

The Siemens logo is displayed in a bold, teal, sans-serif font. It is positioned in the upper left corner of the image, which shows a large-scale mining operation with a dragline bucket dumping material into a deep pit.

SIEMENS

Ingenuity for life

SIMINE Dragline

Large-scale mining excavation
with maximum productivity
and enhanced reliability

[siemens.com/mobile-mining](https://www.siemens.com/mobile-mining)

Lowest cost per ton
of material moved



Good reasons for SIMINE Dragline

- Higher productivity
- Higher drive system efficiency
- Less maintenance
- Lower life-cycle operating costs



Your challenge:

Our customers in the mining business face the challenge of developing and managing safe, efficient, technology-driven, low-cost mining operations. They have a responsibility to their shareholders to provide a superior return on their investment, as well as a commitment to their customers to provide reliable mineral supply. To meet this challenge, they must constantly strive to reduce the production cost per ton of material moved. They must seek out a competitive edge wherever possible, implementing breakthrough innovations based on proven technologies. Customers demand innovative machines with the highest possible yield; reduced maintenance costs; methods for continuously improving the productivity of their equipment; and a more efficient use of power.

Our solution:

Siemens has been in the mining business for over 100 years, delivering cutting-edge technology to meet our customers' requirements. Siemens' powerful AC drives are the most efficient available, requiring the least maintenance and boasting the longest mean time between failures (MTBF) of any drive on the market. In other words, the machine spends more operating time on the bank, which results in the lowest cost per ton available. Siemens' innovations, such as the gearless dragline drive, reduce operating costs even more, eliminating the need for gear maintenance and lubrication systems. Innovation, efficiency, productivity, and reliability are key elements in our extensive mining portfolio. Siemens is proud to be your partner in mining where our technology meets your needs. Our solution fits new draglines and dragline retrofits. The system uses modular electrics and "drop in" AC motors and can easily be adopted for small, mid-size and large machines.



SIMINE Dragline drive system benefits



Higher productivity

Our faster bucket filling times, higher hoisting and lowering speeds, and faster payout reduce machine cycle time and increase productivity. Analyses of several existing dragline operations have identified significant increases in productivity of over 20%.

Higher drive system efficiency

Implementation of static AFE increases system efficiency by approximately 15% and lowers energy costs by the same amount, when compared with rotating M-G sets. In addition, gearless draglines increase efficiency and reduce energy costs even more.



Less maintenance

Our AC solution, with static AFE and brushless AC motors, eliminates the costs associated with maintaining M-G sets and DC motors. Gearless draglines further improve profitability by eliminating the costs of maintaining mechanical gears and associated lubrication systems.

Lower life-cycle operating costs

Lower energy costs and significantly reduced maintenance overhead – together with longer uptime and greater productivity – translate into lower operating costs over the life cycle of the machine, and the lowest cost per ton of material moved of any excavator in existence.

Whether conventional or gearless drive systems, it's all about high efficiency.

Power requires control – electrical system overview

The incoming primary line voltage is transformed into 900 V secondary voltage and then fed through a reactor to the active front end (AFE). AFEs convert AC voltage into a steady 1,800 V for the DC link.

The inverters then convert the DC voltage to a variable-frequency/variable-voltage AC supply for the motors (0–1,400 V).

This modular design can be used to power machines with different requirements. It also can control traditional induction motors for geared applications, as well as synchronous motors for innovative gearless applications.

Active front end

The AFE control algorithm can regulate unity or even a leading power factor to compensate for the effects of existing equipment at the point of common coupling (PCC). This feature can be used to minimize voltage fluctuations in the mine's distribution system. In addition, the AFE's high pulse rate, as registered by the network, results in a very low total harmonic distortion (THD), typically less than 2.5 %. These features improve the power quality of the entire mine. Furthermore, the AFE's dynamic response to load changes results in a system that is extremely robust in the face of power grid disturbances.

Motors

For conventional geared draglines, Siemens has developed an entire range of motors featuring ideal characteristics for all motions. The motor family is suitable for draglines with bucket capacities ranging from 10m³ to 122m³. Motors are coupled to a common gear case to meet the power demands of each motion. Their interchangeability simplifies spare parts management. These motors were designed with

a special emphasis on longevity and high efficiency.

A patented technique cools both sides of the motor's active parts with fresh air, leading to low winding temperatures and high utilization of the motor's active parts. For gearless draglines, Siemens custom designs one synchronous ring motor for the hoist and drag motions. These motors are coupled directly to the drums.

Inverter

During operation, inverters (INV) take power from the DC link to drive the dragline motors. During regenerative braking, the inverters send power from the motors back to the DC link. The common DC link allows the motoring and regenerating drives to exchange energy.

IGBT technology

Insulated gate bipolar transistors (IGBTs) are power electronic devices for AFEs and inverters. These ideal switches for AFEs and INVs feature:

- high switching frequencies, which improve the current quality to the motors
- no snubbers and simple gate drivers
- high overload capacity; electronic protection circuits with no fuses
- traction-grade semiconductors enabling long service lifetime and high cycle durability

Comparison – Geared/Gearless

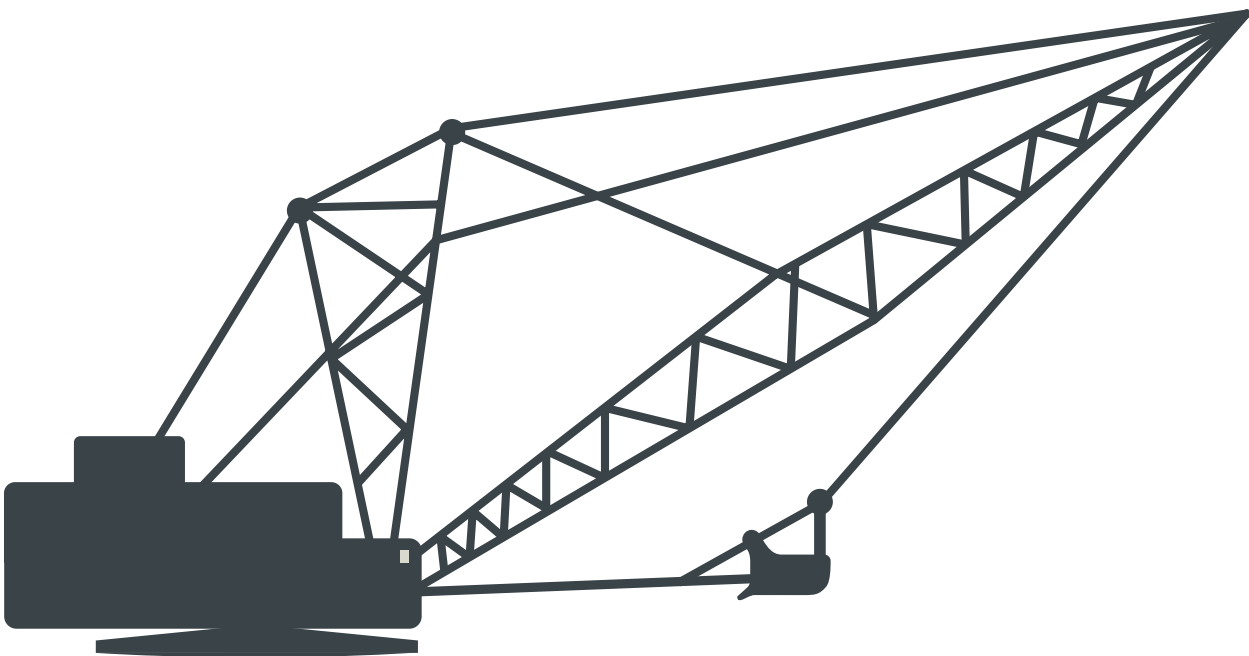
A conventional dragline utilizes multiple inverters to power multiple AC asynchronous induction motors, coupled through gearboxes to a common drum. Siemens' gearless dragline utilizes multiple inverters to power multiple windings in a single AC synchronous ring motor, with the drum built into the rotor assembly. The synchronous ring motor operates at very low speeds and is coupled directly to the drum. The induction motors operate at very high speeds and are coupled to the drum through a gearbox, which reduces speed and increases torque.

SIRAS – Support from anywhere in the world

When a dragline goes down, and lost production costs are mounting, maintenance personnel need to get the machine back into operation as soon as possible. Siemens' remote access system, SIRAS, allows trained personnel to access the onboard drive system and diagnostic tools

and immediately determine the source of the issue. Fast diagnosis greatly streamlines the repair process. On-site service technicians can prepare the equipment required to repair the machine before it leaves the workshop. For more challenging situations, remote support can be provided from factory-trained field service engineers, with a direct line to the original equipment design engineers.

From the Siemens Remote Response command center, qualified factory experts can remotely connect to machines all over the world and access all of the troubleshooting tools available on board the machine. SIRAS not only gives access to diagnostic tools, but also to the drive control system itself. This makes loading new software or adjusting parameters much easier, faster, and more economical. Quick problem diagnosis leads to a lower MTTR, which increases the availability of the machine and the potential for higher productivity.



Remote access and data analysis

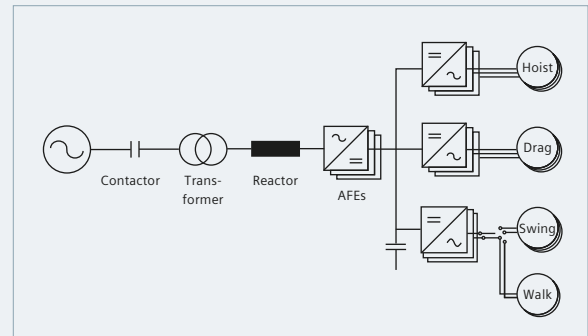
For over a decade, we have been improving our drive systems by integrating custom software solutions that:

- remotely troubleshoot machines (SIRAS)
- monitor real-time performance (MIDAS)
- review historical log files for troubleshooting / performance enhancement (MIDAS)

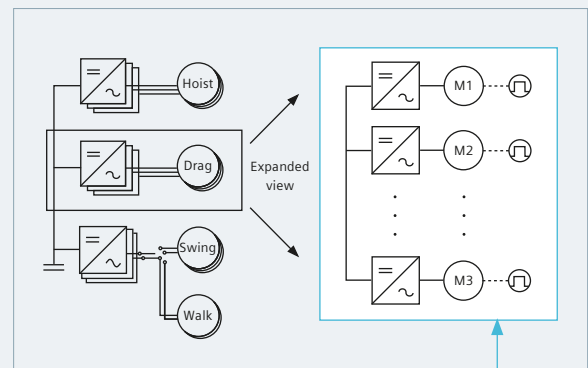
MIDAS – boosting dragline efficiency

MIDAS is the key element that allows the dragline to be used most effectively. Its centerpiece is the real-time data logger where system statistics are stored for later analysis. Data is made available in visual form – either in real time or after the fact – through an intuitive GUI. The report generator pinpoints and describes areas for operational improvements that could lead to yield higher production.

By integrating the MIDAS system into their daily planning and monitoring habits, customers can gain more insight into the machinery itself and how it operates. In addition, they will be able to identify ways to use their equipment more effectively to maximize production capability.



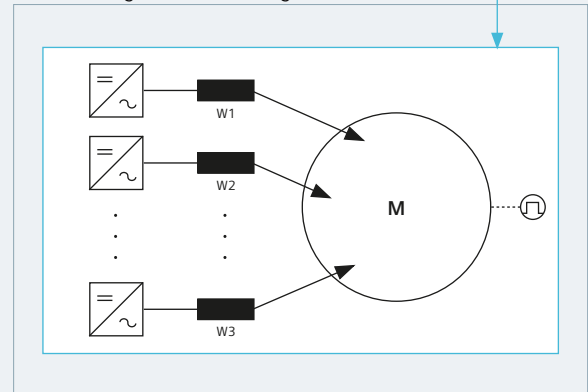
Simplified AC drive system single line diagram



Conventional dragline motor configuration

or

Gearless dragline motor configuration



In summary, both conventional and gearless drive systems provide a highly efficient drive through the use of a static AFE for the line side control. The gearless drive provides even more efficiency by eliminating the gearboxes.

A single IGBT platform – for excavators, draglines, and trucks

A single IGBT platform for excavators, draglines, and trucks

We use a single drive design platform to power excavators, draglines, and haul trucks. This shared drive platform will substantially reduce costs associated with operations, training, maintenance, and support. As a building block, we use proven IGBT power modules, water-cooled, with options to configure them into both OEM and retrofit applications for AC or DC motor control. A single drive platform for all three major pieces of equipment can significantly impact costs and productivity in a mining operation. excavators, trucks, and draglines typically contain multiple subsystems from multiple vendors, requiring numerous

solutions to handle power requirements, harmonics, motion control, automation, displays, and more. As equipment manufacturers and end users migrate to AC controls with their inherent benefits – more efficiency, higher speeds, fewer parts, less maintenance, adjustable power factor and lower harmonics – a single drive design platform is the next logical step to reduce system complexity, training and maintenance requirements, and spare part inventories.

Intelligent Diagnostics

Onboard Maintenance Computer

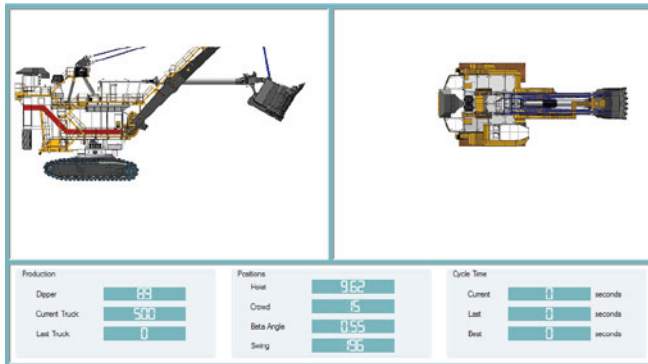
Our onboard Maintenance Computer allows the electrician to monitor all machine functions and to find and eliminate a fault quickly and easily without additional instrumentation. Faulty components identify themselves with location, part number, and exchange instructions. Active logic screens visualize the signal flow so the electrician can easily determine, for example, why the main contactor does not want to close.

SIRAS remote diagnostics

With SIRAS remote diagnostics, we can “keep the factory on the machine” to minimize downtime. Remote-access hardware and software connects the drive system to the Internet and allows Siemens service technicians, as well as other experts, to log on to the excavator from around the world for monitoring, troubleshooting and maintenance.



Liquid cooled AFEs / Inverters platform for excavators



SIRAS log-in screen



MIDAS productivity analysis screen

SIRAS supports full two-way read/write communication so the remote expert can do exactly the same thing as the electrician on board – except for tightening a screw. Software upgrades can be downloaded to the excavator and installed during lunch breaks. The net result is a substantial reduction in MTTR, greater system availability, and reduced maintenance costs.

MIDAS productivity analysis

The MIDAS software package allows the user to monitor the performance of the excavator in real time or through a past log file. The data is relevant to multiple departments within the mine, including production, operator training, and maintenance. The concept is simple: "This is how my machine is performing. How can I make it better?" MIDAS creates a continuous record of all important external input and output signals and presents them in a meaningful manner. This data can then be viewed by multiple users at the same time. Log files allow the users to go "back in time" to analyze what was happening at the very second a fault occurred. A 2D model of the excavator is provided so users can see the machine in motion. A graphic operator interface allows users to see what the machine operator was doing to make the excavator behave that way. Max/Min gauges monitor power section module temperatures, motor temperatures, reactor temperatures as well as air pressure and lube system pressure. All motor and gearbox bearing temperatures are also monitored with the addition of the bearing temperature option.

Real-time production data can be identified, including how much material is moved by each bucket, each truck, and each shift, with the load weigh option. The Siemens load weigh system measures the weight of the bucket indirectly, without using any additional sensors. It does not require frequent recalibrations, as is required on most truck load weigh systems. Therefore, it is not only accurate within $\pm 5\%$, but it is also very reliable and consistent. The built-in report generator gives users the best/worst cycle times during a shift, and can be used to pin down what makes one operator perform better than another. Operator trainers can use this information to train their personnel, resulting in more tons per shift. In short, this powerful program can show how the machine behaves in its environment. Users from different camps can quickly see data relevant to their jobs and use it to produce precise documentation regarding system performance.

From online monitoring to special reports to troubleshooting – we offer flexible service concepts and highly qualified service personnel to maximize your excavator's availability.

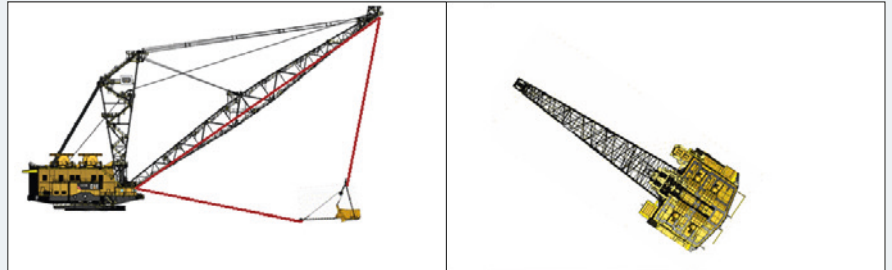
Digital AC excavators – MIDAS Diagnostics

Dynamic real-time monitoring and reliable recording of past events

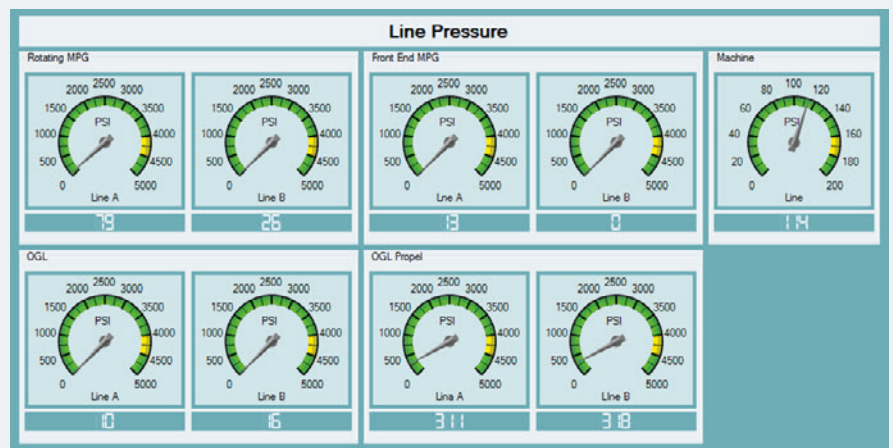
MIDAS product line includes technology features like Real Time Monitoring, Historical Data Review and Web Reporting Tools. The reports feature enables the mine operator analysis to improve the productivity and reduce machine life cycle costs. Localized machine data synchronizes with the mine office servers automatically over the mine network connections. Manual import / export functions are also possible. MIDAS desktop application allows the graphical interface for real time data and the replay interface for historical data.



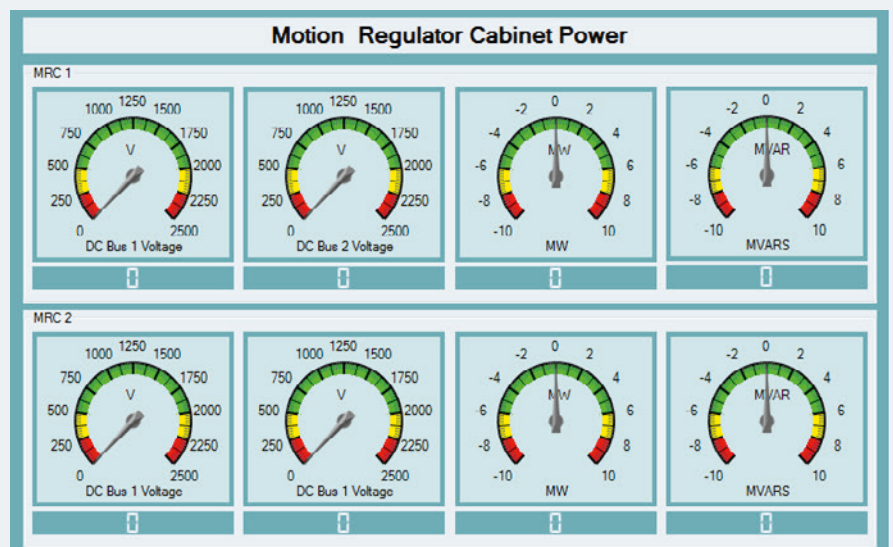
The machine operation sequence can be monitored remotely in real time or by replay mode using the MIDAS desktop application.



Machine lubrication cycles pressure data is recorded and displayed for maintenance analysis.



Vital signals of multiple motion drive systems can be simultaneously monitored for power analysis.



More information:
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