# Installation and Maintenance Manual

Bently Nevada™ Asset Condition Monitoring
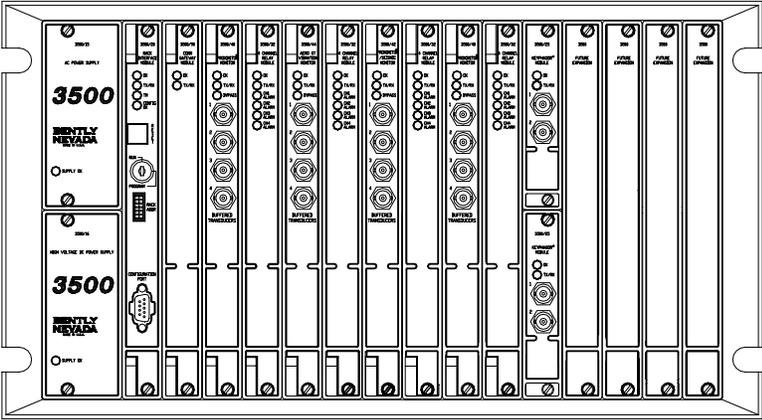
3500 Monitoring System Rack

imagination at work

Contact Information

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Additional Information

3500 Monitoring System Rack Configuration and Utilities Guide (129777-01)

- guidelines for using the 3500 Rack Configuration software for setting the operating parameters of the module
- guidelines for using the 3500 test utilities to verify that the input and output terminals on the module are operating properly

3500 Monitoring System Computer Hardware and Software Manual (128158-01)

- instructions for connecting the rack to 3500 host computer
- procedures for verifying communication
- procedures for installing software
- guidelines for using Data Acquisition / DDE Server and Operator Display Software
- procedures and diagrams for setting up network and remote communications

3500 Field Wiring Diagram Package (130432-01)

- diagrams that show how to hook up a particular transducer
- lists of recommended wiring

Operation and Maintenance Manuals for all the modules installed in the rack

Contents

1. Receiving and Handling Instructions

This will be a short overview of the entire section.

1.1 Receiving Inspection

Visually inspect the system for obvious shipping damage. If you detect shipping damage, file a claim with the carrier and submit a copy to Bently Nevada, LLC.

1.2 Handling and Storage Considerations

Proper handling and storing of printed circuit boards is extremely critical. Circuit boards contain devices that are susceptible to damage when exposed to electrostatic charges. Damage caused by obvious mishandling of the board will void the warranty. To avoid damage, observe the following precautions in the order given.

Application Advisory
Machinery protection will be lost when you remove all power from the rack.

- Do not discharge static electricity onto the circuit board. Avoid tools or procedures that would subject the circuit board to static damage. Some possible causes of static damage include ungrounded soldering irons, nonconductive plastics, and similar materials.

- Use a suitable grounding strap (such as 3M Velostat® No. 2060) to ground yourself before handling or performing maintenance on a printed circuit board.

- Transport and store circuit boards in electrically conductive bags or foil.

- Use extra caution during dry weather. Relative humidity less than 30% tends to multiply the accumulation of static charges on any surface.

When performed properly, you may remove modules from or install modules into the rack while power is applied to the rack. Refer to << Section reference to "Module Installation in section 4 >> for the proper procedure.

2. General Information

Monitoring and computerized vibration information systems provide the information you need to assess the mechanical condition of rotating and reciprocating machinery. These systems continuously measure and monitor various supervisory parameters and provide crucial information for early identification of machinery problems such as imbalance, misalignment, shaft crack, and bearing failures. As such, these systems are an efficient and effective means of satisfying plant management, engineering, and maintenance concerns for:

- Increasing plant safety by minimizing the occurrence of hazardous conditions or catastrophic failures.

- Improving product quality by minimizing process variances caused by improperly operating equipment.

- Maximizing plant availability by servicing only those machines that require it and providing more efficient turnarounds.

- Reducing plant operating costs by minimizing unplanned shutdowns and by making more efficient use of maintenance resources.

For protection of critical machinery, we highly recommend that you permanently install continuous monitoring systems. The term "protection" means that the system can shut down machinery on alarm, without human interaction. These systems include applicable transducers, each with its own dedicated monitoring circuitry and alarm setpoints. The 3500 Monitoring System is the newest addition to the family of continuous monitoring systems offered by Bently Nevada, LLC.

2.1 3500 Monitoring System

The 3500 is a full-feature monitoring system whose design incorporates the latest in proven processor technology. In addition to meeting the above stated criteria, the 3500 adds benefit in the following areas:

- Enhanced operator information

- Improved integration to plant control computer

- Reduced installation and maintenance cost

- Improved reliability

- Intrinsic Safety (IS) option

The following sections discuss these benefits in more detail.

2.1.1 Enhanced Operation Information

The 3500 design includes features to both enhance the operator's information and present this information so that the operator may easily interpret it. These features include:

- Improved data set

  - Overall amplitude

  - Probe gap voltage

  - 1X amplitude and phase

  - 2X amplitude and phase

  - Not 1X amplitude

- Windows®-based Operator Display Software

- Data displayed at multiple locations

2.1.2 Improved Integration to Plant Control Computer

The 3500 improves integration to the plant control computer with:

- Communication Gateways supporting multiple protocols

- Time synchronized vibration and process information

2.1.3 Reduced Installation and Maintenance Costs

The 3500 system provides the following cost-saving features:

- Reduced cabling costs

- Downward product compatibility

- Improved space utilization

- Easier configuration

- Reduced spare parts

- Improved serviceability

2.1.4 Improved Reliability

The 3500 offers several features to improve system reliability.

- Redundant power supplies available

- Triple Modular Redundant (TMR) monitors and relay cards available

- Redundant Gateway and Display Modules permitted

2.1.5 Intrinsic Safety Option

If you wish to monitor equipment that is located in hazardous atmospheres, the 3500 Monitoring System has a range of I/O modules with internal zener barriers. These modules provide an Intrinsically Safe interface between the 3500 rack and the transducers located in the hazardous area.

2.1.6 Multiple Output Interfaces

You can conveniently adjust monitor options (such as full scale ranges, transducer inputs, recorder outputs, alarm time delays, alarm voting logic, and relay configuration) in the field via software. Modular system design employs plug-in components which allow easy servicing and expansion.

The following three independent interfaces are available with the 3500 system:

- Data Manager Interface (Transient Data Interface External or Dynamic Data Interface External)

- Configuration/Data port

- Communications Gateway (support for Programmable Logic Controllers, Process Control Computers, Distributed Control Systems, and PC-based Control Systems)

These interfaces allow you to easily view monitored parameters and their statuses in the following ways:

- System 1® Software

- Bently Nevada™ 3500 Operator Display Software

- Remote display panel

- DCS or PLC display

Convenient front panel coaxial connectors provide dynamic transducer signals and allow you to connect diagnostic or predictive maintenance instruments.

2.2 Common Features

The common features of the modules in the 3500 rack include hot insertion or removal of modules and external and internal termination of the wiring.

2.2.1 Hot Insertion or Removal of Modules

When performed properly, you can remove and replace any module while the system is under power without affecting the operation of any unrelated modules. If the rack has 2 power supplies, removing or inserting a power supply will not

disrupt the operation of the 3500 rack. See <<Section reverence: "Module Installation in section 4 >> for the proper procedure.

2.2.2 External and Internal Termination

External termination uses multi-conductor cables to connect the I/O modules to the terminal blocks. These blocks simplify connecting many wires to the rack in tight areas. External termination is not available on I/O modules with internal zener barriers.
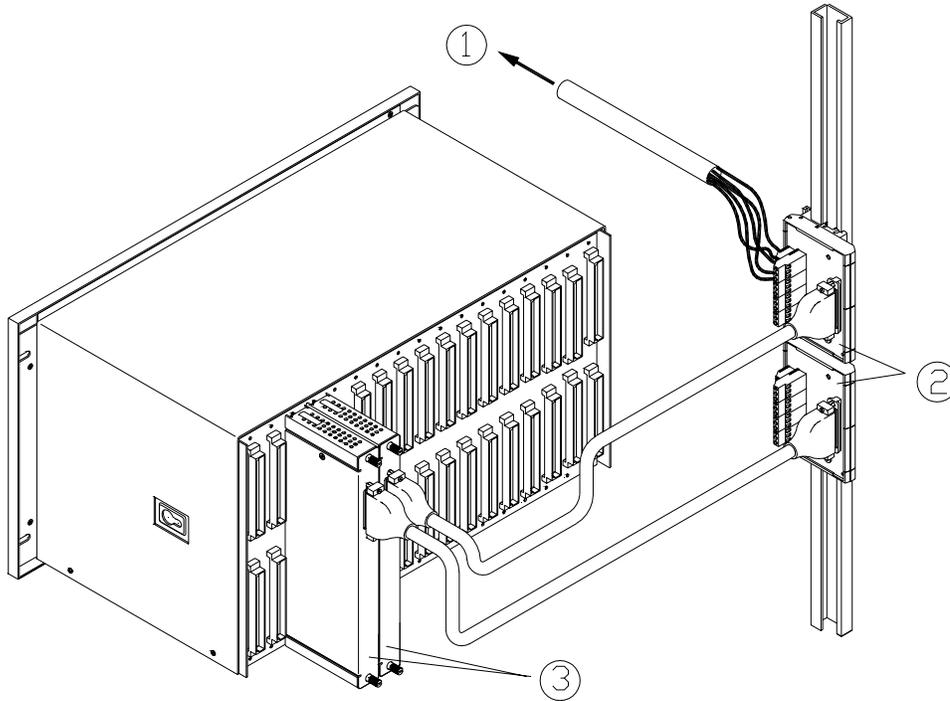
1. To transducer
2. External termination blocks
3. External termination I/O modules

Figure 2-1: External Termination

Internal termination lets you connect transducers directly to the I/O modules.
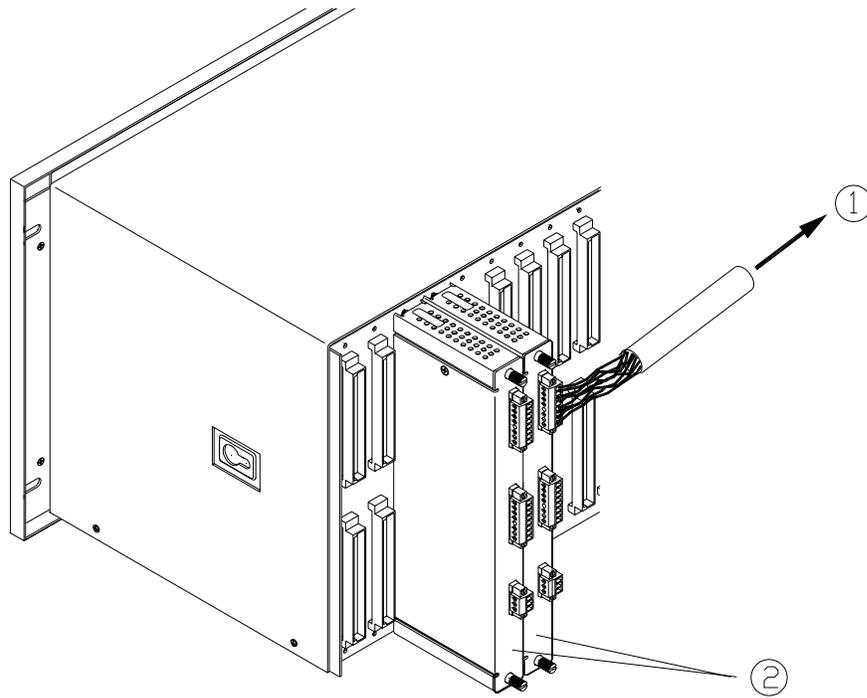
1. To transducers
2. Internal termination I/O modules

Figure 2-2: Internal Termination

2.3 3500 System Components

The 3500 Monitoring System consists of modules that fit into a rack. Figure 2-3 shows a full-size 3500 system rack and system components. Note that the full-size rack has 14 monitor slot positions. The Mini-rack (not shown) is similar, but has 7 monitor slot positions to the right of the power supplies and Rack Interface Module.
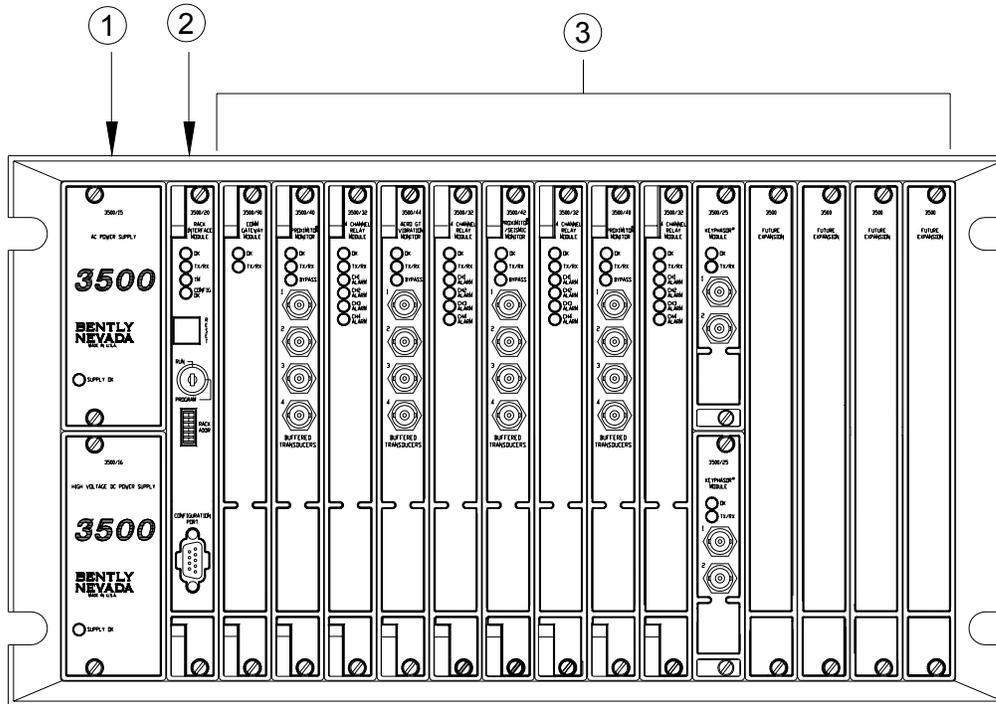
1.   1 or 2 power supplies
2.   Rack Interface Module (standard, Transient Data Interface, (TDI), Triple Modular Redundant (TMR) and TMR TDI)
3.   Monitoring slot positions:
   -   Monitor module
   -   Keyphasor® module (2 maximum)
   -   Relay module
   -   Communication Gateway module
   -   Display module. For the System Face Mount you must install the Display Interface Module in Slot 15.
   -   3500/04-01 Earthing Module. Intallations that use Inernal Barrier I/Os require 1 Earthing Module per rack.

Figure 2-3: 3500 Rack (Full-Size)

The following sections list the function of each module. Refer to the individual operation and maintenance manuals for available options, detailed description, operation and maintenance.

2.3.1 Weatherproof Housing

The weatherproof housing protects the 3500 rack from adverse environmental effects, such as excessive moisture, dirt and grime, and even unclean air. The weatherproof housing will not accommodate a Display Unit or VGA Display.

2.3.2 Rack

2 types of 3500 racks are available: the full-size 19-inch rack and the compact 12-inch Mini-rack. Each rack requires you to install the Power Supplies and Rack Interface Module (RIM) in specific locations. The full-size version offers 14 additional rack positions and the Mini-rack offers 7 additional rack positions. You may use these positions to install any combination of modules. Both racks support Standard (non-redundant) and Triple Modular Redundant (TMR) configurations.

Application Advisory
The TMR system will restrict the location of certain modules.

2.3.3 Power Supply

The Power Supply is a half-height module available in ac and dc versions. You can install 1 or 2 power supplies in the rack. Each power supply can power a fully loaded rack. When you install 2 power supplies in a rack, the supply in the lower slot acts as the primary supply and the supply in the upper slot acts as the backup supply. If the primary supply fails, the backup supply will provide power to the rack without interrupting rack operation. The 3500 design allows you to install any combination of power supply types.

Overspeed Detection and TMR Monitors require dual power supplies.

2.3.4 Rack Interface Module

The Rack Interface Module (RIM) is a full-height module that communicates with the host (computer), a Bently Nevada™ Communication Processor, and the other modules in the rack. The Rack Interface Module also maintains the System Event List and the Alarm Event List. You can daisy-chain this module to the Rack Interface Modules in other racks and to the Data Acquisition / DDE Server Software. The *3500 Monitoring System Computer Hardware and Software Manual* shows how to daisy chain the Rack Interface Modules together. Rack Interface Modules are available in Standard, Triple Modular Redundant and Transient Data Interface versions.

2.3.5 Communication Gateway Module

The Communication Gateway Module is a full-height module that allows external devices (such as a DCS or a PLC) to retrieve information from the rack and to set up portions of the rack configuration. You can install more than one Communication Gateway Module in the same rack. Communication Gateway Modules are available for a variety of network protocols.

2.3.6 Monitor Module

The Monitor Modules are full-height modules that collect data from a variety of transducers. You can install any combination of Monitor Modules in the 3500 rack.

2.3.7 Relay Module

Relay Modules provide relays that you can configure to close or open based on channel statuses from other monitors in the 3500 rack. Relay modules are available in 4-channel, 16-channel, and 4-channel Triple Modular Redundant (TMR) versions.

The TMR Relay Module is a half-height 4-channel module that operates in a TMR system. 2 half-height TMR Relay Modules must operate in the same slot. If you remove the upper or lower Relay Module or the system declares one of the modules as Not OK, then the other Relay Module will control the Relay I/O Module.

2.3.8 Keyphasor® Module

The Keyphasor Module is a half-height module that provides power for the Keyphasor transducers, conditions the Keyphasor signals, and sends the signals to the other modules in the rack. The Keyphasor Module also calculates the rpm values sent to the host (computer) and external devices (DCS or PLC) and provides buffered Keyphasor outputs. Each Keyphasor Module supports 2 channels. You may place up to 2 Keyphasor Modules in a 3500 rack for a maximum of 4 Keyphasor channels. If you use 2 Keyphasor Modules, you must place them in the same full-height slot and the modules will share a common I/O module.

2.3.9 Display Module

The 3500 system offers multiple display options.

The Display Interface Module can display rack data on an LCD-based Interface unit or a 3rd-party Modbus® based display unit.

The VGA Display Module will display rack data on certain touch screen VGA Displays.

The Integrated PC display is a complete rack mount touch screen PC pre-loaded with rack configuration software and display utilities.

2.3.10   Earthing Module

The Earthing Module is a full-height module that provides a low resistance connection (must be less than 1 Ω) from the 3500 rack to the plant's intrinsically safe earth ground. The module operates in conjunction with the 3500 internal zener barrier I/O modules. Your application will require 1 Earthing Module per rack when internal barrier I/O modules are used.

2.4 Standard Rack Relay Options

You can configure the standard (or non-TMR) 3500 rack to have individual relays, bussed relays, or a combination of individual and bussed relays.

2.4.1 Individual Relays

A rack with individual relays contains 1 or more relay cards for each monitor module. You can configure the monitor and relay modules within a 3500 rack in many ways.

Example 1: The application uses 1 relay module 1 monitor module.

Table 2-1: 1 Relay Module Used With 1 Monitor Module

Monitor	Monitor Channel	Alarm Type	Relay Module	Relay Channel
1	1	Alert	1	1
1	2	Alert	1	1
1	1	Danger	1	2
1	2	Danger	1	2
1	3	Alert	1	3
1	4	Alert	1	3
1	3	Danger	1	4
1	4	Danger	1	4

The alarm types are ORed in the above example.

Example 2: The application uses 2 relay modules with 1 monitor module.

Table 2-2: 2 Relay Modules Used With 1 Monitor Module

Monitor	Monitor Channel	Alarm Type	Relay Module	Relay Channel
1	1	Alert	1	1
1	2	Alert	1	2
1	3	Alert	1	3
1	4	Alert	1	4
1	1	Danger	2	1
1	2	Danger	2	2
1	3	Danger	2	3
1	4	Danger	2	4

Example 3: The application uses 1 relay module with 1 monitor module.

Table 2-3: 1 Relay Module Used With 1 Monitor Module

Monitor	Monitor Channel	Alarm Type	Relay Module	Relay Channel
1	1	Alert	1	1
1	2	Alert	1	1
1	3	Alert	1	1
1	4	Alert	1	1
1	1	Danger	1	2
1	2	Danger	1	2
1	3	Danger	1	2
1	4	Danger	1	2

The alarm types are ORed in the above example.

Figure 2-4 shows a typical Individual Relay layout for a standard 3500 rack. You can place the monitors and relay modules in any slot as long as you link 1 monitor to 1 (or more) relay module(s) in the Rack Configuration Software.
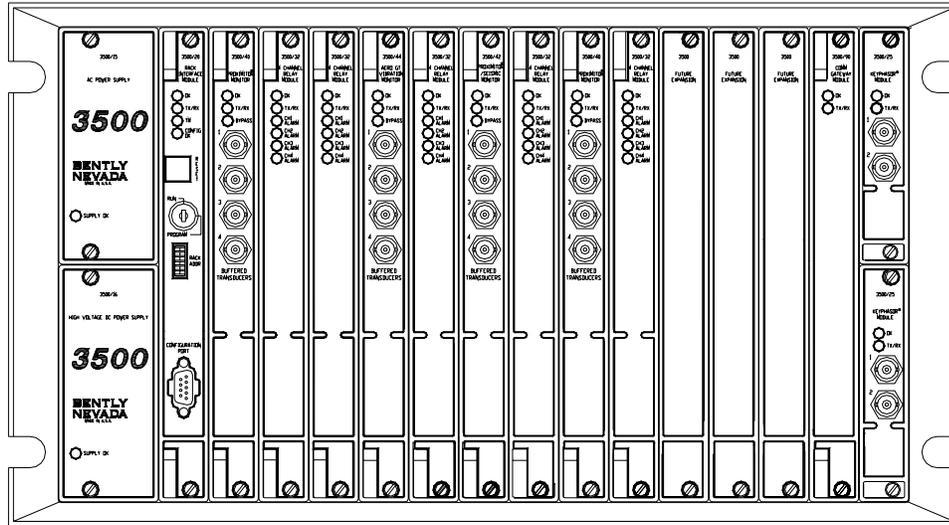
Figure 2-4: Typical Standard 3500 Rack with Individual Relays (Full-Size Rack Shown)

2.4.2 Bussed Relays

In the Bussed Relays configuration a number of monitor channels share a single relay. Use the Rack Configuration Software to define the combination of alarms that will trigger the relay. Figure 2-5 shows a typical Bussed Relay layout for a standard 3500 rack. You can [place the monitors and relay modules in any slot as long as you link the monitors to the relay module in the Rack Configuration Software.
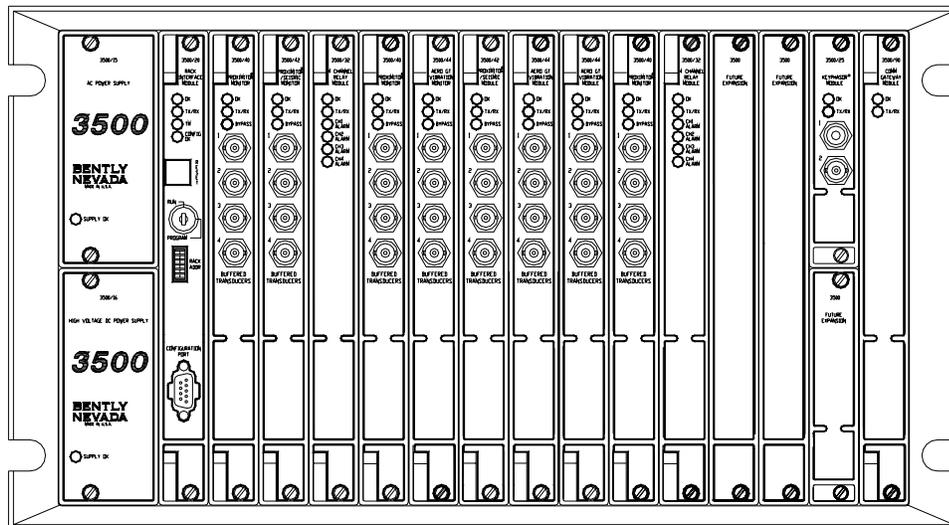

Figure 2-5: Typical Standard 3500 Rack with Bussed Relays (Full-Size Rack Shown)

2.4.3 Triple Modular Redundant (TMR) System
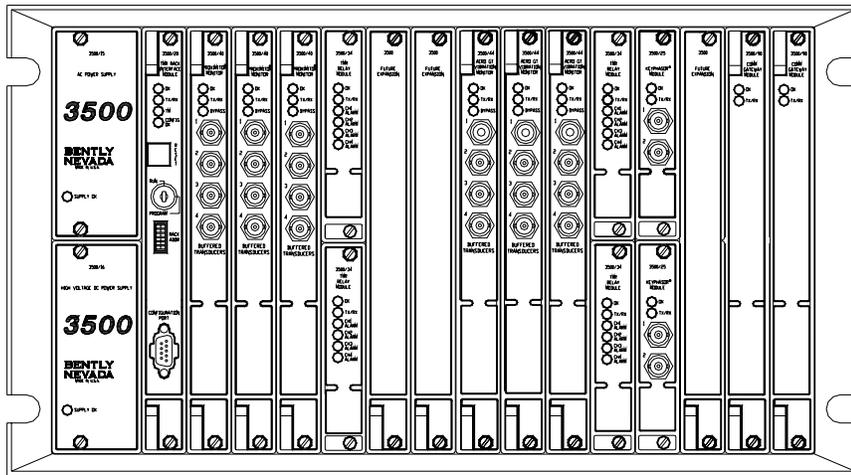
Figure 2-6: Typical TMR 3500 System (Full-Size Rack Shown)

For applications that require high system reliability, the 3500 rack supports Triple Modular Redundancy (TMR). The goal of a TMR setup is to ensure that no single point failure of any component will disable machinery protection for critical machine points. A properly configured TMR system will duplicate or triplicate every function of the rack to achieve this goal.

2.4.3.1   Requirements For a 3500 TMR Rack

- You must set the Rack Jumper to the TMR position (see the Rack Jumper section of this manual)

- Your system must use the TMR version of the 3500/20 or 3500/22 Rack Interface Module (TMR RIM or TMR TDI RIM).

- The 3500 rack requires 2 3500/15 Power Supplies. You should connect these power supplies to independent sources of power so that if the primary supply fails, the monitors will use the secondary supply.

- You must install TMR monitors in sets of 3 in adjacent slots (this is the only difference between TMR and regular monitors). The 3 monitors will monitor the same machine point. You configure only 1 monitor in the 3500 Rack Configuration Software. The software will automatically configure the other 2 monitors the same as the first.

- The TMR group can use separate transducers for each monitor (discrete). All I/O modules support TMR with discrete transducers.

- Some 3500 monitors can share a common transducer across the triple (bussed). Bussed transducers must meet the following conditions:

- Your system must use the TMR I/O Module for that monitor. If a TMR I/O Module is not available for that monitor, your system must use discrete transducers.

- The TMR I/O Module must support the desired channel measurement.

- Your system must use the Bussed ET Block for that monitor.

- Your system cannot use Intrinsic Safety Barriers with bussed transducers

Application Advisory
When using bussed transducers, a single point failure in the transducer or field wiring can cause a loss of machinery protection.

- For truly redundant keyphasors, use 2 3500/25 Keyphasor monitors. Configure your 3500 system such that the primary and secondary Keyphasor signals reside on different Keyphasor modules. The 3500 TMR rack allows non-redundant Keyphasors signals. You may install a maximum of 2 Keyphasor modules per rack.

- You may install independent monitors in a TMR rack to monitor less critical machine points.

- You may use both standard and TMR relay modules in a TMR rack. You can configure the 3500/34 TMR Relay Module only to drive relays from channels in a TMR group. Standard relay modules can drive only relays from channels in an independent monitor.

- The 3500 TMR Rack permits but does not require Redundant Display modules and Communication Gateways. Some modules have configuration restrictions for placing multiple modules in a rack. See the Operation and Maintenance manual for the appropriate module for details.

2.4.3.2 Features Of a Properly Configured 3500 TMR rack

A properly configured 3500 TMR rack will include the following:

- Duplicate power supplies, with all monitors capable of switching between primary and backup supplies without interruption of monitoring

- Triplicate inter-monitor communication networks between RIM, Relay Module and TMR groups.

- Triplicate alarm voting logic and circuitry

- Triplicate relay voting logic and control circuitry

- Duplicate processing of alarm information from monitors in the rack

2.4.3.3   TMR Relay Module

A 3500/34 TMR Relay Module consists of 2 half-height monitors and 1 full size I/O module. The 2 monitors have identical configurations and perform the same monitoring function redundantly. The I/O module contains triplicate relays and control logic.

2.4.3.4   Inside a TMR Rack

Refer to Figure 2-7 for the organization of a TMR rack.
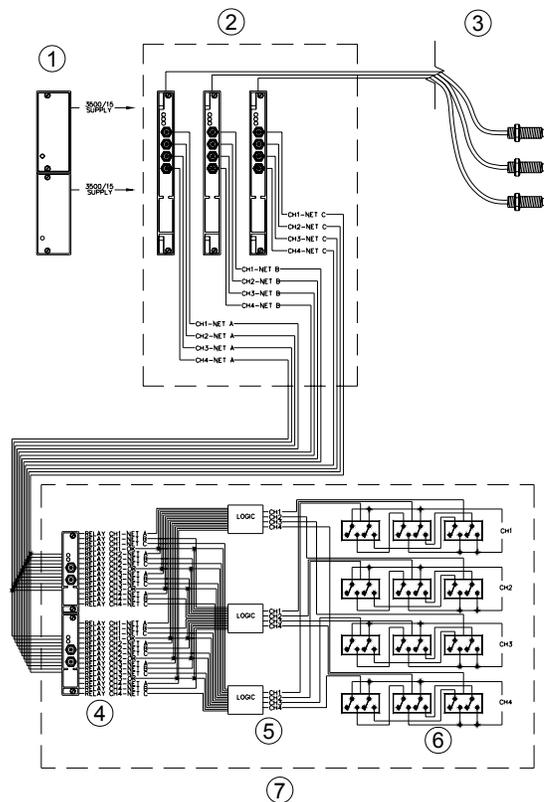
1. Dual 3500 power supplies Independently supply redundant power to each component in the system
2. TMR Monitor group. Each Channel's status is determined independently in each monitor
3. Triplicate transducers monitor a single point. Typical for 4 channels. (Discrete transducer inputs shown)
4. 2 3500/34 half-height cards process alarm events from the other monitor cards in duplicate.
5. TMR Relay I/O module has triplicate relay logic
6. TMR Relay I/O module features 2 out of 3 relay voting
7. 3500/34 TMR relay module.

Figure 2-7: TMR Rack Organization

2.4.3.5   TMR Individual Relays

Figure 2-8 shows a typical TMR rack with Individual Relays. This configuration requires that you place 3 identical monitors next to each other and that you use the Rack Configurationi Software to link the monitors to 1 relay module.

Figure 2-8: Typical TMR 3500 Rack With Individual Relays (Standard Size Rack Shown)

2.4.3.6   TMR Bussed Relays

Figure 2-9 shows a typical TMR rack with Bussed Relays. This configuration requires that three identical monitors be placed next to each other and that the monitor groups be linked to one relay module in the Rack Configuration Software.

1. TMR Group 1.
2. TMR Group 2.
3. TMR Group 3.

Figure 2-9: Typical TMR 3500 Rack With Bussed Relays (Full Size Rack Shown)

2.5   Intrinsic Safety — The 3500 Internal Barrier System

To provide Intrinsically Safe (IS) vibration and process variable monitoring, the 3500 system has a range of I/O modules with internal zener barriers. When you install these modules in a 3500 rack with a 3500/04-01 Earthing Module, they provide an integrated solution for explosion protection for approved Bently Nevada transducer systems that are located within all classifications of hazardous areas (surface industries other than mining).

2.5.1 3500 Internal Barrier System Restrictions

- You must install 1 earthing module in each rack in the internal barrier system. The earthing module occupies 1 slot position in the rack when it uses Internal Barrier I/O modules.

- You must change the grounding configuration of the 3500/15 Power Supplies from the default factory setting. See the *3500/15 Operation and Maintenance Manual* (PN 129767-01) for instructions.

- You must isolate any RS-232 connection to any 3500 module. Monitors that support RS232 connections include Rack Interface Modules, Communication Gateways, and the 3500/95 PC Display. See the *3500/20 Operation and Maintenance Manual* (PN 129768-01) for instructions. This restriction does not apply to RS422 and RS485 connections to the rack. Monitors that support RS422 and/or RS485 connections include the 3500/20, 3500/90, 3500/92, 3500/93, and 3500/95.

- You must not use the 3500/94 VGA Display in internal barrier systems.

- You must not use bussed transducers, as internal barrier systems do not allow bussed transducers. See the TMR section of this manual for more information.

2.5.2 3500 Internal Barrier System Features

- The earthing module supports dual IS Earth connections for cables with cross-sectional areas up to 10 mm^2. This module lets you test IS Earth continuity online.

- The design of the internal barrier I/O modules provides the 2 inches (50 mm) of separation required between safe and hazardous area field wiring.

- The connectors for safe areas and hazardous areas have different field wiring colors (green for safe and blue for hazardous) and connector pitches. This helps to avoid incorrect field wiring installation.

- Quick connect/disconnect connectors simplify field wiring installation and removal.

- You can locate standard and internal barrier I/O modules in the same 3500 rack. We recommend that you group the modules together as shown in Figure 2-10 to facilitate connection to field wiring.
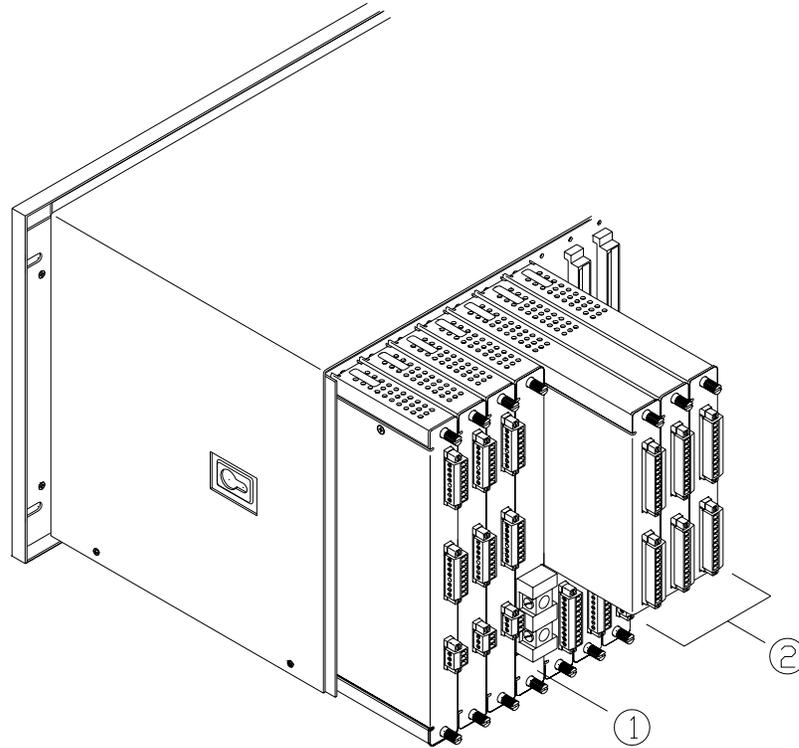
1. Earthing Module.
2. Internal Barrier I/O Modules.

Figure 2-10: Suggested Grouping of Standard and Internal Barrier I/O Modules

3. Initial Rack Installation

This section shows how to install a new 3500 rack.

3.1 General Installation Procedure

1. Review the Installation Checklist (see Section 3.2).

2. Install the Weatherproof Housing (if required) (see Section 3.3).

3. Install the rack (see Section 3.4).

4. Set the jumpers and switches on rack (see Section 3.8).

5. Install the External Termination Blocks (if required) (see Section 3.5).

6. Install the modules (see Section 4).

7. Wire the transducers, relay, and power to the rack and modules (see Section 3.9).

8. Perform the Software Portion of the Rack Installation (see Section 3.10).

3.2 Installation Checklist

Use the following items to plan a 3500 rack installation:

- What are the power requirements?

- Does the rack fit in the proposed location?

- Can you mount the rack in the proposed location?

- Does the proposed location provide enough air circulation?

- Does the rack require a weatherproof housing?

- What termination does the rack require (internal or external)?

- Does the rack require a telephone line?

- Does the location provide good grounding for the rack?

- If you plan to fit Internal Barriers, does the location provide an Intrinsically Safe Earth?

3.3 Weatherproof Housing Installation

This section describes the 3500 weatherproof housing and provides instructions for proper installation.

3.3.1 General Description

The 3500/06 weatherproof housing is an enclosure designed to meet NEMA 4 requirements and to contain one 3500 series rack (rack mount option only). The housing design does not accommodate a Display Unit or VGA display. The housing is available in painted steel or stainless steel versions, with or without conduit fittings, and with or without air purge accessories. A hinged door provides access to the front of the rack. A bolt-on cover provides access to the rear of the rack.
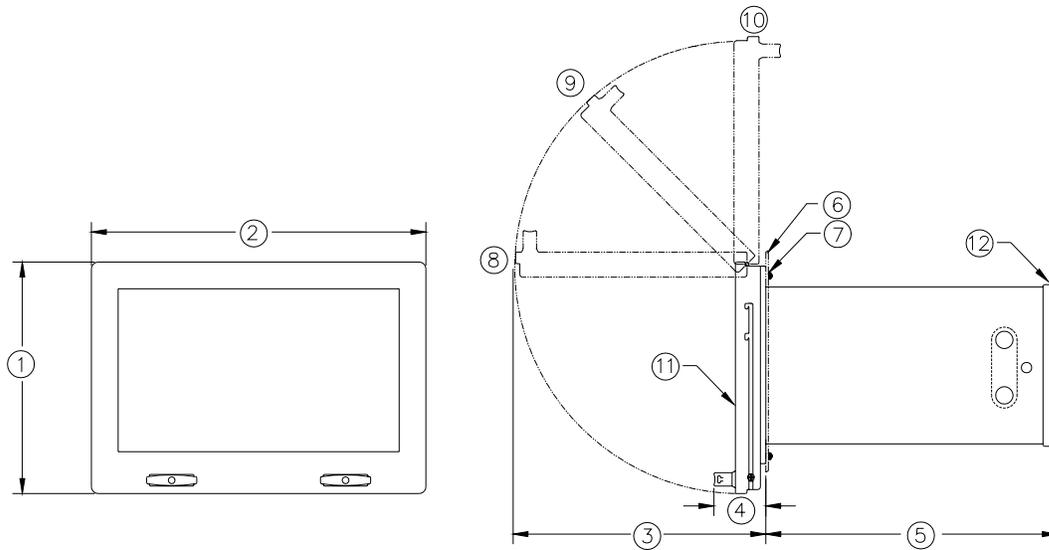
1.   424.2 mm (16.70 in)
2.   595.1 mm (23.43 in) for full-size rack, 417.3 mm (16.43 in) for Mini-rack.
3.   411.5 mm (16.20 in).
4.   95.3 mm (3.75 in).
5.   533.4 mm (21.00 in).
6.   Panel to which the housing mounts.
7.   Thread-seal washers supplied with housing. Use under all internal heads of mounting bolts or nuts to obtain a water-tight seal.
8.   The housing door will latch in this 90º position.
9.   The housing door will latch in this 135º position.
10. The door must be opened to this position to latch or unlatch the door in the 2 shown latching positions. Refer to safety notice below.
11. Hinged door for access to the front of rack.
12. Bolted cover to access to rear of rack.

Figure 3-1: Weatherproof Housing

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┌─────────────────────────────────────────────┐
│   ⚠        CAUTION                           │
├─────────────────────────────────────────────┤
│   The hinged door will NOT latch in the     │
│   180º position (Item 10) shown in Figure   │
│   3-1. An unlatched door can close without  │
│   warning and result in serious injury.  Do │
│   not leave the door unsupported in this    │
│   position.                                 │
└─────────────────────────────────────────────┘
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3.3.2 Rack Temperature Derating

Because the housing restricts ventilation to the rack, the maximum ambient temperature of the rack must be derated. Derating is based on how many watts the rack is dissipating. Refer to Figure 3-2 below.

1. Temperature rise above ambient (ºC)
2. Temperature rise above ambient (ºF)
3. Power dissipated (W)
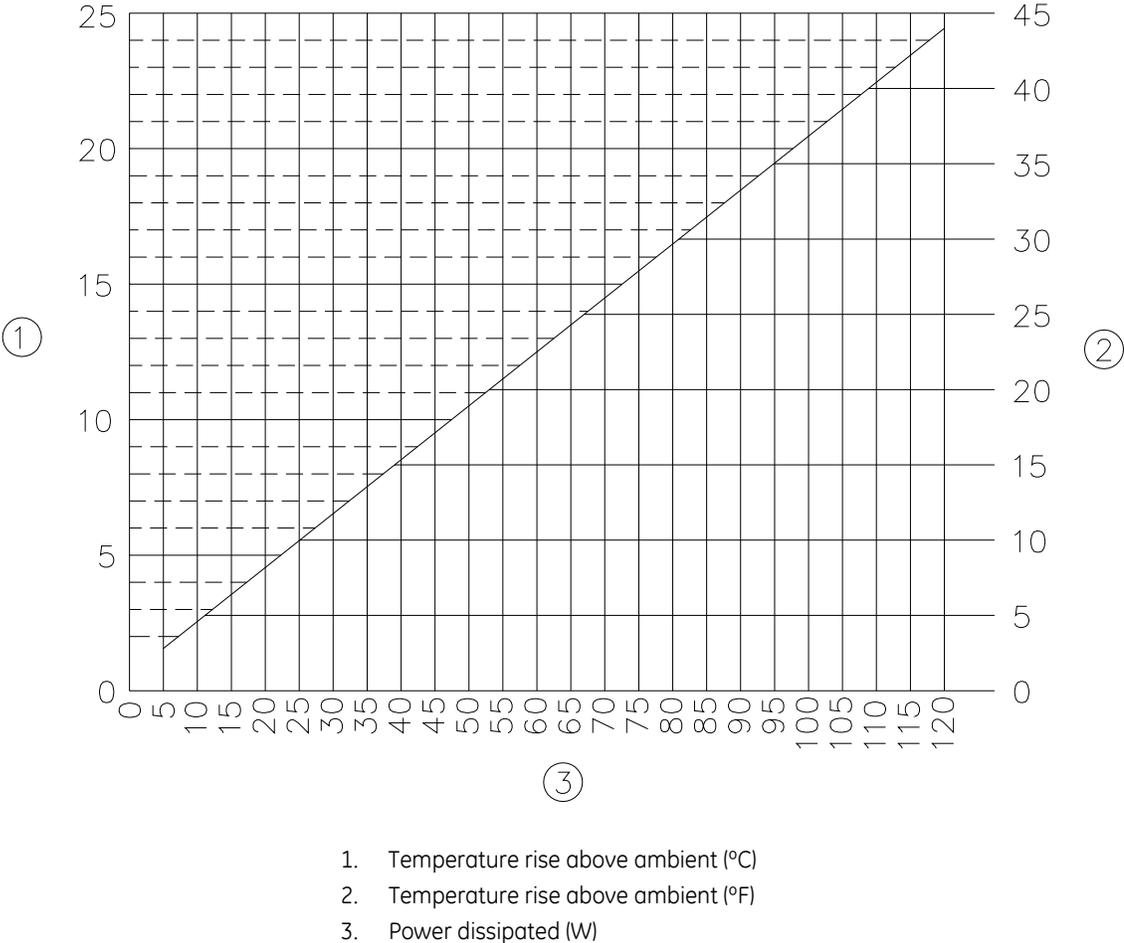
Figure 3-2: Rack Temperature Derating Chart

3.3.3 Panel Cutout

Figure 3-3 shows the recommended panel cutout for the 3500/06 weatherproof housing for a full-size rack. Dimensions are +/- 0.02 inches (+/- 0.51 mm) unless specified otherwise.
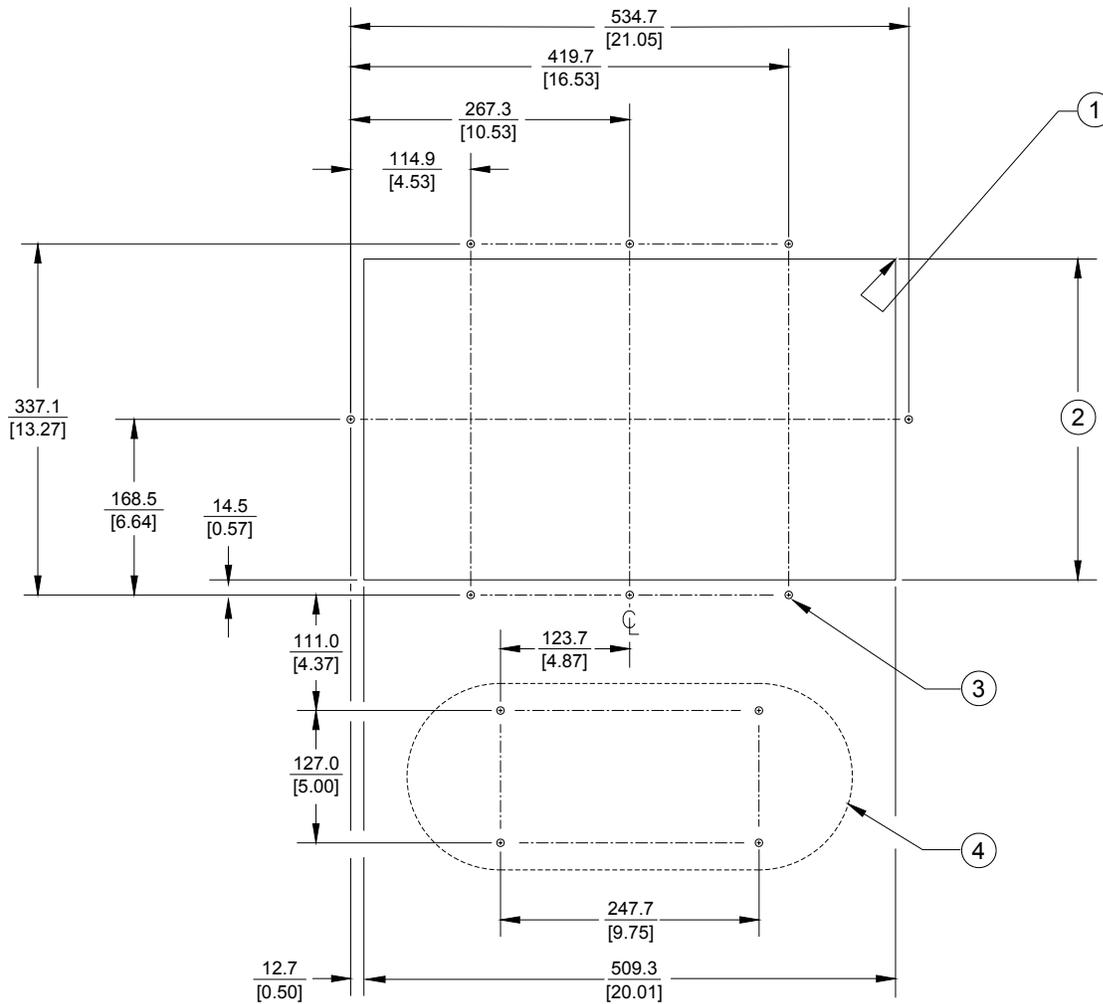

1. 6.4 mm (0.25 in) maximum radius, 4 places
2. 308.1 ± 0.2 mm (12.13 ± 0.06 in)
3. 7.14 mm (0.281 in) diameter clearance hole for 0.250 in diameter bolt or mounting studs. 8 places for housing, 12 places for housing and air purge gauge assembly.
4. Use this 4-hole pattern only when installing the air purge gauge assembly.

Figure 3-3: Recommended Panel Cutout Pattern for Weatherproof Housing (All dimensions shown in millmetres (inches) except as noted)

Figure 3-4 shows the recommended panel cutout for the 3500/06 weatherproof housing for a Mini-rack. Dimensions are +/- 0.02 inches (+/- 0.51 mm) unless specified otherwise.
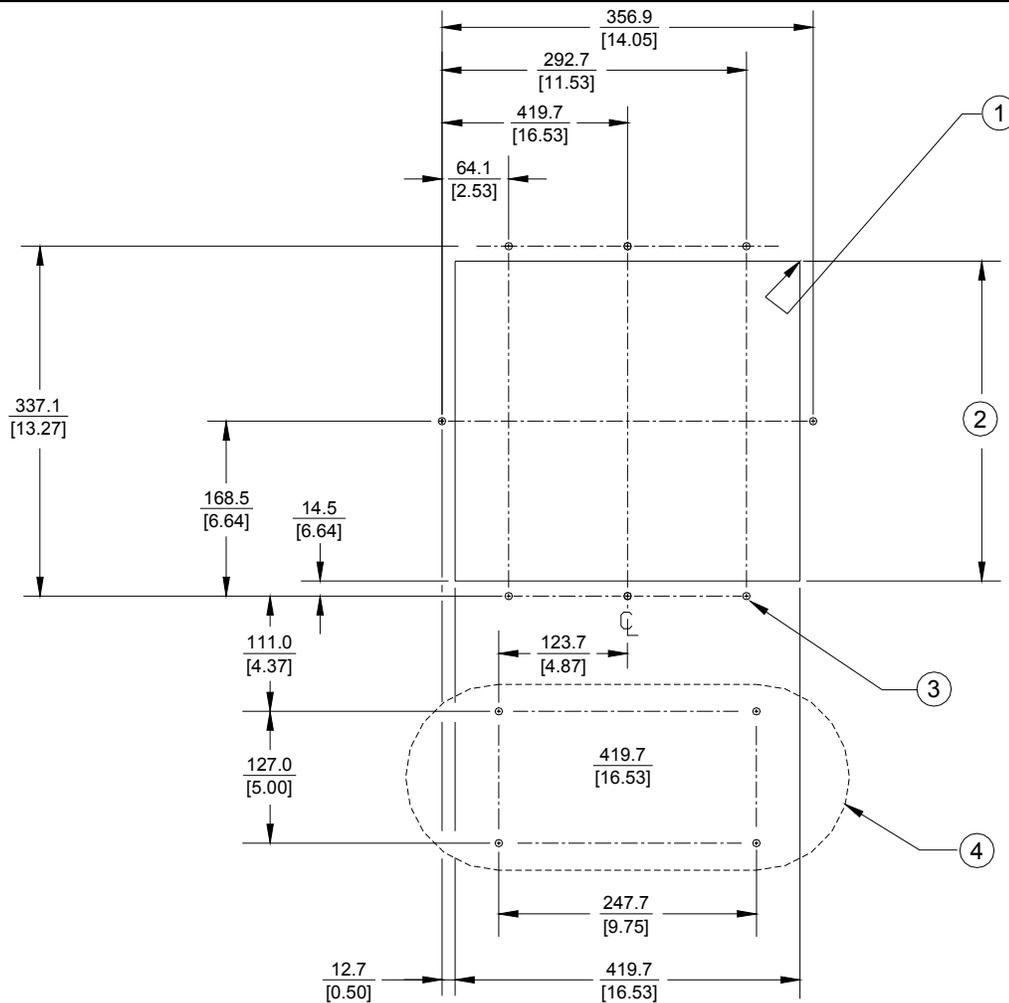
1. 6.4 mm (0.25 in) maximum radius, 4 places
2. 308.1 ± 0.2 mm (12.13 ± 0.06 in)
3. 7.14 mm (0.281 in) diameter clearance hole for 0.250-inch diameter bolt or mounting studs. 8 places for housing, 12 places for housing and air purge gauge assembly.
4. Use this 4-hole pattern only when installing the air purge gauge assembly.

Figure 3-4: Recommended Panel Cutout Pattern for Weatherproof Housing (All dimensions shown in millmetres (inches) except as noted)

3.3.4 Conduit Fitting Operation

The conduit fitting option provides 4 1-1/4 NPT weatherproof hubs. The customer supplies the conduit, and the percentage of fill should not exceed 40% as specified in *National Electrical Code, 1975*, Chapter 9, Tables 1 and 2. The installation is to use the upper conduits for transducer power, signal input and recorder output and the lower conduits for rack power input and relay wiring. You should NOT mix power input and relay wiring with transducer and recorder wiring. Figure 3-5 shows the hubs installed onto the housing.
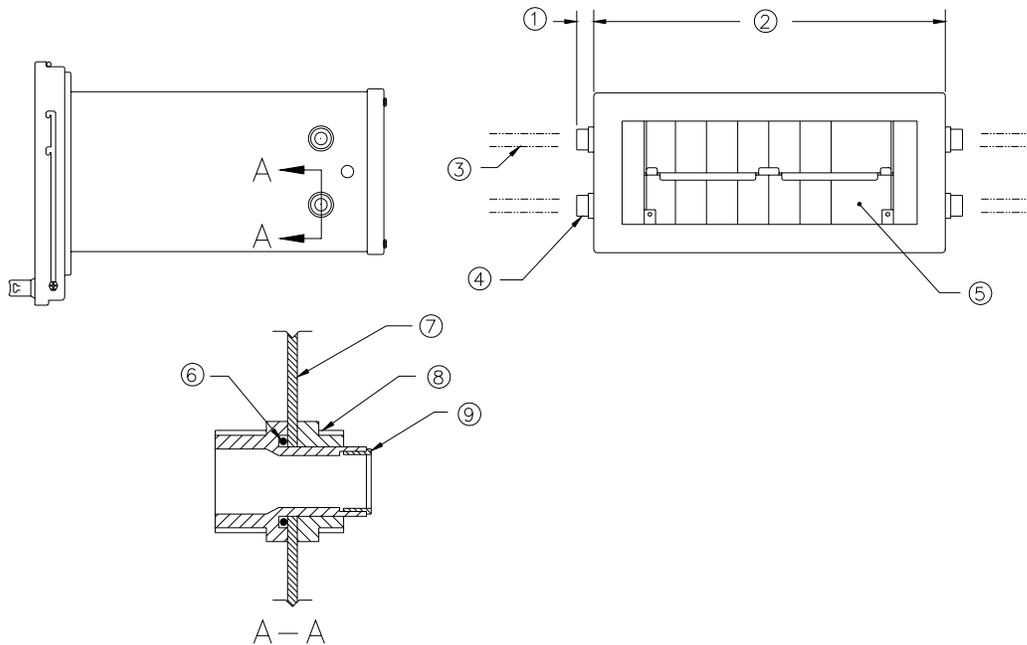
1. a26.2 mm (1.03 in), 4 places.
2. b496.6 mm (19.55 in) for full-size rack, 318.8 mm (12.55 in) for Mini-rack.
3. Customer-supplied conduit, 4 places.
4. Weatherproof conduit hub. Also shown in cross-section A-A.
5. Rear view of housing with rear cover and typical 3500 rack installed.
6. O-ring seal.
7. Housing wall. Arrow points to inside surface of housing.
8. Lock ring.
9. Collar.

Figure 3-5: Housing with Weatherproof Hubs Installed

3.3.5 Air Purge Option

There are two air purge options:

1. The "fittings only" option provides 4 1-1/4 NPT Pour seal type fittings and one 3/4 NPT weatherproof hub, with fittings to reduce down to 1/4 NPT (female) for air input.

2. The "fittings and gauge" option provides the fittings listed above, a gauge assembly, a bulkhead connector and a connecting tube.

An application that requires either of the air purge options will also requires the conduit fitting option.

Static purge pressure (the pressure required to insure that a hazardous atmosphere does not enter the housing) must be above 0.2 inches of water (0.05 kilopascals) for installations that require N.F.P.A. 495-1982 specification. For installations that require Canadian Electrical Code C22.1-1986 specification,

pressure must be above 0.25 kilopascals (1.0 inches of water). This is pressure measured on the gauge (after housing has been purged) with the valve in the closed position.

Application Alert

This housing is NOT equipped with over pressure protection. Maximum working pressure should not exceed 2.49 kilopascals (10 inches of water).

To determine the purge flow rate (the time required to purge 5 or 10 volumes of air through the housing), follow the instructions below:

1. Turn the valve to its vent position and read the gauge to determine housing purge pressure.

2. Find that pressure on Table 3-1 or Table 3-2, whichever is appropriate.

3. Determine the size of the housing that is being purged and read from that column the length of time required to purge the system with your housing pressure. You should permanently mark this number, in minutes, in the space provided on the warning label on the housing door.

Table 3-1: Pressure for 5X Purge per NFPA 496-1982

Pressure (Inches of Water)	Flow Through Air Purge Valve (Cubic Feet per Minute)	Time For Purging Housing (Minutes)
0.2	0.33	46
0.4	0.67	23
0.6	0.83	19
0.8	1.00	16
1.0	1.08	14
1.5	1.25	12
2.0	1.42	11
2.5	1.57	10
3.0	1.72	9
3.5	1.85	8
4.0	2.00	8
4.5	2.11	8
5.0	2.22	7
5.5	2.33	7
6.0	2.42	7
6.5	2.50	6
7.0	2.59	6

Pressure (Inches of Water)	Flow Through Air Purge Valve (Cubic Feet per Minute)	Time For Purging Housing (Minutes)
7.5	2.67	6
8.0	2.74	6
8.5	2.80	6
9.0	2.87	6
9.5	2.93	6
10.0	3.00	5

Table 3-2: Pressure for 10X Purge per Canadian Electrical Code C22.1-1986, Part 1

| Pressure		Flow Through Air Purge Valve		Time For Purging Housing (Minutes)
Inches of Water	Kilopascals	Cubic Feet per Minute	Cubic Metres per Hour	
1.0	0.25	1.08	1.83	28
1.5	0.37	1.25	2.12	24
2.0	0.50	1.42	2.41	22
2.5	0.62	1.57	2.67	20
3.0	0.75	1.72	2.92	18
3.5	0.87	1.85	3.14	16
4.0	1.00	2.00	3.40	16
4.5	1.12	2.11	3.58	16
5.0	1.25	2.22	3.77	14
5.5	1.37	2.33	3.96	14
6.0	1.50	2.42	4.11	14
6.5	1.62	2.50	4.25	12
7.0	1.74	2.59	4.40	12
7.5	1.87	2.67	4.54	12
8.0	1.99	2.74	4.66	12
8.5	2.12	2.80	4.76	12
9.0	2.24	2.87	4.88	12
9.5	2.37	2.93	4.98	12
10.0	2.49	3.00	5.10	10

All tests and recommendations are in accordance with specifications and requirements made by N.F.P.A. in pamphlet 496-1982 for type Y purge, or Canadian Electrical Code C22.1-1986, Part 1. For additional information on purge requirements, refer to the above standards.

Figure 3-6 and Figure 3-7 show installation of the air purge fittings and gauge.
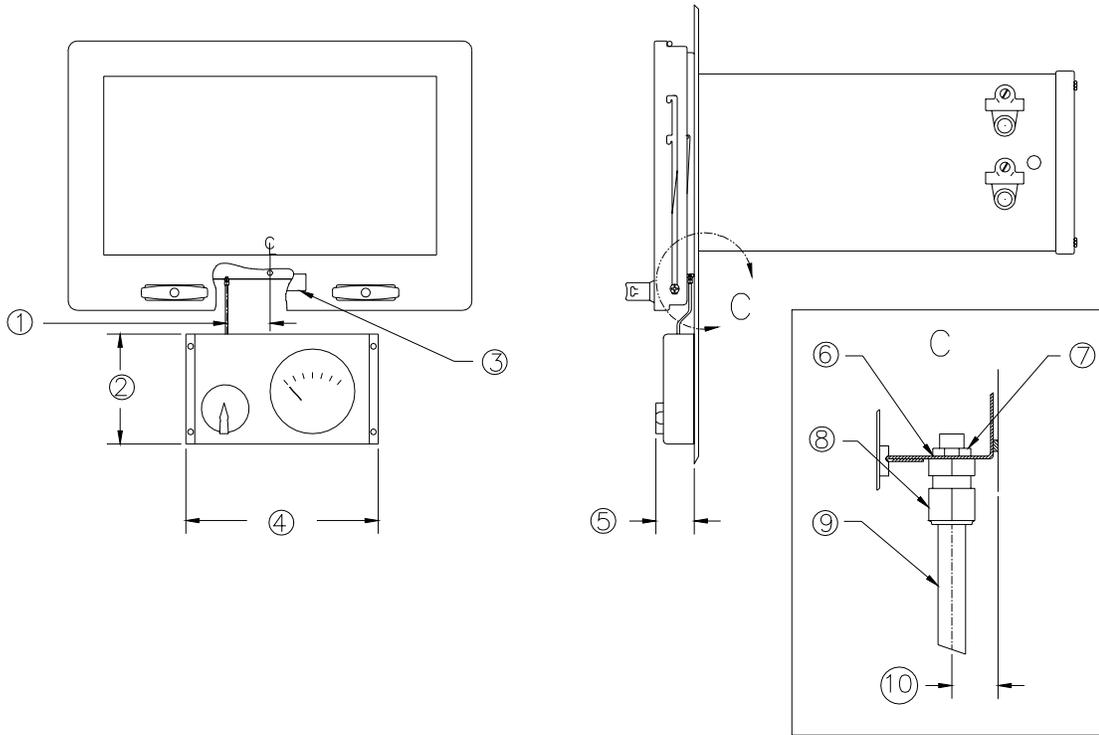
1. 3.00 inches (76.2 mm).
2. 6.00 inches (152.4 mm).
3. Purge warning label.
4. 10.50 inches (266.7 mm).
5. 3.25 inches (88.6 mm).
6. Drill a 0.43 inches diameter mounting hole.
7. Locknut.
8. Bulkhead fitting.
9. Connecting tube.
10. 0.50 inches (12.7 mm).

Figure 3-6: Installation of Air Purge Fittings and Gauge
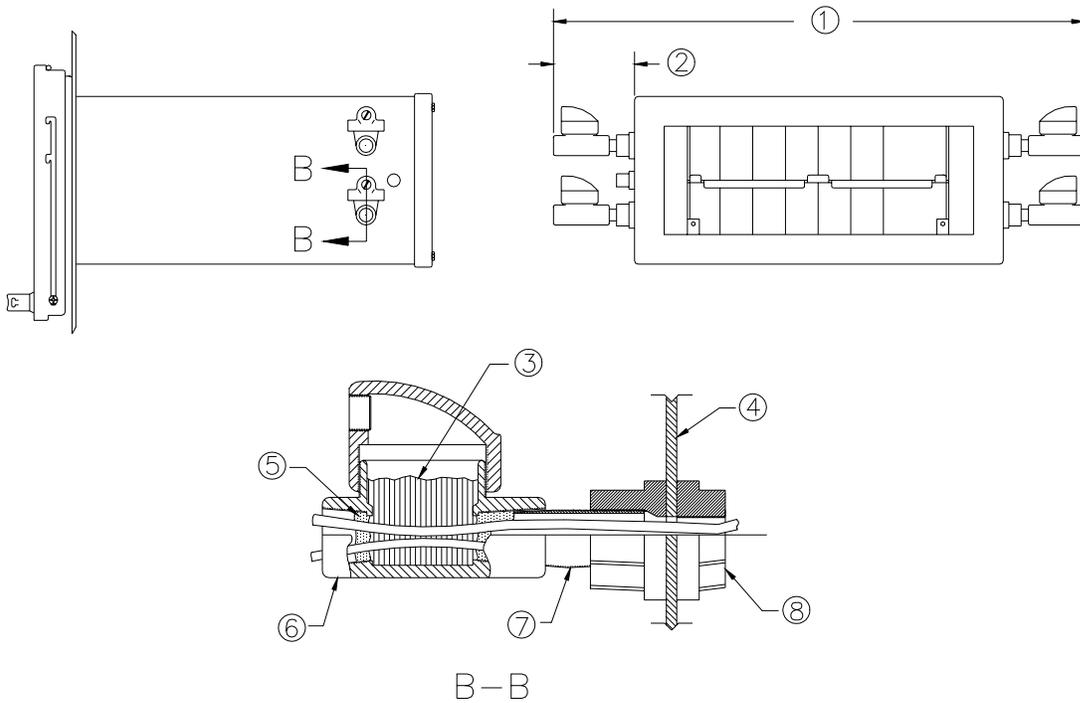
1. 31.05 inches (788.7 mm) full size, 24.05 inches (610.87 mm) for Mini-rack.
2. 5.75 inches (146.1 mm).
3. Sealing compound.
4. Weatherproof housing wall, inside surface.
5. Packing fiber, 2 places.
6. Pour seal fitting.
7. Adapter.
8. Conduit hub.

Figure 3-7: Installation of Air Purge Fittings and Gauge

3.3.6 Installation Instructions

1. Create the appropriate panel cutout for the options you will use.

2. Install the weatherproof housing into the panel cutout.

3. Secure the housing to the panel with 8 1/4-inch bolts. Be sure to use the provided thread seals to ensure a water-tight seal.

4. If required, install the optional fittings and gauge.

5. Install the 3500 system rack per the instructions for a rack-mount system.

6. Remove the rear access cover of the housing.

7. Install the field wiring to the rack.

8.   Secure all fittings.

9.   Install the housing's rear access cover.

10. Perform the necessary installation tests.

3.4   Rack Installation

This section provides instructions for the proper mounting of each type (Panel Mount, Rack Mount and Bulkhead Mount) of 3500 full-size and Mini-racks. When mounting a rack, verify that the rack is mounted to a grounded surface and that the features on the front panels of the main modules are accessible. Be sure to also provide for maintenance access to the I/O modules.

3.4.1 Rack Ventilation

The top and bottom of the rack are perforated to allow cooling air to enter and heated air to escape. In order to help ensure adequate ventilation, maintain the minimum clearances at the top and bottom of the rack as shown below.
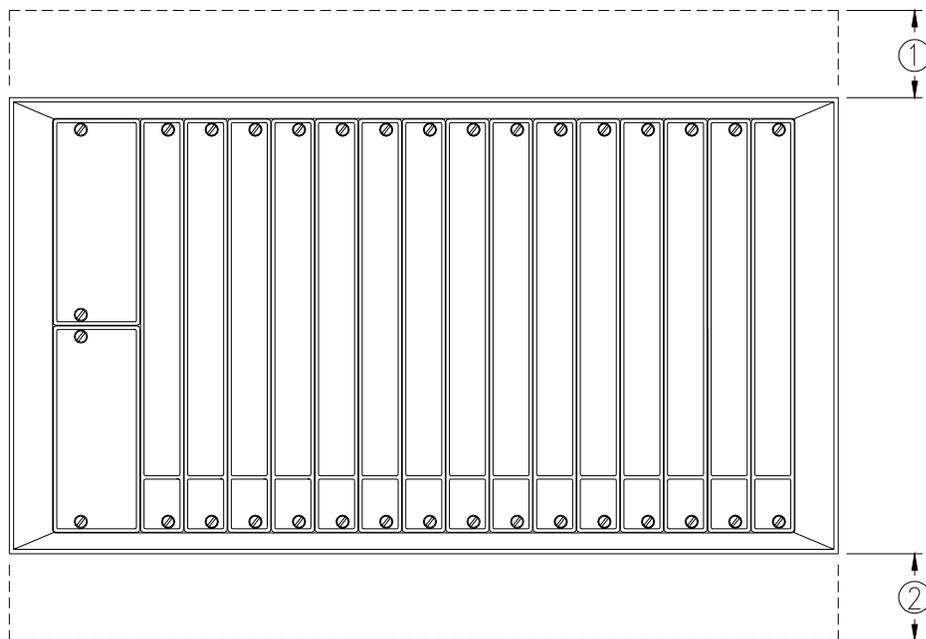
1.   Minimum top clearance = 50.4 mm (2.00 in).
2.   Minimum bottom clearance = 50.4 mm (2.00 in).

Figure 3-8: 3500 Rack Ventilation Minimum Clearances

3.4.2 Panel Mount

Figure 3-9 shows a 3500 panel mount rack. A panel mount rack allows you to install a 3500 rack behind a panel through a sheet metal cutout and clamp it into place.
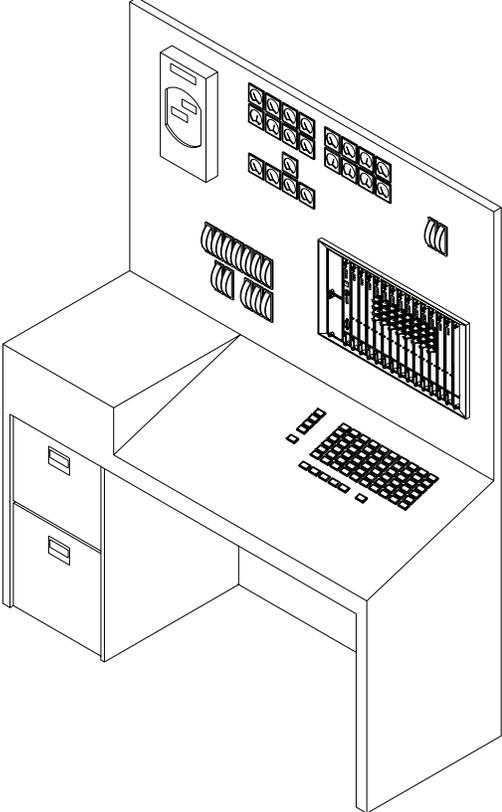

Figure 3-9: 3500 Panel Mount Rack

3.4.2.1   Panel Mount Full-Size Rack
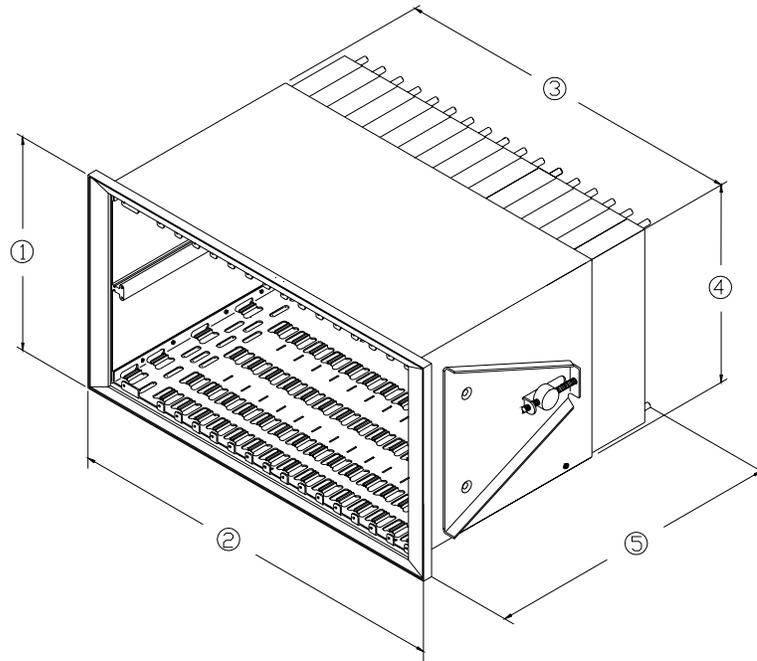
1.   265.94 mm [10.470 in].
2.   482.60 mm [19.000 in].
3.   441.96 mm [17.400 in].
4.   246.38 mm [9.700 in].
5.   349.25 mm [13.750 in], or 422.91 mm [16.650 in] if used with internal barriers.

Figure 3-10: Dimensions of a Panel Mount 3500 Full-Size Rack

> ⚠️ **WARNING**
>
> Clamps may detach if used as handles to carry or install the rack. This may injure personnel and damage the rack. Do not use the clamps as handles to carry or install the rack.

Figure 3-11 shows the required dimensions for the panel cutout.

1. 452.1 ± 1.5 mm [17.80 ± 0.06 in].
2. 3.2 mm [0.125 inches] radius, maximum .
3. 251.5 ± 1.5 mm [9.90 ± 0.60 in].

Figure 3-11: Full-Size Rack Panel Cutout Dimensions

3.4.2.2   Panel Mount Mini-Rack
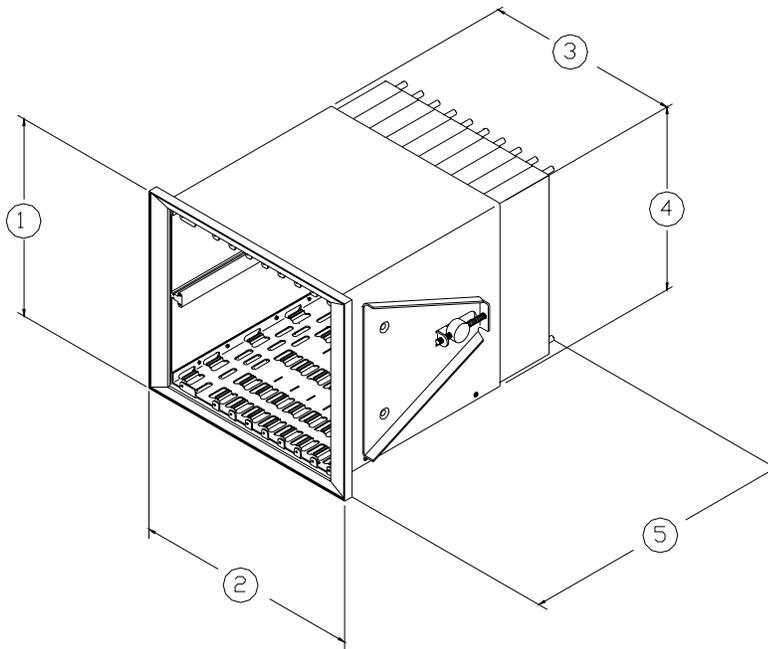
1. 265.94 mm [10.470 in].
2. 304.80 mm [12.000 in].
3. 264.16 mm [10.400 in].
4. 246.38 mm [9.700 in].
5. 349.25 mm [13.750 in], or 422.91 mm [16.650 inches] if used with internal barriers.

Figure 3-12: Dimensions of a Panel Mount 3500 Mini-Rack

⚠️ **WARNING**

Clamps may detach if used as handles to carry or install the rack. This may injure personnel and damage the rack. Do not use the clamps as handles to carry or install the rack.

Figure 3-13 shows the required dimensions for the panel cutout.
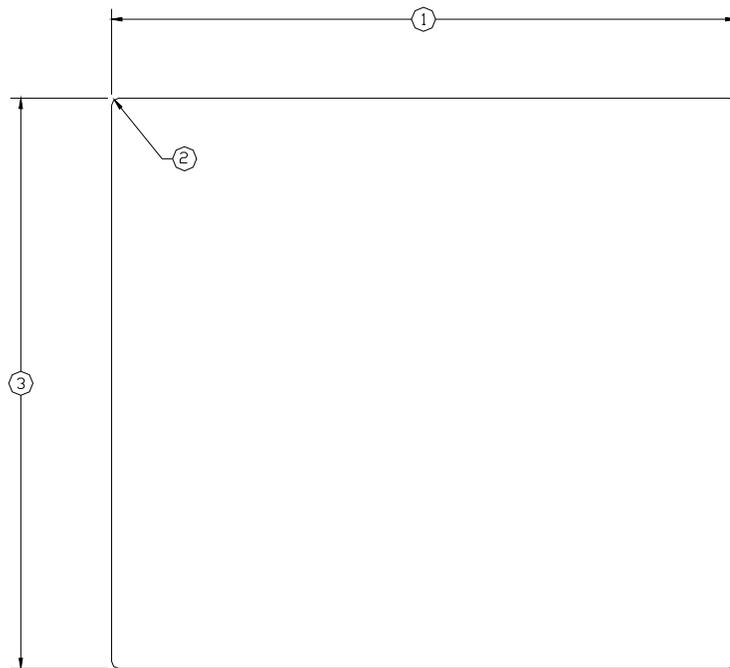
1. 274.3 ± 1.5 mm [10.80 ± 0.06 in].
2. 3.2 mm [0.125 in] radius, maximum.
3. 251.5 ± 1.5 mm [9.90 ± 0.60 in].

Figure 3-13: Mini-Rack Panel Cutout Dimensions

3.4.2.3   Instructions for Installing Panel Mount Rack

1. Cut panel cutout to the required dimensions.

2. If installed, remove the panel mount clamps from the rack.

3. Slide rack through panel cutout as shown in Figure 3-14.
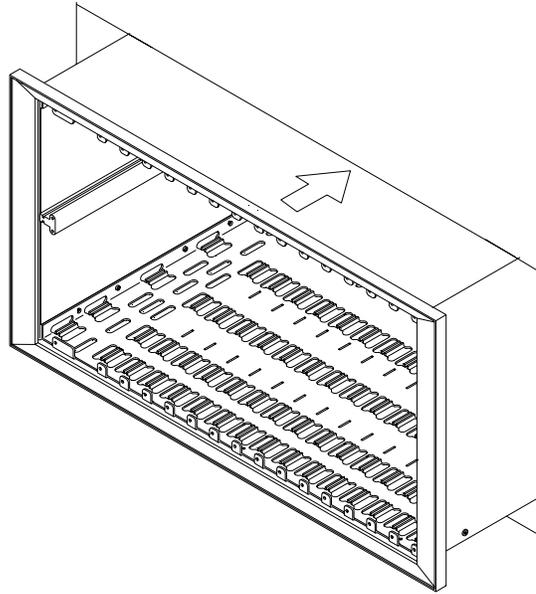
Figure 3-14: Sliding Rack Through Panel Cutout

4. Assemble the clamp as shown in Figure 3-15.
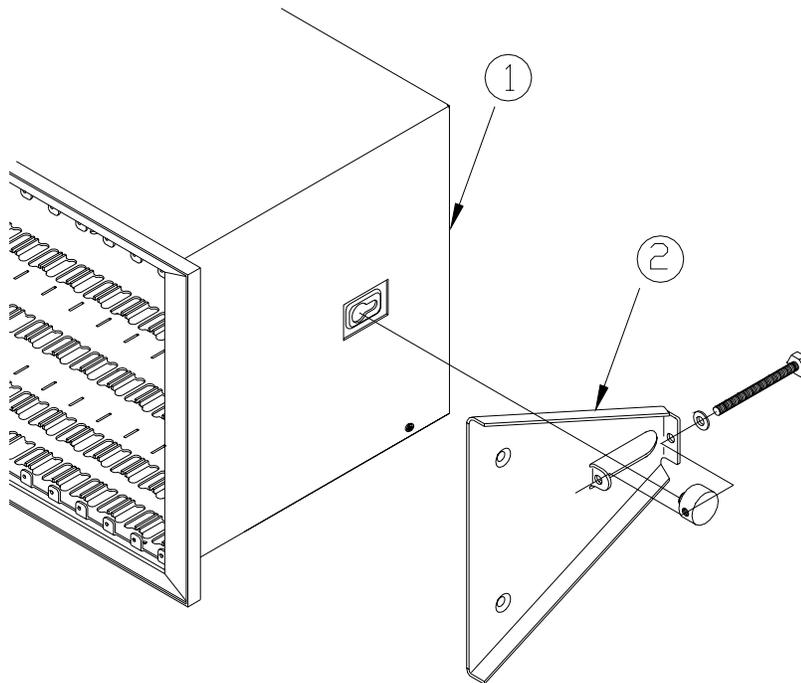
1. Rear of Rack.
2. Clamp.

Figure 3-15: Assembling the Rack Clamp

5. Align the rack in the cutout.

6. Tighten the clamping screws.

3.4.3 Rack Mount

3.4.3.1   Full-Size Rack Mount

Figure 3-16 and Figure 3-17 show a rack mount 3500 full-size rack. A rack mounted 3500 system allows you to install the rack into a standard 19-inch EIA cabinet.
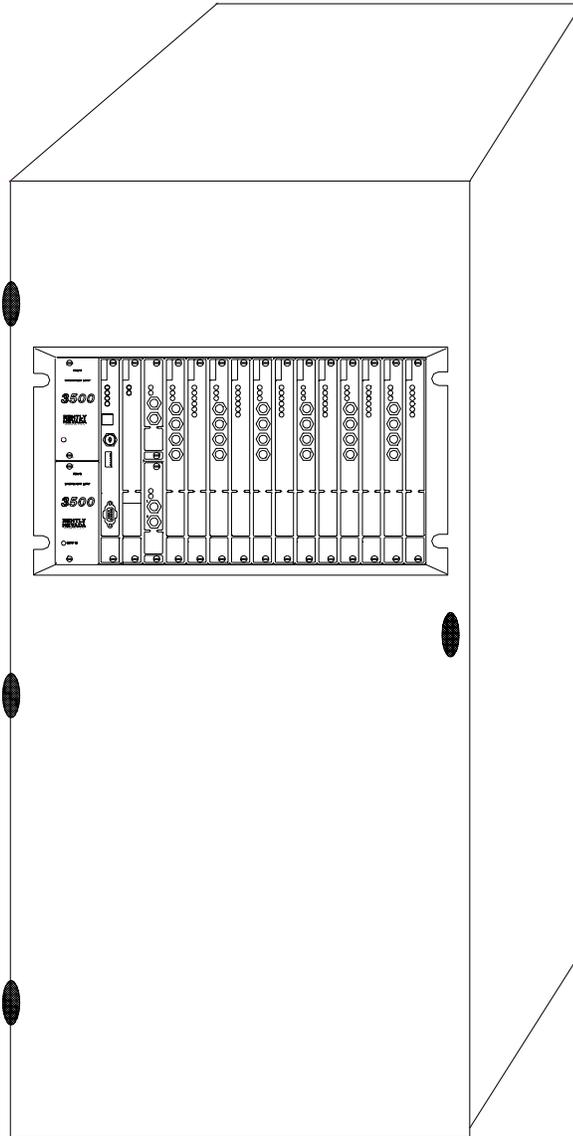
Figure 3-16: Installed Rack Mount 3500 Full-Size Rack
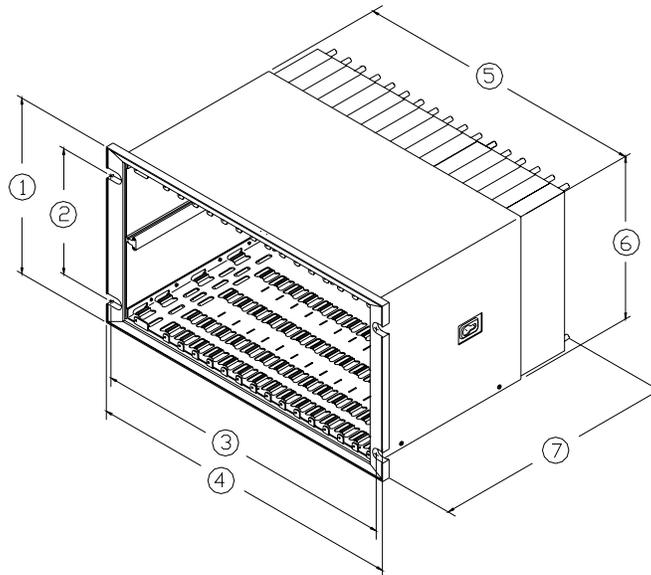
1. 265.94 mm [10.470 in].
2. 190.50 mm [7.500 in].
3. 457.40 mm [18.008 in].
4. 482.60 mm [19.000 in].
5. 441.96 mm [17.400 in].
6. 246.38 mm [9.700 in].
7. 349.25 mm [13.750 in], or 422.91 mm [16.650 in] if used with internal barriers

Figure 3-17: Dimensions of a Rack Mount 3500 Full-Size Rack

3.4.3.2   Instruction for Installing Rack Mount 3500 Full-Size Rack

Install the 3500 rack using No. 10 flat washers (4 places) and 10-32 screws (4 places) at the locations shown by the arrows in the diagram below.
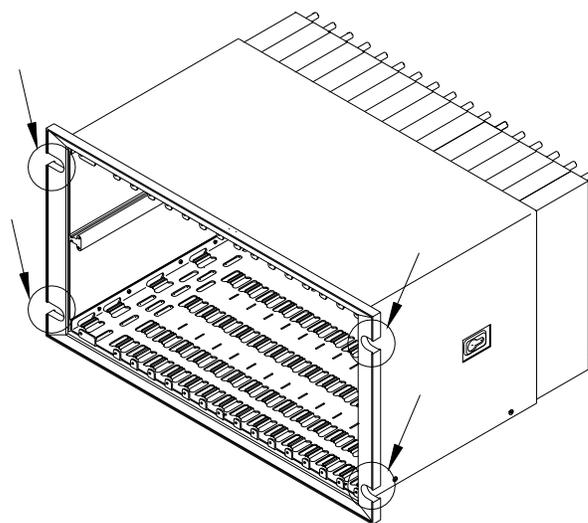
Figure 3-18: Locations for Installation Mounting Hardware

3.4.3.3   Mini-Rack Rack Mount

Figure 3-19 and Figure 3-20 show a rack mount 3500 mini-rack. The Mini-Rack Mounted 3500 system also allows you to install the rack into a standard 19-inch EIA cabinet with the use of the mini-rack Adapter Panel.
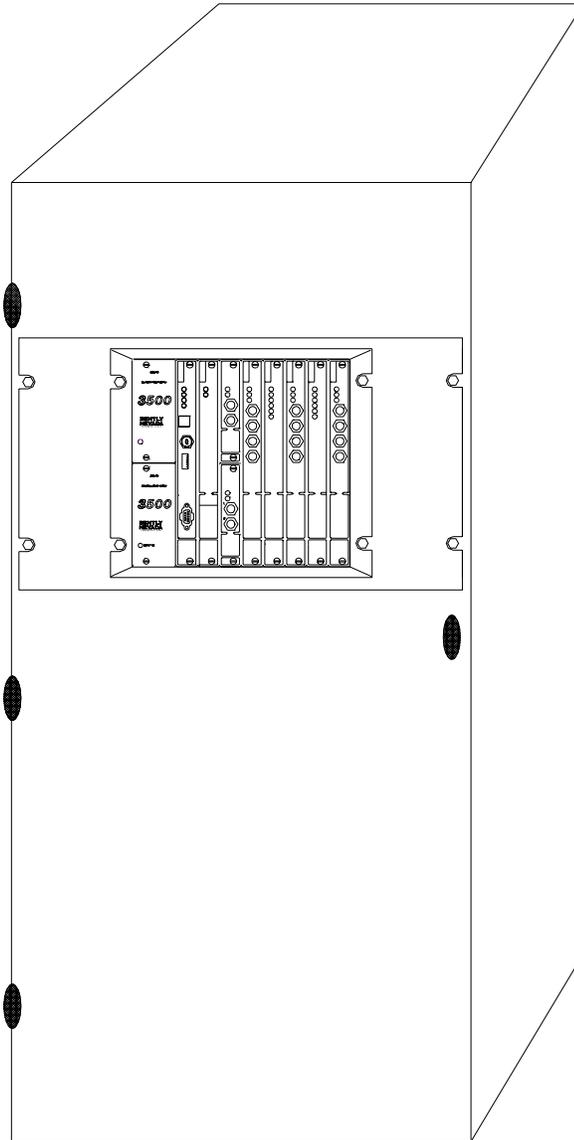

Figure 3-19: Installed Rack Mount 3500 Mini-Rack
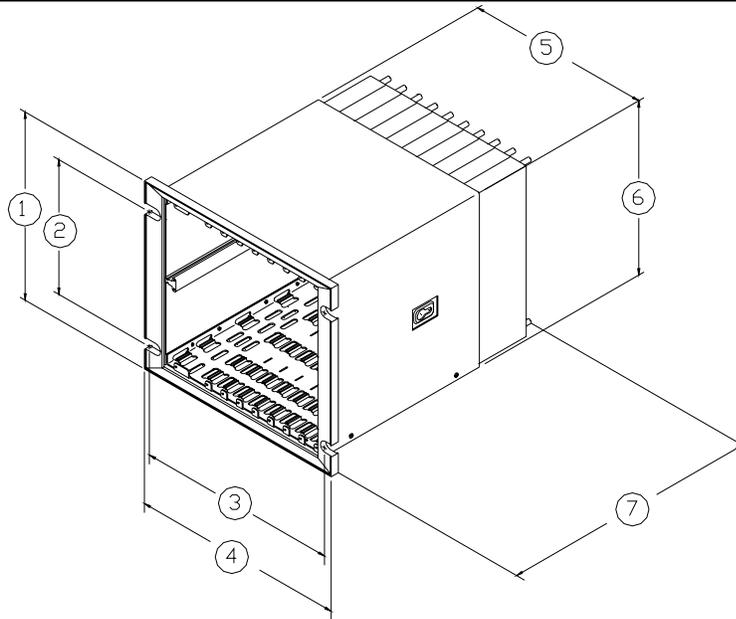
1. 265.94 mm [10.470 in].
2. 190.50 mm [7.500 in].
3. 279.60 mm [11.008 in].
4. 304.80 mm [12.000 in].
5. 264.16 mm [10.400 in].
6. 246.38 mm [9.700 in].
7. 349.25 mm [13.750 in], or 422.91 mm [16.650 in] if used with internal barriers

Figure 3-20: Dimensions of a Rack Mount 3500 Mini-Rack

3.4.3.4   Instructions for Installing a Rack Mount 3500 Mini-Rack

Install the Mini-rack adapter panel into the EIA rack using No. 10 flat washers (4 places) and 10-32 screws (4 places). Next, install the 3500 Mini-rack onto the adapter panel using No. 10 flat washers (4 places) and 10-32 screws (4 places).
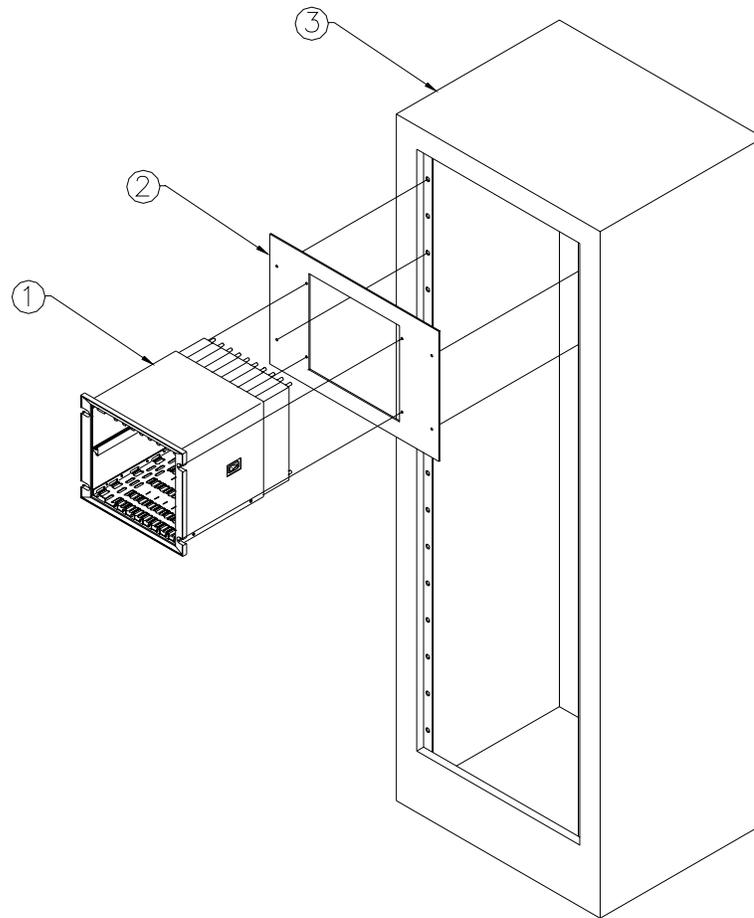
1. 3500 mini-rack
2. Adapter panel
3. Standard 19-inch EIA rack

Figure 3-21: Installing the Mini-Rack Adapter Panel and Mini-Rack

3.4.3.5   Bulkhead Mount

Figure 3-22 and Figure 3-23 show a bulkhead mount 3500 rack. Use a 3500 Bulkhead rack when you want to attach the rack to a wall or want to be able to change the field wiring from the front of the rack.

NOTE
The 3500/05 Mini-rack is not available in the Bulkhead Mount option.
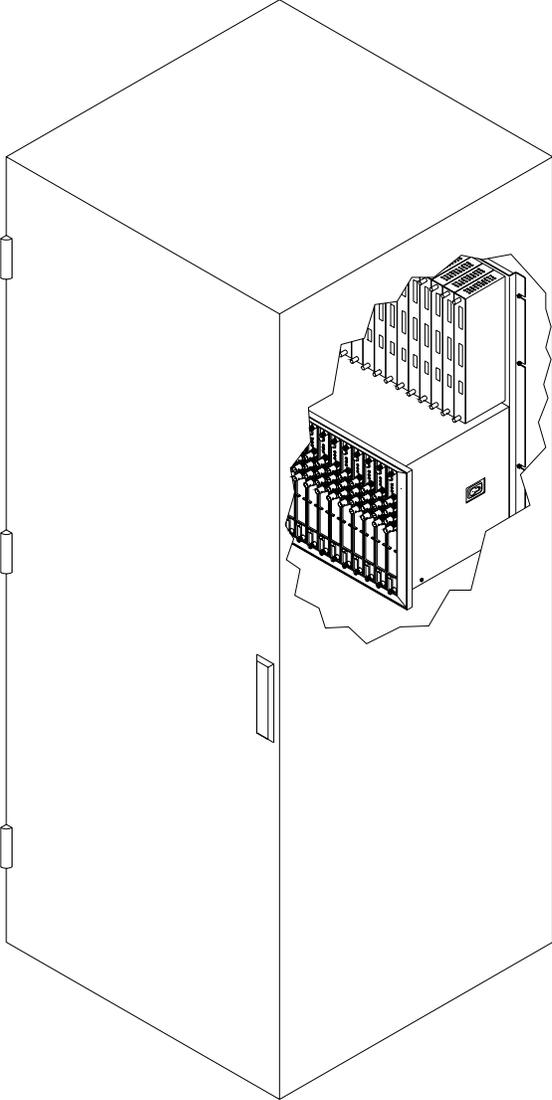
Figure 3-22: Installed Bulkhead Mount 3500 Rack
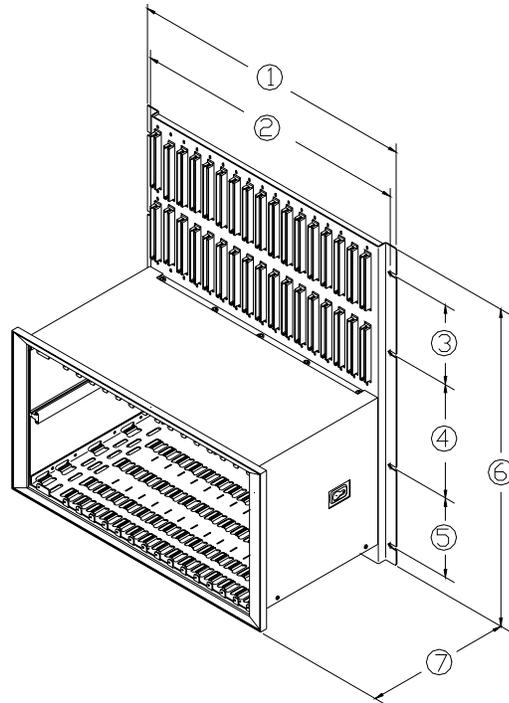
1. 482.60 mm [19.000 in].
2. 459.59 mm [18.094 in].
3. 133.35 mm [5.250 in].
4. 190.50 mm [7.500 in].
5. 133.35 mm [5.250 in].
6. 532.64 mm [20.970 in].
7. 266.70 mm [10.500 in].

Figure 3-23: Dimensions of Bulkhead Mount 3500 Rack

3.4.3.6   Instructions for Installing Bulkhead Mount 3500 Rack

Install the 3500 rack using No. 10 flat washers (8 places) and 10-32 screws (8 places) in the locations shown in the diagram below.
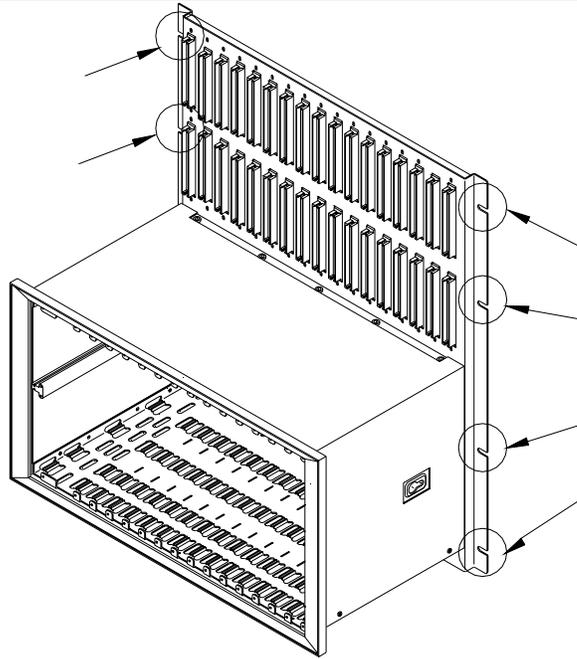
Figure 3-24: Locations for Installation Mounting Hardware

3.5 External Termination Blocks

Section 2.2.2 briefly described when you would use External Termination (ET) Blocks and I/O modules and showed a diagram of the components assembled.

Figure 3-25 shows some of the common DIN rail types to which the ET Blocks can mount. Figure 3-26 and Figure 3-27 show ET blocks mounted on a G-rail.
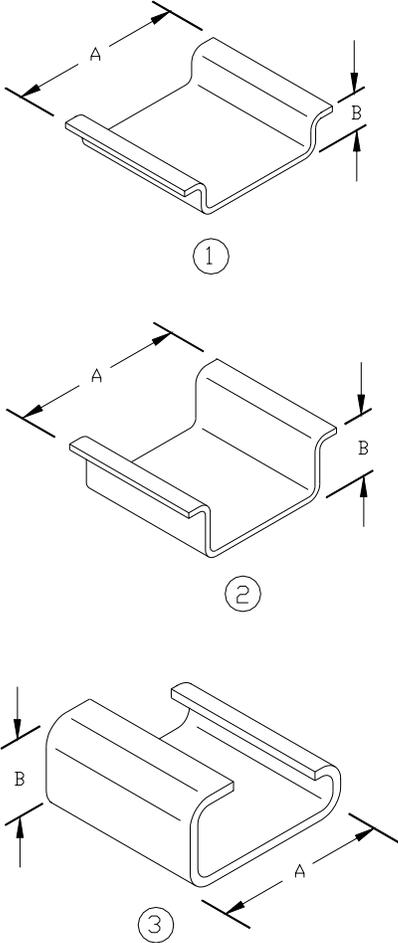
1. U-shaped rail. Dimension A = 35mm and dimension B = 7.5mm. This rail is referred to as U-Rail(7.5) in this section.
2. U-shaped rail. Dimension A = 35mm and dimension B = 15mm. This rail is referred to as U-Rail(15) in this section.
3. G-shaped rail. Dimension A = 32mm and dimension B = 15mm. This rail is referred to as G-Rail in this section.

Figure 3-25: Common DIN Rail Types
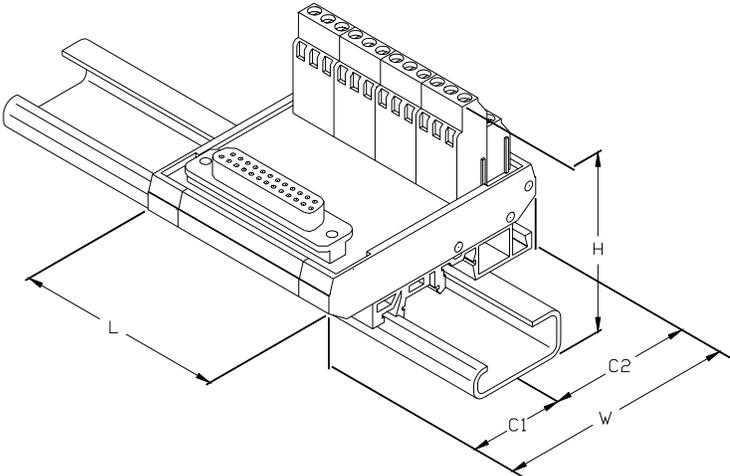
Figure 3-26: Euro-Style ET Block Mounted on G-Rail
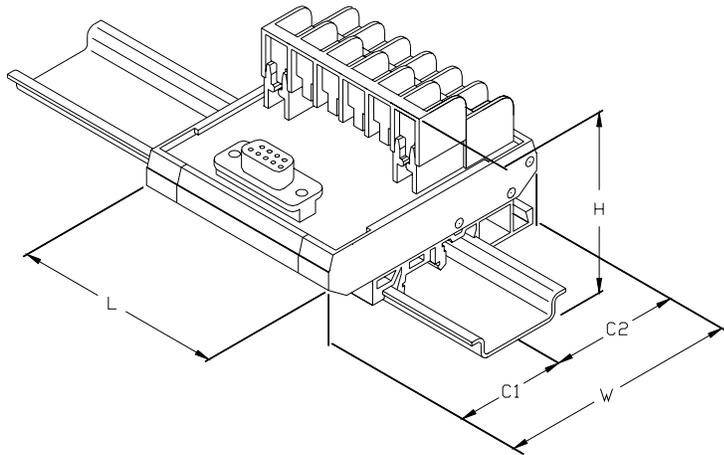
Figure 3-27: Terminal-Strip or Barrier Type ET Block Mounted on G-Rail

You can mount either ET Block type on any of the rail types mentioned above. For a more detailed picture of a particular ET Block, refer to the manual of the applicable 3500 monitor.

Table 3-3 lists the available ET Blocks and their dimensions. Figure 3-26 Figure 3-27 show the location of the dimensions.

Table 3-3: Dimensions of Available ET Blocks in Millimetres

Part Number	L	W	H			C1	C2
			U-Rail(7.5)	U-Rail (15)	G-Rail		
125808	68	77	58	66	63	39	39
128015	113	77	51	59	57	39	39
128702	68	77	58	66	63	39	39
128710	68	77	51	59	57	39	39
128718	90	77	58	66	63	39	39
128726	90	77	51	59	57	39	39
132234	178	90	60	68	65	46	43
132242	153	90	67	75	73	46	43
133392	90	77	58	66	63	39	39
133892	113	77	51	59	57	39	39
133900	68	77	58	66	63	39	39
133908	153	90	60	68	65	46	43
133916	113	77	58	66	63	39	39

Part Number	L	W	H			C1	C2
			U-Rail(7.5)	U-Rail (15)	G-Rail		
133924	113	77	51	59	57	39	39
136595	113	77	51	59	57	39	39
136603	90	77	58	66	63	39	39
140993	90	77	58	66	63	39	39
141001	113	77	51	59	57	39	39
141208	68	77	58	66	63	39	39
141216	153	90	60	68	65	46	43

3.6 Intrinsically Safe Operation

An intrinsically safe (I.S.) installation requires you to maintain a low resistance path to the I.S. earth point of the plant for correct operation. You must connect either 1 or 2 cables of less than 1 Ω combined resistance to the Earthing Module to provide a connection between the rack and the plant I.S. earth. These cables must have a cross-sectional area of between 4 mm^2 (.0061 in^2) and 10 mm^2 (.0155 in^2).

The optimum solution uses 2 cables to connect the Earthing Module to the plant I.S. earth. This connection lets you test the continuity of the I.S. earth connection on-line. If you disconnect 1 cable from the Earthing Module you then can use a suitable milli-ohmmeter to measure the resistance of the 2 cables. A total resistance of less than 2 Ω will ensure that the parallel combination of the 2 cables is less than 1 Ω. You should verify the continuity between the shield of the field wiring from the hazardous area and the Earthing Module.

If the position of the Earthing Module in the rack makes it difficult for you to remove one of the I.S. earth cables to perform on-line testing, then you may replace the standard slotted set screws with the Allen headed set screws provided.

Please refer to drawing number 138547 for additional information regarding the installation requirements for an Intrinsically Safe System.

To avoid ground loops, the system must provide a single point ground. In I.S. applications the 3500 Rack is floated and referenced to an intrinsically safe ground instead of earth ground. RS-232 communications are referenced to earth ground so that you must use a serial data isolator to keep the rack isolated from earth ground. RS-485 uses an isolated ground and requires no additional isolation.

Figure 3-28 shows the connections for testing the I.S. earth resistance.
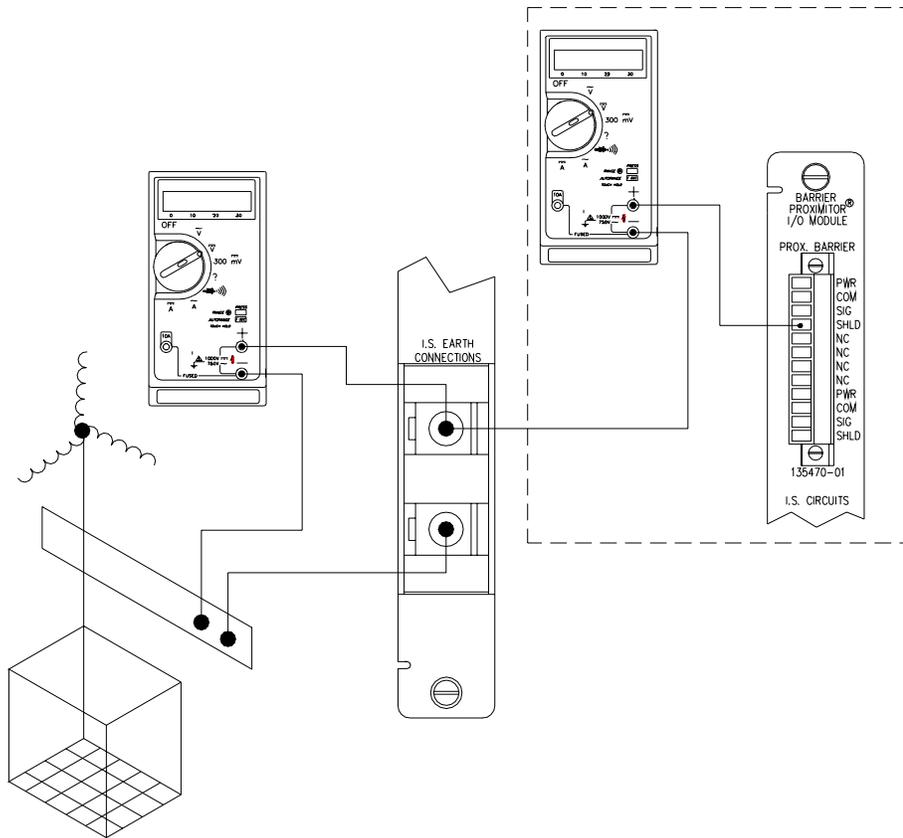
Figure 3-28: Testing I.S. Earth Resistance

3.7 High Electromagnetic Noise Environment and European Conformance (CE) Rack Installation

For the high electromagnetic noise environment or CE installation, you must thoroughly ground the system rack, EMI shield, and cables to provide a ground path for electromagnetic energy (see figures below). You must mount the bulkhead rack and External Termination blocks inside an Electromagnetic Interference (EMI) shielded area.
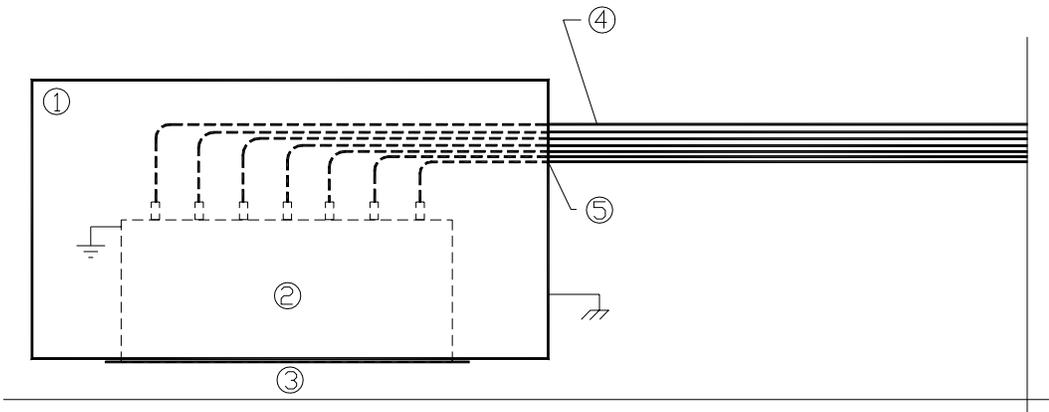
1. Grounded cabinet.
2. 3500 monitoring system.
3. Front of rack.
4. Field wiring cables with both foil and braid shield.
5. Cable shields terminated to EMI shield.

Figure 3-29: Typical Installation - Standard Rack with Internal Termination I/O Modules (Top View of Full-Size Rack Shown).
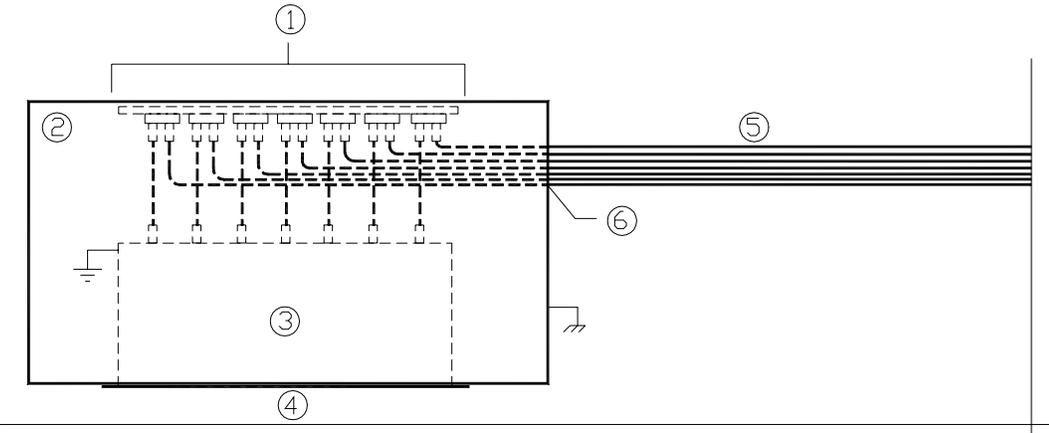
1. External termination blocks, mounted inside EMI shielded area.
2. EMI shielded area.
3. 3500 monitoring system.
4. Front of rack.
5. Field wiring cables with both foil and braid shielding.
6. Cable shields terminated to EMI shield.

Figure 3-30: Typical Installation - Standard Rack with External Termination I/O Modules, External Termination Blocks Installed Inside the Cabinet (Top View of Full-Size Rack Shown).
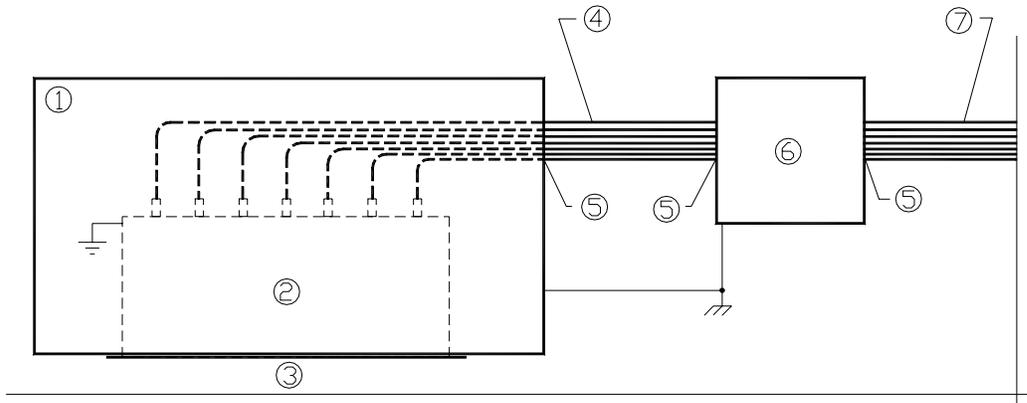
1. Grounded cabinet.
2. 3500 monitoring system.
3. Front of rack.
4. Multi-conductor cables with both foil and braid shielding.
5. Cable shields terminated to EMI shield.
6. External termination block junction box. Is also an EMI shielded area.
7. Field wiring cables with both foil and braid shielding.

Figure 3-31: Typical Installation - Standard Rack with External Termination I/O Modules, External Termination Blocks Installed in a Junction Box (Top View of Full-Size Rack Shown).
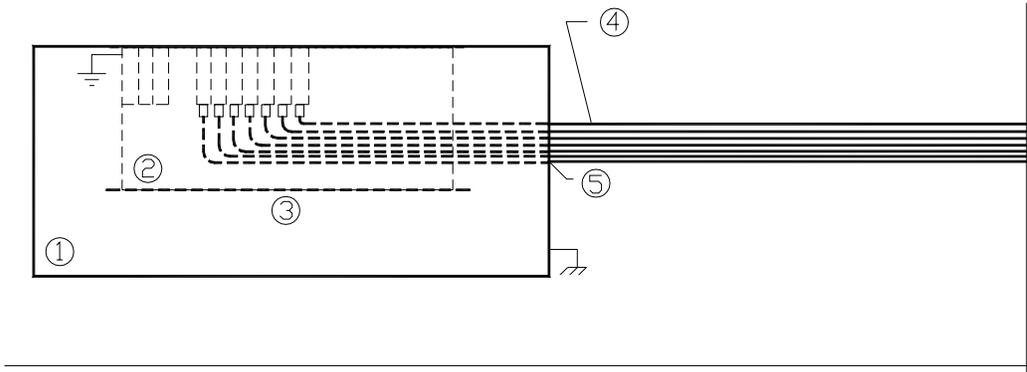
1. EMI shielded area.
2. 3500 monitoring system.
3. Front of rack.
4. Field wiring cables with both foil and braid shielding.
5. Cable shields terminated to EMI shield.

**Figure 3-32: Typical Installation - Bulkhead Rack with Internal Termination I/O Modules (Top View Shown).**
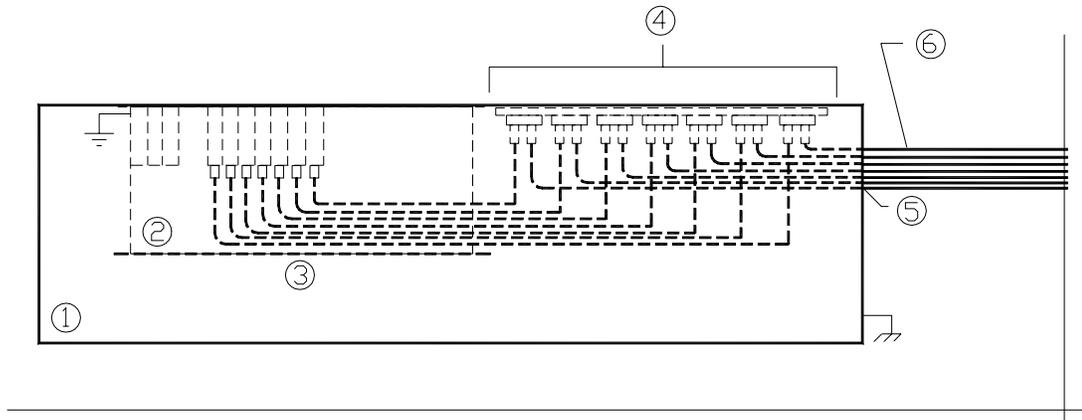
1. EMI shielded area.
2. 3500 monitoring system.
3. Front of rack.
4. External termination blocks, mounted inside EMI shielded area.
5. Cable shields terminated to EMI shield.
6. Field wiring cables with both foil and braid shielding.

Figure 3-33: Typical Installation - Bulkhead Rack with External Termination I/O Modules, External Termination Blocks Installed Inside the Cabinet (Top View Shown).
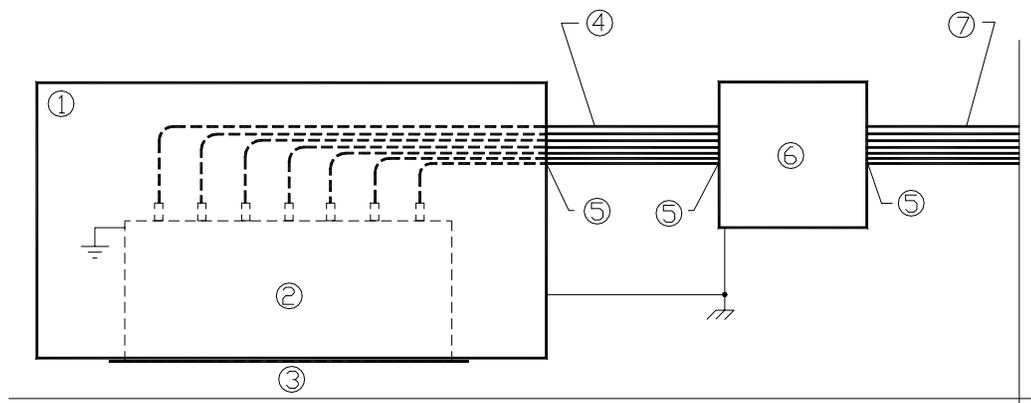
1. EMI shielded area.
2. 3500 monitoring system.
3. Front of rack.
4. Multi-conductor cable with both foil and braid shielding.
5. Cable shields terminated to EMI shield.
6. External termination block junction box. Is also an EMI shielded area.
7. Field wiring cables with both foil and braid shielding.

Figure 3-34: Typical Installation - Bulkhead Rack with External Termination I/O Modules, External Termination Blocks Installed in a Junction Box (Top View Shown).

3.7.1 Wiring

You must shield all wiring that exits the metal cabinet or EMI shielded area. Acceptable EMI shielding includes metal conduit or multi-conductor cables with both foil and braid shielding. In places where cables enter shielded areas, the cable shield should make good electrical contact with the EMI shield and any subsequent junction enclosure. This contact drains off EMI energy from the cable before the cable enters the shielded area.

3.7.2 Considerations for CE Installation to a Public Power Supply

For systems installed in areas that require compliance to EN61000.3.2, the equipment shall only be used in industrial environment with a connection to the industrial power supply network. If the system connects to the public power supply mains, the system must meet EN61000.3.2 by using a 3rd-party device that provides power factor correction.

3.7.3 Considerations for I.S. Systems

3.7.3.1 Field Wiring to Hazardous Area

This should be of steel wire armored construction and should be connected to the EMI shielded area using a suitable cable gland. The inner cores should have an overall screen of foil with a drain wire to connect to the barrier shield terminal of the I/O module. Cables manufactured to BS5308 Part 1, or similar national or international standards, are suitable.

3.7.3.2 Connecting the I.S. Earth

To ensure that I.S. earth cables do not pick up or radiate EMI, install a feed-through capacitor on each I.S. earth cable. You must install these capacitors at the boundary of the EMI shielded area. We recommend a Schaffner FN7000 Series or similar bulkhead mounting type.

Critical filter parameters are:

- 500 V isolation.

- 25 A continuous rated current.

- Less than 0.1 ohm resistance.

- At least 47 nF capacitance.

- Screw terminals with locking washers at each end.

> **Application Advisory**
>
> When planning the installation of the I.S. cables, you must take into account the series resistance of the filter, since the total resistance of the combination of cables and filters must be less than 1 Ω.

3.7.4 Additional Notes

- Larger scale factors are less susceptible to EMI than smaller scale factors.

- Larger full-scales are less susceptible to EMI than smaller full-scale.

- Monitors with narrow bandwidth filter configurations are less susceptible to EMI than monitors configured with wide bandwidth.

- Larger Keyphasor® or hysteresis settings are less susceptible to EMI than smaller hysteresis settings.

- Shorter Alarm delay times may increase monitor susceptibility to transient EMI.

- Environments with higher levels of EMI than tested may cause unpredictable monitor readings and may cause system malfunction.

3.8 Set Rack Jumpers and Switches

Set the following jumpers and switches before operating the rack:

- Rack address switch (on the front of the Rack Interface Module)

- Transducer jumpers on each I/O Module, as required

- Certain I/O Modules have switches to control their mode of operation. Examples include:

  - RIM and Comm Gateway I/O's that support both RS232 and RS422 have a protocol selection switch

  - Overspeed and non-TMR Relay I/O's have Normally Energized/De-energized Relay mode switches

  - Comm Gateway I/O's that support RS485 have termination mode switches

- Setup phone connection to rack / host (if you use an internal or external modem)

  - Phone cable to internal modem in rack

OR

- Phone cable to modem and RS-232 cable from modem to rack

- TMR / SIM jumper on the inside of the 3500 Rack backplane between the Power Supply and the Rack Interface Module as shown in the diagrams below.
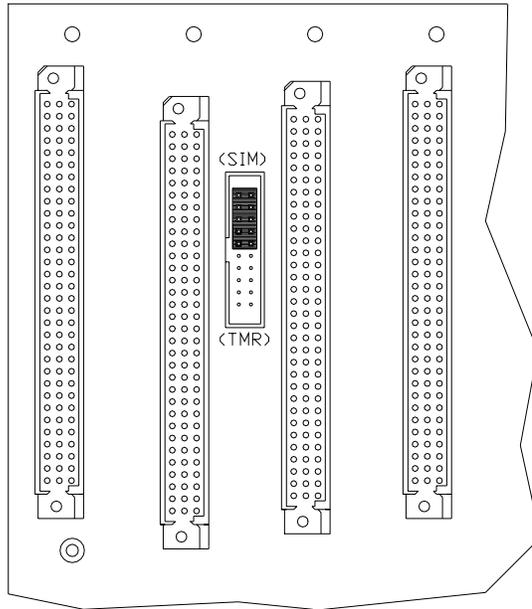

Figure 3-35: Location of SIM/TMR Jumper Block
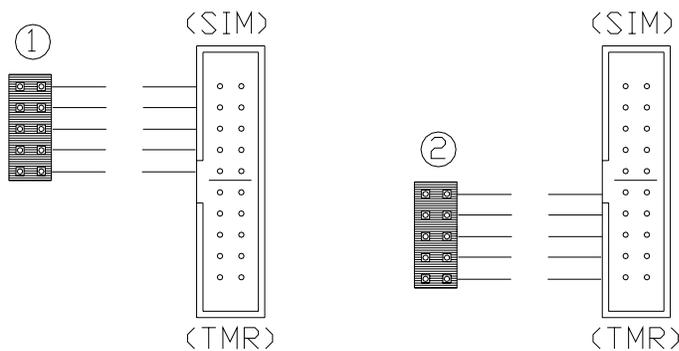
1. 10-legged jumper must be placed in this position for Standard 3500 rack.
2. 10-legged jumper must be placed in this position for TMR 3500 rack.

Note: If the 10-legged jumper is not installed in one of the above positions, the rack will not operate correctly.

Figure 3-36: Setting the SIM/TMR Jumper Block

3.9 Wiring Requirements

Refer to the individual module manuals and field wiring diagrams for detailed instructions for connecting components to the I/O module. Refer to the weatherproof housing section for information specific to those installations. Refer to the high electromagnetic noise environment section for information applicable to those installations.

Connect the I/O modules in the 3500 rack to the following items.

- Transducers (match the selected transducer jumpers)

- Keyphasor transducers

- Power

Connect the external devices to the following terminals.

- Relay outputs

- OK Relay on the back of the Rack Interface I/O Module

- System Contacts (Trip Multiply, Inhibit, Rack Reset, etc.)

3.10 Software Portion of the Rack Installation

Now that the hardware portion of the 3500 rack installation is complete, refer to *3500 Monitoring System Rack Configuration and Utilities Guide* to configure and verify the 3500 Monitoring System. You should perform the following steps in the order shown to configure your rack.

1. Verify the rack communication.

2. Upload default configuration from the rack.

3. Customize the Rack Configuration.

4. Download the configuration to rack.

5. Adjust the Scale Factor, Zero Position, and Manual Keyphasor Threshold.

6. Download any adjustments.

7. Perform rack verification.

4. Module Installation and Removal

This section shows how to install and remove the individual modules (including I/O modules) in a 3500 rack.

In all discussions, the main module is the part that you install in the front of the rack-mount and panel-mount racks, or in the bottom of the bulkhead rack. Main modules have the blue overlays with the model number printed on them.

The input or I/O modules are the parts that you install at the rear of the rack-mount and panel-mount racks, or in the top of the bulkhead rack. This is where you make the power and field wiring connections.

4.1 Installation of Modules

The following section describes how to install modules in a 3500 rack. The procedure assumes that the applicable slot is empty. You need not remove power to the rack before installing a module if you follow the procedures below.

4.1.1 Power Supplies

The following lists general steps for installing the 3500/15 power supplies. Refer to the specific manual for the power supply for details and safety considerations. Verify that the main module and the Power Input Module (PIM) are compatible before proceeding.

4.1.1.1   Install the PIM

1. Configure the PIM for Single Point Ground, if necessary.

2. Attach power cord to the PIM, if it is deemed to be more convenient at this time. Be sure that the power cord is not live.

3. Place the PIM into place at the back (or top for bulkhead racks) of the rack. Tighten the screws to pull the PIM securely against the rack.

4.1.1.2   Install the Main Module

1. Slide the main module into place. Ensure that the module is properly in the guides provided on the rack.

2. Tighten the screws securely.

NOTE
It is important that you tightly secure the thumb screws to ensure that each module is chassis grounded. Loose thumb screws may allow noise to affect the channel readings.

4.1.1.3   Verify Operation

When appropriate, apply power to the PIM and verify operation of the power supply.

4.1.2 Full-Height Modules

The following lists general steps for installing any full-height 3500 module. Refer to the specific manual for the module for details and safety considerations. Verify that the main module and the I/O module are compatible before proceeding.

4.1.2.1   Install the I/O Module

1. Configure the I/O module for available options, if necessary.

2. Place the I/O module into place at the back (or top for bulkhead racks) of the rack. Tighten the screws to pull the I/O module securely against the rack.

3. Attach field wiring to the I/O module, if appropriate at this time.

4.1.2.2   Install the Main Module

1. Ensure that the ejectors are in their normal positions, flush with the front of the module, as shown in Figure 4-1.
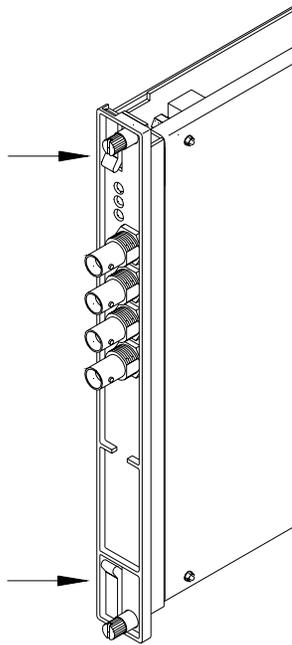
Figure 4-1: Verifying Normal Position of Card Ejectors

2. Slide the main module into place, ensuring that they are properly in the guides provided on the floor and roof of the rack chassis.

3. Tighten the screws securely.

4.1.2.3   Verify Operation

When appropriate, apply power to the rack and verify operation of the module.

NOTE

It is important that you tightly secure the thumb screws to ensure that each module is chassis grounded. Loose thumb screws may allow noise to affect the channel readings.

4.1.3 Half-Height Modules

The following lists general steps for installing any half-height 3500 module other than the power supplies. Refer to the specific manual for the module for details and safety considerations. Verify that the main module and the I/O module are compatible before proceeding.

4.1.3.1 Install the Half-Height Card Guide

Insert the lock the card guide in place in the rack, as shown in Figure 4-2. This may require you to remove other modules in the rack in order to make room for getting the guide into place.
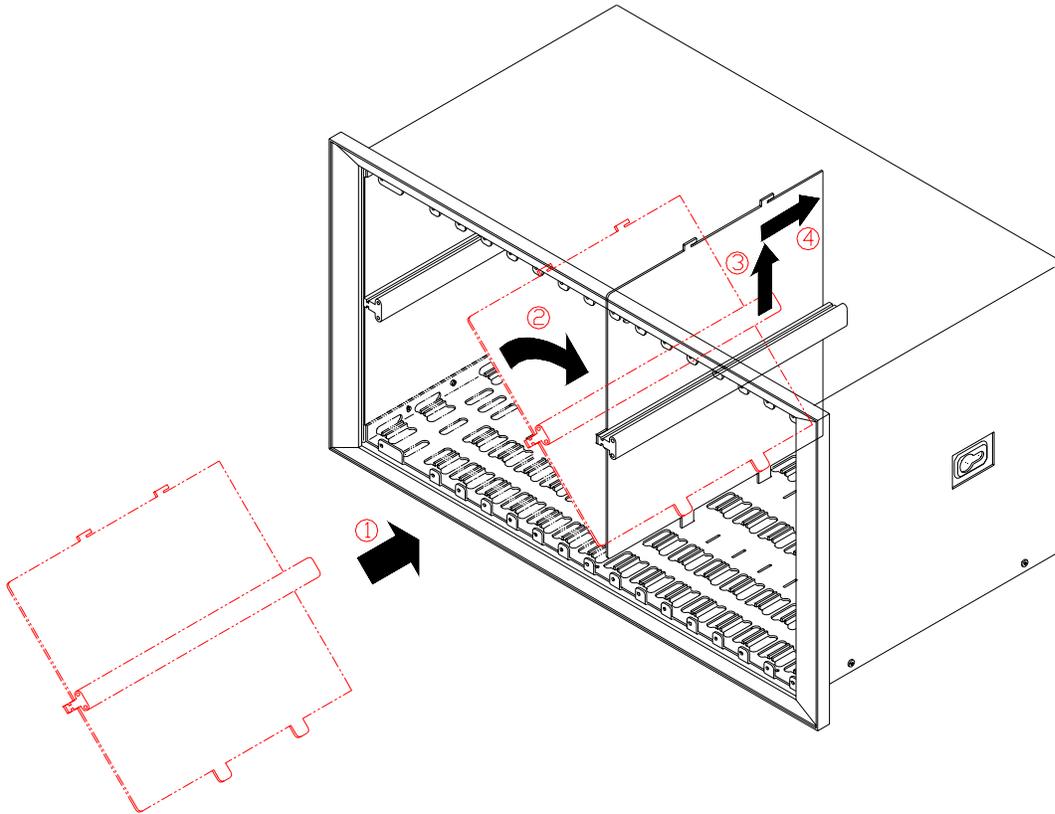
Figure 4-2: Inserting the Half-Height Card Guide

4.1.3.2 Install the I/O Module

1. Configure the I/O module for available options, if necessary.

2. Place the I/O module into place at the back (or top for bulkhead racks) of the rack. Tighten the screws to pull the I/O module securely against the rack.

3. Attach field wiring to the I/O module, if appropriate at this time.

4.1.3.3 Install the Main Module

1. Slide the main module into place, ensuring that they are properly in the guides provided on card guide and the rack chassis.

2. Tighten the screws securely.

4.1.3.4   Verify Operation

When appropriate, apply power to the rack and verify operation of the module.

NOTE

It is important that you tightly secure the thumb screws to ensure that each module is chassis grounded. Loose thumb screws may allow noise to affect the channel readings.

4.2 Removing Modules

The following section describes how to remove the modules from a 3500 rack. You need not remove power from the rack if you follow the following procedures.

4.2.1 Power Supplies

The following lists general steps for removing the 3500/15 power supplies. Refer to the specific manual for the power supply for details and safety considerations.

4.2.1.1   Remove Power to the PIM.

1. Remove power from the PIM that you will remove. Observe applicable safety precautions while handling the power cables.

2. Remove the main module.

3. Loosen the screws to the main module so that they are free of the rack chassis, but still attached to the main module.

4. Use the loose screws as handles to pull the main module out of the rack.

5. Use caution when handling the PIM as the unit may still be carrying a high-voltage charge.

4.2.1.2   Remove the PIM

1. Loosen the screws holding the PIM to the rack. As you loosen the screws, the screws will push the PIM away from the rack.

2. Use caution when handling the PIM as the unit may still be carrying a high-voltage charge.

4.2.2 Full-Height Modules

The following lists general steps for removing any full-height 3500 module. Refer to the specific manual for the module for details and safety considerations.

4.2.2.1   Remove the Main Module

1. Loosen the screws to the main module so that they are free of the rack chassis, but still attached to the main module.

2. Use the ejectors to pry the main module loose from the backplane connectors, as shown in Figure 4-3.
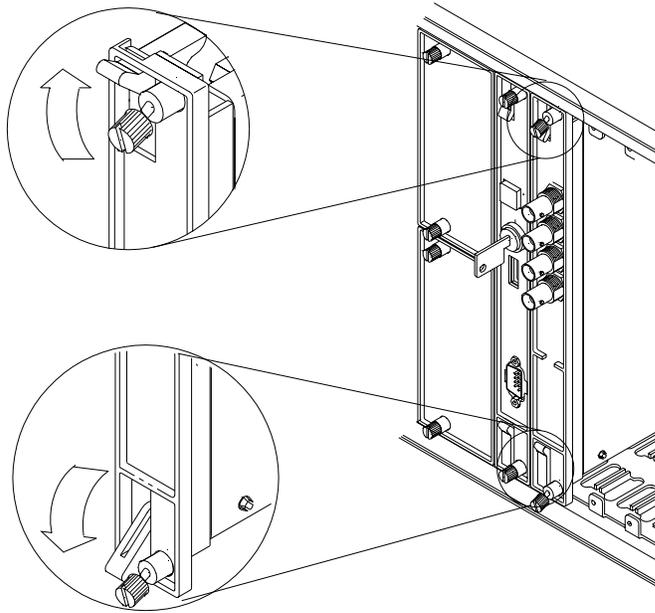
Figure 4-3: Using the Card Ejectors

3. Once freed from the backplane, you can completely remove the main module from the rack.

4.2.2.2   Remove the Field Wiring From the I/O Module

See the applicable manual for removing the connector headers or computer-type cables.

4.2.2.3   Remove the I/O Module

Loosen the screws holding the I/O module to the rack. As you loosen the screws, the screws will push the I/O module away from the rack.

4.2.3 Half-Height Modules

The following lists general steps for removing any half-height 3500 module other than the power supplies. Refer to the specific manual for the module for details and safety considerations.

4.2.3.1   Remove the Main Modules

Note: It does not matter whether you remove the upper or lower main module first.

1. Loosen the screws to the main module so that they are free of the rack chassis, but still attached to the main module.

2. Use the loose screws as handles to pull the main module out of the rack.

3. Remove the half-height card guide.
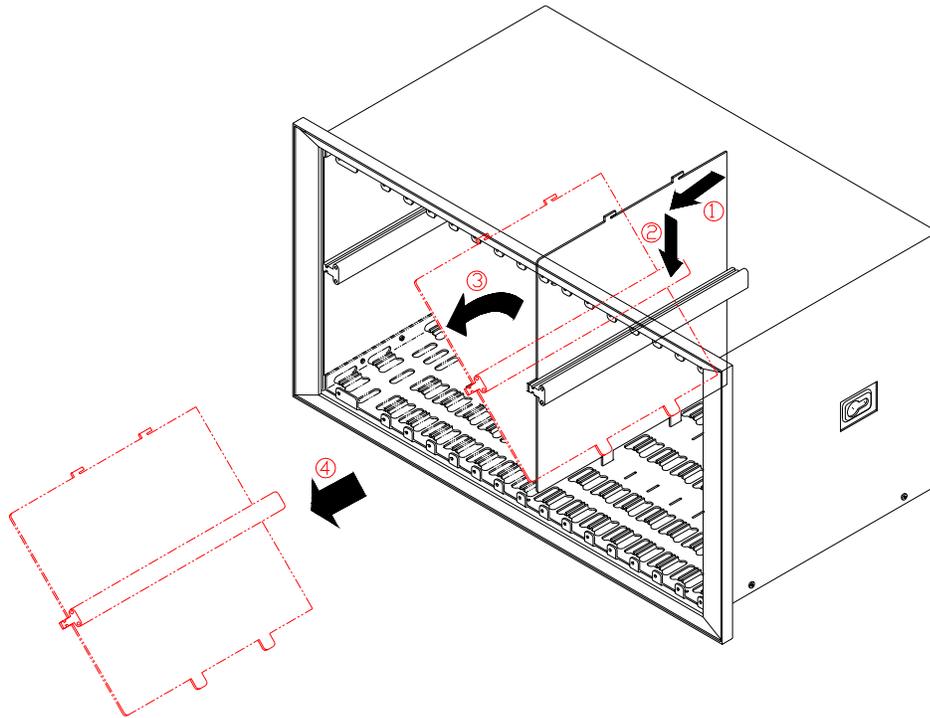
Figure 4-4: Removing the Half-Height Card Guide

4.2.3.2   Remove the field wiring from the I/O module

See the applicable manual for removing the connector headers or computer-type cables.

4.2.3.3   Remove the I/O Module

Loosen the screws holding the I/O module to the rack. As you loosen the screws, the screws will push the I/O module away from the rack.

4.3   Replacing Modules

When replacing modules, whether main or I/O, you need not remove power from the rack if the following procedures are followed. Refer to applicable steps in the procedures above for removing or installing a module.

4.3.1 Main Modules

This assumes that you will replace only the main module of a monitor or power supply. Before you remove any module, refer to the applicable manual to see how this may affect rack behavior, and to identify any special handling requirements that you may require for personal safety.

1. If necessary, upload and save the configuration of the module to be replaced.

2. Remove the main module from the rack.

3. Install the new main module into the rack.

4. If necessary, configure the new main module.

5. Verify operation.

4.3.2 I/O Modules

This assumes that you will replace only the I/O module of a monitor or the PIM of a power supply. Before you remove any module, refer to the applicable manual to see how this may affect rack behavior, and to identify any special handling requirements that you may require for personal safety.

1. If necessary, upload and save the configuration of the module to be replaced.

2. Remove the main module from the rack.

3. Remove the field wiring from the I/O module.

4. Remove the old I/O module from the rack.

5. Install the new I/O module into the rack.

6. Connect the field wiring to the new I/O module.

7. Install the main module into the rack.

8. If necessary, re-configure the main module.

9. Verify operation.

5. Maintenance

5.1 General Maintenance Instructions

You cannot repair the boards and components inside of 3500 modules in the field. 3500 rack maintenance consists of testing module channels to verify that they are operating correctly. You should replace modules that are not operating correctly with a spare.

When performed properly, you may remove modules from or install modules into the rack while power is applied to the rack. Refer to Section 3 for the proper procedure.

The 3500 Monitoring System is a high precision instrument that requires no calibration. The functions of the 3500 modules, however, require verification at regular intervals. You should verify all modules in the 3500 Monitoring System at these maintenance intervals. The procedures in the Maintenance and Troubleshooting sections of the module manuals describe the verification and troubleshooting process.

5.2 Choosing a Maintenance Interval

Use the following approach to choose a maintenance interval:

1. Start with an interval of 1 year and then shorten the interval if any of the following conditions apply:

   - the monitored machine is classified as critical, or

   - the 3500 rack is operating in a harsh environment such as in extreme temperature, high humidity, or a corrosive atmosphere.

2. At each interval, use the results of the previous verifications and ISO Procedure 10012-1 to adjust the interval.

6. Ordering Information

6.1 Rack Ordering Information

3500/05-AXX-BXX-CXX-DXX-EXX

A: Rack Size

        0 1   19-inch Rack (14 Module Slots)

        0 2   12-inch Mini-Rack (7 Module Slots)

B: Mounting Options

        0 1   Panel Mount Option, Full-Size Rack

        0 2   Rack Mount Option, Full-Size Rack (mounts to19-inch EIA Rack)

        0 3   Bulkhead Mount Option (Not available in Mini-Rack)

        0 4   Panel Mount Option, Mini-Rack

        0 5   Rack Mount Option, Mini-Rack

C: Agency Approval Option

        0 0   None

        0 1   CSA-NRTL/C

D: Reserved

        0 0   Reserved

E: European Compliance Option

        0 0   None

        0 1   CE

6.2 Weatherproof Housing Ordering Information

NOTES
1. The 3500/06 Weatherproof Housing does not provide a smaller version designed specifically for the 3500/05 Mini-rack. You must install a Mini-Rack Adapter Panel to use the Mini-rack in the Weatherproof Housing. A "Door Only" option does exist for the Mini-Rack. 2. The 3500/06 Weatherproof Housing design does not accommodate a Display Unit or a VGA Display.

3500/06-AXX-BXX-CXX-DXX

A: Housing Type

>   **0 1**   Painted Steel Housing
>   **0 2**   Stainless Steel Housing
>   **0 3**   Painted Steel Door Only, Full-Size Rack
>   **0 4**   Stainless Steel Door Only, Full-Size Rack
>   **0 5**   Painted Steel Door Only, Mini-Rack
>   **0 6**   Stainless Steel Door Only, Mini-Rack

B: Conduit Fitting Option

>   **0 0**   No Fittings Required
>   **0 1**   Conduit Fittings Required

C: Air Purge Option

>   **0 0**   No Air Purge Accessories Required
>   **0 1**   Air Purge Fittings Only
>   **0 2**   Air Purge Fittings and Gauge

D: Agency Approval Option

>   **0 0**   None

6.3 Earthing Module Order Information

3500/04-AXX

A: Module Type

>   **0 1**   Earthing Module

NOTE

This option requires 1 monitor
slot position in the rack.

6.4 Spares

6.4.1 3500 Rack

00517016

>   TMR/SIM jumper (installed on the 3500 backplane)

00530843

3500/42 Prox/Seismic I/O Module four pin connector shunt

131150-01

Power Supply Blank Front Panel

131151-01

Half-height Blank Front Panel

130944-01

Full-height Blank Front Panel

130768-01

Blank Slot Assembly (Front and Rear)

136719-01

Earthing Module

138257-01

Earthing Module Front Panel Assy

144863-01

Adapter Panel, Mini-rack, 19-inch

6.4.2 Half Height Module Adapter

125388-01

Chassis

125565-01

Card Guide

04300111

Screws (order 3 per adapter)

7. Specifications

7.1 Dimensions (Overall)

Panel Mount Full-Size Rack

Width

482.6 mm (19.0 in)

Height

265.9 mm (10.47 in)

Depth

349.3 mm (13.75 in)

Depth with internal barriers

423.0 mm (16.65 in)

Rack Mount Full-Size Rack

Width

482.6 mm (19.0 in)

Height

265.9 mm (10.47 in)

Depth

349.3 mm (13.75 in)

Depth with internal barriers

423.0 mm (16.65 in)

Bulkhead Mount Rack

Width

482.6 mm (19.0 in)

Height

532.6 mm (20.97 in)

Depth

266.7 mm (10.50 in)

Depth with internal barriers:

266.7 mm (10.50 in)

Panel Mount Mini-Rack

Width

304.8 mm (12.0 in)

Height

265.9 mm (10.47 in)

Depth

349.3 mm (13.75 in)

Depth with internal barriers

423.0 mm (16.65 in)

Rack Mount Mini-Rack

Width

304.8 mm (12.0 in)

Height

265.9 mm (10.47 in)

Depth

349.3 mm (13.75 in)

Depth with internal barriers

423.0 mm (16.65 in)

Weatherproof Housing

Width

595.1 mm (23.43 in)

Height

424.2 mm (16.70 in)

Depth

628.7 mm (24.75 in)

7.2 Weight

Basic (Unloaded Full-Size Rack)

Panel Mount Configuration

7.03 kg (15.5 lb)

Rack Mount Configuration

6.67 kg (14.7 lb)

Bulkhead Mount Configuration

11.93 kg (26.3 lb)

Standard Fully Loaded Full-Size System

Panel Mount Configuration

31.07 kg (68.5 lb)

Rack Mount Configuration

30.71 kg (67.7 lb)

Bulkhead Mount Configuration

35.97 kg (79.3 lb)

Internal Barrier System (typical fully loaded configuration)

This will add approximately 4.00 kg (8.96 lb) to the above weights.

Basic (Unloaded Mini-Rack)

Panel Mount Configuration

5.08 kg (11.2 lb)

Rack Mount Configuration

4.72 kg (10.4 lb)

**Standard Fully Loaded
Mini-Rack System**

> *Panel Mount
> Configuration*

23.18 kg (51.1 lb)

> *Rack Mount
> Configuration*

22.82 kg (50.3 lb)

**Internal Barrier Mini-Rack
System (typical fully
loaded configuration)**

This will add approximately 2.39 kg (5.27 lb) to the above weights.

7.3 Environmental (All 3500 Components)

Temperature

> *Operating*

-30 °C to 65 °C (-22 °F to 150 °F)

> *Operating (Internal
> Barriers)*

0 °C to 65 °C (32 °F to 150 °F)

> *Storage*

-40 °C to 85 °C (-40 °F to 185°F)

Humidity:

0% to 95% non-condensing

Mechanical

> *Impact*

10 g for 11 ms

> *Shipping*

per mil Std 810D - Category G equipment

> *Vibration, Sinusoidal*

3 g at 5 to 100 Hz