	Standards for European Model Railroads	NEM
MOROP	**Electrical Interface PluG** **for large scale model railroads**	**663** Page 1 of 5

| **Recommendation**	**Dimensions in mm**	**Edition 2014** (First English Edition)

1. Purpose of the Standard

This standard describes the interface for vehicles on large scale model railroads that require more than 2 Amperes of power for motors, electrical components and sounds. The interface can be implemented in steps from 16 to a maximum of 44 contacts. The volume is scaled to the number of contacts.

2. Basic Principles

In order to comply with this standard the electrical and mechanical characteristics must be complied with. The space needed to install a decoder according to Table 2 must always be kept clear inside vehicles. It is not required that all functions of the interface be supported. The connections for unsupported functions should not be connected or populated. The manufacturer must document the specifics of the installed interface and any missing functions.
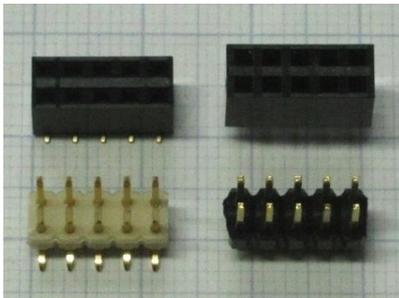
3. Mechanical Properties

The interface is composed of up to four 10 conductor, 0.64mm pin headers and their corresponding pin sockets in a 2.54mm grid spacing on the motherboard of the vehicle.

Protection against improper plug insertion is ensured through the variation of the spacing of the plugs. The assembly in the area of the pin sockets on the decoder has a height of 7 (+1/-0) mm. The assembly in the area of the decoder's pin header has a height of 10 (+1/-0) mm. The spacing between the motherboard and decoder is a minimum of 10mm and can be increased through taller pin/socket headers if needed.
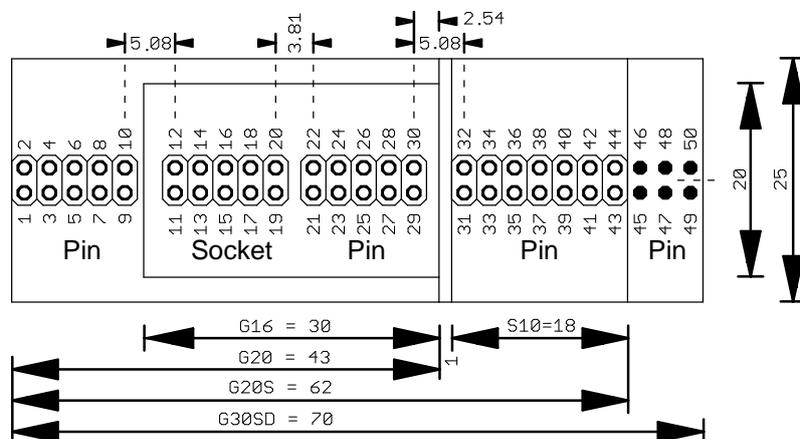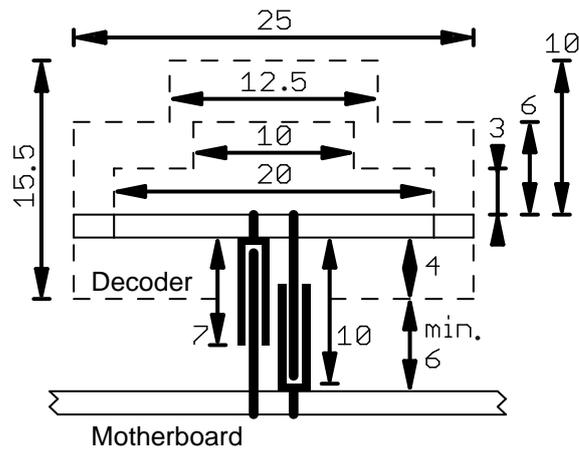

Figure 1: Top View of Motherboard

Figure 2: Side View of Motherboard and Decoder

The respective dimensions can be taken from the above drawings (tolerance +/- 0.5 mm). The maximum height for current conducting contacts of components must each be 1mm less.

The decoder types are found in Table 1.

Table 1:

Type	Pin Numbers	allowed load	Width	Length	Height	Component Height Top Middle/Edge	Component Height Bottom
PluG-16	15 ... 30	2A	20	30	3 … 6	6 / 3	4
PluG-20S	11 ... 40	3A	25	62	6 ... 10	10 / 6	4
PluG-20	11 ... 30	3A	25	43	6 ... 10	10 / 6	4
PluG-S	31 ... 40	-	25	18	6 ... 10	10 / 6	4
PluG-30SD	1 ... 44	3A	25	70	6 ... 10	10 / 6	4

4. Electrical Properties

The load limit is 3 A continuous per contact. Short term spikes in current such as when setting into motion, with a doubled value are allowed and must be supported by decoders. Table 2 describes the assignment of the contacts. Table 3 describes the function connections and voltage carrying signals.

Table 2:

Tech. Data	Direction	Description	Contact		Description	Direction	Tech. Data
10 mA / Logic	◄ ►	Lokbus -a	1	2	Lokbus -b	◄ ►	10 mA / Logic
10 mA / Logic	Dec. ►	IR-Transmitter/F-A17	3	4	F-A18 / IN-6	Dec. ►	PU / Logic
0.3 A / OC	Dec. ►	F-A15	5	6	F-A16	Dec. ►	0.3 A / OC
10 mA / Logic	Dec. ►	Servo-3 / F-A13	7	8	F-A14 / Servo 4	Dec. ►	10 mA / Logic
0.3 A / OC	Dec. ►	F-A11	9	10	F-A12	Dec. ►	0.3 A / OC
10 mA / Logic	Dec. ►	Servo-1 / F-A7	11	12	F-A8 / Servo-2	Dec. ►	10 mA / Logic
Track. prot'd / 22 V	► Dec.	Motor Switch	13	14	F-A6 / IR-Receiver	◄ ►	PU / 10 mA / Logic
1.5 A / 3.0A	Dec. ►	Motor -	15	16	Motor +	Dec. ►	3.0 A / 1.5 A
2.0 A / 3.0A	► Dec.	Track -	17	18	Track +	► Dec.	3.0 A / 2.0 A
1A	Dec. ►	(→Pin35) (GND) Dec-	19	20	Dec+ (→Pin36)	Dec. ►	1 A
0.1 A / OC	Dec. ►	(BC) Buffer Control	21	22	F-A1	Dec. ►	0.3 A / OC
0.3 A / OC	Dec. ►	F-LV	23	24	F-LH	Dec. ►	0.3 A / OC
0.3 A / OC	Dec. ►	F-A2	25	26	F-A3	Dec. ►	1.0 A / OC
PU / 10 mA / Logic	◄ ►	IN-1 / F-A5	27	28	F-A4	Dec. ►	1.0 A / OC
10 mA / Logic	◄ ►	(→Pin39) (Susi-Clk) Bus1a	29	30	Bus1b (Susi-Data) (→Pin 40)	◄ ►	PU / 10 mA / Logic
8 Ohm / min. 2 W	Dec. ►	Speaker-1a	31	32	Speaker-1b	Dec. ►	8 Ohm / min. 2 W
PU / Logic	► Dec.	Clock 1 / IN-2	33	34	Potentiometer (Volume)	► Dec.	0 … 5 k Ohm
0.7 A	► Dec.	(→Pin19) (GND) Dec-	35	36	Dec+ (→Pin20)	► Dec.	0.7A
PU / 10 mA / Logic	◄ ►	F-A9 / IN-3	37	38	IN-4 / F-A10	◄ ►	PU / 10 mA / Logic
10 mA / Logic	◄ ►	(→Pin29) (Susi-Clk) Bus2A	39	40	Bus2B (Susi-Data) (→Pin30)	◄ ►	10 mA / Logic
8 Ohm / min. 2 W	Dec. ►	Speaker-2a	41	42	Speaker-2b	Dec. ►	8 Ohm / min. 2 W
PU / Logic	► Dec.	Clock 2 / IN-5	43	44	+ 5 V	► Dec	100 mA
???	???	- Future use -	45	46	- Future use -	???	???
???	???	- Future use -	47	48	- Future use -	???	???
???	???	- Future use -	49	50	- Future use -	???	???

Note: Pins 45 ... 50 are reserved for future expansion and are not presently populated.

Table 3:

Function/ Voltage Carrying Signal	Description	Comments
Track+	Right rail in direction of travel (special case with 45mm garden layouts = left rail)	
Track-	Left rail in direction of travel (special case with 45mm garden layouts = right rail)	
Dec- / GND	Signal Ground (GND) behind rectifier.	Dec- may be connected to a rectifier on the interface motherboard.
Dec+	Supply voltage after the rectifier.	Dec+ may be connected to a rectifier on the interface motherboard.
Motor +/-	Connection to Motor	Consider rotation direction.
F-Ax, F-Lx	Switched output for additional function.	Observe the technical data of the OC or logic.
OC	Electronically switched output (Open Collector) against GND.	Consumers are supplied by „Dec+" or a regulated voltage.
Logic	Output direct form the processor with 5 V level.	Consumers are supplied by „Dec- / GND". The logic outputs can be protected through series resistors (max. 470 Ohm).
BC	Control connection (OC) to charge and discharge control of storage capacitors.	
Motor switch	Signal input to switch the motor output (Analog + Digital) :	Uin value > 2.0V means ON
+5 V	Auxiliary voltage for sensors or other processors in the vehicle.	This power must NOT be used for consumers (lights, servos, etc.)
IN-x	Control input for clock, Magnetic sensors	
PU	Decoder contains (switchable) pull-up resistor against +5 V for sensors with OpenCollector	
Bus	SuSi-Bus or Lokbus (29 + 30) decoder output , Sound module input (39+40)	Lokbus - future use, defined by VHDM
Lokbus	Future use, defined by VHDM	
Speaker	Minimual power 2 Watt at 8 Ohm	Amplifier output should be adjustable.
Potentiometer	Adjustable resistor to GND: 0 k Ohm (= quiet) to 5 k Ohm (= loud) , voltage over resistor maximum 5 V	
IR-Transmitter / Receiver	Future use, defined by VHDM	
Servo	Standardized control signal for model servo motors	

5.   Bridge Plug

In analog operations an OEM Bridge Plug is utilized.   The connections are made according to Table 4.

Table 4:

Connection from	Contact Number	Connection To	Contact Number	Comment
Motor+	16	Track+	18	
Motor-	15	Track-	17	rather than Track-, on can also connect Motor Switch contact 13
OC		GND	19, 35	if needed
Logic		5 V aux. power	44	if needed

Note: If on vehicle consumers are powered by an auxiliary supply (e.g. 6 V) via a clocked DC/DC converter, then directional outputs should not be directly connected to „Track+" or „Track-" through diodes. Control must be done by an OpenCollector circuit in order to prevent cross currents at the regulator.

6.   Note

The decoder must provide for appropriate feedback signals in Service-Mode in the case of usage of a sound module (PluG-S) without motor control.

7.   Further Information

On the VHDM website (www.railcommunity.org) more information is accessible under RCN-123.