SENTINEL

LIGHTNING AND BONDING GUIDE

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Figures

Purpose

This document serves to help ensure that your storage facility has been installed with the basic bonding and grounding features necessary to protect it from lightning, electrical noise, and other possible electrical phenomenon. It was designed and written to be easily understood by eliminating highly technical discussion, vocabulary, and terms normally associated with this subject matter. The document acts as a straightforward approach to educate, assist, and aid in the most general sense, the fundamentals associated with grounding and bonding a typical storage facility. This document is not intended or approved to act as a substitute or replacement for National Electrical Code (NEC) or any national standard requirements.

It serves to act as a general approach to grounding and bonding a typical storage facility, and in no way should be viewed as a complete and detailed description of all topics or subject matter related to bonding and grounding issues. It should also be emphasized that there are no provisions or guarantees of complete avoidance of electrical complications. Regardless of how well a facility or structure is bonded or grounded, it should never be considered exempt or immune to or from any and all electrical phenomenon such as lightning or electrical noise.

The following three sections (Bonding Sentinel Equipment, Testing Your Bonding, and Testing for Ground Faults) are organized to represent the recommended bonding installation sequence.

1. Connecting the bonding network to Sentinel Systems equipment.
2. Testing the bonding connection to Sentinel Systems equipment.
3. Testing for ground faults.

Explanation of Terms

This section provides provide the basic understanding of the terms used throughout this document.

Grounding

Grounding is simply providing a low-impedance path to earth to prevent hazardous voltages from appearing on equipment.. A grounding conductor is conductive material buried in the ground providing the connection to earth ground. The conductor is connected to your electrical power systems at the mains (Main Breaker, Main Switch, etc.) which then is then bonded to all conductive material within the system. All subsidiary panels on separate buildings will also normally have a grounding conductor which is bonded to the mains ground per the NEC or other national standard.

Bonding

Bonding is simply the permanent joining of conductive or metallic parts to form an electrically conductive path to earth. The primary reason for bonding is for personnel safety. Without bonding, two adjacent metallic equipment enclosures could be at different potentials. Any person touching both pieces of the equipment at the same time would provide a conductive path

between the equipment resulting in shock or worse. This procedure eliminates the possibility for a difference in potential to develop between two or more metallic enclosures.

For purposes of simplicity, we're connecting all conductive objects to each other (multiple earth grounds, equipment cases, subsidiary panels, main panels, etc) to form a bonding network. Depending on the size of your facility or number of powered structures, there may be multiple bonding networks. Always connect to the closest network whenever bonding/grounding Sentinel Equipment.

It is important to remember that any adjacent metal surface including the building itself, must be bonded to the same point. This prevents any potential harmful voltage differential between the adjacent metal surfaces.

Bonding Wires

For the purpose of this document, bonding wires are simply 12 AWG insulated (preferably green) stranded or solid wire with a spade or ring lug on our end. The other end would be attached to the closest bonding point. It is critical that all metal surfaces within touching distance be connected to the same bonding point. The bonding wire should be kept as short as possible not to exceed 20 feet.

Shield Wires

The communication cable recommended for use with Sentinel Systems equipment features an integral overall shield with a drain wire. Normally, during equipment installation, multiple cable stubs are created going from equipment to equipment. Each cable shield is connected to the equipment via the connectors along with the communication and power wires. This shield (drain) wire must ONLY be bonded at the CIM (Communication Interface Module) location.

Bonding Sentinel Equipment

All Sentinel Systems equipment enclosed in a metal enclosure or mounted on metal surfaces must have the enclosure and/or metal surface bonded. All equipment located within touching distance of each other are required to utilize a single point ground (all devices connected to the same grounding point) via bonding wires or equivalent electrical connection (ie, metal conduit which is itself bonded). This includes such devices as keypads, DSBs (Door Status Boards), CIMs (Communication Interface Modules), ECBs (Elevator/Lighting Control Boards), and CRIs (Card Reader Interface Boards).. Depending on the model or system you have will dictate what type of equipment you are using and where the grounding and bonding should occur.

The following sections illustrate the bonding/grounding techniques (surface bonding and wire bonding) for the different types of Sentinel equipment. In these illustrations, the terms grounding and bonding will both be used depending on the specific equipment.

Gate Area

The first step in properly bonding your storage facility is to bond the gate area. This area generally includes keypad/CRI pedestals (gooseneck), gate operator including gate arm, surrounding fencing and any other steel structures or buildings within close vicinity of the gate structure. See Figure ***1*** below illustrating the bonding technique for the gate area.

Normally, the gate, gate operator, fencing, and all other steel structures or buildings are bonded together as part of the construction process. The following only deals with the installation of Sentinel Systems equipment. All bonding connections from Sentinel Systems equipment will be to the existing bonding network. If you have any question about the bonding in those areas where Sentinel equipment will be installed, contact your local electrician or original installer.

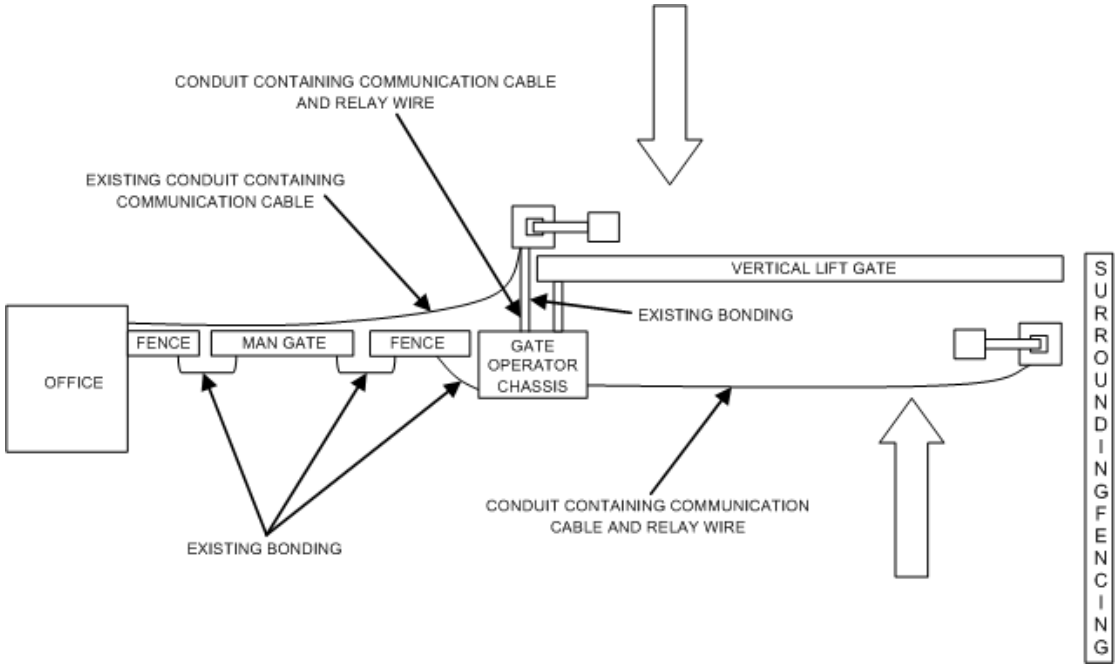

Figure 1 Illustration of a typical gate area.

Figure ***1*** above illustrates a typical gate area and the bonding technique for the gate area. All of these items should be bonded together either by direct contact (metal to metal with low electrical impedance) or using 12 gauge stranded copper wire. Any earth grounds that may have been installed as part of the gate installation are not shown and are assumed to be connected into the bonding network.

CIMs (430, 440, and RS-485)

All Sentinel Systems CIMs (Communication Interface Module) have two connections to the bonding/grounding system: "Earth Ground" and the communication cable shield. **Figure 2** thru **Figure 4** below illustrates the shield and bonding connections for each type of CIM. A 12 gauge (12 AWG) insulated bonding wire is used to connect the CIM to the closest bonding point. The

cable shield wire should be insulated by heat shrink tubing or other product to insulate the shield wire.

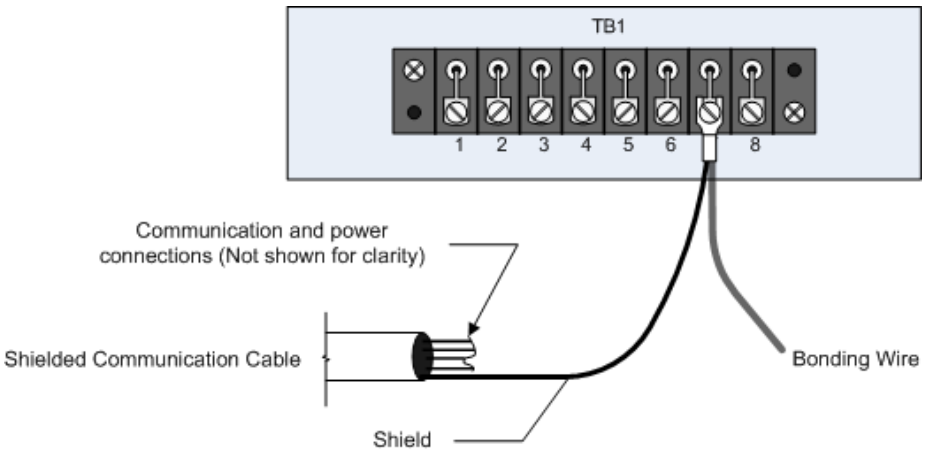

Figure 2 Bonding the Model 430 CIM.

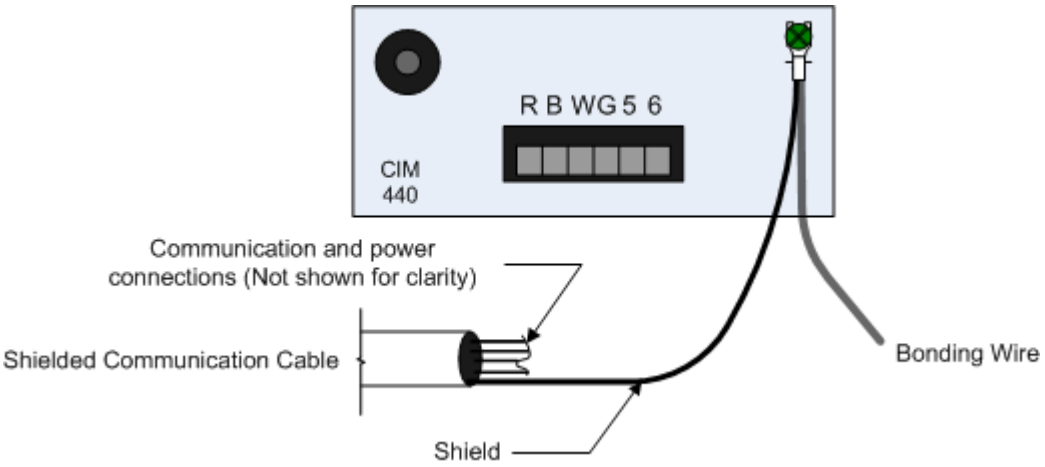

Figure 3 Bonding the Model 440 CIM.

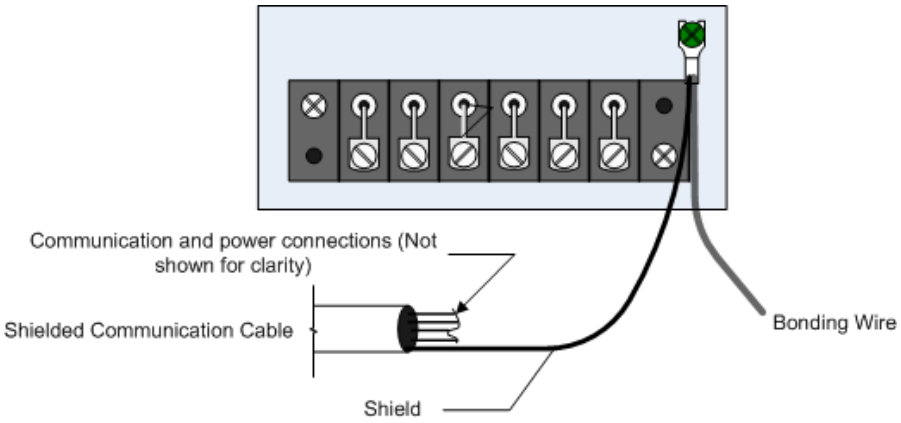

Figure 4 Bonding the Model RS 485 CIM.

Non-Sentinel Communication Interfaces

In those cases where the communication interface is a non-Sentinel Systems designed product, the same care must be taken with bonding/grounding. Consult your communication interface documentation for any required connections. If no bonding/grounding connection is explicitly defined for your communication interface, connect the bonding/ground wire and the cable shield using a method listed below:

1. If the case of your CIM is metal and mounted, connect the shield wire and the bonding wire to a one of the mounting holes in a similar fashion as shown in the figures for the Sentinel Systems CIMs.
2. if the case of your CIM is non-metallic or is not mounted, connect your bonding wire and the cable shield together using a wire nut, crimp connector, or other wire connection mechanism.

Make sure that all connections are properly secured and insulated.

Enclosure Bonding

All Sentinel Systems equipment is either supplied as an enclosed product or must be installed in an enclosure. There are two methods of bonding the equipment enclosures:

1) Surface bonding – Mounting to a metal surface (pedestal, plate, or conduit) that is already connected into the bonding network.
2) Wire bonding - A separate bonding wire is connected between the closest bonding point and the enclosure.

In both methods, care must be taken however, that a good electrical connection is made between the enclosure and the bonded network (see "Testing Your Bonding" on page 11). If testing does not show a good connection, look for any corrosion, paint, or other debris under your connectors. All Sentinel Systems enclosures are powder coated steel which may require carefully scrapping the powder coating/paint off around the mounting holes.

The following sections detail both methods for Sentinel Systems equipment.

Keypads

Sentinel Systems keypads are available in two general mounting styles: Factory enclosure (3200, 3200i, 1600, 3200 DaVinci, and DaVinci) and Faceplate only (314 rubber and metal keypads).

The following sections provide examples of bonding for all keypad styles as well as the two basic bonding methods. The bonding wire shown coming from the pedestal or conduit is only needed if the mounting surface or conduit is not bonded. In all cases the metal enclosure or faceplate (if using keypads with faceplates only) must be bonded to the closest bonding point.

All connections must be tested (see "Testing Your Bonding" on page 11) for continuity before the installation is released for use.

3200, 3200i, 3200 DaVinci, 1600, and DaVinci Keypads

The following figures are examples of the two methods of bonding the factory enclosed keypads: surface and discrete wire. Your specific installation will determine what method is available for your keypad. The bonding wire shown from the faceplate to the mounting bolt must always be installed to ensure contact from the base to the faceplate.

The enclosure for the factory enclosure keypads is powder coated steel for durability and corrosion resistance which requires extra effort to ensure electrical connectivity during bonding. If required, the powder coating can be carefully scraped off around the mounting holes to improve the bonding connection. Care must be taken to remove the minimum amount of the powder coating required for the bonding connection.

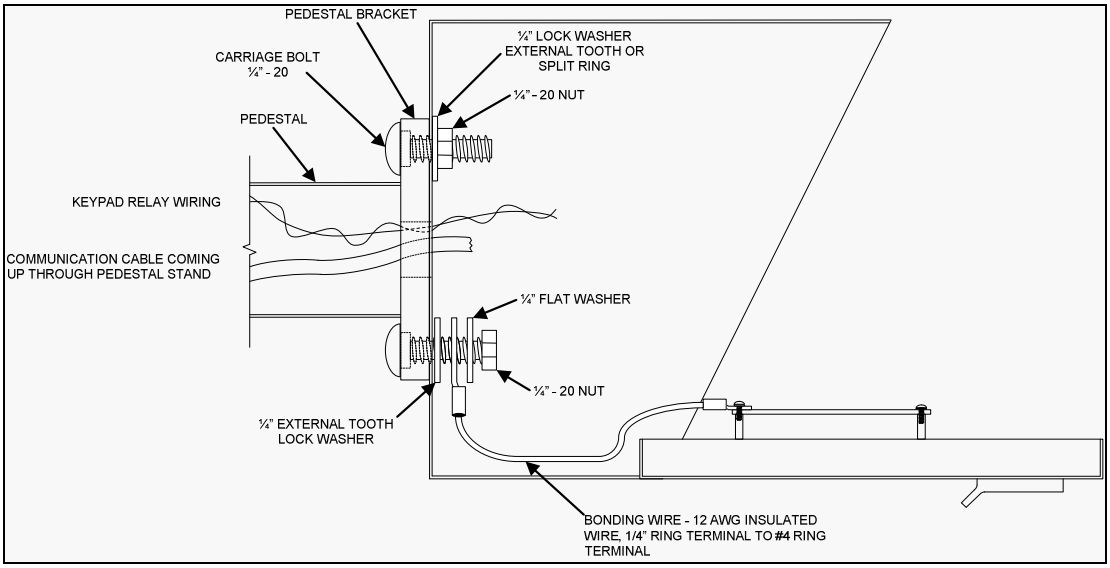

Figure 5 Enclosed Keypad (3200, 3200i, 1600, DaVinci) Surface Bonding Example

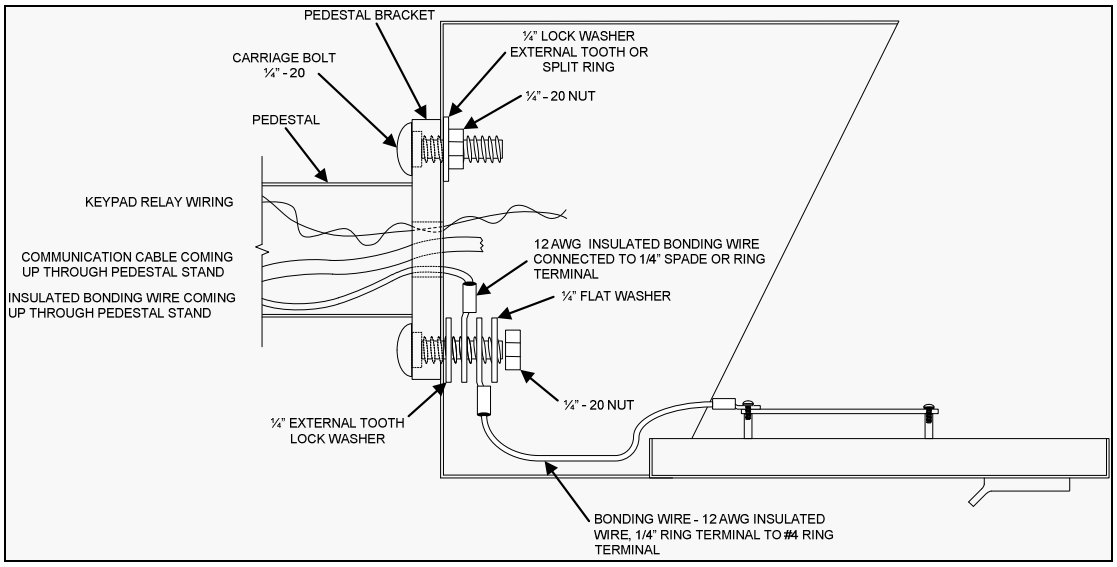

Figure 6 Enclosed Keypad (3200, 3200i, 1600, DaVinci) Wire Bonding Example

314 Rubber/Metal Keypads

The 314 rubber/metal keypads are supplied as faceplates only are intended for installation in a user supplied electrical box. The following figures are examples of the two methods of bonding the keypad or the faceplate: surface or discrete wire. Your specific installation will determine what method is available for your keypad. Both surface bonding and wire bonding to the mounting bolt are intended for use with metal electrical boxes. If your mounting box is non-metallic, use **Figure 9** on page 9 below for the proper bonding connections.

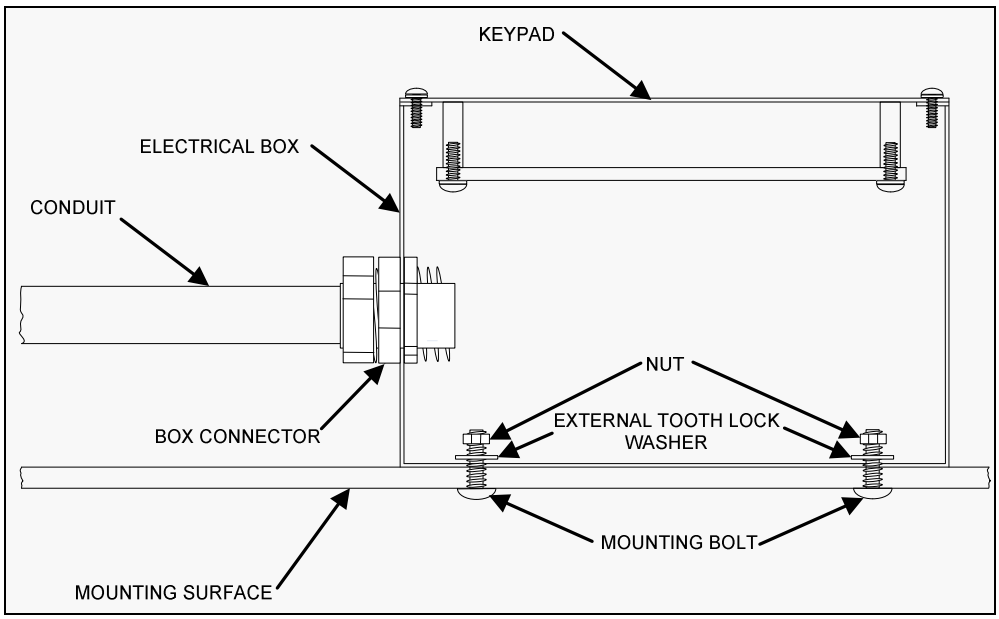

Figure 7 Keypad 314 Rubber/Metal Surface Bonding Example

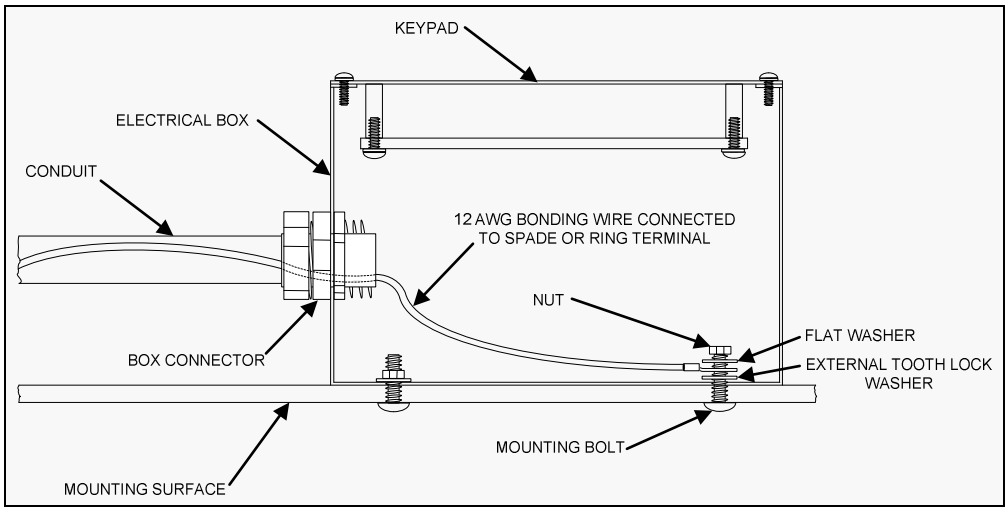

Figure 8 Keypad 314 Rubber/Metal Wire Bonding Example 1

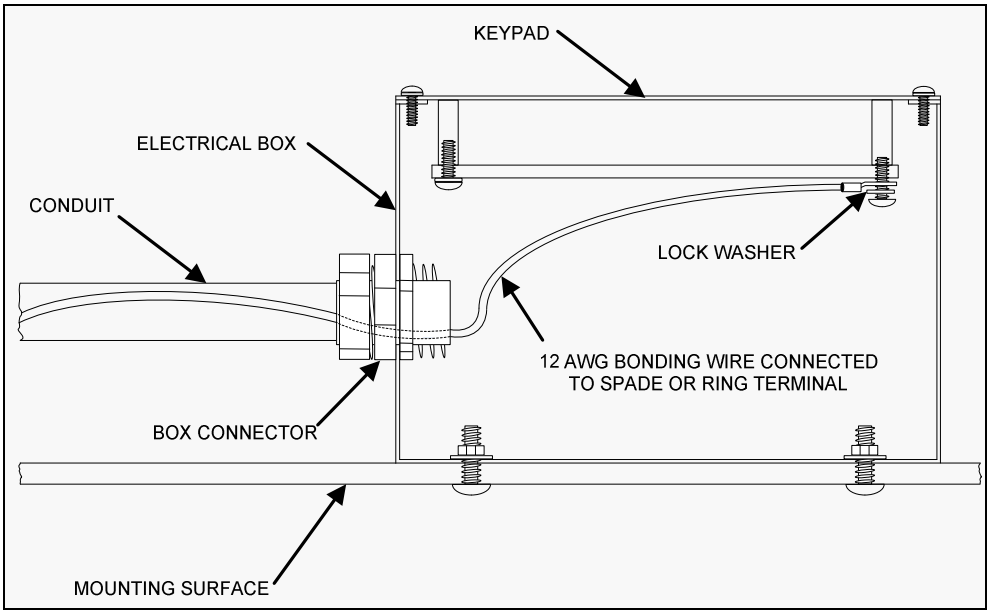

Figure 9 Keypad 314 Rubber/Metal Bonding Example 2

DSB, ECB/LCB, and CRI

All Sentinel Systems peripheral assemblies (DSB, ECB/LCB, and CRI) are intended to be installed in appropriate electrical enclosures (user supplied). These enclosures (where metallic) must be bonded to the closest bonding network point. The following figures are examples of the two methods of bonding the electrical enclosure: surface and discrete wire. Your specific installation will determine what method is available for your keypad.

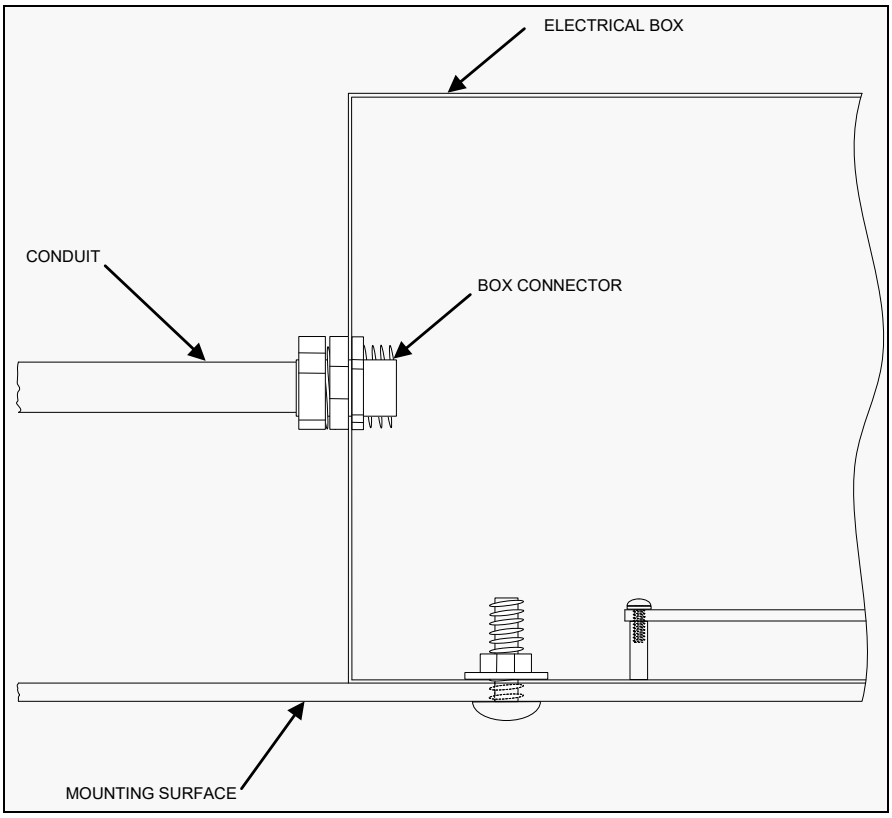

Figure 10 Peripheral Devices (DSB, ECB, CRI) Surface Bonding Example

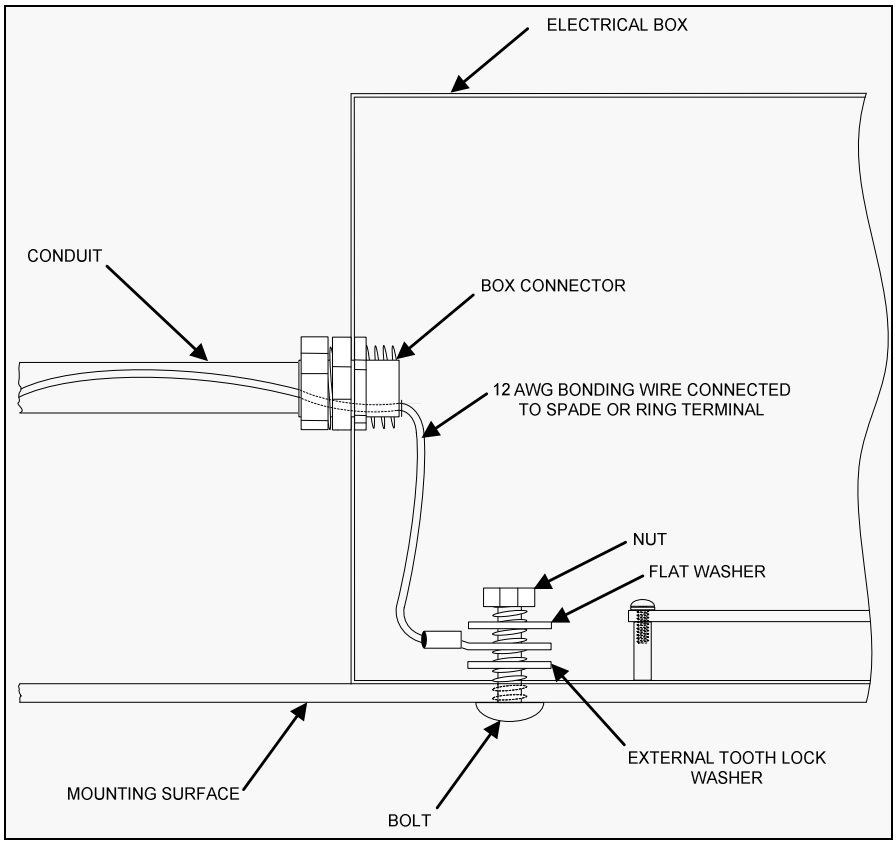

Figure 11 Peripheral Devices (DSB, ECB, CRI) Wire Bonding Example

Testing Your Bonding

Testing is critical to the success of your bonding network. The following sections provide the details on the continuity measurements necessary to ensure your bonding network is electrically connected. The indicated steps need to be performed in the sequence listed to both test the bonding as well as allow easy detection of any discontinuity in the bonding. These tests should be performed using a DMM set for measuring resistance. A measurement of close to 0 ohms (0 Ω) should be observed from the DMM display.

If an open circuit or a resistance of above 5 ohms (5 Ω) is observed during any part of the continuity tests, check to ensure that no foreign debris, powder coating, or paint is prohibiting continuity between the DMM leads and the surfaces being tested. **If an unacceptable reading still persists, the source of the discontinuity must be discovered and corrected immediately before any further testing is continued.** Any discontinuity present within the bonding network will defeat the purpose of bonding.

The following sections detail the measurements required for each bonding method and installed equipment. Refer to the sections that apply to your particular installation type and equipment.

Enclosed Keypads

The following figures show the testing points for the enclosed keypads (3200, 3200i, 3200 DaVinci, and 1600/DaVinci) for both wire bonded and surface bonded systems. Use the section (Surface Bonded or Wire Bonded) that applies to your installation.

Surface Bonded

Any enclosed keypads using the mounting surface as the bonding connection should use this section for bonding tests.

Step 1: Measure the resistance between the pedestal and the enclosure as shown in **Figure 12** below.

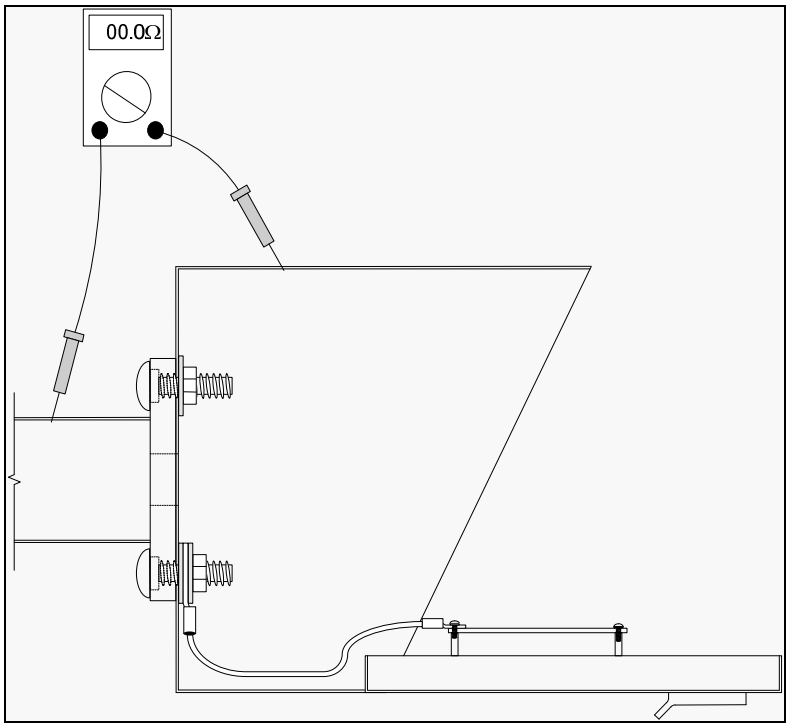

Figure 12 Continuity Testing Enclosure to Pedestal

Step 2: Measure the resistance from the pedestal to the faceplate as shown in **Figure 13** below.

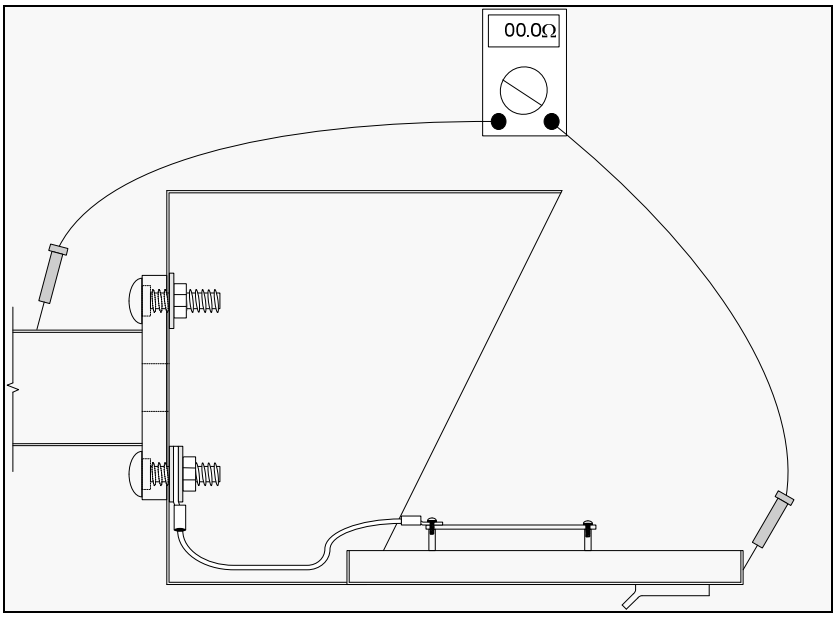

Figure 13 Continuity Testing - Enclosure to Faceplate

Wire Bonded

Any enclosed keypads using a discrete wire as the bonding connection should use this section for bonding tests.

Step 1: Measure the resistance from the bonding wire to the enclosure as shown in **Figure 14** below.

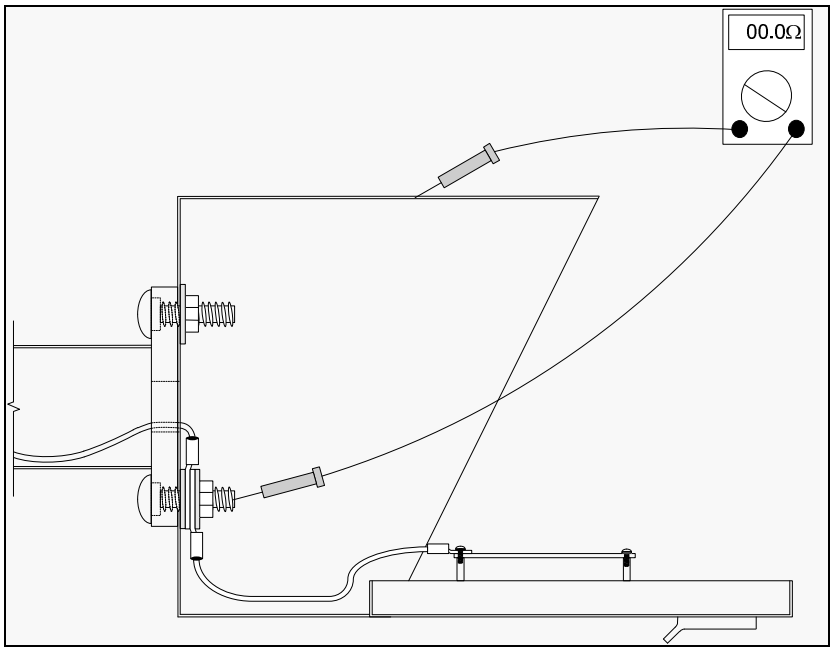

Figure 14 Continuity Testing – Bonding Wire to Enclosure

Step 2: Measure the resistance from the bonding wire to the faceplate as shown in **Figure 15** below.

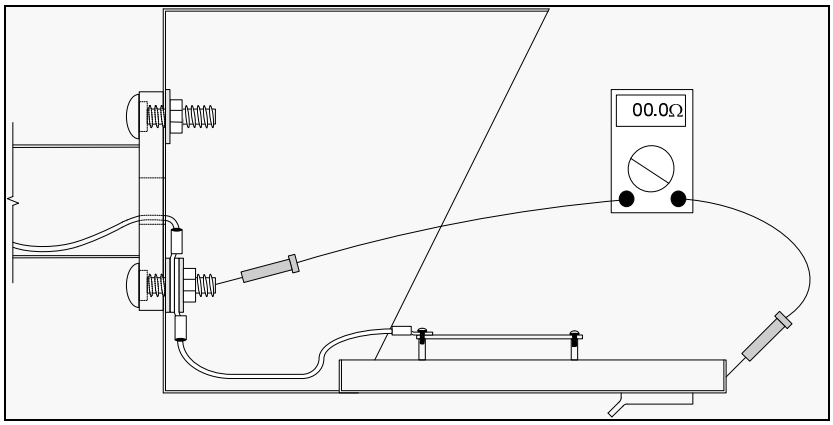

Figure 15 Continuity Testing – Bonding Wire to Faceplate

314 Rubber/Metal Keypads

The following figures show the testing points for the 314 faceplate only style of keypads for wire bonded, conduit bonded, and surface bonded systems. Use the section that applies to your installation.

Wire Bonded

Any faceplate only style keypads using a discrete wire as the bonding connection should use this section for bonding tests. There are two different connections for wire bonding. Use the method that applies to your installation.

Method 1: Wire bonded to enclosure.
Step 1: Measure the resistance from the bonding wire to the enclosure as shown in **Figure 16** below.

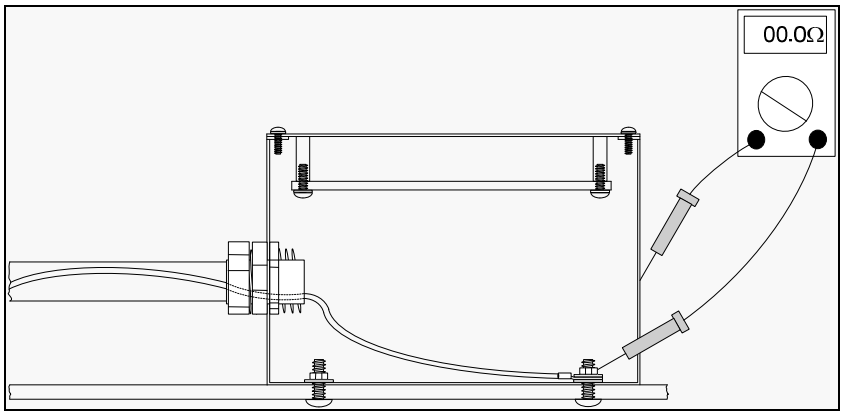

Figure 16 Continuity Testing - Bonding Wire to Case

Step 2: Measure the resistance from the bonding wire to the faceplate as shown in **Figure 17** below.

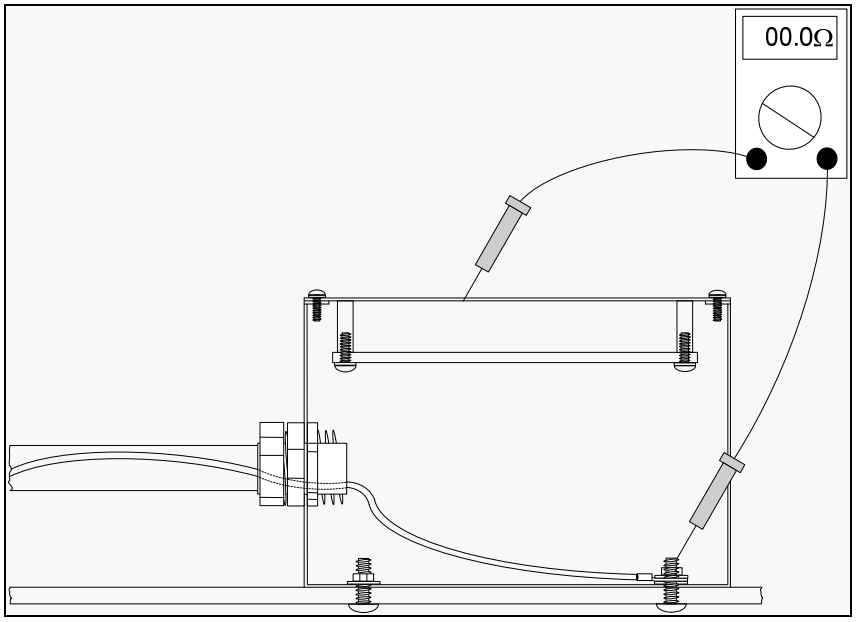

Figure 17 Continuity Testing - Bonding Wire to Faceplate

Method 2: Wire bonded to keypad pcb (printed circuit board)
Step 1: : Measure the resistance from the bonding wire to the faceplate as shown in **Figure 18** below.

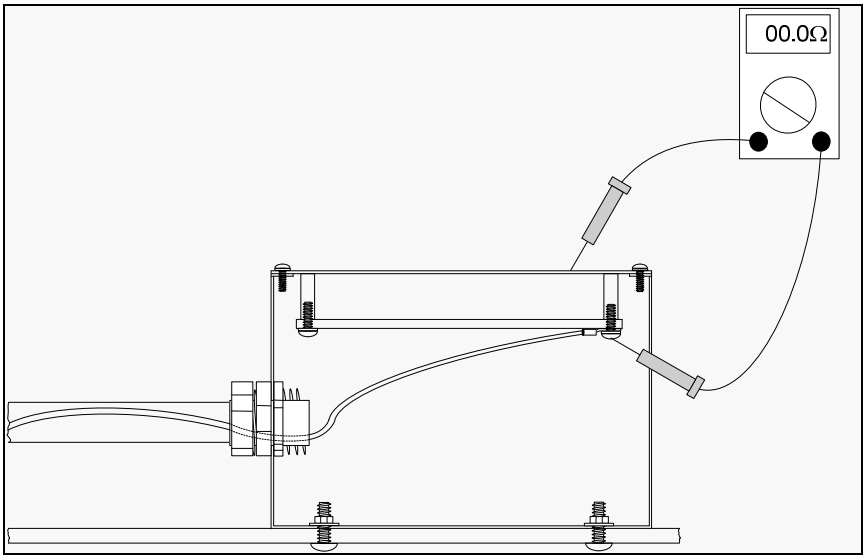

Figure 18 Continuity Testing - Bonding Wire to Faceplate

Step 2: Measure the resistance from the faceplate to the enclosure as shown in **Figure 19** below.

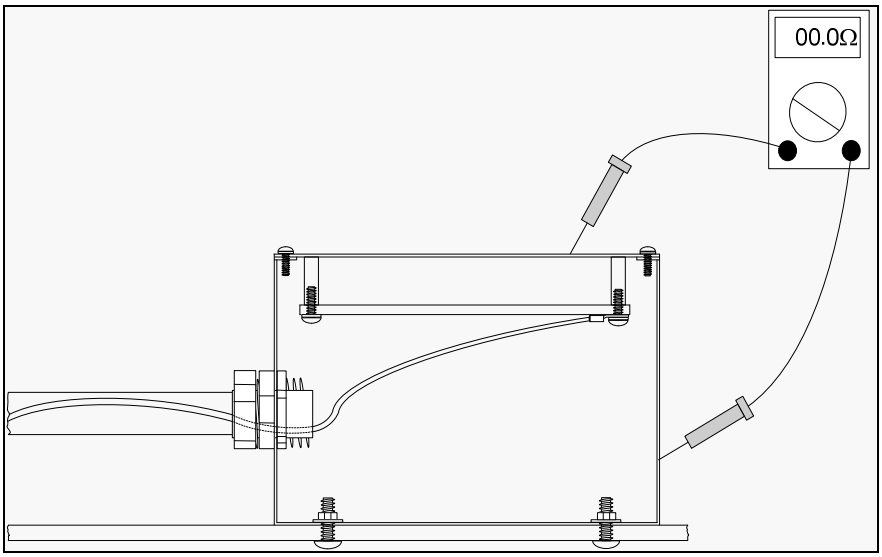

Figure 19 Continuity Testing - Faceplate to Enclosure

Conduit Bonded

Any faceplate only style keypad using conduit as the bonding connection should use this section for bonding tests.

Step 1: Measure the resistance from the conduit to the enclosure as shown in **Figure 20** below.

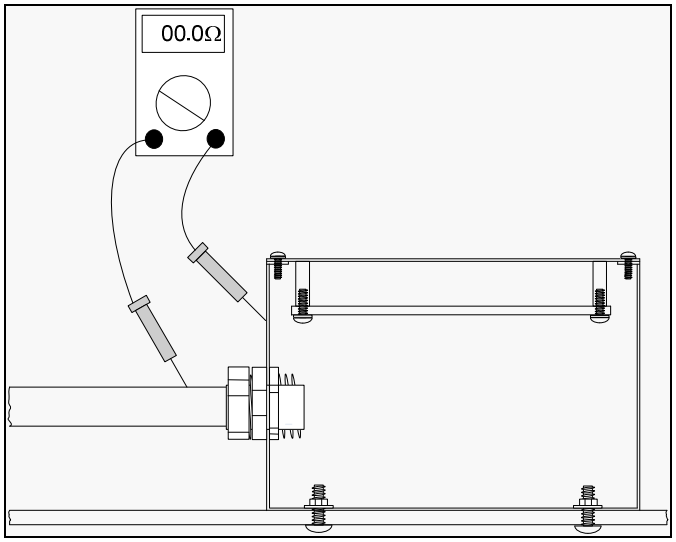

Figure 20 Continuity Testing - Conduit to Enclosure

Step 2: Measure the resistance from the conduit to the faceplate as shown in **Figure 21** below.

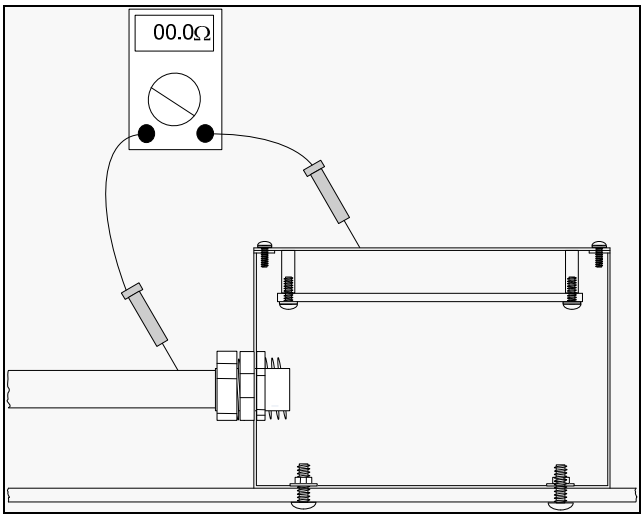

Figure 21 Continuity Testing - Conduit to Faceplate

Surface Bonded

Any faceplate only style keypads using the mounting surface as the bonding connection should use this section for bonding tests.

Step 1: Measure the resistance from the mounting surface to the enclosure as shown in **Figure 22** below.

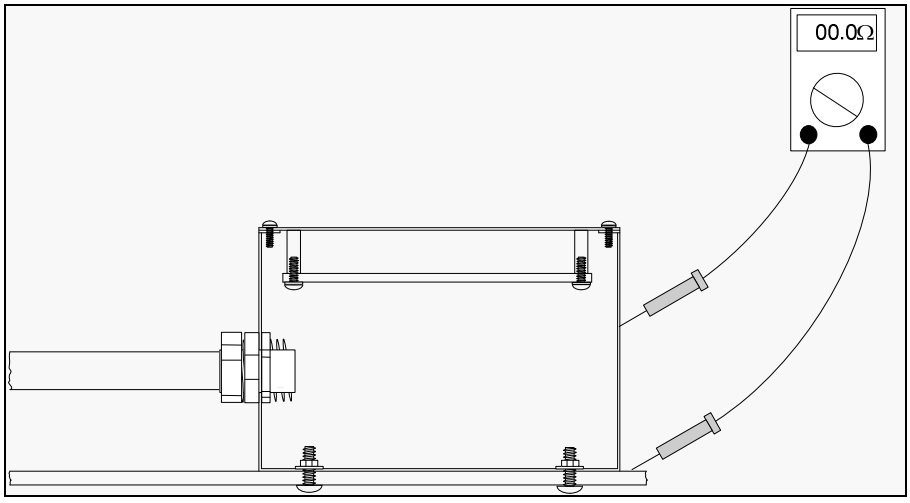

Figure 22 Continuity Testing - Mounting Surface to Enclosure

Step 2: Measure the resistance from the mounting surface to the faceplate shown in **Figure 23** below.

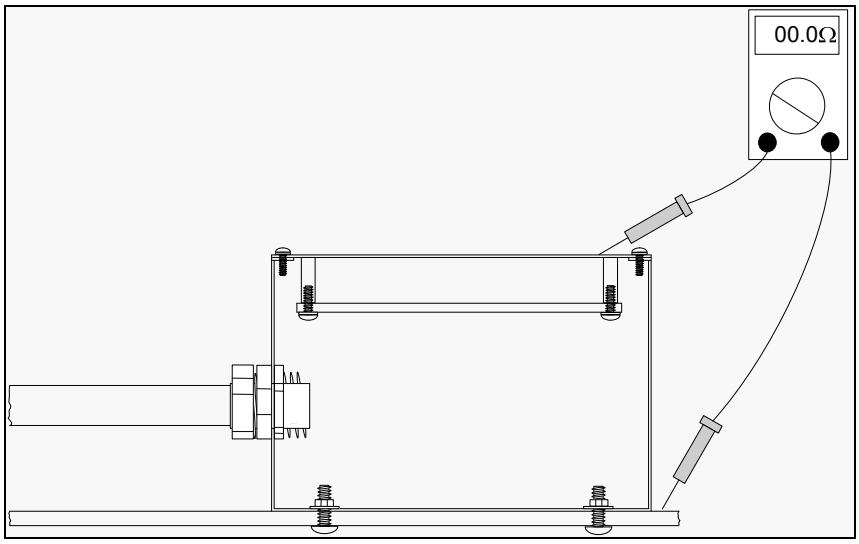

Figure 23 Continuity Testing - Mounting Surface to Faceplate

DSB/CRI/ECB/LCB

The DSB, CRI, and the ECB/LCB are mounted inside an electrical enclosure to allow for bonding and protection. The following figures show the testing points for the three (3) bonding methods (Wire, Conduit, and Surface). Make your measurements using the figure that matches your installation.

Wire Bonded

Measure the resistance from the bonding wire to the enclosure as shown in **Figure 24** below.

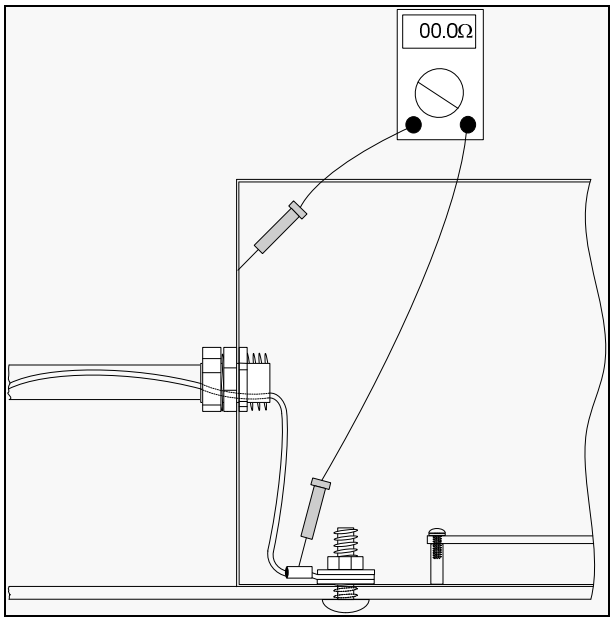

Figure 24 Continuity Testing – Bonding Wire to Enclosure

Conduit Bonded

Measure the resistance from the conduit to the enclosure as shown in **Figure 25** below.

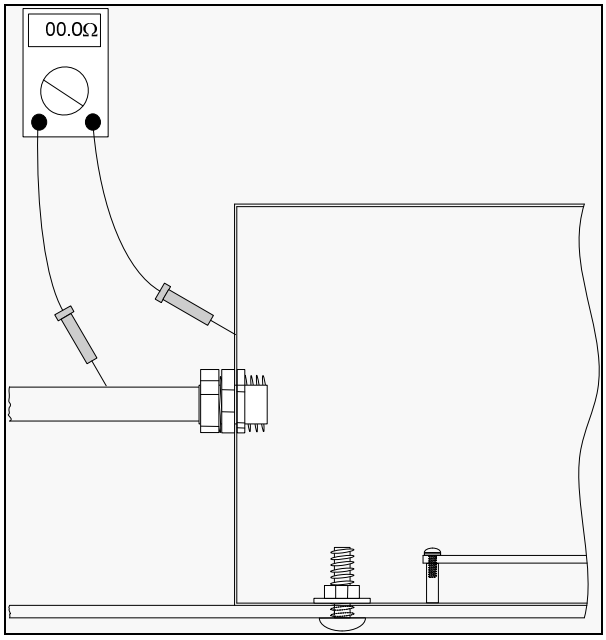

Figure 25 Continuity Testing – Conduit to Enclosure

Surface Bonded

Measure the resistance from the mounting surface to the enclosure as shown in **Figure 26** below.

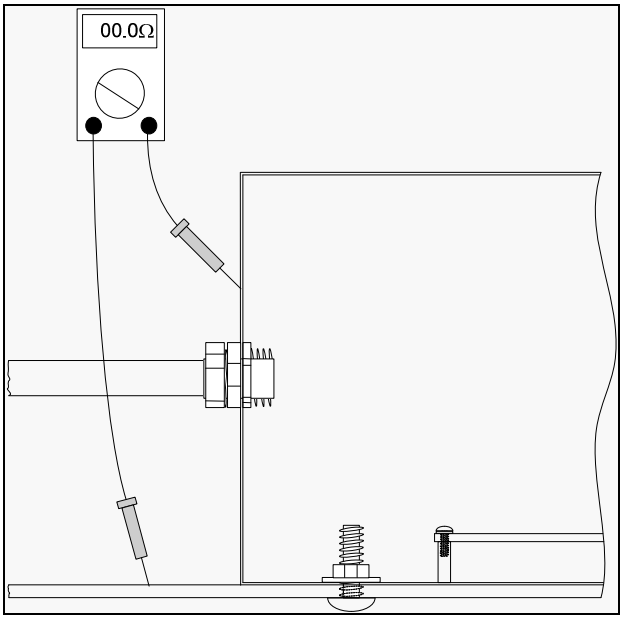

Figure 26 Continuity Testing – Mounting Surface to Enclosure

Testing for Ground Faults

Testing for ground faults is a required step to ensure that the communication/power cable to Sentinel Systems equipment is isolated from the bonding/grounding network. This test can be executed at any time during the installation but must be done prior to powering and attempting communication with Sentinel Systems equipment.

For this test, set your meter to the highest scale for impedance. This insures detection of both high and low impedance faults. All power supplies must be turned off or unplugged during this test. Use **Figure 27** below as a guide to the four (4) measurements comprising this test. Consult the Sentinel Systems documentation for the specific cable connections for your equipment. In all cases, the tests consist of ensuring there is no connection between the bonding/grounding network and the two signal connections and two power connections.

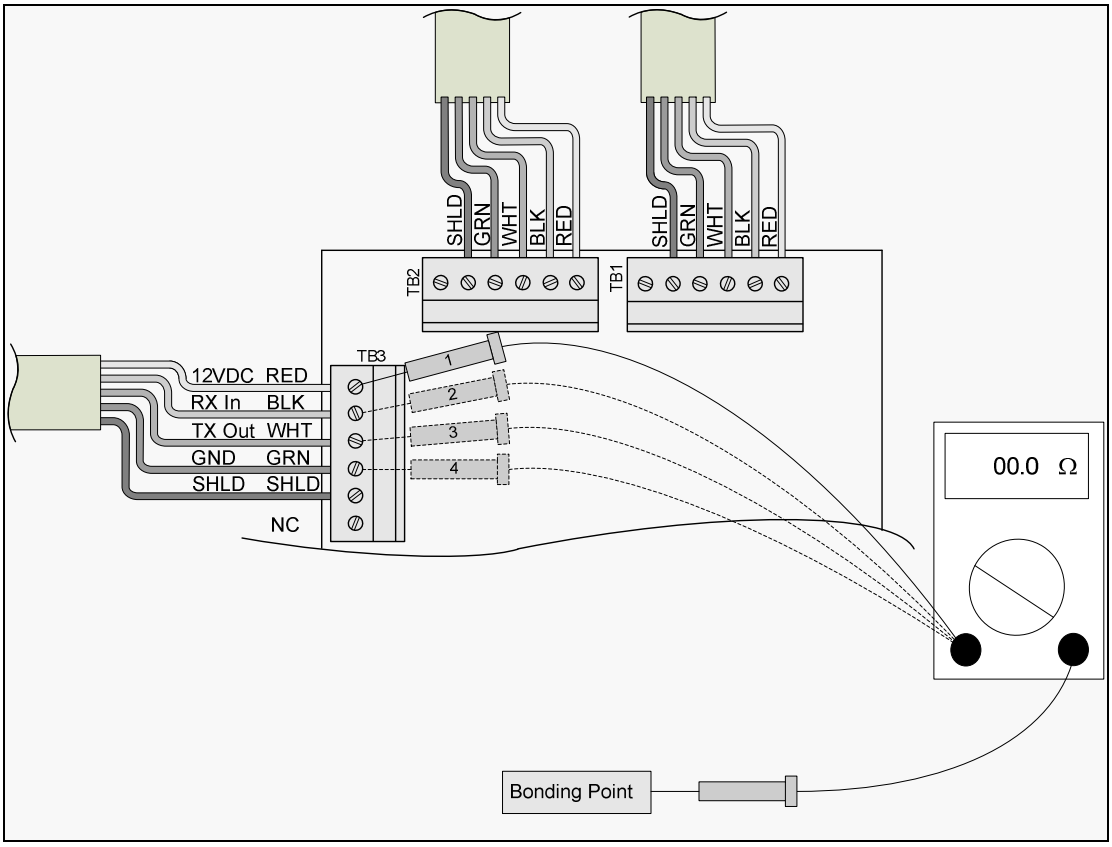

Figure 27 Ground Fault Testing