



### 3. Further specifications of the SX-signal

#### 3.1 Trigger values at the receiver

To ensure the proper functionality of the receiver/decoder, the following trigger values of the track voltage must be met:

Min. trigger value	>   4V
Max. trigger value	<   9V

#### 3.2 Rise/Fall time of the track-signal

The voltage change between the max. voltage level of the clock-pulse ( $\pm 2V$ , refer to 2.1), and the min. voltage of the data-pulse ( $\pm 12 V$ , refer to 2.2) is defined as rise/fall time of the track voltage. It must meet the following condition:

$$| Ss | \geq 2,5 \text{ V}/\mu\text{s}$$

#### 3.3 Ripple of the track-signal

The track signal can be overlaid by any other wave forms, as long as the resulting wave forms conforms with 2.1, 2.2 and 3.2.<sup>3)</sup>

#### 3.4 Self-inflicted distortions

Every equipment using this specification has to meet the current CE-regulations (or FCC-regulations for the US).

#### 3.5 Compatibility

- On all tracks using the described digital track signal only vehicles with digital decoders can be used. Using the digital track signal to directly drive the motor of a locomotive can result in damages to the motor.
- The SX-receiver has to be build in a way that also waveforms of other digital systems do not lead transmitting errors.

### 4. Energy-transfer and Voltage limits

#### 4.1 Energy-transfer

Since the track-signal is also used as the energy-source for all locomotives and other vehicles, the continuously transmission of data bits is essential.<sup>4)</sup>

#### 4.2 Voltage limits

- The virtual value of the track signal shall not exceed the specifications in NEM 630<sup>5)</sup> by more than 2 V.
- The max. peak-to-peak value of the digital track-signal must not exceed  $\pm 24 V$ .
- The min. peak-value of the SX-signals, driving the digital receiver, amounts  $\pm 9 V$ , measured at the track.
- The receivers have to have a direct current (d. c.) voltage life of at least 25 V.

<sup>3)</sup> These overlaid signals can be used for any other control options.

<sup>4)</sup> The typical way for measuring the energy supply is the bridge-circuit.

<sup>5)</sup> The additional voltage serves the compensation of the voltage-drop in the decoder in order to secure the NEM 630 (table 1) specified maximum-voltage at the motor-brushes.