

# RAILWAY STANDARDS

## EN 50121

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## My Background Experience

- Kowloon-Canton Railway Corporation, Senior Engineer – Systems Integration (2003-Present)
- QARS Management & Engineering Consultants Limited, Senior Consultant - EMC (2000-2003)
- Hong Kong Productivity Council, EMC Technician (1997 - 2000)

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## 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

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## 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

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## Internal Sources of Electromagnetic Noise

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

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## 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

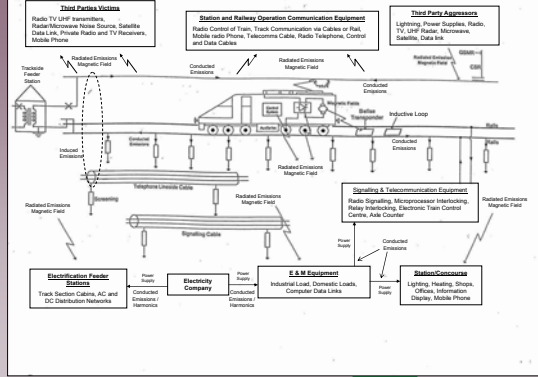
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## General Coupling Mechanisms

- **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 antenna transmitting and receiving energy.

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## Summary of Railway Immunity and Emissions to the Outside World



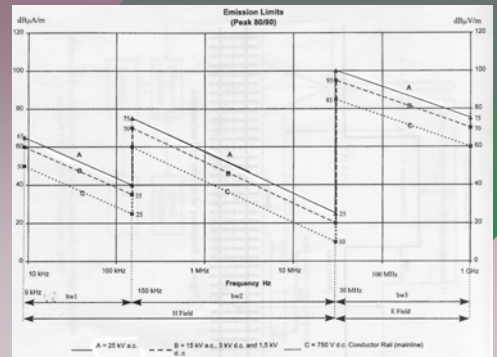
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## EN 50121-2: Railway Applications - Part 2: Emission of the Whole Railway System to the Outside World

- 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

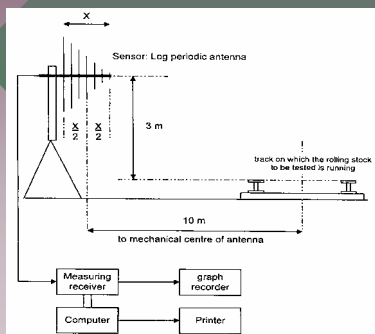
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## Specified Emission Limits (9 kHz to 1 GHz)



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## Test Setup for Emission Measurements (300 MHz to 1 GHz)



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## 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

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## Conversion Formula

$$E_{10} = E_x + n \times 20 \log_{10}(D/10)$$

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.

Frequency range (MHz)	$n$
0.15 - 0.4	1.8
0.4 - 1.6	1.65
1.6 - 110	1.2
110 - 1000	1

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For example:

If the measurement distance is changed from 10m to 3m;

and  $E_{10} = 30$  dBuV/m (at 10m for 1GHz measurement);

then,  $30 = E_x + (1) \times (20) \log_{10}(3/10)$

therefore,  $E_x = 40$  dBuV/m.

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## Test Setup for Emission Measurements



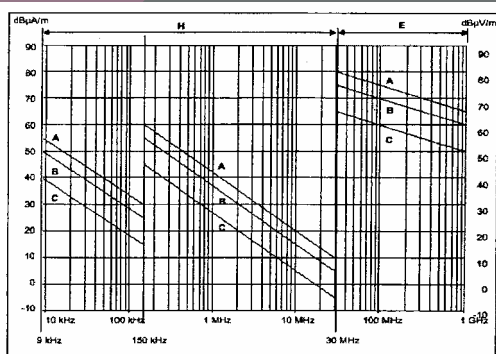
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## EN 50121-3-1: Railway Applications - Part 3-1: Rolling Stock - Train and Complete Vehicle

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

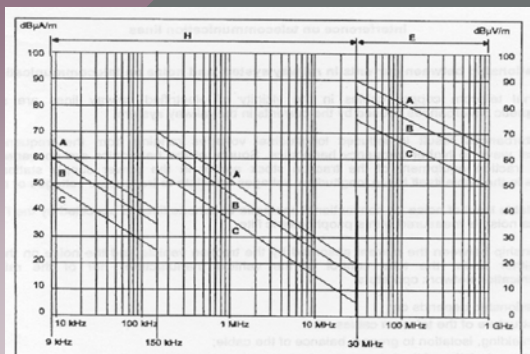
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## Emission Limits for Stationary Test



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## Emission Limits for Slow Moving Test



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## 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

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## 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

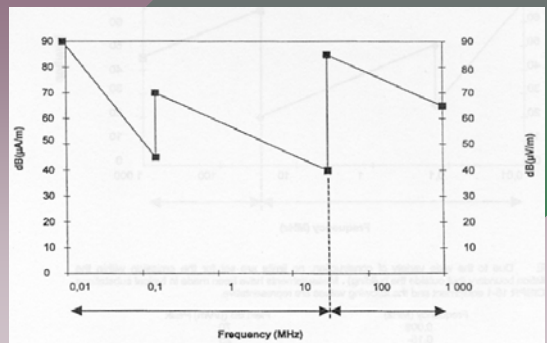
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## EN 50121- 5: Railway Applications - Part 5: Emission and Immunity of Fixed Power Supply Installations and Apparatus

- 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

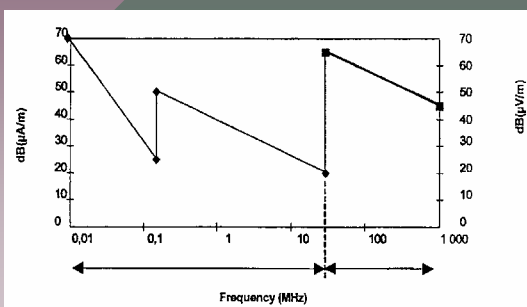
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## Emission Limits for Switches Test



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## Specified Emission within Substation Boundary



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Thank you

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