



## 19 THREE-SECTION, 100% LOW-FLOOR TRAMS

# Avenio Tram – Education City, Doha, Qatar

The Qatar Foundation has commissioned Siemens in 2012 to build a new tram system that operates without overhead contact lines for Education City, the university center in Doha, Qatar. A multiple-line network will link the various university facilities, cultural places and residential areas on the North and South Campuses.

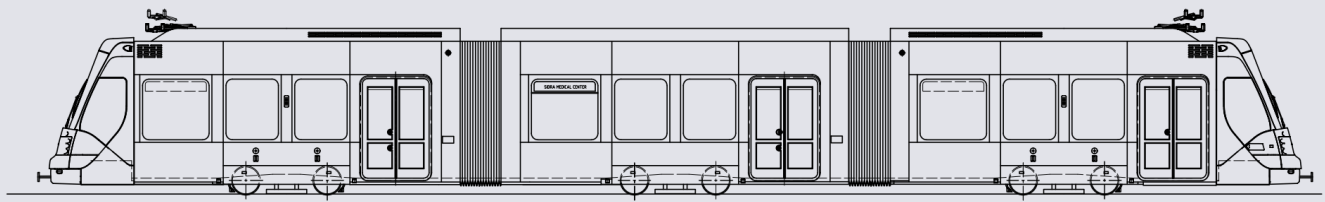
Education City is a new university center west of Doha that will provide housing for around 10,000 national and international students as well as a place to study and work together academically. Education City is distinctive for the unusual architecture of its buildings and facilities, which add modern international elements and traditional national designs to the campus' harmonious and aesthetically sophisticated image.

The strategic design of this Avenio tram, which was honored by the renowned Red Dot Award 2017 and iF Design Award 2018, features a timeless tribute to QF's effort towards promoting sustainable development in Qatar.

### Technical Data

Vehicle type/platform	Avenio (Middle East)
Vehicle configuration	Three-section, low-floor articulated tram for bi-directional operation
Axle arrangement	Bo'2'Bo'
Max. axle load	< 11 tons
Power supply	750 V DC
Track gauge	1,435 mm
Vehicle length/width	27,700 mm/2,550 mm
Vehicle height	3,775 mm (pantograph lowered)
Entrance height	350 mm
Min. curve radius (horizontal)	25 m
Capacity (4 pers./m <sup>2</sup> )	157, incl. 48 seats/3 folding seats
Max. speed	40 km/h
Max. starting acceleration	1.1 m/s <sup>2</sup>
Mean service deceleration	1.2 m/s <sup>2</sup>
Traction power rating	4 x 120 kW

**SIEMENS**



Side view

## General

The Avenio is the well-proven Siemens tram platform which is already successful in passenger service in Munich, Germany and The Hague, Netherlands. Each vehicle comprises three modules, two are powered and each is supported on its own central bogie. The modules are linked by articulated gangways to create an open and bright interior. For bi-directional operation, each end of each car is equipped with a driver's cab.

## Car body

The welded car body consists mainly of weatherproof structural steel (Corten). The entire body shell is covered with a cathodic dip coating.

## Interior design

The Avenio for Education City has an attractive, roomy interior arrangement with two large multifunctional spaces (wheelchairs/strollers) in the end cars. To ensure quick and convenient passenger flows, three double-leaf doors with a clear width of 1.3 meters are arranged on each side of the tram. Seating and handrail arrangements are ergonomically designed. The air conditioning systems for the driver's cabs and passenger areas guarantee a pleasant climate.

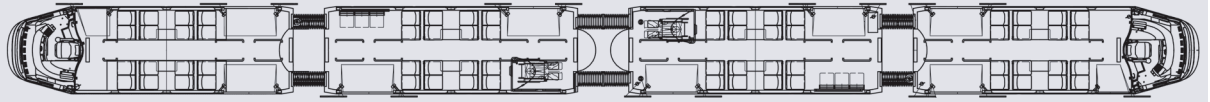
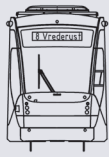
## Project data

Customer	Qatar Foundation in Doha, Qatar
Location	"Education City" university campus on five lines with 11.5 km of track
Delivery period	Turnkey project with delivery of rolling stock, signalling equipment, communications system, power supply, supervisory control and data acquisition system (SCADA), operations control center, traffic light control, depot and workshop equipment
Scope of supply	19 vehicles
Testing	Static tests in the factory in Vienna, dynamic tests in Wildenrath, acceptance tests in Doha

The passenger area is equipped with six emergency intercommunication terminals, which allow passengers to speak directly with the driver.

## Traction equipment

The electrical equipment is concentrated in containers on the car roof. Two modern IGBT pulse-width-modulated inverters, four maintenance-free three-phase asynchronous motors and two 32-bit traction control units (Sibas®32) make up the traction system. Feeding back braking energy into the energy storage system is also possible. The vehicle control equipment is based on a bus transmission system, which, for reasons of redundancy and safety, is backed by a hard-wired fallback level control system for essential train control functions.



Seating configuration

### Brake system

The Avenio features four separate and independent brake systems:

- Electrodynamic brake on powered running gear
- Hydraulic, passive spring-loaded brake on powered running gear
- Hydraulic, active disk brake on non-powered running gear
- Electromagnetic rail brakes on all running gears

Design and brake performance conform to EN 13452 and BOStrab.

### Bogies

The two powered bogies with their two longitudinally arranged drives are characterized by their low center of gravity, minimized unsprung masses and excellent running characteristics, which, due to mechanical coupling of the wheels in the longitudinal direction, have been improved compared to conventional 100 % low-floor running gear without wheel coupling. Optimal dynamic riding comfort is ensured thanks to two suspension stages made from rubber elements in the bogie and wheels with incorporated rubber springs, plus vertical and horizontal dampers.

### Customizations for the Middle East

The following upgrades were performed to meet climatic requirements in accordance to standard EN 60721-3-5:

- More powerful air conditioning systems
- Tinted windows, heat protection glass

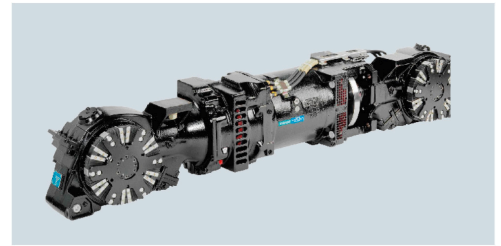
### Power supply concept

Energy is transmitted via roof conductor rails in canopied stations and tunnels. In these sections, the energy storage systems are charged to enable the vehicle to cross subsequent line sections that are without an overhead contact wire.

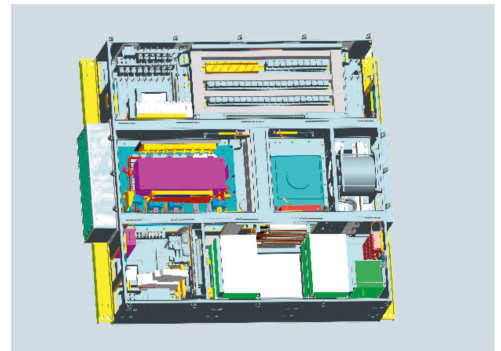
To store the necessary drive energy, a hybrid energy store (HES) is used – a combination of double-layer capacitors and traction batteries. It draws power both externally and from braking energy.

## Technical features/highlights

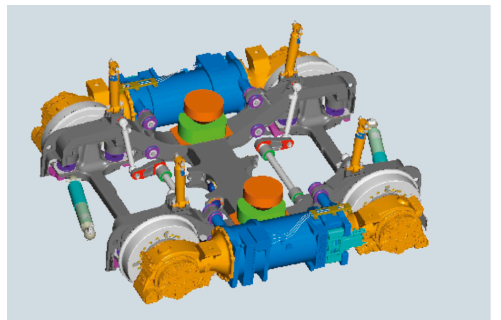
- Highest aesthetic requirements
- Spacious, light-colored interior design
- Perfect riding comfort and optimized wheel/track wear
- Optimal load distribution
- Powerful air conditioning systems
- Roomy door area and evenly spaced double doors
- Two large multifunctional spaces for strollers and wheelchairs
- Large destination displays inside and outside
- Four video cameras to replace exterior mirrors



Traction unit



Traction container



Motorized bogie

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