

## Application Report

# On-Site: Controlled Revolutions

## Knick isolation amplifiers provide flexible solutions for measurement of wind turbines

### ■ Background

In the past few years the development of wind energy production has been characterized by increasingly larger plants up to multi-megawatt size as well as by entering more complex terrains and using offshore sites. Nowadays, the use of wind energy for electricity generation is not only motivated by environmental concern, it is also a business. Large-scale wind farms with increasingly powerful turbines entail higher investment costs. With the growing capital requirements, also the demands on availability and productivity of the wind turbines (WT) are increasing. The German WINDTEST Kaiser-Wilhelm-Koog GmbH has specialized on the inspection and assessment of wind energy projects. Their main tasks include the analysis of energetic, technical, and economical aspects related to a wind power plant.

The location of their headquarters could not have been better chosen: Kaiser-Wilhelm-Koog, a place in the North of Germany situated at the mouth of the Elbe river, has a long tradition of wind energy production. It was the site of the once largest wind energy converter of the world, called "GROWIAN". Compared to modern megawatt plants with nacelle heights of over 100 meters, however, the prestigious giant from the pioneering times of wind energy conversion would now look like a dwarf.



Areas of activity of WINDTEST are measurements, calculations, inspections, and the issuing of survey reports of wind conditions, energy yields, noise impact, or shadow impact.

The company has developed a special software that ensures 24-hour operation in combination with the different data acquisition systems.

The consistent use of fieldbus technology allows capturing more than 100 channels with a sampling rate of at least 25 Hz per channel. The sampling frequency can be increased to the kHz range if required for special inspections.

## ■ Flexibility and Safety

The wind turbine as well as the meteorological mast (met mast) include several sensors, the signals of which must be detected and converted into current and voltage signals. These must be transmitted to the data acquisition system over comparatively long distances. Isolation amplifiers are inserted in all signal lines to reliably suppress the distorting effects of potential differences and to protect against overvoltages. In addition, the unipolar and bipolar signals from the different sensors must be converted into signals suitable for further processing.

As other products turned out to be unreliable, WINDTEST has now been using the VariTrans® P 27000 from Knick for some time. One advantage of this universal isolation amplifier is that up to 480 calibrated input and output ranges can be selected with DIP switches. This selection is digitally controlled. Complicated readjustments are not required. The consequence: High flexibility of application with just one product type. The galvanic isolation of up to 1000 V AC/DC across input and output has proved successful for these measurements. It reliably protects the downstream data acquisition system and the different measurement channels.

Therefore, WINDTEST only requires one type of isolation amplifier for all measurement procedures. Featuring a gain error of less than 0.08 % meas. val. and a temperature coefficient below 0.005 %/K of full scale, the P 27000 ensures a constantly high transmission quality during operation.

Its accuracy exceeds all current demands of industrial measurement. As wind turbines are exposed to wind and weather, the measuring systems must be able to withstand the changing and sometimes extreme environmental conditions. The P 27000 operates in a wide temperature range at very high accuracy even at temperatures much higher than those occurring in control cabinets. Its integrated broad-range power supply allows operation at almost any supply voltage.

WINDTEST itself measures high above: Wind turbines with hub heights of more than 100 m can be precisely measured with mast systems as high as 120 m. The company provides a complete program for measuring the loads on rotor blades, power train, or tower, the noise emission, or the wind speeds.

## ■ Calculating Competence

Since its foundation in 1989 WINDTEST has performed power curve measurements of WTs of the 800 W to 6 MW performance class. In addition to power curve measurement on single wind turbines by use of a met mast, recently the performance evaluation of whole wind farms has become more and more important – especially with regard to the increasing size of wind farms, the complexity of the terrain, and the contractually guaranteed energy yields. The measuring systems of WINDTEST safely detect all events occurring during the operation of a WT and archive them as raw data over time. For this purpose, the automatically generated statistical characteristics of each measurement channel (mean, minimum, maximum, and standard deviation) are calculated and saved. For a daily control of the measurements, this data can be easily transmitted via modem.



*Long signal paths: points of measurement in wind turbine and met mast*

### ■ Cost-Saving Reliability

Against this background, it is imperative that not only the wind turbines themselves operate reliably, but also that the complete sensor system is available around the clock. The demands on accuracy and robustness are extreme. Thanks to an intelligent circuit design, Knick has managed to keep the power loss of the mentioned universal isolation amplifier so low that the reduced development of heat keeps the enclosure cool, which extends the life of the electronics. Thanks to their compact design and 3-port isolation between input, output, and power supply in an only 12.5 mm wide modular housing, up to 80 isolators can be mounted on one meter of DIN rail without ventilation clearances. The longer service life results in reduced maintenance requirement at larger intervals. This is a decisive advantage as the sensors are mounted at large heights, which makes maintenance time-consuming and expensive.

There are two reasons for the high efforts made to ensure exact measurement of the performance data and emissions of wind turbines. Firstly, the limit values for noise, harmonics, or shadow impact must be kept with regard to the licensing authorities and for protecting the amenity of residents. Secondly, by analyzing the data, the plant can be constantly optimized to increase the energy yield. Therefore, the power curve is one of the most important system characteristics of a WT.

Together with the wind resource of the location, it is of considerable interest for the production estimate for planned wind farm projects. In addition, it is an important sales argument and should be measured by an independent institute according to recognized standards.

The VariTrans® P 27000 universal isolation amplifiers from Knick, which are used in the WINDTEST measuring systems, are so flexible that one type is sufficient to implement all measurement procedures properly and interference-free.

Due to their robustness and intelligent circuit design, neither fluctuating mains voltages nor rough winds can put them off.



VariTrans® P 27000  
universal isolation amplifiers



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