



ORBIT 60 SERIES

3500 Retrofit

Technical White Paper

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1. Overview

This document provides general recommendations when replacing an existing Bently Nevada 3500 monitoring system with an Orbit 60 system, where existing 3500 systems are 19-inch EIA rack mount, panel mount, and bulkhead mount installations. Although this document provides general installation guidelines, each installation is unique and must be evaluated on an individual basis. Replacement of other rack-based systems, such as Bently Nevada 3300, Encore, or competitor systems will be similar, but this document does not describe the specifics of upgrading those systems.

2. References

- Comparison of Orbit 60 Series and 3500 White Paper (142M3829)
- Orbit 60 Relay Modules Datasheet (137M0699)
- Orbit 60 Bridging White Paper (148M0693)

3. Application considerations

Customer Intent

The extent of the rack replacement depends on the customer's retrofit goals. These typically fall into one of the following categories:

1. **Modernization** – The existing 3500 installation meets all of the customer's needs, but the system has exceeded its operational life. For SIL installations, this is the defined mission life of the system. An Orbit 60 retrofit installation should generally match functionality 1:1 with the existing system, and the customer does not need or desire advanced features.
2. **Functionality upgrade** – The current 3500 system does not meet the functional needs of the application (for example, using a 3500 to monitor a REB-based balance of plant equipment). For these applications, the system design is similar to a new application and may include sensors, field wiring, and new functionality as needed.
3. **Capacity addition** – Upgrading that includes adding functionality/sensors or machines into the monitoring system. Orbit 60 installations for these retrofits should align with existing installation parameters.
4. **Controls upgrade** – When upgrading as part of a larger machinery retrofit effort, the Orbit 60 installation can be considered as a new installation. All aspects of the installation, other than rack location can be considered, for example, remote I/O.

Installation discovery

Addressing the questions below will help ensure a smooth transition during any retrofit installation. Many of these questions will drive the installation scope but will not drive Orbit 60 specific activities. These may include the following: (not a complete list)

- Is there a System 1 or TDI secure present?
- Are there any Custom Products modifications to the system?
- What type of Comm Gateway is used?
- Is signal ground tied to the TDI I/O?
- Is any device connected to the BTO Module?
- Is there an earthing module used in the system?
- Are there any triple modular redundant elements in the system?
- Are any multi-mode I/Os used (Hydro or Aeroderivative applications)?
- Are there any unsupported applications utilized for release 1? This would include Hydro, Reciprocating compressors, Haz Gas, or Overspeed.

In addition to these general questions, there are differences in Orbit 60 that will drive additional scope or effort to complete the retrofit.

Relays

Which type of relay is right for an application?

Use a solid state relay (SSR) for dry contact/control system input applications and an electromechanical relay (EMR) for load switching.

If the load cannot be determined, understanding the installed 3500 module will yield a reasonable guess. Any application connected to a load (an interposing relay, indicator light, for example) should use an Orbit 60 electromechanical relay. Any 3500 installations connected to a digital input of another system or installed using the gold-plated relay contact modification should use an Orbit 60 solid state relay.

Recorder outs

How many recorder outputs from the 3500 system are used?

Orbit 60 input modules do not include recorder outputs. If the installation uses recorder outputs, then include Orbit 60 Recorder Output modules. Ensure you account for these Recorder Output modules in the chassis slot count. Recorder Output modules provide eight channels per card.

External termination blocks

Does the existing 3500 system use external termination blocks?

If yes, [see External termination blocks on page 10.](#)

Internal Barriers

Does the existing 3500 system include internal barrier I/O modules?

If yes, [see Hazardous areas on page 9.](#)

Hazardous area implementation

Does the existing installation involve hazardous area certifications?

The scheme used to meet the installation criteria must be understood, nL, nA, Ic, Ec. [See Hazardous areas on page 9.](#) for details.

Power supply availability

Unlike 3500, Orbit 60 uses commercial, off-the-shelf, 24 V power supplies. For retrofit applications, use redundant power supplies at 400 watts each for single 6U chassis, and 200 watts each for single 3U chassis. Power supplies are available as part of the Orbit 60 Series retrofit options:

240W Power Supply for 3U chassis

60X/XPS01	with options for: <ul style="list-style-type: none">• Country-specific codes
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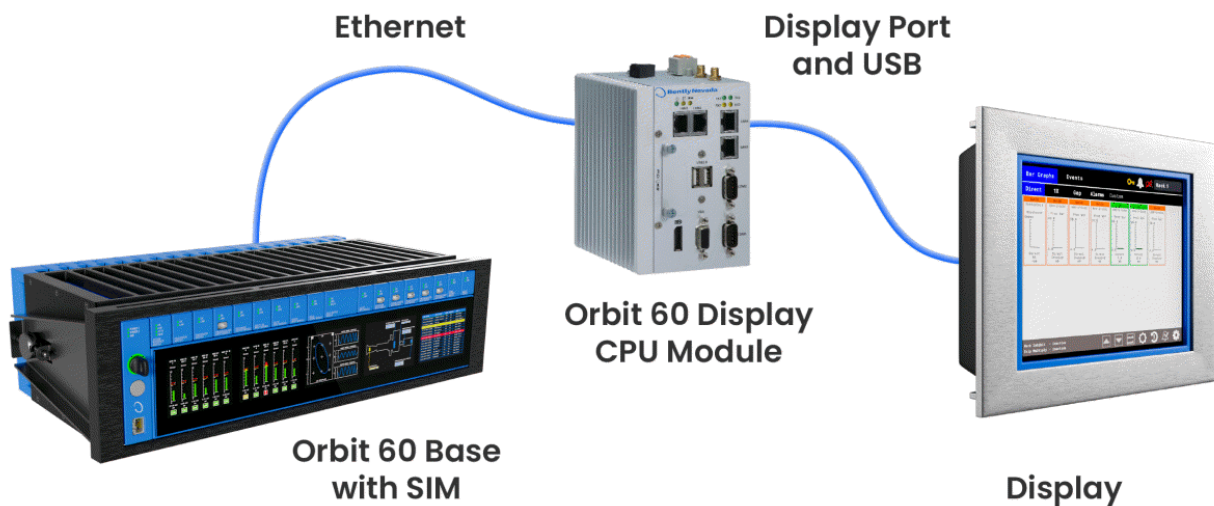
480W Power Supply for 6U chassis

60X/XPS02	with options for: <ul style="list-style-type: none">• Country-specific codes
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Display

Does the existing installation utilize a Bently provided display?

Unlike the 3500, an Orbit 60 display does not take up a slot in the chassis, but utilizes an external DIN rail-mounted industrial PC to drive the display. If a display is shared by multiple 3500 systems, only one of these devices needs to be installed.



4. Physical replacement options

3500 replacements should generally use a 6U x 19-inch Orbit 60 Chassis. Smaller point count 3500 applications may be able to use a 3U x 19-inch chassis from a point count and capacity perspective. However, Bently Nevada's recommendation is to always use the 6U base to fill in the panel/cabinet space and use the integral mounting of power supplies.



Panel mount

The Orbit 60 6U x 19-inch chassis fits directly into the space used by a 3500 panel mount system. You should not expect the need to make panel modifications. The 60R/CHA05-XXX-X chassis provides the necessary mounting fixtures to support the system in a panel mount.

19-inch EIA rack mount

For rack mount installations, the Orbit 60 6Ux19-inch rack fits directly into the same space as the 3500 system. A 60R/CHA04-XXX-X chassis can retrofit a rack-mounted 3500 installation. This ordering option contains all the necessary items to rack mount the Orbit 60 system.

Bulkhead mount

The 3500-bulkhead installation uses a 12U space when installed. The Orbit 60 system only uses 6U. Other components such as barriers, isolators, or a display computer can occupy the additional space. Bulkhead installations use part number 60R/CHA06-XXX-X and include the mounting hardware necessary for bulkhead mounting of the system.

5. Protection systems

For systems that provide shutdown functionality, either through direct wiring of relays or through the communication of measurements the control system uses to trip, consider the following system aspects:

While the Orbit 60 system has high availability and high reliability when implemented in either a basic simplex or in more complex redundant deployments, Bently Nevada recommends that all applications of the Orbit 60 system for protection follow the guidelines below:

1. Use relays as the Orbit 60 protection output.
2. Monitor the SIM's protection Fault Relay to validate that the system is protecting the machine.
3. Use redundant protection processor modules to allow fault tolerance and system repair if a module fails.
4. All elements leading to a protection output should be resident within a single chassis.
5. Use redundant Power Input Modules (PIM) on each each chassis with each PIM wired to separate power supplies using functionally independent external 24 V power sources.
6. Wire sensors on the same location on the shaft to separate input modules (e.g., X probes and Y probes from the same bearing wired to separate input modules).

6. API 670 deployments

This section describes monitoring and protection of a typical API 670 compressor for definition and discussion purposes.

API - Motor-Gearbox-Compressor

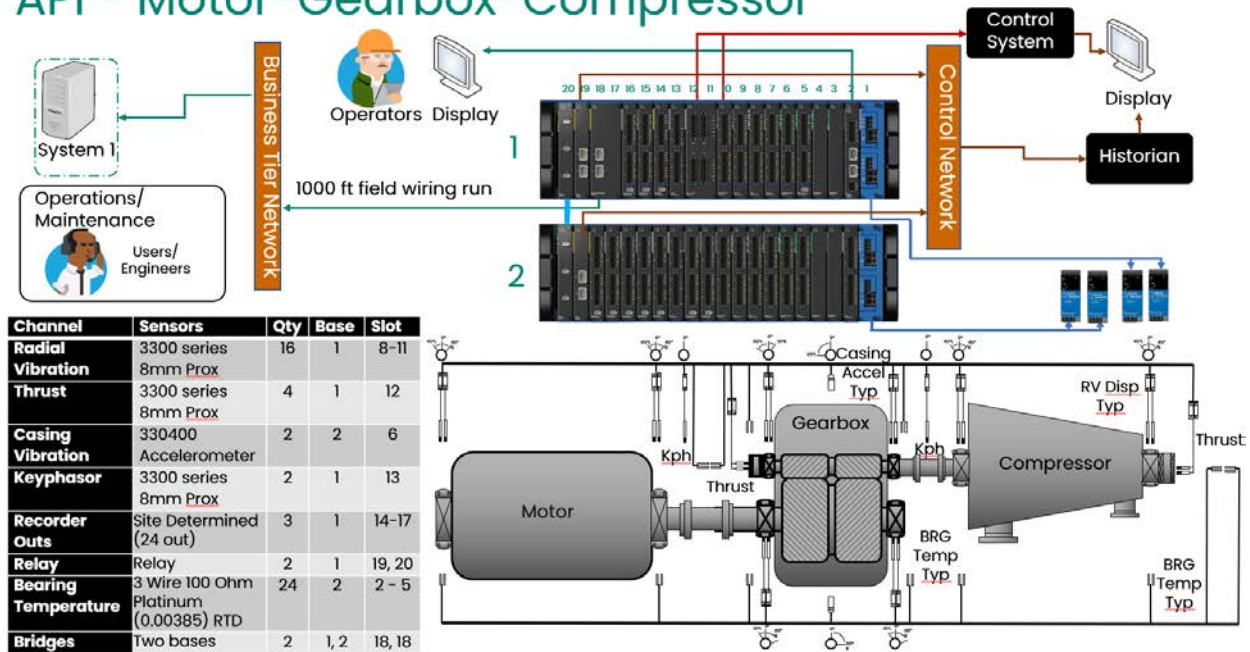


Figure 1: Monitoring and Protection Scheme for Typical API 670 Compressor

Single chassis Installations

For single chassis installations, including the 3U x 19-inch, the 6U x 19-inch and the 3U x 12-inch chassis, the deployment should include the following recommended components:

1. Two redundant Power Input Modules (PIM)
2. Two redundant, independent 24-V Power Supplies
3. Two redundant Protection Processing Modules (PPM)
4. Electro-Mechanical relay (EMR) (Solid State Relay is also valid, if requested)
5. Connection of protection fault relay
6. Single machine train and protection group per system
7. X and Y vibration sensors from a common bearing wired to separate input modules

Multiple chassis Installations

Deployment of installations with two or more chassis bridged together should include the components recommended for single chassis installations listed above and:

1. One PPM per chassis, providing redundancy and single point failure tolerance
2. One relay per chassis with one relay channel per module in series to drive trip
3. A Protection fault relay connected to a customer system for notification
4. Triple redundant bridge (BRG) cables

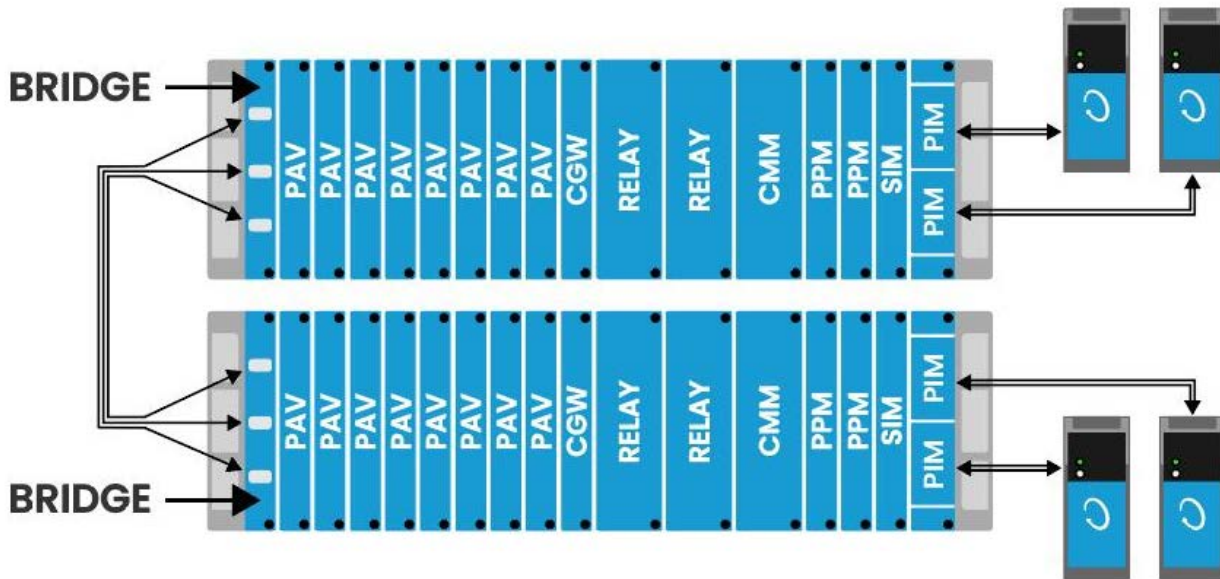


Figure 2: Redundant Monitoring and Protection Scheme Diagram

7. Hazardous areas

Orbit 60 meets or exceeds the hazardous area classifications of the 3500, but regulatory changes necessitate specific differences in implementation. You must evaluate each hazardous area installation prior to retrofit. The installation allowances and calculations for the 3500 system may not be sufficient to allow the installation of an Orbit 60 in the same manner.

1. **Installations using 3500 internal barrier I/O modules** – If the existing installation uses the 3500 I/O modules with internal barriers, the retrofit scope must include services scope for an entity parameter evaluation of the installed sensors as well as the purchase and installation of external barriers. In release 1 of the product, there are no internal barriers. Physical room for external barrier modules must be provided.
2. **Installations using external barriers or isolators** – If the retrofit currently uses non-BN barriers or isolators and does not require replacement for the existing barriers/isolators, no modification is required to retrofit the existing 3500 system.
3. **Installations that follow the nL (non-incendive) implementation** – These are Hazardous area installations with sensors wired directly to non-internal barrier I/O modules. This method of achieving hazardous area safety is no longer supported outside of North America. An existing nL solution cannot be grandfathered in using an Orbit 60 device. A retrofit of this type of installation must include services scope for a technical evaluation of the installation. There are three primary methods to retrofit these installations:
 - **Use external barriers (ic or ia protection scheme)**
The specifics of the installation must be evaluated to ensure the chosen barrier meets or exceeds the entity parameters the 3500 installation provided. Appropriate Earthing Ground requires review or modification of the system ground connection capabilities.
 - **Use isolators**
An external power supply with the capacity to power the isolator is required. Space within the installation for installing the isolators and power supplies is required.
 - **Use nA or Ec protection scheme**
Field wiring changes are required to meet the specifics of this scheme, including field wiring in conduits, IP54 junction boxes, and so on.

8. Field Wiring

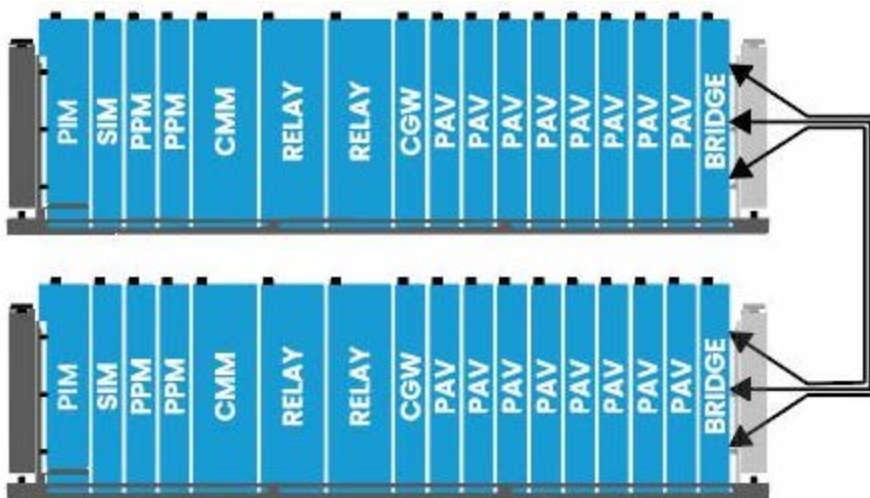
Retrofit applications will generally not alter field wiring. Retrofits must interface to the existing transducer wiring rather than using advanced features such as remote I/O bridging solutions.

To avoid future issues with insulation, aging, and terminations leading to sensor signal integrity issues, it is Bently Nevada's recommendation that all field wiring greater than 20 years old is replaced as a part of the retrofit. While the field wiring may be acceptable at the time of the retrofit, the operational life of the Orbit 60 installation will be in excess of 15 years, leading to a total field wiring lifespan of greater than 35 years.

External termination blocks

3500 retrofitted installations that utilize external termination blocks as part of the installation have two options:

1. Bridged chassis – existing 3500 External Termination Blocks are removed, and one or more Orbit 60 chassis are installed in that location. The chassis contains only input modules and a bridge module, and the field wiring from the ETB is landed at these modules. The existing ETB cables are removed and replaced with bridge cables connecting the input chassis to the main monitoring system chassis.



2. The existing ETBs are left in place and the existing D-sub cables are modified by removing the 3500 input module end of the cable and the individual conductors are landed to Orbit 60 Input modules.

9. Transducers

It is Bently Nevada's recommendation that any 3500 installation connected to sensors that are more than 15 years old should have the transducers replaced as part of the upgrade. 3000 series proximity sensors are not supported within the Orbit 60 platform.

Input Module Type	Supported Transducer Types	Number of Channels
Negative Dynamic Input (PAV)	3-wire (-) Accel 3-wire (-) Prox 2-wire Velomitor 2-wire IEPE Magnetic pickup	4
Negative Dynamic Input (PAS)	3-wire (-) Accel 3-wire (-) Prox Seismoprobe Magnetic pickup	4
Negative Dynamic Input (PAA)	3-wire (-) Accel 3-wire (-) Prox Magnetic pickup HTVAS Acceleration Interface Module	4
Negative Dynamic Input (PAD)	3-wire (-) Prox 3-wire (-) Accel DC LVDT	4
Positive Voltage Dynamic Input (PVT)	3-wire (+) Accel 3-wire (+) Prox 2-wire IEPE	4
High Speed Keyphasor	3-wire Accel 3-wire Prox Magnetic pickup	4
AC LVDT Input	4-wire AC LVDT 5-wire AC LVDT 6-wire AC LVDT	4
RTD / TC Input	Type J, K, E, T 3-wire RTD	6
Isolated TC Input	Type J, K, E, T	6
Isolated Discrete Input /Process Variable	4-20 mA -10 V to +10 V Dry/wet contacts	6



Four channel RTDs are not supported in the Orbit 60 system. These devices will have to be wired into Orbit 60 as 3 wire RTDs

10. Glossary of Terms

Accel	Acceleration	PVD	Isolated Process Variable, Discrete Input
Aero	Aeroderivative	PVT	Positive Voltage Transducer
API	American Petroleum Institute	REB	Roller Element Bearing
BRG	Bridge	REC	Recorder Outputs
BTO	Buffered Transducer Output	RMC	Remote Monitoring Center
CGW	Communication Gateway Module	RST	Reset
CMM	Condition Monitoring Module	RTD	Resistance Temperature Detector
COM	Common	SAI	System Alarm Inhibit
DCS	Distributed Control Systems	SHLD	Shield
EGD	Ethernet Global Data protocol	SIL	Safety Integrity Level
ESD	Emergency Shutdown Device	SIM	System Interface Module
EIA	Energy Information Administration	SSR	Solid State Relay
EMR	electromechanical Relay	SW	Software
HAZLOC	Hazardous Location	TC	Thermocouple
HTVAS	High Temperature Velocity/Accel Sensor	TLS	Transport Layer Security
I/O	Input/Output	RTD/TC	Resistance Temp Detector / Thermocouple
IEPE	Integrated Electronics Piezo-Electric	TCP/IP	Transmission Control Protocol Internet Protocol
ITC	Isolated Thermocouple	TM	Trip Multiply
KPH	High Speed Keyphasor	OEM	Original Equipment Manufacturer
LVDT	Linear Variable Differential Transformer	Velom	Velomitor
NC	Normally Closed		
NEMA	National Electrical Manufacturers Association		
NO	Normally Opened		
NTP	Network Time Protocol		
OEM	Original Equipment Manufacturer		
PAA	Prox, Accel, Aero		
PAD	Prox, Accel, DC LVDT		
PAS	Prox, Accel, Seismic		
PAV	Prox, Accel, Velom		
PIM	Power Input Module		
PLC	Programmable Logic Controller		
PPM	Protection Processing Module		
Prox	Proximitor		

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