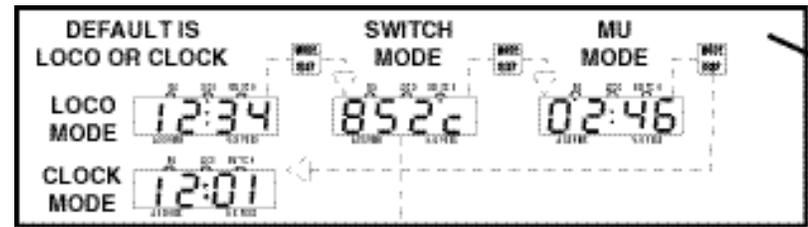
Fill in these convenient tables to keep a record of the routes you set up. Leave any null entries blank (" - - t" on display).

[] indicate switch is the TOP entry for a route.

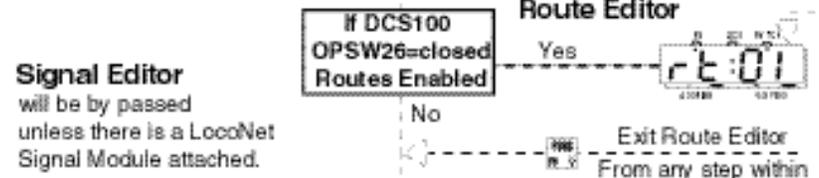
Route Entry	Switch ADR (Three Digits)	Dir (c/t)	Top of another route (Y/N)
rt:____ [TOP] (En:01)	[]		
En:02			rt:
En:03			rt:
En:04			rt:
En:05			rt:
En:06			rt:
En:07			rt:
En:08			rt:

Route Entry	Switch ADR (Three Digits)	Dir (c/t)	Top of another route (Y/N)
rt:____ [TOP] (En:01)	[]		
En:02			rt:
En:03			rt:
En:04			rt:
En:05			rt:
En:06			rt:
En:07			rt:
En:08			rt:

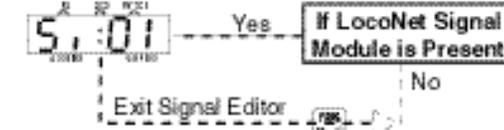
Route Entry	Switch ADR (Three Digits)	Dir (c/t)	Top of another route (Y/N)
rt:____ [TOP] (En:01)	[]		
En:02			rt:
En:03			rt:
En:04			rt:
En:05			rt:
En:06			rt:
En:07			rt:
En:08			rt:



Begin Editor



Signal Editor
will be by passed unless there is a LocoNet Signal Module attached.



Clock Editor



Throttle Knobs & +/- Keys Change This Display.
[M] Saves the updated entry in the system.



"Fr" shows current system fast clock rate
0=stop clock
1=1:1
4=4:1
100=100:1

Clock Alarm Editor

24 Hour Alarm Display for This Throttle



[M] Return to DEFAULT (LOCO or CLOCK) Mode or Timeout

Null Switches

If you try to decrement any switch number below "001" then the switch entry is considered "null" and the switch number will change to "---" or 3 dashes. A null switch will cause no action when a route is being assembled and is the normal state after resetting the Route memory with the OPSW#37 option, i.e., no valid route entries are present and they are all null. You can delete any active switch in the route by simply editing it to null. There may be nulls in any position in an active route, except the TOP switch position. If you null the TOP switch position the whole route is ignored as inactive, even if it contains other non-null entries.

To use routes efficiently, we suggest that you set up and test a few small routes first. Once you have these small routes working the way you want them, you can combine these smaller routes into a larger, more complex route by including the smaller routes' TOP switches in one of the larger ones. This modular approach makes setting up, understanding and debugging of routes a much easier process.

17.2 Triggering A Route From Your DT100IR Keypad

If your DCS100 has Switch Routes enabled and you have set up routes per as outlined above, you can activate a Route or group of switch commands by simply commanding the TOP switch of the route to move to the position stored in the route.

When you select a TOP switch in a Route and the position command you issue matches the position that is stored in the Route, the Route will be triggered. If you select the opposite position from that stored as the Route TOP, then the switch address will simply be commanded to change to that position & no route will be triggered.

DCS100 Switch Command FIFO:

The DCS100 has an incoming switch command FIFO buffer that can store up to 8 switch commands for action. These commands are stored in the order they were received. If you are running purely DCC switch commands the DCS100 can issue switch commands to the track as fast as the LocoNet can present throttle and computer switch requests in real time. If trinary echo's are enabled then the DCS100 will "pace" or meter the switch commands delivered to the tracks to one about every 1/2 second. This allows trinary switch decoders to operate correctly. This switch "metering" is in effect for both individual switch commands and those assembled by the DCS100 in response to triggering a route. If you are not in pure DCC switch mode, for long routes there may be some delay from a users' switch request until his

switch actually changes on the layout. This is due to the DCS100 metering out earlier requests in the Switch command FIFO.

Capacitive Discharge Solenoid types of switch motors

If you are in pure DCC mode [OPSW# 9="thrown"] then you can force switch metering by making OPSW#31 "closed." This can be useful when you are running Solenoid type switch ladders with "capacitive discharge" drive that needs some recovery time between operations.

18.0 Multiple Unit Operations:

The DCS100 command station offers three methods of consist control:

1. The BASIC Consisting method is to reprogram all the locomotives in a consist to the same address and run them off one throttle. In this case all the locos must be headed in the same direction, head to tail, head to tail, head to tail. You probably won't use this method very often in your operations because of its limitations. The Basic method is the only method available to most basic command stations. We mention it here only because it is an option.
2. The ADVANCED Consisting method (also called EPF or Decoder Assisted Consisting) is to store the consist information in each decoder. The locos can be added to and deleted from the consist in any orientation head to head or tail to tail. This method requires that all locomotives in the consist be equipped with decoders that support this feature. This method allows you to set up a consist that will be "transportable" from one DCC layout to another but you must be sure you always put the locos back on the track in the same order and orientation you programmed them for or you can get some unexpected results. This method has the advantage of subtly improving the consist response time and increasing the locomotive refresh rate.
3. The UniVersal Consisting method is handled by the command station and allows you to consist locos with any DCC or Motorola format decoder as well as an analog loco. The locos can be added to and deleted from the consist in any orientation, head to head or tail to tail. This method has the advantage of being able to use all decoders in consists. See section 25.0 for notes on the use of Motorola format decoders with the DCS100.

With the DT100IR & DCS100 you have the best of all methods because the DCS100 automatically optimizes each consist and uses the best method for the combination of locomotives you are linking together. You can consist any decoders by using a combination of UniVersal Consisting and Advanced Consisting. When you make up a consist, the DCS100 will optimize the MU linking and unlinking. The DCS100 will use decoder assisted operations whenever possible. When you initially program decoders that are capable of

advanced consisting you just need to set the second digit of their status codes to "x7"(for Advanced 128 Step Mode) or "x4" (for Standard 28 Step Mode). The DCS100 automatically checks for this status code when consisting locos and uses Advanced Consisting when all the locos in the consist are able to use this method.

You can add a locomotive to a consist in either direction and in any physical location in the train. When you send commands to the consist you use a single address and the command station or decoders handle the rest of the commands to the other locos in the consist. Since the address you will use to control the consist is not necessarily the address of the lead or head loco we have chosen the term "TOP" locomotive for this special address. We always add or MU LINK a loco to the "TOP" loco of a consist. The "TOP" loco is special, in that it is the address that receives the speed & overall direction commands for the entire consist and all other loco's added or linked into the consist will be controlled by running the "TOP" loco on a single throttle knob. The TOP locomotive does not even have to be a physical loco on the track, it can be a phantom. The TOP loco is always defined as the loco on the Right Throttle Knob at the time when the MU-Link is performed.

Consists are controlled through the TOP locomotive & all loco's in the consist will be common, in-use or idle based on the state of the TOP loco. Each loco within a consist maintains its original Advanced 28/128 or Standard 14 speed step mode setting. To run a loco in a consist with loadable speed tables, set the locomotive status for Advanced 28/128 speed step mode & program the decoder to operate with the loadable speed table enabled. See your decoder manual for information about programming loadable speed tables. If you are operating FX decoders, the Loadable table can be used in 128 step mode.

A consist can be made common and then be selected and run by any other throttle. A consist can also be dispatched and picked up on a UT1, UT2, or a BT2. (A DT200 or DT100IR can also pick up dispatched locomotives.)

Note section 25.0 covers the special issues to consider when operating Motorola Trinary style mobile decoders in a consist.

18.1 MU-Link: Adding a Locomotive To A Consist

To set up a consist using your DT100IR throttle:

1. Select and Set the address of the loco you want to be the TOP loco on the Right Throttle Knob "R". Remember that you can use any 2 digit address, aliased address, 4 digit address and/or an analog locomotive running on Address 00 in any combination.

2. Select and Set the address of the loco you want to consist to the TOP loco on the Left Throttle Knob "L".
3. Move the two locos into position. The locos can be headed in either direction. They can be adjacent to each other in the train or one unit can be the mid train helper or a pusher on the end of the train.
4. Before consisting the locos together make sure that both are traveling in the SAME PHYSICAL DIRECTION ON THE TRACK. (The direction indicators  may or may not match, the important thing is that the locos are traveling in the same direction and are not pulling against each other.)
5. Press the  key until the MU mode indicator  on the LCD display is lit. If both throttles are running 2 digit addresses, the left-hand side of the display shows the loco address active on the Left Throttle Knob "L" & the right-hand side of the display shows the loco address active on the Right Throttle Knob "R" (The TOP Loco). The LCD displays are slightly different when performing MU operations with 4 digit addresses or aliased addresses in either throttle. In this case all the operations are performed with the same key-strokes & have the same meanings as for 2 digit addresses. When you enter MU mode, before you add or delete a loco from the consist, if either throttle has a 4 digit address or an aliased address, then the LCD display will show "oooo" with the MU indicator  lit.
6. Press the  key to MU LINK the locos. That's it! The Left Throttle direction indicator  will go off. The Right Throttle Knob "R" will now control the speed & direction of both locos in the consist.

After you have MU LINKED the locos, if the Left Hand Throttle (Linked Locomotive) is a 4 digit address or an aliased address, the display will show ":SEL". If you turn the left throttle slightly, the display will briefly display "-cn-" (indicating that the 4 digit address or aliased address that was in the Left Hand Throttle is now part of a consist) and then will display the 4 digit address or aliased address of the consisted loco in the LCD display.

You can access the functions of the any loco in the consist by selecting the consisted loco to a throttle and using the function keystrokes outlined in section 13.1. You will not be able to change the speed or direction of any loco that is not part of a consist but is not the TOP loco while it is consisted.

Once a consist is set up & linked to the TOP locomotive, this TOP loco can be released & selected to run from either throttle. The consist can also be selected and run on another throttle or it can be dispatched to another throttle..

Nested Consist Linking

The loco that was selected in the Left Throttle "L" to be linked can itself be the "TOP" loco of a consist. When it is MU linked to the current Right Throttle "TOP" loco it will become a "nested" consist. In this case the whole nested consist is linked & itself will be part of the new consist.

18.2 MU UNLINK: Breaking A Loco Out Of A Consist

1. Select the loco address that you want to remove from a consist on the Left Throttle "L". For 2 digit addresses the display the loco address on the left and will show "cn" on the right side of the LCD, confirming this loco is part of a consist. For 4 digit long and aliased addresses the display will flash "-cn-" followed by the 4 digit number, with the DIR & EXP indicators unlit.
2. Press the  key until the MU mode indicator  on the LCD screen is lit.
3. Press the  key to MU UNLINK the locomotive. The unlink is complete.

The Left Throttle "L" automatically becomes active with the loco you just unlinked! If you unlink while the consist is moving, the unlinked loco will be broken out of the consist at the same speed & direction that it was moving in the consist. You can uncouple and run the unlinked loco as an independent loco again!

18.2.1 Nested Consist Unlinking

The loco that is selected in the Left Hand Throttle to be unlinked can itself be the "Top" loco of a nested consist that was linked into the current Right throttle "Top" loco. In this case the whole nested consist is unlinked & returned to the Left Throttle as a consist.

18.2.2 Advanced Consisting

Advanced consisting is very similar to UniVersal consisting except that a consist address is programmed into the decoder to permanently MU locomotives together, even if they are removed from the layout and taken to another layout.

Programming and assigning a consist address is performed automatically by the DCS100 when the locomotive to be MU'ed has a status number of 4 or 7 for the second digit. The status number is the number that appears to the right of the address when selecting a locomotive. For example, if a decoder is using 128 speed steps and one attempts to select this locomotive, the address will be to the left of the colon and 13 or 23 will be to the right if it is

available to be selected. The "1" and "2" means that the locomotive is available and the "3" means that it is using 128 speed steps. To perform Advanced consisting, it is necessary to change the "3" to a "7" for 128 speed steps or "4" for 28 speed steps. This is accomplished by performing a Status Edit.

To Status Edit a locomotive, press SEL as usual and turn a knob to the address, then hit FUNC and turn the right knob to 14, 24, 17, or 27, and hit SEL. Now that the locomotive is selected and the right digit is a "4" or "7", the DCS100 will recognize that this is a decoder that is capable of being Advanced consisted.

Two things should be noted at this point. The first is that many decoders do not support the Extended Packet Format or EPF necessary for advanced consisting. Digitrax decoders that are capable of Advanced consisting the DN140, DN144K, DN145K, DN146A, DN147A, DH121, DH140, DH150A, DH150K, DG380, DG580, and any decoder name ending in 'FX'.

The second item is that the top locomotive's address (the one assigned to the right throttle) in an Advanced consist has to be a two digit (short) address. This does not mean that a locomotive with a two digit address actually has to be at the top of a consist. A locomotive with a two digit address could be the third unit in a consist, but be the top locomotive as far as the throttle is concerned. If you only have four digit addresses, simply select a two digit address that does not actually exist on the layout and assign it to the right throttle. Then MU all of the four digit addresses to the two digit address. Once the locomotives to be assigned to a top locomotive have the proper status, MU'ing the locomotives to be Advanced consisted is then performed in the exact same manner as with UniVersal consisting (MODE, MODE, +). When the consisting takes place, the DCS100 will automatically assign the consist address to CV19 in the decoders being Advanced consisted. When locomotives are removed from the consist, CV19 is automatically changed back to '00'.

18.3 MU of Mismatched Locomotives

If all the locomotives in the consist have performance characteristics that are closely matched, you can run all the consisted locos in 128 step mode. If the units are completely mismatched (for example if you are running an Athearn with a Kato), then we recommend programming the decoders using the User Loadable Speed Table (See section 21.6) & running the DT100IR in the 28 step mode to achieve better speed matching of locos in the consist. This lets you speed match the 28 step operation of each locomotive to a given reference locomotive, so when they are consisted they will run well together.

If you want to consist with a conventional analog locomotive, use the analog locomotive as the reference locomotive & match the DCC locos to it using the User Loadable Speed Table.

If you are using FX type decoders then you can use the Loadable Speed tables in 128 step mode for really superior speed control & matching in MU's or consists.

19.0 DT100IR Configuration Options

The DT100IR has an individual throttle OPTION mode that lets you customize your throttle. The options are assigned as hexadecimal numbers representing combinations of options as shown in the tables below. The default values are generally satisfactory for most operations.

NOTE: It is recommended that all locomotives assigned to this throttle be released before you change any options.

1. Unplug the DT100IR from the network. Press and hold the "SEL/SET" button and plug the DT100IR back into the network. The display will show the Primary Throttle Option Screen "oP:01" (default). This display will appear for approx. 5 seconds if no action is taken, if no action is taken after 5 seconds, the DT100IR will return to "RUN" mode
2. 2. While "oP:nn" is still in the display, use the throttle knobs "R or L" to modify the Primary option value according to the following table:

DT100IR Primary Option Choices

Primary Option Value	Options Enabled				
	Ballistic Tracking	Fast Clock Display	Key & Knob Clicks	Run/Stop Local/Global	Make F3 key a momentary key
00	No	No	Yes	Local	No
01	Yes	No	Yes	Local	No
02	No	Yes	No	Local	No
03	Yes	Yes	Yes	Local	No
04	No	No	No	Local	No
05	Yes	No	No	Local	No
06	No	Yes	Yes	Local	No
07	Yes	Yes	No	Local	No
10	No	No	Yes	Global	No
11	Yes	No	Yes	Global	No
12	No	Yes	No	Global	No
13	Yes	Yes	Yes	Global	No
14	No	No	No	Global	No
15	Yes	No	No	Global	No
16	No	Yes	Yes	Global	No
17	Yes	Yes	No	Global	No
20	No	No	Yes	Local	Yes
21	Yes	No	Yes	Local	Yes
22	No	Yes	No	Local	Yes
23	Yes	Yes	Yes	Local	Yes
24	No	No	No	Local	Yes
25	Yes	No	No	Local	Yes
26	No	Yes	Yes	Local	Yes
27	Yes	Yes	No	Local	Yes

3. Save the primary throttle option code by pressing the  key. The display will then show the Secondary option code screen "oS:23" (default).
1. The Secondary option code screen "oS:23" (default) will appear for approx. 5 seconds, if no action is taken after 5 seconds, the DT100IR will return to "RUN" mode

2. Use the throttle knobs "R or L" to modify the value for the secondary options according to the following table. The Secondary option codes shown allow you to *override* the system default NEW decoder type when selecting with this DT100IR.

DT100IR Secondary Option Choices

Secondary Option Value	Throttle Default For NEW Decoder Type
x0	28 Step
x2	14 step decoder
x3	128 step decoder
x4	28 step FX decoder
x7	128 step FX decoder
x8	Disable NEW type override feature
2x	Radio disabled
4x	Infrared disabled
6x	All tetherless disabled
8x	Disable power save

1. To save the secondary option code press . Throttle will now show the throttle ID number. Make sure the ID is unique to the throttles used on this system. Use the throttle knobs "R or L" to modify the value of the ID. To save the ID code press .
2. The display will then show the Radio Frequency channel " rf :00" (default). This sets the channel for either Infrared or Radio operation if it is installed.

Note: If no keys are pressed, the time-out for Throttle Option Mode is 12 seconds & the DT100IR will go to idLE if you do not press any keys within that amount of time.

20.0 Infrared Tetherless Operation of DT100IR

The DT100IR in your Chief set comes "InfraReady". With the addition to the system, of a UR90 Infrared receiver or a UR91 Radio/Infrared receiver, the DT100IR can be used as an Infrared tetherless walk around throttle. **A 9 volt battery, in the throttle, is necessary to operate the DT100IR "Tetherless"**. Due to the nature of the Infrared signal more than one receiver may be necessary for optimal performance.

When a DT100IR is plugged into a working LocoNet, it will verify that at least one infrared capable receiver is present. The DT100IR will then assume the current Network ID that the infrared capable receiver(s) are set to, and subsequently allow itself to revert to infrared operation when it detects a subsequent LocoNet disconnection.

20.1 LocoNet Connection

On connection to a LocoNet that has compatible infrared capability, the DT100IR LCD display will flash the infrared status code "rA:0n" the

number “n” signifies the LocoNet ID being used by all receiver’s on the system it has plugged into and will be identifying itself with. The display will then revert to normal DT100IR tethered operation displays and actions. If the system does not have a UR90 or equivalent device, the DT100IR will not display the “rA:--“ message to show that it cannot operate “Tetherless” on that system and thus not allow the infrared to be active when untethered.

20.2 Display Power Down

When the DT100IR has connected to a LocoNet and received the LocoNet ID number it will allow tetherless operation of locomotives that have been selected into either throttle knob. If an untethered DT100IR detects no user throttle activity for about 3 minutes it will enter Power Saver mode and display on the LCD the infrared status code “r- PS” until a throttle or key action restores normal activity and displays. If the DT100IR has a locomotive assigned to it and is in Power Saver Mode, it will continue to “check in” with the system every 60 seconds telling the system “Hey I’m still here”. This keeps the system from releasing that locomotive back to “common”. The direction LED’s of active throttles may blink every 1.5 seconds when the DT100IR is checking to see if any new key or encoder input has been made. It may be most convenient to hold down either the  or  key to signal the unit to exit from power saver mode.

You can use the Secondary option to turn off Power Saver mode, see section 19.0.

If you wish to have the infrared throttle enter the lowest power use “idLE” state of a normal DT100IR, then you can connect it to a LocoNet in sleep mode. If the LocoNet is in sleep and has battery saver capability then the DT100IR can take all its power indefinitely from the LocoNet. Alternatively, you may reset the DT100IR by simultaneously pressing the  ,  and  keys , as detailed in the DT100IR instructions. Once the DT100IR is reset it remains “idLE” and cannot become an active infrared throttle until it has been reconnected to a infrared capable LocoNet and has an active address selected. Of course, you may simply remove the DT100IR battery to power down an untethered DT100IR.

If you use Power Saver mode then the DT100IR’s local Fast clock copy will deviate from the System value. It will resynchronize with the system when reconnected.

20.3 LocoNet ID change

In normal operations a DT100IR will accept and use the LocoNet ID offered by the compatible infrared receiver(s) it may see when connected to the network. To allow a LocoNet to be changed to a different ID number, to allow for example 2 clubs to have layouts at the same show, the DT100IR may be used to change the LocoNet ID number of one of the independent LocoNet systems.

To change a LocoNet ID number:

- 1) Disconnect a DT100IR from the LocoNet that you wish to modify the ID.
- 2) Press and hold down the  MODE/DISP key on the DT100IR and then reconnect the unit to the LocoNet. This key being active upon reconnect enables the DT100IR to be allowed to modify the system ID.
- 3) Release the  MODE/DISP key. The DT100IR will flash up the current infrared ID# “rA:0n”, where the “n” digit shows the current LocoNet ID. Use RIGHT HAND THROTTLE to change the ID digit “n” to that desired, in the range 0 to 7, and then press the  SEL/SET key to set the system to the new ID.
- 4) Be sure to reconnect any DT100IR that is going to be used on this system back to the system so it can adopt the new ID number and be able to access the new system ID.

If you add a new UR90 or UR91 to the system and are using a LocoNet ID other than the initial default value of 0, you need to re-synchronize the ID's in all the UR90's and UR91's following the outlined steps above with a new ID for the whole system

If you are operating in a large group or meet with several different LocoNet systems nearby, be sure to issue a new and unique ID to each system before beginning operations.

20.4 “Tetherless” Operation

Selecting a Locomotive

While tetherless, the DT100IR operates as a one-way transmitter. **The DT100IR must be plugged into LocoNet to select an available locomotive address.** After a DT100IR has selected a locomotive, it may then be unplugged from the network and will automatically revert to infrared operation for all subsequent, speed, direction, function and turnout commands.

Releasing a Locomotive

When working untethered with an active address in the LCD display, if the  SEL/SET key is pressed the locomotive address will **immediately** be released as common in the system and that throttle will become inactive. To re-select this locomotive you will then need to reconnect to the LocoNet. The DT100IR will automatically reselect that locomotive when the DT100IR is connected to the network providing that the status of that locomotive remains in common

Multiple Unit Operations

Consists may be assembled and broken up in the normal fashion while the DT100IR is connected to LocoNet, however, the M.U. function is locked out while the DT100IR is being used Tetherless. Once a consist is made up, it may be operated normally using the DT100IR “Tetherless”.

Operations Mode Programming

Operation Mode Programming or OPS mode will work only while the DT100IR is connected to LocoNet.

Service Mode Programming

The DT100IR must be connected to LocoNet to use its Service Mode Programming Mode.

Switch Mode

The DT100IR will operate in the “Switch” Mode while “Tetherless”. It can throw switches and routes using the “t” and “c” buttons in the normal manner.

Ballistic Tracking

While running “Tetherless” Ballistic Tracking will feel slightly different than while connected to LocoNet.

Fast Clock

When using the Fast Clock option, the DT100IR will keep track of and display Fast Time based on what the Fast Time was the last time the DT100IR was connected to LocoNet. If the Fast Time is edited by someone else connected to the network, the DT100IR will not see this change until it is plugged into LocoNet at which time its display will be updated.

20.5 Battery “Fuel Gauge”

The DT100IR continually checks the voltage of the battery while running “Tetherless”. If it detects a voltage in the questionable range, around 6.8 volts, the DT100IR will beep twice in about one second and display “bt:nn” on the LCD. The “n” is the number of times the warning has sounded. The warning will continue every 5 min. until the battery is changed. The display will disappear when any control is activated. **Don’t Panic** when this warning appears. The DT100IR will continue to function normally for an extended period of time depending on the type battery in use. 9 volt alkaline batteries are nearing the end of their life at this voltage, but 7.2 volt NiCad rechargeable batteries may still have lots of life remaining. Experience will determine how long your DT100IR will operate after the warning has sounded. The counter in the display is a useful tool in determining how long your battery will last. The battery can be “Hot Changed” while the DT100IR is plugged into LocoNet and will not lose any locomotive assignments.

20.6 Infrared Override

A value of "23" entered as the Secondary Option for a DT100IR will disable the RF option. A value of "03" will re-enable the RF or infrared option. This may be changed any time the DT100IR is initialized.

DT100IR Secondary Option Choices

Bottom Digit Secondary Option Value	Throttle Default For New Decoder
x0	28 Step
x2	14 step decoder
x3	128 step decoder
x4	28 step FX decoder
x7	128 step FX decoder
x8	Disable NEW type override feature
Top digit Secondary Option Value	Tetherless Features control
0x	Radio with power saver
2x	Radio disabled
4x	Infrared disabled
6x	All tetherless disabled
8x	Disable power save

Example: "oS:23" means 128 step new locomotive, infrared and Power Saver enabled and Radio disabled. This is the normal factory default.

20.7 Keyboard Lock Out

While the DT100IR is being used "Tetherless", there are occasions when you may want to disable the throttle keyboard to prevent accidental commands being sent to the railroad.

Example: Your train is in a siding waiting for another train to pass. You put your throttle in your pocket and go take a break. By locking the keyboard, you will not be able to accidentally start your train if you bump your throttle and press the "Plus +" key.

To lock the keyboard on your DT100IR, simply press both the "PLUS +" and the "MINUS -" keys at the same time. The throttle will display "Locd" in the display and none of the controls will function.

Be careful when locking the keyboard to be sure that you do not give a speed command to the active loco.

To un-lock the keyboard simply press both the "PLUS +" and the "MINUS -" keys at the same time again. This will return the throttle to normal operation. **Plugging the throttle into LocoNet will also unlock the throttle.**

21.0 DCS100 Programming Modes

21.1 Decoder Programming: Customizing Your Decoder's Performance Characteristics

Your DCC Decoders have many different Configuration Variables (CV's for short) that allow you to set up a different set of operating characteristics for each decoder installed in each locomotive.

Each of these CV's controls a characteristic of the decoder. See Table III for a list of the most commonly used CV's and their meanings. These CV's allow you to customize each locomotive's performance characteristics to give you prototypical operation. Each decoder comes pre-programmed from the factory with the settings outlined in your decoder manual. You have the option of changing your decoder's performance characteristics by choosing from among the CV's and setting up each one independently. Each of these CV's can be set up when your command station is in the programming mode or by using the Digitrax PR-1 Computer Programmer & your PC. The CV's are remembered in the decoder until it is reprogrammed to a new value. Please refer to your Mobile Decoder Manual for a complete listing of the CV's that the decoder you are using supports.

It is a good idea to run your decoders with the default values that come pre-programmed in your decoders until you get used to the system & what it can do for you before you begin customizing. Initially, you should keep deceleration numeric values as small as practical. This allows you to adapt to the delays in deceleration you have programmed without crashing your valuable locomotives!

The DCS100 has a built in network accessible Service Mode programmer that lets you read back & write decoders on a separate electrically isolated programming track. With this full time programming track, you can program decoders without shutting down layout operations. The service mode programmer can be accessed from any DT100IR or PC attached via an MS100 running LocoNet compatible DCS100 application software. To use

the DCS100's service mode programming track simply hook up a section of track via the "PROG A" & "PROG B" terminals on the front of the unit and place the locomotive decoder you want to program on this isolated programming track.

The DCS100 implements 3 different methods of Service Mode programming, Paged (most common), Physical (least sophisticated) & Direct, as defined in the NMRA RP-9.2.3. This allows the DCS100 to program DCC compatible decoders from all DCC manufacturers who support this RP. In addition, the DCS100 and DT100IR also implement Operations Mode Programming allowing you to change decoder CV's while a locomotive is on the mainline. See section 21.7 for OPS mode programming

When a DT100IR enters programming mode, the current Programming method it is using is displayed on the LCD screen:

"Page" -Paged Programming (DT100IR's default to this method)

"PHYS" -Primitive Physical register programming

"dir " -Direct Programming

"OPS " -Operations Mode Programming on the mainline to the active throttle's decoder address.

When the DT100IR is in program mode, each time you press the  key the mode will cycle among the 4 programming modes. For convenience, when you exit programming mode, the DT100IR will *retain the last programming mode you used along with the CV# and its data value*. This means that the next time you enter programming mode you will be at the same place where you left off the time before.

21.2 Using Your DT100IR To Program Decoders

1. Once you have your Chief Set up & running enter the programming mode on ANY DT100IR connected to the system by pressing  &  together until the DT100IR programming indicator **PROG**  glows GREEN. When the GREEN indicator is on, the DT100IR is in programming mode. Be sure that only the loco that you want to program is on the programming track section attached to "PROG A/B" terminals of the DCS100 command station. The DT200 throttles are not designed to access the Programming track of the DCS100. You must use DT100IR's for this.

Note that CV 01 is the loco address & displays as "Ad" on the left side of the display. See section 21.5 for more information about programming addresses & other CV's.

2. Turn the Left Hand Throttle knob "L" on the DT100IR until the CV number you want to change is displayed in the left hand side of the LCD screen. *When you first access a new CV#, the DT100IR does not automatically read back the contents of this new CV#, so it will display 2 dashes in the right hand side of the LCD to signify that the CV contents are unknown.* (If you do not wish to read back the current value programmed to the CV selected, proceed to Forced Write below.) If you wish to read or "DISPlay" the current value programmed for this CV from the decoder on the Programming track, press the

MODE
DISP

 key. The DT100IR will flash up the Programming Mode being used followed by the CV# number. As the DCS100 is scanning or reading the decoder on the track, you will see the left most digit moving in a "pretzel" formation to show activity. When a data value is successfully read from this decoder's CV, it will replace the "pretzel" with a flashing number in the 2 right hand digits.

2a. Read back Failure Messages:

"**busy**" means the Programmer is being accessed by another device. Wait briefly & try pressing the key  again.

"**no-d**" means that there is no decoder on the Programming Track or the decoder was removed during programming operations, the DT100IR will abort the current programming activity.

"**noPG**" means that the programmer detects the standby power draw of a decoder but does not get the correct response to programming actions. If this happens, be sure that the decoder has a motor load connected that will allow correct feedback. If this does not correct the problem, try to program the decoder using the Physical register programming mode since this decoder may not support the "Paged CV" programming method. For technical details, refer to the NMRA RP-9.2.3 Specification & your Decoder manufacturer's documentation for information on the types of programming supported. All Digitrax decoders support Paged programming.

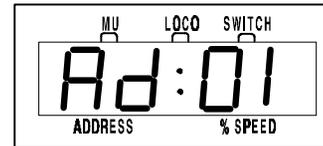
3. At this point if you have read the CV value you now can modify it by turning the Right Hand Throttle knob on the DT100IR until the value you want to program is showing in the right hand side of the LCD display.
4. Press the  key to "set" or write/program the value showing in the right side of the display to the CV showing in the left side of the LCD screen. If this write operation is successful, the DT100IR will flash "Good" on the display to confirm this.
- 4a. Forced Write: If you press the  key when the DT100IR right digits are showing dashes (before the CV value is read back) you can proceed to select a new data value for the CV by using the Right Hand Throttle Knob "R". To force the programmer to write the selected value to the selected CV simply press the  key again.
5. You can continue selecting CV's and reading and writing them until you are finished. When you are finished with your programming session, return the DT100IR to normal throttle mode by pressing  &  together until the D100 programming indicator **PROG**  no longer glows GREEN.

21.3 Programming 2 digit address Decoders

The initial program display will show the last CV# used in the last programming session.

Turn the Left knob counterclockwise to change the left digits to "Ad". A display of "Ad:--" shows the current value of the 2 digit address in the decoder on the programming track has not been read back and is unknown.

Programming Mode Display Example



This display shows "Ad:01". The "Ad" is used to let you know that you can program and change the decoder's 2 digit address (CV#1). The right side of the LCD is the 2

digit address. The DT100IR can write a loco address from 1 to 127 using the *mixed-mode decimal numbers* shown in Table I in section 11.2.

To program a 2 digit address:

1. Once you enter Program Mode by pressing  &  as outlined above, select "Ad" (CV#1) turning the Left Throttle Knob "L" counterclockwise until the Left side of the display is showing a flashing "Ad". At this point, you can read back the 2 digit address by pressing .
- 1a. If you do not wish to read CV1 back, simply use the Right Throttle knob to change the address to the desired value and then press  to proceed directly with a forced write of CV#1.
2. After the decoder address has read back, use the Right Throttle Knob "R" to change the Right side of the LCD screen to the 2 digit address you want to program into the decoder on the programming track. The display will scroll through address numbers & flash indicating you are scanning to a new value for the loco address to store in the "Ad" CV (CV01).
3. When you have the new loco address you want in the Right hand flashing display, press the  key to "SET" or program this value into the decoder. The display will flash up the programming mode in use & the loco will pulse briefly as it is programmed to its new address.
4. If you want to use aliased addressing for this decoder, see section 11.5.3 for information on assigning an alias to this 2 digit address.

21.4 Four Digit Address Programming

To set the 4 digit address of an EPF decoder (like Digitrax FX decoders), you actually have to program CV18 & CV17. To make things more convenient for you, the DT100IR will automatically program both of these CV's simultaneously.

Automated Programming of CV18 & CV17 For 4 Digit Addresses

- 1) Place the locomotive with the EPF decoder on the service mode programming track connected to the DCS100.
- 2) Once you enter Program Mode by pressing  &  as outlined above, use the  key to cycle to either Paged or Direct programming.
- 3) Use the DT100IR's Left Throttle Knob "L" to select CV18 in the left 2 digits of the display.
- 4) Press the  key to read back the decoder's stored value in CV18.
- 5) Before you make any changes, press the  key *again* to force the DT100IR to complete the read back of the complete 4 digit address from the decoder and to display the address as a flashing 4 digit number. While the DT100IR is executing the search for the 2 CV's, the display will show for about 8-10 seconds "LAd-" where the - is the activity "pretzel" showing the unit is working. The "LAd " in the display prompts that the unit has now switched to the *Long Address Programming display and modify mode*.
- 5) You may now use the two throttle knobs to modify the displayed 4 digit address in the decoder. The Left knob will change the 4 digit number in steps of 100 and the right knob changes in steps of 1.
- 6) To write back a modified 4 digit address to the decoder press the  key and the DT100IR will flash "Good" if the programming was successful.
- 7) You write back the 4 digit address flashing in the LCD display every time you press the  key. If you press the  key the DT100IR will exit from the Long address programming mode, back to normal access of CV18.

Remember that to use this 4 digit address you must program CV29 to instruct the decoder to use this address mode. For example if you have a FX decoder (which is capable of using 4 digit addresses) you must set its CV29 to "26" to set the decoder up for 4 digit address mode enabled with 28/128 step light control & analog mode conversion enabled.

21.5 Programming Other Configuration Variables (CV's)

To program a CV (other than the decoder address CV01 and/or CV17 & CV18):

1. To program any other CV simply select it by turning the Left throttle knob "L" until the CV number you want to program appears in the Left hand side of the display.
2. Then turn the Right knob until the data value you want to write to the CV you selected appears in the right side of the display.
3. When the values you want are in the display, press the  key to set the values.

In order to give you the most power possible in a programmer in a unit as compact as the DT100IR, it was necessary to use hexadecimal numbers for the data to be stored in all *but* the Address CV (CV #1). Table VI shows how the hexadecimal numbers correspond to regular decimal numbers you are probably used to. The CV's that you will use most are listed in the following table. Please refer to your decoder manual for more CV's & their meaning as it relates to your specific decoder.

Table III: Most Commonly Used CV's

CV #	Used For	Value range
Ad(01)	Loco 2 digit address	0-99 decimal, "A0 -C7" mixed mode
02	Start voltage (Vstart)	0- FF hexadecimal
03	Acceleration rate	0-1F hex
04	Deceleration	0-1F hex
06	Mid-point voltage (Vmid)	0-FF hex
17*	Loco 4 digit address high	C0- FF hex
18*	Loco 4 digit address low	0-FF hex
19*	Advanced consist address	0-7F hex
29	Configuration register	See Table IV

* CV17, 18 & CV19 are implemented in FX decoders.

CV's 65 to 95 control the 28 step "Loadable Speed Table" function & Table V lists the actual usages.

Refer to your Decoder manual for a complete list of the CV's supported.

Table IV: Configuration Register Values:

These are some of the common hexadecimal (hex) values used in the **Configuration register** (CV #29) & their meaning. A complete table with

all CV29 values and their effects is included in the Digitrax Decoder Manual.

Value in CV29	Meaning to Decoder		
	(in hex)	Speed Steps (Std of Adv)	Address Mode
00	14 (Standard Mode)	2 digit short	No
02	28/128 (Advanced Mode)	2 digit short	No
04	14 (Standard Mode)	2 digit short	Yes
06	28/128 (Advanced Mode)	2 digit short	Yes
16	Enable Loadable Speed Table	2 digit short	Yes
20	14 (Standard Mode)	4 digit long	No
22	28/128 (Advanced Mode)	4 digit long	No
24	14 (Standard Mode)	4 digit long	Yes
26	28/128 (Advanced Mode)	4 digit long	Yes
36	Enable Loadable Speed Table	4 digit long	Yes

Note that with Digitrax Standard Decoders (non FX decoders), if 128 speed steps are sent by the command station then the 14/28 speed step & Loadable speed table selections are not used.

21.6 User Loadable Speed Tables

Loadable speed tables let you customize the throttle response of individual decoders & locomotives by defining your own personal throttle response curve for each decoder in your fleet. The loadable speed table has 28 speed step data entries that let you "draw" an arbitrary "power curve" with a resolution of 1/2%, from stop to full-speed. The shape of this curve defines the "feel" of the decoder throttle response. Once you set up this throttle response curve for a particular DCC loco, you can scale the actual speed set by the throttle by using the forward & reverse trim value which acts like a "volume control." For example, using forward & reverse trim, you can change the maximum forward speed from 45 scale mph to 80 scale mph without having to reload the entire 28 step table. Changing the forward or reverse trim values will scale or multiply all the values used in the table, in the corresponding direction, by the amount desired. Using different forward & reverse trim values allows different forward & reverse speeds. The trim value can increase the table values from 100% to 200% with 1% resolution, or down from 100% to 2% with 1% resolution. All the table values are non-volatile & are remembered when the power is off. Loadable speed tables let you "speed match" locomotives that you would like to use in a consist even if their operating characteristics are very different.

To Set Up a Loadable Speed Table:

1. Follow the programming instructions in section 21.2 to set up your DCS100 command station for programming mode (or use a computer programmer like the PR-1)
2. Place the loco you wish to program on the programming track.
3. With the DT100IR, Program CV's 65 through 96 with the values listed in Table V. To do this dial in the CV# on the Left throttle knob "L" & the value to be entered on the Right throttle knob "R" & press  Select/Set to program the CV & data value. To program the full table you will need to repeat this for each CV from #65 through #96.
4. After programming the table values, program CV29 to the value of 16 for example to enable the loadable speed table (values from 10-19 or 30-39 can also be used). If you want to disable the loadable speed table later, just program CV29 to 06 for example & you will return to operation with the DT100IR (the speed table is still remembered & can be re activated by programming CV29 to a value that enables the speed table later). Note CV29 values of 01-09 or 20-29 can also be used when the speed table is not enabled.
5. If you are using the PR-1 programmer, simply draw the throttle response curve you want on the screen & press the "Send" or Program button.
6. Once the table is loaded, you can exit programming mode and run the locomotive.
7. If you are speed matching locos, you should get the first loco running the way you want & then match subsequent locos to it.
8. When you are speed matching locos it is very helpful to keep a running list of the settings you have entered so that you will know "where you have been" & can work out "where to go next."

The following Table V is an example of a loadable speed table that you might choose to try.

Table V: Example Loadable Speed Table

Usage	CV #	DT200 HEX Data See Note 1	Register	Suggested Setting DECIMAL
			Page 17=PL	
Kick Start	CV65	01	1	1
Forward Trim	CV66	80	2	128
Step 4 value	CV67	0A	3	10
Step 5 value	CV68	0E	4	14
			Page 18=PL6	
Step 6 value	CV69	12	1	18
Step 7 value	CV70	16	2	22
Step 8 value	CV71	18	3	24
Step 9 value	CV72	1c	4	28
			Page 19=PL6	
Step 10 value	CV73	20	1	32
Step 11 value	CV74	24	2	36
Step 12 value	CV75	28	3	40
Step 13 value	CV76	2c	4	44
			Page 20=PL6	
Step 14 value	CV77	32	1	50
Step 15 value	CV78	36	2	54
Step 16 value	CV79	3c	3	60
Step 17 value	CV80	40	4	64
			Page 21=PL6	
Step 18 value	CV81	46	1	70
Step 19 value	CV82	4c	2	76
Step 20 value	CV83	52	3	82
Step 21 value	CV84	5A	4	90
			Page 22=PL6	
Step 22 value	CV85	60	1	96
Step 23 value	CV86	6A	2	106
Step 24 value	CV87	72	3	114
Step 25 value	CV88	7E	4	126
			Page 23=PL6	
Step 26 value	CV89	88	1	136
Step 27 value	CV90	94	2	148
Step 28 value	CV91	A2	3	162
Step 29 value	CV92	b2	4	178
			Page 24=PL6	
Step 30 value	CV93	c6	1	198
Step 31 value	CV94	dA	2	218
Reverse Trim	CV95	80	3	128
Configuration Register	CV29	16	5	22
Page Register	None	None	PL6=Page register	1

Notes for Table V:

1. In order to give you the most programming power possible in a unit as compact as the DT100IR, it was necessary to use hexadecimal numbers for the data to be stored in all CV's except the address CV (CV#1). Table VI shows how hexadecimal numbers correspond to regular decimal numbers that you are used to.
2. The Kick Start table entry allows a short voltage kick to happen when you start the Locomotive decoder from 0 speed or stopped to a moving speed. A value of 0 turns this OFF. Experiment with values for a particular installation to find the best compromise.
3. Forward Trim (CV66) & Reverse Trim (CV95) values of 128 (80 Hex) will yield a scaling of 100%. The same effect will occur if the value 0 or 1 is loaded for Forward or Reverse Trim, i.e., Multiply by exactly 1. A Trim value of 255 (FF Hex) will give 200% scaling of the table entry value.
4. A *final scaled table value* of 255 (FF Hex) represents 100% applied motor voltage or Full speed. A value of 128 (80 Hex) represents 50% applied motor voltage, i.e., the actual table step entry is multiplied by the appropriate Trim value to yield the final scaled table value that defines the voltage to apply to the motor.
5. The Steps defined in the table are for the NMRA 28 step mode. Step 4 is the first motion step in the 28 Speed step code system. Step 31 is the "full throttle" speed step. When configuring the decoder to run 14 step mode, only every second entry is used, the decoder automatically uses the correct data value.
6. The suggested data values given in the table will give a throttle response curve that most US users are comfortable with. The data values can be modified to suit your individual preferences.

Note that if the Configuration Register is set up with the User Loadable Speed Table flag SET to *enable* the Speed Table, the VSTART & VMID values are *not used* to by the decoder when calculating Loadable Speed Table values.

Many Digitrax customers have asked us why we can't formulate tables like this one for the specific locomotives that they are running. The reason for this is that each & every locomotive is different. If we bought 5 identical brand new locos today & put them on the test track, we would probably find that they do not all run exactly the same way. And, as time goes on & we run these locos for different amounts of time under different sets of circumstances they will probably change even more. It's really best to start with the default table shown & work with your own equipment to customize it for your own preferences. If

you are planning to do a lot of customizing, the PR-1 is probably an easier solution for setting up loadable speed tables.

21.7 Operations Mode Programming

Operations mode lets you program CV's in DCC locomotives equipped with EPF decoders while they are on the mainline. A typical use for OPS mode programming would be to change the acceleration rate (CV03) or the deceleration rate (CV04) of your locomotives to simulate the weight and braking capability of the train to compensate for changing the number of cars and power units. You can also modify the FX parameters in CV49 through CV53 and CV62 and CV63.

Operations mode programming can be performed by any DT100IR at any time since the throttles are not competing for usage of the single programming track.

1. Select the DCC loco address that you wish to program and set it to either throttle. Be sure that the address you wish to program is the "display active" throttle when you enter programming mode.
2. Use your DT100IR to enter Operations Mode Programming press  &  as outlined above then press the  key to scroll from Paged, Physical or Direct programming mode to Operations mode, the DT100IR display will show "OPS."
3. Use the Left throttle knob "L" to select the CV you want to modify. Use the Right throttle knob "R" to select the value you wish to enter for the selected CV.
4. When you have selected the CV and its value press either the  or  key and the selected CV and its value will be programmed to the DCC Locomotive address that *was in the active throttle when programming was entered*.
5. If you get a "bUSY" message in response to a  or  key press, the system is temporarily busy and you must press the key again until you get a "Good" response.
6. To return to LOCO mode  from Operations mode programming, simply press  &  simultaneously again to return the DT100IR to LOCO mode .

Changing The DCC Decoder Address With Ops Mode Programming

Operations mode programming **cannot** be used to make changes to CV01 or the 2 digit address of any mainline loco at any time.

Operations mode programming **cannot** be used to make changes to a four digit address (CV18 & CV17) of any mainline loco at that was addressed by its four digit address when you entered programming mode. If you were using 4 digit

addressing to run a loco on the mainline and you try to program a new 4 digit address to the loco, the DT100IR will display a "FAIL" message when you try to use the  to write the new 4 digit address. Note that an aliased address is considered a short address for this purpose.

You **can** use operations mode write a *new 4 digit address* (CV18 & CV17) to the decoder, as long as it was being accessed using its 2 digit address (CV01) when you entered programming mode. If you want to use OPS mode to program a 4 digit address in this case, once you select CV18, press the  key when CV18 is selected and use the throttle knobs to dial up the 4 digit address you wish to program. When the new 4 digit address is in the display, press the  key to write the flashing 4 digit address in the display into the mainline loco.

21.8 Programming DS54's

If you are programming DS54's to switch addresses 129 to 999 you will need to power cycle the DS54 after the new address is input to activate the new address.

Note that earlier DS54 stationary decoders were shipped with "voltage doubler" DCC track circuits and these can cause erratic *read back* of DS54 CV's when used with the high sensitivity DCS100 Service mode programmer. The DCS100 will always write a DS54 CV correctly. The PR-1 has a lower sensitivity read back and can generally read all DS54's back correctly. It is possible to remove this circuit from DS54's to allow correct read back under all conditions. Contact your dealer or Digitrax if you are having problems with this.

21.9 Digitrax PR-1 Decoder Programmer & Your PC!

The PR1 is a low cost IBM PC- Windows based Advanced Programmer developed by Digitrax to give you a more convenient (& less cryptic) method of programming decoders. The programmer software was developed in close cooperation with Tannersoft, who also developed the excellent LocoNet[®] Certified "Winlok 2.0" Windows layout monitoring & control program. For more information about the PR-1 programmer, see your Digitrax Mobile Decoder and PR-1 Manual.

To program decoders using the Digitrax PR1 you will need

- Digitrax PR1 programmer & software
- Windows computer with an available COM port
- 18Volt DC power supply (two 9 volt batteries in series)
- Programming track wired to the PR1 with the cable provided with the PR-1.

With this set up, you can read & write all the decoder CV's without worrying where they are & what they mean. Several features of the PR-1 are of particular value:

- With the PR-1 software's graphical capabilities you can "draw" the Loadable Speed step curve you want & send it directly to the decoder via the PR1's programming track. You can also read back a decoder's Speed table via the PR1 to the same graphical display, & optionally save all the decoder information to & from named files on a computer disk. This makes it simple to load the same speed table into several different decoders.
- FX options can be selected by pointing to choices that let you program the rich variety of possible lighting effects without having to look up numbers in a table & program individual CV's on your DT200. The software loads the appropriate CV #'s with the correct data automatically.
- The PR-1's DS54 option allows full programming of the powerful features of the DS54 Stationary Animation decoder. This makes setting up complex DS54 configurations a breeze, since you can simply click on the options desired. Best of all, on top of being able to read back & write a new configuration to a DS54 it is also possible to read & write that particular setup to a named computer disk file & copy it to another DS54 if desired.
- General access to all RP-9.2.2 CV's & support for decoders without such sophisticated capabilities is also provided.

For users wanting the most convenient & sophisticated Programming capabilities the PR1 is an excellent choice.

22.0 DT100IR Fast Clock

Many operators use a fast clock during operating sessions to simulate prototypical operations. Traditionally, this clock is on the wall and is set up to run at a faster than normal rate. The DT100IR has its own networked fast clock on all the DT100IR's in your LocoNet system. You can use this feature with both DCS100 command stations (Chief Set) and DT200 command stations (Big Boy Sets).

The Fast clock display is a 4 digit 24 Hour format clock. You can tell when your DT100IR is displaying the fast clock when you see the DT100IR's colon  blinking.

You can set up your DT100IR so that its default display is either the fast clock display or the LOCO mode display. When there is no activity on your DT100IR for more than about 6 seconds, the DT100IR will revert to the default display that you set up in the DT100IR. When you press any key or turn either throttle knob, the default display will change to reflect the current throttle activity. Your DT100IR was shipped to you with LOCO mode as the default

display. See section 19.0 for information about making the fast clock your default display and follow the instructions in this section for setting your clock.

If you have more than one DT100IR on a Big Boy set, the DT100IR's will automatically synchronize their Fast clocks, even though the Big Boy's DT200 command station was not originally set up with a Fast clock. This is an example of the upgradeability benefits that a true Peer-to-Peer network architecture offer. With LocoNet you have the ability to simply add or "layer" new functional features onto your existing LocoNet system with no impact on existing hardware.

Any DT100IR you plug in to your LocoNet system will update its fast clock time and rate to be synchronized to the rest of the system a couple of seconds after it is connected after being "idLE".

Each DT100IR can be set up with its own alarm. When the current fast clock time matches the private alarm time set in any DT100IR, then that DT100IR only will beep and flash up the message "ALAr" to indicate that the alarm time has elapsed. The alarm time is of the same 24 Hr format as the fast clock.

The fast clock rate for the Fast clock is user selectable from 1:1 to 100:1 in steps of 1, and the range values of 4:1 to 8:1 are often used.

Freezing the Fast Clock

Setting the clock rate to 00 will STOP or freeze the fast clock in the whole system at the currently displayed time. The time will re-start when a new non-zero rate value is selected.

The current fast clock time, fast clock rate and the DT100IR alarm time can be changed by using the Edit mode. Refer to Diagram 6 for a flow chart of the fast clock editing key strokes.

To Edit Fast Clock Time, Rate & Alarm time.

- 1) From LOCO mode, press the  key to change to SWITCH mode.
- 2) Press the  key to change from SWITCH mode and enter EDITOR modes.
If you have routes enabled in the system, you will enter the Route Editor and the first display you will see is "rt:01". If you do not have routes enabled, you will by pass this step and go straight into the Clock Editor.
- 3) If routes are enabled you will need to press the  key again to change from the Route Edit mode to the Fast Clock Edit mode. The display will flash "cLoc" to show it has entered the clock editor.

- 3a) To set the clock, use the left throttle knob to change the hours and the right throttle knobs to change minutes.
- 3b) When you have a Fast clock time that you want in your display, press the  to "set" it in the *whole* system. If you do not press this key then the system Fast clock will not be changed, and this DT100IR will re-synchronize to the system again.
- 3c) After modifying and setting the fast clock time, or not changing it, you can advance to the fast clock rate editor by pressing the  key again. If you perform no activity for the inactive time-out (approx 6 seconds) then the DT100IR will return back to LOCO mode.

Rate Editor:

- 4) Once you enter the Rate Editor the display will flash up "rAtE" on the first screen and then will flash a second screen showing "Fr:xx" where xx is the Fast rate.
- 4a) You can use either knob or +/- keys to modify the Fast Clock Rate you want for the *whole* system.
- 4b) This Rate will only be updated in the system if you press the  key.

Alarm Editor:

- 5) When you are finished with the fast clock time and rate editors, press the  key to advance to the private Alarm setting for this particular DT100IR. The DT100IR will flash up "ALAr" to indicate it is in Alarm Edit mode.
- 5a) You can use the knobs to modify the Hours and minutes of the 24 Hr format Alarm time.
- 5b) There is no need to press any key to "set" this Alarm time since it is private to this DT100IR. The value on the display is always the current Alarm time.
- 6) Press the  key again to exit Edit modes and return to LOCO mode. You can also allow the DT100IR to time-out back to LOCO mode.

If you "miss" an edit value, or the DT100IR times out due to inactivity, simply restart the Edit mode and return to the Editor you wish to use.

Attached PC's and Clock repeater modules may also access, display and modify the System Fast Clock and rate in the same ways DT100IR's can.

23.0 Shutting Down the System-DCS100 Sleep Mode

The DCS100 Sleep Mode allows you to power down the track between operating sessions while still providing keep alive power to all throttles

connected to LocoNet. It also extends the life of the DCS100's CMOS back up battery and the life of the throttle batteries. In the sleep mode, all boosters attached to LocoNet will turn off their track power when the DCS100 is switched to the "SLEEP" mode. During "SLEEP" mode the DCS100 stops sending out the LocoNet Railsync so, all system boosters will turn off track power.

We recommend leaving the power to the **DCS100 on all the time**. It consumes less energy than a 20th of a normal household lamp.

When you are ready to resume your session exactly where you left off, simply switch the DCS100 "Mode" switch back to the "Run" position . The attached DT100IR's and DT200's will beep within a couple of seconds to indicate that LocoNet is active again and the "idLE" displays on the throttles will change. If the DCS100's track status indicator did not come on when you switched the DCS100 back to "RUN" mode, then press the  &  on any throttle attached to the system to restore track power.

If the input power to the DCS100 is turned off or interrupted, all the internal information such as locomotive settings, consists, alias roster, switch routes, switch states, etc., are fully remembered in battery backed up CMOS memory. This memory has an approximate 1 year battery life, has a low battery alarm & can be "hot swapped" while the power is off so the contents are not lost. The time the DCS100 has input power applied directly extends this typical battery life. Any throttles that were sleeping on LocoNet when the DCS100's power is turned off or interrupted will maintain their throttle option setups as long as their 9 volt batteries last.

The DCS100's Option Switches OPSW33 & OPSW34 are both set to "thrown" at the factory. This will give you "resume with track power off." Every time that the DCS100 resumes from Sleep, Option setup or power on you will have to turn on the Track Power by pressing  &  on any throttle attached to the system.

You can also set up your DCS100 for "instant" resume which means that whenever you switch your DCS100 to "RUN" mode or DCS100 input power is restored, the track power will return to exactly the same state it was in when you originally switched to "SLEEP" mode (or to the same mode it was in before power to the DCS100 was interrupted while in "RUN" mode). To do this change Option Switches OPSW33 and OPSW34 to "closed" as outlined in section 24.0 on DCS100 option set up.

For other "resume" options refer to section 24.0 on DCS100 Option switches.

Sleep mode and Digitrax UP1 & UP3 or other style of RJ12 connector jack for an attached throttle: Be sure that all the 6 pins of the RJ12 jack are connected to exactly the same pins on a DCS100 LocoNet jack through all the intervening wires & connections. To determine whether this is the case, while the DCS100 is in sleep mode, remove the throttle's battery while it is connected to the jack in question. If the jack is wired correctly this will result in the throttle drawing its minimal "keep alive" power from the LocoNet/DCS100 & the display will hold "idLE" indefinitely. Replace the battery. If the jack is not wired properly the LCD display will slowly fade away when the throttle battery is removed!

Note: When the DCS100 is in sleep mode then the LocoNet will not allow any communication between attached components, such as several PC's exchanging information between themselves on LocoNet, independently of the DCS100. This is not a consideration for most layouts

24.0 DCS100 Option Switch Setup

The DCS100 has many customizable system operation options that you can set to customize your operation. The DCS100's power up defaults are fine for most applications and the DCS100 will run "out of the box." The factory default setting for all DCS100 option switches is "t" or thrown. *We do recommend that you change Option Switch OPSW5 to "c" or closed. This will not affect your operations, it will just make diagnostics easier to do.*

The internal battery backed CMOS memory will hold these settings for a year or more in normal usage. When your battery is low, an alarm will sound to let you know that it's time for a new battery. You will be able to "hot" change the battery so that none of your system settings are lost. See section 8.4 for DCS100 battery information. The power fault/ battery fail "clean restart" for all DCS100 option switches is "t" or thrown.

Changing DCS100 Option Switches

1. Move the Left toggle switch on the front of the DCS100 into the "OP"  position. The LocoNet Railsync will go inactive & all other boosters, including the one that is built into the DCS100 will shut down.
2. Connect a DT100IR or DT200 throttle directly to either DCS100 LocoNet port A or B.
3. Press the  key on the Throttle to enter "Switch"  control mode. Since the DCS100 is now in "OP" or Option Switch setup mode, switch commands from a DT100IR or DT200 throttle will now display & control Option switch settings & NOT turnouts on the layout!
4. You can now browse the option settings that correspond to the following table. The option switch number will appear in the left side of the display and the right side of the display will show either "c" or "t" to indicate the current state of the option switch.
5. To change the current state of any option switch press either the  or  key to change the option switch setting.
See * below for special instructions when using switches #36-#39.

Do not adjust any "reserved" option switches since this may give unpredictable operations.

Table VII: DCS100 OPTION SWITCH TABLE Switches 1-20

Option Switch #	Effect on System operation when "closed"
OPSW#01	reserved DO NOT CHANGE always "thrown"
OPSW#02	reserved DO NOT CHANGE always "thrown"
OPSW#03	this DCS100's booster is AUTO REVERSING
OPSW#04	reserved DO NOT CHANGE
OPSW#05	command station master mode always make "closed"
OPSW#06	reserved-DO NOT CHANGE always "thrown"
OPSW#07	reserved-DO NOT CHANGE always "thrown"
OPSW#08	reserved-DO NOT CHANGE always "thrown"
OPSW#09	allow Motorola trinary switch packet command echo for switches 1-256. (DCC switch packets are still sent)
OPSW#10	expand trinary switch echo range from 1-64 to 1-256, when OPSW#9 is "c" (Motorola trinary switch enabled)
OPSW#11	make trinary switches 57-64 long duration (1 sec) ON period, when OPSW#9 is "c", use for uncouplers, etc.
OPSW#12	Motorola trinary/AC digital mobile decoder addresses 1-80 allowed. (User must status edit loco types to "x1")
OPSW#13	loco purge time extended from 200 seconds to 600 seconds
OPSW#14	loco purging is disabled
OPSW#15	purging will force a loco to Stop or 0 speed
OPSW#16	-reserved-DO NOT CHANGE
OPSW#17	automatic advanced decoder assisted [FX] consists are disabled-
OPSW#18	extend the DCS100 booster short circuit shutdown time from 1/8th to 1/2 second
OPSW#19	reserved-DO NOT CHANGE
OPSW#20	disable address 00 or analog stretching for conventional locos. Always "c" for German DCS100's.

Table VIIa: DCS100 Option Switch Table (Switches 21-47)

Option Switch #	Effect on System operation when "closed"
OPSW#21	OPSW21-23 set the global system default type for "NEW" loco selections.
OPSW#22	SW21/22/23, t-t-t 128 STEP mode, t-t-c- 14 step mode, t-c-t 28 step mode
OPSW#23	c-t-t 128 step FX, c-c-t 28 step FX, t-c-c Motorola Trinary
OPSW#24	reserved DO NOT CHANGE
OPSW#25	disable aliasing in this DCS100
OPSW#26	enable routes in this DCS100
OPSW#27	disable normal switch commands, a.k.a. the "Bushby bit." Allows attached PC to perform switch control logic
OPSW#28	disable DS54 interrogate commands at GPON
OPSW#29	reserved-DO NOT CHANGE
OPSW#30	reserved-DO NOT CHANGE
OPSW#31	means meter route/switch output rate when not trinary
OPSW#32	reserved-DO NOT CHANGE
OPSW#33	allow track power to restore to prior state at power on
OPSW#34	allow track to power up to run state, if was run prior to power own
OPSW#35	-reserved-DO NOT CHANGE
OPSW#36*	reset/ clear/ erase all mobile decoder information & consists
OPSW#37*	erase/ clear all routes
OPSW#38*	erase/clear the loco roster
OPSW#39*	clear all internal memory states, including sections. OPSW 36/37/38 clears
OPSW#40	-reserved-DO NOT CHANGE
OPSW#41	diagnostic click when valid LocoNet commands incoming, & routes being output (useful for debug)
OPSW#42	disable 3 beeps on Purging a loco
OPSW#43	disable Loconet update of command station's track status
OPSW#44	expand slot refresh area from 22 (Big Boy Error! Bookmark not defined. compatible) to 120
OPSW#45	disable reply for switch state request
OPSW#46	-reserved-DO NOT CHANGE
OPSW#47	program track is brake signal generator when not Programming. Braking is DCC set to speed 0 (not Emergency stop) for address 0, light ON, broadcast to all addresses

* For Op Switch #36-#39 to work properly, set the op switch to "c" then return the DCS100 to "RUN" mode. The operation will occur (data will be cleared)

and the option switch will reset to “t”. Your DT100IR display will still show “c” eventhough the reset has occurred. The display will update the next time you access the Op Switch.

25.0 Motorola Trinary Format Decoders

Notes on concurrent Usage of Motorola Trinary type of Packets:

For the convenience of users with decoders & equipment that recognize the Motorola Trinary Format but that do not respond to NMRA DCC format, the DCS100 can generate these Trinary packets mixed in with normal DCC packets. Several companies build Command Control decoders that run on the Motorola format.

For running Trinary Locomotives the user MUST "Status Edit" (from a DT200, DT100IR or attached PC) the Loco Status Code to "x1". See section 15.0-15.2. The lower loco status code digit with a value of 1 will force the DCS100 to address that decoder as a Trinary format decoder, e.g., Marklin AC digital HO or Maxi 1 Scale decoders.

Since the DCS100 is a multi-protocol command station there are several subtle issues that you need to be aware of when running in this mode.

- 1) Typically, trinary decoders have not been designed to operate in a multi-protocol environment, so there is no assurance that all trinary decoders will always behave predictably. Our experience has shown all trinary decoders reviewed to date work properly in this environment, but it is up to you, the user, to make this determination for your layout, conditions of usage & the decoders you are using.
- 2) Older trinary decoders can only operate with a fixed polarity of rail connections to the Booster. Be sure that no Boosters driving this mixed DCC/Trinary Protocol are set up for "auto reversing." This is particularly important for trinary switch decoders.

If any trinary decoder fails to respond when selected and the DCS100 is correctly set up to run in trinary mode by setting the DCS100's OPSW#'s 9,10,11 &/or 12 as described in section 24.0, check that the decoder rail connections are of the correct polarity. If they are wrong, swapping the rail/track feeds should correct the problem.

- 3)Trinary loco decoders should be stopped before reversing direction.
- 4) Be cautious mixing DCC & trinary loco's in consists. The trinary decoders do not have an "absolute direction" command. If they ever miss a direction

change they will end up "fighting" the DCC decoders when the locos are physically linked. If you make up a consist, we recommend MU UNLINKING it before you power down the track, to avoid these problems. The DCS100 allows consisting of any DCC, Trinary & even the Analog address "00". Trinary decoders can be "kept alive" with a small DC voltage bias, & this will ensure that they remember the last direction properly, if for example they encounter a Signal controlled Stop section where track power might be OFF. Refer to your decoder documentation on this keep alive.

- 5) If you have selected & operated only trinary decoders on your layout, the DCS100 will not generate any DCC packets. If a DCC decoder is placed on such a layout, it will typically "mode convert" to full speed DC operation, since it won't see any valid DCC packets. To avoid this problem, you can disable Analog Mode conversion in CV29 of your DCC decoders. Alternatively, you can introduce a couple of "dummy" active DCC locomotive addresses which will keep unaddressed DCC decoders on the layout from mode converting if you choose not to disable their Analog Mode conversion feature.
- 6) When you are running an Analog loco without a decoder as address "00", addressing trinary loco decoders will tend to generate a small DC offset. This will cause the Analog loco to creep along even when its throttle is set at 0. The DCS100 compensates for a part of this effect, but it will still occur to a small degree.
- 7) If you select OPSW#9 to enable trinary switch addresses, the DCC commands are still sent for the switch range 1-256, & an extra timed echo is created for the trinary switch of the same address. The DCS100 times this Trinary switch range to ensure that an OFF code is sent to the Trinary switch decoder after about 1/2 second. Because of this the DCS100 employs a 8 deep Switch Command FIFO to buffer requests and DCC switch actions can be delayed from actual switch sections. If you leave OPSW#9 "thrown" to disable Trinary Switch echoing, then the DCC Switch commands are sent immediately.

26.0 Troubleshooting

26.1 Clean Track

The majority of intermittent operation faults can be traced to bad connections & poor or noisy wheel pickups on locomotives. Check track cleanliness & quality of wheel pickups. The DCC digital packet communication strategy performs exceptionally well in a less than perfect environment, & will often mask bad connections until they are really impossible to work with!

26.2 Reprogram the Decoder

If you cannot figure out what a locomotive is doing or "who" it is by address, do not panic! Just reprogram the locomotive.

26.3 Emergency Stop

If the layout starts to "get away" on you, either PRESS  or, turn the track power OFF on the DCS100!!!. Either way will give you a chance to regain your composure, & you will be able to rejoin the contest against many locomotives at once!

26.4 Mechanical Drive Train Problems

Pay attention to the mechanical drive train & free movement of the locomotive wheel sets. This is especially important with inexpensive locomotives. Using Digitrax decoders with appropriate programming settings, you can achieve surprisingly good quality motion, if you carefully audit the mechanisms for smooth running.

26.5 Strange Lights (Not The Ones In The Sky)

If you can't control the operation of the lights in your locomotive with the DT100IR (in default 128, or 28 speed step mode), be sure that the decoder is programmed in advanced 28 speed step mode.

Do this by programming Configuration Variable 29 with a value of "06" (The code for advanced mode per Table IV.) Refer to section 21.0 for complete programming instructions.

Your Digitrax decoder may have been shipped programmed to standard 14 speed step mode (the minimum industry standard). Or, you may have changed your decoder's programming when performing the decoder test procedure. In any case, if you are not able to turn the locomotives lights on & off, you will need to change CV 29 to "06" to have proper light operation when using the DT100IR in its optimum 128 speed step mode.

26.6 LocoNet Doesn't Respond.

If you connect a DT100IR or DT200 to LocoNet and you do not get a beep and the "idLE" display does not clear in a couple of seconds:

1. Check the DCS100 has power applied and its  Mode switch is NOT in the "sleep" position.
2. Check that the DCS100 RED "NET" indicator is on. If this is off when the GREEN "Config" indicator is on, this is an indication that LocoNet is shorted low. To verify this, disconnect LocoNet from both DCS100 LocoNet A & B Ports. The NET indicator should glow RED, showing that the LocoNet is working OK.
 - 2a. Once the NET indicator is glowing RED, plug just a DT100IR or DT200 into the DCS100 LocoNet A port. The throttle should exit the "idLE" mode & log on to the system. The NET indicator will also flicker when any good LocoNet transmission is received. Repeat this process with LocoNet Port B. Once you are sure both LocoNet Ports are working, plug in your layout wiring again and if the NET indicator goes off then you will need to debug your layout wiring. When working on a large wiring scheme it can be useful to turn on OPSW#41 to get a diagnostic beep anytime a good LocoNet message is received by the DCS100.

27.0 Glossary

128 Speed Step Mode: the motor voltage/speed curve of the DCC loco from stop to full speed has 128 discrete speed steps. This means that you have 128 discrete speed steps at your disposal for excellent speed control, especially at very low speeds. 128 speed step operation will give a significant improvement in speed control over 14 or 28 step operation. 128 speed step operation is only offered in advanced and professional level DCC systems.

AC or Alternating Current: An expression used to describe an electrical wave form that cycles or alternates above and below 0 volts. In the U.S., household electricity is 60 cycle, alternating 60 times a second, 110-120 volts.

Acceleration: The rate at which the decoder increases from one speed step to the next in response to a new increase speed command. Use CV 03 to set this value for each decoder. This feature is used to simulate train weight and to cause your model to respond more prototypically when you increase the throttle.

Address, Decoder: a number assigned by the user to a particular mobile or stationary decoder. The DCC system uses the decoder address to send commands to the appropriate loco or accessory.

Address Range: each system has a certain number of addresses that it can handle. Basic DCC systems usually handle between 6 and 16 addresses. Advanced systems usually handle between 99 & over 9000 addresses and Professional systems almost always go to 9000 or more addresses.

Advanced (EPF) Consisting Method: Storage of the consist information in each decoder. The locos can be added to and deleted from the consist in any orientation. This method requires that all locomotives in the consist be equipped with decoders that support this feature (EPF decoders). This method allows you to set up a consist that will be "transportable" from one DCC layout to another but

you must be sure to always put the locos back on the track in the same order and orientation you programmed them for or you can get some unexpected results.

Advanced Mode (28 Speed Step Mode): the motor voltage/speed curve of the DCC loco from stop to full speed has 28 discrete speed steps. This means that speed control will be limited to 28 steps. 28 speed step mode gives fine speed control. Increasing to 128 speed step operation will give a significant improvement in speed control, especially at very slow speeds needed for prototypical switching operations. Advanced mode is offered in most command stations because there are many decoders on the market that are not capable of 128 step mode operation.

Aliased Addressing: Lets you run 2 digit address decoders with 4 digit addresses by selecting them from the system Alias Roster. This feature gives you the ability to operate all DCC equipped decoders with 4 digit addresses. This is a function of the command station, not of the decoders.

Analog Loco: A locomotive operating on a DCC layout without a DCC decoder installed. Also called a Conventional Loco.

Analog Mode Conversion: When a DCC decoder does not see DCC packets on the layout it changes automatically to DC operation. Digitrax decoders support analog mode conversion but not all DCC systems do. Analog conversion can be disabled by programming CV29.

Autoreversing: a feature of some DCC boosters which allows a train to enter and exit reversing sections automatically without the need for the operator to throw a switch to match track polarities on either side of the reversing section.

Ballast Lamp: A high current, low voltage lamp used to protect against unwanted voltage transits. In normal model railroad applications a 12 volt automobile brake lamp wired in series is used. For use as a buffer between DC and DCC, the lamp is connected across one of the double gaps separating the two systems.

Basic Consisting Method: Program all the locomotives in a consist to the same address and run them off one throttle. In this case all the locos must be running in the same direction.

Booster: Boosters receive the DCC signal from the Command Station, amplify it & put it on the track as the power that runs the locos. You can have several boosters on a system, each driving its own track section. You can have both regular or auto reversing boosters depending on your needs. Also called Power Booster, Power Station

Browsing: to scan sequentially through locomotive or accessory decoder addresses and status.

Buffer Track: See Ballast Lamp

Cab: See Throttle.

Command Station: Each system has one Command Station that generates the DCC packets that tell the decoders what to do & produces Rail Sync so that all the devices you attach to LocoNet work together. With the Digitrax System you have a choice of several command stations to allow you to tailor your system to meet your needs. In an effort to keep the price down, we have chosen to combine command station functionality with other system hardware components. The Challenger Command Station is included in every DB100 series booster. The DT200 Command Station/Throttle is used as the command station in the Big Boy Starter Set. The DCS100 Command Station/Booster is the command station for the Chief Starter Set.

Common (Loco Status): a DCC locomotive that is not currently "in-use" by a throttle connected to LocoNet but is still being refreshed by the command station. A loco with a status of "common" is selectable by any throttle on LocoNet.

Common Rail Wiring: A wiring system in which one side of all the track power supplies are connected. The common rail concept simplified block wiring in conventional DC systems, but is **not** recommended for DCC wiring. (see Direct Home Wiring)

Compatibility: the ability of equipment made by various DCC manufacturers to operate together on the same layout. The interoperability of equipment from various manufacturers gives consumers more choices at every price level. It also gives you the assurance that if brand X goes out of business that you will still be able to buy equipment from another company.

Configuration Register (CV29): this special CV controls several different characteristics including: 1. Whether the decoder uses standard 14 speed step mode or advanced 28/128 speed step mode 2. Whether or not the decoder will automatically convert to DC operation when no DCC signal is present 3. In the case of Digitrax FX decoders, the relative direction of locomotive travel 4. Whether the decoder uses loadable speed tables and 5. Whether the decoder uses the 2 digit address or the 4 digit address.

Configuration Variables (CV's): these are special storage locations or "pigeonholes" in your decoders. By programming various CV's, you can control each decoder's performance characteristics. CV's store information like the decoder's short address, long address, start voltage, mid-point voltage, loadable speed tables and many more. Once you have programmed these characteristics, the decoders "remember" them until you change them again. The NMRA Standard and RP's define the usage of each CV.

Conformance Seal: the certification issued by the NMRA after a product has passed the tests established and administered by NMRA volunteers to "prove" that a particular product follows exactly to the letter the Standards and RP's set up by the NMRA that pertain to that product.

Consisting: the action of linking more than one power unit together to be controlled by a single address. Also called Multiple Unit Operation, MU'ing, Multiple Unit Lash Ups, etc.

Constant Brightness Lighting: because you have constant track voltage when you use DCC, you also have locomotive lights that stay on just like the prototype, even when the loco is not moving (unless of course you use their function lead to turn them off).

Conventional Loco: A locomotive operating on a DCC layout without a DCC decoder installed. Also called an Analog Loco or a Standard Loco.

DCC: Digital Command Control.

DC or Direct Current: An expression used to describe an electrical wave form in which the voltage remains more or less at a value above or below 0 volts. The wave form used by most model railroad locomotives. Sometimes referred to as Analog.

Deceleration: The rate at which the decoder decreases from one speed step to the next in response to a new decrease speed command. Use CV04 to set up the deceleration value for each decoder. This feature is used to simulate train momentum so that, just like the prototype, your model won't stop immediately when the brakes are applied.

Decoders, Mobile: the electronic device installed in each locomotive that receives the signal from the command station through the track, decodes it & tells the loco what to do.

Decoders, Stationary (Accessory) : the electronic device for the switches or other accessories that receives the signal from the command station through the track, decodes it & tells the switch/accessory what to do.

Decoder Status: a DCC decoder can be New, In-Use, Common, or Idle in a Digitrax system.

Direct Home Wiring: A wiring system in which the DCC booster powers each rail through an individual conductor or wire. Each booster is wired to it's own power section and there is no common connection between boosters. This is the DIGITRAX recommended wiring system.

Direct Programming: A type of service mode programming

Directional Lighting: loco lights can be set up to automatically change so that the forward lamp is lit when the loco is moving forward and the reverse lamp is lit when moving in reverse.

Dispatching: use your DT200 or DT100IR to set up a loco or consist you want to be run by an operator on a BT2 (Buddy throttle) and then using couple of keystrokes, dispatch the loco from the DT100IR or DT200 and acquire it on the BT2. This feature may also be used by operators who wish to use a fairly strict dispatch discipline in their operating sessions.

Display Active: With the DT100IR and DT200 you can control two different addresses at the same time, one on the Left Throttle and another on the Right Throttle. Because only one throttle can be displayed on the DT100IR's LCD screen at a time, we use the direction indicator to indicate which side is currently "display active". The "display active" throttle is the one with the flashing RED or GREEN .

EPF or Extended Packet Format: an extension of the baseline DCC format that allows us to use long addressing and other expanded decoder features. The extended packet format is part of the NMRA's Recommended Practices.

Fast Clock: used by many operators during operating sessions to simulate prototypical operations. Traditionally, this clock is on the wall and is set up to run at a faster than normal rate so that you can "get in a full day's work on the railroad in a fraction of the time."

Functions, Decoder: function leads are extra decoder wires that you can connect to any device on the loco that you want to control from the hand held or other input device such as a computer. These can be used for locomotive lighting, sound units, smoke units, and other locomotive animation tasks.

FX Functions: specially designed functions (available on Digitrax FX series decoders) that let you set up lights on your loco to simulate Mars lights, Gyra lights, ditch lights, rotating beacons, single or double pulse strobes, flashing lights, random firebox flicker and more. CV's 49-63 are used to set up these special light effects.

Idle (Loco Status): DCC locomotive that has been addressed by the system previously, is currently selectable by a throttle on LocoNet, and is not being refreshed.

In-Use (Loco Status): DCC locomotive that is currently under the control of a throttle connected to LocoNet. An in-use loco is having its data refreshed by the command station and is not selectable by other throttles on LocoNet. The exception to this is if a throttle "steals" an in-use loco

Loadable Speed Table: use CV65 through CV95 to define each discrete speed step in a 28 speed step curve. This feature allows you to customize a loco's performance curve and makes speed matching of locomotives possible. With this feature you can limit the top speed of a loco. Once you have programmed CV65 through CV95 to set up the table, you will also need to set up CV29 to enable it. This allows you to enable and disable the table at will and to keep the table stored even when it is not in use. Digitrax FX & 4th generation decoders go one step further and give you 128 speed step resolution with loadable speed tables.

LocoNet: Digitrax's powerful communications network especially designed for model railroad operation.

Long Address: 14 bit address, extended packet format address.

Mid-Point Voltage: CV 06 specifies the exact voltage to apply to the motor at speed step 15 in a 28 step system and step 7 in a 14 speed step system. This allows you to make a quick adjustment to the motor voltage/speed curve without setting up a loadable speed table.

MU: Multiple unit operations. See Consisting.

New (Loco Status): DCC locomotive that has not been addressed by the system. A new loco is selectable by throttles on LocoNet and is not refreshed.

Operating Mode: 14 or 28/128 speed steps. See also, Speed Steps, Standard Mode, Advanced Mode & 128 Speed Step Mode.

Operations (OPS) Mode Programming: lets you program CV's in DCC locos equipped with EPF decoders while they are on the mainline. A typical use for ops mode programming would be to change the acceleration rate (CV03) or the deceleration rate (CV04) of your locos to simulate the weight and braking characteristics of the train to compensate for changing the number of cars and power units in the train.

Paged Programming: A widely used type of service mode programming.

Physical Register Programming: A primitive type of service mode programming.

Power Booster: See Booster

Power Station: See Booster

Power Supply: a transformer that provides power to the DCC system. The transformer is not usually included with the DCC system.

Programming: the action of entering data into DCC decoders.

Purging: the process by which Digitrax command stations automatically release DCC locomotives from "in-use" to "common" when they are not under the control of a throttle connected to LocoNet for approximately 200 seconds. This makes locos that have been "forgotten" by their operators available to be selected by other operators to prevent collisions during an operating session. In the DCS100 purge time can be lengthened to 600 seconds or disabled completely.

PWM: Pulse Width Modulation.

Refreshed (Data): DCC command stations re-send data to decoders many times to be sure that the signal is not lost and that you have reliable operation. All in-use and common locos in the system will continue to be refreshed until they become idle.

Roster: The Alias Roster is a database of 4 digit numbers that are matched to 2 digit decoder addresses. This Alias roster defines all the power units you wish to operate this way, & is stored in the DCS100. The DCS100 remembers the Alias Roster even if the system is powered down between sessions.

Route: a group of turnouts and their specified positions that will be triggered by the activation of a single "TOP" switch address to a specified position.

Selectable: a DCC decoder is selectable when it is not currently in-use on another throttle.

Service Mode Programming: service mode programming information sent by the command station or programmer as a broadcast signal that goes out to all decoders on the track. Some command stations have separate packet generators to provide independent service mode programming outputs so that the layout can continue operating while decoders are programmed. Others require that the layout be shut down and the packet generator be used for programming decoders.

Short Address: 7 bit address, baseline packet format address

Slot Following: when more than one DT100IR is logged on to a single loco address, both DT100IR's will be controlling that address and both DT100IR displays will be updated with the same information. In other words, both operators will see what the other is doing.

Speed Stabilized Decoder: a decoder that will cause a locomotive to maintain the speed you set no matter what grade the loco encounters. It's like "cruise control for your loco."

Speed Steps: because DCC is a digital system, locomotive speeds are defined by discrete speed steps. The NMRA standard calls for 14 forward and 14 reverse speed steps. This means that as motor voltage is increased that the speed of the locomotive increases in a straight line from stop to full speed with discrete speed values at each voltage.

Splitfield Motor: Another term for AC motor

Standard Mode (14 Speed Step Mode): the motor voltage/speed curve of the DCC loco from stop to full speed has 14 discrete speed steps. This means that speed control will be limited to just 14 steps. 14 speed step mode gives reasonably good speed control. Increasing to 28 speed step operation will give much better speed control and going to 128 speed step operation will give really excellent speed control. Standard mode is offered in most command stations because there are many decoders on the market that are not capable of 28 or 128 step mode.

Start Voltage: or V-Start is the voltage added to the motor drive voltage at the first speed step. This adjustment allows you to trim the loco to compensate for its motor efficiency.

Status Editing Decoders: a DCC decoder's status can be manually changed by a Digitrax command station at any time the decoder is selectable.

Stealing a Loco: this procedure allows a UT2 user on a Genesis Set or a DT100IR user on a Chief Set or Empire Builder to override the in-use interlock and force the throttle to log on to an in-use loco. This can result in having two throttles logged on to and controlling one address. See also Slot Following.

Throttles: Throttles are input devices that tell the Command Station what you want the decoders to do. You can have many throttles on your system. The number is determined by the capabilities of the Command Station you are using. You can also use a computer to create "soft" throttles. Sometimes DCC throttles are also called "**Cabs**."

TOP Locomotive: We call the "key" locomotive that other locomotives are consisted TO, the **TOP** locomotive because it does not *need to be in any particular physical order in the consist*. The TOP locomotive address controls the speed & direction of all locomotives consisted to it by the MU function. The "TOP" locomotive does not have to exist. You can use a 2 digit train number, for example , as your "TOP" locomotive.

Universal Consisting method is handled by the command station and allows you to consist locos with any DCC decoder as well as an analog loco. The locos can be added to and deleted from the consist in any orientation head to head or tail to tail.

Zero-Stretching incorporates a time period between packets to give you an effective DC offset between the two rails. This allows you to control a DC locomotive along with the DCC locomotives on a DCC system.

28.0 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 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 from 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.

For Canadian Users:

"This digital apparatus does not exceed the Class B limits for Radio noise emission from digital apparatus set out in the Radio Interference Regulation or the Canadian Department of Communications."

Le present appareil numerique n emet pas de bruits radio-electriques depassant les limites applicables aux appareils numeriques de la classe B prescrites dans le Reglement sur le brouillage radioelectrique edicte par le ministere des Communications du Canada.

29.0 Warranty & Repair Information

DT100IR, DCS100

One year guarantee on DT100IR & DCS100. These units are not user serviceable. If a defect occurs, return the unit to us for service. We will repair or replace these units 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 & reasonable rates. You will need to open the case of your DCS100 from time to time to change the CMOS battery and to fine tune your track voltage, opening the case for these reasons will NOT void your warranty.

In order to make sure we give you the best service possible, please ship all units that need repair directly to Digitrax, Inc. 450 Cemetery ST #206 Norcross, GA USA 30071-4228. Be sure to include your name, address, and day time phone number along with a note explaining what is wrong with the unit. We also need to know when and where you purchased the unit.

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 & 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.

Table VI: Decimal to Hexadecimal Conversion Chart

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		
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