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Loco Controller with 3-digit Display

for Selectrix, Selectrix-2, DCC and Motorola
with SX-Bus-Plug

DHR-PIC
v1a-2013



Degree of difficulty: easy
medium
difficult

Necessary skills:

- Assembly of the PCB
- Drill, countersink und saw/mill the case
- Dismantle and wiring a 5-pole cable

The Loco Controller DHR-PIC is a comfortable and easy to use hand control unit with SX-Bus-Plug supporting several protocols.

Additionally to Selectrix also the digital formats Selectrix-2, DCC and Motorola are supported. That allows the Control Panel SPF-PIC not only to be used in combination with the Professional Central Unit ZS1, but also with the Digital Central Unit ZS2 or the MTTM FCC.

Five keys and one rotary switch and the 3-digits display grant easy access to controlling locomotives in address range 0 to 999 – also with one hand only.

Special features

- supports Selectrix, Selectrix-2, DCC, Motorola
- Easy handling

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Technical specifications

Compatibility

The following table lists the digital formats and address ranges supported by the Loco Controller DHR-PIC. The Loco Controller DHR-PIC connects to the central unit via the SX-bus.

That makes the Loco Controller DHR-PIC compatible with all Selectrix-only central units and with central units that are equipped with an SX-bus and where the support of different digital formats is based on the Selectrix frame extension.

Supported digital formats and address ranges

The Loco Controller DHR-PIC supports the following digital formats and address ranges:

| Digital format | Address range | Speed steps |
|----------------------|---------------|-------------|
| Selectrix | 0 – 103 | 0 – 31 |
| Selectrix-2 | 1 – 999 | 0 – 127 |
| DCC, short addresses | 1 – 127 | 0 – 28 |
| DCC, long addresses | 1 – 999 | 0 – 28 |
| Motorola (MM new) | 1 – 255 | 0 – 28 |

Size

74mm x 125mm x 27mm

Power supply

The power supply is provided by the SX-bus.

Display

3-digits display

Plugging

The Loco Controller DHR-PIC is delivered with an SX-bus cable. It can be hot-plugged to any of the model railway's SX-bus jacks.

The Loco Controller DHR-PIC must never be connected to the PX-bus!

Assembly notes

The Loco Controller DHR-PIC is assembled following the instructions on the next page. For soldering the components on the PCB a soldering station with the temperate set to approx. 400°C is needed together 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.

Be aware that the PCB mounts from the two sides. For assembly of the case a drill machine (or a portable electric drill), according drill bits (2,0 mm, 7 mm) and a countersink for M2 counter-sunk screws is required.

Non-Use

When the Loco Controller DHR-PIC 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**.

Kit contents

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

General parts:

- 1x PCB
- 1x 28-pin IC socket
- 1x voltage regulator 78L05
- 5x push buttons
- 1x rotary switch
- 3x 7-segment-element
- 1x display frame with red glass
- 1x SX-bus cable (insulated at one side)
- 1x cable strap
- 1x case and sticker
- 1x rotary knob with cover
- 4x counter-sunk screw long
- 4x washers
- 12x threaded stud

ICs:

- 1x PIC16F913
- 1x LM339N

Transistors:

- 1x transistor BC557
- 3x transistor BC547

Capacitors (marking):

- 2x electrolytic 47µF
- 3x ceramic 100nF (104Z)
- 2x ceramic 220pF (221)

Resistors (marking):

- 2x 10kOhm (brown, black, black, red, brown)
- 11x 22kOhm (red, red, black, red, brown)
- 6x 4,7kOhm (yellow, lilac, black, brown, brown)
- 8x 680Ohm (blue, grey, black, black, brown)
- 2x 100Ohm (brown, black, black, black, brown)
- 1x 120Ohm (brown, red, black, black, brown)

Maintenance and care

The Controller DHR-PIC should be cleaned from time to time by blowing or wiping.

The use of any kind of liquid for cleaning is prohibited explicitly.

Please also visit our FAQ page at www.firma-staerz.de for any question first.

Assembly instruction

Assemble the kit in the order of these instructions. All components (except the push buttons, rotary switch and 7-segment-elements) 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"). **The Push buttons, rotary switch and 7-segment-elements are placed on the bottom side and also soldered on that side. All devices have to be placed absolutely plane and equally and must not distance nor bias the PCB.** 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 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, R2: | 10kOhm | (brown, black, black, red, brown) |
| R3: | 120Ohm | (brown, red, black, black, brown) |
| R4, R5: | 100Ohm | (brown, black, black, black, brown) |
| R6-R11: | 4,7kOhm | (yellow, lilac, black, brown, brown) |
| R12-R22: | 22kOhm | (red, red, black, red, brown) |
| R23-R30: | 680Ohm | (blue, grey, black, black, brown) |

2. Socket for PIC, IC

Place and solder the PIC socket and IC3 with the notches according to the component layout diagram on the PCB.

| | |
|---------|----------------|
| IC3: | LM339N |
| Socket: | Socket for PIC |

3. Ceramic capacitors

| | | |
|----------|-------|-------|
| C1 - C3: | 100nF | (104) |
| C6, C7: | 220pF | (221) |

4. Transistors and voltage regulator

The transistor and the voltage regulator can be placed simultaneously when proceeding similar to the resistors. Do not confuse the transistors BC547 and BC557 with the voltage regulator 78L05!

| | | |
|--------|-------|------------------------------|
| Q1: | BC557 | (flat bright labelled front) |
| Q2-Q4: | BC547 | (flat bright labelled front) |
| IC2: | 78L05 | (black front) |

5. 7-segment-element, push buttons and rotary switch

Place and solder these in this order on the bottom side of the PCB. Watch out to place 7-segment-elements with the correct orientation (dots downwards).

6. Electrolytic capacitors, watch polarity!

Electrolytic capacitors are placed reclined. The positive pole (longer lead) of C4 and C5 must face to the left, so that minus poles show towards the shielding.

| | |
|---------|------|
| C4, C5: | 47µF |
|---------|------|

7. Wiring the SX-bus cable

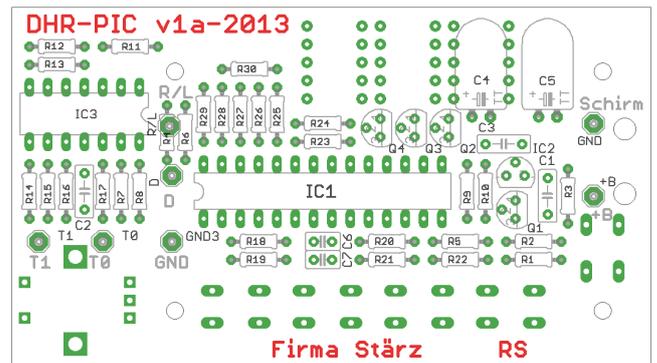
Verify that one of the pins of the SX-bus cable is shortened. The cable is soldered to the corresponding pads on the PCB. To do so dismantle and tin the single wires for about 5 mm and route them through the top side to the bottom side and solder here. Pay attention to not damage the insulations of single wires while soldering another.

| | | | |
|----------------|-----------|---------------|----|
| Non insulated: | Shielding | Yellow: | T1 |
| Black: | D | Orange/Green: | +B |
| Red: | GND | Brown/Blue: | T0 |

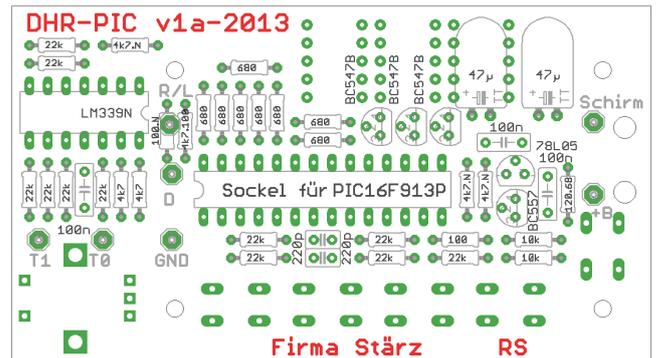
Especially watch out not to violate the insulation of the single wires. The Shield ("Schirm") must never get in contact with other pins (e.g. pins of the push buttons).

Finally the cable is fixed on the PCB using the cable strap. The cable strap must be tightened in a way that a reliable strain relief is granted. The end of the cable strap must be on the top side of the PCB (see image on the following page).

Component layout diagram on the PCB



Populated PCB



8. 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.

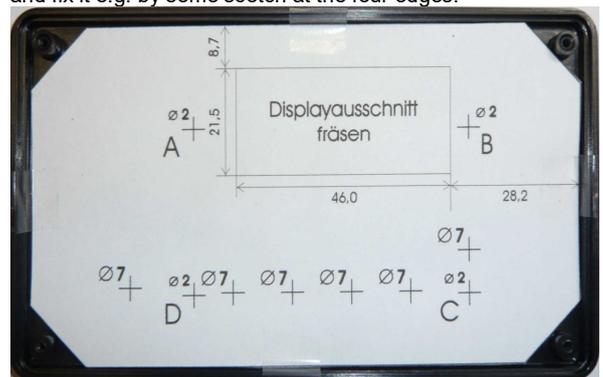
After verification the PIC can be mounted (Notch to R8).

9. Preparing the top case part

The case is to be drilled at several places. To do so, use the drilling template printed on the very last page of these instructions and work very carefully. The PCB might not fit the case properly when to big tolerances occur.

The case top is the flat one of the two case parts.

1. Cut out the drilling template (see below) precisely.
2. Lay the drilling template into the inner side of the case top part and fix it e.g. by some scotch at the four edges.



3. Use a needle to mark drill holes.
4. Scratch the display frame with a sharp tool.
5. Check not to have forgotten any drill hole.
6. Dismantle scotch and drill mask.

7. Use drill of 2.0 mm pitch to pre-drill all holes.



8. Re-drill the bigger holes of 7.0 mm.

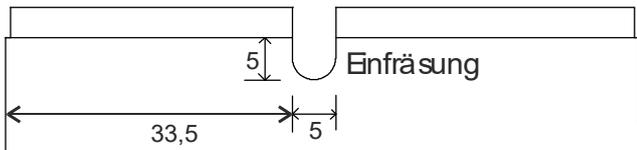
9. Counter-sink the holes of 2 mm. Use a 90°-counter-sunk.



10. Use a fine fret saw or similar to saw the display frame and clean the edges with a fine file.

10. Preparing the bottom case part

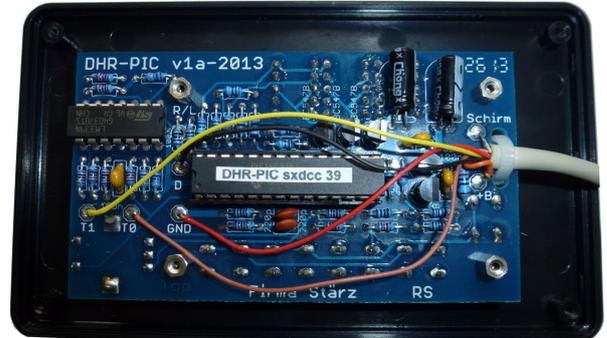
The case has to be prepared to contain the cable corresponding to the following drawing by milling or sawing.



11. Mounting into the case

After concluding the assembly of the main PCB and the display module, they are mounted to the top case part.

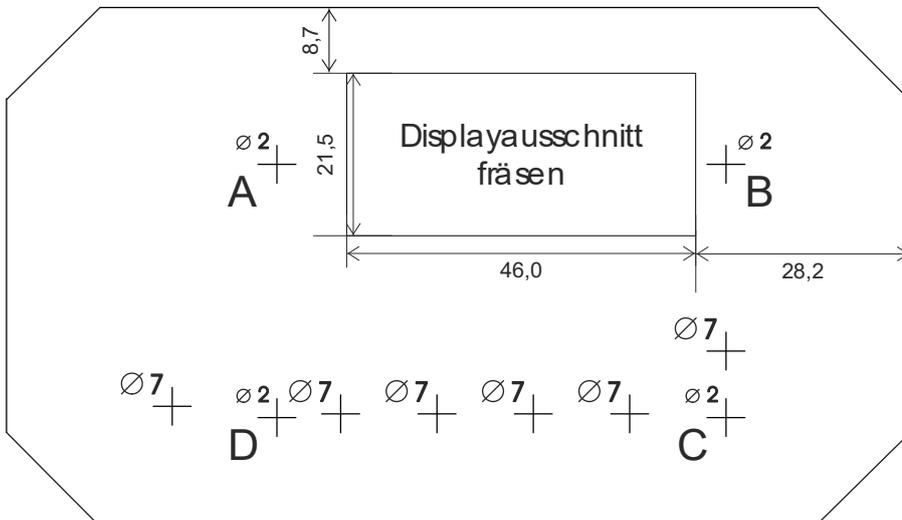
1. Insert the 4 long counter-sunk screws from the case front (A, B, C, D), add 2 washers each and tightened with 1 short threaded stud.
2. Cut out the white areas of the front sticker and attach it to the case. The sticker matches exactly the framed part of the case. Work very precisely here.
3. Add one washer each, mount the main PCB and fix it with the remaining 4 short threaded studs.



4. Mount the bottom case part and fix it using the case screws. Pay once again attention not to quench the SX-bus cable.
5. The rotary knob is assembled. Leave a space of about 1mm to the front to ensure the push button option of the rotary switch
6. Attach the cover to the rotary knob.

Drilling template

Please cut this drilling template carefully and use it for the case according to the assembly instruction point 9



Respect the following remark if you print this document yourself:

You may only use this drilling template if you printed this document in original size!

To do so, select "Page adjustments: None" in your printer settings.

The template has to have a width of 119.2 mm.

Description of operation

Bringing into service

After assembling the Loco Controller DHR-PIC can be hot-plugged to any of the model railway's SX-bus jacks. At start-up the start screen indicating the software version of the Loco Controller DHR-PIC is displayed for a few moments. Then it is switched to the menu  Selection of a locomotive where you enter the address and digital format for the locomotive to choose.

Signs and symbols

In these instructions the following symbols are used:

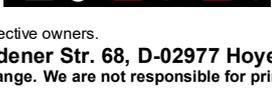
| symbol | name | Explanation |
|---|------|--|
|  | ZE | Press button ZE. Turns on and off the power of the rails |
|  | Lok | Press button Lok. Opens the menu  selection of locomotives |
|  | Li | Press button "light" Switches on and off the loco light |
|  | F | Press button F Activates second loco function |
|  | <> | Press button "<>" Changes direction of travel of the loco |
|  | Push | Press rotary switch Confirm selection (function varies) |
|  | Turn | Turn rotary switch Change selection (function varies) |
|  | | Link to other section of these instructions |

Selection of a locomotive

When switching to the locomotive selection menu, the format and the address of the locomotive are chosen. In the following pictograms blinking is represented by a white hollow.

Selection of digital format

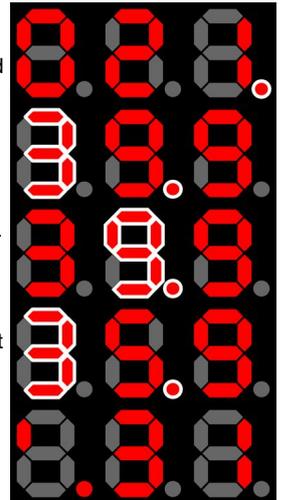
The selected digital format is indicated by blinking points whereas the numbers indicate the address of the locomotive (of the selected format)

| | | |
|---|---|---|
|  | Change to menu selection of a locomotive (last used loco (here SX1) is displayed) |  |
|  | Changes to another digital format (here: Selectrix-2) |  |
| | DCC, short addresses: center and right points blink |  |
| | DCC, long addresses: left and center point blink |  |
| | Motorola (MM new): left point blinks |  |

Selection of an address

After the selection of the digital format the address of the locomotive can be chosen. Blinking numbers highlight the current position which is being changed.

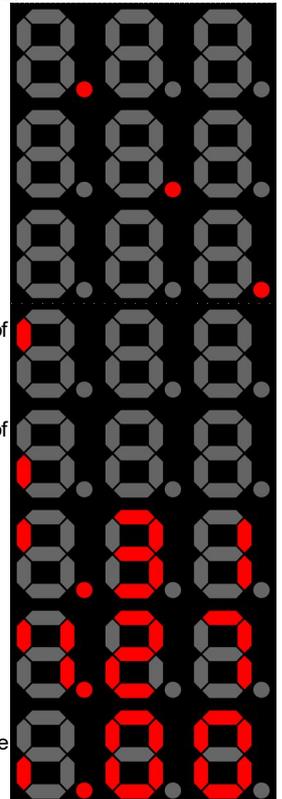
-  Iterates addresses in single steps (only available for Selectrix-1, DCC (short) and Motorola)
-  Switch to mode of entering address of locomotive digit by digit
-  Switch to right next position. (Confirms selection at right most position)
-  Move one position to the left (e.g. to correct address).
-  Quit selection menu. The last displayed address can now be controlled.



Controlling locomotives

In normal driving mode where one loco is selected ( Selection of a locomotive), the following control actions can be carried out and are displayed as show in the pictograms:

-  Switch on or off the power on the rails
-  Turn on and off second loco function
-  Turn on and off light
-  Changes direction of travel of the loco (here: forwards)
-  Changes direction of travel of the loco (here: backwards)
-  Change loco speed (here SX1-Loco: max. 31 speed steps, forwards)
-  Change loco speed (here SX2-Loco: max. 127 speed steps, forwards)
-  Reset speed to 0 and change direction of travel



If the selected locomotive is controlled by a second controller (e.g. second loco controller or central unit), changes are immediately indicated on the display.

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Illustrations and technical data are subject to change. We are not responsible for printing or typographical errors.

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