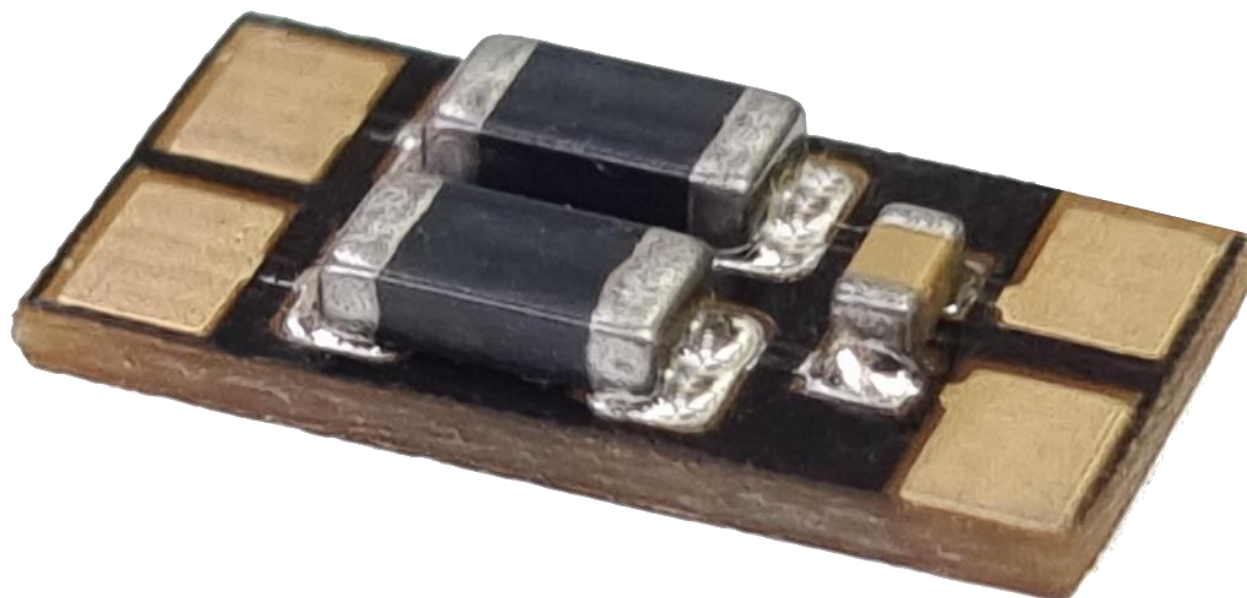




Motor Filter



by **TEHNO
LOGISTIC**

The rotor windings of a DC electrical motor are connected to a commutator that is in mechanical contact with (usually) two carbon/coper conductive brushes. In this way the rotor windings are fed with power successively while the rotor is spinning. That means that when the electrical motor is powered on, a lot of coil switching will happen with a frequency proportional with the spinning speed of the rotor. Consequently, when the brushes are moving from one commutator contact to another, voltage and current variations will occur. Due to friction between the brushes and the commutator coper and/or carbon dust will be present. Also because of repetitive on/off switching of the rotor coils mini sparks will be present and will get both brushes and commutator dirty. Because of the above aging phenomenon, the efficiency of the motor will decrease and it will become “noisier” from electrical point of view. The noisiness refers to the level of voltage pulses in the rails.

The above is influencing an analogue track as efficiency since only power (AC or DC) is traveling on the rails. But this is not applicable for the digital environment where the tracks are transporting PWM (Pulse-Width Modulation) power and control data, and a very noisy motor can alter the digital signals.

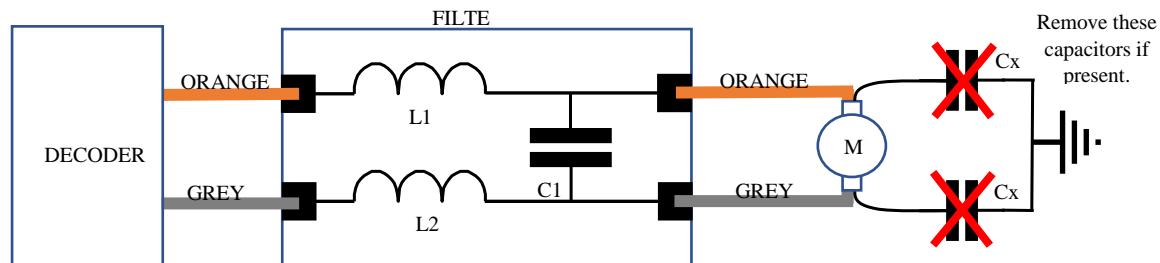
In many locomotives, even if they have a remark that they are DCC ready, there are 2 capacitors (see Cx in **Figure 1**) connected to the chassis to reduce the motor electrical noise. When such a locomotive is converted to digital environment using a decoder, the capacitors must be removed because they will affect the decoder functionality, mostly the BEMF (Back ElectroMotive Force) reading.

Some locomotives already have a filter that looks like the one in **Figure 1** but, because of the used values, BEMF readings can be influenced. In this case those coils and capacitors must be removed and replaced with the Motor Filter board.

In practice there are locomotives that have one of the motor plots connected to the wheel trough the chassis. This requires special attention since this connection can damage the decoder since it will make a short circuit between the input and the output. In this case the connection to the chassis must be removed. As you can see in **Figure 2** there is no direct connection from the rails to the motor.

To achieve the best functional results, the motor must be connected only to the filter board as in **Figure 2**.

Figure 1



The motor decoders output is a transistor H bridge that is feeding the motor. If the electrical motor is very “noisy” than this can affect the decoder functionality in several ways:

- When load compensation is active, the decoder will read the voltage generated by the motor in the BEMF window. Additional “noise” from the motor will alter the reading and the decoder will take wrong decisions.
- The H output bridge is made by transistors that have a certain voltage rating. If the motor is very “noisy”, then the voltage pulses can have a higher level than the nominal voltage rating of the transistors and there is a chance that they can get defective. The primary effect of this phenomenon is that the temperature of the transistors in the H bridge will increase.

To avoid the above malfunctions, it is strongly recommended to connect a filter between the decoder output and the motor (see **Figure 2**).

The component values (inductors and capacitor) are calculated in such way that only the undesired noise will be rejected.

The wires colour coding must be respected to make sure that the locomotive moves in the correct direction. For decoder to filter connections and filter to motor connection orange is + and grey is -. For rail (wheels) to decoder connections red is + (right track) and black is for - (left track)

Figure 2

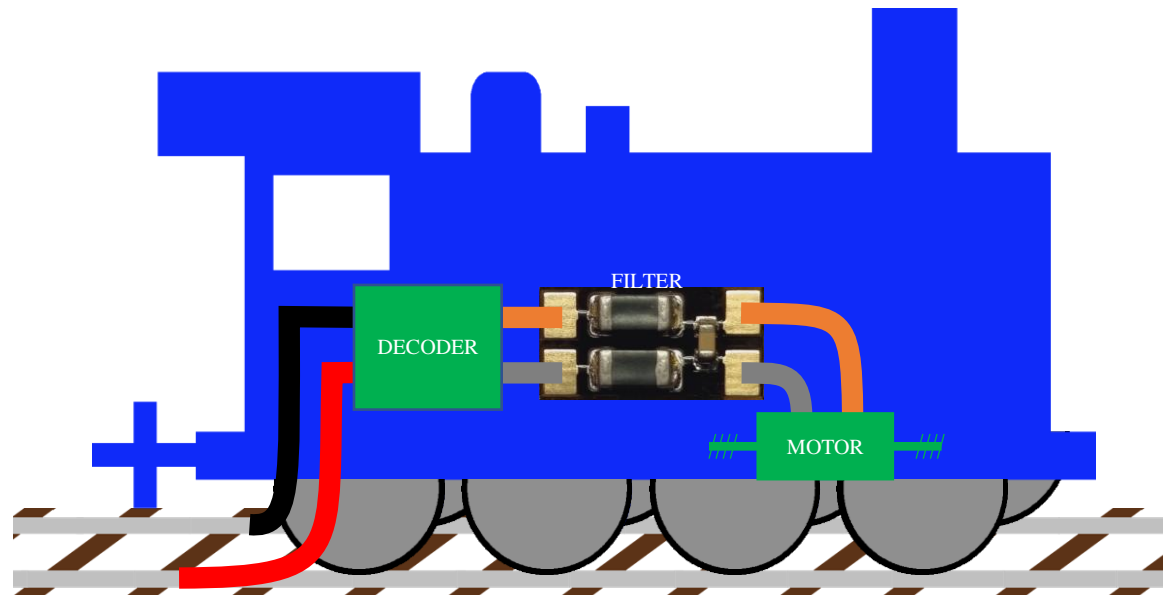





Table 1 – Electrical and mechanical specifications

Max voltage	35	V _{DC}
Max current	1	A
Size (LxWxH)	10 x 5 x 1.6	mm

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