Instruction Panel

Note, this manual is continuously updated. Check
www.mollehem.se/doc/instruktioner/instruktion_Panel.pdf for the latest version.

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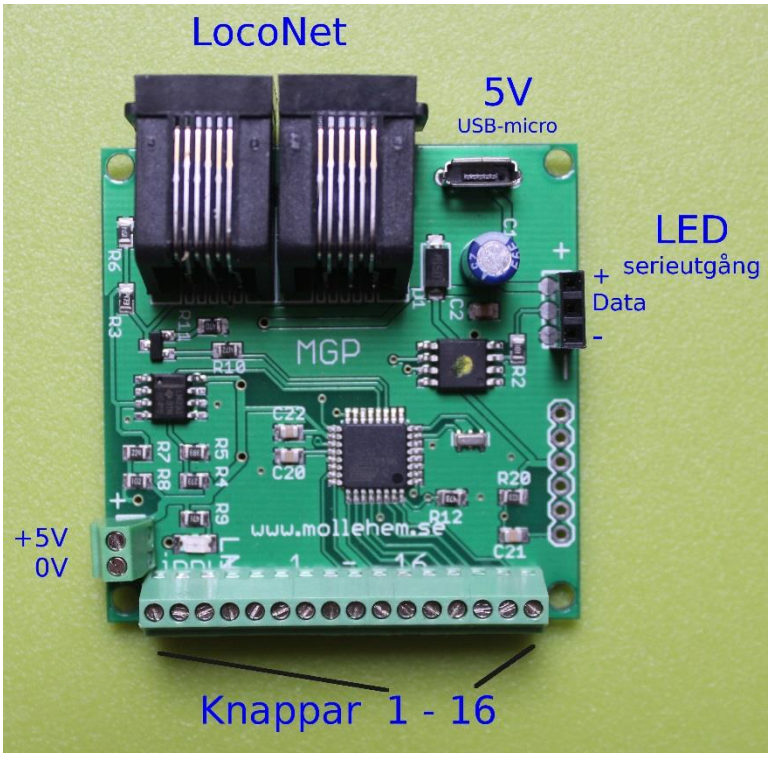
1 PANEL DECODER

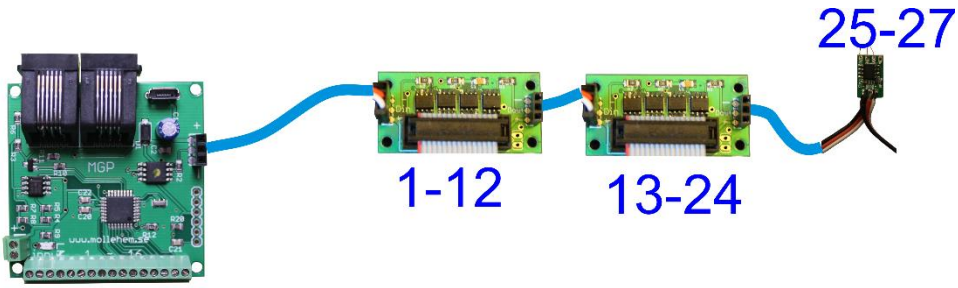
With a panel decoder a control panel for a layout can be built.
The panel is connected to the layout through LocoNet and can control other devices on the layout, e.g. switches and signals.

The function for buttons and LEDs is configured with values in SVs and set with the help of the Programming App.

The decoder has power connections for 5 Volt DC, either through a standard USB micro connection (normal mobile phone charger) or through a terminal block.



LEDs are connected though drivers and the drivers are connected to the decoder in series through a serial bus. The serial bus uses normal extensions cables type R/C servo extensions.



1.1 ADDRESS TO THE DECODER

The decoder has a main address (in SV 21). Default address for the decoder is **20**.
This address is used when configuring the decoder and needs to be unique on the LocoNet.
The decoder address is changed by entering a new address into SV 21 with the programming app. Note that a changed address takes affect first at the next startup, so disconnect and reconnect power to the decoder after changing the address.

1.2 BUTTONS

To control switches etc. buttons are used. 16 buttons can be handled by one decoder.
One side of the button is connected to “0 Volt” and the other to the input block of the decoder.

The buttons are numbered 1-16 and in the decoder the actions that will take place at the press of a button, is configured with SV 30 and forward.
In the app this is configured under “Inputs”,

1.2.1 INPUT TYPES

Different types of messages can be sent when the button is activated.

Orders for a switch to change state can be sent as

- "**Toggle**" - switch order is sent for the switch to change state.
- "**Thrown**" - switch order is sent so that the switch goes to thrown
- "**Closed**" - switch order is sent so that the switch goes to closed
- "**Closed/Thrown**" - when the button is activated, order is sent for closed and when released, order is sent for thrown. This setting is used when the button is of type "switch", ie with two fixed positions, on/off.

Status messages are a type of messages sent from eg. track indication.
In the same way as Switch orders, these variants have "**Toggle**", "**Free**", "**Occupied**" and "**Occupied/Free**".

- "**Interrogation**" is a message with a request for all decoders to report their status for switches, occupancy, etc. Used, for example, to light up a panel with everything in current states. This message can be sent automatically by the panel decoder at startup (SV 24, "Interrogation at startup"), but can also be sent with a pushbutton.
  "**Combo address**" indicates that the button is used for two-button control, but that the definition of this control is in another decoder. Button press tell the second decoder of the button's position and that decoder is then responsible for managing the two-button control.
  The address can be freely selected but should be the same as the other decoder uses in the two-button definition.

From version 9, "**switch status**" can also be sent from the panel.
In the same way as for switch order, these variants have "**Toggle**", "**Thrown**", "**Closed**", and "**Closed/Thrown**".

From version 11, the commands "Track Power" OFF and ON can be sent from a panel.

1.2.2 INPUT ADDRESS

When an input is activated by a button, the message that is configured is sent.
The message is sent to some item on the track, e.g. a switch or a signal. In "Input Address" the address of that item is defined.

1.2.3 INPUT, INITIATE

From decoder version 9, it is possible to set the input to initiate at startup.
This means that the decoder will read the state of the input and send the corresponding message.

This is not the normal behavior but can be needed in some cases.
An example could be If a "switch with a key" is used to lock or unlock the panel. If the key lock is in locked position, the input should be read, and the locking message should be sent to all involved. This will then initiate the panel decoders in locked mode at startup.

1.2.4 INPUT, CAN BE LOCKED

When the decoder is locked, those inputs that has "Can be locked" defined will be locked.

1.3 LED

To indicate the state of devices, e.g. switches, signals etc., LEDs are used. One decoder can handle up to 64 LEDs.
The LEDs are not connected directly to the decoder but to separate driver cards.
Three types of LED driver card are available, for 12, 6 and 3 LEDs. The driver cards are connected to the decoder through a serial bus and as many as needed can be connected with a maximum of 64 LED connections.

LEDs will show the state of a device from a message seen on LocoNet and will show the correct state as soon as the message has appeared on LocoNet.
The decoder can be configured to interrogate LocoNet available devices on LocoNet for the current state. This function is configured with SV 24.

Switches has two normal states, “closed” (straight forward) and “thrown” (switch set to side track). When the switch is moving between those two states, it is in a third “unknown” state, in-between the two normal states.
If the decoder controlling the switch can report this third “unknown state” the LED can be set to flash at this state and this is configured in SV 25.
(Servo decoders from MGP can use this “Unknown state” and in the servo decoder this is configured in SV 42)

LED brightness

The brightness of LEDs is configured in SV 100.

Beginning with version 3 of the decoder software, different LEDs have different brightness. LEDs can be grouped in up to 8 different groups where each group is given a certain brightness.
Which group a led belongs to is specified for each LED, in SV 104 and onwards "Intensity bank number".
The brightness of the group is specified in SV 90-97, "Intensity bank X, Intensity value".

NOTE, SV100 "LED main intensity", still controls the brightness of all LEDs.
The individual settings in the intensity groups are relative to the main setting in the SV100. The value of the various groups is the percentage of the main setting.

Example:
you have a number of red and green LEDs that has the same intensity – these may belong to group 0 (default). Some white LEDs tough, light up very strongly and these can be set to belong to group 1.
The light intensity of Group 1 is then decreased from the default 100(%) to e.g. 25 (%).

LED-control

For troubleshooting etc. it is possible to light up all LEDs for a moment at the startup of the decoder. This is done in SV 25.
It is also possible to start a detection sequence where each LED is switch on and off after each other, starting at LED 1 up to a defined number of LEDs (SV 26). When this test sequence is not used, SV 26 should be 0.

1.4 IMPORTANT ABOUT SWITCH ORDER AND SWITCH STATUS

The technique for controlling a switch is based on two-way communication with the switch, one message is sent with the “switch order”, such as "Switch 100 go to CLOSED", and then the switch replies with a message “Switch Status”, e.g. “Switch 100 in position CLOSED”.

Buttons that control switches thus send an "Switch Order".
LEDs that show the position of a switch are listening to "Switch Status".

Some types of switch decoders, e.g. plain DCC decoders, cannot return any switch status!

If you have defined a button to control a switch and a pair of LEDs for indication of position, then the LEDs will not respond because no message about the status of the switch is sent back.

The "toggle" button function also uses the “Switch Status” message. A “Switch Order” is sent for the opposite state that the switch currently have and if a “Switch Status” reply is missing, then the "toggle" function will continue to send the same Switch Order at the following activations of the button. It only changes when an answer is received that the new state is taken.

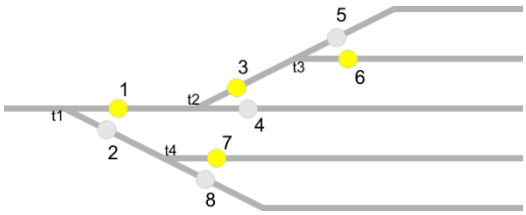
Should the panel decoder be used with e.g. old DCC decoders, there is (from version 9) support for auto generation of switch status messages. See the chapter on "Auto answer for external switches".

Another possibility is to change the behavior of “Switch Toggle”.
Instead of expecting a reply from the switch with state information, the decoder can send orders for “thrown” and “closed” every other time.
This can be done with decoder versions from 9, by setting SV “Use Switch Toggle without answer” to “Yes”.
Use this feature in exceptional cases only. The recommended setting is to use the normal behavior with status reply messages.

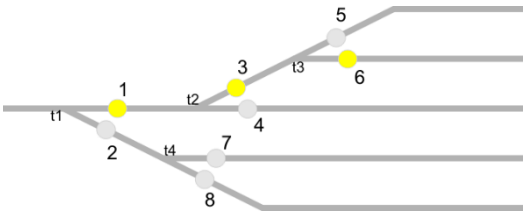
2 LED DEPENDENCY

From version 9 of the panel decoder, an LED can be set dependent of another LED as a requirement to be lit.

Example:
A yard has turnouts t1-t4. Each turnout has its state shown with two LEDs.
Each turnout will now have one LED that is lit and one that is black.



If only those turnouts to which the train can come, should be lit, then LED Dependency can be used.
To achieve that, each of LED number 3 to 8 should define the number of the LED that Is immediately before the LED.
So LED 7 should have dependency to LED 2, and will then be black on the next picture, because LED 2 is black.
LED 3 is dependent of LED 1, and is then lit because LED 1 is lit.



The complete example should be: 3 and 4 dependent on 1, 5 and 6 on 3, 7 and 8 on 2.

2.1 LED GROUP

LED Dependency normally defines another LED.
If a LED is dependent on more than one LED, then a LED Group can be defined.
12 groups can be defined, and each group can have up to 4 LEDs.

A LED Group is defined as “lit” when one or more LEDs in the group are lit.

3 ROUTES AND GROUPS

From decoder version 12, the setting for routes can be used to group occupancy detection and switches also.

3.1 SWITCH ROUTES

”Routes” is used to set a number of switches with one order, to enable a route from one track to another. That could be e.g. from the west entry track of a station to platform 1.

A route will have its own address and is activated as an ordinary switch by sending a “Switch CLOSED” message to that address.

A LED that has been defined to be lit when a route is set correctly. Status is a normal “Switch feedback” and will be “Closed” when the route is correctly set.

Support for routes is found in SV 400 and upwards.

Starting with decoder version 9, a delay for routes can be defined.
The delay will be between the different switch orders sent for a route. This may be useful e.g. if the switch motors take a lot of power and should not be triggered simultaneously.

3.2 GROUPS FOR OCCUPANCY DETECTIONS

From version 12 it is possible to group a number of occupancy detection into one new detector with each own address.

In ”Address” the address of the included occupancy detectors is stated and in ”Direction” should be set to”1/Closed”.

The address of the group will now be seen as a new occupancy detector, that will be occupied when any of the included detectors are occupied.

A typical usage for this group would be if a long track has been divided in several shorter occupancy detectors. In this case it can be good to have one new “detector” that represents the whole track and shows occupied when any part of the track is occupied.

3.3 GROUPING OF SWITCHES

From version 12 there is the option Grouping of Switches as an alternative.

The addresses should be switch addresses and "direction" indicates the position of the switch.

The address of this group will have feedback “Closed” if any of the included switches are in the defined “Direction”.

A typical use for this is to get an indication whenever any of a group of switch routes are set.
Here, the addresses of the switch routes are used and "Direction" is set to "Closed". When any of the switch routes is set, a switch feedback for "closed position" will appear for the address of this group.

4 BUTTON COMBINATIONS

For some functions, e.g. routes in some control panels, it could be of interest to enable send the switch command with the combination of two buttons.
If a button for the entry track to the station is pressed and then the button at platform 1, then that could mean that the route from “entry west” to “platform 1” should be set.

Panel decoders up to version 7 can handle 16 combinations. Buttons must be connected to the decoder where the Combo is defined.
Panel decoder from version 8, can handle 24 combinations. In these combinations buttons connected to other decoders can be used as well.

Button combinations can be set to activate either when the two buttons is pressed simultaneously or after each other within a specified time and the order of the buttons can be set to matter or not.
An example for the use of this would be if the button at “entry west” is pressed before “platform 1”, then the signals would be set to go from west into the station, and in the opposite direction if the button “platform 1” was pressed first.
The maximum time between to pressed buttons can be set up to a max of 15 seconds. If this time is set to 0, that means that the buttons need to be activated simultaneously to be regarded as a button combination.
Note – it is possible to get a visual feedback that the panel is waiting for a second button by connecting a LED to be lit during that time (one LED in each panel can be used for this).

The number of the button connection should be used (1-16).
From version 8, real addresses (1-2047) can be used as well. If real addresses is used, the connection where the button is connected, should have the type “Combo Address” and an address is stated. In this case the button can be connected to any panel decoder, not just the one where the Combo definition is placed.

For each button combination, two addresses can be activated. This is to enable the use of one address for a route and the other address for setting the direction of signals, but both addresses can be used to anything.

Support for button combinations is found in SV 600 and upwards.

5 DIRECTION DEPENDANT OCCUPANCY DETECTION

In some cases it can be useful with a occupancy indication that gives information about the direction of the trains movement.
A direction dependent detection is based on two normal detections that are placed close to each other. Logic will register when a train moves between those two detections and will send occupancy messages based on the direction of travel.

The direction dependent detection will have two addresses that will indicate direction, one for direction “A to B” and the other for “B to A”.

The decoder has a total of eight direction dependent detections, each with detections for both directions.
The addresses are based of one start address, defined in SV 360, “Direction dependent status”->”Start Address”.
The first of the four detections will use the start address for direction “A to B“ and the address+1 for direction “B to A”.
The second detection will use “start address”+2 etc.

For each of the direction dependent detections, the two addresses of the normal detectors, that the direction dependency is based on, are defined.
Those normal detection addresses are defined in Sv ”Direction dependent status”->”Direction dependent status X: Address A” and ”Direction dependent status”->”Direction dependent status X: Address B”.

A normal detection that is used in a direction dependent detection can still be used as a normal detection.

The direction dependent detection will signal “Occupied” when the train reaches the border between the two normal detectors, that is when both detectors signal “Occupied”.
The direction dependent detection will signal “Free” when the train leaves the border between the two normal detectors, that is when one detector signal “Free”.

A delay for the acceptance of the normal detector going from “Occupied” to “Free” can be set. This can be used to minimize the problem for example when train has bad current collection.
The delay time is set in Sv 362, ”Direction dependent status”->”Delay free status (0.1s)”. This time is given in the number of 1/10 of a second, so e.g. the value 10 will give a delay of 1 second.

6 INITIATING AT STARTUP

When power is switched on, the panel decoder does not know the state of switches, signals etc. out on the layout. During the use of those switches they will report their state and when they do the LEDs on the panel will start to lit up.

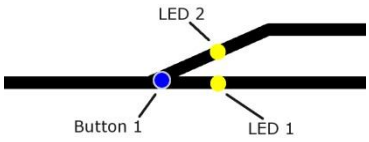
To enable the panel to show the correct states from the beginning it is possible to configure the panel decoder to send a message out on LocoNet to ask all devices to report their status.
This is configured with SV 24, “Interrogate at startup”. Here the panel decoder can be set to interrogate the status a few seconds after startup.
This setting specifies the time after booting that the request should be sent. It is important that sufficient time is used so that other units have had time to start. For example, signal decoder starts slowly when its test function "light al lat startup" is used.

Note, if there are more than one device on the layout capable of interrogation, then only one needs to do the interrogation. All devices will hear the status reports.

It is also possible to activate an interrogation from a button.

7 PANEL LOCKING

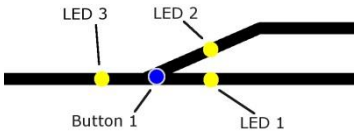
8 EXAMPLE OF BUTTONS/LEDS IN A CONTROL PANEL



A common way to control a switch in a control panel is through a push button and to have two LEDs to indicate the current state of the switch.

In the picture to the right a button has been connected to the input 1 of the decoder and two LEDs has been connected as LED 1 and 2.
They should be programmed in the decoder so that the switch is ordered to change state at each push of the button, and the LEDs should be lit at “closed” respective “thrown” state of the switch.
For both the button and the LEDs the address of the used switch should be programmed.

In the panel decoder the following should be programmed:
- Input 1, Type - ”Switch toggle”
- LED 1, Type - ”Switch Closed”
- LED 2, Type - ”Switch Thrown”



In some control panels a third LED is used to indicate the start of the switch, see the picture. This LED is often lit constantly, but if the used switch decoder is capable of reporting the third state ”unknown”, then this LED could be programmed to be lit only when the switch is OK for a train to pass, and not while the switch is moving between the two normal states.

The servo decoder from MGP can report this “unknown state” and the panel decoder from MGP can use that information.
In the servo decoder, SV 42 should be set to:
- Feedback type - “with unknown state info”
In the panel decoder LED 3 should be configured as:
- LED 3, type - “Switch Known state”

9 AUTO ANSWER FOR EXTERNAL SWITCHES

“Auto answer” is available in decoder version from version 9!

A switch or equivalent that receives a switch command at its address, acts on the exchange order and then responds with its new status.
This status from the switch can be used by other devices in the system such as a signal that depends on the position of this switch.

Sometimes you can have different types of switch decoders unable to report their status to the surroundings. A typical type of such decoders are DCC decoders.
Best is to replace those decoders by decoders that provide information about the status. But if you still want to keep these in the system and their status is important for other parts of the system, the panel decoder can simulate an answer.

An address space can be specified for which the panel decoder will send a status message as soon as it hears a switch order.
The panel decoder sends a response with the status as if the addressed switch has changed state according to order. Note that this will be a guess of the state. If the switch by some reason don't act according to the order, the status will be inconsistent.

The address space is given with a start address and the number of addresses to be answered.
So if you want the addresses 100-124 to be given an automatic answer, enter the starting address to 100 and the number of addresses to 25.
Only decoders that don't produce their own status responses should have addresses inside this space!

10 ACOUSTIC FEEDBACK FOR BUTTONS

Available in decoder version from version 9!

The decoder has 16 inputs. If sound as feedback on keystrokes is desired, "input 16" can be used to send pulses to a sound generator.
As a sound generator, a small piezo sound generator can be used.

The sound generator is connected with its positive pole to the plus of the decoder and minus pole to input 16.

Sound settings are made in SV 27.
Setting is available for feedback at each key stroke or when a two-button combination is activated.

11 SYSTEM VARIABLES – SV, FOR THE PANEL DECODER

Note – some SVs is only visible if the programming app has been set to "advanced mode"!

LocoNet decoders has their configuration stored in System Variables, SVs. These can be changed through the programming app.

The following system variables exists at the moment.

SV number			Decoder version
21	Decoder Address	Identifies the decoder during programming. This address should be unique on LocoNet.	
24	Interrogate at startup	After startup, a request is sent to all devices on LocoNet to report their status. If interrogation is to be used, this SV is the number of seconds to wait before interrogation is sent. All devices on LocoNet must have some time before they are ready to report any status. If not used this SV is set to 0.	
25, bit 0	Send switch message for button	"When button is ON" – 0, "When button is OFF and ON" - 1 Use together with some centrals stations, e.g. Twin Center	2
25, bit 1	Blink at unknown state	Don't blink – 0 Blink – 1	2
25, bit 2	Flash at startup	All LEDs will lit up shortly after start up.	Decoder type 2
25, bit 3	Use Lock	The panel can be locked with a switch message on the address of the decoder 0 -Do not use lock 1- Use locking	7
25, bit 4	Toggle Switch without answer	Input "Switch Toggle" will toogle without a proper answer from switch decoder	9

25, bit 5	Report status at “Track Power On”	Report status at LocoNet message “Track Power On”	11
25, bit 6	Send “Track Power On” during Interrogation	Send “Track Status ON” at the same time as Interrogation.	11
26	LED Test Sequence	LEDs start to flash from LED 1 and up. Can be used to check LED order. The value of this SV is how many LEDs that will be lit starting from LED 1. Set value to 0 to set test sequence off.	Decoder type 2
27, bit 0-2	Button Acoustic Feedback	Feedback when an input is activated. Feedback use ”input 16” as output for a sound device. 0 – No feedback 1 – Feedback for each activation 2 – Feedback for Combo activation	9
27, bit 4-7	Button Acoustic Feedback, Length of tone	Length of pulse, in 1/10s, for the feedback 0-15.	9
30	Input 1, type	Control what happens when button 1 is pressed: 1 – switch changes state at each trigger 2 – switch set to thrown 3 – switch set to closed 4 – switch, closed when button is pressed, thrown when button is released. This is used when a switch button is used instead of a push button 5 – status message is sent, status changes at each trigger 6 – status ”occupied” is sent 7 – status ”free” is sent 9 – send “interrogate” 10 – Combo Address 11 – Switch status toggle 12 – Switch status Thrown 13 – Switch status Closed 14 – Switch status, closed when button pressed, thrown when button released. 15 – ’Send Track Status ON’ 16 – ’Send Track Status OFF’	Value 10 from version 8 Value 11-14 from version 9 Value 15-16 from version 11
31	Input 1, address	The LocoNet address that is used for input 1. (2 byte)	
32, bit 4	Input 1, lock	If this input should be locked when the decoder is locked. 0 – don’t lock this input 1 – this input will be locked	7
33-77	*The following inputs 2-16, in the same way as SV 30-32*		
86,87	Switch Auto Answer, Start Address	Start address for auto generated answers for Switch Requests	9
88,89	Switch Auto Answer, Number of Addresses	The number of addresses that should get a generated answer starting from the first address in SV 86.	9

90	LED intensity group 0	Controls LED intensity for LEDs belonging to group 0. Intensity is relative to the main intensity controlled with "LED max intensity" (Sv 100). Default is 100 (%).	Decoder version 3
91-96	LED intensity group 1-7	Same as Sv 90, but for group 1 to 7.	Decoder version 3
100	LED max intensity	Value between 1-255 that controls the intensity of LEDs. Default is 100.	
104, bit 0-4	LED 1, type	Controls what event that is used for this LED to be lit: 0 – LED is not used 1 – switch is thrown 2 – switch is closed 3 – status "occupied" 4 – status "free" 5 – switch in know state 6 – switch in unknown state 10 – Signal shows Stop 11 – Signal shows GO 12 – Signal shows GO Slow 15 – Combination button A is pressed	Values over 6 only in decoder type 2
104, bit 5-7	LED group	Used to adjust the intensity of the led. The LEDs are divided into groups, 0-7, where each group can get custom brightness. The brightness of a group set up in EN 90-97.	Decoder version 3
105-106	LED 1, address	The LocoNet address that is used for the LED. (2 byte)	
107-295	*The following LEDs 2-64, in the same way as SV 104-106*		
296-359	**Led Dependency**	**A LED can be defined to be dependent of another LED as a condition for this LED to be lit.**	**9**
296, bit 0-5	Led Dep - Address	Address (1-63) the LED in the condition	**9**
296, bit 6	Led Dep – State	What state of the controlling LED that fulfils the condition 0 – "Off" 1 – "On"	**9**
296, bit 7	Led Dep - Type	The controlling LED can either be a LED or a LED Group 0 – "Led" 1 – "Led Group"	**9**
360 - 394	**Direction Dependency Detection**		**8**
360	Start Address	First Address of messages for Direction dependent occupancy. The rest of will be address+1, address+2 etc.	8
362	Delay Free Status	Delay of the acceptance for transision between "Occupied" and "free". Value is number of 0.1 seconds.	8
363	Direction dependant status 1: Address A	The address of the first normal detection that this direction dependency will be based on.	8
365	Direction dependant status 1: Address B	The address of the second normal detection that this direction dependency will be based on.	8
367-394		Address A and B for direction dependent detectors 2-8, in the same way as 363 and 365.	8

400-505	**Routes**	**8 routes with max 5 addresses per route**	**2 – 7**
400-557	**Routes**	**12 routes with max 5 addresses per route**	**8**
400, bit 0-11	Start Address	Address to the first route. The following routes will have the direct following addresses.	Decoder type 2
401, bit 4-7	Delay in routes	Delay between each switch order in a route, in milli seconds	9
402, bit 0	Route 1 Active	0 – Not active 1 – Active	Decoder type 2 up to version 11
402, bit 0-1	Route 1 Active	0 – Not used 1 – Used as Switch Route 2 – Used as Occupancy group 3 – Used as Switch Group	Decoder type 2 From version 12
403	Route 1, Switch 1, Address	12 bit, 8bit in 403 + 4 (0-3) in 404	Decoder type 2
404, bit 4	Route 1, Switch 1, Direction	0 – Thrown 1 – Closed	Decoder type 2
405-414	*Route 1, Switch 2-6*	*Same as 403+404*	Decoder type 2
415-505	*Route 2-8*	*Same as 402-414*	2-7
415-557	Route 2-12	*Same as 402-414*	8
564-599	**LED Group**	**12 LED groups can be defined with up to 4 LEDs each**	**9**
564, bit 0-5	LED Group 1, LED 1 Number	The number of the first LED (1-63) that is a member of this group	**9**
564 bit 6-7 + 565 bit 0-3	LED Group 1, LED 2 Number	The number of the second LED (1-63) that is a member of this group	**9**
565 bit 4-7 + 566 bit 0-2	LED Group 1, LED 3 Number	The number of the third LED (1-63) that is a member of this group	**9**
566 bit 3-7	LED Group 1, LED 4 Number	The number of the fourth LED (1-63) that is a member of this group	**9**
567-599		Same as 564-566 for LED Group 2-12	**9**
600-698	**Button Combinations**	**Definitions for up to 16 two-button combinations** ***** Decoders up to version 7.** **Version 8 is described further down.**	**2 - 7**
600, bit0	Direction dependent	Controls if the button combination should depend on the order that the two buttons is pressed. 0 – No direction 1 – Direction	**2 - 7**
600, bit 1-4	Max time between buttons	The time in seconds when button A is active in waiting for button B to be pressed. 0 – buttons must be pressed at the same time 1-15 – the number of seconds to wait for button B to be active	**2 - 7**
604, bit 0	Combo 1 Active	0 - Not active 1 – Active	**2 - 7**
605, bit 0-3	Combo 1 – Button A	0-15 (for input 1-16)	**2 - 7**
605, bit 4-7	Combo 1 – Button B	0-15 (for input 1-16)	**2 - 7**
606, bit 0-3	Combo 1 – Type 1	0 - Not used 1 – Switch Thrown 2 – Switch Closed 3 – Status Free 4 – Status Occupied	**2 - 7**

606, 607	Combo 1 – Address 1	12 bit, 4bit (4-7) I 606 + 8 bit I 607	**2 - 7**
608, bit 0-3	Combo 1 – Type 2	0 - Not used 1 – Switch Thrown 2 – Switch Closed 3 – Status Free 4 – Status Occupied	**2 - 7**
608, 609	Combo 1 – Address 2	12 bit, 4bit (4-7) I 606 + 8 bit I 607	**2 - 7**
610-698	Combo 2 – 9	Same as 604-609	
600-819	**Button Combinations**	**Definitions for up to 24 two-button combinations**	**8**
600, bit0	Direction dependent	Controls if the button combination should depend on the order that the two buttons is pressed. 0 – No direction 1 – Direction	8
600, bit 1-4	Max time between buttons	The time in seconds when button A is active in waiting for button B to be pressed. 0 – buttons must be pressed at the same time 1-15 – the number of seconds to wait for button B to be active	8
604, bit 0	Combo 1 Active	0 - Not active 1 – Active	8
604, bit 1	Combo 1 Button or Address	Combination use internal Button connection number or External Address 0 – Button number 1 – External Address	8
605, 606	Combo 1 – Button A	0-15 (for input 1-16) or full external address	8
607, 608	Combo 1 – Button B	0-15 (for input 1-16) or full external address	8
609, bit 0-3	Combo 1 – Type 1	0 - Not used 1 – Switch Thrown 2 – Switch Closed 3 – Status Free 4 – Status Occupied	8
609,610	Combo 1 – Address 1	12 bit, 4bit (4-7) in 609+ + 8 bit in 610	8
611, bit 0-3	Combo 1 – Type 2	0 - Not used 1 – Switch Thrown 2 – Switch Closed 3 – Status Free 4 – Status Occupied	8
611, 612	Combo 1 – Address 2	12 bit, 4bit (4-7) in 611 + 8 bit in 612	8
613-818	Combo 2 – 9	Same as 604-611	8

APPENDIX A, HARDWARE

The MGP decoders are compatible with the Arduino computer card family.
They can be reprogrammed with the Arduino IDE and in that case be treated as “Arduino Pro mini”.

The six unpopulated connector holes that sits at the border of each decoder, is the same interface that is found on a “Pro mini”. Looking from outside of the board, “GND” is the hole to the right.

To use them with LocoNet, the LocoNet libraries from “Model Railroading with Arduino” can be used. The first versions of the decoders used them, but due to available memory, the current versions use more compact and less generic code. To use this LocoNet library, use D8 as incoming and D9 as outgoing pins.

To update the decoders with new version of the firmware, the available images can be loaded into the decoder. But - these images are not suitable to load if the decoder has been used with other code before. If a decoder needs to be reloaded with the normal firmware – please contact MGP.