POWER GENERATION AND WATER, SEPTEMBER 2020

ABB Ability Symphony Plus

Turbine Automation Executive Overview

Introduction

Turbine Control Systems

Common challenges

Challenge	Details
Protectionism by Turbine OEMs	Patented black boxed algorithms forces customers to use their expensive service for troubleshooting and maintenance
Isolated islands of control	Customers have to coordinate multi-vendor support and service in events of failure or underperformance Finger-pointing by multiple vendors
Diverse turbine OEM landscape	Very crowded OEM turbine market, particularly in steam A challenge for in-house expertise for automation companies like ABB
Stricter performance and reliability requirements	Fast input-to-output response times and very powerful CP
Strict compliance requirements	Growing enforcement of industry/region certification requirements Cyber-security compliance (i.e. NERC)
Changing operating procedures	With growing share of renewables connected to grid, turbine control systems must be flexible and fast responding to load and frequency fluctuations

Introduction

Turbine Control Systems

What does an ideal solution look like?

Qualities	Details
High reliability, no single point of failure	Fully redundant (dual and/or TMR as applicable)
Fast Response	<20 msec governor response
Open system hardware and software architecture	No black boxes
Integrated with DCS	Integrated with plant controls, engineering and HMI
Fully integrated, proven and optimized single vendor turbine control solution	Governor, excitation, protection, auxiliary systems, valve positioning, condition monitoring, autosynchronization, rotor stress evaluation, mechanical & hydraulic components, etc
Increased turbine performance and protection	Improved ramp rates, runbacks and turn down / Fully automated turbine start-up
Enhanced testing	On-line trip system testing / Individual speed channel testing / Automated valve testing

Introduction

Symphony Plus

Built on a solid platform

Introduced in 1980, Network 90 was one of the first Distributed Control Systems on the market

Network 90, INFI 90, and Harmony are compatible technology upgrades from Network 90

– i.e. Re-compile & download to new hardware

One of the largest installed base of contiguous DCS product lines in the world:

– Over 280,000 controllers

– Over 88,000 console seats

– Over 1,900,000 I/O modules

– Over 3,400 turbine systems installed

Continued development and support on 35+ year commitment to our Customers

Protects capital & intellectual investments through seamless lifecycle management

Symphony Plus

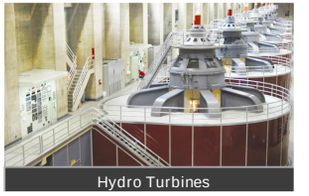
Integrated solution for the turbine island

ABB Turbine Control Footprint

- Fully integrated native turbine control solutions
- #1 among Non-OEM turbine control DCS Vendors
- 3400+ turbine control systems installed
- Expertise in all turbine types and sizes (from a few KW to 1.2 GW)
- Retrofit, Greenfield and OEM markets
- All turbine types: Steam, gas, hydro, waste, geothermal, etc..
- Experience automating all major turbine manufacturers


Utility Steam Turbines


Combustion Turbines


Hydro Turbines


Auxiliary Steam Turbines


Industrial Steam Turbines


Renewable

Symphony Plus

Integrated solution for the turbine island

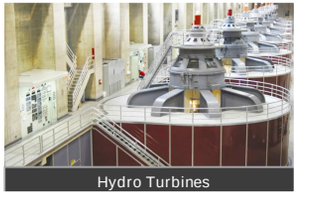
What do we offer?

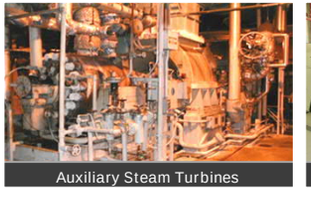
Solutions for all types of turbine control systems

- Complete steam, combustion and hydro turbine capabilities
- Integrated solution allows common DCS platform for all plant equipment
- Open architecture allows interface to any system
- Complete hydraulic design capabilities
- Components and system design
- Full complement of condition monitoring products
- Hardware and software solutions
- New products for turbine automation
- Installation and start-up services


Utility Steam Turbines


Combustion Turbines


Hydro Turbines

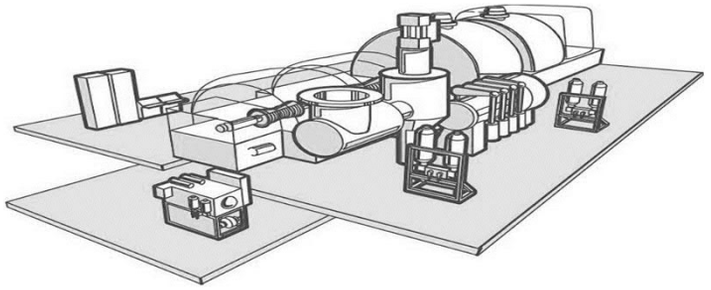

Auxiliary Steam Turbines

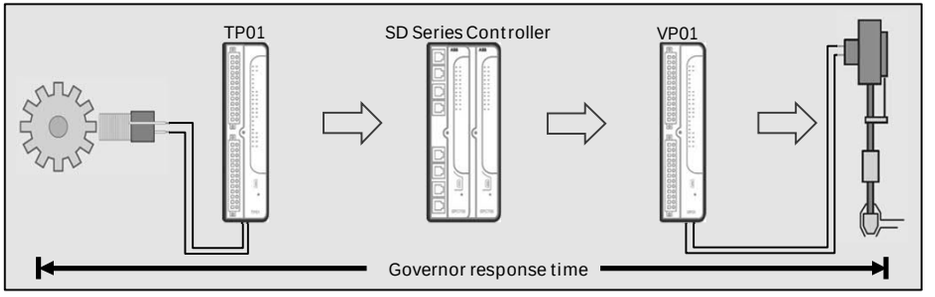

Industrial Steam Turbines


Renewable

Symphony Plus

Integrated solution for the turbine island





- Dedicated Turbine I/O modules integrate turbine automation for power and process industries
- Valve actuator interface with auto calibration and integrated valve test
- Flexible control and protection functions integrated in one solution (1oo2, 2oo3)
- Auto synchronization with independent sync check circuit
- Dedicated SIL-3 turbine overspeed protection system
- Input to Output (speed to servo) governor response time in under 20 milliseconds
- High speed data logging capability for diagnostic and optimization of turbine control functions
- Specialized performance calculation and optimization packages for steam and gas turbine performance

Provides highly integrated automation for all turbine types, sizes & manufacturers

Symphony Plus

Turbine functions

Turbine protection

SIL3 Certified by TUV (SD Series and 800 Series turbine offerings)

Comprehensive set of protection functions

– Overspeed Protection, Overspeed Trip, Acceleration, Trip Anticipation, Load Drop Anticipation, Anti-Surge Protection and Power Load Unbalance

Flexible protection schemes (1oo2, 2oo3, etc)

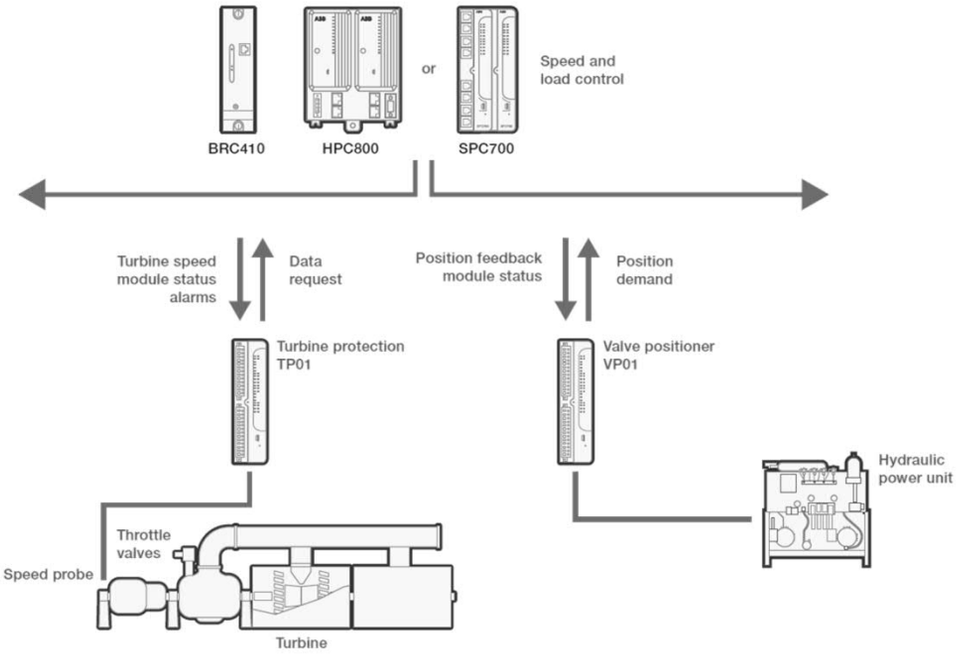
Fast response independent from main controller

Flexible design to address specific application requirements

– I/O configuration, protection function selection, protection set point adjustment, relay output programming, energize/de-energize outputs

Automatic overspeed testing

– Internal injection of ramping frequency signals into speed channels



Symphony Plus

Turbine functions

Valve positioner

Positioning of turbine inlet valves (steam, gas, hydro, etc)

Typical application involves driving dual coil integrating servos with single or redundant LVDT's

I/H Converter Mode

– Direct linear mapping of the demand signal into a current output

Highest availability dual redundancy scheme (master/backup)

Triple Modular Redundancy (TMR) control capable

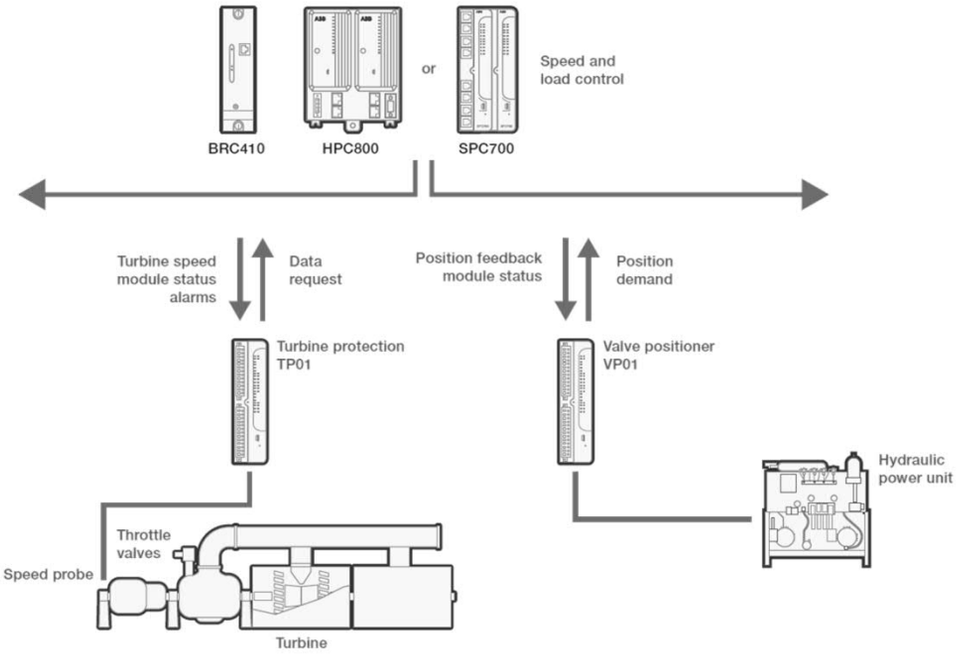
Integrated Valve Curve

– Automatic implementation of mapping function to translate flow demand into valve position demand

Integrated Valve Testing

– Automatic testing ensures proper operation of electronic and hydraulic components

Automatic Calibration



Symphony Plus

Turbine functions

Autosynchronization

Generator to grid synchronization or peer to peer bus synchronization

Automatic matching of voltage, frequency and phase and automatic generator breaker closure

Sync Verification

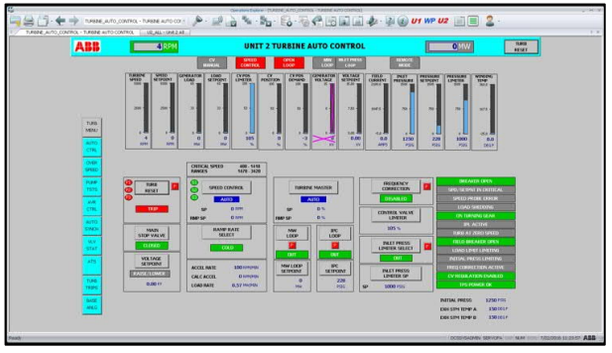
– Built-in independent synchronization circuit (check to primary circuit)

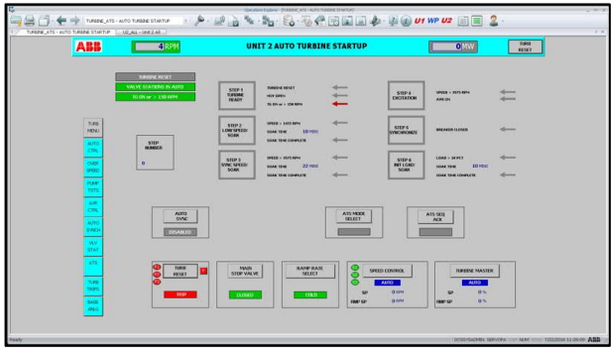
Dead Bus Capability

– Intelligence to recognize dead bus situations and perform breaker closure (upon command)

Stand-Alone Mode

– Using hard-wired digital inputs and serial communication via RS232





Symphony Plus

Turbine automation portfolio

Comprehensive turbine automation family

SD Series Turbine (read more)

- TP01: Turbine Protection Module
- VP01: Hydraulic Servo Module
- AS01: Turbine Auto Synchronization Module

800 Series Turbine (read more)

- VP800: Valve Positioning
- TP800: Turbine Protection
- AS800: Auto Synchronization
- MCM800: Condition Monitoring

HR Series Turbine (read more)

- HSS: Hydraulic Servo module
- TPS: Turbine Protection module
- TAS: Turbine Auto Synchronization module
- FCS: Frequency Counter module
- CMM: Condition Monitoring module

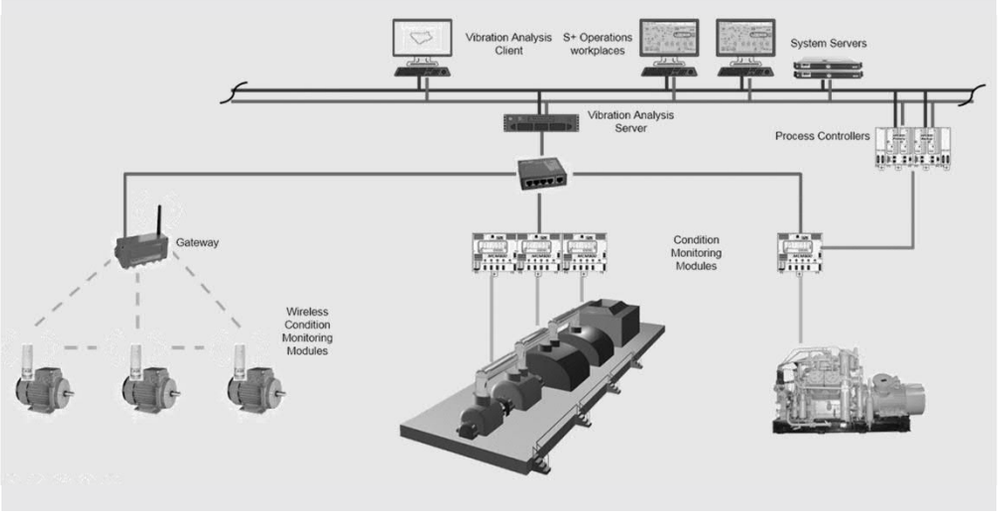
Symphony Plus

Turbine functions

Condition monitoring solution

Condition Monitoring suite ensures safe operation of a plant's critical and essential rotating equipment

- Unique all-in one design measures
  - Seismic and absolute vibration
  - Eccentricity, thrust, case expansion, and differential expansion
- Analyst software application provides specialized plots for rotating equipment assessment
- Prevents costly shutdowns and premature equipment failure as well as catastrophic disasters
- Moves maintenance from costly reactive to proactive and predictive practices



Protects rotating equipment with condition monitoring

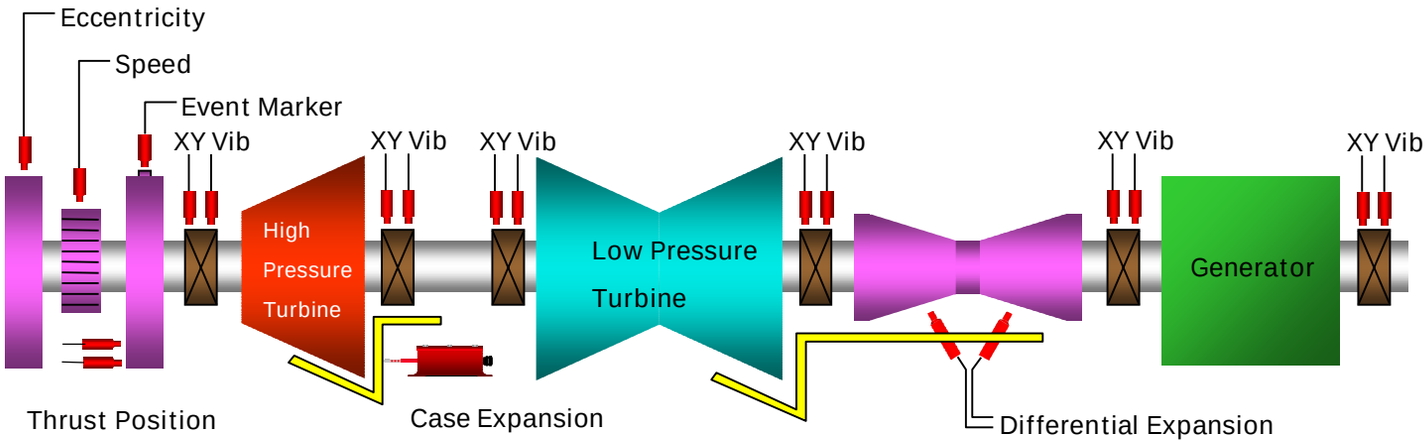
Symphony Plus

Condition monitoring solution

End-to-end engineered solution

End-to-end engineered solution using ABB equipment for data collection and data analysis and 3rd party instrumentation and expertise

- Continuous monitoring and protection
- Determines present condition of equipment
- Provides data for predictive/preventive maintenance



Symphony Plus

Condition monitoring solution

CM hardware

800 Series MCM800

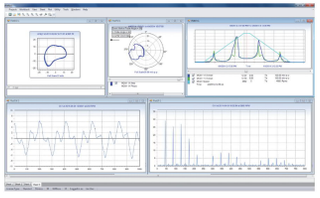
– DIN rail mounted module provides a complete set of functions for comprehensive turbine supervisory instrumentation and is part of ABB's Symphony Plus technology platform. The modules that comprise the MCM800 operate independently from the main DCS controller, providing dedicated monitoring and protection features including vibration monitoring, eccentricity, thrust (rotor) position, differential expansion and case expansion. Read more.

HR Series CMM11

– Rack-based module that is integrated directly into the Symphony Plus HR Series based control system. It monitors bearing vibration, eccentricity and axial rotor position on any type of rotating machinery.

– Measures rotor-to-case differential and case expansion of a turbine shell. The module has four measurement channels and can accept any combination of industry standard transducers including proximity probes, accelerometers, velocity probes and DC LVDT inputs. Read more.

CM software



Analyst software

Analyst condition monitoring software

– Analyst is a graphical analysis software application that provides specialized plots for assessing the condition of rotating machinery. It uses various plot types to present the current and historical vibration data, so that significant patterns and trends can be quickly recognized. This enables the local or remote user to proactively identify problems and deviations in the rotating machinery condition and address them before they can adversely affect operations. Read more.

Protects rotating equipment with condition monitoring

Symphony Plus

Turbine functions

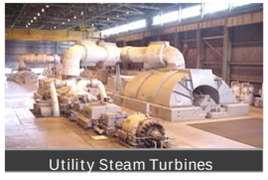
Mechanical / Hydraulic capability

Capability	Details
Hydraulic power units	Self contained and fully instrumented Built in redundancy
Hydraulic Trip Manifolds	SIL3 Certified Extended failure supervision and diagnosis
Hydraulic valve actuators	Fail safe designs Adjustable trip speeds Serviceable on-line
Multiple valve interface options	Final element Pilot valve I/H transducer Electric actuator

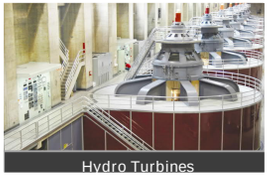
Symphony Plus

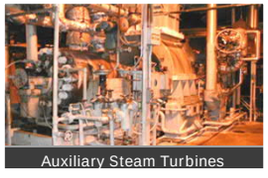
Integrated solution for the turbine island

Key takeaways


Utility Steam Turbines


Combustion Turbines


Hydro Turbines


Auxiliary Steam Turbines


Industrial Steam Turbines


Renewable

ABB is the leading provider of non-OEM turbine control systems worldwide

- 3rd generation of turbine control and protection products has just been released (SD Turbine Modules)
- Unmatched performance and functionality in the market, including commitment to 20 mesc governor response time
- Open systems put the ownership back in the customer hands, reducing service time and costs
- Single vendor fully integrated solutions offer peace of mind now and tomorrow
- Single plant DCS platform offers savings during installation and operation

Symphony Plus

Turbine automation portfolio

SD Series Turbine

Fully integrated, native SD Series turbine solution

Eliminating need for communication gateway results in governor responses times of <20 msec

SOE capability

Multiple redundancy schemes

Comprehensive set of turbine control and protection functions:

- Turbine Protection (TP01)
- Auto-Synchronization (AS01)
- Valve Positioning (VP01)

Provides highly integrated automation for all turbine types, sizes & manufacturers

Symphony Plus

Turbine automation portfolio

SD Series Turbine

Module	Type	Description / Properties
TP01	Turbine Protection	– Full SIL3 rated for all protection functions (certification pending) – Probe detection hardware diagnostics (active, passive & eddy current) – Two built-in heavy duty solid state relays (can be Trip output) – 5 AI's and 5 DI's programmable in terms of functionality – Speed related protection functions executing under 5 msecs – Secondary protection functions executing under 20 msecs – A new speed made available to the main controller every 2 msecs.
VP01	Valve Positioner	– Increased servo current capability to 500 mA per servo coil – Demand to output response time in 1 millisecond – "Current Drive" servo output scheme – Dual electronic redundancy (master/backup) – TMR control capable – Sine wave LVDT excitation – Simultaneous reporting of Both LVDT values – Valve position monitoring-only (for non-modulating valves) is supported
AS01	Auto-Synchronizer	– Higher precision synch check circuit (better than 0.25%) – Built-in calibration for more accurate PT readings (0.25 %) – High reliability Primary and Synch check circuits

Symphony Plus

Turbine automation portfolio

HR Series Turbine

The most widely used Symphony Plus turbine modules

Rack-mounted form factor, fully compatible with INFI 90, Harmony and Symphony systems

Offering includes modules for a wide range of turbine control functions:

- Hydraulic Servo module (HSS)
- Turbine Protection module (TPS)
- Turbine Auto Synchronization module (TAS)
- Frequency Counter module (FCS)

Provides highly integrated automation for all turbine types, sizes & manufacturers

Symphony Plus

Turbine automation portfolio

HR Series Turbine

I/O Module	Capabilities	Description
TPS02	– Operates independent of controllers – Cycle time < 12 msec – Multiple relay outputs for protection functions	– Turbine Protection Module – Triple redundant modules provide 2-out-of-3 overspeed protection
FCS01	– Accurate to 1 count in 10,000 – On-board diagnostics	– Frequency Counter Module
HSS13	– Redundant servo coil outputs – 4-20 mA & 20-160 mA linear outputs – Self calibrating – Alarm diagnostics	– Hydraulic Servo Interface Module – Redundant interfaces to a variety of LVDTs (AC LVDT, DCLVDT) – Interfaces with a variety of E/H devices
TAS01	– Relay interface with exciter for voltage control – Soft signal interface with controller for speed control – Synchronize sequence performed in the TAS module	– Turbine Auto Synchronization Module

Symphony Plus

Turbine automation portfolio

800 Series Turbine

Turbine control solution for use with ABB or non-ABB DCS platforms

Redundant PROFIBUS communications for tight integration with DCS platforms

Comprehensive set of turbine control and protection functions include:

- VP800: Valve Positioning
- TP800: Turbine Protection
- AS800: Auto Synchronization

Provides highly integrated automation for all turbine types, sizes & manufacturers

Symphony Plus

Turbine automation portfolio

800 Series Turbine

Module	Type	Description / Properties
800 Series	Turbine automation	– Convenient and fast soft interface through PROFIBUS to access all module parameters: no need for local adjustment of jumpers or switches – Full integration into turbine control DCS (S+ or any other PROFIBUS capable DCS), resulting in greater exchange of process and diagnostic data – Component commonality with other turbine control specific products – Single vendor solution for entire turbine control DCS (no third party equipment)
TP800	Turbine Protection	– SIL3 certification by TUV – Multiple fully integrated high speed protection functions – Compatible with active or passive speed probes – Built-in online speed channel test
VP800	Valve Positioner	– Fully automatic valve calibration (position feedback and demodulator gains), greatly simplifying initial setup as well as future adjustments – Universal & Flexible: meets the needs of many different turbine OEM's – Can be configured to operate in different modes (servo, I/H, cascaded, etc...) – Can interface to a variety of field device types and ratings – Dual VP800 redundancy capability
AS800	Auto-Synchronizer	– Built-in synchronization check circuit – Cost effective solution for single breaker applications – Stand-alone or DCS integrated operational modes

Symphony Plus

Condition monitoring solution

CM hardware

800 Series MCM800

800 Series MCM800

- Collects high resolution vibration data from vibration sensors for monitoring and protection
- Performs other monitoring and protection measurements commonly referred to as Turbine Supervisory Instrumentation
- Offers redundant RS-485 ports for either Profibus or Modbus RTU, and Modbus TCP communication to DCS controllers and systems
- High resolution vibration data is made available to the Analyst Graphical User Interface software via on-board Ethernet connection
- All the features reside in a single module, eliminating the need for additional hardware other than power supplies (this reduces the need for spare parts)
- Includes four input channels that can be independently configured for any function or sensor type commonly used in Condition Monitoring

Symphony Plus

Condition monitoring solution

CM hardware

HR Series CMM11

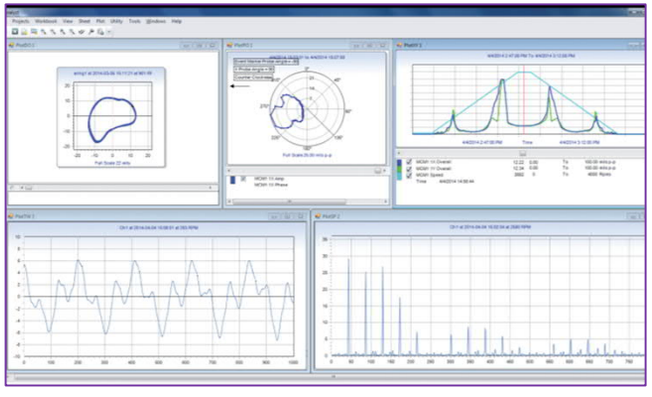
HR Series SPCMM11

- SPCMM11 collects high resolution vibration data from vibration sensors primarily for monitoring and protection
- Performs other monitoring and protection measurements commonly referred to as Turbine Supervisory Instrumentation
- The high resolution vibration data is available for the Analyst Graphical User Interface software via on board Ethernet connection
- Natively communicates to S+ Harmony Rack (and earlier generation) controllers via expander bus
- All the features reside in a single module, eliminating the need for additional hardware other than power supplies (this reduces the need for spare parts)

Symphony Plus

Condition monitoring solution

CM software



Analyst software

Enabling predictive maintenance:
plot types allow vibration specialist to easily determine root cause of degrading rotating equipment performance

Analyst graphical user interface

– Displays the waveform data and process variables in variety of plot types:

Process variables	High-precision waveform data
X – Y plot	Time waveform
Bode plot	Direct orbit
Polar plot	Direct time waveform
Polar + trend plot	(Full) spectrum
Filtered orbit plot	(Full) cascade
Shaft centerline plot	

– Monitor current condition of the equipment

– Compare present and past conditions to assist in predicting potential risks and failures, and preparing for schedule outages

– Allow configuration of the vibration modules prior to equipment operation

CONTACT US & SUPPORT

NEED A QUOTE OR TECHNICAL PARTS REPLACEMENT?

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- 12-Month Quality Warranty on All Industrial Parts
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