A world of solutions.

Rail


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X CERTIFIED QUALITY
MTU is a customer-oriented technological leader.

MTU supplies its customers with technologically-advanced products that are proven in the field. MTU’s range of products and services for off-highway applications is extensive and includes both standard and customized solutions.

MTU is the core brand of Rolls-Royce Power Systems AG, which is a world-leading provider of high- and medium-speed diesel and gas engines, complete drive systems, distributed energy systems and fuel injection systems for the most demanding requirements.

The product range of MTU is one of the widest and most modern in the sector. We offer comprehensive, powerful and reliable engine solutions for yachts, commercial ships and naval vessels, construction and industrial vehicles, agricultural machinery, mining, rail and military vehicles as well as for the oil and gas industry. We also provide a full line of service products to help you maximize uptime and performance.

For over 100 years, MTU has been known for cutting-edge innovation and technological leadership. That same spirit of innovation inspires our sustainability efforts. Today and in the future, our focus is on developing and implementing system solutions to maximize efficiency and meet emissions standards.

An expert technological leader
MTU has always set standards in technological expertise for customized product and system solutions. To deliver you maximum power density, we concentrate on innovation on the continuous advancement of our core competences: fuel injection, turbo charging, exhaust aftertreatment and electronics.

A passionate engine specialist
We spend every day working together with you, our customers, to deliver engines and systems that best fit your needs. Whether a standard system or a customized solution – we are passionate about the art of engine creation.

A reliable partner
We understand the specific demands for diverse applications. In collaboration with you, we look for the solutions which are best suited to your individual requirements. Every step of the way – from the start of project planning, during the design of your integrated system solution, at the point of delivery and commissioning and continuing through the care of your product – we are there with you for the entire life-cycle.

1. Technological leader
As a supplier of high-quality, performance propulsion solutions, MTU stands for the highest level of technological expertise.

2. Passion
MTU is passionate about fulfilling the needs of its customers with the utmost professionalism and precision.

3. Partnership
MTU is a reliable and trend-setting partner which acts with foresight in a results-oriented manner.

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Over the course of their lifetime, trains cover immeasurable distances, carry people and goods, bring support and ensure mobility. They move us and we move them. Our engines and drive systems make rail transportation powerful, reliable and safe.

Back in 1924, standard engines developed and manufactured by MTU were already being used in rail transportation and since 1950, we have supplied up to 20,000 engines as drive units and power generation units for railcars all over the world. Time and time again, over hundreds of millions of kilometers of rail, they have proven their absolute reliability, high operational availability and exceptional economic efficiency. They also incorporate the very latest in environmental technology and have the potential to meet future requirements.

These many years of experience, coupled with a unique level of expertise accumulated over decades, form the basis of our innovative strength and acknowledged systems capabilities. Locomotive and railcar manufacturers all over the world rely on us as their industrial partner.

With MTU ValueCare we offer a comprehensive portfolio of service products that ensure the optimum running and value retention of our drive systems over the long term. Our service network is at your disposal all over the world: always and everywhere.

All our products and services continue to set new standards. Such consistently high levels of quality are also reflected in our leading status in certifications: MTU is the first diesel engine manufacturer in the world to have received International Railway Industry Standard (IRIS) certification.

1 State of the art
MTU rail engines are reliable, powerful and eco-friendly drive units found in many of today’s high-speed trains and many other rail vehicles.

2 Looking back
In 1933 our diesel engines powered the legendary “Flying hamburger” to 160 km/h, a revolutionary speed at that time.

Putting progress on track.
Increasing demand for local public transportation brings with it an ongoing need for modern railcars with the latest drive system technology. MTU – as the experienced specialist – provides the drive systems to support eco-friendly traffic designs.

The innovative MTU Rail PowerPacks® meet all the requirements of this high-performance sector, which demands far more than simply a “powerful engine”. Our extremely compact, complete systems are configured to suit individual customer needs and can then be integrated into the vehicle in a quick and easy process, using Plug&Play.

The high level of reliability of our drive systems ensures that trains can run on time and that operations keep running smoothly – a key factor in economic success. In addition, low operating costs and fuel consumption figures, long maintenance intervals and a maintenance-friendly design all help keep operating costs down and further improve efficiency.
Multiple-Unit trains require top-level performance over a long period, maximum operational availability and uncompromising economic efficiency. For this reason manufacturers and rail operators have depended on MTU’s Series 4000 rail drive systems for many years.

For high-speed trains in particular, which are playing an increasingly major role on national and international routes, the advantages of MTU engines come into their own. Extremely powerful and proven in continuous service, our drive systems demonstrate an excellent power-to-weight ratio and outstanding operational availability, enabling them to deliver the reliability, punctuality and safety expected from these high-tech trains.

A worldwide service network and on-site facilities at railway depots ensure optimum levels of support and minimum downtime.
MTU drive systems for mainline and multipurpose locomotives operate in a wide variety of conditions and are always custom-made to suit their specific areas of activity. They are in continuous use, day after day, and prove their reliability on every continent and over thousands of kilometers. They prove their worth in heavy goods operations just as much as at high speeds on long-haul passenger routes.

Long maintenance intervals, maintenance-friendly design and low specific consumption figures all contribute to keeping overall lifecycle costs low and are thus important factors in the economically efficient running of rail vehicles.

MTU’s worldwide service network and local railroad depots give rail operators the highest possible level of confidence: fast and competent support minimizes unproductive downtime and ensures uninterrupted operational availability of rolling stock.
Shunting and industrial locomotives are true workhorses. Their specialized area of operation involves frequent load changes in all part-load operations and long periods spent in low-load operations. This gives rise to very specific demands on the drive system, which MTU engines meet with ease thanks to their excellent part-load performance and acceleration characteristics.

Our robust and powerful engines prove their reliability – one of the key factors in all rail applications – thousands of times every day. And since the smooth running of overall railroad operations depends to a considerable extent on the reliable functioning of shunting and industrial locomotives, our drive systems clearly have an important economic role to play. Long maintenance intervals and low specific fuel consumption figures are further arguments that convince operators of the efficiency of our engines.

And wherever your fleet may be: we are not far away. Our worldwide service network will ensure that rolling stock powered by our engines is always ready to go – and to operate – under even the toughest of conditions.
To keep railroad operations running smoothly at all times, a range of special rail vehicles provides supporting services. For these special-purpose vehicles, we provide custom-made drive solutions.

Low exhaust emissions make MTU drive systems ideal for use in a range of special-purpose vehicles such as tunnel servicing and maintenance locomotives used for construction or repair work in places like subway systems. A choice of diesel-electric, diesel-mechanical and diesel-hydraulic drive versions is available.

We also offer diesel-hydrostatic drive systems for construction-work and other special vehicles that operate at extremely low speed. Whichever you choose, all our engines come with the uncompromising levels of reliability, availability and economic-efficiency you need.

As an industrial specialist, we offer the complete engineering package for every drive solution, from the project concept phase through to installation. Throughout the entire operating life of our engines, our service network and local rail depots will provide professional support: anytime, anywhere.
MTU PowerPacks® and railroad engines set the benchmark for what diesel drive systems must deliver in this demanding sector. Their uncompromising operational availability ensures that railroad operations run with absolute reliability, while their exceptional efficiency is a key factor in the economic success of railroad operators. The very latest MTU emissions technologies also ensure that our railroad engines are among the cleanest drive systems in the world. Systems like these, that treat natural resources with respect and already meet future emissions standards, help us ensure that we meet our social responsibilities as an engine manufacturer.
A conventional drive system made up of individual components or an MTU PowerPack®. As an experienced system supplier we design and deliver individualized complete solutions, tailor-made to suit a specific application, a broad range of needs, and all associated conditions and requirements.

At the heart of what we do is always the engine. A choice of underfloor or engine room installation, low weight and compact installation dimensions make MTU diesel engines the best solution for drive systems in railroad vehicles.

The high flexibility of the system configuration makes the engines suitable for use in diesel-electric, diesel-mechanical or diesel-hydraulic drive units. This means that complete drive systems can be individually fitted. A wide range of accessories is also available, to suit your requirements and all of those meet the same high quality standards as the engine itself. Such items ensure simple integration at all interface points as well as the functionality of required special features.

The high standard of our comprehensive engineering expertise is just as convincing. During the design phase of individual drive solutions, our Competence Center Rail, as we call it, will provide you with a level of expertise that is unique, anywhere in the world. On the basis of our long-standing experience and solid references, we can understand your requirements - no matter how difficult they may be. And no company except MTU has been able to consistently offer the complete package of capabilities that is necessary for the development of complete customer-specific solutions from one source.

Take advantage of our expertise.
MTU PowerPacks® and Engines

All engines at a glance.
Efficient and powerful:

MTU Power Packs®
for railcars

The MTU PowerPack® is an innovative drive system that combines all the individual system elements into a single functional unit mounted on a supporting frame. This system is specially designed for underfloor installation and is characterized by its particularly flat design. We supply all three types of power transfer: diesel-electric, diesel-mechanical and diesel-hydraulic. Every MTU PowerPack® can be individually configured.

**Features:**
- Responsibility for the design and performance of the traction system as a whole stays in one place. A single supplier is responsible for all elements of the drive system and a single partner is in charge of service and logistics – from the project initiation phase through to the final handover inspection.
- Interfaces are reduced to the most extreme system limits of the PowerPack®. This means that the complete system has been coordinated and tested by MTU well before it is installed in the vehicle.
- The Plug&Play configuration makes installation and removal of the unit quick and easy – also for maintenance purposes. Your trains are sure to run on time.
- The installation of a PowerPack® makes standardization possible and reduces complexity. This leads to better cost-effectiveness than through the use of individual components.
- The compact arrangement of the components reduces the total weight of the PowerPack®.
- An electronic control system monitors, controls and regulates all functions.
- For test purposes, it is possible to run the full drive system outside of the vehicle – even under load.

**Features:**
- The technology for eco-friendly drive systems: We take responsibility for technology – also in the interests of protecting the environment: Our PowerPacks® meet all current legislative requirements, while we also already have the solutions to enable us to meet the next level of emissions standards. We meet US EPA Tier 3, 4i and EU Stage IIIA, with proven technologies, e.g. through an optimized combustion process and SCR technology.
- Selective Catalytic Reduction technology (SCR) involves the targeted aftertreatment of the exhaust gas to convert nitrogen oxides (NOx) to harmless, naturally occurring air components.
- Further features of the PowerPacks® are their low particulate emissions and reduced levels of noise and vibration.

**The MTU PowerPack® offers:**
- Scope for individual configuration; flexible and standardized interface solutions
- Low operating costs
- High performance efficiency
- Lowest fuel consumption
- Minimal exhaust emissions
- Long service life and excellent reliability
- Simple maintenance
- High level of availability
- Minimal resource requirement thanks to Plug & Play
Integration of the energy storage with roof installation:
1. Diesel engine
2. Electric motor/generator
3. Transmission
4. Exhaust aftertreatment (SCR)
5. AdBlue® tank
6. MTU EnergyPack
7. System control

Saving fuel through braking energy recovery
With hybrid drives, braking energy is converted into electrical energy and stored in the battery. This energy can then be reused later as a boost on gradients or to accelerate. As a result, up to 25 percent of the diesel fuel can be saved. Hybrid technology is especially efficient for use on local lines where braking and acceleration in stop-go mode is frequent, and much of the braking energy can be recovered. In this case, the hybrid drive is amortised after just a few years.

Significantly reduced emissions through load point optimization
If during periods of low load factors the diesel engine is operated at a more favorable energetic operating point or switched off entirely, emissions can be reduced substantially: per kilometer, up to 230 grams less CO₂ and up to 0.92 grams less NOₓ compared with conventional systems.

Optimizing travel times with the Boost Mode
With a combined diesel and electric drive, the train accelerates even better. When it comes to keeping tightly calculated schedules or catching up on delays, the electric motor provides additional torque. This means that the railcar can travel uphill faster or reach the target speed quicker. For example, the time for a 72-kilometer-long route can be shortened by more than five minutes.

Significant noise reduction
The electric motor can be used as the main drive when rail vehicles need to be operated as quietly as possible. For example, during travel through residential areas and tunnels or while stopped at a railway station. The noise level when stationary can be reduced by up to 21 decibels.

Flexible vehicle deployment and simple retrofitting
Naturally, rail vehicles with hybrid drive can also be powered exclusively by the diesel engine. This also means great flexibility for the operator: The trains can be deployed on both electrified and non-electrified rail routes. In addition, upgrading to a trimodal* power system – with an additional pantograph – is easy because the system is already equipped with an electric motor. This gives the operator considerable freedom with regard to deployment of the vehicles – it’s a big plus when they can respond flexibly in the future to every route requirement or tender invitation.

* diesel + battery + catenary

MTU Hybrid PowerPack®
The next generation of railcar drive.

The new generation of PowerPacks
The Hybrid PowerPack was developed from the successful MTU underfloor drives. Tried and tested MTU PowerPacks were modified and equipped with additional components and functionalities in order to integrate the hybrid technology. The MTU hybrid concept consists of a modular kit with a variety of drive elements. It satisfies all existing railway standards and can be arranged according to customer specifications.

Thanks to its compact design and the use of power-dense electrical machines, the Hybrid PowerPack can be easily integrated in the existing installation space under the floor, both in new rail vehicles and in repowering of an existing vehicle. MTU EnergyPacks – the energy storage – can be positioned at various places in the vehicle: in the roof or in the space under the floor of the railcar. The modular design creates great flexibility for operators who are planning new vehicles or want to convert existing vehicles.

Marketable technology – tailored solutions
Extensive test runs in a Siemens Desiro Classic Railcar (DB Series 642) have proven the reliability of the MTU Hybrid PowerPack®. The projections of the simulation have also been confirmed. As a result, MTU can make reliable statements to customers with regard to efficiency as well as the reduction of noise pollution and exhaust emissions, and offer them tailored hybrid solutions that in every case will generate the greatest possible benefits for the application.

Based on specifications for the vehicle and the profile of the planned routes, MTU can simulate the lifecycle costs (capital, maintenance and operating costs) of specific projects. This means that a variety of drive options can be defined even before the design stage. Together with the customer, we then determine an optimal needs-based concept.
MTU PowerPacks® for Railcars, Underfloor and Roof Installation

### Series 1800

<table>
<thead>
<tr>
<th>Engine model</th>
<th>DH 1800 R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cylinders</td>
<td>6/in-line</td>
</tr>
<tr>
<td>Power output kW</td>
<td>315 335 360 390</td>
</tr>
<tr>
<td>Bhp</td>
<td>422 449 483 523</td>
</tr>
<tr>
<td>Drive systems</td>
<td>DM/DH/DE/Hybrid</td>
</tr>
<tr>
<td>Speed rpm</td>
<td>1800</td>
</tr>
<tr>
<td>Emissions certification</td>
<td>EU Stage IIIA compl./EU Stage III B/EPA Tier 3 compl.</td>
</tr>
</tbody>
</table>

1) Drive systems:
- DM = diesel-mechanical
- DH = diesel-hydraulic
- DE = diesel-electric

<table>
<thead>
<tr>
<th>Battery System</th>
<th>MTU EnergyPack</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>151M1P 151M2P 151M3P 151M4P</td>
</tr>
<tr>
<td>Energy Content kWh</td>
<td>30.6 61.2 91.8 122.4</td>
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MTU Power Packs® for Railcars, Underfloor Installation

# Series 1600

<table>
<thead>
<tr>
<th>Series 1600</th>
<th>12V 1600 R</th>
<th>12V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine model</td>
<td>12V</td>
<td>12V</td>
</tr>
<tr>
<td>Cylinder</td>
<td>12V</td>
<td>12V</td>
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<td>Power output kW</td>
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<tr>
<td>RPM</td>
<td>2100</td>
<td>2100</td>
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<tr>
<td>Drive systems</td>
<td>DM/DH/DE/DM/DH/DE/DE/Hybrid</td>
<td>DE/Hybrid</td>
</tr>
<tr>
<td>Emissions certification</td>
<td>EU Stage III B</td>
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<tr>
<td>Type</td>
<td>151M1P</td>
</tr>
<tr>
<td>Energy Content kWh</td>
<td>30.6</td>
</tr>
</tbody>
</table>

Available. Reliable. Green. | Rail
Set new Standards:

**MTU engines for railcar trainsets and locomotives**
Engines for Railcar Trainsets and Shunting Locomotives, Engine Room Installation

Series 1600

<table>
<thead>
<tr>
<th>Series</th>
<th>Engine model</th>
<th>1600</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cylinders</td>
<td>12V 1600 R50</td>
<td>12V</td>
</tr>
<tr>
<td>Power output kW</td>
<td>690</td>
<td></td>
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<tr>
<td>Bhp</td>
<td>925</td>
<td></td>
</tr>
<tr>
<td>Speed rpm</td>
<td>1900</td>
<td></td>
</tr>
<tr>
<td>Emissions certification</td>
<td>EU Stage IIIb</td>
<td></td>
</tr>
</tbody>
</table>
Series 4000 – on tracks all over the world.

For over 20 years, MTU Series 4000 engines have been the preferred drive systems for modern locomotives. Over hundreds of millions of kilometers, these engines have set the benchmark for what a high-performance rail drive system needs to deliver in this day and age. Absolute reliability. Maximum operational availability. Uncompromising economic efficiency.

Fewer emissions with less fuel consumption and improved overall economy at the same time – oriented to the very real requirements of the rail operation. The Series 4000 embodies our competences in all essential key technologies, reducing emissions and consumption. It manifests our claim of offering you the optimal system solution in each case. And it provides you – just as you would expect from MTU drive solutions – with much more than just sophisticated and constantly improved technology: all the prerequisites for more success in your application. Now and in the future.

The Series 4000 in overview:
- Cylinder variants 8V, 12V, 16V, 20V
- Lower emissions and consumption thanks to the common rail injection system
- 20 years ago, as the first and only Off-Highway engine manufacturer, MTU introduced the common rail injection system.
- Now in the fourth generation, the tried and tested and continuously further developed key technology ensures that MTU engines will continue to set the standards in economy and low emissions.
- Optimum charging due to MTU exhaust gas turbocharger
  - High charge pressures lead to increased power yield and reduced particulate emissions
  - High efficiency for low fuel consumption
- Optimized combustion process
  - Reduction of NOx due to Miller cycle at optimal fuel consumption
- ADEC electronics (engine control system)
  - Robust MTU electronics, perfectly matched to the engines

Advanced technology for environmental friendliness – the new generation: Series 4000 R04

The new Series 4000 engines with our emissions technology represent the next generation of an engine series that has been proven thousands of times over. They fulfill the current emissions legislation EU Stage IIIb as well as US EPA Tier 3 – and are thereby very compact, powerful and extremely economical.

Our innovative emissions technology meeting EU Stage IIIb is based on both in-engine and aftertreatment solutions.

In-engine technologies minimize the generation of pollutants during combustion:
- Cooled exhaust gas recirculation
- LEAD 2 injection system up to 2200 bar
- 2-stage regulated charging, 3 turbochargers, intercooling
- NOx-optimized valve control (Miller cycle)
- New low-NOx, low-soot combustion process
- Max. cylinder pressure 220 +10 bar
- Advanced Diesel Engine Control system (ADEC) with emissions regulation

The aftertreatment technology eliminates over 90% of particulate emissions through use of a diesel particle filter with passive regeneration.

Further MTU key technologies for the reduction of emissions and consumption can be found in the Overview on page 74/75.

Through Siberian ice deserts. Through sandstorms. In the blistering Australian Outback. Over extreme gradients. Throughout the world, Series 4000 diesel engines drive heavy trains through difficult terrain. In heavy freight train operation as well as at high speeds in passenger train service. Without tiring. The numbers speak for themselves: of the total of 37,000 Series 4000 engines sold since 1996, the rail application accounts for altogether more than 3,000 engines. These alone have already reliably completed 65 million hours of operation for 240 customers in over 70 countries.
Series 4000

Engines for Push-Pull Trains, Shunting Multi-Purpose and Mainline Locomotives, Engine Room Installation

With up to 3,300 kW/4,425 bhp

Series 4000

<table>
<thead>
<tr>
<th>Engine model</th>
<th>Cylinders</th>
<th>Power output (kW)</th>
<th>Speed (rpm)</th>
<th>Emissions certification</th>
</tr>
</thead>
<tbody>
<tr>
<td>R04</td>
<td>12V</td>
<td>1000 – 1200</td>
<td>1800</td>
<td>EU Stage IIIA compliant/UIC IIIA</td>
</tr>
<tr>
<td>R63</td>
<td>20V</td>
<td>2700 – 3300</td>
<td>1800</td>
<td>EU Stage IIIA compliant/ UIC IIIA</td>
</tr>
</tbody>
</table>

1) EU IIIA type approved. Under special preconditions certification available on request.

On request, the range of Series 4000 R04 engines with EU Stage IIIB can also be supplemented with 8V models.
New heart.
New life.
Our expertise as your industrial partner means that MTU will not only provide the engines to be repowered but will also deliver a comprehensive package of support services:

— Design phase through implementation of the drive system; active support and professional engineering through all stages of the repowering project.
— Supply of the very latest, extensively proven engines and PowerPacks® with the compact dimensions that make them simple to mount in the available space, and with an excellent power-to-weight ratio that makes the installation of higher outputs possible without permissible axle loads being exceeded.

After reconditioning and repowering, tried and tested locomotives and railcars can be a genuinely economical alternative to placing a new order with four positive effects:

— The use of a modern MTU diesel engine reduces operating and maintenance costs, maximizing the economic benefits to the operator.
— All legally stipulated exhaust gas emission standards are met. Noise emissions are also significantly reduced.
— The availability and reliability of the vehicles are brought up to the level of a new vehicle.
— The cost of investment is considerably lower than if a new vehicle was purchased.

Following the conversion, the reduced operating costs bring the following potential savings for the operator:

— Reduction in fuel costs.
— Long maintenance intervals and minimal maintenance costs thanks to new maintenance concept.
— Legal requirements are met with well-proven combustion technology; low fuel and oil consumption lead to low pollutant emissions and thus high regard for the environment.
— Lower investment costs through reducing reserve locomotive stock.
— Limited downtime thanks to high availability and high reliability.

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1 Trains repowered with MTU engines run worldwide – safe and reliable.
2 Repowering is an economical alternative for a broad variety of rail applications.
3 Ease of integration thanks to the compact design and small footprint of MTU engines.
4 We care for a smooth repowering process: with excellent support and quality.

Available. Reliable. Green. I Rail I
Powerful engines alone will not meet the many technical demands of all these many different rail vehicles. Maximizing efficiency, reliability and environmental compatibility is about more than just power. This is why sophisticated automation systems take on the control, regulation and monitoring of the engine functions. MTU automation systems feature a modular design, making integration simple and are based on intelligent data bus technology.
# Automation and Peripheral Systems

## All products and benefits at a glance

### Automation system

<table>
<thead>
<tr>
<th>PowerPack Automation</th>
<th>Powerline</th>
</tr>
</thead>
<tbody>
<tr>
<td>MR2 Governor</td>
<td>ADEC Governor</td>
</tr>
<tr>
<td>PEM Safety module</td>
<td>PAU Engine (Power Automation Unit)</td>
</tr>
<tr>
<td></td>
<td>PAU Traction</td>
</tr>
<tr>
<td></td>
<td>POM (Power Output Module)</td>
</tr>
</tbody>
</table>

### Scope of supply

- MR2 Governor
- PEM Safety module
- ADEC Governor
- PAU Engine (Power Automation Unit)
- PAU Traction
- POM (Power Output Module)

### Advantages at a glance

- Central interface for complete system
- For new-production and repowering projects
- Special rail automation system
- Central interface for complete system
- For new-production and repowering projects
- Certified for rail applications
- Central interface for complete system
- Special rail automation system
- For new-production and repowering projects
- Certified for rail applications

### MTU PowerPacks®

**For Railcars**

- **Series 1800**
- **Series 1600**

**MTU Engines for Railcar Trainsets and Locomotives**

- **Series 1600**
- **Series 4000**

### SafeMon (Safety Monitor)

- SIL (Safety Integrity Level) certified monitoring unit
- Safety- and approval-related documentation
- Monitors safety-relevant functions and ensures safe operation
- Documentation simplifies the approval process

### CaPoS (Capacitor Power Sys.)

- Ultracap
- DC/DC voltage transformer
- Connection cable
- Electrical system voltage 16V DC – 154V DC
- CAN interface
- Maintenance-free

### CaPoS smart edition

- Integral charger
- Stand-alone component
- Enclosure rating IP66
- Maintenance-free

Only available for 8V 4000 engines
The PowerPack Automation is an innovative high-end technology of MTU for rail vehicles – e.g. for rail cars. PowerPack Automation optimizes the control, regulation and monitoring of the entire drive system. Representing a modular system, it ensures perfect adaptation of the drive system to the most complex operating conditions in rail applications.

PowerPack Automation allows:
- Easy integration in new or – in case of retrofits – existing vehicle control systems.
- Flexible adaptation to the vehicle or its components and to project-specific requirements.
- Automatic power adjustment or, if required, engine shutdown by the integrated safety system as well as all other required monitoring and safety functions.
- Traction optimization by the integrated load management (torque control) feature depending on the consumers connected (e.g. generator, compressor).

Thus, the new PowerPack® generation provides:
- High power efficiency
- Lowest fuel consumption
- Minimum exhaust emissions which are considerably below the statutory requirements (e.g. valid EU Stage IIIA and EU Stage IIIIB)
- Flexible and standardized interface solutions

Diagnosis and maintenance:
- Interface to the central railcar computer system, including the drive system components.

„PowerPack Automation“ is a modern interface module with a future-oriented design and high connection variability.

PowerPack Automation is a modern interface module with a future-oriented design and high connection variability.

Custom solution:
- Ethernet TCP-IP protocol, socket solutions for remote diagnosis/maintenance and integrated web server
- Standard communication protocols – company-specific solutions possible, programmable to IEC 1131-3/IEC 61131

Other characteristics:
- Control cabinet installation to IP40
- Quick and easy software updating using CF card
- Straightforward diagnosis using integrated web server and mini display

Certification:
- PowerPack Automation meets all common rail specifications
powerline – Managing Your Train’s Drive System

Everything under control.

powerline – MTU’s automation system for train drive units – represents a step into a whole new future of technology for rail vehicles. Even with only the basic components ADEC, POM and PAU, the powerline automation system makes the integration of the engine into the locomotive a simple process. PDM, like ADEC, is an electronic module mounted permanently to the engine. Control, regulation and monitoring are all part of the package that MTU delivers. With the help of optimized interface technology, the engine is quick and easy to install.

powerline for new locomotives or repowering with Series 1600 and 4000

PAU Engine (Power Automation Unit)
Module for the monitoring, control and system integration of peripheral engine components, with the following features:

— Stand-alone component with (redundant) CAN-open interface to vehicle control system
— Transfer of all engine-related operational data including diagnostics to the vehicle control system
— Additional monitoring and control of peripheral engine systems
  • Coolant level monitoring
  • Fuel pump actuation
  • Air filter monitoring
  • Integrated safety functions
  • Data output for fuel consumption indicator
  • Ethernet diagnosis interface (e.g. service laptop)
  • Fault ring buffer
  • Cooling fan regulation
  • Preheating control

ADEC engine control system
The engine control system ADEC (Advanced Diesel Engine Control) for Series 1600, 4000 R03/R04 is a system that has been developed and produced by MTU specifically for use with the very latest high-performance diesel engine technology – designed not only for full control of the Common Rail technology in the Series 4000, but above all for the management of frequent extreme loads and sudden load changes, which can be overcome effortlessly and smoothly using this system.

The most important features at a glance:

— Component mounted on and wired into the engine
— Integrated control and monitoring system
— Fuel-optimized output regulation
— Integrated safety and self-test system
— Data bus interface

POM (Power Output Module) for Series 1600, 4000 R03/R04
Module with actuating function for the starter motor and alternator, with the following features:

— Component mounted on the engine
— Starter relay and other conventional power routing not required
— Optimization of start-up process; starter motor monitoring with engaging function
— Alternator function monitoring
— Line break and short circuit monitoring
— Battery voltage monitoring with start-up intervention plus status indication and error report function
— ADEC and POM linked via CAN data bus
— Fully automated start-up control with ADEC

powerline additional module for repowering of diesel-electric locomotive drive systems

PAU Traction (Power Automation Unit)
Module for the monitoring, control, regulation and system integration of the traction generator and rectifier, with the following features:

— For drive systems with direct-current series-wound engines
— Optimized output regulation, configured for the diesel engine
— Generator, rectifier and vehicle engine monitoring
— Field weakening control for vehicle engine
— Wheel-slip protection
— Integrated safety functions (e.g. power shut-off)
— Ethernet interface (e.g. service laptop)
— Internal fault ring buffer
— Locomotive safety functions
— Specification includes current and voltage transformers plus amplifier for generator excitation

SafeMon for PowerPacks®: the integrated safety center

All-round protection.

For vehicle manufacturers and railway operators, the safety of their passengers has top priority. With the MTU SafeMon (Safety Monitor) we help you to reduce operational risks – and to achieve the set safety objectives even faster and easier.

SafeMon consists of a certified monitoring unit for safety-relevant functions as well as the associated safety- and approval-related documentation. The functions that control these signals fulfill the level of safety specified by the operator, rated according to Safety Integrity Level (SIL). This specifies, that in the event of faulty or defective components, safety-relevant procedures, such as braking, coupling or uncoupling, are guaranteed just as before. As a result, consequential damage due to unwanted traction or overspeed is prevented.

MTU develops the safety technology in-house - and it is therefore perfectly oriented to the MTU PowerPack. SafeMon is integrated directly in the power system via a simple hardware interface, existing vehicles can also be readily upgraded. Manufacturers of rail vehicles receive a complete package that has already been subjected to all hazard- and risk assessments and certified for the safety level that they require; MTU prepares the corresponding documentation.

The separate safety certificate can be included directly in the report for the independent assessment body. This considerably simplifies the approval process for the complete vehicle.

With SafeMon you are safely on route at all times:
- Complete safety concept for the entire power train
- Control of all safety functions according to the required safety level – completely documented and already examined by external bodies
- Complete power system from a single source, certified according to the European Standard for Proof of Safety (EN 50129)
- MTU supplies the associated documentation and thereby simplifies the approval process

The Safety Integrity Levels have been determined in accordance with the CSM Regulation (Common Safety Methods) and confirmed by independent experts.

### Implemented safety functions

**SIL 1**
- Avoidance of unwanted traction
- Protection against overspeeds

**SIL 2**
- Safe shutdown of the PowerPack, if required (Emergency Stop)
- Safe uncoupling

**SIL 3**
- Safe disconnection of the propulsion power (traction)

Optional: Monitoring pressure and temperature for other safety functions
CaPoS – Capacitor Power System for Series 4000

Innovation right from the start.

CaPoS is an innovative UltraCap voltage supply system which obviates the need for conventional starter batteries in railroad applications.

CaPoS uses capacitor technology to optimize startup behavior. The number of UltraCap modules used is dependent on the motor type/power system and its breakaway torque. CaPoS may be used autonomously or in conjunction with the powerline automation system.

The most important features at a glance:

- Autonomous and modular construction
- Maintenance-free system
- Significant reductions in weight and volume compared with conventional starter batteries
- Optimized cold-starting properties
- Low life-cycle-costs
- No voltage dip in the onboard network during the start procedure
- Onboard voltage of 16V – 154V possible
- Wired-up complete system
- CAN interface with powerline

CaPoS with powerline - Sample for the 12V 4000

Available. Reliable. Green. I Rail I 57
CaPoS smart edition – Capacitor Power System for Series 1600, 1800 and 4000

Reliable power right from the start.

CaPoS smart edition was especially developed for heavy and duty applications and provides the high energy required by the 24V DC starters during the starting sequence.

CaPoS smart edition uses capacitor technology to optimize start-up behavior. The number of modules used is dependent on the motor type/power system and its breakaway torque.

The most important features at a glance:
- Autonomous and modular construction
- Maintenance-free system
- Significant reductions in weight and volume compared with conventional starter batteries
- Optimized cold-starting capabilities
- Low life-cycle-costs
- No voltage dip in the onboard network during the start procedure
- Onboard voltage of 24V DC
- Integrated self-monitoring system with interface to vehicle control system
- Integrated DC-/DC converter for automatical recharging
- IP66 protection

According to motor type/power system, use of 1 to 5 UltraCap modules

1) for Series 1800
2) for Series 8V 4000
3) for Series 1600, Series 8V 4000
* Optional for Series 1600
MTU ValueCare

Ensure a long, reliable life.

As your equipment ages, its needs—and yours—change. MTU ValueCare wraps around your MTU investment, providing 360 degrees of customized support, for optimal value at every stage of life.

1. Avoid the unexpected with added protection beyond the standard warranty.
2. Make better decisions faster with data-enhanced tools.
3. Maximize availability and optimize lifecycle costs with an individually tailored Long-term Service Agreement.
4. Improve system performance and extend equipment life with on-demand support from MTU.
5. Keep a good thing going with MTU reman/rebuild solutions.
Preventive Maintenance

Look beneath the surface for lasting value.

Upfront costs are only a small part of your engine investment. Long-term value can only be realized by considering the big picture. We’ve found that preventive maintenance yields tremendous savings in cost and time throughout the life of your equipment. There’s simply no better way to optimize fuel economy, maximize uptime and avoid the unexpected.

Optimize fuel economy. Fuel consumption accounts for up to 90 percent of total lifecycle costs depending on the application—by far one of the most significant costs associated with your equipment. Well-maintained MTU engines deliver industry-leading fuel efficiency, helping you keep fuel costs down over the long term.

Maximize uptime. Preventive maintenance services can be planned around your schedule, so your equipment is available when you need it most.

Avoid the unexpected. Planned maintenance helps solve problems before they start, helping you avoid unexpected downtime and resolve problems early before they escalate.

Work with one source. MTU keeps maintenance simple, safe and efficient. Our factory-approved methods and expert technicians ensure everything is done correctly according to proprietary MTU preventive maintenance schedules, optimizing the availability of your equipment, reducing lifecycle costs and helping you avoid unforeseen problems.

MTU focuses on preventive maintenance to reduce the downtime and added costs of corrective maintenance.
MTU-certified support

Rely on MTU expertise.

To give your equipment a long and productive life, choose a partner you can trust. Only MTU-certified technicians know how to get the job done right using proven service methods, MTU-specified maintenance schedules and genuine OEM parts.

From preventive maintenance to complete rebuild, MTU is your true lifecycle partner. Whatever level of support you need, our global network of factory-trained professionals knows all about your equipment and is ready to prepare a customized plan to help you maximize performance and minimize life-cycle-costs.

Never compromise.
MTU engines and systems are built to last with legendary high standards. When it’s time for service, don’t settle for anything less. To get the most from your equipment, there are no shortcuts. For maximum reliability, performance and uptime, choose a name you can trust—MTU.

Learn from the best.
Training is a great way to become proficient with MTU engines and systems and get maximum efficiency from your equipment. From preventive maintenance to diagnostics and repair, our training programs provide a hands-on learning experience with knowledgeable, expert trainers. We offer a wide range of customized training programs around the world to maximize your return on investment.

If you need us a little:
On-Demand Support—including professional inspections and preventive maintenance recommendations from MTU—helps you identify and address problems early, save on repairs or unexpected downtime, and optimize your equipment’s performance and longevity. Inspections include visual assessment, test run and leak check, on-site oil and coolant analysis, diagnostic evaluation and reporting.

If you need us a lot:
Long-term Service Agreements make it easy to plan the cost of maintenance and maximize availability throughout your MTU equipment’s lifecycle. The details, terms and periods of each package are precisely tailored to match your individual needs, with maintenance performed by MTU-certified technicians using only genuine new or remanufactured parts.
Long-term Service Agreements

Plan ahead.

The annual cost of maintenance can vary dramatically depending on how and where your equipment is used. When optimal equipment availability and performance are essential, and predictable costs are preferred, we can help.

Optimize availability.

Long-term Service Agreements from MTU make it easy to plan the cost of maintenance and maximize availability throughout the lifecycle of your MTU equipment. The details, terms and periods of each agreement are precisely tailored to match your individual needs, with maintenance performed by MTU-certified technicians using only genuine new or remanufactured parts.

Example: Scheduled Maintenance Costs

<table>
<thead>
<tr>
<th>Year</th>
<th>Long-term Service Agreement*</th>
<th>Preventive Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

Extended Coverage

Protect your investment.

MTU engines—backed by Extended Coverage—provide invaluable peace of mind beyond the standard warranty. With Extended Coverage, you can be assured that the costs of unplanned repairs are covered, with service performed by MTU-certified technicians—upholding resale value and ensuring long-term confidence in your MTU investment.

Cover the unexpected.

Extended Coverage protects you from the cost of unexpected repairs beyond your standard warranty, with professional service from MTU-certified technicians and coverage tailored to your needs. Packages can also be extended up to five years and are fully transferable, enhancing resale value. Coverage includes all materials and labor for troubleshooting, fault clearance, and corrective services to engines and on-engine electronics (excluding gearbox, alternators or similar components). To ensure maximum quality, all repairs are conducted using only genuine MTU parts.

Financial Investment

Annual costs are more predictable and consistent with Long-term Service Agreements. * Excludes corrective services.
Data-enhanced Solutions

Make better decisions – faster.

Digitization is more than a buzzword – good data fuels smarter decisions. Data-enhanced Solutions from MTU harness that power, giving you vital information and helpful tools to simplify and streamline MTU equipment ownership, operation and maintenance.

Monitor activity from afar.
Identify faults early and make informed decisions quickly – even thousands of miles from the work site – by accessing vital engine and system information online with Remote Services.

Be proactive.
Remote Services can improve your engine’s performance, and your profitability, by helping you avoid downtime. Using a telemetric device, important data such as fluid pressures and temperatures, alarms, current location and hours of duty is recorded and transmitted in near real-time or at predetermined intervals.

Through early fault identification and a configurable eCall, you can act decisively and proactively to increase engine efficiency, prevent damage, reduce downtime, identify necessary replacement parts, and save on service and repairs. All you need is a computer with an Internet connection.

Get everything you need.
MTU supplies the complete package:
- Telemetric device
- Connection cable and antenna
- SIM card for data transmission via the mobile phone network
- Installation documentation
- Web-based operating instructions
- Storage capability on an MTU remote server

An onboard telemetric device transmits vital equipment data, accessible in near real-time on your computer screen.

Remanufactured Products

Exchange and save.

Factory remanufactured MTU products deliver the same high standards of performance, service life and quality as new MTU products, along with identical warranty coverage – at a fraction of the cost. And with design and model-related updates, they also feature similar technological advancements. Developed by R&D engineers, the remanufacturing process saves you time and money, while benefiting the environment through the reuse of materials. To help you work efficiently, a wide range of remanufactured parts, engines and systems are available worldwide.

Reduce lifecycle costs.
As you evaluate your long-term power needs, you must consider a variety of factors. Factory remanufactured products are a smart solution, helping you reduce the total lifecycle cost of your equipment.

Save time.
Factory remanufactured products put your equipment back to work faster than an overhaul, which reduces downtime, service time and indirect costs such as storage.

Maintain MTU standards.
All products are remanufactured to strict MTU standards by MTU-certified technicians at regional MTU reman centers. Only MTU can remanufacture MTU parts, engines or systems to original MTU factory specifications.

Protect the environment.
Since remanufacturing is an efficient use of resources and energy, factory remanufactured products benefit the environment as well.

Exchanging and maintaining MTU equipment is a two-step process:

1 Customer purchases remanufactured product from local MTU service partner and pays the core deposit.
2 Customer’s original core is returned to collection center by local MTU service partner for core acceptance check.
3 Customer receives core credit based on the core’s technical condition.
4 Accepted cores are sent to regional MTU reman centers, where the remanufacturing process takes place.
5 Remanufactured products are delivered to MTU service partners and made available for purchase.

Exchange Process

- Disassembly
- Cleaning
- Reconditioning
- Model-related updates and assembly
- Quality check (including dynamometer test)
Whenever and wherever you need expert support, MTU specialists are available. Our global service network of more than 1,200 locations – backed by our cutting-edge Parts Logistics Centers – provides you this assurance. To find your local MTU distributor, visit www.mtu-online.com.

Customer Assistance Center
Agents are available 24/7 for fast response to your inquiries and any service needs.

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Asia/Pacific +65 6860 9669
North and Latin America +1 248 560 8888
info@mtu-online.com
# Overview of MTU engines

## Series and emissions qualification

<table>
<thead>
<tr>
<th>Engine model</th>
<th>UIC IIIA</th>
<th>EU Stage IIIA compliant</th>
<th>EU Stage IIIIB certified</th>
<th>US EPA Tier 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTU PowerPacks® for Railcars</td>
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</tr>
<tr>
<td>1 Series 1800</td>
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<tr>
<td>2 Series 1600</td>
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<tr>
<td>MTU Engines for Railcar Trainsets, Push-Pull Trains and Locomotives</td>
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<tr>
<td>3 Series 1600</td>
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<tr>
<td>4 Series 4000</td>
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<tr>
<td>8V/12V/16V/20V 4000 R43 ¹</td>
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<tr>
<td>20V 4000 R43</td>
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<tr>
<td>12V/16V 4000 R54</td>
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<tr>
<td>12V/16V 4000 R64/74/84</td>
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¹ EU IIA type approved. Under special preconditions certification available on request.
# Key technologies for the reduction of emission and consumption

<table>
<thead>
<tr>
<th>Engine model</th>
<th>Exhaust Gas Aftertreatment</th>
<th>Internal Emission Technology</th>
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<tbody>
<tr>
<td><strong>Railcar</strong></td>
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<tr>
<td>Series 1800</td>
<td>1 SCR</td>
<td>4 EGR</td>
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<td></td>
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<td>5 Two-Stage Turbocharging</td>
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<tr>
<td></td>
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<td>6 Advanced CR Fuel Injection</td>
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<tr>
<td>Series 1600</td>
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<tr>
<td>Locomotive</td>
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<tr>
<td>Series 1600</td>
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<td>2 DPF</td>
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<td>3 DOC</td>
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<tr>
<td>Series 4000</td>
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</table>

**Exhaust Gas Aftertreatment**

1. **Selective Catalytic Reduction (SCR)**
The SCR system can remove as much as 90 percent of nitrates from exhaust gas. In SCR development, MTU has primarily focused on low fuel consumption and a low space requirement for SCR components.

2. **Diesel Particulate Filter (DPF)/Diesel Oxidation Catalyst (DOC)**
MTU Diesel Particulate Filters and Diesel Oxidation Catalysts are capable of lowering soot emissions to levels that in some cases are well below the statutory limits. Statutory limits form part of the emissions concept.

3. **Exhaust Gas Recirculation (EGR)**
MTU has designed a solution for compact integration of all EGR components so that virtually no additional space is required. This enables customers to upgrade their rail vehicles for compliance with the new emissions standards at no great expenditure.

4. **Two-Stage Turbocharging**
Turbocharging enables MTU engines to achieve low fuel consumption and high power output across a wide speed range. Turbochargers are finely adjusted to suit the demands on the engine in terms of cost-effectiveness, performance, dynamic response and service life. Space-saving integration of turbochargers into the engine brings the customer the added benefits of compact design.

5. **Advanced Common Rail Fuel Injection**
MTU has been using Common Rail systems with success since 20 years and has continually refined its CR technology in collaboration with Rolls-Royce Power systems subsidiary L’Orange and other suppliers. Thanks to its wide-ranging CR-system expertise, MTU can exploit the full potential of fuel injection to make its engines exceptionally cost-effective and super-clean.

Perfectly tuned key technologies enable MTU to comply with current and future emissions standards and reduce fuel consumption at the same time. As a systems supplier, MTU also ensures that all system components interact perfectly for smooth operation.
Certified Quality

MTU quality is something you can measure – and feel.

We have set the standard by successfully retaining our ISO 9001 certification for many years now, and have so proven time and time over how our capabilities can benefit our customers. Yet what we have already achieved is not enough for us – it is just a basis and gives us the momentum for our further development and continuous improvement.

To add to all this, we have now received a further seal of approval. We are the first diesel engine manufacturer in the world to receive the International Railway Industry Standard (IRIS) certification, putting us a step ahead of the competition. The high-quality standards we set ourselves, plus motivated and experienced employees who constantly think ahead and take anticipatory action where necessary, have enabled us to fulfill the demanding requirements of IRIS.

Other credentials – UIC-certification of Series 4000 engines, the environmental management certificate ISO 14001, and “Q1 supplier” classification by Deutsche Bahn – speak for themselves and for the high level of quality and customer satisfaction that MTU offers.

Leading in quality and certification
MTU is the first diesel engine manufacturer in the world to receive certification according to the International Railway Industry Standard (IRIS). Certification awarded by further renowned certification bodies demonstrates clearly the uncompromising way in which we apply our quality philosophy across all products and processes.