

## 1. Purpose of Standard

This standard defines a Interface which insures a secure and quick installation or replacement of a decoder or function decoder.

## 2. Interface - Description

This interface is usable for AC-Motors (2 field coils) , DC-Motors or bell rotor DC-Motors. 8 outputs are provided for functions and 2 inputs are provided for sensors. The required room for installation of the decoder and its dimension are integral part of this standard.

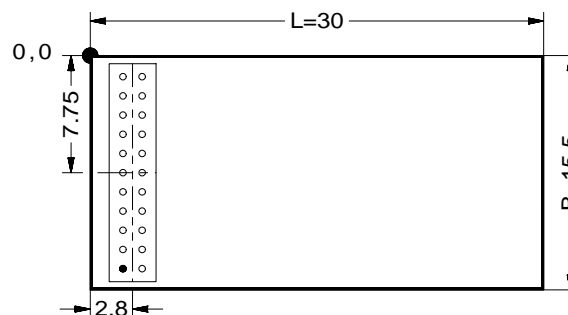
### 2.1 Mechanical Characteristics

The interface on the system PCB (printed circuit board) consists of a 22 pin male plugs arranged in two rows with 1.27 mm interval. The dimension of the decoder are at the most 30 (L) x 15.5 (W(B)) x 6.5 (H) mm. The system PCB must provide sufficient room in order to plug in the decoder without any problem on the PCB.

Male and female plugs form a ridge consisting of 11 contacts in two rows. Preferred is a soldering of the plugs on the system PCB. Not installing pin 11 insures the correct insertion on the PCB (index pin).

#### 2.1.1 Decoder

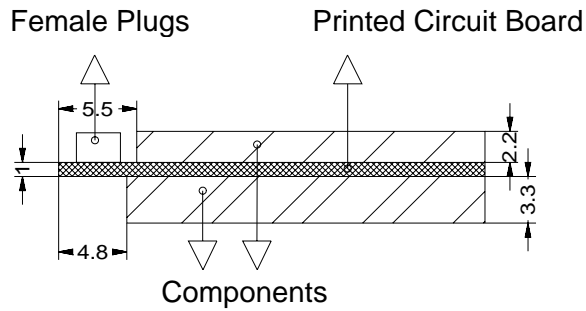
The decoder is provided with a ridge of female plugs. The plugs are oriented on the small side of the decoder PCB as shown in picture 1.



**Picture 1:** Decoder with female plugs, top view

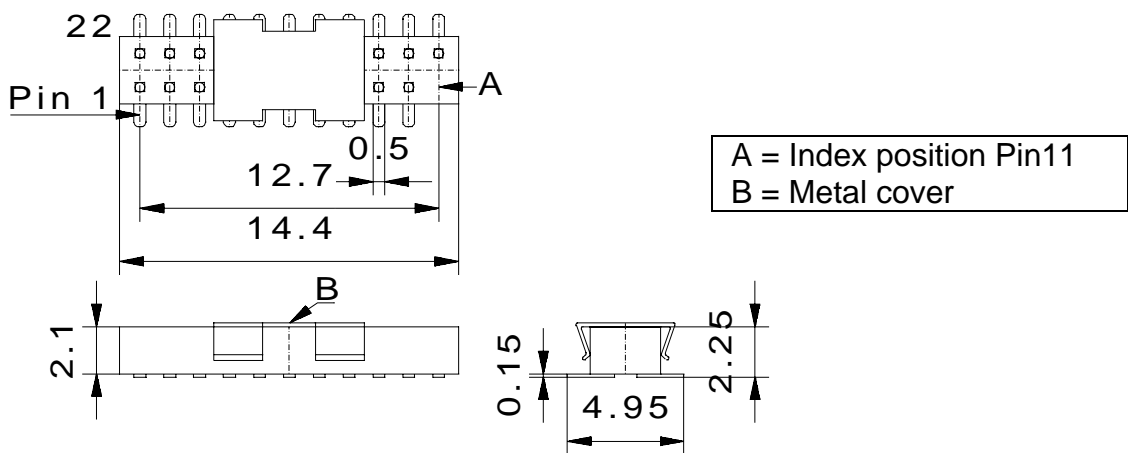
The ridge of plugs must be located from the edge of the PCB as shown in picture 1. The decoder may be shorter than  $L = 30$  mm. The position of the ridge of plugs in reference to 0,0 must be guaranteed.

The maximum height of the decoder is given and must be observed. Picture 2 shows the assembly. For the components the side with the plugs allows a maximum height of 2.2 mm. The other side allows a height of 3.3 mm. The PCB itself has a height of 1.0 mm.



Picture 2: Decoder with female plugs, side view

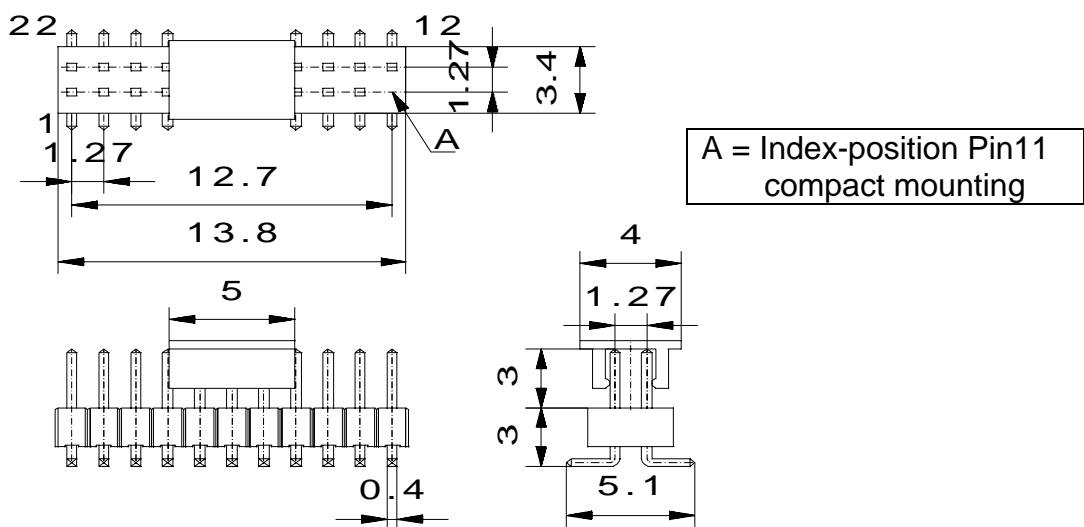
Male and female plugs have common dimensions of this type of connections. The male plugs consist of a length of 3 mm and have either a square profile of 0.40 x 0.40 mm shape or a round profile with 0.43 mm diameter. The surface is gilder and allows a maximum current of 1A.



Picture 3: Female plug-arrangement for decoder

### 2.1.2. System PCB

The system PCB provides the housing for the Decoder according to its maximum dimensions. A suitable male pin arrangement shows picture 4.



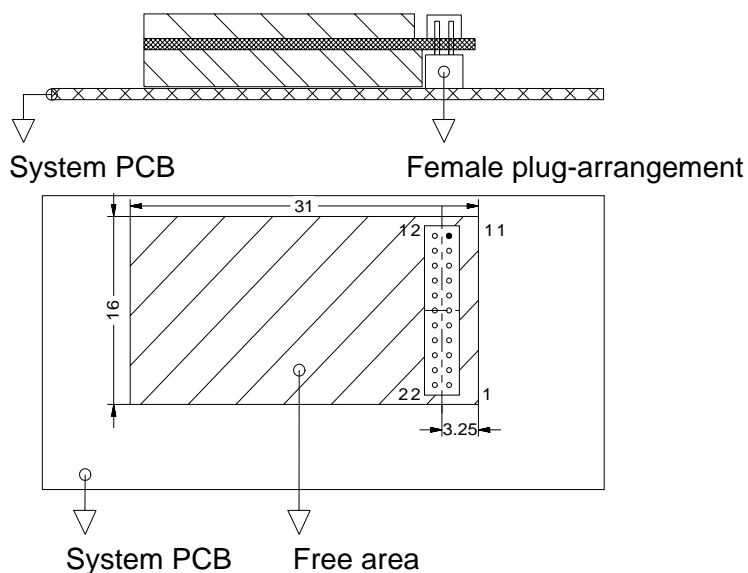
Picture 4: Male plug-arrangement for system PCB

### 2.1.3. Decoder-Mounting

It is possible to mount the decoder in two different positions.

#### 2.1.3.1 Compact Mounting

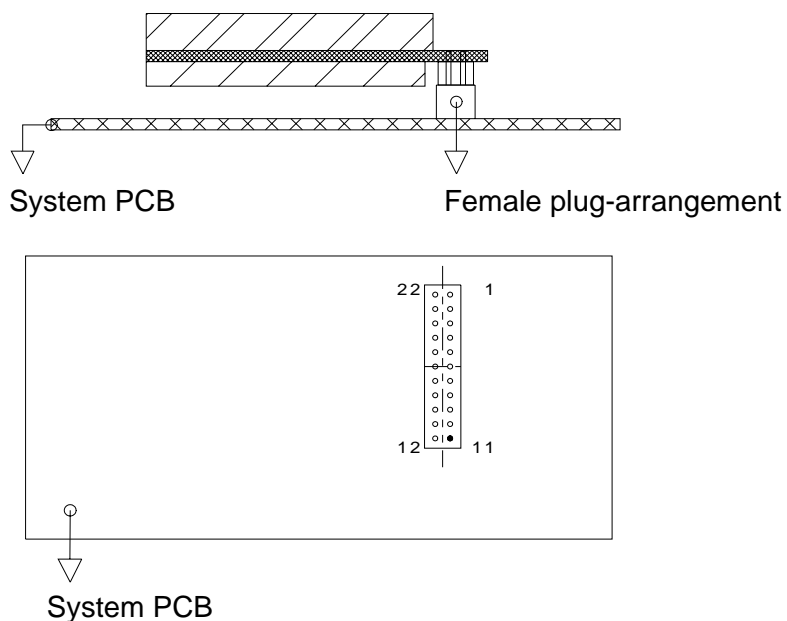
The compact mounting results in the lowest space requirements. In this case the decoder is plugged in with the female plugs on top. The male pins make contact through the PCB of the decoder. The decoder sits plane on the system PCB.



Picture 5: Compact Mounting

#### 2.1.3.2 Up-side-down Mounting

In case it is enough room above the system PCB, but no free area on the system PCB, the decoder may be mounted in the up-side-down position. The Decoder will be plugged with the female plugs oriented down onto the system PCB. The pin orientation of system PCB must be mirrored at the axis of pin 6/17.



Picture 6: Up-side-down mounting

Locomotives with implemented interface according to this NEM shall be identified with the following logo on its package:



## 2.2 Electrical Characteristics

Manufacturer of this decoder must specify the maximum current allowed to draw for each output and input. In case the decoder must be placed in a different space and is connected with a flat ribbon cable the colors of the cables are not mandatory. The colors are required for single cables.

## 2.3 Pin Assignments

The pin assignments for 21MTC are defined in Table 1:

**Table 1:** Pin assignments and definition of function

Pin	Name	Color	Description	Group
1	Input1		Sensor-Input 1	4
2	Input2		Sensor-Input 2	4
3	AUX6		Output 6	8
4	AUX4		Output 4	8
5	ZBCLK		Train Bus Clock	7
6	ZBDTA		Train Bus Data (TxD, RxD)	7
7	F0r	yellow	Light direction rear	5
8	F0f	white	Light direction forward	5
9	LS/A	brown	Speaker Connection A	6
10	LS/B	brown	Speaker Connection B	6
11	Index		Not used, Orientation	
12	Vcc		Internal Decoder-Voltage 1,8 – 5,7 Volt	2
13	AUX3		Output 3	8
14	AUX2	violett	Output 2	5
15	AUX1	green	Output 1	5
16	V+	blue	Decoder Plus, referenced at rectifier, Anschluss Speicherkondensator	2
17	AUX5		Output 5	8
18	Motor2	grey	Motor-connection #2 minus / direction rear	3
19	Motor1	orange	Motor-connection #1 plus / direction forward	3
20	GND		Decoder GND, Referenced at rectifier	2
21	Track left	black	Track left in direction forward	1
22	Track right	rot	Track right in direction forward	1

**Annotation für Groups:**

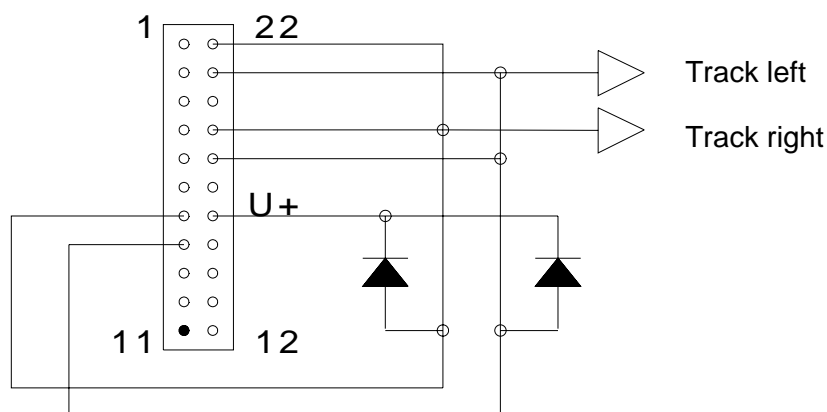
- Group 1:** When supplied with AC-Motors Pin 21 is connected to the outer rails und Pin 22 to the middle rail.
- Group 2:** Pin 12 is not mandatory. It is recommended to supply this pin in order to connect additional processors.
- Group 3:** Pin 19 is field coil A, Pin 18 is field coil B for AC-Motors..
- Group 4:** Pin 1 and 2 are Open-Collector-Inputs and will switch on against GND. The input resistance should be ca. 100 K-Ohm. Sensor-Input 1 shall be used to synchronize wheel movement and sound when steam engines are used.
- Group 5:** In case the rear lights are connected to the decoder separately, the rear lights of locomotive in forward direction 1 are switched from Pin 15 and those in rear direction 2 to Pin 14.
- Group 6:** The speaker impedance is defined by the 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 Ohm.
- Group 8:** Output load may not exceed 0.5 mA and has logic levels according table 2.

**Table 2:**

	Voltage Level Decoder Output	Voltage Level for switching element on the system PCB.
Function switched off	$\leq 0.4$ Volt	$\leq 0.8$ Volt
Function switched on	$\geq 2.4$ Volt	$\geq 2.0$ Volt

**4. Operation without Decoder**

By operation without Decoder it is required to use a female plug. At least the pins track right must be bridged with motor 1 and track left must be bridged with motor 2. If lights exist, the appropriate pins must be bridged to the appropriate pins.



**Picture 7:** Typical female bridge plug

Depending of the connections of the various outputs, the manufacturer may generate a specific female bridge plug.