

ORBIT 60 SERIES

System Overview

Datasheet

Cordant™

137M5182 Rev. AA



Plant-wide • One System

The Bently Nevada™ Orbit 60 Series Protection and Condition Monitoring System provides one continuous, online monitoring system for both critical and plant-wide applications.

Cyber Secure • Data Isolation

Orbit 60 Series data isolation creates a safe industrial data environment designed to meet IEC 62443-4-2 with world class network security features and segregation of protection and condition monitoring functions.

Modular • Flexible • Scalable

The Orbit 60 Series system is deployable in any combination of rackmounted and distributed hardware. This provides for better alignment of instrumentation to the machinery application.

High Speed Process Data Integration

Next generation architecture facilitates full bi-directional communications with plant control systems over a suite of standard protocols.

Extended Field Wiring Length

With the Orbit 60 Series distributed architecture, connection of multiple chassis through Bridge modules decreases overall electrical installation costs, reduces analog ground loops and noise issues, and moves key maintenance activities further from hazardous areas.

Industry Leading System Capabilities

The Orbit 60 Series supports monitoring of one or multiple machine trains in a single deployment. One System Interface Module (SIM) defines each system and can encompass up to 68 dynamic channels.

Protection Processing Module



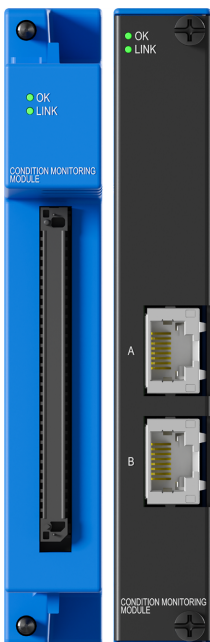
The Protection Processing Module (PPM) serves as the computational engine for the Bently Nevada™ Orbit 60 monitoring system. It extracts all machinery measurements for the protection system and performs alarm determinations. The PPM analyzes signals from transducers, generates measurements and statuses and publishes them to other modules for data collection and external communication. Each PPM occupies a single slot within the system.

Each PPM provides computational capacity for a large number of sensors and can support typical monitored machine trains. The PPM capacity is a function of the type of processing required on each input. If the system requires more processing than a single PPM can provide, additional PPMs can be added to the system for complex monitoring deployments. For protection systems, redundant PPMs are recommended.

The Orbit Studio Configuration Software provides a System Utilization Calculator to evaluate the remaining capacity of the PPMs in your system. If a PPM processing capacity reaches 90%, a warning indicator is displayed in Orbit Studio software, and it is recommended to add another PPM or two PPMs if the system is redundant.

For additional details, see the Protection Processing Module Datasheet (142M8515).

Condition Monitoring Module



The Condition Monitoring Module (CMM) listens to all information within the system, including all measurements, waveforms, digital transducer signals, system controls, status information, system configuration information, process data from external systems, and alarm and events logs. It only listens, with no capability to write, allowing interface to System 1 over the business networks, with no risk to the protection system.

Each module occupies either one slot (60R/CMM02) or two slots (60R/CMM01) within the system. Placing multiple CMM modules allows the connection of two independent System 1 clients to the Bently Nevada™ Orbit 60 System. Data is transferred to System 1 continuously, but in the event the connection is lost, non-volatile storage buffers historical data until the information is off-loaded to the host software. System 1 can configure the CMM module to extract additional measurements and waveforms from system sensor data. Without System 1, the customer can use the CMM module to collect data to diagnose machinery issues when an alarm event occurs in the hardware.

For additional details, see the Condition Monitoring Module Datasheet (145M9028).

Specifications

Orbit 60 System

Full-Load Chassis	
Power Consumption	
3U 19" full load	Typical: 120 Watts Maximum: 180 Watts
6U 19" full load	Typical: 160 Watts Maximum: 300 Watts



The Orbit 60 Series system was qualified with the power supplies listed in datasheet 142M8947. Use of a reduced wattage power supply may result in changed behavior under fault conditions.

Characteristics	
3U Current Draw:	8.6 Amps Max
6U Current Draw:	14.3 Amps Max
Voltage Input	+21 to +32 Vdc
Out of Range Protection	An undervoltage does not harm the PIM. An overvoltage causes the replaceable fuse to open.
Chassis Loading	No minimum chassis loading is required.
Outputs	
Power OK LED	Input Voltage to PIM is within acceptable levels
Weight	
3U 19" Chassis	32 lbs (14.5 kg)
6U 19" Chassis	64 lbs (29.03 kg)

System Physical Dimensions

3U Standard Chassis (19")

See System Modules User Guide (142M9080) for detailed dimensions with illustrations.

Width	19" (48.26 cm)
Height	5.2" (13.21 cm)
Depth	9.67" (24.56 cm): panel and rack mount 9.76" (24.79 cm): bulkhead mount

6U Standard Chassis (19")

See System Modules User Guide (142M9080) for detailed dimensions with illustrations.

Width	19" (48.26 cm)
Height	10.45" (26.5 cm)
Depth	Depth values include mounted power supplies. 14.54" (36.94 cm): panel and rack mount 14.64" (37.18 cm): bulkhead mount

Single Wide Module

Width	0.8" (2.03 cm)
Height	5.2" (13.21 cm)
Depth	9.67" (24.56 cm)

Double Wide Module

Width	1.64" (4.17 cm)
Height	5.2" (13.21 cm)
Depth	9.67" (24.56 cm)

Environmental Limits (All Modules)

Environmental Limits	
Chassis Operating Temperature Range (indoor use only)	3U Chassis: -30°C to +70°C (-22°F to 158°F)  6U Chassis: -30°C to +65°C (-22°F to 149°F)   Temperatures over 50°C (122°F) require forced air convection with a minimum airspeed of 0.5 m/s.
Module Temperature Rating Certification	-30°C to +70°C (-22°F to 158°F)  When using a Bridge module in a 3U chassis, temperatures over 55°C (131°F) require forced air convection with a minimum airspeed of 0.5 m/s.  You must still meet the Chassis Operating Temperature Range defined above.
Storage Temperature Range	-40°C to +85°C (-40°F to 185°F)
Relative Humidity	0% to 95% rH non-condensing operating and storage
Vibration	Without Isolators: 0 g to 0.35 g @ 57-500 Hz With Isolators: 0 g to 5 g @ 57-500 Hz

Environmental Limits	
Shock	2" Incline Drop
Altitude	< 2000 m (6,562 ft)  Higher altitudes are possible but are site specific applications. Contact Bently Nevada support if you require higher altitudes.
Pollution Degree	Pollution Degree 2
Installation Category	Category II



Verify that temperature ratings on the wiring cables match the operating temperature range.



CAUTION

LOCATION TEMPERATURE AND HUMIDITY



While the system has been tested and capable of achieving the design life when operating in environments up to 70°C, whenever operating any electronics system in elevated humidity or temperatures exceeding 40°C, adding environmental controls maximizes the operational life of the system.

Communications Gateway

Communications Gateway (CGW)	
Power Consumption	
Maximum	10.2 Watts
Typical	6.8 Watts
Data Communications	
2 Ethernet ports - utility or rear side	Independent Ethernet ports 1000/100/10 Base-T Auto-negotiation
Connector	RJ-45
Cable Length	100 meters (328 feet) max
Updated Rate	
Modbus	50 ms
EDG	20 ms
PROFINET	100 ms
LEDs	
Module OK LED	Indicates when the module is functioning properly
System Communication LED	Indicates when the module is communicating to the rest of the system
Physical Characteristics	
Required Rack Space	1 Slot
PROFINET Protocol	
Maximum Data Output to PLC	1408 bytes
Output data types	Float (4 bytes), Integer (2 bytes), or single bytes (used for statuses)
Data Input from PLC	Not currently supported

Communications Gateway (CGW)

DCP (Discovery & Configuration Protocol) PLC support	Setting IP address; Setting Name of Station; Flash LED command
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Protection Processor Module

Protection Processor Module (PPM)

Power Consumption	
Typical	6.1 Watts
Maximum	9.7 Watts
Channel Types	

- Acceleration
- Case Expansion
- Differential Expansion
- Dynamic Pressure
- Process Variable
- Radial Vibration
- Recip Cylinder Pressure
- Recip Hyper Plunger
- Recip Impulse Acceleration
- Recip Piston Rod
- Recip Velocity
- Speed
- Temperature
- Thrust
- Valve Position
- Velocity

Measurements and Signal Processing

1X/2X/nX Amplitude and Phase	In a complex vibration signal, notations for signal components having frequencies equal to fractions of rotative speed. Also called subharmonic and subsynchronous.
Amplitude Extraction	Amplitude Extraction measurements can be based on synchronous or asynchronous sampling.

Protection Processor Module (PPM)	
Average Piston Position	This trended variable measures the average of the physical distance between the face of the proximity probe tip and the observed rod with respect to the zero position multiplied by the average correction factor. This measurement is computed over the full rotation of the compressor crankshaft. The system computes average piston position from a configured reference value (zero position) extrapolated from the measurement of the piston rod movement to piston movement inside the cylinder.
Bandpass	Adjustable lowpass and highpass corners based on the frequency range of the transducer.
Bias	Applicable to Acceleration and Velocity sensor inputs. The DC voltage used by the system as a bias for the transducer. Can be used as a diagnostic tool for evaluating system integrity. Note: The bias voltage measurement contains no information about the condition of the machinery being monitored. It is provided only for monitoring system diagnostics.

Protection Processor Module (PPM)	
Case Expansion	A measurement of the axial position of the machine casing relative to a fixed reference, usually the foundation. The measurement is typically made with a Linear Variable Differential Transformer installed on the foundation at the opposite end of the machine from the point where the casing is attached to the foundation. Changes in casing axial position are the result of thermal expansion and contraction of the casing during startup and shutdown.

Protection Processor Module (PPM)		Protection Processor Module (PPM)	
Complimentary Input DE (Composite of Differential Expansion Channel measurements)	Complementary Input Differential Expansion (CIDE) is a method of measuring Differential Expansion. Two proximity probes are mounted and gapped so that the measurement range is twice the range of a single proximity probe. One probe is in its linear range during the first half of the measurement range and the second probe is in range during the second half of the measurement range. The monitor is configured so that it will switch from one probe to the other probe when the gap voltages are at the switch point. The switch point is termed the Cross Over Voltage. The monitor uses the Direct static value from each probe to determine the overall expansion value. The overall expansion value is termed the Composite static value and it is the value used for machine protection and machinery management information.	Degrees of Rod Reversal	This measurement determines the minimum amount of rod load reversal required to properly lubricate the crosshead pin. Several forces such as gas load, inertial load, and friction load act upon the crosshead pin. When the gas load is positive, the crosshead pin is under tension, and when the gas load is negative, the crosshead pin is under compression. The degrees of rod reversal is the smaller value of tension or compression.
Compression Ratio	This measurement is the ratio of the indicated discharge pressure to the indicated suction pressure.	Differential Expansion	The measurement of the axial position of the rotor with respect to the machine casing at some distance from the thrust bearing. Changes in axial position relative to the casing affect axial clearances and are usually the result of thermal expansion during startup and shutdown. The measurement is typically made with a proximity probe transducer mounted to the machine casing and observing an axial surface (e.g., collar) of the rotor.
Crank Angle	This trended variable measures the point in the crankshaft rotation where the maximum position magnitude occurs.		

Protection Processor Module (PPM)	
Direct	Data or a signal which represents the original transducer signal without significant filtering. Sometimes called unfiltered, raw, all pass, or overall data or signal. Bently Nevada signal processing does some filtering to create "direct" data, but it still contains broadband frequency information.
Discharge Pressure, Indicated	For the head-end chamber, the indicated pressure at TDC (top dead center at 0°) is the indicated discharge pressure. For crank end chamber, the indicated pressure at BDC (bottom dead center at 180°) is the indicated discharge pressure.

Protection Processor Module (PPM)	
Dual Ramp (Composite)	Dual Ramp Differential Expansion is a method of measuring Differential Expansion and is a subset of a number of measurement methods, generally termed Ramp Differential Expansion, which make use of ramps to measure axial position. Two proximity probes observe different ramps. The two ramp sections must be mirror images with the same ramp angle. The two probes mount on the same side of the rotor and in the same axial plane. The monitor uses the direct static values from both channels to measure axial position and compensate for the effect of radial movement. The compensated result is termed the Composite static value and is the primary value used for machine protection and machinery management information.
Eccentricity	The radial displacement of the rotor journal centerline from the geometric center of a fluid lubricated bearing. Eccentricity is measured while the turbine is on slow roll (1 to 240 RPM below the speed at which the rotor becomes dynamic and rises in the bearing on the oil wedge) and requires special circuitry to detect the peak-to-peak motion of the shaft.

Protection Processor Module (PPM)	
Gap	The physical distance between the face of a proximity probe tip and the observed surface. The distance can be expressed in terms of displacement (mils, micrometres), or in terms of voltage (millivolts). Standard polarity convention dictates that a decreasing gap results in an increasing (less negative) output signal.
Instantaneous Piston Position	This trended variable measures the position of the rod with respect to the zero position times the correction factor when the rod is in its stroke position described by the configured trigger angle position. The system computes the instantaneous piston position from the configured reference value (zero position) extrapolated from the measurement of the piston rod movement to piston movement inside the cylinder.
Instantaneous Probe Gap	This trended variable measures the voltage representing the physical distance between the face of the proximity probe tip and the observed rod when it is in its stroke position described by the configured trigger angle position.

Protection Processor Module (PPM)	
Integration/RMS	Available for Velocity and Acceleration channels to be applied to Direct, Bandpass, 1X, 2X, nX an SMAX measurements.
Maximum Pressure, Indicated	The highest pressure over the complete revolution for a chamber. No filtering or other processing is applied.
Minimum Pressure, Indicated	The lowest pressure over the complete revolution for a chamber. No filtering or other processing is applied.
Non-Standard Single Ramp DE (Composite)	Nonstandard Single Ramp Differential Expansion is a method of measuring Differential Expansion and is a subset of a number of measurement methods, generally termed Ramp Differential Expansion, which make use of ramps to measure axial position. Two proximity probes observe the same ramp. The two probes are mounted on opposite sides of the rotor (180 degrees apart). The monitor uses the direct static values from both channels to measure axial position and compensate for the effect of radial movement. The compensated result is termed the Composite static value and is the primary value used for machine protection and machinery management information.

Protection Processor Module (PPM)	
Number of Reverse Rotation	Valid when the machine is spinning backwards and has exceeded the reverse speed setpoint, counting revolutions.
Peak Crosshead Pin Compression and Tension	Several forces such as gas load, inertial load, and friction load act upon the crosshead pin. When the gas load is positive, the crosshead pin is under tension, and when the gas load is negative, the crosshead pin is under compression. Peak Crosshead Pin Tension is the largest value of the combined load of these forces when the crosshead pin is under tension. Peak Crosshead Pin Compression is the smallest value of the combined load when the crosshead pin is under compression.
Position	Position has a variety of applications. For the Thrust and Differential Expansion it is the change in axial direction with respect to a fixed reference. Also used in Case Expansion to measure case growth and Valve Position to measure how open or closed a valve is.

Protection Processor Module (PPM)	
Position Angle	This trended variable measures the angle made by the vector representation of the maximum position magnitude referenced from the top of the piston rod in a clockwise direction when viewed from the crank end towards the cylinder. The top of piston rod is identified as 0° position angle. Position Angle provides an indication of the direction of rod movement relative to bore center. For a single vertical probe, this position angle will be 0° when piston rod is above bore center, or 180° when piston rod is below bore center.
Position Magnitude	This trended variable measures the maximum displacement of piston rod relative to the calculated hot bore center reference. The cylinder bore geometric center is calculated based on piston material, expected operating temperatures, and measured bottom and top piston to cylinder wall clearances.
Process Variable	The Process Variable Channel accepts current and voltage proportional inputs from a transmitter for the purpose of monitoring process variables (temperature, pressure, flow, etc.).

Protection Processor Module (PPM)	
Reverse Peak Speed	Valid when the machine is spinning backwards and has exceeded the reverse speed setpoint, storing the highest achieved reverse speed.
Reverse Speed	Valid when the machine is spinning backwards. This measurement behaves like a typical speed measurement.
Rotor Acceleration	Rotor acceleration is a ramp rate of a rotor (in rpm / min) as its speed increases from zero rpm to the machine's running speed value.
Shaft Absolute	Shaft Absolute vibration is the measurement of the shaft motion referenced to free space. It is measured using a vector summation of shaft relative motion and bearing seismic motion. A proximity sensor and an integrated velocity sensor must be mounted at the same location. Shaft Absolute Direct and IX measurements are available on Radial Vibration channels.
SMAX	Measurement of the maximum excursion from an axial position.
Spectral Peak Detection - Async	This measurement includes two trended variables: the amplitude and frequency of the highest peak within the configured spectral band.
Speed	Measurement of the rate of rotational motion.

Protection Processor Module (PPM)	
Standard Single Ramp DE (Composite)	Standard Single Ramp Differential Expansion is a method of measuring Differential Expansion and is a subset of a number of measurement methods, generally termed Ramp Differential Expansion, which make use of ramps to measure axial position. One proximity probe, termed the ramp transducer, observes a ramp and the other probe, termed the flat transducer, observes the shaft. The two probes are mounted on the same side of the rotor and in the same axial plane. The ramp transducer measures axial position and the flat transducer measures radial position. The monitor uses the flat channel Direct static value to compensate the ramp channel Direct static value for the effect of radial movement. The compensated result is termed the Composite static value and is the primary value used for machine protection and machinery management information.

Protection Processor Module (PPM)	
Suction Pressure, Indicated	For the head-end chamber, the indicated pressure at BDC (bottom dead center at 180°) is the indicated suction pressure. For crank end chamber, the indicated pressure at TDC (top dead center at 0°) is the indicated suction pressure.
Valve Position	Measurement of the percentage open or closed of a valve.
Zero Speed	A channel whose transducer is used to monitor the shaft rotational speed of a large rotor machine in revolutions per minute (under 100 rpm) below which the turning gear engagement can safely occur. Continuous shaft rotation during machine shutdown is imperative to prevent shaft bow that could lead to possible machine damage during startup. The channel receives a signal from a transducer whose output frequency is proportional to the speed of a rotor.
Alarming	
Alarm Time Delays	100 ms to 60 sec for vibration and position measurements. 1 sec to 60 sec for speed measurements.
Setpoints	Four setpoint levels available at a each measurement.

Protection Processor Module (PPM)	
Protection States	Up to 32 Protection States that be controlled by Discrete contacts or configurable measurement ranges. Alarm setpoints are adjustable for different Protection States.

Acceleration Channel	
Direct/Bandpass	
Accuracy (2-wire A+/B- inputs)	Within $\pm 0.33\%$ of full-scale typical $\pm 1\%$ maximum up to 20 kHz $\pm 2\%$ maximum up to 40 kHz
Integration	Option allowed
Units	g pk g rms m/s² pk m/s² rms
Integrated Units	in/s pk in/s rms mm/s pk mm/s rms
Low Pass Poles	1, 2, 4, 6, 8
Low Pass Corner Frequency	0.0626 – 40,000 Hz Must be greater than high pass frequency and below Upper Transducer Frequency Response.
High Pass Poles	1, 2, 4, 6, 8

Compliance and Certifications

FCC

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

EMC

European Community Directive:

EMC Directive 2014/30/EU

Standards:

EN 61000-6-2; Immunity for
Industrial Environments
EN 61000-6-4; Emissions for
Industrial Environments

Electrical Safety

European Community Directive:

LV Directive 2014/35/EU

Standards:

EN 61010-1;
EN 61010-2-201;

†India – Battery EPR Marking

GE Oil & Gas India Private Limited

EPR Certificate No.: 1.1595372902047E+20

†Applies to 60R/BRG01, 60R/CGW01
60R/SIM01, 60R/PPM01, and
60R/CMM01

RoHS

European Community Directive:

RoHS Directive 2011/65/EU

Cyber Security

Designed to meet IEC 62443-4-2

*Maritime

ABS Rules for Condition of Classification,
Part 1

- Steel Vessels Rules
- Offshore Units and Structures

*Recorder Output module, Bridge
module, and 6U systems
approvals pending

Functional Safety

SIL 1 Certified / SIL 2 Capable

See the *Orbit 60 Series SIL User Guide*
(134M0398) for details regarding SIL
implementation for SIL 1 simplex and SIL 2
redundancy applications.

PROFINET Field Device Certification Standards

PROFINET V2.4MU3

Hazardous Area Approvals



For the detailed listing of country and product-specific approvals, refer to the [Approvals Quick Reference Guide \(108M1756\)](#).

For additional technical documentation, please log in to bntechsupport.com and access the Bently Nevada Media Library.

cNRTLus

Class I, Zone 2: AEx/Ex ec nC IIC T4 Gc;
Class I, Zone 2: AEx/Ex nA nC IIC T4 Gc;
Class I, Division 2, Groups A, B, C, D T4;
Class I, Division 2, Groups A, B, C, D T4
(N.I.);

T4 @ Ta= -30°C to +70°C (-22°F to +158°F)

ATEX/IECEx



II 3 G
Ex ec nC IIC T4 Gc
Ex nA nC IIC T4 Gc

T4 @ Ta= -30°C to +70°C (-22°F to +158°F)

Ordering Option	Description
XXX	Country Specific Approvals

B – SIL Level

0	No SIL
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System Interface Module

Ordering Option	Description
60R/SIM01-AAA-B • System Interface Module	

AAA – Hazardous Area Certifications

00	No Hazardous Area
01	CSA/NRTL/C (Class I, Div 2)
02	Multi (CSA, ATEX, IECEx)
XXX	Country Specific Approvals

B – SIL Level

0	No SIL
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For an Orbit 60 safety system, SIL certification for the SIM is not required.

Communications Gateway Module

Ordering Option	Description
60R/CGW01-AAA-B • RJ-45 Ethernet Comm Gateway	

AAA – Hazardous Area Certifications

00	No Hazardous Area
01	CSA/NRTL/C (Class I, Div 2)
02	Multi (CSA, ATEX, IECEx)

Ordering Option	Description
XXX	Country Specific Approvals

B – SIL Level

0	No SIL
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Protection Processor Module

Ordering Option	Description
60R/PPM01-AAA-B • Protection Processor Module	

AAA – Hazardous Area Certifications

00	No Hazardous Area
01	CSA/NRTL/C (Class I, Div 2)
02	Multi (CSA, ATEX, IECEx)
XXX	Country Specific Approvals

B – SIL Level

0	No SIL
2	SIL 2

Condition Monitoring Module

Ordering Option	Description
60R/CMM01-AAA-B (Two-Slot)	

AAA – Hazardous Area Certifications

00	No Hazardous Area
01	CSA/NRTL/C (Class I, Div 2)
02	Multi (CSA, ATEX, IECEx)
XXX	Country Specific Approvals

B – SIL Level

0	No SIL
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