3701/46 ADAPT Hydro Monitor

Datasheet

Bently Nevada Machinery Condition Monitoring

103M9138 Rev. J

Advanced Distributed Architecture Platform Technology - ADAPT

The Bently Nevada Advanced Distributed Architecture Platform Technology, or ADAPT 3701, is a family of compact, high performance safety and machinery protection and condition monitoring solutions. ADAPT products are targeted at specific assets and applications, and excel at the intensive signal processing necessary to identify early indicators of machine failure modes long before an alarm.

Description

The ADAPT 3701/46 Hydro Monitor is designed specifically for protection and condition monitoring on Hydro Turbines. It is optimized for the lower speeds of hydro turbines and has specialized measurements to detect rough load zone, propeller, blade, or bucket nX frequencies and cavitation as well as conventional measurements of shaft radial position and vibration, thrust position, and absolute vibration using accelerometers or velocity sensors.

The compact size and channel count of the 3701/46 Hydro Monitor make it well suited for hydro turbines requiring no more than 12 sensor points. Hydro turbines in this category can range in size and type but are most commonly smaller units.

The 3701/46 is configured and validated with Bently Nevada Monitor Configuration (BNMC) software. BNMC is a simple and powerful configuration and validation environment that is licensed per computer. One license can configure an unlimited number of Bently Nevada 3701 monitoring systems. It is ordered separately and is required for operation.

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3701/46 Overview

The 3701/46 is a robust, compact, self-contained 12-channel device with sophisticated signal processing capability and with a form-factor suitable for distribution close to individual hydro machines. It has a modular construction that allows field changing of components and is fully-configurable. It combines protection and condition monitoring (CM) in a single package. With the ability to define measurements and alarms within the monitor itself, it can act as a stand-alone protection and CM system. There is no need for any interaction with external software to trigger or control the monitor during operation.

3701 Digital Communications

The 3701/46 has two independent Ethernet physical RJ45 connections per CPU for digital communication with Bently Nevada software products hosted on network computers and plant automation systems. It uses a proprietary Ethernet protocol for communicating with System_1_Evolution software and the BNMC configuration software.

The 3701/46 includes two independently addressable Ethernet ports which provide Ethernet TCP/IP communications capabilities. Standard industrial protocols are:

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The 3701/46 Hydro Monitor is a self-contained device that is ordered with a single part number and is made up of these major components:

Part	Quantity Required in each 3701/46
3701 Terminal Base	1
3701 Processor Module	1
3701 Input Module	1 or 2
3701 Output Module	1 or none

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- Modbus TCP/IP
- Ethernet Global Data (EGD)

Modbus over Ethernet is available for connection to HMI's, unit control systems, or other plant automation equipment. The 3701 can only be configured as a server.

EGD is a GE protocol used on Mark VI and Mark Vie controllers and by GE Programmable Automation Controllers and certain 3rd party automation equipment.

3701/46 System Description

The 3701/46 monitor is powered by single or dual redundant external +24 V DC power. It consists of four main physical components: the terminal base (single or dual), one or two processor modules, one or two input modules, and an output module.

The terminal base is the mounting platform for the monitor. The different modules install into the terminal base and two pluggable field wiring termination blocks plug into the terminal base. Sensor wiring terminates on the wiring blocks and terminations for discrete inputs (Reset, Trip Multiply, etc.) terminate directly on the base but on the opposite side from sensor wiring.

The processor module is the monitor's CPU. It is the center of the logic and signal processing for the monitor.

The input modules are the interface to the sensors. Each input module type covers multiple sensor varieties but due to the number of sensor types there are different input modules. The input modules condition the analog sensor signals for delivery to A/D conversion on the processor module. The input modules are simple, reliable, analog circuitry but with a simple microcontroller (outside the protection path) to provide diagnostics and fault detection on each module. Buffered transducer outputs are provided at a multi-pin D-sub connector on each input module. An accessory cable is available to fan the buffered outs to BNC or ADRE 408 DSPi compatible connectors.

The output modules provides 8 programmable SPDT relays and a dedicated monitor Protection Fault (OK) Relay. Relay logic is created in the BNMC software using the graphical logic editor.

Processor Module

The processor module, or CPU module, performs A/D conversion, digital signal processing, alarm and logic processing, and communications to Bently Nevada software and plant automation systems. The CPU module employs sophisticated diagnostics and fault detection processing to enhance reliability, availability, and maintainability of the protection and monitoring system.

Input Modules

3701 Proximitor Accelerometer Velomitor (PAV) Input Module

The 3701 PAV input module is a 6-channel + Keyphasor/speed input module that interfaces to a variety of sensors such as: -24 Volt Proximitor sensors, -24 Volt 3-wire Accelerometers, Velomitors, and constant current 2-wire sensors that are compatible with the -24 Volt 2-wire Velomitor interface.

Any of the PAV's six channels (1 – 6) can be independently configured for one of the supported transducers. Each PAV supports one dedicated Keyphasor or speed measurement on channel 7 that is configurable for Proximitor sensors or magnetic pick-ups.

3701 Proximitor Accelerometer Seismic (PAS) Input Module

The 3701 PAS input module is a 6-channel + Keyphasor/speed input module that interfaces to a variety of sensors such as: -24 Volt Proximitor sensors, -24 Volt 3-wire Accelerometers, 2-wire Seismoprobes and compatible 3rd party inertial mass velocity sensors, or dynamic pressure sensors.

Any of the PAS's six channels (1 – 6) can be independently configured for one of the supported transducers. Each PAS supports one dedicated Keyphasor or speed measurement on channel 7 that is configurable for Proximitor sensors or magnetic pick-ups.

3701 Positive (PoV) Input Module

The 3701 PoV input module is a 6-channel + Keyphasor/speed input module that interfaces

to a variety of positively powered sensors such as: +24 V Proximitor sensors, +24 V Interface modules, and 2 wire IEPE sensors using 3.3 mA constant current.

Any of the PoV's six channels (1-6) can be independently configured for one of the supported transducers. Each PoV supports one dedicated negatively powered Keyphasor or speed measurement on channel 7 that is configurable for Proximitor sensors or magnetic pick-ups.

Output Modules

3701 8-Channel Relay Output Module

The 3701 8-Ch Relay Output Module provides 8 SPDT relay outputs or 4 "virtual" DPDT outputs and a dedicated Protection Fault relay. Relay logic is user programmable in the BNMC software using the graphical logic editor. The processor module operates on the relay logic to drive relay state.

The Protection Fault relay is a normally energized SPDT relay that will de-energize on fault conditions that can compromise the monitor's availability to protect machinery. The protection fault relay is similar to a traditional OK relay but certain conditions that do not compromise protection will not cause the Protection Fault relay to de-energize.

The relays are configured for Normally De-Energized (NDE) or Normally Energized (NE) in four banks of two relays each using a switch on the relay module.

Relay wiring terminates on the output module using pluggable connectors and exits on the opposite side of the monitor from the sensor inputs.

Terminal Base

3701 Simplex Terminal Base

The term "simplex terminal base" identifies, or distinguishes this type of terminal base as one with a single (simplex) processor module as opposed to a dual (or duplex) terminal base with two processor modules.

The 3701 simplex terminal base is the mounting and installation component of the monitor. It supports a single processor module, one or two input modules, and an output module.

The terminal base mounts to a bulkhead, or enclosure or wall sub-panel using the four mounting holes at the corners of the base. Mount vertically for optimal convection cooling.

Terminal base features:

- Two plugable terminal blocks provide sensor wiring terminations that are individually marked for the sensor wire type. The termination blocks can be removed for wiring ease or maintenance work and, when installed, are fixed in place with a locking mechanism.
- A dedicated connection terminal for single point connection to system earth.
- A single point earth connection switch to separate physical (chassis) earth from system common (instrument earth) to enable system common connection to an external intrinsic safety earth.
- Primary and secondary connectors for single or redundant +24 V DC power input.
- Six discrete inputs (DI) for dedicated dry contact DIs: Trip Multiply, Alarm/Relay Inhibit, Latch Reset, Special Alarm Inhibit, Run Mode, and IP/Account reset.

Channel Types, Sensors, and Measurements

The 3701/46 Hydro Monitor supports a set of standard channel types and the common sensors used with those channel types as well as custom configurable sensors. Support for sensor types is dependent on input module type as listed in tables located below in this datasheet section. Each channel type has default measurements that can be enabled or disabled and each channel type can have user customizable nX and bandpass measurements added to the channel and then customized to the application.

The 3701/46 can have up to 12 vibration input channels (Six per input module) and 2 Keyphasor/Speed inputs (One per input module). The monitor supports the channel types listed here:

- Acceleration
- Dynamic Pressure
- Radial Vibration
- Thrust Position
- Velocity
- Keyphasor/Speed

Input Module

Table 1: Channel Type Support by Input Module

Input Module	Channel Types
PAS Channels 1-6	Acceleration Radial Vibration Thrust Position Velocity Proximitor Speed
PAS Channel 7	Keyphasor/Speed (Proximitors, single and multi-event or Mag pickup, single and multi-event).
PAV Channels 1-6	Acceleration Dynamic Pressure Radial Vibration Thrust Position Velocity Proximitor Speed
PAV Channel 7	Keyphasor/Speed (Proximitors, single and multi-event or Mag pickup, single and multi-event).
PoV Channels 1-6	Acceleration Dynamic Pressure Radial Vibration Thrust Position Velocity
PoV Channel 7	Keyphasor/Speed (Proximitors, single and multi-event or Mag pickup, single and multi-event).

PAV and PAS channels 1–6 can also be configured to support an additional Keyphasor input provided it is a single event per revolution, less than 10,000 rpm, and uses a Proximitor sensor. This cannot be done with the PoV module.

Input Module Compatibility

Table 2: Input Module Compatibility with Acceleration Inputs

Input Module	Accelerometer or Accelerometer Interface Module
PAS	155023-01 High Freq 200g Accel I/F Module 23733-03 Accel I/F Module 24145-02 High-Freq Accel I/F Module 330400 100 mV/g Accelerometer 330425 25 mV/g Accelerometer 330450 High Temp Accelerometer 350501 Acceleration Charge Amplifier 350900 High Temp Velocity & Acceleration 49578-01 Accel I/F Module Custom
PAV	155023-01 High Freq 200g Accel I/F Module 23733-03 Accel I/F Module 24145-02 High-Freq Accel I/F Module 330400 100 mV/g Accelerometer 330425 25 mV/g Accelerometer 330450 High Temp Accelerometer 350501 Acceleration Charge Amplifier 49578-01 Accel I/F Module Custom
PoV	GSI 122, 124 and 127 Galvanic

Input Module	Accelerometer or Accelerometer Interface Module
	Interface Unit
	TP100 Commtest Accelerometer
	TP500 Commtest Accelerometer
	200350 Accelerometer
	200355 Accelerometer
	786-500 Wilcoxon Accelerometer
	626B02 PCB Accelerometer
	HS-170 Hansford Accelerometer
	HS-100F series Hansford Accelerometer
	CMSS-2100 SKF Accelerometer
	351M35 PCB Accelerometer

Table 3: Input Module Compatibility with Velocity Inputs

Input Module	Velomitors and Interface Modules
PAS	9200 Seismoprobe 74712 Hi Temp Seismoprobe 47633 Seismoprobe 86205 BoP Seismoprobe Custom
>PAV	330500 Velomitor 330525 Velomitor XA 190501 Velomitor CT 330750 High Temp Velomitor 330752 High Temp Velomitor 330505 Low Freq Velocity Sensor 330530 Radiation Resistant Velomitor Custom
PoV	HS-160 Hansford Velocity Sensor

Table 4: Input Module Compatibility with Proximitor Sensors

Input Module	Proximitor Sensor
PAS or PAV PoV (Keyphasor)	3300XL 8 & 11 mm 3300XL NSV 3300 RAM Proximitor 3300 5 & 8 mm 3300 16mm HTPS 7200 5, 8, 11, 14 mm Custom

Table 5: Input Module Compatibility with Dynamic Pressure Inputs

Input Module	Dynamic Pressure Sensor
PAS	3-Wire (Com/Sig/-24VDC)
PAV	3-Wire (Com/Sig/-24VDC) Constant current compatible with Velomitor interface
PoV	2-wire PCB 121A21 2-wire PCB 121A44 2-wire PCB 121A22

Table 6: Default Measurements by Channel Type

Measurement	(2)Configurable Attributes
Radial Vibration	
Direct	Full scale range Units (mils or µm peak-peak or rms) High pass corner frequency Low pass corner frequency High pass filter order (1,2,4,6, or 8th) Low pass filter order (1, 2, 4, 6, or 8th) Clamp value (amplitude)
Rough Load Zone	Full scale range Units (mils or µm peak-peak or rms) Low pass filter order (1, 2, 4, 6, or 8th) Clamp value (amplitude) Running Speed
1X	Full scale range Keyphasor association Integer or non-integer order in increments of 0.1x from 0.1x to 100x (phase not valid for non-integer orders). Units (mils or µm peak-peak or drms) Clamp value (amplitude and phase)
2X	Full scale range Keyphasor association Integer or non-integer order in increments of 0.1x from 0.1x to 100x (phase not valid for non-integer orders).
	Units (mils or µm peak-peak or drms) Clamp value (amplitude and phase)
Gap	
Low Pass Corner Frequency Clamp Value (Volts)	
Accelerometer	
Direct	Full scale range Units (English or metric, peak or rms) High pass corner frequency Low pass corner frequency High pass filter order (1,2,4,6, or 8th) Low pass filter order (1, 2, 4, 6, or 8th) Clamp value (amplitude) Integrated
Cavitation	Full scale range Units (English or metric, peak or rms) High pass corner frequency Low pass corner frequency High pass filter order (1,2,4,6, or 8th) Low pass filter order (1, 2, 4, 6, or 8th) Clamp value (amplitude)

Measurement	(2)Configurable Attributes
1X	Full scale range Keyphasor association Integer or non-integer order in increments of 0.1x from 0.1x to 100x (phase not valid for non-integer orders). Units (English or metric, peak or drms) Clamp value (amplitude and phase) Integrated
2X	Full scale range Keyphasor association Integer or non-integer order in increments of 0.1x from 0.1x to 100x (phase not valid for non-integer orders). Units (English or metric, peak or drms) Clamp value (amplitude and phase) Integrated
Bias	Low Pass Corner Frequency Clamp Value (Volts)
Velocity	
Direct	Full scale range Units (English or metric, peak or rms) High pass corner frequency Low pass corner frequency High pass filter order (1,2,4,6, or 8th) Low pass filter order (1, 2, 4, 6, or 8th) Clamp value (amplitude)
	Integrated
1X	Full scale range Keyphasor association Integer or non-integer order in increments of 0.1x from 0.1x to 100x (phase not valid for non-integer orders). Units (English or metric, peak or drms) Clamp value (amplitude and phase) Integrated
2X	Full scale range Keyphasor association Integer or non-integer order in increments of 0.1x from 0.1x to 100x (phase not valid for non-integer orders). Units (English or metric, peak or drms) Clamp value (amplitude and phase) Integrated
Bias	Low Pass Corner Frequency Clamp Value (Volts)
Thrust	
Position	Full scale range Units (mils or mm) Low pass corner frequency Clamp value (amplitude)
Gap	Low Pass Corner Frequency Clamp Value (Volts)
Dynamic	

Measurement	(2)Configurable Attributes
Pressure	
Pressure	Full scale range Units (psi or mbar peak-peak, dpp or rms) High pass corner frequency Low pass corner frequency High pass filter order (1,2,4,6, or 8th) Low pass filter order (1, 2, 4, 6, or 8th) Clamp value (amplitude)
Bandpass	Full scale range Units (psi or mbar peak-peak or rms) High pass corner frequency Low pass corner frequency High pass filter order (1,2,4,6, or 8th) Low pass filter order (1, 2, 4, 6, or 8th) Clamp value (amplitude)
Bias	Low Pass Corner Frequency Clamp Value (Volts)
Proximitor Speed	
Speed	Top Scale Clamp Value
Gap	Low Pass Filter Frequency Clamp Value (Volts)
Magnetic Pickup Speed	
Speed	Top Scale Clamp Value

(2) In addition, user customizable nX vectors, amplitude extractions and bandpass measurements may be added to each (non-speed) channel.

The number of measurements that can be added and enabled depends on the signal processing capability of the processor module. There is no limitation, other than processor performance, to the number of measurements that can be added to a single channel or across all channels. A performance calculator in the BNMC software provides feedback during the configuration process on performance margin as measurements are added or removed and their attributes modified.

Table 7: Additional Measurements by Channel Type

Measurement	(1)Configurable Attributes
Radial Velocity, Thrust, Dynamic Pressure, Accelerometer, Velocity	
Bandpass	Full scale range Units (English or metric, peak to peak or rms) High pass corner frequency Low pass corner frequency High pass filter order (1,2,4,6, or 8th) Low pass filter order (1, 2, 4, 6, or 8th) Clamp value (amplitude)
nX	Full scale range Keyphasor association Integer or non-integer order in increments of 0.1x from 0.1x to 100x (phase not valid for non-integer orders). Units (English or metric,

Measurement	(1)Configurable Attributes
	peak to peak or drms) Clamp value (amplitude and phase)
Amplitude Extraction	Full scale range Units (English or metric, peak to peak or rms) Clamp value (amplitude) Associated Spectrum Center Frequency Bandwidth
Spectral Band	Full scale range Units (English or metric, peak to peak or rms) Clamp value (amplitude) Associated Spectrum Start Frequency Stop Frequency

(1) Technically feasible configurations depend on the interaction between many factors. Certain selections may not be feasible. Use the BNMC software to create an off-line configuration to determine technical feasibility.

Waveforms and Spectral Data

Acquisition of multiple synchronous and asynchronous waveforms can be configured for each 3701 channel in the BNMC software. These waveforms are used as the data source for extraction of measurements that require spectral data such as nX vectors and peak extractions.

Waveform configuration for spectral data consists of f_{max} and the number of lines in the spectral data.

Asynchronous spectral waveforms:

F_{max} can be set between 10 Hz and 40 kHz in 12 discrete steps. F_{min} is always at 0 Hz.

The number of spectral lines can be set from 12.5 to 3200 in 12 discrete steps.

Synchronous spectral waveforms:

Number of samples per revolution can be set from 8 to 4096.

Number of revolutions per waveform can be set from 1 to 1024.

Amplitude Extractions

An Amplitude extraction is the amplitude at a user configured center frequency and with a user configured bandwidth. The band around the center frequency is limited in size and can range from a single spectral line (bucket) closest to the configured center frequency, to the center spectral line plus 5 lines on each side (11 total buckets).

Alarming and Setpoints

Alert and Danger over and under alarm setpoints can be created for each measurement individually as well as configurable alarm attributes such as enable/disable, alarm time delay (ATD), and latching/non-latching.

In addition, the alarming attributes (enable/disable, ATD, and latching/non-latching) can be set independently on the Alert and Danger alarms on the same measurement.

Relay logic is created in the graphical relay logic editor in BNMC software by mapping the

enabled alarms to OR and AND gates to drive a relay.

Individual relays can be configured as latching/non-latching or enabled/disabled independently (or in addition to) the settings on the measurement alarms.

Network Operation

The processor module supports two Ethernet RJ45 physical connections located on the terminal base. The two connectors are termed Net A and Net B and each has its own configurable IP address. All configuration and interface to Bently Nevada software and 3rd party control and HMI devices use one or both of these connections.

Display and HMI Options

Bently Nevada, LLC offers System 1 Basic as a simple, low cost, easily installed, and light footprint HMI. System 1 Basic is part of the System_1_Evolution platform and offers a subset of System_1_Evolution functionality to provide a basic operator display.

The Modbus TCP or EGD industrial protocols can be used to serve data to an HMI where users can build display environments using standard 3rd party HMI software.

Bently Nevada Configuration Software (BNMC)

BNMC software is necessary to configure and verify the 3701/46 Hydro Monitor.

Bently Nevada Monitor Configuration software will run on most Windows desktop or notebook computers and is designed and fully tested for operation on Microsoft Windows 7, 8 .1 and 10 (64 bit) and Microsoft Windows 2008, 2012 and 2016 (64 bit).

Language support at the current time is English version operating systems with keyboard preference set to English.

BNMC is ordered separately from the monitor hardware. See the spares section in the Specifications portion of this datasheet for the part number.

System_1_Evolution Connectivity

3701 monitors connect to System_1_Evolution and support current value and time-based data collection of all static values, waveforms, and spectral data. This includes System 1 software's full suite of plots and tools for conditioned monitoring and asset management.

When an event is triggered on the 3701 monitor, the high resolution alarm data shown below is forwarded to System 1.

Trended Measurements:

	Duration	Intervals
Pre-event Data	10 minutes	1 second
	20 seconds	100 milliseconds
Post-event Data	10 seconds	100 milliseconds
	1 minute	1 second

Spectrums/Waveforms:

	Duration	Intervals
Pre-event Data	2.5 minutes	10 seconds
Post-event Data	1 minute	10 seconds

In case of network disruption between the 3701 and System 1t, the 3701 can store up to 512MB of Alarm fata and 512MB of transient data.
t Requires System_1_Evolution 17.2 or

newer and Firmware release 4.1 or newer for 3701/4x.

Applications

This section describes selected applications where the 3701 functions and features offers particular benefits.

Radial Shaft Vibration, Axial Position, and Casing/ Structural Absolute Vibration

3701 supports the standard industry measurements for these applications. In addition, the 3701/46 default Radial Vibration and Acceleration channels have user-configurable bandpass trended variables for Rough Load Zone and Cavitation, respectively.

Detection of specific mechanical, electrical, and hydraulic faults can be enabled by additional 3701/46 user-configurable mesurements. For example, discrete frequencies of vibration on a hydroelectric generating unit can be a function of the number of runner buckets/vanes, wicket gates, or electrical grid frequency. >>The 3701 allows users to create custom measurements that track these frequencies of interest using spectral bands, bandpass timebase measurements, amplitude extractions, nX measurements, integrated and non-integrated, and rms or peak measurements.

Trip Multiply

Some events or operating conditions can cause temporarily high levels of vibration. One common example is Rough Load Zone (RLZ) on Francis type turbines operating under part load conditions. While in RLZ conditions the alarm thresholds set for full load conditions may be exceeded, resulting in nuisance alarms.

To avoid nuisance alarms during periods of expected high vibration while preserving tight alarm thresholds for normal operating conditions, the 3701 Trip Multiply feature can be used to temporarily elevate alarm set points. A set point multiplier of 1 to 5 (in increments of 0.1) can be applied to Alert and Danger alarms, individually for each measurement in each channel. Trip multiply can be activated via a set of hardware contacts by a manual input, a control system relay, or a 3701 output module relay actuated by the RLZ or other measurement corresponding to the temporary event or condition.

Gear Boxes

When a hydroelectric generating unit has a gearbox, the 3701 is a flexible and powerful tool for monitoring specific vibration frequencies associated with not only rotor-related vibration and position, but also gear teeth and gear mesh health. A Keyphasor signal may be required to activate these measurements.

This short section is intended only to highlight some particular features of the 3701 system.

Feature	Description
Gear Mesh (GM) 1X, 2X, or 3X	Set a synchronous spectral band, or an nX measurement (or both) on the 1X, 2X, and 3X GM. For each gear set.
Gear Mesh Side Bands	If you know the fundamental frequency of an expected side band based on the gear kinemantics then you can set a synchronous spectral band on a specific sideband.
Enhanced	For API 613 gearboxes where

Feature	Description
measurements from Radial Vibration Proximitors	XY radial vibration probes are typically specified the Technician can set the GM related spectral bands described above as well as nX's based on hi and low speed shaft Keyphasors.
Enhanced measurements from Thrust Position Proximitors	For API 613 gearboxes where axial position probes are typically specified. Axial vibration can be measured by setting bandpass filtered or nX measurements in addition to the conventional thrust position measurement.

Hydro Dynamic Pressure

The 3701/46 is compatible with certain 3rd party dynamic pressure sensors (see Table 5 for the known compatibility list). These sensors are typically installed at the draft tube, head cover, wicket gate, and/or penstock of Francis and Kaplan turbines to detect pressure pulsations associated with vortices, Rough Load Zone, and cavitation. These measurements can help detect and manage conditions that cause erosion, component deterioration, and loss of unit efficiency. The 3701/46 enables the user to add measurements to the dynamic pressure sensor channel(s) that can be customized for the characteristics of each turbine and its unique hydraulic conditions.

Specifications

3701/46 Monitor Power Requirements

Input Voltage	Min. 18 Vdc Max. 36 Vdc
Current	2.3 amps max current (Simplex) 3.0 amps max current (Duplex)
Inrush Current	3.0 amps max inrush less than 5 mS (Per processor card)

Supply must be 2006/95/EC Low Voltage Directive compliant for CE installations.

Supply must be Class I, Div 2 or Class I, Zone 2, (CL2 SELV), compliant for hazardous area Installations.

3701/46 Processor Module Specifications

Inputs	
Max.	12 dynamic signals and 2 Keyphasor/speed signals
Signal/Noise Ratio	110 db @ 102.4 ksps
A/D Conversion	Sigma- Delta 24 bit
Bandwidth	0.5 to 40 Khz
Outputs	
Two Independent Ethernet ports	Net B: 10/100 BaseT
Buffered Signal Outputs	15 pin DSUB connector, available accessory cable for BNC and SMC options. 550 ohm output impedance

LEDs	
Module OK LED	Indicates when the module is functioning
Protection Fault LED	Indicates that the monitor has experienced a fault that is affecting protection
User Inhibit LED	Indicates that there has been a user initiated inhibit of alarming functionality
AttentionLED	Indicates a condition on the monitor has occurred that may require action
Danger LED	Indicates a Danger condition
Alert LED	Indicates an Alert condition
KPH 1 OK LED	Indicates that Keyphasor signal 1 is triggering.
KPH2 OK LED	Indicates that Keyphasor signal 2 is triggering.
Net A	Indicates that Network A has a valid link
TX/RX A	Indicates that network traffic is flowing on Network A
Net B	Indicates that Network B has a valid link
TX/RX B	Indicates that network traffic is flowing on Network B
PWR 1 OK	Indicates that the first power input is functioning correctly
PWR 2 OK	Indicates that the second power input is functioning

	correctly
Accuracy	
Direct pk or rms	Within ± 0.5% of full-scale typical, 1.1% Worst Case
Bias	+0.4 V / -0.8 V typical, +0.8V / -1.34 V worst case.
Tracking Filters	nX tracking filters are have a bandwidth of 0.075X, where X is the speed of the associated speed channel.
Alarming	
Setpoints	Over/under user configurable
Time Delay	100 mS – 60 minutes
Latching	User configurable alarming or relay latching
Input Impedance	
All 3-wire Inputs (PAA & PAV)	Nominal input impedance is 10 kW.
2-Wire Input – PAA (Aeroderivative)	Nominal differential input impedance is 99.8 kW.
2-Wire Input – PAV (Velomitors)	Nominal constant current is 3.3267 mA.
2-Wire Input – PAA - Speed channels (Isolated Magnetic Pickup)	32.08 kW when input signal is below 30 Vpp, and a 9.98 kW when above 30 Vpp
Speed Signal Inputs	
Speed Range Dedicated Speed/Keyphasor Input	1 to 120,000 rpm
Speed Range Auxiliary	1 to 10,000 rpm
Keyphasor Input	
Speed Resolution	1 to 100 rpm ± 0.1 rpm 100 to 2000 rpm ± 1 rpm
Gap	±8.2 mV typical ±22.3 mV worst case
Phase Accuracy	± 1 degree up to 20 kHz for most sensors ♦
Auto Threshold	Use for any input above 1 rpm for 1 event/resolution.
Manual Threshold	±150 mV, user selectable from +3.5 to -23.5 Vdc.
Hysteresis	User selectable from 0.2 to 10 volts.
Signal Amplitude	Minimum signal amplitude for trigger is 2 volts peak-to-peak.

t>Phase accuracy on 2 wire sensors on the PAA input card has ± 1 degree up >>>to 500 Hz and ± 5 degree up to 3 kHz

> >Refer to Hazardous Area Special Considerations Section for Maximum Magnetic Pickup amplitude requirements for hazardous area applications.

Relay Output Specifications	
Relay Type	Single Pole Double Throw (SPDT). Normally Open (NO), Normally Closed (NC), and Armature (ARM) contacts
Contact Ratings	5A/250 Vac/1500 VA Max. 5A/250 Vdc/150 VA Max.

Minimum Switching Current	12 Vdc/100 mA
Normally De-Energized (NDE) or Normally Energized (NE)	NDE/NE independently selectable for Relays 1 – 4 and 5 – 8 using a switch on the relay module.

>Refer to Hazardous Area Special Considerations Section for Relay specifications when used in hazardous area applications.

3701/46 Environmental Specifications

Indoor Use Only	
Operating Temperature Range	-30° C to +65° C♦ (-22° F to 149° F)
Storage Temperature Range	-40C to +85C (-40 F to 185 F)
Relative Humidity	0% to 95% rH non-condensing Operating and Storage
Vibration	5g @ 57-500 Hz. IEC 60068-2-6
Shock	15g, 11ms
Altitude	< 2000 m (6,562 ft)
Pollution Degree	Pollution Degree 2
Installation Category	Category II

♦ >If the 3701 is operated 100% at +65°C, its life will be reduced to approximately 11 years. Any portion of the time it is operated below +65°C or any convective airflow will increase its lifespan.

Physical	
Simplex Base Dimensions	26.7 x 20 x 18.2 cm (10.5 x 7.87 x 7.15 in)
Weight	4.5 kg (9.9 lbs)
Mounting	Bulkhead 4 mounting bolts or screws at corners

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

EN 61000-6-2

EN 61000-6-4

EMC Directive 2014/30/EU

Electrical Safety

EN 61010-1

LV Directive 2014/35/EU

RoHS

RoHS Directive 2011/65/EU

ATEX

EN 60079-0

EN 60079-15

ATEX Directive 2014/34/EU

Cyber Security

Achilles Communications Certification Level 1

Maritime

ABS 2009 Steel Vessels Rules

1-1-4/7.7,4-8-3/1.11.1,4-9-7/13

Complies with ABS Rules for Condition of Classification, Part 1

- 2015 Steel Vessels Rules
- 2015 Offshore units and Structures

Hazardous Area Approvals

For the detailed listing of country and product specific approvals, refer to the *Approvals Quick Reference Guide* (108M1756) available from www.Bently.com.

CSA/NRTL/C

Class I, Zone 2: AEx nA nC IIC T4 Gc;
Class I, Zone 2: AEx ec nC IIC T4 Gc;
Class I, Division 2, Groups A, B, C, and D;

T4 @ Ta= -30˚C to +65˚C
When installed per drawing 100M1872

ATEX/IECEx

II 3 G
Ex nA nC IIC T4 Gc

T4 @ Ta= -30˚C to +65˚C

ATEX Special Conditions of Safe Use

- The equipment shall only be used in an area of not more than pollution degree 2, as defined in IEC 60664-1.
- The equipment shall be installed in an enclosure that provides a degree of protection of not less than IP54 and which meets the enclosure requirements of EN 60079-0 and EN 60079-7/EN 60079-15. The enclosure shall be suitable for an ambient temperature range of -30ºC to +65ºC and a service temperature of 80ºC.
- Transient voltage protection shall be provided by the external circuits to ensure that transient overvoltages to the equpment cannot exceed 140% of 85 V.
- When installed in a metal enclosure, the enclosure shall have an external facitlity for an earth bonding connection which complies with EN 60079-0:2012/A11:2013 clause 15.1.2 and which is electrically in contact with the internal earth connection facility on the equipment.
- The relay output circuits shall not be connected to circuits which exceed 30V, 5A.

Ordering Information

For the detailed listing of country and product specific approvals, refer to the *Approvals Quick Reference Guide* (108M1756) available from Bently.com.

3701/46–AA–BB–CC-DD- EE

A: Redundancy	
01	Simplex
B: Input Module 1	
01	Prox/Accel/Velom
02	Prox/Accel/Seismic
04	Positive Input Module
C: Input Module 2	
00	None
01	Prox/Accel/Velom
03	Prox/Accel/Seismic
04	Positive Input Module
D: Output Module	
00	None
01	8 CH Relay Module
E: Approvals	
00	Nonet
01	CSA
02	ATEX/IECEx
XX	Country Specific

[t]This does include the non-hazardous area general safety certification.

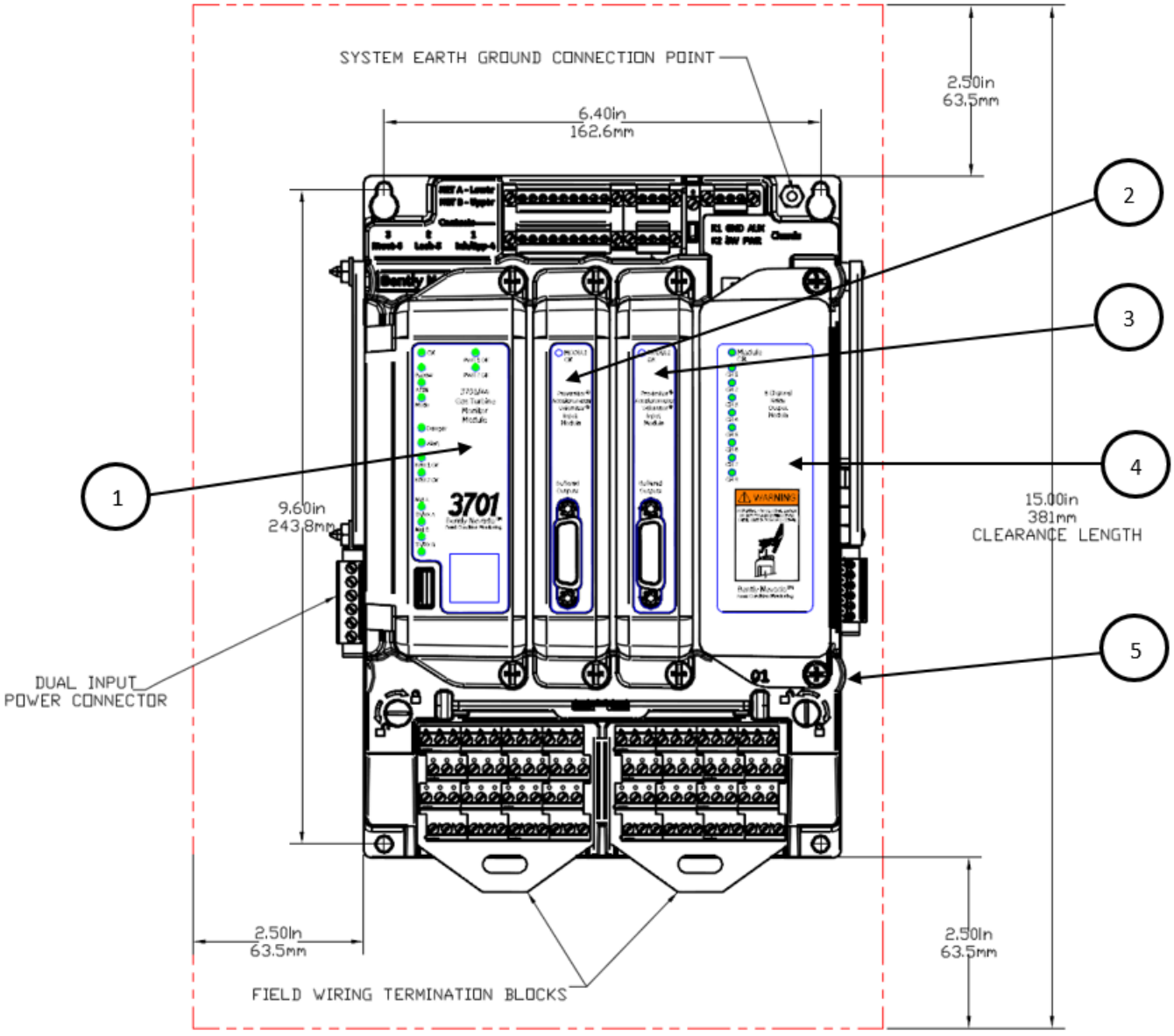
Spares

Part Number	Description
3701/46	3701/46 Hydro Monitor
177896-06	3701/46 Processor Module
177988-01	Prox Accel Seismic (PAS) Module
177989-01	Prox Accel Velom(PAV) Module
105M6001-01	Positive Input (POV) Module
>177897-01	3701 Output Relay Module
>175794	3701 Simplex Terminal Base
177992-01	3701 Terminal Block – Standard
100M9465-01	BN Monitor Configuration SW DVD

Accessories

Part Number	Description
323314-01	Buffered Output cable 15 pin D-Sub to 7 SMA connectors. (SMA connectors work with the ADRE 408)
>323314-02	Buffered Output cable 15 pin D-Sub to 7 BNC connectors
>324343	Weatherproof Housing Kit
>Bently_ Manuals	Customer DVD containing all Bently Manuals, FWD, App Notes, and Install Guides in all available languages

Figures



a. Processor Module
b. Input Module 1
c. Input Module 2
d. Output Module
e. Terminal Base

Figure 1: 3701/46 Simplex Terminal Base Top View

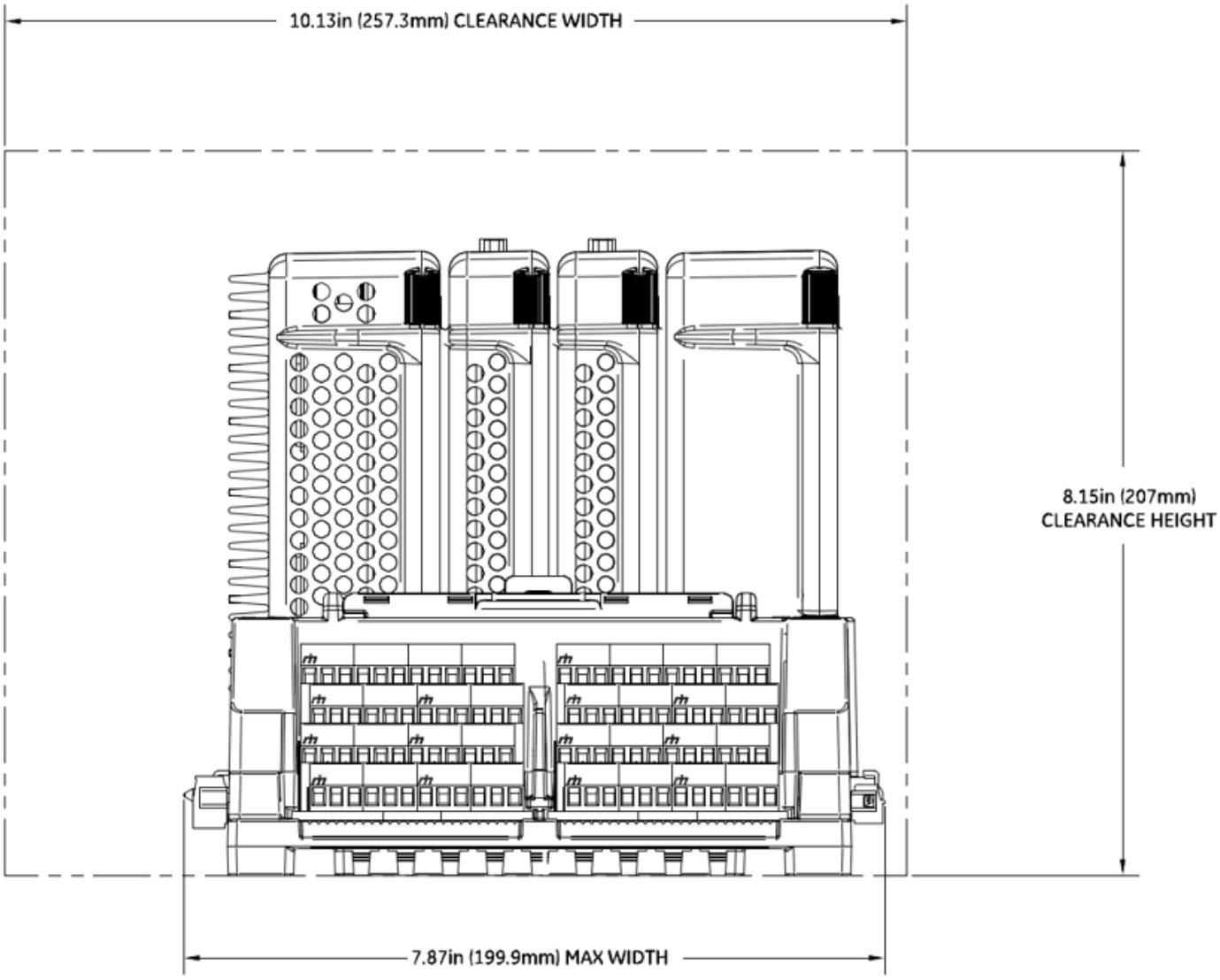


Figure 2: 3701/46 Simplex Terminal Base -Side View

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