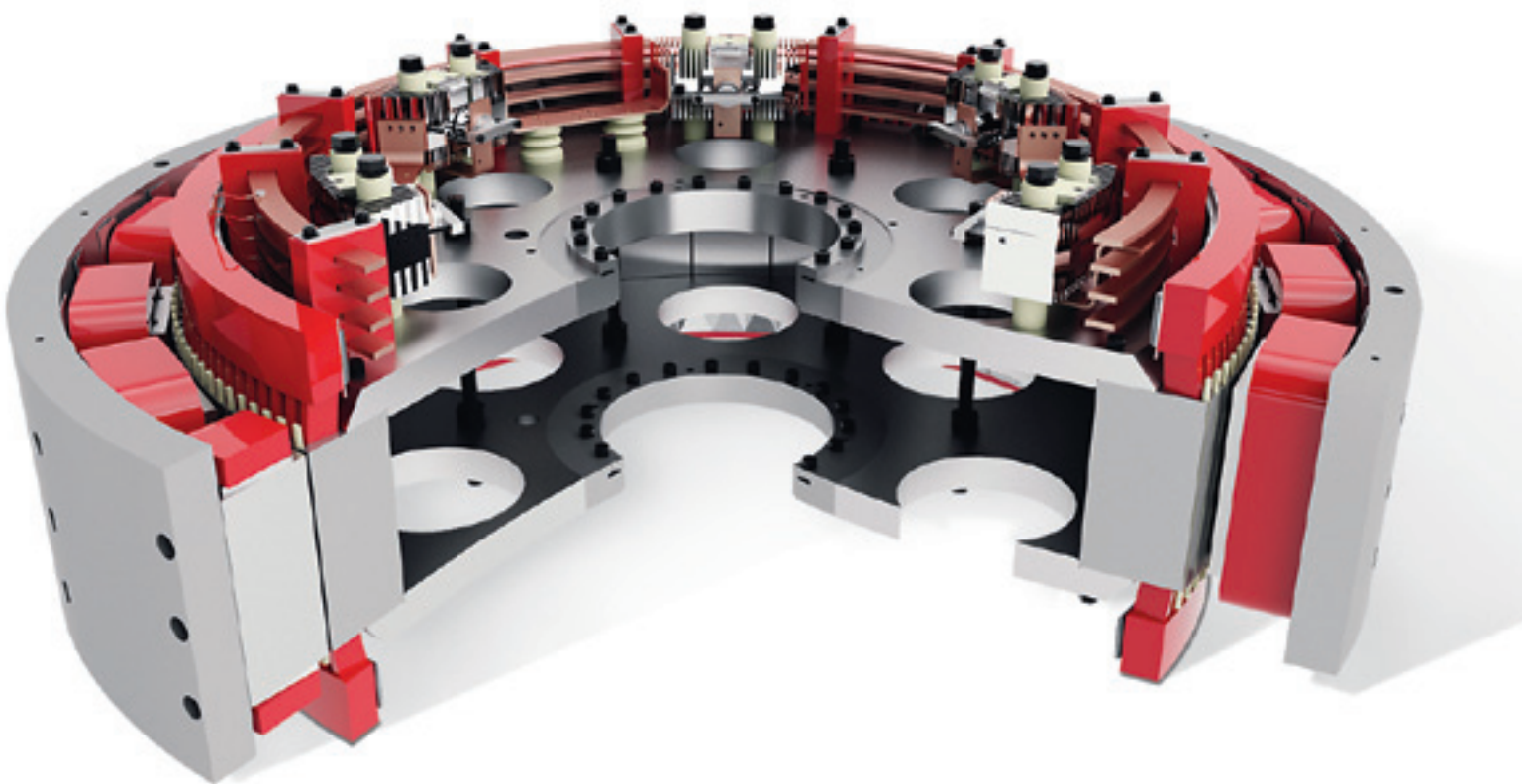


# Maintenance Free Exciter





## Brushless exciter



A picture of the problem that can be avoided:  
with a brushless exciter there is no carbon  
dust and less risk of dangerous and costly  
earth failures during production.

## Minimize maintenance cost. Maximize power production.

The brushless exciter is a simple way to make power production cleaner, safer and more efficient. The Brushless Exciter produces no carbon dust, which means less maintenance and an improved working environment, with less hazardous waste to process. Most importantly, the Brushless Exciter reduces the risk of earth failure.

## Improved productivity, forever.

In some cases brushless exciters cost more to install than static models. In the long term, however, brushless exciters offer considerable savings. The complete absence of carbon dust means lower maintenance costs, increased reliability and less risk of outages. Experience has taught us that brushless exciters significantly reduce costs whilst improving productivity.

### **More reliable, more robust**

The big difference with the brushless design is the use of an external pole generator which ensures power transmission stays inside the rotor. Less wear and tear means fewer parts need to be replaced. The complete absence of carbon dust dramatically reduces the risk of short circuits and earth faults. This combination means the Brushless Exciter is safer, more efficient and more reliable than traditional exciters.

### **Reliable productivity.**

More than 125 conventional brushless exciters have been delivered since the early 1980's. So far they have clocked up over 8.7 million operating hours without any known problems or failures. Replacing static excitation systems or DC rotating exciters with brushless exciters means substantially reduced

maintenance costs with possible savings of approximately 30 000 USD\* per machine, per year.

### **No earth fault. Think about it.**

Installing a brushless exciter is an effective way of reducing the risk of earth faults in the rotor. Roughly one third of all rotor earth faults occur as a result of contamination from carbon dust. By choosing the cleaner, safer, brushless exciter you won't have to worry about carbon dust stopping production.

\* Source: Cigré A1-108 Session 2004.

Conversion of a commutator exciter into a brushless exciter: Benefits, design and achievements.

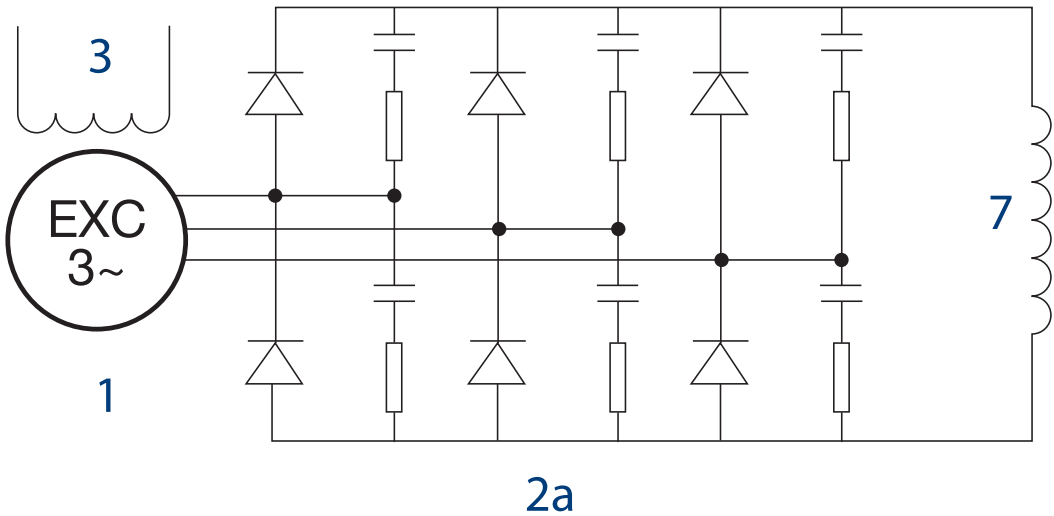




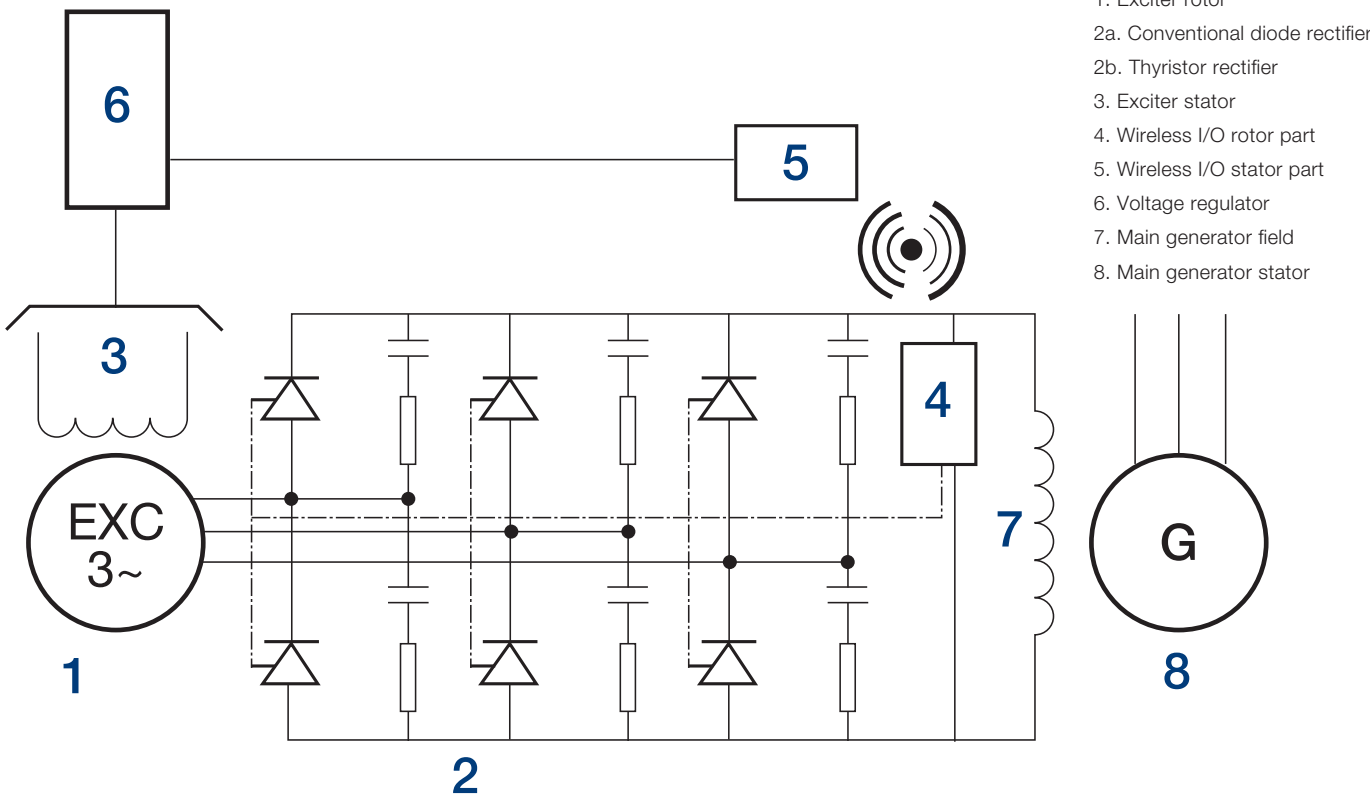
Brushless exciter now  
also available with  
Bluetooth® Technology

# Fastest exciter on the market

Brushless exciters are known to have slow response times during shutdown - a problem that has limited the use of brushless technology. The new VBE-T series of rotating exciters use Bluetooth® technology to provide even faster response times than conventional exciters.



Conventional rotating exciter with diodes



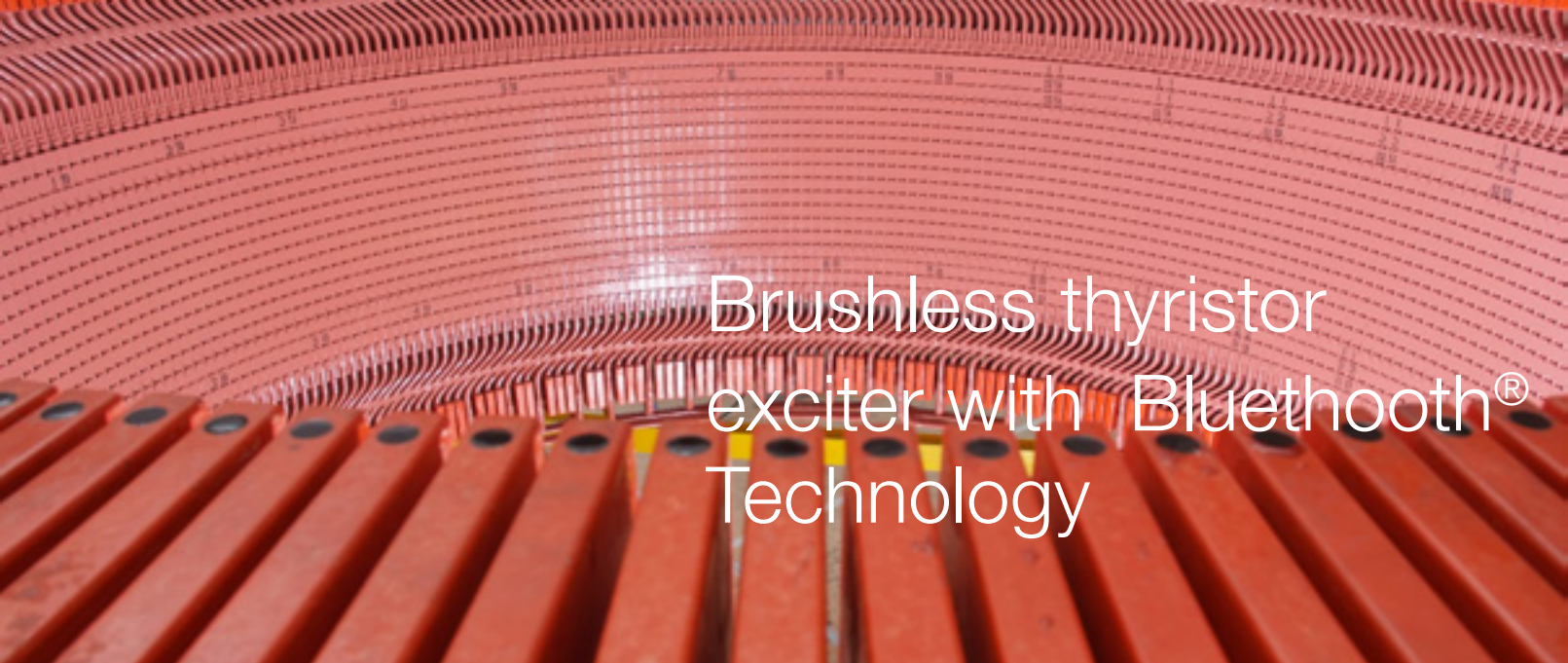
Rotating brushless thyristor exciter

## A new generation of exciters

This new generation of rotating exciters enhances performance by introducing fully controllable thyristors in the exciter rotor. The fully controlled thyristor rectifier replaces the uncontrolled diode rectifier of the conventional brushless exciter. This provides the full functionality of a traditional static exciter system, without the problems associated with slip rings and carbon dust pollutants and it also ensures response time which could be even better than for static excitation systems connected via slip rings.

## Lightning fast “stop and start” via Bluetooth®

The main drawback with brushless exciters has been slow response times. The new Voith Hydro rotating exciter is now equipped with thyristors that react in milliseconds to any voltage fluctuations. All communication is sent instantaneously via Bluetooth® wireless technology, with no need for sensitive cabling or other risk factors. This combination means the new brushless exciter has one of the fastest ‘stop and start’ responses of any exciter on the market.



# Brushless thyristor exciter with Bluetooth® Technology

## Additional benefits with Voith Hydro Bluetooth Technology

Not only fast but also offering value added for your application which is unique for classical brushless excitation systems.

## More powerful solutions

Voith has your solution for a reliable and fast brushless excitation system. Our technology will offer an additional value for your installation: We can provide wireless telemetry data from selected rotor measurements and the data transfer is safe.

### Safe control with Bluetooth®

The rotor electronics and a transceiver installed on the exciter stator communicate with each other via wireless Bluetooth® technology.

The stator transceiver is wired to the voltage regulator that is installed in a cubicle in a common manner.

Bluetooth® technology is robust and reliable. Frequency hopping around the 2.4 GHz band ensures that disturbance to a single channel results in minimal loss of information.

The two transceivers are “paired” to prevent any other Bluetooth® device interfering with operations.

The high carrier frequency ensures immunity against DC and low frequency magnetic flux. Total latency in the wireless link is approximately 10 ms and the range for the radio transceivers is 10 meters.

Rotor embedded supervision sustains excitation in cases where there has been a communication fault. This is done by forcing the thyristors to diode mode and switching the AVR to exciter field control.

### Wireless telemetry

Wireless two-way communication allows for improved diagnostic measurements in the rotor. Data relating to main field voltage and current, temperature, thyristor operation and rotor insulation are transmitted to the stator receiver. Measuring rotor insulation eliminates the need for auxiliary slip rings.

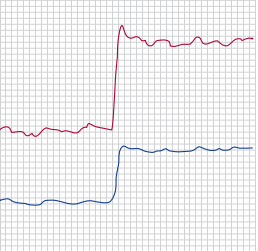
### Measurement features

- Field current via shunt
- Field voltage
- Exciter AC voltage
- Thyristor fault
- Rotor insulation (earth fault)
- Rotor temperature, 6 x Pt100 (optional)

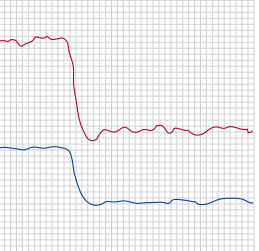
### Thyristor exciter or static system

■ Field current ■ Generator voltage

Up control



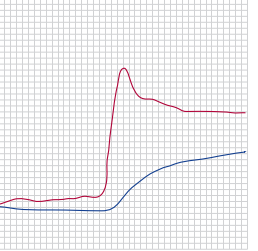
Down control



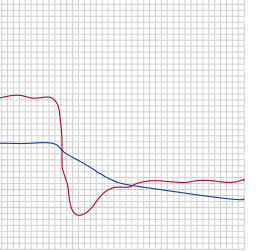
### Diode exciter

■ Field current ■ Generator voltage

Up control



Down control





# The rotating brushless exciter

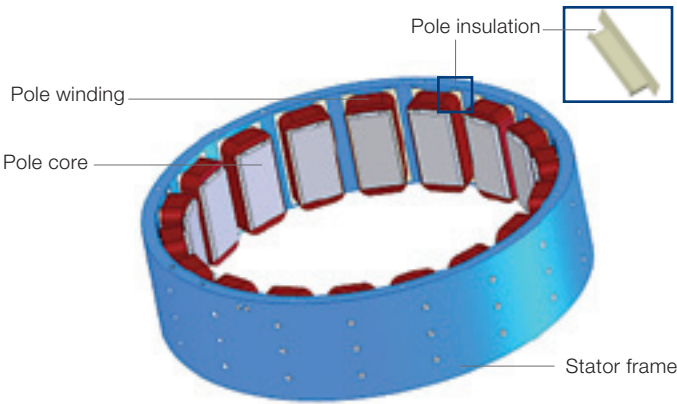
## The Exciter stator

The stator consists of a number of poles retained within the stator frame. The stator frame is composed of a homogenous steel ring with the function to transfer the stator weight, load torque, radial and tangential short-circuit forces.

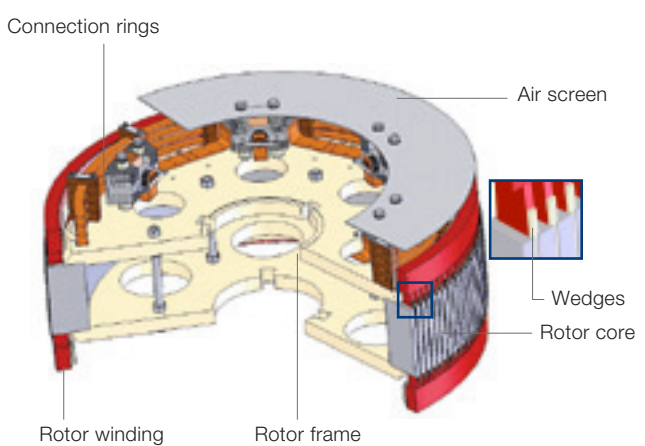
The frame has a number of radial holes for the internally mounted poles that are bolted to the frame. Between the poles there are brackets for the pole interconnections welded to the inside of the frame. The frame is also equipped with connections for the excitation cables.

The pole cores are built with laminated sheets that are pressed and locked under pressure by studs running through the core. Between the core and the winding pole there is insulation made of glass fibre reinforced polyester.

The winding consists of coils, wound from insulated copper wire. The wire is insulated with two types of varnish, the first made of polyester amide and the second polyamideimide-enamel. Together these layers give the wire excellent mechanical, insulating and thermal properties.

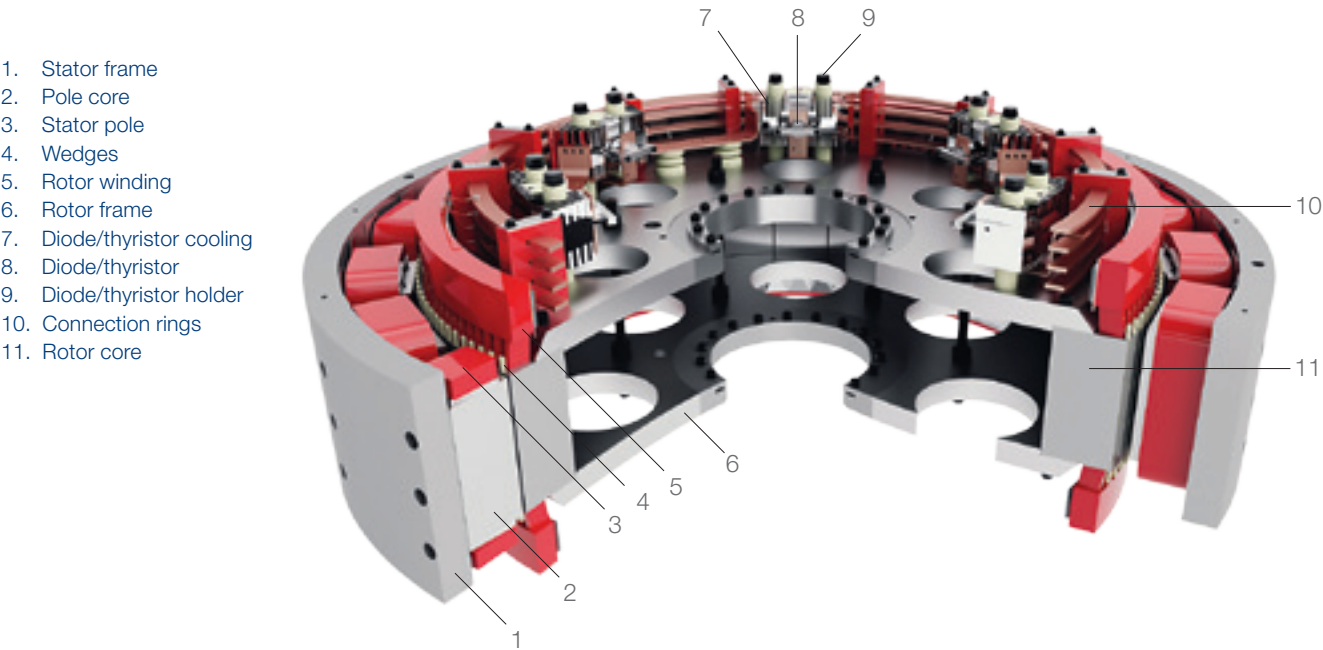


Stator components



Rotor components

## Technical description



## The Exciter rotor

The rotor is equipped with a three-phase AC winding. Its main components are the spider, core and winding. When the magnetic field from the stator passes through the rotor an electric voltage is induced in the rotor winding.

The rotor core is made from stacked electro sheets insulated on both sides with heat resisting varnish, which results in low losses. The sheets are punched in segments and deburred to eliminate the risk of short circuits in the core. The core is dimensioned to meet the centripetal forces from the winding and the ring and handles shape stability when the magnetic forces act between the stator and rotor.

In order to secure a homogenous rotor core, it is stacked continuously with overlap around the circumference. The core is then pressed together between the rotor spider discs by pre-stressed bolts through the core. Furthermore, the air gap surface is coated with penetrating glue.

The rotor spider consists of two massive steel discs that press the rotor core together. The main function of the spider is to support the weight of the rotor core and diode/thyristor bridges and transfer the torque from the shaft. The spider also secures the diode/thyristor bridges, winding support ring and the connection rings. The rotor is secured to the shaft by two clamping rings that transmit torque and centre the exciter rotor.

The rotor core is the rotating part of the magnetic circuit that conducts the magnetic flux between the north and south poles of the stator via the air gap between stator and rotor. The rotor core has semi-enclosed slots in order to secure a good output voltage and minimize forces.

The rotor winding consists of three-phase diamond winding, located close to the air gap surface within the semi-enclosed slots. The multi-turn coils are identical and made up of parallel wound enamelled parts of temperature class F. There are two coil sides per slot and the slot insulation is made of nomex paper.

The rotor winding is manufactured continuously around the circumference. The winding is secured in the slots by wedges. The winding ends are then fixed to the winding support ring on the frame through bandaging with pre-impregnated fiberglass strapping with calculated pre-stressing. After bandaging, the winding terminals are connected to the connection rings and then on to the diode bridges.

If needed, resistance elements for temperature control can be mounted under the slot wedges at six points: three on top and three underneath, which are then divided into two per phase.





1-3 Budarhals, Iceland



#### VBE-T Brushless Thyristor Exciter - Models, speeds and sizes

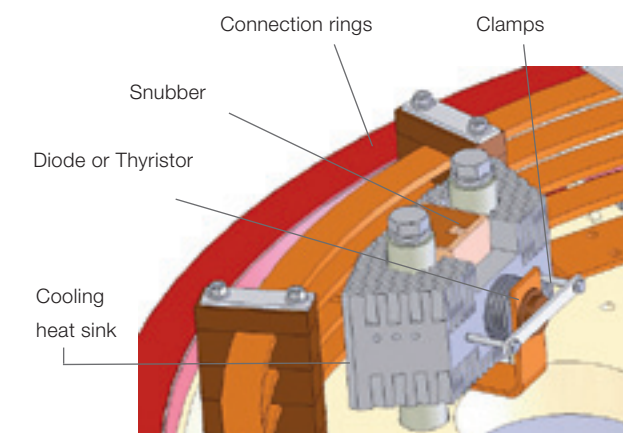
| VBE-T series | Max speed<br>(rpm) | Max cont If<br>(A) | Max cont Uf<br>(V) | Max Shaft Ø<br>(mm) | Max Ø<br>(mm) |
|--------------|--------------------|--------------------|--------------------|---------------------|---------------|
| VBE 830      | 1800               | 1000               | 320                | 300                 | 1160          |
| VBE 1200     | 1300               | 1500               | 450                | 350                 | 1620          |
| VBE 1700     | 1000               | 1700               | 450                | 650                 | 2140          |
| VBE 2200     | 900                | 2500               | 450                | 850                 | 2650          |



#### The conventional rectifier

The AC voltage induced in the rotor winding is rectified through a 2-way, 6-pulse bridge. The exciter rotor winding is then connected to the main rotor field winding.

The rectifier has one diode or thyristor per branch. In order to reduce commutation notches, individual RC circuits are connected in parallel with each rectifying element. The holders have cooling flanges that cool the rectifier. The holder, together with an air screen, act as a fan driving cooling air into the exciter. Diodes or thyristors are placed so that they can easily be checked or exchanged.



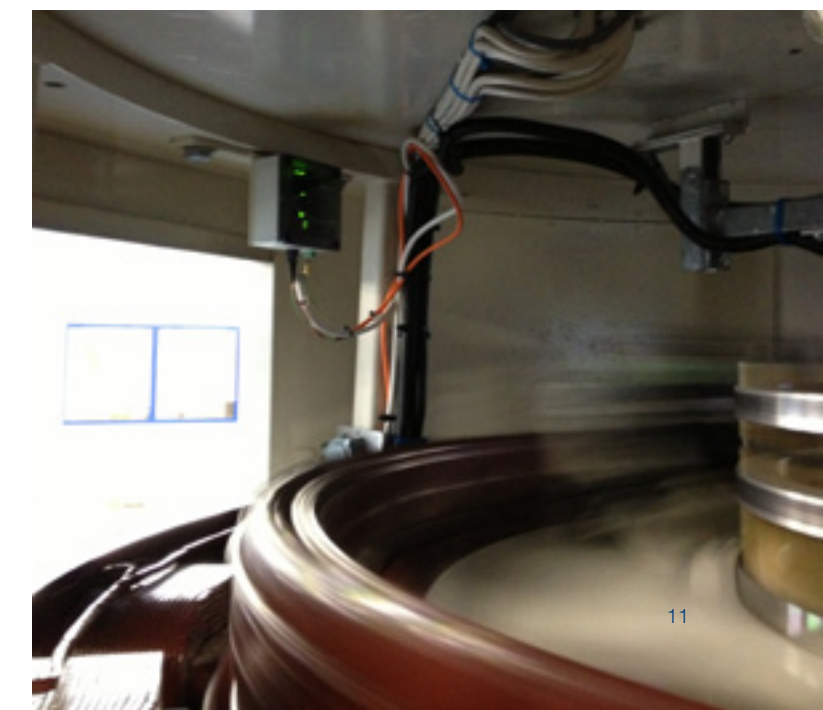
Rectifier components

#### The thyristor rectifier

A fully controlled rotating thyristor rectifier replaces the uncontrolled diode rectifier of the conventional brushless exciter. This ensures that the response time is the same or better as for a static excitation system connected via slip rings.

The additional electronics required for thyristor control is placed inside two robust and protected boxes one located on the rotor and the other inside the exciter stator housing. The box on the exciter stator housing requires only a 24 VDC supply and a profinet connection. The rotor board is easily connected to supply the thyristor gates.

The picture is showing the stator transceiver board in the background and the rotor transceiver board flashing by.



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