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Flexible Slip Energy Recovery Drive

Alternative drive system for variable speed

Answers for industry.

During the last decades, energy saving programs have increased substantially in the mining and cement industries, especially in the milling process in which several solutions have been developed to increase the reliability and performance of the process and consequently reduce the energy consumption.

The flexible Slip Energy Recovery Drive (SER) enhances the traditional subsynchronous SER by increasing the speed range and power while keeping the energy recovery.

Many applications require a high starting torque, which cannot be achieved by squirrel cage motors without a very high starting current of 500 to 700% rated motor current. This will cause unacceptable voltage dips in the medium-voltage power supply, which could affect other consumers fed from the same line.

For safe and reliable operation around the clock, the slip-ring motor is among the proven methods to start and operate large machines at remote locations. The high starting torque, in relation to a relatively low starting current, allows safe starts even at weak power networks.

If the drive application calls for a variation of the motor speed, additional equipment is required to run the motor at the desired speed to ensure optimal process throughput. This is where flexible SER becomes valuable.

Flexible Slip Energy Recovery Drive (SER) for variable-speed applications

Imagine the increase of productivity and quality!

A big step forward was made by launching the flexible SER, allowing sub- and hypersynchronous operation. The typical speed range of 80 to 115% can be used to achieve the best operation point.

Mechanical suppliers usually carefully design gear ratings to obtain the best working conditions and to avoid vibration. However, the fixed motor speed limits the operation and yield optimization at the rated motor speed under all conditions. A flexible speed range could be used to optimize production as long as a sufficient speed gap remains to the critical speed.

This is where the flexible SER shows its assets. The SER provides exactly that speed range. For example, the mill speed can be increased to reach the best grinding results and efficiency, to tap the full potential of the mill. In case the mill begins to experience vibration, the speed can be decreased to calm down the system. A shutdown of the system is no longer required.

Additionally, the system of slip-ring motors (WRIM) and SER provides high availability, because the system can operate at a constant speed in case the SER is out of operation.

The grinding grade, the material quality and quantity can be increased without changing the plant configuration. Throughput and energy consumption are near to optimum, resulting in more tons per kWh. The flexible SER is an effective adjusting screw for optimizing the process.

The SER is sized only for the energy that is fed into or drawn from the rotor circuit (up to approximately 20% rated power). As a side effect, the THD (Total Harmonics Distortions) is marginal, and strict demands and regulations, such as IEEE-519, are generally fulfilled – without any engineering effort.

Products of the SINAMICS S120 inverter family with Active-Front-End technology for controlled infeed / regenerative feedback, and the programmable SIMATIC S7 family, two well-known product lines of Siemens, are used all over the world, where service personnel and spare parts are available. Additionally the LV converter does not require MV converter specialists.

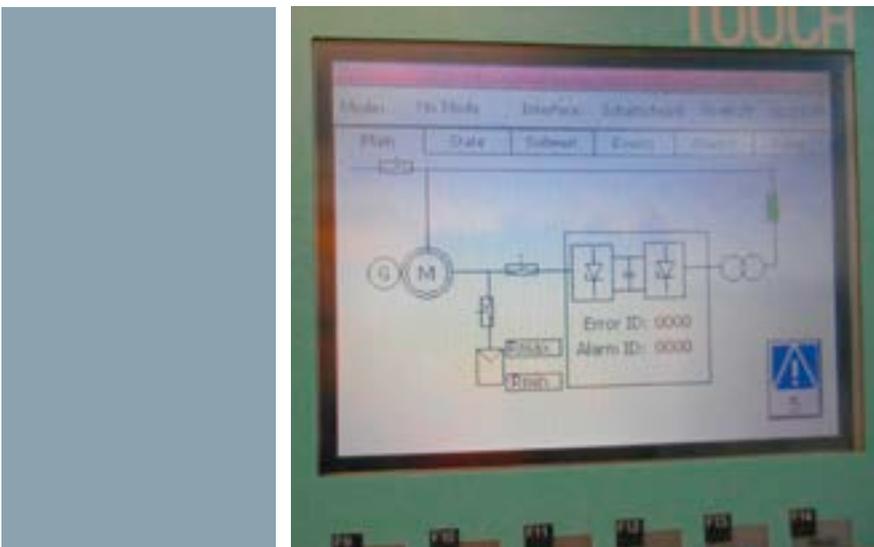


Fig. 1 – Visualization at the operator panel



Fig. 2 – SER with SINAMICS S120 converter

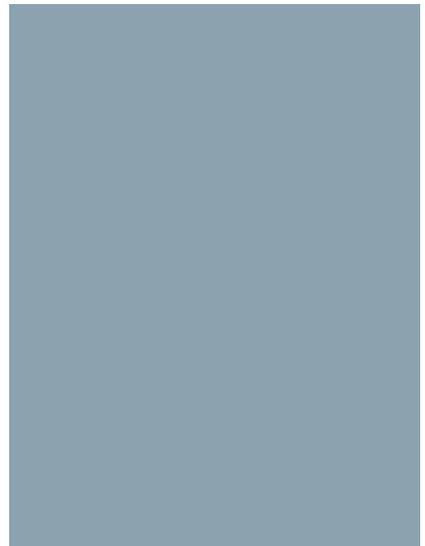
Applications

- SAG mills and ball mills in the mining industry, where an increase of efficiency and productivity is desired while availability is maintained
- Vertical mills
- Conveyors
- Applications with square load curves, where redundant operation is required (e.g., mine ventilation, cooling pumps of power stations, etc.)

Design

SINAMICS S120 with IGBT technology

- Active Front End to line side
 - this means total harmonic distortion on the power line is negligible
 - optional regulation of power factor of the line side
- SINAMICS S120 motor modules to the motor side
- SIMATIC S7 components
- Profibus DP serial interface
- Smooth starting against overload torque with liquid starter
- Rotor circuit of existing motors can be protected against voltage peaks
- Distribution to the line
- Standard IEC
- Approvals cULus, cURus



Operation modes

Operating modes of constant torque drives see, Fig. 4

- Startup with rotor starter
 - moderate starting current in spite of high starting torques
 - safe starts even at weaker power networks
- Operation at motor-rated speed with bypass during inverter service
 - high availability
- Subsynchronous operation
 - energy is fed back from the rotor circuit through the inverter via feedback transformer and back into the power supply
- Hypersynchronous operation
 - energy is fed from the power supply via the feedback transformer and the inverter to the rotor

Optionally, the line side inverter can be used to improve the overall power factor of the drive. For this feature the sizing of the inverter and transformer must be adapted, since additional reactive power must be fed back into or drawn from the power supply for the power factor compensation.

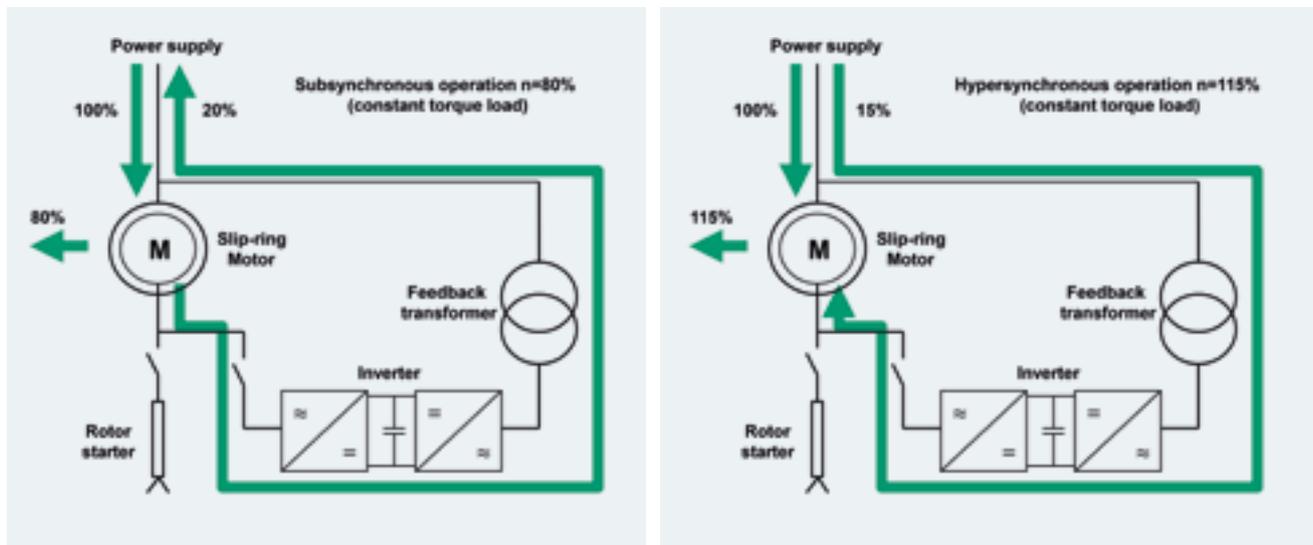


Fig. 4 – Single line diagram (comparison of energy flow with subsynchronous and hypersynchronous operation SER)

Customer benefits

Energy saving

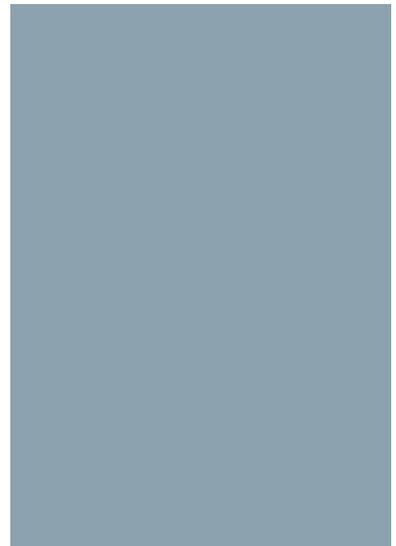
- Feedback of energy during subsynchronous operation
- Optimization of the mill's throughput and thereby energy consumption
- High overall drive efficiency, since converter power is only approximately 20% of motor power
- Excess capacity of the converter can be used to improve the power factor of the system
- Avoiding shutdowns leads to energy saving and lowers downtime cost

After-sales service

- Use of standard off-the-shelf components
 - easy availability of spare parts from distributed spare part stocks around the world with 24-hour spare part service
- Qualified after-sales service locally available
- Business partner for the plant lifecycle

Availability

- Bypass during inverter service allows operation at motor-rated speed
- When a fault in the SER occurs, motor operation changes automatically to rated speed
- Safe start even at weak networks. Robust response to voltage dips
- In case of vibrations: change of speed to calm down the system. No shutdown is necessary



Scope of supply and services that Siemens can offer you:

We analyze, select, and design your new flexible SER, initiate calculations according to your individual requirements, and perform modernization work. We also perform tests, commissioning, and service.

This means that just one partner handles all aspects of your new installation / modernization / revamping project, including:

- Analysis of your specific equipment configuration
- Focus and collaboration on the modernization project
- Configuration and calculation
- Project management and consulting
- Hardware and software engineering
- System and integration test
- Commissioning and service
- Training of operating staff

The result

Your technology is made state-of-the-art by Siemens, ready to deliver top performance for many years to come. You receive proven Siemens equipment, new or adapted individually to your existing system, at very reasonable costs and from a single source, both for spare part deliveries as well as for on-site services.

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Subject to change without prior notice 05/14
Order No.: E20001-A540-T195-X-7600
DISPO 21662
DR.VM.LD.14XXMI.52.13
GB 140327 WS 05140.5
Printed in Germany
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