



uptime  
magazine

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Brüel & Kjær Vibro



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**Brüel & Kjær Vibro**

Uptime Magazine is a newsletter published by Brüel & Kjær Vibro to keep you up-to-date with new machine monitoring trends and technology.

This issue of Uptime focuses on safety monitoring systems.

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## Today's Safety Systems with Today's Technology

Important decisions had to be made when we were developing our new safety monitoring system VC-6000.

Should it be totally innovative and break all benchmarks, should it be a copy of the de facto systems already on the market, or should it fulfil today's norms but with extended functionality?

No matter what solution we chose, the bottom line for any safety system was that it should provide **maximum protection** with **minimal intrusion** to the customer's plant.

Was a total makeover an option?

Not at all! Safety systems are heavily guided by some very important international standards. It's a fact that these standards are several years old but this doesn't mean today's safety system technology should also be old! Technical improvements can be made in a lot of areas without compromising safety standard compliance:

- **Maximum protection** - This requires optimal fault detection techniques and signal conditioning with a wide range of inputs. There should also be high availability of the monitoring system, fast reaction time, accurate indication on the status of the system and reliable system installation and setup.

- **Minimal intrusion** - This means it should be easy to operate and maintain, and uses the customer's existing communications interface with no network overloading. It should also have minimal cabinet space requirements, and is competitively priced.

The challenge of developing an improved safety monitoring system solution with today's technology was achieved with the VC-6000. The same system is also designed as the building block to our condition monitoring system, which ensures plant machinery uptime, reliability, maintainability and performance, without jeopardizing safety system reliability.

Read about the successful results of this development in this special issue of Uptime about safety monitoring!



**Peter Allpass**  
*Vice President  
of Technology  
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## A Visit to the Brüel & Kjær Vibro Project Group

When visiting the Project office at the Brüel & Kjær Vibro headquarters in Denmark, it looks like any other office area – some people on the telephone, some looking at drawings, others working on their computer. But when you go into the assembly hall, it is a completely different world.

**A**t first glance, it looks more like an assembly line factory. The area is full of cabinets at various stages of completion. Some technicians are installing and wiring the rack-mounted monitoring units while others are using instruments to test the connections. A FAT is being done on a couple of the cabinets at one

end of the hall with five customers intently watching on. What exactly is Project delivery? How important is it to the monitoring system business, and how important is it to the customer?

Project delivery is basically the process of taking Brüel & Kjær Vibro's

standard products such as the VC-6000 safety monitors, sensors and user-interface software and combine them together with a host of third-party accessories. This is then integrated into the customer's solution. After testing and training, the project is then handed over to the Service Department. "Many people have the idea that a monitoring project delivery is no more than a two-step process" says Ole Holm, Project Delivery Manager at Brüel & Kjær Vibro. "Wire the cabinets in the factory and then install them on site." Ole takes a project planner sheet from his desk that lists several hundred individual activities. "This gives an idea on the kind of tasks involved for a single customer". He flips the



faces, signal conditioning, alarm limits and relay voting logic also have to be set up, and many times the entire setup has to be reconfigured and tested again at the last minute by customer request.

The cabinet building is an important part of the Project Group, but there

tem suppliers. There is an entire orchestra of players, where an unexpected delay with one can affect all the others.

As today's projects grow in size and complexity, so do the demands for effective project delivery. Ineffective planning and execution of a project delivery can risk costing the customer millions due to downtime and delayed plant start-ups. In order to be successful, the Project Group requires team leadership and coordination, diligent project planning, and effective oversight of the delivery process. This is crucial in order to ensure the standard and customized monitoring systems are implemented on schedule and on budget.



is in fact a number of other specialized project delivery services that take place both in the factory and on-site. These include documentation, database building (condition monitoring applications), and overall project management.

The overall project management part of a project delivery is often required where turnkey solutions are delivered. This typically involves plant-wide safety and/or condition monitoring systems where there are hundreds of machines monitored. This also includes setting up the LAN network or field bus communication interfaces to a number of remotely located operators, the process control system and even other monitoring systems. Scheduling and planning is not just done with the end-user, but also with contractors, OEM suppliers, distributed control systems (DCS) suppliers and other monitoring sys-

“Brüel & Kjær Vibro Project Group has been implementing monitoring system projects with many of the world's leading oil & gas, petrochemical and power companies for more than 30 years” says Ole. “We know the requirements with respect to project management, documentation, reporting, training and testing. Over the years we have developed the most effective solutions that allow us to coordinate numerous project activities with all the relevant contacts” he adds.

Back in the bustling assembly hall, the five customer's intense gaze quickly gives way to smiles and nods as the last channels are tested. The FAT for project O3MM095 is successfully finished. ■

paper over to show the backside. “This is only for a safety monitoring system project - a condition monitoring application can be several orders of magnitude larger than this”.

The cabinet building in itself is a comprehensive process with many activities. In addition to wiring the monitoring modules, all machine and measurement points in the monitoring system have to be uniquely set up with the customer's own tag names. The communication inter-

Photos in this article: [Kaalund Photography](#)

## VC-6000

# Today's Safety Monitoring System

The preconception that a safety monitoring system is like an electrical fuse – install and forget until it trips – doesn't have much validity today. A modern safety system can and should do much more than this!

**S**afety monitoring systems designed to comply with international standards such as API 670, ISO 7919 and ISO 10816 may all have similar monitoring functionality, but vary widely in terms of reliability, manpower to operate the system, and usability of information provided by the system. This article gives a glimpse on how the Brüel & Kjær Vibro's VIBROCONTROL 6000 Safety Monitoring System (VC-6000) was designed to tackle these issues.

### Remote access

For optimal efficiency, profitability and safety, modern process industries are becoming more and more automated. Enormous quantities of energy, oil & gas, steel, and other products are produced every day under the watchful eyes of just a few operators. Effective management of a machine monitoring system is no exception to this. An increasingly larger number of machines are being monitored in a plant – several hundreds in a typical petrochemical plant.

To deal with this increasing expansion, one of the important requirements for a safety .....

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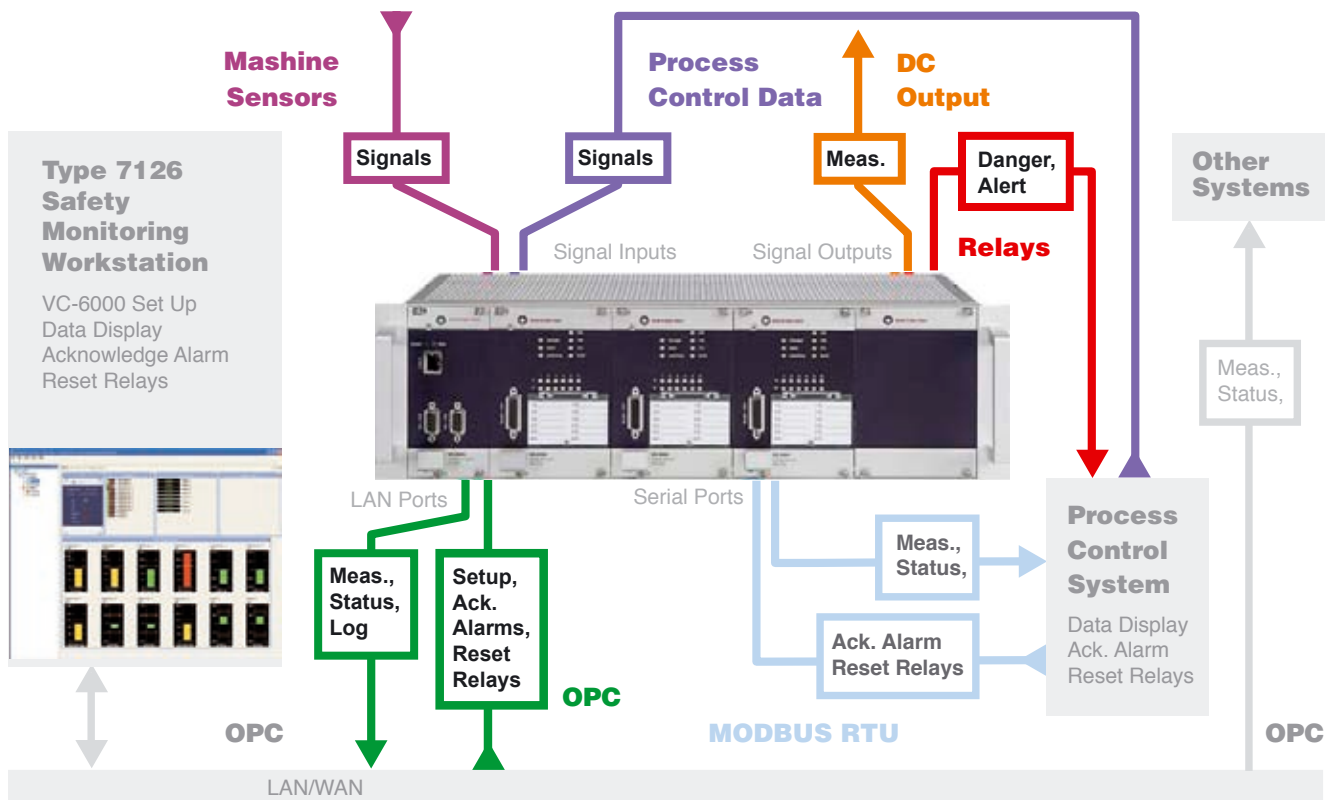


Figure 1 The flexibility of the VC-6000 inputs and outputs combined with the 7126 safety monitoring workstation software provides incomparable versatility.

monitoring system is to provide remote access in the control room for the monitoring alarm status of the machines and the condition of the monitoring system itself. Local LED indication on the individual modules is necessary to comply with the international standard compliance, but real-time display of information is necessary to optimize cost-effective productivity. This includes:

- Vibration and process measurement values
- Monitoring alarm status
- Safety system monitoring configuration (e.g. channel inputs, signal conditioning parameters, alarm limits, relay voting logic)
- Safety system operational status

The VC-6000 uses non-proprietary remote communications for displaying data and alarm status, such as

the OPC interface and MODBUS RTU serial communications. As shown in Figure 1, the **7126 Safety Monitoring Workstation software** allows all of this to be done on a Windows-based PC over a LAN. The same software also allows the operator to remotely reset relays and reconfigure the monitoring system setup, as explained in the article on the 7126 software on page 10.

#### Application-ready modules

One of the tedious tasks of implementing a safety system is the time exhaustive process of configuring the measurement channel inputs. The VC-6000 eliminates this problem by offering a wide range of standard monitoring modules with specific sensor inputs, measurements and outputs for specific monitoring tasks. This simplifies the process of both selecting the safety system compo-

nents and configuring them. The user still has the flexibility to change those parameters that reflect the specific monitoring application using the 7126 software, but little else needs to be done.

**Small foot print, high channel density**

Size means a lot for a monitoring system – the smaller the better! Firstly, the 19” rack mounted housing has a reduced height of 3HE units. Secondly, each monitoring module can have up to 12 input channels, so there can be up to 48 input channels per rack. This allows a medium and small-sized machine to be sufficiently monitored with a single rack. The

monitoring system’s small size in no way compromises its operation – the VC-6000 has also one of the fastest relay reaction times in the industry (10ms in many cases).

**Self Checking**

Last but not least, the importance of reliability can never be underestimated in a safety monitoring system. This is reflected in part by the quality of the components used, system architecture, assembly and testing. The VC-6000 has high MTBF values. In addition to this, the VC-6000 has an extensive self-checking function that continuously checks for sensor connections, power supply, communication and monitoring module faults. A

complete system of local and central OK relays automates the process while at the same time providing instant status display.

These are but a few of some of the important technical design considerations that went into the VC-6000. Talk to your local Sales Representative to get the full story. ■

**RC-600**  
19” Rack



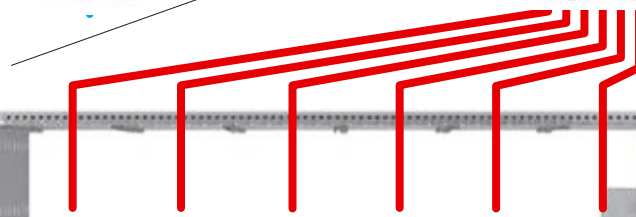
**CI-6XX**  
Communication Interface Module



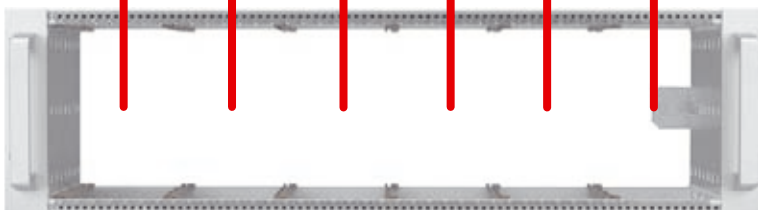
**PS-610**  
Power Supply Modules



**SM-610-XXX**  
Monitoring Modules



**RC-610**  
19” External Power Supply Rack



*Figure 2 The basic hardware components of the VC-6000 system.*

# Comprehensive monitoring in a safety box

Brüel & Kjær Vibro's 3-channel **VC-6000 Compact monitor** combines reliable safety monitoring with early fault detection. This competitive, off-the-shelf monitor is ordered from the factory with firmware already installed in it for a specific monitoring task, so there is minimal configuring to be done by the user, and delivery time is short (often less than a week).

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**E**arly fault detection and safety monitoring couldn't be easier! The Compact monitor has a wide range of application specific configurations, but the signal conditioning parameters can be flexibly changed to meet your needs. The Compact monitor also allows you to view data on a Windows computer over an OPC interface.

### Reliable safety monitoring functionality

Safety monitoring provided by the the Compact monitor includes casing vibration monitoring (ISO-10816), relative shaft vibration monitoring (ISO 7919), axial shaft position monitoring and process parameters. Relay activation is fast, and easily configured, and can be remotely reset. Redundant power supply is also possible for each unit.

### Powerful early fault detection capability

One of the unique features of this unit is the smart values function - a toolbox full of special-purpose measurement techniques for detecting specific types of faults, such as those found in gearboxes, electric motors, turbines, couplings, impeller cavita-

tion, bearing faults, rolling-element bearings, reciprocating compressor rod drop, and in a host of other machines and machine elements.

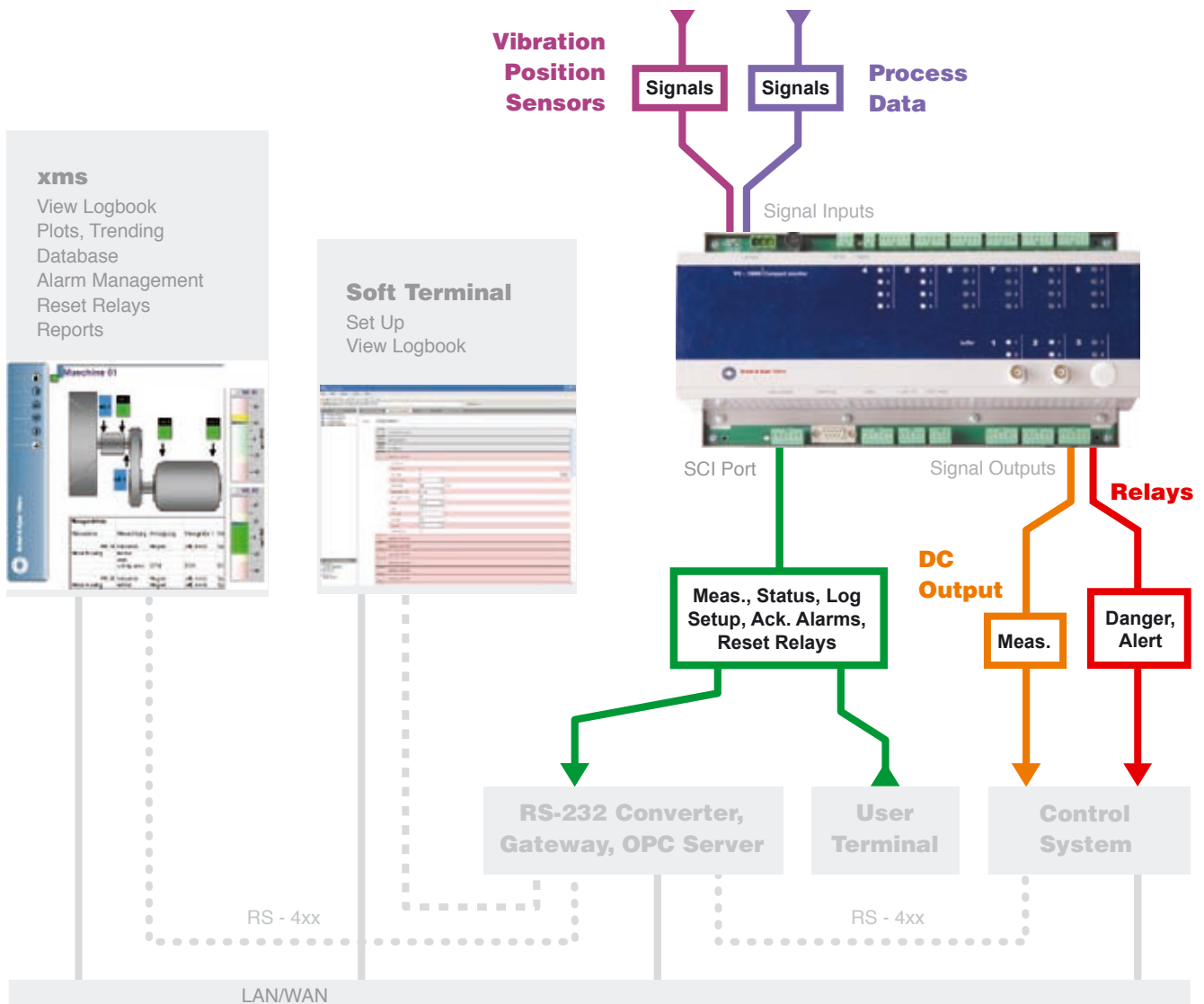
### Fast and easy configuration

The modular box is ordered with firmware already installed in it for a specific monitoring task. This means the major part of the configuration is already done when it is shipped from the factory. The user can use one of the methods shown in Figure 1 to change the default signal conditioning parameters such as signal detection, filtering, alarm limits, etc.

There is certainly a standard or customized solution that can meet your application. Compact monitor features include:

- **Sensor Inputs** - Velocity, accelerometers, displacement sensors, process (voltage, current), reference sensors, binary inputs
- **Measurements** – ISO bandpass, variable bandpass, rolling-element bearing bandpass, harmonics, process values (DC), axial shaft position (DC), BCU for rolling-element bearings
- **Signal conditioning** – RMS, Peak, Peak-peak (mm/s, m/s<sup>2</sup>)





for casing vibration, and Smax, Max(x,y) (mm) for relative shaft vibration

- **Outputs** – Relays (optionally with relay logic), DC outputs (4-20mA)

The Compact monitor has many other features, such as:

- Self-monitoring function for reliability
- Logbook

The Compact monitor is currently being used in a number of successful industrial applications, including a

number of special applications:

- Hydro – Generating units
- Oil & Gas – Reciprocating compressors
- Steel – Rolling mill
- Manufacturing – Manufacturing machines
- Maritime – Diesel engines

Contact your local sales representative to find out how the Compact monitor can best be used in your application. ■

Figure 1 Input/output and communications flexibility of the Compact monitor. Brüel & Kjær Vibro's Soft Terminal software can be used for remotely setting up the Compact monitor. A hand-held user terminal can be connected to the serial interface for the same purpose. The xms software can be used both for data visualisation and setup.

# Versatile User Interface to the VC-6000

The Type 7126 Safety Monitoring Workstation does more than just set up the VIBRO-CONTROL 6000 system (VC-6000). It provides a monitoring overview of all the machines for a number of plants.

The alarm status for all machines and measurement points are displayed live together with the measurement data. The 7126 also allows for alarms to be remotely acknowledged and can even be used for data logging.

The Windows-based 7126 provides complete secure control of your VC-6000 safety monitoring system via an OPC interface over a LAN network or MODBUS connection. The simple yet powerful software package allows you to easily perform a number of different tasks remotely.

### At-a-glance Overview

The “tag browser” on the left side of the window allows you to easily navigate through all VC-6000 modules and measurement points to get an overview of the monitor-

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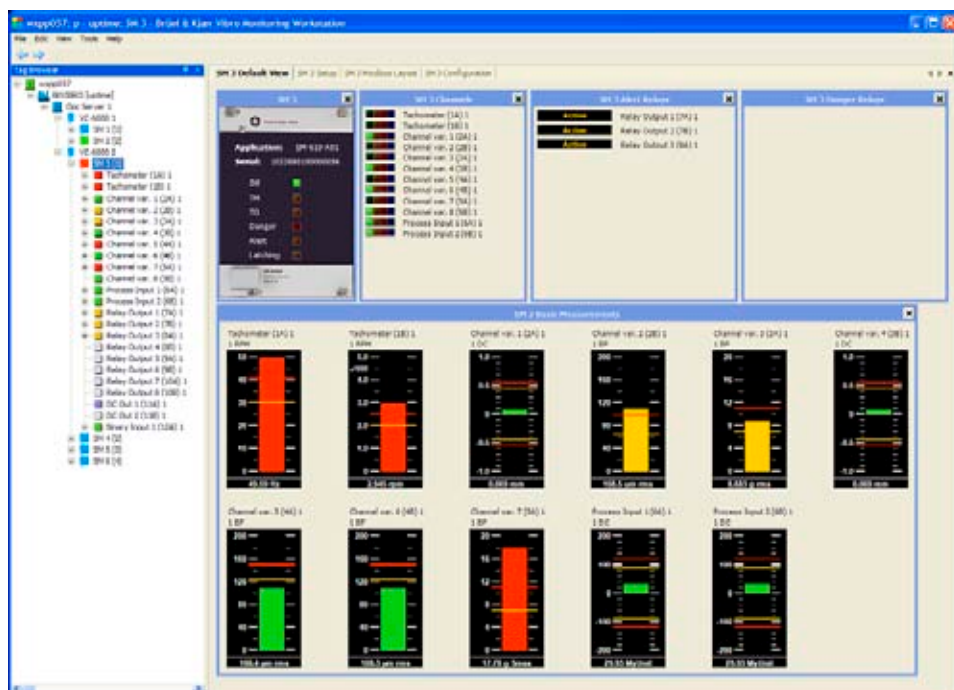


Figure 1 VC-6000 rack configuration (top) and module display (bottom) that shows module measurement values (even the status LEDs are live).

ing system configuration and view data. The colour of the icons in the browser indicates alarm status, disabled tags, etc. Click the measurement icon to see a live display of the value. Right click the tag browser icons to acknowledge alarms. This intuitive operation and display of the 7126 makes it useful as a control room user-interface for viewing data, checking alarm status and resetting relays.

### Setup

All VC-6000 communication and monitoring functions are set up by the 7126. This includes the CI-615 and CI-620 Communications Interface Modules for completely configuring the OPC, LAN, Modbus interfaces, and the SM-610 Monitoring Modules for configuring inputs, measurements, alarm limits and outputs.

### Data Logging

All scalar vibration and process data – both steady-state and transient – can be accessed via the OPC in-

terface and saved to a spreadsheet compatible format (.csv). The data can be used for basic diagnosis and analysis of detected faults as well as for baseline documentation and commissioning of machines. This is a unique feature for the standard VC-6000 system – no add-on condition monitoring system is needed!

The full-function 7126 software is a standard delivery with all VC-6000 safety Monitoring Systems. ■

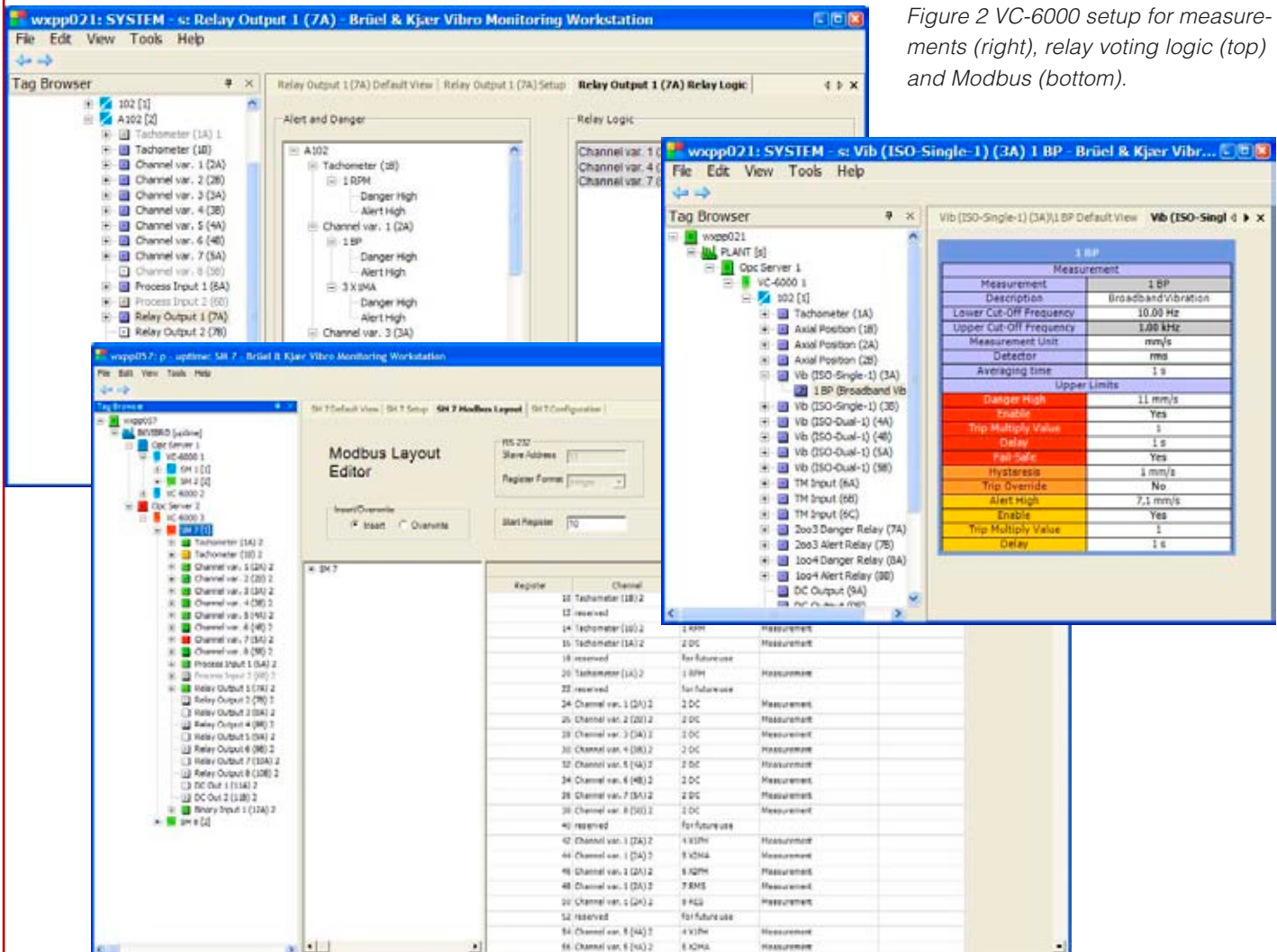


Figure 2 VC-6000 setup for measurements (right), relay voting logic (top) and Modbus (bottom).

# DS Series of Displacement Sensors

Brüel & Kjær Vibro has introduced a new series of inductive (eddy current) displacement sensors that have many advantages over the conventional sensors.

The DS-series of displacement sensors have some technical improvements over conventional sensors that make them particularly useful for special applications.

The probe tip is sealed to IP-68 protection class, which means it can be used in applications with up to 5-bar pressure, according to DIN EN 60529. Water in oil fluid mediums – often the culprit to conventional displacement sensor failure – is no problem for the DS-series sensor. The sensor can also be customised to much higher pressures, on request.

The DS-series includes the following improvements:

- The probe has a ceramic tip that is resistant to chemicals
- A new coil material gives improved temperature stability in the range -30° to 180° C. The new coil material also extends the useable measuring range to 2.2 mm without changing the sensor head dimensions

- The triaxial extension cable has been improved with an outer metal sheathing that gives better mechanical protection
- A modern oscillator housing is provided with a flexible mounting adaptor (DIN rail or hole pattern)

The DS-series sensor head is otherwise comparable to the conventional sensors in dimensions and configurations. It complies with API 670, and ISO 7919 and - besides the VIBRONECS series - is the only displacement sensor in our product portfolio that is ATEX approved for use in hazardous areas.

The high quality of our DS-series sensors is ensured by the fact that:

- Sensor production quality assurance is approved according to ISO 9001 and ATEX Directive 94/9/EG
- Each sensor is subjected to 100% final test for calibration and tensile strength. ■



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**17 - 23 February 2008**

Mexican - Danish Business Forum  
Mexico City, Mexico

32 Danish companies participate in the forum on the occasion of the State Visit to Mexico by HM Queen Margrethe II and HRH the Prince Consort

<http://www.ees.dk/6db0029/GSID/1965025/>

**10 - 11 March 2008**

ASIA 2008

Danang, Vietnam

Second International Symposium on Water Resources and Renewable Energy Development in Asia

<http://www.environmental-expert.com/resultEachEvent.aspx?cid=10605&codi=5420&idproducttype=3&idmainpage=0&level=0>

**21 - 25 April 2008**

Hannover Messe  
Hannover, Germany

World's leading showcase for industrial technology.

You will find us in hall 7, booth D04  
<http://www.hannovermesse.de>

**5 - 8 May 2008**

Offshore Technology Conference (OTC) Houston, USA

World's foremost event for the development of offshore resources in the fields of drilling, exploration, production, and environmental protection.

<http://www.otcnet.org>

**10 - 11 June 2008**

Global Sales Partner meeting  
Darmstadt, Germany

Our sales and service partners from around the world will meet to discuss how we can best serve our customers. There will be sales presentations, product training, strategic planning and workshops

**10 - 12 June 2008**

Global Petroleum Show 2008  
Calgary, Canada

World's largest oil and gas event  
<http://www.petroleumshow.com/globalpetroleum/page.cfm/NewSection=Yes/GoSection=0>

**18 - 19 June 2008**

World Engineering Congress,  
Bangkok, Thailand

This year's theme; "Engineers shape the sustainable future"

<http://www.worldengineeringcongress.com/>

**25 - 27 June 2008**

Wind Power Asia  
Beijing, China

5th Asian International Wind Energy Exhibition and Conference

<http://www.windpowerasia.com>

**9 - 13 September 2008**

HUSUMwind

Husum, Germany

The leading international trade fair for Wind Energy.

You will find us in Booth No. 2 B09

<http://www.husumwind.com>

**15 - 18 September 2008**

RIO OIL AND GAS

Expo and Conference

Rio de Janeiro, Brazil

Attracts important professionals and industry leaders in search for new technologies and management practices in the oil and gas industry

**24 - 26 September 2008**

Power Expo

Zaragossa, Spain

6<sup>th</sup> International Exhibition on Efficient and Sustainable Energy

<http://www.feriazaragoza.com>

**14 - 16 October 2008**

MAINTAIN

Munich, Germany

International fair for machine maintenance and condition monitoring

[www.maintain-europe.com](http://www.maintain-europe.com)

**16 - 19 March 2009**

EWEC 2009

Marseille, France

European Wind Energy Conference & Exhibition

[www.ewec2009.info](http://www.ewec2009.info)

**11 - 15 May 2009**

ACHEMA 2009

Frankfurt am Main, Germany

29<sup>th</sup> International Exhibition-Congress on Chemical Engineering, Environmental Protection and Biotechnology

[www.achema.de](http://www.achema.de)