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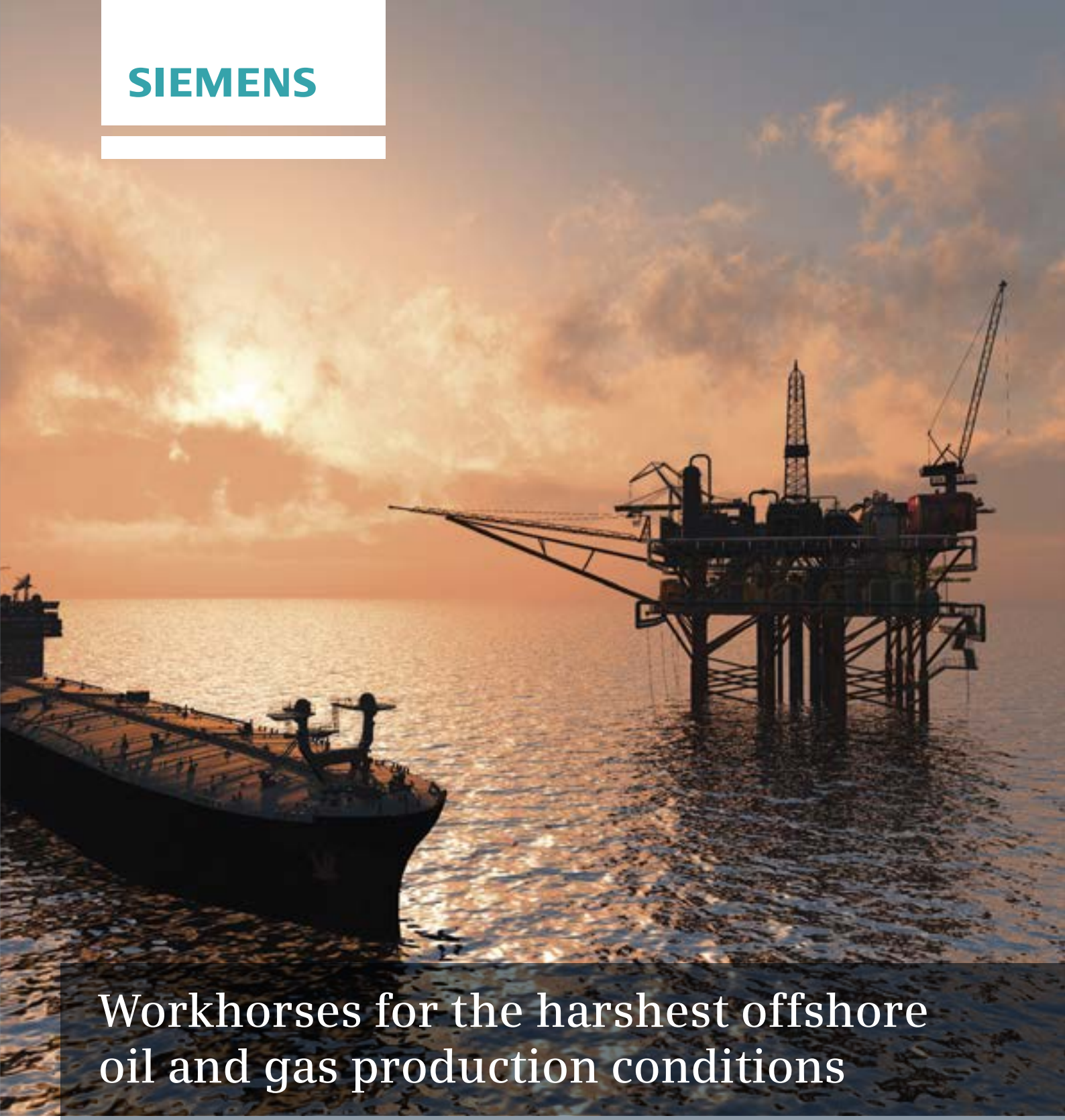


Workhorses for the harshest offshore oil and gas production conditions

SINAMICS PERFECT HARMONY GH180 air-cooled variable frequency drives

siemens.com/drives

Powerful workhorses proven in offshore oil and gas production applications worldwide

SINAMICS PERFECT HARMONY GH180 air-cooled drives

For years, the world's biggest names in offshore oil production have deployed and now rely on SINAMICS PERFECT HARMONY GH180 air-cooled medium-voltage drives across a wide range of pump and compressor applications. These powerful workhorses continually perform, on both fixed and floating platforms, in the most adverse environmental conditions.

The end result has been substantial cost savings in energy, maintenance and other areas that have lowered operating costs. Oil producers utilizing these drives have gained much more precise control that has increased their production efficiencies. Simultaneously, they've been able to count on exceptional reliability through advanced cell bypass.

Here are some examples of the demanding applications in which the SINAMICS PERFECT HARMONY GH180 air-cooled medium-voltage drives can operate:

- Electric Submersible Pumps (ESPs) in downhole oil extraction and subsea boosting system applications
- Centrifugal pumps in subsea compression, boosting system, separation and injection and well stimulation, as well as export pumping and compression applications
- Multi-Phase Pumps (MPPs), both twin screw and helico-axial types, for downhole extraction and subsea boosting system applications

In addition, SINAMICS PERFECT HARMONY GH180 air-cooled medium-voltage drives can efficiently, precisely and reliably operate a myriad of compressors used in offshore oil and gas production:

- Rotary compressors for discharge pressure up to approx. 25 bar
- Reciprocating compressors for wide-ranging pressures and capacities
- Centrifugal compressors with multiple impellers
- Axial compressors and counter-axial rotating models for high-volume applications

Today, our offshore oil production customers have deployed more than 130 SINAMICS PERFECT HARMONY GH180 air-cooled medium-voltage drives operating on their floating platforms off the coasts of Brazil, Australia, and the North Sea.

Perfect drive solutions for offshore oil and gas fixed and floating platforms

Few industrial operating environments are as hostile and unforgiving as offshore oil and gas production. Foul weather. High seas. Relentless, penetrating corrosion. Limited supply lines. Space constraints.

All this is especially true for floating platforms, which are also subject to the nonstop pitch and roll from the surrounding seas. Extreme waves and ocean currents cause significant lateral and vertical forces that on-board machinery must be able to offset. In some cases, they also have extremely long cable lengths between drives and sea-floor motors that have special electrical requirements.

With decades of experience in engineering solutions to these demanding conditions, Siemens is now producing drives specially designed for the floating platforms that have come to predominate offshore oil and gas production.

Our SINAMICS PERFECT HARMONY GH180 drives are engineered and built to counter:

- The ocean's penetrating salt air that's extremely corrosive to electrical components
- The extreme motion conditions that come with operating in deep waters
- The challenges of long cable applications, such as waterdepth and cable length
- The space constraints of platforms, requiring equipment to have the most space-efficient footprint possible

Compact. Energy-efficient. Precise. Durable. Reliable.

SINAMICS PERFECT HARMONY GH180 air-cooled drives

Variable Frequency Drives (VFDs) like the SINAMICS PERFECT HARMONY GH180 air-cooled medium-voltage drives offer a host of advantages over line-fed, fixed-speed motors. Primary among them are:

Energy savings
Because systems seldom need 100 percent power, the variable frequency drive provides only the necessary power to the motor. As demands increase or decrease, the drive can respond with the precise power level needed.
Other energy savings occur at motor start-up. Line-fed motors "slam on" when they start, drawing up to six times their full load amperage. The SINAMICS PERFECT HARMONY GH180 drive employs a "soft start" approach instead. While it gradually increases power to the motor, it delivers full rated torque while the motor accelerates to its required speed. Avoiding the "slam on" effect and inrush of current helps to extend a motor's lifespan.

Element integration and footprint savings
Additional savings accrue from the SINAMICS PERFECT HARMONY GH180's overall design integration that cuts the number of functional elements by more than half. This translates to less maintenance, fewer spare parts, a smaller footprint and greater reliability.

Conventional VFDs have five functional elements – harmonic filtering, power factor correction, insolation transformer, power converter and a motor filter – while the SINAMICS PERFECT HARMONY GH180 drive has just an isolation transformer and a power converter. This provides less components and less cabinet footprint saving valuable floor space on the floating platform.

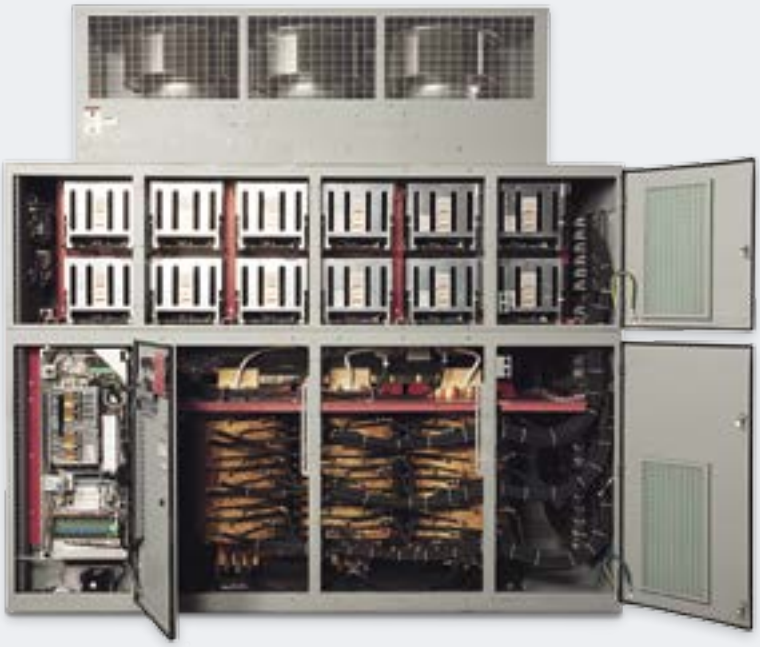
Compliance with industry standards
In fact, the SINAMICS PERFECT HARMONY GH180 meets the most stringent IEEE 519 1992 requirements for current harmonic distortion without filter or harmonic mitigation equipment.

Easy maintenance
When maintenance is needed, we designed the SINAMICS PERFECT HARMONY GH180's sea-hardened cabinets for accessibility, so it can get done much easier and faster.

Designed for reliability
SINAMICS PERFECT HARMONY GH180 air-cooled medium-voltage drives are designed with a 20-year life expectancy. For our floating platform models, we've taken even more additional steps to ensure their dependability and reliability against harsh ocean conditions.

Designed to drive motors even with extra long output cables (over 40km).

This requirement is very common in the Oil & Gas industry for top-side converter installation.



Features and benefits

- Energy efficiency of entire drive is greater than 96.5%, with high efficiencies maintained for motor speeds as low as 25% of maximum RPM
- Sustains 35% undervoltage conditions with reduced torque
- Low torque ripple to minimize mechanical load stress and increase equipment lifespan
- Advanced cell bypass and redundancy help achieve high availability
- Built to offset extremes of pitch, roll, shock and vibration typical of offshore marine environments
- Added hardening to withstand deeply penetrating, highly corrosive sea air includes:
  - Aluminum parts coated or anodized
  - Anodized heat sinks
  - Galvanized parts coated or replaced with stainless steel parts
  - Double vacuum pressure impregnation (VPI) of the transformer
  - Paint finish suitable for marine environment or stainless steel enclosure
  - Coated printed circuit boards
  - Low-smoke, zero-halogen cables
  - Space heaters
  - Small compact footprint conserves space
- Scalable output voltage compensates for long distances between drives and motors, sometimes several kilometers
- Patented transformer technology provides flexible input/output voltages, eliminates need for additional components
- Full internal accessibility offers easy serviceability, with converter, cooling and control subassemblies designed for average repair times of less than 30 minutes
- Designed for easy maintenance
  - Front access
  - Front removable blowers
- Meets or exceeds all applicable standards: IEC 61800-5-1 (safety); IEC 61800-3 (electromagnetic radiation); IEEE 519-1992 (harmonics); IEC 60529 (IP 42 enclosure)
  - Germanischer Lloyd (GL) VI–7–2 (Test requirements for Electrical / Electronic Equipment and Systems)
  - This standard specifically addresses environmental conditions such as tilt, shock, and vibration
- Output sine filter available as an option for cable lengths greater than 2km

Advanced features, specially engineered for the rigorous demands of offshore oil and gas production

While offshore oil and gas platforms, both fixed and floating, have embraced the use of VFDs over line-fed, fixed-speed motors, extreme operating conditions demand VFDs that are specially engineered to meet the rigors of marine environments – like the SINAMICS PERFECT HARMONY GH180 air-cooled drive.

For example, designed to meet motion requirements in line with Germanischer Lloyd (GL) VI–7–2 (Test requirements for Electrical / Electronic Equipment and Systems). This standard specifically addresses environmental conditions such as tilt, shock and vibration. Marine agency certifications such as LR, ABS, DNV and BV are available upon customer request.

The SINAMICS PERFECT HARMONY GH180 is designed to drive motors mounted on the sea floor via electrical cables that can be over 40 kilometers long. Small output sine filters for cable lengths greater than two kilometers are available to mitigate reflected voltage waves that are created by the cable impedance.

Reliability and mechanical endurance are critical requirements for all industrial applications, but none more so than in gas and oil production. Here, downtime is measured in hundreds of thousands of dollars an hour.

The SINAMICS PERFECT HARMONY GH180 can withstand failures that would overwhelm conventional drive systems. Its cell-based architecture provides an advanced bypass feature which activates should a cell fail.

Depending on the process requirement and drive's configuration, a cell fault could have minimal or no impact on the process. As a result, the motor output power quality remains within defined parameters.

In advance of a cell failure, however, we built into the SINAMICS PERFECT HARMONY GH180 what we call the Process Tolerant Protection Strategy (ProToPS). This provides a hierarchical warning system that can warn operators in time to evaluate a drive disturbance and respond appropriately to avoid a system shutdown. Drive trips and process interruptions only occur in extreme circumstances.

SINAMICS PERFECT HARMONY GH180 transformer secured to meet the stringent requirements.

Low-smoke, zero-hallogen cable and double VPI for corrosive environment are included in the transformer.

Protecting your investments in advanced drive technology by keeping SINAMICS PERFECT HARMONY GH180's core topology intact

Siemens' global presence and R&D investments ensure dedicated support and technology advancements for decades to come

Introduced in 1994, the SINAMICS PERFECT HARMONY GH180 drive continues to set the pace in the industry for efficiency, reliability and an ever smaller footprint – all key values for offshore oil and gas producers.

Today's SINAMICS PERFECT HARMONY GH180 incorporates technology advancements driven by experience gathered from our worldwide installed base of more than 2.2 million kilowatts, backed by Siemens enormous R&D investments each year.

Unlike other drive manufacturers, we've made advances to our drives while maintaining the SINAMICS PERFECT HARMONY GH180's core topology to protect our customers' investments and ensure full product life-cycle support. By keeping the same topology, our customers see a reduction in maintenance and spare parts as well as an increase in quality and lower life-cycle costs.

Siemens has a global presence that can provide you with direct sales, engineering and technical support anywhere in the world. The stability of Siemens guarantees a high-level of support and will allow us to earn your trust for decades to come.

Product Line Characteristics	
Input Voltage and Tolerance	2.3 to 13.8 kV, ±10%*
Input Frequency	50 or 60 Hz with ±5% variation
Input Transformer	Dry type Copper windings Forced air-cooling
Drive Rating	224 to 2,050 kW
Output Current Rating	40 to 260 A
Output Voltage Rating	2.3 to 5.3 kV
Output Frequency Rating	0.5 to 330 Hz, ±0.5%**

*Output power de-rating required for –5 to –10% voltage tolerances
**De-rating required for 168 to 330 Hz

Environmental Requirements	
Condition	**Operation**
Stationary sinusoidal vibration • Displacement amplitude • Acceleration amplitude	 1.0 mm (2 to 9.4 Hz) 0.35 g (9.4 to 100 Hz)*
Angular motion, dynamic conditions • Rotation around X/Y/Z axis (period)	 22.5 degrees (10 sec)*

*Values shown are accelerated life test parameters per GL VI 7-2

Standard Drive	
Includes	**Transformer, Cells, Controls and Blowers**
Width	116.5 in – 2,952 mm
Height	222 in – 3,099 mm
Depth	47.5 in – 1,199 mm
Approximate Weight	16,000 lb – 7,257 kg

*Additional features may increase footprint and weight

Marine agency certifications are available from:

- American Bureau of Shipping (ABS)
- Bureau Veritas (BV)
- Det Norske Veritas (DNV)
- Lloyd's Register (LR)

Find out more:

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Experience how Integrated Drive Systems can boost the competitiveness of production plants and entire companies in every sector.

The advantages of Integrated Drive Systems at a glance

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