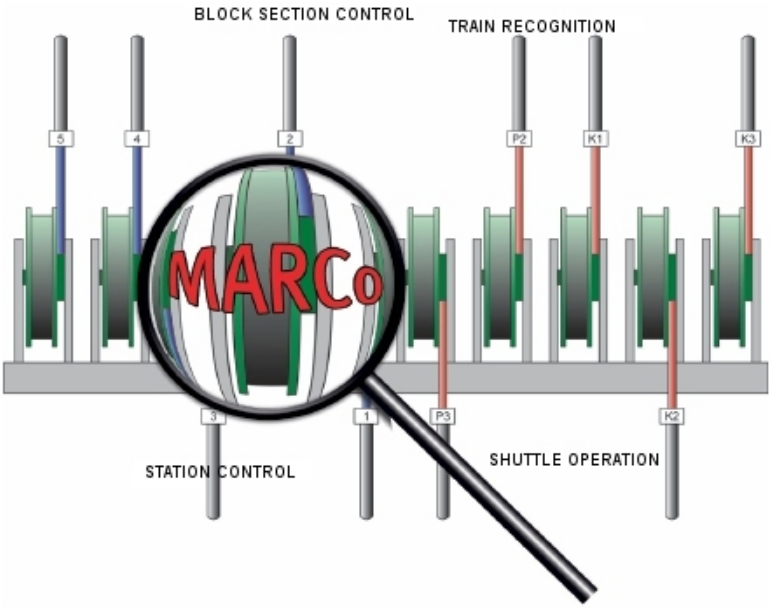
MARCo

Automation with RailCom®

Handbook



Uhlenbrock digital

RailCom by Lenz Elektronik GmbH

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1. MARCo – Modular Automation with RailCom®

Finally, your digital layout can have all the things that have been possible on analogue layouts for a long time. MARCo fulfils the demands of railway modellers, who wanted to have simple automatic control of their layout, with block systems and auto-reversing, a digital system which up till now needed the aide of a computer.

1.1 MARCo does this on a digital layout:

MARCO consists of an Infrared sender, which is installed under a vehicle, and one receiver module with its two Infrared detectors built into the track. The locomotive address, train category, speed and travel direction are detected by the infrared receiver and conveyed via the LocoNet. Additionally, without the use of a computer, some automatic control functions are possible.

- **Train recognition**
  MARCo recognizes the locomotive and indicates which train has pulled into a track at the station.
- **Shuttle train control**
  MARCo steers a shuttle train into the terminus of a single-railed branch line.
- **Locomotive-dependent shadow-station control**
  MARCo administers your shadow-station, finds an independent track for each individual train and if necessary automatically dispatches it again from the shadow-station.
- **Digital Block control**
  MARCo is a new style of block system for digital layouts and controls the blocks on the layout automatically, without the necessity of a computer.
- **Holding Point**
  MARCo stops the train at a station on the branch line and allows it to drive on after a configurable time.
- **Starting and brake delay at signals**
  MARCo brakes and stops each digital locomotive at a red signal, with the decoder's internal brake.
- **Automatic control of locomotive auxiliary functions**
  MARCo switches on the situation-dependent sound of locomotives, e.g. the whistle before entering a tunnel or the horn at a level crossing. MARCo turns OFF the sound of locomotives equipped with "IntelliSound" while they travel in invisible areas (shadow-station, tunnel).
- **Locomotive-dependent switching from solenoids and routes**
  MARCo switches the light of a particular locomotive ON or OFF after a specified time, e.g. if the engine driver has turned the locomotive OFF
- **Locomotive-dependent Speed influence**
  MARCo controls the speed of locomotives, e.g. on entry to a station or along slow sections of track
- **Programming of decoder CVs**
  MARCo can read and program CVs of RailCom capable locomotive decoders and RailCom transmitters, while they are running on the main line.

1.2 How MARCo operates

MARCo is an automation system, based on the RailCom® Technology, which represents a bi-directional feedback system. Simply stated, the locomotive sends its address to the track and in return receives new driving instructions from the track. The information is therefore transferred from locomotive to the track. A detector which can receive this information is connected to the track Gleis. So that the information can be transferred, the digital signal and the booster must allow a corresponding gap in the DCC digital signal (e.g. Power 4, Part No. 63240). This gap is known as “Cutout”. If the detector has received the information, it is passed to the MARCo-Receiver. The MARCo-Receiver reacts with its programming and then sends, e.g. new locomotive instructions across the LocoNet to the Intellibox. The center puts the instructions into a DCC signal and then sends it to the locomotive decoder via the track, which then controls the locomotive with the new information.

The RailCom Technology functions exclusively with the DCC data format.

The locomotive information is sent from a RailCom transmitter or a RailCom capable locomotive decoder. The RailCom transmitter is described in the MARCo system as MARCo transmitter. This MARCo transmitter in a vehicle is contacted via a digital address like a locomotive decoder. The address is sent via the track to the MARCo receiver.

The MARCo-Receiver can have different instructions to change speeds, to switch locomotive functions (e.g. Sound) or to switch from turnouts, signals or entire routes, that are stored in the Intellibox. The instructions are implemented or not, depending upon the recognized address. Furthermore, the MARCo-Receiver can switch routes in the IB-Switch, or control a PC program, through track occupation reporting. The MARCo-Receiver recognizes a locomotive’s address, and scans all stored instructions to determine if there is one to do for that address.

Since the MARCo receivers can be installed anywhere in the vehicle, i.e. not centrally located, it forms a modular assembly. This has given the system its Name: Modular Automatic for RailCom - MARCo.

The MARCo-Receiver can also be set up for different kinds of complex automatic operations, e.g. shuttle-track or Block-section. In this instance it implements functions without being programmed for a special vehicle. Thus it becomes a terminus for shuttle trains, which stop and after a waiting period, pull out again in the opposite direction, independent of the train’s address. It is also suitable for monitoring or setting of signals. In a section block all trains will drive through on a green signal, stop on a red signal.

Each MARCo-Receiver has a clear receiver address (base address). It can be identified by this address by the Intellibox at any time. It is also possible to read or reprogram this address.

2. Quick Installation

The following steps explain how you can very simply fit your MARCo transmitter and MARCo-Receiver and obtain your first results. Preferably these steps are carried out with the help of a small test track, which is separate from the layout.

IMPORTANT! Read through the manual step by step to familiarize yourself with all functions and capabilities of the MARCo system. After each section work through the small example, in order to complete your understanding of the operation of MARCo.

Conditions:

In order to work through the examples listed in the following section, you need the following:

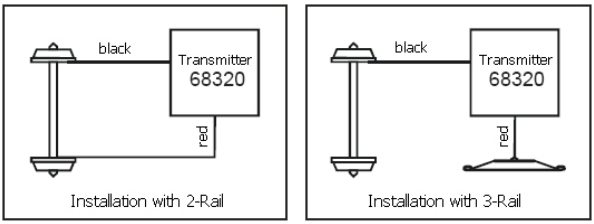
- Intellibox with Transformer e.g. 70VA transformer Part No. 20 075
- Power 4 Part No. 63240 with Transformer e.g. 70VA transformer Part No. 20 075
- MARCo set consisting of two MARCo transmitters 68 320, a MARCo-Receiver 68 500 and a LocoNet cabME2.15 m.
- DCC Locomotive decoder

NOTE

- *You can work through the examples with any Intellibox without problems. However, should you wish to program your MARCo-Receivers later, you will need an Intellibox (from firmware version 1.3) or Intellibox-Basic or IB-Com, or Intellibox II (recommend from System software version 1.011-1.011).*
- *You will find the version of the Intellibox system firmware in the basic menu under software version. Firmware updates are available for download from our InterNet site - www.uhlenbrock.de*

2.1 Installation of a MARCo transmitter 68 320

Attach the MARCo transmitter to the digitalized DCC locomotive with the enclosed double-sided tape. Take care that no short circuit occurs between the transmitter and chassis. If you do not have space under a locomotive for the MARCo transmitter (particularly in N gauge) the MARCo transmitter can be mounted under a wagon, in which case that wagon and locomotive *must* be used as a unit.



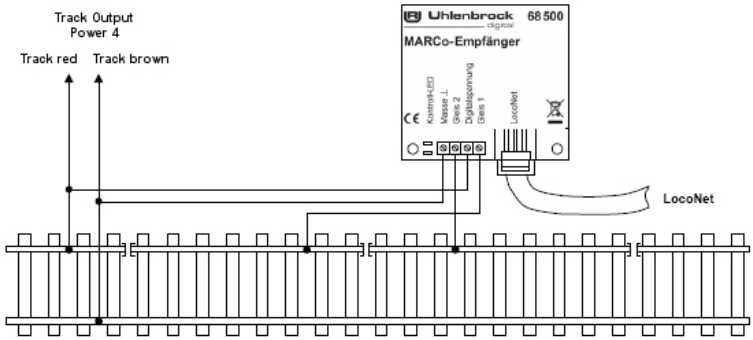
Connect the wires of the MARCO transmitter to the power pickup of your locomotive: the red wire with the right (isolated) pickup of its locomotive, the black wire with the left (non-isolated) pickup.

2.2 Installation of MARCo-Receiver 68 500

Connection of MARCo-Receivers

Every MARCo-Receiver is connected to the track output of the RailCom capable Booster (here Power 4). Two track sections can be connected to each MARCo receiver. Isolate the track sections which are to be monitored from the rest of the layout. Connect the first section in the travel direction to input Gleis 1 (track 1) and the second to input Gleis 2 (track 2). The length and position of the isolated sections depend on the selected function and the type of traffic the receiver is to control (e.g. acceleration and braking) of your locomotives. A locomotive should always fit completely into the section. If, for example, only simple switching processes are to be executed, short sections are sufficient. If, on the other hand, precise stopping is to be implemented (chap. 7.5.2), the first track section must be long enough to allow the locomotive with the longest braking distance to brake fully before it reaches the second section.

***Important**: Insert the isolation breaks into the side of the track that is connected to the digital power's red wire (3-Rail track, the centre rail). The 'earth' wire (brown) remains without isolation.*



***Note:** If multiple boosters are used then take care to ensure that the chassis connections of all the transformers are connected together, to ensure trouble free operation.*

Mounting the MARCo Receivers

Mount the MARCo receivers under the layout in proximity to the track sections. For this you position the MARCo-Receiver under the layout baseboard. Mark the mounting hole of the module. Turn two round screws (round head ⌀2.5 x 10) far into the board so that the notches in the MARCo-Receiver slide over the screws. Then turn the screws tight.

Now connect the track power and track sections, according to the description, to the terminals of the MARCo receiver.

Connect the module to the LocoNet T-Socket of the Intellibox with any LocoNet. Upon complete connection the control LED on the MARCo-Receiver will light momentarily.

***NOTE:** With larger distances you must eventually extend the LocoNet cable to the Intellibox. You will find accessories for the LocoNet in our catalogue.*

2.3 First test drive

Each freshly inserted MARCo transmitter has a digital address just like a locomotive. The preset address is 3. As the locomotive and the MARCo transmitter must have the same address, place the locomotive on the programming track of the Intellibox and program the locomotive address with a DCC Programming (DCC byte or register programming).

The MARCo-Receiver has the factory set module address of 1 and has two switching functions programs. For each recognized locomotive it switches the front light ON when running in one direction and OFF when running in the other direction. When driving the locomotive or wagon past the detectors, the control LED of the MARCo-Receiver should light up briefly.

Call up the just programmed locomotive address on the controller and drive the locomotive into the first track section: the control LED of the MARCo-Receiver should light up briefly. When driving into the track section, the locomotive's front light should change state. It switches ON when driving from section 1 to section 2 and/or OFF when driving from section 2 to section 1. If testing with a wagon (without front lighting), observe the state of the indicator LED of the "function" key on the Intellibox. It changes when driving into the section.

If nothing happens, examine the individual steps of the instructions again:

- Did the MARCo-Receiver control LED blink as it was being connected to the LocoNet?
- Are the four connections and the LocoNet correctly connected?
- Did the control LED blink when the vehicle entered the section?

3. MARCo transmitter

MARCo infrared transmitters are used for all vehicles that are to perform control functions and in which there are no RailCom capable decoders. They send locomotive addresses ranged 1 to 9999. They can also be mounted (e.g. Control wagons) and send the same address as that in the locomotive in this arrangement.

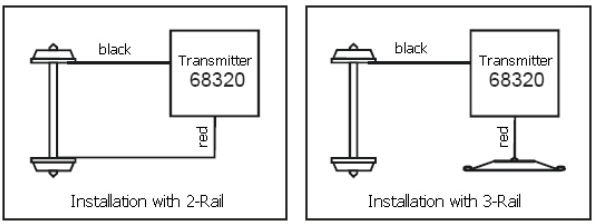
3.1 Technical Specification

The MARCo transmitter 68 320 has its own processor and can therefore be installed in any desired DCC digital locomotive. If a mixed LISSY/MARCo operation is wanted a LISSY Mini-transmitter 68 400 can be connected to the MARCo transmitter then this sends same address as the MARCo transmitter.

Property	**68 330**	**68 400**
Dimensions	13.1 x 7.5 x 1.9mm	7 x 5.1 x 1.7mm
Used with	Any desired DCC loco decoder	Loco decoder with LISSY Output MARCo transmitter
Short address	Preset to 3	same as decoder/MARCo address
Long address	Preset to 2000	same as decoder/MARCo address
Locomotive addresses	1-9999	1-9999
Programmable	With DCC centers	-

3.2 Installation and Connection

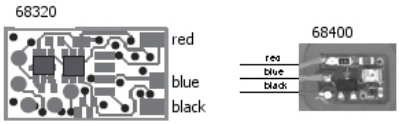
Attach the MARCo transmitter to the underside of the DCC digital locomotive with the enclosed double-sided tape. Ensure that there us no shorting between the transmitter and the chassis. If there is not enough space under a locomotive for the MARCo transmitter (particularly in N gauge) the MARCo transmitter can be mounted in a wagon, in which case that wagon and locomotive ***must*** be used as a unit.



Connect the wires from the MARCo transmitter with the power pickups of the locomotive: The red wire to the right (insulated) of pickup and the black to the left (non-insulated) pickup.

3.2.1 Connecting the LISSY Mini-transmitter 68400

Connecting the LISSY Mini-transmitter to a locomotive decoder is done according to the instructions for the particular decoder manual. The LISSY Mini-transmitter 68400 can be connected to the MARCo transmitter 68320 according the the following diagram.



3.3 Programming and Reading

The MARCo transmitter 68320 can be programmed with the Intellibox, on the programming track in. The MARCo transmitter stores its information exactly like a DCC locomotive decoder in CVs and/or registers as in the following table:

CVs Loco	CVs MARCO	Meaning	Value Range	Factory default
1	116	Short address	0-127	3
17	117	Long address High byte	192-231	199
18	228	Long address Low byte	0-255	208
29	129	0=Short address valid, 32=Long address valid	0-32	0

Programming of long Addresses without Programming Menu

If the MARCo transmitter is not installed in a locomotive with digital decoder (e.g. in a Wagon), then the long address can not be programmed from the Intellibox Programming. CVs 117 and 118 must be calculated and individually programmed.

Here is a guide for programming address 2000.

- Divide the address value by 256 (2000:256 = 7 remainder 208).
- Take the whole number result (7) and add 192.
- Enter the result (199) as the value in CV 117 (Factory default).
- Enter the remainder (208) as the value in CV 118 (Factory default).
- Important: Set CV 129 to 32, so that the decoder uses the long address.

TIP: *If you do not wish to calculate the values for CVs 117 and 118, then if you have a locomotive with the same address, you can read the values of CVs 17 and 18 in the locomotive decoder and program them into CVs 117 and 118 of the MARCo transmitter.*

Important*:* Set CV 129 to 32, so that the decoder uses the long address.

It is also possible to program the the decoder using mainline programming from a digital center while it is driving around. The precise method is carried out according to the manual for the center.

If the MARCo transmitter is installed it is programmed, together with the locomotive, using the CV programming according to the column “Locomotive CVs”.

The MARCo transmitter can also be programmed separately from the locomotive, when the CVs are programmed according to the column “CVs MARCo”.

ATTENTION: *There are some locomotive decoders that also use the CVs from the “CVs MARCo” column but for a totally different purpose. In this case the MARCo transmitter can only be programmed separately from the locomotive.*

The MARCo transmitter CVs can also be read with the Intellibox (see Intellibox Handbook). If it is installed in a locomotive with a decoder it is always read together with that decoder. This can lead to error reports especially if the locomotive decoder and MARCo transmitter have different values in the CVs. In this case the locomotive decoder must be disconnected from the power pickup, i.e. remove the decoder’s plug from its socket. Reading of the values from a MARCo transmitter is similarly possible.

NOTE: *For programming the decoder, the vehicle must always be on the Intellibox programming track alone. If a number of vehicles are on the programming track then all locomotive decoders and MARCo transmitters are programmed the same!*

3.4 Train categories

With the Intellibox II (from Software version 1.011 - 1.011) and the MARCo-Receiver, 15 train categories can be used. Since the MARCo transmitter does not send train categories, a linking mechanism in the Intellibox II between locomotive address and one of the 15 train categories is used.

Categories are different identifiers with which vehicles can be divided into different groups to use for control on you layout: for example passenger trains, freight trains, express trains, regional trains, special trains.

The MARCo-Receiver executes its stored instruction not only depending on recognized addresses but also because of individual categories.

The categories can be freely selected. Your fantasy is no boundary for this.

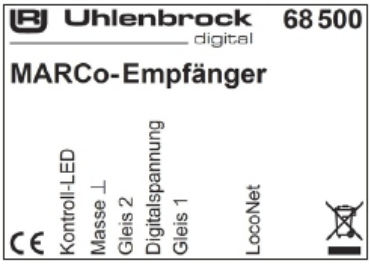
4. MARCo-Receiver

MARCo receivers are always installed where control functions are required on the layout.

The MARCo-Receiver is a high-quality, electronic circuit in a small housing. Do not remove electronics from the housing, as this could cause damage.

4.1 Technical Specification

All MARCo-Receivers have an address range of 1 to 4095, are programmable with the Intellibox II, Intellibox I (from Version 1.3), Intellibox Basic, IB-Com and TwinCenter. Data transfer takes place via the LocoNet.



In every MARCo-Receiver there are two detectors. If the isolated track section, to which the detectors are connected, are located directly behind each other (Operating as Double detector), then direction dependent instructions can be programmed into the MARCo Receivers, i.e. the one direction different instruction can be execute than in the other direction. You also have the possibility to locate the track section at different locations on the layout (2 single detectors). So you can program one receiver for two different locations which then are independent of direction.

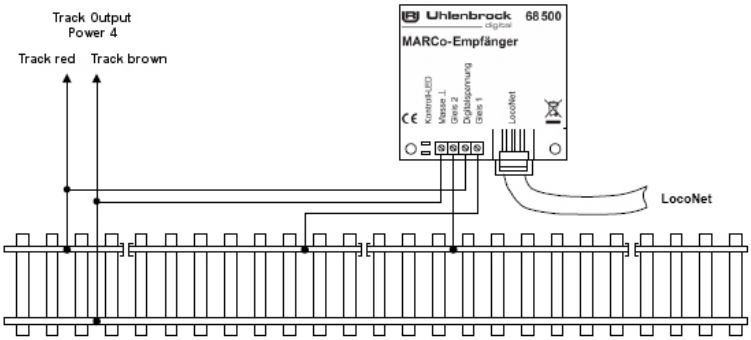
Property	**68 500**
Dimensions in mm	53 x 50 x 21
Address rage	1-4095
Automatic operations	12
Travel direction independent functions	yes
Travel direction dependent functions	yes
RailCom detectors	2
Switching commands per double detector	30
Switching commands per single detector	15
Current load on LocoNet	approx. 25mA
Module address ex-factory	1

4.2 Installation of MARCo-Receivers 68 500

4.2.1 Connecting the MARCo-Receivers

Every MARCo-Receiver is first connected to track power from a RailCom capable booster (here Power 4). Two track sections can be connected to each MARCo-Receiver. Isolate the monitored track section from the rest of the layout. Connect the first track section, according to driving direction, to input Gleis 1 (track 1) and the second to input Gleis 2 (track 2). The length and position of the isolated sections depend on the selected function and the type of traffic the receiver is to control (e.g. acceleration and braking) on your locomotives. A locomotive should always fit completely into the section. If, for example, only simple switching processes are to be executed, short sections are sufficient. If, on the other hand, precise stopping is to be implemented (chap. 7.5.2), the first track section must be long enough to allow the locomotive with longest braking distance to brake fully before it reaches the second section.

Important: Insert the isolation breaks into the side of the track that is connected to the digital power's red wire. The 'earth' wire (brown) remains without isolation.



NOTE: *If multiple boosters are used take care to ensure that the chassis side of the supply transformers are coupled so as to perform without interference.*

4.2.2 Installing the MARCo-Receivers

Fasten the MARCo-Receiver in the proximity of the detectors under your layout. Position the MARCo-Receiver under the layout board and mark the mounting holes of the module. Turn two screws (round head screws Ø 2.5 x 10) so far into the board that they will still push into the slots of the MARCo-Receiver.

Now connect the track power and the track sections to the terminals of the MARCo-Receiver in line with the labelling.

Connect the module to the Intellibox LocoNet T-Socket with any suitable length LocoNet cable. With correct connection the MARCo-Receiver's control LED will light up for a short time.

4.3 Connection the MARCo-Receiver to the LocoNet

Connect the enclosed LocoNet cable between the modules with the LocoNet socket on the Intellibox. With larger distances you may need to extend the LocoNet cable to the Intellibox. In our catalogue you will find suitable accessories.

When connected correctly the MARCo-Receiver control LED will always light up when a vehicle enters a MARCo track section.

IMPORTANT: *Before installing the MARCo-Receiver it is important to set the decoder to another address in accordance with Chapter 5. The receiver is factory set to address 1. If several MARCO receivers are attached to the LocoNet with same address, it will no longer be possible to access them individually.*

4.4 MARCo-Receiver Programming

After installation and connecting, but prior to programming a MARCo Receiver, it is important to check if it is functioning correctly, and that the Intellibox is able to communicate with it.

As described in chapter 4.3, the MARCo-Receiver signals recognition of a vehicle in its section by flashing its control LED. If this occurs, the MARCo-Receiver and detectors are connected correctly.

To verify correct installation the MARCo-Receiver can perform a few preset instructions. These are factory preset. MARCo receivers switch the front light of any locomotive 'ON' when it passes from detector 1 to detector 2 and in the other direction, from detector 1 to detector 2, Should this be detector 2 to detector 1 'OFF'.

If you drive a locomotive with a MARCo-transmitter into a track section from the MARCo-Receiver you can test the operation of the MARCo-Receiver, by calling up the locomotive's address on the Intellibox, noting the light function. This will be switched on and off.

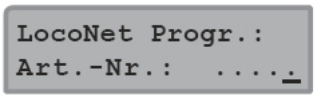
To program a MARCo-Receiver an Intellibox (650, 65000 or 65050 with Software Version from 1.3) or Intellibox II (65100, all Software Versions) is required. Information about the Version of the system software for the Intellibox (650, 65000 or 65050) is found in the Basic Settings Menu under Software Version. You can download Software Update from our internet site www.uhlenbrock.de at any time.

4.4.1 Programming with the Intellibox (650, 65000, 65050)

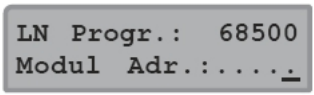
4.4.1.1 Selecting a MARCo-Receiver

Programming the LocoNet CV's

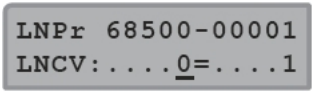
- Ensure that the receiver is correctly connected to the LocoNet.
- Press the Intellibox [menu]-key followed by the [mode]-key.
- Step through the menu options with the [↓]-key to locate "LocoNet Prog.".
- Step into the submenu with the [→]-key.



- Enter the part number of the receiver (here 68 600) and press the [↵]-key.



- Enter the address of the receiver (in this case e.g. 1) and press the [↵]-key.



The top line will display the part number of the receiver and its address. The lower line will indicate LocoNet CV (in this case "0" as the module address) and its present value (here 1). The cursor will flash under the "0" on the lower line. The top line will remain unchanged during entire programming period. To confirm that the MARCo-Receiver is communicating correctly, the control LED will flash.

4.4.1.2 Programming and Reading

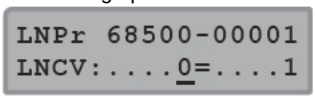
The MARCo-Receivers are configured with the Intellibox in a similar way to the locomotive decoders, i.e. by adjusting various configuration variables (CV), e.g. the instructions called up as a MARCo transmitter passes the detectors. In order to differentiate MARCo-Receiver CVs from Locomotive decoder CVs, receiver CVs will be referred to as LNCVs, because the receivers are connect to the LocoNet and not the track.

If the cursor flashes in the LNCV area, the number of your MARCo-Receiver LNCV can be entered. Then press the [↵]-key and the value of the selected LNCV will be read from the receiver.

With the [←]-key move back to the LNCV number for the next LNCV you wish to configure. Pressing the [←]-key will take you back to input another receiver address, if a further MARCo-Receiver is to be configured. The [menu]-key will take you out of LocoNet programming mode

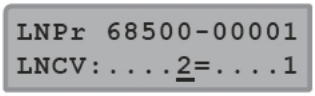
Method:

- After calling up the desired MARCo-Receiver you see the following display:

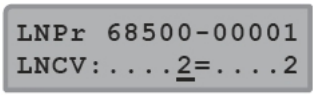


  LNCV 0 (module address) is displayed with value is 1, and the cursor flashes under the 0.

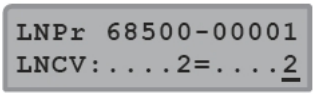
- At the cursor position enter the LocoNet–CV number using the numeric keys on the Intellibox, e.g. 2 to select the operating mode



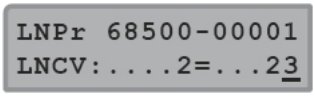
- Press the [↵]-key display the value of the LNCV. Value is displayed.



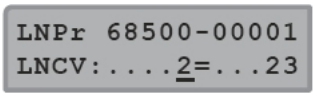
- Press the [→]-key to move to the value.



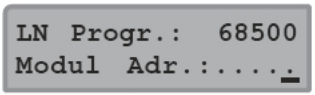
- Enter the desired value for this LNCV, e.g. 23 to select function Block status reporting.



- Press the [↵]-key and the changed value is programmed.
- Press once [←]-key to select of another LNCV.



- Press twice [←]-key to select of another MARCo-Receiver.



- To terminate programming mode the press the [menu]-key.

TIP: *As you become accustomed to the Intellibox, numerical values at the cursor position can also be changed by using the [+] and [↓] keys to count up or down respectively.*

NOTE: *When programming a MARCo-Receiver all previous programming will be erased from memory.*

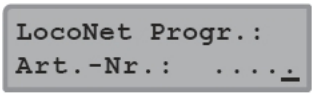
4.4.1.3 Universal address

As you saw above, a MARCo-Receiver can only have its configuration read if it is selected under its module address (LNCV 0). It can thereby by be differentiated from all other MARCO receivers on the layout.

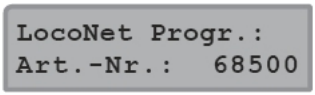
What if you have forgotten the address of a MARCo-Receiver? In this case the Universal address 65535 will help.

Procedure

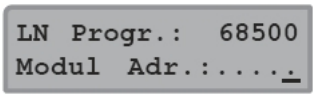
- Connect only the MARCo-Receiver with the unknown module address to the LocoNet T-Socket, i.e. without any other MARCo-Receivers.
- Press the [menu] key followed by the [mode] key in order to enter the Basic Settings Menu.
- With the [↓]-key move to the menu "LocoNet Prog." option
- Press the [→]-key



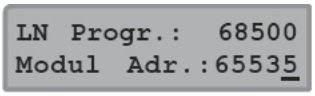
- Input the MARCo-Receiver part number 68 500



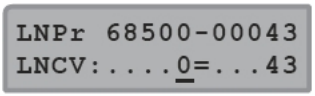
- Press the [↵]-key



- Input of the Universal address 65,535



- Press the [↵]-key
- The display will indicate LNCV 0 with the programmed module address.

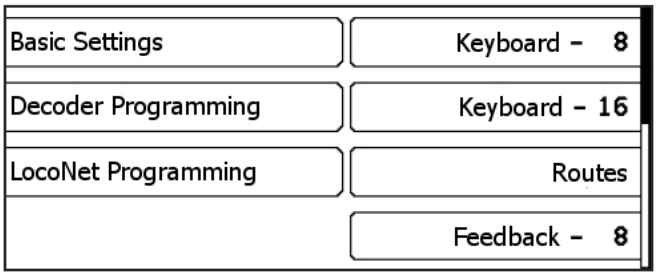


This address can now be changed or maintained. The MARCo-Receiver then be reconnected to the layout.

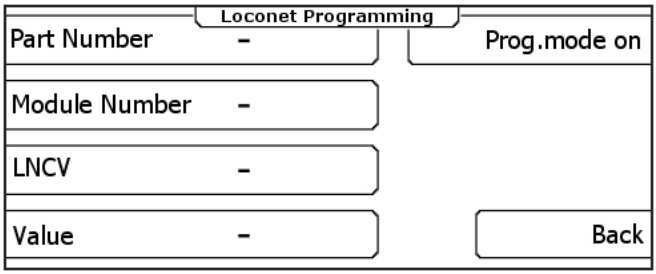
4.4.2 Programming with an Intellibox II (65100)

4.4.2.1 MARCo-Receiver selection

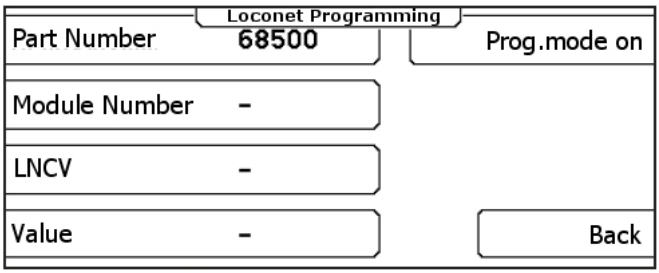
- Press the [mode]-Key, to get to the Main Section menu:



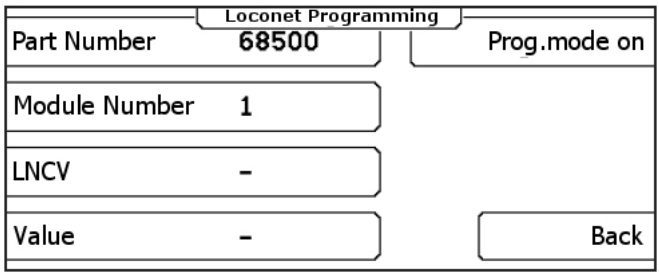
- Press the “LocoNet Programming” button:



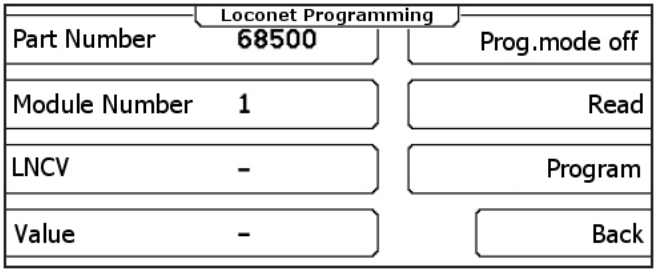
- Press the “Part Number” button, enter the MARCo-Receiver part number 68500 and press the Enter key [↵]:



- Press the “Module Number” button, enter the MARCo-Receiver’s module number (Factory default “1”) and press the Enter key [↵] :



- Press the “Prog.mode on” button:



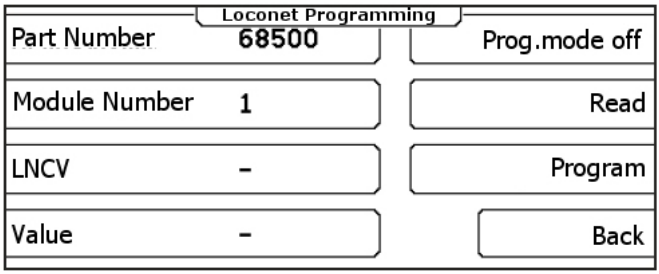
- Now the MARCo-Receiver is in programming mode. One of the blue LEDs blinks and you can program and read the MARCo-Receiver LNCVs.

4.4.2.2 Programming and Reading

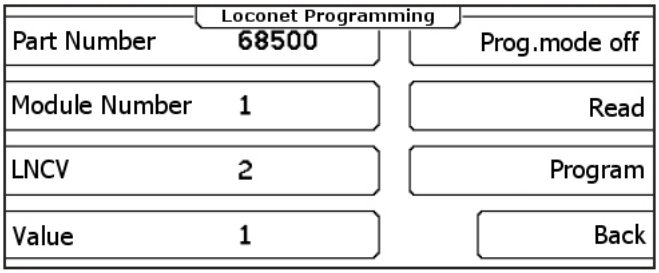
Similar to locomotive decoders, MARCo-Receiver programming is done with a variety of Configuration variables (CV). To distinguish locomotive decoder CVs from the CVs in the MARCo-Receiver, the latter are known as LocoNet-CVs (LNCV), since they are not connected to the track, but to the LocoNet in the Intellibox.

Method:

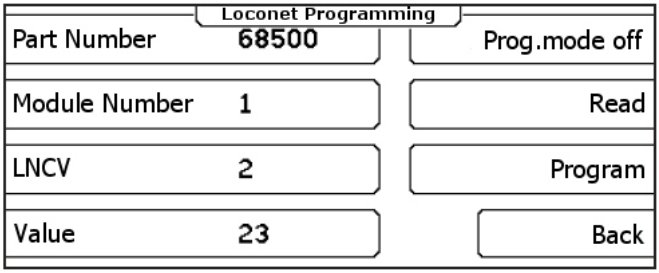
- After calling up the desired MARCo-Receiver as described in Chapter 4.5.2.1 the following display appears:



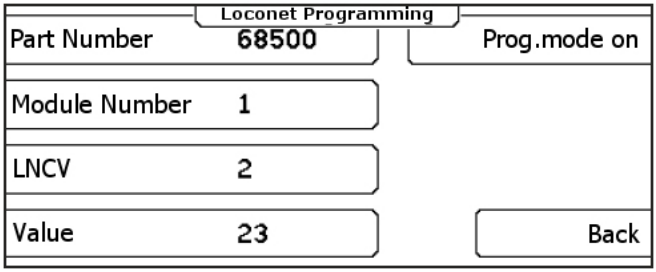
- Press the “LNCV” button, enter the number of the desired LocoNet-CV (in this Example “2”) and press the Enter key [↵]. LNCV 2 is read and the value is displayed in last display row after “Value” (in the Example Value “1”):



- If you with to change the LNCV press the “Value” button, enter the new value (in this Example “23”) and press the Enter key [↵].



- To program the value into the module you must press the “Program” button on the right hand side. The LNCV is now programmed. To verify you can press the “Read” button to check if the programming worked.
- Further LNCVs can then be programmed, or, by pressing the “Prog.mode off”, the MARCo-Receiver will return to normal operating mode. The blue LEDs switch off.



- To leave programming press the “Back” button. You return to the Main Menu and back to the control panel by pressing the [mode]-Key.

4.4.2.3 Universal Address

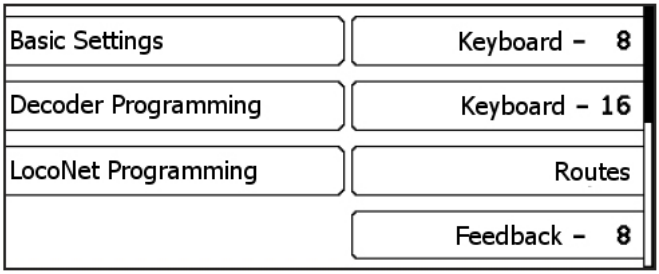
As you saw above a MARCo-Receiver can only be read when it is called under its module address (LNCV 0). That way it can be distinguished from all the other MARCo-Receivers on the layout.

What if you have forgotten the address of a MARCo-Receiver? In this case the universal address 65535 will help you.

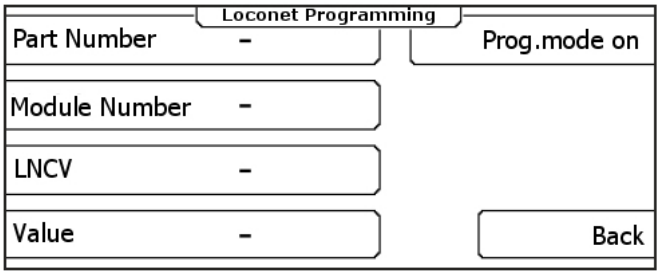
Method:

- Connect the MARCo-Receiver with the unknown module address alone, i.e. without any other MARCo-Receivers, to the Intellibox II LocoNet T-Socket.

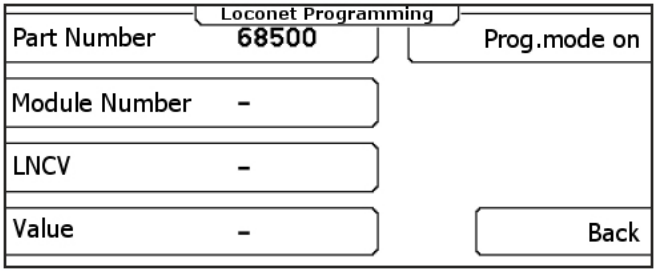
- Press the [mode]-Key to get into the Main Menu:



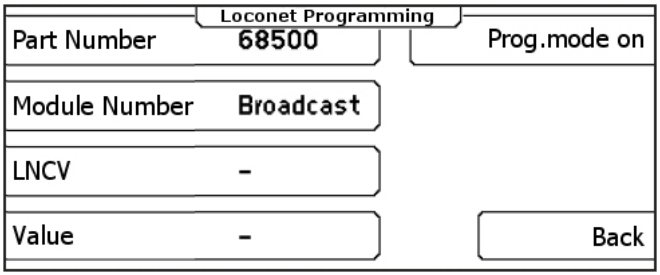
- Press the “LocoNet Programming” button:



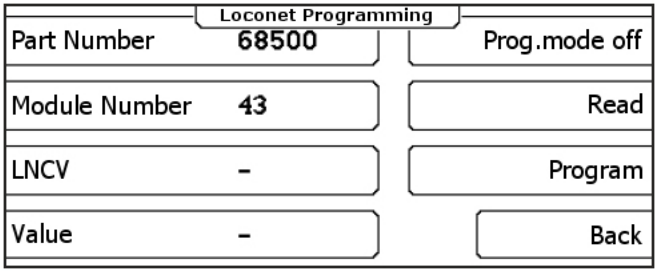
- Press the “Part Number”, enter the MARCo-Receiver part number 68500 and press the Enter key [↵]:



- Press the “Module Number”, enter the module number 65535 or press the [↓]-Key to the “Broadcast” menu and finally press Enter key [↵]:



- Press the “Prog.mode on” button:



- In the display the actual module address will be shown (in this example the value 43). This address can now be changed in LNCV 0 or left as it is. The MARCo-Receiver can then be connected to the layout again.

4.4.3 Programming with the LISSY/MARCo Creator Program

LISSY/MARCo-Creator is the PC-Program with which you can easily and quickly plan your layout with a MARCo-System and program all the MARCo-Receivers with their required settings.

With a track plan on hand, the desired automation can be planned. Whether its a shuttle line, a holding point, a shadow station or switching of locomotive functions, all automatic control operations which the MARCo supports can be implemented in your layout planning with the LISSY/MARCo-Creator.

The program also sets up all addresses that are used on your layout for solenoids, feedbacks, MARCo-Receiver, or Routes which are needed, for example, for station control.

Routes in the Intellibox (650, 65000, 65050), the Intellibox® II (65100), IB-Control II (65410) can also be programmed directly with the LISSY/MARCo-Creator. All layout data can be saved and printed.

5. MARCo receiver's basic functions

After learning how to program and read an individual LNCV, this chapter will acquaint you with some basic functions and how to adjust these by configuring LNCVs.

5.1 Receiver address

The module address by which the MARCo-Receiver is identified is in LNCV 0. This is also the address for the first detector or double detector.

LNCV	Description	Value Range	Factory default
0	Module address and track 1 address	1-4095	1
1	Address track 2 (2. single detector) for track 2, or as feedback address used in Automatic functions 4 - 28	1-4095	2

If the detectors are inserted in two independent locations on the layout and used as a double detector, then each detector needs its own address, by which it is identified in the system later. While track 1 is identified by the module address (first detector address) in LNCV 0, track 2 is identified by the address in LNCV1. In this case the address in LNCV1 is used as a decoder address.

When direction dependent automatic functions are to be employed, the second detector is used for direction recognition. The address in LNCV 1 is used as a feedback address to send a 'vacant' or 'occupied' message.

Method:

Call up the LocoNet Programming Menu in the Intellibox as outlined in Chapter 4.5 and enter following steps:

Step 1:	Call up MARCo-Receiver, as in described Chap. 4.5.			
Step 2:	LNCV 0	Value 2	program	Set Module address to 2
Step 3:	LNCV 1	Value 3	program	2. Detector address (Entry Track 2) is set to value 3.
Step 4:	End programming			

5.2 Selection of the different functions

LNCV	Description	Value Range	Factory default
2	Selection of the different functions of the module: 0-1 = Basic function 1-3 = switching operation 4-28 = automatic functions 96-99 = delete functions	0-10, 20-26, 96-99	2

Detailed information to the different functions and how they are adjusted are outlined in chapter 7.

6. First applications

In this chapter we will use 2 examples to demonstrate how easily MARCo can be configured with the Intellibox.

Before you try the examples out, delete all current LNCV values in the MARCo receiver, by programming the LNCV 2 with the value 98.

LNCV	Description	Value
2	All LNCVs to the value 0 sets, except LNCV 0 and 1 (module and detector address)	98

Flushing the module

Method:

Call up the LocoNet Programming Menu in your Intellibox as in Chapter 4.5 and execute the following steps:

Step 1:	Call up MARCo-Receiver, as in described Chap. 4.5.			
Step 2:	LNCV 2	Value 98	program	All LNCV are set to 0, except the module address
Step 3:	End programming			

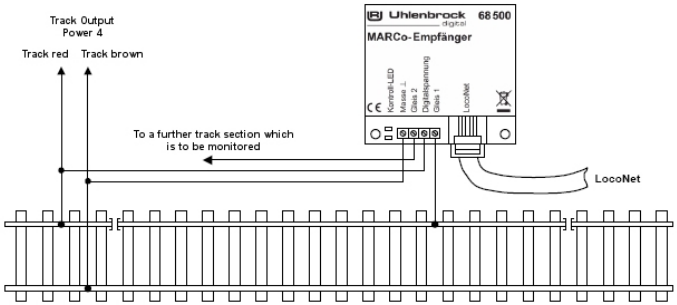
After this all LNCVs are set to a value 0 and thus no functions are programmed. LNCV 0 (module and 1st detector address) and LNCV 1 (2nd detector address) are not deleted.

6.1 To switch a turnout

Function

Every locomotive that drives over the detector is to set turnout 20 to “green/straight”.

Install a detector at the location you wish to switch the turnout and attach it to the MARCo-Receiver as follows:



Program the LNCVs as indicated in the table:

LNCV	Description	Value
2	Switching operation with 2 single detectors in 2 different places of the layout, without direction recognition	3
80	Address the locomotive that is to trigger the switch 20000 means that any locomotive can trigger the switch	20000
90	Instruction for switching the solenoid with address 20 into the green/straight position	201

Method:

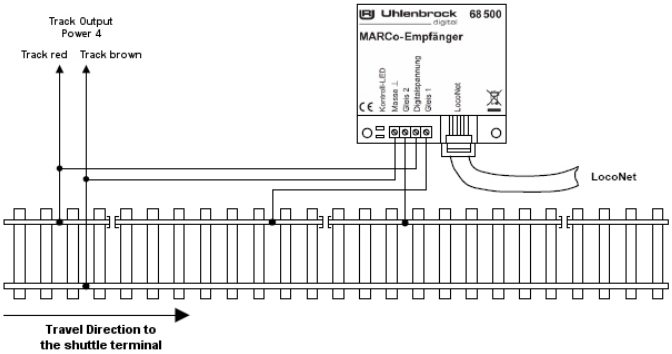
Step 1:	Call up MARCo-Receiver, as in described Chap. 4.5.			
Step 2:	LNCV 2	Value 98	program	All LNCV are set to 0, except the MARCo-Receiver module address
Step 3:	LNCV 2	Value 3	program	Set function "2 Single detector without direction detection"
Step 4:	LNCV 80	Value 20000	program	Set "Every locomotive"
Step 5:	LNCV 90	Value 201	program	Set solenoid 20 to green
Step 6:	End programming			

If the LNCVs 80 and 90 are changed as follows, then only the locomotive with the address 10 switches the solenoid with the address 30 to red (round).

LNCV	Description	Value
2	Switching operation with 2 single detectors in 2 different places of the layout, without direction recognition	3
80	Recognition of locomotive address 10 only to activate the switch	10
90	Instruction for switching the solenoid with address 30 into the red/round position	300

6.2 Setting up a Shuttle train terminus

The following automation is done with a MARCo receiver:



- A locomotive which drives over a double detector from Track 1 to Track 2 is stopped with the decoder's internal braking inertia. At the same time the signal with solenoid address 10 is switched to "red".
- The locomotive is stationery for 20 seconds
- After that the travel direction is changed
- The signal with solenoid address 10 is switched to "green"'
- The locomotive drives off using the decoder's acceleration inertia
- 5 seconds after the locomotive departed the shuttle terminus is ready for the next locomotive

Connect two the track sections as double detector of the MARCo-Receiver at the location where the trains are to reverse.

Program the following LNCVs as indicated in the table:

LNCV	Description	Value
2	Set function for shuttle train terminal, with timed departure	4
4	Waiting time at terminus, 20 seconds	20
6	Address of exit signal at which the shuttle will wait. In this example the signal that is to be switched by the MARCo-Receiver is operated by a solenoid decoder with address 10	10
10	Block option: only after 5 seconds after the train has left on a green signal, is the track regarded as clear by the MARCo receiver. Only then can a new train enter into the terminus.	5

Method:

Call up the LocoNet Programming Menu in your Intellibox as described in Chapter 4.5 and execute the following sequence:

Step 1:	Call up MARCo-Receiver, as in described Chap. 4.5.			
Step 2:	LNCV 2	Value 98	program	Flush MARCo-Receiver
Step 3:	LNCV 2	Value 4	program	Set function “Shuttle train”
Step 4:	LNCV 4	Value 20	program	Set waiting time in seconds
Step 5:	LNCV 6	Value 10	program	Enter signal address 10
Step 6:	LNCV 10	Value 5	program	Delay in seconds after which the block is ready for the next train
Step 7:	End programming			

If the LNCV 10 is changed as follows, then automatically 10 seconds after the Locomotive’s shuttle train drives off, the signal at address 10 will have its solenoid switched to red.

LNCV	Description	Value
10	Block option: 10 seconds after the train has left on a green signal, the MARCo-Receiver will regarded the track as clear. Only then can a new train enter into the terminus. Also the signal will be switched to red.	266

How to calculate the value 266, to program this operation, is described in chapter 8.5.5 "Automatic operation - occupancy detection".

NOTE: *In order a completely automate a shuttle train two receivers are required, one in each terminus.*

7. Functions

This chapter concerning the functions of the MARCo-Receiver 68,600 is the most important chapter in this book. Please read it thoroughly, so you can derive many hours of pleasure from the automation of your layout.

7.1 Preparation of the MARCo receiver

Before we can start programming, it is important that the MARCo-Receiver be prepared. As already learned in the previous chapters the MARCo-Receiver is pre-programmed to facilitate quick testing after installation and connection, to check that everything is functioning correctly.

7.1.1 Deletion of old programming

Method:

Call up the LocoNet Programming Menu in your Intellibox as in Chapter 4.5 and execute the following steps:

Step 1:	Call up MARCo-Receiver, as in described Chap. 4.5.			
Step 2:	LNCV 2	Value 98	program	All LNCV are set to 0, except the module address
Step 3:	End programming			

After this all LNCVs are set to a value 0 and thus no functions are programmed. LNCV 0 (module and 1st detector address) and LNCV 1 (2nd detector address) are not deleted.

Further details about the deletion or resetting of the receiver can be found in chapter 7.5.7.

7.1.2 Programming table preparation

In the context of programming a MARCo-Receiver we recommend that you record your programming. This avoids having to flush the programming frequently because you have forgotten which LNCVs have been programmed.

In the appendix you can find two examples of programming tables. You can copy the table, so that can make your own table for every MARCo-Receiver you program.

The table is explained in detail in this section

7.2 Basic functions

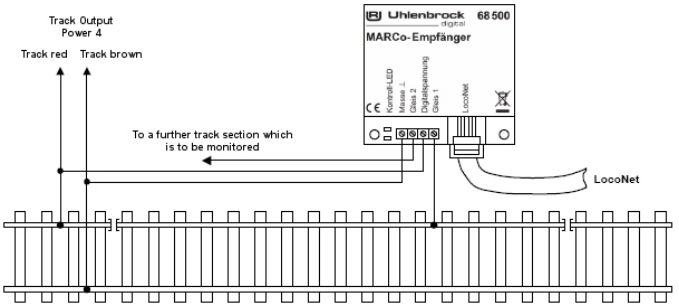
In the basic function a MARCo-Receiver is to capture a passing locomotive's address and train category. In addition it can, after setting up, also determine the speed and driving direction.

The data sent to the LocoNet can be in different formats. This can be specified in LNCV 15 (module pre-setting). If LNCV 15 is set to 1, the MARCo-Receiver sends data in a format that can be used by Uhlenbrock LocoNet modules (e.g. LocoNet display 63 450. A value of 2 or 3 sends Digitrax compatible data, which some PC control programs also use.

LNCV	Description
0	Module address and address track 1
1	Address for track 2 (only when using 2 single detectors)
2	*Basic function* 0 = locomotive detection using a double detector. determines address, category, driving direction and speed. 1 = locomotive detection using 2 single detectors in 2 independent places of the layout. determines address and category
15	*Selection of the transmission format* 0 = Don't send any transmission format (ÜF) to the LocoNet 1 = Send ÜF Uhlenbrock with Locomotive address 2 = Send ÜF Digitrax with Locomotive address and Block status (vacant/occupied)

7.2.1 Reporting train number and category

The MARCo-Receiver is only there to register locomotive address and train category of a passing train. An individual detector in the track is sufficient for this. One MARCo-Receiver module can therefore supervise two track sections.

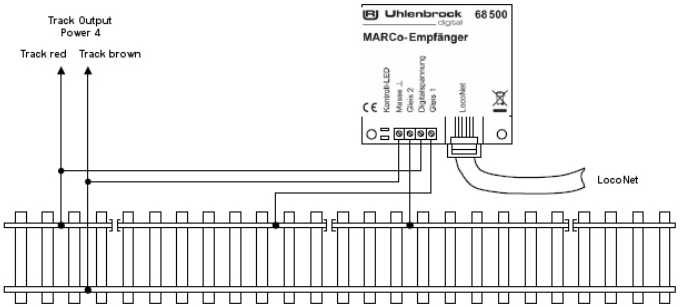


For simple train monitoring in two places with a module the following functions must be programmed:

LNCV	Description	Value
0	Module address and track 1 address	1-4095
1	Address track 2 (2. Dingle detector) for track 2	1-4095
2	Read locomotive data from 2 Single detectors for 2 independent locations on the layout. Output of the address	1

7.2.2 Reporting the direction

If, in addition to the locomotive address, the driving direction is to be reported on the LocoNet, then both detectors must be connected to the monitored section.



LNCV	Description	Value
2	0 = locomotive detection using a double detector. determine address and direction	0

In addition the following function must be programmed:

Driving direction

To report the driving direction, the module must know which of the two detector should be passed first. Automatic operations, e.g. how long a train should stop for, can be adjusted, by specifying the active driving.

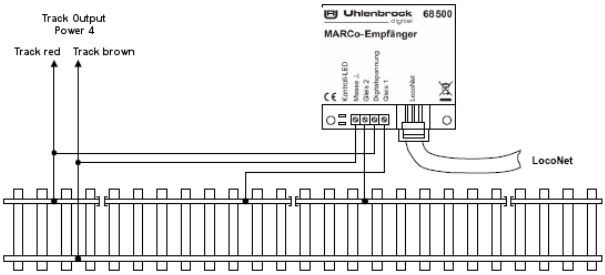
LNCV	Description	Value
3	Driving direction, in which the automatic function is active according to LNCV 2 0 = detection reported when driving direction is from track 1 to track 2 1 = detection reported when driving direction is from track 2 to track 1	 0 1

7.3 Switching operation

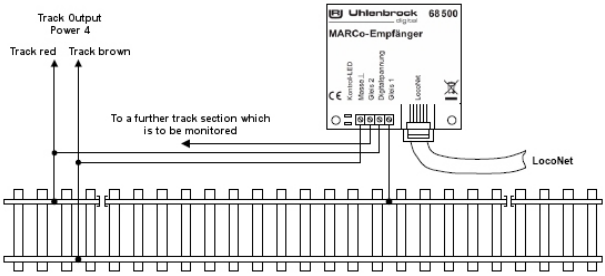
After a MARCo-Receiver is installed into a layout, you can accomplish a range of diverse controls. This may be a simple *Switching operation* (switching turnout before a station, switch lights on at tunnel entrance) and speed instructions (decrease speed in a speed restriction section), up to complex *operations* (terminus of a shuttle-train, section control with signalling). In LNCV 2 you specify the function the MARCo-Receiver is to have.

In order to setup a *switching operation*, program LNCV 2 as follows:

LNCV	Description	Value
2	Switching operation with 1 double detector with direction recognition	2



LNCV	Description	Value
2	Switching operation with 2 detector without direction recognition	3



With switching operation individual instructions in 3 groups can be programmed and called into operation later:

- Switching of special functions (light, telex coupling, smoke, sound, single noises etc..)
- Changing speeds (only meaningful with locomotives)
- Switching of turnouts, signals or routes

Each instruction group has 10 instructions that can be programmed. For Double detectors all 10 instructions are available for both detectors. With two single detectors 5 instructions are available for each detector.

In practice, switching operations apply when processing the functions in the following table:

Sequence	Function	If, then
1.	Are individual speed instructions to be sent?	implement
2.	Are solenoids, route or occupancy instructions to be sent?	implement
3.	Are individual function instructions to be sent?	implement

7.3.1 General instruction description

For the programming of *switching operation* the MARCo-Receiver has LNCVs 20 to 109 available. By programming certain combinations of value into these LNCVs you can develop executable instructions.

A complete instruction always consists of three entries:

- Vehicle address
- Command value
- Command options

Vehicle addresses

As addresses the following values can be used:

LNCV	Description
0	No instruction is required to be present
1-9999	Locomotive address; should the MARCo-Receiver recognize this address, the programmed instruction will be sent to this address by the Intellibox
20001-20015	Train category: shown in chapter 3.4, can be assigned in MARCo transmitter CV 115. This category value (1-4) becomes part of the vehicle address to be sent. If an instruction is present for a recognized category, it is implemented for the particular vehicle address. The address 20001 corresponds to the category 1, address 20002 corresponds to category 2 etc.
20000	Broadcast locomotive address: the programmed instruction is always implemented, independent of Vehicle address or category

Command value and command option

The entries for command value and option depend on whether it is speed, function, or solenoid instructions. While the address is simply taken from the above table, you also need to determine the numerical value for the command, or command option which is to be used.

The advantage of the computed values is that single instructions can operate a number of items at the same time, or with a particular command option, different command variants can be produced. This is explained further in following sections.

7.3.2 Priorities in processing instructions

In the respective groups, the programmed actions are sequentially processed in ascending order of LNCV numbers. In each group, instructions can be executed for the recognized address, the recognized category, or broadcast to every vehicle. A specific vehicle can have several instructions programmed.

The different address formats have the following priorities:
1. Highest priority: Address instructions (addresses 1-9999)
2. Middle priority: Category instructions (addresses 20001-20015)
3. Lowest priority: Broadcast instructions (address 20000)

During the processing of a group of instructions in ascending order, every valid instruction is immediately implemented. However, lower priority instructions will only be implemented so long as no suitable instruction of higher priority is found for the vehicle. Further instructions with lower priority after that will not be implemented.

Thus if a category instruction is found, further category instructions will be implemented, but broadcast instructions will not. An address instruction results in further address instructions being implemented, but no further category or broadcast instructions can be implemented.

Example 1

Locomotive 3 with the train category 1 (address 20001) arrives at the detector. The LNCV entries for the functions are programmed as follows:

Programming of function instructions

Command	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Address	**2...**	20000	20001	3	20002	103	20001	20000	3	-	-
Value	**3...**										
Option	**4...**										

The actions are implemented as follows:

Command priority of function for the locomotive address 3 and category 1

LNCV	Value	Instruction	Action
20	20000	Broadcast	Implemented
21	20001	category	Category match: implemented, but no more broadcast instructions
22	3	address	Address match: implemented, but no further instructions with lower priority
23	20002	category	Not implemented, wrong category
24	103	address	Not implemented, wrong address, but priority matches
25	20001	category	Category too low: Not implemented
26	20000	Broadcast	Broadcast not implemented, too low priority
27	3	address	Address matches: implemented

Example 2

Locomotive 3 with the train category 1 (address 20001) arrives at the detector. The LNCV entries for speeds are programmed as follows:

Programming of speed instructions

Speed	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Address	**5...**	20002	20001	3	20000	103	20001	3	-	-	-
Value	**6...**										
Option	**7...**										

The actions are implemented as follows:

Command priority of speed instructions for the locomotive address 3 and category 1

LNCV	Value	Instruction	Action
50	20002	category	Not implemented, wrong category
51	20001	category	Category match: implemented, but no more broadcast instructions
52	3	address	Address match: implemented, but no further instructions with lower priority
53	20000	broadcast	Not implemented, too low priority
54	103	address	Not implemented, wrong address, but priority matches
55	20001	category	Category too low: Not implemented
56	3	address	Address matches: implemented

Example 3

Locomotive 3 with the train category 1 (address 20001) arrives at the detector. The LNCV entries for solenoid are programmed as follows:

Programming of solenoids and route instructions

MA/FS	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Address	**8...**	3	20002	20000	20001	103	20001	3	-	-	-
Value	**9...**										
Option	**10...**										

The actions are implemented as follows:

Command priority of solenoid instructions for the locomotive address 3 and category 1

LNCV	Value	Instruction	Action
80	3	address	Address match: implemented, but no further instructions with lower priority
81	20002	category	Not implemented, wrong category
82	20000	broadcast	Not implemented, too low priority, but priority matches
83	20001	category	Not implemented, category too low
84	103	address	Not implemented, wrong address, but priority matches
85	20001	category	Category too low: Not implemented

86	3	address	Address matches: implemented

7.3.3 Switching Locomotive auxiliary functions

The 10 instructions for auxiliary functions, such as front lighting (f0) or sound and/or other special functions (f1 to f12) are programmed into LNCVs 20 to 49. The following applies:

LNCV	Description
20-29	Address of vehicle to receive the function instructions
30-39	Values for function
40-49	Options for function

LNCVs belonging to an instruction are always separated by 10. Example: the data for the first instruction are in LNCVs 20, 30, 40, those for the second instruction in LNCVs 21, 31, 41 etc.. The following table clarifies the basics, each column representing an instruction:

Allocation of the LNCVs for function instructions

For receivers with a double detector	**double detector**									
For receivers with two single detectors	**1st Detector**					**2nd Detector**				
LNCV for the address	20	21	22	23	24	25	26	27	28	29
LNCV for the value	30	31	32	33	34	35	36	37	38	39
LNCV for the option	40	41	42	43	44	45	46	47	48	49

Switch function LNCV 2 = 2 LNCVs for function instructions with double detector.

Switch function LNCV 2 = 3 LNCVs for function instructions with 2 single detectors.

Values for switching OFF auxiliary functions

If a locomotive e.g. is to have the light switched ON or OFF, you press [f0]-key or [off]-key on the Intellibox. Should the decoder have further functions (e.g. Sound decoder: On/Off, whistle, pump, inertia etc.), then these further functions are switched with keys [f1] to [f4] also key [loco #] as shift key for the functions [f5] to [f8].

The MARCo-Receiver can call up functions f0 to f12, provided the locomotive decoder supports them. The meaning of these functions is different from decoder to decoder. Please take note of the operating instructions of your decoder.

Programming a function value into the appropriate LNCV does switching of the function. The function values are shown in the following table:

Computation of the command value for the change of locomotive special functions (LF)

LF	**F0**	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**	**F9**	**F10**	**F11**	**F12**	**Calculated value for LNCV 30-39**
Value	1	2	4	8	16	32	64	128	256	512	1024	2048	4096	
Selection														
Sum														

If several functions are to be switched simultaneously, mark them off in the corresponding column in the "selection" row. Then transfer the numerical values of the selected column from the "value" row into the last row. The sum of the values is then programmed into an LNCV within the range 30 to 39.

Example

The light and horn are to be switched on, e.g., before a tunnel. The light is turned by function f0 ([function] key on the Intellibox) and the horn is, e.g. f2, thus the following example table results:

Computation of the command value for the change of locomotive special functions (LF)

LF	**F0**	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**	**F9**	**F10**	**F11**	**F12**	Calculated value for LNCV 30-39
Value	1	2	4	8	16	32	64	128	256	512	1024	2048	4096	
Selection	x		x											
Sum	**1**		**4**											**5**

In this example the value 5 must be used as the command value.

It is not possible to turn one function ON and another OFF in the same instruction. For this several instructions must be used.

Options for switching of special functions

The changes to be performed to the special functions are specified in the LNCV for the command options. Here you specify if the action is travel direction dependent or not, whether the auxiliary function is be switched ON or OFF, or whether the state of the auxiliary function is to be changed. This means, if the function was OFF before passing the detector, it will switch ON. If, on the other hand, it was ON, it will switch OFF after passing the detector. Finally the auxiliary function can also, for a defined time, switch ON and after a set time automatically switch OFF again.

The following table shows which values specify the various options.

Computation of the command option for the change of locomotive special functions

Opt No.	Description	Selection	Value	Sum
1	Do not evaluate driving direction		0	
	Driving direction from Track1 to track2		2	
	Driving direction from Track2 to track1		3	
2	Switching function 2 or 3		0	
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off		4	
3	Switch auxiliary function off		0	
	Switch auxiliary function on		8	
	Change auxiliary function		16	
4	Auxiliary function timed change		32	
5	Switching duration in seconds (max. 31) * 256		* 256	
6	Position in the sequence (0-4) * 8192 (see Chap. 7.4.6)		* 8192	
			Calculated value for LNCV 40 to 49	

Setting the time delay for the execution of function instructions

In *the switching operation* the function instructions are executed immediately the detectors are passed. With *automatic operation* the function can be executed upon arrival at the detector or when the locomotive is departing (see chapter 7.4.6).

Timed special functions

For switching On and/or OFF (not for toggling) a timer can be set. After this time the instruction is reversed, i.e. the opposite Instruction is followed. e.g. there is a sound decoder, with a sound which only occurs when a particular function is switched ON. When switching the function OFF nothing happens. By use of the timer can you can without further effort and without the necessity for a further MARCo receiver, automatically switch the function off again, so that the vehicle is ready for the next power-on procedure.

Example

The MARCo-Receiver is programmed according to the following table:

Programming of function instructions

Command	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Address	**2...**	20000	20002	103							
Value	**3…**	33	1	2							
Option	**4…**	16	11	4130							

What do these instructions mean?

LNCVs 20, 30 and 40 give the following instruction:

With all locomotives (20000 is the locomotive Universal address), in both driving directions, when over-driving the MARCo-Receiver detectors, functions f0 (light) and f5 (smoke) are toggled.

The numerical values for the command in LNCV 30 and the command option in LNCV 40 are shown in the following two tables:

Computation of the command value for the change of locomotive special functions (LF)

LF	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	Calculated value for LNCV 30
Value	1	2	4	8	16	32	64	128	256	512	1024	2048	4096	
Selection	x					x								
Sum	**1**					**32**								**33**

Computation of the command option for the change of locomotive special functions

Opt No.	Description	Selection	value	sum
1	Do not evaluate driving direction	X	0	0
	Driving direction from Track1 to track2		2	
	Driving direction from Track2 to track1		3	
2	Switching function 2 or 3	X	0	0
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off		4	
3	Switch auxiliary function off		0	
	Switch auxiliary function on		8	
	Change auxiliary function	X	16	16
4	Auxiliary function timed change		32	
5	Switching duration in seconds (max. 31) * 256		* 256	
6	Position in the sequence (0-4) * 8192 (see Chap. 7.4.6)		* 8192	
			Calculated value for LNCV 40	16

LNCVs 21, 31 and 41 give the following instruction:

All category 2 locomotives (i.e. 20002) switch the light ON (f0) when driving in the direction from detector 2 to detector 1.

The numerical values for the command value in LNCV 31 and the command option in LNCV 41 are shown over the following two tables:

Computation of the command value for the change of locomotive special functions (LF)

LF	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	Calculated value for LNCV 31
Value	1	2	4	8	16	32	64	128	256	512	1024	2048	4096	
Selection	X													
Sum	**1**													**1**

Computation of the command option for the change of locomotive special functions

Opt No.	Description	Selection	Value	Sum
1	Do not evaluate driving direction		0	
	Driving direction from Track1 to track2		2	
	Driving direction from Track2 to track1	X	3	3
2	Switching function 2 or 3	X	0	0
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off		4	
3	Switch auxiliary function off		0	
	Switch auxiliary function on	X	8	8
	Change auxiliary function		16	
4	Auxiliary function timed change		32	
5	Switching duration in seconds (max. 31) * 256		* 256	
6	Position in the sequence (0-4) * 8192 (see Chap. 7.4.6)		* 8192	
			Calculated value for LNCV 41	11

LNCVs 22, 32 and 42 give the following instruction:

The locomotive address 103 switches f1 (e.g. sound), in driving direction from detector 1 to detector 2. The function is to be switched off again after 16 seconds have elapsed.

The numerical values for the command value in LNCV 32 and the command option in LNCV 42 arise over the following two tables:

Computation of the command value for the change of locomotive special functions (LF)

LF	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	Calculated value for LNCV 32
Value	1	2	4	8	16	32	64	128	256	512	1024	2048	4096	
Selection		X												
Sum		**2**												**2**

Computation of the command option for the change of locomotive auxiliary functions

Opt No.	Description	Selection	Value	Sum
1	Do not evaluate driving direction		0	
	Driving direction from Track1 to track2	X	2	2
	Driving direction from Track2 to track1		3	
2	Switching function 2 or 3	X	0	0
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off		4	
3	Switch auxiliary function off	X	0	0
	Switch auxiliary function on		8	
	Change auxiliary function		16	
4	Auxiliary function timed change	X	32	32
5	Switching duration in seconds (max. 31) * 256	X	4096	4096
6	Position in the sequence (0-4) * 8192 (see Chap. 7.4.6)		* 8192	
			Calculated value for LNCV 42	4130

NOTE:

- *If detection of the driving direction is switched off, then setting the driving direction of detector 1 to detector 2 or in reverse of detector 2 to detector 1 has no meaning, i.e. driving direction need not be programmed.*
- *When using 2 individual detectors in different places of the layout the driving direction cannot be determined. The detection of the driving direction should then be switched off.*

Method:
Call up the LocoNet Programming Menu in your Intellibox as in Chapter 4.5 and execute the following steps:

Step 1:	Call up MARCo-Receiver, as in described Chap. 4.5.			
Step 2:	LNCV 2	Value 98	program	Flush MARCo-Receiver
Step 3:	LNCV 20	Value 20000	program	Set “All locomotive”
Step 4:	LNCV 30	Value 33	program	Select functions f0 and f5
Step 5:	LNCV 40	Value 16	program	Change special function without direction
Repeat steps 3-5 for LNCV groups 21, 31, 41 – 22, 32, 42 etc.				
Step 7:	End programming			

7.3.4 Speed changes

The 10 speeds instructions are programmed into LNCVs 50 to 79 as indicated in the following table:

LNCV	Description
50-59	Address of Vehicle for the speed change
60-69	Value for the speed
70-79	Options for changing the speed

LNCVs belonging to an instruction are always separated by 10. Example: the data for the first instruction are in LNCVs 50, 60, 70, those for the second instruction in LNCVs 51, 61, 71 etc. The following table clarifies the basics, each column represents an instruction:

Allocation of the LNCVs for speed instructions

For receivers with a double detector	Double detector									
For receivers with two single detectors	1st Single Detector					2nd Single Detector				
LNCV for the address	50	51	52	53	54	55	56	57	58	59
LNCV for the value	60	61	62	63	64	65	66	67	68	69
LNCV for the option	70	71	72	73	74	75	76	77	78	79

Switch function LNCV 2 = 2 LNCVs for function instructions with double detector.

Switch function LNCV 2 = 3 Each of the two single detectors has 5 instructions available.

Values for the speeds

The speed of a vehicle can be programmed with absolute values, percentages or in kilometres per hour.

Absolute speed, values 0-127

The speed is programmed to a particular speed step. The transmitted speed step values range from 0 to 127. Speed step 0 means stopped. Brake application on speed step 0 is implemented by the locomotive decoder's internal delay values. Speed step 1 is an emergency stop without any delays. Speed steps 2-127 converted into the max. possible speed step range of the Locomotive decoder depending on the respective data format.

For locomotive decoders with 128 speed steps, the value entered corresponds to the desired speed step. If the locomotive decoder uses a different number of speed steps, then its speed value must convert to the range 0-127. To assist, tables for the different data formats are found in the appendix. As a guide the following equation can be used:

$$\text{absolute speed} = \text{total value}\left\{\frac{\text{desired speed step}}{\text{max. number of steps for the decoder}} \bullet 126 + 1\right\}$$

Example

The decoder has 14 drive positions. The locomotive is to drive with speed step 10.

10/14 * 126 + 1 = 1260/14 + 1 = 90 + 1 = 91

Therefore, in this instance speed value of 91 would be programmed into the LNCV.

Relative speed values 0-255

The speed can also be entered as a percentage, relative to the current speed, within the range of 0% to 255%. 50% means halving the speed, 200% a speed doubling. The number of speed steps of the decoder is irrelevant in this case.

Options for speed

Instructions for one set of LNCV command options are specified here: i.e. how to program a change of speed. The option value to be programmed is calculated by adding the different option priorities. In command options one can select in which direction the speed instruction is to operate, its absolute, or relative velocity value, or a speed in Km/h etc. The following Table shows all speed options:

Computation of the command option for the change of locomotive speed

Opt No.	Description	selection	value	sum
1	Do not evaluate driving direction		0	
	Driving direction from Track1 to track2		2	
	Driving direction from Track2 to track1		3	
2	Switching function 2 or 3		0	
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off		4	
3	Speed specified as absolute value (0-127)		0	
	Speed specified in percent (0-255%)		8	
	Speed specified in Km/h		16	
			Calculated value for LNCV 70 to 79	

Examples

The MARCo-Receiver is programmed in accordance with the following table:

Programming of speed instructions

Command	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Address	**5...**	20000	20002								
Value	**6…**	80	50								
Option	**7…**	0	11								

What do these instructions mean?

LNCVs 50, 60 and 70 give the following instruction:

All locomotives (20000 is the Universal address for all locomotives) will be switched to an absolute of 80 when passing the MARCo-Receiver in either direction

The numerical value for the command option in LNCV 70 is determined from the following example table:

Computation of the command option for the change of locomotive speed

Opt No.	Description	Selection	Value	Sum
1	Do not evaluate driving direction	X	0	0
	Driving direction from Track1 to track2		2	
	Driving direction from Track2 to track1		3	
2	Switching function 2 or 3	X	0	0
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off		4	
3	Speed specified as absolute value (0-127)	X	0	0
	Speed specified in percent (0-255%)		8	
	Speed specified in Km/h		16	
			Calculated value for LNCV 70	**0**

LNCVs 51, 61 and 71 give the following instruction:

All category 2 locomotives (according to 20002), travelling in direction from detector 2 to detector 1 will have their speed reduced to 50%.

The numerical value for the command option in LNCV 71 is computed from the following table:

Computation of the command option for the change of locomotive speed

Opt No.	Description	Selection	Value	Sum
1	Do not evaluate driving direction		0	
	Driving direction from Track1 to track2		2	
	Driving direction from Track2 to track1	X	3	3
2	Switching function 2 or 3	X	0	
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off		4	
3	Speed specified as absolute value (0-127)		0	
	Speed specified in percent (0-255%)	X	8	8
	Speed specified in Km/h		16	
			Calculated value for LNCV 71	**11**

NOTE

- If detection of travel direction is turned OFF, then the selection of the travel direction from track 1 to track 2 or in reverse from track 2 to track 1 is meaningless, so travel directions need not be programmed.
- When using 2 individual detectors in different locations of the layout, detection of travel direction should be turned OFF.

Method:

Call up the LocoNet Programming Menu in your Intellibox as in Chapter 4.5 and execute the following steps:

Step 1:	Call up MARCo-Receiver, as in described Chap. 4.5.			
Step 2:	LNCV 2	Value 98	program	Flush MARCo-Receiver
Step 3:	LNCV 50	Value 20000	program	Set “All locomotive”
Step 4:	LNCV 60	Value 33	program	Select functions f0 and f5
Step 5:	LNCV 70	Value 0	program	Change special function without direction
Repeat steps 3-5 for LNCV groups 51, 61, 71 – 52, 62, 72 etc.				
Step 7:	End programming			

7.3.5 Solenoid and route switching

The 10 instructions for switching individual solenoids (switches, signals) or entire routes, which are stored in the Intellibox, are set up in LNCVs 80 to 109. Furthermore feedback commands can be set up here as well, like the one sent by LocoNet Feedback modules (e.g. 63320 or 63330). With the feedback it is possible to set up track routes that have been stored in the Intellibox or and also track lighting in the TrackControl can monitor the feedback. This following table applies to this feature:

LNCV	Description
80-89	Address of Vehicle which triggers the instruction
90-99	Value for switching the solenoid or sending feedback
100-109	Options for the solenoid or feedback function

LNCVs belonging to an instruction are always separated by 10. Example: the data for the first instruction are in LNCVs 80, 90, 100, those for the second instruction in LNCVs 81, 91, 101 etc. The following table clarifies the basics, each column represents an instruction:

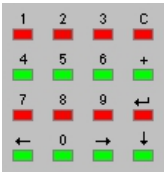
Allocation of the LNCVs for solenoid instructions

For receivers with double detector	**double detector**									
For receivers with 2 single detectors	**1st Detector**					**2nd Detector**				
LNCV for the address	80	81	82	83	84	85	86	87	88	89
LNCV for the value	90	91	92	93	94	95	96	97	98	99
LNCV for the option	100	101	102	103	104	105	106	107	108	109

Switch function LNCV 2 = 2 LNCVs for function instructions with double detector. All 10 instructions are available for both installed detectors.

Switch function LNCV 2 = 3 Each of the installed detectors has 5 function instructions available.

Command values for solenoids and/or feedback instructions



The keys of the Numeric pad

With the Intellibox you can switch 1 to 2000 solenoids. In Keyboard mode the Intellibox always has direct access to 8 solenoids with the 16 central keys. Each pair of keys, e.g. Keys 1 and 4, can switch the assigned signal to red (key 1) or green (key 4).

This also happens when switching solenoids from the MARCo receiver, only that the LNCVs cannot specify "red" or "green". The MARCo-Receiver represents these as numbers thus: "red"=0, "green"=1. If red key 1 is pressed, the command means e.g. "set solenoid 1 to red". Hence the LNCV for this solenoid contains 2 numbers: Solenoid address (1) and switching direction (0). For programming of the command value of the MARCo receiver, the switching direction and the solenoid address are combined, therefore to set solenoid 1 to red "the instruction value is 10".

If the MARCo-Receiver is to deliver a feedback command, you proceed in a similar manner. The feedback address has the number 2 added if the track section is free and the number 3 added, if the track section is occupied.

Generally: to switch a solenoid to "red" (signal red, turnout round) the solenoid address number 0 is added; to switch a solenoid to "green" (signal green, turnout straight) the solenoid address number 1 is added.

Sending a feedback with the condition is done the same way. For "vacant" add the number 2 to the feedback address, or for "occupied" add the number 3 to the feedback address.

A few examples: the command value 431 switches the solenoid 43 to green/straight, the command value 4560 switches the solenoid 456 to red/round. The command value 2002 sends feedback for the address 200 with the condition "free", whereas the Command value 5913 sends a feedback for the address 591 with the condition "occupied".

Commands for Routes

Besides switching individual solenoids, track routes can be implemented. You can switch routes with solenoid commands when using the Intellibox and using feedback commands to switch the routes using the Intellibox or IB-Switch.

To decide which command values to use in order to activate routes in the Intellibox, refer to the following table:

Translation between the route number of the Intellibox and the command value programmed in a MARCo receiver

Group 1		
Route No.	**Solenoid Add**	**MARCO value**
1	2001-red	20010
2	2001- green	20011
3	2002-red	20020
4	2002- green	20021
5	2003-red	20030
6	2003- green	20031
7	2004-red	20040
8	2004- green	20041
9	2005-red	20050
10	2005- green	20051
11	2006-red	20060
12	2006- green	20061
13	2007-red	20070
14	2007- green	20071
15	2008-red	20080
16	2008- green	20081

Group 2		
Route No.	**Solenoid Add**	**MARCO value**
1	2009-red	20090
2	2009- green	20091
3	2010-red	20100
4	2010- green	20101
5	2011-red	20110
6	2011- green	20111
7	2012-red	20120
8	2012- green	20121
9	2013-red	20130
10	2013- green	20131
11	2014-red	20140
12	2014- green	20141
13	2015-red	20150
14	2015- green	20151
15	2016-red	20160
16	2016- green	20161

Group 3		
Route No.	**Solenoid Add**	**MARCO value**
1	2017-red	20170
2	2017- green	20171
3	2018-red	20180
4	2018- green	20181
5	2019-red	20190
6	2019- green	20191
7	2020-red	20200
8	2020- green	20201
9	2021-red	20210
10	2021- green	20211
11	2022-red	20220
12	2022- green	20221
13	2023-red	20230
14	2023- green	20231
15	2024-red	20240
16	2024- green	20241

Example

Route 13 of Group 2 routes is switched by the command value 20150.

Routes in the IB-Switch are activated over feedback commands. Each key of the IB-Switch can be assigned a feedback instruction with an individual address and one feedback condition (occupied or vacant). For details refer to the IB-Switch manual.

Options for solenoid and feedback instructions

Follow the same method as for speed and function programming. Compute an entry for the LNCV for the command option to execute the solenoid and/or feedback instruction. The following table shows the possible Option values:

Computation of the command option for solenoid and feedback instructions

Opt No.	Description	selection	value	sum
1	Do not evaluate driving direction		0	
	Driving direction from Track1 to track2		2	
	Driving direction from Track2 to track1		3	
2	Switching function 2 or 3		0	
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off		4	
	Calculated value for LNCV 100 to 109			

NOTE: *In a normal switching operation the solenoid and feedback instructions are implemented immediately the detector is passed. The use of command option 2 is meaningless in this case. It is only meaningful in automatic operation (see chapters 7.4.1 to 7.4.4).*

Examples

The MARCo-Receiver is programmed in accordance with the following table:

Programming of solenoid and route instructions

Command	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Address	**5...**	94	103	20000							
Value	**6…**	580	20131	1003							
Option	**7…**	2	3	3							

What do these instructions mean?

LNCVs 80, 90 and 100 show the following instruction:

The locomotive address 94 is to switch the solenoid 56 to red/round (LNCV 90 = 560), and when travelling from detector 1 to detector 2.

The value for LNCV 100 is computed from the following example table:

Computation of the command option for solenoid and feedback instructions

Opt No.	Description	selection	value	sum
1	Do not evaluate driving direction		0	
	Driving direction from Track1 to track2	X	2	2
	Driving direction from Track2 to track1		3	
2	Switching function 2 or 3	X	0	0
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off		4	
			Calculated value for LNCV 100	**2**

LNCVs 81, 91 and 101 give the following instruction:

The locomotive address 103 is to use route 10 from Group 2 of the Intellibox (LNCV 91 = 20131 (see above table) when travelling from detector 2 to detector 1.

The value in LNCV 101 computed from the following table:

Computation of the command option for solenoid and feedback instructions

Opt No.	Description	selection	value	sum
1	Do not evaluate driving direction		0	
	Driving direction from Track1 to track2		2	
	Driving direction from Track2 to track1	X	3	3
2	Switching function 2 or 3	X	0	0
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off		4	
			Calculated value for LNCV 101	**3**

LNCVs 82, 92, 102 give the following instruction:

All locomotives (LNCV 82 = 20000, Universal address) announce feedback address 100 with the "occupied" condition (LNCV 92 = 1003). The feedback takes place when the locomotive passes the double detector when travelling from detector 2 to detector 1.

NOTE

- *If you turn detection of travel direction OFF, then selection of travel direction from Track1 to track2 or in reverse from Track2 to track1 is meaningless, so travel direction need not be programmed.*
- *When using 2 individual detectors in different locations of the layout, detection of travel direction should be turned OFF.*

Method:

Call up the LocoNet Programming Menu in your Intellibox as described in Chapter 4.5 and execute the following sequence:

Step 1:	Call up MARCo-Receiver, as in described Chap. 4.5.			
Step 2:	LNCV 2	Value 98	program	Flush MARCo-Receiver
Step 3:	LNCV 50	Value 20000	program	Set “All locomotive”
Step 4:	LNCV 92	Value 1003	program	Value feedback address 100 “occupied”
Step 5:	LNCV 102	Value 3	program	Travel direction from track 1 to track 2
Repeat steps 3-5 for LNCV groups 80, 90, 100 – 81, 91, 101 etc.				
Step 7:	End programming			

7.4 Automatic System

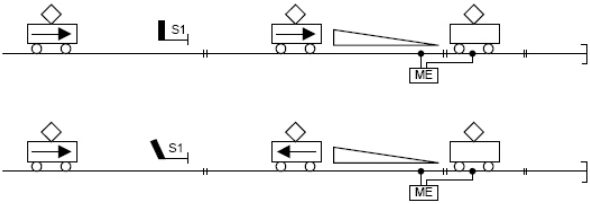
The previous section (8.3 Switching operation) showed how to change the speed, special functions (light, horn etc..), for each individually recognized vehicle i.e. switch individual turnout, track routes or send feedbacks.

There are also events on your layout which must be reacted to immediately, independently of the vehicle address. e.g. in a sectioned system, every locomotive, irrespective of the address, must stop at a red signal and can proceed with a green signal. It therefore makes no sense for every vehicle to have its own set of instructions programmed.

We refer to sequences, which are executed for all vehicles, as *automated systems*. The various possibilities, which the MARCo-Receiver offers in an automated layout, are described in the following sections.

7.4.1 Basic Function Time controlled Shuttle traffic

To operate shuttle traffic as shown in the following diagram.



The following sequence is made available by this automatic mode:

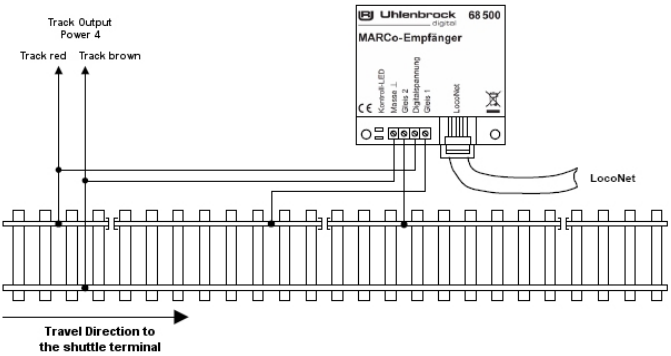
- A locomotive passes signal S1 in the reverse direction.
- The locomotive over-drives the double detector of the MARCo receiver.
- The signal S1 is switched to red.
- The locomotive brakes with its inertia and stops.
- An adjustable waiting period, (same for all vehicles).
- During the wait the driving direction is changed (light changes).
- Signal S1 is set to green.
- The locomotive accelerates back to its original speed.

In order to set up this sequence, the following LNCVs need to be programmed:

LNCV	Description	Value
0	Module and first detector address	1-4095
2	Selection of sequence type, shuttle train with terminus delay time	4
3	Direction, in which the sequence in LNCV 2 is activated Active when travelling from detector 1 to detector 2 Active when travelling from detector 2 to detector 1	 0 1
4	Waiting time at the terminus in seconds	0-255
6	Address exit signal at which the train at the terminus waits. This is switched by the MARCo-Receiver and does not have to physically exist on the layout.	S1
10	Block option: the time after which the section is set to vacant again after the train has left on a green signal	0-511

Example

Timed shuttle-service with exit signal (solenoid address10) is programmed into the MARCo-Receiver with the module address 2. The detectors are connected to the MARCo-Receiver so that on arrival the train passes over detector 1 first. All trains are held for 20 seconds before they drive off again. 10 seconds after a train has driven off, the MARCo-Receiver is ready again for the next shuttle train (block option).



In order to setup the example specified above, the following LNCVs need to be programmed:

LNCV	Description	Value
0	Module and first detector address	2
2	Selection of sequence type, shuttle train with terminus delay time	4
3	Direction, in which the sequence in LNCV 2 is activated ihen train travels from detector 1 to detector 2 If it's travelling in the other direction nothing happens	0
4	Waiting time at the terminus, 20 seconds	20
6	Address exit signal at which the train at the terminus waits. In this case address 10, switched by the MARCo receiver.	10
10	Block option: 10 seconds after the train has left, the MARCo-Receiver considers the section vacant again and the next train can enter.	10

Method:

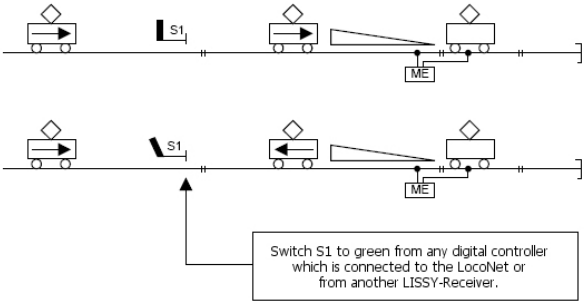
Call up the LocoNet Programming Menu in your Intellibox as described in Chapter 4.5 and execute the following sequence:

Step 1:	Call up MARCo-Receiver, as in described Chap. 4.5.			
Step 2:	LNCV 2	Value 98	program	Flush MARCo-Receiver
Step 3:	LNCV 0	Value 3	program	Set module address to 3
Step 4:	LNCV 2	Value 5	program	Function “Shuttle service remote controlled”
Step 5:	LNCV 4	Value 2	program	Enter waiting time in seconds
Step 6:	LNCV 6	Value 10	program	Enter signal address 10
Step 7:	LNCV 10	Value 10	program	Enter waiting time in seconds, after which the track is ready for the next train
Step 8:	End programming			

NOTE: *This automatic function can be combined with various other functions which are described in Chapter 7.4.5.*

7.4.2 Basic operation Shuttle traffic manually started

Setting up shuttle traffic in accordance with following illustration:



The following operational sequence is set up by this automated operation:

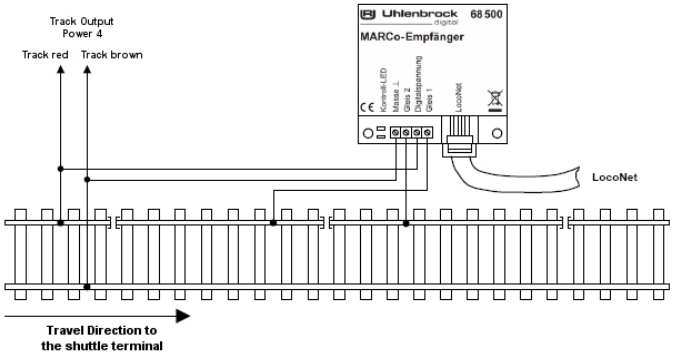
- A locomotive passed signal S1 in reverse direction.
- A locomotive runs over the double detector of the MARCo receiver
- The signal S1 is switched to red
- The locomotive brakes to a stop with its internal system.
- A preset timer function is started. This is the same for all vehicles
- During this time the locomotive’s travelling direction is changed (light changes)
- The MARCo-Receiver monitors signal S1 and waits, till it is switched to green by another device that is connected to the LocoNet: (Intellibox, IB-control, DAISY, IB-Switch or a computer program via the Intellibox), an instruction from a route (Intellibox or IB-Switch) or from another MARCo receiver.
- Once the signal is green, the locomotive is switched into motion in the opposite direction to return to its original location.

In order to setup the example specified above, the following LNCVs need to be programmed:

LNCV	Description	Value
0	Module and first detector address	1-4095
2	Selection of sequence type, shuttle train with terminus delay time	4
3	Direction, in which the sequence in LNCV 2 is to be activated Active when travelling from detector 1 to detector 2 Active when travelling from detector 2 to detector 1	 0 1
4	Waiting time at the terminus in seconds	0-255
6	Address exit signal at which the train at the terminus waits. This is switched by the MARCo-Receiver and does not have to physically exist on the layout.	S1
10	Block option: the time after which the section is set to vacant again after the train has left on a green signal	0-511

Example

The shuttle train is manually started by switching the exit signal at solenoid address 10 with the exit signal connected to the MARCo receiver, with the module address 3. The track sections are connected to the MARCo-Receiver so that trains entering the terminus pass section 1 first and then section 2. All trains are to stop 2 seconds before the MARCo-Receiver monitors the exit signal. If the exit signal with address 10 is on green, it accelerates the train to its original speed. 10 seconds after a train has left, the MARCo-Receiver is ready for the next shuttle train (block option).



In order to setup the example specified above, the following LNCVs need to be programmed:

LNCV	Description	Value
0	Module and first detector address	3
2	Selection of sequence type, shuttle train with terminus delay time	5
3	Direction, in which the sequence in LNCV 2 is to be activated when train travels from detector 1 to detector 2 If it's travelling in the other direction nothing happens	0
4	Waiting time at the terminus, 2 seconds	2
6	Address exit signal at which the train at the terminus waits. In this case address 10, switched by the MARCo receiver.	10
10	Block option: 10 seconds after the train has left, the MARCo-Receiver considers the section vacant again and the next train can enter.	10

Method:

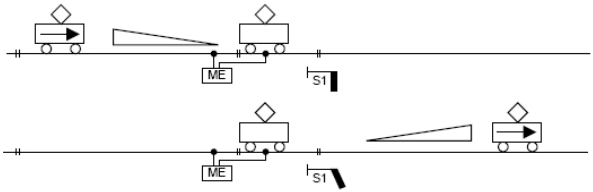
Call up the LocoNet Programming Menu in your Intellibox as described in Chapter 4.5 and execute the following sequence:

Step 1:	Call up MARCo-Receiver, as in described Chap. 4.5.			
Step 2:	LNCV 2	Value 98	program	Flush MARCo-Receiver
Step 3:	LNCV 0	Value 3	program	Set module address to 3
Step 4:	LNCV 2	Value 5	program	Function “Shuttle service remote controlled”
Step 5:	LNCV 4	Value 2	program	Enter waiting time in seconds
Step 6:	LNCV 6	Value 10	program	Enter signal address 10
Step 7:	LNCV 10	Value 10	program	Enter waiting time in seconds, after which the track is ready for the next train
Step 8:	End programming			

- **NOTE:** This automatic function can be combined with various other functions which are described for both receivers 68 600 and 68 610 in Chapter 7.4.5.

7.4.3 Basic Operation Holding point

To operate a train automatically as shown in the following diagram:



The following operational sequence is setup by this automated operation:

- The locomotive enters the track section of the MARCo receiver.
- The signal S1 is switched to red.
- The locomotive brakes with its own inertia (locomotive decoder) and stops.
- An adjustable waiting period, which is the same for all vehicles, expires.
- Signal S1 is set to green.
- The locomotive accelerates again back to its original speed.

In order to achieve this sequence, the following LNCVs must be programmed:

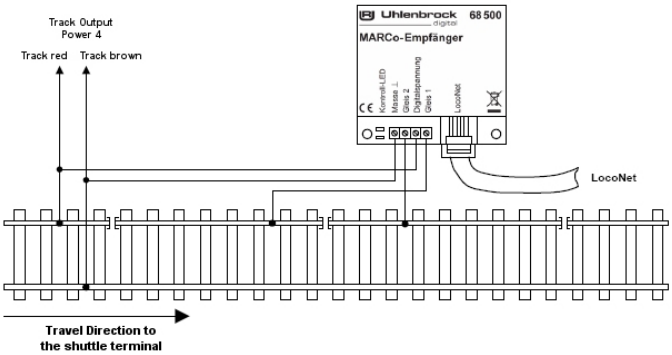
LNCV	Description	Value
0	Module and first detector address	1-4095
2	Selection of sequence type, Holding point	6
3	Direction, in which the sequence in LNCV 2 is to be activated Active when travelling from track 1 to track 2 Active when travelling from track 2 to track 1	 0 1
4	Holding time at the terminus in seconds	0-255
6	Address exit signal at which the train at the terminus waits. This is switched by the MARCo-Receiver and does not have to physically exist on the layout.	S1
10	Block option: the time after which the section is set to vacant again after the train has left on a green signal	0-511

Holding point for both driving directions

LNCV 6 contains the address of the directional signal that is located at the programmed holding point. Especially with the holding points it is possible to automate it in both directions. In this case (LNCV 3 = 2), it is also necessary to install two signals at the location. In LNCV 6, address S1 is the signal in driving direction from detector 1 to detector 2. In driving direction detector 2 to detector 1, the signal S1+1 then automatically switches. Neither signal need be physically present on the layout.

Example

A MARCo-Receiver with the module address 4 is installed at the holding point with the exit signal with solenoid address 12. The detectors are connected to the MARCo-Receiver so that the sequence is triggered when the train travels from detector 1 and to detector 2. All trains stop for 30s. After that the MARCo-Receiver sets the exit signal to green and then accelerates back up to its original speed. 10 seconds after the departure, the MARCo-Receiver should be ready to handle a new train (block option).



In order to setup the example specified above, the following LNCVs need to be programmed:

LNCV	Description	Value
0	Module and first detector address	4
2	Selection of sequence type, Holding point	6
3	Direction, in which the sequence in LNCV 2 is to be activated Active when travelling from detector 1 to detector 2 Active when travelling from detector 2 to detector 1 Active in both travelling directions (holding point only)	 0 1 2
4	Holding time at the terminus in seconds	30
6	Address exit signal at which the train at the terminus waits. This is switched by the MARCo-Receiver and does not have to physically exist on the layout.	12
10	Block option: the time after which the section is set to vacant again after the train has left on a green signal	10

Method:

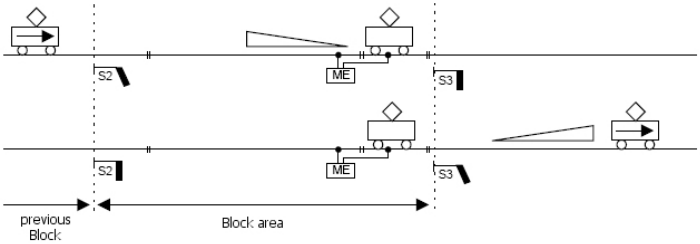
Call up the LocoNet Programming Menu in your Intellibox as described in Chapter 4.5 and execute the following sequence:

Step 1:	Call up MARCo-Receiver, as in described Chap. 4.5.			
Step 2:	LNCV 2	Value 98	program	Flush MARCo-Receiver
Step 3:	LNCV 0	Value 4	program	Set module address to 4
Step 4:	LNCV 2	Value 6	program	Function “Holding Point”
Step 5:	LNCV 4	Value 30	program	Enter waiting time in seconds
Step 6:	LNCV 6	Value 12	program	Enter signal address 12
Step 7:	LNCV 10	Value 10	program	Enter waiting time in seconds, after which the track is ready for the next train
Step 8:	End programming			

NOTE: This automatic function can be combined with various other functions which are described in Chapter 7.4.5.

7.4.4 Basic operation Block sections

To protect a section of track with a signal, so that entry signal S2 prevents a subsequent train from entering the block section, if it is already occupied. The train in this block section is affected by exit signal S3. This signal depends on the condition of the following block section and becomes controlled manually or automatically.



With this basic operation for a block system a longer track distance is divided into several blocks, which can be traversed automatically. For a meaningful, automatically controlled block system, it must consist of at least 3 blocks. A block system can always control one train less than the number of blocks. The behaviour of a locomotive in a block depends on the state of the exit signal at the end of the Block, which is also the entry signal for the next block. For automatic operation one MARCo-Receiver is needed per block.

The following operational sequence shows how each MARCo receiver, in an automatic block system, is programmed. It assumes that the signal at the end of the block is red:

- The locomotive passes the detectors of the MARCo-Receiver and therefore completely enters the Block with the signal S3.
- The signal S3 at the end of the block is red, the locomotive brakes and stops.
- The signal S2 of the previous block, from which the locomotive came, is also set to red (this happens as a matter of course).
- The signal S1 of the block before, which is now vacant, is set to green (this happens as a matter of course).
- The MARCo-Receiver monitors the signal S3 and waits for it to be set to green by another device attached to the LocoNet (Intellibox, IB-control, DAISY, IB-Switch or a computer program via the Intellibox), an instruction from a route (Intellibox or IB-Switch) or another MARCo receiver.
- If the signal turns green S3, e.g. is switched by a MARCo receiver, 2 blocks ahead in the travelling direction, the locomotive accelerates to its original speed again and proceeds into the next block
- As soon as the train is completely in the next block, the signal S3 must be set back to red, e.g. by the MARCo receiver, that controls the following block.

In order to setup this operation, the following LNCVs must be programmed:

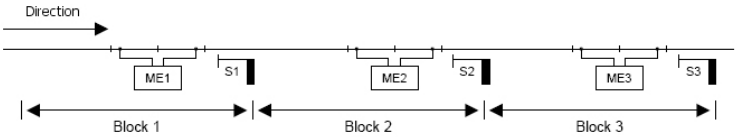
LNCV	Description	Value
0	Module and first detector address	0
2	Automatic mode: block section/station block	7
3	Direction, in which the sequence in LNCV 2 is to be activated Active when travelling from detector 1 to detector 2 Active when travelling from detector 2 to detector 1	 0 1
6	Exit signal of the controlled block The exit signal S3 is monitored by the MARCo-Receiver for its status: red signal stops the train, with green signal the train travels through. *Note: The signal does not physically have to be on the layout.*	S3
7	Exit signal red the previous block The exit signal S2 of the now vacant block behind of the train is now automatically switched to red by MARCO receiver. *Note: The signal does not physically have to be on the layout.*	S2-0
8	Entry signal green the previous block The entry signal S1 of the now free, the MARCo-Receiver switches block before it to green automatically, thus a following train can proceed. *Note: The signal does not physically have to be on the layout..*	S1-1
10	Block option The block status is changed from "occupied" to "vacant", if a train in the block departs or drives through the block's exit signal (LNCV 6) it switches to "red".	0

NOTE: *Whilst LNCV 6 contains only the pure signal address, LNCV 7 and LNCV 8 link to the signal addresses depending on the travel direction (0 = red, 1 = green).*

If the signal at the end of the block is green, if the locomotive passes over the detectors, it does not change speed. However in all cases signals S2 and S1 of the previous blocks change.

Example block section

We will discuss an individual block, block 3, within a block system of at least three blocks.



The solenoid addresses of the signals.

Description	S1	S2	S3
Sol. Address	5	6	7

The MARCo-Receiver for block 3 in the example is programmed as follows:

LNCV	Description	Value
0	Module and first detector address	3
2	Automatic mode: block section/station block	7
3	Direction, in which the sequence in LNCV 2 is to be activated Active when travelling from detector 1 to detector 2	0
6	Exit signal of the controlled block The exit signal S3 is monitored by the MARCo-Receiver for its state, red signal stops the train, with green signal the train travels through. *Note: The signal does not physically have to be on the layout.*	7
7	Exit signal red, the previous block The exit signal S2 of the now vacant block behind the train is now automatically switched to red by MARCo receiver. *Note: The signal does not physically have to be on the layout.*	60
8	Entry signal green from the previous block The entry signal S1 of the now free, the MARCo-Receiver switches the block before it to green automatically, thus a following train can proceed. *Note: The signal does not physically have to be on the layout.*	51
10	Block option The block state is changed from "occupied" to "vacant", if a train in the block departs or drives through, the block's exit signal (LNCV 6) switches to "red".	0

What do these entries mean?

- The MARCo-Receiver has the module address 3 (LNCV 0)
- The operating mode is Block Section (LNCV 2 = 7)
- The block operates when passing the detectors from detector 1 to detector 2 (LNCV 3).
- For the exit, the signal with address 7 (LNCV 6) is monitored. On entry, signal 6 is set to "red" (LNCV 7). This signal is for the block which the train has just left. Further signal 5 is set to "green" (LNCV 8). A possible waiting train here then moves on to the red signal 6.

Method:

Call up the LocoNet Programming Menu in your Intellibox as described in Chapter 4.5 and execute the following sequence:

Step 1:	Call up MARCo-Receiver, as in described Chap. 4.5.			
Step 2:	LNCV 2	Value 98	program	Flush MARCo-Receiver
Step 3:	LNCV 0	Value 3	program	Set module address to 3
Step 4:	LNCV 2	Value 7	program	Function "Block Section"
Step 5:	LNCV 6	Value 7	program	Enter signal address 7
Step 6:	LNCV 7	Value 60	program	Set signal 6 to red
Step 7:	LNCV 8	Value 51	program	Set signal 5 to green
Step 8:	LNCV 10	Value 0	program	Enter waiting time in seconds, after which the track is ready for the next train
Step 9:	End programming			

***NOTE:** This automatic function can be combined with various other functions which are described for both receivers 68 600 and 68 610 in Chapter 7.4.5.*

7.4.5 Station administration

With MARCo you can administer an entire station. This can consist of up to 10 parallel tracks with a common entry track.

Each arriving train selects its designated track in the station. If this track is occupied, the train waits at the station entrance at a red signal, until its designated track is vacant. Only then will the train automatically enter its designated track.

A complete station administration is developed as follows: Install a MARCo-Receiver as the automatic *entry manager* in the block before the station and in the block after the station, install a MARCo-Receiver as the automatic *exit manager*. The MARCo receivers in the station tracks are automatic *block sections with block feedback messages*.

The entry manager ensures that each track in the station is designated to be used for up to 8 different locomotive addresses or categories. The routes from the approach to the station track are automatically switched as track routes. These routes must be stored in the Intellibox or IB-Switch. The exit manager provides for automatic departure of the trains from the station. It selects a train for departure and switches the appropriate route, which is stored in the Intellibox, Intellibox II or IB-Switch.

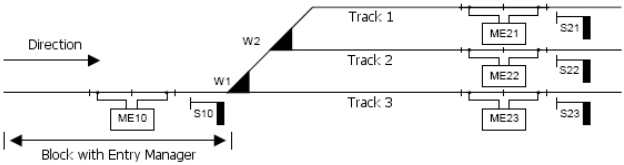
The station can be completely integrated into an automatic block system.

It is also possible to use only the entry manager. In this case the station arrivals are controlled automatically and within the station the trains are controlled manually. If one uses only the Exit Manager, i.e. the station departures are automatically controlled and the arrivals are controlled manually.

In addition, it is possible, for the entry and exit manager to operate separately from each other. In this case station entry, and/or exit are automatically controlled, and the remainder controlled manually.

7.4.5.1 Entry managers

You have a station with a number of parallel tracks as in the following diagram:



At the entrance into the station there is a single approach track with the signal S10. The approach track is a block section with a MARCo-Receiver set up as the automatic *Entry manager*. This regulates the entry of the train to the designated track.

After the signal, the track branches out to the parallel station tracks. Each station track is monitored by a MARCo-Receiver programmed as an automatic *block section with block status messages*. The MARCo-Receiver in the station track regulates the deceleration of the individual train ahead of the respective block exit signal, as well as activating auxiliary functions, e.g. switching on Front lighting and calling up sounds.

The allocation of an individual train to the tracks takes place via the entry manager as a function of the vehicle addresses and categories, which are programmed in LNCVs 20 to 119.

NOTE: ***T****he routes to the individual tracks of the station must be setup in the Intellibox or IB-Switch. The last instruction of each route must switch the signal at the station, i.e. the exit signal of the entry manager (here S10) to green, so that a waiting train can proceed into the station.*

If a train arrives at the entry manager signal, a vacant track, into which this train is permitted to enter, is selected, and the pertinent route switched.

To set a MARCo-Receiver as entry manager to a station the LNCVs are programmed as follows:

LNCV	Description	Value
0	Module and first detector address	1-4095
2	Automatic mode: entry manager	8
3	Direction, in which the sequence in LNCV 2 is to be activated Active when travelling from detector 1 to detector 2 Active when travelling from detector 2 to detector 1	 0 1
5	Waiting period for processing solenoids - route or feedback instructions. (in seconds.)	0-255
6	Exit signal of the controlled block The exit signal S10 is monitored by the MARCo-Receiver for its state, red signal stops the train, with green signal the train travels through. *Note: The signal does not physically have to be on the layout.*	S10
10	Block option: The block status is changed from "occupied" to "vacant", if a train in the block departs or drives through the block's exit signal (LNCV 6) switches to "red".	0

The administration of the station is done with LNCVs 20 to 119. Each track uses 10 LNCVs for the following purpose:

- The address of the MARCo-Receiver for the monitoring of the station track
- The instruction for switching a route is setup in the Intellibox or IB-Switch. This route must contain switching of all turnouts required to free the path to the desired track. The final instruction of the route must always switch the station entry signal to green.
- The addresses of the locomotives, which may enter a particular track. This can be an individual Locomotive address, a train category or the Universal address for all locomotives. Up to 8 different entries are possible.

LNCV	Description
20	Station track 1 Address (LNCV 0) of the MARCo-Receiver that supervises track 1 of the station
21	Route to track 1 Instruction for switching the route in Intellibox or IB-Switch, which leads to track 1 of the station (see also ch. 7.3.5)
22	1. Address or train category of the locomotive, which may enter track 1
23	2. Address or train category of the locomotive, which may enter track 1
24	3. Address or train category of the locomotive, which may enter track 1
25	4. Address or train category of the locomotive, which may enter track 1
26	5. Address or train category of the locomotive, which may enter track 1
27	6. Address or train category of the locomotive, which may enter track 1
28	7. Address or train category of the locomotive, which may enter track 1
29	8. Address or train category of the locomotive, which may enter track 1
30	Station track 2 Address (LNCV 0) of the MARCo-Receiver that supervises track 2 of the station
31	Route to track 2 Instruction for switching the route in Intellibox or IB-Switch, which leads to track 2 of the station (see also ch. 7.3.5)
32-39	Addresses or train categories of the locomotives, which may enter track 2
40	Station track 3 Address (LNCV 0) of the MARCo-Receiver that supervises track 3 of the station
41	Route to track 3 Instruction for switching the route in Intellibox or IB-Switch, which leads to track 3 of the station (see also ch. 7.3.5)
42-49	Addresses or train categories of the locomotives, which may enter track 3
50	Station track 4 Address (LNCV 0) of the MARCo-Receiver that supervises track 4 of the station
51	Route to track 4 Instruction for switching the route in Intellibox or IB-Switch, which leads to track 4 of the station (see also ch. 7.3.5)
52-59	Addresses or train categories of the locomotives, which may enter track 4

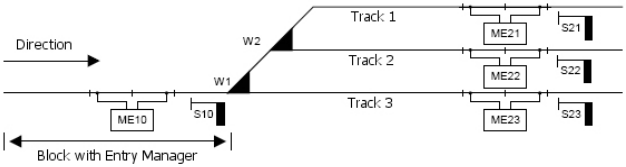
LNCV	Description
60	Station track 5 Address (LNCV 0) of the MARCo-Receiver that supervises track 5 of the station
61	Route to track 5 Instruction for switching the route in Intellibox or IB-Switch, which leads to track 5 of the station (see also ch. 7.3.5)
62-69	Addresses or train categories of the locomotives, which may enter track 5
70	Station track 6 Address (LNCV 0) of the MARCo-Receiver that supervises track 6 of the station
71	Route to track 6 Instruction for switching the route in Intellibox or IB-Switch, which leads to track 6 of the station (see also ch. 7.3.5)
72-79	Addresses or train categories of the locomotives, which may enter track 6
80	Station track 7 Address (LNCV 0) of the MARCo-Receiver that supervises track 7 of the station
81	Route to track 7 Instruction for switching the route in Intellibox or IB-Switch, which leads to track 7 of the station (see also ch. 7.3.5)
82-89	Addresses or train categories of the locomotives which may enter track 7
90	Station track 8 Address (LNCV 0) of the MARCo-Receiver that supervises track 8 of the station
91	Route to track 8 Instruction for switching the route in Intellibox or IB-Switch, which leads to track 8 of the station (see also ch. 7.3.5)
92-99	Addresses or train categories of the locomotives, which may enter track 8
100	Station track 9 Address (LNCV 0) of the MARCo-Receiver that supervises track 9 of the station
101	Route to track 9 Instruction for switching the route in Intellibox or IB-Switch, which leads to track 9 of the station (see also ch. 7.3.5)
102-109	Addresses or train categories of the locomotives, which may enter track 9
110	Station track 10 Address (LNCV 0) of the MARCo-Receiver that supervises track 10 of the station
111	Route to track 10 Instruction for switching the route in Intellibox or IB-Switch, which leads to track 10 of the station (see also ch. 7.3.5)
112-119	Addresses or train categories of the locomotives, which may enter track 10

NOTE

- *If a locomotive (train) passes over the detectors of the entry manager, it firstly checks whether the recognized address was programmed for one of the station tracks. If this track is vacant, the appropriate route is switched. The last instruction of the route switches the entry signal to green and the train heads into its destination track.*
- *If the destination track is occupied, the locomotive waits at the red entry signal, until the destination track becomes vacant.*
- *A locomotive address can also be programmed for several tracks. Then the locomotive is sent to the first vacant track which is found.*
- *If the address of the locomotive is not allocated for any track, the entry manager checks if the recognized category is assigned to one of the tracks. If this is the case, it again checks if the track is vacant. If a vacant track is found, the route is switched for entry to this track. The last instruction of the route must switch the entry signal to the station to green. The train enters the station.*
- *Categories can also be assigned to several tracks of the station.*
- *If the entry manager does not find a track for a recognized address or category, it checks if one of the tracks is approved for the entry by all vehicles (address entry 20000). If a track is programmed that way and vacant, the train is moved to there.*
- *The search for a vacant track starts with LNCV 20 of MARCo receiver. Then, all following LNCV entries are cyclically scanned in ascending order.*

- ***ATTENTION:*** *A locomotive, whose address and category are not assigned to a track, does not automatically enter a station without a track for all vehicles (address entry 20000), but stops at the red signal. This locomotive must be then driven manually into a free track.*

Example: Entry into a 3-track station



You have a 3-track station with a single approach track. The associated MARCo-Receiver is programmed as entry manager as follows:

LNCV	Description	Value
0	Module and first detector address, 1-4095	10
2	Automatic mode: entry manager	8
3	Direction, in which the sequence in LNCV 2 is to be activated Active when travelling from detector 1 to detector 2	0
5	Waiting period between switching the track route and starting the waiting locomotive. It applies to all automatic modes setup with LNCV 2 Value is given in seconds.	5
6	Exit signal for the controlled block The exit signal state is monitored by the MARCo receiver. A red signal stops the train, a green signal allows it to drive through. Note: The signal does not physically have to be on the layout.	10

	LE	Route	Locomotive addresses and categories							
LNCV	**... 0**	**... 1**	**…2**	**…3**	**…4**	**…5**	**…6**	**…7**	**…8**	**…9**
2	21	20010	94	78	86					
3	22	20011	20002	218	100					
4	23	20020	20000							
5										
6										
7										
8										
9										
10										
11										

What do the entries in the previous tables mean?

- The MARCo-Receiver has the module address 10 (LNCV 0).
- The operating mode is entry manager (LNCV 2 = 8).
- The entry manager works when travelling from detector 1 to detector 2 (LNCV 3).
- To enter the station, signal S10 with the address 10 (LNCV 6) is monitored.
- Before entering the station the train waits for a period of 5 seconds (LNCV 5) for switching the routes
- The 3 tracks of the station are monitored by MARCo receivers 21 (LNCV 20), 22 (LNCV 30) and 23 (LNCV 40).
- The routes to the 3 tracks of the station are routes in the Intellibox: Group 1/route 1 (LNCV 21), Group 1/route 2 (LNCV 31), Group 1/route 3 (LNCV 41). All routes must switch the turnouts first, and signal 10 to green, last.
- For example, the tracks are entered as follows: Steam locomotives BR94, BR78, BR86 drive into track 1, diesel locomotives V100 and BR218 and category 2 locomotives drive into track 2, all other trains drive into track 3.

Extended operation: Solenoids or feedback messages, independent of address of the locomotive in the block section

Once the basics are working, the time delays for the trains may need to be modified.

Chapter 8.3.5 showed how to switch solenoids for signals or routes and/or sending feedback. With LNCV 7 and LNCV 8 there are two ways to produce such instructions. These instructions are implemented immediately after the detectors are passed, independently of the recognized vehicle address, i.e. all vehicles switch the same solenoids and/or routes and send the same feedback.

LNCV	Description
7	1. Solenoid, route or feedback Address and direction of first solenoid to be switched, i.e. the address has 0 or 1 added, and/or address of a route or address of a feedback with attached Status 3 for “occupied” or 2 for “vacant” or the address of a route. *Note: The signal does not have to physically be on the layout.*
8	2. Solenoid, Route or feedback Address and direction of a second solenoid to be switched, i.e. the address has 0 or 1 added, and/or. address of a route or address of a feedback with attached Status 3 for “occupied” or 2 for “vacant” or the address of a route *Note: The signal does not have to physically be on the layout.*

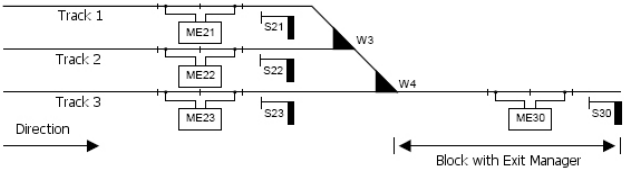
Further examples for entry managers can be found in the Examples chapter.

***NOTE:** Since LNCVs 20 to 111 are used to configure the Entry Manager, it is not possible to use them for functions outlined in Chapter 7.3.*

7.4.5.2 Exit managers

Basic operation

You have a station with a number of parallel tracks in as shown in the following diagram:



Different trains are located in the station waiting for the exit signals to turn green, which can happen manually. They monitor the state of the section, i.e. the block section following the station. If this block is vacant, i.e. no vehicle is in the block, a train from the station can depart and enter this block. To do this, switch all appropriate turnouts to the exit and lastly the exit signal of the desired station track, to green.

This task can however also be done by a MARCo-Receiver with the automatic *Exit manager operation* in the first block after the station. The exit manager does nothing different to the example. When the supervised block is vacant, the exit manager selects an occupied track and switches the route from this track to the exit block section. This route then switches the exit signal of the selected track to green.

The routes of the individual station tracks to the exit block must be in the Intellibox or IB-Switch. The last instruction of each route must switch the exit signal of the respective station track to green.

To set a MARCo-Receiver as exit manager for a station, the LNCVs are programmed as follows:

LNCV	Description	Value
0	Module and first detector address, 1 4095	9
2	Automatic mode: exit manager The tracks are checked in *chronological* order if they are occupied. The next occupied track is selected for departure. The tracks are checked *randomly* in their occupied state. The next, *randomly* found, occupied track is selected for departure.	10
3	Direction, in which the sequence in LNCV 2 is to be activated Active when travelling from detector 1 to detector 2 Active when travelling from detector 2 to detector 1	 0 1
5	Waiting period for processing switching commands for solenoids and routes. (in seconds).	0-255
6	The state of the exit signal S30 is monitored by the exit manager, red signal causes the train to stop, a green signal permits passing through. *Note: The signal does not have to physically exist on the layout.*	S30
7	Station exit on red Instruction for switching a route in Intellibox, Intellibox II or IB-Switch, sets all station signals to red again (see also ch. 7.3.5). turnouts do not need to be monitored	

The administration of the station is done with LNCVs 20 to 119. Each track uses 2 LNCVs for the following purpose: Address of the MARCo-Receiver for monitoring the station track and instruction for switching a route in the Intellibox or IB-Switch. This route must contain all turnout-switching instructions, to clear the route from the station track to the station exit. The last instruction in this route must always switch the exit signal of the station to green.

LNCV	Description
20	Track 1: Address (LNCV 0) of the MARCo-Receiver that supervises Track1
21	Track 1: Route switching instruction in the Intellibox or IB-Switch, for the route to Track 1 exit.
30	Track 2: Address (LNCV 0) of the MARCo-Receiver that supervises Track2
31	Track 2: Route switching instruction in the Intellibox or IB-Switch, for the route to Track 3 exit.
40	Track 3: Address (LNCV 0) of the MARCo-Receiver that supervises Track3
41	Track 3: Route switching instruction in the Intellibox or IB-Switch, for the route to Track 3 exit.
50	Track 4: Address (LNCV 0) of the MARCo-Receiver that supervises Track4
51	Track 4: Route switching instruction in the Intellibox or IB-Switch, for the route to Track 4 exit.
60	Track 5: Address (LNCV 0) of the MARCo-Receiver that supervises Track5
61	Track 5: Route switching instruction in the Intellibox or IB-Switch, for the route to Track 5 exit.
70	Track 6: Address (LNCV 0) of the MARCo-Receiver that supervises Track6
71	Track 6: Route switching instruction in the Intellibox or IB-Switch, for the route to Track 6 exit.
80	Track 7: Address (LNCV 0) of the MARCo-Receiver that supervises Track7
81	Track 8: Route switching instruction in the Intellibox or IB-Switch, for the route to Track 7 exit.
90	Track 8: Address (LNCV 0) of the MARCo-Receiver that supervises Track8
91	Track 8: Route switching instruction in the Intellibox or IB-Switch, for the route to Track 8 exit.
100	Track 9: Address (LNCV 0) of the MARCo-Receiver that supervises Track9
101	Track 9: Route switching instruction in the Intellibox or IB-Switch, for the route to Track 9 exit.
110	Track 10: Address (LNCV 0) of the MARCo-Receiver that supervises Track10
111	Track 10: Route switching instruction in the Intellibox or IB-Switch, for the route to Track 10 exit.

NOTE: *The switching routes must be entered into the Intellibox, Intellibox II or IB-Switch*

Coordination with the entry manager

The operation of entry and exit managers described so far operate totally independent of one another. Thus the exit manager does not know which locomotive has just arrived at the Entry Manager and is waiting to enter an occupied track. It can therefore easily happen that the Exit Manager dispatches a few trains from the station, before the destination track for the waiting train is vacated. In stations with many tracks and block traffic with relatively few blocks the danger therefore exists that the rail traffic becomes grid locked, because no track is being cleared for the waiting train, as due to full blocks a vehicle in the Exit Manager block will not be able to leave.

This problem can be solved by entering into the exit manager's LNCV 13 the address of the entry manager. Furthermore in LNCVs 22-29, 32-39, to 112-119, make the same entries about locomotive track allocations as in the entry manager. Before the exit manager vacates a track according to one of the procedures described above, (chronological or random), it queries the entry manager about the address and/or category of locomotive that is waiting for a vacant track. If it finds that the destination track is actually occupied, its normal track selection is interrupted and it first vacates the destination track for the waiting train.

LNCV	Description
13	Link of the exit manager with the entry manager.
22-29	Locomotive addresses or train categories, which may enter in track 1
32-39	Locomotive addresses or train categories, which may enter in track 2
42-49	Locomotive addresses or train categories, which may enter in track 3
52-59	Locomotive addresses or train categories, which may enter in track 4
62-69	Locomotive addresses or train categories, which may enter in track 5
72-79	Locomotive addresses or train categories, which may enter in track 6
82-89	Locomotive addresses or train categories, which may enter in track 7
92-99	Locomotive addresses or train categories, which may enter in track 8
102-109	Locomotive addresses or train categories, which may enter in track 9
112-119	Locomotive addresses or train categories, which may enter in track10

ATTENTION: *The entry manager, with whom the exit manager is linked, must have LNCV 15 set to Uhlenbrock protocol (see chapter 7.6).*

NOTE: *When searching for a track which can be vacated, the exit manager proceeds in exactly the same way as the entry manager searches for a destination track. It first tries to locate a locomotive in the station under its individual address. If this fails, it searches for an appropriate train category. If this also fails it checks if a track for general traffic was vacated.*

With LNCV 8 you have a further possibility of sending a switching command. This instruction is implemented immediately after passing the detectors, irrespective of the recognized vehicle address, i.e. all vehicles switch the same solenoid, route or send the same feedback.

LNCV	Description
7	1.Solenoid, Feedback or Route Address and direction of a second solenoid to be switched, i.e. the address has 0 or 1 added, and/or address of a route or address of a feedback with attached Status 3 for "occupied" or 2 for "vacant" or the address of a route *Note: The signal does not have to physically be on the layout.*
8	2. Solenoid, Route or feedback Address and direction of a second solenoid to be switched, i.e. the address has 0 or 1 added, and/or address of a route or address of a feedback with attached Status 3 for "occupied" or 2 for "vacant" or the address of a route. *Note: The signal does not have to physically be on the layout.*

NOTE: *Since LNCVs 20 to 111 are used to configure the Entry Manager, it is not possible to use them for functions outlined in Chapter 7.3.*

7.4.5.3 MARCo Receivers for station tracks

The individual tracks in the station are monitored by MARCo receivers with the automatic mode of '*Block section with block status message*'. This operates in exactly the same way

as the automatic *block section* function, however in addition it reports its status to an entry or an exit manager via the LocoNet. That means that all MARCo receivers supervise the station tracks with the entry into LNCV 7 to set the same signal to red, i.e. the entry signal to the station at the entry manager.

In order to achieve this operation, the following LNCVs are to be programmed:

LNCV	Description	Value
0	Module and first detector address, 1-4095	1-4095
2	Automatic mode: block detector with status message.	23
3	Direction, in which the sequence in LNCV 2 is to be activated Active when travelling from detector 1 to detector 2	0
6	The exit signal, at the end of the track is monitored by the track manager. A red signal stops the train, a green signal allows it to drive through. *Note: The signal does not physically have to be on the layout.*	S2x
7	The station entry signal S10 is automatically set to red by the track manager. *Note: The signal does not have to physically be on the layout.*	S10-0
8	The entry signal into the entry manager's block is automatically set to green by the MARCo receiver, so the next train can the entry manager's vacant block section *Note: The signal does not have to physically be on the layout.*	

As the MARCo-Receiver with the automatic mode '*block section with block status message' operates* exactly like the automatic mode '*block section'*, for all further programming of basic operation and extended functions refer to chapter. 7.4.4 Block sections.

ATTENTION: *LNCV 15 must be to value 1 or 9 (transmission format Uhlenbrock, see Ch. 7.6)*

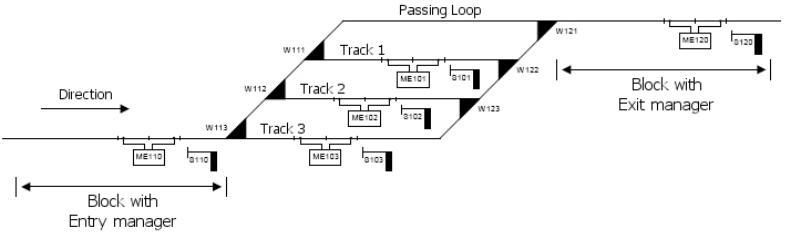
Each MARCo-Receiver can report its internal state "vacant" or "occupied" over that LocoNet. Status reporting is setup by adding the number 16 to the function code (value 4-10) in LNCV 2 (functions), e.g. Function 4 is a terminus section *without* active block status message and function 20 is the same terminus section *with* active block status message. Function 8 is an entry manager *without* active block status message and function 24 the same entry manager *with* active block status message.

Therefore it is possible to automate e.g. a shuttle terminus controlled by an entry manager which allows trains to enter, or a station with more than 10 tracks is administered as several stations in one.

Automatic modes from LNCV 2	without block status message	with block status message
Shuttle terminus time controlled	4	20
Shuttle terminus signal controlled	5	21
Holding point	6	22
Block section	7	23
Entry manager	8	24
Exit manager cyclically chronologically	9	25
Exit manager *random selection*	10	26
Exit manager cyclically chronologically and selective track switching	11	27
Exit manager random and selective track switching	12	28

7.4.5.4 Station control with passing loop

The station passing loop serves to bypass the station on a specially designated track. The track does not require its own MARCo-Receiver to monitor it. All trains that use this track, , to go directly from the station entrance (Block with entry manager) to the exit (Block with Exit manager) without stopping.



The passing loop can be utilized in two different ways:

1. When a particular solenoid address is switched to “green“, all trains arriving in the Entry Manager block, travel via the passing loop directly the Exit Manager block. In this case the Entry Manager behaves like a block which is located just ahead of the Exit Manager. The automatic now proceeds, so, when the block exit signal turns green the route to the passing loop is also set.
2. If the solenoid address is set to “red” all trains that are entered in the Entry Manager’s LNCVs 122-127, run through the passing loop.

Programming the Entry Manager

The passing loop is enabled in the Entry Manager by LNCVs 13, 120 and 122-127 with the following meaning:

- The solenoid address which selects the passing loop for all trains (Setting this solenoid to “green”) or only for particular trains (Setting this solenoid to “red”)
- MARCo-Receiver address with which the Entry Manager reports the passing loop as occupied or vacant.
  Attention: *This address must not be used by any other MARCo Receiver.*
- The addresses of the trains which are to use the station’s passing loop. This can be an individual locomotive address or a train category. Up to 6 different entries are possible.

LNCV	Description	Value
2	Automatic function Entry Manager	8 or 24
13	Meaning of the LNCV, in case LNCV 2 has a value of 8 or 24: Passing loop controlled by solenoid address Solenoid green = All trains use the passing loop Solenoid red = Only the address or train categories in LNCV 122 to 127 use the passing loop	1-2000
120	Virtual address, with which Exit Manager reports the passing loop as occupied or vacant. *This address (LNCV 0) can’t be used by any other MARCo Receiver.*	1-4095
121	Not used	-
122-127	addresses (1-9999) or train category (20001-20015) of the locomotive which is to automatically use the passing loop.	1-9999, 20001-20015

Function Description

The Entry Manager reports the passing loop as “occupied” as soon as train arrives, which is meant for this track. If the solenoid with the address specified in LNCV 13 is switched to “green” (all trains should bypass the station), the Entry Manager reports the passing loop as “vacant” until the solenoid is switched to “red” again. If the MARCo-Receiver is programmed as Entry Manager and has the programming for a passing loop LNCV 120 then a programmed time dependent block vacant report, specified in LNCV 10, is ignored and the block is always reported as “vacant”, when the block exit signal (LNCV 6) is switched from “green” to “red”.

Programming Exit Manager

The passing loop is enabled in the Exit Manager with LNCVs 13 and 120 to 123 with the following meaning:

- The address of the station’s Entry Manager

- MARCo-Receiver address with which the Entry Manager reports the passing loop as occupied or vacant (the Entry Manager's LNCV 120).
  ATTENTION: *This address must not be used by another MARCo Receiver.*
- The instruction to switch a route in the Intellibox or IB-Switch. This route must contain all turnout switching instructions which clear the path from the Entry Manager block to the Exit Manager block. The last instruction in the route must always be to switch the station entry signal to "green".
- If the station bypass is executed and the desired train arrives at the Exit Manager detector then, for safe block traffic, the exit signal for the Exit Manager's block must be switched to "green" and the exit signal for the Entry Manager to "red". These instructions do not apply to those in LNCVs 7 and 8 in station operation for tracks 1-10. On arrival of a train that has taken the path via the passing loop the instructions from LNCV 7 and 8 are replaced by those in LNCV 122 and 123.

LNCV	Description	Value
13	Meaning of the LNCV, if LNCV 2 is valued 9, 10, 25 or 26: Linking the function of Entry Manager and Exit Manager. 0 = No linking of Entry Manager and Exit Manager 1-4095 = if the address from LNCV 0 of the matching Entry Manger is entered here, the Exit Manager ascertains if a locomotive is waiting at Entry Manager, to enter the station. The Exit Manager clears a track so the waiting train can enter the station. The prerequisite for this that the entries in LNCVs 20-119 are the same in both managers. Furthermore a new train selection is made in case a station control with passing loop is set to status "all trains must use the passing loop" is returned to "normal operation".	1-4095
120	Address, with which the Entry Manager reports the passing loop as occupied or vacant. *This address (LNCV 0) must not be used by another MARCo Receiver.*	1-4095
121	Route from the station entry to the station exit Instruction for switching the route in the Intellibox or IB-Switch which is the path from the station entrance (Entry Manger block) to the station exit (Exit Manager block).	10-20483
122	If a train enters the passing loop instead of the instruction in LNCV 7 the value programmed here is used. (programming see LNCV 7)	10-20483
123	If a train enters the passing loop instead of the instruction in LNCV 8 the value programmed here is used. (programming see LNCV 8)	10-20483

Function Description

For the Exit Manager the passing loop is a station track with two special characteristics:

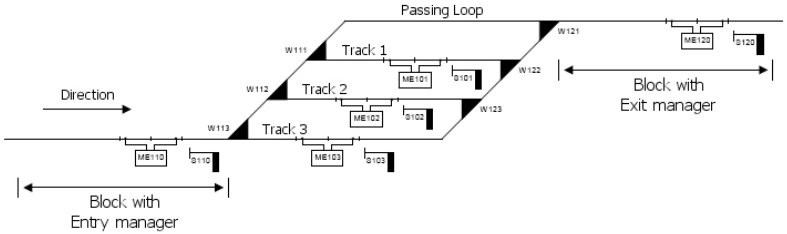
1. If this track is occupied, the preference is to clear this track before all other tracks and the route is set according to LNCV 121.
2. If this track was used when a train arrives, the values LNCVs 7 and 8 will be replaced by the values from LNCVs 122 and 123.

If the Entry Manager receives the instruction, via solenoid command, that all trains are to use the passing loop, it reports the passing loop as vacant. The Exit Manager now directs all arriving trains directly via the passing loop. This means as soon as the Exit Manager block becomes vacant, the entry signal for the station is switched to "green" and a train arriving then can immediately travel through to the Exit Manager block, via the passing loop.

If the Exit Manager has given such a train the all clear and the route via the passing loop has been setup the Exit Manager waits the arrival of a train. If the Entry Manager state is switched with a solenoid according to LNCV 13, back to allowing trains running through station, the Entry Manager spontaneously reports the passing loop as vacant. So that no train collisions occur the Exit Manager waits until such time that a train arrives at the Entry Manager. After that the Exit Manager makes a new train selection and a new route out of the station is selected and switched. This new selection can only take place if LNCV 13 contains the module address of the linked Entry Manager.

Example 1: 3-Track Station control with Passing Loop

The automatically controlled station consists of three station tracks and a passing loop. The station tracks 1 to 3 are available to all trains, except trains with a train category 4 and the locomotive with address 200. Trains of category 4 and locomotive 200 bypass the station via the passing loop. Solenoid address 100 is to be used so all trains travel via the passing loop. Solenoid address 130 switch the entire station control off.



Basic Programming of LNCVs 0-15 of the five MARCo Receivers

LE	Function \ LNCV	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
101	Block section	101	0	23	0	0	2	101	1100	0	0	0	130	0	0	0	9
102	Block section	102	0	23	0	0	2	102	1100	0	0	0	130	0	0	0	9
103	Block section	103	0	23	0	0	2	103	1100	0	0	0	130	0	0	0	9
110	Entry Manager	110	0	8	0	0	2	110	0	0	0	0	130	0	100	0	9
120	Exit Manger	120	0	9	0	0	2	120	20201	0	0	0	130	0	110	0	9

Additional Programming of MARCo-Receiver ME110 (Entry Manager)

	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Track 1	2...	101	20170	20000	0	0	0	0	0	0	0
Track 2	3…	102	20171	20000	0	0	0	0	0	0	0
Track 3	4…	103	20181	20000	0	0	0	0	0	0	0
Passing Loop	12…	100	0	20004	200	0	0	0	0	0	0

Additional Programming of MARCo-Receiver ME120 (Exit Manager)

	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Track 1	2...	101	20181	20000	0	0	0	0	0	0	0
Track 2	3…	102	20190	20000	0	0	0	0	0	0	0
Track 3	4…	103	20191	20000	0	0	0	0	0	0	0
Passing Loop	12…	100	20200	1100	0	0	0	0	0	0	0

Programming of the Routes in the Intellibox I

Route Group and Route Number	**3/1**	**3/2**	**3/3**	**3/4**	**3/5**	**3/6**	**3/7**	**3/8**
Route Function	Entry Track 1	Entry Track 2	Entry Track 3	Exit Track 1	Exit Track 2	Exit Track 3	Passing loop	Signal in Sta.- red
Solenoid address	20170	20171	20180	20181	20190	20191	20200	20201
Step 0	113 R	113 R	113 G	122 R	123 R	123 G	113 R	101R
Step 1	112 G	112 R	110 G	121 R	122 G	122 G	112 G	102R
Step 2	111 R	110 G		101 G	121 R	121 R	111 G	103R
Step 3	110 G				102 G	103 G	121 G	
Step 4							110 G	

The last example is achieved with routes in an IB-Switch in the following section.

Basic Programming of LNCVs 0-15 of the five MARCo-Receivers

LE	LNCV / Function	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
101	Block section	101	0	23	0	0	2	101	1100	0	0	0	130	0	0	0	9
102	Block section	102	0	23	0	0	2	102	1100	0	0	0	130	0	0	0	9
103	Block section	103	0	23	0	0	2	103	1100	0	0	0	130	0	0	0	9
110	Entry Manager	110	0	8	0	0	2	110	0	0	0	0	130	0	100	0	9
120	Exit Manger	120	0	9	0	0	2	120	83	0	0	0	130	0	110	0	9

Additional Programming of MARCo-Receiver ME110 (Entry Manager)

	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Track 1	2...	101	13	20000	0	0	0	0	0	0	0
Track 1	3…	102	23	20000	0	0	0	0	0	0	0
Track 1	4…	103	33	20000	0	0	0	0	0	0	0
Passing Loop	12…	100	0	20004	200	0	0	0	0	0	0

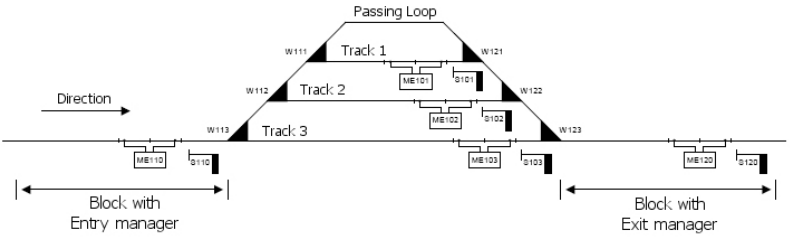
Additional Programming of MARCo-Receiver ME120 (Exit Manager)

	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Track 1	2...	101	43	20000	0	0	0	0	0	0	0
Track 1	3…	102	53	20000	0	0	0	0	0	0	0
Track 1	4…	103	63	20000	0	0	0	0	0	0	0
Passing Loop	12…	100	73	1100	0	0	0	0	0	0	0

Programming of the Routes in an Intellibox II or IB-Switch

Route Number	1	2	3	4	5	6	7	8
Route Function	Entry Track 1	Entry Track 2	Entry Track 3	Exit Track 1	Exit Track 2	Exit Track 3	Passing loop	Signal in Sta.- red
Set route via feedback address	1 occupied	2 occupied	3 occupied	4 occupied	5 occupied	6 occupied	7 occupied	8 occupied
Step 1	113 R	113 R	113 G	122 R	123 R	123 G	113 R	101R
Step 2	112 G	112 R	110 G	121 R	122 G	122 G	112 G	102R
Step 3	111 R	110 G		101 G	121 R	121 R	111 G	103R
Step 4	110 G				102 G	103 G	121 G	
Step 5							110 G	

Example 2: Same Example with a different track plan



Basic Programming of LNCVs 0-15 of the five MARCo-Receivers

LE	LNCV / Function	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
101	Block section	101	0	23	0	0	2	101	1100	0	0	0	130	0	0	0	9
102	Block section	102	0	23	0	0	2	102	1100	0	0	0	130	0	0	0	9
103	Block section	103	0	23	0	0	2	103	1100	0	0	0	130	0	0	0	9
110	Entry Manager	110	0	8	0	0	2	110	0	0	0	0	130	0	100	0	9
120	Exit Manger	120	0	9	0	0	2	120	20201	0	0	0	130	0	110	0	9

Additional Programming of MARCo-Receiver ME110 (Entry Manager)

	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Track 1	2...	101	20190	20000	0	0	0	0	0	0	0
Track 1	3…	102	20191	20000	0	0	0	0	0	0	0
Track 1	4…	103	20100	20000	0	0	0	0	0	0	0
Passing Loop	12…	100	0	20004	200	0	0	0	0	0	0

Additional Programming of MARCo-Receiver ME120 (Exit Manager)

	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Track 1	2...	101	20101	20000	0	0	0	0	0	0	0
Track 1	3…	102	20110	20000	0	0	0	0	0	0	0
Track 1	4…	103	20111	20000	0	0	0	0	0	0	0
Passing Loop	12…	100	20120	1100	0	0	0	0	0	0	0

Programming of the Routes in the Intellibox

Route Group and Route Number	**2/1**	**2/2**	**2/3**	**2/4**	**2/5**	**2/6**	**2/7**	**2/8**
Route Function	Entry Track 1	Entry Track 2	Entry Track 3	Exit Track 1	Exit Track 2	Exit Track 3	Passing loop	Signal in Sta.- red
Solenoid address	20090	20091	20100	20101	20110	20111	20120	20121
Step 0	113 R	113 R	113 G	121 R	122 R	123 G	113 R	101R
Step 1	112 G	112 R	110 G	122 R	123 R	103 G	112 G	102R
Step 2	111 R	110 G		123 R	102 G		111 G	103R
Step 3	110 G			101 G			121 G	
Step 4							122 G	
Step 5							123 R	
Step 6							110 G	

The last example is achieved with routes in an Intellibox II or IB-Switch in the following section.

Basic Programming of LNCVs 0-15 of the five MARCo-Receivers

LE	**LNCV / Function**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
101	**Block section**	101	0	23	0	0	2	101	1100	0	0	0	130	0	0	0	9
102	**Block section**	102	0	23	0	0	2	102	1100	0	0	0	130	0	0	0	9
103	**Block section**	103	0	23	0	0	2	103	1100	0	0	0	130	0	0	0	9
110	**Entry Manager**	110	0	8	0	0	2	110	0	0	0	0	130	0	100	0	9
120	**Exit Manger**	120	0	9	0	0	2	120	83	0	0	0	130	0	110	0	9

Additional Programming of MARCo-Receiver ME110 (Entry Manager)

	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Track 1	2...	101	13	20000	0	0	0	0	0	0	0
Track 1	3…	102	23	20000	0	0	0	0	0	0	0
Track 1	4…	103	33	20000	0	0	0	0	0	0	0
Passing Loop	12…	100	0	20004	200	0	0	0	0	0	0

Additional Programming of MARCo-Receiver ME120 (Exit Manager)

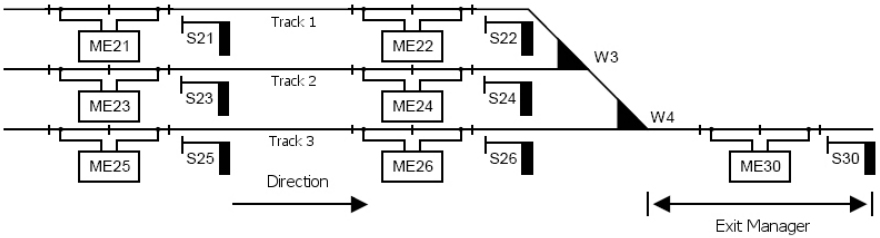
	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Track 1	2...	101	43	20000	0	0	0	0	0	0	0
Track 1	3…	102	53	20000	0	0	0	0	0	0	0
Track 1	4…	103	63	20000	0	0	0	0	0	0	0
Passing Loop	12…	100	73	1100	0	0	0	0	0	0	0

Programming of the Routes in an Intellibox II or IB-Switch

Route Number	1	2	3	4	5	6	7	8
Route Function	Entry Track 1	Entry Track 2	Entry Track 3	Exit Track 1	Exit Track 2	Exit Track 3	Passing loop	Signal in Sta.- red
Set route via feedback address	1 occupied	2 occupied	3 occupied	4 occupied	5 occupied	6 occupied	7 occupied	8 occupied
Step 1	113 R	113 R	113 G	121 R	122 R	123 G	113 R	101R
Step 2	112 G	112 R	110 G	122 G	123 G	103 G	112 G	102R
Step 3	111 R	110 G		123 R	102 G		111 G	103R
Step 4	110 G			101 G			121 G	
Step 5							122 G	
Step 6							123 G	
Step 7							110 G	

7.4.5.5 Exit Manager with selective track switching Option

Exit from a 3-track station with Block sections in the tracks



In the example, the Exit Manager needs to selectively switch the signals associated with each of the block sections in the station. It is no longer sufficient, like in the previous example, to switch route when the at the Exit Manager to switch all signals in the station to “red”, e.g. a train from track 1 reaches the Exit Manager, then signal 22 must be switched to “red” and signal 21 to “green”.

The routes for the individual tracks in the station to the exit block must be stored in the Intellibox, Intellibox II or IB-Switch. The last instruction in every route must definitely be to switch the exit signal at the end of the corresponding station to “green”.

The Exit Manager’s MARCo-Receiver LNCVs are programmed as follows:

LNCV	Description	Value
0	Module and first detector address, 1 4095	9
2	Automatic mode: exit manager The tracks are checked in *chronological* order if they are occupied. The next occupied track is selected for departure. The tracks are checked *randomly* in their occupied state. The next, *randomly* found, occupied track is selected for departure.	10
3	Direction, in which the sequence in LNCV 2 is to be activated Active when travelling from detector 1 to detector 2 Active when travelling from detector 2 to detector 1	 0 1
5	Waiting period for processing switching commands for solenoids and routes. (in seconds).	0-255
6	The state of the exit signal S30 is monitored by the exit manager, red signal causes the train to stop, a green signal permits passing through. *Note: The signal does not have to physically exist on the layout.*	S30

The management of the station happens via LNCVs 20 to 119. Every track has 2 LNCVs with the following entries: address of the MARCo-Receiver that is to monitor the station track and the instruction to switch the route in the Intellibox, Intellibox II or IB-Switch.

LNCV	Description
20	Track 1: Address (LNCV 0) of the MARCo-Receiver that monitors this track
21	Track 1: Route switching instruction in the route from leading this track to station exit.
30	Track 2: Address (LNCV 0) of the MARCo-Receiver that monitors this track
31	Track 2: Route switching instruction in the route from leading this track to station exit.
40	Track 3: Address (LNCV 0) of the MARCo-Receiver that monitors this track
41	Track 3: Route switching instruction in the route from leading this track to station exit.
50	Track 4: Address (LNCV 0) of the MARCo-Receiver that monitors this track
51	Track 4: Route switching instruction in the route from leading this track to station exit.
60	Track 5: Address (LNCV 0) of the MARCo-Receiver that monitors this track
61	Track 5: Route switching instruction in the route from leading this track to station exit.
70	Track 6: Address (LNCV 0) of the MARCo-Receiver that monitors this track
71	Track 6: Route switching instruction in the route from leading this track to station exit.
80	Track 7: Address (LNCV 0) of the MARCo-Receiver that monitors this track
81	Track 8: Route switching instruction in the route from leading this track to station exit.
90	Track 8: Address (LNCV 0) of the MARCo-Receiver that monitors this track
91	Track 8: Route switching instruction in the route from leading this track to station exit.
100	Track 9: Address (LNCV 0) of the MARCo-Receiver that monitors this track
101	Track 9: Route switching instruction in the route from leading this track to station exit.
110	Track 10: Address (LNCV 0) of the MARCo-Receiver that monitors this track
111	Track 10: Route switching instruction in the route from leading this track to station exit.

NOTE: *Coordination (LNCV 13) with the Entry Manager is not possible in this case. Therefore LNCVs 22-29, 32-39, to 112-119 are not programmed with the same locomotive-track assignments as the Entry Manager.*

When a train arrives at the Exit Manager the switching instructions in LNCV 7 and 8 are executed. These are entered in LNCV 22, 23, or 32, 33 to 112, 113, selective track switching sequences.

LNCV	Description	Value
22	Exit signal “red” for the last block in track 1	S22-0
23	Entry signal “green” for the second last block in track 1	S21-1
32	Exit signal “red” for the last block in track 2	S24-0
33	Entry signal “green” for the second last block in track 2	S23-1
42	Exit signal “red” for the last block in track 3	S26-0
43	Entry signal “green” for the second last block in track 3	S25-1
etc.		
112	Exit signal “red” for the last block in track 10	Sx-0
113	Entry signal “green” for the second last block in track 10	Sy-1

Station control with passing loop is possible in these operating modes as already described. The following LNCVs must be programmed:

LNCV	Description	Value
13	0= No coupling of Exit Manager and Entry Manager	0
120	Address with which the Entry Manager reports the passing loop as occupied. The addresse (LNCV 0) must not be used by any other MARCo-Receiver.	1-4095
121	Route from the station entrance to the station exit Instruction for switching route in the Intellibox, Intellibox II or IB-Switch, that leads from the staition entrance (Block with the Entry Manager) to the Exit Manager (Block with the Exit Manager).	10-20483
122	If a train arrives at in the passing loop the instruction entered here is executed.	10-20483
123	If a train arrives at in the passing loop the instruction entered here is executed.	10-20483

7.4.6 Extended Functions for Shuttle service, Holding Point and Block Section

The automatic functions, Shuttle train time controlled, Shuttle train remote controlled, holding point and block section can be combined with three additional functions which are described in the following section.

Overall Switching Operation

Once the basics are working, the time delays for shuttle train may need to be modified.

Chapter 7.3.6 shows how to switch solenoids for signals or routes and/or sending feedback. With LNCV 7 and LNCV 8 there are two ways to produce such instructions. These instructions are implemented immediately after the detectors are passed, independent of the recognized vehicle address, i.e. all vehicles switch the same solenoids and/or routes and send the same feedback.

LNCV	Description
7	1.Solenoid, Feedback or Route Address and direction of a second solenoid to be switched, i.e. the address has 0 or 1 added, and/or address of a route or address of a feedback with attached Status 3 for “occupied” or 2 for “vacant” or the address of a route *Note: The signal does not have to physically be on the layout.*
8	2. Solenoid, Route or feedback Address and direction of a second solenoid to be switched, i.e. the address has 0 or 1 added, and/or address of a route or address of a feedback with attached Status 3 for “occupied” or 2 for “vacant” or the address of a route. *Note: The signal does not have to physically be on the layout.*

Individual Switching Operation

Chapter 7.3 is concerned with switching operations, how set up a specific vehicle’s functions, speeds or solenoid change and/or sending Feedback. All switching functions described can also be programmed individually for automated shuttle train systems.

Chapter 7.3 described adjusting command options, whether the programmed Instruction is executed the instant the detectors are passed or later when the automatic departure is to be implemented. Speed instructions generally are implemented only at departure.

Processing the instructions of the individual switching operation apply as follows:

Sequence	Function	If, then
1.	Are locomotive special function instructions from LNCV 20-49 to be sent to Position 0?	implement
2.	*Are sonlenoid, route- or feedback instructions from LNCV 80-109 to be sent?*	implement
3.	Are locomotive special function instructions from LNCV 20-49 to be sent to Position 1?	implement
4.	Has a waiting period been programmed into LNCV 5?	delayed
5.	Are locomotive special function instructions from LNCV 20-49 to be sent to Position 2?	implement
6.	Is an individual waiting period programmed for this locomotive in LNCV 110-127?	implement
7.	Are locomotive special function instructions from LNCV 20-49 to be sent to Position 3?	implement
8.	Is an individual speed change instruction from LNCV 50-79 to be sent?	implement
9.	Are locomotive special function instructions from LNCV 20-49 to be sent to Position 4?	implement

For this, functions 4 to 7 are sequentially executed if the block signal is switched from “red” to “green”, so the train departs. They are not executed if the train arrives at the sensor when the block exit signal is green.

Time delayed switching of solenoids

If the switching operation is to switch an entire route for the vehicle, it does not make sense for the vehicle to depart immediately after sending the route switching command. The selected route may not have been completely implemented at the time, the individual solenoids could still be changing. In order to prevent this, a waiting period can be set, in LNCV 5, after sending the route or feedback instructions, for which the MARCo-Receiver waits before it implements the speed instruction. The waiting time from LNCV 5 is inserted at Position 4 in the above executed sequence, if the block signal is switched from “red” to “green” when the train is to depart.

LNCV	Description	Value
5	Waiting period for processing solenoids, routes or feedback instructions, in seconds.	0-255

Further examples with locomotive specific switching commands can be found in the “Examples” section of this manual.

Locomotive specific Delay

LNCV 5 determines for all trains the length of time to wait at the block exit signal after it has turned “green”. In LNCVs 110 to 117 and 120 to 127 can contain additional delays for individual locomotives, so that, for example, a rail car stays at the platform longer than a freight train. The programming is done with the following LNCVs:

LNCV	Description
110-117	Vehicle addresses which trigger the Delay
120-127	Delay in Seconds (0-255)

The vehicle addresses are programmed according to the same convention that is also used for all other functions in switching operations (see Chap. 7.3.4 to 7.3.6).

Switching of Locomotive functions at various Points in the Automatic Sequence

As shown in the sequence of the automatic operation above, there are 5 positions at which an action, which switches locomotive special functions, can be activated.

In the Option for the switching of special functions it can be specified at what point in the switching sequence the programmed switch function is to be executed. Valid are:

Calculation of Instruction option for Changing of Locomotive Special Functions

Opt No.	Description	Selection	Value	Sum
1	Do not evaluate driving direction		0	
	Driving direction from Track1 to track2		2	
	Driving direction from Track2 to track1		3	
2	Switching function 2 or 3		0	
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off		4	
3	Special function is switched off		0	
	Special function is switched on		8	
	Special function is toggled		16	
4	Special function is toggled with a delay factor		32	
5	Switching duration in Seconds (max. 31) * 256		• *256	
6	Position in the sequence (0-4) * 8192		*8192	
			Calculated Value for LNCV 40-49	

With this function it is possible, in automatic operations, to switch multiple special functions of the locomotive in a block section.

Example

A rail car with address 15, in block operation, is first the sound of closing of doors (f3) and then as it departs the sound of the whistle (f2). In this example the special function for closing doors must be activated in position 2 and the special function for the whistle in position 4. Both operations must be programmed in different LNCVs. Next, a pause of 5 seconds can be inserted between the two sounds by a locomotive specific Delay. The programming:

Special function f3 at Position 2 is switched on for 1 Second.

Calculation of Instruction option for Changing of Locomotive Special Functions

n	Description	Selection	Value	Sum
1	Do not evaluate driving direction		0	
	Driving direction from Track1 to track2	X	2	2
	Driving direction from Track2 to track1		3	
2	Switching function 2 or 3		0	
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off	X	4	4
3	Special function is switched off		0	
	Special function is switched on	X	8	8
	Special function is toggled		16	
4	Special function is toggled with a delay factor	X	32	32
5	Switching duration in Seconds (max. 31) * 256	1s	• *256	256
6	Position in the sequence (0-4) * 8192	2	*8192	16384
			Calculated Value for LNCV 40	**16686**

For switching on special function f2 at position 4 for 1 second:

Calculation of Instruction option for Changing of Locomotive Special Functions

Opt No.	Description	Selection	Value	Sum
1	Do not evaluate driving direction		0	
	Driving direction from Track1 to track2	X	2	2
	Driving direction from Track2 to track1		3	
2	Switching function 2 or 3		0	
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off	X	4	4
3	Special function is switched off		0	
	Special function is switched on	X	8	8
	Special function is toggled		16	
4	Special function is toggled with a delay factor	X	32	32
5	Switching duration in Seconds (max. 31) * 256	1s	• *256	256
6	Position in the sequence (0-4) * 8192	4	*8192	32768
			Calculated Value for LNCV 41	**33070**

Programming of Function Instructions

Command	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Address	2...	15	15								
Value	3…	8	4								
Option	4…	16686	33070								

Programming of individual Delay

Command	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7
Address	11...	15							
Value	12…	5							

7.5 Special functions

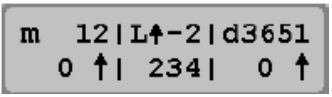
7.5.1 DirectDrive

The direct take-over of a locomotive by a controller on a control desk without the need to enter the locomotive address is known as **DirectDrive**. This simple and convenient method of locomotive control can be used in combination of MARCo with a number of Uhlenbrock control desks.
The prerequisite for DirectDrive is that the MARCo-Receiver is setup so that it sends the Uhlenbrock data format. For this LNCV 15 must have a Value 1 or 9 (more about LNCV 15 in Chap. 7.6). Then the MARCo-Receiver sends all locomotive information via the LocoNet, as soon as a locomotive arrives at the Detector. The controllers connected to the LocoNet can then support locomotive selection with the DirectDrive Function.

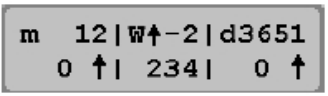
7.5.1.1 DirectDrive and Intellibox/IB-Control

The Intellibox MARCo Mode (from Software Version 1.55) can be selected by multiple operation of the [mode]-key or pressing the [mode] and [6] in quick succession. The middle of the display changes to match the selected mode.

NOTE: Even though the mode here is known as LISSY-Mode, it functions in exactly the same way, with the information transmitted by the MARCo-Receiver.

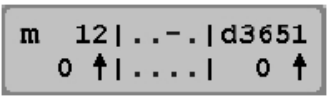


If the LISSY Mode is selected the MARCo-Receiver can be monitored in the middle part of the display:



In the display represented above it shows that the monitored receiver was passed by a locomotive with address 234 in the direction indicated by the arrow. The 2 shown after the dash is the train category. If the monitored point is passed by a wagon with a MARCo transmitter it is indicated in the display with a W:

For a MARCo-Receiver in a vacant block section the middle section of the display is cleared.



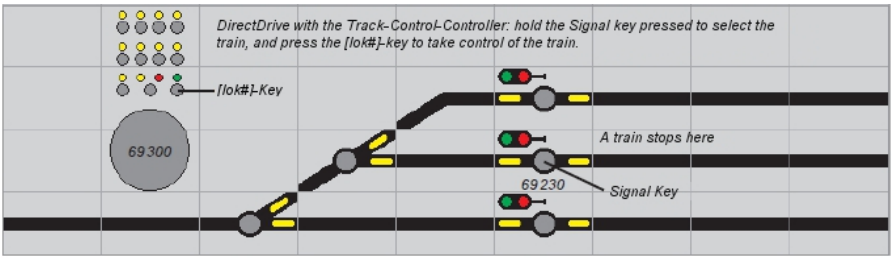
If a locomotive is reported by MARCo Receiver, as shown in the middle part of the displays, then this locomotive can be taken over one of the two controllers on the Intellibox. For this you press the [←]-key to take over the locomotive on the left controller and the [→]-key, to take over the locomotive on the right controller.

7.5.1.2 DirectDrive and Track-Control

The TrackControl Speed Controller 69 300 similarly supports the DirectDrive Function. As soon as a locomotive passes the MARCo Receiver's Detector which is assigned to the controller the LED above the [lok#]-key blinks "green". Now only the [lok#]-key needs to be pressed once and the locomotive is taken over by the controller.

Also every TrackControl Signal module 69 230 can have a MARCo-Receiver assigned to it using LocoNet programming. For this, LNCV 37 of the signal module must be assigned with the MARCo Receiver's module address. If this is done, the signal module remembers the locomotive which last passed the detector of the assigned MARCo Receiver. If now the button on the signal module is pressed at the same time as the [lok#]-key on the controller 69 300, the locomotive which last passed the detector is taken over. This way you take control of trains

that are stopped at a red signal in your station, using the keys on your TrackControl speed controller.

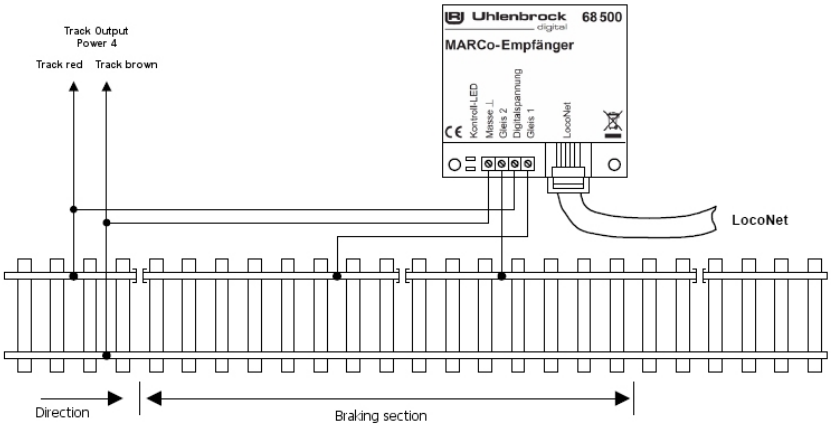


7.5.2 Braking before a signal

Lengthening the Braking section with a Precision stop

This Chapter is about shuttle trains, holding point, block section and station block, explaining that every vehicle will brake immediately it passes over the first track section (Track 1) by using its internal braking settings. Thus, the point at which a vehicle comes to rest is dependent on its speed when it enters the block and the design of the vehicle. So every locomotive will stop at a different place.

This behaviour can be modified second track second is the actual stopping point that is when the signal is reached. The locomotive brakes after passing the first detector to an adjustable speed (the programmed speed step applies to all locomotives) and moves forward at this speed to the second detector, where it finally stops. By setting a slow speed, a point can be realized at which all vehicles stop, if the mechanical characteristics of the locomotive are not too different.



This can be achieved by programming a block speed in LNCV 9.

LNCV	Description
9	Block speed If a speed step (2-127) is entered here, then the module in the automatic modes 4-12 and 20-28 (LNCV 2) will reduce the speed to the preset value when a train is recognized. After reaching the second track section (track 2) the train brakes to speed step 1. 0 = stopping with the decoder-internal delay 1 = emergency stop (stop without delay) 2-127 = speed step for the slow section

The speed step values 2 to 127 are automatically converted by the Intellibox depending on the number of speed steps the individual locomotive is set to DCC 14/27/28/128 speed steps. The calculated values are rounded to a whole number.

After passing over detector 1, the locomotive will use its decoder-internal deceleration to reduce speed to the programmed speed step for this section, and finally stops only after it passes over detector 2.

The factory default for LNCV 9 = 0, *block speed function* is switched off.

7.5.3 Deactivating the automatic mode via solenoid address

Sometimes, e.g. when manually shunting within tracks with MARCo receivers, it can be useful to switch *an automated* MARCo-Receiver off and to restart it on completion of the manual process. The MARCo-Receiver must then have a solenoid address assigned to it in LNCV 11. If this is set to "red", the MARCo-Receiver is deactivated. By switching it to "green" the MARCo-Receiver is reactivated. When switching the MARCo-Receiver OFF, the current state values are deleted and it restarts the automatic mode from scratch.

When restarting the automatic mode, the MARCo-Receiver assumes the respective block section is free for a new vehicle. If the reactivated unit acts as an exit manager, then after switching on in the vacant state, a train will automatically be cleared to leave the station. For safety reasons, to avoid collisions, this procedure must be manually started, by setting a station exit signal to green.

LNCV	Description
11	Automatic mode on/off switch, by solenoid address. 0 = automatic operation not influenced by the solenoid address 1-2000 = solenoid address with which MARCo-Receiver deactivated (red) or activated (green)

7.5.4 Train dependent automation (only with Intellibox II, from Ver. 1.0.11-1.0.11)

It is possible to affect *the layout automation* by a train's category. For this there is LNCV 12:

LNCV	Description
12	Train dependent automation = switchin automatic function on or off by train category.. For Functions 4-12 and 20-28 according to LNCV 2 0 = automation not influenced by categories 1-15 = For all train categories other than the one entered, the automatic function is to be executed after arriving in the track section 101-115 = only the entered train category is to execute the automatic function after arriving in the track section.

NOTE: *With Intellibox II (from Software version 1.011 - 1.011) 15 train categories can be used. For this, a linking option in the Intellibox II between locomotive address and one of 15 locomotive categories can be used.*

This permits interesting operational sequences to be set up e.g. the Valley Station for the shuttle train for the mountain railway, at which the driving direction is reversed. All other trains drive through without direction changes.

7.5.5 Block option "vacant/occupied" in the automated layout

When a vehicle with MARCo transmitter drives over a MARCo-Receiver programmed for an *automatic mode*, it then implements the program. Internally the MARCo-Receiver saves the "occupied" state. That means that the MARCo-Receiver must become "vacant" again before it can accept the next vehicle. As long as the MARCo-Receiver is "occupied", it cannot handle any further vehicles automatically.

Should a vehicle that entered a block automatically be 'released' manually, the block must be set to "vacant" again before the next vehicle can enter the block.

During the automatic operation the MARCo receivers always switch to the "occupied" state when a vehicle passes the detectors. LNCV 10 can specify how the MARCo-Receiver can be returned to the "vacant" state.

In particular, for the *shuttle terminus* or *holding point,* it is advisable to switch the abandoned stop back to "vacant" via a timer and also set signal back to "red".

LNCV	Description
10	Block option = options for the block change in state of "occupied" to "vacant", if a train left the block or drove through. 0 = exit signal (LNCV 6) is switched to "red". after the block is vacated 1-255 = if afterwards the indicated number of seconds passed. Value in seconds. 257-511 = like preceding option. Now the exit signal indicated in LNCV 6 is also set to red. Also the exit signal specified in LNCV 6 is switched to “red” Value in seconds + 256.

7.5.6 Resetting and deletion

In the course of operating a layout it can be necessary to set a MARCo-Receiver to a known, defined state.

If you want to program your own functions, then we recommend that you delete the factory installed pre-programmed Functions before you commence programming, otherwise these can interfere with your desired operation.

If you have a MARCo-Receiver with unknown contents, it is better that you reset it to factory default. In factory default condition you have a number of known pre-programmed functions. Therefore you can simply test the operation.

The delete and/or reset is done via programming a special mode of operation into the LNCV 2 of your MARCO receiver. Four different options exist for deletion and/or resetting:

LNCV	Description	Value
2	*Delete functions* 96 = Clear the current operating conditions. Programmed LNCVs is not changed. 97 = Clear all LNCVs for the switching mode (starting from LNCV 20) 98 = Set all LNCVs to 0, except LNCV 0 and 1 (address) 99 = Reset to Factory default, without changing address	96-99

Factory default settings of MARCo Receivers:

Function	LNCV	Description	Value
Basic Settings	0	Module address, and first detector address	1
	1	Second detector address	2
	2	Direction sensitive switch mode	2
	15	Save module operation mode at power off	8
Switching Function 1	20	For all trains	20000
	30	…f0 (light)	1
	40	…Turn off if direction S1 -> S2	2
Switching Function 1	21	For all trains	20000
	31	…f0 (light)	1
	41	…Turn on if direction S2 -> S1	11

All other LNCVs are programmed to the Value 0.

7.6 Module Settings

With the help of LNCV 15 various module settings can be affected.

Opt No.	Description	Selection	Value	Sum
1	Send transfer format (ÜF) to the LocoNet		0	
	Send ÜF Uhlenbrock format with loco address and category		1	
	Send ÜF Digitrax format with loco address and block vacant		2	
	Send ÜF Digitrax format with loco address and block occupied		3	
3	Does not save operating status when switching off		0	
	Saves operating status when switching off		8	
4	Sends no feedback (vacant/occupied) for the block (vacant/occupied)		0	
	Sends feedback (vacant/occupied) for the Block (vacant/occupied) the address in LNCV 1 (address tracl 2) in operating mode LNCV 2 = 4-12 and 20-28		16	
5	Sends no feedback (vacant/occupied) for the block (vacant/occupied) for track1		0	
	Sends feedback (vacant/occupied) for the Block (vacant/occupied) with the address in LNCV0 (1. Module address) for track1 in operating mode LNCV 2 = 1 and LNCV 2 = 3		32	
6	Sends no feedback (vacant/occupied) for the block (vacant/occupied) for track2		0	
	Sends feedback (vacant/occupied) for the Block (vacant/occupied) with the address in LNCV0 (2. Address track2) for track1 in operating mode LNCV 2 = 1 and LNCV 2 = 3		64	
			Calculated value for LNCV 15	

With option 1 you can specify whether and which LocoNet protocol format is sent to other LocoNet devices that will use the MARCo receiver's reported data (address, category, driving direction, receiver address of the MARCo receiver). e.g. if a LocoNet display (item No. 63450) is to Indicate the locomotive address to be used, the MARCo-Receiver must be set to send Uhlenbrock format.

With the option 3 you can specify whether the MARCo-Receiver saves status information when the power is switched off.

Option number 4 determines if the MARCo-Receiver sends Feedback occupied or vacant with the address of the second track section (LNCV 1). Only for automatic functions (LNCV 2 = 4 - 28).

Option number 5 can determine if the MARCo-Receiver sends feedback occupied or vacant with the module address for track1 (LNCV 0). Only for operating modes *Basic function* and *Switching function* with double detector. (LNCV 2 = 1 or 3)

Option number 6 can determine if the MARCo-Receiver sends feedback occupied or vacant with the address of the second track section (LNCV 1). Only for operating modes *Basic function* and *Switching function* with double detector. (LNCV 2 = 1 or 3)

LNCV 15 is set to 8 in the Factory.

Number of valid received Address bytes

Before the locomotive address is sent over the LocoNet and an automatic function is executed, a minimum number of vaslid bytes, specified in LNCV 17, must be received by the RailCom Telegrams when a locomotive enters a particular decoder section.

LNCV	Description	Value
17	Number of valid received Address bytes that must be received by RailCom before the address is accepted.	0-255

Waiting time to the next Automatic Start

Waiting time in Seconds after which a locomotive has left a detector track section, before a new locomotive can activate an automatic function (not in operating mode 3, two single detectors).

LNCV	Description	Value
18	Time to the next automatic start in seconds (not with operating mode 3, two single detectors).	0-255

Startup Time

The MARCo-Receivers attempt, at start-up, to register their temporarily saved administered locomotive addresses with the center. If many MARCo-Receivers are installed it can lead to data loss if they all want to register at the same time.

In order to control these train registrations in a regular way the MARCo-Receiver has a startup time in LNCV 19. This determines the time after power on that the MARCo-Receiver waits, before it attempts to register the administered locomotive address.

LNCV	Description	Value
19	Startup time in 0.5s steps (maximum 127.5s)	0-255

It makes sense therefore to increment the startup time from one MARCo-Receiver to the next by a value of 1.

8 Tips and Tricks

8.1 Switching off and state saving

In the course of running the layout the MARCo-Receiver saves different state information such as: Locomotive address, category, speed, occupancy etc. The MARCo-Receiver is factory set so that these states are retained if the layout power is OFF. When turning the power back ON saved state information is restored. The layout can continue where it left off when it was turn off. If the MARCO Receivers are connected to a LocoNet segment which is powered by LocoNet Power Injector (63100), this power injector must be switched on after the Intellibox has fully booted.

After an erasing process, this function is deactivated. All LNCVs, except the address are deleted during this procedure (LNCV 2 = 98). To activate state saving again LNCV 15 must be set to value 8.

8.2 Commuter trains and multi-traction

As described in chapter 7.5.5, the MARCo-Receiver uses the first recognized address to set the internal occupied state (block option). Further vehicles, passing the detectors, don't trigger the 'program' again.

Should a commuter train's control cab car be fitted with a MARCO transmitter with the same address as the locomotive, the train will stop correctly at a red signal irrespective of its travelling direction. As soon as the address is recognized, an appropriate speed instruction is sent regardless of whether the address was sent by the locomotive or by the control cab car.

It is similar with multi-traction. The first vehicle identifies itself with its address. This does not have to be the so-called guidance address of the multi-traction. The system recognizes the fact that it concerns multi-traction and sends the appropriate Instructions to all vehicles driving in the traction.

8.3 Command execution time

When processing individual groups of instructions *of the switching operation,* the current instruction must be completed before the next one can be implemented.

The instruction for switching an individual solenoid takes approx. 0.5 seconds. If several solenoids are to be operated in a sequence, processing will take accordingly longer.

In the group of the function instructions it is possible to time the functions, switching them on for a certain time (chapter 7.3.4) and then automatically switching off again. Processing of the sequence can only continue after such an instruction has timed out.

NOTE: *Avoid long times and too many timed functions. Otherwise there is a possibility that instructions at the end of the command string are implemented too late.*

8.4 Extended stations

Chapter 7.4.5 showed that with an *entry manager*, *station block* and *exit managers* it is possible to automate simple stations. In the example in the aforementioned Chapter the station block operates (track manager) e.g. as block busy response. As the MARCo-Receiver can automatically send an Occupied or Free message, every other function, and not only the block, is suitable for station administration.

The entry and exit supervised tracks do not necessarily have to be in the close range of the station, but in principle can be distributed around the layout. Thereby varied operational sequence can be arranged. This however requires a very good knowledge of the operation of the layout and Documentation of MARCo-Receiver programming. The possibility of "distributed stations" is therefore for advanced users.

8.5 MARCo and Fleischmann TwinCenter

If your TwinCenter has Software Version 1.1 or higher you can use all the functions and programming possibilities described in this manual for use with the Intellibox I.

The software update to Version 1.1 is available from the Fleischmann Company's internet site.

Appendix

A.1 MARCO transmitter 68320 Configuration Variable (CVs)

CVs Loco	CVs MARCO	Meaning	Value Range	Factory default
1	116	Short address	0-127	3
17	117	Long address High byte	192-231	199
18	118	Long address Low byte	0-255	208
29	129	short address valid long address valid	0-32	0

A.2 LNCV Table for the MARCo Receiver

LNCV	Description	Value Range	See chapter
0	Module address and first detector address General address : 65535	1-4095 65535	5.1
1	Address track 2 (2. Single detector) for track 2, or as feedback address (according to Module configuration in LNCV 15)	1-4095	5.1, B2
2	Selection of the different modes *Basic functions* 0 = Receiving locomotive data via a double detector. Transmission of address, category, driving direction and speed. *Note: Transmission on the LocoNet is activated with LNCV 15.* 1 = Receiving locomotive data over 2 single detectors in 2 independent places on the Layout. *Note: Transmission on the LocoNet is activated with LNCV 15.* *Switching operation* 2 = Switching operations with double detector in a single location on the layout with direction sensing 3 = Switching operations with 2 single detectors at 2 indepentent locations on the layout with direction detection *Automatic functions <u>without</u> block reporting* 4 = time controlled shuttle traffic terminus 5 = signal controlled shuttle traffic terminus 6 = time controlled holding point 7 = block section/station block 8 = entry manager 9 = exit manager, chronological track sequence 10 = exit manager, random track sequence 11 = exit manager, chronological track sequence, selective track switching 12 = Exit manager, random track sequence, selective track switching *Automatic functions <u>with</u> block reporting* 20 = time controlled shuttle traffic terminus with block status message 21 = signal controlled shuttle traffic terminus with block status message 22 = time controlled holding point with block status message 23 = block section/station block with block status message 24 = entry manager with block status message 25 = exit managers, chron. track sequence with block status message 26 = exit managers, random track sequence with block status message 27 = exit manager, chronological track sequence, selective track switching 28 = exit manager, random track sequence *Delete functions* 96 = delete current operating status. Programmed LNCVs are not changed. 97 = delete all LNCVs starting from LNCV 20 98 = all LNCVs sets 0, except LNCV 0 and 1 (address) to the value 99 = restore factory defaults, without address change	0-10, 2,3 4-12 20-28 96-99	5.2 And 7.

LNCV	Description	Value Range	See chapter
3	Direction in which the automation is active according to LNCV 2 0 = Automatic active with travel direction from track 1 to track 2 1 = Automatic active with travel direction from track 2 to track 1 2 = Automatic active in both travel directions (only stopping point)	0-2	7.4
4	Holding time for shuttle traffic and terminus (automatic functions in set in LNCV 2). Value in seconds.	0-255	7.4.1 7.4.3
5	Delay period between switching the locomotive's route and the departure of the waiting locomotive applies to all modes set in LNCV 2. Value in seconds.	0-255	7.4.5
6	Solenoid address of the exit signal for the automatic mode set in LNCV 2. In automatic modes 4, 6, 20 and 22 the signal is set by the module; in automatic modes 5, 7-10, 21 and 23-26 the signal is monitored stopping the train. *Note: This signal must always be specified in automatic mode.*	1 2000	7.4.1 7.4.4
7	1. Address for solenoid, routes from Intellibox or feedback for those Automatic modes set in LNCV 2. The appropriate instruction is sent, if the detector is passed. 0 = no address instruction is sent 20010 - 20241 = switch an Intellibox route 10, 20, 30 - 20000 = solenoid 1, 2, 3 - 2000 set to red/round 11, 21, 31 - 20001 = solenoid 1, 2, 3 - 2000 to green/straight set 12, 22, 32 - 20482 = feedback address 1, 2, 3 - 2048 - vacant 13, 23, 33 - 20483 = feedback address 1, 2, 3 - 2048 - occupied 20010-20241 = Intellibox I – Route switching	0-20483	7.4.1 7.4.5
8	2. Address for solenoid, routes in Intellibox or feedback for those automatic mode as set in LNCV 2. See LNCV 7.	0-20483	7.4.1 7.4.5
9	Block speed If a speed step (2-127) is entered here, then the module in the automatic modes 4-10 and 20-26 (LNCV 2) can use a 3 detector system. The normal double detector detects the train and reduces its speed to the specified value. Detector 2 and 3 are connected in parallel - 2. Detector 3. then brakes the train to speed step 1 (= emergency stop). 0 = stop with the locomotive decoder's-internal delay 1 = emergency stop (stop without delay) 2-127 = speed step for the slow section	0-127	7.4.2
10	Block option = options for reporting the change in block status from "occupied" to "vacant", if a train drives out of or through the block. 0 = exit signal (LNCV 6) is set to "red" after the block is vacated 1-255 = the statue is reported after the specified Value in seconds. 257-511 = like previously. Now the Exit signal in LNCV 6 is set to red. Value in seconds + 256	0-511	7.4.5
11	Automatic operation functions by solenoid address switch on or off. 0 = no mechanism influence by the solenoid address 1-2000 = solenoid red: MARCo-Receiver is not active or green is activate	0-2000	7.4.3
12	Train dependent automation = switching automatic functions on or off by train categories. For functions 4-12 and 20-28 as in LNCV 2 0 = no automatic influence by train categories 1-15 = All train categories the except the one entered should influence the automatic function upon arrival in the track section, 101-115 = Only the one entered should influence the automatic function upon arrival in the track section.	0-15 101-115	7.4.4

13	Meaning of the LNCV, if LNCV 2 has a value of 9, 10, 25, or 26: Linking of the Exit manager and Entry manager functions. 0 = no linking from the Exit Manager to the Entry manager 1-4095 = enter the address from LNCV 0 of the associated Entry manager, so Exit manager can determine if a train is waiting to enter the station at the Entry manager. The Exit manager clears a track so that the waiting train can enter the station. The conditions for this are the values in LNCVs 20-119 with both managers programmed the same. Also, a new train selection is automatic if the station control with passing loop has the condition, “all trains should use the passing loop”, and is returned to “Normal operation“.	0-4095	7.4.5.2
15	Presets for the Receiver module 0 = Don’t send any transmission format (ÜF) to the LocoNet 1 = Send ÜF Uhlenbrock with Locomotive address 2 = Send ÜF Digitrax with Locomotive address and Block status (vacant/occupied) **Attention**: only one transmission format can be used at one time. 4 = The MARCo-Receiver is used with a LokBoss 8 = Save the actual operating state at power down 16 = Send a feedback message vacant/occupied for the vacant/occupied block with the address from LNCV 1 (address track 2) in operating modes LNCV 2 = 4-12, 20-28 32 = Send a feedback message vacant/occupied for the vacant/occupied block with the address from LNCV0 (1.Module address) in operating modes LNCV 2 = 1 or 3 64 = Send a feedback message vacant/occupied for the vacant/occupied block with the address from LNCV 1 (address track 2) in operating modes LNCV 2 = 1 or 3 ***Note**: The selected values are totalled and entered into the LNCV.*	0-63	7.6
16	Software version	varies	-
17	Number of valid received Address bytes that must be received by RailCom before the address is accepted.	0-255	7.6
18	Time to the next automatic start, in seconds (not with operation mode 3, two single detectors).	0-255	7.6
19	Startup time in 0.5s steps (maximum 127.5s)	0-255	7.6

A.2.1 Extended LNCV Table for the MARCo-Receiver

In principle, the LNCV table for the MARCo Receiver. Shown below, are only the LNCVs whose meaning differs or extended**.**

Function: "Station Control with Passing Loop"

The receiver is configured as Entry Manager; LNCV 2 is set to 8 or 24.

LNCV	Description	Value Range	See chapter
13	Passing loop controlled by solenoid Solenoid green = all trains use the passing loop Solenoid red = only trains and train categories entered in CV 122 to 127 use the passing loop	0-2000	7.4.5.4
120	Virtual Address, with which the Entry Manger reports the passing as occupied or vacant. *This address (LNCV 0) must not be used by other MARCo Receivers.*	1-4095	7.4.5.4
121	Not used	-	-
122-127	Addresses of Locomotives (1-9999) or train categories (20001-20004), that should automatically use the passing loop.	1-9999, 20001-20015	7.4.5.4

The receiver is configured as Exit Manager; LNCV 2 is set to 9,10, 25 or 26

LNCV	Description	Value Range	See chapter
13	Linking the function of Entry Manager and Exit Manager. 0 = No linking of Entry Manager and Exit Manager 1-4095 = if the address from LNCV 0 of the matching Entry Manger is entered here, the Exit Manager ascertains if a locomotive is waiting at Entry Manager, to enter the station. The Exit Manager clears a track so the waiting train can enter the station. The prerequisite for this that the entries in LNCVs 20-119 are the same in both managers. Furthermore a new train selection is made in case a station control with passing loop is set to status "all trains must use the passing loop" is returned to "normal operation".	0-2000	7.4.5.4
120	Address with which the Entry Manager reports the passing loop as occupied or vacant. *This address (LNCV 0) must not be used by another MARCO Receiver.*	1-4095	7.4.5.4
121	Route from the station entry to the station exit Instruction for switching the route in the Intellibox or IB-Switch which is the path from the station entrance (Entry Manger block) to the station exit (Exit Manager block).	10-20483	7.4.5.4
122	If a train enters the passing loop, instead of the instruction in LNCV 7, the value programmed here is used. (programming see LNCV 7)	10-20483	7.4.5.4
123	If a train enters the passing loop, instead of the instruction in LNCV 8, the value programmed here is used. (programming see LNCV 8)	10-20483	7.4.5.4

Function "Locomotive specific Delay" in automatic operation of a Shuttle service, Holding point and Block Section

LNCV	Description	Value Range	See chapter
110-117	Vehicle addresses which trigger the Delay	1-9999	7.4.6
120-127	Delay in Seconds (0-255)	0-255	7.4.6

A.3 MARCo-Receiver Factory defaults

You can set the MARCo-Receiver to the above values with a RESET, by programming the LNCV 2 to 99. The value for the addresses in LNCV 1 and 2 remains unchanged.

Function	LNCV	Description	Value
Basic settings	0	Module address, and track 1 address	1
	1	Address Track 2 (2. Single detectors) for Track 2, or as feedback address used in automatic functions 4 - 28	2
	2	Direction sensitive switch mode	2
	15	Save module operation mode at power off	8
	17	8 valid address bytes must be received via RailCom before the address is accepted.	8
	18	5 seconds before the automatic start	5
	19	Startup time in 0.5s	1
Switch Function 1	20	For all trains	20000
	30	...The light	1
	40	...Turn off if direction S1 -> S2	2
Switch Function 2	21	For all trains	20000
	31	...The light	1
	41	...Turn on if direction S2 -> S1	11

A.4 Speed step table

Table for converting speed steps to absolute speed:

DCC 14 SS	
1	2
2	10
3	19
4	29
5	38
6	48
7	57
8	67
9	76
10	86
11	95
12	105
13	114
14	124

DCC 27 SS	
1	2
2	8
3	13
4	17
5	22
6	26
7	31
8	35
9	40
10	44
11	49
12	53
13	58
14	62
15	67
16	71
17	76
18	80
19	85
20	89
21	94
22	98
23	103
24	107
25	112
26	116
27	121

DCC 28 SS	
1	2
2	7
3	11
4	16
5	20
6	25
7	29
8	34
9	38
10	43
11	47
12	52
13	56
14	61
15	65
16	70
17	74
18	79
19	83
20	88
21	92
22	97
23	101
24	106
25	110
26	115
27	119
28	124

A.5 Route Table for the Intellibox 1

Translation between the route number of the Intellibox 1 and the command value programmed in a MARCo receiver

Group 1		
Route No.	Solenoid Add	MARCo value
1	2001-red	20010
2	2001- green	20011
3	2002-red	20020
4	2002- green	20021
5	2003-red	20030
6	2003- green	20031
7	2004-red	20040
8	2004- green	20041
9	2005-red	20050
10	2005- green	20051
11	2006-red	20060
12	2006- green	20061
13	2007-red	20070
14	2007- green	20071
15	2008-red	20080
16	2008- green	20081

Group 2		
Route No.	Solenoid Add	MARCo value
1	2009-red	20090
2	2009- green	20091
3	2010-red	20100
4	2010- green	20101
5	2011-red	20110
6	2011- green	20111
7	2012-red	20120
8	2012- green	20121
9	2013-red	20130
10	2013- green	20131
11	2014-red	20140
12	2014- green	20141
13	2015-red	20150
14	2015- green	20151
15	2016-red	20160
16	2016- green	20161

Group 3		
Route No.	Solenoid Add	MARCo value
1	2017-red	20170
2	2017- green	20171
3	2018-red	20180
4	2018- green	20181
5	2019-red	20190
6	2019- green	20191
7	2020-red	20200
8	2020- green	20201
9	2021-red	20210
10	2021- green	20211
11	2022-red	20220
12	2022- green	20221
13	2023-red	20230
14	2023- green	20231
15	2024-red	20240
16	2024- green	20241

A.6 Table to use Extended Functions

Computation of the command value for the change of locomotive special functions (LF)

LF	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	Calculated value for LNCV 30-39
Value	1	2	4	8	16	32	64	128	256	512	1024	2048	4096	
Selection														
Sum														

Computation of the command option for the change of locomotive auxiliary functions

Opt No.	Description	Selection	Value	Sum
1	Do not evaluate driving direction		0	
	Driving direction from track 1 to track 2		2	
	Driving direction from track 2 to track 1		3	
2	Switching function 2 or 3		0	
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off		4	
3	Switch auxiliary function off		0	
	Switch auxiliary function on		8	
	Change auxiliary function		16	
4	Auxiliary function timed change		32	
5	Switching duration in seconds (max 31) * 256		*256	
6	Position in the sequence (0-4) * 8192		*8192	
			Calculated value for LNCV 40 to 49	

Computation of the command option for the change of locomotive speed

Opt No.	Description	selection	value	sum
1	Do not evaluate driving direction		0	
	Driving direction from track 1 to track 2		2	
	Driving direction from track 2 to track 1		3	
2	Switching function 2 or 3		0	
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off		4	
3	Speed specified as absolute value (0-127)		0	
	Speed specified in percent (0-255%)		8	
			Calculated value for LNCV 70 to 79	

Computation of the command option for solenoid and feedback instructions

Opt No.	Description	selection	value	sum
1	Do not evaluate driving direction		0	
	Driving direction from track 1 to track 2		2	
	Driving direction from track 2 to track 1		3	
2	Switching function 2 or 3		0	
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off		4	
			Calculated value for LNCV 100 to 109	

A.7 Copying templates

Following this you will find two tables that you can copy to record the programming for each of your MARCo receivers.

Naturally you can create your own tables if you wish, in order to document your layout. We recommend that you thoroughly document your layout, so that after some time you are still able to determine what each receiver is programmed to do. This helps you to fully enjoy your layout.

MARCo-Receiver No. _____

Configuration

	Switch Operation		Shuttle Service		Holding Point		Block Section

Basic programming

LNCV	Value	Type
0		1. Address (module address)
1		2. Address (track 2)
2		Function (mode)
3		Driving direction
4		Holding time
5		Delay for solenoid switching
6		Signal to sets
7		1. Solenoid/feedback address
8		2. Solenoid/feedback address

LNCV	Value	Type
9		Speed before stopping
10		Block option
11		Solenoid address for on/off Op.
12		Category option
13		Address entry manager
15		Module configuration
16		Number of address bytes
17		Time to next auto. Start
18		Startup time

Programming of function instructions

Command	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Address	2...										
Value	3...										
Option	4...										

Programming of speed instructions

Command	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Address	5...										
Value	6...										
Option	7...										

Programming of solenoid and route instructions

Command	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Address	8...										
Value	9...										
Option	10..										

Programming of individual Delay

Command	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7
Address	11...								
Value	12...								

○

MARCo-Receiver No. _____

Configuration

	Entry Manager		Exit Manager

Basic programming

LNCV	Value	Type
0		1. Address (module address)
1		2. Address (track 2)
2		Function (mode)
3		Driving direction
4		Holding time
5		Delay for solenoid switching
6		Signal to sets
7		1. Solenoid/feedback address
8		2. Solenoid/feedback address

LNCV	Value	Type
9		Speed before stopping
10		Block option
11		Solenoid address for on/off Op.
12		Category option
13		Address entry manager
15		Module configuration
16		Number of address bytes
17		Time to next auto. Start
18		Startup time

Receiver switches the following Routes

	LE	Route	Locomotive addresses and categories							
LNCV	**... 0**	**... 1**	**…2**	**…3**	**…4**	**…5**	**…6**	**…7**	**…8**	**…9**
2…										
3…										
4…										
5…										
6…										
7…										
8…										
9…										
10…										
11…									-	-
12…									-	-

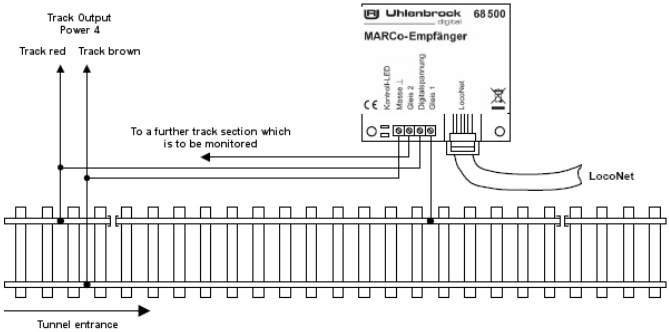
Examples

1. Example

Fading IntelliSound in/out

On the layout is a tunnel that travels in a particular direction. In the tunnel the locomotives do not operate with IntelliSound. At the tunnel exit the sound is to be reactivated. Via the special function f8 the IntelliSound module can fade the sound out, if it is on. If the special function f8 is switched off, then the sound will be faded in audibly.

In order to trigger this operation automatically with each locomotive, track 1 is installed just outside the tunnel entrance and track 2 is placed just before the tunnel exit.



Programming necessary for this example is:

Basic programming of the LNCVs 0-19

LNCV	Value	Type
0	1	1. Address (module address)
1	2	2. Address (track 2)
2	3	Function (mode)
3	0	Driving direction
4	0	Holding time
5	0	Delay for solenoid switching
6	0	Signal to sets
7	0	1. Solenoid/feedback address

LNCV	Value	Type
8	0	2. Solenoid/feedback address
9	0	Speed before stopping
10	0	Block option
11	0	Solenoid address for on/off Op.
12	0	Category option
13	0	Address entry manager
15	0	Module configuration
19	1	Startup time

Programming of function instructions

		Detector 1					Detector 2				
Command	**LNCV**	**... 0**	**... 1**	**...,2**	**... 3**	**... 4**	**... 5**	**... 6**	**... 7**	**... 8**	**... 9**
Address	**2...**	20000	0	0	0	0	20000	0	0	0	0
Value	**3...**	256	0	0	0	0	256	0	0	0	0
Option	**4...**	8	0	0	0	0	0	0	0	0	0

Computation of the command value for the change of locomotive special functions (LF)

LF	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	Calculated value for LNCV 30/35
Value	1	2	4	8	16	32	64	128	256	512	1024	2048	4096	
Selection									x					
Sum									256					256

Computation of command options to change the locomotive special functions

Opt No.	Description	Selection	Value	Sum
1	Do not evaluate driving direction	X	0	0
	Driving direction from Track 1 to Track 2		2	
	Driving direction from Track 2 to Track 1		3	
2	Switching function 2 or 3	X	0	0
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off		4	
3	Switch auxiliary function off		0	
	Switch auxiliary function on	X	8	8
	Change auxiliary function		16	
4	Auxiliary function timed change		32	
5	Switching duration in seconds (max 31) * 256		*256	
6	Position in the sequence (0-4) * 8192		*8192	
			Calculated value for LNCV 40	8

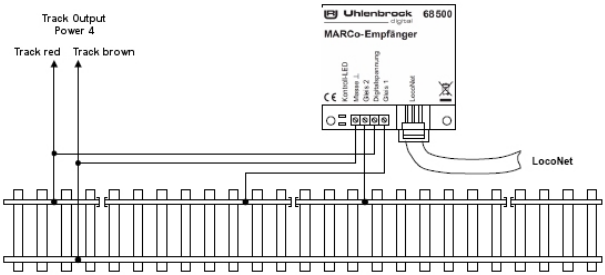
Computation of command options to change the locomotive special functions

Opt No.	Description	Selection	Value	Sum
1	Do not evaluate driving direction	X	0	0
	Driving direction from Track 1 to Track 2		2	
	Driving direction from Track 2 to Track 1		3	
2	Switching function 2 or 3	X	0	0
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off		4	
3	Switch auxiliary function off	X	0	0
	Switch auxiliary function on		8	
	Change auxiliary function		16	
4	Auxiliary function timed change		32	
5	Switching duration in seconds (max 31) * 256		*256	
6	Position in the sequence (0-4) * 8192		*8192	
			Calculated value for LNCV 45	0

2. Example

Solenoid switching and feedback

In the example, a track section will be travelled in only in one direction, and reports as occupied, if a train is in the section.



The feedback for the track section uses an address over 50. Furthermore upon entry to the section, route 3 from group 2 in the Intellibox is to be enabled, if a train from category 3 enters the section. Locomotive 100 is to set the exit signal for the track with the solenoid address 30 to "green".

Basic programming of the LNCVs 0-19

LNCV	Value	Type
0	**1**	1. Address (module address)
1	**2**	2. Address (track 2)
2	**3**	Function (mode)
3	**0**	Driving direction
4	**0**	Holding time
5	**0**	Delay for solenoid switching
6	**0**	Signal to sets
7	**0**	1. Solenoid/feedback address

LNCV	Value	Type
8	**0**	2. Solenoid/feedback address
9	**0**	Speed before stopping
10	**0**	Block option
11	**0**	Solenoid address for on/off Op.
12	**0**	Category option
13	**0**	Address entry manager
15	**0**	Module configuration
19	**1**	Startup time

Programming of solenoid and route instructions

		Detector 1					Detector 2				
Command	**LNCV**	**... 0**	**... 1**	**...,2**	**... 3**	**... 4**	**... 5**	**... 6**	**... 7**	**... 8**	**... 9**
Address	**2...**	20000	20003	-	-	-	20000	100	-	-	-
Value	**3...**	503	20100	-	-	-	502	301	-	-	-
Option	**4...**	8	0	-	-	-	0	0	-	-	-

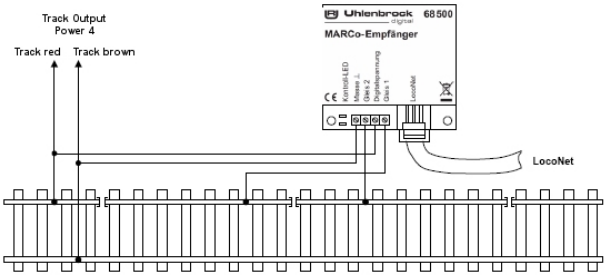
Computation of the command option for solenoid and feedback instructions

Opt No.	Description	selection	value	Sum
1	Do not evaluate driving direction	X	0	0
	Driving direction from Track 1 to Track 2		2	
	Driving direction from Track 2 to Track 1		3	
2	Switching function 2 or 3	X	0	0
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off		4	
	Calculated value for LNCV 100-109			0

Feedback from when passing a Track Section

Only for MARCo-Receiver Automatic functions 4-28

In the example a section of track is to be fitted with a double detector and report it as occupied or vacant when a train enters from track 1 to track 2 or departs.



The feedback message for the track section should be via feedback address 10. The MARCo-Receiver has module address 2 and works as a block section with block status reporting. Its exit signal has address 1.

Basic programming of the LNCVs 0-19

LNCV	Value	Type
0	**1**	1. Address (module address)
1	**10**	2. Address (track 2)
2	**23**	Function (mode)
3	**0**	Driving direction
4	**0**	Holding time
5	**0**	Delay for solenoid switching
6	**0**	Signal to sets
7	**0**	1. Solenoid/feedback address

LNCV	Value	Type
8	**0**	2. Solenoid/feedback address
9	**0**	Speed before stopping
10	**0**	Block option
11	**0**	Solenoid address for on/off Op.
12	**0**	Category option
13	**0**	Address entry manager
15	**17**	Module configuration
19	**1**	Startup time

Since the 2. Sensor address (LNCV 1) is not used as Sensor address it now works as a feedback address. Thus the entries in LNCVs 80 - 109 from the previous example are no longer required. The state of the automatic function for block status message (here LNCV 2 = 23) is programmed. Also options 1 and 4 must be programmed in the module configurtion (LNCV 15 = 17). If additional operating states are to be saved at power down they are added to the module configuration (LNCV 15 = 17 + 8 = 25).

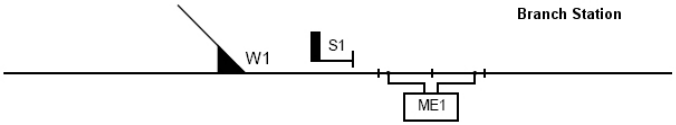
3. Example

Shuttle train terminus in a branch line

In a branch line station as shown in the sketch below, some trains, which come from the left, are to stop in the station, then reverse out over turnout W1 and drive up the branch line.

For this these trains are assigned train category 2. The MARCo-Receiver ME1 in our example is put into *time delayed shuttle time* operating mode, however this function is only active if a train from category 2 arrives. All other trains drive through without stopping.

If the train stops and drives off again, then the turnout W1 is switched to the branch position. So that the turnout is fully switched over before the train drives off, the train not start till 5 seconds after the turnout switching command is issued. Additionally the motor coach with the locomotive address 96 will honk when driving off (special function F2) and the locomotive with the address 80 will ring its bell for10 seconds (special function F3).



Allocation of the solenoid addresses

Designation	W1	S1
Solenoid address	10	20

The necessary programming of the MARCo-Receiver ME1 is:

Basic programming of the LNCVs 0-19

LNCV	Value	Type
0	**1**	1. Address (module address)
1	**0**	2. Address (track 2)
2	**4**	Function (mode)
3	**0**	Driving direction
4	**60**	Holding time
5	**5**	Delay for solenoid switching
6	**20**	Signal to sets
7	**0**	1. Solenoid/feedback address

LNCV	Value	Type
8	**0**	2. Solenoid/feedback address
9	**0**	Speed before stopping
10	**2**	Block option
11	**0**	Solenoid address for on/off Op.
12	**12**	Category option
13	**0**	Address entry manager
15	**8**	Module configuration
19	**1**	Startup time

Programming of solenoid and route instructions

Command	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Address	**8...**	20002									
Value	**9…**	101									
Option	**10..**	6									

Computation of the command option for solenoid and feedback instructions

Opt No.	Description	Selection	Value	Sum
1	Do not evaluate driving direction		0	
	Driving direction from Track1 to track2	**X**	2	**2**
	Driving direction from Track2 to track1		3	
2	Switching function 2 or 3		0	
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off	**X**	4	**4**
			Calculated value for LNCV 100 to 109	**6**

Programming of function instructions

Command	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Address	**8...**	96	80	-	-	-	-	-	-	-	-
Value	**9…**	4	8	-	-	-	-	-	-	-	-
Option	**10..**	302	2606	-	-	-	-	-	-	-	-

Horn (F2) switched on for 1 second:

Computation of command value to change the locomotive special functions

Auxiliary	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	Calculated value for LNCV 30
Value	1	2	4	8	16	32	64	128	256	512	1024	2048	4096	
Selection			**x**											
Sum			**4**											**4**

Computation of command option to change the locomotive special functions

Opt No.	Description	selection	value	sum
1	Do not evaluate driving direction		0	
	Driving direction from Track1 to track2	X	2	2
	Driving direction from Track2 to track1		3	
2	Switching function 2 or 3		0	
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off	X	4	4
3	Switch auxiliary function off		0	
	Switch auxiliary function on	X	8	8
	Change auxiliary function		16	
4	Auxiliary function timed change	X	32	32
5	Switching duration in seconds (max 31) * 256	1	*256	256
6	Position in the sequence (0-4) * 8192		*8192	
			Calculated value for LNCV 40	302

Bell ringing (F3) switched on for 10 second:

Computation of command value to change the locomotive special functions

Auxiliary	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	Calculated value for LNCV 31
Value	1	2	4	8	16	32	64	128	256	512	1024	2048	4096	
Selection				x										
Sum				8										8

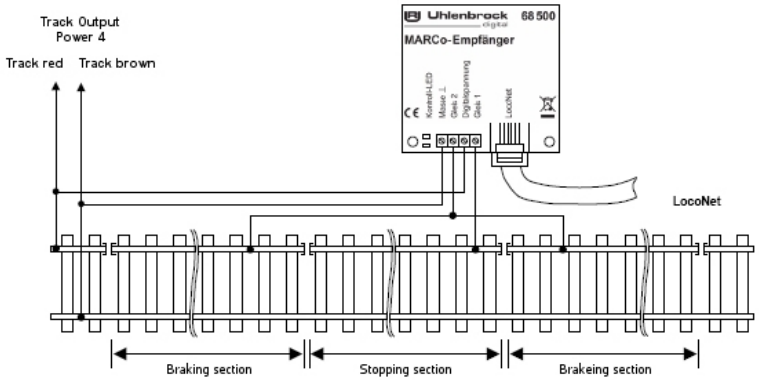
Computation of command option to change the locomotive special functions

Opt No.	Description	Selection	Value	Sum
1	Do not evaluate driving direction		0	
	Driving direction from Track1 to track2	X	2	2
	Driving direction from Track2 to track1		3	
2	Switching function 2 or 3		0	
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off	X	4	4
3	Switch auxiliary function off		0	
	Switch auxiliary function on	X	8	8
	Change auxiliary function		16	
4	Auxiliary function timed change	X	32	32
5	Switching duration in seconds (max 31) * 256	10	*256	2560
6	Position in the sequence (0-4) * 8192		*8192	
			Calculated value for LNCV 41	**2606**

4. Example

Braking at a holding point with two directional traffic

In order to stop a train in either direction at the same place you must use the ancillary circuit as shown, so no more than 2 photo detectors are attached to the receiver input. Control of two signals with different addresses is however not possible with the circuit indicated here, because in this case the module's operating mode is '*direction dependent holding place*' and the travelling direction is recognized by different detectors. The MARCo-Receiver controls only one signal with the solenoid address, which is entered in LNCV6.



Basic programming of the LNCVs 0-19

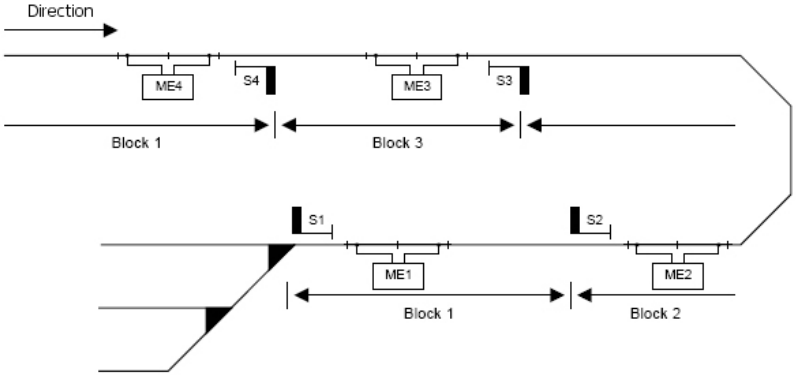
LNCV	Value	Type
0	**1**	1. Address (module address)
1	**0**	2. Address
2	**6**	Function (mode)
3	**0**	Driving direction
4	**60**	Holding time
5	**2**	Delay for solenoid switching
6	**10**	Signal to sets
7	**0**	1. Solenoid/feedback address
8	**0**	2. Solenoid/feedback address

LNCV	Value	Type
9	**10**	Speed before stopping
10	**2**	Block option
11	**0**	Solenoid address for on/off Op.
12	**0**	Category option
13	**0**	Address entry manager
15	**0**	Module configuration
17	**8**	Number of receiver addr. bytes
18	**0**	Time to next automatic start
19	**1**	Startup time

5. Example

Block section control

In the above example the one-way traffic block is at entrance to a station entry, which is protected by signal S1 (entry signal). As is normal, in our example, a train, which enters a vacant block, sets the block protection signal to "stop" and the block which the train has left, is free for a new train. In our example, if a train enters block 2, because signal S3 is on "green", signal S3 is switched to "red", as soon as the train reaches the detector ME2. At the same time signal S4 can be set to "green", since block 3 is vacant again.



Allocation of the solenoid addresses

Designation	S1	S2	S3	S4
Solenoid address	11	12	13	14

Signal S1 is the entry signal for the station and in our example is switched manually.

Basic programming for LNCVs 0-19, of MARCo-Receiver ME 1-4

LE	LNCV / Function	0	1	2	3	4	5	6	7	8	9	10	11	12	13	15	19
1	Block section	1	0	7	0	0	0	11	120	131	0	0	0	0	0	8	20
2	Block section	2	0	7	0	0	0	12	130	141	0	0	0	0	0	8	21
3	Block section	3	0	7	0	0	0	13	140	0*	0	0	0	0	0	8	22
4	Block section	4	0	7	0	0	0	14	0*	0*	0	0	0	0	0	8	23

* This LNCV can be used, to control block sections, which lie before track section "block 4".

If the modules ME 1 to ME 4 are not to implement any further switching functions, LNCVs 20-109 are set to zero.

Extension of the example

All trains with the train category 2 that enter the Station, i.e. if signal S1 is switched to green, the track route 10/group 1 in the Intellibox is selected. For this route the turnouts to the station are switched so that the trains of the category 2 can enter track 1.

So that all turnouts have time to move to their new position before the train proceeds, MARCo receivers ME 1 waits 5 seconds before it allows the train to depart. The route can be switched during this time. The more items that have to be switched for the route the more time has to be allowed for the process to finish.

Basic programming of MARCo-Receiver ME 1

LE	LNCV / Function	0	1	2	3	4	5	6	7	8	9	10	11	12	13	15	19
1	Block section	1	0	7	0	0	0	11	120	131	0	0	0	0	0	8	20

Programming of solenoid and route instructions

Command	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Address	**8...**	20002	-	-	-	-	-	-	-	-	-
Value	**9…**	20051	-	-	-	-	-	-	-	-	-
Option	**10..**	6	-	-	-	-	-	-	-	-	-

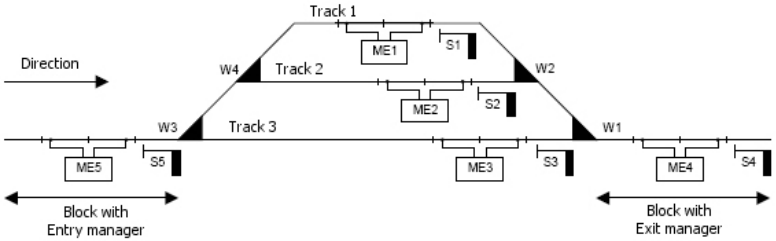
Computation of the command option for solenoid and feedback instructions

Opt No.	Description	Selection	Value	Sum
1	Do not evaluate driving direction		0	
	Driving direction from Track1 to track2	**X**	2	**2**
	Driving direction from Track2 to track1		3	
2	Switching function 2 or 3		0	
	Automatic operation 4-12, 20-28: on arrival at the detector		0	
	Automatic operation 4-12, 20-28: when driving off	**X**	4	**4**
			Calculated value for LNCV 100	**6**

6. Example

Shadow station

The shadow station in our example should have the following track plan:



Functionality:

Trains, which enter the entry manager's track section in the travel direction, will always be stopped at signal S5. MARCo-Receiver ME5 then determines into which track the arriving train may go and switches the route which leads to that track. These route instructions must switch all the turnouts and as the last instruction the command switches signal S5 to "green". Thus the route to the track is prepared and entry signal S5 is set to "green", and MARCo-Receiver ME5 allows the train into the selected track.

As soon as the exit manager's track section is vacant, this seeks out an occupied track in the station and switches the route, from this track to Station exit track. In this route the switching commands must switch all of the turnouts and as a last instruction, the switch of that track's exit signal to "green". This way the exit from a Track to the exit is prepared for the appropriate train. That train is then set in motion by the appropriate MARCo-Receiver ME1, 2 or 3.

The station control if necessary can also be accomplished with entry manager or Exit manager, if entry or exit is controlled manually. In this case the appropriate routes or turnouts and Signals are to be operated manually.

Solenoid address 20 is used in the example to deactivate the exit manager. If the solenoid with the address 20 switched to "red", then the exit manager is switched OFF and train will not depart the station automatically. Should the layout that has the shadow station be switched OFF, then the solenoid 20 is set to "red". The automatic train departures from this station are thereby stopped. Seeing the entry track to the station with trains is controlled automatically, you must wait until all the tracks are fully occupied. Now the layout can be switched off. The data: which train is on which track, is stored and after restarting the layout, automatic traffic can again commence. For this only, a train needs to be manually driven out of the shadow station, by e.g. switching one of the signals S1 to S3 to green or switch an appropriate route for a train to exit.

Allocation of the solenoid addresses

Designation	W1	W2	W3	W4	S1	S2	S3	S4	S5
Solenoid address	1	2	3	4	11	12	13	14	15

Basic programming for LNCVs 0-19, of MARCo-Receiver ME5

LE	LNCV / Function	0	1	2	3	4	5	6	7	8	9	10	11	12	13	15	19
1	Block section	1	0	23	0	0	0	11	150	0	0	0	0	0	0	9	20
2	Block section	2	0	23	0	0	0	12	150	0	0	0	0	0	0	9	21
3	Block section	3	0	23	0	0	0	13	150	0	0	0	0	0	0	9	22
4	Entry manager	4	0	9	0	0	0	14	20040	0	0	0	20	0	9	9	23
5	Exit manager	5	0	8	0	0	2	15	0*)	0	0	0	0	0	0	9	24

* This LNCV can be used, to control block sections, which lie before track section the Entry Manager.

Programming of the MARCo-Receiver ME 5 (entry managers)

Command	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Address	**2...**	1	20010	20000	0	0	0	0	0	0	0
Value	**3…**	2	20011	20000	0	0	0	0	0	0	0
Option	**4...**	3	20020	20000	0	0	0	0	0	0	0

Programming of MARCo-Receiver ME 4 (exit managers)

Command	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Address	**2...**	1	20021	20000	0	0	0	0	0	0	0
Value	**3…**	2	20030	20000	0	0	0	0	0	0	0
Option	**4...**	3	20031	20000	0	0	0	0	0	0	0

All not specified LNCVs are to be set to zero, if the MARCo-Receiver is to carry no other switching tasks.

Note: *So that this example functions correctly the Intellibox needs to be equipped with the software should Version 1.55 or higher.*

Programming of the routes in the Intellibox

Routes Number	Function	Solenoid Number	2		3		5	
			Address	State	Address	State	Address	State
1	entry track 1	2001 - red	3	Red	4	green	15	green
2	entry track 2	2001 - green	3	Red	4	red	15	green
3	entry track 3	2002 - red	3	green	15	green		
4	exit track 1	2002 - green	2	green	1	red	11	green
5	exit track 2	2003 - red	2	green	1	red	12	green
6	exit track 3	2003 - green	1	green	13	green		
7	S1/S2/S3 red	2004 - red	11	Red	12	red	13	red

Extension of the example

The trains with the locomotive address 3 and 10 are to be brought in only in track 1 and the train category 1 only into track 2. These tracks can also be occupied by other trains.

Programming of the MARCo-Receiver ME 5 (entry managers)

Command	LNCV	... 0	... 1	... 2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Address	**2...**	1	20010	20000	3	10	0	0	0	0	0
Value	**3…**	2	20011	20000	20001	0	0	0	0	0	0
Option	**4...**	3	20020	20000	0	0	0	0	0	0	0

Programming of MARCo-Receiver ME 4 (exit managers)

Command	LNCV	... 0	... 1	... 2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Address	**2...**	1	20021	20000	3	10	0	0	0	0	0
Value	**3…**	2	20000	20000	20001	0	0	0	0	0	0
Option	**4...**	3	20031	20000	0	0	0	0	0	0	0

Implementation with Intellibox and IB-SWITCHES

The routes for the example are switched with the IB-SWITCH.

Basic programming for LNCVs 0-19, of MARCo-Receiver ME 1 to ME 5

LE	LNCV / Function	0	1	2	3	4	5	6	7	8	9	10	11	12	13	15	19
1	Block section	1	0	23	0	0	0	11	150	12	0	0	0	0	0	9	20
2	Block section	2	0	23	0	0	0	12	150	22	0	0	0	0	0	9	21
3	Block section	3	0	23	0	0	0	13	150	32	0	0	0	0	0	9	22
4	Entry manager	4	0	9	0	0	0	14	73	72	0	0	20	0	5	9	23
5	Exit manager	5	0	8	0	0	2	15	0*)	0*)	0	0	0	0	0	9	24

*) These two LNCV can be used, to control the block section, which before the track section with the entry manager.

Programming of the MARCo-Receiver ME 5 (entry managers)

Command	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Address	**2...**	1	13	20000	0	10	0	0	0	0	0
Value	**3…**	2	23	20000	0	0	0	0	0	0	0
Option	**4...**	3	33	20000	0	0	0	0	0	0	0

All not specified LNCVs are to be set to zero, if the MARCo-Receiver is to carry no other switching tasks.

NOTE: *All dependencies between the routes should be deleted, and the IB-Switch should be so set up that routes are restored if they contain solenoids to be switched (special option 5 = 7). The MARCo receivers 1-3 have the following programming for switching of solenoids:*

Programming of MARCo-Receiver ME 4 (exit managers)

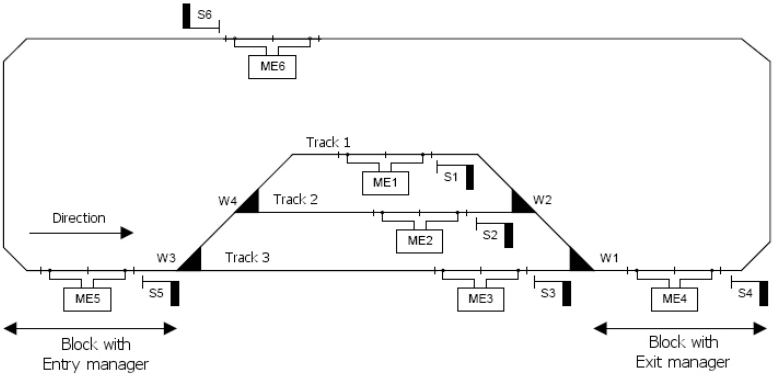
Command	LNCV	... 0	... 1	...,2	... 3	... 4	... 5	... 6	... 7	... 8	... 9
Address	**2...**	1	43	20000	0	10	0	0	0	0	0
Value	**3…**	2	53	20000	0	0	0	0	0	0	0
Option	**4...**	3	63	20000	0	0	0	0	0	0	0

Programming of the routes in the Intellibox II or IB-SWITCH

Routes Number	Route Function	Route via feedback		Section 1		Section 2		Section 3	
		Set	Release	Address	State	Address	State	Address	State
1	Entry track 1	1-red	1-green	3	red	4	green	15	green
2	Entry track 2	2-red	2-green	3	red	4	red	15	green
3	Entry track 3	3-red	3-green	3	green	15	green	-	-
4	Exit track 1	4-red	4-green	2	green	1	red	11	green
5	Exit track 2	5-red	5-green	2	green	1	red	12	green
6	Exit track 3	6-red	6-green	1	green	13	green	-	-
7	S1/S2/S3 red	7-red	7-green	11	red	12	red	13	red

Extension to an automatically controlled oval track with 3-track station

If the entry and exit managers are interconnected by the track, as in the example, an automatically controlled layout with a 3-track station can be made.



The connecting track has yet another MARCo-Receiver LE6 to manage that block section. This results in three block sections between the stations entry and exit. The automation is done by means of the following programming:

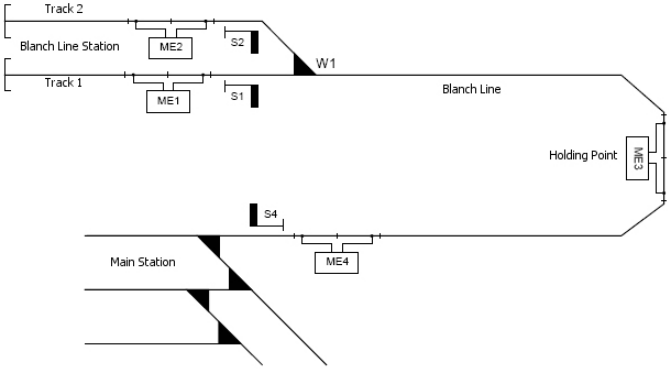
Basic programming of LNCVs 0-19 of MARCo receivers ME1 to ME 6 using the Intellibox I for route control

LE	LNCV / Function	0	1	2	3	4	5	6	7	8	9	10	11	12	13	15	19
1	Block section	1	0	23	0	0	0	11	150	161	0	0	0	0	0	9	20
2	Block section	2	0	23	0	0	0	12	150	161	0	0	0	0	0	9	21
3	Block section	3	0	23	0	0	0	13	150	161	0	0	0	0	0	9	22
4	Exit manager	4	0	9	0	0	0	14	20040	0	0	0	20	0	5	9	23
5	Entry manager	5	0	8	0	0	2	15	160	141	0	0	0	0	0	9	24
6	Block section	6	0	7	0	0	0	16	140	0	0	0	0	0	0	9	25

7. Example

Automatic control of a small branch line

Shown below is a sketch of Branch line, which is to be controlled automatically.



In the example above two motor coaches with the addresses 60 and 61 are to drive into the Branch line. The motor coach with the number 60 is to use track 1 of the Branch line and the motor coach with the number 61 is to use track 2. For this turnout W1 is switched accordingly, when the motor coaches arrive at the holding point. Both motor coaches always do an intermediate stop at the holding point before they continue. Both wait in the Branch line station and at the holding point for 3 minutes and eventually go back.

On the return trip from the branch line yard to the main station, the motor coaches wait automatically at the entry signal into the main station S4. Signal S4 is set to “red” by either motor coach as it arrives at the holding point on its return trip, thus the motor coaches will wait at the station entrance before they enter the station. The signal can then be operated manually and set to “green” after turnouts have been set for entry into the appropriate track for the motor coach.

All other trains only enter the Branch line with manual control and are not automatically controlled. For this the motor coaches are assigned to train category 1. MARCo receivers ME1-3 are programmed so that only trains with category 1 are automatically controlled. The MARCo-Receiver at the station entry ME4 stops every train, if that signal S4 is on red.

Allocation of the solenoid addresses

Designation	W1	S1	S2	S4
Solenoid address	1	11	12	14

Basic programming of the LNCVs 0-19 the MARCo-Receiver ME 1 to 4

LE	LNCV / Function	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Timed shuttle train	1	0	4	0	180	2	11	0	0	0	10	0	11	0	8	20
2	Timed shuttle train	2	0	4	0	180	2	12	0	0	0	10	0	11	0	8	21
3	Holding point	3	0	6	2	180	2	0	0	0	0	10	0	11	0	8	22
4	Block section	4	0	7	0	0	0	14	0	0	0	0	0	0	0	8	23

The MARCo-Receiver also has the 3 following settings for switching solenoids:

Programming of MARCo-Receiver ME 3

Command	**LNCV**	**... 0**	**... 1**	**...,2**	**... 3**	**... 4**	**... 5**	**... 6**	**... 7**	**... 8**	**... 9**
Address	**8...**	20001	60	61	0	10	0	0	0	0	0
Value	**9…**	140	11	10	0	0	0	0	0	0	0
Option	**10..**	3	2	2	0	0	0	0	0	0	0

Computation of command option for solenoid and Feedback instructions

Opt No.	Description	Selection	Value	Sum
1	Do not evaluate driving direction		0	
	Driving direction from Track1 to track2		2	
	Driving direction from Track2 to track1	**X**	3	**3**
2	Switching function 2 or 3		0	
	Automatic operation 4-12, 20-28: on arrival at the detector	**X**	0	**0**
	Automatic operation 4-12, 20-28: when driving off		4	
			Calculated value for LNCV 100	**3**

Computation of command option for solenoid and Feedback instructions

Opt No.	Description	Selection	Value	Sum
1	Do not evaluate driving direction		0	
	Driving direction from Track1 to track2	**X**	2	**2**
	Driving direction from Track2 to track1		3	
2	Switching function 2 or 3		0	
	Automatic operation 4-12, 20-28: on arrival at the detector	**X**	0	**0**
	Automatic operation 4-12, 20-28: when driving off		4	
			Calculated value for LNCV 100	**2**

Product Overview MARCo and Accessories

Part No. 68 100	MARCo Set
Part No. 68 400	LISSY Mini-Transmitter module for decoders with SUSI Interface
Part No. 68 500	MARCo-Receiver
Part No. 68 500	MARCo Special Edition Shadow station controller
Part No. 63 100	LocoNet Power Injector 500 mA
Part No. 63 450	LocoNet Display
Part No. 62 015	LocoNet Cable 0.28 m
Part No. 62 025	LocoNet CabME2.15 m
Part No. 62 045	LocoNet Cable 0.60 m
Part No. 62 065	LocoNet Cable 6 m
Part No. 62 120	LocoNet Branch 2.15 m
Part No. 62 225	LocoNet Coupling
Part No. 62 250	LocoNet Distributor 5-way
Part No. 69 250	Track-Control Train number display
Part No. 19 300	LISSY/MARCo-Creator (Graphic Programming software LISSY & MARCo)
Part No. 63 120	USB-LocoNet Interface including LocoNet-Tool (Programming)

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