MODELLBAHN DIGITAL PETER STÄRZ

Dresdener Str. 68 – D-02977 Hoyerswerda – ☎ 🖷 +49 3571 404027 – www.firma-staerz.de – info@firma-staerz.de

Short circuit proof reverse loop module for large scale railways for all digital control systems

KS-GB
v1-2007

based on dynamic occupancy detection

Degree of difficulty: easy
medium
difficult

Necessary skills:
- Simple assembly and soldering procedure of the board

The reverse loop module KS-GB is a device for adjusting polarity of model railway reverse loops automatically. The module monitors sensor track blocks and switches the polarity of the reverse loop accordingly. Reverse loop module KS-GB can be used with all digital control systems.

Special features

- suitable for all digital systems
- absolutely short-circuit-free due to sensor tracks
- occupancy detection within the reverse loop sections is possible
- minimum power consumption by bistable relays
- Up to 8A continuous, up to 15A short time

Technical specifications

Size
64mm x 77mm x 30mm

Power Supply
The module is powered by track voltage or the digital voltage from a booster or a central unit.

Operating current
5mA (idle)
50mA (during the switching operation lasting for about 30ms)

Output current
8A (continuous)
15A (short time)

Connectors (Screw terminal blocks 5mm pitch)
5 terminals for sensor track 1 and 2:
    10   Red (Senors1 R)
    9   Blue (Sensor1 B)
    8   Occupancy detection
    7   Blue (Sensor2 B)
    6   Red (Sensor2 R)
3 terminals for the reverse loop section
    5   Blue (Kehrschl B)
    4   Occupancy detection (Kehrschl S)
    3   Red (Kehrschl R)
2 terminals for power feed
    2   Red (Input R)
    1   Blue (Input B)

Assembly notes
The reverse loop module KS-GB is assembled following the instructions on the next page. For soldering the components on the PCB a soldering iron of 12 to 25 Watts or a soldering station with the temperate set to approx. 400℃ is needed togeth er with 0.5 or 1.0 mm soldering wire with rosin flux. No special tools are required. Do not use soldering flux! Pay attention to solder speedy to avoid device damage by overheating.

Installation site

Your reverse loop module should be located in a dry, ventilated and clean area being easily accessible and lying beside or next to the model railway layout.
The reverse loop module KS-GB must kept free of coarse dirt or electro conductive parts falling down.
The reverse loop module KS-GB may be arranged without a housing needed. In that case the module shall be put on an insulating sub floor by means of the plastic spacer sleeves and screws delivered.
Keep all electro conductive tools, assembly kits and cables away from the reverse loop module KS-GB during operation, please.
A negligently and by external circumstances caused short-circuit (impinging on the module from above or from the bottom) may destroy the reverse loop module KS-GB. If that happens, all terms of warranty will become invalid.

Accessory and expendabilities

The following equipment is available:
Housing:
-   **Housing for KS-GB: G 523**   **Art. 203**

For further information, please refer to the FAQ section of our website at http://www.firma-staerz.de.

Kit contents

Please first verify that the kit contains all the components listed below.

General parts:
    1x circuit board
    3x diode BYW54
    2x relay
    1x voltage regulator 78L05
    4x screws
    4x spacer rings
Connectors:
    2x Terminal clamps 3-pin (5mm pitch)
    2x Terminal clamps 2-pin (5mm pitch)
ICs:
    4x SFH628A-3
    1x 8-pin IC socket
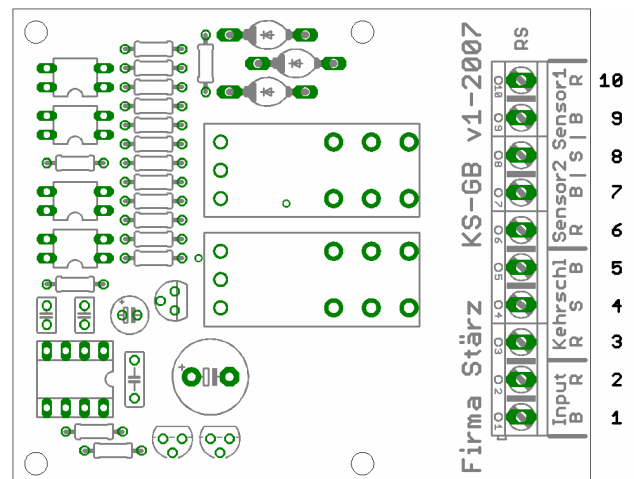   1x PIC12F629
Transistors:
    2x transistor 2N7000
Capacitors (marking):
    1x ceramic 100nF (104Z)
    2x ceramic 47pF
    1x electrolytic 47µF
    1x electrolytic 220µF
Resistors (marking):
    8x 3,9kOhm (orange, white, black, brown, brown)
    4x 390Ohm (orange, white, black, black, brown)
    1x 47Ohm (yellow, lilac, black, silver, brown)
    2x 10kOhm (brown, black, black, red, brown)
    2x 1,5kOhm (brown, green, black, brown, brown)

Terminal assignment

Maintenance and care

Dust clumping together can, in combination with condensating liquids, become conductive and deteriorate the functionality of the short circuit proof reverse loop module KS-GB. It is therefore important to remove dust regularly by blowing it off or vacuuming the module.
CAUTION: A liquid cleaning of the part is prohibited!

Non-Use
When the short circuit proof reverse loop module KS-GB is not used it should be stored at a dry and clean place.

The Instruction
The full content of the instruction is important. Very important information is marked in **colours**; critical information is highlighted in red.

Assembly instruction

Assemble the kit in the order of these instructions. All components are placed on the top side of the PCB (marked "top") as close to the PCB as possible and soldered on the bottom side of the PCB (marked "Bottom"). Use a bending tool (e.g. Conrad 425869 – 62) for bending. Cut the leads of components flush using a wire cutter after soldering.

Solder cleanly and precisely!

1. Resistors

Bend the resistor leads for 7.5 mm pitch before insertion. To facilitate placing components on the PCB support the edges of the board with the help of two books, for instance, to leave enough space for the leads under the board. Insert the resistors on board aligning the coloured rings of all the resistors in the same way to make it easier to verify the value of the resistors later. Place a suitable plane piece of wood or similar on top of the resistors on board. Turn the board together with the wood upside down. The underside of the board is now conveniently accessible for soldering the components.

Solder one end of each resistor first and check that they are positioned properly before soldering the other end of each resistor.

R1 - R8:	3,9kOhm	(orange, white, black, brown, brown)
R9 - R12:	390Ohm	(orange, white, black, black, brown)
R13:	47Ohm	(yellow, lilac, black, silver, brown)
R14, R15:	10kOhm	(brown, black, black, rot, brown)
R16, R17:	1,5kOhm	(brown, green, black, brown, brown)

2. Diodes

Proceed as with resistors. Observe the polarity of components: the stripe on one end of a diode must be aligned with the stripe printed on the circuit board silkscreen layout.

D1 - D3:   BYW54

3. Optocouplers

Observe the polarity: The orientation notch of the component must be aligned with the one printed on the circuit board. In case of optocouplers being marked otherwise, the designation must show to the inner side of the circuit board.

U1 - U4:   SFH628A-3

4. Socket for PIC

Place and solder the PIC socket with the notches according to the component layout diagram on the PCB.

Sockel: Socket for PIC

5. Ceramic capacitors

C3:   100nF (104)
C4, C5:   47pF

6. Voltage regulator, transistors

The transistor and the voltage regulator can be placed simultaneously when proceeding similar to the resistors. Do not confuse the transistors with the voltage regulator 78L05!

V1, V2:   2N7000
V3:   78L05

7. Terminal blocks

Pay attention to the correct alignment and attach the terminal blocks before soldering.

X1:   10-pin terminal

8. Relays

Place and solder according to the component layout diagram.
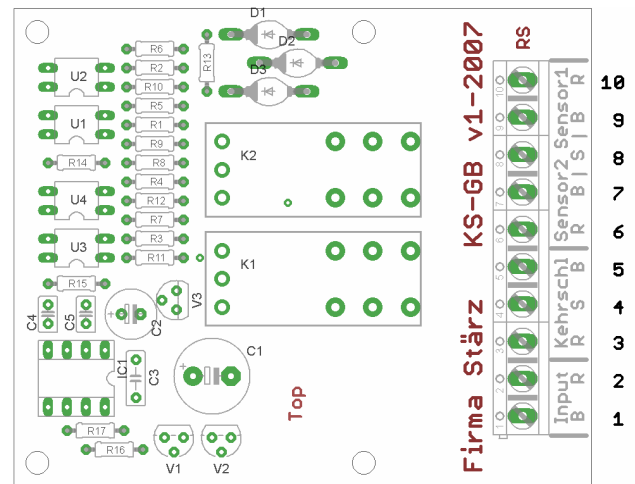
K1 – K2:   Relays

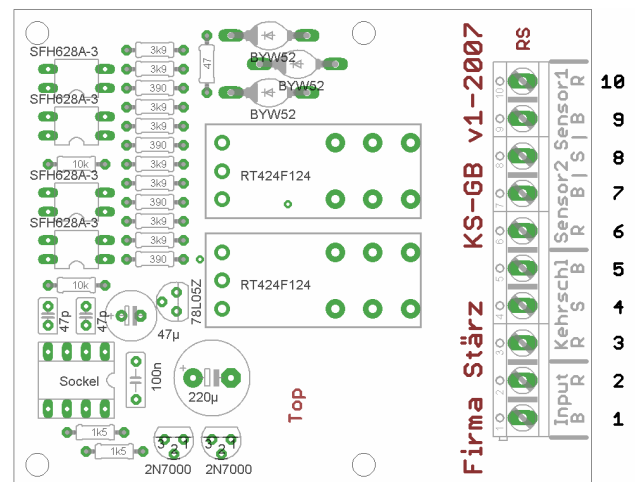### 9. Electrolytic capacitors, watch polarity!

The minus side of the capacitor must be facing the terminal blocks, the plus side (longer lead) must be towards to PCB edge.

C1:   220µF
C2:   47µF

Component layout diagram on the PCB

Populated PCB

10. Verification and mounting the PIC

After soldering all components on the PCB verify once more that they are placed according component layout diagram and that they are oriented properly. Check that all solder points on the bottom side of the PCB look correct. Note especially if there are any undesired solder bridges between solder pads.

After the verification the PIC can be mounted:

IC1:   PIC

Description of operation

Operating principle of the reverse loop module

Every reverse loop is equipped with two sensor track sections, one at both ends of the reverse loop section. A train entering the reverse loop is detected when it reaches the first sensor track. The polarity of the reverse loop is then adjusted dynamically for the incoming train. For train detection to work it is not necessary to have either a locomotive or an illuminated coach in front of the train. The minimum requirement is at least one axle with metallic wheels in the train. If, however, the reverse loop is monitored with a block occupancy detector (sensor track blocks 1 and 2 and the reverse loop block), current drain sensors of the occupancy detector will require either a locomotive or an illuminated coach in the train. The entry sensor track block detects the train entering the reverse loop and switches the polarity of the loop block accordingly in order to avoid a short circuit. When the train reaches the exit side sensor block, the polarity of the loop section is inversed again to match the polarity of the track section following reverse loop thus avoiding a risk of short circuit again.

An external power supply for the module is not required since the digital power for the track provides the power for the module as well.

Occupancy detection in the reverse loop

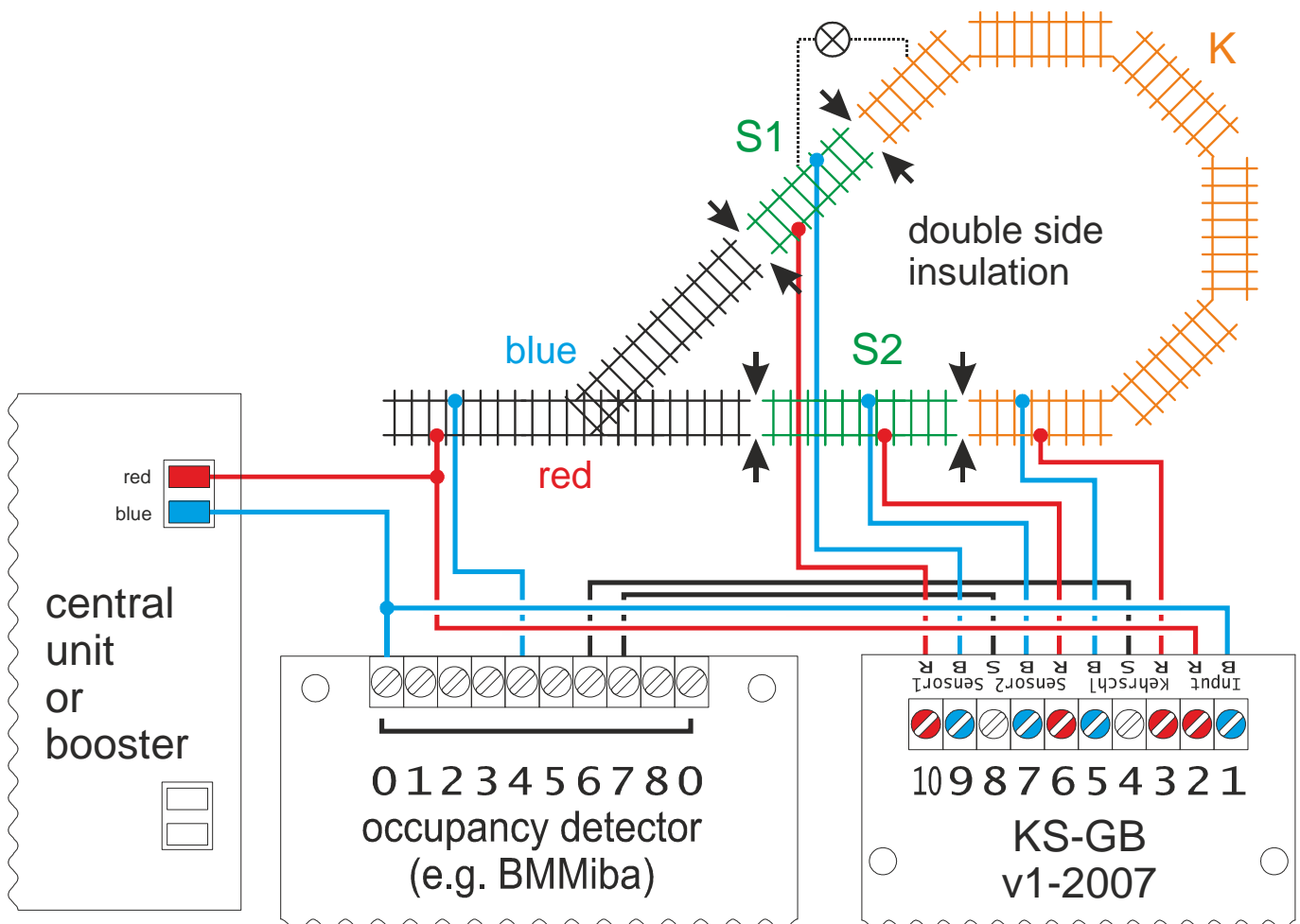Occupancy detection is possible for the entire reverse loop section.

The section is divided in three blocks: Sensor track 1, sensor track 2 and reverse loop section. Two occupancy blocks are defined: A common one for the two sensor tracks and one for the reverse loop section itself. Those blocks can be forwarded to any block occupancy detector unit. For occupancy detectors which can monitor several blocks (e.g. Selectrix detectors) that also means that those two blocks can be connected to any free slot of any occupancy detector or even to several different occupancy detectors. The reverse loop does not require a dedicated detector unit and the remaining decoder circuits of one unit can be used for other track blocks in the layout.

Bringing into service

Before using the module for the first time, the wiring of the module should be tested. This is best done using a light bulb (voltage 16V-19V, current 30mA - 50mA). When the power is switched on, simulate a locomotive in section S1 by connecting the light bulb on the left and the right rail in S1 (KS-GB may switch the loop polarity). Now connect the light bulb between the blue rail of S1 and the blue rail of the track outside the loop sections. If the lamp is on, the blue and red wires of section S1 have to be inversed. Next, test the section K by connecting the light bulb on the blue rail of sections S1 and K as shown. If the lamp is on, red and blue wires of section K are to be inversed. Now simulate a locomotive on section S2 by connecting the light bulb on both rails of the section (again, KS-GB may switch the loop polarity). Test the lamp on blue rails of S2 and K. If the light is on, the two wires of S2 are to be inversed.

Connection scheme

Reverse loop with occupancy detector

Connection of the reverse loop module

The correct wiring is vital for the proper functioning of KS-GB reverse loop module (see 📖 bringing into service for hints).

To connect the reverse loop module the track forming the reverse loop has to be made up of 3 double side insulated consecutive rails. The insulated track sections are connected as follows:
-   Sensor track block 1 (S1, green, terminals {9, 10}),
-   Reverse loop block (K, orange, terminals {3, 5}) und
-   Sensor track block 2 (S2, green, terminals {6, 7}).

The reverse loop block must be at least as long as the longest train that will travel through the loop.

For sensor track blocks a length of 5 to 10 cm is sufficient.

Even if the reverse loop is long enough for several occupancy detection blocks, the three blocks S1, K and S2 must always be placed in the same consecutive order next to each other. Additional blocks must be placed outside these three sections. Section K cannot be divided in several detection blocks.

For all the three track sections there are the track wires red (R) and blue (B). The wiring of a simple reverse loop is shown in the picture below. Some variations to the basic loop are also given and

in some cases two reverse loop modules are required, but the same connection principles apply.

Terminals 1 (B) und 2 (R) serve as the connection point to the rest of the model railway layout. They also supply the power to the reverse loop module and the track current for reverse loop track sections S1, K and S2.

The further wiring of the reverse loop module KS-GB depends on whether an occupancy detector is used or not.
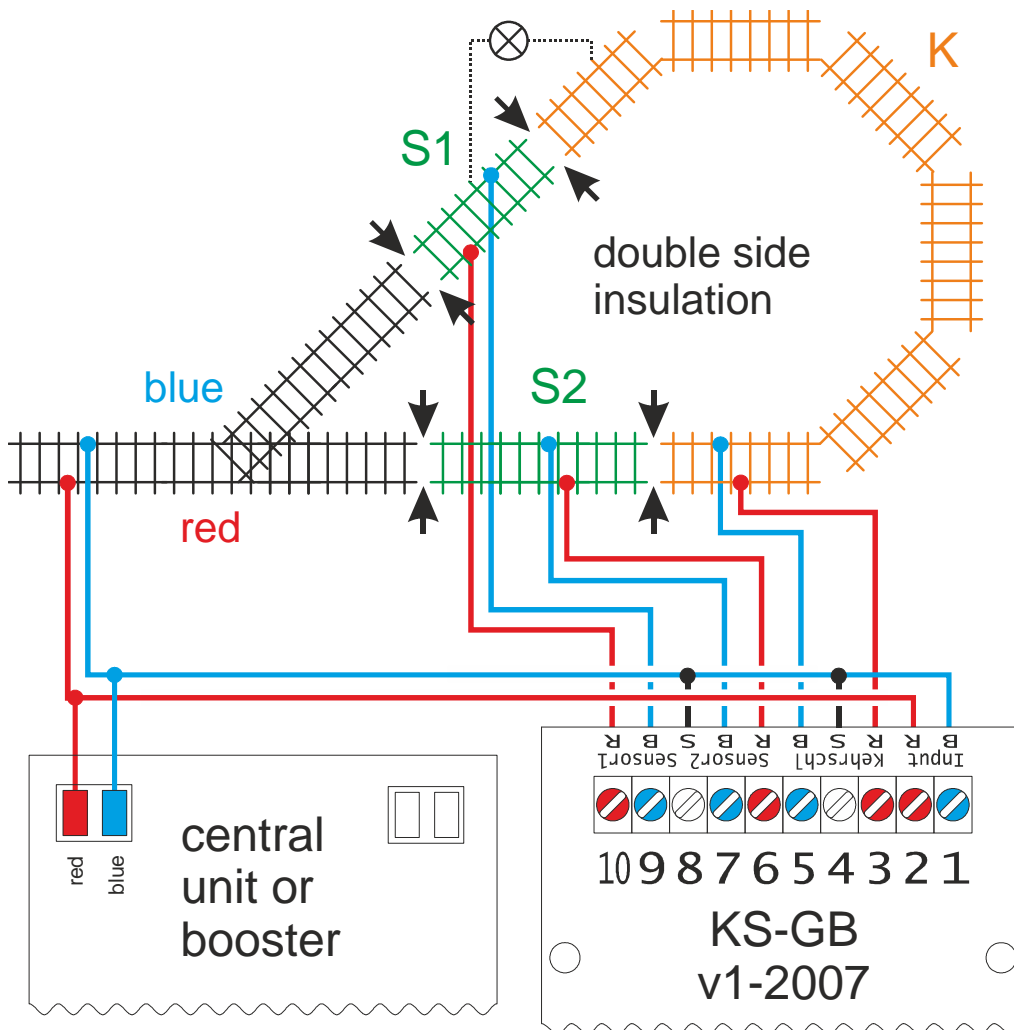
Wiring variations with or without a detector unit are shown below.

If the reverse loop is only partially monitored for track occupancy (for instance, K monitored, sensor tracks 1 and 2 not), all the unused occupancy signals must be wired together and to the terminal 1. (In our example the terminals 8 would be wired to terminal 1).
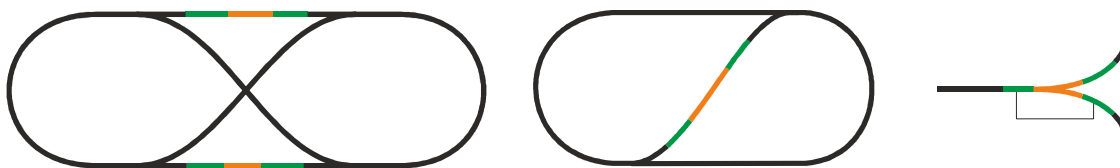
If there is no occupancy detector unit at all, the terminals 1, 4 and 8 must be wired together as shown in the illustration "Reverse loop without an occupancy detector" below.

Pay attention to the colours in the connection schemes: colours can differ or be inverted. Blue is used here for the track connection that is distributed to the occupancy detectors.

Reverse loop without occupancy detector

Other schematic track layouts

Modellbahn Digital Peter Stärz, Dresdener Str. 68, D-02977 Hoyerswerda

Illustrations and technical data are subject to change. We are not responsible for printing or typographical errors.   **Printable version of 27.09.2012**