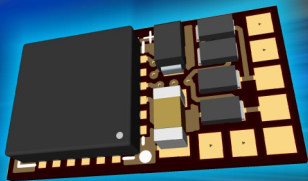




# Miniature Digital Decoder



## ZM05A

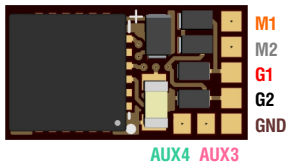
### User's Manual

Art. No: ZM05A-1, ZM05A-2

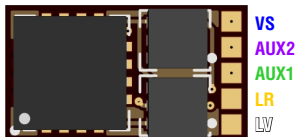
Ver. 1.07

# Introduction

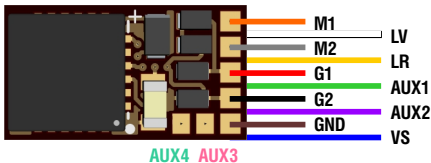
## Top Side



## Bottom Side



## Variant with connection wires



## Specifications

|                                |                                          |
|--------------------------------|------------------------------------------|
| <b>Operating mode:</b>         | DCC, MM, SX1, SX2, DC analog             |
| <b>Dimensions (L x W x H):</b> | 9 x 5 x 2 mm                             |
| <b>Total load capacity:</b>    | 0.5 A                                    |
| <b>Maximum motor current:</b>  | 0.5 A                                    |
| <b>Maximum track voltage:</b>  | 30 V                                     |
| <b>LV, LR:</b>                 | 150 mA each, dimmable                    |
| <b>AUX1, AUX2:</b>             | 300 mA each, dimmable                    |
| <b>AUX3, AUX4:</b>             | Unamplified, 5V 20 mA each, non-dimmable |

## Outputs

|                   |                                                      |
|-------------------|------------------------------------------------------|
| <b>M1, M2</b>     | Motor connection 1, 2                                |
| <b>G1, G2</b>     | Track connection 1, 2                                |
| <b>LV</b>         | Front light, 150 mA max                              |
| <b>LR</b>         | Rear light, 150 mA max                               |
| <b>AUX1, AUX2</b> | Additional functions 1, 2, 300 mA max                |
| <b>AUX3, AUX4</b> | Additional functions 3, 4, unamplified, 5V 20 mA max |
| <b>VS</b>         | Supply voltage (+)                                   |
| <b>GND</b>        | Ground (-)                                           |

## Connecting options

**ZM05A-1** Without connecting wires

**ZM05A-2** With 10 stranded wires, length 100 mm

## Package contents

### ZM05A-1

- 1x Digital decoder
- 1x Shrinking tube
- 2x 5 x 8 mm double sided stickers for mounting
- 1x User's Manual

### ZM05A-2

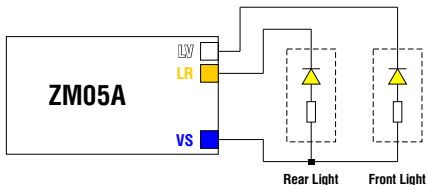
- 1x Digital decoder with cables
- 2x 5 x 8 mm double sided stickers for mounting
- 1x User's Manual

# Installation

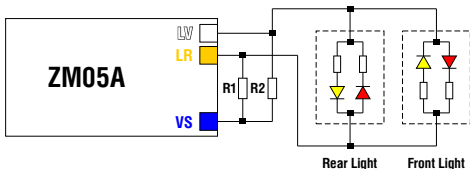
**IMPORTANT: Soldering work required for installation of this decoder. Soldering iron with thin tip (1 mm) and good soldering skills needed for this.**

1. Prior to installing the digital decoder, make sure your locomotive runs perfectly in analog mode without jerks and stalls.
2. Make all necessary measurements inside your locomotive in order to be sure that the digital decoder will fit in the available space. It is recommended to have a margin of 0.5 - 1 mm on all sides for safe and reliable placement of the digital decoder.
3. Disconnect the motor and all lights of the locomotive from the tracks and make sure that both outputs of all these consumers are fully isolated from the track connections. It is also recommended to remove all capacitors connected to the motor and lights.
4. Connect G1 and G2 pads of the digital decoder (or red and black wires for the version of the digital decoder with wired outputs) to the track connections, M1 and M2 pads (or orange and gray wires) to the motor outputs.
5. Connecting light functions: use the following variants of connections depending on the type of light features your locomotive has:

## A) The locomotive is equipped with white headlights

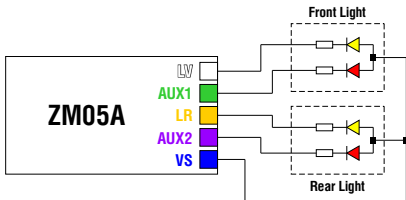


**B) The locomotive is equipped with directionally controlled white headlights and red tail lights**



Resistors R1 and R2 should have a value of 1 k $\Omega$  if the track voltage is 10-12 V. For higher track voltage, the value should be not less than 1.5 k $\Omega$ .

**C) The locomotive is equipped with separately controlled white headlights and red tail lights**



This is the most advanced variant of controlling light functions of the locomotive. It allows independent switching of all lights according to different usage scenarios. Please see “Programming” chapter of this User’s Manual for more information.

**NOTE:** It is recommended always to use VS output of the digital decoder as a common wire for the light functions instead of using one of the track connections for this purpose in order to eliminate constant pulsating blinking of the light functions.

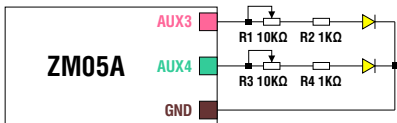
**IMPORTANT:** Always connect LEDs to the outputs of the digital decoder with appropriate resistors in series! The value of the resistors is normally 1-10 k $\Omega$ , depending on the type of LED and track voltage. It is allowed to connect only suitable lightbulbs to the outputs of the digital decoder directly.

Some factory-installed LED lights in the locomotives already fitted with resistors; no additional resistors needed in this case.

**6. Using AUX3 and AUX4 outputs:** these outputs are non-amplified and cannot switch high-current loads. They provide maximal output voltage of +5 V, regardless of the track voltage. Please note that the common wire for AUX3 and AUX4 is GND (-), not VS (+).

Each of AUX3 and AUX4 outputs provides maximum current of 20 mA. It is enough to connect, for example, 1 to 5 small low-power LEDs with resistors in series. AUX3 and AUX4 outputs are non-dimmable. For smooth adjustment of the output voltage, trimming resistor should be used.

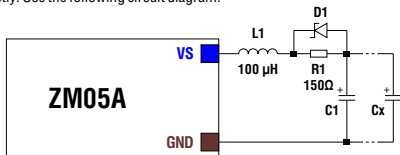
Here is a sample of connecting small low-power white LEDs to non-amplified outputs AUX3 and AUX4 with separate brightness adjustment:



For switching consumers that require higher current (> 20 mA) and/or higher voltage (> 5 V), switching amplifiers should be used - such as MOSFETs, bipolar transistors etc.

**7. Connecting external energy storage modules:** additional power buffering circuit should be connected to VS (+) and GND (-) pads. In case of using energy storage module, energy saving mode should be turned off. Please see CV137 in “Programming” chapter of this User’s Manual for more information.

**IMPORTANT:** It is not allowed to connect single capacitors to these pads directly. Use the following circuit diagram:



It is possible to connect several capacitors in parallel (C1-Cx) in order to achieve desired total capacity. Minimal recommended capacity from which the buffering effect becomes visible is 470  $\mu$ F. Optimal capacity for reliable power buffering for small scales such as N and Z is 1000-2000  $\mu$ F.

**IMPORTANT:** Use capacitors with a good margin of rated voltage (20-25%), depending on the track voltage. For example, it is recommended to use capacitors rated for 16 V if the track voltage is 12 V. If the track voltage is 16 V, use capacitors rated for 25 V, and so on.

It is possible to use different types of capacitors - electrolytic, Tantalum, polymer and also ceramic (MLCC). In case of using polarity sensitive capacitors, please always observe polarity!

Use suitable Schottky diode (D1) instead of conventional diodes in order to increase efficiency of buffering due to the lower voltage drop. Inductor (L1) should have sufficient current rating according to the total current consumption of all consumers (motor, lights etc.)

It is recommended to use Zmodell energy storage modules ZM-ESM-01 or ZM-ESM-02\*. These modules provide very good power buffering efficiency thanks to the high capacity packed in a very small size.

*\*Subject to availability; please contact your supplier.*

**8. Swapping connections:** in case of an incorrect wiring of the motor (M1 and M2 outputs swapped), lighting (LV and LR outputs swapped) and track (G1 and G2 swapped), there is no need to unsolder the cables, as the assignment of mentioned outputs can be interchanged electronically by adjusting decoder settings. Please see CV51 in “Programming” chapter of this User’s Manual for more information.

**9. Check after installation:** after finishing soldering work and connecting all cables, check all connections and soldering joints thoroughly once again. All consumers - motor, lights etc. should be reliably isolated from any of the track connections.

**ZM05A-1:** it is recommended to additionally secure the digital decoder with a piece of shrinking tube that comes in the package. Use heat gun heated up to 150 °C for this.

**10. Test operation:** put the locomotive on the programming track and read out the locomotive address. Program the desired locomotive address and start running the locomotive. After the first check you can modify the driving parameters according to your requirements.

In case your command station or programming device returns an error during reading out the locomotive address, please check again the wiring of the locomotive. Pay attention to the electrical separation of the motor and lights from the tracks. **Never put such a locomotive into operation!**

## Programming

This digital decoder is based on Doehler & Haass® proprietary hardware and software technology. All functions and features of ZM05A digital decoder are equal to those of Doehler & Haass® DH05C multiprotocol digital decoder (except ZCLK/AUX5 and ZDAT/AUX6 outputs presented only in DH05C).

Here is listed a short set of the most important settings of ZM05A digital decoder in DCC mode. Full list of decoder settings, as well as detailed information about all available features and programming in other modes (MM, SelecTRIX 1 and 2) can be found on Doehler & Haass® official website: <https://doehler-haass.de>.

| CV        | Description                                                                                                                                                                                                                                                                                                                                                      | Range        | Default   |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------|
| <b>01</b> | <b>Address</b><br>Addresses higher than 127 are only usable in MM-operation                                                                                                                                                                                                                                                                                      | <b>1-255</b> | <b>3</b>  |
| <b>02</b> | <b>Starting speed</b>                                                                                                                                                                                                                                                                                                                                            | <b>0-15</b>  | <b>0</b>  |
| <b>03</b> | <b>Acceleration time</b><br>The value corresponds to the time in seconds from start to maximum speed                                                                                                                                                                                                                                                             | <b>0-255</b> | <b>3</b>  |
| <b>04</b> | <b>Deceleration time</b><br>The value corresponds to the time in seconds from the maximum speed to stop                                                                                                                                                                                                                                                          | <b>0-255</b> | <b>3</b>  |
| <b>05</b> | <b>Maximum speed</b>                                                                                                                                                                                                                                                                                                                                             | <b>0-127</b> | <b>92</b> |
| <b>08</b> | <b>Decoder reset</b><br>Write "8" to this CV in order to reset the digital decoder to default settings                                                                                                                                                                                                                                                           |              |           |
| <b>13</b> | <b>Activation F1-F8 in analog mode</b><br><br><div> <div>Bit   Function   Value</div> <div>0.....F1.....1</div> <div>1.....F2.....2</div> <div>2.....F3.....4</div> <div>3.....F4.....8</div> </div> <div> <div>Bit   Function   Value</div> <div>4.....F5.....16</div> <div>5.....F6.....32</div> <div>6.....F7.....64</div> <div>7.....F8.....128</div> </div> | <b>0-255</b> | <b>1</b>  |
| <b>14</b> | <b>Activation F0, F9-F12 in analog mode</b><br><br><div> <div>Bit   Function   Value</div> <div>0...F0 (forward)....1</div> <div>1...F0 (reverse)....2</div> <div>2.....F9.....4</div> </div> <div> <div>Bit   Function   Value</div> <div>3.....F10.....8</div> <div>4.....F11.....16</div> <div>5.....F12.....32</div> </div>                                  | <b>0-63</b>  | <b>3</b>  |
| <b>48</b> | <b>Speed step characteristic</b><br>Deflection of the speed step characteristic<br>0 = linear ... 7 = strongly curved                                                                                                                                                                                                                                            | <b>0-7</b>   | <b>5</b>  |

| CV     | Description                                                                                                                                                                                                                                                                                                                                              | Range | Default  |       |        |                                         |   |        |                                         |   |        |                                         |   |     |   |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------|-------|--------|-----------------------------------------|---|--------|-----------------------------------------|---|--------|-----------------------------------------|---|-----|---|
| 51     | <b>Swapping connections</b><br><table><tr><th>Bit</th><th>Function</th><th>Value</th></tr><tr><td>0.....</td><td>Motor (swapping M1 and M2 outputs).....</td><td>1</td></tr><tr><td>1.....</td><td>Light (swapping LV and LR outputs).....</td><td>2</td></tr><tr><td>2.....</td><td>Track (swapping G1 and G2 outputs).....</td><td>4</td></tr></table> | Bit   | Function | Value | 0..... | Motor (swapping M1 and M2 outputs)..... | 1 | 1..... | Light (swapping LV and LR outputs)..... | 2 | 2..... | Track (swapping G1 and G2 outputs)..... | 4 | 0-7 | 0 |
| Bit    | Function                                                                                                                                                                                                                                                                                                                                                 | Value |          |       |        |                                         |   |        |                                         |   |        |                                         |   |     |   |
| 0..... | Motor (swapping M1 and M2 outputs).....                                                                                                                                                                                                                                                                                                                  | 1     |          |       |        |                                         |   |        |                                         |   |        |                                         |   |     |   |
| 1..... | Light (swapping LV and LR outputs).....                                                                                                                                                                                                                                                                                                                  | 2     |          |       |        |                                         |   |        |                                         |   |        |                                         |   |     |   |
| 2..... | Track (swapping G1 and G2 outputs).....                                                                                                                                                                                                                                                                                                                  | 4     |          |       |        |                                         |   |        |                                         |   |        |                                         |   |     |   |
| 52     | <b>Dimming LV/LR outputs</b><br>0 = dark ... 31 = full brightness                                                                                                                                                                                                                                                                                        | 0-31  | 31       |       |        |                                         |   |        |                                         |   |        |                                         |   |     |   |
| 53     | <b>Dimming low beam light</b><br>0 = dark ... 31 = full brightness                                                                                                                                                                                                                                                                                       | 0-31  | 15       |       |        |                                         |   |        |                                         |   |        |                                         |   |     |   |
| 54     | <b>Dimming AUX1</b><br>0 = dark ... 31 = full brightness                                                                                                                                                                                                                                                                                                 | 0-31  | 31       |       |        |                                         |   |        |                                         |   |        |                                         |   |     |   |
| 55     | <b>Dimming AUX2</b><br>0 = dark ... 31 = full brightness                                                                                                                                                                                                                                                                                                 | 0-31  | 31       |       |        |                                         |   |        |                                         |   |        |                                         |   |     |   |
| 61     | <b>Maximum speed in shunting mode</b>                                                                                                                                                                                                                                                                                                                    | 0-127 | 63       |       |        |                                         |   |        |                                         |   |        |                                         |   |     |   |
| 62     | <b>Deceleration time in shunting mode</b><br>The value corresponds to the time in seconds from the maximum shunting speed to stop                                                                                                                                                                                                                        | 0-255 | 1        |       |        |                                         |   |        |                                         |   |        |                                         |   |     |   |
| 137    | <b>Advanced decoder settings</b><br><table><tr><th>Bit</th><th>Function</th><th>Value</th></tr><tr><td>1.....</td><td>Switch off energy saving mode.....</td><td>2</td></tr></table>                                                                                                                                                                     | Bit   | Function | Value | 1..... | Switch off energy saving mode.....      | 2 | 0-63   | 0                                       |   |        |                                         |   |     |   |
| Bit    | Function                                                                                                                                                                                                                                                                                                                                                 | Value |          |       |        |                                         |   |        |                                         |   |        |                                         |   |     |   |
| 1..... | Switch off energy saving mode.....                                                                                                                                                                                                                                                                                                                       | 2     |          |       |        |                                         |   |        |                                         |   |        |                                         |   |     |   |

## Default functions mapping

**F0** - Directionally controlled LV and LR outputs

**F1** - AUX1 output

**F2** - AUX2 output

**F3** - AUX3 output

**F4** - AUX4 output

**F5** - Low beam light

**F6** - Shunting mode

All functions and outputs can be reassigned using advanced function mapping capabilities of the digital decoder. Please see complete Doehler & Haass® programming manual for reference.

CV13-CV14 settings define which functions should be switched on in DC analog mode. By default, F0 and F1 are active in analog mode.

By default, low beam light function reduces the brightness of LV and LR outputs only. This function can be also reconfigured to reduce the brightness of any dimmable outputs of the digital decoder at the same time. Please see CV156 (Dimming mask for low beam light) in complete Doehler & Haass® programming manual for reference.

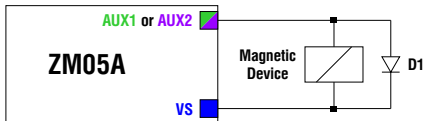
## Additional Information

This digital decoder supports coreless motors, as well as conventional DC brushed motors. Default settings already optimized for coreless motors. Decoder also offers plenty of settings for an optimal adoption to the motor. Advanced load regulation technology provides smooth and stable driving in any possible conditions.

The digital decoder supports 14, 28 and 126 speed steps. In case the speed steps programmed on the decoder differ from those of the control device, malfunctions may occur.

This decoder supports braking with asymmetric digital voltage (four diodes connected in series and one antiparallel diode), slow approach (with appropriate brake modules) and the bidirectional communication (locomotive address check back signal in DCC operation, RailCom®).

In case of connecting inductive consumers (such as electric couplers equipped with electromagnets), decoder outputs should be obligatory fitted with freewheeling diodes in order to protect them from damaging by a high voltage induced by magnetic devices during switching off:



Use the coupling function “Timer for switching off AUX” (CV117-118) to make sure that the function output will be switched off in any case according to specified maximum activation time.

**ATTENTION:** This product is intended only to experienced users! Please perform all operations with all precautions that apply to work with ESD sensitive devices. This product is not suitable for children under 15 years. The functioning of every decoder is fully tested before delivery. Should nevertheless a failure occur, please contact the supplier where you purchased the decoder or directly the manufacturer. The warranty period is one year from the date of purchase. The manufacturer is not responsible for any damage to the train model and/or digital decoder caused by improper installation, assembly or disassembly of the model, as well as by exceeding the maximum allowed operating parameters.

**IMPORTANT: Soldering work required for installation of this decoder. Soldering iron with thin tip (1 mm) and good soldering skills needed for this.**

Miniature Digital Decoder ZM05A User's Manual Ver. 1.07

**Art. No: ZM05A-1, ZM05A-2**



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