

Northern California Free-mo DCC Standards

Revised 7/22/2008

120VAC Power, General

Any quantity and location of 120VAC outlets may be used. The “only one outlet” rule is no longer required.

Outlets must have the safety earth-ground “third hole”.

Multi-outlet power strips and multi-outlet extension cords are allowed for distributing power around the layout and setup area, per the following rules modeled on national electrical safety codes:

- Power strips and extension cords must have the safety earth-ground “third prong”.
- Power strips and extension cords must be rated for 15 Amps minimum.
- Power strips must have built-in resettable overload protection.
- Power strips are allowed to plug into wall outlets only.
- Power strips are not allowed to plug into another power strip or into an extension cord.
- Extension cords are allowed to plug into wall outlets or into power strips.
- Extension cords are not allowed to plug into another extension cord.
- Stand-alone outlet expanders are not allowed.

Power Supplies for Boosters and Command Station

The AC power cord must have the safety earth-ground “third prong”.

Power supply exposed metal surfaces, such as enclosures, must be tied to the safety earth-ground.

TBD: is a standard power supply required to ensure all boosters output the same track voltage?

Boosters and Command Station AC Power Connection

All boosters and the command station with their power supplies, referred herein as “units” for simplicity, are co-located to form a “Booster Farm”. Refer to Appendix D for images of a typical setup.

All unit’s AC cords plug into a power strip that is plugged directly into an AC outlet. Choose an AC outlet located as close as possible to the layout’s center.

TBD: The command station shall have an EMI filter on its power input.

Boosters and Command Station Commons Connection

NOTE: Digitrax DCS100 and DB150 units have a front-panel connector, with one terminal labeled “ground”. This terminal is herein referred to as “Common” to avoid confusion with the AC safety earth-ground.

Each unit must have an owner-supplied 8-position screw-style terminal strip located within 6” of its front panel connector. Owner-supplied 12-AWG wire must connect the 7 front-panel connector terminals to 7 of the terminal strip screws, leaving open the last terminal position adjacent to the “Power” terminals. Note: the terminal strip also provides a more robust and convenient platform to connect power inputs, program track, configuration jumpers, etc.

Each unit must be accompanied by at least one owner-supplied standard “Commons Jumper”.

The standard Commons Jumper is a 36”-long, single-conductor, 12-AWG stranded wire, with spade lugs crimped and soldered at both ends.

At setup time, all units’ “Common” terminals are linked together by installing standard Common Jumpers at the terminal strip “Common” position, connecting from one unit to the next daisy-chain style.

Commons Jumpers longer than 36” may be assembled at setup time on an as-needed basis, but kept as short as possible. All other parameters must match the standard Commons Jumper.

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Commons to Safety Ground Connection

Every DCS100 unit must include a connection of the AC safety earth-ground to the open terminal on the 8-position terminal strip (the end position, adjacent to the "Power" terminals). Note: DB150 units may also include this connection, though it will not be used at Free-mo setups.

At setup time the Commons daisy-chain must be connected to the AC safety earth-ground at one point, and only one point. This connection shall always be made at the single DCS100 unit designated as the command station by installing a jumper on its terminal strip to connect the AC safety earth-ground terminal to the "Commons" terminal.

Boosters and Command Station Settings

The command station must be a Digitrax DCS100 unit.

At the start of each operating day, the command station must be completely cleared and reset, and its Operations Switches configured to the standard settings.

The command station and booster Operations Switches configuration is standardized as follows:

Op Sw	Command Station	Booster	Reverse Booster	Action
#39	close	close	close	"close" = clear all memory (addresses, consists, routes) move toggle to "SLEEP", move toggle to "RUN", then move toggle to "OP" ("t" will not show until next access)
#02	throw	close	close	"close" = normal booster only
#03	throw	throw	close	"close" = auto reversing booster only
#05	close	throw	throw	"close" = command station & booster
#15	close			"close" = force purged loco to stop
#20	close			"close" = disable address 00 and analog stretching
#25	close			"close" = disable aliasing
#44	close			"close" = expand to 120 address slots (DCS100 only)

The standard Operations Switches configuration and the setting procedure must be posted on or near each unit. Refer to Appendix A at end of this document for a printable version designed to mount on the top of Digitrax units.

The "Scale" toggle switch must be set to "HO" on all boosters.

Track Power Distribution and Connections

The command station shall not be used to provide track power or Accessory Bus power to any portion of the layout.

Each booster must have a user-supplied standard Track Power Pigtail installed on its 8-position terminal strip, at the "Rail A" and "Rail B" positions.

The standard Track Power Pigtail is 6" long maximum, two-conductor, 12-AWG stranded wire, with a female 2-pin Cinch-Jones connector at one end.

The group-owned Standard Track Power Cables connect each booster's Track Power Pigtail to its assigned power district on the layout.

The standard Track Power Cable is 50' long maximum, two-conductor, 12-AWG stranded wire, with a male 2-pin Cinch-Jones connector at the booster end, and a female 2-pin Cinch-Jones connector at the layout end.

Track Power Cables shorter than 50' are acceptable. All other parameters must match the standard Track Power Cable.

A maximum of two Track Power Cables may be daisy-chained to lengthen a run.

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Track Power Cable runs shall not exceed 100' each.

Each Track Power Cable must connect near the middle of its target power district on the layout.

Track Power Cables connect to the layout's Track Bus by opening one module joint Cinch-Jones connection, and attaching the Track Power Cable's female Cinch-Jones to the module's male Cinch-Jones. The second module joint Cinch-Jones connection is connected as usual. Note: selecting the proper connection to open is determined by matching the track power phase during the DCC system setup.

LocoNet Distribution, Connections, and Power

A group-owned "LocoNet Junction Box" must be used to distribute LocoNet from the command station to boosters and the layout. Refer to Appendix C for schematic. The LocoNet Junction Box performs the following functions:

- Disconnects the 'LocoNet' signals (pins 3 and 4) from the boosters, such that they receive only 'RailSync' signals and cannot interfere with the 'LocoNet' signals.
- Disconnects the 'RailSync' signals (pins 1 and 6) from the layout and instead connects a dedicated 12VDC supply, such that voltage sags from too many throttles do not affect command station internal electronics.
- Provides one RJ12 jack for LocoNet connection from command station.
- Provides one RJ12 jack for LocoNet connection to layout (aka 'throttle bus').
- Provides multiple RJ12 jacks for LocoNet (actually RailSync) distribution to boosters (aka 'booster bus').
- Provides one DC power jack, 2mm-inside x 5.5mm-outside positive-center type, for connecting a regulated 12VDC supply.

A regulated 12VDC power supply connects to the LocoNet Junction Box DC power jack for supplying throttle power to the layout's LocoNet bus. This supply may plug into the Booster Farm power strip, or any available AC outlet.

One RJ12 jack on the command station connects to the LocoNet Junction Box RJ12 jack labeled "command station" using a RJ12 cable not to exceed 36 inches in length. The shortest cable possible is preferred. Note: the command station's second RJ12 jack is used for setting Ops Switches, debugging the DCC system, or programming locomotives.

One RJ12 jack on each booster connects to one LocoNet Junction Box RJ12 jack labeled "booster" using a RJ12 cable not to exceed 36 inches in length. The shortest cable possible is preferred. This method results in RJ12 cables forming a "star" configuration from the LocoNet Junction Box out to the boosters. Note: the booster's second RJ12 jack is used for setting Ops Switches or debugging the DCC system.

One RJ12 jack on the layout's LocoNet bus (used mainly for throttles) connects to the LocoNet Junction Box RJ12 jack labeled "layout" using a RJ12 cable not to exceed 10 feet in length. The shortest cable possible is preferred.

Additional "remote" LocoNet power is allowed on an as-needed basis. This power shall be provided ONLY from dedicated power supplies, such as "wall wart" units. Using the Track Bus or Accessory Bus is NOT allowed.

Dedicated power supplies for additional "remote" LocoNet power shall be 12VDC. All supplies must be approved by the layout DCC Chief or Run Chief before connecting to the layout. These supplies may plug into any available AC outlet.

Digitrax UR91 radio receiver units MUST be powered by dedicated "remote" power supplies.

Decoder Settings

All decoders shall have Analog Mode Conversion (i.e. DC operation) disabled. Set CV29 bit 2 to 0 (off or low). Most decoders default with this mode enabled – decoder owners must change it when programming the decoder. After a global reset to the decoder, remember to disable this mode again. Note: this setting is subject to inspection and correction on any decoder at any time by the layout DCC Chief or Run Chief (the owner will be consulted first); non-compliant units shall be removed from the layout until the correction is made.

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DCC System Installation, Configuration, and Test Procedure

Refer to Appendix B for interconnections

CONNECT BOOSTER FARM

1. Select AC outlet near layout center and define Booster Farm area nearby; do not plug in Booster Farm power strip yet.
2. Collect Command Station unit and all booster units into Booster Farm area.
3. Assign a DCS100 unit as Command Station and label it as such.
4. Plug all units' AC cords into power strip. Plug regulated 12VDC power supply into power strip, attach its output to LocoNet Junction Box. Do not plug in Booster Farm power strip yet.
5. Install brown Commons Jumpers to daisy-chain together all units' Common terminals.
6. On Command Station only, install green Ground Jumper to connect Commons daisy-chain to AC safety-ground.
7. Install Track Power Cables between each booster and its target layout power district as modules come online.
8. Label each booster with its assigned layout power district name.
9. At each power district boundary, ensure track has insulated joiners on both rails and all Track Bus Cinch-Jones connectors are open (not connected).

CONFIGURE COMMAND STATION

10. Toggle all units' "Mode" switches to SLEEP. Verify all units' "Scale" switches are set to HO.
11. For units that have them, set power supply switches to ON.
12. Now plug Booster Farm power strip into AC outlet. All units' "Power On" lamps should be lit.
13. Plug throttle into Command Station and configure its Ops Switches (chart attached to unit):
 - a. toggle "Mode" switch to OPS, close #39 Ops Switch.
 - b. toggle "Mode" switch to RUN, then back to OPS.
 - c. close various Ops Switches 05 to 44 following chart column labeled "Command Station".
 - d. verify no other Ops Switches are closed.
14. Install a LocoNet cable between Command Station and LocoNet Junction Box jack labeled COMMAND STATION.
15. Install LocoNet cables into LocoNet Junction Box jacks labeled BOOSTER, one for each slave booster. Do not connect these cables to the boosters yet.
16. Set Command Station's "Mode" switch to RUN. Verify its "Net" lamp is lit solid red; if not, there is a short in the LocoNet jumper cables or the LocoNet Junction Box. Locate and correct the problem as needed.
17. Set Command Station's "Mode" switch to SLEEP.

CONFIGURE SLAVE BOOSTERS

18. Move throttle from Command Station to a slave booster. Configure booster's Ops Switches (chart attached to unit):
 - a. toggle "Mode" switch to OPS, close #39 Ops Switch.
 - b. toggle "Mode" switch to RUN, then back to OPS.
 - c. close Ops Switch 02 for a normal booster, or close Ops Switches 02 and 03 for a reversing booster, depending on how that unit is used in the layout.
 - d. verify no other Ops Switches are closed.
 - e. toggle "Mode" switch to RUN, then back to SLEEP.
19. Attach a LocoNet cable (installed at step 15) from LocoNet Junction Box to the booster.
20. Toggle the booster's "Mode" switch to RUN. Then Toggle the Command Station's "Mode" switch to RUN.
21. If Command Station's "Track Status" lamp is dark, use throttle to turn on track power.
22. The booster's "Track Status" lamp should light unless there is a track short in the layout district connected to it (pending step 7 completion). Locate and correct the short as needed.
23. Repeat steps 18 - 23 for each slave booster unit.

TURN ON TRACK POWER

24. Toggle all units' "Mode" switches to SLEEP. Toggle all slave boosters' "Mode" switches to RUN. Then Toggle Command Station's "Mode" switch to RUN. Verify "Track Status" lamp is lit on all units. Track power now should be on in all districts, though there may be phase reversals.
25. Use a multi-meter in AC-VOLTS mode to measure across rails in each district; it should read between 14 and 15 VAC. If not, locate and correct problems as needed.
26. Test for phase reversals at each district boundary. Measure across insulated joiner on one rail (i.e. not across the two rails); if it reads more than 7 VAC there is a phase reversal. Swap the Cinch-Jones connectors where Track Power Cables attach to layout power districts as needed.
27. Test each booster's short-circuit response by shorting rails with a coin in each power district. A slow booster shut down, or no reaction at all, indicates a high resistance somewhere in the track wiring for that district. Locate and correct problems as needed.

CONNECT LOCONET TO LAYOUT

28. Install a LocoNet cable into LocoNet Junction Box jack labeled "LAYOUT". Plug a throttle into Command Station. Test this cable using LocoNet Tester (Digitrax LT1); all 4 LEDs should light brightly. If not, replace or repair the cable.
29. Once the cable test succeeds, remove the LT1. Attach the LocoNet cable to the layout's LocoNet bus.
30. Plug a throttle into layout's LocoNet bus. Use LocoNet Tester to check each throttle jack on layout, progressing outward from where LocoNet Junction Box is attached. All four LEDs should light brightly. If not, correct module LocoNet wiring as needed.
31. Remove LocoNet Tester for operations.

DCC System Power-Down Procedure

AT END OF OPERATING DAY

1. Toggle Command Station "Mode" switch to SLEEP.
2. Toggle all slave booster's "Mode" switches to SLEEP.
3. Turn off or unplug the Booster Farm power strip so that AC power is cut off from all units.

DCC System Power-Up Procedure

AT START OF OPERATING DAY

1. Verify all booster's "Mode" switches are set to SLEEP.
2. Verify Command Station "Mode" switch is set to SLEEP.
3. Turn on or plug in the Booster Farm power strip so that AC power is applied to all units.
4. Plug throttle into Command Station and configure its Ops Switches (chart attached to unit):
 - a. toggle "Mode" switch to OPS, close #39 Ops Switch.
 - b. toggle "Mode" switch to RUN, then back to OPS.
 - c. close various Ops Switches 05 to 44 following chart column labeled "Command Station".
 - d. verify no other Ops Switches are closed.

Note – this will clear all consists, so operators must create their consists again.
5. Toggle Command Station "Mode" switch to RUN, then back to SLEEP.
6. Toggle all slave boosters' "Mode" switches to RUN. Then toggle Command Station "Mode" switch to RUN.
7. Verify the Command Station "Net" lamp is lit solid red.
8. Verify that "Track Status" lamps are lit on all units. If not, use a plugged-in throttle to turn on track power. It may be necessary to cycle track power off and then on again.

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Appendix A

Operations Switches Configuration Procedure and Settings

Print and attach on or near each DCS100 and DB150:

DCS100 / DB150 Operations Switch Configuration

- 1) Set right toggle switch to OP
- 2) Disconnect LocoNet cables, plug in throttle at either LocoNet port
- 3) Change to "switch" mode [DT100: "MODE"] [DT400: "SWCH"]
left display = op-sw number right display = current state
- 4) Select op-sw number [DT100: right knob] [DT400: number keys]
- 5) Set op-sw state [DT100: "c-R"=close, "L-t"=throw] [DT400: "CLOC c"=close, "OPTN t"=throw]

NOTE: All DCS100 ops-switches default to "t" after a #39 clear

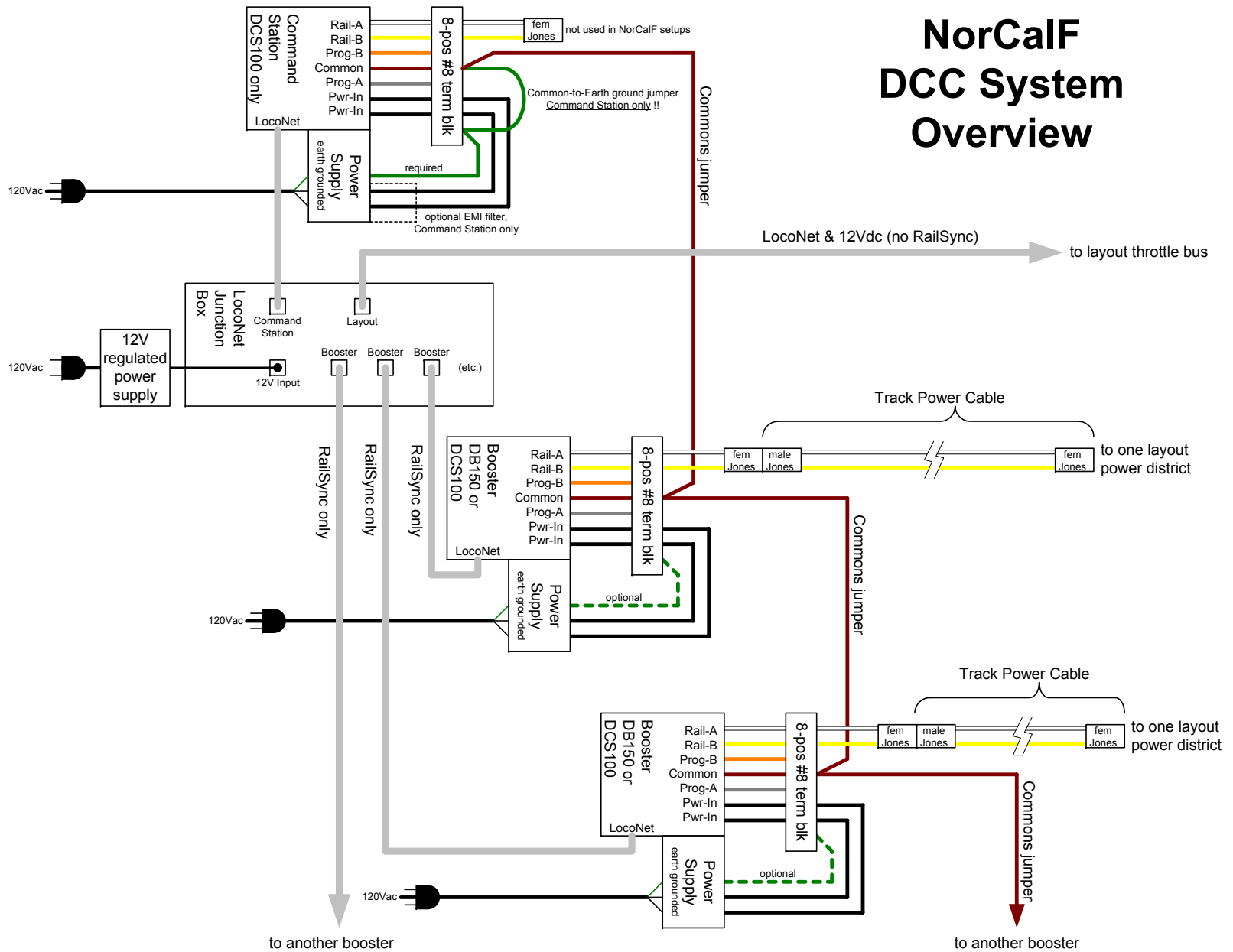
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#02	throw	close	close	"close" = normal booster only
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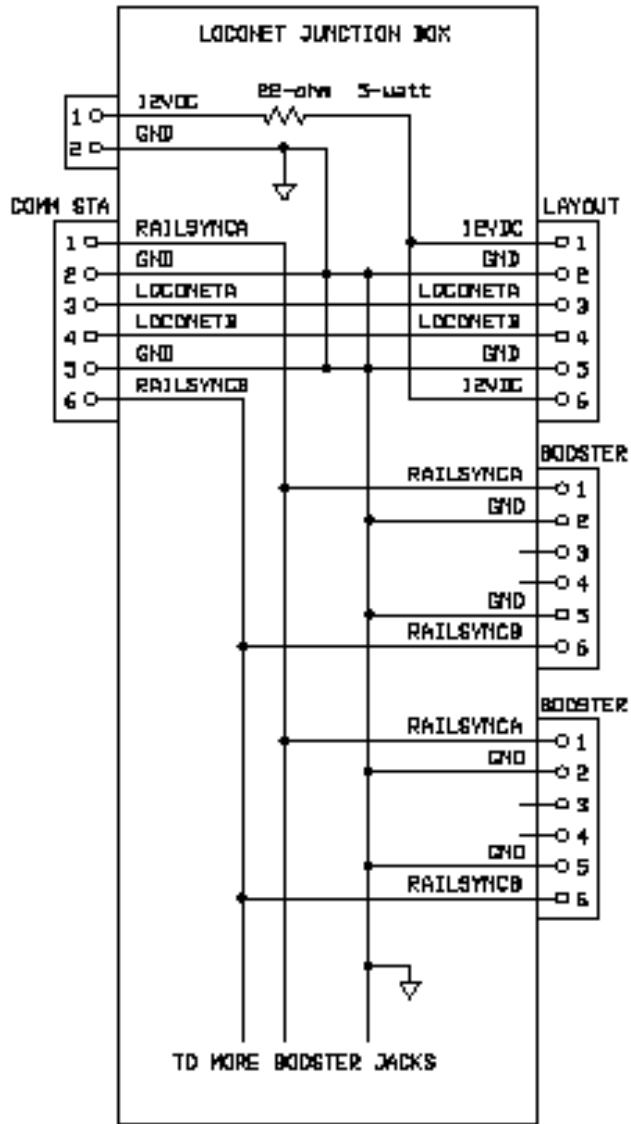
Appendix B

NorCalF DCC System Overview



Appendix C

LocoNet Junction Box Schematic

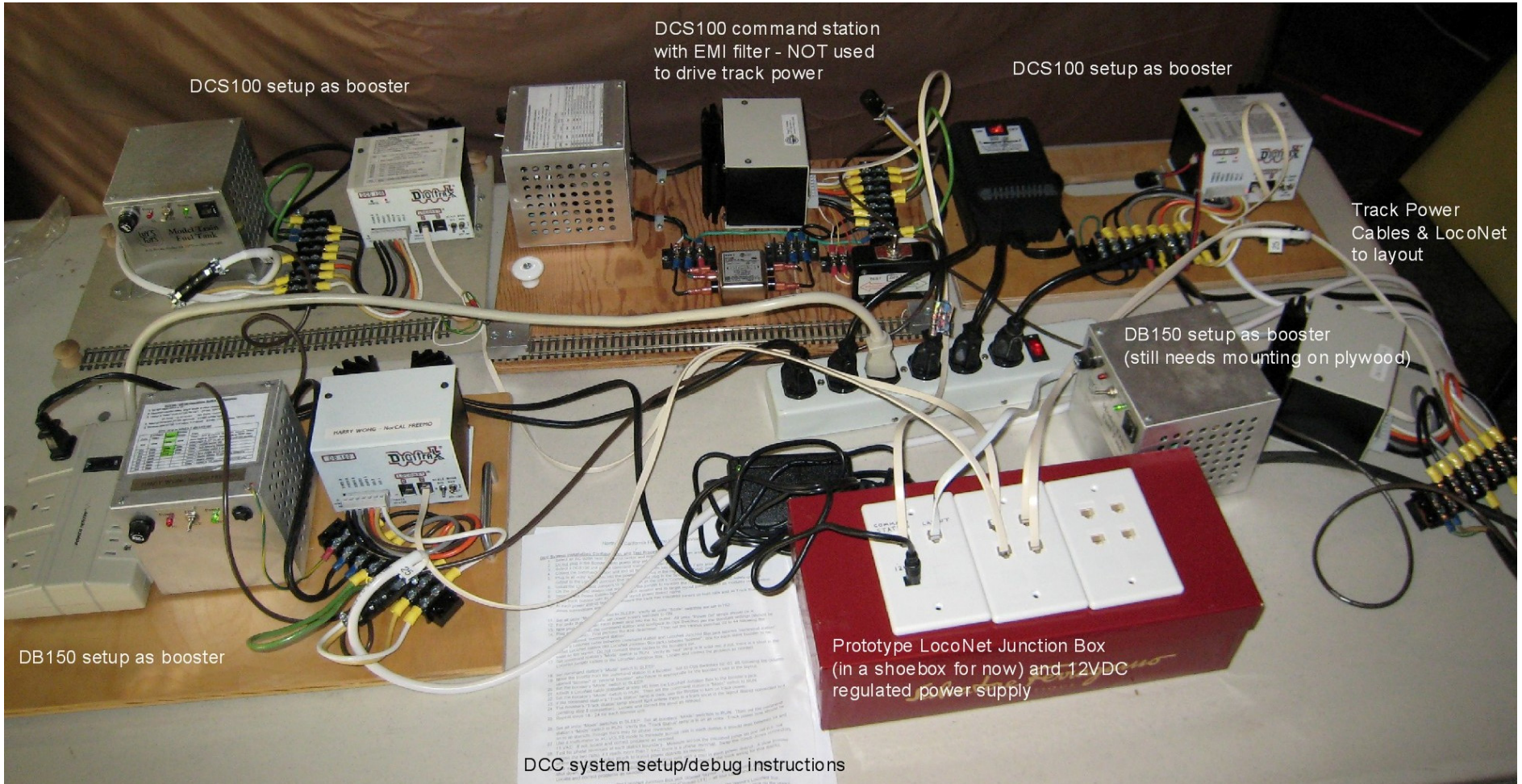


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Appendix D

Booster Farm Images



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