VPEB Van Perlo Elektronica & Besturingstechniek

DINAMO Plug & Play

Manual

Smart electronics for your miniature world

Author: Leon J.A. van Perlo
Version: 1.2
Date: December 21st, 2017

Release Management

This manual applies to the kit consisting of:

Module:

- RM-C/1+ Rev00/01
- TM44 Rev01
- OC32/NG Rev10

If you have an RM-U P&P and/or an OC32 (not /NG version) please refer to version 1.1 of this manual for the hardware description of the respective parts. You can however use all firmware and software described in this manual version 1.2.

Firmware:

- RM-C Firmware 1.30A
- TM44 Firmware 1.20
- OC32 Firmware 3.01

Software:

- DinamoConfig 1.30A
- OC32Config 3.01

Preface

The Dinamo Control System is a versatile solution to control analogue trains, digital trains, digital cars and all accessories on your miniature world in scale 00 (1:67.2) to scale Z (1:220) including all intermediate scales. Application of Dinamo with larger scales is possible, however some limitations may apply.

The versatility of Dinamo may confuse less electronic mind users. For this reason VPEB released Plug&Play. In this version, the number of different types of modules and the possible choices are reduced in favor of clarity and simplicity. Dinamo P&P is in contrast to Dinamo "Classic" **not** suited for application with larger scales than H0/00 (and so primarily intended for scales from 00 to Z).

This manual describes strictly the Dinamo Plug&Play concept and its application for the operation of trains for the novice user as simply as possible. Dinamo P&P can be enhanced with additional modules from the Dinamo "Classic" range e.g. the UCCI/E-s for controlling of digital cars. There are also other choices not described in this manual that are possible, however these are outside the scope of this manual. The user is advised to refer to the individual manuals for the other modules for in-depth details.

Even though the application of Dinamo P&P has been significantly simplified compared to the "Classic" version, before you apply this to your final model layout it is important to understand the principles and to understand how the software and Dinamo system cooperate with each other. Creating a temporary simple test layout has proven to be very effective way to learn and most of the items can be reused afterwards in your final layout.

©2017 This document, or any information contained herein, may not be copied or distributed, in whole or in parts, in whatever form, without the explicit written approval of the original author. The making of copies and prints by users of the Dinamo system and/or Dinamo modules for their own use is allowed.

Contents

1 Dinamo 4
1.1 Principle 4
1.2 Blocks and sections 4
1.3 Dinamo Plug & Play 5
2 RM-C/1+ 7
2.1 Introduction 7
2.2 Communication, power supply and mounting 7
2.3 LED indicators 7
2.4 PC Connection 7
2.5 Testing using DinamoConfig (Windows) and learn some of the basics 8
3 TM44 11
3.1 Functions 11
3.2 Overview of the TM44 and location of connections and functions 11
3.3 Mounting 12
3.4 Connect Power Supply to the TM44 12
3.5 Capacity and Choice of Power Supply 13
3.6 Safety 13
3.7 Power Supply Cabling 13
3.8 Connecting Blocks to the TM44 14
3.9 Cabling of Blocks 14
4 OC32/NG 16
4.1 Introduction 16
4.2 Overview of the OC32/NG and location of connections and functions 17
4.3 Mounting the OC32/NG 17
4.4 OC32/NG Power Supply 18
5 The Dinamo RS485 network 19
5.1 Wiring the network 19
5.2 Terminators 20
5.3 Addressing 22
5.3.1 TM44 Addressing 22
5.3.2 TM44 Master/Slave 23
5.3.3 OC32 Adressing 23
5.3.4 Changing Addresses 24
6 Commissioning your Dinamo system 25
6.1 Power-up your system 25
6.2 Testing communication 25
6.3 Some additional words on DinamoConfig 27
6.4 Configuring your OC32/NG's 27
7 Turnouts 28
7.1 Provide track power to turnouts 28
7.2 Turnout groups, Block Separations, Section Separations 28
7.3 Addtitional Pseudo-blocks 29
7.4 Delivering Track-power to Turnouts via Relays 30
Appendix A: TM44 Address Table 31

1 Dinamo

1.1 Principle

The control-principle of Dinamo is derived from the way train-traffic is usually secured: By means of a block-system. The block-system means that the layout is subdivided into blocks. A train may enter a block only when the block is free. This means any block can contain no more than a single train.

When using Dinamo, the layout is not only divided into blocks security-wise, but also every block has it's individual electrical power circuit. Since every block can contain no more than a single train, in this setup every train can be controlled individually as that specific train requires at that specific moment. With Dinamo this applies to digital (DCC) AND analogue trains.

To determine in what way every block needs to be driven, at every moment it must be known which train is in which block. In practice this is achieved using control software on a PC that keeps track of the positions of all trains on the layout. So the control software not only secures the traffic, but at the same time ensures the most optimal control of every train. In theory Dinamo can function without a PC, but in practice it is hardly ever done.

To be clear: Controlling your layout by PC does not mean by definition everything runs automatically. It is perfectly possible to control your layout by a PC and still make many decisions yourself or even control trains "manually" and individually. Many digital control systems on the market are nothing more or less than specialised computers with specialised software. In case of Dinamo this is no different, just the control unit is not a specialised "box", but any ordinary PC with software.

Blocks can be connected sequentially, but also be separated by turnouts, so the train can "choose" what the next block on it's route will be. Security-wise the collection of turnouts by which the train is routed from one block to the next is never part of any block, however electrically this can be the case (see chapter 7).

In the real World, the passage between 2 blocks is secured by signals. Signals are at the exit of each block. If the next block in the route of the train is free, is reserved by that train and the turnouts leading to the destination Block is free and safe, the signalling system will allow the train to pass on.

1.2 Blocks and sections

Dinamo drives blocks individually and symmetrically. Symmetric means that both tracks are driven with an identical but exactly opposite electrical signal. So there is no track having zero voltage or "ground". Consequently Dinamo demands that every block has its both tracks electrically separated from the surrounding blocks. In other words, between two blocks both rails shall be electrically separated.

To control trains on the layout by software, it is necessary that the software is aware of the position of the trains. Usually it is insufficient to know just in which block the train is. In addition the software needs to know where in the block the train is. To achieve that, blocks are split in sections. The precise split in sections depends mainly on the requirements of the software, so for details you should consult the manual of your control software.

Dinamo P&P provides 4 sections per block. It is not necessary to use all of them. In most cases 2 or 3 sections per block will be sufficient. To be able to distinguish between different sections in the same block, between sections one of the rails needs to be electrically isolated.

As a result, within one block, we have a continuous rail and a non-continuous rail split into sections. Since every block offers the possibility to drive in both directions and in case we use digital (DCC) control, the signal is a square-wave alternating signal it makes no sense to talk about "plus" and "minus". Therefore Dinamo talks about the A-rail and B-rail. The A-rail always is continuous, the B-rail can be interrupted between sections. To identify the direction in which the train travels, within Dinamo the "positive direction" is the direction with the A-rail on the right hand side. To be clear: There is no need or reason to have the "positive direction" equal to the direction the train normally travels. "Positive" and "negative" directions are just names to identify in which way the train travels with respect to the A-rail and B-rail. We explicitly do not use "forward" or "reverse" because this would apply to the front and rear of the loco.
The general advise is to choose the rail in which you make the section-separations as consistently as possible without taking into account normal direction of travel.

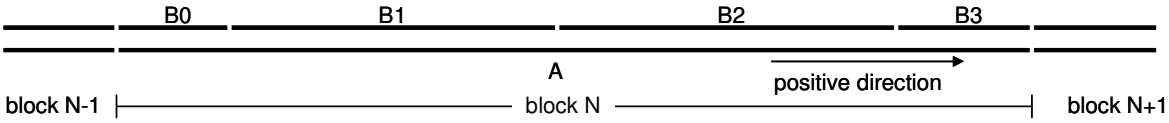


Fig 1: Subdivision of a block in a Dinamo system

1.3 Dinamo Plug & Play

Dinamo P&P consists of just 3 different modules, by which all possible parts of your layout can be controlled, including analogue trains, digital trains, turnouts, signals and many other accessories.

The modules that are part of the Plug & Play concept are:

- RM-C/1+: This module handles communication with the PC, communication to all other modules and ensures that all modules, for which this is necessary, operate fully synchronized;
- TM44: This module controls trains and reads positions by means of current detection. Each TM44 can drive 4 blocks and detects trains in 4 sections per block. Each system (RM-C) can connect up to 32 TM44 modules for a total capacity up to 128 blocks.
- OC32(/NG): This module controls turnouts, signals, decouplers, railroad crossings and virtually all other accessories you may find on your miniature world, requiring control. One system can host a maximum of 16 OC32 modules.

Schematically the topology looks as follows:

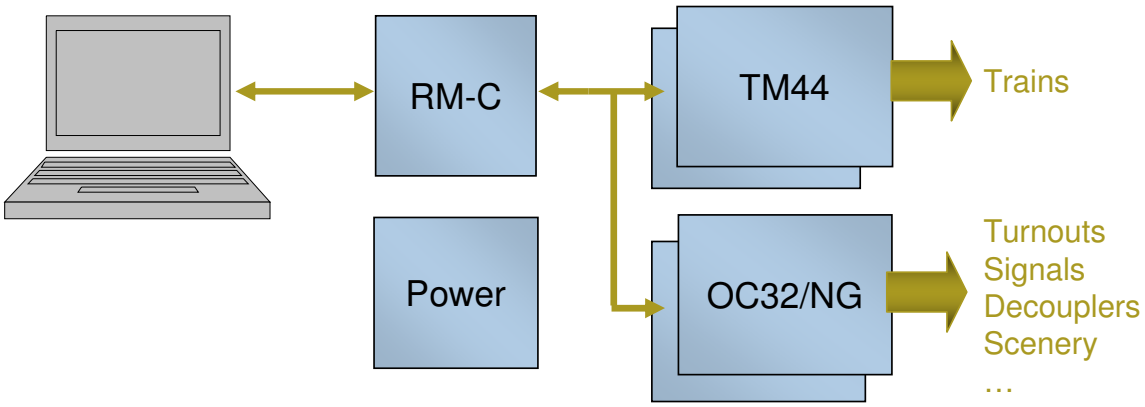


Fig 2: Dinamo P&P Diagram

The Power Supply is not part of the Dinamo P&P program and can in principle be every decently stabilized DC power supply with sufficient power. The choice of power supply is not primarily determined by Dinamo itself, but merely by what you want to control with Dinamo.

Instructions for the choice of power supply to provide your trains with the right energy, can be found in paragraph 3.5. The supply for accessories in many cases can be derived from the same power supply. In some cases however it may be wise or necessary to obtain a separate power supply for (some) accessories.

2 RM-C/1+

2.1 Introduction

The RM-C is the central unit in a Dinamo Plug & Play control system. A Dinamo P&P system can be used to control analogue/digital trains, digital cars or a combination thereof. This manual however applies to control of trains only.

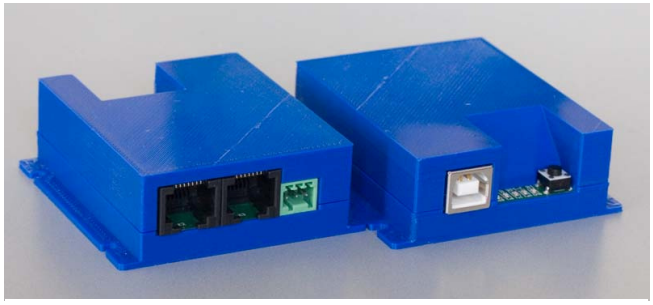


Fig 3: RM-C/1+ (2 modules shown)

The RM-C has the following main functions:

- Communicate to the PC via USB
- Handle TM44 modules to control trains
- Handle OC32(/NG) modules to control accessories (being everything except the trains themselves)

2.2 Communication, power supply and mounting

The RM-C communicates with the controlling-PC by means of USB. The power for the RM-C is supplied from the PC through the USB cable, so you won't need a separate power supply for your RM-C.

Communication with the TM44 and OC32 modules on your layout is done through RS485 (more on this in Chapter 5). RS485 is quite insensitive to electromagnetic disturbances and the (total) length of the RS485 bus can be up to 1.200 meters. USB in the contrary is much more susceptible to electromagnetic interference. Therefore, place the RM-C as close to your PC as reasonably possible and keep the length of your USB cable short.

Mount the RM-C using the four screws that come with the unit or use double-sided adhesive tape if you mount the RM-C on a surface you cannot or do not want to put screws in.

2.3 LED indicators

On the RM-C you will find 5 LED indicators. From left to right:

- USB (Blue): USB Active
- Tx0 (Yellow): Not Used on the RM-C/1+
- Tx1 (Yellow): Transmit on RS485
- TxH (Orange): Transmit on USB
- CMD (Green): Command Received

To the right you'll find a pushbutton to reset the RM-C

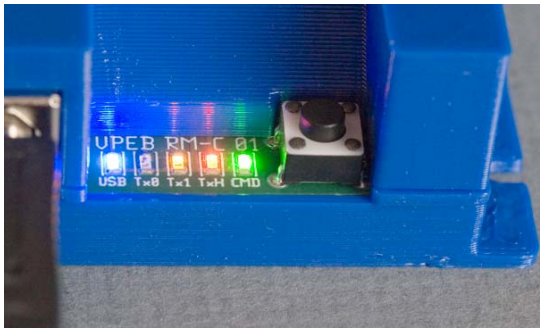


Fig 4: RM-C LEDs and Reset button

2.4 PC Connection

To use USB, of course your PC needs to be equipped with one or more USB ports. Also you'll need a driver (software) to communicate with the USB interface on your RM-C. Windows Vista and later will automatically detect and recognize the USB chip on your RM-C when it is plugged in. **If** your PC has Internet access, it will automatically download and install the correct drivers, when you plug in the interface for the first time.

If your PC has no Internet access or when using an older version of the Windows OS, **before** connecting your RM-C USB for the first time, you will have to download and install the correct driver software manually. You can download them free of charge from the Future Technology Devices website: www.ftdichip.com/Drivers/VCP.htm
Alternatively the driver can be downloaded from the Dinamo User Group although then you may not necessarily have the latest version..
The easiest way is to download and run the "setup executable for default VID and PID values".

The FTDI drivers are available from Windows98 up. Correct operation under Windows95 is not guaranteed. Besides Windows, there are drivers for Linux and Mac OS-X. The latest Linux kernels have default support for the FTDI chipset used in the USB interface.

After you have loaded the correct driver software onto your PC, or have made sure your PC has Internet access, you can connect the RM-C with a standard USB A-B cable. Preferably use one specified for USB2.0, because usually these have better screening. If all is well, your RM-C is recognized automatically and a "virtual com-port" is created for it. When the PC is connected to RM-C, the blue LED on the RM-C will be lit (during installation of the driver the LED may flash a few times).

Fig 5: RM-C USB Interface

2.5 Testing using DinamoConfig (Windows) and learn some of the basics

Testing whether your RM-C is correctly attached and recognized by your PC, can be done with the DinamoConfig test –and configuration program. DinamoConfig can be downloaded free of charge from the VPEB website (www.vpeb.nl) or the Dinamo User Group (www.dinamousers.net). Make sure you have DinamoConfig 1.30A or later.

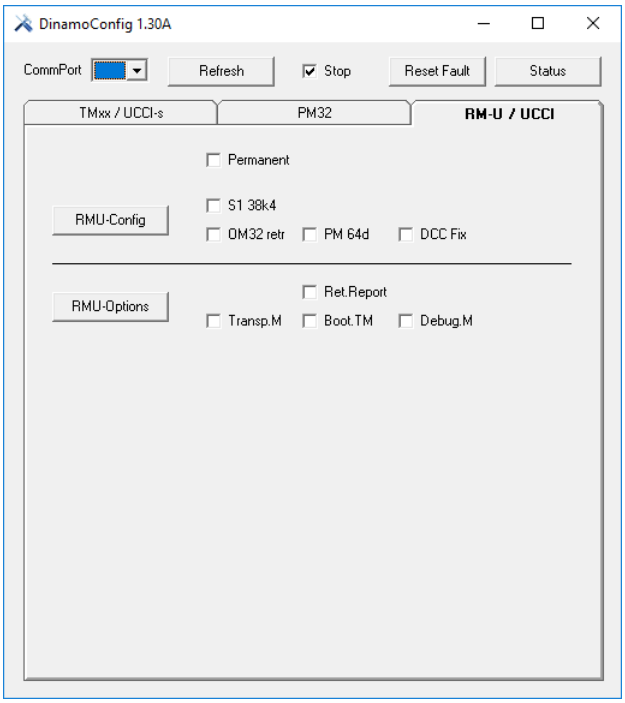


Fig 6: DinamoConfig 1.30A

Before starting DinamoConfig, the program needs to be installed. Run the "Setup" program (once) and follow the instructions. After you have successfully installed DinamoConfig, you can start the program. You should see the window in fig 6. In the top/left-hand corner you can select the com-port by which DinamoConfig communicates with your Dinamo system. Click on the triangle next the blue field and select the correct com-port. Sometimes it can be troublesome to find out which com-port is assigned to your RM-C. If this is the case, follow this procedure:
Disconnect the USB cable between RM-C and PC. Wait 5 seconds and click the "Refresh" button. Now look at the list of com-ports you can choose from and remember this, or write it down. Reconnect the RM-C to the PC. Wait 10 seconds and click "Refresh". Look again at the list of com-ports you can choose from. You will have one additional port, that's the one.

Select the correct com-port and click "Status". A window similar to the one in fig 7 will show. Because you have connected nothing else to your RM-C so far, the status of all modules will show "Not Found". In the top/left-hand corner you'll find the "Protocol Version" and "System Version" of your RM-C. This indicates your PC and RM-C can communicate.

If "System Version" shows an older version than 1.30A, update the firmware of your RM-C, otherwise a large part of this manual does not apply to your system.

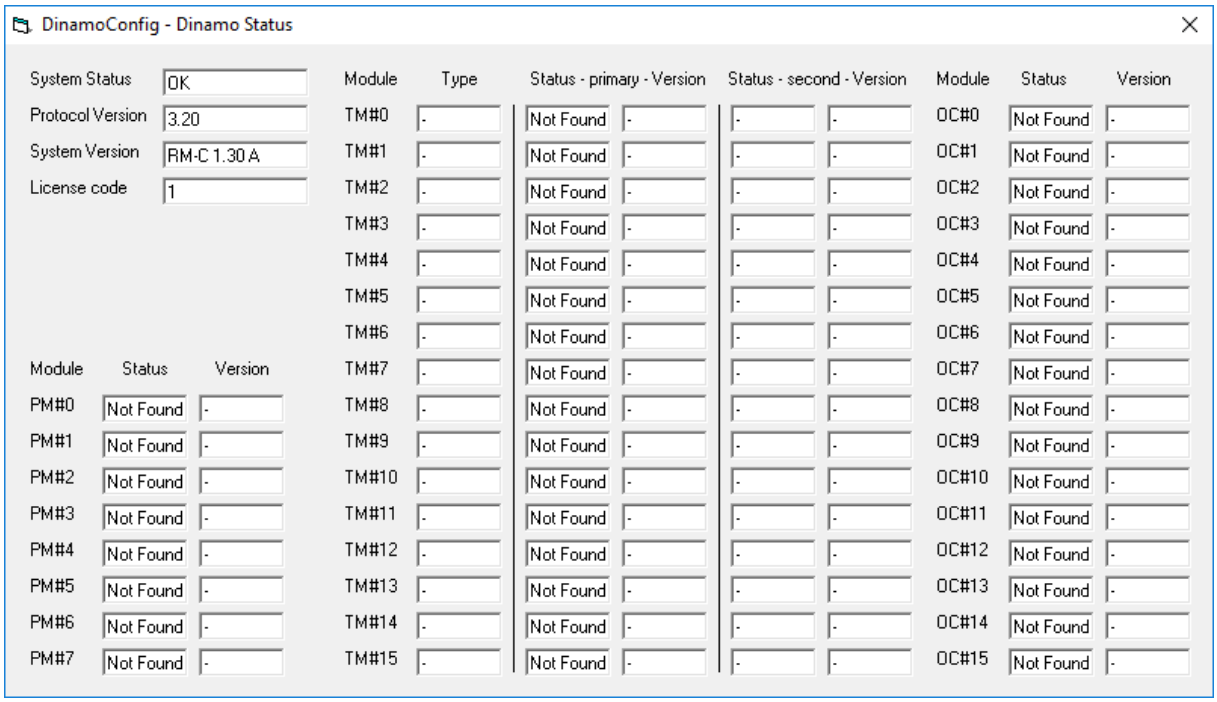


Fig 7: DinamoConfig Status Window

If "System Status" shows "Fault", there is no reason (yet) to be worried. This is part of "normal behaviour".

At this point, notice the LEDs on your RM-C:

- The blue LED should be lit to show you have USB connectivity.
- The yellow Tx1 LED is flashing quickly to indicate that the RM-C is transmitting on the RS485 bus, but it does not find anything since you have not connected any modules yet.
- The orange LED is flashing quickly to indicate the RM-C is actually interchanging messages with the DinamoConfig program on your PC. Messages are empty, but are send back and forth between the two systems to indicate all is well (or not so well in some cases).
- The green LED indicates that the RM-C is processing a command from the PC. To see this, you can press the "Status" button in the main window while watching the LEDs on your RM-C. You should see the green LED lit briefly, indicating the "Status" command is processed (actually being some 45 commands al together being executed).

While the orange LED is lit or flashing, do not disconnect your USB interface, since this will cause the virtual com-port to disappear while it is in use by the DinamoConfig program. If you want to disconnect USB, you need to stop communication first. In DinamoConfig this can be done by pressing the "Refresh" button in the main window. This will actually refresh the list of com-ports available, but the side-effect is that the active com-port is closed. Now press the "Refresh" button and see the orange LED go off. Wait (at least) 5 seconds and press "Status". You will see the window of fig 7, however "System Status" will show

“Fault”. The reason for this is that communication with the Dinamo system has been interrupted (by you) for more than 2 seconds. That caused the Dinamo system to execute a safety measure: “Stop all traffic!” If your trains (and/or cars) would be running and your PC or PC program should crash, an uncontrolled situation might occur otherwise.
The Dinamo system demands a fault state to be explicitly cleared from the PC program. DinamoConfig allows you to do that by pressing the “Reset Fault” button in the main window. If you now press the “Status” button again, your status window should show “System Status = OK”.

At the top of the DinamoConfig main window you see a tickbox “Stop”. When active, this makes sure that no traffic is running while DinamoConfig is active. The use of this function is rare and is beyond the scope of this manual.

3 TM44

3.1 Functions

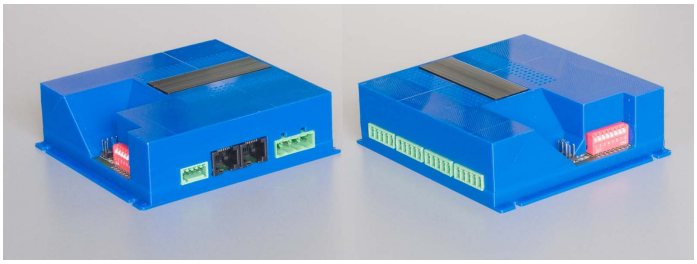


Fig 8: TM44 in enclosure (2modules shown)

The TM44 had been designed as block-control unit, to be used in a Dinamo control system and offers the following functions:

- Driving 4 independent blocks in 2-rail configuration
- Position feedback by means of current detection in 4 sections per block
- Control of trains by Pulse Width Modulation (analogue)
- Control of trains by DCC (digital)
- Integrated HF illumination for analogue loco's and trains

The TM44 is supplied as an assembled module only. Optionally the TM44 can be supplied with or without enclosure. Enclosures are also sold separately. The TM44 is part of the Dinamo Plug & Play concept.

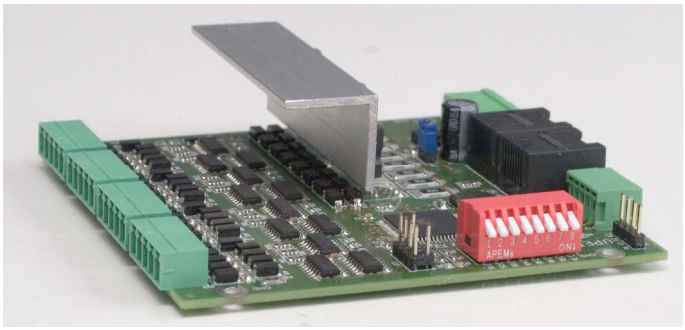


Fig 9: TM44 (bare unit)

3.2 Overview of the TM44 and location of connections and functions

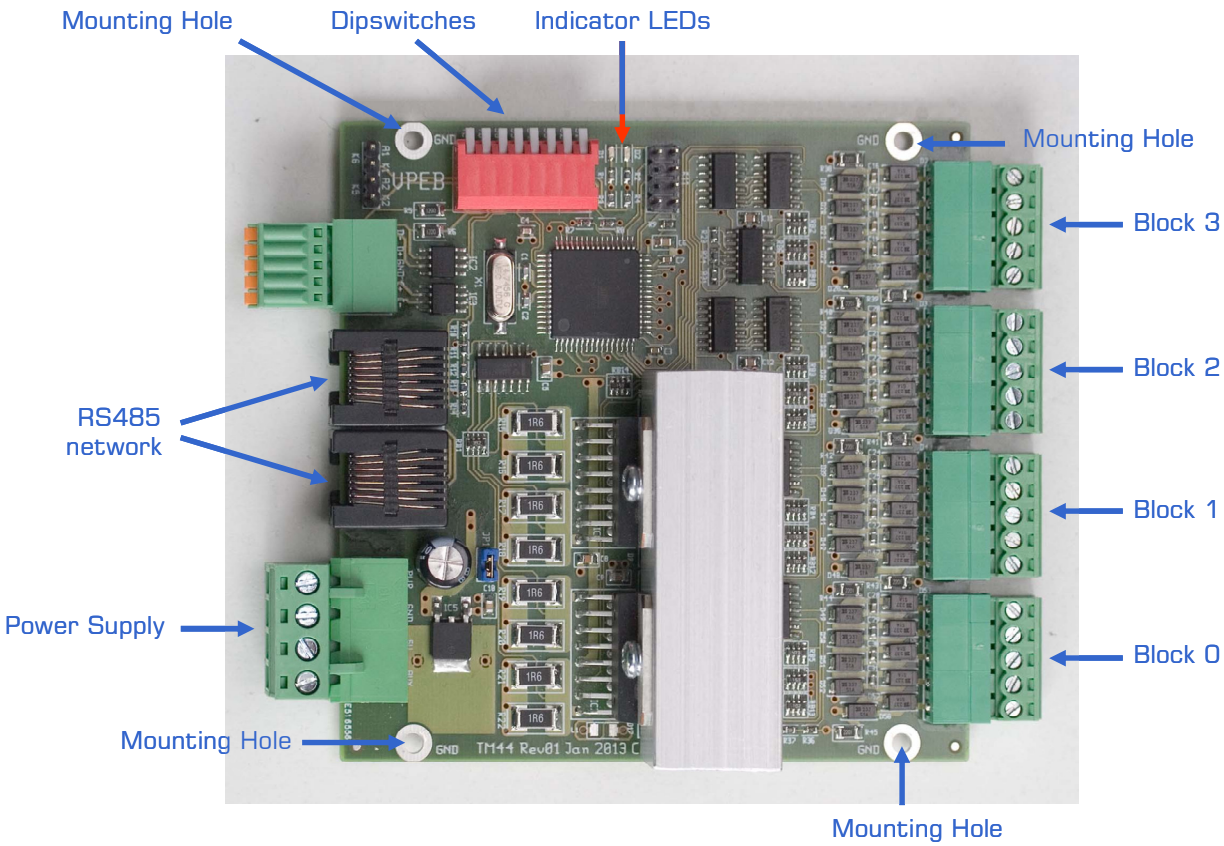


Fig 10: Overview and functions TM44

3.3 Mounting

The TM44 is intended to be placed behind or underneath the miniature world. Preferably the TM44 is mounted close to the tracks it supplies power to. It is recommended to limit the cable length between TM44 and tracks to 10 meter. For practical reasons, multiple TM44's can be mounted close together, if this does not result in long leads to the tracks.

The TM44 (bare unit) has 4 mounting holes (3mm). Preferably use spacers (approximately 10 mm) when mounting the TM44, so that the back of the TM44 does not get into contact with the mounting panel. This is especially important when you mount the TM44 on a metal surface! When mounting the TM44 on a metal surface, keep especially in mind that the mounting holes are connected to 0V/GND and that the metal mounting surface will carry the same potential in this case.

The TM44's (as bare unit) are "stackable" by using M3 x 30mm spacers between the modules. When mounting the modules, make sure to allow for enough space to insert the connectors including cables and make sure you can still access the dipswitches at the side.

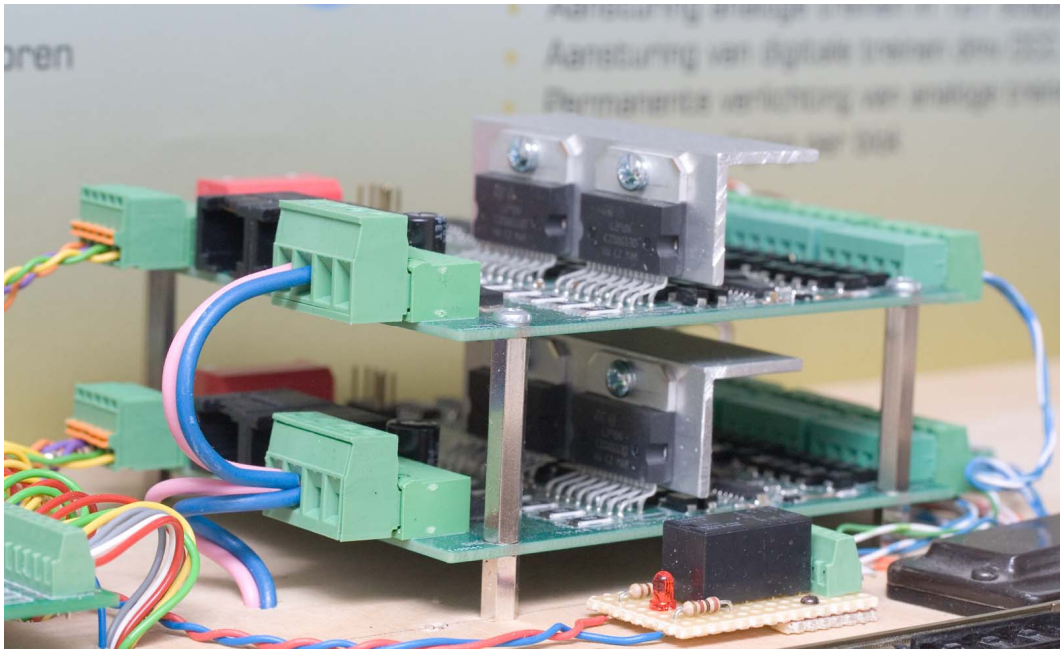


Fig 11: Stacking multiple TM44's

If you have the TM44 in enclosure, simply mount the TM44 using the 4 screws that come with the unit or enclosure to a suitable flat surface. As with the bare unit, make sure to allow for enough space to insert the connectors including cables and make sure you can still access the dipswitches at the side.

3.4 Connect Power Supply to the TM44

The TM44 shall be powered by a **DC power** only!

Power supply is delivered to the TM44 through connector K1. This connector has 4 terminals, from which P&P only uses Pin 1 and 2. So **do not connect pin 3 and 4!** (see figure 13)

1. **PWR:** +12..20 Volt DC
   This terminal is meant for the running power (Vrs) = power for your trains.
2. **GND**: Ground, Earth, 0V or reference-potential, in other words, the 'minus' pole of the power supply/supplies

Fig 12: Connecting power supply to the TM44

3.5 Capacity and Choice of Power Supply

The total power supply to your layout shall be sufficient to supply your trains with energy. As rule of thumb you can assume that a scale H0/00 train consumes about 1A. In scale N that will be about half that figure. Consumption depends to a large extent on the properties of the trains, whether they have illumination, etc. The internal consumption of the TM44 can be ignored in the calculations.

For the running power voltage, (so what you supply to the PWR of the TM44), a value between 14V and 18V is usually a good choice. For an average sized layout, a power supply with a capacity of 150W can be selected. In H0/00 this can provide power for about 10 trains running simultaneously. In scale N probably more than 15. If you need more power, use a higher capacity supply or use multiple power supplies.

MeanWell have a suitable range of power supplies at a very reasonable price. For universal use the HRP150-15 could be selected. This is a compact 15V-10A switching power supply, according to the specs adjustable from 13.5V to 18V. Cost around €60.
For scale Z, a lower Voltage 10V to 13V and significantly less power is necessary. In this case it is better to use a smaller supply e.g. 12V adjustable +/- 20%

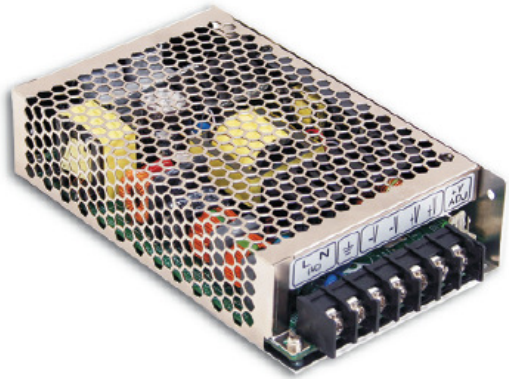


Fig 13: MeanWell HRP 150-15

3.6 Safety

Connecting power supplies includes working with 230V mains power. Working on these voltages and power can be potentially dangerous and in some countries it may only be done by certified professionals.
In this manual we cannot give detailed directions for all possible cases. Stick to the legal regulations, applicable for your region. Use common sense and if you are in doubt or do not have the necessary knowledge, ask advice from someone you consider knowledgeable or hire a professional.

3.7 Power Supply Cabling

The electrical power for your trains is transported by copper wires from your power supply unit to the TM44's underneath your layout. To make sure the wires can transport enough current, these wires should be properly sized. In the full TM44 manual you will find guidelines and calculations for distances and wire sizes. In this manual we limit this to some "rules of thumb" that should be sufficient in most cases:

- Preferably use stranded wire (instead of wire with solid core), because stranded wire conducts current with high-frequencies better.

- Wire as much as possible in star-topology from a central distribution point near your power supply.
- Keep the wires (PWR and GND) together. Preferred is one cable with multiple conductors.
- H0/00: Use wire with a cross section of 1.5mm^2 at minimum. Connect a maximum of 4 TM44's per cable on a maximum distance of 3.5 meter. If the distance is more than this, use wire with a cross section of 2.5mm^2 and connect a maximum of 4 TM44's per cable on a maximum distance of 5 meter.
- N: Use wire with a cross section of 1.0mm^2 at minimum. Connect a maximum of 4 TM44's per cable on a maximum distance of 3.5 meter. If the distance is more than this, use wire with a cross section of 1.5mm^2 and connect a maximum of 4 TM44's per cable on a maximum distance of 5 meter.
- If desired you can use regular mains electrical cable with the correct cross section. Mark the wire ends clearly, so you'll never accidentally connect these cables to your 230V mains power system. Alternatively you can purchase special cable used for low power halogen illumination in cross sections varying from 1,5mm^2 to 6mm^2.

3.8 Connecting Blocks to the TM44

On one side of the TM44 you'll find 4 screw connectors to connect the blocks: 1 connector per block. Each connector has 5 terminals. One for the A-rail and 4 for the sections B0 to B3. The picture below shows the pinout and positions of the connectors.

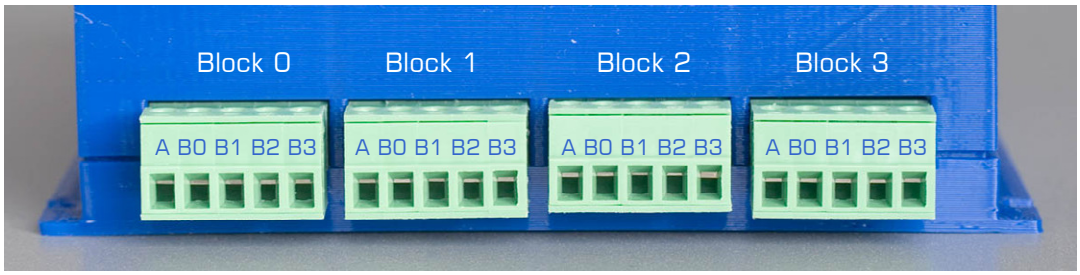


Fig 14: Connecting blocks to the TM44

3.9 Cabling of Blocks

The cabling by which the blocks are connected to the TM44 transports the energy from the TM44 to the track to make the train move and to enable other functions of the train to work. The wiring needs to be thick enough to carry the necessary current. Thin wire leads to loss of energy and possibly less constant behaviour of your trains. When controlling digital trains, to thin wire can lead to bad reception of information by the decoder and strange behaviour.

Since the TM44 is designed to be placed in the direct vicinity of the tracks it controls, the wiring to the tracks can be kept relatively short. In that case the cross section of the wires is not of crucial importance. The 'standard' 0.14mm^2 model-railroad wire however is considered somewhat to thin. Preferably use wire with a minimum cross section of 0.2mm^2. If the wires are longer than 4 meter or so, then use a thicker wire. 0.5mm^2 has been used successfully in practice on distances up to 10 meters.

To minimise electromagnetic interference as much as possible it is highly recommended to keep the wires of a single Block together. Therefore a multi-conductor cable per block is the preferred option.

If lengths are limited to approx. 4 meters, you can use UTP LAN cable (8 wires). The quality cat3, 5, 6 is unimportant. UTP LAN cable usually has a cross section of 24AWG (US standard) which corresponds to approximately 0.2mm^2. The wires in these cables are twisted in pairs. Every pair usually has a white and a coloured wire.

If you want to connect 4 sections per block, at the side you connect to the TM44, bundle all white wires and put then in the terminal for the A-rail. The individual colours (blue, orange, green, brown) are used as B0 - B3.

At the track-side, connect the colours blue, orange, green and brown to the B-rail of the corresponding section. Connect the white wire of the same pair to the opposite side of the track. In this way you feed the track at multiple locations which helps preventing problems with bad rail contacts.

If you do not need 4 sections per block, you may use each wire-pair as an individual wire. On both ends bundle the coloured and white wire of each pair. This way you will effectively have a cable with 4 conductors with a cross section of 0.4mm^2 each to connect up to 3 sections per block.

The best way to connect the wire to the track is soldering it to the outer side or bottom of the rail. Soldering to the bottom is usually only possible when you have not laid your track yet. The advantage is that it is invisible. The disadvantage is that maintenance can be problematic. If the wire breaks you won't be able to reconnect it the way you originally did.

4 OC32/NG

4.1 Introduction

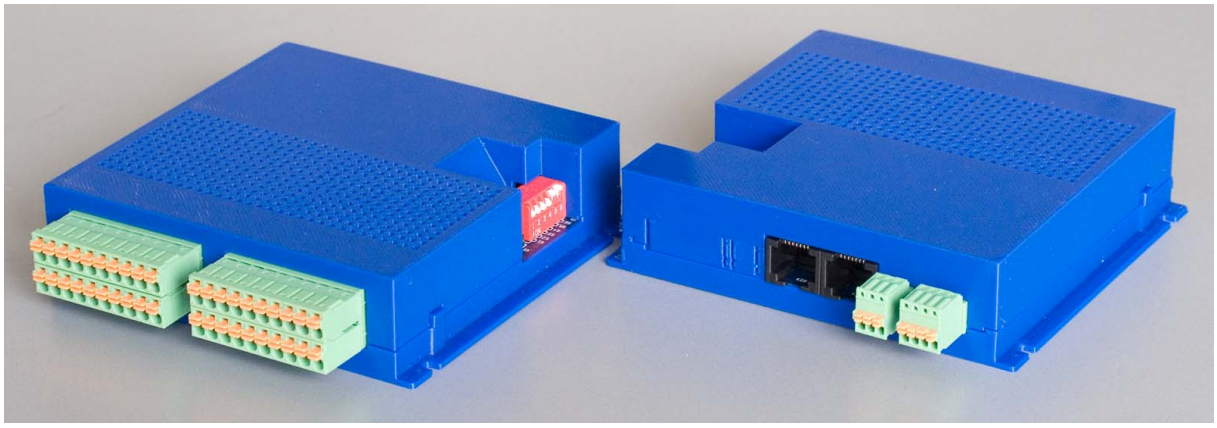


Fig 15: OC32/NG (2 modules shown)

The OC32 can be used to control all accessories on and around your railroad and many other applications. This manual applies to the use of the OC32/NG version only. If you have the previous version of the OC32 (not /NG), please refer to previous versions of this Dinamo P&P manual.

The possibilities of the OC32 are almost infinite. It is impossible to cover all topics in this Dinamo P&P manual. We therefore limit the description here to how you power the OC32/NG and how you can connect the OC32/NG to the Dinamo Network.

In most cases the OC32 has to be configured before it can be used to control devices in your miniature world. This configuration is done by the OC32Config program. For a description how to connect devices to your OC32 and how to configure the OC32, please consult the appropriate OC32 manuals.

4.2 Overview of the OC32/NG and location of connections and functions

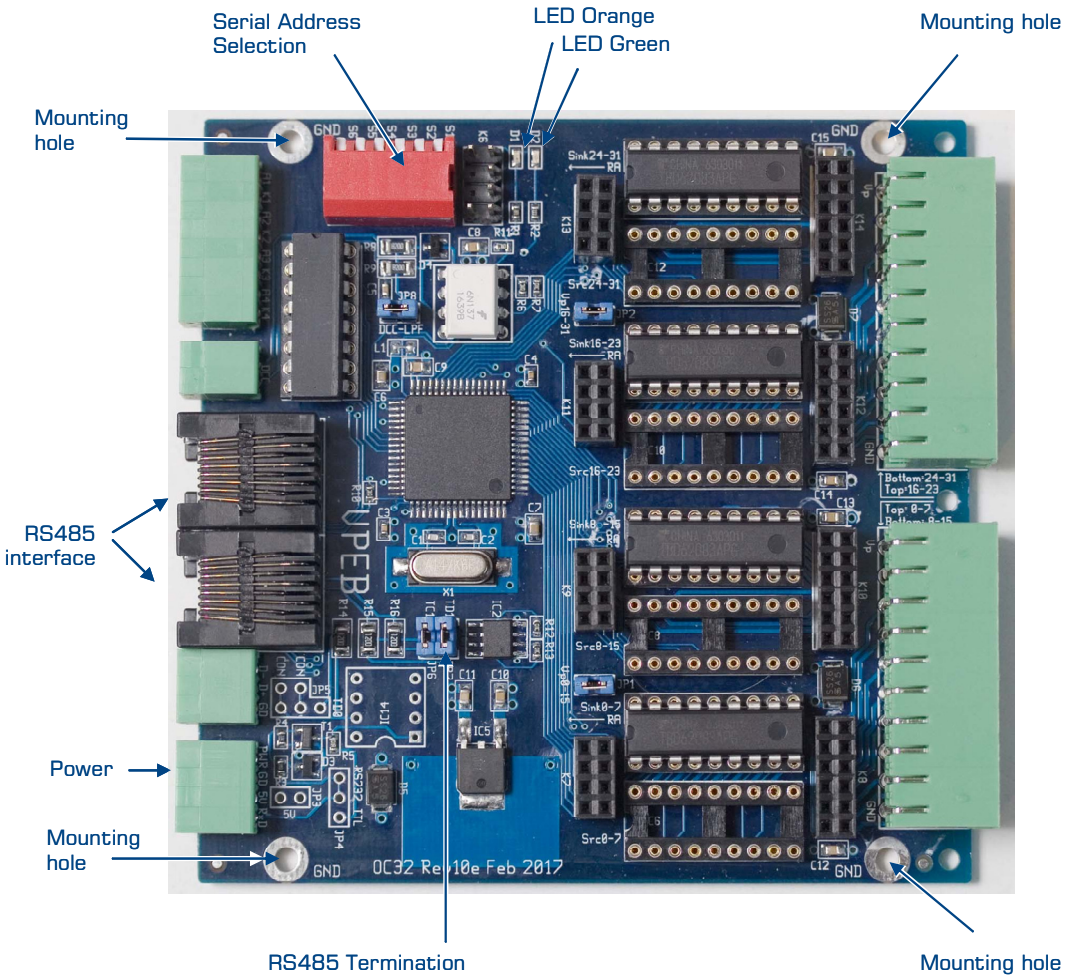


Fig 16: OC32/NG Overview

The above picture only shows the elements relevant for this manual. For a complete overview, please consult the OC32/NG and OC32 configuration manuals.

4.3 Mounting the OC32/NG

As the TM44, the OC32/NG is intended to be placed behind or underneath your miniature world. The OC32/NG is very flexible and configurable. Note that the OC32/NG can be used simultaneously for many other things beside your train-accessories. Use the flexibility to place your OC32/NG's at strategic locations throughout your miniature world and keep the wiring to your devices short and tidy.

The OC32/NG (bare unit) has 4 mounting holes (3mm). Preferably use spacers (approximately 10 mm) when mounting the OC32/NG, so that the back of the module does not get into contact with the mounting panel. This is especially important when you mount the OC32/NG on a metal surface! When mounting the OC32/NG on a metal surface, keep especially in mind that the mounting holes are connected to 0V/GND and that the metal mounting surface will carry the same potential in this case.

The OC32/NG's (as bare unit) are "stackable" by using M3 x 20mm spacers between the modules. You can even stack TM44's and OC32/NG's since the mounting holes are aligned. When mounting the modules, make sure to allow for enough space to insert the connectors including cables and make sure you can still access the dipswitches at the side.

If you have the OC32/NG in enclosure, simply mount the OC32/NG using the 4 screws that come with the unit or enclosure to a suitable flat surface. As with the bare unit, make sure to allow for enough space to insert the connectors including cables and make sure you can still access the dipswitches at the side.

4.4 OC32/NG Power Supply

The power for the OC32 and the devices controlled by the OC32 can be derived from the power supply used for your trains (read: the TM44), or you choose one or more separate power supplies for your OC32('s). Which choice you make depends on the optimal Voltage you need to drive your accessories and the amount of power you need.

If you use multiple power supplies, make sure the negative poles (minus or 0V terminals) of all the power supplies in your system are connected to each other.

The power supply for your OC32 and connected devices shall always be a positive DC supply! Most devices that, according to the manufacturer, need AC current, can be fed with DC current without any problem. Should you have devices that absolutely need AC current, use a relay to switch them.

The supply for the OC32 is connected to pin 1 (+) and 2 (-) on the 4-pole connector. See fig 17.

Fig 17: Connecting power supply to the OC32

5 The Dinamo RS485 network

In the previous chapters we have described the three different Dinamo P&P modules. In this chapter we will show how to interconnect them and make the Dinamo system work.

5.1 Wiring the network

The easiest way to contruct the Dinamo RS485 network is using standard RJ45 UTP (unshielded twisted pair) network cables. These cables can be attained in every shop selling computers and or networking components. The "quality" of the cable is unimportant, certainly for the regular distances you encounter in a layout at home. So Cat3, Cat5, Cat5e, Cat6 or no Cat, in principle it will all work, as long as the RJ45 connectors are mounted properly and at least the inner 6 pins are connected straight.

The total length of the RJ45 network can (in theory) be 1.200 meters. You will probably need some ambition to reach that length at your layout at home. Therefore the length of the cables you run between the units is not crucial, however do not make (or buy) them significantly longer than reasonably necessary, as if it were only to keep the installation tidy.

The start of the RJ45 network is at the RM-C/1+. Looking at the back of the unit (fig 18) you'll see two RJ45 sockets. In a standard configuration you need to use the RJ45 socket closest to the green 3-pole socket.

Fig18: RM-C/1+ RJ45 network socket

On every TM44 and OC32/NG module you will find two RJ45 sockets as well:

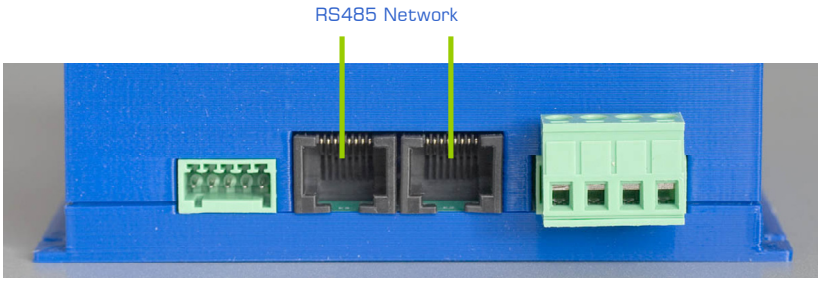


Fig19: TM44 RJ45 network sockets

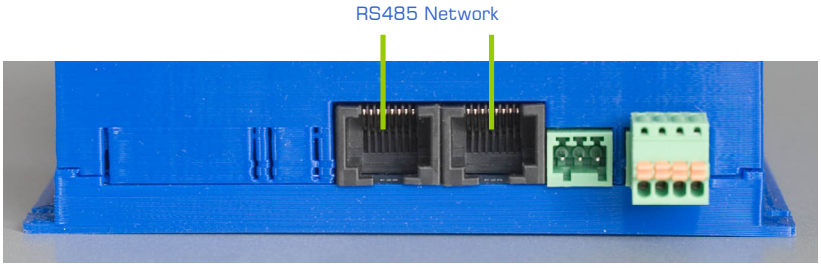


Fig20: OC32/NG RJ45 network sockets

Insert an RJ45 cable in the indicated RJ45 socket of the RM-C/1+, run it to the closest TM44 or OC32/NG module and insert the other end of the cable in one of the RJ45 sockets on the TM44 or OC32/NG module. Which of the two RJ45 sockets you use is irrelevant, however for ease of troubleshooting (should it be needed) you may want to keep the left sockets to point towards the RM-C and the right ones to point away from the RM-C, or the other way around as you like. As said, the choice is arbitrary and technically irrelevant.

Now insert another RJ45 cable in the other, free RJ45 socket of the module you just connected and run the cable to the next TM44 or OC32/NG module. Insert it in one of the RJ45 sockets of the module. Repeat this process unless you have reached the last module.

Note that the order in which you connect your modules is completely irrelevant. Just follow the route that is most practical.

When you are done, you should have a continuous string of modules connected to each other. We will call this string "a bus". All modules have both RJ45 sockets occupied, except for the RM-C/1+ and the last module in the chain. Your network should look somewhat like fig 21.

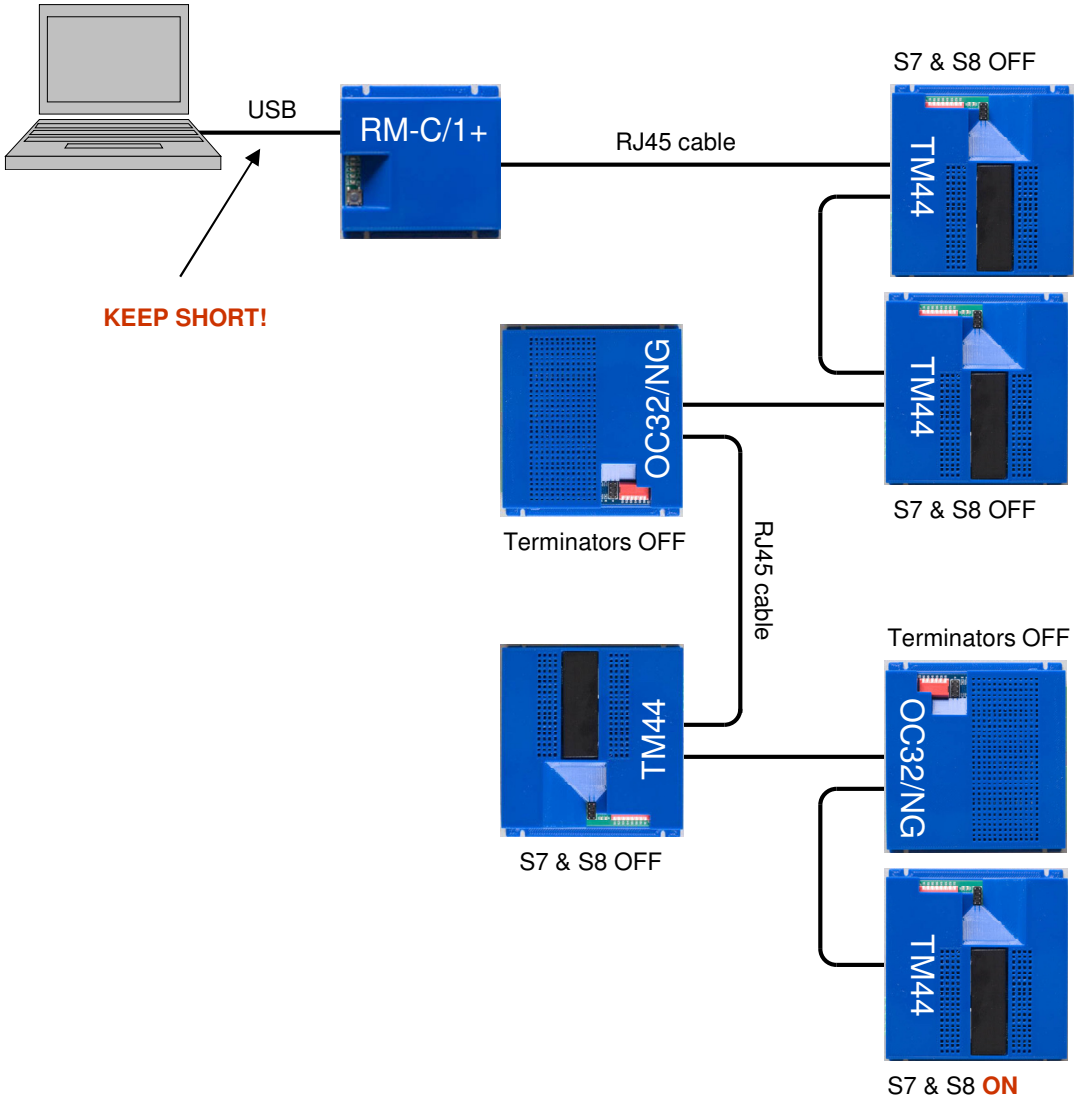


Fig 21: An example Dinamo P&P RS485 network

5.2 Terminators

This term is not referring to the sci-fi series with an Austrian actor. In RS485 a terminator is used to close the RS485 bus. To visualize it, think of it as a plug in the end of the bus to prevent the electrons from falling out.

The first module on your RS485 bus is the RM-C/1+. In standard configuration your RM-C/1+ will have the terminator activated by default. The last module on your bus is the module with only one RJ45 socket occupied. Also this last module shall have it's terminator

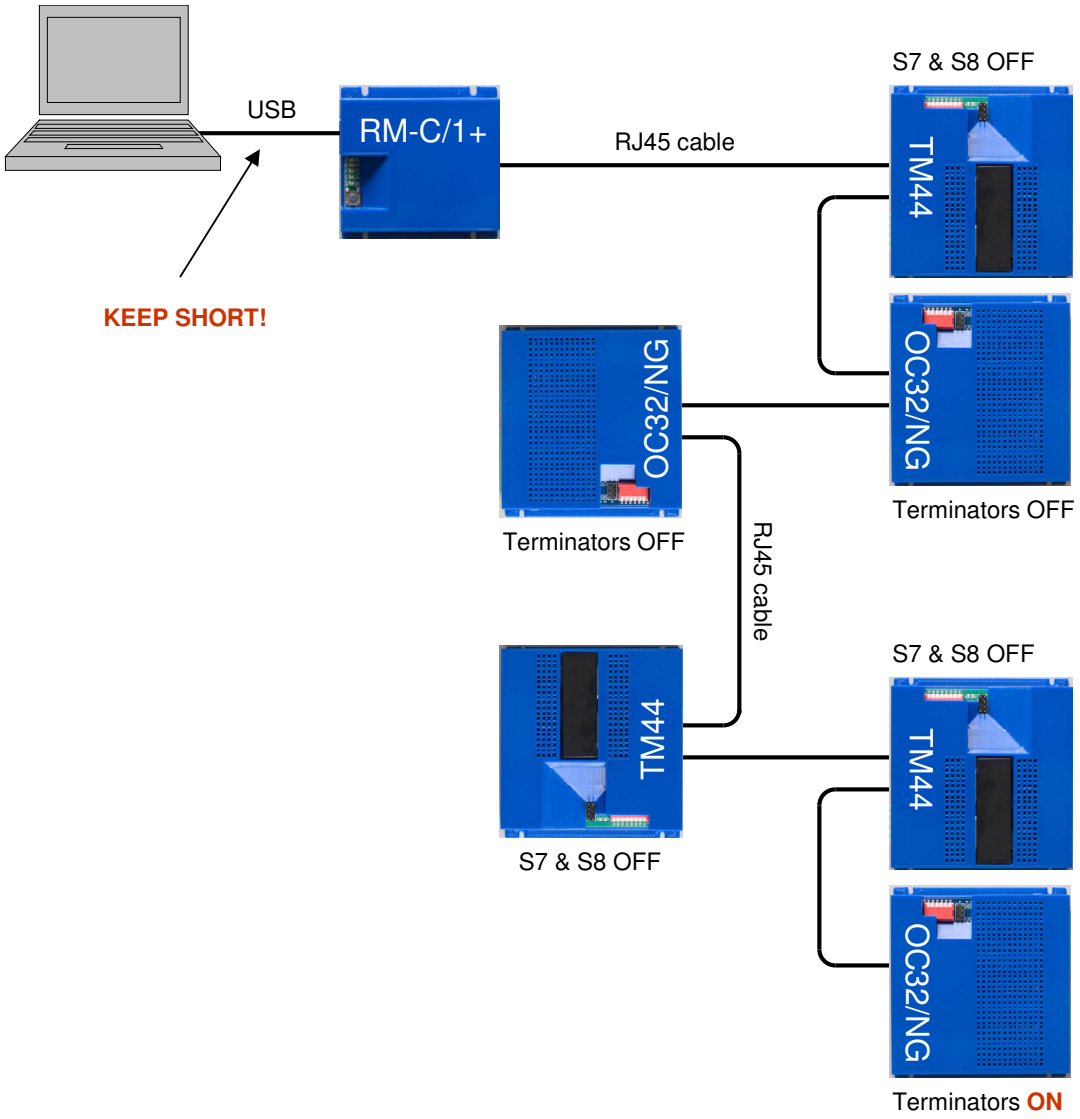


Fig 22: Another Dinamo P&P network example

activated. **All other modules shall have their terminator de-activated.** If you don't comply with this rule, the good news is that your network will still work (in most cases). However, the bad news is that communication may be instable, or at some point become instable, causing vague problems in your system.

The terminators on your TM44 modules are activated by dipswitches you find at the side of the unit (fig 24). S7 and S8 determine whether the terminator is active:

- S7 & S8 = OFF: Terminator NOT active
- S7 & S8 = ON: Terminator Active

Always put both switches in either the ON or OFF position

The terminators on the OC32/NG module are activated by jumpers. If you have an OC32/NG with enclosure you need to open the case. This can be done very easily. For instructions, if you need them, please consult the OC32/NG manual.

The location of the OC32/NG termination jumpers is depicted in figure 16 and a detail is shown in fig 23. To activate the terminator, place **both** jumpers as indicated in fig 23. Pay attention that

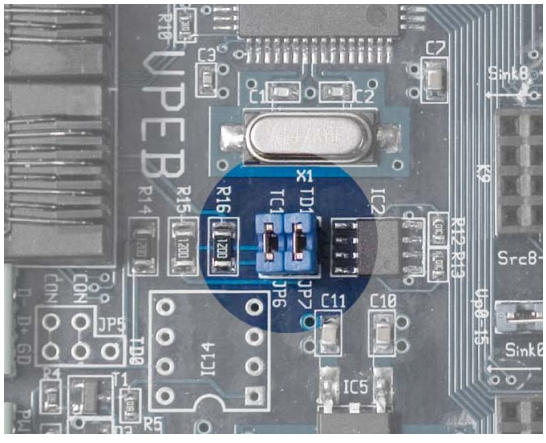


Fig 23: Terminator location on the OC32/NG

you don't insert them 90 degrees rotated, because then your network won't work. To de-activate the terminator, remove **both** jumpers. If you don't want to loose the jumpers while the terminator is de-activated, you can park the jumpers each on one pin only.

5.3 Addressing

Your Dinamo system will, at some point, consist of multiple TM44's and OC32/NG's. In order for the RM-C to communicate with every individual module, each module shall have a **unique** address. OC32's and TM44's are different "families", so you can have an OC32 with address 5 and at the same time have a TM44 with address 5, but you may never have two OC32's or two TM44's with identical addresses.

Note that there is no relation at all between the order the modules are physically interconnected (fig 21 and 22) and the address they use.

5.3.1 TM44 Addressing

TM44 modules are addressed in pairs of two. Every TM44-pair has a module-address (0..15) and within each pair, each TM44 has a sub address (0/1). This results in a total amount of 16 x 2 = 32 addresses, thus a maximum of 32 TM44 modules per system.

If you have an odd number or TM44's, at least one of them will remain single. Any "single" TM44 always shall have sub-address 0. A TM44 with sub-address 1 can exist only when accompanied by a TM44 with sub-address 0 at the same module address.

Note in DinamoConfig TM44's with sub-address 0 are called "primary" while TM44's with sub-address 1 are called "secondary". Be rested, there is no difference in performance between a primary and secondary module

The module/sub-address is set by dipswitches 1 - 5

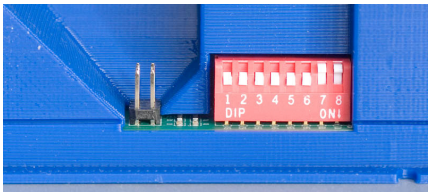


Fig24: TM44 Dipswitches

Adres	S1	S2	S3	S4	S5	Adres	S1	S2	S3	S4	S5
0.0	On	On	On	On	On	0.1	Off	On	On	On	On
1.0	On	Off	On	On	On	1.1	Off	Off	On	On	On
2.0	On	On	Off	On	On	2.1	Off	On	Off	On	On
3.0	On	Off	Off	On	On	3.1	Off	Off	Off	On	On
4.0	On	On	On	Off	On	4.1	Off	On	On	Off	On
5.0	On	Off	On	Off	On	5.1	Off	Off	On	Off	On
6.0	On	On	Off	Off	On	6.1	Off	On	Off	Off	On
7.0	On	Off	Off	Off	On	7.1	Off	Off	Off	Off	On
8.0	On	On	On	On	Off	8.1	Off	On	On	On	Off
9.0	On	Off	On	On	Off	9.1	Off	Off	On	On	Off
10.0	On	On	Off	On	Off	10.1	Off	On	Off	On	Off
11.0	On	Off	Off	On	Off	11.1	Off	Off	Off	On	Off
12.0	On	On	On	Off	Off	12.1	Off	On	On	Off	Off
13.0	On	Off	On	Off	Off	13.1	Off	Off	On	Off	Off
14.0	On	On	Off	Off	Off	14.1	Off	On	Off	Off	Off
15.0	On	Off	Off	Off	Off	15.1	Off	Off	Off	Off	Off

Table 1: TM44 Addressing

You are not obliged to number (address) your TM44's consecutively, however it will make life a lot easier if you do. So we suggest you start at 0.0, 0.1, 1.0, 1.1, etc and work your way up that way. This will also lead to a logical numbering of blocks:

The TM44 module/sub-address determines by which block number the blocks are controlled from your control software and which feedback-numbers are reported when a train occupies a section. Per TM44 the numbering is as follows:

Section	Number	Section	Number	Section	Number	Section	Number
0b0	0	1b0	4	2b0	8	3b0	12
0b1	1	1b1	5	2b1	9	3b1	13
0b2	2	1b2	6	2b2	10	3b2	14
0b3	3	1b3	7	2b3	11	3b3	15

Table 2: TM44 Block –and feedback numbering

Attention: The way your control program numbers the blocks and sections is determined by your control software (iTrain, Koploper, Rocraill, etc). Some programs use a linear numbering of blocks (0..127) and sections (0..2047) while others use a modular approach, like 0.0 to 31.3 or 0.0 to 15.7 for blocks and similar for sections. Some control programs even give you a choice between different numbering schemes.
Also pay attention that many programs start numbering at 1 and therefore add 1 to the Dinamo module, block and section numbering. So TM44 module 0.0 may show up like module 1.1 in your software and Dinamo Block 5 therefore may be Block 6 in your control software. Note this is up to the control software and you will need to consult the manual of the respective software to get the details.

If your software uses linear addressing, the block and section numbers should be as follows

- Block number = Module-address x 8 + sub-address x 4 + block number (0..3)
- Feedback = Module-address x 128 + sub-address x 64 + section-number (0..15)

And keep in mind that there may be an offset +1 introduced by your control software.

The above formulas should not be to difficult, but if you didn't pay attention during math at school, you will find a table in Appendix A of this manual to save you.

5.3.2 TM44 Master/Slave

The TM44's shall be exactly synchronised to prevent a short circuit when a train passes from one block to the next. To achieve that, exactly one TM44 shall lead the crowd and all others shall follow. The leading TM44 is called Master and the others are Slaves. Dipswitch 6 determines whether the module behaves as 'Master' or 'Slave'. Each Dinamo system shall have **exactly one** Master, so in a Dinamo P&P system there should be **exactly one** TM44 that has S6=ON, all others shall have S6=OFF. Unless there is a clear reason to deviate from this, select module 0.0 as Master.

- S6 ON = Master
- S6 OFF= Slave

5.3.3 OC32 Adressing

As is the case with the TM44, every OC32 in the network shall have a unique address too. You can connect a maximum of 16 OC32 modules per Dinamo P&P System. The OC32 address is selected with the dipswitches on the OC32.

Note that there are 6 DIPswitches on the OC32/NG. At this point only 4 are used:

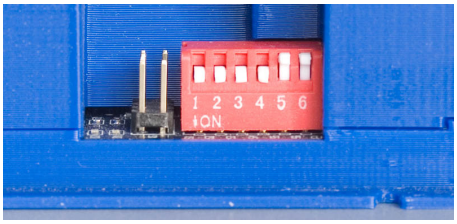


Fig 25: OC32/NG Dipswitches

Address	S1	S2	S3	S4	Address	S1	S2	S3	S4
0	On	On	On	On	8	On	On	On	Off
1	Off	On	On	On	9	Off	On	On	Off
2	On	Off	On	On	10	On	Off	On	Off
3	Off	Off	On	On	11	Off	Off	On	Off
4	On	On	Off	On	12	On	On	Off	Off
5	Off	On	Off	On	13	Off	On	Off	Off
6	On	Off	Off	On	14	On	Off	Off	Off
7	Off	Off	Off	On	15	Off	Off	Off	Off

Table 3: OC32 Addressing

As is the case with the TM44, mind that your control software may offset all addresses +1.

5.3.4 Changing Addresses

Be aware that if you change the DIPswitch settings on your TM44 and/or OC32/NG modules while the modules are powered-on, changes will have no effect at that time. DIPswitches are only read by the modules at boot-time. Therefore in order to read the new address (and for TM44, the maser/slave setting), your TM44 and OC32/NG modules need to be rebooted (power-off - power-on).

Changing addresses in a live Dinamo P&P network would not work anyway and could lead to very strange behaviour. If you read and understand section 6 of this manual you will know why. To prevent these errors from happening, al modules store their address at boot-time in memory.

6 Commissioning your Dinamo system

6.1 Power-up your system

Now you have connected all your TM44's and OC32/NG's, and assigned unique addresses to all modules, you can verify whether they are correctly identified by your RM-C.

While the power to your Dinamo system is off and your RM-C is connected to your PC, watch the yellow Tx1 LED on the RM-C flash quickly. As written in paragraph 2.5 this indicates that is RM-C is transmitting on the RS485 bus, but does not receive any reponses. Every flash of the Tx1 LED is a message asking "is there anything out there?"

When you switch on your system power supply, the RM-C will continue scanning for connected modules, but your modules will start to answer. This search process will take from 5 to 20 seconds, depending on the size of your system (read: the number of TM44 and OC32 modules). The bigger your system, the faster the search will be finished. During search, the yellow Tx1 LED at the RM-C will continue to flash and the orange LEDs at your TM44's and OC32's will flash now and then.

When the search is finished, the yellow Tx1 LED at the RM-C will be lit continuously and the orange LEDs at your TM44's and OC32's will either be lit constantly or flash quickly. The RM-C now knows how many players are in it's team and what kind they are. It will constantly monitor the status of all members. If one module fails (e.g. is disconnected) the RM-C will keep trying to reach this unit while still communicating with all others. It will do so until all units are gone. If there is nothing left to take care of, the RM-C will initiate a new search.

Note while the RM-C is communicating with it's team members, it will never search for additional modules. So if you add another module "on the fly", it will not be recognized until you either:

- Interrupt communication with all modules or
- Reset the RM-C

Note that in case you power TM44's and OC32/NG's from different power sources, these power supplies shall be powered up more or less at the same time. Should the detection of your TM44's be finished and just after that you power up your OC32's, the OC32's will never be found since the application to become a team member is already closed.

If, once the search is finished, the Tx1 LED on your RM-C is not lit continuously, but goes off briefly now and then, this is an indication that your network is not stable. In that case, check connections and terminators!

6.2 Testing communication

If you repeat the test from paragraph 2.5 and hit the "Status" button, the status window now should show for each connected TM44 module the type (TM44), the status and it's version. Also it will show the status and version of each OC32 module.

See figure 25 for an example: This system has two TM44's and two OC32's. Two TM44's? Yes. The TM#0 address reports Type=TM44 and reports a Primary module (0.0) and a Secondary module (0.1), both version 1.20. In the column at the right you see OC#0 and OC#1 both reporting version 3.01

Note that the RM-C only reports detected modules when the search is finished. While search is running and therefore, if you hit the Status button to early, the list will be empty.

At this point **check** that the reported version numbers of all your TM44 modules are identical. If you mix different versions your system may behave unexpectedly. If you

encounter different versions, upgrade all TM44's to the latest firmware level. How this can be done is described in the manual TM44 Bootloader.

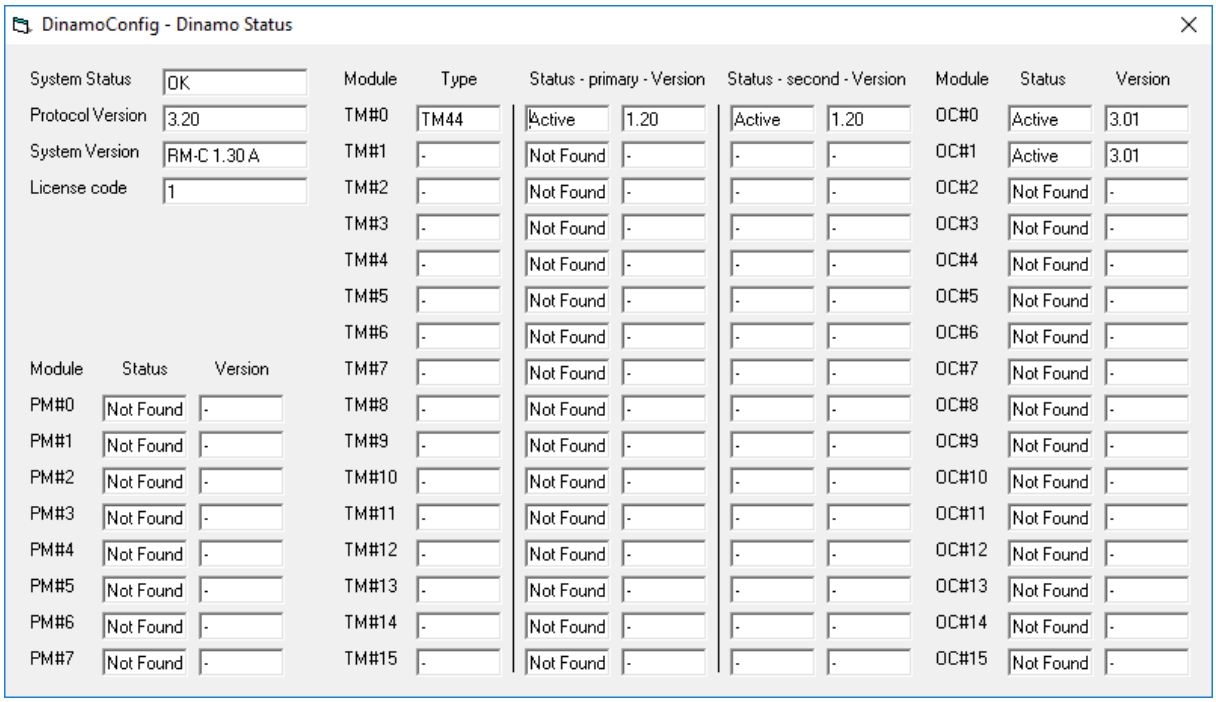


Fig 26: Status window of a live Dinamo P&P system

The version numbers of the OC32's are less crucial, however, we suggest that you also keep your OC32's on the same firmware level.

At this point you may want to perform one additional test:
After you have hit the Status button at least once (you may close the status window after that, or leave it open), select the Tab TMxx/UCCI-s and select Module = All_TM in the upper left corner (fig 26).

A button "Check MS mode" will appear. If you hit that button, a pop-up window appears telling you the Master/Slave settings of your system. If it does not report "OK", check the dipswitch settings of your TM44 modules and remember that they need a reboot if you change any.

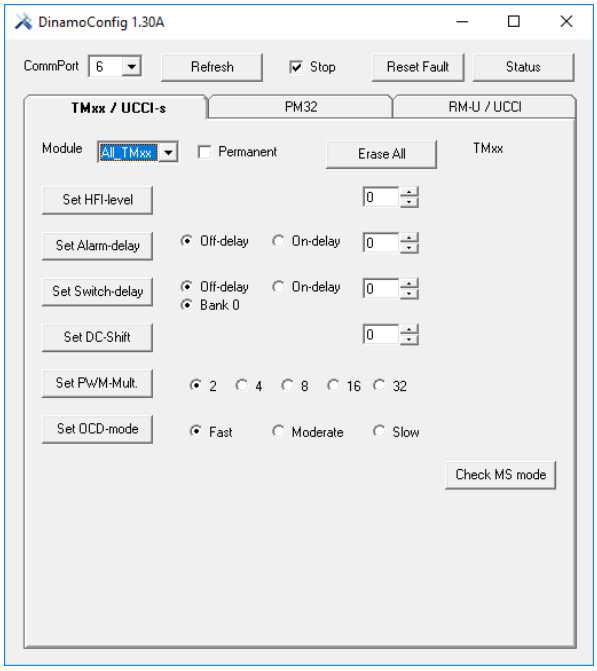


Fig 27: Check Master/Slave settigs from DinamoConfig

Fig 28 (Left):
Master/Slave OK

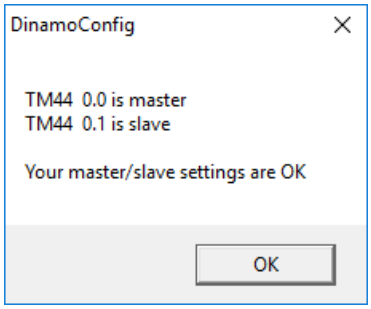
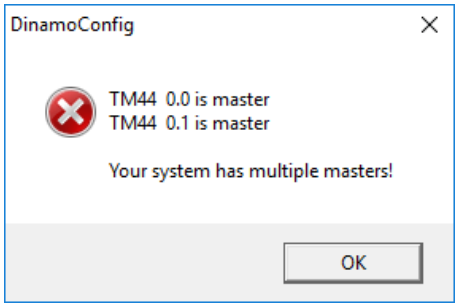


Fig 29 (Right):
Master/Slave not OK:
Check your TM44 Dipswitches!



6.3 Some additional words on DinamoConfig

DinamoConfig is a simple program to check the basic functions of your Dinamo system and change firmware settings of your TM44, TM-H, UCCI, PM32 and RM-U/RM-C modules. Many of these modules are not considered part of the Dinamo P&P concept and fall outside the scope of this manual. Also we think that the factory-default settings of your RM-C and TM44 modules should be fine to start with. If you want to become more familiar with the TM44 and RM-C settings, consult the respective manuals or have a look at the firmware release notes at https://www.dinamousers.net

6.4 Configuring your OC32/NG's

Configuration of your OC32's requires a separate (free of charge) program "OC32Config". OC32 Configuration is described in detail in the OC32 configuration manual. In this manual we will just make one additional note how to connect OC32Config to your OC32 modules:

In earlier days, you had to put the RM-C in "Transparent Mode" to configure your OC32's, connected behind an RM-C. With the current versions this is no longer neccessary. Your RM-C supports "Jumbo Packets" and "OC32 Message Tunnelling" by which DinamoConfig can configure and test OC32's in your Dinamo P&P system.

Install OC32Config as described in the OC32 Configuration Manual. Before you run the program close other programs that occupy the RM-C interface. Start OC32Config, select the COM port by wich your PC communicates with your RM-C (the same port as you used for DinamoConfig) and tick the "Dinamo Tunnelling" box in the upper part of the OC32Config window. To check that it works you could select a valid OC32 module address (mind the +1 offset if you keep that checkbox selected) and press "Request Version". Your OC32 should report the same firmware as you saw when testing with DinamoConfig.

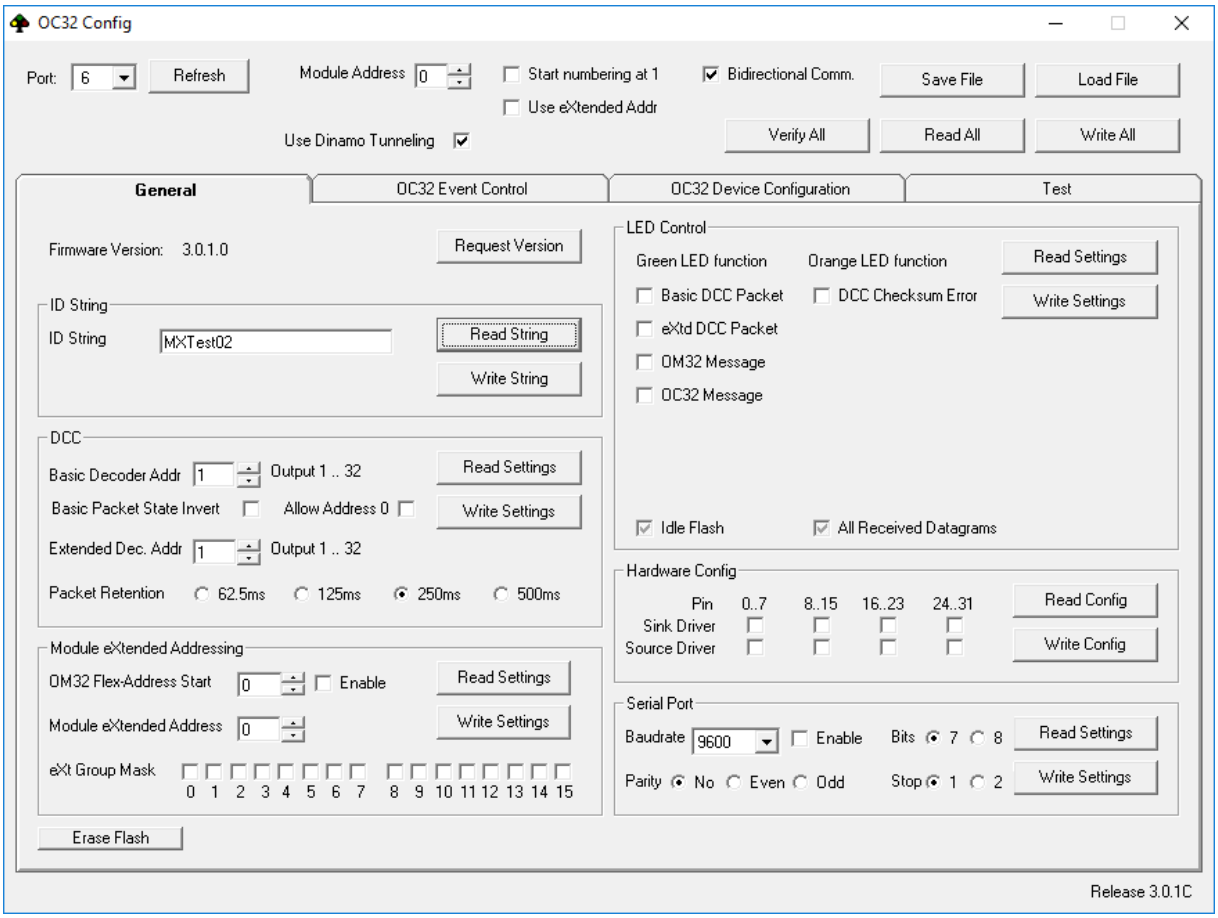


Fig 30: Communicating with OC32 at Address 0 via OC32Config

7 Turnouts

7.1 Provide track power to turnouts

As indicated in paragraph 1.1, turnouts and turnout-groups are not part of any block. The rails on a turnout however will need power supply to allow the train to pass over it. In a Dinamo system a turnout usually is electrically attached to an adjacent block when the turnout can only be accessed when running to or from that block. As an example:

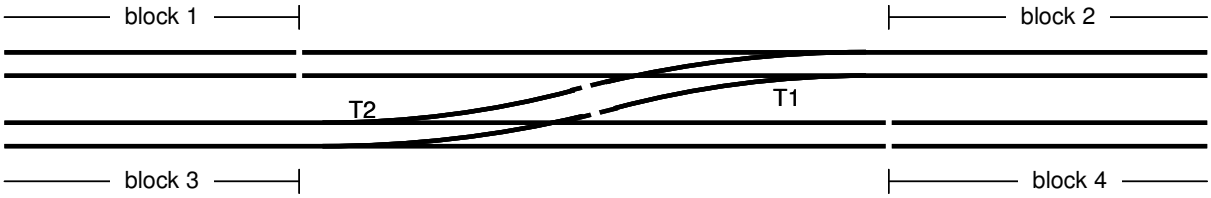


Fig 31: Attaching turnouts to an adjacent block

T1 can only be passed from or to block 2. So it is allowed to attach the rails of T1 electrically to block 2. Also T2 can be passed only from or to block 3. Therefore it is allowed to derive the power for T2 from block 3.

Rule: At the "sharp side" of a turnout (at the side where the tracks join) there will never be an electrical block-separation.

Even when multiple turnouts are lined up this rule counts. Have a look at the example in figure 32:

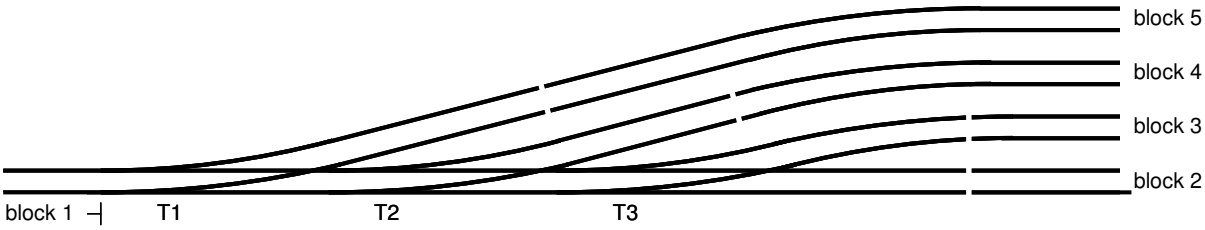


Fig 32: Multiple turnouts in-line

T1, T2 and T3 all can only be accessed from or to block 1, so they are all electrically connected to block 1.

7.2 Turnout groups, Block Separations, Section Separations

The exact location where you make the block-separation is of no great importance to Dinamo, however it may be important for your control software. Therefore, read the documentation of your control software product and/or make a test-layout before you apply this to your target layout. Mind that a block separation is also a section separation by definition, so it is a means for the software to determine where exactly the train is. We mention 2 important points of interest:

1. If you are using 'full detection', which means all axles of all your rolling stock shall draw some current from the tracks, your software can determine, if it supports this feature, in which block and section something is present. So, for instance, your software can see that a turnout-section is completely free before it is reserved for another train. In this case it is important that 'free' means 'truly free' and not that the last tiny part of your train still 'hangs over' the turnout. Therefore always keep some distance between the block-separation and the adjacent turnout, as shown in figure 31.
   Also if you do not use full detection, or if your software does not support it, it is good to keep the above rule in mind. What is not the case now may become the case in the future. Changing software is normally a lot easier than changing your physical layout.

2. Do not make sections extremely short. Dinamo is by the design of the detector unit capable to generate an event even at the shortest possible sections. However, to do that, there must be something to detect. Some loco's have a number of wheels with rubber tires that will not generate detection. If that loco runs with the isolated wheels in front, only the second axle will generate the event. If the section that generates a stop in front of a signal starts just a few cm before that signal you will risk the train sticking it's front past the signal, or even worse, over the turnout the signal should protect.
   Also bear in mind that an event needs to go from Dinamo to the PC, the PC-software has to process it and then the PC has to send a command to Dinamo, that also has to process it in order to stop the train. If the train has a decoder with mass-simulation it may take some distance before the train actually stops. Even if everything is processed fast, there is no guarantee that the response is immediate, so don't build it all too critical in terms of lengths and distances.

Since a turnout is never part of a block security-wise, it makes sense to assign a turnout group that is fed from an adjacent block a separate section. If your software supports it, it can then 'see' if the train is actually in the block itself or in the adjacent turnout. In most cases you'll have sufficient sections available to do this.

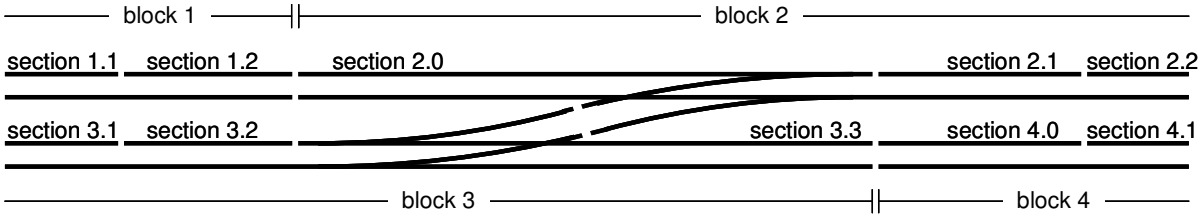


Fig 33: Connected turnouts in separate sections

7.3 Addtitional Pseudo-blocks

In some cases a turnout cannot be passed to or from one single adjacent block only. An example of such situation is the crossing turnout:

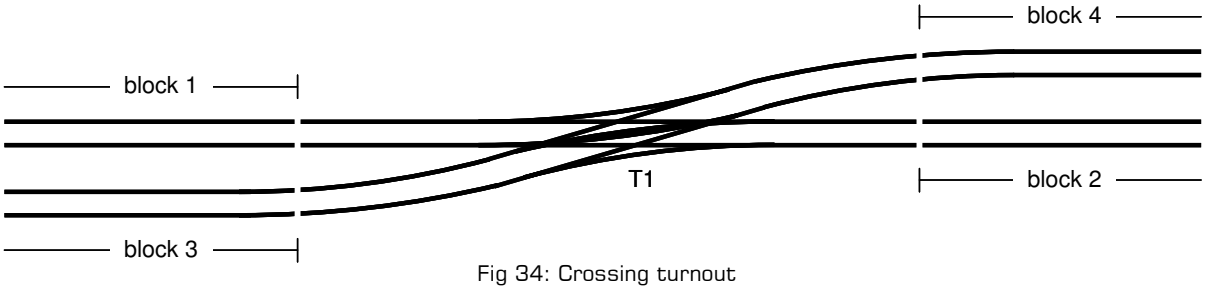


Fig 34: Crossing turnout

In the example above T1 can be passed from block 1 to block 2, but also from block 3 to block 4. So there is no possibility to feed the tracks of T1 from either of the adjacent blocks. There are two solutions for this problem:

1. Define T1 as a separate pseudo-block. Since a turnout is never part of any block this is not a real block, but a piece of track that is powered separately as if it was a block.
2. Use a relay with 2 change-over contacts to connect the tracks on T1 to one of the adjacent blocks, dependent on the selected route. See paragraph 7.4. In the above example from figure 34, T1 can be connected to block 1 or block 2, because in any case one of these blocks is part of the route the train follows.

Note that the capabilities of your control software may limit your choices to apply the above options.

7.4 Delivering Track-power to Turnouts via Relays

In paragraph 7.3 we explained that in some cases it is necessary to power the tracks on turnout groups separately. If you don't want to do that with an additional block-output or if you cannot do that because your software does not support it, you can solve this with a relay, controlled from an OC32 output. Since the track, the relay powers, is only occupied while the train passes to or from the adjacent blocks there is functionally no disadvantage, except that it requires an electromechanical component and it may be slightly more complex to wire.

We look again at the example from paragraph 7.3, the crossing turnout. To deliver power to the tracks you need a relay with two crossover contacts (DPCO = Dual Pole Cross Over). Each contact has 3 terminals on the relay: C (common), B (break) and M (make). If the relay is not activated, C is connected to B and M is isolated. If the relay is activated, C is connected to M and B becomes isolated. Besides the 2 x 3 terminals, on the relay you'll find 2 additional terminals for the relay activation-coil. On some models you will encounter an explicit + (plus) and – (minus) pole, but in most cases it will be irrelevant in which direction current flows through the coil.

The relay activation-coil is connected to an OC32 output with sink-driver. In the example below (figure 35) both "C" terminals are wired to rail A and B of turnout T1. The "B" terminals are wired to the A and B3 connections of block 1. The "M" terminals are wired to the A and B3 connections of block 3. We assume in this example that sections B3 of blocks 1 and 3 are not in use by the block itself.

If you have wired the setup according to figure 35, you need to instruct your PC control software when the relay shall be activated. When a train passes from or to block 1, the relay shall **not** be activated. When a train passes from or to block 3, the relay **shall** be activated.

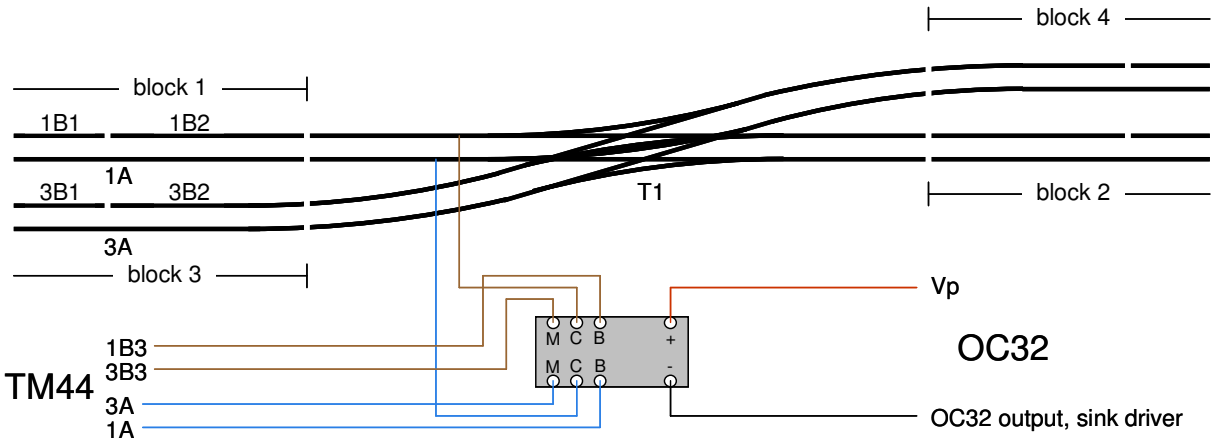


Fig 35: Connecting turnout tracks by relays

Relays for this application can be obtained from a regular electronics components store. Types that are specified to switch 1Amp per contact are fine. Also the VPEB partners offer ready-made modules with one or more relays, equipped with pluggable connectors or screw-type terminals for easy wiring. Often you'll find an additional LED, that shows whether the relay is activated. Not absolutely necessary, but it may come in handy while troubleshooting.

Appendix A: TM44 Address Table

This table applies if your control software uses linear addressing and adds an offset +1 to block and feedback addresses.
Note that the TM44 numbering is kept as in this manual, starting from 0.0

TM44	Block				Section															
	0	1	2	3	0B0	0B1	0B2	0B3	1B0	1B1	1B2	1B3	2B0	2B1	2B2	2B3	3B0	3B1	3B2	3B3
	Block Address				Feedback Address															
0.0	1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0.1	5	6	7	8	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
1.0	9	10	11	12	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144
1.1	13	14	15	16	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208
2.0	17	18	19	20	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272
2.1	21	22	23	24	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336
3.0	25	26	27	28	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400
3.1	29	30	31	32	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464
4.0	33	34	35	36	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528
4.1	37	38	39	40	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592
5.0	41	42	43	44	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656
5.1	45	46	47	48	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720
6.0	49	50	51	52	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784
6.1	53	54	55	56	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848
7.0	57	58	59	60	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912
7.1	61	62	63	64	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976
8.0	65	66	67	68	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040
8.1	69	70	71	72	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104
9.0	73	74	75	76	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168
9.1	77	78	79	80	1217	1218	1219	1220	1221	1222	1223	1224	1225	1226	1227	1228	1229	1230	1231	1232
10.0	81	82	83	84	1281	1282	1283	1284	1285	1286	1287	1288	1289	1290	1291	1292	1293	1294	1295	1296
10.1	85	86	87	88	1345	1346	1347	1348	1349	1350	1351	1352	1353	1354	1355	1356	1357	1358	1359	1360
11.0	89	90	91	92	1409	1410	1411	1412	1413	1414	1415	1416	1417	1418	1419	1420	1421	1422	1423	1424
11.1	93	94	95	96	1473	1474	1475	1476	1477	1478	1479	1480	1481	1482	1483	1484	1485	1486	1487	1488
12.0	97	98	99	100	1537	1538	1539	1540	1541	1542	1543	1544	1545	1546	1547	1548	1549	1550	1551	1552
12.1	101	102	103	104	1601	1602	1603	1604	1605	1606	1607	1608	1609	1610	1611	1612	1613	1614	1615	1616
13.0	105	106	107	108	1665	1666	1667	1668	1669	1670	1671	1672	1673	1674	1675	1676	1677	1678	1679	1680
13.1	109	110	111	112	1729	1730	1731	1732	1733	1734	1735	1736	1737	1738	1739	1740	1741	1742	1743	1744
14.0	113	114	115	116	1793	1794	1795	1796	1797	1798	1799	1800	1801	1802	1803	1804	1805	1806	1807	1808
14.1	117	118	119	120	1857	1858	1859	1860	1861	1862	1863	1864	1865	1866	1867	1868	1869	1870	1871	1872
15.0	121	122	123	124	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936
15.1	125	126	127	128	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000

Table 4: TM44 block –and section numbers

(This page is intentionally left blank)