



## **ELECTRIC DRIVES**

FOR EVERY DEMAND



## **Subsynchronous converter cascade SCC**

Product information





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## Product information

### General information

The undisputed advantages of the three phase induction motor over the synchronous motor quickly led to attempts to use the induction motor for variable speed drives as well.

Next to changing the speed using adjustable armature resistors, cascade circuits with secondary machines (Krämer and Scherbius cascades) were developed and deployed. With the introduction of converter technology, these were replaced by the subsynchronous converter cascade (SCC).

In a "cascade", an uncontrolled rectifier and a controlled converter are connected in series in the rotor circuit of the three phase induction motor to feed back the slip power into the mains.

The SCC can basically be deployed in all branches of industry. The traditional SCC (Fig 1) is suitable where no high dynamics are required and a limited speed range ( $0.5 \dots 0.9 n_s$ ) is sufficient. Examples include drives for centrifugal compressors, blowers and rotary pumps.

As compared with throttle-type flow-rate control, e.g. for water pumps, the use of a subsynchronous converter cascade can yield an energy saving of 50% and more. Converting existing slip-ring motor drives which include rotor resistors for speed adjustment into subsynchronous converter cascades is particularly effective if the motor power margin is not less than 10 per cent.

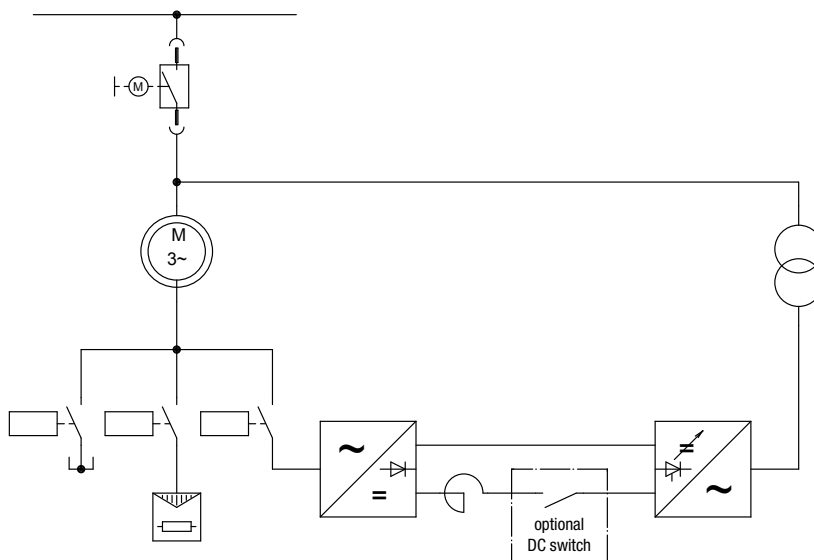


Fig 1: Basic circuit diagram of a traditional SCC, Operation range  $0.5 \dots 0.9 n_s$

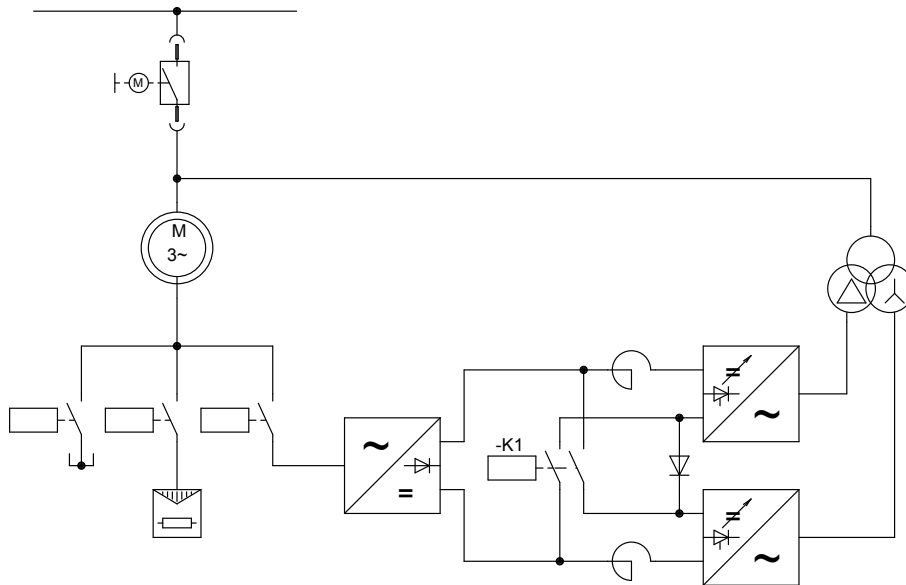


Fig 2: Basic circuit diagram of a VEMoDRIVE SC<sup>2</sup>,  
 Operation range 0...0.9  $n_s$   
 · K1 open: series operation  
 · K1 closed: parallel operation

The traditional SCC has experienced a renaissance in recent years due to the VEMoDRIVE SC<sup>2</sup>, developed by VEM (Fig 2).

### How it works

The SCC is a device for a speed adjustable three phase drive including a slip-ring induction motor, the slip power of which is fed back into the mains via a passive rectifier and a line-commutated converter. This slip power is expressed in rotor voltage and rotor current. The rectified rotor voltage decreases linearly with increasing speed and the rectified rotor current is proportional to the torque.

The direct current or the torque are controlled by adjusting the counter voltage of the converter in the direct current intermedi-

ate circuit. Due to the phase angle control, the adjusting range of the converter voltage lies between zero and the maximum negative rectifying value.

Torque control is superposed by speed control. By setting a limit for the current controller, it is possible to limit the rotor current and therefore the torque to an adjustable value, thus providing an electrical and mechanical overload protection.

VEMoDRIVE SC<sup>2</sup> –  
 Subsynchronous converter  
 cascades for slip-ring motors  
 Application example: SCC  
 for 6.6 kV, 850 kW motor,  
 customer-specific version



## Advantages

A drive system with a traditional SCC or the VEMoDRIVE SC<sup>2</sup> provides the user with the following advantages:

- the rectifier technology is more robust, has a longer lifetime and is more cost efficient than comparable solutions with frequency converters
- smaller volume, lower mass, lower losses
- largely maintenance free
- negligible emission of high frequency interferences
- inexpensive low voltage technology can be used even with high motor powers, because the converter power is always lower than the rated motor power.

The series VEMoDRIVE SC<sup>2</sup> additionally provides the following advantages over the traditional SCC:

- full speed adjustment range because the converters are operated in series or in parallel
- low circuit feedback due to 12-pulse operation
- starting resistors can be omitted

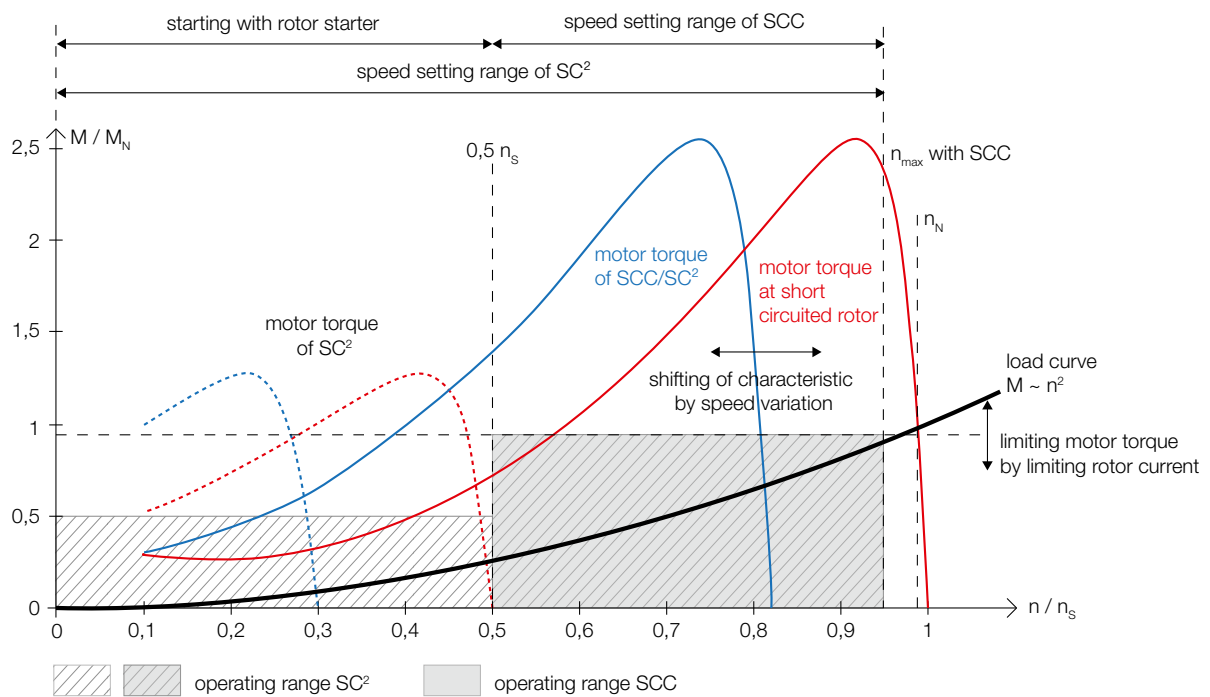


Fig 3: Speed-torque characteristic of subsynchronous converter cascade

### Possible applications

The SCC can be used to control motor speeds in all industries and thereby helps companies save energy. It is suitable where torque is comparatively low at low speeds, and the requirements regarding control dynamics are unexacting.

Examples include the drives of

- centrifugal compressors
- blowers
- rotating pumps

In these cases the power is reduced to 1/8 of the rated value at half speed. This way of controlling a drive can also be used in drives for process technology and materials handling, since here a reduction of the speed to 50% is sufficient in most cases.

Examples include:

- mills
- mixers, kneaders
- briquette presses
- extruders, worm extruders
- conveyor belts

In general, the ratio between the achievable energy savings and the procurement price for the system is economically favourable at a performance range between approx. 500 kW and several megawatts.

As the typical power of the traditional SCC is proportional to the selected speed adjustment ratio, this technology will preferably be used for drives with speeds in the required range that are considerably above half the synchronous speed. The upper limit of the range should not exceed 95 % of the synchronous speed.

If the speed adjustment range lies near half the synchronous speed, it is advisable to use the VEMoDRIVE SC<sup>2</sup> that allows for control over the full speed range.

SC <sup>2</sup>	Traditional SCC
$0.0 n < n < 0.95 n_{nom}$	$0.5 \dots 0.8 n_{nom} < n < 0.95 n_{nom}$

### Our range of products and services

- Thyristor rectifiers for DC motors
  - Power range: 100 kW to 28 000 kW
- IGBT frequency converters for low voltage three phase motors
  - Power range: 2 kW to 5 600 kW
- IGBT frequency converters for medium voltage three phase motors
  - Power range: 250 kW to 27 000 kW
- Starting converters for synchronous motors
  - Power range: to 12 000 kW (higher powers on request)
- Subsynchronous converter cascades
  - Power range: 500 kW to 12 000 kW
- Excitation units for synchronous motors
- Induction motors and synchronous motors
- Transformers
- Automation systems

#### Other Services:

- Servicing
- Commissioning
- Spare parts







## **ELECTRIC DRIVES**

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### **VEM GmbH**

Pirnaer Landstraße 176  
01257 Dresden  
Germany

### **VEM Sales**

Low voltage department  
Fon +49 3943 68-3127  
Fax +49 3943 68-2440  
E-mail: [low-voltage@vem-group.com](mailto:low-voltage@vem-group.com)

High voltage department  
Fon +49 351 208-3237  
Fax +49 351 208-1108  
E-mail: [high-voltage@vem-group.com](mailto:high-voltage@vem-group.com)

Drive systems department  
Fon +49 351 208-1154  
Fax +49 351 208-1185  
E-mail: [drive-systems@vem-group.com](mailto:drive-systems@vem-group.com)

### **VEM Service**

Fon +49 351 208-3237  
Fax +49 351 208-1108  
E-mail: [service@vem-group.com](mailto:service@vem-group.com)

**[www.vem-group.com](http://www.vem-group.com)**

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