RAILWAY STANDARDS
EN 50121

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My Background Experience

- Kowloon-Canton Railway Corporation, Senior Engineer – Systems Integration (2003-Present)
- Hong Kong Productivity Council, EMC Technician (1997 - 2000)

EN 50121 Series

- EN 50121-1 Electromagnetic Compatibility – Part 1: General
- EN 50121-2 Electromagnetic Compatibility – Part 2: Emission of the Whole Railway System to the Outside World
- EN 50121-3-1 Electromagnetic Compatibility – Part 3-1: Rolling Stock – Train and Complete Vehicle
- EN 50121-3-2 Electromagnetic Compatibility – Part 3-2: Rolling Stock – Apparatus
- EN 50121-4 Electromagnetic Compatibility – Part 4: Emission and Immunity of the Signalling and Telecommunications Apparatus
- EN 50121-5 Electromagnetic Compatibility – Part 5: Emission and Immunity of Fixed Power Supply Installations and Apparatus

EN 50121-1: Railway Applications - Part 1: General

- Outlines Structure and Content of the whole set of EN 50121 Railway Standards
- Describes the Characteristics of Railway Systems that affect EMC behavior
- Specifies Performance Criteria
- Management of EMC for infrastructure / EMU interface

Internal Sources of Electromagnetic Noise

- Static Elements
- Mobile Elements
- Auxiliary Power Converters
- Trackside Equipment
- Traction Return Current

External Sources of Electromagnetic Noise

- Neighbouring Railway Systems
- Trackside Radio Stations
- Portable Radios
- Radar sets at airports on aircraft
- Industrial plants which disturb the electricity supply network
General Coupling Mechanisms

- Conductive Coupling
  - the source and victim circuits share a common conduction path.

- Inductive Coupling
  - a varying voltage in one circuit produces voltage changes in a victim circuit via a mutual capacitance.

- Capacitive Coupling
  - the varying voltage in one circuit produces voltage changes in a victim circuit via a mutual capacitance.

- Electrostatic Coupling
  - a charged body is discharged to the victim circuit.

- Electric and Magnetic Radiation
  - a circuit structure acts as an antenna transmitting and receiving energy.

Summary of Railway Immunity and Emissions to the Outside World

EN 50121-2: Railway Applications - Part 2: Emission of the Whole Railway System to the Outside World

- Sets the Emission Limits from the whole railway system that including EMU and Traction Substation etc.
- Describes the Emission Measurement Method
- Gives cartography values for the fields most frequently encountered

Specified Emission Limits (9 kHz to 1 GHz)

Method of Emission Measurement

- Locations for tests
- Frequency range
- Bandwidth
- Antenna positions
- Conversion of results if not measured at 10m
- Measuring scales
- Statistical treatment
- Frequency selection
- Railway conditions
  - Weather
  - Speed, Traction Power
  - Multiple sources from remote trains
- Number of traction vehicles per train
Conversion Formula

\[ E_{10} = E_x + n \times 20 \log_{10} \left( D/10 \right) \]

Where:
- \( E_{10} \) is the value at 10m
- \( E_x \) is the measured value at \( D \) m
- \( n \) is a factor taken from the table below.

<table>
<thead>
<tr>
<th>Frequency range (MHz)</th>
<th>( n )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.15 - 0.4</td>
<td>1.8</td>
</tr>
<tr>
<td>0.4 - 1.6</td>
<td>1.65</td>
</tr>
<tr>
<td>1.6 - 110</td>
<td>1.2</td>
</tr>
<tr>
<td>110 - 1000</td>
<td>1</td>
</tr>
</tbody>
</table>

For example:

If the measurement distance is changed from 10m to 3m;
and \( E_{10} = 30 \text{ dBuV/m} \) (at 10m for 1GHz measurement);
then, \( 30 = E_x + (1)\times(20) \log_{10}(3/10) \)
therefore, \( E_x = 40 \text{ dBuV/m} \).

Test Setup for Emission Measurements

EN 50121-3-1: Railway Applications - Part 3-1: Rolling Stock - Train and Complete Vehicle

• Specifies the emission and immunity requirements for all types of rolling stock.

Emission Limits for Stationary Test

Emission Limits for Slow Moving Test
EN 50121-3-2: Railway Applications - Part 3-2: Rolling Stock - Apparatus

- Defines limits and test methods for electromagnetic emissions and immunity test requirements
- Frequency range from d.c. to 400 GHz
- The application of tests shall depend on the particular apparatus, its configuration, its ports, its technology and its operating conditions

EN 50121- 4: Railway Applications - Part 4: Emission and Immunity of Signalling and Telecommunications Apparatus

- Applies to signalling & telecommunication apparatus installed in railway environment
- Specifies limits for emission and immunity
- Specifies Performance Criteria

EN 50121- 5: Railway Applications - Part 5: Emission and Immunity of Fixed Power Supply Installations and Apparatus

- Applies to electrical and electronic apparatus and systems intended for use in railway fixed installations associated with power supply.
- Specifies limits for emission and immunity (Emission limits same as EN 50121-2)
- Specifies Performance Criteria

Emission Limits for Switches Test

Specified Emission within Substation Boundary

Thank you