

Instruction Signal10

Note, this manual is continuously updated.

Check www.mollehem.se/doc/instruktioner/Instruction_Signal10_en.pdf for the latest version.

| | | |
|--------|--|----|
| 1 | Signal decoder | 2 |
| 1.1 | Connections..... | 3 |
| 1.2 | Basics..... | 3 |
| 1.3 | Signal status messages | 5 |
| 1.3.1 | Feedback through security messages | 5 |
| 1.3.2 | Feedback through "Switch feedback" | 5 |
| 1.4 | GO 40, GO 40 SHORT WAY | 6 |
| 1.5 | Rules to allow for "GO" aspects | 6 |
| 1.5.1 | Complex signal cases | 7 |
| 1.6 | Distant signalling | 8 |
| 1.7 | Direction dependency | 8 |
| 1.8 | Trigger rules | 9 |
| 1.9 | Adjustment of the Signal brightness | 9 |
| 1.9.1 | Overall brightness adjustment..... | 9 |
| 1.9.2 | Individual adjustment | 9 |
| 1.10 | Slave signals | 10 |
| 1.11 | Signal types | 10 |
| 1.11.1 | Main signals..... | 10 |
| 1.11.2 | Distant signals..... | 10 |
| 1.11.3 | Road crossings | 10 |
| 1.11.4 | Dwarf signals | 10 |
| 1.12 | Extra control functions for some complex signals | 11 |

| | | |
|-------|---|----|
| 1.13 | Connections for feedback | 11 |
| 1.14 | Direction dependant Occupancy detection | 12 |
| 2 | Supported signals per country | 14 |
| 2.1 | Swedish signal decoder | 15 |
| 2.2 | Danish signal decoder | 16 |
| 2.3 | German signal decoder | 17 |
| 2.3.1 | KS signals, numbering of LEDs | 18 |
| 2.3.2 | H/V Einfahr Combination, numbering of LEDs..... | 18 |
| 2.4 | Czech signal decoder | 19 |
| 2.5 | US signaldecoder..... | 20 |
| 3 | System variableS – SV, Signal decoder | 21 |
| | Appendix A, Hardware..... | 28 |

1 SIGNAL DECODER

The Signal decoder manages railway signals.

One decoder can handle 10 signals with up to 7 lights per signal, with a maximum of 64 lights.

The signals should have lights in the form of LED and is connected to the decoder through LED driver cards (12- and/or 3-cards). The LED driver cards is connected to the LED connection on the decoder in serial. Read more in the documentation of the LED driver cards.

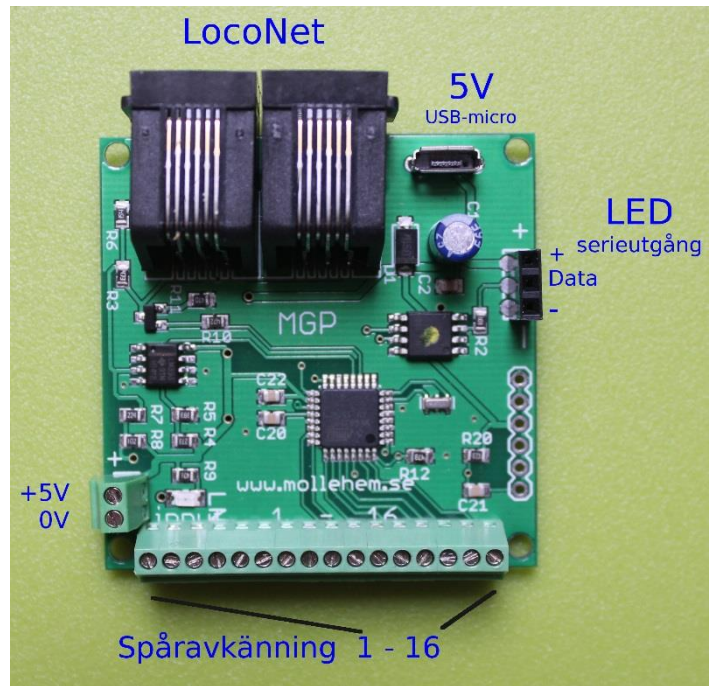
In the decoder, each connected signal is configured to its type. Signal types are e.g. the Swedish “Main 5 light signal”. The decoder will then handle the logic that controls which signal picture that is to be shown based on the state of the railway.

A connection is available for occupancy detection of up to 16 tracks. These connections sense a logic 0/1 (1 = 5 Volt) and is suited for e.g. the MGP range of occupancy detectors.

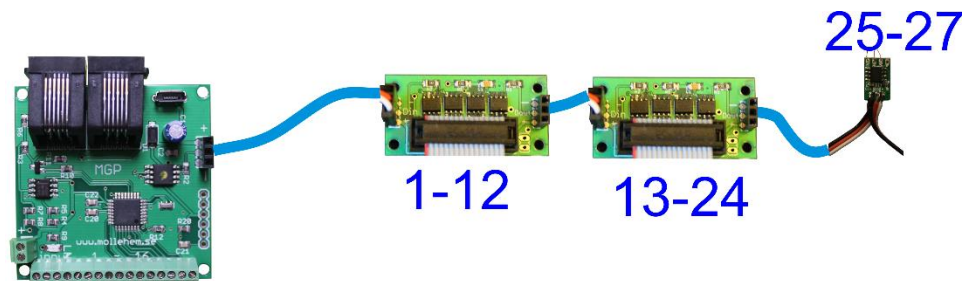
1.1 CONNECTIONS

The decoder has the following connection (see picture):

- LED where the signals is connected through the LED driver cards.
- 16 connection for Occupancy detectors.
- 5 Volts power through USB micro
- 5 Volts power screw terminal
- LocoNet



The signals are connected to LED driver cards and the driver card are connected in serial to the decoder. The cable used is the same as for extension cables for servos.



The LEDs of each signal should be connected to the driver card in continuous numerical order in order how the LEDs are place on the signal, from upper left to the right, and down. The LED placed to the top left will get the lowest number.

On the signal VSI, the white and red light is placed on the same spot and here the white light is LED number 1 and the red is led number 2.

1.2 BASICS

A decoder will have a **base address**. This address should be unique on the LocoNet. Each connected signal should get the following data defined:

- **Signal type**, e.g. "Main signal 2 light", "Distant signal 3 light" etc.
- **LED number**, which is the connection number for the first LED of the signal.

Signal types are built in to the decoder. On the decoder card, beside the serial number, an id is found, defining the country that the decoder supports, SE for Swedish signals, DK for Danish, DE for Germany etc.

Decoder base address

The decoder should have an address in the interval, 1-2038. When delivered it will have **80**.

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 effect first at the next startup, so disconnect and reconnect power to the decoder after changing the address.

The base address is also used for addresses to the signals.

Signal addressing

The decoder has the base address "n".

Addresses for the signals will then be the same, "n", for signal 1. Signal 2 will be addressed with "n+1", signal3 with "n+2" etc.

If all 10 signals is used, the decoder will response to then addresses, "n" to "n+9". No other decoders should use the same addresses.

Signal "basic state"

With the signal address, the "basic state" of the signal is controlled, which defines if the signal should show "stop" or any variant of "go".

The signal basic state is changed with a "switch message" on the signals address. If "Switch Order CLOSED" is received by the signal it will set its basic state to "go", and if "Switch Order THROWN" is received, it will be "stop".

A signal with the basic state "stop" will always show "stop".

If the basic state is set to "go", the signal picture shown will be "go" only if all defined dependencies to surrounding items will allow the signal to show "go".

Signal type and LED-number

The signal head with its LEDs are connected to the LED driver card. On the serial bus.

On the serial bus the LEDs are numbered according to their place on the serial bus. The LED in the first position on the first LED driver card (connected nearest to the decoder) is numbered 1. If this signal has three LEDs connected, then the next signal could be connected to position 4 and that signal then has the first LED numbered 4.

In the signal decoder, for each connected signal, at least two data needs to be configured. That is the number of the signals first LED, "**First LED number**" and the type of the signal, "**Type**", e.g. "Main signal 3 lights" ("HSI3").

With this basic information, the decoder knows which LEDs that belong to the signal and what aspects the signal is capable of showing, so the signal can now be controlled.

"Go 40"

Is the signal of the type that can display reduced speed, "Go 40", enter the address of the trailing switch (switches) in the "**Diverging Address**".

When the signal now should show "Go" it will select between "Go 80" or "Go 40" based on the subsequent trailing switch.

Pre signaling

If the signal is a pre signal (for example. HSI4 and HSI5), that is, it can display the state of a signal ahead, enter the address of the next signal in setting "**Next signal address**".

Rules for when a signal may show "run"

A signal should not be able to show "Go" if the track ahead is occupied or a trailing switch is wrong.

For this, it is possible to set rules for when the signal is allowed to show "run".

This is done in the setting of "GO logic". Here can, for example, the address of an occupied indicator be specified.

The rules in the "GO logic" must be met in order for the signal to be set to "GO".

If the signal's default is "Running" but a rule in the "GO logic" is not met, then the signal will show "STOP". When something happens that will give the rule a new result, e.g. when a track is free, the signal will change "GO" (given that other rules allow it).

If the signal's default is "Stop", the signal will show "STOP" regardless of the rules in "GO".

A signal can not be forced to "GO" if the terms of ' GO logic ' is not met!

Trigger-rules

The behavior of the signals can be largely automatic.

For example, if an entry signal to a small station is made dependent on the occupancy of station track, then the signal will show "GO" when the station track is free. When the train is at the station, the entry signal will show "STOP". When the train has left the station, the signal will once again show "GO".

Would you instead want the signal to continue to show "STOP" even after the train left the station and not show "GO" until, for example, the station personal actively set the signal to "GO", then "a trigger rule" can be used. In the above case, a trigger rule is defined that sets the "basic state" to "STOP" when the station track becomes occupied.

The signal will then remain in "STOP" until someone change the basic state to "GO" from eg. a control panel. If the "GO logic" is met, the signal will then show "GO".

1.3 SIGNAL STATUS MESSAGES

There are two ways that the signal notifies the status to the surroundings.

The first one is through SE-messages (security messages) and the second is through "Switch feedback" (feedback on the control message, " Switch order").

The powerful SE-messages is utilized throughout the MGPs system.

However, there are other vendors of LocoNet decoders that do not manage SE messages and therefore, if necessary, a signal can also give its status with "Switch feedback".

1.3.1 FEEDBACK THROUGH SECURITY MESSAGES

The signal always reports the change in its status, with SE-messages. These messages are the basis of how eg. a distant signal can display the correct aspect based on its main signal ahead.

When a signal changes its status, its signal aspect, it announces this with a message. Other devices on the LocoNet can hear these messages and take action accordingly.

Examples are a distant signal changing its aspect when it gets the message that its main signal has changed its aspect. Another example is a control panel with LEDs indicating the status of signals, that can update the view of the signals when new status messages arrive in the form of SE messages.

1.3.2 FEEDBACK THROUGH "SWITCH FEEDBACK"

The signals "basic state", "STOP" or "GO" is set with a message of the type "Switch Order" on the signal address. When the signal is receiving a "Switch Order", the signal answers with a "Switch Status" message. What this "Switch Status" message means is dependent on a setting, "**Sv23, Send switch feedback for signals**".

The default setting is that the value at "Switch feedback" message specifies the "basic mode" of the signal, i.e. the setting done by the "Switch Order message".

Feedback indicates, therefore, if the signal is set to display "STOP" or "GO". If it really shows "GO", depends on if the

“signal logic” rules allows the display of "GO".

This is the default setting for the decoder and "Sv 23, Send switch feedback for signals" then have the value "No".

If components is present in the system, that do not support SE messages and needs to know about signals current status, then the meaning of the signals "Switch feedback message" can be changed.

If the value of "Sv23, Send switch feedback for signal" is set to "Yes", the feedback message will tell the current state of the signal.

However, this setting also means that the "basic state" of the signal is not shown, this must be remembered by other means. Also note the status told by the switch feedback message just say "STOP" or "GO", so information like "GO SLOW" cannot be used this way. When possible, use the more powerful SE-messages.

1.4 GO 40, GO 40 SHORT WAY

Some signals that shows "GO" can show aspects like "GO 80" or "GO 40". This is based on eg. if succeeding "facing switch" is in the straight or diverging position.

For one signal up to 3 different diverging switches can be specified. In the Sv "Set Diverging", define the addresses of "diverging switches" that should affect the signals aspect "GO 40".

A Swedish "5 light main signal" can also show the aspect "GO 40, short way".

In the Sv "Short way" can be set if the aspect "short way" should be used. This will mean that in situations where "GO 40" should be shown, the aspect "GO 40, short way" will be used instead.

From version 7 of the decoder the concept of "short way" has been extended. Here it is possible to use an additional rule to specify the circumstances under which the "short way" should be used.

In Sv "Special Rules, Extra rule number", the number of an "Extra rule" can be specified. This rule will then define the conditions for when the "short way" should be used. Note that the Sv "Short way" must be turned on.

1.5 RULES TO ALLOW FOR "GO" ASPECTS

A signal should show GO only if certain conditions are met. This can be if the track behind the signal is free, or if a "trailing switch" is set correct.

In Sv "Set GO...", up to six conditions that allow for GO can be set.

For a "trailing switch" the address of the switch and the correct state of the switch is defined.

For free tracks to the address on the track's occupancy sensor is defined.

And if it is another signal, the address of that signal is given and the state of that signal that should enable go.

If more than one condition is defined, the relation between the conditions must be stated. This is done through logic AND/OR.

To the right is an example where the train is coming from the left, and meets the signal S1. The signal should show GO only if switch V100 is set correct and that the track T200 is free.

The rule for S1 is then be show GO only if "V100/Closed AND T200/free".



More complex logic can be created.

If the track branches into two alternative tracks with track indication, the controlling track indication must be selected depending on the switch position.

In the example to the right, a train from the left meets signal S1.

For S1 to show GO, then track where the switch



leads to must be free.

The rule for S1 is then show go only if "V100/Thrown AND T200/free OR V100/Closed AND T201/free".

1.5.1 COMPLEX SIGNAL CASES

If a signal is placed so that there will be many and/or tricky dependencies to the surroundings, there are primarily three ways to manage it, use routes, use "ghost signals" (signals defined in only in the decoder with no corresponding signal mast) or to increase the number of rules for that signal.

Routes in signal logic

If several switches must be set in order to get the train to a particular track, these switches can be specified as a route. Routes can be defined in the turnout decoders and the panel decoders, and provides a status for the entire sequence of switches. Routes has an address in the same manner as a switch and if used in the rules, it acts just like a normal switch. When the routes is set correctly, the route address will have the status "Closed" as feedback.

In a signal logic condition, the address for a route can be specified and the condition is then true only when the route is set correct.

Extra rules

In the decoder, there is space for 5 additional rules. These can be used as parts of normal GO-rules.

A useful use of additional rules are when several signals have the same dependencies to a part of the track plan. The rule for this part of the track plan can then be expressed as an "extra rule" and used in the signals that need this.

When the result of an extra rule is calculated, the entire extra rule is calculated by itself and then the result is placed into the referencing rule.

If the logic is drawn as a logical expression on a piece of paper, it means that the logic placed in the extra rule should be drawn with brackets around it, in the logical expression.

Use the definition space from another signal

It is possible to use the rule space for the definitions from the next signal. This is done by SV "Combined with next". This means that the space for logical expressions are doubled. The logic of the extended space will work in the same way as in the usual shorter series. It is also possible to connect several signal definitions.

Ghost signals

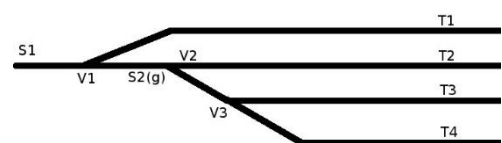
A signal that is defined for an item in the track plan but does not have any real light signal, is called "ghost signal".

A ghost signal can be used to reduce the complexity of GO logic of other signals.

In the picture to the right there is an entry signal S1. It should show "GO" if the track to which switches lead to is free.

This requires some conditions in the rule, more than there is space for in Sv for GO logic.

This can be solved by adding a ghost signal S2 in the front of V2 and this signal will then show signal aspects based on the track T2-T4.



For S1 this will hide tracks T2-T4 and instead the rule of S1 can be based on the state of S2.

The logic for S1 will then be, GO is allowed only when "V1/Thrown AND T1/free OR V1/Closed AND S2".

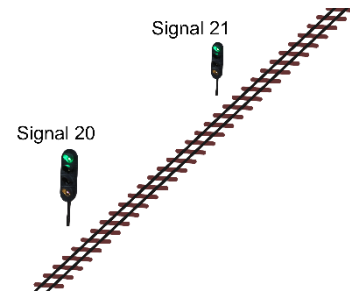
Note - if signal S2 has aspect "GO 40", then that information will be transferred to S1, i.e. S1 will also show "GO 40".

1.6 DISTANT SIGNALLING

Main signals with aspects for distant signaling and genuine distant signals, show aspects that are dependent of the next signal. If the next signal is showing "GO" then this distant signal can show something like "Expect GO".

In Sv "Next signal" the address of the subsequent signal is defined.

In the picture to the right, Signal 20 shows information about the next signal 21



1.6.1 DISTANT SIGNAL SELECTORS

Sometimes there is a diverging turnout behind the signal, so that the state of the turnout should decide which signal to show the information about.

In the picture signal 20 should tell what is coming for signal 21 when the turnout is in closed position, but for signal 22 when the turnout is thrown.



The SV "Next Signal" can only have one address. To solve this case a "Distant Signal Selector" is used.

A "Distant Signal Selector" has an address and can be used as a signal, so we define a new "Distant Signal Selector" that we give the address 800.

SV "Next Signal" for Signal 20 will be given the address of the "Distant Signal Selector", 800.

The definition of a "Distant Signal Selector" is the address (800) and a turnout address that is the selecting item (100). For the turnouts closed and thrown positions, signal addresses are given respectively (21 and 22).

When turnout 100 is in closed position, "Distant Signal Selector" 800 will mirror information about Signal 21, and when in thrown position it is signal 22 that is mirrored.

So, our Signal 20, that has "Distant Signal Selector" 800 as "Next Signal" will now show information about the correct signal depending on the state of turnout 100.

1.7 DIRECTION DEPENDENCY

A signal is directed in one direction along the track.

If you want to control a line with signals, so that signals along a track one direction shows the "STOP" while the signals in the other direction shows "GO", then directional control can be used.

The direction is named in programming app as "West to East" or "East to West".

Direction control could be used for a number of block sections of a line between two stations, or it can be one half of a station, for example the east entrance.

A signal decoder can handle 3 different controlled areas and each is given an address. Multiple signal decoders can handle the same direction addresses which will be the case if they have signals that are part of a larger joint directional line.

A direction controlled line can be set in either "Eastern" or "Western" direction and each signal present on the route is defined to belong to either the East or West direction.

If direct controlled signals is to be used, the following shall be set in the decoder:

- enter an address of "directional stretch in SV "Direction Address 1", "Direction Address 2" or "Direction Address 3"
- For the signals to be direction controlled SV "Direction Control", eg. "1 - West to East".

The direction of the line can then be controlled by sending Thrown or Closed as a switch message on the address of the direction.

1.8 TRIGGER RULES

(from program version 2)

Previous GO logic places static rules on the behavior of the signal. An example could be an exit signal at a station that is dependent of occupancy detection on the track behind.

When the train is leaving the station and occupies the track behind, then the signal will turn to STOP. But when the train leaves the track section, then the signal will revert to GO again – all static rules are fulfilled.

If the signal is to show aspect for STOP, then the "basic state" of the signal needs to be changed to "STOP" – perhaps through a button at a control panel.

To make the change of the "basic state" for the signal automatic, then "trigger rules" can be used.

A trigger rule changes the basic state of a signal when the rule logic is fulfilled.

In the previous example a trigger rule can be defined to follow the occupancy detector and when it gets occupied it will change the basic state of the signal to "STOP".

1.9 ADJUSTMENT OF THE SIGNAL BRIGHTNESS

1.9.1 OVERALL BRIGHTNESS ADJUSTMENT

Signal brightness can be adjusted with "Sv85 Std LED intensity".

In a bright room the value could be increases the value, while the value can be put down in a darkened room.

1.9.2 INDIVIDUAL ADJUSTMENT

Signal lights is given by different colored LEDs and these exist in a wide range of brightness.

To get a nice and even light from individual LEDs of different types, brightness of different colors can be customized.

This is done with the term "Intensity bank" where each "bank" provides one setting per color.

Each signal is defined to follow one "Intensity bank" and the default is bank number is 1.

Which bank a signal follows is specified in Sv "Intensity bank number".

For each bank (1-3), the different colors can be customized.

Default, the colors are set to 100%, i.e. the strength is 100% of the card's "Std LED intensity". If one type of LED is brighter than average, then the value in the bank for this color can be lowered.

For the various banks ' color settings, see Sv 86-97, "Intensity bank ...".

Example:

Signal masts from a particular manufacture have white LEDs that are a lot brighter than the other colours, then the brightness value for white can be lowered in one intensity bank. All the signals from this manufacture can then be defined to belong to this bank.

If signals used from different manufacturers, then allocate one bank for each manufacture and trim the values so that all signals look good together.

1.10 SLAVE SIGNALS

The Signal decoder support separate slave signals. This support is intended primarily for modules at module meetings.

Signals on model railway is very small, and these can be hard to follow for a human driver. Larger, more visible signals can then be placed on the side of the module, for example. at the entrance to a station, intended to clearly show the signal for the driver.

Signal aspects for these are simplified and only displays the GO/STOP (2 lights).

For each slave signal the signal number of the regular signal is defined and then slave signal will then follow the signal aspect on the regular signal.

1.11 SIGNAL TYPES

The following describes the signals found in the Swedish version of the decoder.

1.11.1 MAIN SIGNALS

Abbreviation HSI 2 – HSI 5 are main signal and is used as entry and exit signals on a station and for blocking signals on the line.

HSI 4 and HSI 5 has also includes aspects for distant signaling, which means that they show information of what to expect from the next signal on the line.

1.11.2 DISTANT SIGNALS

FSI 2 and FSI 3 are distant signals and show information of what to expect from the next signal on the line.

Repeat is a signal with one light and it shows "GO" if the next signal shows GO. Is used when the visibility of the main signal might be reduced from a distance.

1.11.3 ROAD CROSSINGS

Signals around a road crossing

VSI – a signal with one light for the track. It can show both white (GO) and red (STOP) In the programming app two versions exist, depending on what type of LEDs that are used in the signal.

"VSI 2" is used if the signal is built with two separate Leds, one white and one green..

"VSI rgb" is used when the signal is built with on multi colored LED.

VFSI – signal with three light that is used for the track as a distant signal for the VSI signal.

VTSI – signal with three lights and is used for the road.

1.11.4 DWARF SIGNALS

Dwarf signals are handled a bit special.

There are two main types of dwarf signals, "dwarf" ("DVSI") and "main dwarf signal" ("HDVSI").

Main dwarf signal

The Main dwarf signal is a combination of a "main signal" and a "dwarf signal" and is defined as a separate main signal together with a separate dwarf signal.

In signal decoder a master dwarf signal is defined as two different signals – a "main dwarf - Main" ("HdvM") + a dwarf ("Dvsi").

The main part, "HdvM", is set up and works much like a regular Hsi3. The dwarf part, "Dvsi", is defined as a normal dwarf, but also specifies the address of its main signal (a HdvM or normal main signal) in the setting of "Next Signal".

Dwarf signal

The Dwarf signal, "Dvsi", is controlled as usual with "Switch message" on the signal address.

This changes between basic state "STOP" and one of "GO aspects".

The aspect for "GO" is defined by "Switch messages" on two additional addresses. These addresses are specified in Sv "Diverging Sw 1 and 2".

If both of these addresses state 0 ("thrown") then the dwarf will show aspect "GO".

if the address in Sw1 is given state 1 ("closed") to display "Leaning Left" and if the address in Sw2 are given order 1 ("closed") to display "Leaning Right."

Important!

To use the extra addresses with the dwarf signals, these addresses must send feedback messages!

This is enabled by setting Sv 106 and 108, "Use switch order" to "Yes, handle feedback".

1.12 EXTRA CONTROL FUNCTIONS FOR SOME COMPLEX SIGNALS

Some signals have signal aspects for special cases, for example shunting aspects.

To control such cases, there are "Special Signal Controls".

For each signal there are three such additional control functions that can be switched on or off.

Only a few signals use these functions - see signal table.

These control functions are switched on and off via addresses specified for each control. These are switched on with a turnout message at the specified address.

The functions respond to the feedback message from the turnout message, ie the state of a turnout or signal can be used to control.

Which state activates the function is specified in the "State" setting.

It is thus the feedback message that normally controls the functions and the address must then be in an active turnout or signal.

If you want to control this function directly with the turnout message, then the feedback generation can be switched on for this function. This is done with the setting "Generate Feedback".

Under what circumstances the additional functions of a signal are available depends on the type of signal. An example could be that the extra functions can only be used when the signal has its basic state in "STOP".

In such cases, some signals allow the function to be forced to activate. Allowing this is done with the setting "Force view".

1.13 CONNECTIONS FOR FEEDBACK

The decoder has 16 connections that can be used for feedback.

In decoders of up to version 7, feedback is supported for track occupancy.
Decoders of version 8 supports feedback for either track occupancy OR switch status.
Decoders from version 9 supports feedback for both track occupancy and switch status.

The connections react to 0 and 1, where 0 is when the connection is connected to "ground", i.e. the negative side of the power connection.

1 is 5 volt or as unconnected. It is enough if the used hardware connects to ground when active and leaves the connection open in the others case.

Higher voltage then 5 volt must not be used!

There is a configuration that controls if the state of the input should be "floating", which is useful in some specific applications.

Important – this configuration is controlled by SV32, "Input unconnected state" and the value should be "Normal, always high".

The other value "undefined, floating" should only be used when a connected detector explicitly requires that.

The type of feedback can be either "Occupancy detection" or "Switch feedback".

The address of the feedback is defined in SV30 "Input start Address". This address will be used for the first connection on "Input 1". The following connection will get the following addresses, "adress+1", "adress+2" etc.

The number of used inputs is defined in SV32, "Number of used Input".

Only the number of inputs stated will be sending messages and the should be connected starting with input 1.

Normal use of inputs are for track occupancy. To the inputs, any of the MGP track occupancy sensors, can be connected. The decoder will sen track occupancy messages on to the LocoNet.

SV33, "Input type" should be set to "Occupancy Sensor".

On a layout, older types of switch motors and decoders could exist. A signal decoder can be used to let that older set of equipment, send their status on to LocoNet.

In this case the SV33, "Input type" should be set to "Switch feedback".

From version 9 the input connections can be organized in two groups. One group can be defined to support track occupancy feedback and the other group to switch feedback.

Used start addresses, number of connections, and what type of feedback is defined in SV30/SV40, SV32/SV39 and SV33.

Group 1 will always start with the first input connection and will use as many inputs that are defined for the group.

Group 2 will start at the first free input connection and will use as many as defined for that group.

The sum of the number of used inputs for the two group can not be more then 16.

1.14 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 four direction dependent detections, each with detections for both directions.

The addresses are based of one start address, defined in SV 550, "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 552, "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.

2 SUPPORTED SIGNALS PER COUNTRY

A signal decoder implements signals for a given country.
In this chapter the currently supported signals are listed.

Note, if a signal is missing and needed, please contact MGP to ask for it.

In the tables the headings are the following:

Description: A short description of the signal

Token: the basic name within the decoder. Normally not visible, but if a language lacks a translation for this signal, it will be visible in the app.

Num of leds: The number of leds that the decoder expects the signal to have.

RGB: normally the signal lights are implemented with a single colored led. Some signals use a RGB-led, and they are marked in this column.

Special 1-3: Some signals have extra features controlled by the "Special Signal Controls". If so, the function is explained in these columns.

Comment: any extra comments needed for this signal.

Signal decoders currently available are:

Swedish, Danish, German and Czech.

A beta version under development is available for a **US decoder**.

Dutch and Norwegian decoders are planned, and development have begun. Welcome to contact MGP about these.

2.1 SWEDISH SIGNAL DECODER

| Description | Token | Value | Num of leds | RGB | Special 1 | Special 2 | Special 3 | Comment |
|---|-----------|-------|-------------|-----|--|-----------|-----------|---------|
| Main signal with 2 lights | Hsi 2 | 1 | 2 | | | | | |
| Main signal with 3 lights | Hsi 3 | 3 | 3 | | | | | |
| Main signal with 4 lights | Hsi 4 | 4 | 4 | | | | | |
| Main signal with 5 lights | Hsi 5 | 5 | 5 | | | | | |
| Main part of the "large dwarf signal", to be used together with the normal "shunting dwarf" | HdvM | 6 | 3 | | | | | |
| Dwarf signal | Dvsi | 7 | 4 | | | | | |
| Distant 2 lights | Fsi 2 | 8 | 2 | | | | | |
| Distant 3 lights | Fsi 3 | 9 | 3 | | | | | |
| Repeat signal 1 lights | Repeat | 10 | 1 | | | | | |
| Road crossing signal against trains (made with 2 separate LEDs) | VSI 2 | 11 | 2 | | | | | |
| Road crossing signal against trains (made with one RGB LED) | VSI rgb | 12 | 1 | RGB | | | | |
| Road crossing signal, distant signal | VFSI | 13 | 3 | | | | | |
| Road crossing signal against road | VTSI | 14 | 3 | | | | | |
| Stop signal | S1 | 15 | 1 | | | | | |
| TGOJ exit signal 3 lights | TGOJ Ut 3 | 20 | 3 | | | | | |
| Main dwarf | HVDv | 16 | 7 | | S1/S2/S3: 1/1/1 = "Snett höger blink" 1/1/0 = "Snett vänster" 1/0/1 = "Snett höger" 1/0/0 = "Alla släckta" | | | |

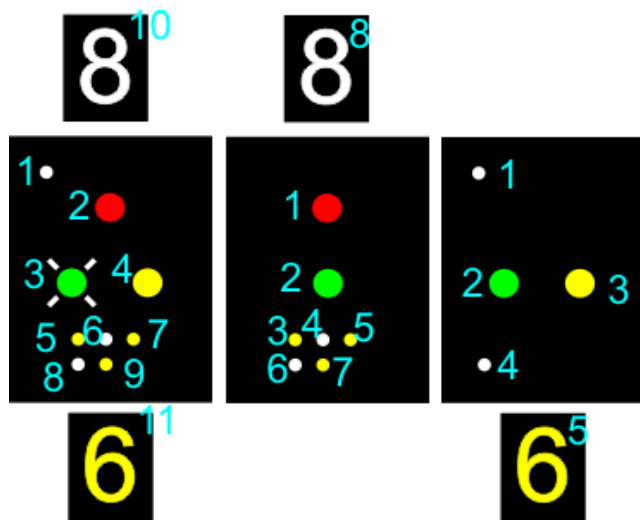
2.2 DANISH SIGNAL DECODER

| Description | Token | Value | Num of leds | RGB | Special 1 | Special 2 | Special 3 | Comment |
|--------------------------|-------------|-------|-------------|-----|-----------|-----------|-----------|---------|
| Innkjørhovedsignal 2 lys | I-signal 2 | 2 | 2 | | | | | |
| Innkjørhovedsignal 3 lys | I-signal 3 | 3 | 3 | | | | | |
| Innkjørhovedsignal 4 lys | I-signal 4 | 4 | 4 | | | | | |
| Utkjørhovedsignal 2 lys | U-signal 2 | 5 | 2 | | | | | |
| Utkjørhovedsignal 3 lys | U-signal 3 | 6 | 3 | | | | | |
| Forsignal 2 lys | F-signal 2 | 7 | 2 | | | | | |
| Forsignal 2 lys | F-signal 3 | 8 | 3 | | | | | |
| Mellembloksignal 3 lys | AM-signal 3 | 11 | 3 | | | | | |
| Dværgsignal | Dv-signal | 15 | 4 | | | | | |
| Perron-Udkørselssignal | PU-signal | 14 | 6 | | | | | |

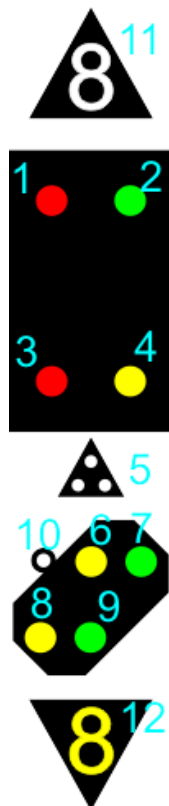
2.3 GERMAN SIGNAL DECODER

| Description | Token | Value | Num of leds | RGB | Special 1 | Special 2 | Special 3 | Comment |
|--|------------------------|-------|-------------|-----|---|---|--|------------------------------------|
| Hauptsignal, 2 lights | HP Block 2 | 1 | 2 | | | | | |
| Hauptsignal, einfahr, 3 lights | HP Einf 3 | 2 | 3 | | | | | |
| Hauptsignal, ausfahr, 6 lights | HP Ausf 6 | 3 | 6 | | | | | |
| Vorsignal, 4 lights | V 4 | 4 | 4 | | | | | |
| Vorsignal, 5 lights | V5 | 6 | 5 | | | | | |
| Hauptsignal mit Vorsignal, 10 lights | Hp/V 10 | 5 | 10 | | | | | |
| Schutz signal, 4 lights, older signaling scheme | Hp Schutz alt | 17 | 4 | | | | | |
| Schutz signal, 4 lights, newer signalling scheme | Hp Schutz neu | 18 | 4 | | | | | |
| Kombinationssignal Vorsignal | Ks Vor | 10 | 5 | | Vorsignal-wiederholer, Bottom white- ON | | | Se chapter.2.3.1 for LED numbering |
| Kombinationssignal Hauptsignal | Ks Haupt | 11 | 8 | | Hp0+Zs1 ersatz-signale, "Bottom white"-ON | HP0+Zs7, Vorsicht-signal, "Yellow V"-ON | HP0+Sh1, "Fahr-verbote aufgehoben", "White /"-ON | Se chapter.2.3.1 for LED numbering |
| Kombinationssignal Mehrabschnittsignale | Ks Voll | 12 | | | Hp0+Zs1 ersatz-signale, Bottom white-ON | HP0+Zs7, Vorsicht-signal, "Yellow V"-ON | HP0+Sh1, "Fahr-verbote aufgehoben", "White /"-ON | Se chapter.2.3.1 for LED numbering |
| Kombinationssignal "Letter sign". | Ks 'Buchstabe' | 13 | | | | | | |
| H/V Einfahr combination | HV Einfahr Combination | 15 | 12 | | Emergency, "Top Red"-ON | Ersatzsignal, "White triangle"-ON | | Se chapter.2.3.2 for LED numbering |

2.3.1 KS SIGNALS, NUMBERING OF LEDS



2.3.2 H/V EINFAHR COMBINATION, NUMBERING OF LEDS



2.4 CZECH SIGNAL DECODER

| Description | Token | Value | Num of leds | RGB | Special 1 | Special 2 | Special 3 | Comment |
|----------------------------------|------------|-------|-------------|-----|----------------------------|--|-----------|---------|
| Entry signal 2 lights, G/R | Cz V2 | | 2 | | | | | |
| Entry signal 3 lights, Y/G/R | Cz V3 | | 3 | | | | | |
| Entry signal 4 lights, Y/G/R/Y | Cz V4 | | 4 | | | | | |
| Entry signal 5 lights, Y/G/R/W/Y | Cz V5 | | 5 | | Shunting allowed, White-ON | Calling-on signal, Proceed slow, being prepared to stop Red-ON White-Blink | | |
| Exit signal 2 lights, G/R | Cz O2 | | 2 | | | | | |
| Exit signal 3 lights, G/R/Y | Cz O3 | | 3 | | | | | |
| Exit signal 3 lights, G/R/W | Cz O3_GRW | | 3 | | Shunting allowed, White-ON | Calling-on signal, Proceed slow, being prepared to stop Red-ON White-Blink | | |
| Exit signal 4 lights, G/R/W/Y | Cz O4 | | 4 | | Shunting allowed, White-ON | Calling-on signal, Proceed slow, being prepared to stop Red-ON White-Blink | | |
| Shunting signal, 2 lights, B/W | Cz P | | | | Shunting allowed, White-ON | | | |
| Distant signal, 2 lights, Y/G | Cz Distant | | | | | | | |

2.5 US SIGNALDEKODER

The US signal decoder is under development!

The first supported signals are from the Burlington Northern Railway.

The work of prioritizing new signals to be added is done in cooperation with the current users.

| Description | Token | Value | Num of leds | RGB | Special 1 | Special 2 | Special 3 | Comment |
|--|--------------------|-------|-------------|-----|-----------|-----------|-----------|---------|
| Stop signal, 1 light | SigPic Us stop | | 1 | | | | | |
| Burlington Northern, 1 head, 3 lights | SigPic Us BN shGYR | | 3 | | | | | |
| Burlington Northern, 2 head, 2*3 lights | SigPic Us BN dhGYR | | 3 | | | | | |
| Burlington Northern, 1 head, Searchlight | SigPic Us BN shSL | | 1 | RGB | | | | |
| Burlington Northern, 2 head, Searchlight | SigPic Us BN dhSL | | 1 | RGB | | | | |

3 SYSTEM VARIABLES – SV, SIGNAL 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.

In the SV table below there is a column for "decoder version". This specifies a version number for the Sv that has not been present from the beginning.

In "Sv 2, Software version number" the current version of the software is shown.

NOTE, use primarily programmeringsappen by changes in values. In programmeringsappen set all values in plain text and the risk of wrong input is small.

The following system variables exists at the moment.

| SV number | | | Decoder version |
|-------------|---|--|-----------------|
| 21 | Decoder Address | Identifies the decoder during programming. The address must be unique on the LocoNet. | |
| 23, bit 0 | Signal addressing mode | 1 – Smart control | |
| 23, bit 1 | Send switch feedback for signal | Defines the meaning of the feedback on the signal address. 0 – Feedback is the basic state of the signal. If the switch order is "GO" then "GO" is returned as feedback even if GO is prohibited by some rule. 1 - Feedback is the current state of the signal. Note – the signal will always send SE messages about its state. These messages should be used as the first choice when information about the signals state is needed. | |
| 23, bit 2 | Flash at startup | All LEDs are lit for a moment during restart. | |
| 23, bit 3 | LocoNet connected | 1 if LocoNet is used Can be set to 0 if the decoder is unconnected to the Loconet in order to avoid that the decoder spends time on unnecessary messages. | 4 |
| 23, bit 7 | Add SE delay | In normal usage this SV should have the value No. | 3 |
| 24 | Direction Address 1 | Address for direction control | |
| 26 | Direction Address 2 | Address for direction control | |
| 28 | Direction Address 3 | Address for direction control | |
| 30 | Group 1, Feedback Start Address | Address on which input 1 reports occupancy detection. Input 2 reports on this Addressen+1, etc. | |
| 32, bit 5 | Input sensor, value for unconnected state | 0 – Normal, always high 1 – Occupied at High | |
| 32, bit 6 | Input unconnected state | 0 – Normal, always high 1 – undefined, floating | |
| 32, bit 0-4 | Group 1, Number of inputs used | 0-16 | |

| | | | |
|-------------|---|---|---|
| 33, bit 0 | Input type, Group 1 | Input should be used for Occupancy feedback or for Switch feedback 0 – Occupancy Sensor 1 – Switch feedback | 8 |
| 33, bit 4 | Input type, Group 2 | Input should be used for Occupancy feedback or for Switch feedback 0 – Occupancy Sensor 1 – Switch feedback | 9 |
| 34,35 | Input filter pre (ms) | Is the shortest time that an input must be activated in order for the input to be detected? Mainly used for buttons to avoid “button bounces”. | |
| 36,37 | Input filter succ (ms) | Is the time that an input must be stable before a new input change is accepted. Mainly used for occupancy detection to avoid bursts of messages due to bad electrical connection on the loco. | |
| 38 | LED Test Sequence | The LEDs are lit on sequence from 1 and upwards. Is used to control LED problems. The value states how many LEDs that should be lit (1-64). 0 is used to disable this feature. | 3 |
| 39, bit 0-4 | Group 2, Number of inputs used | 0-16 | 9 |
| 40,41 | Group 2 Feedback Start Address | Address on which input 1 reports occupancy detection. Input 2 reports on this Address+1, etc. | 9 |
| 78,79 | Switch Auto Answer, Start Address | Start address for auto generated answers for switch orders. | 9 |
| 80,81 | Switch Auto Answer, Number of Addresses | The number of addresses that should be answered counting from the first address in SV 78. | 9 |
| 83, bit 0-3 | Fast blink frequency 1 | 10-ths of seconds that a LED is lit. Used by some signals with a more rapid frequency then the standard frequency (example signals for road crossings). | |
| 83, bit 4-7 | Fast blink frequency 2 | 10-ths of seconds that a LED is lit. Used by some signals with a more rapid frequency then the standard frequency. | |
| 84 | Standard Hsi Blink Frequency | 10-ths of seconds that a LED is lit. | |
| 85 | Standard LED Intensity From ver. 9: Night LED Intensity | 0-255 Controls the intensity of all LEDs. From version 9 this intensity chang can be controlled with switch command sent to the address specified in SV 98 | |
| 86 | Intensity Bank 1, green | 0-255 % of the Standard LED intensity | |
| 87 | Intensity Bank 1, red | 0-255 % of the Standard LED intensity | |
| 88 | Intensity Bank 1, white | 0-255 % of the Standard LED intensity | |
| 89 | Intensity Bank 1, yellow | 0-255 % of the Standard LED intensity | |
| 90 | Intensity Bank 2, green | 0-255 % of the Standard LED intensity | |

| | | | |
|----------------|----------------------------------|--|---|
| 91 | Intensity Bank 2, red | 0-255 % of the Standard LED intensity | |
| 92 | Intensity Bank 2, white | 0-255 % of the Standard LED intensity | |
| 93 | Intensity Bank 2, yellow | 0-255 % of the Standard LED intensity | |
| 94 | Intensity Bank 3, green | 0-255 % of the Standard LED intensity | |
| 95 | Intensity Bank 3, red | 0-255 % of the Standard LED intensity | |
| 96 | Intensity Bank 3, white | 0-255 % of the Standard LED intensity | |
| 97 | Intensity Bank 3, yellow | 0-255 % of the Standard LED intensity | |
| 98,99 | Night Address | A switch message (Closed) on this address will turn Night Intensity active 0-2048 | 9 |
| 100-389 | | Signal Definitions | |
| 100, bit 0-4 | Signal 1, Type | 0 – not used 1 – Hsi 2 3 – Hsi3 4 – Hsi4 5 – Hsi5 6 – HdvM 7 – Dvsi 8 – Fsi2 9 – Fsi3 10 – Repeater 11 – VSI_2 12 – VSI_rgb 13 – VFSI 14 – VTSI 15 - SI 20 – TGOJ UT 3 | Dvärgsignaler version 3 TGOJ from version 6 Stopplykta from version 9 |
| 100, bit 7 | Signal 1, Startup default | 0 – STOP 1 – GO | 2 |
| 101, bit 0-5 | Signal 1, first LED | First LED used for this signal value 1-64 | |
| 102, bit 0 | Signal 1, Short way | | 3 |
| 102, bit 1-3 | Signal 1, Direction Control | 0 – "Not used" 2 – "Direction 1, West to East" 3 – "Direction 1, East to West" 4 – "Direction 2, West to East" 5 – "Direction 2, East to West" 6 – "Direction 3, West to East" 7 – "Direction 3, East to West" | |
| 102, bit 4-5 | Signal 1, Intensity Bank Number | The intensity bank used for this signal. | |
| 102, bit 6 | Signal 1, Combined with next | Signal 1 is also using the space for the next signal | |
| 102, bit 7 | Signal 1, Combined with previous | Read Only! Space is used by the previous signal | |

| | | | |
|-------------------|---|--|--|
| 103 | Signal 1, Next Signal | If this signal should show aspect depending on the next signal, tis is the address of the next signal. | |
| 105 | Signal 1, Diverging Switch 1 | Address to a diverging switch that should affect the state of this signal. | |
| 106, bit 7 | Signal 1, Set Diverging 1, Use switch order | Defines if the decoder listens passively to this address (the address is handled by some other decoder) or if this address should be fully handled with feedback etc. Default is "No". "Yes" is used e.g. if the signal is of the type "Dwarf signal". 0 - "No, react on normal feedback" 1 - "Yes, handle feedback" | |
| 107 | Signal 1, Diverging Switch 2 | Address to a diverging switch that should affect the state of this signal. | |
| 108, bit 7 | Signal 1, Set Diverging 2, Use switch order | See SV 106 bit 7 | |
| 109 | Signal 1, Diverging Switch 3 | Address to a diverging switch that should affect the state of this signal. | |
| 110, bit 7 | Signal 1, Set Diverging 3, Use switch order | See SV 106 bit 7 | |
| 111, bit 0 | Signal 1, Set GO 1, Logic | The logic connection of this condition to the previous condition 0 – OR 1 – AND | |
| 111, bit 4 | Signal 1, Set GO 1, Type | Type of unit that sends feedback on this address 0 - "Not used" 1 - "Sw status" 2 - "Occ sensor" 3 - "SE" 4 – Extra rule | |
| 112-113, bit 0-12 | Signal 1, Set GO 1, Address | Address (or rule number) that should affect GO for this signal | |
| 113, bit 6 | Signal 1, Set GO 1, Status | The value of the feedback that should give GO 0 - "Thrown/0" 1 - "Closed/1" | |
| | | | |
| 113-128 | Signal 1, Set GO 2-6 | GO conditions 2-6 in the same way as previous Sv's | |
| 129-389 | Signal 2-10 | Definitions for signal 2-10 | |
| | | | |
| 400- | EXTRA RULES | 5 extra rules with 6 conditions each that can be used in GO rules | |
| 400, bit 0 | xRule 1, Set GO 1, Logic | The logic connection of this condition to the previous condition 0 – OR 1 – AND | |
| 400, bit 4 | xRule 1, Set GO 1, Type | Type of unit that sends feedback on this address 0 - "Not used" 1 - "Sw status" 2 - "Occ sensor" 3 - "SE" | |

| | | | |
|------------------|---|---|---|
| 401, bit 0-11 | xRule 1, Set GO 1, Address | Address (or rule number) that should affect GO for this signal | |
| 402, bit 6 | xRule 1, Set GO 1, Status | The value of the feedback that should give GO 0 - "Thrown/0" 1 - "Closed/1" | |
| 403-418 | xRule1, Set GO 2-6 | Conditions 2-6 in the same way as previous Sv's | |
| 420-498 | xRule 2-5 | Same as 400-218 | |
| | | | |
| 500-519 | Slave signal | 2-light signals that follow the aspects of other signals | |
| 500, | Slave 1, type | 0 – Not used 1 – 2 light signal | |
| 501 | Slave 1, first LED | First LED used for this signal 0-63 (0 for LED 1, 1 for LED 2, etc) | |
| 500, bit 4-5 | Slave 1, Intensity Bank Number | The intensity bank used for this signal | |
| 502-503 | Slave 1, main signal address | Address of signal to follow | |
| 504-519 | Slave 2 – 4 | Same as 500-503 | |
| | | | |
| 550 - 568 | Direction Dependency Detection | | 8 |
| 550 | Start Address | First Address of messages for Direction dependent occupancy. The rest of will be address+1, address+2 etc. | 8 |
| 552 | Delay Free Status | Delay of the acceptance for transision between "Occupied" and "free". Value is number of 0.1 seconds. | 8 |
| 553 | Direction dependant status 1: Address A | The address of the first normal detection that this direction dependency will be based on. | 8 |
| 555 | Direction dependant status 1: Address B | The address of the second normal detection that this direction dependency will be based on. | 8 |
| 557-567 | | Address A and B for direction dependen detectors 2-4, in the same way as 553 and 555. | 8 |
| | | | |
| 600-699 | Trigger rules | | |
| 600, bit 1-4 | Rule 1, Signal number | The signal number, whitin this decoder, that is controlled, 1 till 10. 0 – no signal 1-10 – signal number | 2 |
| 600, bit 5 | Rule 1, State | The state that should be used when the condition is met. 0 – STOP 1 – GO | 2 |
| 601, bit 0 | Rule 1, statement 1, Logic | 0 – OR 1 – AND | 2 |

| | | | |
|---------------------|---|--|---|
| 601, bit 1 | Rule 1, Statement 1, Status | 0 – Thrown/0 1 – Closed/1 | 2 |
| 601, bit 2-4 | Rule 1, Statement 1, Type | 0 – not used 2 – Switch Status 3 – Sensor | 2 |
| 602,603 | Rule 1, Statement 1, Address | Address of Switch/Occupancy sensor | 2 |
| 604-607 | Rule 1, Statement 2 | Same as 601-603 | 2 |
| 608-609 | Rule 1, Statement 3 | Same as 601-603 | 2 |
| 610-699 | Rule 2 – Rule 10 | Same as 600-609 | |
| 700-725 | Signal Selectors | | 9 |
| 700,701 | SigSelect Start address | Address of first signal selector. Next signal selector will have this address +1, etc | 9 |
| 702,703 | SigSelect 1, Switch Address | Address of switch that will be the selector | 9 |
| 704,705 | SigSelect 1, Thrown Signal Address | Address of the signal when switch is in THROWN state | 9 |
| 706,707 | SigSelect 1, Closed Signal Address | Address of the signal when switch is in CLOSED state | 9 |
| 708-725 | | Same as 702-707, but for Signal Selector 2-4 | 9 |
| | | | |
| 800-859 | Special Signal Controls | For the control of extra features on more complicated signals | 9 |
| 800 +801 bit 0-4 | Signal 1, Control 1, Address | The address that should be used for this control. | 9 |
| 801 bit 5 | Signal 1, Control 1, Generate feedback | Specifies whether the signal decoder is passively listening to this address (the address is used by another feature), or if it handles this address and sends feedback. Normal setting is “No”. 0 - “No, react on normal feedback” 1 - “Yes, handle feedback” | 9 |
| 801 bit 6 | Signal 1, Control 1, State | Specifies which state the control should be activate on. | 9 |
| | Signal 1, Control 1, Force view | Indicates whether the control is to be forced out independently of rules and the like. | 9 |
| 802-803 | Signal 1, Control 2 | The same as 800-801, but for control 2. | 9 |
| 804-805 | Signal 1, Control 3 | The same as 800-801, but for control 3. | 9 |
| 806-859 | Signal 2 – Signal 10 | The same as 800-805, but for signals 2-10 | 9 |
| | | | |

| | | | |
|-----|-----------------|---|----|
| 900 | RGB color order | When RGB led used, the order that the colors some as. 0 – RGB 1 – GRB 2 – RBG 3 – GBR 4 – BRG 5 – BGR | 10 |
| | | | |

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.