

Ingeteam

Bilbao tramway



Ingeteam Traction has developed and supplied the electrical traction system for the two families of tramways of Bilbao, 70% low floor and 100% low floor systems.

The main elements composing the tramway traction system are the traction converter and the traction motors. For the 70% low floor solution, the tramway is equipped with two traction converters, each of the feeding two induction three-phase motors situated in each of the two traction bogies, one per axle. For the 100% low floor solution, a double traction converter has been designed, feeding each half of the converter two motors, one per wheel. The traction system is controlled by a 32 bit microprocessor control system, designed, manufactured and programmed by Ingeteam Traction.

Other elements of the traction system, such as electric pantograph, circuit breaker and surge arrester have been

specified by the engineering of Ingeteam Traction, providing the customer with a turn-key solution for the traction system.

Likewise, the tramway is equipped with a 3 x 380 Vac 50Hz 50 kVA auxiliary converter which includes a high-frequency battery charger (6 kW).

The traction system is equipped with a regenerative braking system in order to minimize the power consumption of the tramway system operation. Likewise, the maintainability and reliability of the converter has been one of the key elements that have been taken into account in the converter design, in order to minimize the Life Cycle Cost of the units.

The tramways of Bilbao are successfully in operation since December 2002.

Maintainability and reliability of the converter have been taken into account in the design, in order to minimize the life cycle cost of the units

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Technical data

1 70% low floor traction converter

2 converters are included per tramway. Controlled by a Drive Control Unit (DCU). Have been designed using DSPs and are based on IGBTs as the switching element.

| | |
|------------------------|-----------------------------|
| Supply voltage | 750 Vdc+25%-30% (500-900 V) |
| Rated power | 200 kW |
| Maximum power | 500 kW |
| Output frequency range | 0-270 Hz (0-80km/h) |
| Switching frequency | 2.2 kHz |
| Output current | 325 A / 700A _{máx} |
| Output voltage | 0-550 Vac |

2 100% low floor traction converter

Controlled by a DCU, have been designed using DSPs and are based on IGBTs as the switching element. Each traction converter consists of two separate inverters.

| | |
|------------------------|------------------------------|
| Supply voltage | 750 Vdc+25%-30% (500-900 V) |
| Rated power | 200 kW |
| Maximum power | 500 kW |
| Output frequency range | 0-270 Hz (0-80 km/h) |
| Switching frequency | 2.2 kHz |
| Output current | 325 A / 780 A _{máx} |
| Output voltage | 0-550 Vac |

3 70% low floor traction motor

4 self-ventilated closed asynchronous motors with squirrel cage rotors.

| | |
|-----------------------------|-----------------------|
| Rated power/Maximum power | 98 kW / 167 kW |
| Rated voltage | 550 V |
| Rated frequency | 80 Hz |
| Rated speed / Maximum speed | 1,600 rpm / 3,800 rpm |
| Insulation class | 200 |
| Nr. of poles | 6 |

4 100% low floor traction motor

8 self-ventilated asynchronous motors with squirrel cage rotors.

| | |
|-----------------------------|-----------------------|
| Rated power/Maximum power | 55 kW / 94 kW |
| Rated voltage | 550 V |
| Rated frequency | 89 Hz |
| Rated speed / Maximum speed | 1,766 rpm / 3,837 rpm |
| Insulation class | 200 |
| Nr. of poles | 6 |

5 Braking resistors

Two stainless steel electrical braking resistor benches situated on the roof.

| | |
|-------------------------------------|--------|
| Permanent rated power | 67 kW |
| Minimum cold Ohm value (Min. Temp.) | 1.25 Ω |
| Maximum hot Ohm value | 1.5 Ω |

6 Control electronics

Redundant system based on the control hardware architecture SISTEAM-A.

Our SISTEAM-A PLCs are compliant with IEC-1131-3 standard. It makes possible to configure a decentralised control system based on distributed and redundant I/Os in the CPU which is based on a 32-bit microprocessor.

7 Pantograph

Each unit includes an electrical driven pantograph.

| | |
|-------------------------------|--------------------------|
| Maximum speed | 120 km/h |
| Rated voltage | 750 Vcc y 1500 Vcc |
| Maximum functioning voltage | 1,800 Vcc (1500 Vcc+25%) |
| Rated current/Maximum current | 1,200 A / 2,200 A |

8 Transducer box

Containing:

- 2,000 A line current transducer
- 2,000 V line voltage transducer
- Fuses for the auxiliary converter

1 surge arrester per unit. Rated voltage: 2 kV

9 Master controller

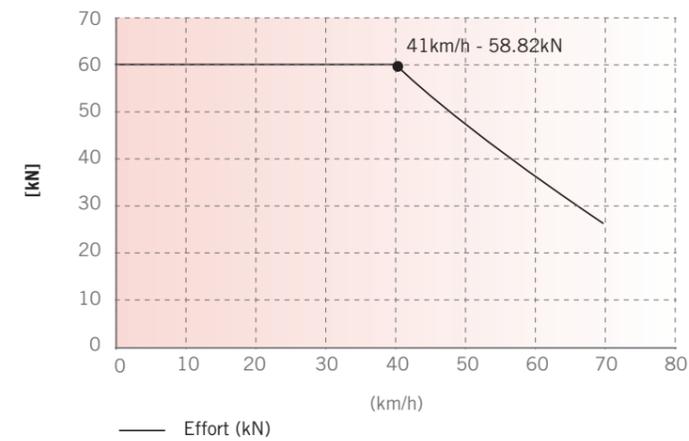
Linear with PWM output:
“Dead man’s control” on the handle
4-positions available: traction, coasting, service brake and emergency brake.

10 Main circuit-breaker

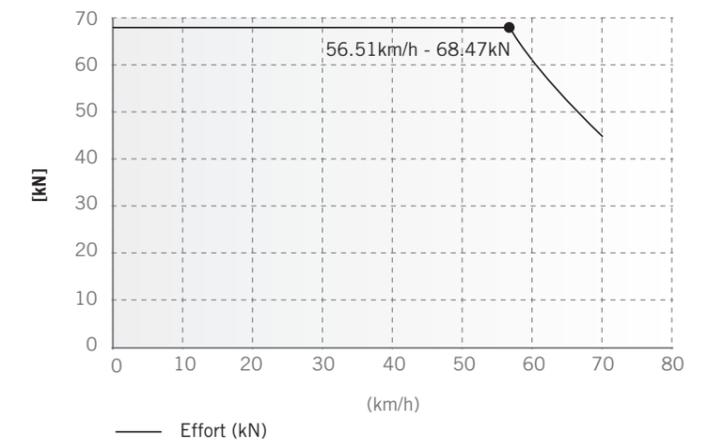
Electrical driven single-pole circuit-breaker.

| | |
|----------------|---------|
| Rated voltage: | 1.000 V |
| Rated current: | 1000 A |

Traction effort in relation to speed.
MTM unit with 2 traction modules and 4 motors
70% low floor



Braking effort in relation to speed.
MTM unit with 2 traction modules and 4 motors
70% low floor



Power diagrams by motor car

