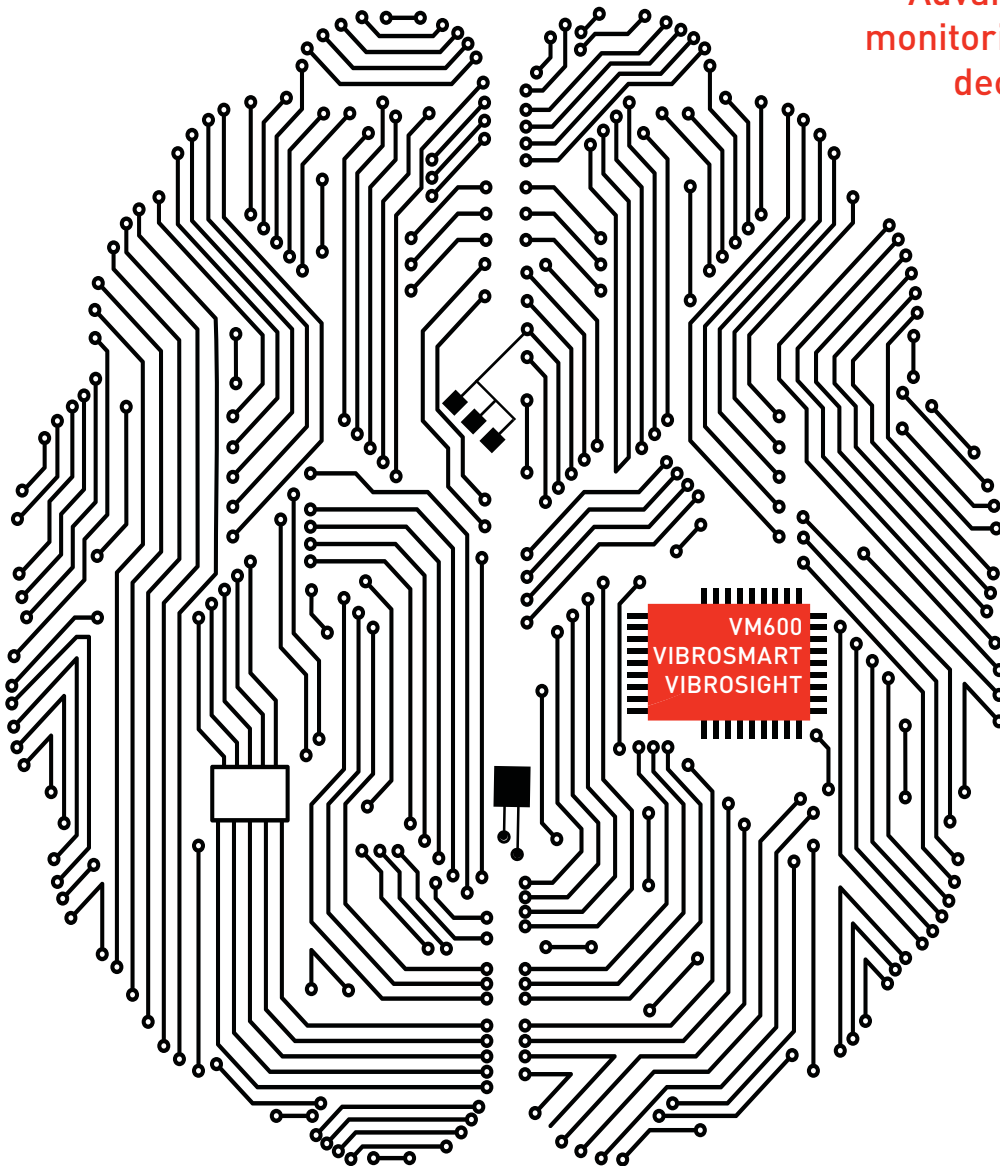


**MEGGITT**  
smart engineering for  
extreme environments

# Knowledge is power

Advanced condition  
monitoring for critical  
decision-making



Distributed, centralized and hybrid solutions • Data from the world's highest performing sensors  
• Visualization and diagnostics on one smart platform • **Economic advantage, guaranteed**

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## Available€ = viable€

It's a simple equation. Optimized power plant health based on an advanced condition-monitoring strategy equals significant economic advantage.

- Improve reliability and avoid unplanned outages
- Diagnose problems and determine appropriate action rapidly
- Maintain on condition, not on schedule alone
- Forecast potential equipment failures and develop realistic risk management strategies
- Optimize shutdowns by planning and scheduling specific maintenance activity
- Minimize spare parts inventory and maintenance costs
- Extend component life by optimizing operating conditions
- Help reduce fuel consumption, CO<sub>2</sub> and NO<sub>x</sub> emissions to meet regulatory requirements
- Link intelligent data to control
- Monitor hazardous areas remotely

## Breaking down can break your business

When the margin of profit within a power supply contract can range from less than a single dollar to thousands of dollars per megawatt hour, plant managers need superior data on which to make critical decisions about the timing and optimization of maintenance downtime.

That's why financiers as well as engineers turn to Meggitt's advanced condition monitoring tools for diagnosis, prognosis and machinery protection.

### Hard data for hard decisions

Whether you provide base load power where the critical success factor is *reliability* or peak-demand generation where it is *availability* that really counts, breaking down can break your business.

Reconciling the commercial requirements of owners with legal and environmental requirements, safety factors and the long-term health of the plant requires a detailed risk management strategy.

Optimal decision-making depends on the correct inputs—availability of spares and personnel, emissions limitations, financial data and, of course, very precise and wide-ranging information on plant condition.

### Knowledge really is power

Meggitt's centralized (VM600) and distributed (VibroSmart) condition monitoring systems provide detailed insight into the health of your critical assets and the diagnostics that enable you to plan the right intervention for incipient problems.

What's more, our systems enable smart managers to engage in sophisticated prognostic thinking. They ensure the unexpected will not stop you from running turbines and auxiliary equipment safely and scheduling outages to minimize the impact on the economics of your operation.

Machinery protection comes as standard. All Meggitt systems alert operators when measurements exceed established limits and can shut down key equipment to prevent catastrophic failure.

### Systems for every plant architecture

With one common data visualization, event management and diagnostic platform, plant operators can choose the system or combination of systems that suit their plant architecture. All our products can be integrated seamlessly within existing control systems.

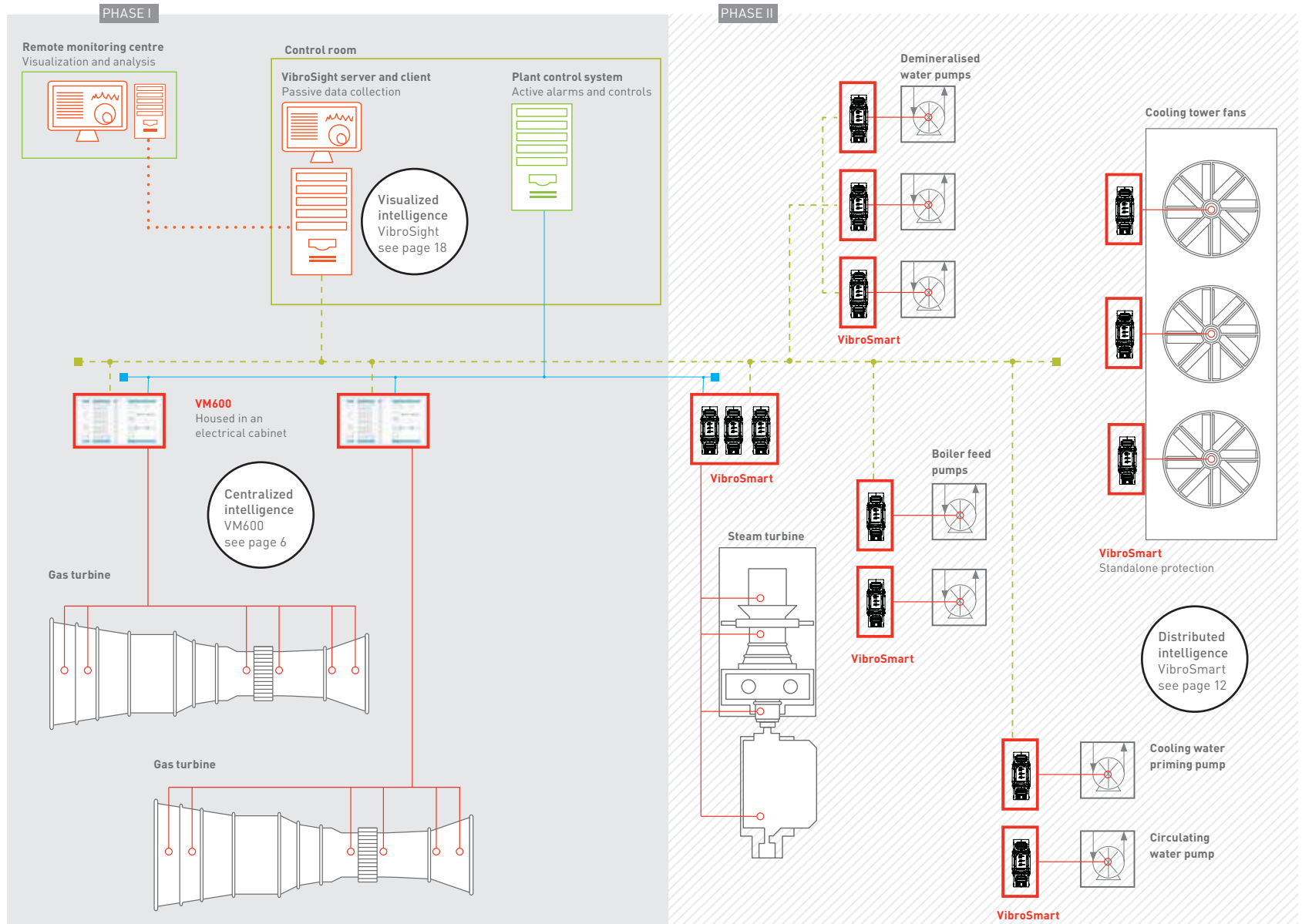
# Flexible, scalable and upgradable

**Phase I:** A regional utility installed two gas turbines with enough generating capacity to meet current demand. Because VM600 was integral to achieving fuel optimization goals, the turbine manufacturer provided Meggitt's equipment as standard—protection, condition and combustion monitoring.

**Phase II:** The plant realized an increase in capacity and efficiency by adding a steam turbine powered by waste heat from the two gas turbines. With the cooling fans and pumps required to support steam generation, the utility selected Meggitt's VibroSmart distributed monitoring system. Its pioneering architecture is an ideal solution to the dispersed nature of balance-of-plant equipment without compromising the protection and monitoring of the steam turbine.

As the utility had already installed VibroSight condition monitoring software, integrating the new monitoring points into the existing database was seamless.

- Meggitt products
- Plant machinery
- Infrastructure
- Sensors
- - - LAN
- ⋯ WAN
- Fieldbus



# From sensors to answers

## High performance sensors

After decades working with the world's turbine manufacturers and power plant integrators, Meggitt has developed one of the widest ranges of active sensors for extreme environments and acquired extensive knowledge of the specific measurements needed for turbine and rotating asset monitoring.

Today, we monitor virtually every parameter with the extreme environment sensors necessary to provide detailed information on equipment condition.

They are the foundation on which to integrate the advanced diagnostic tools that help users with the prognostics needed to turn data into explicit maintenance actions and monitoring into active management of system condition.

We honed our skills in vibration and complex signal processing. We continue to work with the latest analytic techniques, advancing the science of measurement using piezoelectric, optical, microwave and eddy current sensing technologies.

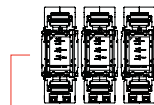
## Intelligent systems

With one common data visualization, event management and diagnostic platform, plant operators can choose the system or combination of systems that suit the requirements of a given plant.

**VM600**  
Machinery protection and condition and combustion monitoring for steam, gas and hydro turbines.

**VibroSmart®**  
Distributed condition monitoring, plus machinery protection for power generation turbines and balance-of-plant and auxiliary equipment. Modules can be mounted directly on machinery, eliminating the need for costly cabling.

**VibroSight®**  
The software platform through which data from both platforms are visualized. Sensor data is fed through VM600 and VibroSmart's advanced monitoring and diagnostic functions, enabling informed decisions on all aspects of power plant management.



## Capabilities

### Machinery protection

Regulations usually dictate that power plants install protection systems to monitor and measure the events that cause a change in the level—or behavior—of vibration from critical rotating machines. Should a breakdown threaten, our system would initiate a shutdown within a fraction of a second.

### Condition monitoring

To cut the cost of unscheduled maintenance, unnecessary inspection and trouble-shooting, system operators must anticipate wear and tear and recognize incipient failure conditions. That's why, when planning operations, maintenance and inventory, they come to Meggitt for the latest sensing and condition-monitoring tools.

The architecture of our machinery protection systems and condition-monitoring tools is scalable and modular.

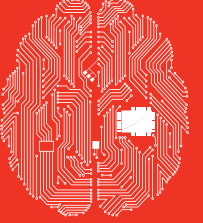
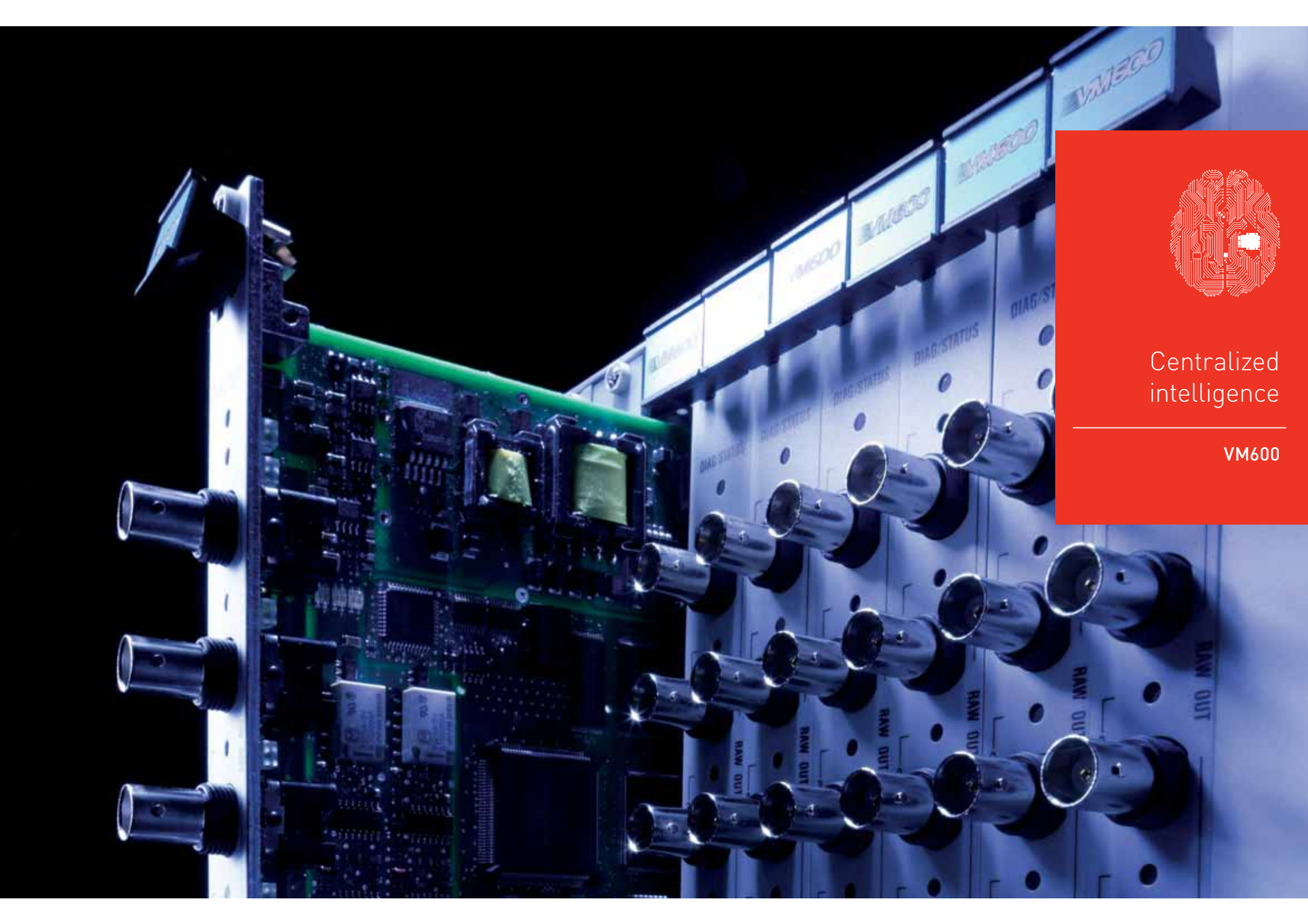
### Combustion monitoring

Modern gas turbines curb emissions of harmful, ozone-forming greenhouse gases and NO<sub>x</sub> through advanced combustor designs, a by-product of which involves combustion-driven pressure, heat release and flow rate oscillation which can damage the turbine package, adversely affecting performance.

Our unique turnkey system aids active protection, alerting control systems to the signs of instability through variation in pressure amplitude and discrete frequencies observed within designated frequency range bands.

The measurement chain starts with Meggitt's high temperature, high sensitivity dynamic pressure sensors which can survive indefinitely within harsh environments. Data acquisition cards and condition monitoring software enable continuous output to control systems enabling engineers to determine the cause of instability or high emissions and undertake remedial action such as adjusting gas and air mixes and combustion sequencing.

VibroSight software includes spectrogram plots ideal for visualizing and analyzing combustor pulsations.



Centralized  
intelligence

VM600

## Centralized intelligence VM600

Choose rack-mounted VM600 where rotating plant is concentrated on one area, requiring centralized monitoring and very high channel counts.

### For complex installations

VM600's high channel density addresses complex installations. Dynamic inputs from proximity probes, accelerometers, velocity, dynamic pressure and ice detection sensors are fed into standard 19-inch, 6U racks.

Specialized electronics preserve signal integrity up to 3,000 feet (1,000 meters) from the monitored machinery to a control room or remote monitoring location.

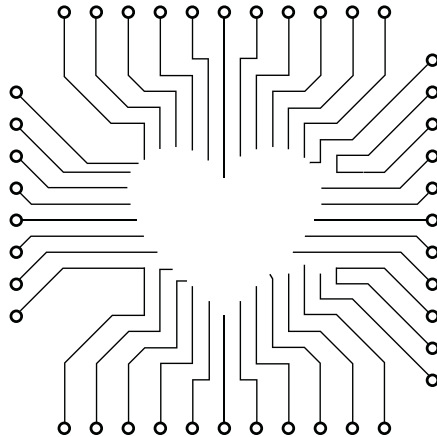
### Accessible

VM600 is designed for plants where measurement data from all machines is accessed in a safe, central area, with personnel obtaining waveforms by physically connecting to raw signals.

### For reactive or proactive management

Whether you require advanced combustion dynamics analyses to ensure safe and optimal fuel mixtures, or you want to fit and forget a reliable vibration protection system, the VM600 covers basic to highly sophisticated analysis.

Up to 6,400 spectral lines can be selected, depending on the detail and frequency resolution of the data needed. VM600's deeper resolution enables combustion or rolling element bearing diagnostics. VM600 has a strong history with engine test bed applications as well as straightforward trending and reliable protection.



### Staying power

While we have pioneered distributed monitoring, we continue to invest in our powerful rack-based system. Our new combustion and vibration cards employ state-of-the-art designs to achieve advanced condition monitoring strategies with our next-generation VibroSight software.

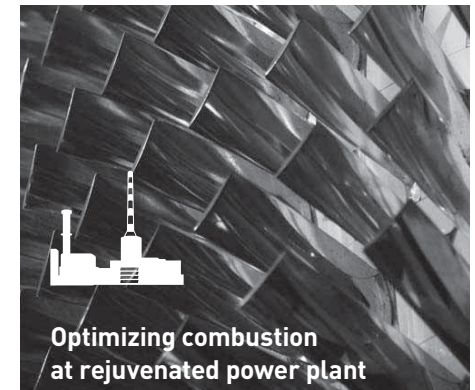
Our field-proven system has achieved unparalleled mean time between failure performance to become one of the industry's most reliable and respected monitoring systems. VM600 monitoring cards are hot-swappable so you can keep your safety system running virtually continuously should a card fail, while replacement cards auto-configure based on saved settings, further minimizing downtime and complexity.

### Certification from the regulating élite

VM600 machinery protection cards are SIL 1 certified by TÜV Nord, the industry standard for reliability and safety (IEC 61508 and EN ISO 13849-1) and fulfills the intentions of the API 670 standard.

### Smaller rack, fewer channels

For monitoring mid-sized rotating machinery, VM600 Slimline offers the processing power of the full system in a compact (1U) rack with fewer channels.



Optimizing combustion at rejuvenated power plant

## Machinery protection and combustion monitoring with VM600

When a 1960s era power plant was upgraded with three SGT6-8000H turbines, Siemens selected Meggitt to provide the sensors and system for machinery protection and combustion monitoring. We provided two VM600 racks for each turbine, plus 23 vibration and 24 dynamic pressure sensors.

Meggitt's dynamic pressure sensors, which survive continuous operation inside the combustion chamber, feed data on pressure fluctuations to the VM600 for processing. Data from the combustion-monitoring system is integral to the mechanism that controls fuel and airflow ratios, helping to ensure the turbines run safely and at optimal efficiency.

# Centralized intelligence VM600

## Machinery protection

### Vibration and dynamic channels

#### MPC4 card

- Four dynamic channels (e.g. for vibration, pressure, etc) and two tachometers
- Digital broad-band and tracking filters
- Front panel BNC connectors for easy analysis of raw signals
- Power supply for IEPE accelerometers, proximity and other sensors
- Four 0-10V or 4-20mA outputs
- Four relay outputs, assigned by software to alarm signals

### Temperature and plant process channels

#### AMC8 card

- Eight channels with software-selectable functions: thermocouple, Resistance Temperature Detector (RTD), current and voltage inputs
- Analog signal inputs: 0-25mA and 0-30V on all channels
- Cold Junction Compensation (CJC) sensor processing on two selectable channels
- User-defined polynomial coefficients for non-linear compensation
- Eight 0-10V or 4-20mA outputs
- Eight relay outputs, assigned by software to alarm signals

### Real-time measurement and monitoring

#### MPC4 and AMC8 cards

- State-of-the-art DSP technology
- Fully software configurable via serial or Ethernet interface
- Programmable and adaptive levels: alert, danger and line check
- Front panel LEDs showing monitoring status and alarms

### User-friendly machinery protection software

#### MPS1 and MPS2

- Easy-to-use, standalone graphical interface
- Connects to the VM600 through a serial or Ethernet interface
- Configures VM600 hardware (installed modules) and programming functions
- MPS2 allows operators to display real-time values (bar graphs and strip charts), trend and long-term data average charts

### Network communications and micro display

#### CPUM module

- Accessibility through Ethernet and serial ports
- Manages configuration of all modules with external PC
- Front-panel LCD bar-graphs and LEDs
- Levels and status display

### Backplane, no internal wiring

#### ABE04x 19-inch, 6U rack

- VME digital bus
- Raw bus line shares input signals between cards
- Open collector drives relays
- Tacho bus shares rotating speed information
- Standard for cabinet installation
- EMC-compliant design, immune to EMI
- CE and CSA-certified
- Separate circuits with 2.1kV insulation (compliant IEC/CEI 60255-5)

### Combustion monitoring

#### XMC16 and XIO16T cards

- Accepts and processes signals from dynamic pressure sensors

### Condition monitoring

#### XMV16 and XIO16T cards

- Accepts and processes signals from accelerometers and proximity probes

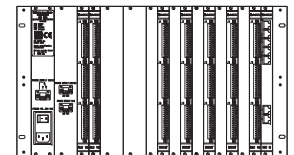
### New XMV16 and XMC16 cards

- Designed for operation and configuration with VibroSight software
- 16 dynamic channels and four tachometer channels, all individually configurable
- Simultaneous data acquisition on all channels
- Up to 20 configurable processed outputs per channel
- High-resolution FFT up to 6,400 lines
- Internal card processing cycle duration as short as 100 milliseconds
- Configurable asynchronous and synchronous sampling
- 24-bit data acquisition with data quality checks
- Five configurable severities per processed output and eight detection levels with hysteresis and time delay
- EMI protection on all inputs
- Direct gigabit Ethernet communication on every card

### Relay outputs on the rear of rack

#### RLC16 module

- Flexible comprehensive Boolean voting logic combinations
- 16 SPDT relay outputs



### Process complex Boolean equations

#### IRC4 module

- 86 discrete inputs
- 16-bit microcontroller
- High level of configurability
- Four DPDT or eight SPDT relay output
- Up to eight specific logic equations
- AND, OR, NOT or VOTE logical operators
- Fully software configurable
- Non-volatile configuration
- Smart LED indicators
- Embedded communication port

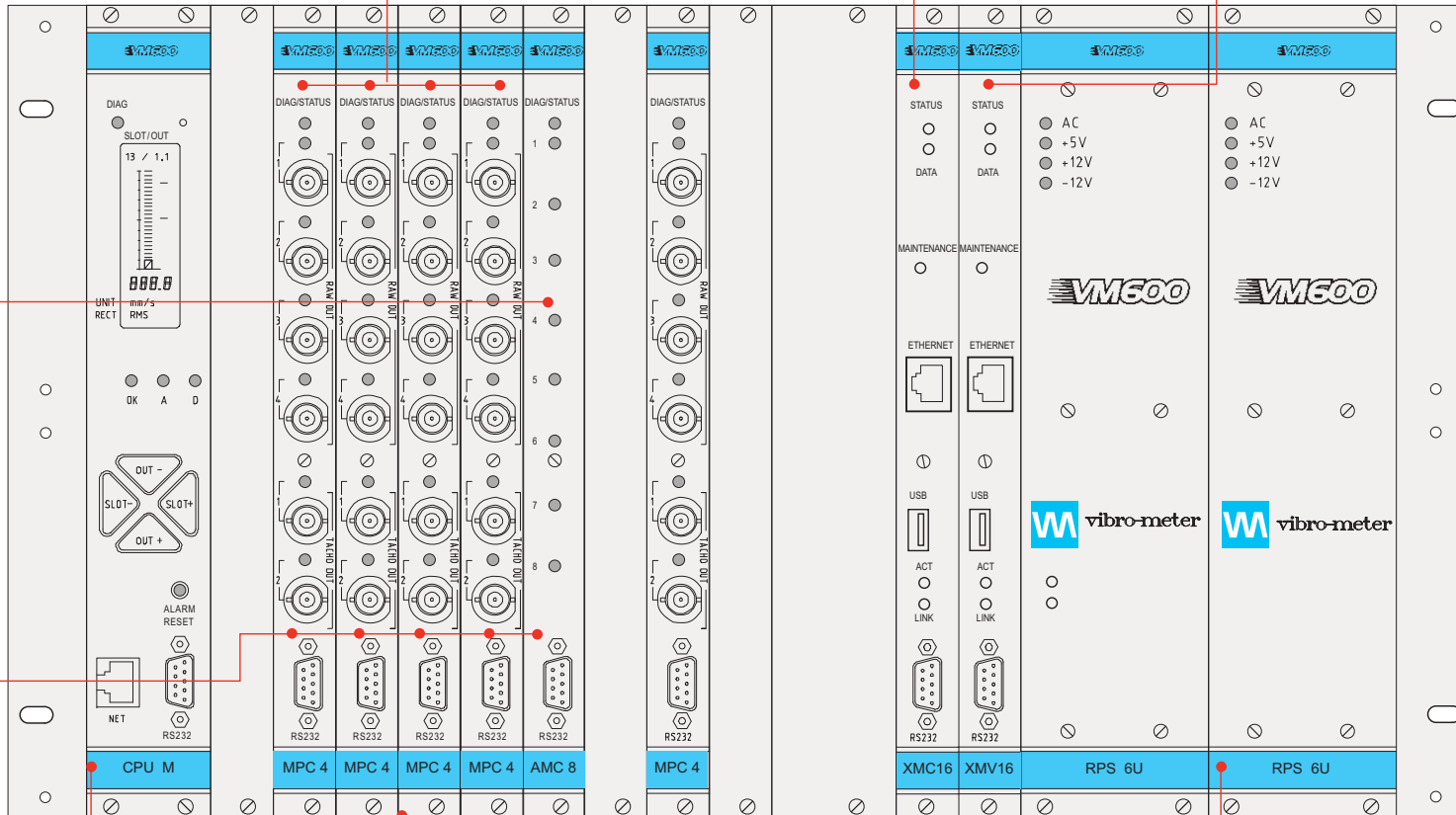
### Hot swappable

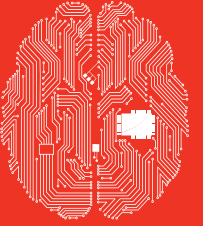
To make maintenance easier, rack power can stay on when adding or removing MPC4, AMC8, XMV16 or XMC16 modules, and cards automatically reconfigure based upon the saved settings.

### Redundant power supply

#### RPS6U module

- Highly reliable: true redundancy (dual, crossed between power modules and mains lines)
- AC or DC power input
- Power status relays





Distributed  
intelligence

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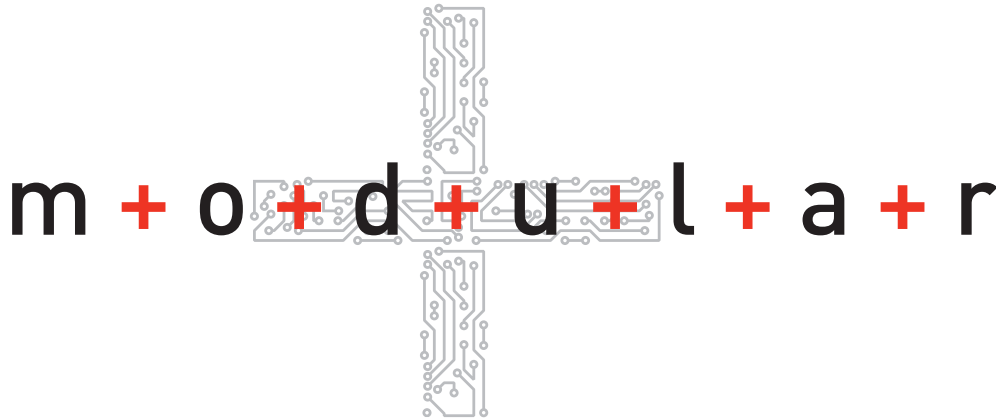
VibroSmart



## Distributed intelligence VibroSmart

VibroSmart distributed monitoring for turbines, critical machinery and balance-of-plant equipment enables more assets to be monitored, across more plants and more cost-effectively—with no compromise on performance.

It is designed for plants where a distributed architecture makes sense for the control system, often involving plant and machinery dispersed over large areas and where the cost of sensor wiring must be contained.



### Modular, scalable

Our next generation monitoring solution offers the same rock solid safety assurance as our centralized solution but priced by channel, so more assets can be monitored for less capital investment.

VibroSmart's easily extended modular construction delivers first-class machinery protection and health monitoring for rotating equipment. Patented real-time distributed networking monitors smaller critical assets and dispersed balance-of-plant equipment requiring low-channel counts.

### Versatile

VibroSmart's structure is highly flexible and supports all sensor types to deliver API-standard machinery monitoring functions. What's more, when combined with VibroSight condition monitoring software, it enables detailed insights into machinery health.

VibroSmart can be a standalone system for vibration-based machinery protection or provide advanced diagnostic tools for superior asset management decisions.

### Low-cost installation

Due to its distributed design, our Ethernet-enabled system costs up to 30% less to install.

VibroSmart can be skid-mounted directly on the equipment you need to monitor, requiring only a few meters of low noise cable.

### Smart engineering for extreme environments

In common with all Meggitt products, VibroSmart is designed and certified to work in extremes—harsh industrial environments characterized by explosive atmospheres, high temperatures and high mechanical stress.

Meggitt's ATEX-certified sensors complement ATEX Zone 2 (CSA Class I Division 2) certified VibroSmart modules.



Safeguarding water supplies for city dwellers

## Condition monitoring with VSV300 VibroSmart modules

Water utilities operate thousands of pumps as they extract water from major waterways for domestic use in the world's greatest cities. Water supply is as critical as power supply, with the same economic considerations, the same safety and service imperatives and the same requirement for rich data on which to base active management of assets.

Traditionally, rack-based monitoring is considered too expensive to install on anything but large turbines. The distributed nature of VibroSmart technology, however, can reduce cabling costs so that monitoring the health of components and sub-systems such as water pumps becomes a realistic solution to managing a large number of small but often operationally critical assets.

Remotely-mounted modules would relay high-speed dynamic data back to a central control facility via the utility's Local Area Network. By seeing in real-time how their equipment is operating, technicians would not need to visit each installation to be certain they are providing management with accurate information on which to base operational decisions.

# VibroSmart main features

## Vibration and dynamic channels

- Distributed measurement modules, easily integrate into measurement blocks that share measurement data, tachometer, alarm and trigger messages
- Hazardous area certification (ATEX Zone II Ex nA and Class I Division 2)
- Operates in temperatures up to 70°C and areas of high mechanical stress
- Interfaces with a full range of sensors: accelerometers, proximity probes, dynamic pressure sensors
- Remote monitoring via Ethernet or fieldbus

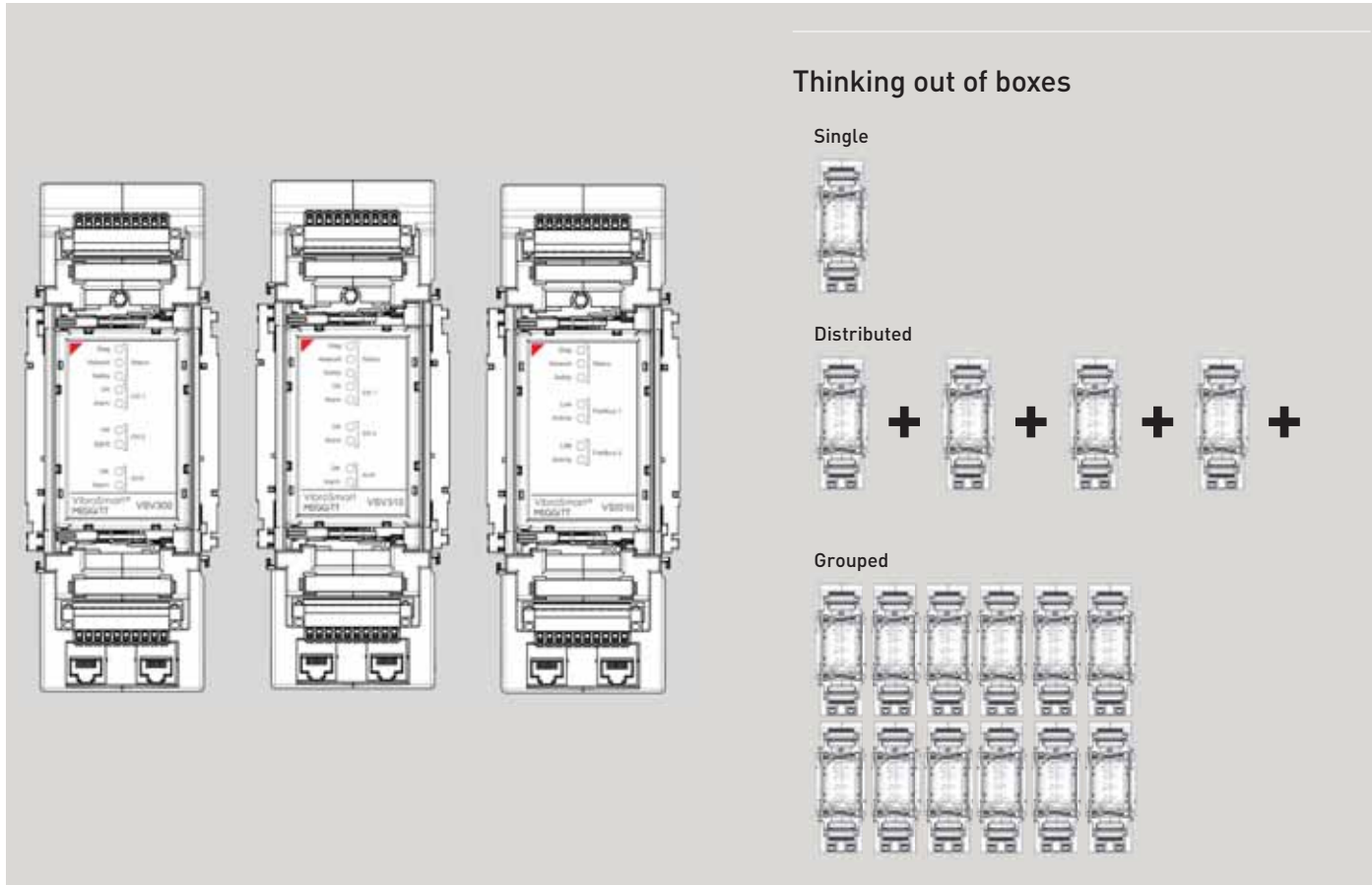
## Availability

- Redundant power supply
- Redundant physical communication path between modules
- Self test and diagnostic
- Hot-swappable modules with auto-configuration based upon the configuration stored in the terminal base

## Industry standard communications

### VSI010

- Real-time Ethernet based communications between modules
- Ethernet communication to VibroSight host computer
- VSI010 fieldbus communication interface acts as gateway between measurement block and plant control systems such as PLC, DCS, SCADA
  - Modbus (RTU or TCP) for non-safety-relevant communications
  - Profisafe over Profibus protocol for safety-relevant communications (alarms, triggers) guarantees correct transmission and reception and immunity to other potential transmission errors
- Built-in fieldbus chipset enables fast integration of additional protocols



## Terminal base

### VSB300

The VSB300 is more than a mounting base for VSV300 and VSV310 modules. Sensors wire into the terminal base, transmitting signals to the measurement module. VSB300 accepts inputs from two redundant power supplies and, when mounted adjacently, modules share data directly via the system bus. Non-volatile memory stores the module configuration to allow automatic reconfiguration when modules are replaced.

## Real-time Ethernet switch

### VSN010

The VSN010 provides fault-tolerant network redundancy using ring topology so there is no single point of failure in a measurement block. This state-of-the-art real-time network enables synchronization down to 1µs within a measurement block.

## Thinking out of boxes

### Single



### Distributed



### Grouped



## Measurement modules

### VSV310 and VSV300

- Two dynamic channels accept data from and supply power to accelerometers, proximity, velocity and dynamic pressure sensors – from Meggitt or other suppliers
- One auxiliary channel (phase reference or DC input channel)
- Each module provides standalone machinery protection
  - Two relays
  - Two 4-20 mA analog outputs
  - Three buffered raw outputs

## Machinery protection

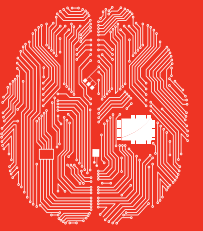
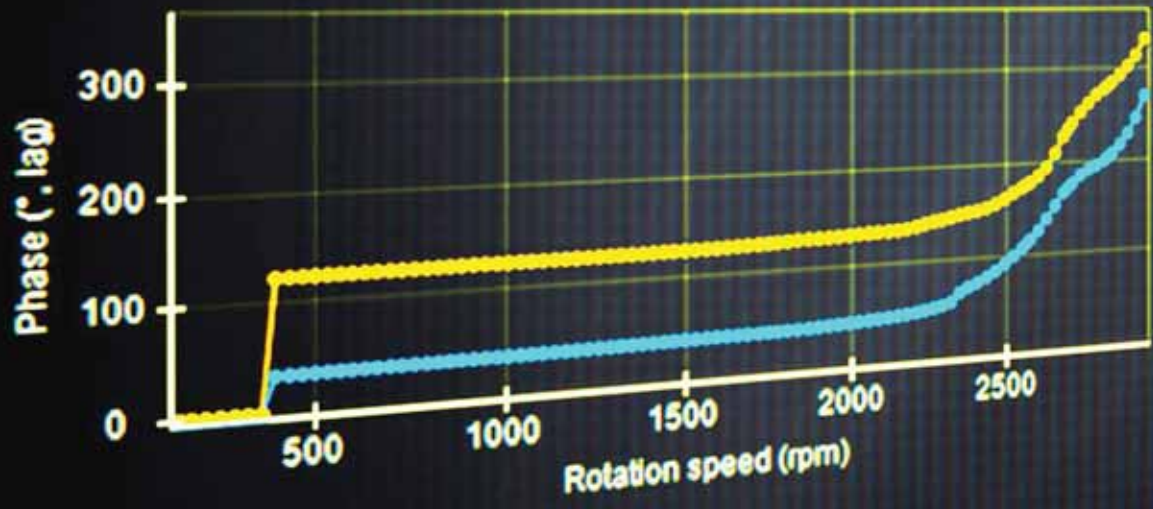
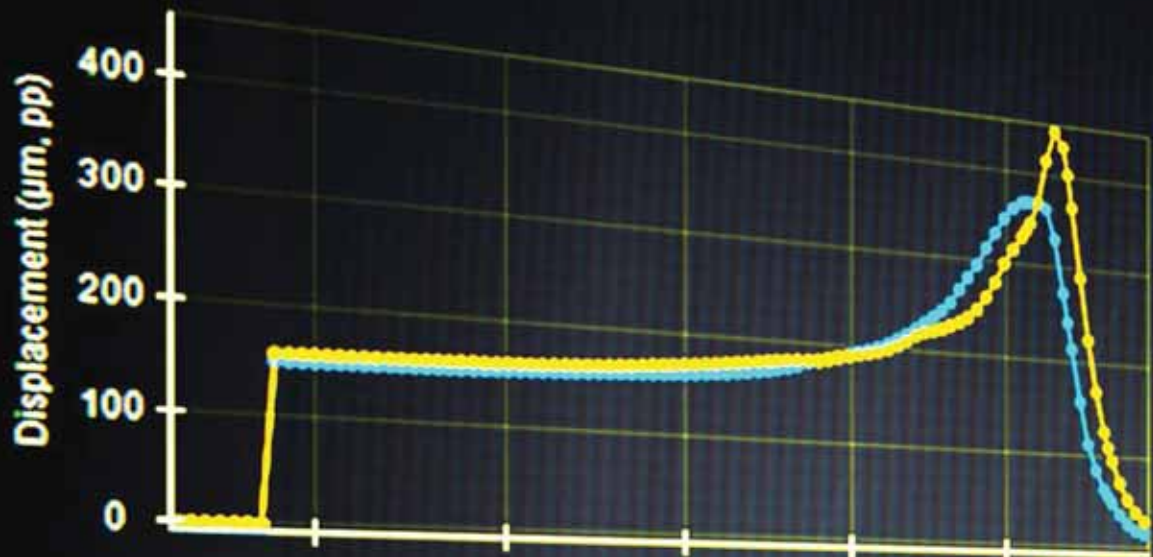
### VSV310

- Up to 10 configurable extracted outputs
- Processing capabilities
  - broadband measurement of bearing absolute vibration
  - narrow-band tracking
  - shaft relative vibration
  - shaft thrust
  - eccentricity
  - S<sub>MAX</sub> processing (ISO 7919-1 methods B and C)

## Machinery protection and condition monitoring

### VSV300

- Up to 20 configurable extracted outputs
- In addition to VSV310 processing capabilities, performs
  - broadband pressure/pulsation (combustion)
  - shaft absolute vibration
  - slow-roll/run-out compensation
  - when combined with VibroSight, becomes a powerful condition monitoring system
  - orbit
  - waveform and full spectrum up to 1,600 line FFT every second

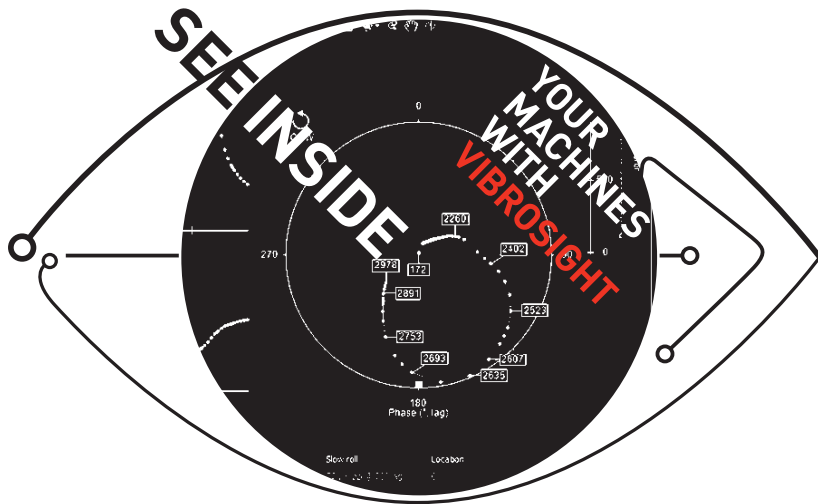


Visualized intelligence

VibroSight

## Visualized intelligence VibroSight

Meggitt's latest generation software platform visualizes data from all acquisition devices for all applications, flagging critical events and monitoring machinery health so you improve equipment availability and reliability and optimize maintenance costs.



### All acquisition devices

Competitively-priced and simple to use, VibroSight works with our entire range of monitoring systems, accepting data from all types of sensors.

VibroSight configures, trends and analyzes data from VibroSmart, VM600 (standard and Slimline) or a combined solution. It can process data from a single compact system or thousands of parameters across a networked system for several plants to provide fleet-wide asset management. Its open architecture makes it easy to expand the system and integrate additional data with existing monitoring functions.

To ensure a smooth migration, users who wish to upgrade from Meggitt's CMS software can benefit from a range of attractive customized packages and consulting services.

### All applications

VibroSight visualizes vibration, combustion and performance monitoring data from gas, steam and hydro power generation turbines and critical and balance-of-plant rotating assets.

View live data and historical trends with graphical interfaces and plots from application-specific packages which include gas turbine combustion and hydroelectric generator air gap monitoring.

### Data to decision

The reports resulting from this highly integrated software enable the predictive methodologies needed to help operators make informed decisions about power plant management and improve the effectiveness of machinery.

- Remote access via a PC
- Validated by major turbine manufacturers



**Improving tanker safety and operating efficiency**

## Remote diagnostics with VibroSight data transfer capabilities

The engines of the world's merchant fleet are subject to routine maintenance checks and Class surveys. However, while rarely breaking down entirely, propulsion system malfunctions can affect their progress. The benefits of continuous condition monitoring are as significant here as they are with land-based turbines. The ability to anticipate wear and tear has an enormous impact on commercial viability and safe operation.

A redundant, real-time network of VibroSmart monitors placed across the propulsion system could relay signals to an onboard server running VibroSight software.

For machinery protection, no human intervention is required as the hardware sends a signal to shut down an engine automatically should it malfunction.

For diagnostic tools, VibroSight software could be used to collect engine data and, through an OPC interface, send time- and frequency-domain data to monitor multiple ships simultaneously. Scheduled database cloning to back up the data takes place once a ship returns to port.

## VibroSight main features

VibroSight is a suite of user-friendly application software modules for analyzing machinery health. It supports the flexible configuration of channels, processing, outputs, alarms and plant structure, helping to monitor the condition of all critical assets and gas turbine combustion. Operators can assess the overall condition of machines at a glance or use the full suite of visualization and analysis tools and plots to undertake in-depth analyses.

With continuous data acquisition offering seamless monitoring of even short events, VibroSight is suitable for the most stringent test-bed applications. However, configurable data-logging rules enable users to ensure they are not overwhelmed by data.

### At a glance

- Event management for alarms or external triggers
- Customizable overview displays live monitoring data and directly opens plots for further analysis

### Visualization and analysis

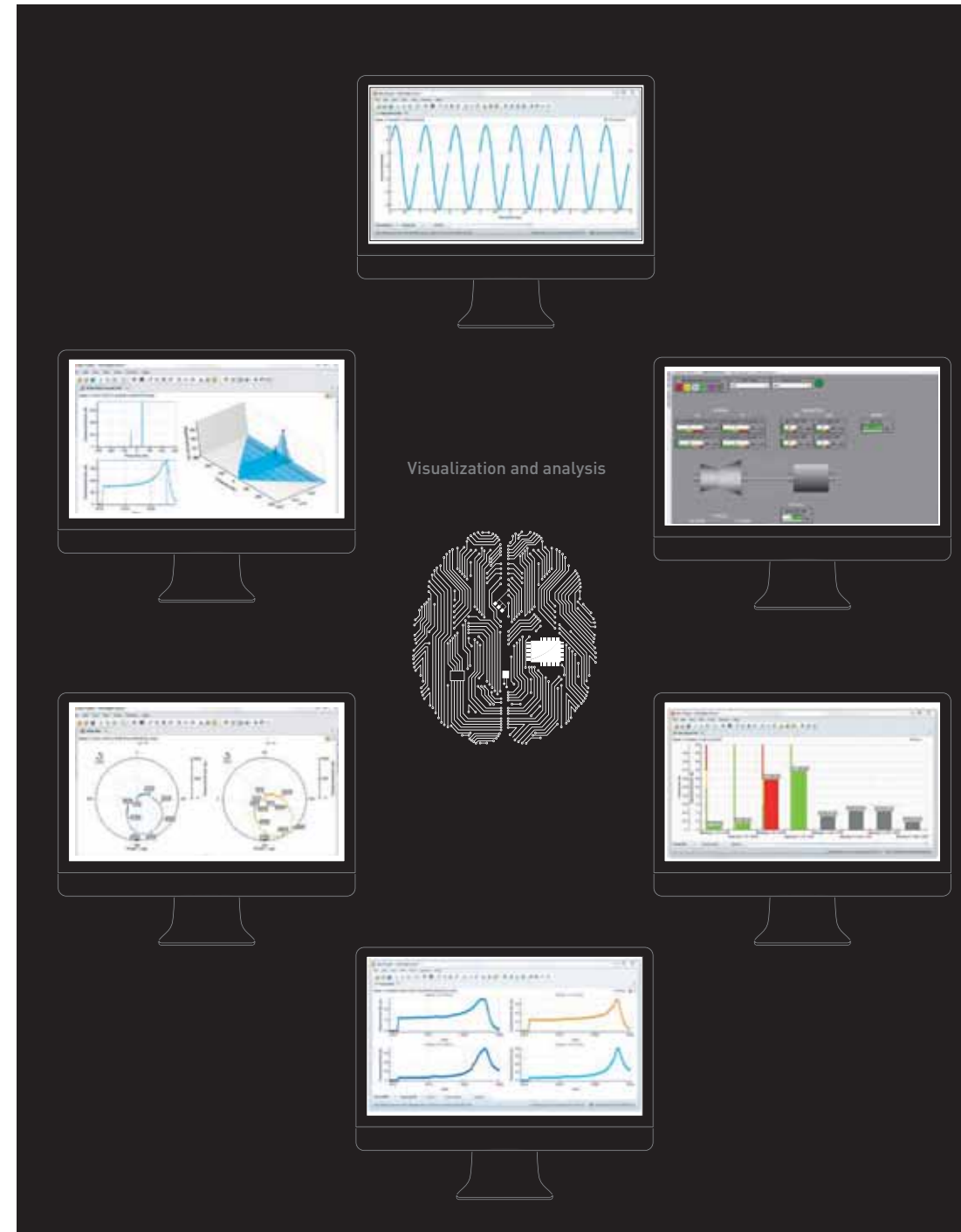
- Live and historical data display
- Online or offline data presentation and analysis
- Setup and storage of user-defined plots as projects
- User-friendly and powerful data plotting
- Optional combustion and hydroelectric air gap monitoring packages
- Full suite of condition monitoring plots
  - static: bar chart, Bode, correlation, polar, shaft centreline, table, trend
  - dynamic: orbit, spectrogram, spectrum, full spectrum, waterfall/cascade, full waterfall/cascade, waveform

### Data management

- Scheduled complete or selective database copy, purge and backup
- Flexible data-logging rules can be configured based upon time, machine speed, alarm state or machine state
- Database data ageing to reduce storage requirements
- Pre- and post-trigger definitions for event-driven data storage
- Automatic data acquisition and storage

### Works with

- Supports the VM600 XMx16 extended monitoring card pairs: XMV16/XIO16T, XMVS16/XIO16T and XMC16/XIO16T
- Supports VibroSmart devices: VSV300, VSV310, VSI010 and VSN010
- NTP synchronization of all system components
- Modbus import and export of data
- OPC DA import and export of data
- Runs on Windows 7, Windows XP, Windows 8 and Windows Server 2003/2008 operating systems
- Server-client architecture (multiple client connections to server)
- Uses a Sybase SQL Anywhere 11 database



## About us

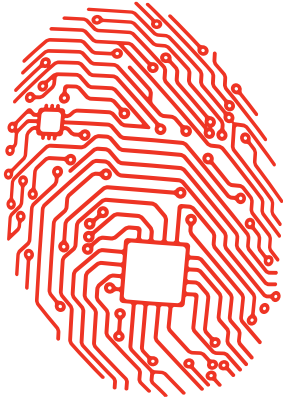
Meggitt pioneered high performance sensing and condition monitoring solutions for extreme environments through its antecedents—ECET, Endevco®, Ferroperm Piezoceramics, Piezo Technologies, Lodge Ignition, Sensorex®, Vibro-Meter® and Wilcoxon Research®. Today these operations are integrated within the Meggitt Sensing Systems division, providing complete systems from a single supply base.

After working with the world's turbine manufacturers for over 60 years, Meggitt remains master of all aspects of condition monitoring—from high performance sensing, data acquisition and management to the high speed digital networking and the signal processing algorithms that can deliver diagnostics for prescriptive maintenance solutions.

### Meggitt PLC

Headquartered in the United Kingdom, Meggitt PLC is an international group operating in North and South America, Europe and Asia. Known for its specialised extreme environment engineering, Meggitt is a world leader in aerospace, energy and defense markets. An 11,000-strong workforce serves customers from around 40 manufacturing facilities and regional offices worldwide.

[www.meggitt.com](http://www.meggitt.com)



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**MEGGITT**  
smart engineering for  
extreme environments