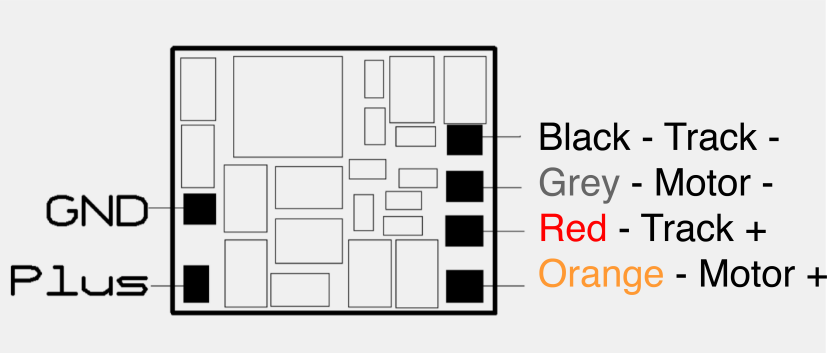
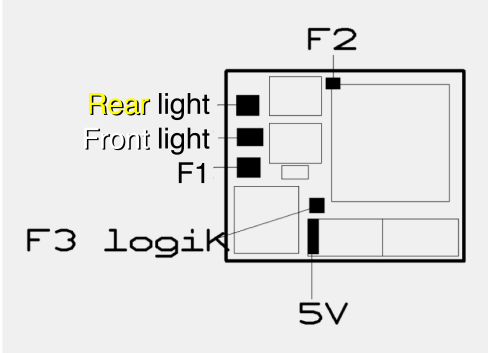
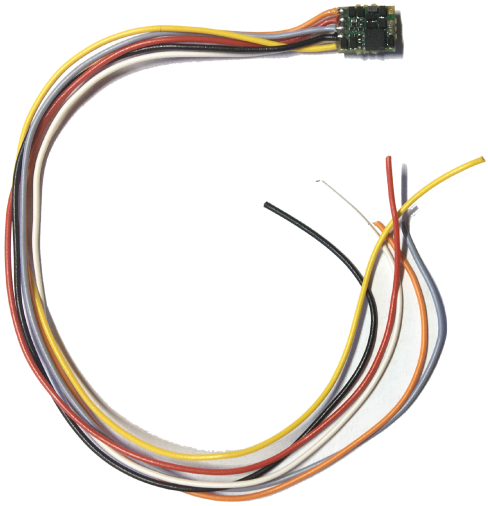
CT-Elektronik DCX65 Programming Manual

DCX65

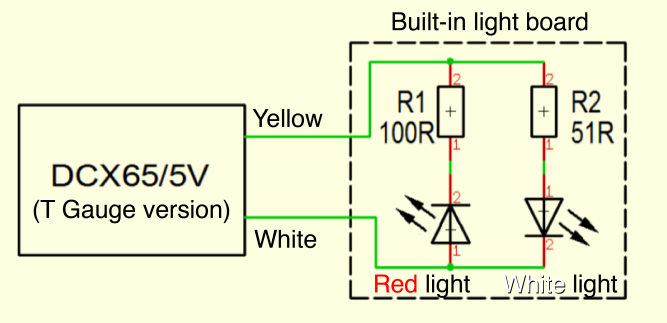


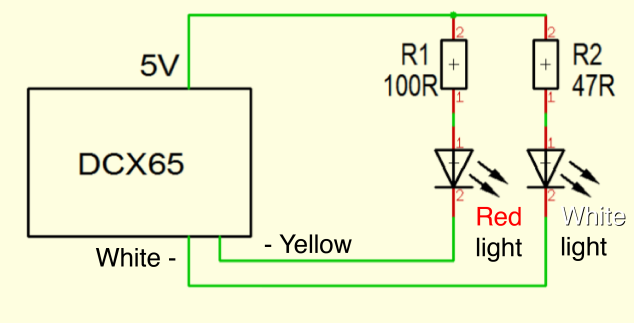


- Smallest decoder available in the world
- NRMA DCC data format with function mapping
- 6 x 5 x 1.8mm
- Driving voltage: 7-21V (not suitable for TT gauge +)
- Motor voltage: 3-8V (features overload protection)
- Motor max continuous current: 0.25A
- Motor peak current (5 sec): 0.4A
- Functions max total current: 0.05A (50mA)
- Max total motor + function output: 0.25A
- 4 amplified function outputs
  - 1 un-amplified logic output (not protected): 10mA
- Addresses 1-10240
- Lighting effects: flashing, dimming, soft start, American lighting effects, etc.
- Keep alive capacitor connection pads
- Shunting mode and programmable to two complete sets of CV's
- Operable on DC



This decoder comes standard as hardwire. The decoder does not feature a blue wire (common voltage wire) as standard. In order to complete circuits for lights connected to the white and/or yellow wires, connect a wire from the left rail (-) to the appropriate light (see diagram at bottom of previous page). If you have purchased the DCX65/5V T gauge version, follow the diagrams below.





In addition to the white and yellow wires, extra wires may be carefully soldered to the F1, F2 (& F3 if you're insane)! pads as shown in the diagram at the top of this page. A blue wire may be soldered to the 'Plus' pad. A wire may also be soldered to the 'GND' pad as part of connecting a keep alive capacitor/s.

Translated from German to English by Jarryd Langford - Buckambool Model Trains
(Last updated 13th of September 2019)

Buckambool Model Trains

IMPORTANT INSTALLATION NOTE:
There is no factory heat shrink plastic supplied around these decoders. It is highly recommended to insulate the surfaces inside the locomotive where the decoder will be installed with 'Kapton tape', especially the metal mechanism, as not doing so will cause the decoder to short which will result in total failure of the decoder.
It is not recommended by CT-Elektronik to wrap the decoder in insulating tape as this may result in overheating of the decoder.

Note about CV (configuration variable) 'values' and 'bits':
CV's have a possible range of programmable values, which is 0-255. The value of the number programmed against a certain CV determines a specific function achieved by the decoder; this can be either switching a feature on or off, or altering a feature, or even altering multiple features. Examples of these different types of programming are shown below in dot point form:

- CV13 can be programmed to either 0 or 255 in order to enable or disable function outputs (lights etc.) on DC track power.
- CV3 can be programmed to any value between 0 and 255 in order to vary the rate at which the locomotive will accelerate to a certain speed
- CV29 can be programmed to a large number of specific values that will combine the activation or deactivation of approximately 5 different functions. See notes below about the addition system

Addition System
The addition system uses multiple 'bits' to activate various functions within a CV, that can each be programmed as active/inactive. When a bit is active, it equals '1'. When a bit is inactive, it equals '0'. This is similar to a computer on/off 0/1 switch system. Therefore the active CV value for bit 0 is '1', '2' for bit 1, and then '4' for bit 2, and so on. (The previous bit value is squared). The inactive CV values for each bit are always '0'

	Values	
Bit	Inactive	Active
0	0	1
1	0	2
2	0	4
3	0	8

How to use CV table
CV values marked in '**bold**' and 'underlined' (e.g. '**2**') are important values, however some more important than others. Values marked in normal non-bold text (e.g. '2') are of less importance

CV	Description	Factory setting	Possible values
1	Decoder address To reset decoder CV's write CV1 = 0 Decoder will return to base address '3' once reset (reset does not restore speed table values (CV67-CV94) and CV109)	3	1-127
2	Starting voltage Voltage applied to the motor at power level '1'	2	0-255
3	Acceleration Time required for locomotive to accelerate from standstill to full speed	4	0-255
4	Deceleration Time required for the locomotive to decelerate from full speed to standstill	4	0-255
5	Maximum speed Sets maximum speed of the locomotive	255	0-255
6	Middle speed This CV value works in conjunction with CV2 and CV5. A curve is formed between CV2 and CV5, CV6 determines the centre point of the curve. The curve will be linear with a value of CV6 = 0	0	0-255
7	Decoder version number	-	Variable
8	Manufacturer's code (CT Elektronik)	117	117
9	Motor control frequency Frequency is calculated as f = 1953/Value from CV9 For 'difficult cases', low frequency is recommended: 30-150Hz, by using CV9 = 13-63 Factory default normal setting: 16kHz For 16kHz and higher frequencies, set CV9 = 134-191 For 'special cases' it is possible to use 32kHz, by setting CV137 = 128	134	13-63 or 134-191
13	Analog mode control of function outputs For all function outputs to be enabled in DC analog operation, program CV13 = 255	0	0-255

17+18	Long address Activated when CV29 bit 5 = 1 (add value of 32 to CV29) CV1 (decoder address)	0	128-10240
19	Consist address Suitable for easily controlling multiple locomotives of the same type via the same address. Note: It is important to check that locos in a consist have similar programming in terms of max speed, acceleration, deceleration etc. Must be different to addresses used for CV1 and CV17+18 When CV19 is not programmed as 0, the locomotive will only respond to this address for drive commands with the controller. To control lights and other functions, either the CV1 or CV17+18 address (short or long address) will need to be dialled up on the controller	0	1-127

29	Configuration bits Bit 0: Locomotive direction Changes travel direction of locomotive, independent of front and rear lights 0 = normal (default) 1 = reversed Bit 1: Speed mode Changes number of speed steps. 28 steps is the usual, older control units may only work with 14 steps 0 = 14 steps 1 = 28 steps (default) Bit 2: Operating mode Changes whether the decoder will function on Analog DC voltage 0 = DCC only (default) 1 = DCC and DC Bit 3: *not used* Bit 4: Speed characteristic Changes motor speed control between the basic speed curve and the advanced speed curve. The basic speed curve is controlled with CV's 2, 5, 6 The advanced speed curve is controlled with CV's 67-94 0 = basic (default) 1 = advanced Bit 5: Address range selection Changes the address from which the decoder can be controlled from. Either CV1 short address (1-127), or CV17+18 long address (128-10240) 0 = short (default) 1 = long Bit 6: *not used* Bit 7: *not used*	Calculation for CV29: Bit 0: 0 or 1 Bit 1: 0 or 2 Bit 2: 0 or 4 Bit 3: 0 or 8 Bit 4: 0 or 16 Bit 5: 0 or 32 Bit 6: 0 or 64 Bit 7: 0 or 128 (Add values in above table for desired active bits) Default: 2	0-255
30	Error analysis *Read only values* 1 = Motor 2 = Light 3 = Motor and light have a short circuit	0	0-3

33-46 163-176	Function mapping 4 function outputs See table below:		0-255

CV	Button	Exit	A22	A21	A20	A19	A18	A17	A16	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5 Maneu-vering function	A4	A3	A2 Lih	A1 Liv	
33	f 0	Front															128	64	32	16	8	4	2	**1**	1
163	f 0	Front							128	64	32	16	8	4	2	1									
34	f 0	Rear															128	64	32	16	8	4	**2**	1	2
164	f 0	Rear							128	64	32	16	8	4	2	1									
35	f 1																128	64	32	16	8	**4**	2	1	4
165	f 1								128	64	32	16	8	4	2	1									
36	f 2																128	64	32	16	**8**	4	2	1	8
166	f 2								128	64	32	16	8	4	2	1									
37	f 3	Maneuvering function															128	64	32	**16**	8	4	2	1	16
167	f 3								128	64	32	16	8	4	2	1									
39	f 4													128	64	32	16	8	**4**	2	1				4
168	f 4					128	64	32	16	8	4	2	1												
40	f 5													128	64	32	16	**8**	4	2	1				8
169	f 5					128	64	32	16	8	4	2	1												
41	f 6													128	64	32	**16**	8	4	2	1				16
170	f 6					128	64	32	16	8	4	2	1												
42	f 7													128	64	**32**	16	8	4	2	1				32
171	f 7					128	64	32	16	8	4	2	1												
43	f 8													128	**64**	32	16	8	4	2	1				64
172	f 8					128	64	32	16	8	4	2	1												
44	f 9										128	64	32	**16**	8	4	2	1							16
173	f 9		128	64	32	16	8	4	2	1															
45	f 10										128	64	**32**	16	8	4	2	1							32
174	f 10		128	64	32	16	8	4	2	1															
46	f 11										128	**64**	32	16	8	4	2	1							64
175	f 11		128	64	32	16	8	4	2	1															
47	f 12										**128**	64	32	16	8	4	2	1							128
176	f 12		128	64	32	16	8	4	2	1															

50	Back EMF Determines how aggressively the decoder will alter motor voltage in order to keep the motor spinning at a set speed. Locomotives will slow when travelling up grades, and accelerate down grades under load. Back EMF is designed to correct this gain/loss of speed. 255 represents very fast and accurate adjustment from the decoder	255	0-255
51	P - controller Changes the control characteristics of the motor	80	0-255
52	I - controller Changes the control characteristics of the motor	40	0-255
53	Decoder lock If the decoder has been programmed, accidental reprogramming can be disabled by setting CV53 = 66 To unlock the decoder, set CV53 = 77	0	0-255

54 (follow CV57)	Dimming of function outputs (lights) Value of 50 represents %50 (half brightness), corresponding to the average half rail voltage of the system The value set here is applied to all outputs, which is stored in CV57	50	0-100
56 (follow CV56, 58)	Dimming of coupling outlets	50	0-100
56	Switching time for coupling clutch outputs	60	0-255
57	Dimming Mask 1: Function outputs The 'mask' selects which outputs (A1 to A8) will be defined as lamp and LED outputs. This then determines which functions will be dimmed under the value set in CV54. Bit 0 = Front light Bit 1 = Rear light	Calculation for CV57: Bit 0: 1 = A1 Bit 1: 2 = A2 Bit 2: 4 = A3 Bit 3: 8 = A4 Bit 4: 16 = A5 Bit 5: 32 = A6 Bit 6: 64 = A7 Bit 7: 128 = A8 (Add values in above table for desired active bits) Default: 0	0-255
58	Dimming Mask 2: Coupling outputs	0	0-255
59	Train influence: "L" Selected speed for 'L', see also CV137, 96, 97, 98	168	0-255
60	Train influence: "U" Selected speed for 'U', see also CV137, 96, 97, 98	84	0-255
61	Start-up delay time Time between release and drive in HLU mode, units in sec See also CV137, 96, 97, 98	1	0-255
64	Control reference Performance depending on the rail tension	110	0-255
67-94	Advanced speed steps The values (CV67-94) are used when bit 4 is active (bit 4 = 1) in CV29	9-252	0-255
96	Train Control "F-L"	212	0-255
97	Train Control "L-U"	126	0-255

98	Train control “U-Stop”	42	0-255
105	User CV This CV has no effect on the function of the decoder. It can be used to record any number between 0-255, e.g. date of purchase	0	0-255
106	User CV This CV has no effect on the function of the decoder. It can be used to record any number between 0-255, e.g. date of purchase	0	0-255
109	Selection of CV groups Bit 0: 0 = standard group 1 = special group This CV allows for 2 completely different sets of variables to be programmed for all CV values onto the decoder, and have the ability to switch between them. E.g. CV variables set up for club running, and CV variables set up for home layout running The factory set group is the standard group (bit 0 = 0)	0	0-1
111	Intensity of acknowledgement pulses during programming	255	0-255
114	Dimming value of effects Reduces average voltage by pulse width modulation at 1.2kHz. The pulse width is set in percent, e.g. 50 means half average rail voltage. The value set here applies to all effects stored in CV154-161 For lower brightness value light effects, see CV154 to 161	0	0-100
115	Pause duration of effects Defines the time (duration) between two effects	0	0-255
116	Shunting manoeuvre	0	0-95
117	Number (F1,F2 etc.) of function key to activate high/ dipped beam The decoder can simulate high/dipped beam electronically. Only one function key can be defined at a time (F1-F12) Variable programmed indicates function key e.g. ‘2’ = F2	0	1-12

118	Mask for dimming function This CV determines which outputs (A1 to A8) are dimmed with the function key from CV117. A max of 8 outputs can be defined. Bit 0 = A1 (front light) Bit 1 = A2 (rear light) Bit 2 = A3 Bit 3 = A4 Bit 4 = A5 Bit 5 = A6 Bit 6 = A7 Bit 7 = A8	Calculation for CV118: Bit 0: 0 or 1 Bit 1: 0 or 2 Bit 2: 0 or 4 Bit 3: 0 or 8 Bit 4: 0 or 16 Bit 5: 0 or 32 Bit 6: 0 or 64 Bit 7: 0 or 128 (Add values in above table for desired active bits) Default: 0	0-255
119	Dimming value for dimming function Reduces average voltage by pulse width modulation at 1.2kHz. The pulse width is set in percent, e.g. 50 means half average rail voltage. The value set here applies to all effects stored in CV118 ’50’ = approx. 50% brightness ‘100’ = approx. 100% brightness	0	0-100
120	Cycle duration of effects Defines how long an effect should last. Determines speed of an effect	0	0-255
137	Special CV Bit 0: ZIMO-MAN function selection correction Bit 1, 2, 3 & 5 - not used Bit 4: ZIMO signal train control Bit 6: Evaluation of LGB pulses via F4 Bit 7: 32kHz motor drive frequency 0 = CV9 1 = 32kHz	Calculation for CV137: Bit 0: 0 or 1 Bit 1: 0 or 2 Bit 2: 0 or 4 Bit 3: 0 or 8 Bit 4: 0 or 16 Bit 5: 0 or 32 Bit 6: 0 or 64 Bit 7: 0 or 128 (Add values in above table for desired active bits) Default: 0	0-255
138	Braking time (HLU ZIMO) Braking delay on the HLU section	3	0-255
139	Short circuit threshold 1 Immediate shutdown if the additional functions are overloaded	15	0-255

140	Short circuit threshold 2 Rapid shutdown if the additional functions are overloaded	12	0-255
141	Short circuit threshold 3 Slow shutdown if the additional functions are overloaded	10	0-255
142	Short circuit threshold 1 Immediate shutdown if the additional functions are overloaded	90	0-255
143	Short circuit threshold 2 Rapid shutdown if the additional functions are overloaded	80	0-255
144	Short circuit threshold 3 Slow shutdown if the additional functions are overloaded	70	0-255
147	Relief of the clutch (ZIMO coupling)	20	0-126
148	Drive away (wagons) (ZIMO coupling)	50	0-126
149	Discharge time (ZIMO coupling)	10	0-255
150	Drive away (ZIMO coupling)	30	0-255
151	Button selection for automatic uncoupling (ZIMO coupling)	0	0-12
152	Disconnect mask (forward) (ZIMO coupling)	8	0-255
153	Disconnect mask (backward) (ZIMO coupling)	8	0-255

154-161	Effects for CV154-161 Value 0 = no effect Value 1 = flash Value 2 = flashing in opposite direction Value 3 = single pulse strobe Value 4 = double strobe Value 5 = flashing headlight Value 6 = left ditch-light Value 7 = rear ditch-light Value 8 = rotary beacon Value 9 = gyralight Value 10 = mars light Value 11 = soft start (slow flicker of functions) Effect No. + value 64 = output Ax is only active when moving forward Effect No. + value 128 = output Ax is only active when moving backward Effect No. + value 0 = output Ax is active in both directions Defining certain effects at certain outputs is one of the main tasks of this CV group. The exact properties of these effects are determined by CVs 114, 115 and 120. The other main task of this CV group is to give the assigned outputs and keys from CV33 a certain directional function. CV154 - effect for front light (A1) CV155 - effect for rear light (A2) CV156 - effect for output A3 CV157 - effect for output A4 CV158 - effect for output A5 CV159 - effect for output A6 CV160 - effect for output A7 CV161 - effect for output A8	0	0-139
162	Sensitivity of the diode voltage: Balancing the asymmetry, values between 1 and 50 are generally well tolerated	10	0-255

Contact Details:

If you have any issue with this programming manual, please do not hesitate to contact me:

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