MITRAC Energy Saver

When a vehicle brakes, energy is released. To date, most of this energy has been lost in hot air. The challenging alternative is to store the braking energy on the train and use it during acceleration or operation of the vehicle.

The solution – Bombardier's MITRAC Energy Saver sets new standards

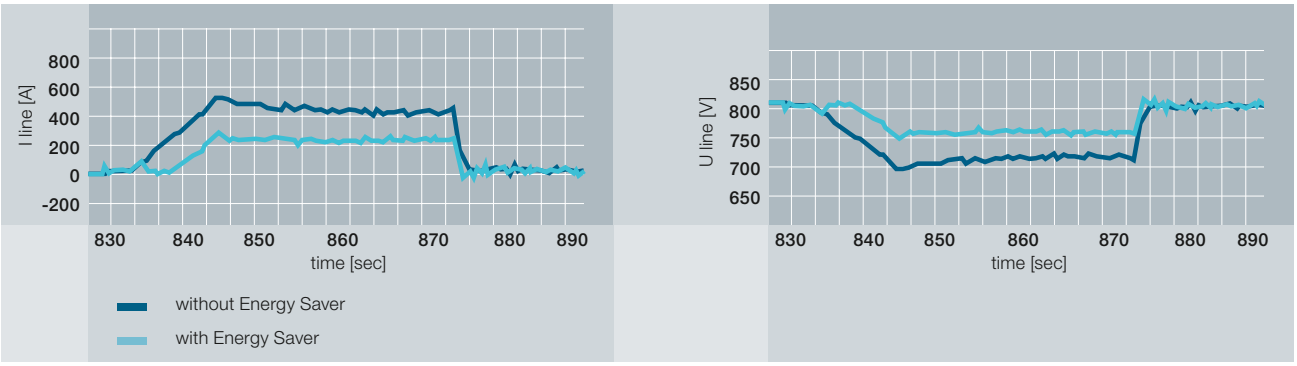
Unlike conventional batteries, the *BOMBARDIER* MITRAC** Energy Saver provides vehicles with an energy source that allows frequent starting and braking, coupled with considerably longer service life. The secret is in the *MITRAC* Energy Saver, based on high-performance double layer capacitor technology (ultracapacitors).

The system works by charging up these storage devices with electrical energy released when braking. This stored energy can be used in many ways.

Energy savings and power supply optimization

Resources need to be deployed and utilized efficiently, in a manner that is easy on the environment – and today's rail transport systems are no exception. Environmental awareness plus reduced operating costs are now major considerations in procuring advanced rail vehicles for public transport. The benefits to customers are obvious.

The *MITRAC* Energy Saver can help reduce the energy consumption of a light rail or metro system by up to 30 percent! Moreover, lower peak current demand means that



Power supply optimization with MITRAC Energy Saver

fewer substations are needed and they can be further apart, which reduces infrastructure costs. Using *MITRAC* Energy Saver for diesel multiple units allows energy savings by even up to 35 percent! Alternatively, the stored energy can be used as performance booster: the *MITRAC* Energy Saver enhances the performance of a vehicle by adding extra power during acceleration.

Catenary free operation

Bridging short unpowered sections

Not only does the *MITRAC* Energy Saver reduce energy consumption and thus cut running costs, it is also the ideal solution for operation in sections without an overhead contact line. A light rail vehicle incorporating the *MITRAC* Energy Saver can travel normally for around 500 meters with lowered pantograph. That makes it possible to bridge unpowered sections owing to maintenance work or sections that are iced up in extremely cold winter weather.

Longer intraurban sections

Where longer-range operation without an overhead contact line is desirable (e.g. in historic or picturesque urban districts) stopping-points can incorporate a charging station that tops-up the *MITRAC* Energy Saver while the vehicle is waiting for passengers to leave and enter. Stops are usually less than 500 meters apart in such areas, so reliable point-to-point operation is assured.

Performance boosting

The additional power from the *MITRAC* Energy Saver can be used to boost the vehicle's speed when line current or engine power are limited. Assuming e.g. 30% power from the Energy Saver could result in 30% higher power while keeping the same line current demand. This extra power results in additional tractive effort and allows significantly higher train acceleration. Thus, the energy saver compensates the disadvantage of the usually limited power of the diesel engines or increases the throughput capacity of a light rail or metro system.

Benefits of the *MITRAC* Energy Saver:

- Energy savings
- Power supply optimization
- Catenary free operation
- Performance boosting

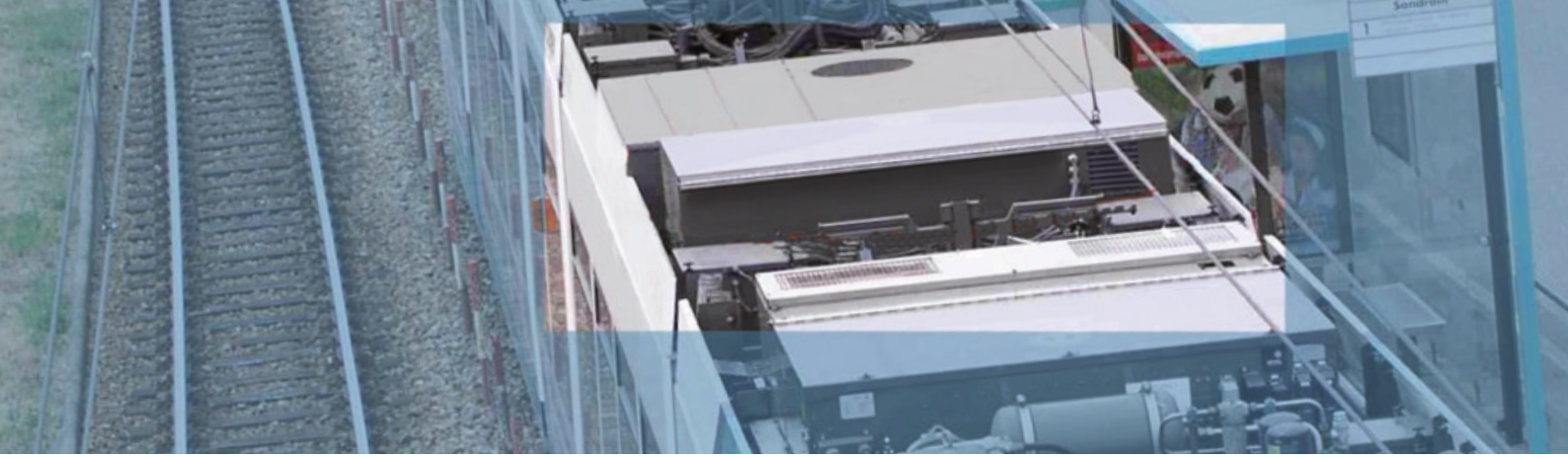
How does the MITRAC Energy Saver work?

The *MITRAC* Energy Saver stores the energy released when braking and uses this energy during the next acceleration of the vehicle. Each time the vehicle brakes, the energy storage devices are loaded again. During the next acceleration, the stored energy is released. This additional energy lowers current demands from the network, yet the traction effort stays the same. Measurements during acceleration up to 50 km/h show a reduction of the peak power demand by up to 50 percent.

The technology behind

The most challenging operating conditions for storage devices on board of traction vehicles are high number of load cycles during the vehicle lifetime, relatively short charge and discharge times as well as high charge and discharge power values. In contrast to high-maintenance, flywheel-based, mechanical energy storage used in vehicles such as buses, the *MITRAC* Energy Saver operates on a purely electrical basis.

AGC solution with underframe mounted MITRAC Energy Saver



The MITRAC Energy Saver prototype in daily revenue service for MVV Verkehr AG

The *MITRAC* Energy Saver solution is based on double-layer capacitors with a long service life and ten times higher performance than conventional batteries. Several hundred high-performance storage cells are connected in series to create a *MITRAC* storage unit. They store the electrical brake energy with relatively low losses.

Proven technology

A prototype light rail vehicle fitted with *MITRAC* Energy Saver technology completed a four year trial period- it has been tested in the system of the public transportation operator in Mannheim, Germany starting in 2003. The vehicle was in daily revenue service. The energy storage system, fitted to the roof of the vehicle, proved to be an efficient and reliable energy saving technical solution. Encouraged by the success of the trial, the German operator Rhein-Neckar-Verkehr GmbH (RNV) ordered *MITRAC* Energy Saver equipments for nineteen light rail vehicles.

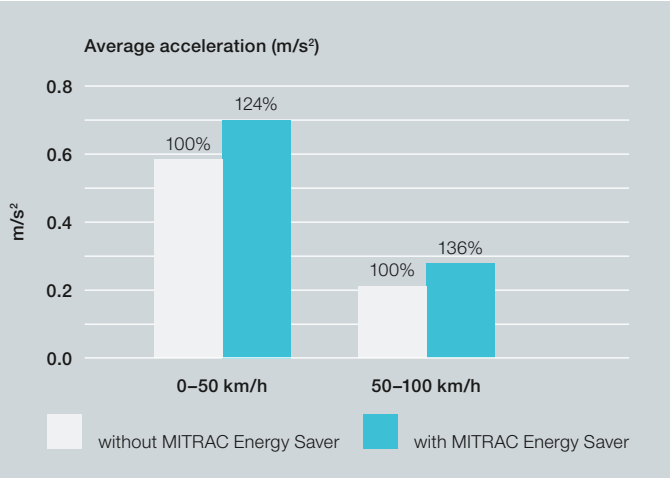
The proven benefits of the *MITRAC* Energy Saver:

- Clear reduction of tractive energy and peak power demand
- Catenary free operation to bridge around 500 meters
- Catenary free operation in intraurban sections with charging stations on stopping points

How much energy does it really save?

As the trial of the *MITRAC* Energy Saver equipped prototype proved, the energy savings reach up to 30% of the traction energy without taking the energy consumption of the auxiliary converters into account. That complies with a reduction of the total energy demand of more than 20%. In consideration of the fact that the yearly energy cost for the operation of a LRV accounts around 30.000 Euro and approximately 150.000 Euro for a metro, these figures mean a high saving potential for the operators.

MITRAC Energy Saver provides performance boosting for DMUs



MITRAC Energy Saver

MITRAC Energy Saver – Applications

The *MITRAC* Energy Saver is an important contribution to a more sustainable transport system, enhancing the already established environmental advantage of public rail transport not only for light rail vehicles but also for metro systems and diesel electric multiple units. The energy saving potential is exceptionally high when the line capacity is low and the Energy Saver is used frequently, thus if there are short distances between the stops.

The proven energy savings of 30% by the light rail vehicle prototype and the corresponding emission reduction is in line with various local and global energy saving programs set up by e.g. the European Union and major railway operators. The on board energy storage is one of the main future technologies to increase competitiveness of public transport systems by making them more economic and environmentally friendly.

The MITRAC Energy Saver Unit

The *MITRAC* Energy Saver technology fits in one special aluminum container which shields the energy storage cells from environmental effects. The ultracapacitors are forced air cooled. The *MITRAC* Energy Saver can be used in conjunction with any traction converter of the *MITRAC* TC 500 and *MITRAC* TC 1000 families.

ECO4 – Energy, Efficiency, Economy and Ecology
The *MITRAC* Energy Saver forms part of Bombardier's *ECO4** environmentally friendly technologies. Addressing the growing challenges among operators to reduce Energy consumption, improve Efficiency, protect the Ecology while making sense Economically, *ECO4* is the concrete validation of Bombardier's declaration – *The Climate is Right for Trains**.

Technical data MITRAC Energy Saver

	MITRAC Energy Saver Unit		
Application	LRV 2003	LRV 2008	DMU
Installed energy (kWh)	1	1	1.17
Max output power (kW)	300	300	100
Cooling	forced air cooling	forced air cooling	natural convection cooling
Weight (kg)	477	400	466
Dimensions (mm)	1900x950x455	1700x680x450 (partly 550)	1800x1500x250
Typical application	2 Boxes for 30m LRV 2 kWh, 600 kW	2 Boxes for 30m LRV 2 kWh, 600 kW	6 Boxes for 4 car AGC 7 kWh, 600 kW

- Technology based on ultracapacitors (double-layer capacitors)
- Power Output is ten times greater than conventional batteries
- Up to four times longer service life than conventional batteries
- Ease of installation as one single container with only passive components
- Easy maintenance and low life-cycle cost
- Reliable technology as proven in daily revenue service for more than 4 years

Reference projects

MVV Verkehr AG, light rail system
Mannheim, Germany
1 *MITRAC* Energy Saver prototype

Rhein-Neckar-Verkehr GmbH (RNV)
Mannheim, Germany
19 *MITRAC* Energy Saver equipped light rail vehicles

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