Kuehn

NMRA-DCC/Motorola Universal Switch decoder WD10

The switch decoder WD10 is used to switch points (twin solenoid), signals, uncouplers, light signals (two or more lights), lighting and other consumers. The WD10 is a multi-protocol decoder and can be used with controllers that support the Märklin-Motorola-format (e.g. 6021), and DCC controllers (e.g. Lenz, Multimaus)

Technical data and features:

- in DCC-format 2044 addresses
- in Motorola-format 320 addresses
- in total 16 transistor outputs (e.g. for 8 points or block signals)
- RailCom® (bidirectional communication, only in use with DCC
- Power from the digital controller or external AC or DC power unit
- simple choice of address and operation mode by internal programming button
- programmable on the program track of the DCC controller
- programmable in built-in state through programming on the main
- selectable light (shadowing) effects for light signals
- minimal power   12 V
- maximum power (AC)   16 V
- maximum power (pure DC)   24 V
- maximum current per switch output   1,0 A
- maximum current per output group (group A or B)   1,0 A
- maximum total current   1,8 A
- working temperature   0 to 60°C
- measurements (in mm, without assembly points)   ca. 83 x 60 x 25

Important note: The decoder is only provided for use in model railway layouts in dry rooms. The use of the decoder is only permitted under supervision. The extra power supply has to be a model railway transformer, that will switch of by a short circuit to prevent fire. The connection of the decoder is only allowed in powerless mode.

Content

1.   Safety measurements

This product is not a toy! Not recommended for children under 14 years. **Not
suitable for children under 3 years due to small parts that can be swallowed!**
Improper use may result in injuries because of sharp edges and tips. Please keep
this manual for later use. Only use this decoder in electrical model railway layouts.
Another application is not allowed

2.   Functions of the switch decoder WD10

2.1.   Digital formats

The decoder automatically detects the digital formats DCC and Motorola. On delivery, the outputs of group A are assigned to the point addresses 1 to 4 and the outputs of group B to the point addresses 5 to 7.

2.2.   Switch outputs

The decoder has 16 switch outputs for connecting points (dual solenoid), signals, uncouplers, light signals (two or more signal images), lighting etc.. The outputs are divided into two groups (A and B) with 8 outputs each. For each group, the digital address and the type of consumer (mode) can be set.

2.3.   Power

The power can be supplied completely by either the digital system or a separate power unit (transformer). The digital inputs are galvanically separated from the external power input by opt couplers.

2.4.   Operation

The switch decoder WD10 supports two setting procedures by the user. On the one hand, the decoder address and the mode (e.g. points, light signals, lighting) can be set for each output group by the programming button.

Furthermore settings can be made on the programming track of your digital controller. For example can the switching time be changed, outputs can be set to flashing mode for railway crossing lights and much more... These settings also can be changed or adapted when installed by programming on the main (POM).

2.5.   RailCom®

RailCom® is a technique for transmitting information from the decoder to the digital controller in DCC mode (CV content after POM command). By default RailCom® is activated, the transmission takes place only when the digital controller is providing the right signal. In Motorola the RailCom® mode is not used.

3.   Installation of the decoder

3.1.   Connections and controls

The decoder has 16 switch outputs divided in two groups (A and B) with 8 outputs each.

The connection points **ext.Pow** are used to connect the power supply (transformer connection).

The digital information is received by the decoder over the **Digi-In** connections. Should the points be operated by local buttons then the **GND**-connections come in use.

There is a sunken pushbutton in the housing to set the decoder address.

The LEDs of the output groups are showing the program step or the error message of the switch decoder.
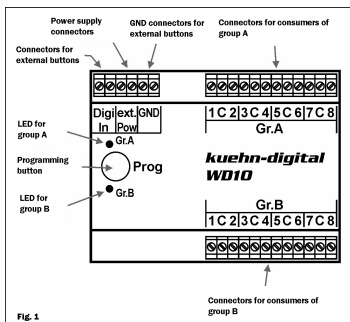
Fig. 1

3.2.   **Power from the digital controller**

The easiest way to connect the power is from the digital system. However „expensive" digital power is consumed in this mode. Connect the connections **DIGI_IN** with the connections **ext.Pow** (external Power) according to figure 2.

Fig. 2

This type of connection is definitely required for **programming** on the program track of your digital controller! Depending on the controller, it may be necessary to use a resistor 0f 33 Ohm in the power line (See figure 2a).

Fig. 2a

3.3.   External power supply

By many consumers that need a lot of energy an external power supply for the switch decoder is recommended. This prevents the use of „expensive" digital current. Use only suitable power supplies (e.g. model railway transformers). The decoder will receive the switch commands of the digital controller through the

connections **DIGI_IN**. The external power supply is connected to the connections **ext.Pow** .

Fig. 3

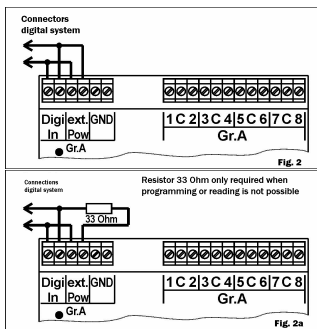**Hint: Connecting the GND-connections on the power is not allowed and can cause damage of the WD10!**

3.4. Connection of consumers

You can connect different consumers to the switch decoder. Both the output groups A and B behave identically.

Fig. 4

Connecting dual solenoid points:
The common wire of the solenoid has to be connected with C. The other two wires of the solenoid are connected left and right of C (see figure 4). Is the position of the point not according to the button pressed, exchange both wires of the solenoid.

Connecting light signals with bulbs: The common wire of the light signal has to be connected with C. The other two wires of the bulbs are connected left and right of C (see figure 4).

Connecting light signals with LED: The common wire of the light signals has to be connected with C. This connector has a positive potential, which means that the anodes of the LED have to be connected to C. The LED should never be connected directly. You need a series resistor! Check if your signal already has one built-in.

Connecting point motors: Motorized points cannot be connected directly to the decoder. Use either a toggle relays or an adapter for motorized points (MA10).

3.5. Switching of consumers

The control of the switch decoder is varies a lot from controller to controller, please read the manual of your digital controller.
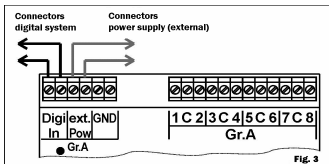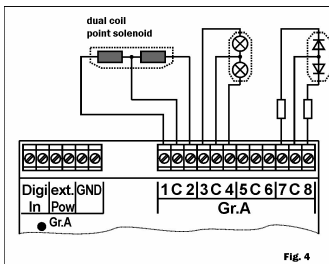
4. Decoder settings

4.1. General instructions of the settings

The switch decoder WD10 has two output groups with 4 connection pairs each (in total 8 connections per group). Very often these output pairs are used for switching points – one connection sets the point to straight the other connection to branch. These connection pairs are addressed under their point numbers over the digital controller. To set a connected point, the switch decoder must be set to the number of the point. Each output group of the decoder includes 4 consecutive point numbers. The number of this „group of four" corresponds with the decoder address. In the table below you will find an example of the assignment of point numbers to a decoder address (CV#1 for group A and CV#35 for group B) for the first 40 point numbers:

Point number	Decoder address	Point number	Decoder address
1,2,3 and 4	1	21,22,23 and 24	6
5,6,7 and 8	2	25,26,27 and 28	7
9,10,11 and 12	3	29,30,31 and 32	8
13,14,15 and 16	4	33,34,35 and 36	9
17,18,19 and 20	5	37,38,39 and 40	10

Hint	At the Multimaus (ROCO) and Lenz *compact* version 3.0 the point numbers associated with the decoder address are always one down, e.g. point 5 is associated with decoder address 1.

4.2. Operation modes of the switch decoder

The switch decoder WD10 can for the most used applications very easily be set by the selection of operation modes.
If you want to make additional adjustments for your desired performance, set the user-mode (mode 1). Thereby you will have full access to the many adjustments of the WD10 through DCC programming. The setting of the operation mode is either be done by the programming button (see next chapter) or by programming the registers with your DCC controller.
On delivery the operation mode is set to 2. The outputs are driven in pairs (e.g. switching points). Regardless the duration of the activation of the point button, the output will shut down after 0,064 seconds, to protect the solenoid) (factory settings). A renewed push on the button is only possible after 0,5 seconds.

Mode	Description	Similar to
1 (5)*	**User mode:** All settings can be done through the configuration register, e.g. changing switch times, operate barriers and barrier lights, etc.	-
2 (6)*	**4 output pairs on pulse output,** output remains active according the timer settings (factory set 0,064 seconds) regardless the duration of the pressing of the button	Lenz LS100 **(standard)**
3 (7)*	**4 output pairs on pulse output,** output stays active as long as the button is pushed or until the controller switches of automatically	Märklin® K83
4 (8)*	**4 output pairs on continues operation,** available for, per example, two light signals without soft light change or other continuous consumers (no layout power switchable, therefore use an external relays)	Märklin® K84 **Other wiring !**
5 (9)*	**Light mode** depending on the command different light-effects are made for construction sites or billboards (see chapter 6).	-
6 (10)*	**Light signals with two signal images (block signals)** You can connect 4 light signals with two signal images per output group. The signal will prototypically light up and dim.	-
7 (11)*	**Light signals with max. 4 signal images** You can connect 2 light signals with 4 signal images per output group. The signal will prototypically light up and dim.	
8 (12)*	**NS-light signals with max 4 signal images** From „red" to „green" will be prototypically switched over „yellow". The lamps will prototypically light up and dim.	

*) **Hint**	For the Multimaus and Lenz *compact* version 3.0 use a 4 higher switch number to set the mode with the programming button, e.g. for mode 5 (light mode) switch point 9.

4.3.   Set up by programming button

The switch decoder can be set to the most important applications very easily and without extensive programming on the programming track, using the integrated

programming button. You can set the decoder address and mode for each of the two output groups (A and B) separately. This method has to be used if you are using a digital controller with only the Motorola format (e.g. 6021).

The decoder will go through the programming mode in 5 steps after entering the set mode (steps 2 to 6 in table below). You can skip each of the set points by pressing the programming button and move to the next input. In this way e.g. it is possible to change only the mode of group B without reprogramming all the other settings.

Step	Input	LED Gr. A	LED Gr. B
1.	Start set up	lights up	lights up
2.	Input point address group A	lights up	out
3.	Set up mode group A	flashes	out
4.	Input point address group B	out	lights up
5.	Set up mode group B	out	flashes
6.	Reset the switch decoder	flashes	flashes

Set up step by step:

1. Connect the switch decoder with the power. Press the programming button for a few seconds until the LED of group A and the LED of group B light up.

2. Release the programming button – only the LED of group B will light up. The decoder is waiting for the input of the decoder address. Select on your digital controller which point number you want to switch with the first output of group A of the WD10. Turn the selected point in any direction. For all the outputs of group A the point numbers will be assigned automatically.
   Hint: during set up: do not connect a point to the switch decoder.
   If the decoder understood the address for group A, the LED of group A and the LED of group B will illuminate for approximately 3 seconds.

3. Now the LED of group A flashes. The decoder is waiting for the input of the operation mode for group A. Select a point number that corresponds with the number of the desired operating mode. (users of the Multimaus and the Lenz compact version 3.0 use the numbers between the brackets) and switch this point once. If the decoder understood the inputs for the operation mode of group A the LED of group A and the LED of group B will illuminate for approximately 3 seconds.

4. On the WD10 the LED of group B illuminates and the decoder is waiting for the input of the decoder address. Select on your digital controller the point number, which you want to operate with the first output of group B of the WD10. Switch the selected point in any direction. For all the outputs of group

A the point numbers will be assigned automatically..
If the decoder understood the address for group B, the LED of group A and the LED of group B will illuminate for approximately 3 seconds.

5. Now the LED of group B flashes. The decoder is waiting for the input of the operation mode for group B. Select a point number that corresponds with the number of the desired operating mode. (users of the Multimaus and the Lenz compact version 3.0 use the numbers between the brackets) and switch this point once. If the decoder understood the inputs for the operation mode of group B the LED of group A and the LED of group B will illuminate for approximately 3 seconds

6. Now the LED of group A and the LED of group B are flashing simultaneously. If you **don't** want to perform a reset, then press the programming button and both LEDs will go out. The switch decoder is ready to use.
    Switch point 8 on your digital controller and the decoder will be set to the factory settings. Users of the Multimaus and the Lenz compact version 3.0 have to use point 12 for a reset. Other point numbers will not perform a reset..

4.4.   Set up by DCC-programming

The **kuehn** – decoder WD10 can be adjusted to the desired performance by programming the so called configuration variables (CV's). Follow the instructions in the manual of your digital controller during DCC programming. Programming on the program track can be performed by *Physical Register Addressing*, *Paged CV Addressing* or *Direct Mode Addressing*. In programming mode only certain CVs can be addressed.

All configuration variables of the **kuehn** – switch decoder (except the addresses) can also be changed, when installed, with *Operation Mode Programming*. Depending on the capabilities of your digital controller, you can access the WD10 under his point-decoder address or under, only for programming, the used locomotive address („help"-address).

Programming with „old Arnold controller" (identical to Märklin Digital = art. nr. 6027): With digital controllers that use the programming mode *Physical Register Addressing* only the registers R1 to R5 can be programmed. Addresses and registers that contain a value of 0 can be programmed but not be read. The range of values for these controllers lies between 1 and 99, therefore their use for programming the decoder is limited.

Programming with the controller *compact* by Lenz : with digital controllers version 3.1 you only can program the registers R1 to R6. With the newer version you can program and read all CV's.

Programming with Märklin® „Control Unit" 6021 or Märklin® „Mobile Station"
(controllers without DCC data format)
With digital controllers, that only support the Motorola data format you cannot adjust the extended settings of the configuration variables. In this case use the quick adjustment of the decoder by the programming button. Does your „Mobile Station" support the DCC format, so take advantage of this for a comfortable setting of the decoder.

4.5.   Reset the decoder

Decoder – reset: If you lost track after programming your decoder and you wish to reset de decoder on factory settings, please program a value of 8 in CV#8.

4.6.   List of the configuration variables of the decoder

CV-nr.	Meaning	Value	Factory value	Your value
CV#1	Basic address part 1 group A	0...63	1	
CV#3	Timer output 1,2 group A	0...255	0	
CV#4	Timer output 3,4 group A	0...255	0	
CV#5	Timer output 5,6 group A	0...255	0	
CV#6	Timer output 7,8 group A	0...255	0	
CV#7	Version number	-	>37	
CV#8	Manufacturer number	-	157	
CV#9	Basic address part 2 group A	0...7	0	
CV#17	POM address, part 1	192...231	192	
CV#18	POM address, part 2	0...255	0	
CV#28	RailCom settings	0, 2	2	
CV#29	Configuration register	0...40	8	
CV#35	Basic address part 1 group B	0...63	2	
CV#36	Basic address part 2 group B	0...7	0	
CV#53	Fade down time	0...15	7	
CV#54		0	0	
CV#55	Fade up time	0...15	15	
CV#56	Dimmer brightness	0...15	15	
CV#57	Operation mode group A	1...8	2	
CV#58	Operation mode group B	1...8	2	
CV#59	Timer output 1,2 group B	0...255	0	
CV#60	Timer output 3,4 group B	0...255	0	

CV-nr.	Meaning	Value	Factory value	Your value
CV#61	Timer output 5,6 group B	0...255	0	
CV#62	Timer output 7,8 group B	0...255	0	
CV#63	Speed chase light	0...255	64	
CV#64	Flash & Strobe speed	0...255	1	
CV#127	Sub version software		>=1	
CV#128	Effect output 1, group A	0...255	1	
CV#129	Effect output 2, group A	0...255	1	
CV#130	Effect output 3, group A	0...255	1	
CV#131	Effect output 4, group A	0...255	1	
CV#132	Effect output 5, group A	0...255	1	
CV#133	Effect output 6, group A	0...255	1	
CV#134	Effect output 7, group A	0...255	1	
CV#135	Effect output 8, group A	0...255	1	
CV#136	Effect output 1, group B	0...255	1	
CV#137	Effect output 2, group B	0...255	1	
CV#138	Effect output 3, group B	0...255	1	
CV#139	Effect output 4, group B	0...255	1	
CV#140	Effect output 5, group B	0...255	1	
CV#141	Effect output 6, group B	0...255	1	
CV#142	Effect output 7, group B	0...255	1	
CV#143	Effect output 8, group B	0...255	1	
CV#144-159	Setting the switch level of the used outputs	0...255	see table	
CV#160-175	Validity mask of the outputs to the switch commands	0...255	see table	

4.7.   Description of the configuration register

- **CV#1, CV#9 decoder address group A**: the decoder address of group A is stored in two parts. The decoder address is valid for 4 consecutive point addresses. If the decoder should switch with group 1 the points 1, 2, 3 and 4 enter as decoder address a 1 in CV#1 for the point address 5, 6, 7 and 8 a 2 has to be entered in CV#1, etc.. If the address range of CV#1 is not enough (max. value is 63) CV#9 is also set.. The decoder address is calculated as follows: decoder address = value of CV#9 * 64 + value in CV#1.

- **CV#3 Timer for output 1, 2 of group A**: the content of this CV specifies how long the outputs 1 and 2 remain active after switching on before they are automatically switched off again. The automatic switch-off is used for

protection of your point to prevent burning out. The duty cycle is calculated as follows: duty cycle = value in CV#3 * 0,064 seconds. Is the CV value 0, points with a higher power consumption can be switched (correspondents with factory settings).

In operation mode 1 the timer value for all 8 outputs of the group is equal.

- **CV#4 Timer for output 3, 4 of group A** : description see CV#3
- **CV#5 Timer for output 5, 6 of group A** : description see CV#3
- **CV#6 Timer for output 7, 8 of group A** : description see CV#3
- **CV#7,8** : Here you will find the manufacturer number (*kuehn* – decoder always have the number 157) and the version number of the decoder.
- **CV#9 Part 2 of the decoder address group A:** In CV#1 and CV#9 the decoder address is stored, see description for CV#1.
- **CV#17,18 POM - Address** : the switch decoder can be programmed by CVs also in built-in situation. Since most digital controllers only allow programming on the main track with locomotive decoders, additionally the switch decoder WD10 is able to receive an extended locomotive address for a later programming on the main. The own point address for switching is not affected.
- **CV#28 RailCom-settings**: remark: channel 1 is not used in the WD10.

Bit-Nr.*⁾ Description		Bit-value	CV-value
1	RailCom data in channel 2 do not send	0	0
1	RailCom data in channel 2 send	**1**	**2**

- **CV#29 Configuration register**: defining the fundamental properties of the decoder, e.g. RailCom® on/off and use of extended locomotive address for programming on the main (POM). The CV values of the desired functions must be added and the sum has to be stored in CV#29.

Bit-Nr.*⁾ Description		Bit-value	CV-value
3	RailCom out	0	0
	RailCom on	**1**	**8**
5	**POM- address (CV#17,18) do not use**	**0**	**0**
	POM- address (CV#17,18) use	1	32

  *⁾ By Lenz digital the bits are numbered opposite of the NMRA standard 1 – 8.

⇒*Tip :*   common values for CV#29:

CV#29	Description
0	RailCom out, POM-address not active
8	RailCom on, POM-address not active
32	RailCom out, POM-Adresse active
40	RailCom on, POM-Adresse active

- **CV#35, CV#36 Decoder address group B**: the decoder address of group B is stored in two parts. The decoder address is valid for 4 consecutive point addresses. If the decoder should switch with group 1 the points 1, 2, 3 and 4 enter as decoder address a 1 in CV#35 for the point address 5, 6, 7 and 8 a 2 has to be entered in CV#35 etc.. If the address range of CV#35 is not enough (max. value is 63) CV#36 is also set. The decoder address is calculated as follows: decoder address = value of CV#36 * 64 + value in CV#35.
- **CV#53 Fade down time**: time to fade down the light signal lights (simulation of the afterglow of bulbs).
- **CV#55 Fade up time**: time to fade up the light signal lights.
- **CV#56 Dimmer brightness**: this value adjusts the maximum brightness of the light.
- **CV#57, CV58 :** operation mode group A and B, see page 7
- **CV#59 Timer for output 1, 2 of group B** : description see CV#3
- **CV#60 Timer for output 3, 4 of group B** : description see CV#3
- **CV#61 Timer for output 5, 6 of group B** : description see CV#3
- **CV#62 Timer for output 7, 8 of group B** : description see CV#3
- **CV#63 Speed of the light effect at construction sites/advertising lights**: setting the index speed. This setting applies both for group A and B.
- **CV#64**: Frequency (repetition rate) of the flash effect from the effect registers CV#128 to CV#143
- **CV#127 Software sub version:** this CV is read-only and contains additional information on the software sub version of the decoder (see also CV#7).
- **CV#128 to CV#143 Effects:** by means of this CVs you can set special light effects for the switch outputs (e.g. flashing, strobe, fade down effect, etc.).

CV-nr.	Output	Group	0...128
128	1	A	Light effect:
129	2	A	0: normal ON/OFF (continuous light)
130	3	A	1: Impulse (one pulse)
131	4	A	2: Strobe
132	5	A	4: Flashing phase A
133	6	A	8: Flashing phase B
134	7	A	32: only fade up (only in operation mode 1)
135	8	A	64: only fade down (only in operation mode 1)
136	1	B	128: total brightness (dimmer)
137	2	B	
138	3	B	
139	4	B	

140	5	B	
141	6	B	Hint: in operation mode 1 only fade up or
142	7	B	fade down can be set, however not both
143	8	B	effects simultaneously.

The numerical value of the desired light effect (see right column) is programmed in the appropriate effect register. A value of 0 turns off all the effects of the outputs and only the ON and OFF state are then available. The flashing effects are opposite and therefore usable for an alternating flasher.

- **CV#144 to CV#159 Output level of the switch outputs:** these CVs determine which level (ON or OFF) the switch outputs have, according to the validity mask (see CV#160 to CV#175).

CV-nr.	Output	Outputs of group A							
	(switch command)	8	7	6	5	4	3	2	1
144	1st point red/"-"/➔	128	64	32	16	8	4	2	**1**
145	1st point green/"+"/⬅	128	64	32	16	8	4	**2**	1
146	2nd point red/"-"/➔	128	64	32	16	8	**4**	2	1
147	2nd point green/"+"/⬅	128	64	32	16	**8**	4	2	1
148	3th point red/"-"/➔	128	64	32	**16**	8	4	2	1
149	3th point green/"+"/⬅	128	64	**32**	16	8	4	2	1
150	4th point red/"-"/➔	128	**64**	32	16	8	4	2	1
151	4th point green/"+"/⬅	**128**	64	32	16	8	4	2	1

CV-nr.	Output	Outputs of group B							
	(switch command)	8	7	6	5	4	3	2	1
152	1st point red /"-"/➔	128	64	32	16	8	4	2	**1**
153	1st point green/"+"/⬅	128	64	32	16	8	4	**2**	1
154	2nd point red/"-"/➔	128	64	32	16	8	**4**	2	1
155	2nd point green/"+"/⬅	128	64	32	16	**8**	4	2	1
156	3th point red/"-"/➔	128	64	32	**16**	8	4	2	1
157	3th point green/"+"/⬅	128	64	**32**	16	8	4	2	1
158	4th point red/"-"/➔	128	**64**	32	16	8	4	2	1
159	4th point green/"+"/⬅	**128**	64	32	16	8	4	2	1

- **CV#160 to Cv#175 Validity mask of the used outputs for each switching command:** By means of the CV#160 to 175, you can specify which outputs are used by a certain switch command. The respective switching state (ON or OFF) is defined in CV#144 to 159. Example: The first point of group A is switched by two pushbuttons and the outputs 1 and 2 of the WD10 are used. Through the numerical values 1+2=3 in the CV's 160 and 161 the corresponding assignment of the control command on the used outputs will be carried out.

| CV-nr. | Output | Outputs of group A | | | | | | | |
	(switch command)	8	7	6	5	4	3	2	1
160	1st point red /"-"/➔	128	64	32	16	8	4	**2**	**1**
161	1st point green/"+"/⬅	128	64	32	16	8	4	**2**	**1**
162	2nd point red/"-"/➔	128	64	32	16	**8**	**4**	2	1
163	2nd point green/"+"/⬅	128	64	32	16	**8**	**4**	2	1
164	3th point red/"-"/➔	128	64	**32**	**16**	8	4	2	1
165	3th point green/"+"/⬅	128	64	**32**	**16**	8	4	2	1
166	4th point red/"-"/➔	**128**	**64**	32	16	8	4	2	1
167	4th point green/"+"/⬅	**128**	**64**	32	16	8	4	2	1

| CV-nr. | Output | Outputs of group B | | | | | | | |
	(switch command)	8	7	6	5	4	3	2	1
168	1st point red /"-"/➔	128	64	32	16	8	4	**2**	**1**
169	1st point green/"+"/⬅	128	64	32	16	8	4	**2**	**1**
170	2nd point red/"-"/➔	128	64	32	16	**8**	**4**	2	1
171	2nd point green/"+"/⬅	128	64	32	16	**8**	**4**	2	1
172	3th point red/"-"/➔	128	64	**32**	**16**	8	4	2	1
173	3th point green/"+"/⬅	128	64	**32**	**16**	8	4	2	1
174	4th point red/"-"/➔	**128**	**64**	32	16	8	4	2	1
175	4th point green/"+"/⬅	**128**	**64**	32	16	8	4	2	1

5. Troubleshooting

Reset:

The switch decoder WD10 can be put to the factory settings through the programming button on the decoder or through DCC programming with the digital controller. (default values).

- Reset with the programming button: press the programming button with power switched on until the LED of group A and the LED of group B will light up permanently and simultaneously. Now press the programming button 4 times until both LEDs are flashing. Switch point 8 with the digital controller and the decoder is set to the factory settings. Users of the Multimaus and the Lenz compact version 3.0 have to use point number 12.
- Reset by DCC programming: program in CV#8 a value of 8.

Short circuit:
In case of a short circuit/overload at one of the outputs, the affected group is deactivated and the corresponding LED of the affected group will start to flash. At the next switching command for the group the decoder is testing if the bug is still present.. If there is no error any more, the output group can be operated as normal. Hint: In pulsed operation of the group, an erroneous output can be defined by switching all the 8 outputs step by step.

Other hints and tips for using the decoder are to be found on the internet: www.kuehn-digital.de

6. Application notes

6.1. Connecting external pushbuttons

Points and signals with dual coil solenoids can also be operated by external **potential-free** contacts (e.g. reed contacts) next to digital control. Thereby you can, for example, switch semaphores to „red" after the train has passed. When using external contacts the solenoids should have an end switch. You should only use the external button, if there is no digital command at the solenoid at the same time.

Fig. 5
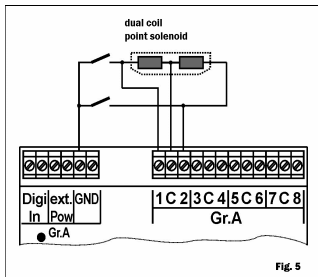
Important hint: Only use potential-free contacts and use them only, if there is no digital command at the same time!

6.2. Connecting LED

If you use LED equipped light signals, a series resistor is required for operation with the WD10 to limit the current.

Operation without a series resistor will damage the LED!
Check your signal if this series resistor is already installed. If not, you must install an

- always use a series resistor
- use a resistor with a value of 1...2,7kOhm if necessary
- kathode of the LED on the switch output
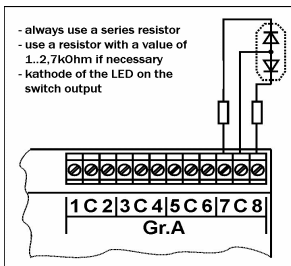
external resistor between the LED and the decoder output. The resistor value should be in the range between 1kOhm to 2,7kOhm and depends on the used power supply and the desired brightness of the LED.

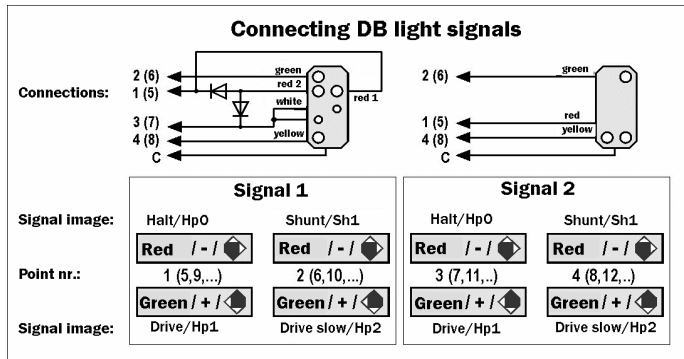## 6.3. Connecting light signals of the DR, DB, ÖBB, SBB

DB – light signals

Set the used output group of the decoder WD10 tot the operating mode „light signals with max 4 signal images" (operation mode 7). You can connect 2 light signals with maximal 4 lights each to this output group. Signal 1 is connected to the connectors 1 to 4 and signal 2 to the connectors 5 to 8.
In the sketch the necessary series resistors for the LED are not shown. Suitable diodes are the switching diodes, for example, 1N4148. The point numbers in the sketch are shown only as an example, the actual numbers correspond with the point numbers that you selected during programming.
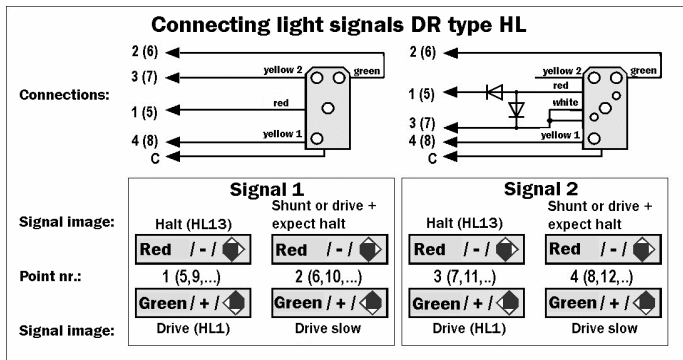
DR – Light signals type HL

Set the used output group of the decoder WD10 to the operating mode „light signals with max 4 lights" (operation mode 7). You can connect 2 light signals with maximal 4 lights each to this output group. Signal 1 is connected to the connectors 1 to 4 and signal 2 to the connectors 5 to 8.

The position „slow approach" corresponds with the signal image Hl3a (without light stripes). By connecting a light stripe to the connector 4 (8) you can generate the signal images Hl2 and Hl3b. The position „shunting" shows in conjunction

Connecting DB light signals

	Signal 1		Signal 2	
Signal image:	Halt/Hp0	Shunt/Sh1	Halt/Hp0	Shunt/Sh1
	Red / - / ◆	Red / - / ◆	Red / - / ◆	Red / - / ◆
Point nr.:	1 (5,9,...)	2 (6,10,...)	3 (7,11,..)	4 (8,12,..)
	Green / + / ◆	Green / + / ◆	Green / + / ◆	Green / + / ◆
Signal image:	Drive/Hp1	Drive slow/Hp2	Drive/Hp1	Drive slow/Hp2

Connections: 2 (6), 1 (5), 3 (7), 4 (8), C — green, red 2, white, yellow, red 1 — 2 (6), 1 (5), 4 (8), C — green, red, yellow

with white LED the signal image Ra12. Connect the connector 4 (8) with the connection yellow2 of your signal and you can create the signal image „Drive and expect halt" (HL10).
The point numbers in the sketch are shown only as an example, the actual numbers correspond with the point numbers that you selected during programming. In the sketch the necessary series resistors for the LED are not shown. Suitable diodes are the switching diodes, for example, 1N4148.

Connecting light signals DR type HL

ÖBB – Light signals

Set the used output group of the decoder WD10 to the operating mode „light signals with max 4 lights" (operation mode 7). You can connect 2 light signals with maximal 4 lights each to this output group. Signal 1 is connected to the connectors 1 to 4 and signal 2 to the connectors 5 to 8.

The position „slow approach" can, depending on the wiring, have two meanings: speed 40km/h if the yellow light is connected to connector 4 (8), or 60km/h if the green light is connected to connector 4 (8).
The point numbers in the sketch are shown only as an example, the actual numbers correspond with the point numbers that you selected during programming. In the sketch the necessary series resistors for the LED are not shown. Suitable diodes are the switching diodes, for example, 1N4148.
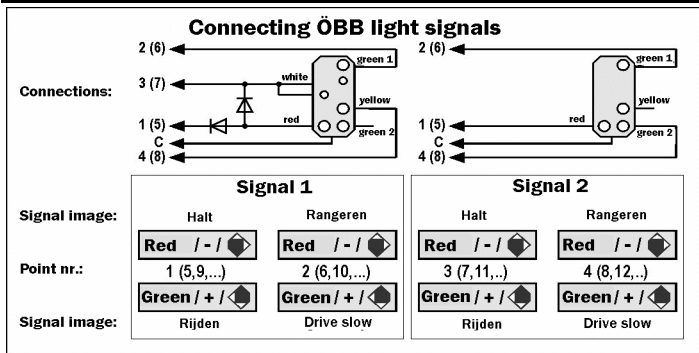
Connecting ÖBB light signals

	Signal 1		Signal 2	
Signal image:	Halt	Rangeren	Halt	Rangeren
	Red / - / ◆	Red / - / ◆	Red / - / ◆	Red / - / ◆
Point nr.:	1 (5,9,…)	2 (6,10,…)	3 (7,11,..)	4 (8,12,..)
	Green / + / ◁	Green / + / ◁	Green / + / ◁	Green / + / ◁
Signal image:	Rijden	Drive slow	Rijden	Drive slow

SBB – Light signals type L

Set the used output group of the decoder WD10 to the operating mode „light signals with max 4 lights" (operation mode 7). You can connect 2 light signals with maximal 4 lights each to this output group. Signal 1 is connected to the connectors 1 to 4 and signal 2 to the connectors 5 to 8.

The position „slow approach" can, depending on the wiring, have two meanings: Speed 40km/h if the 2nd green light is connected to connector 4 (8) or 60 km/h if the 2nd yellow light is connected to connector 4 (8). The decoder can also represent the signal image „drive with 40km/h and short brake distance", therefore connect both the yellow lamps with connector 3 (7). The point numbers in the sketch are shown only as an example, the actual numbers correspond with the point numbers that you selected during programming. In the sketch the necessary series resistors for the LED are not shown. Suitable diodes are the switching diodes, for example, 1N4148.
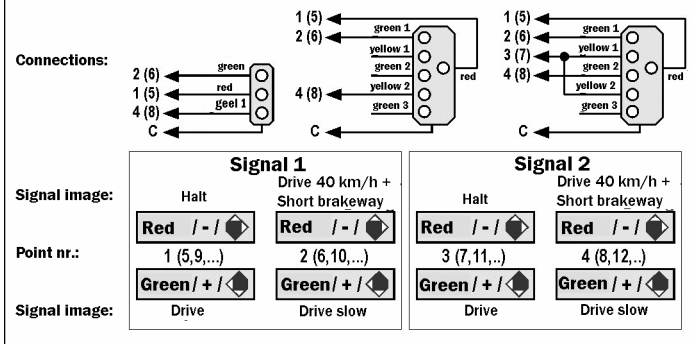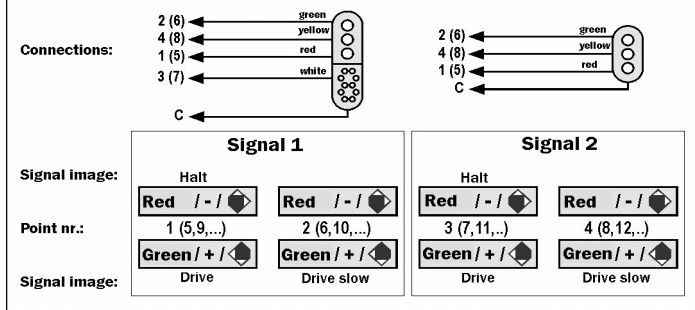
Connecting SBB light signals

Connections:

2 (6) ◄	green	
1 (5) ◄	red	
4 (8) ◄	geel 1	
C ◄		

1 (5) ◄	green 1	
2 (6) ◄	yellow 1	
	green 2	
4 (8) ◄	yellow 2	red
	green 3	
C ◄		

1 (5) ◄	green 1	
2 (6) ◄	yellow 1	
3 (7) ◄	green 2	
4 (8) ◄	yellow 2	red
	green 3	
C ◄		

	Signal 1		Signal 2	
	Halt	Drive 40 km/h + Short brakeway	Halt	Drive 40 km/h + Short brakeway
Signal image:	Red / - / ◆	Red / - / ◆	Red / - / ◆	Red / - / ◆
Point nr.:	1 (5,9,...)	2 (6,10,...)	3 (7,11,..)	4 (8,12,..)
	Green / + / ◀	Green / + / ◀	Green / + / ◀	Green / + / ◀
Signal image:	Drive	Drive slow	Drive	Drive slow

6.4. Connecting light signals of the NS

Set the used output group of the decoder WD10 tot the operating mode „light signals with max 4 signal images" (operation mode 8). You can connect 2 light signals with maximal 4 lights each to this output group. Signal 1 is connected to the connectors 1 to 4 and signal 2 to the connectors 5 to 8.

Connecting NS light signals (Nederlandse Spoorwegen NV)

Connections:

2 (6) ◄	green	
4 (8) ◄	yellow	
1 (5) ◄	red	
3 (7) ◄	white	
C ◄		

2 (6) ◄	green	
4 (8) ◄	yellow	
1 (5) ◄	red	
C ◄		

	Signal 1		Signal 2	
	Halt		Halt	
Signal image:	Red / - / ◆	Red / - / ◆	Red / - / ◆	Red / - / ◆
Point nr.:	1 (5,9,...)	2 (6,10,...)	3 (7,11,..)	4 (8,12,..)
	Green / + / ◀	Green / + / ◀	Green / + / ◀	Green / + / ◀
Signal image:	Drive	Drive slow	Drive	Drive slow

6.5.   Create light signal images yourself

In user mode (mode 1) you can specify using the CVs 160 to 175, which outputs of the decoder are used by a certain command (validity mask). In the CVs 144 to 159 you can set the switch status of the outputs for the respective commands (ON or OFF). If individual outputs should flash you can determine this for each output in the CVs 128 to 143. If you create signal images yourself, you can also use fading for the static signals.

More examples for signal images or application notes are to be found on the internet: www.kuehn-digital.de

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6.6.   User mode: programming a barrier

As an example of the possible settings in user mode, the connection of a barrier with flash lights is described.

The barrier lights are connected To the connectors 1 and 4 oF group A and to the connectors 2 and 3 of the barrier. Operation is done with both pushbuttons (pushbuttons „red" and „green") of the first point.

Firstly the effects of the output are set: the outputs 1 and 4 should flash and the outputs 2 and 3 should only be switched on (normal ON/OFF). In the effect registers of the outputs the values
- CV#128= 4   (output 1 flash)
- CV#129= 0   (output 2 normal ON/OFF)
- CV#130= 0   (output 3 normal ON/OFF)
- CV#131= 4   (output 4 flash)

are entered.
In the second step the outputs are set, that will be switched ON or OFF by pressing the pushbutton „red" or „green".
With the „red" pushbutton the outputs 1 to 4 are operated. According to the table for CV#160 the numerical value of the used outputs have to be added and the sum has to be entered in the CV (1+2+4+8=15).
- CV#160 = 15

With the „green" pushbutton the outputs 1 to 4 are operated. According to the table for CV#161 160 the numerical value of the used outputs have to be added and the sum has to be entered in the CV (1+2+4+8=15).
- CV#161 = 15

When pressing the „red" pushbutton the outputs 1 to 4 are switched OFF an by pressing the „green" pushbutton the outputs 1 to 4 are switched ON. According to the table for CV#145 the numerical values of the switched on outputs have to be

added and the sum has to be entered in the CV (1+2+4+8=15).
- CV#144 = 0   All outputs on „red" switched OFF
- CV#145 = 15   All outputs on „green" switched ON

6.7. Light mode

In this mode the 8 outputs of a group create different light effects. These are switched ON or OFF by point commands that are assigned to point numbers on this group.

Light effect:	All lights out	Light sequence with 8 lamps as light point	Light sequence with 4*2 lamps as light point	Light sequence with 2*3 lamps on con. 2-6 con. 1 and 8 flashing as light point
	Red / - / ◈	**Red** / - / ◈	**Red** / - / ◈	**Red** / - / ◈
Point nr.:	1 (5,9,...)	2 (6,10,...)	3 (7,11,...)	4 (8,12,..)
	Green / + / ◈	**Green** / + / ◈	**Green** / + / ◈	**Green** / + / ◈
Light effect:	Light sequence with 8 lamps as light band	Light sequence with 2*4 lamps as light point	Light sequence with 6 lamps on con. 2-6 con 1 and 8 flashing	Light sequence with 6 lamps on con 2-6 con. 1 and 8 flashing

7. Warranty

Each decoder is fully checked before delivery. The warranty period is 2 years from the date of purchase of the decoder. If an error occurs during this period, please contact your local shop or contact the manufacturer directly. If after inspection a manufacturing or material defect is detected, the decoder will be repaired or replaced free of charge.

The guaranty does not cover damage to the decoder due to improper handling, not following the instructions in this manual, improper use, overload, faulty wiring, unauthorized intervention, structural modifications, use of force, overheating, excessive input voltage, etc.

Sending in the decoder has to include your sales receipt or invoice, otherwise there is no guaranty.

(symbol)	This product is not to be disposed at the end of its useful live through normal household waste. Please consult the local authority or your local dealer for appropriate disposal.
CE	Nicht geeignet für Kinder unter 3 Jahren wegen funktionsbedingter scharfer Kanten und Spitzen! Enthält verschluckbare Kleinteile! Verpackung aufbewahren! Not suitable for children under 3 years. Ne convient pas aux enfants en dessous de 36 mois.

Any responsibility for damage or consequential damage due to improper use, not following the instructions of this manual, unauthorized intervention, structural changes, use of force, overheating, overloading, exposure to moisture, etc. is excluded.

Translation Dutch and English: Paul de Groot 's-Hertogenbosch