

Using Digitrax Devices on a Non Digitrax DCC Controlled Layout – Rev. 3

By Elmer McKay < emckay70@member.afa.org >

The following information was written to help the Non-Digitrax user; use, control, and interface some selected Digitrax devices to a Non Digitrax layout. This paper was written to simplify making a LocoNet bus and working with LocoNet devices on non-Digitrax DCC systems, and the BDL-168 in particular. As proposed by Digitrax in their manuals and on their web site, their way of using or connecting a BDL-168 to a non-Digitrax DCC system and setting up a Loconet has proven to be more complicated than necessary.

The connection and hook-up information that is discussed here has been gathered from several sources, since no one place contained everything that was required. Most of these sources are quoted, but no formal references are given. The sources were: The BDL-168 manual, the RR-CirKits LocoBuffer-USB manual, the Digitrax Tech Support Depot, and some members of the NCE and JMRI user groups on Yahoogroups.com. Only one wiring method will be shown and explained. This method was built and tested by the author, and works for him. Other methods may be available and it is up to the user to research these alternate methods. It is also the users responsibility to have or learn the basic electronic information and skills necessary to work with DCC electronic systems and components.

Use this information at your own risk. The author is not responsible in any way for any damages or injury occurring from using this information. Digitrax boards were designed for use with Digitrax systems and equipment.

Overview

The devices most commonly used on DCC layouts by Non-Digitrax users are the BDL-168 Occupancy Detector, the SE8C Signal Controller, and the DS-64 Turnout Controller or Stationary decoder. These devices, due to their specifications and the things they detect and control, are usually connected to a computer through an interface and control program. These three devices are typically used for detection and signaling of a model RR layout. These devices can be used on a non-Digitrax layout with proper implementation and wiring. The manuals for all of the devices discussed can be found on the Internet and should be read thoroughly before proceeding with any wiring. Digitrax boards will interface to and operate with NCE PowerPro, Lenz Set 100, and CVP Easy DCC systems. Other DCC systems that have computer interface connections may work as well.

Wiring and Device Requirements for the LocoNet

The things that need to be set up for using Digitrax boards on the Non-Digitrax layout are:

- LocoNet bus, which is the Digitrax control network and Command bus. (The LocoNet bus is in addition to the command bus that is required for the DCC system that you are currently using.) When a LocoNet wiring system (bus) is set-up on a non-Digitrax layout or system, the LocoNet must have the proper voltage on it (current source) and be terminated as well.

- There must also be the correct track power interface to the BDL-168 which is a Rail Sync signal connection to Rail "A" of your DCC system. (The other two devices, the SE8C and DS-64 do not require a track power interface, but need to be attached to the LocoNet. (The DS-64 may be connected to track power, but it's connection is not as critical as connecting the BDL-168.))
- A Computer Interface device for input & output signals to & from the boards is also required.
- A Computer Some form of LocoNet control is required for non-Digitrax layouts in order to use Digitrax devices. This is usually in the form of a computer running a program that will interface with the LocoNet for detection and operation of the Digitrax devices.

Power for the LocoNet

- UP5 LocoNet Universal Panel and Power Supply

A Digitrax UP5 LocoNet panel may be used with an external power supply (12VDC wall-wart or PS14) to provide power to the LocoNet. (Connect the power to the power connector, plug in the LocoBuffer-USB LocoNet cable to one of the front connectors, and connect the Digitrax devices via LocoNet cable to the back connectors.)

Termination

- The LocoNet must be terminated to work properly. The LocoBuffer-USB provides the Termination for the LocoNet.

Computer Interface and Control

- LocoBuffer-USB (LocoNet Interface Device and Terminator)

The RR-CirKits LocoBuffer-USB can be used for the computer interface to LocoNet and provide a terminator as well. (This is the author's choice, and is easiest to use.)

- A Computer running a Control Program

JMRI Panel pro and/or Decoder Pro is one program set that can be used. Links for other programs that can be used by Digitrax can be found on the Digitrax web site.

Wiring the LocoNet

The following items are used to implement the LocoNet bus. Of course you must use a cable to actually create the LocoNet bus. The cable is a six pin / wire Telco type. RJ11 or RJ12 connectors that have six pins can be used. (NCE uses the same cable and connectors as Digitrax uses for their LocoNet.)

- A Digitrax UP5 panel.
- A power supply (12 or 14VDC) to plug into the UP5. A Digitrax PS-14 is recommended.
- A RR-CirKits LocoBuffer-USB Interface device and Terminator.

Mount the UP5 in a convenient place and connect the power supply per the instructions. Next, connect the LocoBuffer-USB per the instruction manual and install a jumper on terminal 6 to make it the Terminator. (A small jumper as used in computer work can be used, and it is not included with the LocoBuffer-USB.) Your LocoNet connection is to the front of the UP5. (The other rear connections will be used to branch off to the LocoNet devices such as the SE8C etc.) You should now be able to power up the computer and LocoBuffer according to the instructions, and get the correct indications described.

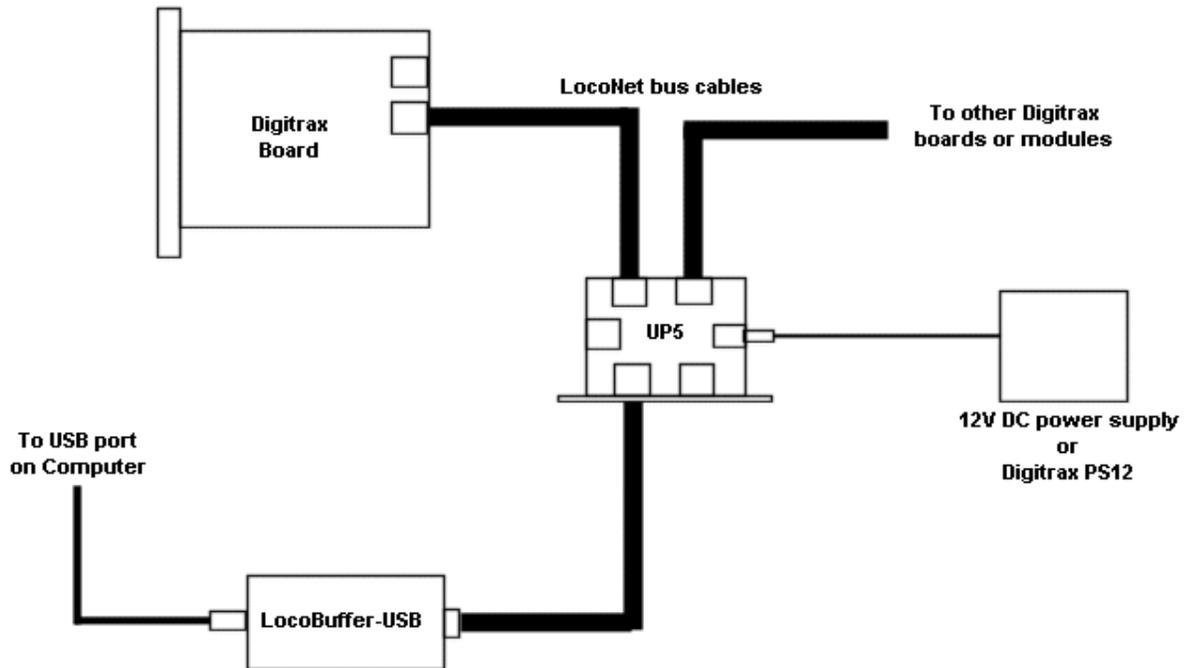


Fig. 1 Setting up the Digitrax LocoNet Bus

At this time, a Digitrax board is not required, although an SE8C or DS64 can be connected. Connecting a BDL-168 and testing the new LocoNet will be discussed next.

BDL-168 Installation (for Non-Digitrax Layouts).

The BDL-168 is a track occupancy detector. As such, it must be connected to the track. Connecting to a Digitrax layout is easy. Connecting it to a Non Digitrax layout is a little different.

- First, there are some "OP" switches that may be required to be set up. Typically, these OP switches are set by using a Digitrax throttle connected to the LocoNet. You can, if you wish, get a Digitrax throttle and connect it to our newly formed LocoNet to use in setting the OP switches, but it is not necessary as it can be done from the computer.

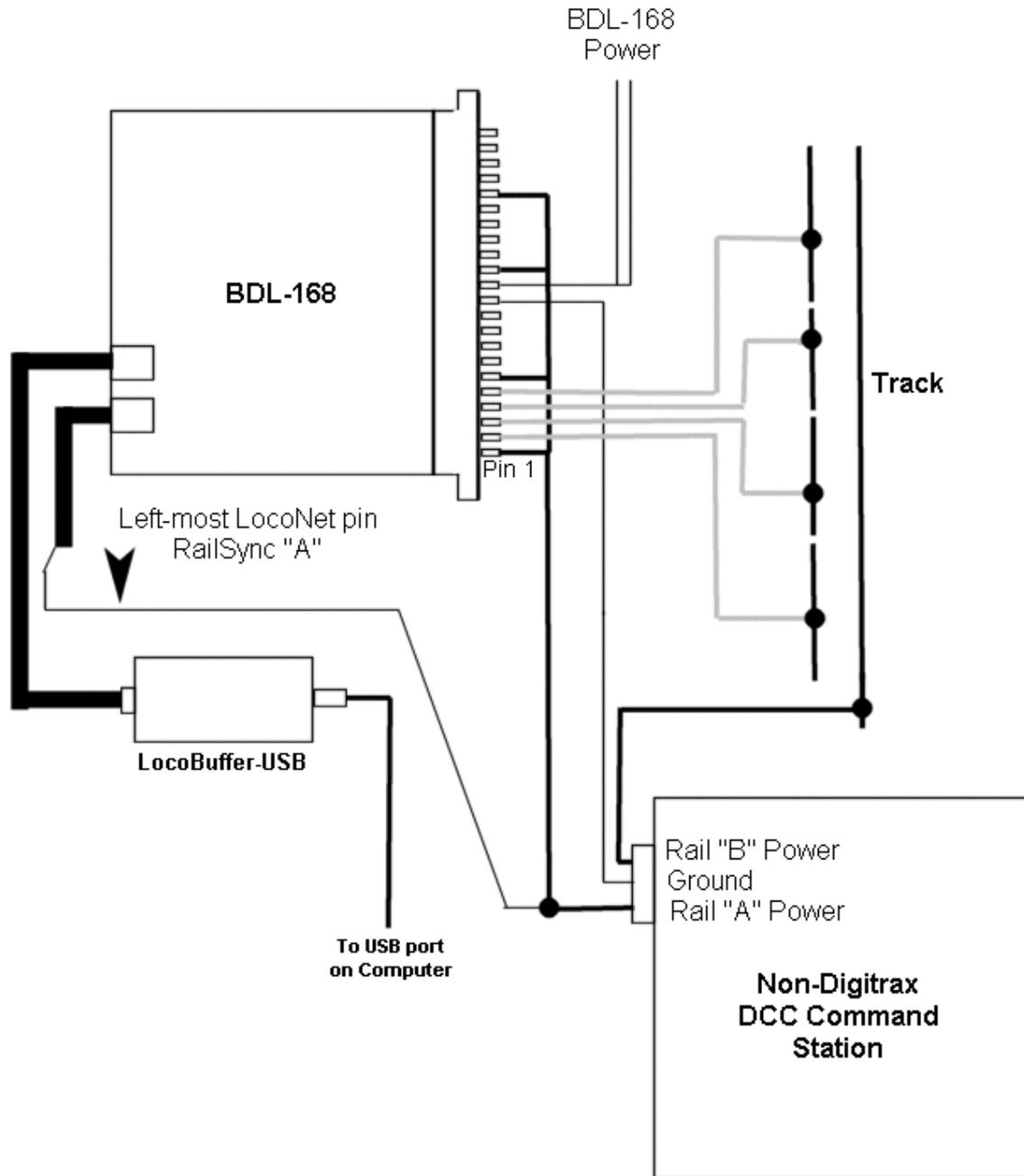


Fig. 2 Setting up the Digitrax LocoNet Bus and BDL-168 to a non-Digitrax Command Station / Booster

(Refer to the BDL-168 manual for other wiring details)

- Second, there is some specific wiring that has to be set up between the layout and the BDL-168. The BDL-168 manual shows the general wiring scheme. It also shows one Booster for each BDL-168. However, more than one unit can be connected to a single booster if you use some type of common DCC current protection device. (DCC circuit breaker) Most of these devices only protect the output by tripping or switching off one wire. If the device only switches off a single leg or wire, then the switched wire must be placed in the detection common rail wiring.

- Third, a RAIL-SYNC signal or voltage needs to be connected to the unit. This is a DCC voltage taken from the rails. The source of the DCC signal must match the DCC signal being sent by the booster to the detection sections or Zone common handled by the BDL-168. Digitrax calls this Rail A.
- Fourth, because we are not using a Digitrax system, we should name or designate our rail wires so we can keep everything straight in our wiring. So, Rail A is the Zone Common power wire, and Rail B is the Detection Common wire. It doesn't matter what color wires your layout is using, or even the phase of the voltage on the wires. What matters is that you be consistent throughout your system. If your RED wire is Rail A, then Rail A will be the RED wire on your entire layout. Write it down.

Connecting a BDL-168 to Your New LocoNet

You should read the BDL-168 manual before starting, so you will become familiar with the set-up. (Refer to fig. 2 for the following steps.) Mount the BDL-168 and plug it into its connector. Attach the power supply wires as directed in the BDL-168 manual. Attach a ground wire from the case of your command station to the connector as described. (NOTE: The case of the command station should be grounded through the command station power source. Usually case ground goes to the wall outlet ground.) You will also need to make a short LocoNet pigtail that connects the Left-most pin from one of the LocoNet connectors on the BDL-168 board to Rail "A" on your DCC system. (See fig.3, left side) (If you are setting up a temporary test without actually wiring to the track, jumper this wire to pin 1 on the BDL168 connector.) Rail "A" is the one that you decide that gets connected to pin 1 of the BDL-168 connector. (This is the RailSync signal) You should now be able to power up the computer, the LocoBuffer-USB, and the BDL-168 according to the instructions, and get the correct indications described.

The RailSync signal should not be allowed to go to the LocoBuffer-USB, so use the appropriate cable so that you are using one that has been modified as shown on the right side of fig. 3.

To test the set-up, apply power to the computer first and make sure you get the power light on the LocoBuffer-USB. Then power up your DCC system and the BDL-168 or other Digitrax board. The green and red LED's may come on for a short time, then go out, then the green one will blink off occasionally. The second green LED on the LocoBuffer should also come on. When you generate some LocoNet commands, the Red LED on LocoBuffer and the BDL-168 and/or other devices will blink. I created traffic by reading the configuration of the BDL-168. This traffic also showed up in the LocoNet monitor in JMRI.

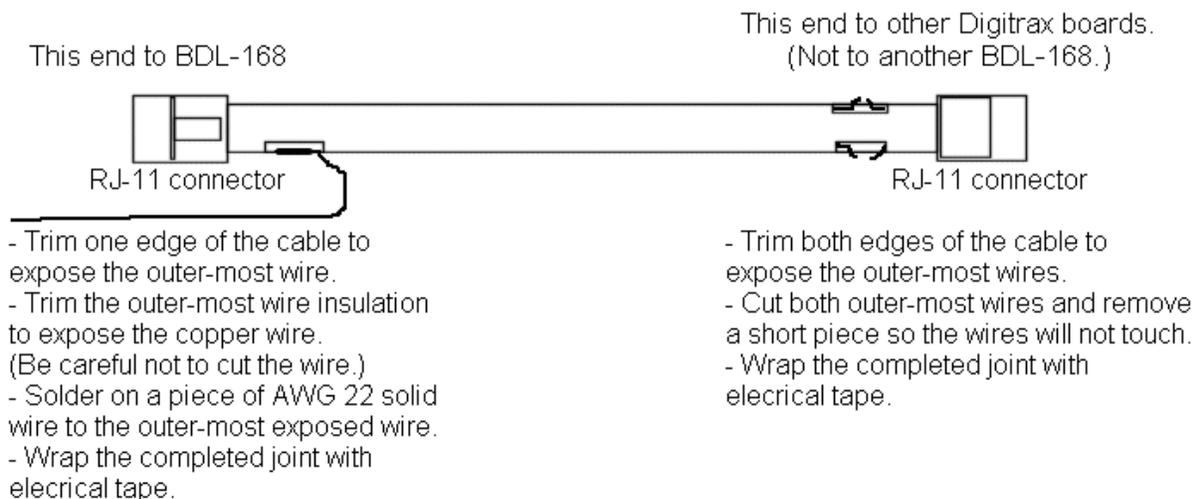


Fig. 3 Special LocoNet Cable for BDL-168

Adding Other Digitrax Boards

When using a BDL168, it is normally being used along with an SE8C Signal board. Because of this, there are a couple of precautions that should be taken. As has been seen, when you are hooking up a BDL168, you need to connect one of the LocoNet Rail-Sync wires to Rail 'A' of your DCC system. Rail-Sync is only needed for the BDL168. The normal Rail-Sync signal on a Digitrax system is a low power version of track power. However, on a non-Digitrax system, you need to connect Rail 'A' track power to the BDL168 through a LocoNet cable. This puts full track voltage on the LocoNet, which in my opinion, is not desirable to do. It is best if the Rail-Sync full track voltage be kept from other devices attached to your LocoNet. To do this you should make a special cable, and possibly modify one or more of your other LocoNet cables. (See fig. 3, right side) The modification is to cut the outer-most two wires (blue and white) of any LocoNet cable that comes from a BDL168. See fig. 4 for how to use the modified LocoNet cable as made according to fig. 3.

One other point. Because you have connected a ground connection to the BDL168 and LocoNet, the power supplies that you use for powering any UP5's, BDL168's, SE8C's, and any other LocoNet devices should be isolated from a common ground. Using a PS12 type of power supply or wall-wart to power these previous named devices is recommended because they are isolated from ground.

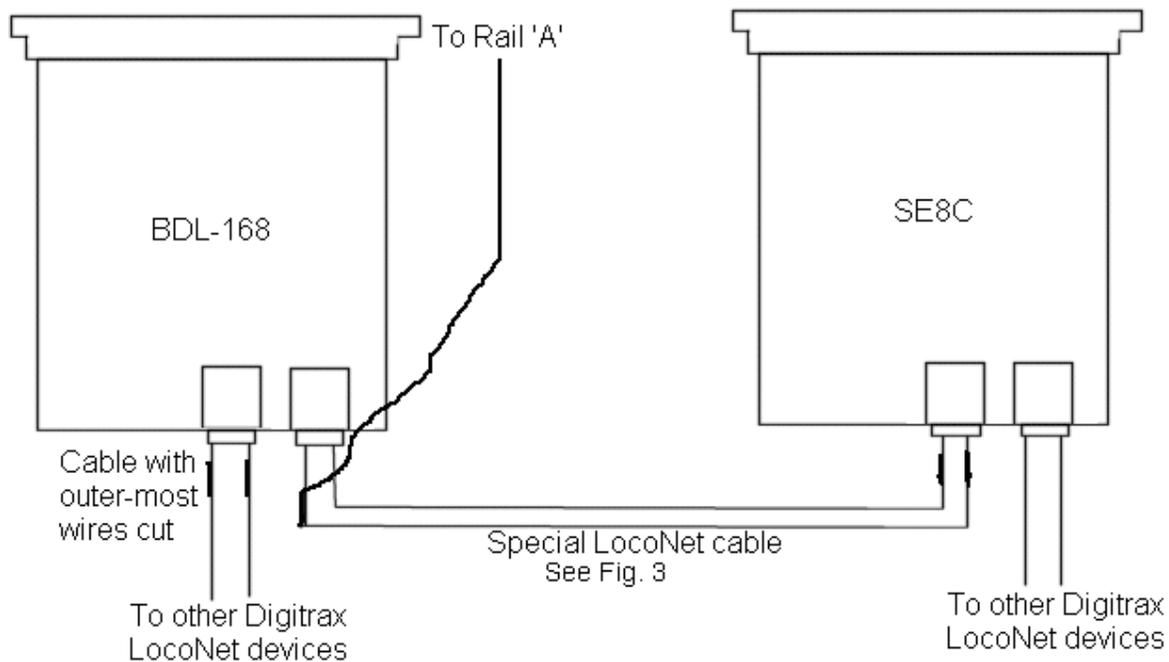


Fig. 4 Connecting A BDL-168 to an SE8C or other Digitrax device via LocoNet

OP Switch Settings

The Digitrax boards have Op Switches that may require you to set up or change. The first one that comes to mind is the board address. Since you have a valid LocoNet set up, you could purchase a Digitrax throttle and use it to change the address and Op Switches. The other way is to use the “Turnout Control” window in the JMRI program, under the Tools menu. Set the OpSw number that you want in the Turnout entry box, then issue a Closed or Thrown command. When the command is sent, you will see the red LED’s flash on the Digitrax boards indicating LocoNet traffic. You can also see what commands were sent by opening “Monitor LocoNet” window under the LocoNet menu of Panel Pro or Decoder Pro of JMRI. It is not necessary to make the BDL-168 a “Master”, or set the OpSw to make it terminate the LocoNet if you have set-up your new LocoNet according to fig. 1.

Other General Information of Interest

One caution about multiple systems in JMRI:

Make sure the one you want as the 'throttles and programming' is the LAST listed system. So if you had your NCE as the sole entry, you would have to move it to the second system and put the Digitrax as the first entry. The last mentioned system that supports a given feature, like throttles or programming, is the one that wins. All the other things you can pick and choose by using the right system names, like LS1 for the first LocoNet sensor while NS1 would be the first NCE based sensor as example.

Multiple power Districts

If you are wiring for multiple power districts, and each power district has its own booster, there should be double gaps between power districts, and no common track bus wires from one district to the other. That means that THE BDL-168 OpSw set up can be the factory default except for the addresses. You don't need to set one as the master, and you don't need to set one as the terminator. It should be set for common rail wiring only if you have one rail common (no gaps) throughout the entire layout. Otherwise set it for Direct Home Wiring. Each BDL-168 must be connected to the associated booster ground, and each BDL-168 needs to have its own Rail A connected to its associated booster. The LocoNet cables between boosters should not pass the Rail A signal from one to the other, so cut the appropriate wires in the LocoNet cable as shown in FIG. 3, right side. (I feel that if this Rail A signal is passed from one booster to another, you just made your layout common rail.)

Technical Information

The following section is mostly quoted information and information that has been gleaned from various Digitrax and RR-CirKits sources.

Excerpts from the BDL-168 Manual:

To make set up simpler and easier for non-Digitrax layouts to use the BDL-168, there are two quick configuration buttons that let you set up your unit to work with either direct home or whole layout common rail without using a Digitrax throttle or computer.

1. If you are using direct home wiring, use Section 5.1 as an example for wiring detection sections. If you are using whole layout common rail wiring, use Section 5.2 as an example for wiring detection sections.

2. Connect the left-most pin of the RJ12 socket (the Rail-Sync pin) to Rail A output of your system. The source of the DCC signal must match the DCC signal being sent by the booster to the detection sections handled by the BDL-168. It is best that this signal stays active even when the booster output is shorted or disconnected from the BDL-168 zone inputs, for example by a PM42 Power Manager.

3. Configure the BDL-168 for your wiring system

- a) For direct home wiring layouts, the "ID" switch behind the green ID LED is held down when AC power is first applied, the BDL-168 will operate on direct home layouts (the factory setting). When DCC packets are supplied to the Rail-Sync pin of the RJ12 connector the ID LED will be lit and "wink" off once every 2 seconds to indicate direct home operation is selected.

- b) When operating on a whole layout common rail system, the "OPTION" switch behind the red option LED is held down when AC power is first applied to the BDL-168. When DCC packets are supplied to the Rail-Sync pin connector the ID LED will be lit and "wink" off twice every 2 seconds to indicate whole layout common rail operation is selected.

Note: If either switch is pressed when the BDL-168 is first powered up, the BDL-168 will be re-configured.

4. To make multiple BDL series detectors work with non-Digitrax DCC layouts, they must be connected via LocoNet. One of the BDL series detectors must be set up as a master by

setting OpSw 11 to thrown (See Section 7 for information about setting option switches). This allows LocoNet to communicate occupancy status to a computer.

Other BDL-168 Considerations

1. If a device is used to switch off power feeding the BDL-168 and the track it is connected to, for example, a PM42 Power Manager, or other type of circuit breaker device, it should break the track power to both the zone and detection common rail. If a device only switches off a single leg, then it must be placed in the detection common rail wiring.

2. 12 to 16V AC or DC can be used for power, but must provide at least 100ma current. Solder one wire (AC1) from a 12-16V AC or DC power supply to the pin 12 and the second wire (AC2) from the power supply to the pin N on the BDL-168's 44-pin connector. This powers the BDL-168. Multiple BDL-168 units can be supplied by a single shared supply as long as you provide at least 100mA for each BDL-168. This power supply should not power any devices other than BDL-168s or SE8C boards.

(From the SE8C manual - Solder one wire from a 12V AC or 15V DC power supply to Pin 3 and the second wire from the power supply to the Pin C on the 44-Pin edge connector. This powers the SE8C. Multiple SE8Cs can be powered by a single shared power supply as long as you provide at least 100mA for each SE8C. This power supply should not power any devices other than SE8C and BDL16 series detectors.)

Other Digitrax Boards

Other Digitrax boards such as the SE8C and the DS-64 do not have to connect to track power, so will be relatively easy to hook up and program. The DS-64 may be connected to the track for power, and if it is, the Rail A and Rail B connections that you have previously designated for the BDL-168 should be followed.

Other Quoted Sections:

The following is from the RR-CirKits LocoBuffer-USB manual which can be found on the RR-CirKits web site:

3.3 Power Connections

The LocoBuffer-USB does not use any external power source. The LocoBuffer-USB processor is powered by the USB connector. It only draws power when the USB driver is active and the computer is not in suspend or sleep mode. This allows the LocoBuffer-USB to remain connected to a laptop computer and not drain the battery when the computer is in low power mode. The LocoNet receiver and driver circuits receive their power from the Rail_Sync lines and draw only a few milliamperes.

3.4 Status Indicators

The LocoBuffer-USB has three status indicators located next to the RJ-12 connector. The two green status indicators show the power status. The upper green indicator shows the power status of the LocoNet Rail-Sync power input. The lower green indicator shows the power status of the USB connection. The third red status indicator normally shows LocoNet activity, and activity/error status during a boot loader firmware upgrade.

7.0 LocoNet Terminator

This device (Loco Buffer - USB) includes a built in 15 ma. terminator for the LocoNet® bus. This can be used to provide the “Master” termination for a LocoNet® segment. ** If the LocoNet® Rail-Sync power is at least 12V it will supply the required termination power. **

(AUTHORS NOTE: The Rail-Sync voltage may not be present in its usual form since we are not using a Digitrax Booster or Command station.)

The use of an external Rail Sync power supply such as provided by the various Digitrax UP panels may be required. To enable the terminator, carefully snap open the case and install a jumper at position 6 of the option connector JP1 labeled "Term".

UP5 LocoNet Universal Panel

A Digitrax UP5 LocoNet panel may be used with an external power supply (wall-wart or PS12) to provide power to the LocoNet for the terminator.

About the Rail Sync +/- pins on LocoNet:

h) LocoNet devices may draw up to 15 mA from the RAIL_SYNC+ /- lines whenever the voltage is greater than 7V. The unloaded voltage is between 12V and 26V max. It is general practice to provide a LOCAL current limited copy of the closest track voltages, to pins 1&6 of Throttle jacks around the layout. In this case the master "backbone" copy of RAILS SYNC +/- is not on the Throttle jack.

i) The RAIL_SYNC+/- are a low power copy of the DCC data to be transmitted to the rails. The signals may be received by a differential receiver and boosted to drive the rails.

About RAIL SYNC: The two outside wires, typically Blue and White in a 6-conductor Telco ribbon, actually carry opposite phase copies of the master system rail packets, this is called RAIL SYNC. Because these are broadcast differentially in a single cable, we can accurately and reliably tap a remote Track booster anywhere along a LocoNet cable run. We can do this many thousands of feet from the Master Packet generator (Command station) with very good signal fidelity, even in the presence of a lot of noise and interference! Also, this signal is capable of supporting a number of low current draw modules that can tap on anywhere in the network.