

## 1. Purpose of the Standard

This standard defines uniform interfaces according to the PluX standard for safe and fast installation or replacement of electronic assemblies (decoders or others) in vehicles using 12-, 16- or 22-pin connectors depending on the range of functions.

**Notes:** Interfaces according to this standard sheet essentially correspond to those according to NMRA RP-9, S-9.1.1.4 Edition of July 2021 without PluX8 and supplemented by PluX12. Detailed information on this interface can be found in RailCommunity standard RCN-122, Edition of August 2020 ([www.railcommunity.org](http://www.railcommunity.org)).

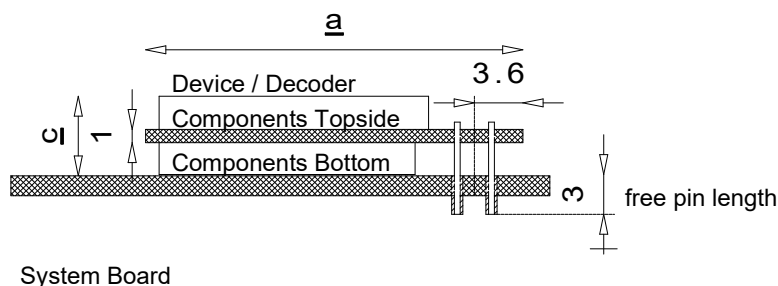
## 2. Interface Description

This interface can be used in vehicles with DC motors and / or function decoders.

### 2.1 Mechanical Properties

The interface on the system board is composed of 12, 16 or 22 sockets in two rows parallel with a pitch of 1.27 mm.

The number of pins of the male decoder connectors is matched against the system board. If the number of pins is less than the number of sockets on the socket, not all possible locomotive functions will be available. In the event that there are more pins than sockets on the female plug (as long as there is sufficient space and the holes allow it) it will not be possible to use all decoder functions. The electrical devices (decoders) have pin-interfaces on their bottom side (see fig. 1).



**Fig. 1:** Arrangement of the decoder on the system board, dimensions according to table 2

Pin and socket headers are arranged in two rows of 6, 8 or 11 contacts and preferably soldered directly into the circuit boards. The center of the pin header is 3.6 mm from the edge of the decoder board.

Pins and sockets correspond to the usual dimensions of this connector type. The pins have either a square profile with 0.40 mm edge length or a round profile with a diameter of 0.43 mm, a gold-plated surface and a contact load capacity of max. 1 A.

Correct orientation of the decoder with the vehicle circuit board respective is achieved by omitting Pin 11 on the decoder and blocking the associated socket. See also figure 2.

Compliance with the free pin length is crucial for the reliable function of the plug connection below the underside of the module, with a length of 3 mm minimum and 4 mm maximum and a socket length of approx. 2 mm.

Vehicles with a factory-installed interface must be clearly marked on the packaging with the identification letters PluX12, PluX16, PluX16-S or PluX22.

## 2. Electrical Properties

Manufacturers must specify the maximum output current capability of the decoder.

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

### 2.3 Contact assignment of the interface for the use of decoders

The contact assignment of the interfaces in the PluX version is defined in Table 1. PluX12 is no longer recommended for new developments.

**Table 1:** Pin assignment, wire color and description of the function

PluX12 Pin	PluX16 Pin	PluX22 Pin	Name	Description	Group
		1	GPIO / C	General purpose input / output 10 <sup>1)</sup>	4
		2	AUX3	Output 3	5
	3	3	GPIO / B	Train bus clock, alternatively output 8 <sup>1)</sup>	7
	4	4	GPIO / A	Train bus data, alternatively output 9 <sup>1)</sup>	7
	5	5	GND	Decoder minus, tap behind rectifier	
	6	6	V+ Cap.	Decoder plus, tap after rectifier, Connection of buffer capacitor	2
7	7	7	F0f	Light during forward direction of travel	5
8	8	8	Motor +	Motor connection plus <sup>2)</sup>	3
9	9	9	V+	Decoder plus, tap behind rectifier	
10	10	10	Motor -	Motor connection minus <sup>2)</sup>	3
11	11	11	Index	Not used, Decoder orientation	
12	12	12	Power pick-up right	Power pick-up on the right in the forward direction of travel	1
13	13	13	F0r	Light during backwards direction of travel	5
14	14	14	Power pick-up left	Power pickup on the left in the forward direction of travel	1
15	15	15	LS / A	Loudspeaker connection A	6
16	16	16	AUX1	Output 1	5
17	17	17	LS / B	Loudspeaker connection B	6
18	18	18	AUX2	Output 2	5
		19	AUX4	Output 4	5
		20	AUX5	Output 5	5
		21	AUX6	Output 6	5
		22	AUX7	Output 7	5

<sup>1)</sup> It should be noted that when the decoder processor is being started, uncontrolled states including a high-resistance state at outputs with logic level can occur for a short time. Critical hardware on the mainboard must be secured accordingly.

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

**Annotations for the Groups:**

- Group 1:** When supplied with AC-Motors Pin 14 is connected to the wheels and Pin 12 to the power pick-up to the center conductor.
- Group 2:** Pin 6 (Cap+) is specially designed for connecting storage capacitors. This plus connection should be switchable in order to switch off the storage capacitor, for example when programming the decoder. It carries a maximum of the track voltage to V +.
- Group 3:** Pin 8 is field coil A, Pin 10 is field coil B for AC-Motors.
- Group 4:** GPIO / C can be output or input. As an input, it must be switched to GND. The input resistance should be approximately 100 kΩ. It has TTL-compatible logic levels (see table 2) as output and can be loaded with a maximum of 0.5 mA.
- Group 5:** When switched on, these outputs are connected to GND on the decoder side. The voltage for the switched load results from the track voltage at V +.  
If the rear signal lights are connected to the decoder separately, the rear signal lights of vehicle in forward direction 1 are switched with Pin 16 (AUX1) and those in rear direction 2 with Pin 18 (AUX2).
- Group 6:** The speaker impedance is defined by the decoder manufacturer and is as such documented.
- Group 7:** The microcontroller-pins of the train bus are connected through a serial resistor with a maximum of 470 Ω. The levels correspond to TTL-compatible logic levels (Table 2).  
These pins can also be used as function outputs with a logic level.

The logic-level outputs according to Table 2, switched to GND and with maximum load 0.5 mA.

**Table 2:**

	Voltage Level Decoder output	Voltage Level for switching element on system board
Function Switched Off	≤ 0.4 V	≤ 0.8 V
Function Switched On	≥ 2.4 V	≥ 2.0 V

### 3. Dimensions of the space for electronic assemblies

With the exception of the PluX12, the electronic assemblies are arranged symmetrically to the interfaces. With PluX12, the assembly is off-center by 1.27 mm (1 pin grid) from 7/8. This also applies to the vehicle installation space.

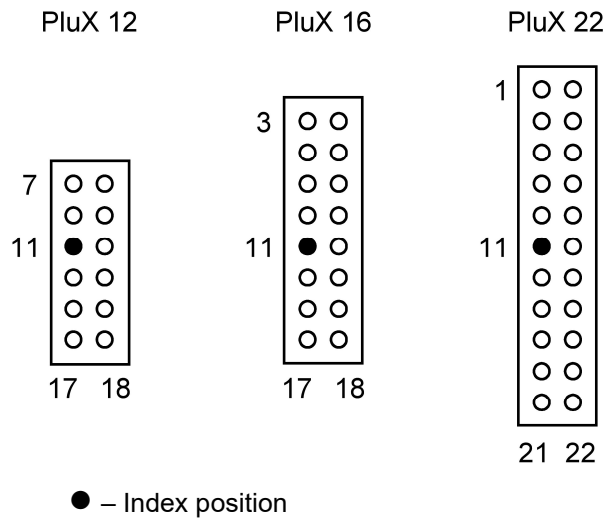
**Table 3:** Decoder Dimensions

	PluX12	PluX16	PluX16-S (Sound)	PluX22
Length a	20.0	20.0	28.0	35.0
Width b	11.0	11.0	16.0	16.0
Hight c	4.2	4.2	6.0	6.0

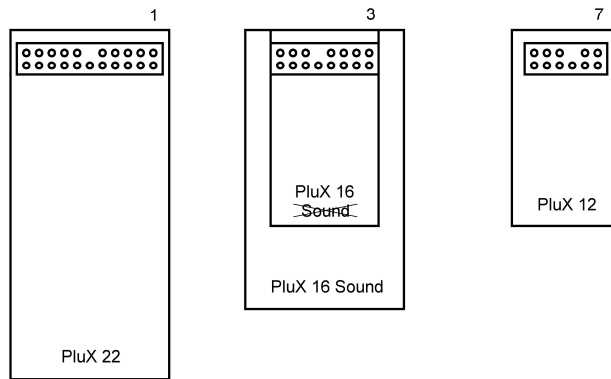
**Notes:** The installation space for the decoder in the vehicle must be sized in such a way that it is compatible with the maximum dimensions according to table 2 without constraint. Installation and removal must not require special tools.

Below the socket strip additional room for the maximum pin length of the decoder must be provided so that physical contact between the pins and parts below the mainboard is impossible.

A distance of 4.5 mm from the upper edge of the socket strip (plug-in plane) is recommended.



**Fig. 2:** Assignment of the connector variants of the PluX version and identification of the indexing with relation to the socket strips.

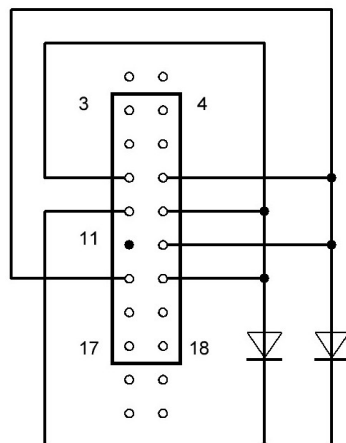


**Fig. 3:** Size comparison of the areas reserved for the electronic assemblies depending on the PluX variants. (schematic, about 1:1), view of the top of the decoder

#### 4. Operation without a decoder

For operating without a decoder, a blanking plug shall be used which must connect socket 12 with socket 8 (right rail pickup to Motor +) and socket 14 with socket 10 (left rail pickup to Motor -).

In order to enable vehicle lighting, bridge connections should be provided to operate the lights, for example with diodes.



**Fig. 4:** Typical Jumper plug