# Vibration alarm in the wind power plant!

***Company***
*TWK Elektronik*
*Heinrichstr. 85*
*DE-40041 Duesseldorf*
*Tel.: +49-211-96117-0*
*Fax: +49-211-637705*
*info@twk.de*
*www.twk.de*

*Founded in 1962, the company develops, manufactures, and sells sensor systems for rotary and linear measurement. The sensors are used in different applications ranging from labeling machines and large paper machines to camera control systems and wind turbines.*

***Introduction***

*Wind power plants are complex systems, which have been refined down to the last detail, bearing witness to the fine art of engineering. Equally high demands are made on the individual components, which comprise such a system, and by no means least on the sensor system, which is employed. However, a sensor system is not only required to operate such a wind power plant, there are also a number of sensors, whose task is to protect the system.*

CANopen networks have been in use for a long time in wind power plants as an interface for communication between the control system and some device. It not only enables the measurement data to be transmitted quickly and securely. In addition, CANopen may be used to transmit a range of parameters, which are important as regards safe function, e.g. to the sensors. This enables the customer to easily undertake extensive checks and parameterization in order to set the sensor to the desired requirements, as will be explained in greater detail further on.

One important physical measurement variable, which has to be recorded in order to protect the system, is the vibrations, which occur during operation, primarily in the gondola or just beneath the gondola in the mast. If these vibrations are excessively strong, the entire system is detrimentally affected. Cracking or even fractures may occur in the mast due to the acceleration forces, which arise. Irrespective of why excessive vibrations occur, the system has to be shut down when danger is looming.

Firstly such vibrations may be caused by internal occurrences. If, for example, the transmission or the bearings are damaged, extensive vibrations may occur in the main shaft. These vibrations lie in a frequency range from approximately 10 Hz to 50 Hz. Secondly, external influences may cause the system to oscillate. Amongst other aspects, this includes rotor blade icing. This does not occur evenly and leads to rotor imbalance, which may cause the entire system to vibrate. Or not favorable wind conditions lead to extensive movement on the part of the gondola and thus the mast. In this case, the frequencies typically lie in the 0,1 Hz to 15 Hz range.

These vibrations and oscillations have to be determined as part of a wind power plant's vibration monitoring in order to cause the control system to shut the system down or halt it in the event that relevant limit values are exceeded.

This is where the NVA65 vibration sensor comes into play. This device is specifically designed to meet the needs and requirements of wind power plants, and is equipped with a CANopen interface, which is used to parameterize the sensor. The MEMS acceleration sensor, which is used registers the vibrations in a frequency range from 0,1 Hz to approximately 50 Hz. With a 32-bit controller, this frequency range is subdivided into several bands using high-order digital band-pass filters in order to separate the different causes of the vibrations. Uninteresting interference frequencies are filtered out. The sensor measures on two axes, i.e. the acceleration, which occurs in each direction on the x/y plane is continually registered and output as an analogue signal (4 to 20 mA). Either with x and y separated or as the geometrical sum $s = \sqrt{x^2+y^2}$.

This therefore enables the system's oscillation and vibration status to be ascertained at any time as part of system monitoring. One further interesting characteristic offered by these NVA65 series sensors is their integrated limit value relays. These have the task of switching in the event that certain acceleration limit values are exceeded. This enables the actuation of peripheral devices, which e.g. shut the system off or initiate other measures. In the TWK model, ▷

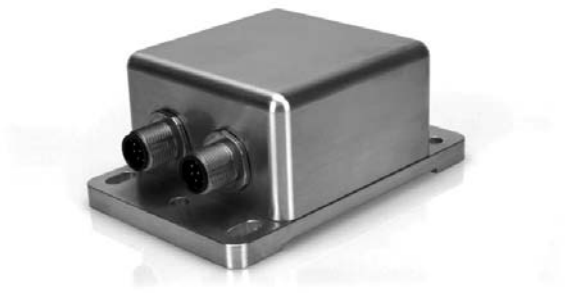

*Figure 1: NVA65 vibration sensor*

the geometrical sum S is used to switch the relays. As S increases, a warning message is initially output via a relay; if it continues to increase, an alarm is then output via a further relay. Separate relays are provided for the various frequency ranges to enable the warning and alarm to be output separately depending on the cause. The customer can parameterize the two limit values for the warning and alarm. This is carried out using the CANopen interface that complies with CiA 301 (application layer) and CiA 410 (inclinometer profile). This profile reveals certain objects, which can be used for parameterization purposes. In this case, this refers to the objects $6000_h$ to $6006_h$. These can be used firstly to define the resolution (object $6000_h$) and secondly, the acceleration limit values at which they are to trigger can be assigned to the limit value relays. This is important to the wind power plant manufacturer, as it enables the sensor to be adapted to the relevant type of plant without having to separately order several different types of sensor from the supplier. For example, object $6001_h$ is used to transmit the triggering value of the warning relay for the low mast vibration frequencies (band from 0,1 to 0,6 Hz) to the vibration sensor. Object $6002_h$ involves the corresponding value for the alarm relay. The subsequent objects are used for the higher mast vibration frequencies (band from 0,6 to 15 Hz).

***Conclusion***

*The described sensor shows that the CANopen interface offers a suitable solution even in the case of a complex measurement. Due to its flexibility and variability, it is not only possible to transmit the measured values to the control system – a number of different parameterization and control options are also available. Following the development of the play-free electronic NOCx64 switching cam encoder for pitch and azimuth regulation, the NVA65 vibration sensor extends and rounds off the manufacturer's range of sensors for the wind power industry.*