

Ingeteam

High speed dual voltage locomotive



The traction system has been developed with a modular concept in order to maximize its maintainability and availability, and to minimize the Life Cycle Cost

Ingeteam Traction has developed and supplied the turn-key electrical engineering for a new generation of high-speed (260 km/h), dual voltage, variable gauge locomotives in collaboration with Talgo, including the design and manufacturing of the key components of the locomotive such as traction converter, traction motors, auxiliary converter and vehicle control unit.

This locomotive provides a mixed service on both RENFE classic lines, with track width of 1.664 mm, and high speed lines, with UIC track width of 1.435 mm.

The traction system of this dual voltage locomotive (25 kVac 50 Hz, 3 kVdc) includes in-house design and manufactured two traction converters, feeding each of them, with independent inverters, two in-house manufactured induction three-phase motors. Our engineers have as well specified all other components of the traction system providing the customer with a turn-key traction system. The traction system has been developed with a modular concept in

order to maximize its maintainability and availability, providing as well regenerative braking, in order to minimize the Life Cycle Cost of its operation.

The Vehicle Control Unit of the locomotive is based in Ingeteam's SISTEAM OCS electronic, with decentralised I/Os, with MVB and WTB communication buses according to IEC 61375-1 TCN standards.

The locomotive is equipped with signalling equipments compatible with all RENFE classic and high speed lines, such as ERTMS, ASFA, LZB and EBICAB, as well as communication systems as GSM-R and train-land system.

Due to the technical relevance of this project, it was included in the PROFIT research program of the Ministry of Science and Technology.

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Technical data

1 Traction converters

Input voltage	25 kVac(17-29 kVac) 50 Hz, 3 kVdc (2-4 kVdc)
Stablished intermediate circuit voltage	3,600 Vdc
Output voltage	0-2,807 Vac
Output frequency	0-150 Hz (0-260 km/h)
Maximum frequency	165 Hz (4,950 rpm=286 km/h)
Control features	PWM (Vectorial), Synchronous Modulation, Full Wave
Dimensions (W/D/H)	2,900 / 1,070 / 1,970 mm
Weight	2,100 Kg
Maximum equipment losses	70 kW (one-hour rating)
Cooling system	Closed circuit water
Coolant type	Tap water with anti-freeze

Controlled by drive control unit, based on SISTEAM OCS, including control DSPs.

Each traction converter includes: 4 AFEs, 2 inverters and a 250 kW auxiliary converter.

2 Battery charger

A 110V 15kW rated power battery charger with the following features:

Input data	
Rated voltage	400 Vac $\pm 10\%$ (360 Vac-440 Vac)
Frequency	50 Hz $\pm 20\%$ (40 Hz-60 Hz)
Dielectric strength	2.5 kV ac
LC input filter and RFI filter for electromagnetic compatibility	
Output data	
Output voltage	110 Vdc. Two levels: load and floating
Floating voltage	121.8 Vdc (84 cells x 1.45V/ cell)
Voltage stability	$\pm 1\%$ (99 Vdc - 121 Vdc)
Rated current/ maximum current	120 A (for 126 V output) / 150 A
Rated power	15 kW
LC output filter included	

3 Traction motors

4 motors per unit	
Rated voltage composed between phases	2,807 V
Rated power	850 kW
Rated start-up torque (Nm)	6,400 Nm, 8,000 Nm exceptional torque
Rated current	209 A
Maximum speed	4,500 rpm
Number of poles	4
Open-type motor with forced ventilation	
Rated frequency	72 / 152 Hz
IP44 protection	IP44
Insulation class	200
Compliant with the IEC 349-2 standard	

4 HMI

Human-Machine Interface for assisting the driver	
Compliant with standard UNE-EN 50155:2002	
Buttons	24
Luminosity	1000 Nits (automatic and/or manual luminosity control)
Vision angle	$\pm 70^\circ$ horizontal, $+40/-60$ vertical
CPU	Pentium MMX 226 MHz
Buses	Ethernet (10/100 Base-T), MVD (ESD+ u OGF), USB 1.0
Other interfaces	IrDA (FIR up to 4 Mbps), two RS232 ports (isolated), two composite video inputs (CVBS), two audio outputs

5 Control electronics

Based on SISTEAM OCS (32 Bits), decentralised, redundant configuration and programmable in accordance with IEC standard.

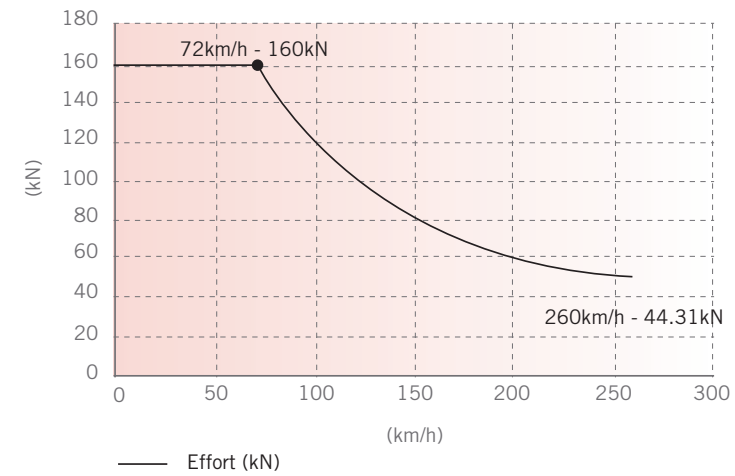
The PLC communicates via MVB, TBX III, RS-485, and Ethernet.

6 High voltage cells

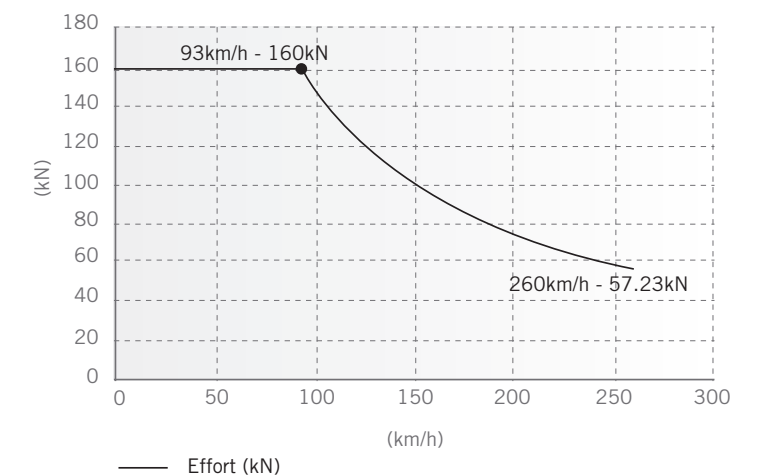
This unit contains the high-voltage elements for protecting staff against accidental contacts:

- 3 kV circuit breaker
- Earthing switch
- 50 Hz sensor
- 25 kV motorized switch
- 3 kV voltage transducer
- Current transducer for 3 kV line
- Current transducer for 25 kV line

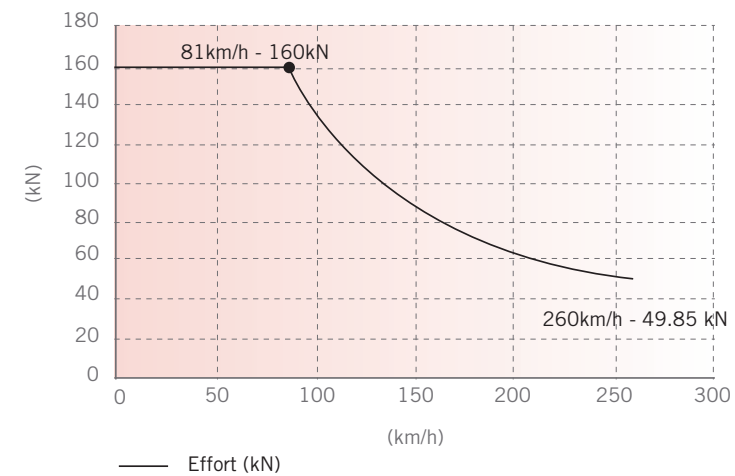
Maximum axle traction effort available in relation to speed, for 4 traction motors, under rated conditions



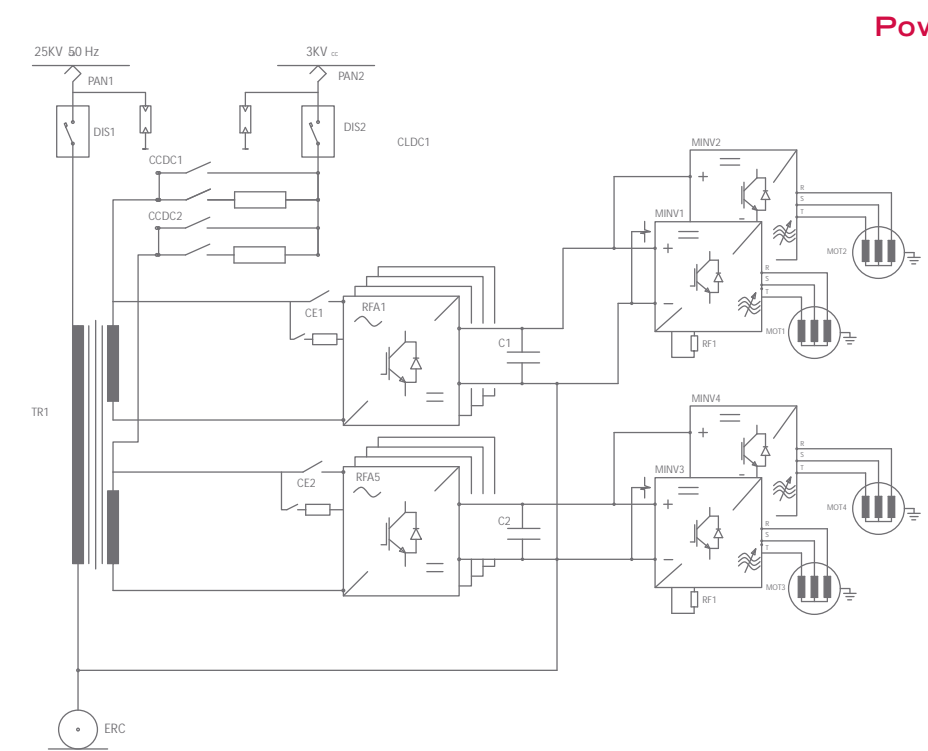
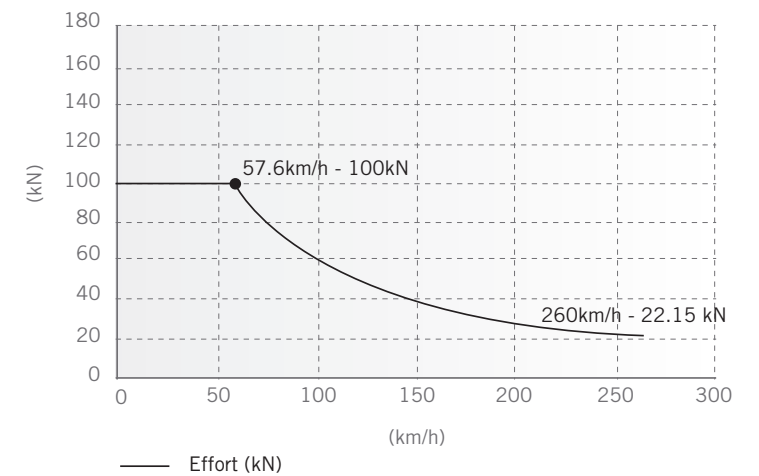
Maximum axle braking effort in relation to speed, for 4 traction motors, under rated conditions



Maximum axle traction effort in relation to speed, for 4 traction motors under one-hour conditions



Maximum one-hour traction effort in relation to speed, for 2 traction motors in overstress conditions for 30 milliseconds start-up



Power diagram