Offline EMC_Math analysis - We help make sure your train arrives on time!

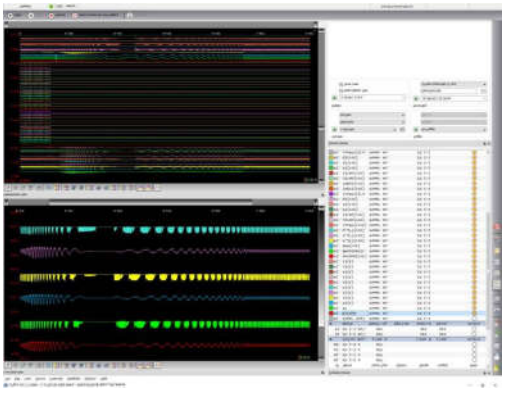
To ensure that the safety systems on tracks and rails function reliably, the electromagnetic interference emitted by trains and their drives must not exceed specified limit values.

To check electromagnetic compatibility, we now offer a new **all-in-one solution** consisting of our reliable, high-precision LTT24 and LTTsmart measuring devices and a new LTTpro software solution that subsequently evaluates the recorded measurement data and can output and display the results in a variety of ways.

For this purpose, the recorded data is read in after the measurement has been completed. The measurement data per channel is then filtered according to the previously defined filter characteristics and frequency bands and the RMS values of the emissions are calculated.

The results are output in the time and frequency domain, i.e. both the time course of the emissions per frequency band and their exact frequency dependence can be analyzed.
The results are then plotted and saved.

Compliance with the limit values can thus be easily checked visually and the plots can be used directly.



As all settings can be freely configured, **individual** frequency bands for internal tests or changed legal standards are no problem.
To speed up the evaluation, all files of a measurement campaign can be processed as a batch task and in parallel so that you don't have to wait long for your results.

Have we aroused your interest? We would be happy to make you an offer.
Get in touch with us today!

LTTpro - Our measurement software solution for your measurement data. **Improve and increase your efficiency or that of your customers** with high-precision measurement data acquisition from Labortechnik Tasler GmbH

We are happy to assist you with our measurement technology and support you with our many years of experience in all metrological challenges.

We look forward to hearing from you and send our best regards from Würzburg

Your Labortechnik Tasler team

Technical/Mathematical Data Sheet Offline EMC_Math Analysis

Applicable standard:

BS EN 50592:2016

Railroad applications - Testing of railway vehicles for electromagnetic compatibility with axle counters

Limits and specifications:

According to the applicable standard

Test preparation:

Measurements shall be performed using the specified measuring antennas, under specified vehicle operating conditions.

Compatibility tests of vehicles can be carried out with any type of rail. The influence of the rail type on the measurement result is taken into account in the compatibility limits and the associated margin.

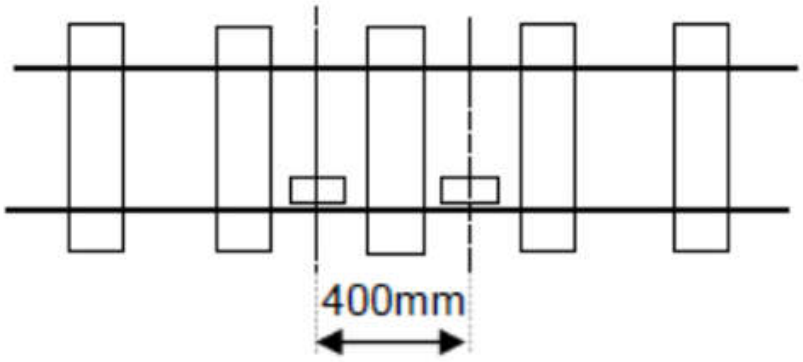
The train must be tested under the electrification system(s) for which it is to be approved.

The methodology is also applicable to other vehicle types.

The emissions caused by the vehicles are measured as magnetic fields in the X, Y and Z directions.

Ambient noise measurements must be carried out before the tests.

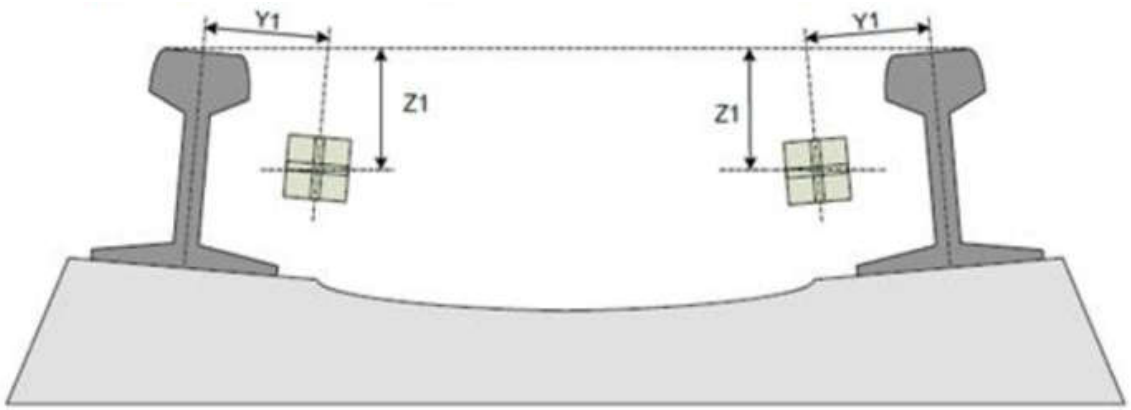
In order to minimize the influence of ground currents and other parasitic effects, the measuring antenna must be placed between two thresholds.



Mounting the measuring antenna between two sleepers

Mounting position

Table 1 is used to determine the mounting position of the measuring antennas for the frequency range under consideration. The center point (Y1, Z1) of the measuring antenna results from the arithmetic mean value of all relevant axle counter sensor types per frequency range
(LFR, HFR).



Coordinates of the center point

The center point of the measuring antennas must have the following coordinates in relation to the center line of the rail web for Y1 and the connecting line between the highest position of the two rail heads for Z1:
Table 1 - Y1 and Z1 coordinates of the center point of the measuring antennas

MA center position (10 kHz up to 1.3 MHz)

- Y1 Tolerances (mm) 96 (-3 ; +3)
- Z1 Tolerances (mm) 73 (-5 ; +5)

Test conditions for vehicles

Locomotives

The following operating conditions must be tested for locomotives:
When passing the antenna, the vehicle must accelerate and decelerate (with electric brakes and brake chopper, if present) with approximately 1/3 of its maximum tractive effort.

In addition to the following different speeds:

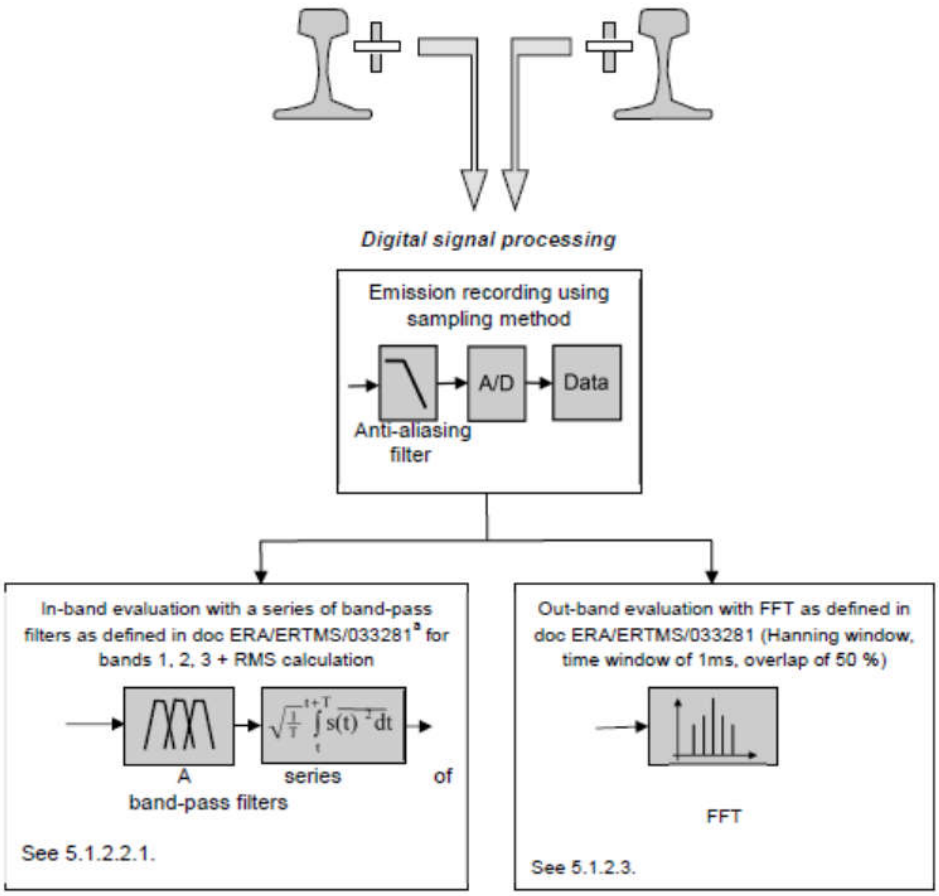
- Speed v1: very low speed of around 5 km/h to 10 km/h;
- Speed v2: approx. 70 % to 90 % of the speed reached during the transition from asynchronous to synchronous switching (maximum pulse repetition frequency);
- Speed v3: about 70 % to 90 % of the speed reached at the transition to the power hyperbola, where the maximum DC link voltage is reached.

The vehicle supplier must specify the speeds and operating conditions at which maximum emissions (including reverse currents, due to the field generated by reverse currents) are to be expected and take these into account in the tests.

Test procedure:

The emissions must be measured in the X, Y and Z directions with a sampling rate of at least 300
kHz for the LFR and at least 3 MHz for the HFR.

In-band and out-band evaluation
Evaluation of the bandpass
For the in-band evaluation, the recorded data files are then filtered through a series of bandpass filters in the X, Y and Z directions and analyzed.
Series of bandpass filters in the X, Y and Z directions and in the 3 bands defined in document ERA/ERTMS/033281.
The following parameters must be taken into account:
a) 3 dB bandwidth, type and order of the digital bandpass filters according to the Definition in document ERA/ERTMS/033281 for bands 1, 2 and 3:



Band 1:

i) from 27 kHz to 52 kHz: 300 Hz, Butterworth, 4th order
ii) from 41.2 kHz to 44.8 kHz (only for the y-direction): 40 Hz, Butterworth, 2nd order

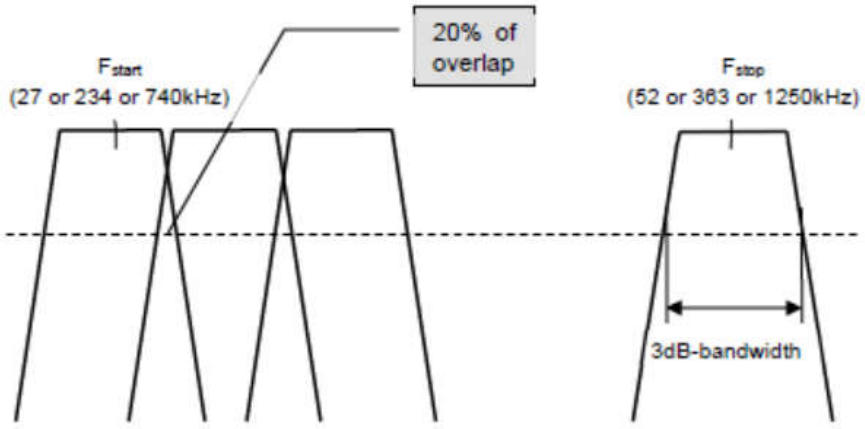
Band 2:

i) from 234 kHz to 363 kHz: 7500 Hz, Butterworth, 4th order
ii) from 287 kHz to 363 (only for the Z direction): 4000 Hz, Butterworth, 4th order

Band 3:

i) from 740 kHz to 1250 kHz: 10 kHz, Butterworth, 4th order

b) 20% frequency overlap (3 dB points) of the filters in all 3 bands, see illustration:



For band 1, analysis using filters with 300 Hz bandwidth and 20 % overlap means center frequency steps of 240 Hz.

To obtain a whole series of filters starting at 27 kHz, the frequency sub-bands to be analyzed should be exactly as follows:

- 27 kHz to 41.4 kHz or 41.16 kHz
- 41.4 kHz or 41.16 kHz up to 44.76 kHz or 45 kHz
- 44.76 kHz or 45 kHz up to 51.92 kHz or 52.2 kHz

For band 2, analysis using filters with a bandwidth of 7500 Hz and 20 % overlap means a $\triangle f$ of 6 kHz.

To obtain a whole number of filters of 234 kHz, the frequency sub-bands to be analyzed should be exactly as follows:

- 234 kHz to 288 kHz
- 288 kHz to 360 kHz or 366 kHz

For band 3, evaluation by filters with 10 kHz bandwidth and 20 % overlap means a △f of 8 kHz.

To obtain a total number of filters of 740 kHz, the frequency subbands to be analyzed should be exactly as follows:

a) 740 kHz to 1028 kHz
b) 1028 kHz to 1244 kHz or 1252 kHz
c) Integration time for the RMS value calculation according to document ERA/ERTMS/033281 for bands 1, 2, 3 with a time overlap of 75%

    1) Band 1: 1 ms
    2) Band 2: 1,5 ms
    3) Band 3: 1,5 ms

NOTE: A time overlap of 75 % means that with an integration time of 1 ms, the time Intervalbetween successive windows is 0.25 ms.

5.1.2.2.2 FFT evaluation

In order to shorten the processing time, the in-band evaluation can be performed with a Broadband analysis of each band using the FFT with 75% time Hanning-window, overlap and a time window of:

- 1 ms for Band 1
- 0,5 ms for Band 2
- 0,5 ms for Band 3

If the vehicle complies with the emission limits in the documents ERA/ERTMS/033281 fulfilled the assessment using filters with movable passband according to section 5.1.2.2.1 is not required.

5.1.2.3 Evaluation outside the tape

For out-of-band evaluation, the FFT of the recorded data must be calculated using the parameters defined in document ERA/ERTMS/033281: :

- Hanning Window
- Time window of 1 ms
- Time overlap of 50 %