

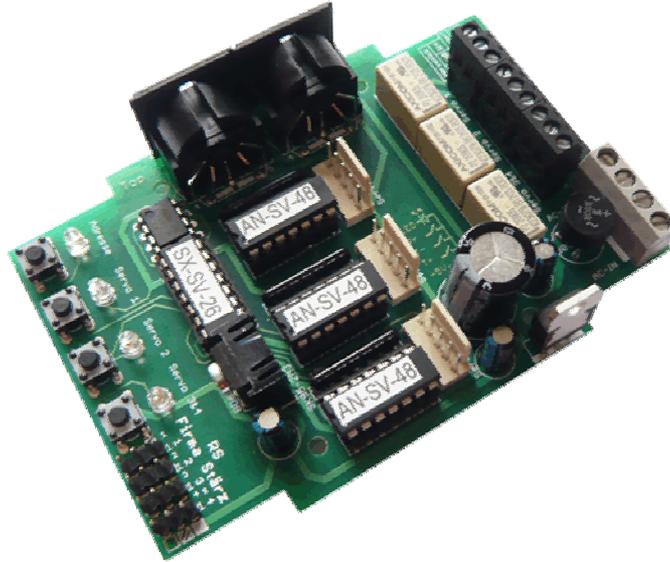
# MODELLBAHN DIGITAL PETER STÄRZ

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## Servo Decoder for analogue and Selectrix® steering 3 Servo motors including frog polarisation

HSXT  
v1-2010



**Degree of difficulty:** **easy**  
medium  
difficult

#### Necessary skills:

- Very easy assembly and soldering of the PCB

The Servo Decoder is a switching module to comfortably control 3 servo motors of a model railway layout including frog polarisation. In addition to the two end and central positions one can adjust moving velocity (per direction), turn off behaviour and moving pause in central position for the servo motor for each servo individually.

Steering of the Servo Decoder is done via the Selectrix-bus or alternatively or in parallel also by external buttons.

When steering via the Selectrix-bus, each servo motor is addressed by a single bit resulting in a need of 3 bits only for the whole Servo Decoder. The corresponding address is free of choice for all three bits individually. In addition, a single- or dual-bit feedback can be activated for each servo motor.

When steering the servo motors via buttons, the position is also forwarded to the Selectrix-bus. Both steering options (via buttons, via SX-bus) are equivalent and entirely parallel.

#### Possible applications are e.g.:

- Turnouts and semaphores
- Opening and shutting gates
- Any other forth and back movements

#### Special features

- For analogue (buttons) and digital (Selectrix®) steering
- Isolated inputs by optocouplers
- Individual steering of each servo motor: precise and reliable
- Various settings (Turn off the servo after switching, post luffing of railway crossing gates, etc.)
- Integrated frog polarisation
- 1-bit or 2-bit feedback enable

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## Technical specifications

### Size

104,6mm x 73,9mm x 30mm

### Power supply

The Servo Decoder requires a suitable external power supply. A regular model railway transformer can be used:

Alternating current: 10V – 18V

Direct current: 14V – 25V

The use our model with 14V AC, 70W is recommended.

### Connections

- 2x SX-Bus jacks
- 2x 2 terminals for power supply
- 4x 3-pinned header for servo motors
- 3x 3-pinned terminal for buttons and LEDs
- 3x 3-pinned terminal for frog polarisation
- 3x 5-pinned header for programming mouse

### Indicators

- 3 yellow LEDs: Programming indicator of each output
- Red LED: Programming indicator for SX-Bus

### Plugging to SX-Bus

The module is connected to the SX-data-bus via an (optional) SX-bus cable.

**The module must never be connected to the Selectrix-Power-Bus (PX-bus)!**

**Bus cables may only be plugged or unplugged at power down of the model railway layout.**

### Assembly notes

The Servo Decoder 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. 420°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.

### Non-Use

When the module 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**. A recommended value for any setting is marked with an (\*).

**These instructions cover the full functionality of the Servo Decoder HSXT – including frog polarisation, SX-Bus jacks and buttons as input. There are modifications with less functionality available. Depending on the modification some of the here described features are not available or not applicable.**

## Accessory and expendabilities

The following equipment is available for the Single Servo Module:

### Housing:

- **Housing for Servo Decoder: G 523 E** Art. 285

### Expendabilities:

- **Programming mouse** Art. 291

To configure the positions of the Servo motor (mandatory).

## Kit contents

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

### General parts:

- 1x circuit board (populated with SMD devices on bottom)
- 1x rectifier B80C1500
- 4x LEDs (1x red, 3x yellow)
- 4x push buttons
- 1x voltage regulator 78L05
- 3x relay
- 3x resistor network 10kOhm
- 1x heat sink
- 1x metal screw
- 4x screws
- 4x spacer rings
- 1x SX-Bus cable (optional)

### Connectors:

- 2x SX-Bus jacks
- 1x terminal RM5.0 4-pinned
- 3x double row terminal RM3.5 6-pinned or
- 3x terminal RM3.5 3-pinned
- 4x 3-pinned header
- 3x 5-pinned header with cladding

### ICs:

- 1x LM393
- 4x 14-pinned IC socket
- 3x PIC „AN-SV-xx“
- 1x PIC „SX-SV-xx“

### Transistors:

- 1x BD677

### Capacitors (Marking):

- 3x electrolytic 47µF
- 1x electrolytic 1000µF (1000µF35V)

## Installation site

**The 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 module must be kept free of coarse dirt or electro conductive parts falling down.

The heat sink on the module may heat up and may thus not be placed in a confined site (e.g. between Styrofoam).

The module 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 rings and screws delivered.

Keep all electro conductive tools, assembly kits and cables away from the module during operation.

A negligently and by external circumstances caused short-circuit (impinging on the module from above or from the bottom) may destroy the module. If that happens, all terms of warranty will become invalid.

## Maintenance and care

Dust clumping together can, in combination with condensating liquids, become conductive and deteriorate the functionality of the module. 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.

## Update

The heart of the Servo Decoder is 4 PICs that store the software. A socket for each PIC provides easy access for the purpose of any software update.

Never use other PICs than those dedicated to this module. Disregarding may lead to destruction of the module and all term of warranty will become invalid.

Please also visit our FAQ page at [www.firma-staerz.de](http://www.firma-staerz.de) for any question first.

## 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.

**When soldering, pay specific attention not to unsolder the pre-populated SMD devices on the bottom layer.**

**Solder cleanly and precisely!**

### 1. IC, Socket for PIC

Pay attention to the orientation: Solder the notches according to the component layout diagram on the PCB.

IC5: LM393N  
Socket: Socket for IC1 to IC4

### 2. Resistor networks

Place the resistor networks according to their marking: the marking has to face to the IC sockets each.

RN1-RN3: 10kOhm (7A103)

### 3. LEDs and push buttons

LEDs are mounted with their cathodes facing to the inner of the PCB. The shorter lead of the LED is the cathode and the collar is also flat on the cathode side. Then assemble the push buttons.

H1-H3: yellow  
H4: red  
S1-S4: buttons

### 4. Terminals, relays, rectifier

Solder the relay first, then the 4-pinned terminal. The rectifier should be soldered in the same height as the terminals. Especially take care for the polarity: The positive pole has to face to the PCB corner. At last mount the double row terminals.

K1-K3: relay  
X3: terminals  
B1: rectifier  
X4-X6: double row terminals

### 5. Pin headers

Watch the polarity when soldering the 5-pinned header: The cladding must face away from the IC socket.

SV1-SV4: 3-pinned header  
SV5-SV7: 5-p. header with cladding

### 6. Transistor BD677 and voltage regulator

**First use a piece of tape to insulate the heat sink and the PCB.** Before soldering the transistor, fix it to the heat sink using the metal screw. Watch the orientation: The transistor has to be mounted to the heat sink with its metallic side (metallic shiny or straight black without label). Solder the voltage regulator next.

T1: transistor  
IC6: voltage regulator

### 7. Electrolytic capacitors, Watch polarity!

The negative pole of the electrolytic capacitors is mounted facing left.

C2-C4: 47µF  
C1: 1000µF

### 8. SX-bus jacks

Solder the shielding (big pads) of the jacks generously.

### 9. Verification and mounting the PICs

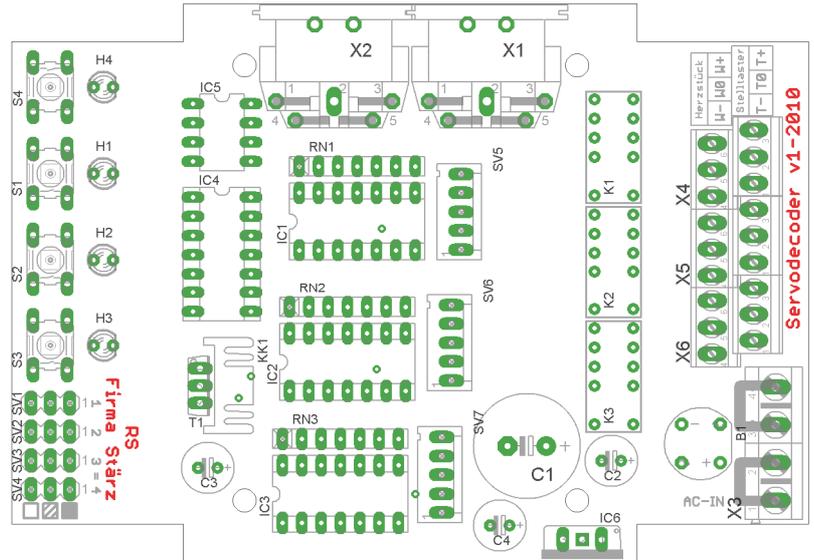
After soldering all components on the PCB verify once more that they are placed according component layout diagram and that they are oriented properly. Check that all solder points on the bottom side of the PCB look correct. Note especially if there are any undesired solder bridges between solder pads.

After the verification the PICs can be mounted:

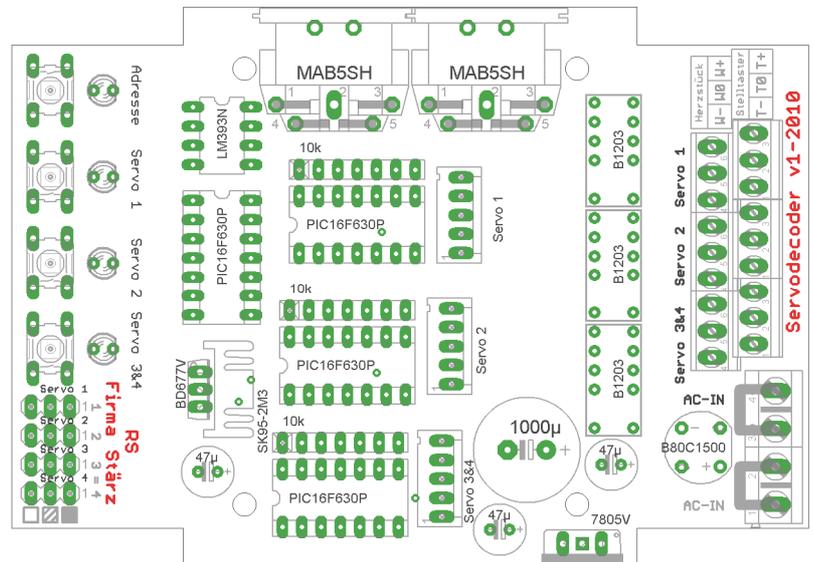
IC1-IC3: PIC „AN-SV-xx“  
IC4: PIC „SX-SV-xx“

**After mounting the PIC IC4, please make sure that there is enough space between the PIC and the heat sink. Otherwise the PIC may be damaged!**

### Component layout diagram



### Populated PCB



## Conversion of binary and decimal

Entering the settings (programming) of the steering address and others is done by the 8 bit wide SX-Bus. The following example illustrates the conversion of values given in bits into the decimal system, e.g. for addresses:

Bit	1	2	3	4	5	6	7	8
State	1	0	1	0	1	0	1	0
Value	1	2	4	8	16	32	64	128

In our example: the decimal value (e.g. setting as an address) is being calculated by:  $1 + 4 + 16 + 64 = 85$ . The decimal value is calculated by summing up the values of each bit which is activated (state = 1).

## Description of operation

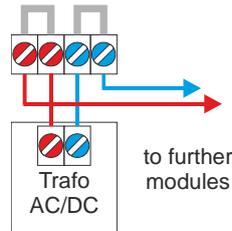
The Servo Decoder is controlled via the SX-Bus as well as via external buttons. Controlling the Servo Decoder with buttons automatically leads to information forwarding to the SX-Bus. Connecting the Servo Decoder to a central unit via a SX-Bus cable is thus optional.

Each servo motor is steered separately by a dedicated PIC which makes the servo motors fully independent of each other.

For each Servo motor a steering address and a dedicated steering bit can be adjusted, see Parameters of the SX-Bus. Furthermore, the Servo Decoder supports settings for end positions (left, right), as well as central position (to switch frog polarisation), moving velocities, turn off behaviour and an option for post luffing, which all can be configured according to the Configuration of the servo positions.

### Power supply and wiring

The Servo Decoder must be fed by an adequate transformer. Plug the transformer to the terminals "AC IN" of the terminal block X3 according to the right hand side figure..



### Steering and feedback via the SX-Bus

Via Parameters of the SX-Bus the steering address and steering bit can be adjusted for each servo output individually.

#### Steering bit interpretation

0 (respectively -) Servo in position straight  
1 (respectively /) Servo in position turn out

Additionally for each servo output a Feedback can be activated.

### Connecting servo motors

On the left side of the Servo Decoder there are 4 3-pinned JR headers available to plug up to 4 servo motors to. The pin assignment is as follows:

#### Pin assignment JR connector

1 (right: filled square) PWM  
2 (center: hatched square) +5V  
3 (left: empty square) GND

Note that output 4 is a duplicate of output 3 and they are thus identical! That means all settings and options are the same for those outputs. This duplicated output may be useful e.g. when steering a crossover when two turn outs are steered in parallel. Plugging a servo motor is as follows:

#### Connecting servo motors to the JR pin header:

Pin	Modelcraft	EMAX
1	Orange	Orange
2	Red	Red
3	Brown	Brown

**Watch out the correct polarity when using the JR pin header! Inverting the connection may cause damage to the servo motor and to the Servo Decoder!**

### Connecting a programming device

To adjust the servo settings a programming device (programming mouse) must be plugged to the Single Servo Module. For that purpose the 5-pinned header with cladding is available.

#### Pin assignment for the programming device

5 (down) LED (cathode)  
4 Button to start programming  
3 Button T-  
2 Button T+  
1 (up) Power supply (+5V)

### Connection of buttons

To steer the servos and to adjust the Configuration of the servo positions the lower row of the double row terminals may be used to plug two powered buttons (as usual for track layout switch boards) as depicted in the Wiring scheme of buttons.

When steering the servo motors via buttons the information is also forwarded to the SX-Bus to provide it to modules and e.g. to the computer.

### Connection of LEDs to monitor position

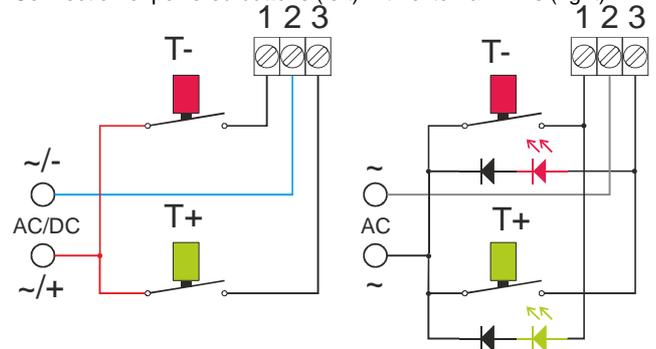
If an alternating current is used for plugging the powered buttons, then also LEDs may be plugged in parallel to the buttons to monitor the position of the servo outputs, as depicted in the Wiring scheme of buttons. Pay attention to supply each LED with a diode (e.g. 1N4148) in row, to prevent damage from the LED.

In the moment of pressing the button to switch the servo position the LED is off. It lights up again until the servo motor reaches its central position. Only after passing this position the LEDs turn off and the other LED turns on.

When steering via the SX-Bus the LEDs also switch only when the servo motor passes its central position.

### Wiring scheme of buttons

Connection of powered buttons (left) with external LEDs (right)



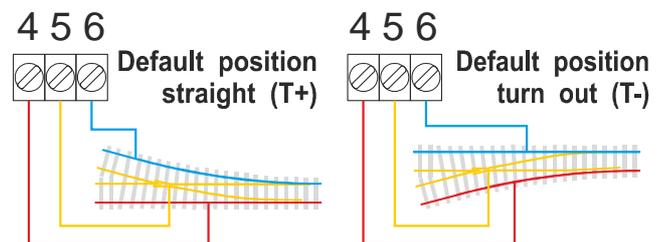
### Connection of frog polarisation

The Servo Decoder offers the option to connect a frog polarisation for each output.. The upper row of the double rowed terminals on the right side of the Servo Decoder is available for that purpose. The polarity of the connection here depends on the default position of the turn out – refer to the Connection scheme for frog polarisation.

#### Pin assignment of frog polarisation

4 (down: W-) Contact turn out position  
5 (center: W0) Frog  
6 (up: W+) Contact straight position

#### Connection scheme for frog polarisation



## Installation of the servo motor

Before installation of the servo motor it is strongly recommended to have it moving to the central position to ensure a correspondence with the servo's mechanical central position.

To facilitate installation you may keep the **Prog** button pressed when turning on the power supply (the programming LED will not light up).

That induces the servo motor to move to its absolute central position (not the central position configured by programming!) and stay there until pressing the **Prog** again to start configuring the servo motor positions, or until pressing one of the controlling buttons not entering position configuration and to move to normal operation instead.

## Configuration of the servo positions

For configuring the servo positions (programming) an external programming device (e.g. Stärz Programming Mouse or Rautenhaus Programmer SLX861, with buttons **T+**, **T-** and **Prog**) is to be plugged to the 5-pin header with cladding.

In the following we'll only be referring to the button **Prog** and the buttons **T+** and **T-** and consistently mean the ones of the servo just being adjusted.

**Do not confuse the button **Prog** with the programming button on the Servo Decoder for SX-Bus programming!**

### Overview of the standard settings

**By pressing the **Prog** button, step by step the following settings can be configured. Changing a setting is achieved by pressing the buttons **T+** or **T-** respectively.**

Setting	LED-display
<p><b>Central position (*)</b> In dependence of the extended settings, here you configure the position where the relay shall be switched, the position that shall be taken when pressing <b>Tm</b> or the position that shall be reached at post luffing of railway crossing gates, respectively.</p>	continuously on
<p><b>End position straight (**)</b> Here you configure the position that shall be reached when pressing <b>T+</b>.</p>	Long on, short off
<p><b>End position turn out (**)</b> Here you configure the position that shall be reached when pressing <b>T-</b>.</p>	Short on, long off
<p><b>Moving velocity</b> In this setting the servo motor continuously moves from one end position to another while the moving velocity can be adjusted.</p>	Fast blinking
<p><b>Turn on and off behaviour/Optimisation</b></p> <p><b>Normalised, active:</b> When turning on the power supply, the servo is normalised, which means <b>it moves to its last stored position</b>. After each steering the servo motor stays active. In this setting, the servo motor may create humming in end positions.</p> <p><b>Normalised, passive:</b> When turning on the power supply, the servo is normalised but after each steering it is turned off.</p> <p><b>Not normalised, passive:</b> When turning on the power supply, the servo is not normalised and it is turned off after each steering.</p> <p><b>Normalised, passive, smoothened</b> Like "Normalised, passive", but still some servos react with a little kick off. This setting removes this kick off for many servos.</p>	Variable blinking: Blinking once Blinking twice Blinking 3 times Blinking 4 times

Pressing the **Prog** button again terminates the configuration mode. Having the programming device still plugged, one can now switch between both end positions to verify the settings and to readjust them directly if necessary by pressing the **Prog** button again and to start over with the configuration cycle.

## Reset to factory default settings

The Single Servo Module can be reset to its factory default settings by pressing the **Prog** button for ca. 3 seconds until the LED lights up as confirmation and turns off after reset.

## Extended settings

(Attention: The extended settings are not adjustable via the powered buttons that are AC-powered! Use DC-powering for this purpose or the recommended programming device instead!)

In addition to the standard settings the following extended settings can be made:

### Pause in central position

A pause of up to 1.2 seconds can be adjusted in steps of 0.02 seconds (20 ms).

This is useful for e.g.:

- Turnouts: re-grabbing switchstand, 200-500ms (\*)
- Semaphores: re-grabbing switchstand, 200-500ms (\*)
- Crossing gates: Catching the gates when closing 200-300ms (\*)

To adjust this extended setting, enter the configuration of the moving velocity (press the **Prog** button 4 times until the servo moves back and forth).

Now, hold button **T+** and press the **Prog** button repetitively to increase the pause by 20 ms for each press until you reach the desired pause length. Then, release the button **T+**.

To reduce the pause in steps of 20 ms, hold button **T-** and press the **Prog** button repetitively until reaching the desired pause length or pause is deactivated. Now, release the button **T-**.

You may now leave the configuration (pressing the **Prog** button until the LED turns off) or you may proceed to the next extended setting.

### Distinguished moving velocities

One can adjust the moving velocity individually for the both moving directions.

This is useful for e.g.:

- Semaphores: Lift up slower then downwards
- Scything: Pulling back slowly

To adjust this extended setting, enter the configuration of the moving velocity (press the **Prog** button 4 times until the servo moves back and forth).

Now, hold button **Prog** and press the **T+** button repetitively to increase the velocity for moving back for each press until you reach the desired velocity. Then, release the button **Prog**.

To reduce the velocity for moving back, hold button **Prog** and press the **T-** button repetitively until reaching the desired velocity or velocities for back and forth are equal again. Now, release the button **Prog**.

If you want to increase the velocity for the forth moving instead, keep pressing **T-** (with button **Prog** held).

Similarly you can reduce the velocity for moving forth by repetitive pressing of the **T+** button until both velocities equalise.

You may now leave the configuration (pressing the **Prog** button until the LED turns off) or you may proceed to the next (extended) setting.

### (\* , \*\*) Post luffing of railway crossing bars

A post luffing is adjustable in one of the two end positions which might be enabled for railway crossing gate.

(\*) The central position then defines the point that shall be reached at post luffing of the railway crossing gate.

(\*\*) To enable the post luffing (in that end position setting), hold the **Prog** button and press button **T+** until the LED blinks for confirmation.

(\*\*) To disable the post luffing (in that end position setting), hold the **Prog** button and press button **T-** until the LED blinks for confirmation.

## Parameters of the SX-Bus

It is recommended to adjust the  Configuration of the servo positions first before proceeding.

By the parameters the steering addresses and bits as well as the feedback addresses and bits are adjusted for each servo motor individually.

### Overview of parameters

#### Address 0: Parameter selection (binary) 1 to 7

By the here made bit pattern the parameter to be adjusted via addresses 1 and 2 is selected.

Bit	12345678	Parameter to be adjusted
	10000000	Steering address servo 1
	01000000	Steering address servo 2
	11000000	Steering address servo 3
	00100000	Feedback address servo 1
	10100000	Feedback address servo 2
	01100000	Feedback address servo 3
	11100000	Steering bit correction

**Address 1: Steering / feedback address 1 to 103 / 111 (85)**  
(of the servo selected via address 0)  
(steering bit correction enabled, respectively)

**Address 2: corresponding steering / feedback bit Bit 1 to 8**  
(of the servo selected via address 0)

## Feedback

The Servo Decoder offers two options of feedback:

<b>Single bit feedback</b>	<b>Dual bit feedback</b>
<b>Position straight</b>	<b>Position straight:</b>
<b>Bit 1 = 0</b>	<b>Bit 1 = 0</b>
	<b>Bit 2 = 1</b>
<b>Position turn out</b>	<b>Position turn out:</b>
<b>Bit 1 = 1</b>	<b>Bit 1 = 1</b>
	<b>Bit 2 = 0</b>

For each output the feedback address and the feedback bit (or the feedback bits) can be adjusted individually. Address 0(\*), the steering addresses and the corresponding bits are not available.

In dual bit feedback mode the left selected bit is interpreted being bit 1 and the right selected bit is interpreted being bit 2 (refer to example).

### Steering bit correction

If this is active, when switching a servo (e.g. by the powered buttons) not only the feedback is written accordingly to the SX-Bus, but also the steering bit is corrected. If the feedback is disabled, steering bit correction is always active.

### Reset to factory default settings

Setting the value of 255 to the parameter selection (address 0) and quitting programming by pressing the programming button will reset all parameters to their factory default settings:

Servo	Address	Bit	Feedback
1	10101010 (85)	10000000	disabled
2	10101010 (85)	01000000	disabled
3	10101010 (85)	00100000	disabled
	10000000 (01)	Steering bit c.	enabled

## Programming parameters e.g. with the Control Panel SPF-PIC

### Preparations for Programming:

To be able to programme the parameters, the Servo Decoder is required to be connected to a central unit via the SX-bus cable.

### Enter programming mode:

Set the central unit to STOP mode by pressing the "ZE"-key (ZE aus).

Press the programme button of the Servo Detector. The module's LED activates to indicate programming mode.

Remark: Activate decimal decoding in the Control Panel to facilitate decimal conversion.

### Selection of the parameter to be adjusted:

#### Select address 00 in Control Panel.

Enter switching mode by key "Adr" and enter 0, 0.. The selection steering address of servo 1 is pre-selected:

Adr /-----=001  
000 12345678 aus

#### Enter new selection

e.g.: Steering address of servo 2 by key 2:

Adr -/-----=002  
000 12345678 aus

### Enter the address of the selected servo:

#### Select address 01 in Control Panel.

Enter switching mode by key "Adr" and enter 0, 1. The current steering address is displayed, e.g.: address 85:

Adr /-/-/-/=085  
001 12345678 aus

#### Enter new steering address

e.g.: address 34 by keys 2, 6:

Adr -/---/==034  
001 12345678 aus

### Enter the corresponding steering bit:

#### Select address 02 in Control Panel.

Enter switching mode by key "Adr" and enter 0, 2. The current steering bit is displayed, e.g. bit 1:

Adr /-----=001  
002 12345678 aus

#### Enter new steering bit

e.g. 5 by key 5:

Adr ----/----=016  
002 12345678 aus

The steps **Selection of the parameter to be adjusted**, **Enter the address of the selected servo** and **Enter the corresponding steering bit** can be repeated for the remaining servos, with adequate choice in address 0, respectively. As an example, here we point out how to adjust the feedback address of servo 2 in the following:

### Selection of the parameter to be adjusted:

#### Select address 00 in Control Panel.

Enter switching mode by key "Adr" and enter 0, 0.. The selection steering address of servo 1 might be pre-selected:

Adr /-----=001  
000 12345678 aus

#### Enter new selection

e.g.: Feedback address of servo 3 by keys 2 and 3:

Adr -//-----=006  
000 12345678 aus

### Enter the feedback address (\*) of the selected servo:

#### Select address 01 in Control Panel.

Enter switching mode by key "Adr" and enter 0, 1. The current feedback address is displayed, e.g. address 85:

Adr /-/-/-/=085  
001 12345678 aus

#### Enter new feedback address

e.g.: feedback address 35 by keys 1, 2 and 6:

Adr //---/---=035  
001 12345678 aus

(\* If the value of 0 (all bits off) is entered here, then feedback is disabled. Feedback is also disabled if the feedback address is set to the steering address of this servo.

### Enter the corresponding steering bit:

#### Select address 02 in Control Panel.

Enter switching mode by key "Adr" and enter 0, 2. The current feedback bit is displayed, e.g. bit 3

Adr --/-----=004  
002 12345678 aus

#### Enter the new feedback bit(s)

e.g. dual bit feedback via bit 4 and 5 via keys 4 and 5:

Adr ---//---=024  
002 12345678 aus

### Exit programming mode:

Press the programme button of the Servo Decoder or enable track current by pressing "ZE" at the central unit or Control Panel. The LED will blink twice for confirmation.

All parameters have been stored in the registers of the Servo Detector.

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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 12.08.2014