Yaw Systems
Motion Control Equipment for Wind

SINAMICS Yaw Solutions
The YAW system of a wind turbine controls the position of the nacelle by turning the nacelle into the most effective angle to the wind direction for optimal power generation.

The nacelle has to be held in a stable position in case of:

- emergency
- maintenance work on the turbine structure
- wind speeds higher than 25 m/s

For higher operational reliability and more efficiency in the drive train!
SINAMICS Yaw Solutions
System requirements

- High availability of all mechanical and electrical components gear, motor and drive unit
- All components have to be robust and climate proven
- Use of proven safety concepts to secure life and investment
- Continuous data logging to allow consequent condition monitoring
- Use of bus Drive (i.e. Profinet / Profisafe)
- Commissioning quick and easy
- Low costs for service and maintenance (Plug&Play); spare parts worldwide available

How can these requirements be fulfilled effectively?
Limits of today’s uncontrolled YAW systems

- No balanced load distribution between YAW motors leads to an inharmonic positioning
- Higher impact load on YAW gearbox shortens life time of mechanical components
- No condition monitoring data available
- From gusty winds activated movements of the nacelle can not be handled properly during operation
Torque YAW drive with different parameter adjusted

Optimized motion control

On- / Off signal with drive system
Standard parameter set up

September 2012
Torque YAW drive with different parameter adjusted

Standard parameter set up
Torque YAW drive with different parameter adjusted

Optimized parameter set up
Sinamics YAW solutions

Switchgear based YAW
- directly linked to the grid
- soft start solution

Drive based YAW
- centralized drive single drive based
- decentralized drive single drive based
- drive unit single- or group- drive based

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Sinamics YAW solutions

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September 2012
# SINAMICS Yaw Solutions

The perfect solutions for every requirement

<table>
<thead>
<tr>
<th>Drive Unit</th>
<th>Motors</th>
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<tbody>
<tr>
<td><strong>Standard</strong></td>
<td>Simotics GP low voltage motors</td>
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<tr>
<td>Sinamics G120</td>
<td>1LE1</td>
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<tr>
<td>central drive unit single</td>
<td></td>
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<tr>
<td>based drive</td>
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<tr>
<td>Sinamics G120D</td>
<td>1LE1</td>
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<tr>
<td>de-central drive unit</td>
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<tr>
<td>single based drive</td>
<td></td>
</tr>
<tr>
<td>Sinamics S120</td>
<td>1FK7</td>
</tr>
<tr>
<td>drive unit with single- or</td>
<td></td>
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<tr>
<td>group based driveX</td>
<td></td>
</tr>
<tr>
<td>Select between Simotics S-1FK7 servo motor or Simotics GP low voltage motor</td>
<td>1LE1</td>
</tr>
</tbody>
</table>
SINAMICS YAW Solutions
Solution for single drive with central drive unit

Benefits

- only standard components used
- high availability
- low wiring complexity
- 4Q drive unit – no brake resistor necessary, because of full energy recovery with PM250
- all YAW drives are able to interact via Profibus or Profinet
- integrated Safety functionality
- comprehensive diagnostic functions – even usable with superior condition monitoring system
- pricewise close to a complete soft starter solution with SIMOCODE diagnoses
SINAMICS YAW solutions
Solution for single drive with decentralized drive unit

Benefits

- no electrical cabinet space necessary
- only standard components used
- high availability because of less used components
- marginal wiring because of a ready-for-use cable
- 4Q drive unit – no brake resistor necessary, because of full energy recovery with Sinamics G120D
- all YAW drives are able to interact via Profibus or Profinet
- integrated Safety functionality
- comprehensive diagnostic functions – even usable with superior condition monitoring system
SINAMICS YAW Solutions
Solution for group drive with decentralized drive unit

Benefits

- only standard drive components used
- high availability
- marginal wiring costs
- 4Q-drive unit / braking energy will be fully recovered / all YAW motors are connected to the same Sinamics S120 power module during run-up of the YAW motor, reduced mechanical load on the YAW unit
- integrated Safety functionality (TM54-F)
- comprehensive diagnostic functions – even usable with superior condition monitoring system
SINAMICS YAW Solutions
Our strength for your benefit

Reduction of Loads and Wear
- Integrated drive functions for load reducing Yaw control methods for yaw gear boxes and motor brakes

Reduction of Parts
- Minimized installation volume through decentralized drive solutions

Reduction of Maintenance and Lifecycle-Costs
- Robust and high efficiency AC-Motors
- All Components out of industrial high quantity production at highest quality standards

Excellent Cost Situation
- Use of high quantity standard products

For higher operational reliability and more efficiency in the drive train!
The decision to use SINAMICS Yaw Solutions implies:

- to get proven industrial control and drive technology
- to get newest innovative products
- to get world wide support
- to get the flexibility of a modular system
- to get best product and supply quality
- to get competitive prices on comparable products
- to be ready for new YAW control concepts

Know-how from Industrial Motion Control for your benefit!
Motion Control Equipment for Wind

- Sinamics G120P
- Sinamics G120C
SINAMICS G120P offers high user-friendliness
- integrated application-specific wizard and macros for easy start-up and commissioning and easy-to-use facilities for diagnostics and maintenance.

SINAMICS G120P offers functions to exploit energy efficiency in the entire process chain
- low apparent power consumption thanks to efficient inverter topology.

Efficient and consistent solutions
- via TIA, consistency from SINAMICS through to the automation level
The cost optimized Sinamics for Pumps, Fans and Compressors

Smallest size
- Compact design (integrated braking chopper)
- Side-by-side mounting without derating
- Fast mechanical installation (i.e. pluggable terminals)

Easy to use
- Simple, optimized commissioning with the SIZER/STARTER
- Effective, adequate parameter set (simple storing and cloning)

Leading edge technology
- Energy-efficient, sensorless vector control - automatic flow reduction with V/F ECO
- Safety (STO) with PROFIsafe
- PROFIBUS, CAN and USS/ Modbus RTU
Yaw-Controlling with Switchgear and Softstarter
Requirements

According to the wind direction the Nacelle has to be turned

- The turning of the nacelle has to be extremely reliable.
- Robust and despite of this cost efficient concepts are needed, which work 20 years for sure.
- Established technologies, which approved the reliability of operation are in demand here.
- Preserve mechanics and permanent monitoring of loads is needed for preventive maintenance.

Are industrial control products (switchgear) suited for such high expectations?
Concept with Basic Components

Fast, easy and safe assembly thanks to spring-loaded connection system, infeed systems, connecting modules and function modules

Minimum coil power and optimized contact transfer resistances

18.5 kW on 45 mm width

If mounting, wiring and testing expenditures have to be reduced

If power loss inside the control cabinet has to be reduced

If space requirements inside the control cabinet have to be reduced
Concept with Basic Components

Topics:
- All operating data available (Current, Voltage, Load, Energy, Earth fault…)
- Compact & well proved standards

High availability Data for preventive maintenance very cost-efficient.
Compact Starter

**Anforderung**
- Platzsparend (In Windkraftanlagen ist es eng)
- Zuverlässigkeit der Anlage.

**Lösung**
Here Compact Starter have their strength.

**Highlights**

**Compact:**
- Up to 15 kW (32 A at 400 V AC)

**Reliably:**
- CPS acc. to IEC 60947-6-2 Control and Protective Switching Device
- Even at a short circuit: No welding of contacts
- Remote-Reset after a temporarily motor-overload possible (e.g. by software)
- Connection with spring-loaded terminals → safe connection even at vibrations and extreme temperature changings

**Easy:**
- Less amount of cabling → simple installation & less sources of error

**Transparent:**
- Many diagnostic-data via IO-Link

A Compact Starter combines functional switching, overload and short-circuit current protection (contactor, circuit breaker, overload relay).

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Concept with Compact Starters

Optional:
- **Soft Starter** → preserve mechanics
- **Load Control** → current, voltage…
- **Limiter** → more short-circuit current prevention

PROFINET

400V ~

ET200S

IO-Link

Compact Starter

Components
Concept with Compact Starters

All Components are redundant!

→ Extreme high operational reliability
## Concept with Compact Starters

### Compact Starter
- Remote or auto reset possible.
- Variants enormous reduced: UL and IEC certified. Wide spread (integrated electronic). Overload: Class 10 or 20 can be set.
- Vibrations are no danger: With our Cage Clamp technology you get a firm connection at all the time.
- At each single motor the following parameters are monitored all the time:
  - Switching status, end of service life, overload, short circuit and more

### IO-Link
- Only one 2-wire-cable per 4-motors-groupe is needed to transfer all above mentioned parameters.
- All data are available at the PLC e.g. controller SIMATIC S7 → Diagnosis & preventive maintenance.
- The second IO-Link makes redundancy sure.

### Soft Starter
- Preserve mechanics and avoiding electric current peaks while starting of motors.
- Additional increasing of compact starters life-time (switching operations).
- The second soft starter makes redundancy sure.

→ **All under control, compact and cost efficient**
→ **Total redundant and therefore extreme high available system**