T-TRAK™ N-Scale Modular Railroading

North American T-TRAK Organization

Tips N SCALE Techniques

Digital Command Control (DCC) for T-TRAK Layouts

June 15, 2020

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.

Note that this TipsNTechniques applies to T-TRAK layouts, and not individual T-TRAK modules, which are wired according to the Blue-White-White-Blue (BWWB) standard. See the standards document on the web site.

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 12-gauge 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.

Bus Wire Fundamentals

Track buses should be constructed in 2-foot, 4 foot and 8 to 10 foot lengths of 12 gauge zip wire with Anderson Powerpole connectors on each end. The intent is to provide sufficient length so that the junction between track bus wires falls under the corner modules in the layout, plus the shorter lengths allow connecting power to any other modules with track feeders.

The color coding for the track bus will be the following:

- DCC Rail "A" = Kato white wire = NTRAK red wire (ribbed wire)
- DCC Rail "B" = Kato blue wire = NTRAK black wire

Track Bus Connectors

The track bus connectors to be used for T-TRAK layouts are the 30 Amp Anderson Powerpole connectors, the same connectors specified in the 2011 NTRAK Electrical Standard. The connector shell colors shall be blue and white.

For layouts that normally use one track bus per mainline the Powerpole connector shells could be red/white and yellow/white.

Connectors in Europe and Australia

Many T-TRAK modelers in Europe and Australia have adopted RCA jacks and plugs instead of Kato/Tamiya and Powerpole connectors. RCA twin sockets are mounted on the module backboard or equivalent. The White RCA socket is connected to the Front track and the Red socket is connected to the Back track. For each socket, the Inner pin connects to the Inner rail and the Outer skirt connects to the Outer rail. For more information refer to the "Australian T-TRAK-N Guidelines".

Track Bus Design

Each track bus must be 12-gauge stranded copper zip wire (red/black zip wire, outdoor low-voltage lighting wire or speaker wire), or equivalent. This wire has a thin section between the two wires and can be "zipped" apart. One side of the covering has a rib molded along its length; connect the ribbed wire (or red wire in the case of red/black zip wire) to the white connector at the end of each bus.

The lengths of the bus wire are to be 2 feet, 4 feet and 8 – 10 feet.

Each bus will be connected to the next bus using Anderson PP30 30 Amp Powerpole connectors at

each end of the bus. The following table is a summary of the Powerpole configuration.

Single Bus	Right	Vertical	Blue over White
	Left	Vertical	White over Blue
Red Track	Right	Vertical	Red over White
	Left	Vertical	White over Red
Yellow Track	Right	Vertical	Yellow over White
	Left	Vertical	White over Yellow

The Powerpole housings are to be stacked *vertically* using the built-in dovetails, hood up, tongue down, *white over blue* on the left end of the cable and *blue over white* on the *right* end.

An example of a track bus cable is shown in the photograph.

Track Bus Feeder Connectors

The connectors used for track feeders must be compatible with the connectors provided by Kato with their Unitrack line. These connectors are Mini-Tamiya connectors The Mini-Tamiya connectors are correctly referred to as Tamiya/Kyosho connectors. The Tamiya connector is the female housing with male pins. The Kyosho connector is the male housing with female pins and the clip tab that holds it to the Tamiya connector. Kato uses these connectors with a 22-gauge blue/white wire pair for track power, and a red/black wire pair for turnouts.

Following is ordering information:

- Male/Female set with two housings and pins for one Tamiya and one Kyosho connector: Cat. No. 2913
- Male (Kyosho) connector with female pins and clip tab: Cat. No. 2914
- Female (Tamiya) connector with male pins: Cat. No. 2917

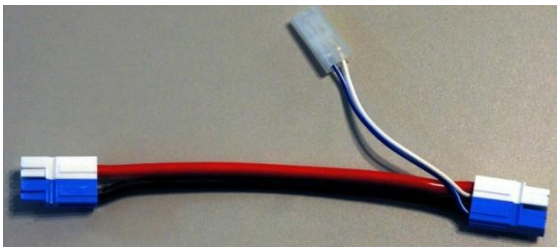
The pins require a standard Molex type crimp tool capable of crimping .062" diameter pins, such as the GC/Waldorm W-HT-1921. These connectors can be ordered from Maxx Products at http://www.maxxprod.com/, and other suppliers.

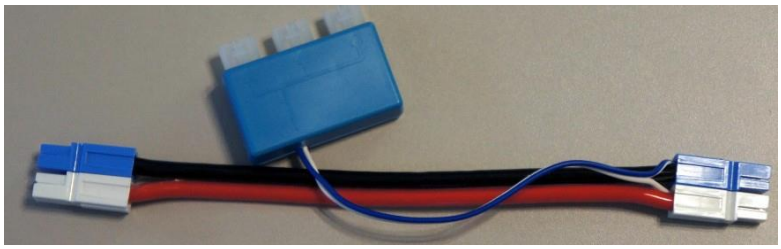
The Tamiya (female) connector (Cat. No 2917) is the connector used on the Track Bus Feeder pigtail. (The Kyosho 2914 male housing with clip connector and female pins attaches to the Track wire coming from the track feeder sections or terminal UniJoiners.) The blue wire goes to the square opening and the white wire to the round opening on the 2917 connector.

Track Bus Feeder Design

The track bus feeder is a short (6" – 8") pigtail bus constructed just like a normal track bus, but with a feeder cable connected to the Powerpole connectors at the blue over white end. When inserted between two Track Bus cables in correct polarity orientation this cable provides power feed to the Red track. When inserted between two Track Bus cables in the reverse polarity orientation this cable provides power feed to the Yellow track yet keeps both the Red and Yellow tracks with the same polarity for successful DCC control and operation.

A track bus feeder with pigtail is shown at left below. The photo on the right shows track bus feeder with the Kato 3-way connector to connect to multiple module track feeders.





The Track Bus Feeders shown can be used in layout with either a single Track Bus or one Track Bus per track.

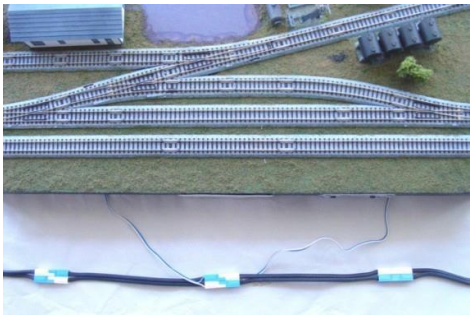
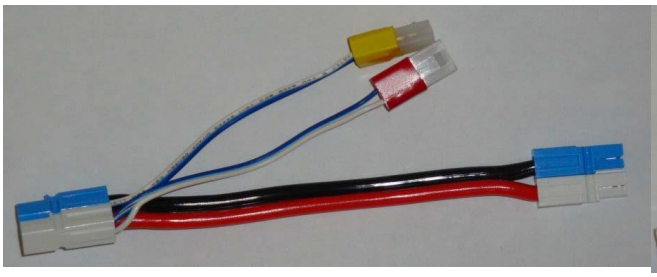


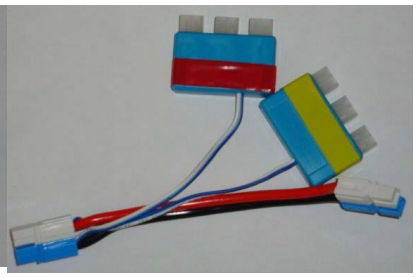
Diagram: Steve Jackson, NVNTRAK

This last photo shows the connection of the track bus feeders reversed to permit changing the blue-white-white-blue to blue-white-blue-white needed for single bus DCC control and operation.

The following track bus feeders can be used with a single Track Bus only.



Track Bus Feeder with Color-coded Pigtails for Red and Yellow Tracks



Track Bus Feeder with Kato 3-Way Connectors

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.

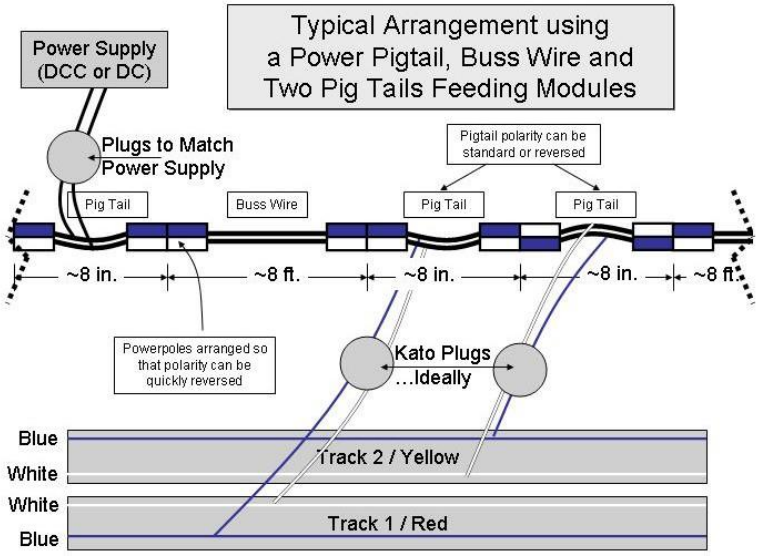


Diagram: Steve Jackson, NVNTRAK

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

Accessory Bus

Some T-TRAK modules will include operating accessories (such as building and streetlights, animated scenes, etc.) that require low voltage power to operate. Rather than having individual power supplies such as wall-warts it is recommended to run an Accessory Bus parallel to the Track Bus(es), color coded and configured as shown in the table.

Application	End	Stackin	Configuration
Accessory Bus	Right	Horizontal	Brown on left, black on right (viewed from contact end)
	Left	Horizontal	

It is recommended that the Accessory Bus be powered from a 15 VAC 5 Amp supply, such as a Digitrax PS515 or equivalent. For modules that need DC a bridge rectifier circuit should be placed on the module in the Accessory Bus Feeder. Voltage regulators should be mounted on the module(s) as required to provide the correct voltage to specific accessories.

Accessory Bus Feeder

The Accessory Bus Feeder will follow the design of the Track Bus Feeder, i.e. a short (6" – 8") pigtail bus constructed just like a normal accessory bus, but with a feeder cable connected to the Powerpole connectors at one end. It is the responsibility of the module owner to provide the Accessory Bus Feeders for their module(s) with appropriate connectors, voltage regulators and/or bridge rectifiers mounted to the bottom of the module at the module end of the pigtail cable.

Turnout Control with DCC Accessory Decoders

Kato Unitrack turnouts can be controlled with DCC accessory decoders. These include the following Digitrax accessory decoders: DS51K1, DS52 and DS64. Accessory decoders from other manufacturers can also be used. All accessory decoders can receive their commands from a connection to DCC track power. For T-TRAK modules it is recommended that any accessory decoders receive their track power from the Red track. Doing this has two requirements:

- The Red track must be DCC powered.
- If there is any chance the Red track could be DC powered then a DPST switch must be inserted in the leads between the accessory decoder(s) and the Red track so the connection can be broken when the Red track is DC powered. DC power will damage the accessory decoder.

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).

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 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 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 are 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.

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.

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"), and the NTRAK Command Station would be the Command Station for the whole complex.. This configuration enables ease of transfer of locomotives and throttles between the layouts; you do not 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.

An economical approach to providing WiThrottle is the use of a low-cost Raspberry Pi computer running JMRI. This approach is described in another TipsNTechniques.

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.

As above, a Raspberry Pi computer with added monitor, keyboard and mouse can be used for this purpose.

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 (14 gauge) 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 groups.io
- Digitrax-Users Email list at groups.io
- JMRI Users Email list at groups.io
- Kato Unitrack Email list at groups.io

Source

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