

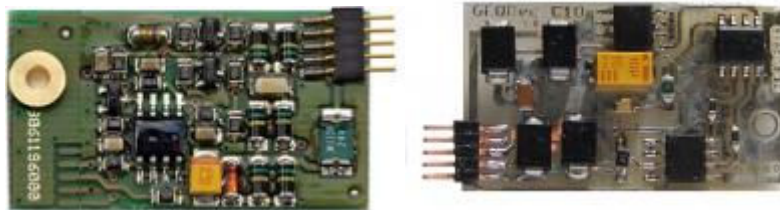
# GEODec C10 - DCC decoder for Roco GeoLine turnouts

Translation in progress.

The **GEODec C10** DCC decoder is intended to control electromagnetic actuator of Roco® GeoLine® turnouts. The decoder is functional replacement of the original factory Roco® 61196 decoder. The power and DCC signal is supplied by the plug located onto the point actuator.

The intention of this project is to deliver to railroad modellers the possibility to build the decoder on their own. Only basic knowledge of electronics is needed. In [Decoder building](#) chapter all the necessary information to build the working decoder can be found.

Below are the pictures of factory Roco decoder and described in this article self-build decoder.



**Pic.1** Comparison of decoders: on the left Roco 61196, on the right GEODec C10

## Decoder features

The GeoDec C10 decoder provides the following features:

- works with DCC systems which support NMRA standards (for ex. Roco MultiMouse, Lenz)
- supports 2048 device addresses (doesn't support locomotive addresses)
- address programming by two CV's
- programmable output on-time from 10ms to 2,55s (with 10ms steps)
- swapping direction of switching can be set by CV
- output activation / deactivation controlled by CV
- decoder lock - decoder stops responding to service commands – unlocking by writing value of 123 into CV8
- decoder reset – restores factory set default values of all Configuration Variables

- responds to Direct Mode or Paged Mode programming commands

## Installation

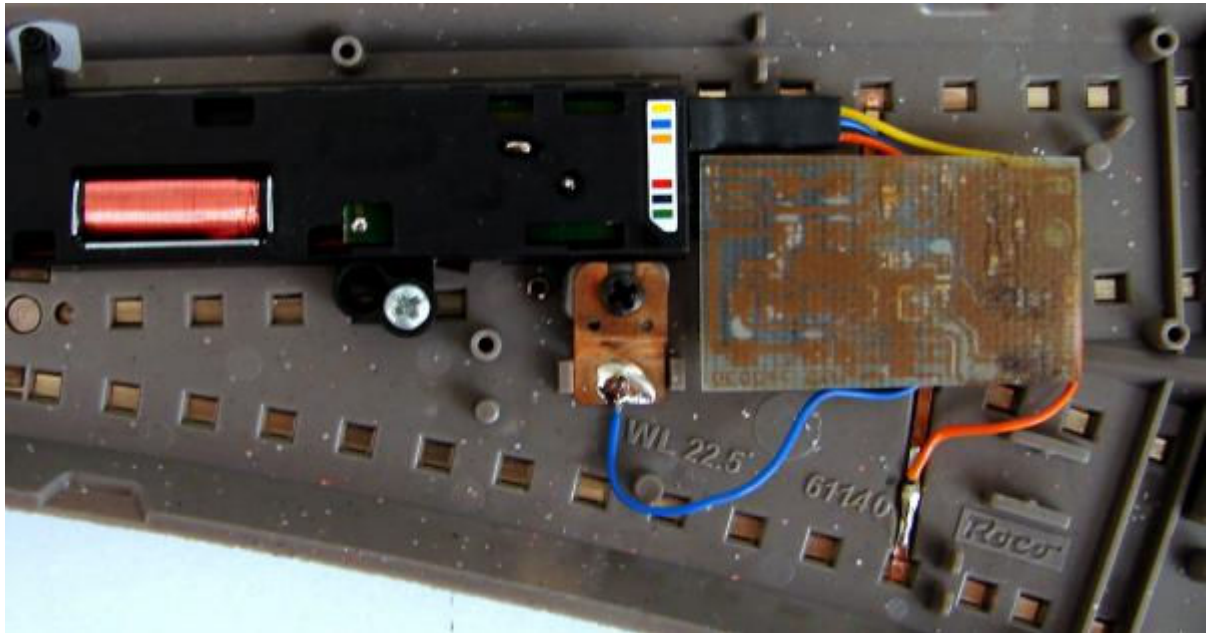
Decoder fits into right (WR) and left (WL) railroad switches, and also can be used with DKW and DWW switches (last two items need to install two separate **GEODec C10** decoders or one double decoder **GEODec C20** which is currently under construction)  
The device connects directly to the Roco 61195 point actuator with 5-pole connector. Contacts of the connector should be softly inserted into holes of point actuator. The way the decoder is mounted onto WR switch is shown on the picture below.

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**Pic.2** GEODec C10 decoder mounted onto WR switch

In case of installing onto left switch (WL) the decoder has to be installed upside down.



**Pic.3** GEODec C10 decoder mounted onto WL switch

## Programming

The list of CV's supported by the decoder is described in the table below. Because some DCC systems don't support programming of CV's higher then 512, the decoder supports double numbering of variables, high and low.

CV high	CV low	Values	Default	Description
513	1	0-255	1	Device address (lower 8 bits)
514	2	0-255	255	Output activation Bit 0 (1) – 0: A output (green) inactive, 1: A output active, Bit 1 (2) – 0: B output (red) inactive, 1: B output active
515	3	1-255	50	On-time for output A (in 10ms steps)
516	4	1-255	50	On-time for output B (in 10ms steps)

519	7			Decoder version
520	8	33,123		Manufacturer identification. Writing value of 33 sets all CV's to default values (decoder reset), writing value of 123 unlocks decoder programming – see CV546 for information about decoder locking
521	9	0-7		Device address (bits 8,9,10)
541	29	128	128	Configuration (128: accessory decoder)
545	33	0,1	0	Switching direction Bit 0 (1) – 0: default direction, 1: reverse direction  The other bits of the variable have no influence on decoder operation
546	34	0-255	1	Other settings Bit 0 (1) - remember points position Bit 1 (2) - turn on ACK for programming Bit 2 (4) - lock programming of CVs Bit 3 (8) - not implemented Bit 4 (16) - not implemented Bit 5 (32) - not implemented Bit 6 (64) - not implemented Bit 7 (128) – not implemented

The values in brackets are the bit values of selected bits. To activate functions which are controlled by individual bits, the values of corresponding bits should be added together and the aggregated value should be written to the CV. The value of bits of inactive functions is 0 (corresponding bit is not set).

### Device address setting

The decoder is addressed with device address according to the Roco Multimouse device numbering. Setting device address of 1 results in decoder responding to commands sent to turnout number 1 from Roco Multimouse.

Addresses from 1 to 256 are set in CV1, when CV9 is set to 0. To set addresses higher then 255 the folowing formula should be used:

$$CV9 \times 256 + CV1 = \text{device address}$$

for example, to set address of 256 write value of 1 into CV9 and value of 0 into CV1, to set device address of 625 program value of 2 into CV9 and value of 113 into CV1.

The following table could be helpful when calculating CV1 and CV9 values:

Device number	1024	512	256	128	64	32	16	8	4	2	1
Weight	CV9			CV1							
	4	2	1	128	64	32	16	8	4	2	1
1											1
256			1								
625		1			1	1	1				1

The table contains examples for calculating device numbers of 1, 256 and 625. Use values from first row to calculate the desired device address, for example to achieve the value of 625 sum up the following values 512+64+32+16+1. Write ones in columns corresponding to selected values. In the next step add together blue values from third row (from columns marked before with ones) to get CV1 value (1+16+32+64 = 113) and in the same way add together red values to get CV9 value (2). Write calculated values to corresponding CVs. In this way 2048 of device addresses can be calculated. (With MultiMouse only addresses from 1 to 1024 can be used).

## Output configuration

The on-time of the outputs can be set separately for each direction. For A output (green) the time is configured in CV3 (CV515) and for B output (red) the time is configured in CV4 (CV516). The unit of time for CV3 and CV4 is 10ms (default value of 50 sets the on-time of output to 500ms what gives a half of the second). Test of the decoder showed that the default value is sufficient to proper turnout operation, so there is no need to change it.

If the direction of switching is reversed, it can be altered by setting bit 0 in CV33 (CV545).

## Setting up other functions

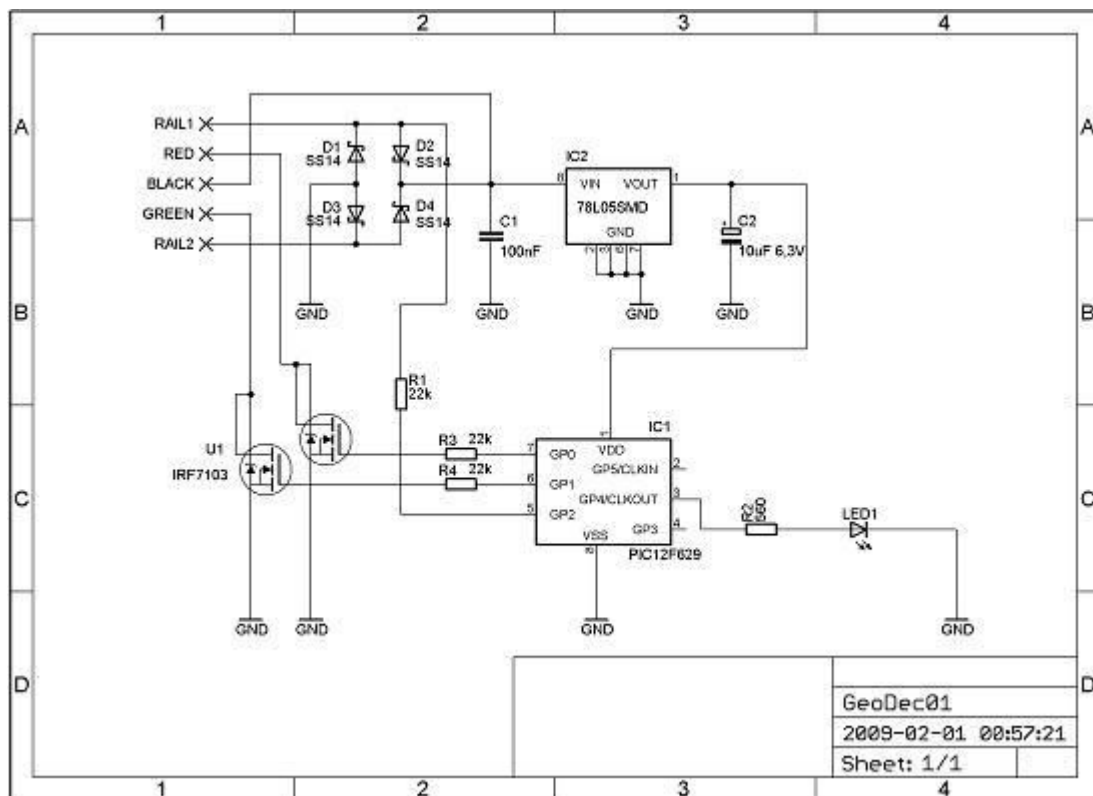
In CV34 (CV546) advanced settings of the decoder can be set. One of the most useful options is decoder lock (Bit 2), which sets the decoder in only operations mode and stops the decoder from responding to service mode commands like programming the CVs. It protects the decoder against accidental reprogramming when the decoder is connected to the working track layout and there is no special programming track. Thanks to the lock, locomotives can be programmed on the main track without affecting the configuration of the decoder. To unlock the decoder programming value of 123 must be written to CV8.

Setting bit 1 in CV34 (CV546) an Ack signal can be activated, the decoder will provide an increased load to the track by applying power to the point actuator coils to acknowledge service mode commands. When Ack is deactivated programming is confirmed by flashing Ack LED on decoder board. In this case command station can detect programming error in fact there is no feedback from the decoder.

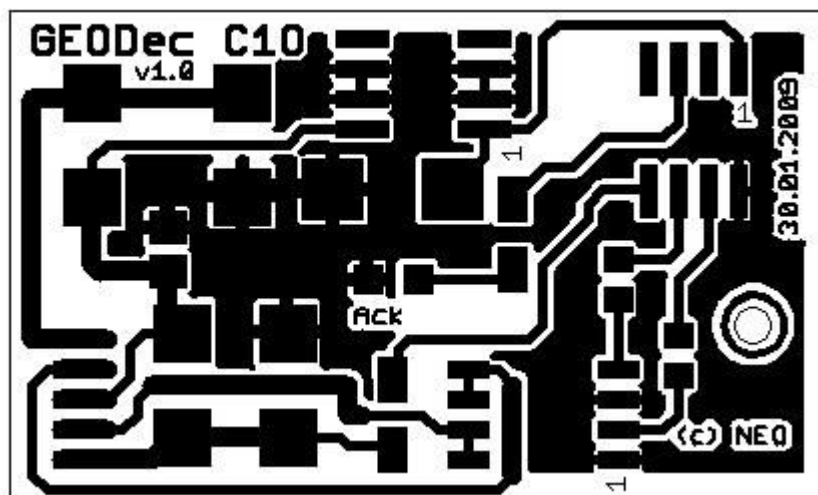
### **Decoder building**

The circuit and the microcontroller software are based on the Paco Cañada's "4 Servo Decoder v.2" describer on [http://www.tinet.org/~fmco/download\\_en.html](http://www.tinet.org/~fmco/download_en.html) web page. The "heart" of the decoder is PIC 12F629 microcontroller. For driving decoder outputs double N-MOSFET transistor is used. As the decoder is configured by CVs, the address programming button has been removed from the circuit. The LED diode is used to confirm CV programming when ACK is disabled.

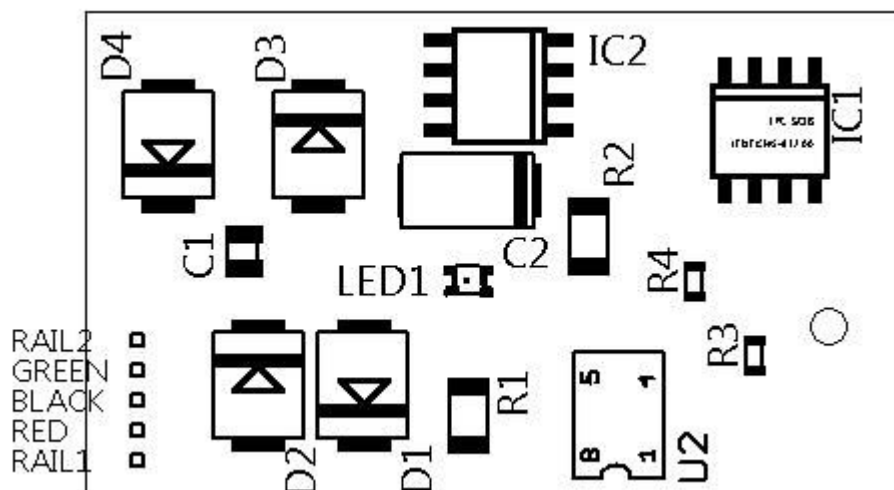
### **The circuit and the printed board**



**Pic.4** Electrical circuit of the GEODec C10 decoder



**Pic. 5** Printed board



**Pic. 6** Component layout

Budowę rozpoczynamy od wykonania dowolną metodą płytki drukowanej. W warunkach domowych polecam metodę z folią transferową oraz drukarką laserową – daje bardzo zadowalające efekty. Kolejnym krokiem jest zaprogramowanie mikrokontrolera. Opis wykonania płytek drukowanych oraz programowania mikrokontrolera dostępne są w dziale [Technika](#). Następnie montujemy wszystkie elementy oprócz mikrokontrolera i podłączamy układ do napędu. Mierzmy napięcie na kondensatorze tantalowym – powinno wynosić 5V. To pozwoli określić, czy układ zasilania procesora działa prawidłowo i uchronić go przed ewentualnym uszkodzeniem. Po tym zabiegu można zamontować zaprogramowany mikrokontroler. Dekoder jest gotowy do użycia. Wystarczy zaprogramować adres urządzenia i ewentualnie zmienić inne ustawienia dekodera.

### Bill of material

D1 – D4	Diody Schottky’ego SS14, SS16 lub podobne 1A 30V
C1	Kondensator ceramiczny SMD 100nF
C2	Kondensator tantalowy SMD 10uF/6,3V
R1,R3,R4	Rezystor 22KΩ SMD 0603
R2	Rezystor 560Ω SMD 0603
IC1	Mikrokontroler Microchip PIC12F629 SO-8
IC2	Stabilizator 78L05 SMD SO-8
U2	2xN-MOSFET IRF7103 SMD SO-8

- LED1      Dioda LED SMD 0603
- X          Złącze pięciopinowe o rastrze 1,27mm

