1. Purpose of the Standard

This standard describes an interface [1)] for vehicles with a small installation volume for electronic components (loco and function decoders). The interface is therefore suitable for vehicles of scale N and TT, as well as for small vehicles of scale H0.

2. Interface Description

The interface provides up to 12 function outputs. It is not necessary to support all functions of the interface. Connections for unsupported functions must remain unconnected. This applies to both vehicles or other equipment in which the socket portion is installed, as well as for decoders or other equipment where the plug portion is installed. The installation volume as well as the size of the decoder are a part of the interface.

2.1 Mechanical Characteristics

The interface composed of an encapsulated 28-pin connector strip on the mainboard of the vehicle and an also encapsulated 28-pin plug strip on the circuit board of the decoder.

In addition to the regular 24 contacts, the interface also uses the four guide pins in the corners.

Fig. 1: Socket Strip (in the vehicle)

Fig. 2: Plug Strip (at the decoder)

(Symbolic images of other pole numbers)

A symmetrical arrangement of the electrical connections and corresponding installation space restrictions in the vehicles ensure protection against twisting and incorrect installation.

Precautions must be taken in the vehicle to ensure that the decoder is not inserted twisted. This can also be achieved by components on the circuit board, e.g., a capacitor, which prevents incorrect installation.

2.1.1 Decoder

Table 1:

Dimension	Description	E24
a	Decoder Length	19.5 mm
b	Decoder Width	8.4 mm
c	Decoder height without socket and components on the underside	2.6 mm
d	Distance from board edge to plug center line	1.6 mm
e	Distance between the edge of the circuit board and the components on the underside	3.2 mm
f	Maximum height of the components on the underside	0.7 mm

The decoder has components with a maximum height of 0.7 mm on the side with the socket. The highest components on the underside should not have any electrically conductive surfaces on their upper side to prevent short circuits to the vehicle circuit board or vehicle parts.

[1)] This recommendation is based on the RailCommunity standard RCN-124, Edition July 2025.

2.1.2 Decoder Installation

The installation space in the locomotive must be designed such that components of the decoder cannot touch bare metal or conductive paths. The installation space (dimensions per Table 1) should be dimensioned such that the decoder fits without restriction.

Fig. 3: View from below, component side of the plug Vehicle mainboard

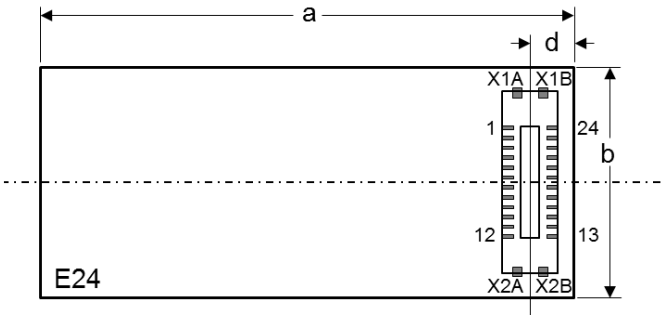
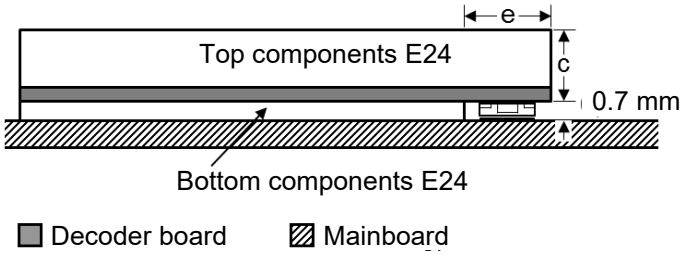


Fig. 4: Decoder Side view



The maximum mounting height of components on the top side of the electronic components is calculated from the maximum decoder height minus the thickness of the printed circuit board used. The connector is not included in the decoder height according to this standard.

2.2 Electrical Characteristics

Contacts 1 to 24 may be driven with a maximum of 0.3 A, while the guide pins marked X## used for currant pickup may be driven with 3.0 A. The motor connections and GND (decoder negative to rectifier) are each connected to two contacts. The maximum load on these connections is therefore 0.6 A.

2.3 Pin Assignments

Table 2:

Description	Pin #.	Pin #	Description
Power pickup left	X1A	X1B	Power pickup left
LS_B [2)]	1	24	ZBDATA / AUX11 / GPIO_B
LS_A [2)]	2	23	ZBCLK / AUX12/ GPIO_A
GND	3	22	GND
Motor -	4	21	AUX3
Motor -	5	20	AUX4
Motor +	6	19	AUX10 / GPIO_C
Motor +	7	18	Vcc
Cap +	8	17	U+
F0_f	9	16	AUX5
F0_r	10	15	AUX6
AUX1	11	14	AUX7
AUX2	12	13	AUX8
Power pickup right	X2A	X2B	Power pickup ríght

Connections that are not used on the vehicle side should be routed to soldering points on the vehicle mainboard.

2.4. Signal Descriptions

Table 3:

Name	Description
Power pickup right	Power pickup right in direction of forward travel [1)], (in analog mode connected to motor +)
Power pickup left	Power pickup left in direction of forward travel [1)], (in analog mode connected to motor -)
Motor +	Motor connection positive [1) 2)]
Motor -	Motor connection negative [1) 2)]
F0_f	Head signal in direction forward, amplified output
F0_r	Head signal in direction rear, amplified output
AUX1 and AUX2	Function output 1 and 2 (amplified outputs) [3)]
AUX3 and AUX4	Function output 3 and 4 (logic signal, no power outputs)
AUX5 to AUX8	Function output 5 to 8 (amplified outputs)
ZBCLK / AUX12 / GPIO_A	Trains Bus Clock, input or output A (logic signal, no power output) [4)]
ZBDTA / AUX11 / GPIO_B	Train Bus Data, input or output B (logic signal, no power output) [4)]
AUX10 / GPIO_C	Input or output with logic level, preferably for wheel synchronization on steam locomotives
LS_A and LS_B	Speaker connections A and B, The speaker impedance is specified by the manufacturer of the decoder and is to be documented.
Vcc	Internal Decoder-Voltage 1.8 – 5.7 Volt, This connection is not necessarily assigned. It is recommended that this connection be used only for the train bus interface.
Cap.+	Decoder plus, tap after rectifier, Connection of buffer capacitor [5)]
GND	Decoder negative after rectifier [1)]
U+	Decoder positive after rectifier to be used for functions

2.4.1 Description of the Function Outputs

The function outputs F0_f, F0_r, AUX1, AUX2 and AUX5 to AUX8, designed as amplified, are intended to switch loads (power outputs). The loads are switched on by the decoder connecting the respective function outputs to ground via an electronic switch. The maximum load current on the function outputs is 100 mA.
The function outputs F0_f, F0_r, AUX1 and AUX2 have to be supported by all decoders.

In vehicles, function outputs must not require the presence of higher function outputs or special buses that are not standardized by the RailCommunity. This means that if a decoder with fewer function outputs or without a special bus is used, the function outputs available on the decoder must continue to function.

A vehicle mainboard produced voltage U+ may not be connected to the pin 17 (U+) of the decoder.

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1) **Two contacts are utilized to increase the current load capacity**.

2) **The specified polarity refers to the motor connections for direction of travel 1 (forward) as per NEM 631.**

3) **If the rear signals are connected separately from the front signals in the vehicle, the rear signal at vehicle end 1 is connected to AUX1 (pin 11) and the rear signal at vehicle end 2 is connected to AUX2 (pin 12).**

4) **The processor pins of the train bus are made available with maximum of 470 Ohm series impedance.**

5) **Cap.+ is specifically intended for connecting storage capacitors. This connection must not be supplied with voltage on the vehicle side. Electrolytic capacitors used in the vehicle must have a nominal voltage of at least 16 V and tantalum capacitors 25 V.**

2.4.2 Description of the Logic Signals

The logic signals of connections AUX3, AUX4, and AUX10 / GPIO_C to AUX12 / GPIO_A are suitable for switching external load switches (on the vehicle's mainboard). The maximum load capacity of the logic outputs is 0.5 mA.

It should be noted that when the decoder processor is being started, uncontrolled states including a high-resistance state at the outputs with logic level can occur for a short time. Critical hardware on the mainboard must be secured accordingly.

Table 4:

	Voltage level at output of the decoder	Voltage level for the load switch (on the motherboard of the vehicle)
Function switched off	≤ 0.4 Volt	≤ 0.8 Volt
Function switched on	≥ 2.4 Volt	≥ 2.0 Volt

GPIO_A and GPIO_B may be used as digital inputs, they are switched to GND. The decoder must then have a pull-up in the range 10 to 50 kΩ. GPIO_C can also be used as an analog input. In this case, the static input resistance must be greater than 100 kΩ. The control signal from the vehicle must not exceed 3.3 V. GPIO_C should preferably be used for wheel synchronization on steam locomotives.

Servos should preferably be controlled via GPIO_A and GPIO_B. Serial buses should always use GPIO_A and GPIO_B.

2.4.3 Usage of the Interface on Function Decoders

This interface can be deployed in vehicles without motors (e.g. control cab cars). Since the motor connections are not wired in this case, the decoder must provide the necessary feedback signals in DCC service mode by means of internal circuitry.

3. Operation without Decoder

To operate the vehicle without a decoder in the interface, a jumper plug must be used that connects at least the connections for power pickup on the right (pins X2A and X2B) with motor+ (pins 6 and 7) and the left-hand current pickup (pins X1A and X1B) with the motor- (pins 4 and 5).

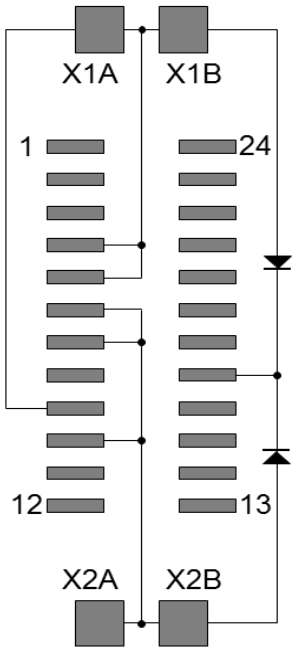

Fig. 5: Typical Jumper plug

If functions are to be controlled via the jumper plug, U+ in the jumper plug must be supplied to pin 17 via two diodes from the current tap pins.

4. Specification of Components for Plug Strip and Socket Strip

Type of connector strip: MOLEX 5050702422, type of socket strip: MOLEX 5052702412

The dimensions and recommended PCB layout are available on the MOLEX website under

https://www.molex.com/en-us/products/part-detail/5050702422?display=pdf and

https://www.molex.com/en-us/products/part-detail/5052702412?display=pdf respectively.