North American T-TRAK Organization

Application Note

Digital Command Control (DCC) for T-TRAK Layouts

September 6, 2019

Originally designed for DC (analog) control, T-TRAK layouts have evolved to wireless Digital Command Control (DCC). Trains are operated today on T-TRAK layouts with both DC and DCC active on the same layout, with only DC or with only DCC control.

Digital Command Control System

Since most clubs with T-TRAK modules also have NTRAK modules the default DCC system for T-TRAK is usually the same system used for NTRAK layouts — the Digitrax Digital Command Control System. The remainder of this document will be directed specifically to the Digitrax system, although most information will be applicable to any brand of DCC system.

Track Bus

Much effort has been applied to specifying the track bus for the successful design, setup and operation of NTRAK layouts. The NTRAK track bus concept using Powerpole connectors and 12ga bus wire is the basis for the T-TRAK track bus specification. Uniformity with NTRAK allows power supplies/boosters and cables to be easily interchanged between T-TRAK and NTRAK and allows a Club to use the same parts for both modular formats.

In NTRAK, each track (red / yellow / blue / green, etc.) has its own track bus. This concept can also be applied to the two T-TRAK mainlines (red / yellow). However, since T-TRAK layouts tend to be much smaller and less complex than NTRAK layouts, for many applications a single track bus will meet the layout needs. Following are the rules for the number of track buses needed:

- If both tracks are DCC-only powered, then one track bus may be sufficient.
- If one track is DC powered and the other is DCC powered, then each track must have its own track bus.
- If both tracks are DC powered and each track is to be controlled separately from DC power packs then each track must have its own track bus.
- Any track that will be switched from DC to DCC or vice-versa during a show will require its own track bus, i.e. two buses total.

The track bus design for T-TRAK specified in this document provides the flexibility for clubs to use either a single track bus or one track bus per mainline as they deem necessary for their layout configuration. The track bus design can also be used for DC-controlled layouts.

The overall track bus consists of two components:

- The **Track Bus** — the main bus under the modules, which connects to other track bus sections and track feeder bus sections, and to the DCC Booster or DC powerpack.
- The **Track Bus Feeder**— a short bus section with blue/white pigtail leads to a Tamiya female connector, which connects to the module track feeder.

Detailed information, specifications, instructions on how to construct, and where to purchase Track Buses and Track Bus Feeders are provided in an Application Note: T-TRAK Bus, available on the t-trak.org web site.

Electrical Rating for Kato Unitrack

Kato electrically rates its Unitrack product line at 12V and 3A, i.e. 36 watts. The reliable rail connections provided by the UniJoiner ensure the DCC signal is dependably transmitted.

The 3A current limit means that a Power Manager (PM), set to trip at 3A maximum, must be placed between any Booster and the track if the Booster outputs 3A or more, and is recommended even when the output is less than 3A.

Command Stations and Boosters for T-TRAK Layouts

The table below lists the various Digitrax Command Station/Boosters (CS/B) and Boosters (B), indicating whether a Power Manager (PM) is required:

Designation	Model	Type	Output	PM Required	PM Setting	Memory Slots
Zephyr	DCS50	CS/B	2.5A	Recommended	3A Max	10
Zephyr Extra	DCS51	CS/B	3.0A	Recommended	3A Max	20
Zephyr Express	DCS52	CS/B	3.0A	Recommended	3A Max	20
Chief	DCS100	CS/B	5.0A	Yes	3A Max	22 or 120
Chief	DCS200	CS/B	8.0A	Yes	3A Max	22 or 120
Evolution	DCS210	CS/B	5/8A	Yes	3A Max	100
Advanced	DCS240	CS/B	5/8A	Yes	3A Max	120 or 400
DB100	DB100	B	5.0A	Yes	3A Max	n/a
Empire Builder	DB150	CS/B	5.0A	Yes	3A Max	22
DB200	DB200	B	8.0A	Yes	3A Max	n/a
DB210	DB210	B	3/5/8A	Yes	3A Max	n/a
DB220	DB220	2x B	2x 3/5/8A	Yes	3A Max	n/a

Important Note: N Scalers often connect 5A Boosters directly to the track without a Power Manager. **Do not do this with T-TRAK**. A 5A Booster at 12V is 60 watts, which significantly exceeds the safe rating for Kato Unitrack. A short circuit may not only damage a locomotive or other rolling stock, but it can also damage the track as the heat may melt or distort the plastic base.

Suitable Power Managers are the PM42 from Digitrax and the DCC Specialties PSX Power Managers, or equivalent. The PM42 can be set to 1.5A minimum, and the PSX can be set to 1.27A minimum. The PM42 has an advantage in that it can be connected to LocoNet and its trip current can be set using JMRI or LocoNet Checker software loaded on a computer connected to LocoNet via a LocoBuffer or PR3/PR4 (see later section). Note that PR3/PR4 interfaces are built into the DCS52, DCS210 and DCS240 Command Station/Boosters.

For many smaller and less complex T-TRAK layouts the Zephyr, Zephyr Extra and Zephyr Express Command Station/Boosters provide sufficient capacity to operate the layout. Of the three, the Zephyr Extra and Express provide 3.0 Amps and 20 memory slots vs. the Zephyr at 2.5 Amps and 10 memory slots and is recommended.

Memory slot management is important for T-TRAK layouts just as it is for larger NTRAK layouts, especially if using a DCS50, DCS51, DCS52 or DB150 as the Command Station. Operators should be encouraged to un-consist their consists, set the locomotive speed to “0”, and Release their locomotives after they are finished operating on the layout.

Connecting Power Supplies to the Track Bus

A modified version of the Track Bus Feeder is used to connect the track bus(es) to the layout power supplies, whether a DCC Booster or a DC powerpack. The design is identical to the track Bus Feeder except the feeder cable has the appropriate gauge wire and connectors for the power supply.

The Whole Picture

The following diagram shows how everything fits together for a single Track Bus in terms of the power supply, the track bus, the track feeder bus with the connection to the module.

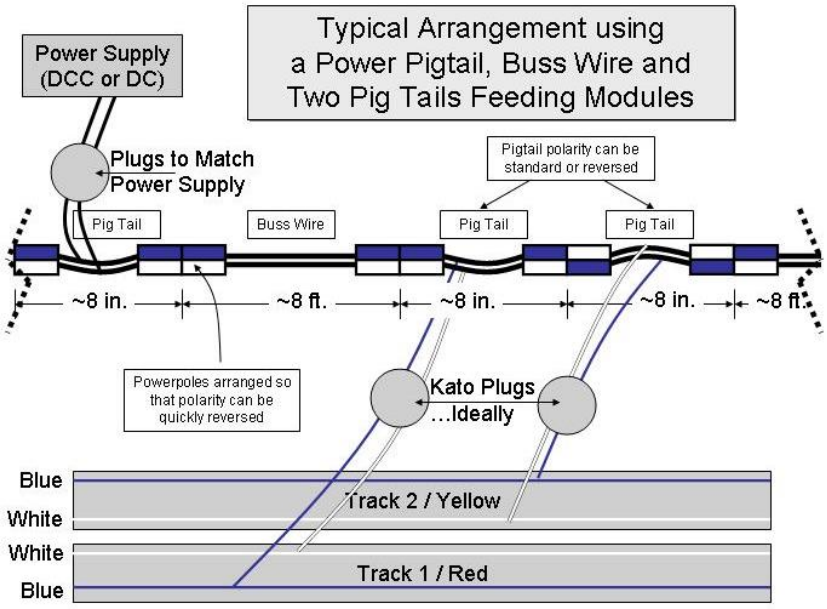

Diagram: Steve Jackson, NVNTRAK

Note that following the configuration described here means that loops (Balloon modules) and wyes will require reversing sections.

Example of a Command Station/Booster Configuration for T-TRAK Layouts

The photograph below shows a basic Command Station/Booster configuration that can be used for a T-TRAK layout.

- Base is ¼" plywood 8½" x 11" on ½" x ½" frame.
- Digitrax Zephyr Extra DCS51 Command Station/Booster, 3A, 20 slots with Digitrax PS314 Power Supply (both secured to base with Velcro)
- RR-CirKits 6p6c-5 Five outlet 6-wire LocoNet connector plugged into LocoNet Jack A on Zephyr Extra.
- DCC Specialties PSX Circuit Breaker connected to Zephyr Extra Track A and B.
- Outputs using Powerpole connectors for Program Track (Red/Black) and Track Bus (Purple/Black
- Digitrax UR92 Duplex Radio Transceiver. Front panel removed and mounted above PSX breaker using brackets. Powered by external Digitrax PS14 power supply. Rear LocoNet jack connected to LocoNet Jack B on Zephyr Extra.

The physical size of the mounting board was chosen to be the same as a standard sheet of paper (8½" x 11") for ease of transport in containers such as a banker's box.

Electrical Districts

When the current (ampere) requirements of a T-TRAK layout exceed the capacity of a single DCC Booster the layout must be split into two or more electrical districts, just as is done with NTRAK layouts. Each district will have its own Booster (or section of a Power Manager). The electrical district boundary will feature the following:

- Standard UniJoiners will be replaced with Insulated UniJoiners.

- The Track Bus connectors will not be plugged up underneath the modules on each side of the boundary.
- The Boosters will be located in approximately the geographical center of their electrical district.
- LocoNet cables will be run from the Command Station to the Booster(s).
- Booster common cables will be run between Boosters and the Command Station

Sharing a LocoNet between NTRAK and T-TRAK Layouts

Where a club's NTRAK and T-TRAK layouts are located in close proximity it can be advantageous to use a single Command Station for both layouts and run a LocoNet cable (e.g. duct-taped to the floor) between the two layouts. The Command Station/Booster (e.g. DCS51) that would normally power the T-TRAK layout would be set to Booster only (OpSw #2 = "c"). This configuration enables ease of transfer of locomotives and throttles between the layouts; you don't need to plug in the throttle or reacquire the locomotives.

Wireless Throttles for T-TRAK Layouts

Since most T-TRAK layouts can be viewed from both sides of the banquet tables only wireless throttles should be used on T-TRAK layouts at train shows. This will keep throttle cables away from the space that could be occupied by spectators. T-TRAK layouts should provide the ability to use Digitrax wireless throttles, and the ability to utilize the JMRI WiThrottle tool for iPhones, iPads and iPods, and Android tablets and phones.

Digitrax Wireless Throttles

Provision must be made for operators who use Digitrax wireless throttles, both simplex and duplex. This is accommodated through the use of UR91 Radio receivers for simplex throttles and UR92 Duplex Radio Transceivers for duplex throttles, both of which will require a LocoNet connection to the LocoNet network and 14VDC power (PS14 or equivalent).

For the vast majority of T-TRAK layouts a single UR91 and/or UR92 will suffice. The UR91/UR92 units should be mounted as high as possible, at least five (5) feet above the table to ensure best signal reception/transmission. The mounting can be a pole that is clamped to the edge of a table or a stand that can be mounted on a table. The UR91/UR92 tower should be located in approximately the geographical center of the layout.

Both a UR91 and UR92 can be mounted one above the other (UR91 on top) on the same pole or stand, leaving about 3" between them vertically, and both can be powered from a single power supply. Jumper wires can be run from the UR92 to the UR91 to provide power to the UR91.

Both the UR91 and UR92 must be connected to LocoNet. Connect a short LocoNet cable from the UR91 to the UR92, and then connect a cable of sufficient length to connect the UR92 down the pole or stand to the nearest LocoNet connection.

JMRI WiThrottle

Provision should be made for a computer running the JMRI suite to be connected to the Command Station (via a LocoBuffer, PR3 or PR4) and to a wireless router so that the WiThrottle application can be used to permit operators with an iPhone, iPad or iPod Touch device to control their train using the iOS WiThrottle App, and operators with an Android device to use the Android Engine Drive App.

Computer Control & Monitoring

Computer control and monitoring of a T-TRAK layout consists of a computer running JMRI software and interfaced to the Command Station via a Digitrax PR3, PR4 or RR-CirKits LocoBuffer. While many T-TRAK layouts will probably not need computer monitoring and control, it can be very useful for tasks such as setting the LocoNet ID and Duplex Group Name and Channel, setting PM42 trip current, and monitoring the slots. Slot monitoring is especially useful if the Command Station is a DCS50, DCS51, DCS52 or DB150 with their limited number of slots.

Booster Common (Grounding)

A “DCC Common” should be provided between DCC system components to provide an internal voltage reference point for proper operation. Although often (incorrectly) referred to as a “ground”, there is no functional need to also connect it to an external ground. In Digitrax DCC systems, DCC Common may be provided on LocoNet wires 2 and 5, although a separate, heavier (14ga) common wire is recommended. The “common” is connected to the “Gnd” terminals on Boosters, etc.

The prime purpose of “grounding” the various DCC components, as described, is to provide smooth transition of locomotives across the double insulated gaps in the track that separate two electrical districts and prevent the possibility of voltage doubling between Boosters which can damage decoders. It also provides more stable operation of the Boosters.

LocoNet Distribution for T-TRAK Layouts

If desired, Universal Panels (UP3, UP5, others) can be mounted on the front side (fascia) of T-TRAK modules, especially corner modules, for the distribution of LocoNet around the layout, where needed.

T-TRAK modules are usually placed on standard hotel-style 30” x 8’ or 30” x 6’ banquet tables, which can be made of wood or plastic. All these tables have a lip around the edges, to which Universal Panels (UP) can be attached. Clamps can be used for this purpose; screws should not be used to fasten Universal panels to banquet tables.

Either C-clamps or spring clamps can be used to fasten the UPs, although spring clamps are easier to use.

UPs where used should be located in the center of the tables supporting the modules, on each side, as this will provide for easy access by operators. Thus a length of 9 – 10 feet will be about right for LocoNet cables going between tables, and about 33” for cables going from the UP on one edge of each table to the other edge of the same table.

Some unique length cables may be required for special needs such as radio receivers/transceivers, etc.

It is unlikely that a T-TRAK layout will be so complex that the LocoNet would have to be broken down into a separate ThrottleNet and ProtectedNet as may be required with NTRAK layouts. A single LocoNet running from the Command Station to all DCC devices should suffice. Should circumstances indicate a need for separate LocoNets the same guidelines as for NTRAK layouts apply.

References

- Documentation from T-TRAK official web site at http://www.t-trak.org and NTRAK Newsletters.
- Email communications with several people.
- Glenn McLain & Steve Jackson, Northern Virginia NTRAK, “T-TRAK Powerpole Bus Wires”
- Paul Musselman, “The Unofficial T-TRAK Handbook”, at http://T-TrakHandbook.com
- Kato Unitrack information from Kato official web site at http://www.katousa.com.
- Wiring for DCC, Alan Gartner at http://wiringfordcc.com.
- T-TRAK Email list at Yahoo Groups
- Digitrax-Users Email list at groups.io
- JMRI Users Email list at Yahoo Groups
- Kato Unitrack Email list at Yahoo Groups

Source

This Application Note originated with the North Raleigh Model Railroad Club and has been used and modified with their permission.

Comments, questions, corrections and suggestions should be addressed to the T-TRAK Standards Committee at info@ntrak.org.