SAMSUNG HEAVY INDUSTRIES

SAMSUNG WIND POWER SOLUTIONS

Contents

If wind is your challenge, Samsung is the solution.

Wind's time has come. It's clean, free, available around the clock, and closer to grid parity than any other renewable. The hardest challenge now is choosing the right wind turbine for the job.

At Samsung, we believe we are the solution to that challenge. Backed by nearly four decades of insights and know-how in the design and construction of high-tech marine vessels, offshore facilities, industrial infrastructure, and intelligent systems, we've partnered with some of the top names in wind technology to create the first of what will be a family of wind turbines that we believe will set a new benchmark for reliability, performance, and value in the years ahead.

Reliability is what we promise

At Samsung, we aim high. We aspire to be a global leader in every business we enter. Before we put our name on a product, it must measure up to the highest standards of technology, quality, and reliability.

Innovation is what we create

At Samsung, we thrive on innovation. We are constantly exploring and expanding our knowledge and expertise as we leverage our cutting-edge technology and experience in creative new ways to build a sustainable future.

Challenge is what we do

At Samsung, we think big. During our 36 years in the heavy manufacturing field, we have continually taken on major challenges and built world-class businesses that have consistently risen to the top of their industries in record time. Now we're ready to do the same in wind.

Solutions
are what we deliver

Synergy is in the air at Samsung. It's not just a feeling, either.
It's a very real fulfillment of our vision to build world-class
wind turbines worthy of the Samsung name. And your investment.

Dear prospective customer,

It gives me great pride to introduce Samsung 2.5 MW wind turbines, the first in a new family of advanced onshore and offshore wind solutions that we believe will bring new energy to the global marketplace.

While Samsung Heavy Industries is new to the wind industry, we're no stranger to energy. For nearly four decades, we've been delivering innovative solutions to the immense challenges of tapping the oil and gas resources beneath the world's oceans. Our drillships, fixed offshore platforms, and floating production, storage, and offloading units are simply the best in the business. And the vast wealth of mechanical and electrical engineering and manufacturing expertise we've accumulated along the way gives us unique insights and capabilities as we aim to bring new energy to the wind industry.

We designed our 2.5 MW turbines to deliver best-in-class reliability and performance with a 25-year design life–20% longer than the industry standard. In the first quarter of 2010, the Samsung 25s (IEC class IIa) drive-train passed comprehensive dynamometer testing at the US National Wind Technology Center in Colorado with flying colors. In February, we received the GL Statement of Compliance for the B-Design Assessment, and our first turbine erected in Lubbock, Texas in late January entered commercial operation in April.

As I mentioned before, these 2.5 MW wind turbines are just the first models in our growing onshore and offshore solution lineup. To meet the widest possible range of customer needs, we now offer variants for low wind (25x) and cold-climate areas (25sc/25xc). We're also developing several other onshore models as well as 6 MW class offshore models that we plan to bring to market in 2012.

Thank you again for your interest in Samsung wind power solutions. Our goal is to deliver superior value with quality solutions and service that are second to none, empowering you to generate clean, reliable wind power for today and tomorrow. And the trust and satisfaction we generate together will make the world a better, more sustainable place.

I. S. Roh

In-Sik Roh

President & CEO
Samsung Heavy Industries

Introducing the Samsung 2.5 MW wind turbine

Engineered for reliability, optimized
for performance, and built for maintainability,
Samsung 2.5 MW turbines have a future
that's as unlimited as the wind that drives them.

Designed to be the best

Samsung wind turbine components are designed for a 25-year service life—excluding the blades—and matched to provide best-in-class reliability, performance, and maintainability.

Blades

\ Delivers quieter, class-leading aerodynamic performance with pre-bending and low-noise tip designs.

\ Meets the highest IEC standards for lightning protection with multiple receptors.

Pitch system

\ Continuously optimizes the angle of each individual blade to maximize power generation with electric drives.

\ Significantly reduces blade root and shaft fatigue loads over collective pitch control systems.

Yaw system

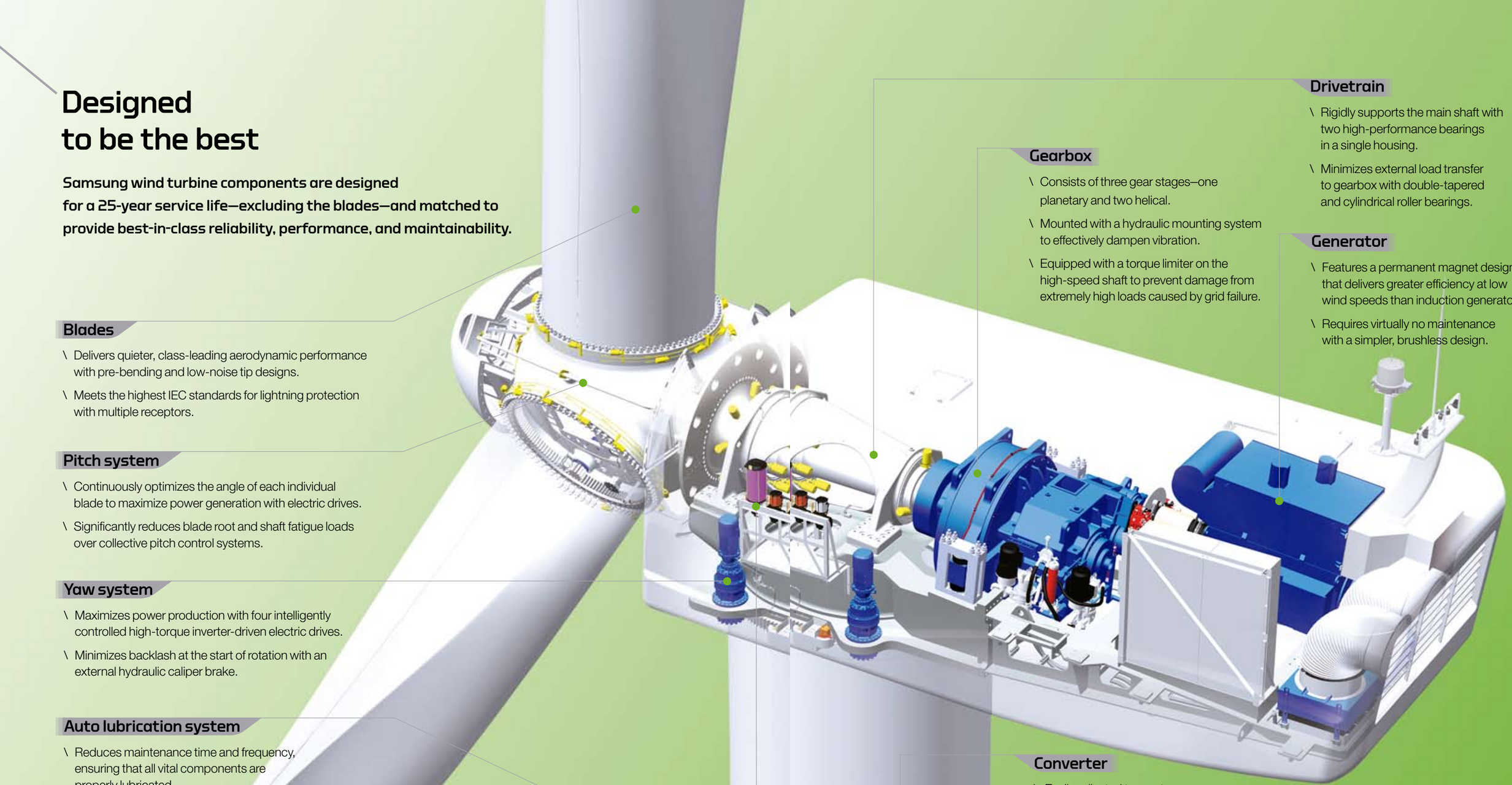
\ Maximizes power production with four intelligently controlled high-torque inverter-driven electric drives.

\ Minimizes backlash at the start of rotation with an external hydraulic caliper brake.

Auto lubrication system

\ Reduces maintenance time and frequency, ensuring that all vital components are properly lubricated.

\ Covers main bearings, pitch and yaw bearings and drives, and generator bearings.



Drivetrain

\ Rigidly supports the main shaft with two high-performance bearings in a single housing.

\ Minimizes external load transfer to gearbox with double-tapered and cylindrical roller bearings.

Gearbox

\ Consists of three gear stages—one planetary and two helical.

\ Mounted with a hydraulic mounting system to effectively dampen vibration.

\ Equipped with a torque limiter on the high-speed shaft to prevent damage from extremely high loads caused by grid failure.

Generator

\ Features a permanent magnet design that delivers greater efficiency at low wind speeds than induction generators.

\ Requires virtually no maintenance with a simpler, brushless design.

Converter

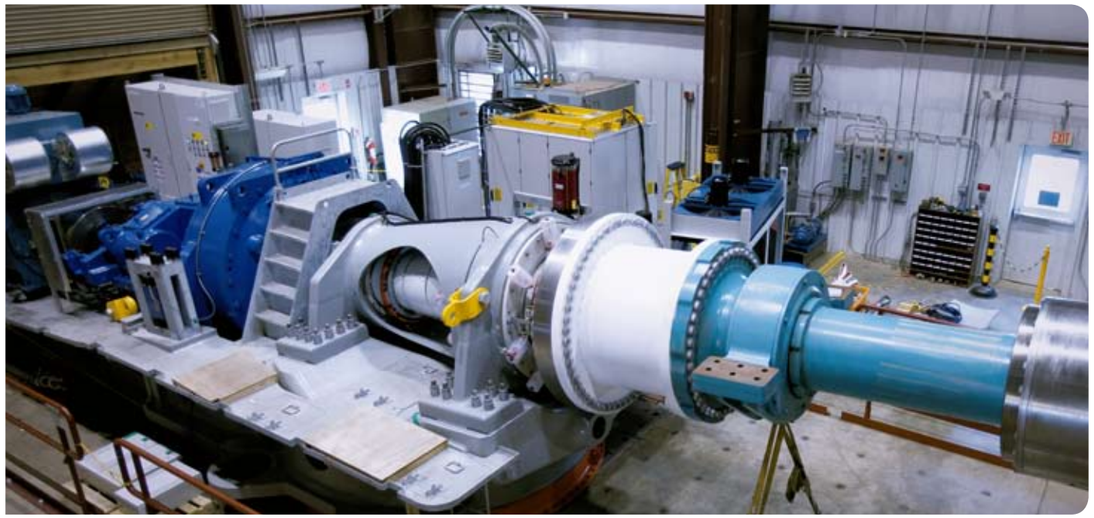
\ Easily adjusted to meet any grid-connection requirement.

\ Uses superior harmonic filtering for lower total voltage harmonic distortion.

\ Features advanced zero-voltage ride-through capability to maintain grid connection during disturbances.

Engineered for reliability

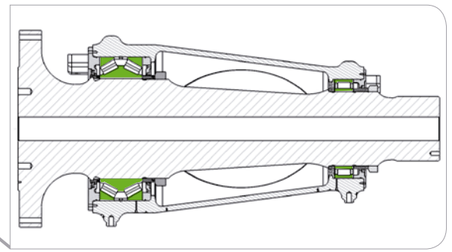
Samsung 2.5 MW wind turbines are designed, analyzed, and GL-validated to set a new standard for reliability and durability with a 25-year design life.



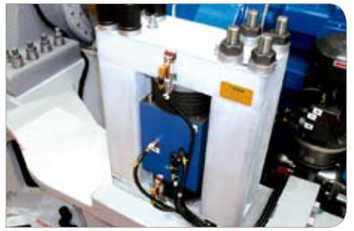
NWTC drivetrain dynamometer test

Drivetrain design

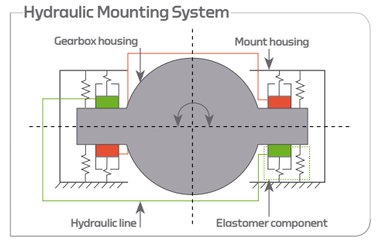
The main shaft is supported by two bearings in a single housing, significantly reducing external load transfer from the rotor to the gearbox. It is connected to a three-stage gearbox featuring an advanced hydraulic mounting system that effectively dampens shock and transient vibration for reliable performance.

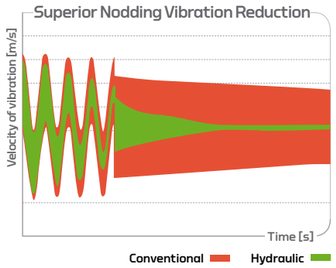


Main bearing housing assembly



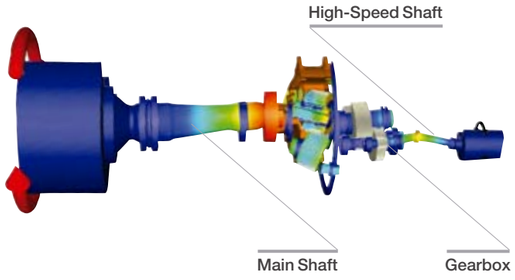
Hydraulic mount





Dynamic analysis

Using advanced analysis tools, we calculated the static and fatigue strength of each drivetrain component. We also simulated the dynamic response of the entire drivetrain for all loading scenarios to verify stability.



Experimental validation

Drivetrain

We put our 2.5 MW wind turbine through comprehensive dynamometer testing at the US National Wind Technology Center in Boulder, Colorado to test power performance and quality, verify safety logic, and validate mechanical functionality and structural stability in various wind conditions.

Gearbox

We validated gearbox design life with HALT testing under GL observation. We also measured gearbox efficiency of well over 97% at rated torque through functional testing on a back-to-back test rig.

GL-witnessed HALT results

Gear bending fatigue life: > 25 years
Gear contact fatigue life: > 25 years

Optimized for performance

Samsung 2.5 MW wind turbines feature an advanced control system that enables consistent output and excellent availability to deliver maximum performance with high-quality power in all operating conditions.

Pitch and torque control

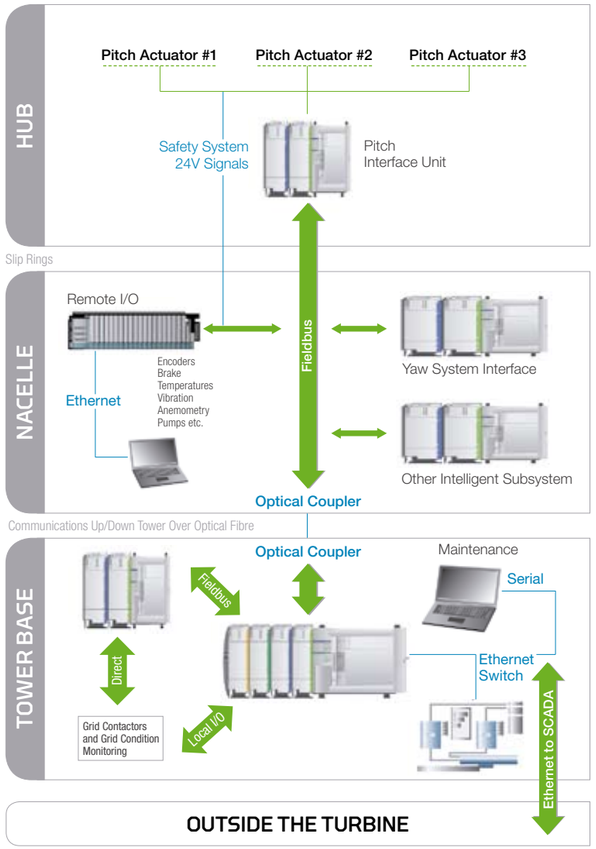
Our advanced control system couples control of blade pitch and generator torque for optimal generating performance in all wind conditions.

\ Below the rated wind speed, it controls generator torque to maintain maximum power.

\ Beyond the rated wind speed, it optimizes loads to maintain the generator at its rated power.

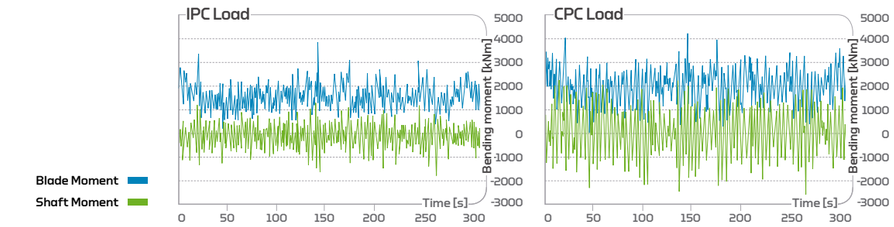
Monitoring and feedback control

Our advanced control system incorporates a number of monitoring and feedback control features to increase availability. These include drivetrain monitoring as well as tower vibration feedback control, which adjusts blade pitch to dampen excessive vibration.



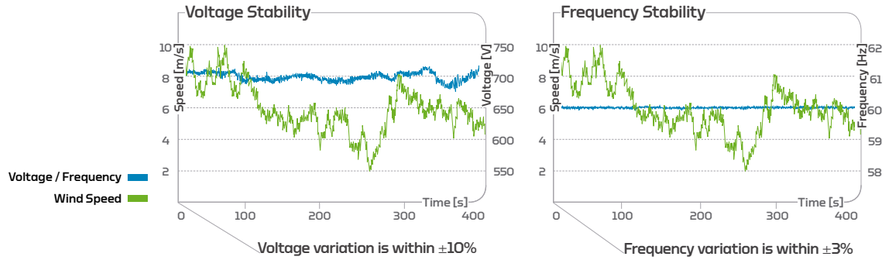
Individual pitch control

Our advanced control system is programmed to handle highly directional or vertical shear wind conditions. Individual pitch control (IPC) significantly reduces fatigue loads compared to collective pitch control (CPC), resulting in enhancing output, availability, and durability.



Power quality

Our 2.5 MW wind turbines have a permanent magnet generator that interfaces with the grid through a high-performance converter, ensuring excellent voltage and frequency stability even at extreme turbulence intensities.



Certifications of electrical specification and PSS®E turbine model

Grid compatibility

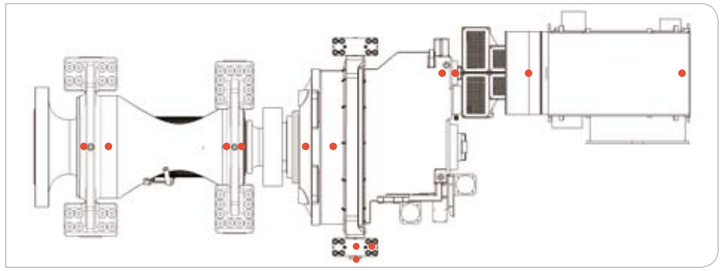
Our 2.5 MW wind turbines are certified for technical compliance with major US industry standards (IEEE, UL), grid codes (ERCOT, NERC, FERC), and safety requirements such as lightning protection, generator protection, fire protection, FAA lighting requirements, UL panel certification, and grounding. The convertor also has superior zero-voltage ride-through capability for even longer fault durations.

Built for maintainability

Backed by quality manufacturing and support, Samsung wind turbines are equipped with a number of time- and cost-saving maintenance features that will enhance profitability.

Condition monitoring system

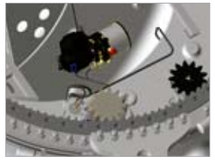
Our advanced system continuously monitors vital drivetrain components in 13 locations, analyzing data with a signal conditioning system driven by the industry's most extensive database. The system alerts the operator of abnormal operating conditions, allowing major issues to be proactively addressed to avoid more costly repairs down the line.



Drivetrain sensor locations

Auto lubrication system (ALS)

This system lubricates all major moving components–the main bearings, pitch bearings and drives, yaw bearing and drive, and generator bearings–at appropriate intervals for enhanced durability as well as significantly reduced maintenance time and frequency.



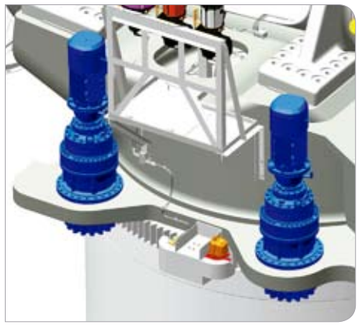
Pitch bearing/drive ALS

Main bearing and yaw bearing/drive ALS

Pitch and yaw drive systems

Electric drive systems reduce maintenance costs by eliminating the need for the regular inspection and maintenance required by hydraulic drive systems. All drives are inverter driven to prevent transient shock to gear teeth for longer life.

Pitch drive system



Yaw drive system

Permanent magnet generator

More efficient than induction generators, the permanent magnet generator never needs contact brush replacement, virtually eliminating maintenance.

Gearbox offline oil filtration system

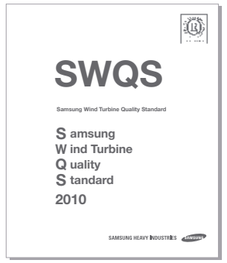
In addition to the inline filtration system, the gearbox has an offline filtration system capable of removing 3 micron and larger particles for superior oil cleanliness and less maintenance.

Manufactured with excellence

Samsung wind turbines are built with a commitment to zero-defect quality in a manufacturing environment that meets the highest international HSE standards.

Quality management

Backed by ISO 9001-certified manufacturing facilities, we have established the Samsung Wind Turbine Quality Standard (SWQS) to ensure customer satisfaction and guide us forward to GL type certification. Our turbines are built with quality-tested components subject to the Samsung Q-mark certification system. All tolerances and alignments of the assemblies are strictly controlled by a real-time digital monitoring system (RTDMS). As in each of our other businesses, we are committed to delivering defect-free products.



- ISO 9001
- SWQS
- Samsung Q-mark

HSE management

Risk management is a key element of our health, safety, and environment policy. We proactively identify hazards, assess risks, and implement necessary control measures. Our HSE management system satisfies all ISO 14001 and OHSAS 18001 requirements.

- ISO 14001
- OHSAS 18001

Committed to satisfaction

Samsung wind turbine solutions are backed by a growing global service and support network that is available around the clock to meet your needs.

Service and support

We are committed to providing 24/7 customer service with real-time remote monitoring and troubleshooting through our division headquarters in Korea and service centers in Houston and a growing number of other global markets. We offer annual on-site diagnostic services for the lifetime of our turbines. Our parts supply chain is prepared to provide service parts anytime, anywhere. We are also setting up training centers in major markets to provide courses to client operating staff and O&M technicians.

Competitive warranty

Backed by a global reputation for excellent quality and customer service, each Samsung wind turbine comes with a warranty exceeding the industry average.

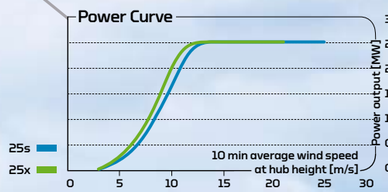
Solutions for onshore

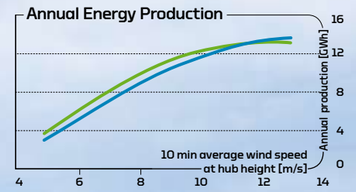
Wind is an abundant source of free power that can be economically tapped in most regions of the world. Our wind turbine family includes models designed for optimal generation performance in all wind conditions and regimes. The 25s covers IEC class Ib to IIb sites, while the 25x covers class IIb to IIIb sites.

Samsung 25s/25x

Technical Specifications

	Model	25s	25x
Rotor	Wind class	IEC class IIa	IEC class IIIa
	Rotor diameter	90 m (295.3 ft)	99.8 m (327.4 ft)
	Cut-in speed	3.5 m/s (6.7 mph)	3.5 m/s (6.7 mph)
	Cut-out speed	25 m/s (55.9 mph)	21 m/s (46.9 mph)
Drivetrain	Main bearing	Two bearings (DTRB + CRB), single housing	
Gearbox	Type	One-stage planetary, two-stage helical gear	
	Support	Hydraulic mount	
	Output shaft	Power lock type, torque limiter	
Generator	Type	Permanent magnet generator	
	Rated speed	1,650 rpm	
	Rated power	2,640 kW	
Converter	Type	Pulse-width modulated	
	Frequency	50/60 Hz	
	Cooling	Water cooled	
Pitch	Pitch bearing	Two-row ball bearings	
	Pitch drive	Electric, individual	
Yaw	Yaw drive	Electric, 4 drives	
	Yaw brake	Electro-mechanical hydraulic, 6 calipers	
Tower	Height	80 m (262.5 ft), custom heights available	
Operating temperature		-10°C to 40°C, Cold Climate Package available	





Performance will vary with site conditions. Calculated at inverter output assuming an air density of 1.225 kg/m³, 10% turbulence, and Rayleigh distribution.

Samsung Heavy Industries

Recognized around the globe, the Samsung name has come to stand for excellence and quality across a wide range of industries. Established in 1974, Samsung Heavy Industries is a global leader in the shipbuilding and offshore facility industries as well as a world-class player in the engineering and construction and digital control fields. Today, we are adding wind power solutions to our growing and diversified business portfolio as we continue our quest to help our customers create a more prosperous, sustainable future.

100%
World-leading
LNG-FPSO
market share

World's largest
semi-submersible
drilling rigs

2009 Facts & Figures

Revenue
USD 11.2 billion

Net income
USD 574 million

Order backlog
USD 26 billion

Employees
29,800

USD figures based on Dec 31, 2009 exchange rate

Shipbuilding Since we delivered our first vessel in 1980, we have booked orders for or delivered over 855 ships to customers around the globe. Today, we are a global leader in high-tech, value-added specialty ships such as arctic shuttle tankers, LNG carriers, ultra-large containerships, and passenger ships.

Offshore Facilities Over the past three decades, we have helped oil and gas majors around the globe bring the vast energy resources beneath the oceans to market. Today, we are a global leader in innovative offshore facilities such as drillships, crude and LNG FPSOs, floating offshore structures, and fixed platforms.

Engineering & Construction Starting out as a residential builder in 1981, we have expanded and grown to become one of Korea's premier general engineering and construction firms. Today, we are committed to building tomorrow's landmarks–projects and facilities that are unparalleled in beauty, usability, technology, quality, and durability–that will stand the test of time.

Wind Power We joined the renewable energy revolution in 2008 when we launched development our 2.5 MW onshore wind turbines. Today, we are in the process of developing a full lineup of onshore and offshore solutions as we set up an integrated global sales, service, and manufacturing network that will power our emergence as a global industry player.

Global sales and service

Our global wind strategy targets major growth markets around the world, beginning with North America in 2010 and progressively expanding to Asia and Europe. Our objective is to put in place an integrated global sales, service, and manufacturing network at the earliest possible date as we aim to deliver the highest level of service, support, and satisfaction in the wind industry.

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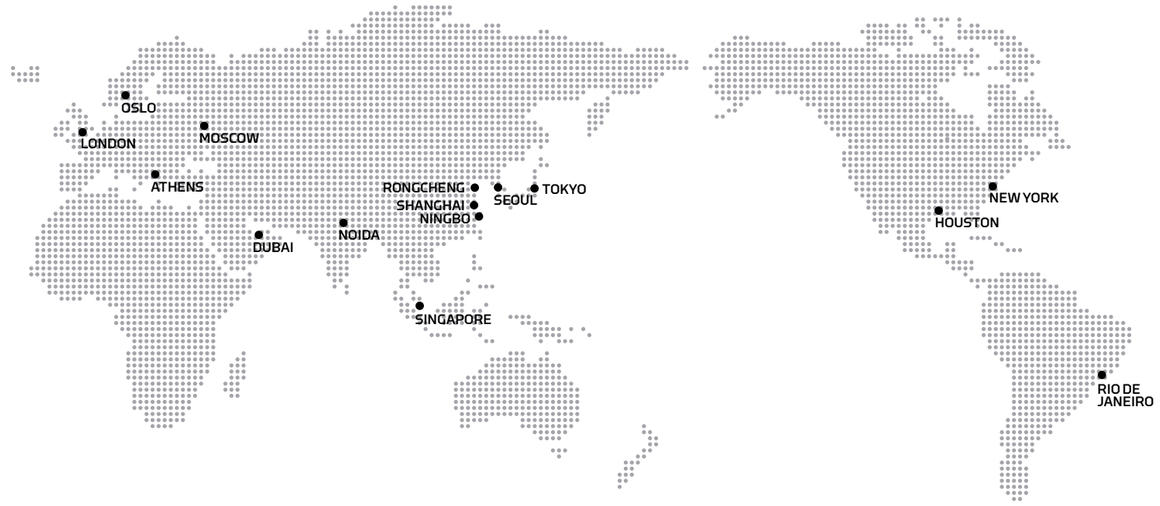
Global network



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Samsung
is the solution.

Thank you again for your interest in
Samsung wind power solutions.

The future of wind is bright. And in the coming years, we aim to make it even brighter by delivering innovative wind turbine solutions that set the standard for reliability, performance, and value. We look forward to the opportunity to share and explore that future with you soon.

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