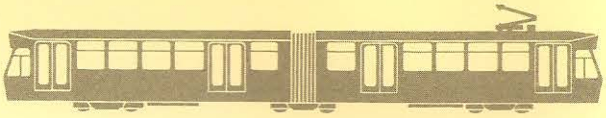
LIGHT RAIL

from GEC



Contents

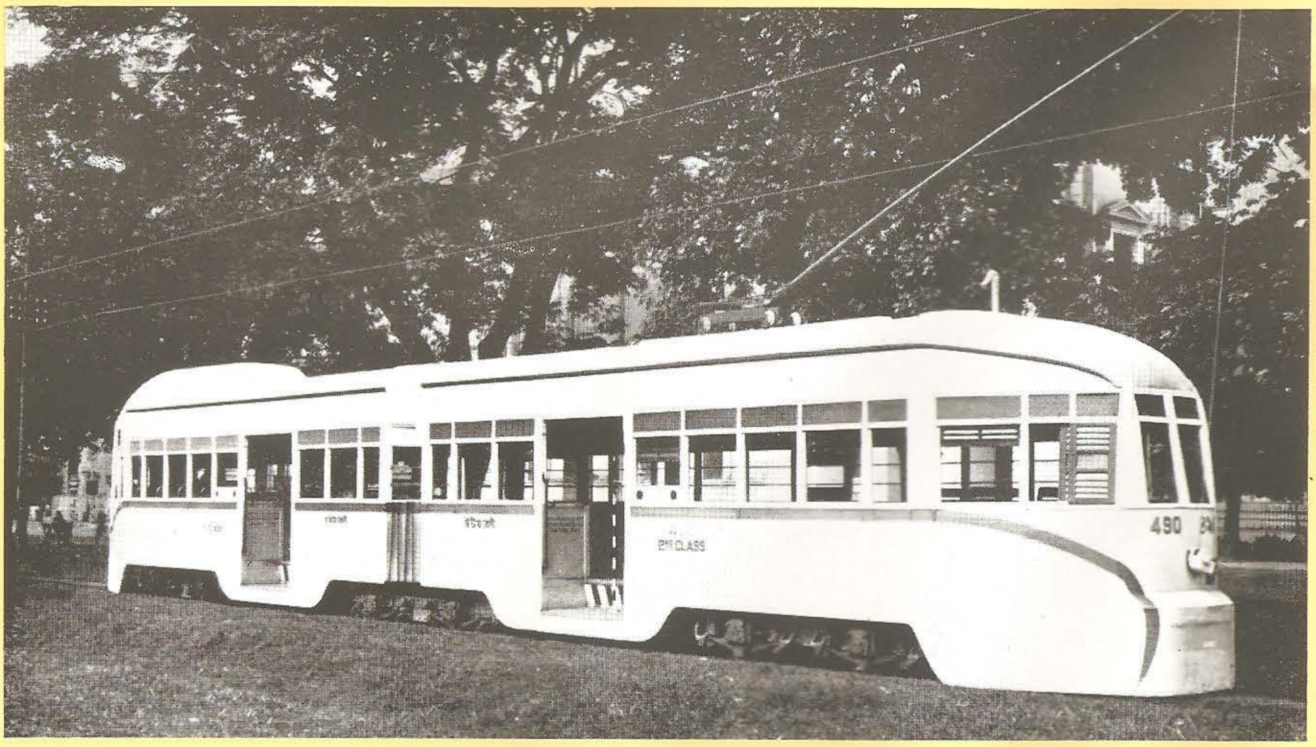
GEC and its subsidiaries have been involved in electric traction for over a century having been responsible (in 1883) for the design and supply of rolling stock, a power station and power distribution for the Giants Causeway to Bushmill Tramway.

The early part of the twentieth century saw a tremendous increase in the number of trams, or light rail vehicles as they would now be known. The Company designed and built more than 8000 complete vehicles in its own works and equipped a further 16000 – 24000 in total – for service throughout the world.

In addition to light rail vehicles the Company has, of course, supplied or equipped 18000 heavy rail multiple units, plus 17000 locomotives (diesel and electric) and 8000 trolley buses.

We record our grateful thanks to car builders Metro-Cammell Ltd. and Linke-Hofmann-Busch GmbH, whose vehicles are illustrated in this brochure.

An articulated LRV equipped by the Company in 1931 for service in India.



LIGHT RAIL

Options LRV's from GEC are available in a wide variety of options.

Power supply

may be ac or dc.

Power may be collected either from an overhead catenary or at low level.

A simple light weight overhead power distribution system.

Low level conductors may have side, top or bottom contact or may be shrouded.

They may be

steel wheel

rubber tyred

or

Maglev
(magnetically levitated)

A GEC powered Maglev vehicle.

We hope this brochure will tell you more about some of the options which are possible. No brochure can tell the full story, however, so if you have a light rail requirement please get in touch with us.

They can be designed for

street running

or

operation on segregated track

A GEC LRV in Rotterdam.

They may be

driver operated

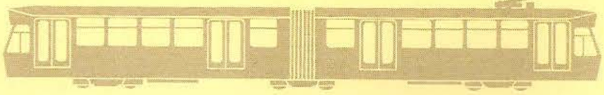
or

fully automatic

Note: Automatic operation is not possible if street running is required.

On-board fare-collection is possible, provided there is an attendant on board.

GEC



Car layout options

A number of car layout options are available.

4 axles,
non-articulated

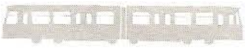
6 axles,
with single articulation

8 axles,
with double articulation

Vehicle capacity Passenger capacity is affected by the proportion of floor allocated to seated passengers.

Typically a small non-articulated car could have a capacity of 100 passengers (40 seated and 60 standing) whilst a double articulated car could carry more than 200 passengers (80 seated and 120 standing.).

System capacity If passenger demand increases in the future these capacities can, of course, be doubled or trebled simply by operating cars in tandem or triple unit.

number of cars	frequency	passengers per hour
	5 minutes	2400
	5 minutes	4800
	3 minutes	8000

A typical interior layout with 2 x 2 seating (which gives probably the highest proportion of seated passengers).

An alternative arrangement with 2 x 1 seating gives more space for standing passengers.

A very high proportion of standing passengers can be carried if 1 x 1 seating is adopted. A further alternative is longitudinal (inward facing) seating.

GEC equipment powers these cars on the Tyne and Wear Metro – the UK's only recent light rail project.

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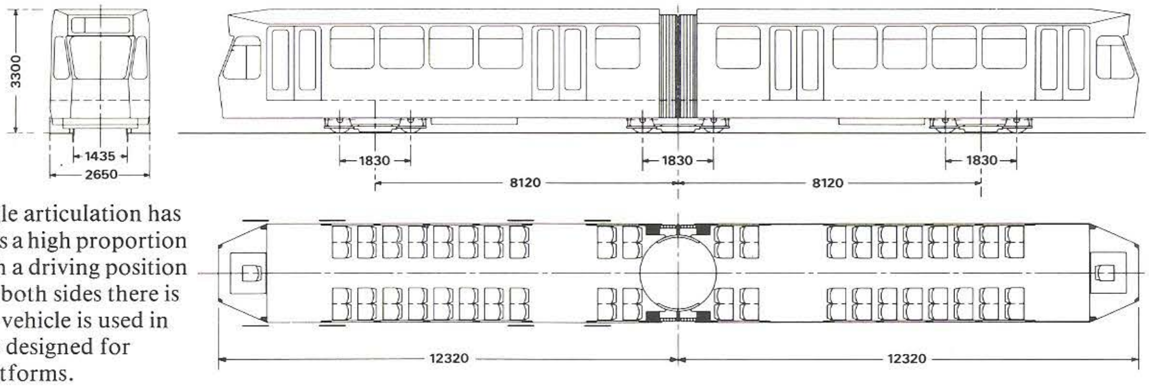
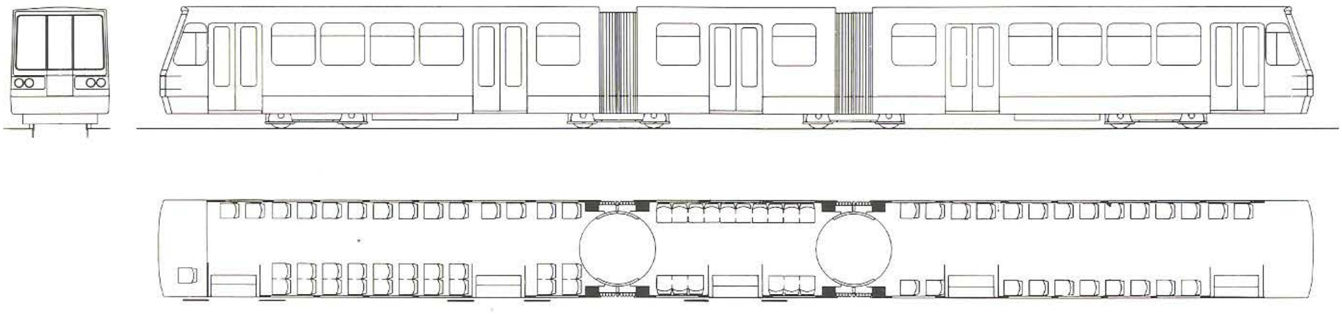
Dimensions and seating arrangements



This six-axle car with single articulation has 2 × 2 seating which permits a high proportion of seated passengers. With a driving position at each end and doors on both sides there is no restriction on how the vehicle is used in service. The entrances are designed for access from high level platforms.



This illustration shows a number of alternative seating arrangements. With a single driving position and doors on one side only it is obviously restricted to service running in only one direction. The low level entrances with steps permit access directly from street level.

Passenger access can be from either high level platforms or from street level.

Track and environmental considerations

There is a mistaken view that steel-wheel on steel-rails is inherently noisy. This derives from older tramway systems and even from some current installations where minimum noise requirements have not been taken into consideration. With modern techniques it is possible to build car and track systems comparable with rubber tyred vehicles. This has been demonstrated from recorded noise levels.

Energy consumption and low maintenance favour the steel-wheel on steel-rail solution. Track laid on concrete has obvious aesthetic and maintenance advantages over ballasted track, and will include effective sound insulation.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GEC

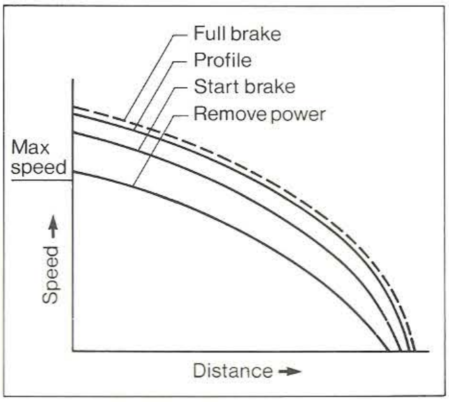
Automatic operation

We have the technology to supply and operate completely unmanned vehicles or, if operators prefer, vehicles with a supervising *attendant* on board.

Auto-docking is a form of automatic train control for systems where fully automatic operation is not required. It stops trains automatically at station platforms using trackside markers located at fixed positions ahead of the platforms.

Train borne equipment is used to compute the necessary brake application rates which are then automatically controlled and updated as necessary by further trackside markers to ensure that the train is brought to an accurate stop at the platform. The train borne computer is equipped with memory banks containing train performance data to allow the necessary braking ratio and periods to be accurately computed using only a limited number of trackside markers.

GEC Traction designed and supplied the automatic control system on the Glasgow underground trains. On this system, central control provides a signal permitting the train to start and thereafter acceleration, speed control and stopping is entirely automatic. To date several million such stops have been reliably made within a tolerance of ±0.3 metre. This degree of accuracy would permit the use of platform doors if required.



The diagram shows speed/distance relationships for the auto-docking installation in Glasgow.

LIGHT RAIL

ALERT – Automatic Light Electric Rapid Transit

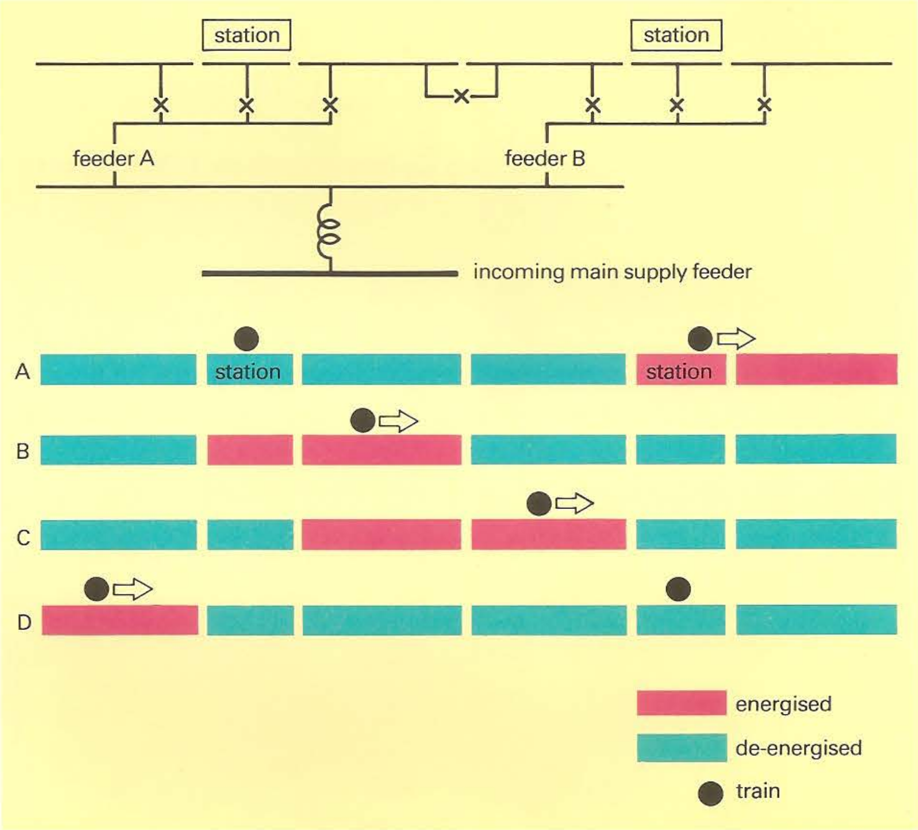
GEC's ALERT is a system of *off-vehicle* control. It is inherently suitable for automatic operation but it can be used with a driver (or attendant) if operators prefer this as an interim measure.

GEC's ALERT system is available in two forms:

in its *ac form* ALERT would take its power from a three-phase trackside conductor system.

in its *dc form* ALERT could take its power from either a trackside supply or from an overhead catenary.

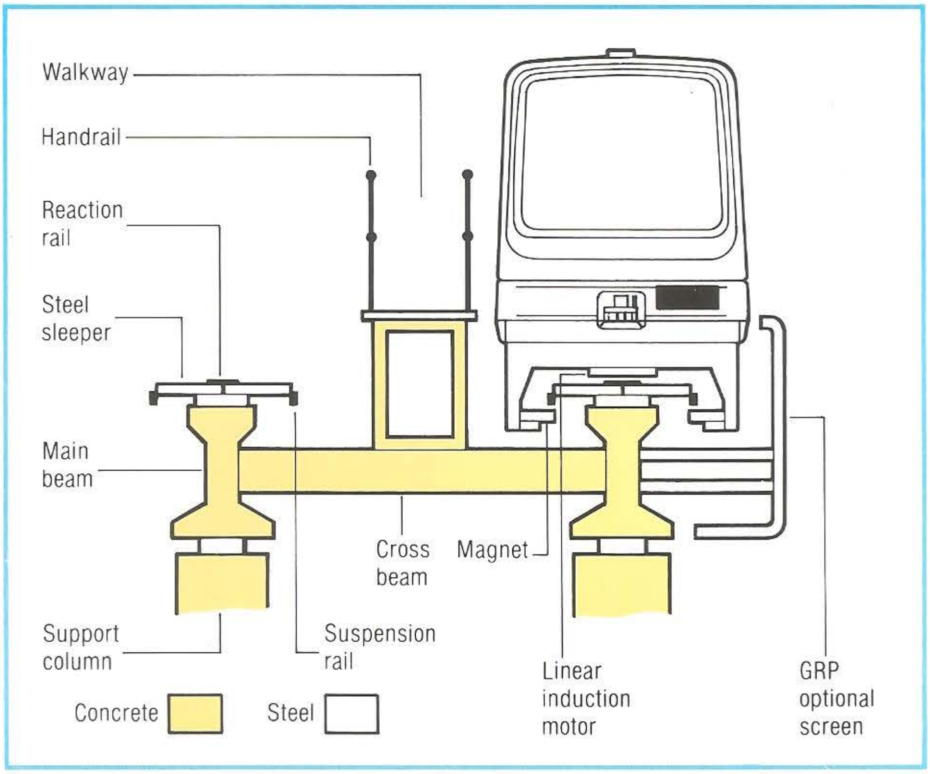
Note: GEC introduced off-vehicle control (ie an earlier form of ALERT) when it equipped the fully automatic Post Office Railway in London in the 1920's.



Simplified schematic for a typical ALERT scheme with a sequence of switching operations to show the progress of vehicles along the system.

Maglev

The Maglev project at Birmingham (for which GEC provided engineering co-ordination and project management) is an example of a different form of automated light rail.



Power conditioning

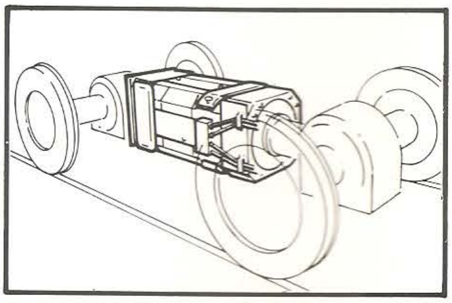
Several options are possible

On-board control equipment

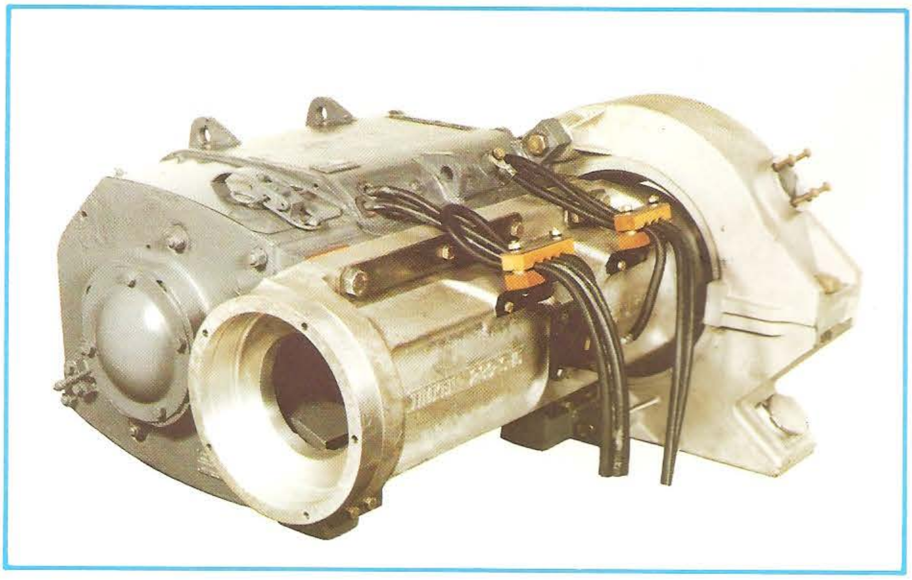
1 Thyristor control (from either an ac or dc supply) of dc traction motors.
2 Camshaft control of dc traction motors.
3 Three-phase rotary induction motors fed at variable-frequency from a direct-current supply.
4 Linear induction motors fed at variable-frequency from a direct-current supply.

Off-vehicle control

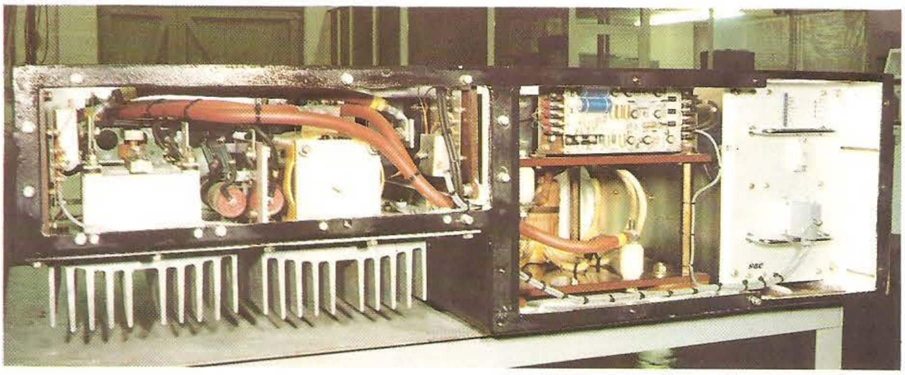
5 ac ALERT }
6 dc ALERT } as described on page 9



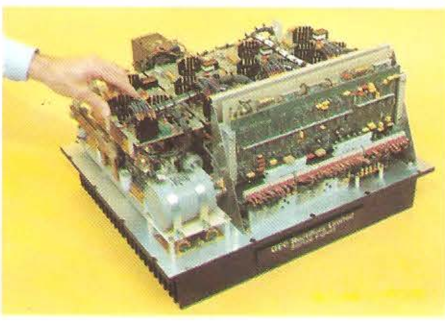
General arrangement of the 'mono-motor' style traction motor supplied for the Tyne and Wear light rail vehicles.



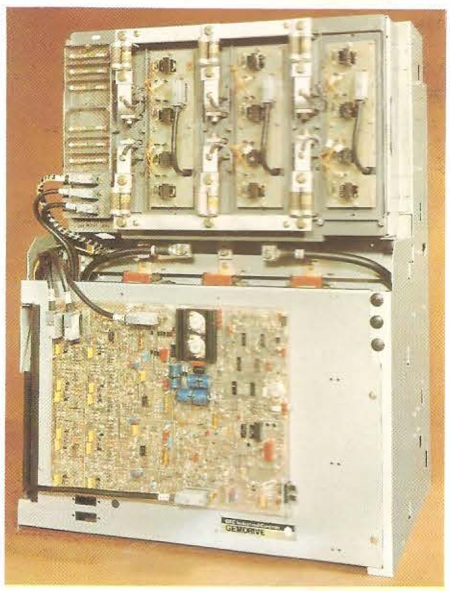
(Left) A nose-suspended dc traction motor supplied for light rail duties.
(Above) A three-phase induction motor which was designed to be mechanically interchangeable.



A 200kW chopper equipment for light traction.



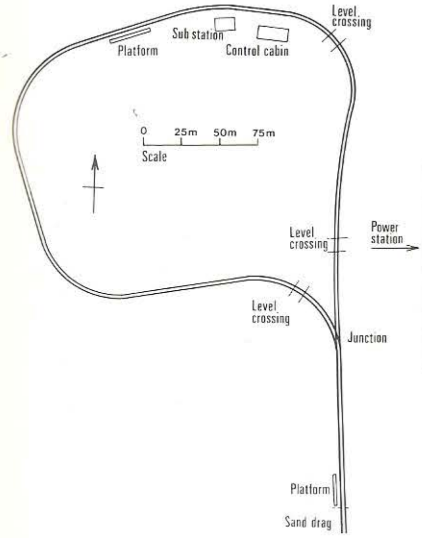
A module from a vehicle-mounted variable-frequency inverter.



A typical ac power-control module suitable for off-vehicle control

Testing

GEC Traction is able to provide comprehensive testing. The Company's combined testing facility at Preston enables complete propulsion equipments (and auxiliaries) to be tested together on-load. Actual service conditions can be simulated (the route of the run, its gradients and speed limits, etc) and equipment can be subject to the most rigorous conditions which would be encountered in service.



A vehicle evaluating three-phase, off-vehicle control is seen on the Company's test track in 1983. The layout of the test track is shown (left).

The combined testing facility at Preston and *(top)* the control room.

The DITMCO test equipment automatically carries out a sequence of wiring checks (both on equipment cases and on vehicles) and gives a printout of any faults found.

The Beaver carries out similar checks automatically on printed circuit boards and other electronic equipment.

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