DCC Recommended Practices for NTRAK Layouts

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There are two major objectives for this reference. One is to recommend practices that should be followed by clubs wishing to use DCC operations in conjunction with other clubs. The other is to provide guidelines and trouble shooting suggestions that will enhance operations.

Many of these recommendations are based on the excellent "DCC Rule Book for DCC Operations" produced by the North Raleigh Model Railroad Club. It is required reading for anyone contemplating organizing a large DCC presence for an NTRAK layout involving two or more clubs. This reference can be found on their website which can be accessed through Digitrax's web site. These recommendations were also made with the help of Armin at Digitrax.

Many NTRAK clubs have added DCC operations to their layouts at both local shows and at larger regional and national gatherings. Some clubs such as the North Raleigh Model Railroad Club have done extensive testing and have worked out most of the kinks. As of now there are no national standards that will ensure that a large layout made up of modules from a number of different clubs will be able to be set up and maintained as an effective, trouble-free DCC operation. For the most part, the DCC equipment choice will determine many of the standards that are followed, but there is a need to follow recommended practices that will ensure that the set up and operation of the DCC portion of the layout is carried out with maximum efficiency.

It is extremely important that recommended practices and procedures be followed when using DCC. With analog DC, bad wiring results in slow running trains or electrical dead spots. The fixes are usually quite obvious. With DCC, problems will seem to arise mysteriously and will be hard to resolve. If the system is set up correctly and if it is managed carefully, few problems will arise and the DCC operation will go smoothly.

Which System?

As far as quality and utility goes, there are a number of systems that can be used to operate DCC on NTRAK layouts. It is recommended that the Digitrax system be used if for no other reason than most NTRAK clubs have already opted to use Digitrax equipment. It has proven to work well and many clubs are already familiar with it and competent with it. Over the years Digitrax has given us strong technical support. Even though it can be done to some extent, don't allow the mixing of DCC systems; it will complicate things too much. This is true for the home layout as well as a large NTRAK layout.

Why DCC?

There should be a purpose behind the running of a DCC operation. Here are some benefits of running trains on DCC on NTRAK layouts.

1. It can be a proving ground for DCC. If a participant is considering DCC for his or her home layout, a trial run of a DCC powered train will provide valuable decision making information. Undoubtedly, DCC "experts" will be available to answer questions and to demonstrate the use of the equipment.

2. Radio controlled operation will most likely be available. Engineers can be in control of their own trains as they circle the layout. On large layouts most participants want to stay with their train. It makes sense to allow them to also control their trains rather than require each local throttle operator to adjust the speed settings for them.

3. Multiple unit locomotive lashups (consisting) can be set up. Mid-train helpers and pushers can be used if the rolling stock is properly weighted and has body mounted couplers. With appropriate coupler modification, pusher engines can be added to and removed from a train on the fly.

4. DCC equipped locomotives can be fine tuned to make them run well with other locomotives (i.e. make two unlike locomotives run at the same speed on the same throttle setting.

5. The number of trains that can be run on a mainline is limited by the number of throttles and DCC trains available, not by the number of blocks. (There should be no problem with locomotive motors drawing more amps than the system can provide, if the guidelines for setting up power districts are followed.)

6. Trains can be realistically dispatched on the DCC sections of the layout. Train operators will not have to worry about power routing options for the most part since DCC can operate without blocks. The task of the engineer will be hold at sidings for passing traffic and to align switches.

7. The potential exists to run DCC sections of the layout with a computer. Clubs can build modules with signals, detection blocks, and DCC components that tie into other standard modules. These modules can then control sections or the entire DCC operation.

Advance Planning For A Large NTRAK Layout

The first step is to organize a DCC committee. One person should oversee the entire operation. Assistants should be appointed and assigned responsibilities.

The next step to take for a worthwhile DCC operation is to develop a layout plan that will work well with DCC. To enjoy the full benefits of DCC operation, consider distributing passing sidings throughout the DCC loop to simulate the running of trains on a single track line where numerous meets take place at the sidings.

Undoubtedly, you will share running rights with the Analog (DC) operators. In most cases, opt out for either the red line or the blue line. Base your choice partially on the availability of operating passing sidings on these lines, the comparable lengths of the available runs, and the interests of the members.

As the layout plan develops, decide just how big a DCC operation you will be able to support. Take an inventory of available command stations, boosters, network resources,

radio receivers, and throttles. If the resources are stretched too far, the operation is bound to suffer. You will probably have to consult with other clubs to determine the suitable DCC resources they can contribute.

Read the section on Equipment to help you decide how big an operation you can support. Make up a plan of the layout showing the location of command stations, boosters, radio receivers, the LocoNet network, and power districts.

Consider designing the LocoNet with three or four major branches emanating from a UP-3(s) close to the command station. This will help to isolate problems that arise with defective LocoNet cables and connectors.

Finally, document your DCC plan. Take a diagram of the layout and indicate the location of all of the DCC components. Don't forget to show the gaps between the power and sub-power districts.

Gather References

You should have on hand at every show with DCC:

1. The manuals for each device you are using.

2. The North Raleigh Model Railroad Club's "Rule Book for DCC Operations on NTRAK Layouts." This manual can be downloaded from their web site.

3. Manuals for both Digitrax and Lenz decoders.

4. An on-site DCC techie who knows the fine points of the Digitrax.

Equipment Needs

1. A Command Station: Most likely it will be a Digitrax Chief. Package Your Equipment: Your club should build DCC units that contain the following: a power supply for the command station/booster, a command station/booster, at least two Power Shields or one PM4, a UP3, and female Cinch-Jones plugs for each sub-power district output. A program track built into the unit may prove handy. Be consistent with your wiring. It is recommended that the Rail A output of the command station/booster be wired to the number 1 pins of the Cinch Jones plugs and that the number 1 pins in turn be connected to the "front" rails of the module tracks.

2. Boosters: The boosters should also be ready to plug into the track (Cinch-Jones plugs).

3. Power Shields (Tony's Train Exchange) or PM4's (Digitrax): A successful DCC operation on a large layout needs power districts in order to distribute power to the tracks and to isolate problems to smaller areas of the layout. These devices will be wired with Cinch-Jones connectors to allow for quick set ups. Relatively inexpensive Power Shields or PM4's can be used in the system in lieu of boosters. (There are other brands of current limiting devices for DCC that may also be used.)

4. Power Distribution Cables: You cannot rely on the module wiring and Cinch-Jones plugs to carry heavy amperage through any more than five or six modules without risking excessive voltage drops. If a booster is to be used for two or more sub-power districts, cables should be made up distribute the power to the center of the sub-power districts from the boosters. The wire should be at least 14 gauge. The appropriate gauge is based on a number of factors: length of wire runs and current draws by locomotives and other devices. Make these wire runs at least 16 feet. This will allow the placement of a booster at the gap between two sub-power districts with the cables plugged in near the centers of the sub-power districts. These cables make the most sense for applications where one line is being used for DCC and the booster is needed to handle at least two sub-power districts. If all of the lines (red, yellow, blue) are being used for DCC, then a booster will probably be placed in the center of a group of modules making up a power district. Most likely the booster will be placed on the floor under a module; cables at least four feet long will be needed to reach up to the Cinch-Jones plugs on the modules. A PM4 will probably work well here.

5. Radio Receiver UR91: For a large layout, two or more may be needed to eliminate poor reception areas. Note that the system can handle (guaranteed) at least ten locomotive consists, most likely many more, without a problem. The maximum amount of radio traffic that can be handled depends on the number of commands being sent at a particular moment and the number of receivers in the LocoNet system. (In the unlikely event that every train operator made a throttle adjustment at the same time, there would probably be a delay in the processing of commands.

6. LocoNet cables: You should have an assortment of ready-made cables on hand. For a really large layout, it's a good idea to have a spool of cable and RJ-12 connectors on hand to make up long cable runs.

7. Throttles: Plug in throttles may be handy near the yard staging area, but plan on using radio throttles to run most of the trains. Infrared throttles are a bit difficult to use at a show, because their signals may be blocked by people and by other objects. (Radio throttles have another advantage over plug in throttles. An operator can't cause system problems by hitting the wrong buttons when he/she is not plugged into LocoNet.)

8. Extra 110 volt extension cords with multiple connectors.

9. UP-3 panels should be available to place near staging yards and other convenient areas of the layout. Play it safe and don't accept homemade multi-plug panels. An improper wiring job may go undetected. Panels are also available from Loy's Toys and Tony's Train Exchange.

10. Spare Parts: 9-volt batteries, a spare battery for the command station, RJ-12 connectors, and an assortment of cable splitters and double female connectors. Cinch-Jones jumper cables with male and female connectors at each end come in handy when joining together track lines.

11. Tools: volt/ohm meter, crimping tool for RJ-12 connectors, soldering gun and solder, assorted screwdrivers, pliers, etc.

12. Radios: Trouble shooting is much easier if the trouble shooting team has radio communication. They should be on their own channel (frequency).

Specialized Modules

Besides owning an assortment of Digitrax components, a club should consider making up cables with 14 gauge wire to distribute power to the center of modules. Perhaps the club's corner modules or other key modules can be set up with cables and other DCC equipment build into them. It might even prove expedient to permanently mount a command station and/or boosters and UP-3 panels on these modules. As interest in DCC operations grows, these modules

could have signaling and block occupancy detection devices added to them.

System Capacities

There will always be just one command station handling the entire system. The boosters will do nothing more than receive and repeat messages and provide power for the power districts. A Chief command station has these capacities:

1. It can be set to store the addresses of up to 120 locomotives

2. It can keep track of 999 throttles in its memory.

3. The command station can track the status of 999 switches and other devices controlled by DS54's or similar devices.

Final DCC Planning and Setup

1. Work with a plan of the layout showing yards, setup tracks, and other DCC lines connected to the DCC main line.

2. Verify the inventory of all available DCC equipment that can be used in the layout.

3. Update the master plan for the DCC operation showing the location of the command station, boosters, power districts, sub-power districts, radio receivers (UR91), terminal panels (UP3), and the layout of the LocoNet. This master plan should be available for reference during the show.

4. Establish a location for the sign-in table and the programming track (preferably one connected to a stand-alone computer).

5. Set up the command station. Follow the suggestions offered by the North Raleigh Area NTRAK club for setting OP codes in the command station. Listen for trouble codes. You may also refer to the manuals.

6. Check 110 volt lines before you plug into them. There should be no reversed wiring and a good ground.

7. Make sure that the track you are about to connect to the DCC command station is electrically isolated from other systems (DC).

8. As you check the DCC trackwork for power district and sub-power district gaps, add tags to the Cinch-Jones plugs to indicate that they will be left open to create gaps. If the connecting tracks are not yet in place, leave a reminder note that indicates that insulated rail joiners should be used on the DCC track(s). This will go a long way towards avoiding problems created by well-intentioned helpers who aren't knowledgeable about the DCC operation.

9. Connect the command station to its power district (the track). Test run a locomotive (use a non-radio throttle at first). Undoubtedly, you will encounter dirty track. (Send out the track cleaning crew.)

10. Check the track voltage at the extreme ends of the sub-power district. The "dime test" is a good way to test for low voltages since it puts a load on the system. A helper will come in handy here to listen to or observe the command station or the power shield/PM4 response to the test. If you are using 14 gauge feeder wires, no problems should arise.

11. Start to build the LocoNet. Test each LocoNet cable after it is plugged into the system using the Digitrax LocoNet tester. If a cable is good, four lights will go on. (A throttle should be plugged into the system.) Repair or replace defective cables on the spot. Check all outlets. Sometimes one of the outlets in a UP3 will be defective. Do not allow the LocoNet to plug back into itself. There can be many branches but never a closed loop.

12. Set up a booster. Make sure that OP codes and/or wiring modifications are made to ensure that the device is set up to operate as a booster. Perform any needed OP programming while the booster is still isolated from the LocoNet.

13. Check the power district(s) for the new booster to make sure that the tracks are still electrically isolated.

14. Connect the booster to the track. Connect the booster to the LocoNet. (Test the LocoNet output from the unused plug.) Bring the booster on line and run a test locomotive into its power district.

Try the dime test at the extremes of the new power district(s). Repeat the process (steps 11-13) to get all of the boosters on line and in operation. (Running the test locomotive into the next power district will verify that there are no polarity problems.)

15. Check with the Digitrax techie (if there is one) to determine with which access code you will operate the radio throttles on the layout. If no techie is available, survey the other Digitrax users at the show to find out which channels they are using and reach an agreement on channel usage.

Each DCC operation should have its own access code or else the NTRAK layout will pick up signals from other users. The instructions for changing the access code can be found in the command station or the radio receiver manual.

16. Connect the LocoNet to the radio receiver (UR91). The UR91 comes with a "wall wart" power supply which needs to be connected to the UR91 and plugged into a 110 volt line. It is a good idea to place the UR91 in an elevated position above the height of the sky boards. Test radio throttles in different locations around the layout to make sure that there are no dead zones. If necessary add a second radio receiver. (Make sure it is set to the same access code as the first one.)

17. Make sure that all electrical devices connected to the LocoNet are powered by plug-in transformers or by fresh batteries. Don't give out throttles or allow operators to use their own throttles if they have weak batteries.

18. Set up sign-up sheets and devise a system for assigning locomotive addresses. An erasable board works well for tracking addresses in use.

19. Make arrangements to staff the DCC operation: a dispatcher and troubleshooter are needed as a minimum.

20. Set up a separate command station completely isolated from the layout to use with a programming track. Strange things can happen when the wrong buttons are pushed while programming, and it is safer to keep this operation isolated from the rest of the layout. A computer with DCC programming software can enhance the programming and testing of locomotives.

21. Let it be known that no modifications will be made to the DCC system without the approval of the person in charge of DCC operations at that time. Modifications to the system will be noted on the master DCC layout plan.

22. For multiple day shows, the command station should be reset (OP codes) at the start of each day. Follow the North Raleigh club manual or the command station manual for this procedure. (Most of the time only OP 39 will be set to closed.)

Controlling the Operation

It won't take long to bring down a DCC operation if the users are not given proper instruction and a set of procedures to follow. Anyone who wants to take a train out should:

1. Sign in and be given ID codes for their locomotives. A programming track should be available to check addresses and to assign new addresses as needed.

2. Be given necessary instruction in DCC basics if needed. This can be done individually or in a clinic prior to the show.

3. Understand that they have to remove consists and dispatch locomotives when they are finished running.

4. Follow a systematic procedure for trouble shooting.

Trouble Shooting

Follow systematic steps to ensure that the system is brought back on line with the least delay.

Here are some problems that may arise and ways to solve them:

1. One sub-power district is down. Check for shorts (look at the power shield or PM-4 for indications). Is there a short at a switch? Check the booster.

2. Check LocoNet connections. Go to the last device connected to each branch of the LocoNet and test the LocoNet network.

3. The entire system is down. Check to see if the command station is still on line. Reset if needed.

Disconnect the LocoNet at the command station and see if its power district comes back on line.

Break up the LocoNet connection to each booster, and reconnect them one at a time checking the status of each power district.

4. Shut down the command station and restart it.

5. Isolate the command station and reset the OP codes.

DCC Inventory

Chief DCS 100
Booster, DB 150, DB 100+
Big Boy (booster)
Radio Receiver UR91
Radio Throttle DT 100R
Throttle non-radio (DT 100)
Throttle UT-1
Plug In Panel UP-3
Power Shields/PM4's
LocoNet Cables
Feeder Cables

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Sample Wiring Plan for DCC on NTRAK Layout