

Qdecoder

Connections and Operating Modes of Z2

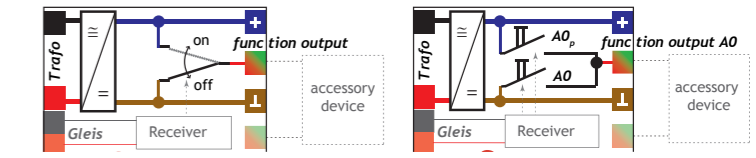
This manual applies to all standard and all-in-one class Qdecoder of the Z2 series

Z2 series decoder are shipped configured to DCC accessory addresses 1 to 4 and setup for motoric turnout drives.

The Z2 series provides 8 equal and independently controllable function outputs. They can be switched on and off with commands from the digital control unit or with locally connected key buttons.

The decoder uses DC power to switch the connected accessories, regardless of whether the decoder's terminals *Trafo* are connected to a transformer, a power supply or the track signal.

The following pictures show the function principle of the Z2 series. On the left side the power supply and the track terminals and on the other side the function outputs and the local supply terminals for accessories are depicted.



The Z2 operates a switch for each function output between local supply and local ground. The Z2+ uses two independent switches per function output. Thus function outputs of the Z2+ can be switched to high ohmic state (no current flow).

Accessory devices of the Z2 series are often connected between two function outputs.

Examples

This chapter presents some examples of applications for the Z2 Qdecoder series. They should provide inspiration for your own ideas.

The symbols used are taken from the folder "Overview on Qdecoder CVs":

Symbol	Description	Symbol	Description
t_{on}	On time	t_{off}	Off time
t_r	Fade-in time	t_f	Fade-out time
n_{puls}	Number of pulses	d	Dimming

Example how to "read" the following table: A turnout is connected to two function outputs („1" and „2", which could be any pair of consecutive outputs). The Mode-CV of the first function output has to be set to "2". The required "0" for the Mode-CV of output „2" is programmed automatically.

Application	Mode	Address	further CV properties
Turnout	1	2	$A_{Turnout}$ t_{on} = switching puls duration
	2	0	$t_r, t_f = 0$

The address of the turnout has to be configured for the first output. A possible address for the second output is ignored. Opposing to the default settings the switching pulse duration, the fade-in and fade-out times must be set for both outputs. This requires a total of 6 to 8 CV write commands in opposite to the simple usage of the programming button. This, however, will set up all function outputs of the decoder to identical values (besides the address), which is not always desired.

The following examples will focus on that CVs differing from the configuration of shipped decoders (differences to the default settings).

Application	Mode	Address	further CV properties
Motor with long startup	1	2	A_{Motor} $t_r, t_f = 138$ (correlates to ~ 10 second in- and decreasing of rotation speed)
	2	0	-
Motor with soft start	1	2	A_{Motor} $t_r = 138, t_f = 0$ (10 seconds for soft start, immediate shutdown)
	2	0	-
decreased rotation speed	1	2	A_{Motor} d = 40
	2	0	(40% of maximum voltage / speed)
3-aspect light signal	1	19	A_{Signal} A three-aspect light signal requires the CV-Mode value = „19" as an exception. No further changes required
	2	0	-
	3	0	-

$A0_p$	CV572	CV 573	CV573 + 256 * CV572	CV574	CV192 - CV201
$A1_p$	CV575	CV 576	CV576 + 256 * CV575	CV577	CV202 - CV211
$A2_p$	CV578	CV 579	CV579 + 256 * CV578	CV580	CV212 - CV221
$A3_p$	CV581	CV 582	CV582 + 256 * CV581	CV583	CV222 - CV231
$A5_p$	CV584	CV 585	CV585 + 256 * CV584	CV586	CV232 - CV241
$A4_p$	CV587	CV 588	CV588 + 256 * CV587	CV589	CV242 - CV251
$A6_p$	CV590	CV 591	CV591 + 256 * CV590	CV592	CV252 - CV261
$A7_p$	CV593	CV 594	CV594 + 256 * CV593	CV595	CV262 - CV271

¹⁾MSB: most significant part of the address: CV-value_{MSB} = address / 256
²⁾LSB: least significant part of the address: CV-value_{LSB} = address - (address / 256)

Example: If a motor is connected to **A5 and A6**, CVs 563, 564 and 565 have to be configured. Values in CVs 566 to 5768 will not influence the behaviour of the decoder.

Accessory Addresses

Accessory addresses are divided into two configuration variables. Addresses from 1 to 65535 can be configured in principle. Digital control units typically support only a limited range of addresses, often only up to the address 1023. For the Motorola protocol the address range is even far smaller. Please refer to the documentation of your control unit for the supported address range.

Examples for accessory addresses (for CV numbers see table on the left):
 Accessory address for A0 = 1 : CV9 = 0, CV1 = 1
 Accessory address for A0 = 10 : CV9 = 0, CV1 = 10
 Accessory address for A1 = 100 : CV551 = 0, CV552 = 100
 Accessory address for A2 = 255 : CV554 = 0, CV555 = 255
 Accessory address for A0 = 256 : CV9 = 1, CV1 = 0
 Accessory address for A3 = 1000 : CV557 = 3, CV558 = 232

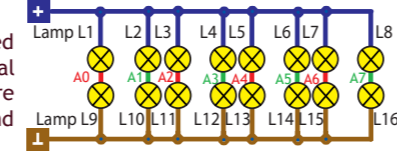
For the Z2+ the addresses of the two on/off switches per function output can be setup to different values. The decoder inhibits short circuits automatically. If the switch to ground is closed the switch to the local supply is opened immediately.

Mode-CVs

The Mode CV is usually configured to setup how many function outputs are switched together beginning with the output belonging to that CV. For all the following (belonging) outputs the value "0" has to be set. When writing values greater than "1" to a Mode CV, automatically all other mode variables for the other (belonging) function outputs will be set to "0".

Light Decoder Mode

Z2-8: Comand 4
 Every output **A0** to **A7** is switched on and off with one individual accessory address. The outputs are configured to continuous mode and fading of 1/4 second.



Command	Command to switch on															
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16
4	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
8	5	6	7	8	9	10	11	12	5	6	7	8	9	10	11	12
+4	+4 /															

The ■-command switches on one lamp L1 to L8 and the ■-command will switch off the corresponding lamp L9 to L16.

Operating Modes using Configuration Variables

The properties of a Z2 decoder can be changed with various configuration variables (CVs). For details see folder "Overview on Qdecoder CVs" or the „Qdecoder Book".
 Configuration variables can be read and written with most digital control units. For details please refer to the user guide of your control unit.

One accessory address and one mode CV are assigned to each Z2 on/off switch. Further properties of each output can be configured using up to 10 other CVs. CVs belonging to the on/off switches are listed in the following table. The first column of the table provides the first output for a connected device.

Out-put	Accessory Address			Mode	Properties
	MSB ¹⁾	LSB ²⁾	Calculation		
A0	CV9	CV 1	CV1 + 256 * CV9	CV550	CV112 - CV121
A1	CV551	CV 552	CV552 + 256 * CV551	CV553	CV122 - CV131
A2	CV554	CV 555	CV555 + 256 * CV554	CV556	CV132 - CV141
A3	CV557	CV 558	CV558 + 256 * CV557	CV559	CV142 - CV151
A4	CV560	CV 561	CV561 + 256 * CV560	CV562	CV152 - CV161
A5	CV563	CV 564	CV564 + 256 * CV563	CV565	CV162 - CV171
A6	CV566	CV 567	CV567 + 256 * CV566	CV568	CV172 - CV181
A7	CV569	CV 570	CV570 + 256 * CV569	CV571	CV182 - CV191

Turnout drives at 1 function output

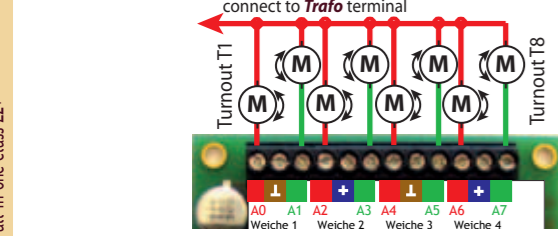
Z2-8+: Command 1, 2, 3

Motor with soft start at 1 function output

Z2-8+: Command 4

Motoric or magnetic turnout drives can be connected to the decoder, also in mixed configurations.

The principle of connecting these devices is shown on the right. See chapter "Connection of accessory devices" overleaf for reference.



The turnouts are switched (after configuration using the programming button) with the following accessory addresses:

Command	Address to switch							
	T1	T2	T3	T4	T5	T6	T7	T8
1	2	3	4	5	6	7	8	
5	6	7	8	9	10	11	12	
+4	+4							

Example: To configure the turnouts for addresses from 129 and following send a command between 129 and 132, e.g. „130" for 1 second pulse duration.

The addresses of the turnouts can be changed using the following CVs:

Accessory addresses			
Turnout 1	$A_{c1} = CV1 + 256 * CV9$	Turnout 5	$A_{c5} = CV573 + 256 * CV572$
Turnout 2	$A_{c2} = CV555 + 256 * CV554$	Turnout 6	$A_{c6} = CV579 + 256 * CV578$
Turnout 3	$A_{c3} = CV561 + 256 * CV560$	Turnout 7	$A_{c7} = CV585 + 256 * CV584$
Turnout 4	$A_{c4} = CV567 + 256 * CV566$	Turnout 8	$A_{c8} = CV591 + 256 * CV590$

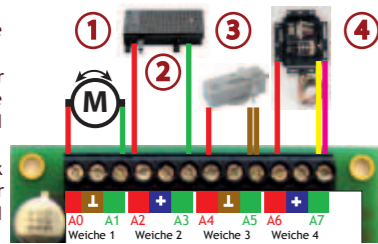
The pulse duration and soft start duration is configured by CVs as described in chapter „Turnouts/Motors at 2 function outputs" overleaf.

Connection of accessory devices to the Z2

➔ Motoric turnout drives and DC motors

Motoric turnout drives (M) are connected to the decoder terminals (A) and (B) of a pair of outputs A0/A1 to A6/A7. If the turnout does not switch as intended switch the connection of the (A) and (B) terminal. The turnout drives of known suppliers are connected as follows:

- Turnout drives of LGB or Piko are wired the same way.
- Using a Conrad motoric turnout driver connect both brown cables to one terminal of the decoder and the red one to the other terminal.
- Connect both the yellow and pink cable of Tillig turnout drivers together to one terminal of the decoder and the red cable to the other terminal.



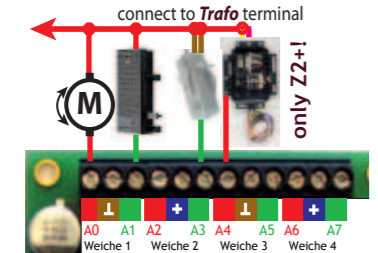
With an Z2-8+ decoder up to eight turnout drives can be attached to the function outputs and the power supply of the **Trafo** terminal.

The picture on the right shows the connection of different turnout drives to the terminals A0, A1, A3 and A4. Applying the same principle more turnout drives can be connected to the other function outputs.

Switching motors to the **Trafo** terminals is only possible when using an AC source or the digital track signal for supplying the decoder.

Never switch a motor to the track signal if the **Trafo** terminals are not connected to the track signal. The decoder or accessory device may be destroyed.

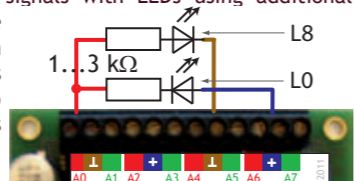
The standard-class Z2 decoder is not suitable for switching devices to the track signal, e.g. a motor connected this way would rotate continuously and just change directions.



➔ Single bulbs and LEDs

Bulbs or LEDs are connected to the function outputs A0 to A7 and one of the common return conductors (+ or L). In any case use just every second „center terminal“ as common return for lamps, light signals or turnouts.

It is mandatory to connect light signals with LEDs using additional resistors. In some cases these resistors are already included in the signal socket. Operating LEDs without resistors may lead into immediate destruction of the LEDs or signals.



Another possibility is depicted in the figure on the right side:

One single function output e.g. A0 can drive two LEDs - one connected to the blue (+), the other connected to the brown (L) terminal. Using a Z2-8 one of both lamps will be active, the other not. A Z2-8+ allows switching of both LEDs at the same time. In any case it is not possible to activate both lamps together.

Decoder class	A0	A8	L0	L8
standard (Z2-8)	off	-	off	on
	on	-	on	off
all-in-one (Z2-8+)	off	off	off	off
	off	on	off	on
	on	off	on	off
	on	on	on	off

Using CVs 112, 122, ... or additional resistors the brightness of lamps can be reduced.

➔ Permanently switched on lamps and LEDs

In each configuration permanently switched on lamps or LEDs can be applied between the blue (+) and brown (L) terminals.

➔ Light signals with common anode

The lamps of light signals with common anode are connected to the function outputs A0 to A7. The common return conductor of the signal has to be attached to the blue (+) terminal. Many light signal manufacturers ship their models with a common anode.

➔ Light signals with common cathode

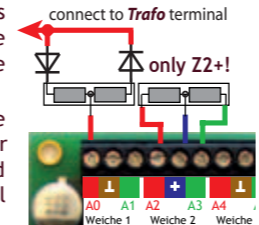
Light signals with common cathode are switched to the brown (L) terminal. The lamps of the light signal are connected to the function outputs A0 to A7, but controlled by A8 to A15.

➔ Turnouts, relays and semaphore signals

The two coils of magnetic drives are attached to the terminals (A) and (B) of output groups A0/A1 to A7/A8. Usually the (A)-output switches the turning track of the turnout, while the straight track switches with the (B)-output. If the turnout switches not as expected, change the terminals accordingly. With semaphore signal drives the wire for the „stop“ signal aspect is connected to the (A)-output.

The common return conductor of the coils is connected to the (+)-terminal as shown for the turnout, connected to A2 and A3, in the image on the right.

The all-in-one class Z2-8+ is able to drive inductive (magnetic) devices as depicted in the image for function output A0: the device is connected with anti-parallel diodes to the **Trafo** terminal which is supplied by AC or the track signal.



➔ Additional key buttons for switching turnouts

➔ Evaluation of key buttons

Turnouts or semaphore signals can be switched manually or automatically (train controlled) by key buttons, reed relays or light barriers attached in parallel to any function output terminal of an Z2+ **Qdecoder** of the all-in-one class. This decoder type is able to evaluate key button levels or reed relays for the signal aspect generator as well (like the Z1).

Since switching inductive (magnetic) loads causes in some cases high currents, which will lead to malfunction or destruction, please make sure to consult an expert for the correct configuration of these applications.

Operating modes using the programming button

Use the **Prog** button to select one of the following modes for Z2-**Qdecoder** series. Notice that the operating modes for standard and all-in-one class are slightly different:

Com-mand	Z2		Z2+	
	Operating mode	1) Pulse	Operating mode	1) Pulse
1 (A)	Turnouts and motors without soft start	¼ s	Turnouts and motors without soft start	2
1 (B)		½ s		1
2 (A)		1 s		2
2 (B)		2 s		1
3 (A)	... with soft start	continuous mode	... with soft start (or light decoder)	2
3 (B)				1
4 (A)	Light decoder	1	1	2
4 (B)				1

1) Number of function outputs per turnout / motor / device

The table lists the commands for addresses 1 to 4. If a command with address 5 to 8 is received the function outputs are configured for addresses beginning with 5 and following. For details of address configuration see folder „**Qdecoder Setup**“.

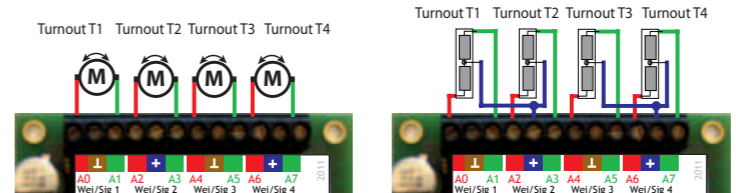
➔ Turnout drives / Motors at 2 function outputs

Z2-8 : Command 1 (A), 1 (B), 2 (A), 2 (B), 3 (A)

Z2-8+ : Command 1 (A), 2 (A), 3 (A)

➔ Motor with soft start (command 4 (A))

Motoric or magnetic turnout drives can be connected to the decoder, also in mixed configurations. The principle of connecting motoric drives is shown on the left and for magnetic drives on the right. See chapter „Connection of accessory devices“ for reference.



The operating mode „continuous mode“ is suitable for turnouts with limit stop. Other turnouts require a pulsed mode. Often the shortest pulse duration is sufficient. If the turnout does not switch properly use a longer pulse duration.

The duration of the switching pulse is set with the programming command. Use CV3 to CV6 for changing the pulse duration of a pair of function outputs if required. The maximum pulse duration is 2.55 seconds. Furthermore CV117/CV116 configures the pulse duration for A0 independently from A1 (CV127/CV126). (CV137/CV136 for A2, and so on)

The turnouts are switched (after configuration with the programming button) with the following accessory addresses:

Command	Address to switch			
	Turnout 1	Turnout 2	Turnout 3	Turnout 4
1 (A), 1 (B), 2 (A), 2 (B), 3 (A)	1	2	3	4
5 (A), 5 (B), 6 (A), 6 (B), 7 (A)	5	6	7	8
+4 (A) / (B)	+4			

Example: To configure the turnouts for addresses from 245 and following send a command between 245 and 248, e.g. „245 (A)“ for ¼ second pulse duration.

The addresses of the turnouts can be changed using the following CVs:

Accessory addresses	
Turnout 1	$A_{s1} = CV1 + 256 * CV9$
Turnout 2	$A_{s2} = CV555 + 256 * CV554$
Turnout 3	$A_{s3} = CV561 + 256 * CV560$
Turnout 4	$A_{s4} = CV567 + 256 * CV566$

Example: To configure turnout 2 to address 700, write the value $700/256 = 2$ into CV554 and the value $700 - (2 * 256) = 188$ into CV555.

The rotation speed of motors is increased and decreased during 1/4 second in soft start mode. This operating mode is suitable for two-aspect light signals (red/green) as well. The lamps of a block signal are connected to terminals (A) and (B) of an output pair A0/A1 to A6/A7. The common return conductor of the signal is attached to the blue (+) terminal.

The soft start duration is configured using CV114 for A0, CV124 for A1, CV134 for A2 and so on. The soft-stop duration is setup in CV115 for A0, CV125 for A1, CV135 for A2 ...