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

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
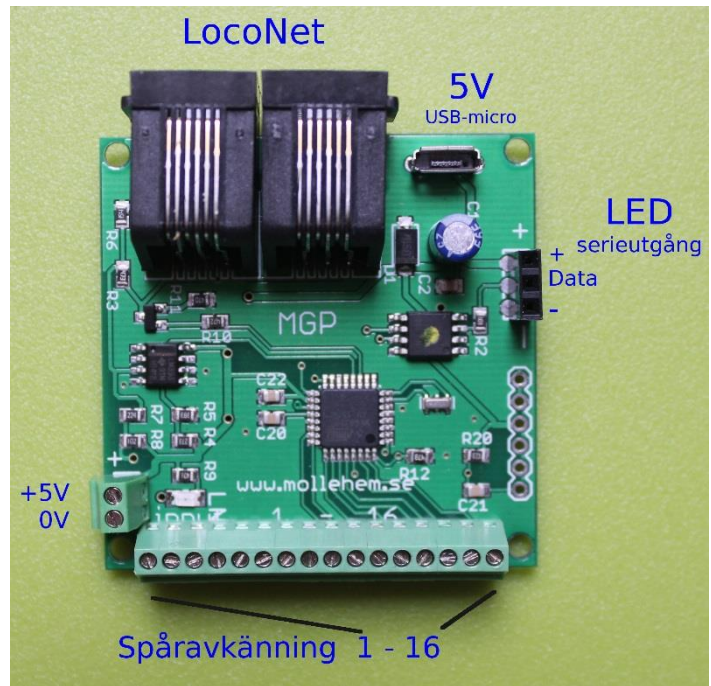
The signals are connected to LED driver cards and the driver card are connected in serial to the decoder. The cable used is the same as for extension cables for servos.
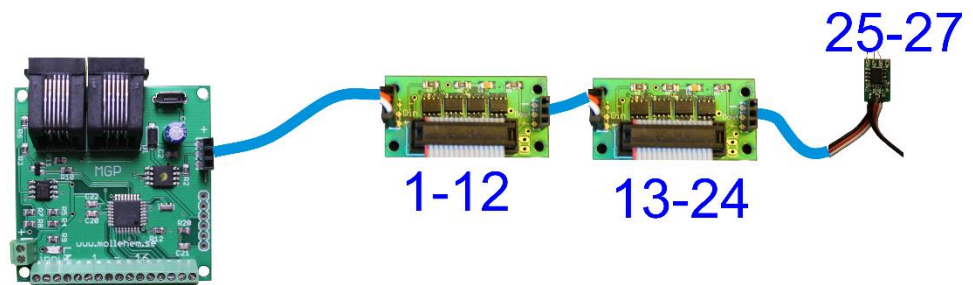
The LEDs of each signal should be connected to the driver card in continuous numerical order in order how the LEDs are place on the signal, from upper left to the right, and down. The LED placed to the top left will get the lowest number.
On the signal VSI, the white and red light is placed on the same 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 affect 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" erc.
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.
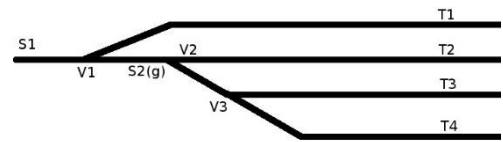
For S1 this will hide tracks T2-T4 and instead the rule of S1 can be based on the state of S2.
The logic for S1 will then be, GO is allowed only when "V1/Thrown AND T1/free OR V1/Closed AND S2".

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

.
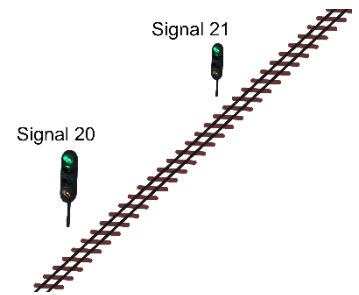
1.6.1   DISTANT SIGNAL SELECTORS

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.

Note that the signal selector will appear as a signal and can be used by other functions as a signal.
That means that signal selectors can be cascaded, so if there are e.g. three distant signals that should be selected from due to the state of two turnouts.

So, if we add one track to the previous example and the signal 23. To have the signal 20 pre signal any of signal 21-23, we need two "Distant Signal Selector".

One "Distant Signal Selector" selects between signal 22 and 23 based on turnout 101 (green area in the figure). Let's give this selector address 801. Another selector will select between 21 and 800 based on turnout 100 (yellow area). This selector could get the address 800.

So then the signal 20 can have 800 as "Next signal" and that will be any of the signals 21-23 based on the state of turnout 100 and 101.
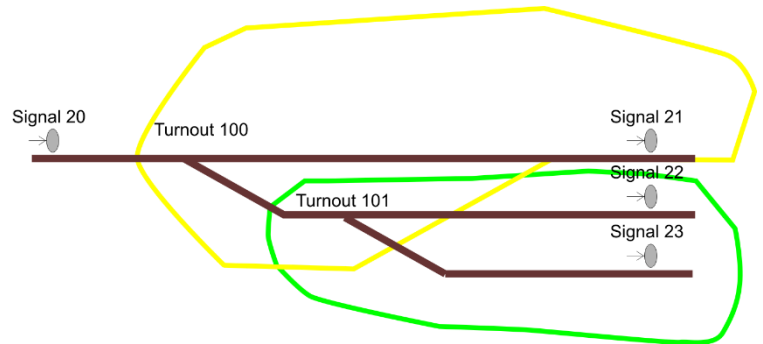
1.7   DIRECTION DEPENDENCY

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 programing 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 though 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 then 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 four such additional control functions that can be switched on or off. Note that 4 controll is in decoders version 12 and for decoders up to version 11 the number of controls are 3.
Only a few signals use these functions - see the signal table.

These control functions are switched on and off via addresses specified for each control. These addresses can be of type turnout, Track status, Signal status and "Extra Rule". They can also be set to be a constant setting not changeable from the outside.

If the address used is of type "Turnout", the functions respond to the feedback message from the turnout message, ie the state of a turnout or signal can be used for control.
As it is the feedback message that normally controls the functions, 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".

For addresses of type Signal messages, the state of the feedback is controlled by "STOP" on one hand, and "any kind of GO" on the other.

For an address of type "Extra Rule", it is the number of the extra rule that go into the address, 1-5.
In the extra rule more complex logic can be placed and so it will control the state of the control function.

If the type is set to Static, then the value that is set for default value will be the permanent setting for the control function.
Which state activates the function is specified in the "State" setting.

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.
Decoders from version 13 double inputs for switch status, and support for "wire connected module signaling".

1.13.1 ELECTRICAL CONNECTION FOR INPUTS

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".

1.13.2 ADDRESSES FOR INPUTS

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.

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.

1.13.3 FEEDBACK FOR TRACK OCCUPANCY

A common use for the of inputs are for track occupancy.
To the inputs, any of the MGP track occupancy sensors, can be connected. The decoder will see track occupancy messages on to the LocoNet.
SV33, "Input type" should be set to "Occupancy Sensor".

1.13.4 FEEDBACK FOR SWITCH STATUS

MGP's decoders for switches, always reports the state of the switches. That means that control panels, computers, signals etc. always know the real state of a switch.

On a layout, older types of switch motors and decoders could exist, e.g. DCC decoders. If the switch motors have some kind of state connection, this connection could be connected to the signal decoder and the signal decoder will relay that information on LocoNet as switch status messages.

One input per switch could be used and then the signal decoder will report Closed and Thrown depending on the state of the input.
In this case the SV33, "Input type" should be set to "Switch feedback".

If the switch motor has double state connections that gives information when the switch has reached its end state, then two inputs has to be used for each switch. One input will generate the message for CLOSED and the other THROWN.

When the switch is moving between the states, the decoder will report "Unknown state"

For double inputs the SV33, "Input type", should be set to "Double switch status".

1.13.5 WIRE BASED SIGNAL SYSTEM FOR MODULES (WBS)

Within a number of module groups, a wire-based system has been developed to be able to build independent block divided lines between stations on the module path.

Such stations / block sections are connected one after the other with a multi-wire cable. No addresses are used for signals and track detection. Instead the sections are connected through a cable and signaling between the parts works based on the sections position on the cable.

The cable contains 5 wires plus ground where the use is, two with information from neighboring signal, two where this unit sends out information about its own signal, and one wire indicating the track occupancy state for the line between this unit and the next.

6 wire cable to next module

6 wire cable to next module
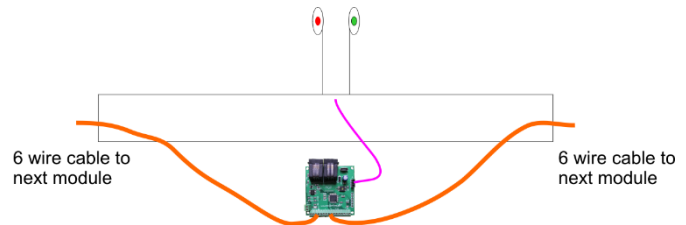
To use the inputs in this way, SV33, "Input type" must be set to "Wired signal set".
The number of inputs to be used is 5, 10 or 15.

One group of wires connected to the decoder use the inputs in this order:

1. Input, remote signal information – Go
2. Input, remote signal information – Go Slow
3. Output, local signal information – Go
4. Output, local signal information – Go Slow
5. Input, track Occupancy

Go
Go Slow
Go
Go Slow
Track Occupancy

Go
Go Slow
Go
Go Slow
Track Occupancy

In the image to the right, two groups are connected, one for each side of the block module.
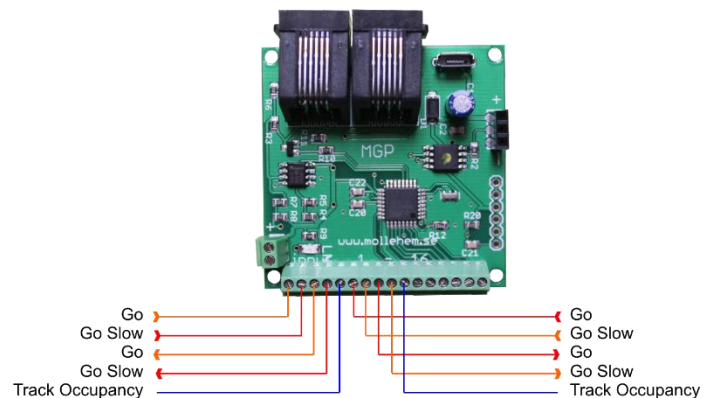
1.13.5.1 WBS: SETTINGS IN THE DECODER FOR WIRE BASED SIGNALLING

The input type is specified as "Wire based signaling " and the number of inputs used is set to 5, 10 or 15 depending on how many groups are used.

Start address is specified and this becomes the address used by the remote signals, ie the signal from group 1 gets "start address", the signal in group 2 gets "start address +1", etc.

The remote signal can now be used in the decoder under this address and local signals can use the as the "next signal, and it can be used in rules etc.

The connected track indication will be available under the same address, ie the track occupancy from group 1 gets "start address", the track occupancy from group 2 gets "start address +1", etc.

Note that the remote signals and track occupancy indication are available on the LocoNet where the decoder is connected with these addresses and can thus be used in control panels, other signals etc.

Two of the wires (3 and 4) are outputs that send information about local signals to the wire connection.
The address of the signal to be connected to the outgoing wires is stated in "Outbound wired signals". Here, the LocoNet address of the local signal is specified, which means it may be a either a signal on the local decoder, or some other signal on the connected LocoNet.

1.13.5.1 WBS: CONNECTION OF OCCUPANCY DETECTOR

The fifth wire in each group indicates the occupancy state of the track between the block modules.

This wire should use a track detector of the type that connects the wire to "GND" during occupancy (so-called "open collector").

Several detectors can be connected to the same wire, e.g. if many modules with their own track detection are connected between two block modules.

1.13.5.2 WBS: CONNECTIONS WITH THE "MSS-STANDARD"

MSS is a "standard" used within some module groups.

The picture to the right shows the connection in the decoder with the naming according to this "standard".

"**Go**" then is mapped to "**Approach**",
"**Go Slow**" to "**Advanced Approach**" and
"**Track occupancy**" to "**Local**".

Advanced App - >4   6<- Advanced App
Approach - >3   7<- Approach
Local - >5   10<- Local
Approach - >1   8<- Approach
Advanced App - >2   9<- Advanced App
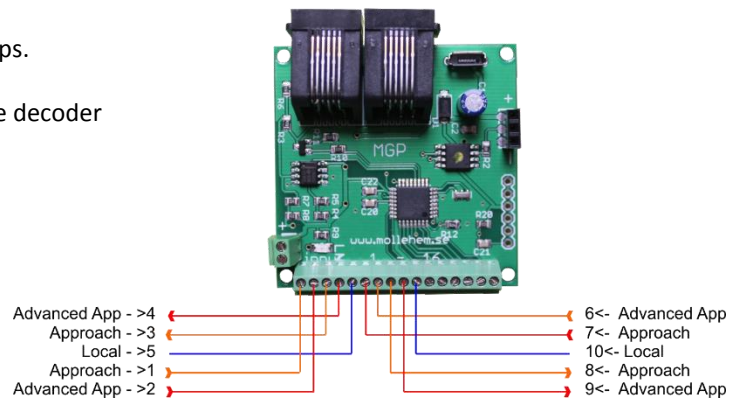
1.14 DIRECTION DEPENDANT OCCUPANCY DETECTION

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	Special 4	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						From version 12, use the "Main dwarf" signal instead.
Dwarf signal	Dvsi	7	4		Movement allowed Track not clear	Movement allowed Check Points and clearance			
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		Movement allowed	Movement allowed Track not clear	Movement allowed Check Points and clearance		Shunting signals only when signal is in STOP state

2.2   DANISH SIGNAL DECODER

Description	Token	Value	Num of leds	RGB	Special 1	Special 2	Special 3	Special 4	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		Turn GO lights OFF				
Dværgsignal	Dv-signal	15	4		Careful movement allowed	Signal not in action			
Perron-Udkørselssignal	PU-signal	14	6		Movement allowed	Careful movement allowed	Signal not in action	Use RED for stop	Shunting signals only when signal is in STOP state
Stopsignal		10	1						

2.3   NORSK SIGNALDEKODER

Description	Token	Value	Num of leds	RGB	Special 1	Special 2	Special 3	Special 4	Comment
Main signal 2 lys,	Hsi2Ytter	2	2						
Main signal 2 lys, inside of station	Hsi2Indre	3	2						
Main signal 3 lys,	Hsi3Ytter	4	3						
Main signal 3 lys, inside of station	Hsi3Indre	5	3						
Main signal 4 lys,	Hsi4Ytter	12	4						

Main signal 4 lys, inside of station	Hsi4Indre	13	4					
Main signal 5 lys,	Hsi5Ytter	10	5					
Main signal 5 lys, inside of station	Hsi5Indre	11	5					
Distant signal, 2 lights	Fsi2	6	2					
Dværgsignal	Dv-signal	7	4		"Varsom kjøring tillatt"	"Frigitt for lokal skifting"	"Frigitt for lokal skifting"		
Repetition signal	Rep1	8	1					
Repetition signal	Rep2	9	2					
Stopsignal		14	1					

2.4   GERMAN SIGNAL DECODER

Description	Name	Value	Num of leds	RGB	Special 1	Special 2	Special 3	Special 4	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.2.4.1 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.2.4.1 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.2.4.1 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.2.4.2 for LED numbering

2.4.1 KS SIGNALS, NUMBERING OF LEDS
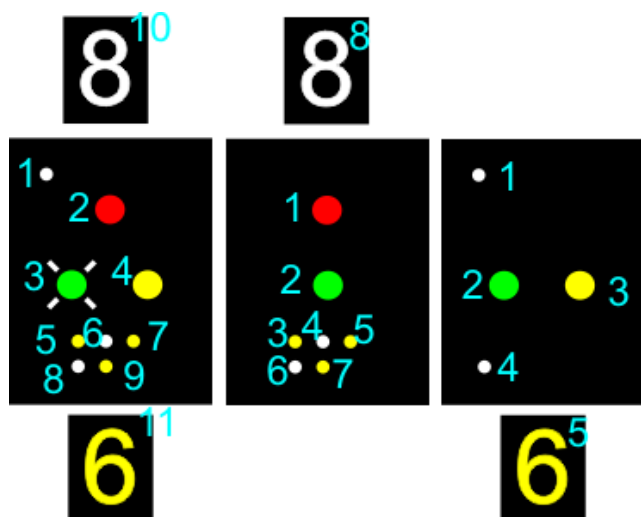
2.4.2 H/V EINFAHR COMBINATION, NUMBERING OF LEDS
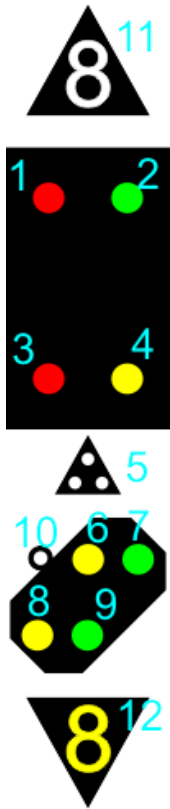
2.5 CZECH SIGNAL DECODER

Description	Name	Value	Num of leds	RGB	Special 1	Special 2	Special 3	Special 4	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		2		Shunting allowed, White-ON				
Distant signal, 2 lights, Y/G	Cz Distant		2						

Stop signal, 1 light1	Cz StopLight		1						From version 11
Railway crossing, signal against road	Cz RoadCrossing		3						From version 11

2.6   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	Special 4	Comment
Stop signal, 1 light	SigPic Us stop		1		Turn of lights				
Burlington Northern, 1 head, 3 lights	SigPic Us BN shGYR		3		Turn of lights				
Burlington Northern, 2 head, 2*3 lights	SigPic Us BN dhGYR		6		Turn of lights				
Burlington Northern, 3 head, 2*3 lights	SigPic Us BN thGYR		9		Turn of lights				
Burlington Northern, 1 head, Searchlight	SigPic Us BN shSL		1	RGB	Turn of lights				
Burlington Northern, 2 head, Searchlight	SigPic Us BN dhSL		2	RGB	Turn of lights				
Burlington Northern, 3 head, Searchlight	SigPic Us BN thSL		3	RGB	Turn of lights				

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 Addressen+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 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"	
403-417	xRule1, Set GO 2-6	Conditions 2-6 in the same way as previous Sv's	
420-489	xRule 2-5	Same as 400-218	
500-515	**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	
504-515	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 transition 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
557-568		Address A and B for direction dependent 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, within 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 0-3	Signal 1, Control 1, Address	The address that should be used for this control.	9
801 bit 4	Signal 1, Control 1, Default State	Defines the state that the control should have at system start up.	12
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
801 bit 7	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
806-807	Signal 1, Control 3	The same as 800-801, but for control 4.	12
808 bit 0-3	Signal 1, Control 1, Address Type	Controls the meaning of the address: 0 – Not used 1 – Turnout status 2 – Track status 3 – Signal status 4 – Extra rule 5 – Permanent	12
808 bit 4-7	Signal 1, Control 2, Address Type	Controls the meaning of the address: 0 – Not used 1 – Turnout status 2 – Track status 3 – Signal status 4 – Extra rule 5 – Permanent	12
809 bit 0-3	Signal 1, Control 3, Address Type	Controls the meaning of the address: 0 – Not used 1 – Turnout status 2 – Track status 3 – Signal status 4 – Extra rule 5 – Permanent	12

809 bit 4-7	Signal 1, Control 4, Address Type	Controls the meaning of the address: 0 – Not used 1 – Turnout status 2 – Track status 3 – Signal status 4 – Extra rule 5 – Permanent	12
810-899	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.