MANUFACTURER DOCUMENT PACKAGE

# Manufacturer's Manual

Reference package for procurement and maintenance review

BENTLY NEVADA

## 3701/40 177988-01

**PROXIMITY ACCELERATION SEISMIC INTERFACE**

Used with the applicable 3701/40 PAS input module configuration.

REFERENCE PACKAGE

OFFICIAL DOCUMENT

Selected official manufacturer pages follow this cover.

Source: Bently Nevada 3701/40 ADAPT Monitor, 103M2037 Rev. K.

# 3701/40 ADAPT Machinery Dynamics Monitor

## Datasheet

Bently Nevada Machinery Condition Monitoring

103M2037 Rev. K



3701/40 Simplex



3701/40 Duplex

## 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 3701/40 Machinery Dynamics (MD) Monitor is designed for use on a broad range of machine trains or individual casings where the sensor point count fits the monitor's channel count and where advanced signal processing is desired. The 3701/40 is optimized for intensive signal processing required on complex machinery such as gearboxes, planetary gearboxes, and roller element bearing (REB) machines as well as offering advanced measurement capabilities on conventional monitoring methods such as radial vibration, thrust position, and casing absolute vibration. The 3701/40 Dual Redundant (DR) monitor is designed for applications that require a higher level of reliability from the vibration system.

The 3701/40 has a rugged industrial design allowing it to be skid mounted close to the machine and reduce installation wiring. Its compact size provides more mounting options compared to traditional rack based solutions. It is capable of accepting a wide array of sensor types, including eddy current proximity probes, accelerometers, velocity, acceleration, dynamic pressure, Integrated Circuit Piezoelectric Sensors (IEPE), and magnetic speed pick-ups.

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The 3701/40 is configured and validated with Bently Nevada Monitor Configuration (BNMC) software. BNMC is a simple and powerful configuration and verification software. It is ordered separately and is required for operation.

The 3701/40 MD Monitor is a self-contained device that is ordered with a single part number for either a simplex or duplex terminal base and is made up of the following major components:

| Part | Quantity Required in each 3701/40 |
|---|---|
| 3701 Simplex Terminal Base | 1 |
| 3701 Processor Module | 1 |
| 3701 Input Module | 1 or 2 |
| 3701 Output Module | 1 or none |

| Part | Quantity Required in each 3701/40 |
|---|---|
| 3701 Duplex Terminal Base | 1 |
| 3701 Processor Module | 2 |
| 3701 Input Module | 1 or 2 |
| 3701 Output Module | 1 or none |

# 3701/40 Overview

The 3701/40 is a robust, compact, self-contained 12-channel device with sophisticated signal processing capability and with a form-factor suitable for distribution close to machinery. 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, 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.

The 3701/40 DR Machinery Dynamics Monitor is a compact, field mountable, vibration protection system that utilizes dual redundant processor modules.

In the DR version, each processor module is identically configured and redundantly digitizes and processes all sensor inputs, executes identical logic, and each processor module independently drives separate alarm relays.

## 3701 Digital Communications

The 3701/40 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 3701/40 includes two Ethernet ports per CPU which provide Ethernet TCP/IP communications capabilities. Standard industrial protocols are:

- Modbus TCP/IP

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.

- Ethernet Global Data (EGD)

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.

## 3701/40 System Description

The 3701/40 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.

There are two terminal base configurations:

- A simplex base, which contains 1 CPU processor card
- A duplex base which contains 2 CPU processor cards.

The use of 2 processor cards allows for redundancy for all the dynamic measurements; both processors have access to all signal channels from each input module.

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 Dsub connector on each input module. An accessory cable is available to fan the buffered

**Table 1: Channel Type Support by Input Module**

| Input Module | Channel Types |
|---|---|
| PAS<br>Channels 1 - 6 | Acceleration<br>Dynamic Pressure<br>Radial Vibration<br>Thrust Position<br>Velocity<br>Proximitor Speed |
| PAS Channel 7 | Magnetic Pickup Speed<br>Proximitor Speed (single and multi-event) |
| PAV<br>Channels 1 - 6 | Acceleration<br>Dynamic Pressure<br>Radial Vibration<br>Thrust Position<br>Velocity<br>Proximitor Speed |
| PAV Channel 7 | Magnetic Pickup Speed<br>Proximitor Speed (single and multi-event) |
| PoV<br>Channels 1-6 | Acceleration<br>Dynamic Pressure<br>Radial Vibration<br>Thrust Position<br>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, but cannot be done with PoV.

**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<br>23733-03 Accel I/F Module<br>24145-02 High-Freq Accel I/F Module<br>330400 100 mV/g Accelerometer<br>330425 25 mV/g Accelerometer<br>330450 High Temp Accelerometer<br>350501 Acceleration Charge Amplifier<br>49578-01 Accel I/F Module<br>Custom |
| PAV | 155023-01 High Freq 200g Accel I/F Module<br>23733-03 Accel I/F Module<br>24145-02 High-Freq Accel I/F Module<br>330400 100 mV/g Accelerometer<br>330425 25 mV/g Accelerometer<br>330450 High Temp Accelerometer<br>350501 Acceleration Charge Amplifier<br>49578-01 Accel I/F Module<br>Custom |
| PoV | GSI 122, 124 and 127 Galvanic Interface Unit<br>TP100 Commtest Accelerometer<br>TP500 Commtest Accelerometer<br>200350 Accelerometer<br>200355 Accelerometer<br>786-500 Wilcoxon Accelerometer<br>626B02 PCB Accelerometer<br>HS-170 Hansford Accelerometer<br>HS-100F series Hansford Accelerometer<br>CMSS-2100 SKF Accelerometer<br>351M35 PCB Accelerometer |

**Table 3: Input Module Compatibility with Velocity Inputs**

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

**Table 4: Input Module Compatibility with Proximitor Sensors**

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

**Table 5: Input Module Compatibility with Dynamic Pressure Inputs**

| Input Module | Dynamic Pressure Sensor |
|---|---|
| PAS | 3-Wire (Com/Sig/-24VDC) 350500 DPCA |
| PAV | 3-Wire (Com/Sig/-24VDC) 350500 DPCA orPCB 102M206 |
| PoV | 2-wire PCB 121A21<br>2-wire PCB 121A44<br>2-wire PCB 121A22 |

## Measurements

Each channel type has a set of default measurements typical of the channel type. In addition, user customizable nX vectors and bandpass measurements may be added to each 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.

| Measure | Configurable Attributes (1) |
|---|---|
| Accelerometer | |
| Bandpass | Full scale range<br>Units (g's or m/s$^2$ peak or rms; or integrated accel: in/s or mm/s peak or rms)<br>High pass corner frequency<br>Low pass corner frequency<br>High pass filter order (1,2,4,6, or 8$^{th}$ )<br>Low pass filter order (1, 2, 4, 6, or 8$^{th}$)<br>Clamp value (amplitude) |
| nX | Full scale range<br>Keyphasor association<br>Integer or non-integer order in increments of 0.1x from 0.1x to 100x (phase not valid for non-integer orders).<br>Units (g's or m/s 2 peak or rms; or integrated accel: in/s or mm/s peak or rms)<br>Clamp value (amplitude and |

# Specifications

## 3701/40 Monitor Power Requirements

| Input Voltage | |
|---|---|
| Minimum | 18 Vdc |
| Maximum | 36 Vdc |
| Non-isolated | 24 Vdc nominal |
| **Current** | |
| (Simplex) | 2.3 amps max current |
| (Duplex) | 3.0 amps max current |
| **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.

## 3701/40 Processor Module Specifications

| Inputs | |
|---|---|
| **Maximum** | 12 dynamic signals and 2 Keyphasor/speed signals |
| Signal/Noise Ratio | 110db @ 102.4 ksps |
| A/D Conversion | Sigma- Delta 24 bit. |
| Bandwidth | 0.0625Hz to 40Khz |

| Outputs | |
|---|---|
| Two Independent Ethernet ports | Net A: 10/100 BaseT<br>Net B: 10/100 BaseT |
| Buffered Signal Outputs | 15 pin DSUB connector, available accessory cable for BNC and SMC options.<br>550 ohm output impedance |
| **LEDs** | |
| Module OK LED | Indicates when the module is functioning properly. |
| 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. |
| Attention LED | Indicates a condition on the monitor has occurred that may require action. |
| Danger LED | Indicates a Danger condition. |
| Alert LED | Indicates and Alert condition. |
| KPH 1 OK LED | Indicates that Keyphasor signal 1 is triggering |
| KPH 2 OK LED | Indicates that Keyphasor signal 2 is triggering |
| NetA | 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 |

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

## 3701/40 Environmental Specifications

| Indoor Use Only | |
|---|---|
| Operating Temperature Range | -30° C to +65° C†<br><br>(-22° F to 149° F) |
| | † If the 3701 is operated 100% at +65C, its life will be reduced to approximately 11 years. Any portion of the time it is operated below +65C or any convective airflow will increase its lifespan. |
| Storage Temperature Range | -40°C to +85°C<br><br>(-40° F to 185° F) |
| Relative Humidity | 0% to 95% rH non-condensing Operating and Storage |
| Vibration | 5g @ 57-500 Hz.<br><br>IEC 60068-2-6 |
| Shock | 15g, 11ms<br><br>IEC 60068-2-27 |
| Altitude | < 2000 m (6,562 ft) |
| Pollution Degree | Pollution Degree 2 |
| Installation Category | Category II |

## Physical

| | |
|---|---|
| Simplex Base Dimensions | 26.7 x 20 x 18.2 cm (10.5 x 7.87 x 7.15 in) |
| Simplex Weight | 4.5 kg (9.9 lbs) |
| Duplex Base Dimensions | 26.7 x 27.7 x 18.2 cm (10.5 x 10.9 x 7.15 in) |
| Duplex Weight (fully loaded) | 7.7 kg (17.1 lbs) |
| Mounting (Simplex and Duplex) | Bulkhead 4 mounting bolts or screws at corners. |

# Ordering Information

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

### 3701/40–AA-BB-CC-DD-EE

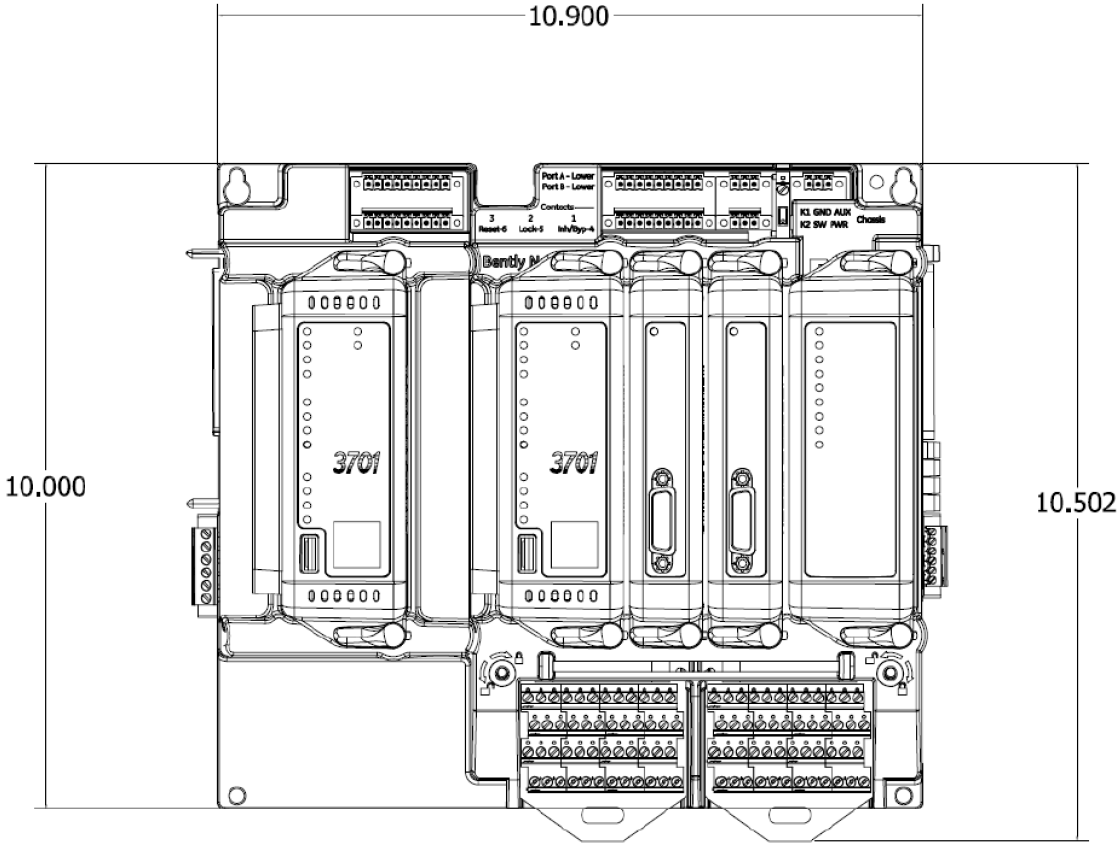
| | |
|---|---|
| **A: Redundancy** | |
| **01** | Simplex |
| **02** | Duplex |
| **B: Input Module 1** | |
| **00** | None |
| **01** | Prox/Accel/Velom |
| **02** | Prox/Accel/Seismoprobe |
| **04** | Positive Voltage Module |
| **C: Input Module 2** | |
| **00** | None |
| **01** | Prox/Accel/Velom |
| **02** | Prox/Accel/Seismoprobe |
| **04** | Positive Voltage Module |
| **D: Output Module** | |
| **00** | None |
| **01** | 8 CH SPDT Relay Module |
| **E: Approvals** | |
| **00** | None (This does include the non-Hazardous area general safety certification) |
| **01** | CSA |
| **02** | ATEX/IECEx |
| **XX** | Country specific |

## Spares

| Part Number | Description |
|---|---|
| 3701/40 | 3701/40 Machinery Dynamics Monitor |
| 177896-05 | 3701/40 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 |
| 178372-01 | 3701 Terminal Block - Duplex |
| 100M9465-01 | Bently Nevada Monitor Configuration (BNMC) 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 | Nema 4 Weatherproof Housing Kit |
| Bently_ Manuals | Customer DVD containing all Bently Manuals, FWD, App Notes, and Install Guides in all available languages. |




1. Processor Module (2)
2. Input Module 1
3. Input Module 2
4. Output Module
5. Terminal Base

**Figure 2: 3701/40 Duplex Terminal Base Top View**

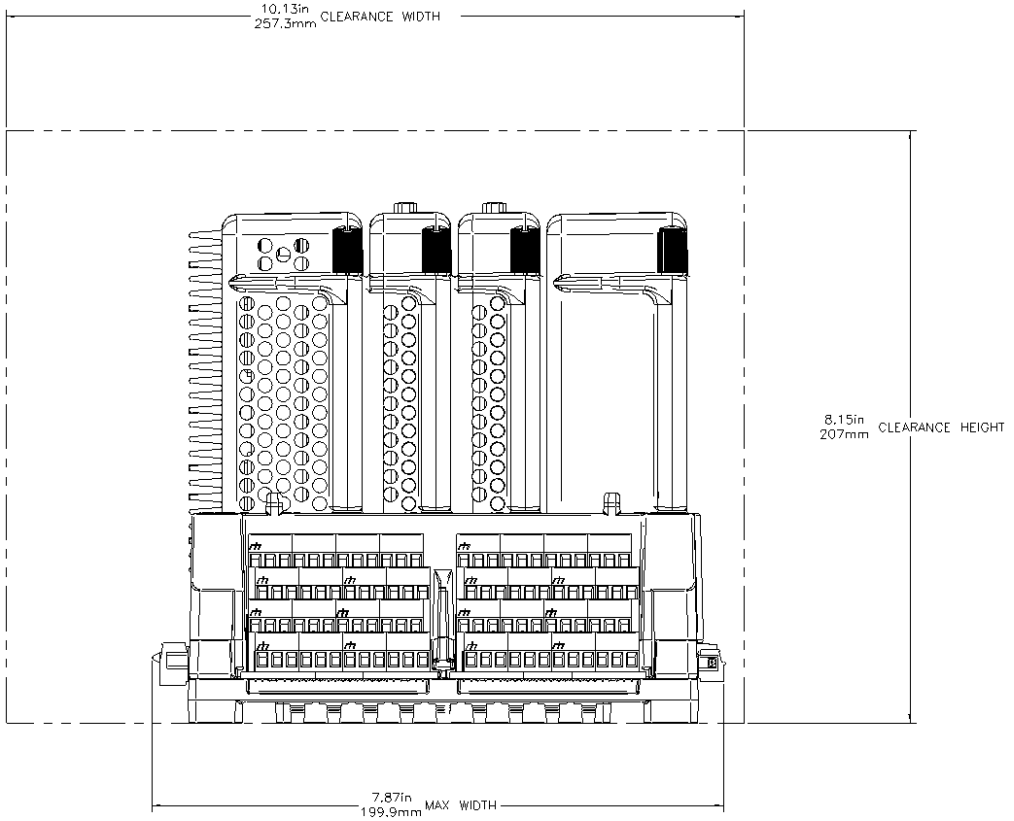



**Figure 3: 3701/40 Simplex Terminal Base Side View**

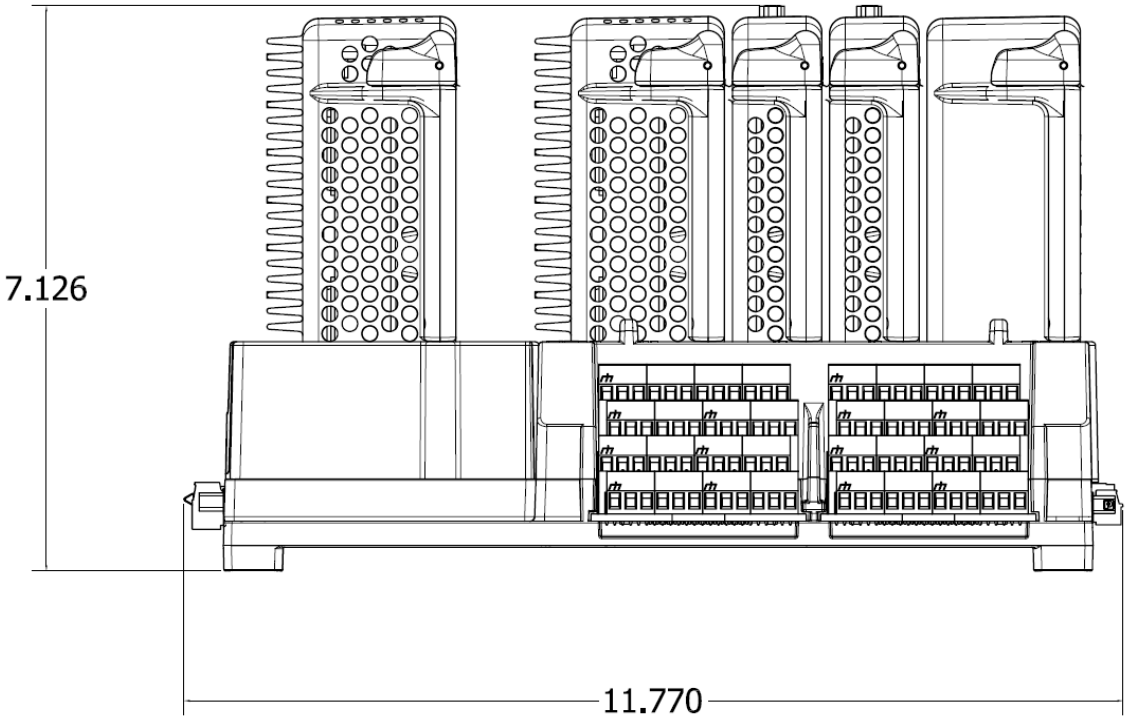



**Figure 4: 3701/40 Duplex Terminal Base Side View**