# RAILWAY ELECTRICAL TRACTION SIMULATOR

# Mod. REP-1/EV



## INTRODUCTION

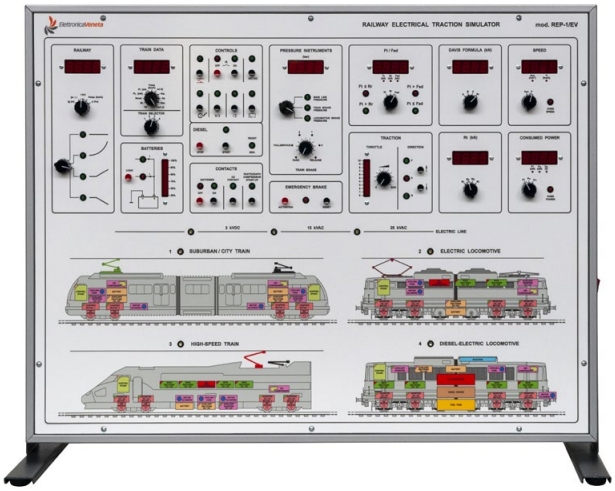
The railways system is, in any country, one of the key columns of the land transport for passengers and goods.
The architecture of a national railway structure is a complex system, that includes many interrelated technical disciplines. Such complexity leads to consider Railway engineering as a specialized branch of engineering itself (usually regarded as a post-graduate discipline).
Moreover, the **Railway engineering** involves different specialized fields such as:

- **Infrastructure:** to chart the railway lines, considering the country regions to be crossed (straight paths, ramps and curves, tunnels, viaducts to be build up etc.). In the initial steps, this means also selecting the track width and the railway type foundation.
- **Traction type:** nowadays there are two main ways for railway traction: one is the pure electrical traction; the second, the Diesel-Electric traction.
- **Signaling & Communications:** critical chapter for the railway traffic management and their safety.
- **Train Material:** all above is subordinated to the train operation (locomotives, wagons, carriages, and their relative position in each train configuration). The infrastructure, the traction method, the signaling and the communications are defined at the moment of the railway design and not modified except in long time span or exceptional situations. Instead, the train configurations are dynamic, that is, they are changed daily according to the traffic requirements. The correct selection of the train elements and configuration determine the service quality, its maintenance and its economy.

The simulator is part of a project concerning the railway systems whose aim is the training of:

- Postgraduate courses in railway engineering
- High-level technicians working for national or private railways enterprises
- Seminars on railway systems

The Simulator has been specifically designed to study the fundamentals of train dynamics. The student will be able to test what learnt in theory by modifying different parameters of the system and visualizing the effects on the train dynamics.




## TRAINING PROGRAM

Railway traction analysis:

- General concepts
- Motion resistance in straight paths, with no bends nor slopes (the Davis formula): mechanical motion resistance (independent from the train speed), speed-depending motion resistance and squared-speed motion resistance (aerodynamic resistance)
- Motion resistance in bends
- Motion resistance in slopes
- Motion resistance due to rotating masses
- Traction and braking forces
- Deepening on braking: service braking system and emergency braking system. Calculus of the distance and time required for a complete train stop.
- Wheel-track friction factors. The adherence force and the required necessary and sufficient conditions for the train motion
- Traction and total motion resistance forces curves as a function of the train speed. Motion limits imposed by the vehicles
- Examples of the theory application on real trains configurations



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## TECHNICAL CHARACTERISTICS

The simulator is a computerized table-top unit (PC not included) with a wide color screen-printed front panel.
The supplied software allows visualizing the panel parameters as well as their modification and setting.

**Type of train analyzed.** Color prints of four different kinds of train (three electrical and one Diesel-Electric), including the main device blocks. The data used for the calculations are supplied by the manufacturers.

**Variable parameters** can be modified by controls such as potentiometers, selector switches or via software. Example of some variable parameters:

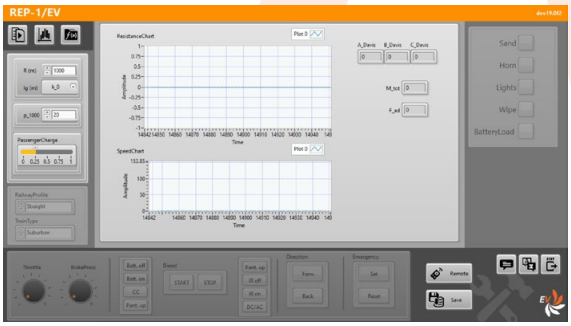
- Throttle (to vary the traction force Ft)
- Bend radius (m)
- Slope angle (+/-)
- Emergency / Service braking selector

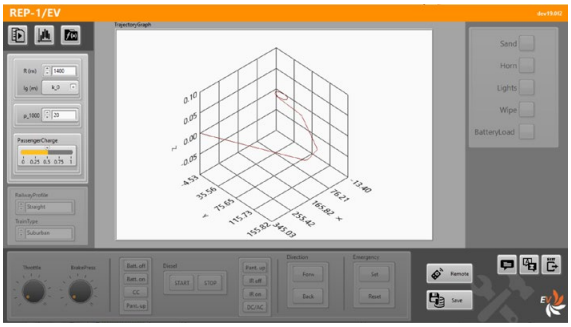
**Displayed parameters (results)** are calculated by the software and shown on digital displays according to the variable parameters previously set by the user. Example of some displayed parameters:

- Train speed (km/h)
- Davis formula: coefficients A, B, C and Rm
- Motion resistance on bends Rc and Vmax in bends
- Motion resistance on slopes Rp, according to the slope angle
- Total motion resistance: Rt = Rr + Rp + Rc
- Traction force (Ft) as a function of train speed; adherence force (Fad), as a function of the static or dynamic μ (friction coefficient between wheels and rails)
- Consumed Power (kW) depending on the type of train and its speed
- Braking distance (m) and time (s) depending on the braking mode (service or emergency) and speed

**Alarms and warning lights.** LEDs associated with both variable and displayed parameters alert the user when a technical limitation has been reached by the train.

**Power supply:** 230 Vca 50 Hz single-phase - 50 VA
(Other voltage and frequency on demand)
**Dimensions:** 800 x 600 mm (panel)
840 x 450 x 660 mm (framework)
**Weight:** 19 kg approx.


**REQUIRED (NOT INCLUDED)**

- **PERSONAL COMPUTER**

**SUPPLIED WITH**

**THEORETICAL-EXPERIMENTAL HANDBOOK**



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