

## BD8 Power supply

The original BD8's have been designed so that they need no external power supply. But since there is some electronics on the BD8, some sort of supply is required and the BD8 takes its supply from both the LocoNet and the rail power. In reality, most of the BD8 power supply is coming from the LocoNet sync lines, as the BD8 has to be (at least partially) powered, when rail power is down.

However, this power supply scheme is not really suited to a good operation of the Digitrax system, since adding BD8's collapses the LocoNet sync signal to an unacceptable level. Although there is no defined limit as to the number of BD8's that can be connected to the LocoNet, a reasonable number is considered to be around 4-5 BD8's. Adding more BD8's may collapse the LocoNet sync signal to such a low level that the throttles won't work anymore.

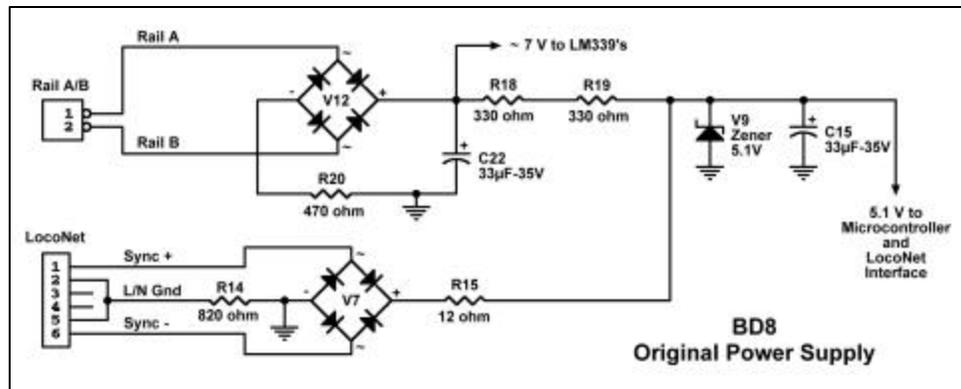
I have some trials to power my BD8's externally, using the existing power circuitry, but with no success.

Since I own a good number of these devices and didn't want to lose my investment, I decided to look at a better way to power the BD8's, that would be independent of the LocoNet and the rail power. I finally came up with the modification described below which allows to power the BD8's from an external AC source and also add some interesting features to the BD8 operation.

This modification requires a rather extensive modification of the BD8 and also making a small PCB for the new supply. So, this modification is not for the faint-hearted.

### Some electronics

The figure at right shows the original BD8 power supply scheme. As can be seen, most of the power is coming from the LocoNet sync signals. Also, when rail power is off, the LM339N modules (the detectors) are powered with a low level voltage not allowing the detectors



to operate properly. This is the reason why when rail power is shut off (either by switching power off, or due to a short circuit on the layout), all track sections controlled by BD8's appear as occupied. When rail power is on, then the LM339N modules are properly supplied (about 7.5 volts) and actual track occupancy is reported.

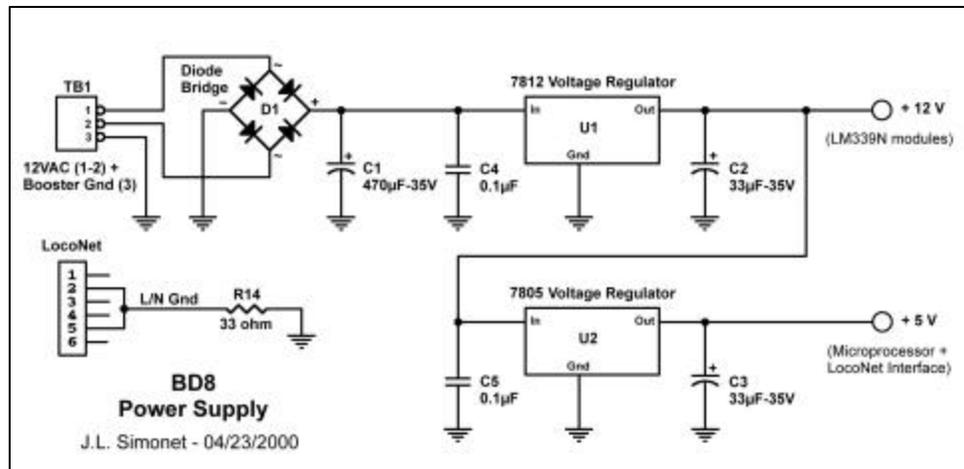
Also, the design is based on some amount of current flowing between the BD8 ground and the LocoNet ground, thus creating a ground loop and a significant voltage drop (about 3 volts) through R14.

The new power supply scheme is shown below. It is a basic power supply scheme working from an external 12VAC power supply and comprised of a diode bridge, two voltage regulators and the required capacitors, for decoupling. You may notice that the LM339N detectors modules are now supplied by a 12V voltage (instead of 7.5V previously). This is not a problem as these modules can be supplied with voltages up to 36V without any performance change, and allows to use a more common 12V voltage regulator.

As this new scheme eliminates the ground current between the BD8 ground and the LocoNet ground, some levels are now shifted in the LocoNet interface and require some minor modification of the LocoNet interface, for proper operation (not shown on the schematics).

The new power supply scheme offer the following advantages over the original one :

- No more current drawn from the LocoNet.
- No more ground loops.
- Detectors are always powered, thus eliminating false occupancy reporting when the track is un-powered.
- The same 12VAC power supply can be shared between as many BD8's as desired (current draw approx. 20 mA per BD8)
- The new scheme is compatible with the current Digitrax equipment so that the same power supply could be shared between BD8's, PM4's and the BDL16 to come shortly (although I haven't experimented with that yet).



### Bill of Materials

#### Parts for the new PCB :

Reference	Part
C1	470µF - 35V electrolytic capacitor
C2, C3	33µF - 35V electrolytic capacitor
C4, C5	0.1µF - 50V ceramic capacitor
D1	1Amp DIL diode bridge
TB1	3 pos. TB for PCB (5mm spacing)
U1	7812 voltage regulator
U2	7805 voltage regulator

#### Replacement parts for the BD8 :

Reference	Part
R3	15 kohm - ¼ W
R5	33 kohm - ¼ W
R14	33 ohm - ¼ W

Note : the references for the replacement parts are the references shown on the BD8 board.

All these parts should be obtained for around 5-6 \$ per BD8 to be modified.

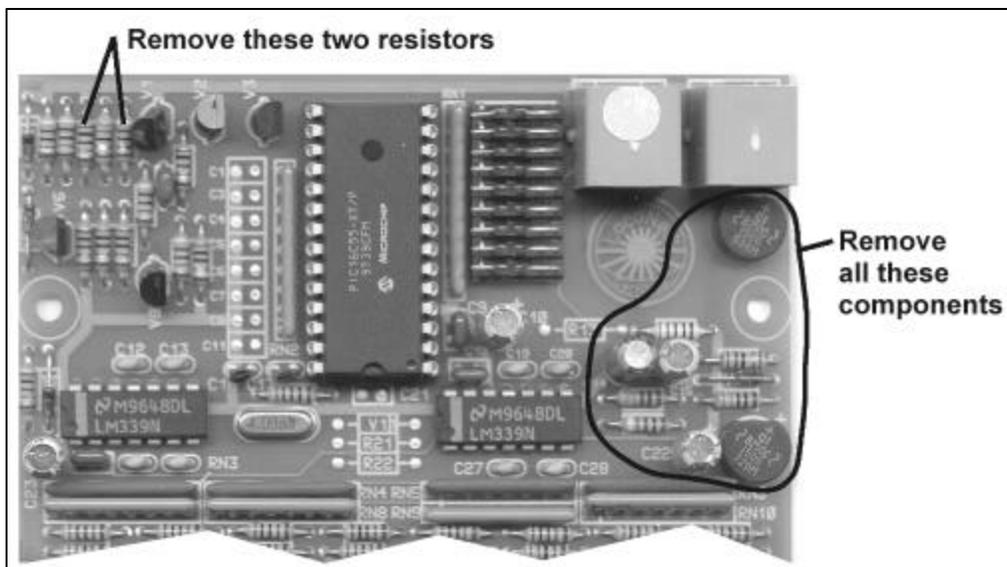
## **Implementation**

The implementation consists in removing a number of components from the BD8, replacing some other components, building the new power supply PCB and connecting it to the BD8.

We'll look at this modification step-by-step :

### **1. Removing components**

The figure below shows all the components to be removed / replaced. The best way to remove components is to use solder wick, as described in the box next page :

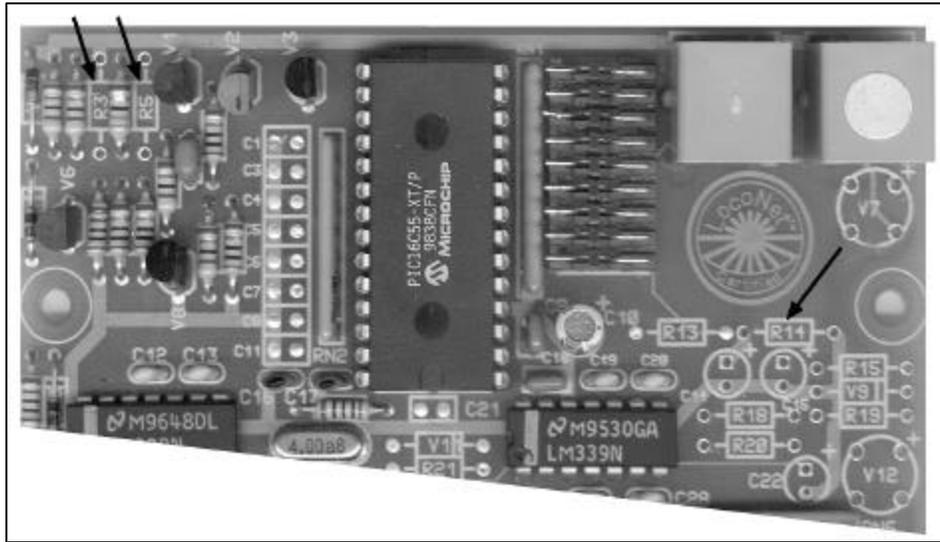


#### **Using solder wick**

Solder wick is a copper braid that is applied on the solder, heated with a soldering iron and which sucks up the solder. There are many brands of solder wick but I recommend the rosin soaked type since it does a better job, more quickly. A good one is SODER-WICK Rosin SD from Chemtronics.

- Apply the end of the solder wick on the solder.
- Heat with a 30 watt soldering iron for 2-3 seconds. You'll see the solder being absorbed by the solder wick. At this point there should remain very little solder in the mounting hole and you should be able to see through the mounting hole.
- Repeat for other leads of the component.
- Using a small pair of pliers, move the component leads sidewise in the mounting hole so as to "break" the remaining bits of solder.
- Remove the component.
- Cut the end of the solder wick soaked with solder, after you work each solder, so that you always start a new solder with fresh braid. This is really important !
- Don't overheat the printed circuit board as this may damage it.

After removing all the components described above the BD8 card should look like what's shown below :



## 2. Adding new components

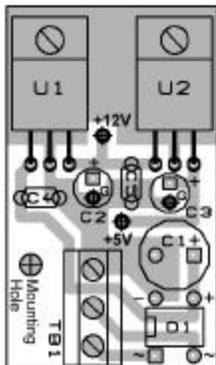
After removing all components required from the BD8, it's now time to add a few components (resistors) that will replace some of the previous components. These components are shown by black arrows in the above picture :

- Install and solder a 33 ohm 1/4 W resistor at location marked R14 (replaces the previous 820 ohm resistor).
- Install and solder a 33 kohm 1/4 W resistor at location marked R5 (replaces the previous 47 kohm resistor).
- Install and solder a 15 kohm 1/4 W resistor at location marked R3 (replaces the previous 10 kohm resistor).

That's all there is to do on the BD8 card, for the time being. The next step is to build the small PCB which will be later installed on top of the BD8.

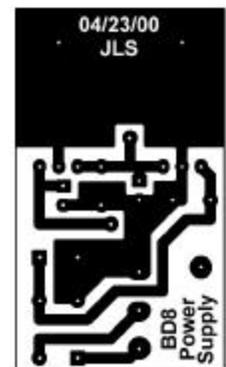
## 3. The new PCB

The figure at right shows the small PCB (bottom view/solder side - scale 1:1) that should be made to accommodate the new components for the Power Supply. This PCB is 1.1 x 1.9 inches. It is a single sided PCB that can be easily made at home.



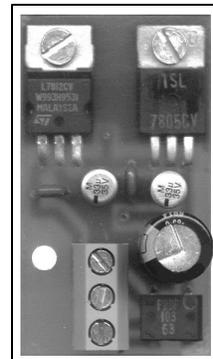
The figure at left shows the assembled PCB (top view/component side). Refer to the above parts list for components to be installed on this PCB and make sure that all electrolytic capacitor have their positive side as indicated on the drawing. The two voltage regulators have their 3 leads soldered to the PCB and their upper tab attached to the PCB using brass screws/washers/nuts.

The four "heavy" holes indicates the places from where this PCB will be connected to the BD8, in corresponding holes, just below. In order to prepare connecting this PCB to the BD8, do the following :

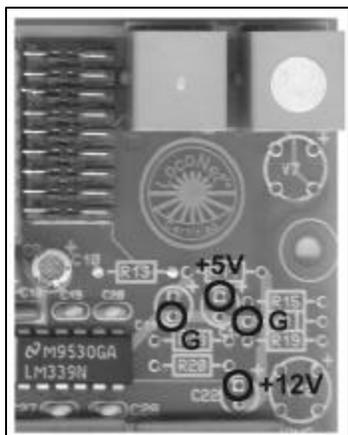


- DO NOT CLIP the negative leads of capacitors C2 and C3 (marked as "G") as they will be used to connect this PCB to the BD8 ground pads.
- Solder 2 pieces of solid wire (such as leftover resistor leads) about 3/4 inch long in the holes marked +12V and +5V. Each piece of wire should be installed square to the PCB and protruding on the bottom side of the PCB. These pieces of wire will be the connections to the corresponding pads on the BD8.

The new PCB, shown assembled at right, is now ready to be installed on the BD8.



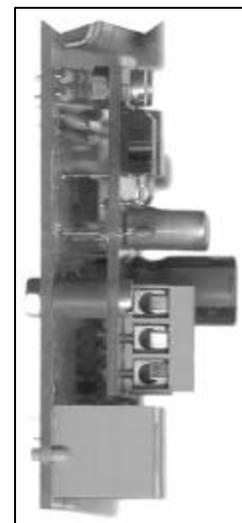
#### 4. Installing the new PCB on the BD8



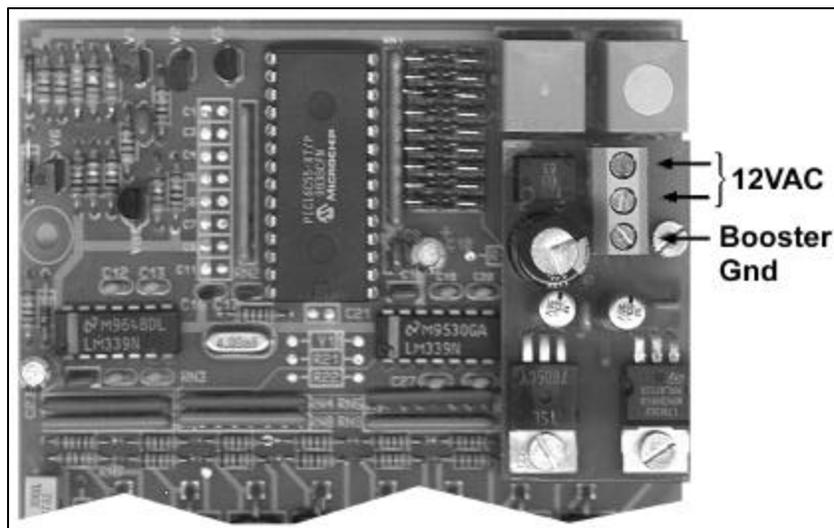
Insert the four wires protruding from the bottom of the small PCB in the corresponding holes of the BD8, indicated by the circles in the figure at left. The two wires from capacitors C2 and C3 (negative leads) goes in the holes marked as "G", while the +12V and +5V wires goes to the corresponding holes.

Attach the small PCB to the BD8 using a screw/washer/nut and a 3/8 in. spacer between the two boards at the mounting hole location and solder the four wires at the bottom of the BD8.

The figure at right shows a side view of the final assembly. You can see the spacer used for mounting the PCB, as well as the wires going from the top PCB to the bottom PCB.



The resulting BD8, with its new power supply, is shown in the picture below, along with its connections to the Power supply.



You are now ready to use your BD8 by connecting the 12VAC supply and the Booster ground, as indicated and enjoy...

Note that the Rail B connection is not used anymore and does not need to be connected.

For sure, this modification will void the BD8 warranty. But who still has a BD8 under warranty, nowadays ?

For any question or comment regarding this BD8 modification, don't hesitate to contact me ([simonet@club-internet.fr](mailto:simonet@club-internet.fr)).