

# Using Digitrax Devices on a Non Digitrax DCC Controlled Layout

By Elmer McKay

The following information was written to help the Non-Digitrax user - use, control, and interface some selected Digitrax devices to a Non Digitrax layout, as proposed by Digitrax in their manuals.

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. The two wiring methods shown and described were built and tested by the author, and work for him.

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 the 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.

## Requirements

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

1) A 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.

A- LocoNet Power;

B- A LocoNet Terminator.

2) 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.))

3) A Computer Interface device for input & output signals to & from the boards.

4) 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.

## **LocoNet Wiring for non-Digitrax Systems and Layouts**

### **Power for the LocoNet**

There are two different ways to easily apply the correct power for the LocoNet.

#### **1- UP5 LocoNet Universal Panel**

A Digitrax UP5 LocoNet panel may be used with an external power supply (12VDC wall-wart or PS12) 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.)

#### **2- BDL-168**

Connecting a BDL-168 may also provide power to the LocoNet. It's connections are described farther down in the section on the BDL-168.

### **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.)

#### **- PR3**

The PR3 is the Digitrax equivalent of LocoBuffer.

#### **- 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.

### **LocoNet Termination**

The following devices can provide the Termination for the LocoNet:

- PR3
- LocoBuffer-USB
- BDL168

Each of these devices require you to set them up to be the Terminator. Also, the LocoNet can have only one active Terminator on the line.

### **How to set-up the LocoNet**

#### **- One Way to do it**

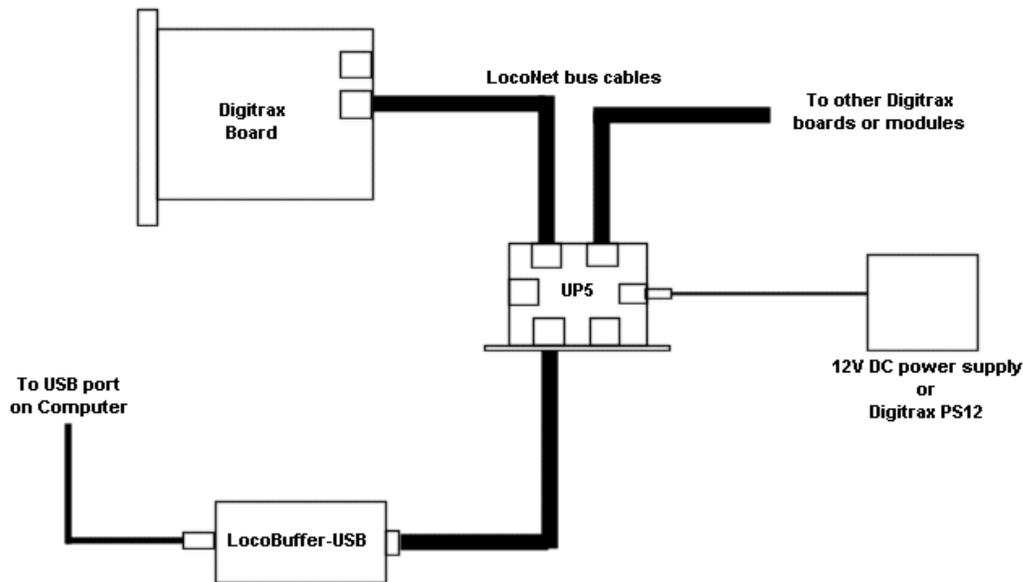
(If you are not using a BDL-168 board, this method is the one that should be used.)

The following three items can be used to implement a 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.)

1. A UP5 type panel.
2. A power supply (12VDC) to plug into the UP5.
3. 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.



### Setting up the Digitrax LocoNet Bus

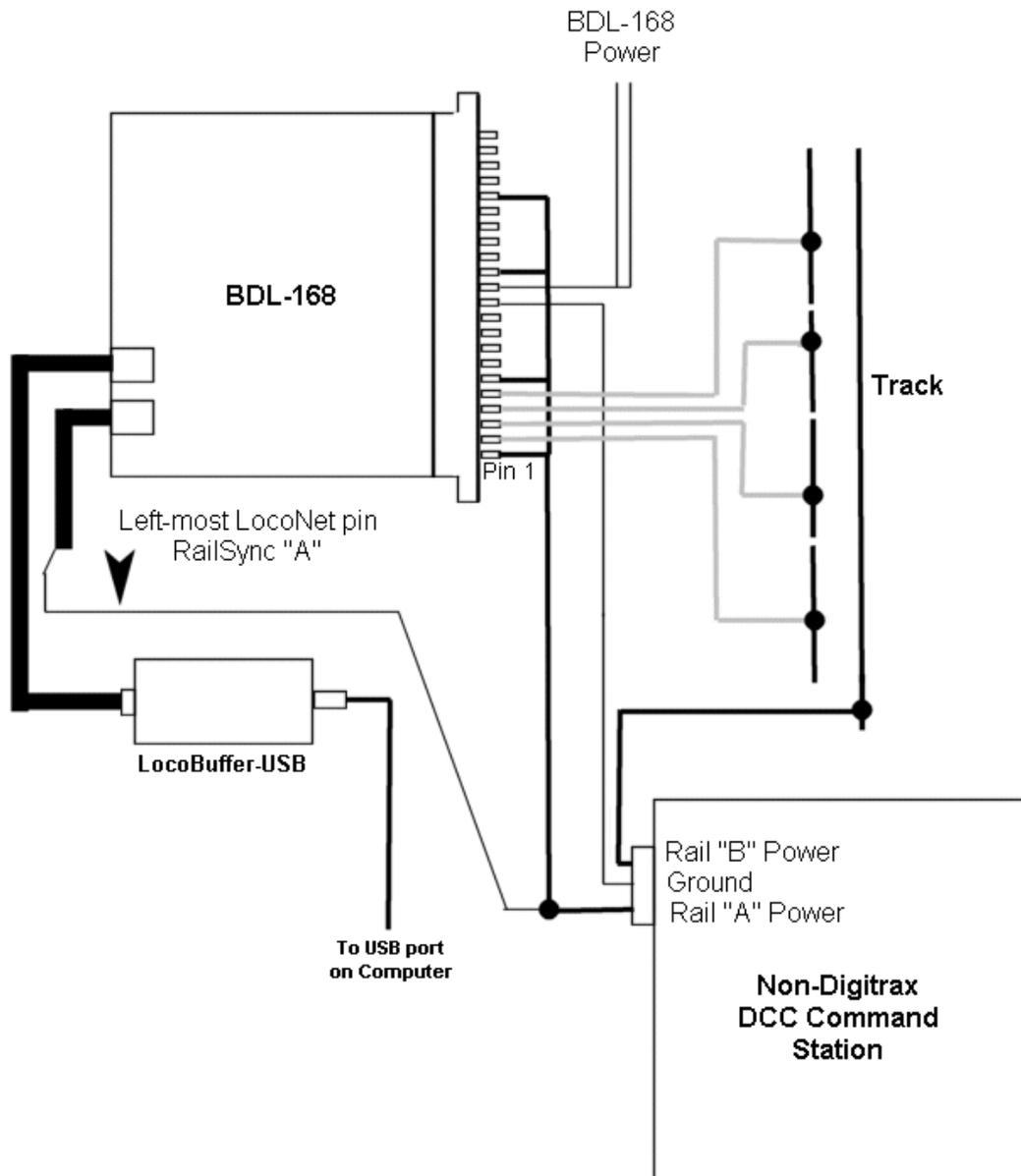
#### - An alternate Method

If you ARE using a BDL-168, this method may work, as it did for me. You will need:

1. A BDL-168
2. A power supply for the BDL-168. (12 to 15V DC or AC)
3. A RR-CirKits LocoBuffer-USB device.
4. And of course a cable to form the LocoNet bus.

You should read the BDL-168 manual before starting, so you will become familiar with the set-up. Mount the BDL-168 and plug it into it's 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. (If you are setting up a temporary test without actually wiring to the track, also 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) 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.) You should now be able to power up the computer, LocoBuffer, and the BDL-168 according to the instructions, and get the correct indications described. If you are using one BDL-168 and no other LocoNet devices or boards, you may not need to set OpSw 11. (If you are going to be using any other Digitrax boards on your newly formed LocoNet bus, you should set OpSw 11 to "thrown", making the first BDL-168 the master LocoNet device.) From the information studied, setting OpSw11 to "Thrown" may provide a more stable LocoNet power source, other than what is received from the RailSync signal.

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. 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 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.



### 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)

### **- 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. (This will require the use of a UP5 and power supply on your LocoNet bus.) 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.

### **More Information**

The following sections are included as additional information and is generally where it was determined how to set-up the LocoNet for other DCC systems, and contains some detailed information, mostly from the manuals of the various boards and equipment.

#### **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 are 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.
- 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, then it 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.

The following section and referencing the manual will describe how to perform the above steps.

#### **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 track 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.

### **JMRI Set-up and Programming Notes from Users**

From John Plocher:

I use a similar system - NCE for throttles and command station stuff, Digitrax and DIY LocoNet devices for power districts, reversers, turnout control, block detection, and (future) either CMRI or LocoNet

based signals. JMRI handles them all flawlessly, and without any extra programming. The only thing that isn't "there" is a default bridge between the systems. That is, you can't use Digitrax throttles to control your NCE command station and the like...

The "secret" is to open the preferences window, select ADVANCED preferences, and then choose one of the LocoNet devices (MS100 [uugh], PR3 [uugh], or LocoBuffer-USB [Yeah!]) as a secondary system. Save and restart JMRI and both systems will be active.

Make sure your Locobuffer-USB or BDL is set up to be a "Loconet Bus Master" current source, and plug the Locobuffer, BDL and SE8C's together with a 6-pin loconet cable. Bring up JMRI's Loconet Tools Loconet Monitor window, and you should see traffic from the BDL detector as you run trains.

When you reference Nxyyyy things in panelpro, you get the NCE stuff. Lxyyyy things are Loconet (and Cxyyyy are CMRI).

As you set up signals, you will want to reference Lxyyy sensors on the BDL detector, and turnout position feedback from whatever you use to drive turnouts; both can be used by the Simple Signal Logic to drive your SE8c... -John Plocher

From Ken Cameron:

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. -ken cameron

From Al Silverstein:

The Digitrax LocoNet can act as a stand alone network if properly configured. I have tested this application using the BDL168 for block occupancy detection, SE8c for signal control, DS64 for turnout control, PR3 for LocoNet to computer interface, and JMRI software. I set up the PR3 to act as the LocoNet terminating device.

The above test was performed on my small test layout that consists of an oval, passing siding, and spur. The layout consisted of 13 blocks, three turnouts, and 7 signal masts.

After testing the layout with a Digitrax Chief command station the layout was tested with a NCE PowerPro command station followed by a Lenz Set 100 command station followed by a CVP Easy DCC command station.

All four command systems worked fine and so did the signaling system.

-Al Silverstein