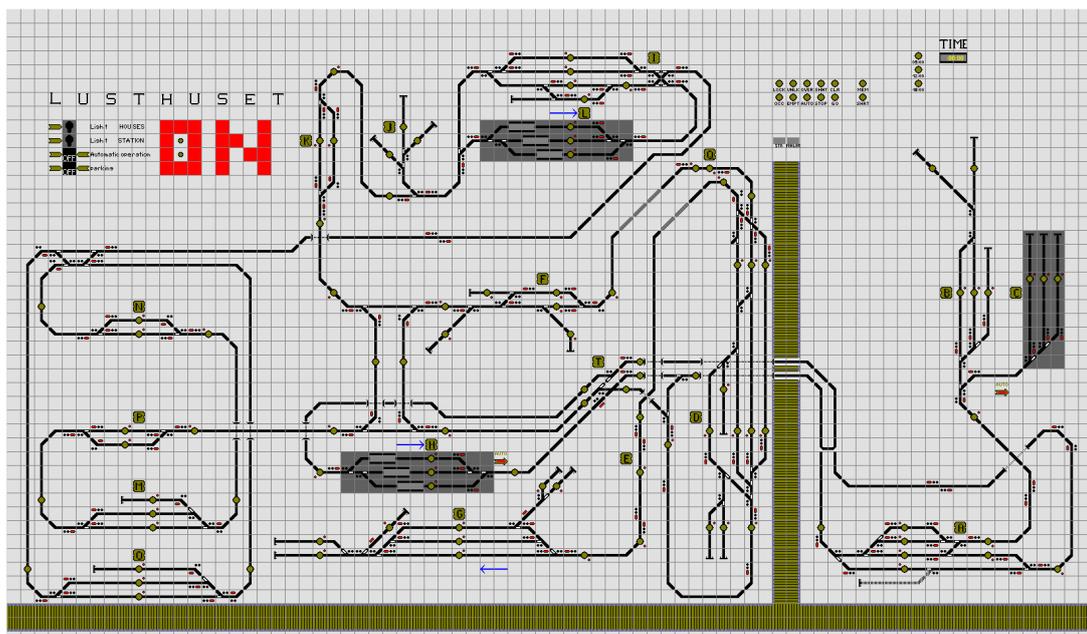


# Lusthuset narrow gauge garden layout

## About this document

This document describes the technical documentation, describes the connections on the layout especially MX8/9 structure and connections. All known parameters like CV values are described.



Customer Homepage at <http://www.lusthuset.se>

## AMW Consulting

Is a company specialized in model railroad electronics and IT infrastructure based projects. It provides consulting, implementation, training and sales on related goods. It is based in Vienna Austria.

## Lusthuset Layout Project Goal

A garden layout in northern part of Sweden will be set up with automatic operation. Visitors should enjoy a nice garden with a train on display. Operation should be automatic to offer as many movements as possible. Manual intervention by an operator or visitors should be always possible

### ZIMO DCC System and STP controlling SW

#### ZIMO

ZIMO was chosen because it is known in the market as high end solution for model railroad enthusiasts. This layout has many complex requirements; previous effort to solve it with other vendor's technology was given up.

The ZIMO system has a command station and peripheral devices to influence the layout. There are decoders in each loco which receive commands over the track, where they also pull the energy. DCC as a normed command language is used.

ZIMO inserts some cut out times into the flow of the track signal to send additional broadcast information to the locos. This offers the advantage to define speed levels independent from the actual loco address. This is different compared to all other train controlling systems. The user gains much quicker response of trains to new conditions and the controlling PC has less stress.

#### STP (Sperrer)

STP is a computer based train control program which offers the GUI of a mosaic panel. Like an controller engineer all commands are entered via push buttons which are here replaced with mouse clicks. It is possible to use a touch screen as input as well.

Complementing the prototype procedures STP offers automatic modes as well. In this case we heavily use that feature to offer automatic movements without user intervention.

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# Chapter 2

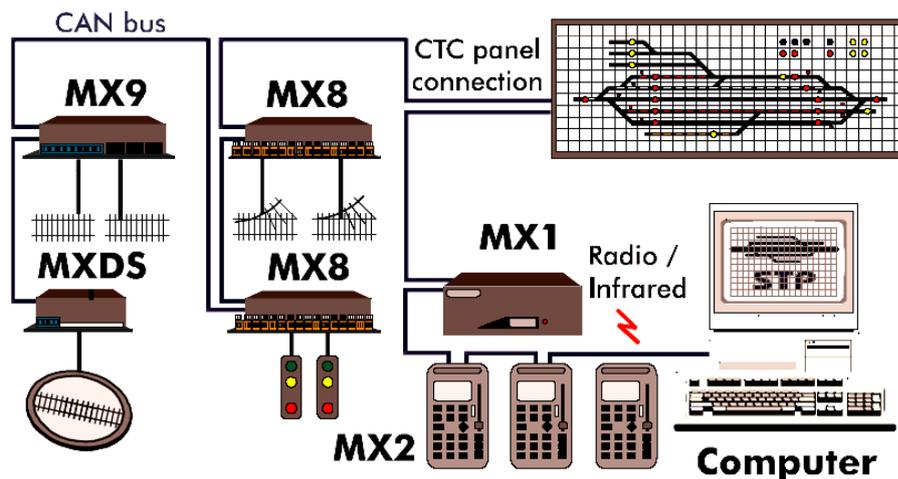
## Computer and HW Setup

The controlling equipment uses off the shelf components. An office PC is used to control and display all required actions.

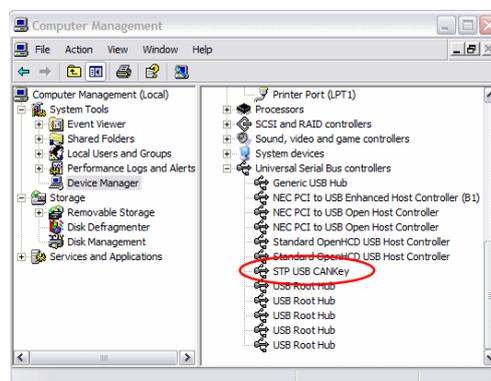
### PC Setup

A PC with Windows XP is used, Vista is supported as well. STP has a small disk footprint of about 10MB. It is recommended to have >512MB Memory and more than 500MHz PIII CPU.

The basic connection setup looks like the following plan:



Usual PC stability actions like updating all service packs and using a virus scanner are recommended.



There is a potential problem with the Microsoft Update Service. It may replace the CAN Key driver by a newer FT Serial Port driver. You may check this in the device manager. If the STP CANKey does not show up but a USB Serial converter is displayed instead, you have that problem. To fix it just double click on the entry and do a roll back. This will restore the CAN Key driver. There are also updates available in the download section of the STP WEB. Especially for Vista there is an updated version available. See <http://www.stp-software.at>.

## PC and Layout connection

The ZIMO system uses the CAN Bus as a interconnection transport system. The CAN Bus was developed for rough electrical industry conditions. Model railroads are usually “dirty” from an electrical point of view. The CAN Bus connects all peripheral components reliably together and forms the ZIMO system.

MX8 and MX9 which power turnouts and track sections get installed as near as possible to the actual usage point.

The connection to the PC is made via an interface. The CAN Key from Sperrer is used. It offers CAN connection to USB interface.

As the USB CAN Key has a ground connection to the PC via the USB cable, ground loops between the Layout and the PC can electrically happen. Usual environments with proper protective ground will not cause any problems. To avoid danger through thunderstorms it is recommended to disconnect the PC as a precaution.

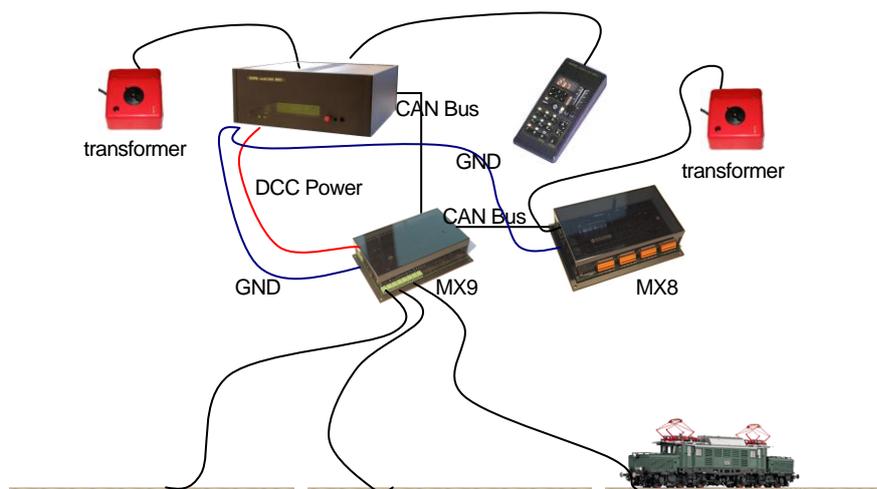
## Basic connection Principle

Connecting all components is rather simple. For a large layout like this project some precautions need to be applied.

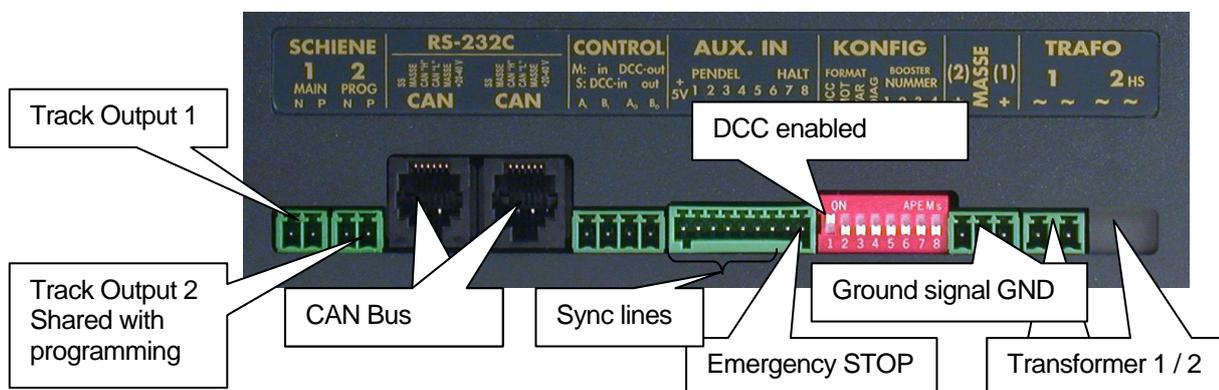
1. All components need to be connected to a ground signal. This ground starts at the MX1. The modules on the layout should all have their individual ground line. At least to each cluster of modules a star sized cabling for ground is recommended. The hub of the star is the MX1.
2. As far as possible MX9 section lines should run separated from the main DCC supply line. The sections should be supplied with  $0,75\text{mm}^2$  lines,  $1,5\text{mm}^2$  is recommended for long lines to avoid voltage drops.
3. CAN Bus is daisy chained through all devices. It is not allowed to build a star or a ring.
4. All MX modules require proper environment protection. Especially in garden layouts humidity is known to cause problems. Often overseen are damages caused by animals. Cables should be protected from mice. Ants are also a cause of problems when they decide to settle down in cabinets. It is recommended to seal all cable throughputs to the electrical components to hinder small insects to use them to settle down there.
5. MX8/9 drain the power for their own logic over the CAN Bus cable out of the MX1. The MX1 offers up to 2A current. This limitation and the thin wired inside the phone cables used to build the CAN Bus may require to provide additional power. Experience show that starting at 8 modules latest at 15 modules requires extra power supply. AMW offers the CAN Bus Power Module to do this in a convenient way.



## Connection diagram



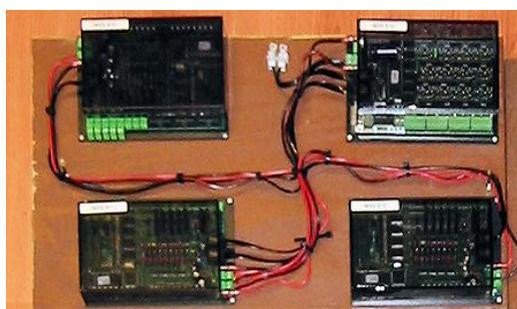
The MX1 offers all required connections at the rear side:



Most ZIMO Devices have 2 CAN Bus plugs. They are both equal wired 1:1 on the board. The can bus should be like a chain, all devices daisy chained.

For small distances ~30cm a star may be built. Never do a fork over longer distances. Reflections on the cable will cause hard to find problems.

## Module installation



It is recommended to install all modules humidity protected, morning dew may damage the modules. The layout was built up with installation boards, prewired in the office. On the actual installation point all cables to the individual Devices should be clearly marked to avoid misinterpretation.

Each device is additionally labeled with its individual address to allow easy identification.

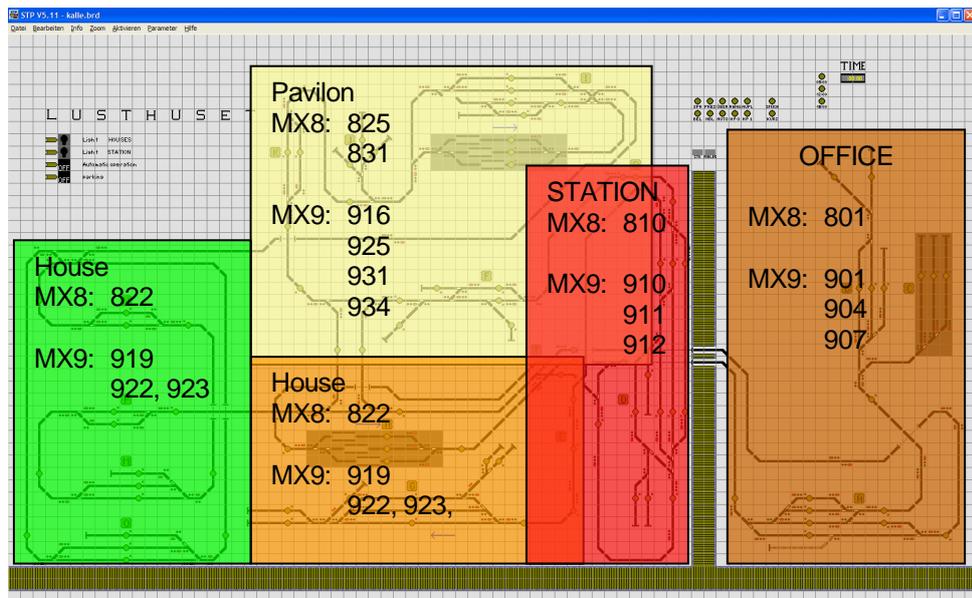
# Chapter 3

## MX8 and MX9 Modules

There are 4 locations on the layout where components are installed. Each location is responsible for some stations (marked with alphabetic letters) and surrounding track connections

### Track Plan

The plan shown underneath displays the supply areas of the layout. MX8 and MX9 are mounted offsite the layout in the office and some houses. There is a special house at station D inside the layout to keep distances short.



### MX9 Address and section number



Each MX9 has 16 sections. STP counts them continuously. The first MX9 has section numbers 1-16, the second 16-32. The list underneath summarizes the section numbers.

In this project MX8/9 got numbers which align them to a specific area. This makes it easier to identify each box. For a station up to 3 addresses got reserved. So the MX9 addresses used have some missing numbers as we do not always need 3 of them.

The table underneath shows the possible station indicators (A...U) at the first column. The second to fourth column lists the corresponding module address. The next 6 col-

umns show the start and end address of each line output for STP. This allows allocation of the right numbers.

Station	MX9 Addr			from to	from to	from to			
A	1	2	3	1	16	17	32	33	48
B	4	5	6	49	64	65	80	81	96
C	7	8	9	97	112	113	128	129	144
D	10	11	12	145	160	161	176	177	192
E	13	14	15	193	208	209	224	225	240
F	16	17	18	241	256	257	272	273	288
G	19	20	21	289	304	305	320	321	336
H	22	23	24	337	352	353	368	369	384
I	25	26	27	385	400	401	416	417	432
J	28	29	30	433	448	449	464	465	480
K	31	32	33	481	496	497	512	513	528
L	34	35	36	529	544	545	560	561	576
M	37	38	39	577	592	593	608	609	624
N	40	41	42	625	640	641	656	657	672
O	43	44	45	673	688	689	704	705	720
P	46	47	48	721	736	737	752	753	768
Q	49	50	51	769	784	785	800	801	816
R	52	53	54	817	832	833	848	849	864
S	55	56	57	865	880	881	896	897	912
T	58	59	60	913	928	929	944	945	960
U	61	62	63	961	976	977	992	993	1008

### MX8 addresses

MX8 are addresses similar to MX9. There is one extra 4<sup>th</sup> digit which indicated how the output lines should be used. To address an MX8 it needs to be at address 800, if not reprogram it to address 800. To set a address just program it to the desired address and add 2,3,4. Usually 2 is used to have 16 turnouts connected. 3 allows 8 Turnouts on the first 2 conectors and 16 lamps on the remaining ones. 4 is for 32 lamps.

### Testing correct cabling

It is important to verify correct cabling after installation. There are 16 section cables connected to one MX9, a mistake is easily made. The simplest verification is to push a loco over the track and watch changing occupation on the track plan. This requires an working STP definition and a laptop out at the layout.

As an alternative the cabs offer a feedback as well. Entering the MX9 address with <A> 9xx <A> calls up a MX9 monitor. 2 lines are displayed. An occupied section displays a block. The picture on the side shows MX9 901 with section 2A (the 3<sup>rd</sup> output) occupied.



ATTENTION the MX9 monitor does not work on a MX31FU in wireless mode to save bandwidth. It is necessary to operate the MX31FU in cable mode! Use a CAN Bus splitter temporarily to insert the MX31 for diagnostic purposes.

The turnouts can be tested by calling up the address for example <A>805<W> 5.1 should be displayed and then pressing the corresponding button to activate the turnout. To reach the next group of 8 turnouts press "W" again now 5.2 is displayed the 2<sup>nd</sup> group of 8 turnouts are now accessible. This works also on radio mode on a MX31FU.

## MX9 tips

This document should not replace the ZIMO documentation. Nevertheless I want to point out to some useful items in configuration which might get overseen in the documentation.

Setting a MX9 to address 900 allows reprogramming the MX9 address. It does NOT do a module reset. To clear all CVs inside, you need to set CV1=0. This causes all CVs reset to factory default. MX8 does not have a reset feature. A reset is recommended if the EPROMs are upgraded, just as a precaution.

MXAZN daughter boards are used to read the loco address. STP is able to remember that number and carries it forward also to sections where there are no readers installed. Loco addresses are used to display them on the panel. For STP they are used to identify locos and insert them into train groups. Train groups are finally used to define different behavior for trains. For example tracks that may not be used for short or long trains. Or a specific train should stay in a part of the layout and should never go to other areas. It is necessary that the loco address is read BEFORE a decision is made. Recommended locations are sections in front of automatic points usually before and behind stations. STP allows to save loco addresses during shutdown. If the layout is not modified during STP shutdown, the PC will know all addresses when it comes online.

MXALA can be used to drive up to 8 output lines. The MX9 is already there installed in the field. It is used to power 8 outputs to control light in houses or start other equipment.

## MX9 Fallback Solution

If a MX9 fails and needs to get returned, the whole layout cabling will be broken. To bridge the gap the MX9 Dummy may be used. It offers pass through connection for all connectors. It keeps the cables on place and allows continued operation of the rest of the layout. Of course the dummy module does not offer the MX9 functionality.



There are several MX9 Dummy modules on site. They may be used for temporary expansions as well. The layout cabling can be installed

## MX8 Issues

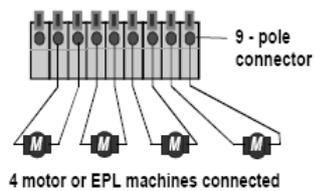


MX8 addresses are issued the same way as the MX9. Obviously there are never 3 MX8 required, so the holes will be much bigger. As there is enough space we stay with the numbering concept.

For EPL motors the MX8M type is required, the smaller MX8S is not able to reverse the current direction. This is necessary as the EPL motor has only 2 connections and works by reversing DC power to change direction. It has no end position switch, so only pulses NO permanent power should be used to operate it.

All MX8 are used as turnout modules for all output lines. They need to be programmed in the “.2” mode, see MX8 documentation for details. When the MX8 is addressed it is necessary to attach a 2 to the end of the address, for example 8252.

Each MX8 output sends a pulse to the attached device. The default pulse length is 200ms. Under rough conditions the energy transmitted during the 200ms may be too weak, the turnout may not operate reliably. Especially worn out EPL motors or some dirt inside may cause high friction. The best solution is always to clean the motor. Additionally the pulse time may be increased as well. This is done by reprogramming the MX8 CV515-518, each CV for one group of 4 turnouts. The value runs from 1-255 which is 100ms to 25 seconds. Do not use “0” that would mean permanent power which would overload MX8 and EPL motor!

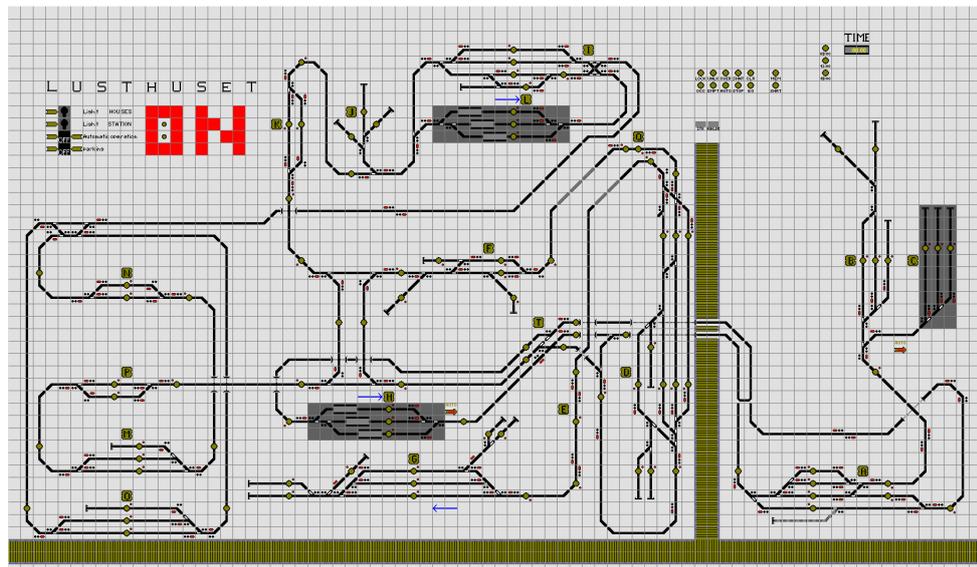


The first connection on the MX8 plugs carries (+) signal. For EPL motors this signal will not be used so please leave it open!

This chapter gives some basic STP usage advices and explains the specific situation in the Lusthuset layout. For further details about STP pls consult the STP manual

## Track Plan

The track plan follows the actual layout as far as possible. The brown stripes indicate the visitor path to the layout.



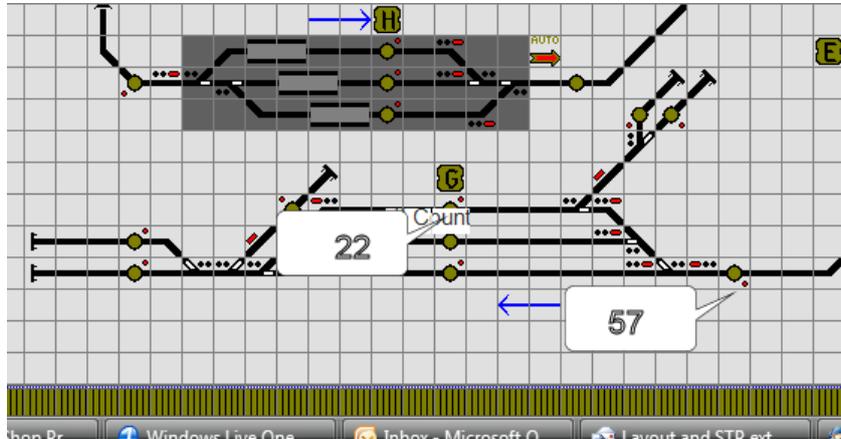
The red "ON" in the upper left corner of the layout indicates offline state. When STP goes online it turns green, executed via the S:0/1: route.

The gray shaded stations are hidden stations to park trains protected against rain during the night. There are special modes to collect trains, see details further down in section "Automatic Start and Stop Procedure".

As fallback solution if the PC fails there is a AOS based solution around station "A" using also a path through station "H". This allows movement of trains even if the PC fails for some reasons.

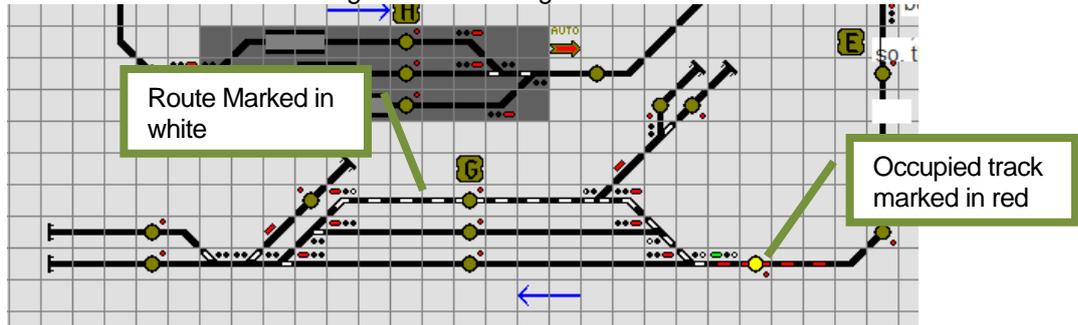
## Example to enter a station manually

This example shows how to use start and destination buttons to start a route in STP



This is station "G" on the front edge of the layout. Let's assume a train waits in front of the station. The loco has the throttle pushed up, so it will normally go. The <MN> button is switched off (LED does not blink) so the MX9 keeps the loco stopped. Now click on button 57 it will become red. Next, click on the button 22 or one of the other two others below it.

You should now see something like the following:



The red mark indicates that there is a train waiting. The white marked track shows the currently switched route. The turnouts should now be in the correct position and the signal at the entrance will turn green. As soon as that is established the MX9 will allow the loco to go. The loco should go into the station and stop at the end. As soon as the end is reached the route should be cleared up. As long as a route exists no other routes can be built up using a part of this existing route.

To clear a route manually right click on the start button (the yellow one). All existing activated tracks are cleared by entering "0 <enter>"

## Automatic Operation

STP tries to simulate a switchboard of the prototype. It executes routes on the layout. For the model railroader automatic functions got included, which are definitely not there in the real world.

This automatic stuff is started when a occupation changes. So if STP recognizes that a train runs from one section to another an automatic procedure can happen. Some conditions can be applied to allow more specific conditions.

Buttons have an indicator on the side. Green indicates that an automatic action is possible, red means it is switched off. A brown mark indicates that the automatic is currently running, or waiting that some track gets cleared up.

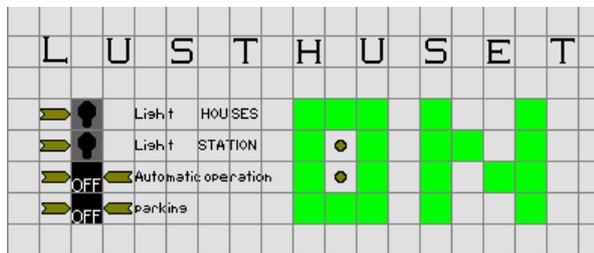


The STP programmer needs to make use of these conditions. Additionally it is possible to allow the execution of automatic modes only for specific train groups. This offers limitation of DCC addresses to specific parts of the layout.

## Automatic Start and Stop Procedure

When STP goes online it automatically executes a startup procedure. The Code is S:0/1:. Several commands are executed here. Parking positions in station H,L,C are freed up, many automatic buttons are set to green.

The STP Screen has a big ON sign which turns green when STP is on online mode:



There are more buttons, on the left lower side of the picture above. Pressing the brown buttons executes procedures where automatic functions get enabled / disabled to set the layout in the desired state.

The parking line enables collecting trains in the shadow stations to prepare for shut-down. The automatic buttons in the corresponding stations will be set to red. Now all trains are caught here. The ON / OFF sign shows the condition. HINT: a turnout symbol is misused for this.

The line above enables automatic mode. This is enabled via the S:0/1: procedure as well. It allows automatic mode of the layout. For manual operation it can be switched off easily with this two buttons.

Similar activities are planned with the 2 light buttons above. Currently there is no function behind it. The layout has no cables installed as well.

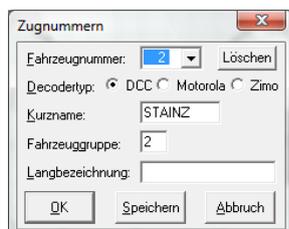
## Train Groups

Train Groups are used to allow selection of trains to do different things. For example stop at a specific station or running through.

Number	Usage or Name	Action Behavior
1	Train Bus	Stops in small station other trains run through
2	Short Passenger	
3	Long Passenger	
4	Short Cargo	
5	Long Cargo	
6		

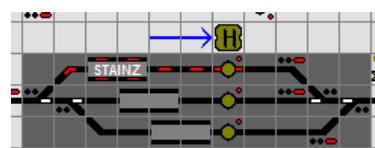
As an example in station “Q” only the Train Bus should stop. All other trains should run through. Or no long trains should exit station D in direction to E as station G has no capacity for long trains.

To allow STP to select train groups it is necessary that STP knows the DCC address of a train. Normal operations are independent of the DCC address, one of the big advantages of signal influenced train operation.



To set a train group just right click on a occupied track and enter the required information. If you enter a short name as well STP will display that name in the loco number fields instead of the normally shown DCC address.

To avoid mistakes it is best to do the assignments on a track with a loco number field. The updated information is im-



mediately displayed. Keep in mind that only limited space is available in the display field. The loco number is displayed as well for **any** track section in a field on the upper right corner, if the mouse pointer is moved over it. The picture to the left shows this situation. The loco text “STAINZ” is displayed here while the mouse was pointing to a section where loco number 2 was causing an occupation.

## Error conditions

### Can Key blinks strange

Just unplug the USB and CAN connectors wait a few seconds and reconnect it again

### STP complains about missing connection to modules

Either the Module is not installed or a cable is disconnected or broken. Remember the module address STP is complaining about and check the HW.

### Error Message in status bar or extra window

In STP.INI you can specify where error messages are displayed. `MessagePos=x` where `x=1` means lower window border, `x=2` upper window border, `x=3` popup window.

### Error field displays a number

As soon as STP recognizes a CAN Bus problem it will display the address in the error field. Under normal conditions this field should be always empty. An address here indicates that this module did not answer. This is usually caused by broken cables. The module may be damaged as well of course.



The MX1 has offers an PC independent automatic operating sequence.

### AOS

AOS is used to offer an backup solution, just in case STP fails. AOS works like a tape deck. It records all user inputs and plays them back. To adopt to changing environment conditions it is possible to synchronize the playback via 8 input lines. Usually reed contacts along the track are used.

### Setup

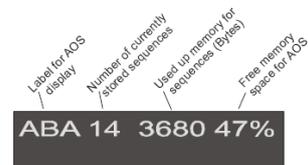


There are 10 addresses from 790 to 799 with 9 buttons available, this gives 90 individual recordings. The recording is limited by available space inside the MX1!

To record a AOS enter <A>7xx<A>, where xx is between 90-99. All 9 keys are now displaying the condition where green means no recording behind the key and yellow indicated that this key has a AOS recorded.

To record a new AOS press an green key, it starts flashing red. Now exit back to the loco which should be driven. You do this with <A>loco number<F>. Do drive the loco. When the recording is done return to the AOS procedure with <A>7xx<A> and press the red flashing key, it should stop blinking and stay yellow – you are done!

During recording and playback when a sync switch is touched the MX1 displays a information. Pay attention to the free memory display. If the MX1 is out of memory no further recordings can be done. To save memory, try to avoid changing the speed by doing slow increments. This causes continued data change resulting in memory usage. It is recommended to set the speed and let the loco go.



To increase reliability, it is recommended to change the speed a bit after a sync point has been passed. This allows the MX1 to change the speed of the loco at this point. Doing that increases precision of halt points, as timing and speed are resynced to that location. The Exx information in the MX1 display informs which sync line was triggered. The information stays in the display for some seconds.

Hint: there should be no other AOS running at this time. If there is another AOS on playback the commands there will be recorded as well. This will usually cause unwanted effects!

If the memory is full you may see the following display: where 2 means no changes in AOS possible and ERR 3 indicates full memory. Just delete unused AOS sequences. They easily collect up behind the 10 possible addresses!

```
ABA ERR 2
MU 2.5 E02 3276
```

ATTENTION: clearing the memory of the MX1 with CV24=111 will delete all AOSes as well! There is a plan to backup and restore that data via ZST in a future version.

## Playback

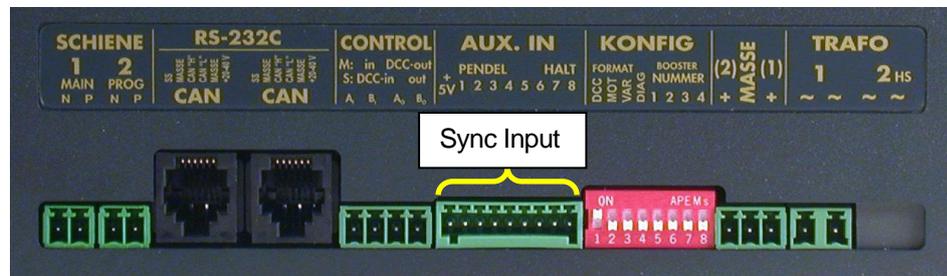
Enter <A>7xx<A> and select the key you want to play back. During playback the key flashes yellow.

To stop a AOS press the key again, the AOS will be stopped at the end of the recording. During that time the LED flashes red. If you want to immediately stop the AOS press the key twice! The LED is yellow again the AOS may be restarted any time.

It is possible to execute multiple AOS at the same time, remember do not do this for recording!

## Sync contacts

Any signal on one of the 8 input lines of the MX1 can be used.



Usually a reed contact from one of the track sides to the MX1 input is quite handy to do that. The cable from the reed switch to the MX1 may be a thin cable, there is no power requirements on it. Try to keep it away from DCC or track power cables. Alternatively short insulated track sections can be used as well. This would mean 2 cuts in a track which may cause some mechanic problems on garden layouts.

The input line 8 is used as a emergency stop. It is recommended to offer emergency stop buttons on convenient locations all over the layout. All buttons may be wired parallel. The other side of the button may be a track signal as well. CV38 of the MX1 should be set to CV38=2 which is common stop or CV38=3 which is track power off.

The other CVs for lines 1-7 CV31-37 should be set to "0" this means AOS sync point. No further CV programming is necessary the MX1 recognizes the usage automatically.