Electronic Kit Silent Drive WA5

for two Servos

MBTronik

PiN – Präsenz im Netz GITmbH

Assembly instructions for the Servo Drive Type WA5

Congratulations for your new silent point mechanism. In order to take advantage of the special characteristics of the drive, please read this assembly and installation guide. Safely build this kit for the silent mechanism by following carefully the instructions contained in this guide. Take a moment to read this guide before starting the construction of the kit. You will then enjoy assembling the kit and using the drive.

Warning: This kit is meant to be used for model railways and is not a children toy. Please note that this kit contains small parts that may be swallowed so don't let children have access to this kit. Sharp points remain especially on solder side after construction.

During operation, some components may become warm especially the radiators.

Needed tools:

For the assembly of the kit you need the following tools not contained in the kit:

- a small side cutter
- a fine soldering iron with a thin point
- electronic tin solder 0,5-1mm

All other necessary parts are contained in the kit.

All elements of the kit are RoHS conformant, thus lead free. Nevertheless you can use solder containing lead.

Assembly instructions:

Please proceed with the assembly of the kit by following the sequence the parts list and check each item when mounted. Following the indicated sequence has proven to be helpfull because parts of same or similar heigth are mounted in ascending order. Thus you can always secure the parts against the PCB (Printed Circuit Board) by using a foam rubber.

Many parts must be mounted in a correct position. **These parts are indicated in bold face in the parts list.** You will also find the indication of the correct position of the part. Concerning the integrated circuits (ICs) there is a mark (point printed or engraved in the plastic) which indicates pin 1. This mark must correspond to the notch of component legend (silk screen) printed on the board. Further assistance is provided by the photo of the finished drive later on in this document.

Please note that it is very difficult to unsolder misplaced parts as the printed circuit is double-sided and has plated-thru holes. Take your time when placing components to avoid misplaced parts and face such a situation.

Pay attention when soldering components not to produce solder bonds. This is one of the most frequent cause of errors. Note also that soldering for a long time is more harmful than soldering with a hot iron. Use the 1-2-3 rule: Apply the iron tip to the component wire and the board's pad, count 1, 2, 3. At 1, you warmup the connection to solder, at 2 you apply the tin solder, at 3 you remove the tin keeping the iron tip on the connection so that the via will be filled with solder. Wait 3-5 seconds after removing the solder iron for the tin to solidify. Do not move the components while they cool down. It's better to put more tin solder than too few. The plated-thru hole "sucks" the tin up to the component side of the printed circuit board. If after soldering some tin is visible on the component side, the soldered connection is optimal. **The components must not be soldered from the component side!** The small holes in the PCB which are covered with stop lacquer (solder mask) must not be soldered. They are the Vias (contact passages).

After assembly connect the silent drive according to the installation instructions. If the servo does not react, please check the polarity of the servo connection and the plug direction of the processor. No fear, even if misinstalled for a short time, the processor will usually be safe. Verify again the circuit. Should a component strongly warm up, please verify polarity of all components. Heat up to 50°C is

still normal with the voltage regulators. In addition all regulators are protected against overheating.

After the assembly of the electronic board, it's time to play with the combination of the electronic, the servo and the programming device. Place the servo's arm on the the servo's shaft, connect the servo to the electronic board and connect some supply voltage as well as the programming device. Do not put the board on metal. This happen more frequently than you think! Now you can play with all the adjustment possibilities. After this play phase, reset the board back to its factory default settings (see below).

Some hints:

- For different component the inscription can vary depending upon manufacturer. So the PC817 or PC814 can be marked also with LTV817 and/or LTV814. Also the ICs of the type 317T can carry different letter combinations such as LM317T, µA317T or similarly.

- **The ICs can have different characteristics for marking the pin 1. Usually it is a notch at the narrow end, where pin 1 is located. Another form is a diagonal edge at the side, where pin 1 is. If one takes for example IC3 on the assembly picture, then the notch would be down and pin 1 at the right of the notch. Then pin numbering is counter-clockwise. OK5 would have then pin 1 on the right above.**

- **The light emitting diodes are provided with a long and a short wire. The short wire (cathode) points to the inscription LED1 and/or LED2, thus to the edge of board.**

- **The two diodes 1N4148 and BAT43 may not be exchanged. Both diodes are marked but 1N4148 is supplied with a dark red band while BAT43 is supplied with a light red band. Should you exchange the diodes, no defect may appear, but the digital signal may be affected.**

- **The most sensitive components when soldering are the servo connections and the 2x2 jumper block. Small pressure on the pins may slide them thru the board. If that happens, you can slide the pin back by warming it up. The best is to avoid any pressure on the pins during soldering.**

Parts list:

Part	Value	Qty.	Designation	Note	Step	OK
Resistor	680	1	R15	Blue-gray-brown	1	
Resistor	220	1	R13	Red-red-brown	1	
Resistor	2k2	6	R8,R9,R14,R17,R18,R19	Red-red-red	1	
Resistor	1k5	11	R1,R2,R3,R5,R6,R7,R10,R12,R16,R20,R21	Brown-green-red	1	
Resistor	33k	2	R4,R11	orange-orange-orange	1	
Diode	**1N4148**	5	**D3,D4,D6,D7,D8**	**Consider polarity**	**2**	
Diode	**BAT43**	1	**D1**	**Consider polarity**	**2**	
Capacitor	100n	7	C2,C3,C4,C5.C6.C7,C10		3	
Optocoupler	**PC817**	4	**OK7,OK8,OK9,OK10**	**Consider polarity**	**4**	
Optocoupler	**6N137**	1	**OK6**	**Consider polarity**	**4**	
Optocoupler	**PC814**	4	**OK1,OK2,OK4,OK5**	**Consider polarity**	**4**	
Rectifier	**B40DIL**	1	**B**	**Consider polarity**	**4**	
IC-Socket	**28-pol**	1	**For IC3**	**Consider polarity**	**4**	
LED	**Green**	1	**LED2**	**Short wire outward**	**5**	
LED	**Red**	1	**LED1**	**Short wire outward**	**5**	
Pin row	3-poles	2	SERVO1,SERVO2		6	
Pin row	2x2-poles	1	M D		6	
Connector	4-poles	1	DIGI	Latch outward	7	
Connector	4-poles	2	RM1,RM2	Latch outward	7	
Connector	4-poles	2	AN1,AN2	Latch outward	7	
Connector	5-poles	2	PROG1,PROG2	Latch outward	7	
Connector	6-poles	2	POL1,POL2	Latch outward	7	
Connector	4-poles	1	~ ~	Latch outward	7	
Voltage regulator	**7805L**	1	**IC4**	**Consider polarity**	**8**	
Transistor	**BC337**	5	**T1,T2,T3,T4,T5**	**Consider polarity**	**8**	
Capacitor	**47μ**	1	**C8**	**Consider polarity**	**9**	
Relais	JZC-33F	4	REL1,REL2,REL3,REL4		10	
Capacitor	**470μ**	1	**C9**	**Consider polarity**	**11**	
Voltage regulator	**7812T**	1	**IC1 with radiator**	**Consider polarity**	**12**	
Voltage regulator	**LM317T**	1	**IC2 with radiator**	**Consider polarity**	**12**	
Processor	**ATMEGA8**	1	**IC3 socketed**	**Consider polarity**	**13**	

Bill of material
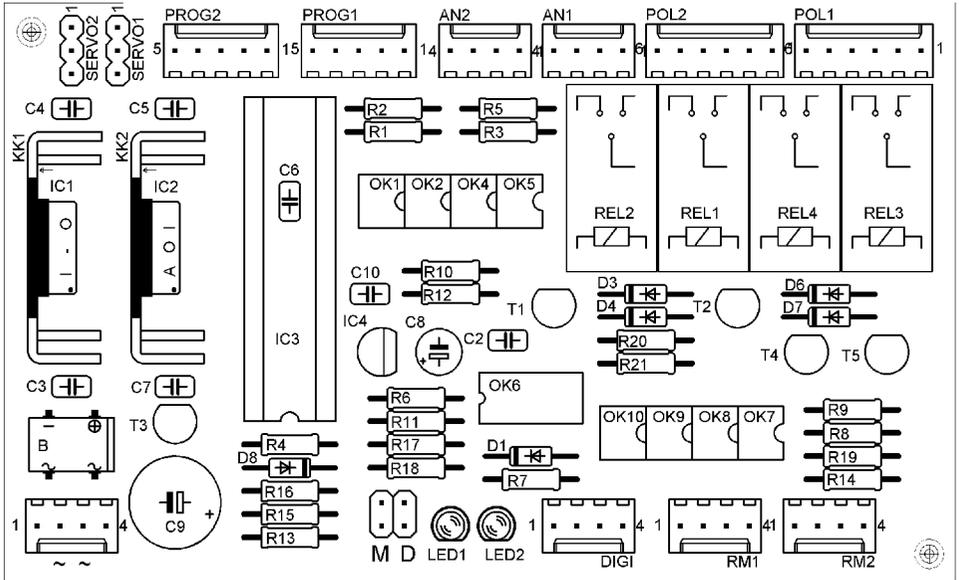
Assembled board
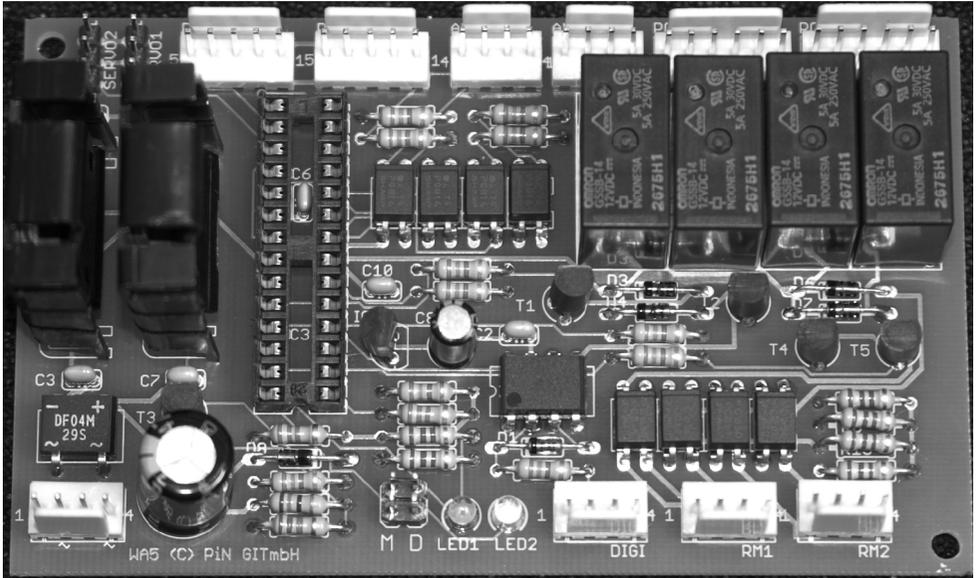
Installation and adjustment instructions

1. The spring wire needs a drill of approx. 8mm of diameter or a slotted hole of appropriate length in the direction of motion of the spring wire. In the case of use of a slotted hole the break-through is less noticeable, however the longitudinal positioning of the servo must take place more precisely. If the framework is very thin (few millimeters) then some additional material might be necessary to facilitate the motion of the spring wire. In any case, the spring wire should be allowed to move freely in all directions.

2. Connect the servos to the electronics (SERVO1 or SERVO2). Be aware that the connectors are not secured against polarity. The minus terminal of most servos is black or brown, the positive terminal red and in the center, and the impulse terminal (P) blue, white, orange or yellow. **The minus connections are identified on the board by a ' 1 ' and are at the border of the board.**

3. Connect the electronics to supply voltage (contacts 1+2 and 3+4 with ~~ marked plug). The pins 1+2 as well as 3+4 are connected on the PCB. This allows you to connect the arrival of the supply to Pin 1 and Pin 3 and connect next drive thru Pins 2 and 4. Two wires do not have to be "squeezed" into one contact.

4. At this time the servo moves to its central position. Electronics is setup at factory to generate the pulses for the central position of the servo. **It is mandatory to place each servo in this central position before installation. Should you modify the electronics at any time (or perform updates) you will avoid an uncontrolled position of the drive. The electronics is always supplied with the same basic settings and you can reset it to these settings**.

5. Switch the electronics off and disconnect the servo. **At this time do not adjust the servo arm.**

6. Put the double adhesive tape on the servo and put the servo's arm on the servo's shaft so that it is placed vertically downward. (Fig. 1 and Fig. 2). It is not necessary to bolt the arm. It is maintained fimrly on the shaft and won't move even in case of transportation of the layout. Insert the spring wire in the arm and fix it with a drop of glue in the lower hole.

7. Stick the servo with the adhesive tape, with the arm and spring wire so that the spring wire would bring the switch into the central position. The adhesive tape is only there to permit adjustment of the installation. **Do not adjust the position of the servo arm.**

8. Make sure the spring wire may move freely especially in case on a slotted hole and that nothing would disturb its movement. Now you can fix the servo with the enclosed mounting bracket.

9. Fasten the electronics near the servo. Connect the servo to the electronics and connect the supply voltage to the electronics. The servo cable can be extended with extension cords (separately available) up to a maximum of 2 meters.

10. Connect the programming device to the electronics at the desired port (PROG1/PROG2) and adjust the endpoints. **Please consider that as-delivered the two endpoints are identical, thus the servo won't move.** Only after at least one endpoint is setup will the servo move. This pre-setting to a null displacement is meant to avoid damages at installation time.

11. The green (straight) and red (branch) positions of the switch is not related to the installatation's position of the silent drive. Simply adjust the end positions of the switch like you want. Adjust the endpoints of the silent drive so that, for example, Green is the straigthforward position and Red is the branch position.

12. Please be aware that the colors of the LEDs are not related to the switch positions, but serve to distinguish the servos. The red LED1 is associated with Servo1, the green LED2 with Servo2.

13. To program the **green** (straight) end position, please press the following keys in sequence: the

black Progam key (S - schwarz) (the LED belonging to the corresponding servo starts to blink slowly), the **green** Direction key (G) (the LED belonging to the appropriate servo begins to flash faster, and the servo may possibly move) and again the **green** Direction key (G). The LED on the board shines now constantly. Now you can press the green or red Direction key to adjust the endposition. The servo moves slowly as you keep the key pressed. To store the programmed position press the black Program key S.

14. To program the **red** (branch) endposition, please press the following keys in sequence: the black Program key (S) (the LED belonging to the corresponding servo starts to blink slowly), the **red** Direction key (R) (the LED belonging to the appropriate servo begins to flash faster, and the servo may possibly move) and again the **red** Direction key (R). The LED on the board shines now constantly. Now you can press the green or red Direction key to adjust the endposition. The servo moves slowly as you keep the key pressed. To store the programmed position press the black Program key S.

15. In case you've selected the wrong direction, do not modify the endposition but press the key until the LED shines constantly and simply press the black Program key (S).

16. Now examine the spring wire action by hand. After reaching the endposition, only a small additional step is needed to maintain the pressure on the track. It is not necessary to apply a high pressure as the point rails are kept in the correct position by the spring wire.

17. Examine now the Green and Red positions by using the corresponding keys on the programming device. **Please be aware that, as initially setup at factory, the end positions are identical and thus the servo will not move. Only after at least one end position has been setup, will the servo move. This null displacement permit to avoid damages at installation if the servo were to travel with a too large span.**

18. Please note that by applying a too high pressure the power consumption will increase. This becomes apparent when the servo „humms". The electronics and servo are dimensionned to support this increased load but the power supply must be able to provide the additional current especially for several servos. Such operating conditions should be avoided.

19. For adjustment of the servo speed, press the black Program key (S) three times. At first pressure, the corresponding LED starts to flash slowly, at second pressure the LED begins to flash faster and at the third pressure the LED shines constantly and the servo starts to travel between the two end positions at the currently adjusted speed. Use the **Green** key to **increase** the speed and the **Red** key to **decrease** the speed. If you keep the key pressed, the speed will slowly change until you release the key. After you press the black Program key (S) the servo speed is stored in processor memory. Note that for very slow speed the movement is hardly noticeable.In case of doubt you can reset to the high-speed situation or maintain the green key pressed for some time. The longest travel lasts for approx. 160 seconds for 90 degrees, that is nearly 3 minutes.

20. For the choice of the digital systems (Motorola or DCC) use the jumper with the pin rows marked M D. To select Motorola format, put ythe jumper on M side, for DCC format on D side. If the jumper is missing or misplaced then the board will not react to the digital signal. The analog and programming connections are functional without any jumper.

21. To setup the digital address, connect the digital port to the digital supply (contacts 1+2 and 3+4 from DIGI). These contacts are, like the power supply contacts, connected by pair on the PCB to allow easy routing of the digital signal. Press twice on the black Program key (S). The corresponding LED start to flash slowly at first key, then faster at second key pressed. Using your digital system send a position command at the desired address. After reception of a valid position command from the digital system, the servo starts to move between the two end positions and the corresponding LED shines continuously. The sent address is finally stored when the black Program key (S) is pressed.

22. If you want to retrieve the factory default settings, press three times the black Program key (S) for more than 2 seconds each. The end positions, the servo speed, the special parameters are put back to their factory values and the digital address is deleted.

23. In case the servo hums at the end positions without high pressure, there is the possibility to stop the pulse generation after the servo has reached its end positions. You'll find the necessary combination of keys in the programming table in the lines entitled „End Position Impulse Deactivation". Please note that, in that case, the servo will be free to be moved from its current position

24. For the polarization of the frog or for other switching functions, you can use the included relays. The pin assignement and the connection diagram can be found in the table „POL1/POL2 Polarization".

25. In case you use the feedback optocouplers outputs, note that the maximum output current is 50 mA and the maximum voltage to be applied should be less than 70 V. Not also that the necessary current is not provided and verify the polarity of the connections. Usually a pull-up resistor is used.


Fig. 1

Fig. 2

Connection to the digital system:

The digital signal is attached to DIGI. The contacts 1+2 and 3+4 are connected together. It is then possible to fasten a cable to a plug and route the signal without several cables. Unfortunately the markings of the digital systems are very different. For the system from Lenz, the digital signal is available at connectors J and K while for Märklin system you should use wires brown and red from the Central or the Boosters. The polarity is not important.

Programming different speeds for each direction

The silent drive offers the possibility to program seperate speeds for each rotation direction. This can be used, for example, for reproduction of the fast stop case with emergency signals. Proceed as follows for the adjustment of each speed: Press the black Program key (S) twice. At first pressure the corresponding LED will blink slowly, then after the second the LED will blink faster. Then select the desired direction by pressing on the Green or Red key. The LED shines continuously and the servo starts to travel back and forth. If you press the green key now, the motion will become faster, if you press the red key, it will be slower. When the speed is adjusted, press the black Program key S.

Programming the settings for the second Digital address

This version of the silent drive makes it possible to give two additional end positions to each servo controllable over a second digital address. Follow this procedure: Press the black Program key S. Then press for more than 2 seconds the Red or Green key depending on the direction to setup. The servo moves to the central position or to the previously set second end position of the given color. Press shortly again the key of the color choosen, then you're able to adjust this second end position by using the color keys. By pressing on the black Program key S the adjusted position is then stored.

You set the rotational speed of these second endpositions by pressing the black Program key S once, then again with a long pressure, and then, as described above, for the calibration of the first endpositions.

The second digital address is adjusted by pressing the black Program key S once, then a second time for at least 2 seconds. Send a control command from the digital central and when the LED constantly shines and the servo moves back and forth, store the address by a last pressure on the black Program key S.

Adjusting the automatic movement

The silent drive WA5 can be programmed to select sequentially the four possible positions of a servo with ajustable delays. For each individual position the delay can be adjusted. These delays can be adjusted between a minimum corresponding to the relay and servo rotation delay up to a maximum of 1300 seconds. The sequence repeatedly follows the order green1, green2, red2 and red1. The positons green2 and red2 are used only if their corresponding delays are preset. If no delay is preset for position red1 or green1 then the sequence stops there. The operational sequence is started by a digital or analog set point command. If waiting periods are set for all positions, then the servo constantly rotates. During pause time, the LED associated with the position shines permanently.

Programming table:

Several key sequences are required to setup the various parameters of the silent drive. The basic adjustment functions are however easy to access and remember.

The description provides for each case the required key sequence. First the key is indicated, then the duration of the pressure (short or long). The long pressure on the key must take at least 2 seconds.

In the table the first letter means the key (R=red, G=green, S=schwarz/black) and the second letter means the duration of the key pressure (K=kurz/short, L=long – at least 2 seconds). If only the key letter is indicated, you can press longer on the key for adjusting the function. The letter U in the table means „Await circulation", until the servo is in the correct position. If the letters are lower case, then

this is the actual adjustment procedure. If the electronics reacts with a back and forth motion of the servo, this is characterized by the letter P (oscillation, pendular).

Operating sequence for Settings:

Key sequence	Settings
Test of the Settings	
GK	Test Green End Position 1
RK	Test Red End Position 1
GL	Test Green End Position 2
RL	Test Red End Position 2
Settings for the first end positions	
SK GK U GK g/r SK	Green End Position 1
SK RK U RK g/r SK	Red End Position 1
SK SK SK P g/r SK	Speed 1
SK SK GK P g/r SK	Speed for green 1
SK SK RK P g/r SK	Speed for red 1
SK SK <cmd> SK	Digital Adress 1
Settings for the second end positions	
SK GL U GK g/r SK	Green End Position 2
SK RL U RK g/r SK	Red End Position 2
SK SL SK P g/r SK	Speed 2
SK SL GK P g/r SK	Speed for green 2
SK SL RK P g/r SK	Speed for red 2
SK SL <cmd> SK	Digital Adress 2
SK SL SL	Erase Digital Adress 2
Reset the second end positions	
SK SK SL P g/r SK	Speed 2 set to Speed 1
SK GK SL	Green End Position 2 set to Green End Pos. 1
SK RK SL	Red End Position 2 set to Red End Pos. 1

Special settings:

Key sequence	Settings
SL SL SL	Reset all values to factory default
SL SK GK	End Position Impulse Deactivation on
SL SK GL	End Position Impulse Deactivation off
SL SK RK	Automatic sequence on
SL SK RL	Automatic sequence off
Automatic sequence	
SL GK GK r/g SK	Pause1 green (Pause length = Stop time green key, red key = Pause set to zero)
SL RK RK r/g SK	Pause1 red
SL GL GK r/g SK	Pause2 green
SL RL RK r/g SK	Pause2 red

Technical Data:

Description	Electronics for the independant control of two model radio control servos
Pulse type	positive pulse, 1-2ms, center position 1,5ms
Operating voltage	12-18V a.c.- or 16-24V d.c. voltage
Digital input	DCC- or Motorola-Digital signal
Current consumption	Approx. 80 mA quiescent, 100-400mA in action (dependent on the mechanical load and the servo speed)
Settings	End positions and peripheral speed for each servo digitally programmable
Relay output	For each end position of each servo a relay 1xum with 5A maximum load
Feedback signal	For each end position of each servo an optocoupler output (transistor)

Assignment of connectors:

~ ~ (Supply voltage)

Pin	Assignment	Supply
1+2	Supply (Plus or Minus)	AC voltage 12-18V DC voltage 16-24V
3+4	Supply (Minus or Plus)	

AN1/AN2 (Analog input)

Pin	Assignment	Comment
1+3	Red position	Red position has priority
2+4	Green position	DC or AC voltage starting approx. 9V, approx. 10-15mA

DIGI1/DIGI2 (Digital input)

Pin	Assignment	Comment
1+2	Digital signal	J (Lenz), brown (Märklin) or appropriate signal
3+4	Digital signal	K (Lenz), red (Märklin) or appropriate signal

RM1/RM2 (Optocoupler feedback signal)

Pin	Assignment	Comment
1	Red Optocoupler Emitter	NPN-Transistor, max. 50 mA
2	Red Optocoupler Collector	Max. 50 mA
3	Green Optocoupler Emitter	NPN-Transistor, max. 50 mA
4	Green Optocoupler Collector	Max. 50 mA

SERVO (Servo)

Pin	Assignment	Connection
1	Ground (PCB edge)	Black or brown
2	Plus	Red
3	Pulse (PCB center)	White, yellow or orange

PROG1/PROG2 (Programming device) Warning: Polarity opposite to WA4!

Pin	Assignment	Connection
1	Ground	To all 3 keys
2	Green position	To Green key (green)
3	Red position	To Red key Rot (red)
4	Programm input	To Program key (blue/black)
5	Green	free (NC)

POL1/POL2 Polarisierung

Pin	Assignment
1	Green normal close
3	Green normal open
2	Red normal close
5	Red normal open
6	Red relay common
4	Green relay common

Frog polarization

Kontakte an POL1 o. POL1

3

6+4

5
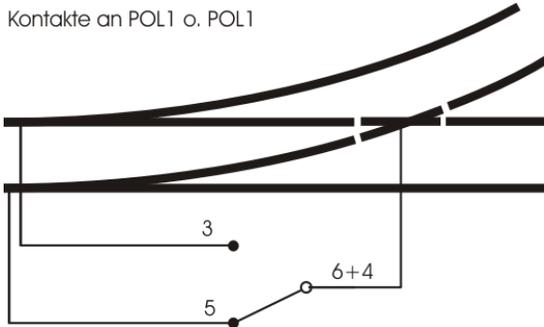
Connection variants for the analog operation

two momentary switches

STRAIGHT

~ 1 2 AN1(2) o. AN2(2)

THROWN

1 2 AN1(1) o. AN2(1)

~ AN1(3+4) o. AN2(3+4)

toggle switch

TOGGLESWITCH

1 AN1(2) o. AN2(2)

~ 2

3 AN1(1) o. AN2(1)

~ AN1(3+4) o. AN2(3+4)
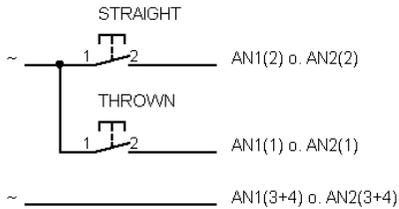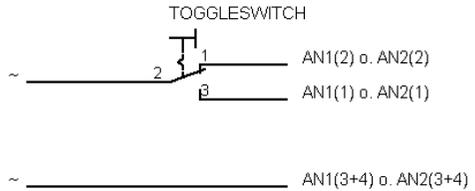
make switch (relais replacement)

MAKESWITCH

~ 1 2 AN1(1) o. AN2(1)

AN1(2) o. AN2(2)

~ AN1(3+4) o. AN2(3+4)
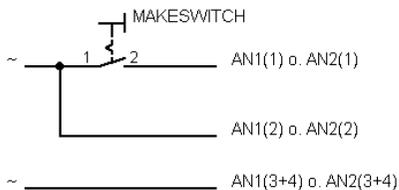
toggle switch (polarity reverse)

REVERSE

1

2 1N4148 AN1(2) o. AN2(2)

3

1N4148 AN1(1) o. AN2(1)

+ 4

5 AN1(3+4) o. AN2(3+4)

- 6

REVERSE

14

15
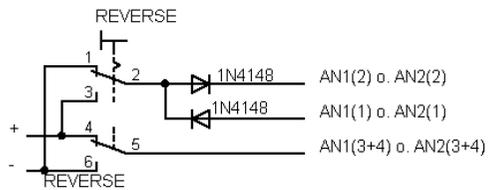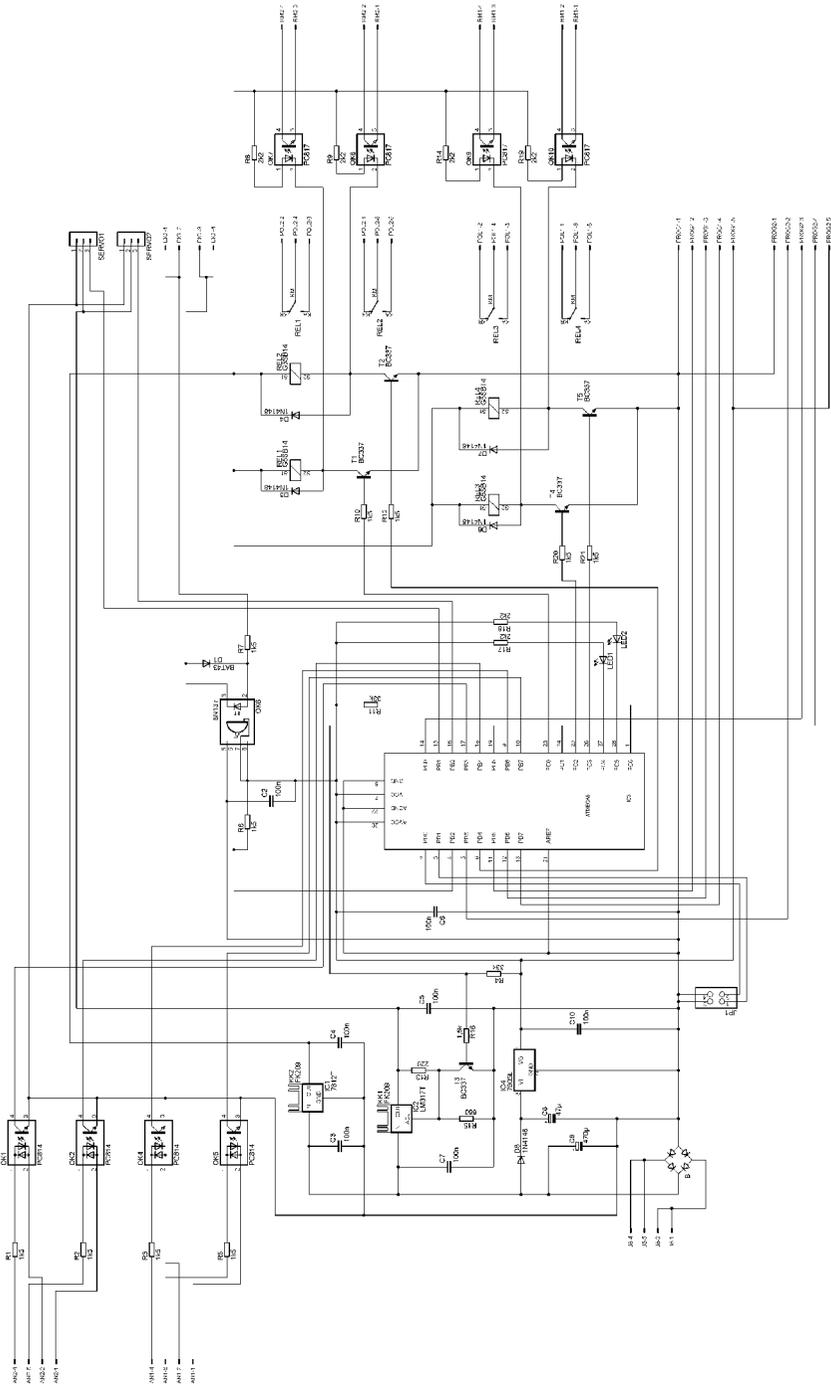
And now we wish you a lot of joy with your new point mechanism.

You can send questions by e-mail, fax or a letter with return postage. We will answer them immediatly.

The contact address is:

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