Traffic Safety Corporation

In-Roadway Warning Light System
AC Powered SC-TS1100 Model
Installation, Operation and Maintenance Manual

TSC Technical Support Center

Toll Free: 888-446-9255
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TSC-IM08, Rev. E
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Technical Support Center Reference Information

As soon as the system is unpacked, record the system information in the spaces provided below. In the event that warranty service is required this information will help the TSC support staff locate your system documents, and provide you with the very best support and service.

System Controller Serial Number _____

Fixture Model _____

Above Ground Warning Device Type _____

Activation Device Type _____

Date Shipment Received _____

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Introduction

Traffic Safety Corporation's In-Roadway Warning Lighting System is one of the most durable and reliable lighting systems ever developed. To ensure the integrity of the system over its lifetime the system must be properly installed. Failure to install the system properly will negatively impact the performance of the system, shorten its life, and may void the warranty.

The proper installation and operation of your system is our top priority. For that reason this installation manual has been designed to guide you through each of the major steps of the in-pavement and electrical installation of the system. We recommend that a copy of the manual be given to both the design engineer and the installer of the system in advance of the installation.

The major steps covered in this manual include:

A. In-pavement Installation

1. Placement and Orientation of Fixture Base Cans
2. Drainage System Considerations
3. Typical Base Can Installation Methods
4. Concrete Work

B. Electrical Installation

1. Fixtures
2. Activation Devices
3. Solar Panels
4. System Controller

Please call if you have any questions or concerns about the installation requirements, system set-up or system operation. Suggestions for improving the TSC Installation, Operation, and Maintenance Manual are welcomed. The TSC Technical Support Center can be reached, toll-free, at 1-888-446-9255.

Section 1 – General Information

A. Warranty Requirements

TSC offers a 5-Year Limited System Warranty on its In-Roadway Warning Lighting System, the industry's longest warranty. **In order to qualify for the warranty the following requirements need to be met:**

1. System must be installed properly. Failure to install the system properly may affect the integrity of the system and shorten its life.

2. Use only the TSC supplied components shipped with your system. This is a matched component system. The use of any non-TSC components may affect system performance or damage the system.

3. Do not replace LED Arrays in the field. The long-life High Bright LED arrays are replaceable only in the factory. Factory replacement includes overall fixture inspection, replacement of the LED array(s), replacement of the gaskets and/or O-Rings, and validation of seal and functionality.

B. Installation Precautions and Recommendations

1. All installation information in this manual is provided as a reference of what a typical installation may require. In developing the final plans for a project, local codes and conditions must be taken into account, and are the responsibility of the project engineer.

2. Verify that the drainage system is working properly by pouring water (Gallon) into the drain hole of each base can before pouring concrete, and checking that the underlying drainage is absorbing the water. This should be done after the core drilling or trenching, but before the base can is installed and the concrete is poured. The water absorption test is done prior to pouring concrete so that, if the drainage system is not performing properly, it can be repaired without having to remove and then re-pour the concrete.

3. Verify that the base cans are installed level with the road surface, and are positioned so that when the fixtures are inserted, they will point parallel to the direction of traffic flow.

4. After pouring concrete, allow enough time for the concrete to cure before removing the base can mounting jigs. Removal of the mounting jigs prior to the concrete curing may result in some settlement of the base can while the drying process continues. If settlement occurs, a portion of the fixture light beam may be blocked by the pavement, compromising the effectiveness of the warning light system.

5. Base cans are shipped with a protective plywood cover, TSC's Part# BA-PLCVR-3/4. The cover is used to protect the flange ring and keep debris out of the base can during installation, whenever the fixtures need to be removed for routine maintenance, during road resurfacing or during fixture shipment. After installation, the plywood covers should be marked, "DO NOT DISCARD", and stored in a safe location until needed.

C. Technical Support Center Contact Information

Before proceeding, if you have any questions or concerns
Call the TSC Technical Support Center
Open Monday through Friday, 8:00 am to 5:00 pm PST
Toll Free: 1-888-446-925

Section 2 – In-pavement Fixture Installation

A. Fixture Placement – MUTCD Standard and Examples

The Federal Highway Association (FHWA) specifies the use of In-Roadway (In-Pavement) lights in the Manual of Uniform Traffic Control Devices (MUTCD). For convenience, sections of the MUTCD referring to the application of these systems are included below:

MUTCD - 2009 Edition Chapter 4N: In-Roadway Lights

Section 4N.01 Application of In-Roadway Lights

Support:
01 In-Roadway Lights are special types of highway traffic signals installed in the roadway surface to warn road users that they are approaching a condition on or adjacent to the roadway that might not be readily apparent and might require the road users to slow down and/or come to a stop. This includes situations warning of marked school crosswalks, marked midblock crosswalks, marked crosswalks on uncontrolled approaches, marked crosswalks in advance of roundabouts as described in Chapter 3C, and other roadway situations involving pedestrian crossings.

Standard:
02 In-Roadway Lights shall not be used for any application that is not described in this Chapter.

03 If used, In-Roadway Lights shall not exceed a height of 3/4 inch above the roadway surface.

04 When used, In-Roadway Lights shall be flashed and shall not be steadily illuminated.

Support:
05 steadily illuminated lights installed in the roadway surface are considered to be internally illuminated raised pavement markers (see Section 3B.11).

Option:
06 In-Roadway Lights may be flashed in a manner that includes a continuous flash of varying intensity and time duration that is repeated to provide a flickering effect (see Section 4N.02).

Section 4N.02 In-Roadway Warning Lights at Crosswalks

Option:
01 In-roadway lights may be installed at certain marked crosswalks, based on an engineering study or engineering judgment, to provide additional warning to road users.

Standard:
02 If used, In-Roadway Warning Lights at crosswalks shall be installed only at marked crosswalks with applicable warning signs. They shall not be used at crosswalks controlled by YIELD signs, STOP signs, or traffic control signals.

03 If In-Roadway Warning Lights are used at a crosswalk, the following requirements shall apply:

A. Except as provided in Paragraphs 7 and 8, they shall be installed along both sides of the crosswalk and shall span its entire length.

Section 2 – In-pavement Fixture Installation

A. Fixture Placement – MUTCD Standard and Examples

B. They shall initiate operation based on pedestrian actuation and shall cease operation at a predetermined time after the pedestrian actuation or, with passive detection, after the pedestrian clears the crosswalk.

C. They shall display a flashing yellow light when actuated. The flash rate shall be at least 50, but no more than 60, flash periods per minute. If they are flashed in a manner that includes a continuous flash of varying intensity and time duration that is repeated to provide a flickering effect, the flickers or pulses shall not repeat at a rate that is between 5 and 30 per second to avoid frequencies that might cause seizures.

D. They shall be installed in the area between the outside edge of the crosswalk line and 10 feet from the outside edge of the crosswalk.

E. They shall face away from the crosswalk if unidirectional, or shall face away from and across the crosswalk if bidirectional.

04 If used on one-lane, one-way roadways, a minimum of two In-Roadway Warning Lights shall be installed on the approach side of the crosswalk. If used on two-lane roadways, a minimum of three In-Roadway Warning Lights shall be installed along both sides of the crosswalk. If used on roadways with more than two lanes, a minimum of one In-Roadway Warning Light per lane shall be installed along both sides of the crosswalk.

Guidance:
05 *If used, In-Roadway Warning Lights should be installed in the center of each travel lane, at the center line of the roadway, at each edge of the roadway or parking lanes, or at other suitable locations away from the normal tire track paths.*

06 *The location of the In-Roadway Warning Lights within the lanes should be based on engineering judgment.*

Option:
07 On one-way streets, In-Roadway Warning Lights may be omitted on the departure side of the crosswalk.

08 Based on engineering judgment, the In-Roadway Warning Lights on the departure side of the crosswalk on the left side of a median may be omitted.

09 Unidirectional In-Roadway Warning Lights installed at crosswalk locations may have an optional, additional yellow light indication in each unit that is visible to pedestrians in the crosswalk to indicate to pedestrians in the crosswalk that the In-Roadway Warning Lights are in fact flashing as they cross the street. These yellow lights may flash with and at the same flash rate as the light module in which each is installed.

Guidance:
10 *If used, the period of operation of the In-Roadway Warning Lights following each actuation should be sufficient to allow a pedestrian crossing in the crosswalk to leave the curb or shoulder and travel at a walking speed of 3.5 feet per second to at least the far side of the traveled way or to a median of sufficient width for pedestrians to wait. Where pedestrians who walk slower than 3.5 feet per second, or pedestrians who use wheelchairs, routinely use the crosswalk, a walking speed of less than 3.5 feet per second should be considered in determining the period of operation.*

Section 2 – In-pavement Fixture Installation

A. Fixture Placement – MUTCD Standard and Examples

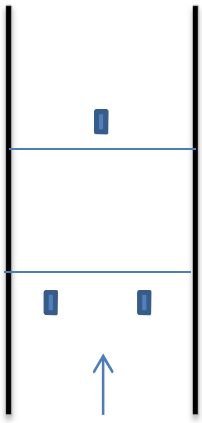
Standard:

11 If pedestrian pushbuttons are used to actuate the in-roadway lights, a Push Button To Turn On Warning Lights (with pushbutton symbol) (R10-25) sign (see Figure 2B-26) shall be mounted adjacent to or integral with each pedestrian pushbutton.

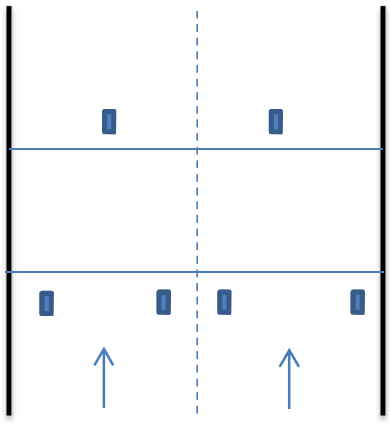
12 Where the period of operation is sufficient only for crossing from a curb or shoulder to a median of sufficient width for pedestrians to wait, median-mounted pedestrian actuators shall be provided.

Placement Examples

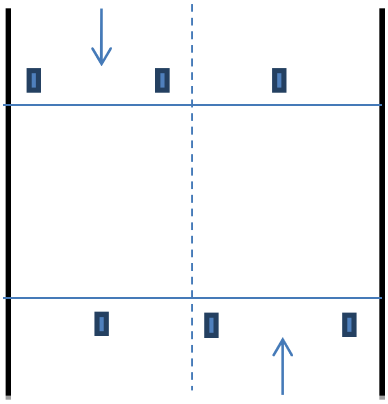
Many possible fixture configurations are possible depending on the type of road that the crosswalk is being installed across. Always refer to the project engineer's drawings for the actual number and placement of fixtures.



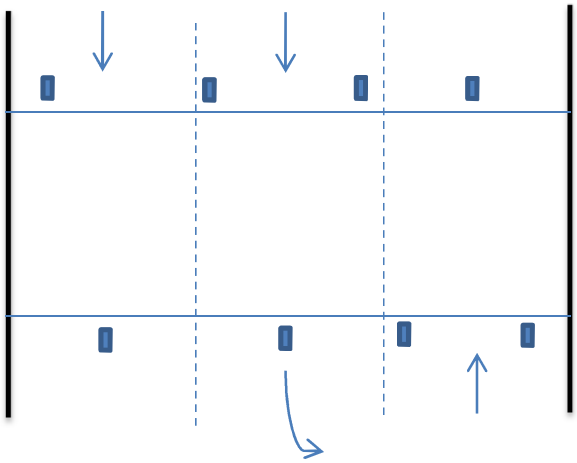
Drawing 1 - One Way, One Lane



Drawing 2 - One Way, Two Lanes



Drawing 3 - Two Way, Two Lanes

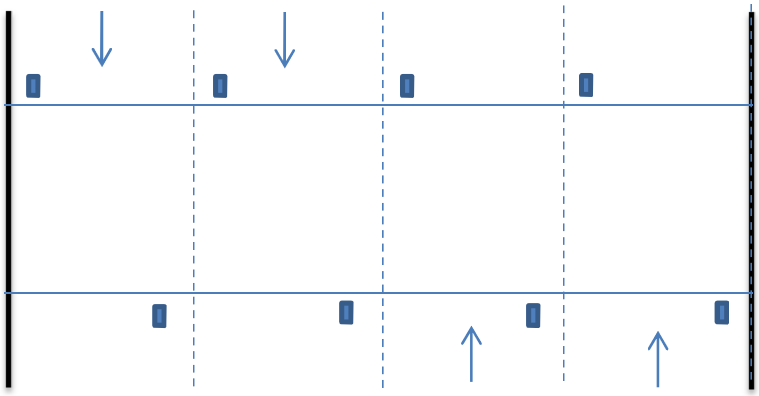


Drawing 4 - Two Way, Two Lanes + Turn Lane

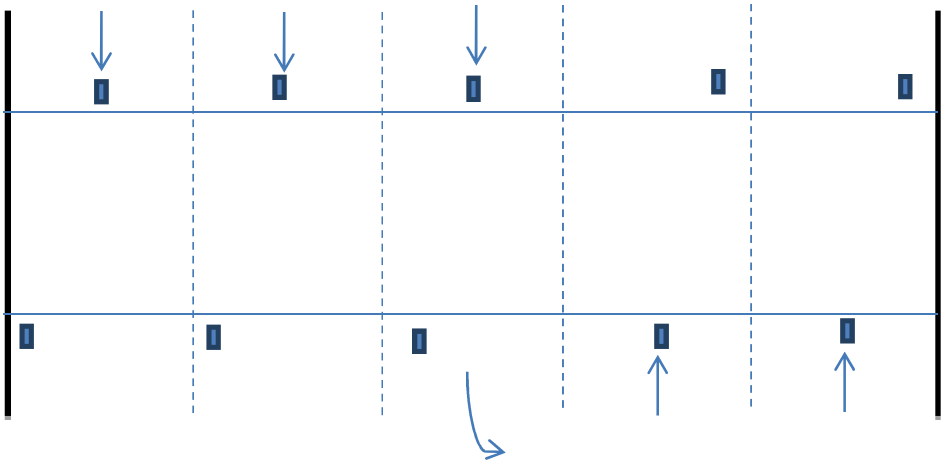
Section 2 – In-pavement Fixture Installation

A. Fixture Placement – MUTCD Standard and Examples

Placement Examples



Drawing 5 - Two Way, Four Lanes



Drawing 6 - Two Way, Four Lanes + Turn Lane

Section 2 – In-pavement Fixture Installation

B. Drainage System Requirements

The truism that water and electricity don't mix holds for In-Roadway Lighting Systems. Roadway pavement is subject to many sources of moisture, the most serious of which is ground water. The TSC In-roadway lighting system is designed to prevent water and water vapor from making contact with electrical conductors, contacts and connections. Fixtures used in the TSC system employ seals that prevent moisture from entering the light fixture. The connectors used are waterproof and provide connection between the fixture, and control system without fear of electrical shorting to ground. However, water within the base cans, left for long periods of time, may create problems. Standing water in the base can is especially undesirable in colder climates because of damage that can be done when water freezes and expands. To prevent problems caused by standing water in the base cans a proper drainage system must be designed and prior to the electrical installation of the fixtures and pouring of concrete.

Failure to install a proper drainage system may result in damage to the system components and void the system warranty.

C. Drainage System Design

A number of drainage system designs may be used to provide proper drainage for the TSC In-roadway warning light system. **Two types of drainage systems are typically used in the installation of the system:**

- **Modified French Drain** – This drain typically consists of a 1 1/2 inch diameter PVC pipe discharging into a drain rock section, which is installed directly under the drain hole of the base can. See Figures 1 and 2.

- **Piped Drain** - This drain provides positive drainage from each base can through a pipe system that carries any water that gets into the system off the edge of the street where it will drain into an open ditch, storm drain system, or other drainage facilities that are available. See Figure 3. If no existing drains are available, then an excavation can be made at the outside of the street section and this excavation filled with drain rock. This will serve as a retention area for water produced in the system and an area to allow for percolation of this water into the surrounding ground.

All installations should be done by a qualified individuals acording to all federal, state, and local electrical codes which apply. All information contained in this manual is intended to provide general guidance and information.

Because local codes, soil conditions and weather conditions are unique to each location TSC will not specify a drainage system for a specific installation. The typical installations described in the following pages are provided as general guidelines and may not apply at your site location.

Refer to the Project Engineer's drawing for the drainage system specified for your specific installation. If one has not been prepared, ask the Project Engineer to prepare one before proceeding with the installation. If you, or the design engineer, have any questions about the need for a drainage system, we urge you to contact the TSC Technical Support Center, toll-free, at 1-888-446-9255.

Section 2 – In-pavement Fixture Installation

D. Base Can Installation – Core Drill and Saw Cut (Figure 1)

1. Remove the plywood base covers from the base can, mark them “Do Not Discard”, and store them in a safe location.

2. Begin the core drilling **(typically 12 inches in diameter and 24 inches deep)** and saw cut process. Holes should be drilled at fixture locations. Saw cuts should then be made to allow room for the fixture power cables **(typically 3” deep and ½” wide).** Saw cuts provide a connecting path between all of the base cans (fixtures) and system controller.

3. In this installation, the base can fixture cable conduit holes will not be used with conduit. However, the fixture cables will pass from the edge of the saw cut into these holes. The cables will be held in place and the holes sealed with a sealing compound such as **Dollie Duct Seal compound**, or equivalent.

4. Prepare the drainage system specified by the project engineer. With this type of installation it is impractical to install a piped drain system. It is recommended that the modified French drain system be utilized. Refer to figure 1.

5. Attach the mud ring to the base can using the bolts that came with the base can. Then install the base can drain fittings provided into each base can drain hole. Run **1-½ inch size pipe, Schedule 40 PVC**, into the fittings of the base can. Pipe length should be cut so that the pipe, when positioned over the drain, extends approximately 3 to 4 inches into the drain rock.

6. Suspend the base cans so the top of the mud ring is flush with the surface of the pavement. Note: If a mud ring is not used, the base will need to be suspended 3/4" below the surface of the pavement. Base cans should be oriented so that the fixture optics will be aligned parallel with the traffic lane. Use of mounting jigs is recommended for proper alignment of base cans. Consult the design plans for the preferred method of base can suspension for your installation.

7. Test the drainage system by pouring water into the base can at each fixture location before concrete is poured. Pour enough water **(typically a gallon)** to verify that the underlying ground is absorbing the water. If the base can is not draining properly, modifications to the drainage system will be necessary. In this case consult with your design engineer before proceeding. Once you’re satisfied that the drain is working properly, move on to the next step.

8. Install the fixture cables. Run fixture power cables to each base can, one black wire and one white wire to each can. If grounding is required by local code, run an additional wire (green or blue) to each base can. The ground wire can be attached to the base can using the ground strap provided at the bottom inside of each base can.

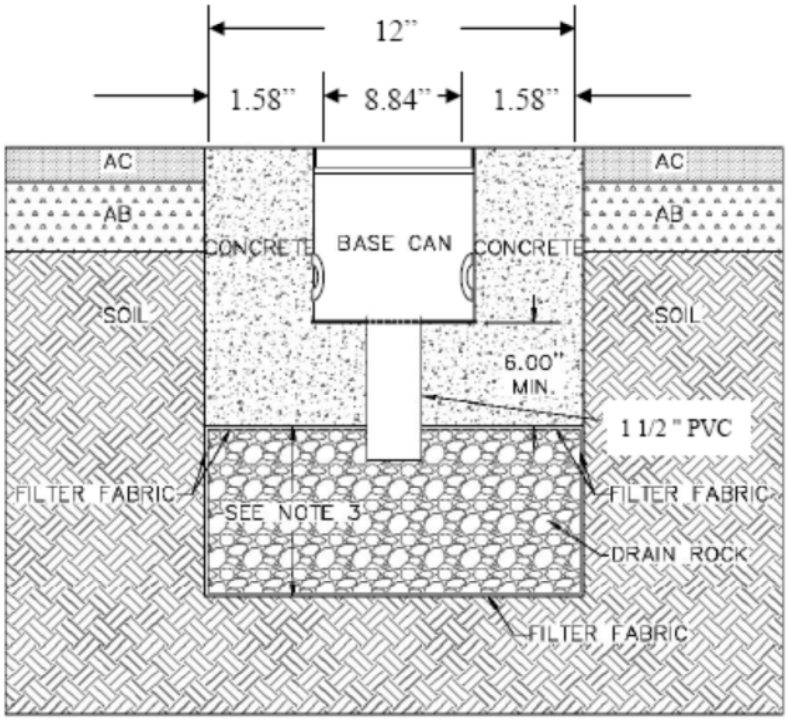
9. Make sure that the filter fabric is in place above the drain rock to prevent slurry from clogging up the drain. Then encase the base cans and drainage system in concrete. It is recommended that at least 6 inches of concrete be used below the base. Fill saw cuts with Traffic Loop Sealant, or equivalent.

10. After the concrete has cured, remove the mounting jigs, clean out base cans, and replace protective plywood covers until fixtures are ready for installation. **Note: Removal of the mounting jigs prior to the concrete curing may result in some settlement of the base can while the drying process continues. If settlement occurs, a portion of the fixture light beam may be blocked by the pavement, compromising the effectiveness of the warning light system.**

Section 2 – In-pavement Fixture Installation

D. Base Can Installation – Core Drill and Saw Cut (Figure 1)

Figure 1: Base Can Installation – Core Drill and Saw Cut



Notes

1. Drain rock shall be graded from 1 inch to ¼ inch.

2. Drain rock shall be encased in a filter fabric material to avoid soil infiltration into the drain rock.

3. Recommended depth of drain rock unit varies dependent upon the type of existing soils.
   a. Where existing soils are granular and permeable the depth of the drain rock unit can be limited to 1 foot.

   b. Where existing soils are fine graded and have low permeability the depth of the drain rock unit should be increased to 3 feet or greater to provide a reservoir for short term retention. Refer to engineering plans for the requirements specified by the project engineer.

4. Concrete shall be 3/8 inch maximum aggregate mix, use a minimum of seven sacks of cement per cubic yard of concrete and poured from a height of approximately 5 inches above the can. Concrete should only be poured from one side. Vibrate or rod concrete to completely fill the area below and on all sides of the base can. When concrete is visible on the side opposite the side that concrete is being from, pouring can commence from alternate locations.

5. Abbreviations: Asphalt Concrete (AC), Aggregate Base (AB).

6. Drawing not to scale.

Section 2 – In-pavement Fixture Installation

E. Base Can Installation – Trench and Fill – Option 1 (Figure 2)

1. Remove the plywood base covers from the base can, mark them “Do Not Discard”, and store them in a safe location.

2. Begin trenching process. After trenching is completed along fixture locations, prepare the drainage system as specified by the design engineer. Refer to figure 2.

3. Attach the mud ring to the base can using the bolts that came with the base can. Then install the base can drain fittings provided into each base can drain hole. Run **1-½ inch size pipe, Schedule 40 PVC**, into the fittings of the base can. Pipe length should be cut so that the pipe, when positioned over the drain, extends approximately 3 to 4 inches into the drain rock.

4. Suspend the base cans so the top of the mud ring is flush with the surface of the pavement. Note: If a mud ring is not used, the base will need to be suspended 3/4" below the surface of the pavement. Base cans should be oriented so that the fixture optics will be aligned parallel with the traffic lane. Use of mounting jigs is recommended for proper alignment of base cans. Consult the design plans for the preferred method of base can suspension for your installation.

5. Test the drainage system by pouring water into the supported base can at each fixture location. Pour enough water **(typically a gallon)** to verify that the underlying ground is absorbing the water. If the base can is not draining properly, modifications to the drainage system will be necessary. In this case consult with your design engineer before proceeding. Once you’re satisfied, move on to the next step.

6. Install fixture cable conduit. Run **1 inch pipe size, Schedule 40 PVC**, between each base can. PVC conduit should fit snugly into the grommets located at each base can conduit hole. Complete installation by running conduit from the last base can in the system to the system controller, as specified by the design engineer.

7. Install the fixture cables. Run fixture power cables through the conduit into each base can, one black wire and one white wire. If grounding is required by local code, run an additional wire (green or blue) through the conduit to each base can. The ground wire can be attached to the base can using the ground strap provided at the bottom inside of each base can.

8. Make sure that the filter fabric is in place above the drain rock to prevent slurry from clogging up the drain. Then encase the base cans and drainage system in concrete. It is recommended that at least 6 inches of concrete be used below the base.

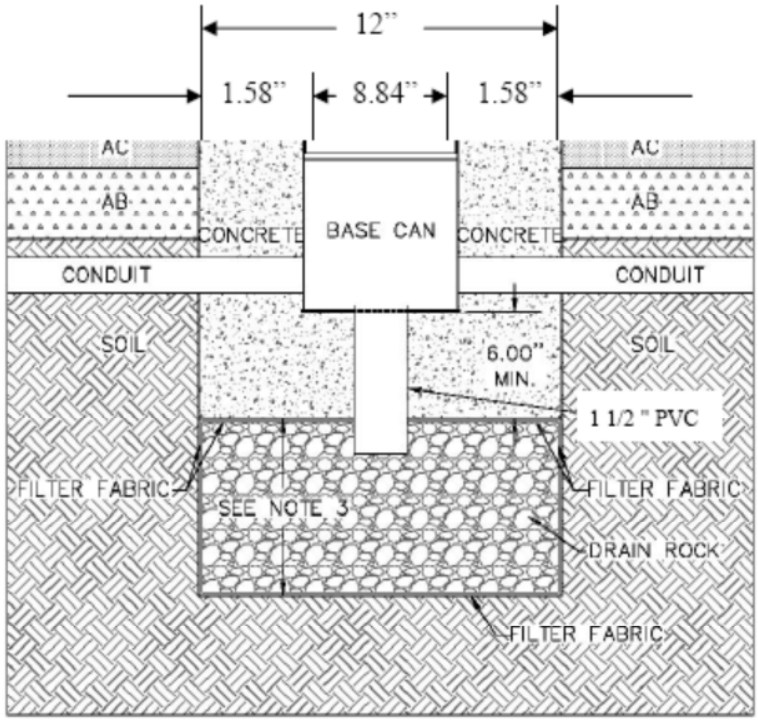
9. Backfill the trench with specified material, compact and cover per the designer’s specifications, taking care not to damage conduit or drainage system. Remove mounting jig, clean out base can and replace protective plywood covers until fixtures are ready for installation.

10. After the concrete has hardened, remove the mounting jigs, clean out base cans, and replace the protective plywood covers until fixtures are ready for installation.

Section 2 – In-pavement Fixture Installation

E. Base Can Installation – Trench and Fill – Option 1 (Figure 2)

Figure 2: Base Can Installation – Trench and Fill (Option 1)



Notes

1. Drain rock shall be graded from 1 inch to ¼ inch.
2. Drain rock shall be encased in a filter fabric material to avoid soil infiltration into the drain rock.
3. Recommended depth of drain rock unit varies dependent upon the type of existing soils.
4. Where existing soils are granular and permeable the depth of the drain rock unit can be limited to 1 foot.

    c. Where existing soils are fine graded and have low permeability the depth of the drain rock unit should be increased to 3 feet or greater to provide a reservoir for short term retention. Refer to engineering plans for the requirements specified by the project engineer.

    a. Concrete shall be 3/8 inch maximum aggregate mix, use a minimum of seven sacks of cement per cubic yard of concrete and poured from a height of approximately 5 inches above the can. Concrete should only be poured from one side. Vibrate or rod concrete to completely fill the area below and on all sides of the base can. When concrete is visible on the side opposite the side that concrete is being from, pouring can commence from alternate locations.

5. Abbreviations: Asphalt Concrete (AC), Aggregate Base (AB)
6. Drawing not to scale.

Section 2 – In-pavement Fixture Installation

F. Base Can Installation – Trench and Fill – Option 2 (Figure 3)

1. Remove the plywood base covers from the base can, mark them **"Do Not Discard"**, and store them in a safe location.

2. Begin trenching process. After trenching is completed along fixture locations, prepare the drainage system as specified by the design engineer. Refer to Figure 3.

3. Attach the mud ring to the base can using the bolts that came with the base can. Then install the base can drain fittings provided into each base can drain hole. Suspend the base cans so the top of the mud ring is flush with the surface of the pavement. Note: If a mud ring is not used, the base will need to be suspended 3/4" below the surface of the pavement. Base cans should be oriented so that the fixture optics will be aligned parallel with the traffic lane. Use of mounting jigs is recommended for proper alignment of base cans. Consult the design plans for the preferred method of base can suspension for your installation.

4. Install drain conduit. Run **1½ inch size pipe, Schedule 40 PVC**, from each base can fitting into the proper coupling (right angle bend, T-adapter, etc.). Connect all couplings together using the proper length PVC pipe. Run the end of the drain conduit into the drainage system, ditch, or leaching pit. The drainage conduit pipe should have a slight negative slope.

5. Test the drainage system by pouring water into the supported base can at each fixture location. Pour enough water to verify that the drainage system is absorbing the water. If the base can is not draining properly, modifications to the drainage system will be necessary. In this case consult with your design engineer before proceeding. Once satisfied move on to the next step.

6. Install fixture cable conduit. Run **1 inch pipe size, Schedule 40 PVC**, between each base can. PVC conduit should fit snugly into the grommets located at each base can conduit hole. Complete installation by running conduit from the last base can in the system to the system controller, as specified by the design engineer.

7. Install the fixture cables. Run fixture power cables through the conduit into each base can, one black wire and one white wire. If grounding is required by local code, run an additional wire (green or blue) through the conduit to each base can. The ground wire can be attached to the base can using the ground strap provided at the bottom inside of each base can.

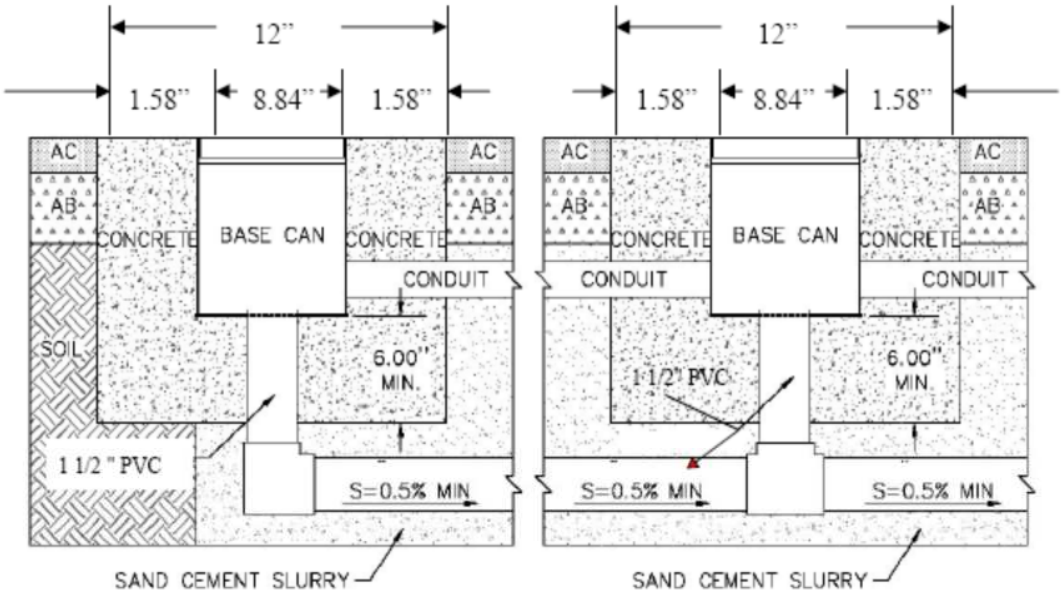
8. Encase the base cans and drainage system in concrete. It is recommended that at least 6 inches of concrete be used below the base. After the concrete has hardened, remove the mounting jigs, clean out base cans, and replace the protective plywood covers until fixtures are ready for installation.

9. Backfill the trench with specified material, compact and cover per the designer's specifications, taking care not to damage conduit or drainage system.

Section 2 – In-pavement Fixture Installation

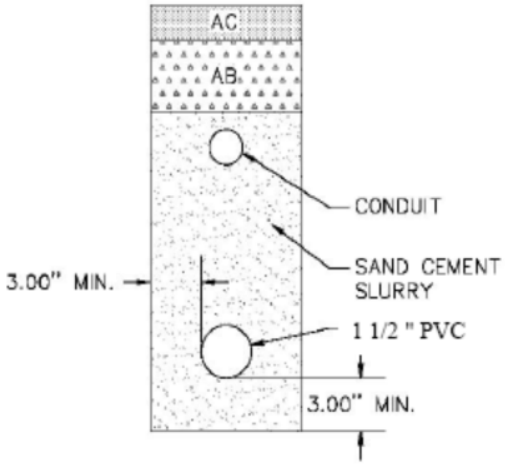
F. Base Can Installation – Trench and Fill – Option 2 (Figure 3)

Figure 3: Base Can Installation – Trench and Fill (Option 2)



Notes:

1. The 1 1/2 inch PVC drain conduit is used to discharge water into the existing drainage system, existing ditches or if necessary a leaching pit.
2. The leaching pit can consist of a 36 inch diameter drilled hole carried to a depth of 6 to 10 feet and filled with drain rock.
3. Abbreviations: Asphalt Concrete (AC), Aggregate Base (AB), Slope (S).
4. Drainage slopes of 1% are typical.



5. Drawing not to scale.

6. Concrete shall be 3/8 inch maximum aggregate mix, use a minimum of seven sacks of cement per cubic yard of concrete and poured from a height of approximately 5 inches above the can. Concrete should only be poured from one side. Vibrate or rod concrete to completely fill the area below and on all sides of the base can. When concrete is visible on the side opposite the side that concrete is being from, pouring can commence from alternate locations.

Section 2 – In-pavement Fixture Installation

G. Fixture Cabling

1. Using **12 AWG conductors,** of appropriate type to meet local codes, pull one White wire (+12 VDC) and one Black wire (Return) to each fixture (parallel circuit). If local code requires grounding, pull an additional green wire to each fixture.

> **Note:** Red wire may be substituted for White wire in DC circuits to reduce confusion between AC and DC circuits. Red wire will then be connected to the white lead wire on pigtail.

2. For +12 VDC systems, cable may be installed directly into saw cut **(typically 3 inch depth x 1/2 inch wide),** instead of running it through a conduit. Cable should be stacked into the saw cut, held down to the bottom using a backing rod and sealed using **Bondo P606** or equivalent sealing compound. If using conduit pull cable through conduit. **Ensure that all wiring conforms to NEC, State, Local and other applicable codes.**

3. Make a parallel circuit with **3M** or similar waterproof splice kits. At each fixture, using TSC's Part# CO-1051903021 connector, connect the BLACK pigtail lead to the BLACK **#12 AWG wire** and connect them WHITE pigtail lead to the WHITE **#12 AWG wire**. The use of drip-loops is recommended. Check the integrity of the splices to make sure that there are no shorts.

> **Note:** Before inserting fixtures into sockets, test each fixture using the test fixture socket and power plug cable supplied. The power plug plugs into any standard 12 volt car accessory socket. Each fixture is tested by inserting its connecting plug into the tester socket.

H. Fixture Plug to Connector Socket Assembly

1. Test each fixture using the fixture test cable supplied before inserting fixture plug into connector socket.

2. Using electrician's tape, make three wraps around the plug-socket assembly.

3. Prior to bolting down the fixtures, coat the mounting flange of each base can and bolt treads with marine grade anti-seize grease, like **Corrosion Block** or equivalent.

4. Bolt the fixtures to the base cans using the stainless steel bolts provided.

5. Fill-in both the area between the fixture and base can wall and the area in the bolt well, with a silicon sealant such as **RTV silicon sealant,** or equivalent.

Section 3 – Activation Device Installation

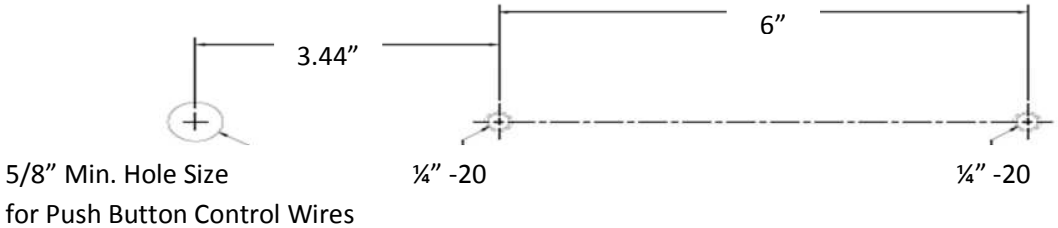
A. Push Button Activation Option

There are different pedestrian push-button models that may be shipped with the system. The specific model is determined by the requirements of the project. All models are fault resistant, preventing them from locking-up in a mode that forces the system to run indefinitely. Some projects will be equipped with audible buttons that are capable of playing an audio caution message to pedestrians when the system is activated. In some cases the pedestrian push-button assembly will include a microphone in one or more of the units to allow for ambient noise compensation (dynamic volume control) of the audio output. Pedestrian push-button frames may also be equipped with embedded LED lamps that flash in sync with the in-pavement lights when the system is activated. Push-buttons are typically installed so that they are compliant with ADA requirements. Typically the pedestrian push-button is mounted with the center of the push-button between 39" to 44" above grade. If the enclosure is mounted with its bottom at 30" above grade, the center of the push-button can be positioned at approximately 41.5" above grade, which is within the ADA height range requirement. The following sections cover the installation and wiring for the various push-button models. Installation of the push-button assembly is best done during installation of the system controller enclosure on the pole.

B. Model AC-BDL3 and AC-XAV2E-LED Push Button Installation

Use the mounting hole diagram in Figure 1 to drill and tap the pole for the push button station (PBS). The maximum recommended distance from the ground to the center of the push button is 39 inches. Less than 39 inches is acceptable. The PBS comes with the button arrow pointing in a certain direction. The button arrow can be made to point left, right, or up, depending on the location of the PBS on the pole. The arrow should always point through the crosswalk. For example, if you stand facing the button and the crosswalk is on your left, the arrow should point to the left. If the crosswalk is directly in front of you, the arrow should point up. If the crosswalk is on the right, the arrow should point to the right. Remove the sign from the PBS by removing the four attachment screws. If the arrow direction is correct, there is no need to open the unit. If the arrow needs to be changed, remove the 6 cover screws and carefully bring the cover to approximately 60° which frees the bottom hinge, then remove the cover. Place the cover on a flat surface with the backside facing you (see Figure 2). To change the arrow direction, loosen the 4 screws holding the diaphragm 1-2 turns each. Press on the front of the button and turn it counter-clockwise until it pops out. Orient the arrow in the desired direction then replace the diaphragm so each tab sits in its pocket with a corner under each screw head. Tighten each screw making sure the diaphragm is not pinched between the screw and cover. The screw head is intended to keep each tab in its pocket. The screw must not bind the tab preventing it from moving freely. Reinstall cover and six screws. Be careful not to drop the cover and break the hinge.

Figure 1 –AC-BDL3 and AC-XAV2E-LED Mounting Hole Diagram



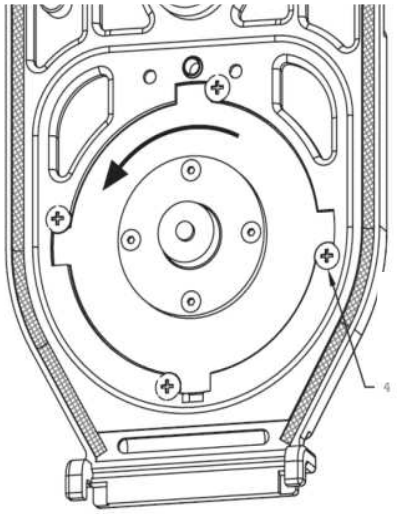
Section 3 – Activation Device Installation

B. Model AC-BDL3 and AC-XAV2E-LED Push Button Installation

Route the switch wires out the lowest drilled hole and connect to the two middle screws of the terminal block on the rear of the PBS. The connection has no polarity. Attach the PBS to the pole using the supplied ¼-20 bolts and washers. Re-attach the sign as shown in the sketch.

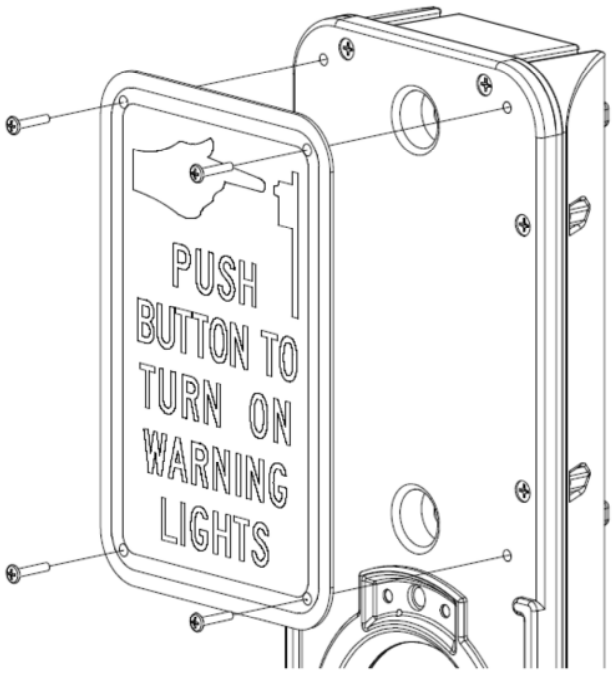
Figure 2 – Arrow Adjustment

Turn while lightly pressing on push button from the other side to remove



Four Screws holding diaphragm

Figure 3 – Front Sign Removal



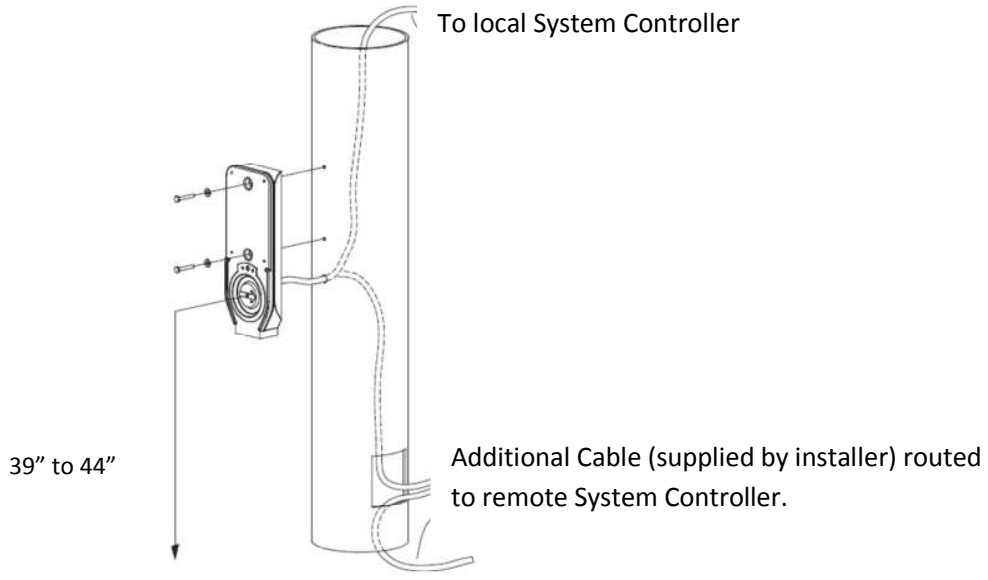
Section 3 – Activation Device Installation

B. Model AC-BDL3 and AC-XAV2E-LED Push Button Installation

The model AC-BLD3 push button with LED uses two-conductor cabling between the PBS and controller (polarity independent). Any 18 AWG conductor cable suitable for direct burial may be used. The push button wires provide a contact closure for triggering the light controller. The controller push button input must comply with the voltage and current limits listed in the AC-BLD3 specification. The light controller must provide an output capable of flashing the LEDs and must meet the requirements listed in the AC-BLD3 specification.

The model AC-XAV2E-LED system uses 8-conductor cabling between the PBS and control unit. If the PBS and XAVCU2 are mounted on the same pole, then the PBS cable may attach directly to the XAVCU2. Otherwise additional cable is required. Any direct burial suitable cable with AWG 18 stranded conductors and matching color coding (Belden 27601A) or equivalent is recommended.

Figure 4 – Push Button Mounting



Section 3 – Activation Device Installation

B. Model AC-BDL3 and AC-XAV2E-LED Push Buttons

Figure 5 – Model AC-BDL3 Push Button

BullDog III Push-Button

BullDog III Push-Button Station

Figure 6 – Model AC-XAV2E-LED Push Button

XAV2E-LED Push-Button Station

Section 3 – Activation Device Installation

B. Model AC-BDL3 and AC-XAV2E-LED Push Button Installation

XAVCU2 Operation (Option 2)

The XAVCU2 has two LED indicators. The red PWR LED flashes once per second and indicates that the board has operating power and the on-board microcontroller is functioning. The red BUTTON LED indicates whenever a PBS button is pressed and activated.

MESSAGE REPEAT SELECTION: Dip switch positions 1 and 2 are used to select the number of message repeats when the system is activated.

Table 1 – Message Repeats

SW1	SW2	RESULT
OFF	OFF	1 REPEAT
ON	OFF	2 REPEAT
OFF	ON	3 REPEAT
ON	ON	CONTINUOUS (WHILE ACTIVE)

If any of the message repeats, 1, 2, or 3, is selected, then any button push during the flashing will restart the message count.

LOCATE TONE SELECTION: Dip switch positions 3 and 4 are used to configure the PBS locating tone.

Table 2 – Locator Tone Selection

SW3	SW4	RESULT
OFF	OFF	NO LOCATOR TONE
ON	OFF	LOCATOR TONE EVERY 2 SECONDS
OFF	ON	LOCATOR TONE EVERY THREE SECONDS
ON	ON	LOCATOR TONE EVERY FOUR SECONDS

MESSAGE SELECTION: Dip switch position 5 selects the message type.

Table 3 – Message Selection

SW5	RESULT
OFF	ENGLISH LANGUAGE ONLY
ON	ENGLISH LANGUAGE FOLLOWED BY SPANISH LANGUAGE

Section 3 – Activation Device Installation

B. Model X2/X2-LED/XAV2/XAV2-LED Push Button Installation

XAVCU2 Operation (Option 2)

Volume Control

The output volume from the XAV2 system is chosen automatically based on the ambient noise level received by the microphone. The volume can self-adjust over a wide range. The microphone sensitivity (MIC SENS) control can increase or decrease the volume change due to a change in ambient noise. MIN and MAX controls are provided for both voice message and locate tone. These adjustments restrict the volume range chosen by the microphone control. The MIN control sets the lower limit for the volume and the MAX control sets the upper limit. If both controls are set the same, or the MAX is set below the MIN, the volume will be fixed. The MAX control takes precedence over the MIN.

Troubleshooting Information:

The following are descriptions of the XAVCU2 terminals to help identify sources of trouble. PWR+ TERMINAL – This point should always have a DC voltage present. For the XAVCU2, this voltage should be 13 to 15 volts most of the time. It will typically fluctuate some if the voice message is currently playing. For XAVCU2-DC, the voltage should match the DC INPUT voltage. This voltage is measured between PWR+ and PWR-.

PWR- TERMINAL – This is the circuit ground for the AC- XAV2E system.
BTN TERMINAL – Connecting this terminal to ground (PWR-) should cause the BUTTON LED to light and cause the BUTTON OUT terminals to change to a low resistance state between them. Pressing the PBS button should cause the voltage at the BTN terminal to drop to near zero.
LED TERMINAL – This is an output from the XAVCU2 to the PBS. It's an open collector type output that connects to ground to turn on the PBS LEDs. This output should turn on the LEDs whenever the voltage is present at the LTS IN input.
MUTE TERMINAL – This is an output signal which switches the audio amplifier in the PBS between operate and standby modes. It should go to ground whenever a sound is to be played.
MIC TERMINAL – This is a low voltage signal from the PBS which represents the ambient noise level. It is generally less than 1 volt above ground and can range from 0 to 1.5 volts. It should change as the ambient noise changes.
AUD1, AUD2 – This is a balanced audio signal which provides the input signal to the audio amplifier.
FLSH COM, FLSH1, FLSH2 – Output signals for driving external flash relays. These are typically used only on the XAVCU2F.
BUTTON OUT – Solid state opto-relay contact closure while BUTN terminal is grounded.
LTS IN – Input from an external flash controller. For the XAVCU2, this signal must be present in order to trigger the voice message and also to flash the PBS LEDs.

IMPORTANT!
1. The message will not play without proper inputs from light flashing controller on "LTS IN" (Does not apply to XAVCU2F).
2. Check to see that the striped "RED/BLK" and "BLU/BLK" and non-striped "RED" and "BLUE" wires are not mixed with each other. All wires should be connected to their appropriate matching color.

Section 3 – Activation Device Installation

C. Pedestrian Crossing Pad Activation Option

AC-PEDXPAD

The AC-PEDXPAD is essentially a loop detector in a box. The mat in the middle rests on a deflection plate. When a pedestrian steps on the mat, the mat and the deflection plate both move downward. This causes a change in the inductance of the loop, which is detected by the loop detector in the system controller as a shift in the operating frequency of the loop. As a result, the loop detector generates a control signal which activates the system and causes the warning lights to begin flashing.

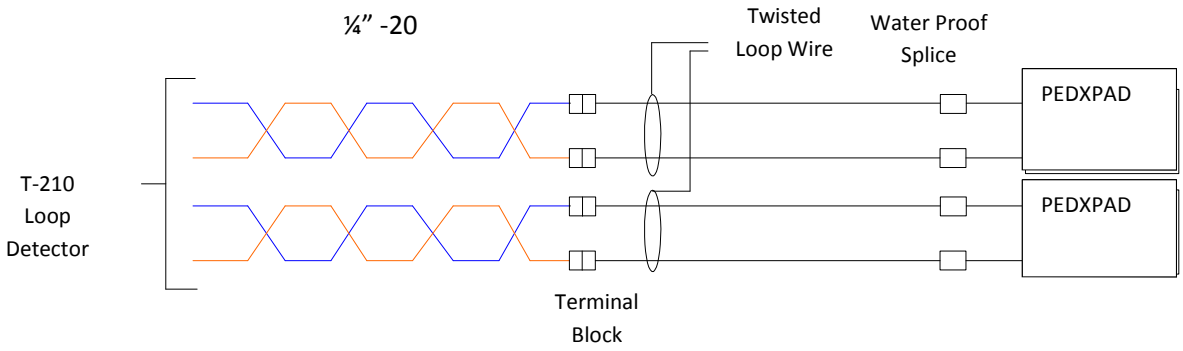
It is absolutely essential that the PEDXPAD assembly be installed according to the instructions included in its installation manual.

Failure to properly install the unit can and will lead to ongoing problems and cannot be covered under the system warranty. Connections to the mat and the lead in wire must be clean, dry and tight to ensure proper operation. Lead in wire, known as loop detector wire, is typically available as an off-the-shelf item from many traffic equipment dealers. Typically the wiring going to the PEDXPAD Loop Assembly will need to be twisted to minimize any electrical noise from surrounding sources. Figure 5 shows a wiring diagram for reference.

T-210 Loop Detector

All wiring from the PEDXPADs is connected to either channel one or channel two of the T-210 loop detector. Typically, the PEDXPADs on each side of the crosswalk are connected to a separate channel on the T-210 dual channel loop detector. During setup, the sensitivity of each channel of the loop detector is adjusted for proper activation from each side of the crosswalk (see operating instructions for the T-210 Loop detector). If multiple pads are use on a crosswalk side, the pads are connected in series and then connected to a single channel. It's not uncommon for a second round of adjustments after the concrete has completely cured (typically after a week). **Note:** If the PEDXPADS are not connected, the Loop detector will detect an open circuit (fault condition). An open circuit fault condition will generate a continuous activation signal, which in turn will continually activate the system and cause all lights to flash continuously until the fault is removed.

Figure 7 – Typical system wiring for the AC-PEDXPAD



Section 3 – Activation Device Installation

C. Pedestrian Crossing Pad Activation Option

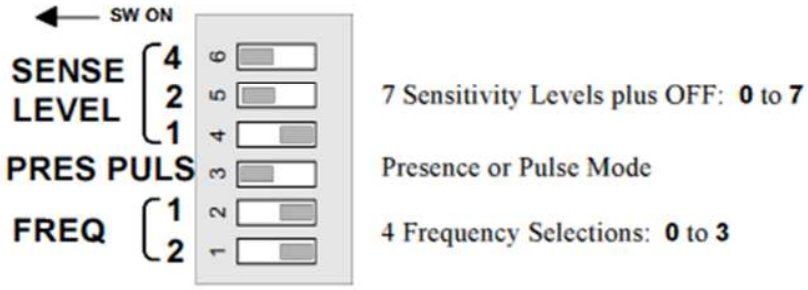
T210-Opeartion:

The Model T-210 is a scanning, two-channel, shelf mount loop detector with Delay and Extension timing. Once the detector is connected to an appropriately wired harness, it will begin to operate. The detector automatically tunes itself and is operational within two seconds after application of power or after being reset. Full sensitivity and hold time require approximately 30 seconds of operation. The detector is fully self-compensating for environmental changes and loop drift over the full temperature range and the entire loop inductance range. The Model T-210 is available with solid state or relay outputs. The operation of each channel is independent and is programmed using one of two, front panel mounted, six-position DIP switches. Each channel has a single, dual color (green / red) Detect / Fail LED indicator. The LED provides an indication of the channel's output state and loop failure conditions. OUTPUT STATE conditions are indicated when the Detect / Fail LED are illuminated in a green state. LOOP FAILURE conditions are indicated when the Detect / Fail LED is illuminated in a red state. The Model T-210 also has a TEST mode that verifies proper operation of the outputs, LED indicators, DIP switches, and loop-oscillator circuitry.

T210-Operating Controls:

Front Panel Mounted Programming DIP Switches: The two, six-position DIP switches located on the front panel that are labeled 1, and 2 affect each channel independently. To turn one of these DIP switches ON, push the switch to the left.

Figure 8 – Control DIP Switches



Frequency (FREQ) (DIP Switches 1 and 2): Each channel of the Model T-210 detector has four (4) frequency selections that allow altering the resonant frequency of the loop circuit. DIP switches 1 and 2 are used to select the frequency for a given channel. The values (1 and 2) to the left of the DIP switches are assigned to the switch when the switch is ON. If the switch is OFF, the switch has a value of zero (0). By adding the switch ON and OFF values, the two switches will combine for values from 0 to 3 that indicate one of the four Frequency selections. The following table is a reference for the switch settings and associated frequency selections.

Reset: To reset the detector, press the pushbutton labeled RESET. Changing the position of any of an individual channel's front panel mounted programming DIP switches (except the Frequency switches) resets the channel. The detector can also be reset by the reapplication of power after a power loss. Changes made to any of the Delay and/or Extension Timing DIP switches do not reset the detector.

Section 3 – Activation Device Installation

C. Pedestrian Crossing Pad Activation Option

Detect / Fail Indicators: The Model T-210 detector has a single two color (green / red) light emitting diode (LED) per channel to indicate a CALL output and/or the status of any current or prior loop failure conditions. A continuous ON (green) state indicates a CALL output. A continuous ON (red) state indicates that a current open loop failure condition or an inductance change condition of greater than +25% exists. This indication also generates a CALL output. A one Hz (red) flash rate indicates that a current shorted loop failure condition or an inductance change condition of greater than -25% exists. This indication also generates a CALL output. A flash rate of three 50 millisecond (red) flashes per second indicates a prior loop failure condition. A flash rate of three 50 millisecond (red) flashes per second followed by a single 750 millisecond (green) flash indicates a prior loop failure condition and a current CALL output (detect state). If either channel has Delay and/or Extension Timing set, that channel's Detect / Fail LED will display one (or both) of two unique flash sequences [four flashes (green) per second - Delay Timing set; 16 flashes (green) per second - Extension Timing set], thus providing an alert that the channel has Delay and/or Extension Timing set and the feature is active. If either channel has the audible detect feature activated, that channel's Detect / Fail LED will be illuminated in an orange state for any CALL output condition.

Table 4 – Indicator Descriptions

Detect / Fail LED	Meaning
Off	No Detect (No CALL Output)
Solid ON (Green)	Detect (CALL Output)
Solid ON (Orange)	Audible Detect Signal Activated, Detect (CALL Output)
Four flashes per second (Green)	Vehicle detected, Delay Timing active, No Detect (No CALL Output)
Four flashes per second (Orange)	Audible Detect Signal Activated, Vehicle detected, Delay Timing active, No Detect (No CALL Output)
16 flashes per second (Green)	Detection zone vacant, Extension Timing active, Detect (CALL Output)
Solid ON (Red)	Open Loop Failure or Inductance change condition of greater than +25% exists
One Hz flash rate (Red) (50% Duty Cycle)	Shorted Loop Failure or Inductance change condition of greater than -25% exists
Three 50 ms (Red) flashes per second	Loop Failure condition occurred but no longer exists
Three 50 ms (Red) flashes per second followed by a single 750 ms (Green) flash	Loop Failure condition occurred but no longer exists and Detect (CALL Output)
Three 50 ms (Red) flashes per second followed by a single 750 ms (Orange) flash	Loop Failure condition occurred but no longer exists, Audible Detect Signal Activated and Detect (CALL Output)
Three 50 ms (Red) flashes per second followed by four flashes per second (Green)	Loop Failure condition occurred but no longer exists and Vehicle detected, Delay Timing active, No Detect (No CALL Output)
Three 50 ms (Red) flashes per second followed by four flashes per second (Orange)	Loop Failure condition occurred but no longer exists, Audible Detect Signal Activated and Vehicle detected, Delay Timing active, No Detect (No CALL Output)
Three 50 ms (Red) flashes per second followed by 16 flashes per second (Green)	Loop Failure condition occurred but no longer exists and Detection zone vacant, Extension Timing active, Detect (CALL Output)

Section 3 – Activation Device Installation

C. Pedestrian Crossing Pad Activation Option

CALL EXTENSION (EXTEND) (DIP switches 1, 2, 3, 4, 5, and 6): The two, twelve-position DIP switches labeled CHAN 1 and CHAN 2 located on the front panel are used to program Call Delay and/or Call Extension. To turn any of these DIP switches ON, push the switch to the left. CALL EXTENSION (EXTEND) (DIP switches 1, 2, 3, 4, 5, and 6): Engineering Excellence! DIP switches 1, 2, 3, 4, 5, and 6 are used to control the amount of time a CALL output is extended. The values ¼, ½, 1, 2, 4, and 8 that appear to the left of the DIP switches are assigned to a DIP switch when it is turned ON. When a DIP switch is turned OFF, its value is 0. By adding the values of each DIP switch that is turned ON, effective values of 0 to 15.75 can be achieved indicating the amount of Extension time (in seconds) that has been selected for the channel. The factory default setting of all of these switches is OFF (no Extension time programmed). The following table contains examples of switch selections and Extension time settings.

Table 5 - Call Extension Timing

SWITCH						SWITCH VALUES (EXTENSION TIME PROGRAMMED)
1 (¼ Sec)	2 (½ Sec)	3 (1 Sec)	4 (2 Sec)	5 (4 Sec)	6 (8 Sec)	
OFF	OFF	OFF	OFF	OFF	OFF	0 + 0 + 0 + 0 + 0 + 0 = **0.00**
ON	OFF	OFF	OFF	OFF	OFF	¼ + 0 + 0 + 0 + 0 + 0 = **0.25**
OFF	ON	OFF	OFF	OFF	OFF	0 + ½ + 0 + 0 + 0 + 0 = **0.50**
OFF	ON	OFF	ON	OFF	OFF	0 + ½ + 0 + 2 + 0 + 0 = **2.50**
OFF	OFF	ON	OFF	ON	OFF	0 + 0 + 1 + 0 + 4 + 0 = **5.00**
ON	OFF	ON	OFF	ON	OFF	¼ + 0 + 1 + 0 + 4 + 0 = **5.25**
OFF	ON	OFF	ON	OFF	ON	0 + ½ + 0 + 2 + 0 + 8 = **10.50**
ON	ON	ON	ON	ON	ON	¼ + ½ + 1 + 2 + 4 + 8 = **15.75**

CALL DELAY (DELAY) (DIP switches 7, 8, 9, 10, 11, and 12): DIP switches 7, 8, 9, 10, 11, and 12 are used to control the amount of time a CALL output is delayed. The values 1, 2, 4, 8, 16, and 32 that appear to the left of the DIP switches are assigned to a DIP switch when it is turned ON. When a DIP switch is turned OFF, its value is 0. By adding the values of each DIP switch that is turned ON, effective values of 0 to 63 can be achieved indicating the amount of Delay time (in seconds) that has been selected for the channel. The factory default setting of all of these switches is OFF (no Delay time programmed). The following table contains examples of switch selections and Delay time settings.

Section 3 – Activation Device Installation

C. Pedestrian Crossing Pad Activation Option

Table 6 – Call Delay Timing

SWITCH						SWITCH VALUES (DELAY TIME PROGRAMMED)
7 (1 Sec)	8 (2 Sec)	9 (4 Sec)	10 (8 Sec)	11 (16 Sec)	12 (32 Sec)	
OFF	OFF	OFF	OFF	OFF	OFF	0 + 0 + 0 + 0 + 0 + 0 = **0**
ON	OFF	OFF	OFF	OFF	OFF	1 + 0 + 0 + 0 + 0 + 0 = **1**
OFF	ON	OFF	OFF	OFF	OFF	0 + 2 + 0 + 0 + 0 + 0 = **2**
OFF	ON	OFF	ON	OFF	OFF	0 + 2 + 0 + 8 + 0 + 0 = **10**
OFF	OFF	ON	OFF	ON	OFF	0 + 0 + 4 + 0 + 16 + 0 = **20**
ON	OFF	ON	OFF	ON	OFF	1 + 0 + 4 + 0 + 16 + 0 = **21**
OFF	ON	OFF	ON	OFF	ON	0 + 2 + 0 + 8 + 0 + 32 = **42**
ON	ON	ON	ON	ON	ON	1 + 2 + 4 + 8 + 16 + 32 = **63**

NOTE: After changing any frequency switch setting(s), it is necessary to reset the detector by momentarily changing one of the other switch positions.

Table 7 –Frequency Settings

Frequency	Switch 2	Switch 1	Effective Value
HI *	OFF *	OFF *	0 + 0 = **0** *
MED HI	ON	OFF	1 + 0 = **1**
MED LO	OFF	ON	0 + 2 = **2**
LO	ON	ON	1 + 2 = **3**

* Factory default setting.

Presence / Pulse Mode (PRES PULS) (DIP Switch 3): DIP switch 3 controls the output mode of each channel.

PRESENCE (PRES): When the switch is in the ON position, Presence Mode is selected. Presence Mode provides a Call hold time of at least four minutes (regardless of vehicle size) and typically one to three hours for an automobile or truck. This is the factory default setting and the most common setting.

PULSE (PULS): When the switch is in the OFF position, Pulse Mode is selected. Pulse Mode will generate a single 125 millisecond pulse output for each vehicle entering the loop detection zone. Any vehicle remaining in the loop detection zone longer than two seconds will be tuned out providing full sensitivity for the vacant portion of the loop detection zone. Full sensitivity for the entire loop detection zone is recovered within one second following the departure of any vehicle that has occupied the loop detection zone longer than two seconds.

Section 3 – Activation Device Installation

C. Pedestrian Crossing Pad Activation Option

Sensitivity (SENSE LEVEL) (DIP Switches) (DIP Switches 4, 5, and 6): There are seven (7) selectable sensitivity levels, plus an OFF for each channel. The seven sensitivity levels and the OFF setting are selected via DIP switches 4, 5, and 6 on each of the two front panel mounted six-position DIP switches. The values (1, 2, and 4) to the left of the DIP switches are assigned to the switch when the will combine for values from 0 to 7 that indicate OFF or one of the seven Sensitivity Level selections. The following table is a reference for the switch settings and associated sensitivity selections.

NOTE: Changing the sensitivity level setting will RESET the detector channel.

Table 8 – Sensitivity Settings

Sense Level	-ΔL/L	Switch 4	Switch 5	Switch 6	Effective Value
0 (OFF)	OFF	OFF	OFF	OFF	0 + 0 + 0 = 0
1	0.64%	ON	OFF	OFF	1 + 0 + 0 = 1
2	0.32%	OFF	ON	OFF	0 + 2 + 0 = 2
3	0.16%	ON	ON	OFF	1 + 2 + 0 = 3
4	0.08%	OFF	OFF	ON	0 + 0 + 4 = 4
5	0.04%	ON	OFF	ON	1 + 0 + 4 = 5
6 *	0.02% *	OFF *	ON *	ON *	0 + 2 + 4 = 6 *
7	0.01%	ON	ON	ON	1 + 2 + 4 = 7

*** Factory default setting.**

Front Panel Mounted Pushbutton - Detector Reset: A front panel mounted pushbutton labeled RESET is used to reset the detector. To reset the detector, press the pushbutton. iii. Front Panel Mounted Pushbutton - Audible Detect

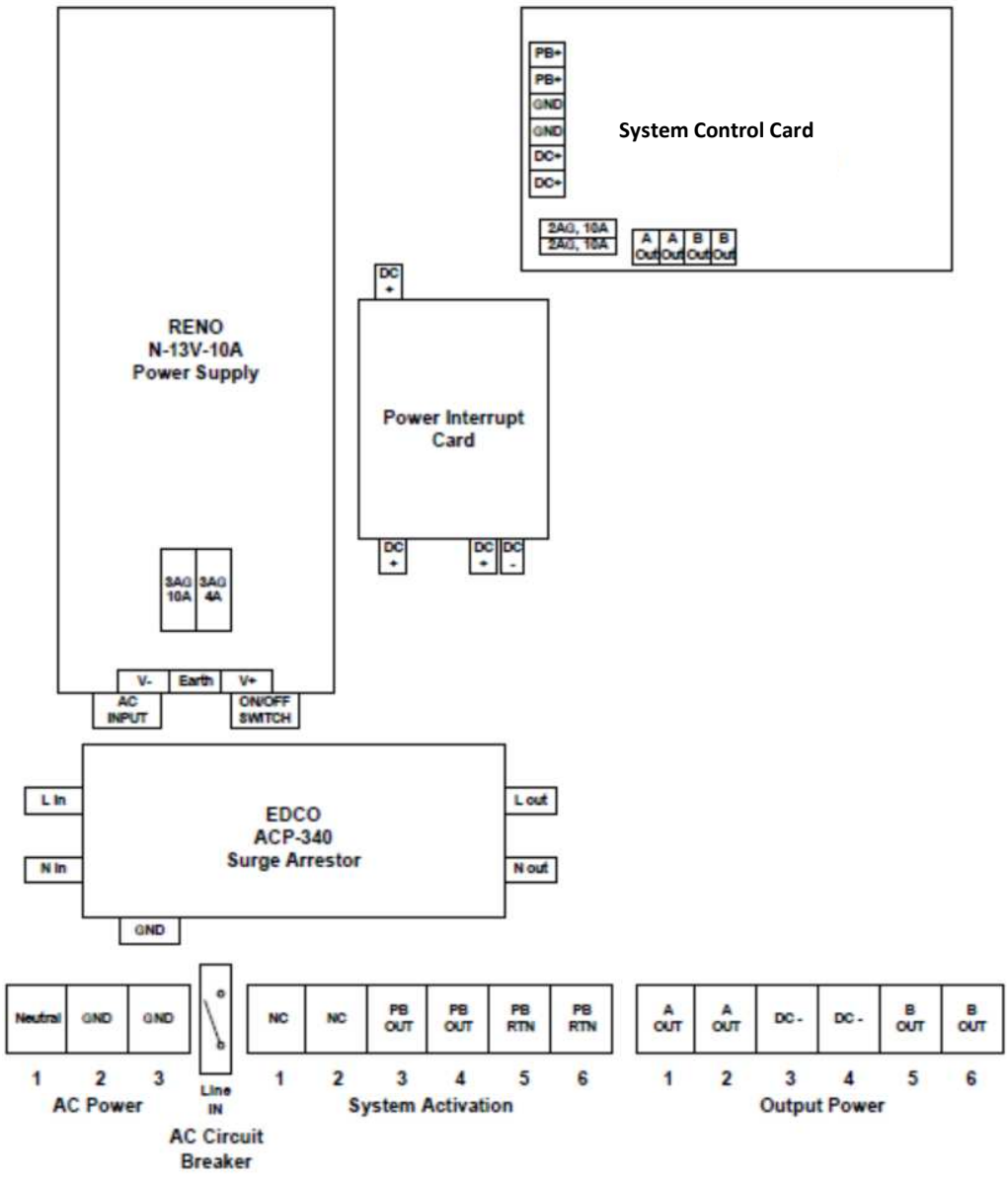
Buzzer: A front panel mounted pushbutton labeled BUZZER is used to enable an audible detect signal that is emitted any time a given channel's detection zone is occupied. To activate this feature, press the pushbutton. Only one channel can have this feature active at any given time. The first time the pushbutton is pressed, a short (50 millisecond) audible signal confirms the activation of the feature for Channel 1. The second time the pushbutton is pressed, two short (50 millisecond) audible signals confirm the activation of the feature for Channel 2. To deactivate this feature, press and hold the pushbutton for one second. A long (250 millisecond) audible signal confirms the deactivation of the feature. This feature will automatically turn off 15 minutes after activation. NOTE: When operating in Pulse mode, the audible detect signal will cease if a vehicle occupies the detection zone for more than two seconds.

Section 4 – System Controller

A. Control Panel Layouts and Wiring Diagrams

A number of versions of the solar powered system controller are available. Options include: Option 1 – Support for a BDL3 Type Push Button, Option 2 – Support for an XAV2E Type Push Button, Option 3 Support for a Pedestrian Crossing Pad, and Option 4 – Support for both a Pedestrian Crossing Pad and BDL3 Type Push Button. Each builds on the core system (Option 1), composed of the main back panel. The main back panel, shown in Figure 1, includes the system controller card, circuit breakers, terminal blocks and a solar charge and load controller. All of these items are mounted on a removable panel assembly for easy repair or upgrades. Figure 2 shows the show the electrical wiring diagram for the back panel (Option 1). All field wiring connections for warning devices, activation devices, and the solar panel are routed through the back of the enclosure through the knockouts provided. All field wiring connections are made directly to the panel terminal blocks provided. Other system options are shown in Figures 3-6.

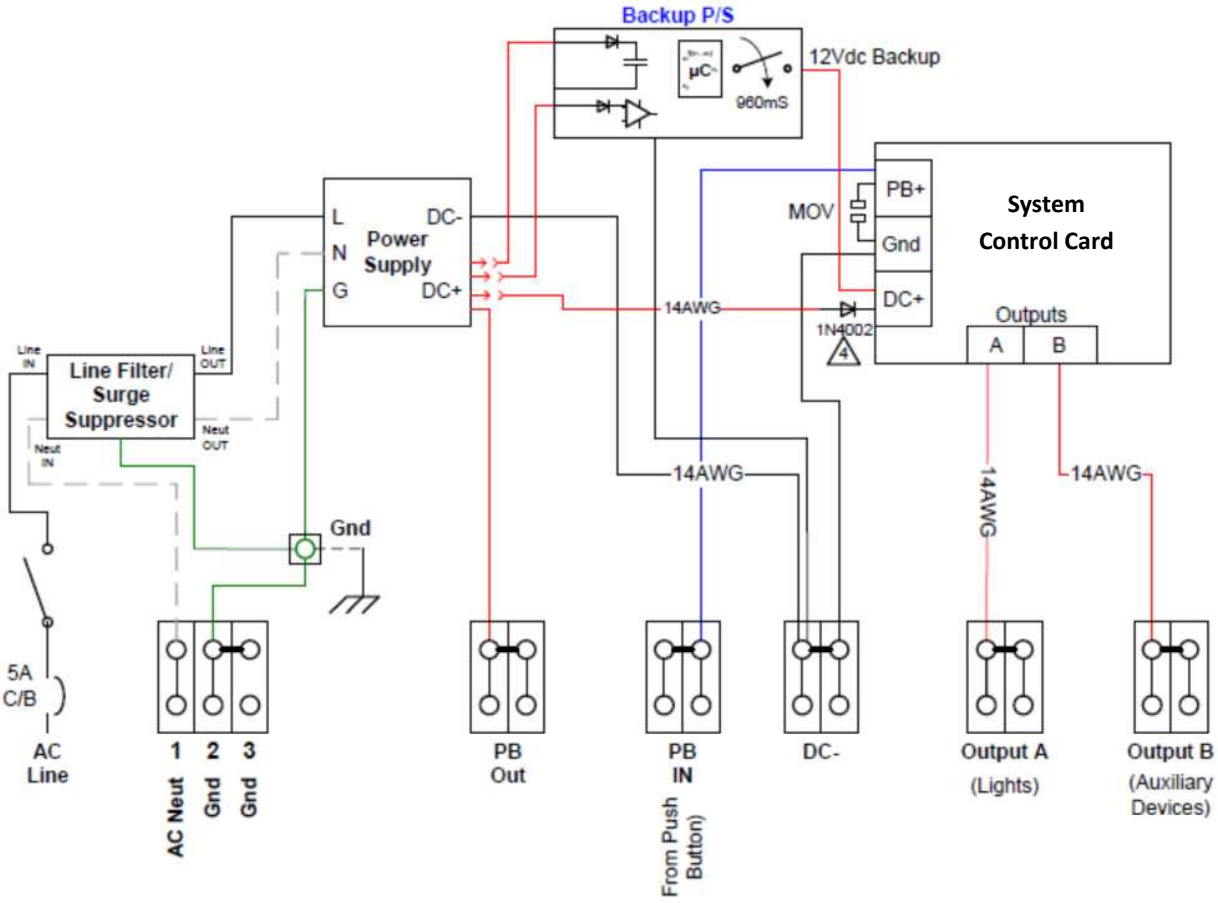
Figure 1 – Main Back Panel Component Layout (Option 1)



Section 4 – System Controller

A. Control Panel Layouts and Wiring Diagrams

Figure 2 – Main Back Panel Wiring (Option 1)



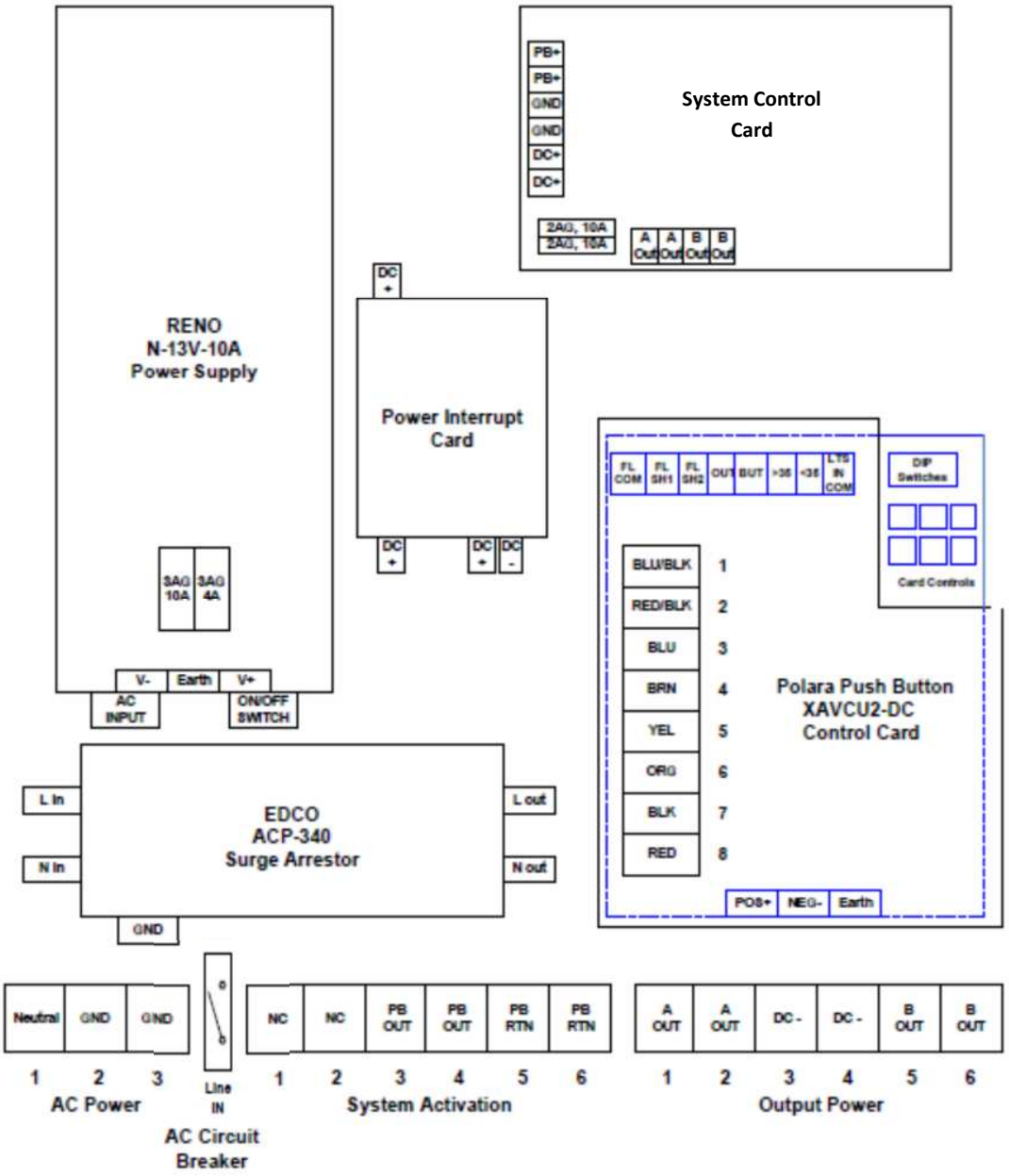
NOTE:

1. All interconnect wires shall be Teflon, rated for 105°C minimum.
2. AC wiring is 14AWG, DC is 18AWG unless otherwise noted.
3. Dashed lines indicate white wires or terminal blocks.
4. The diode must be enclosed by heat shrink tubing.

Section 4 – System Controller

A. Control Panel Layouts and Wiring Diagrams

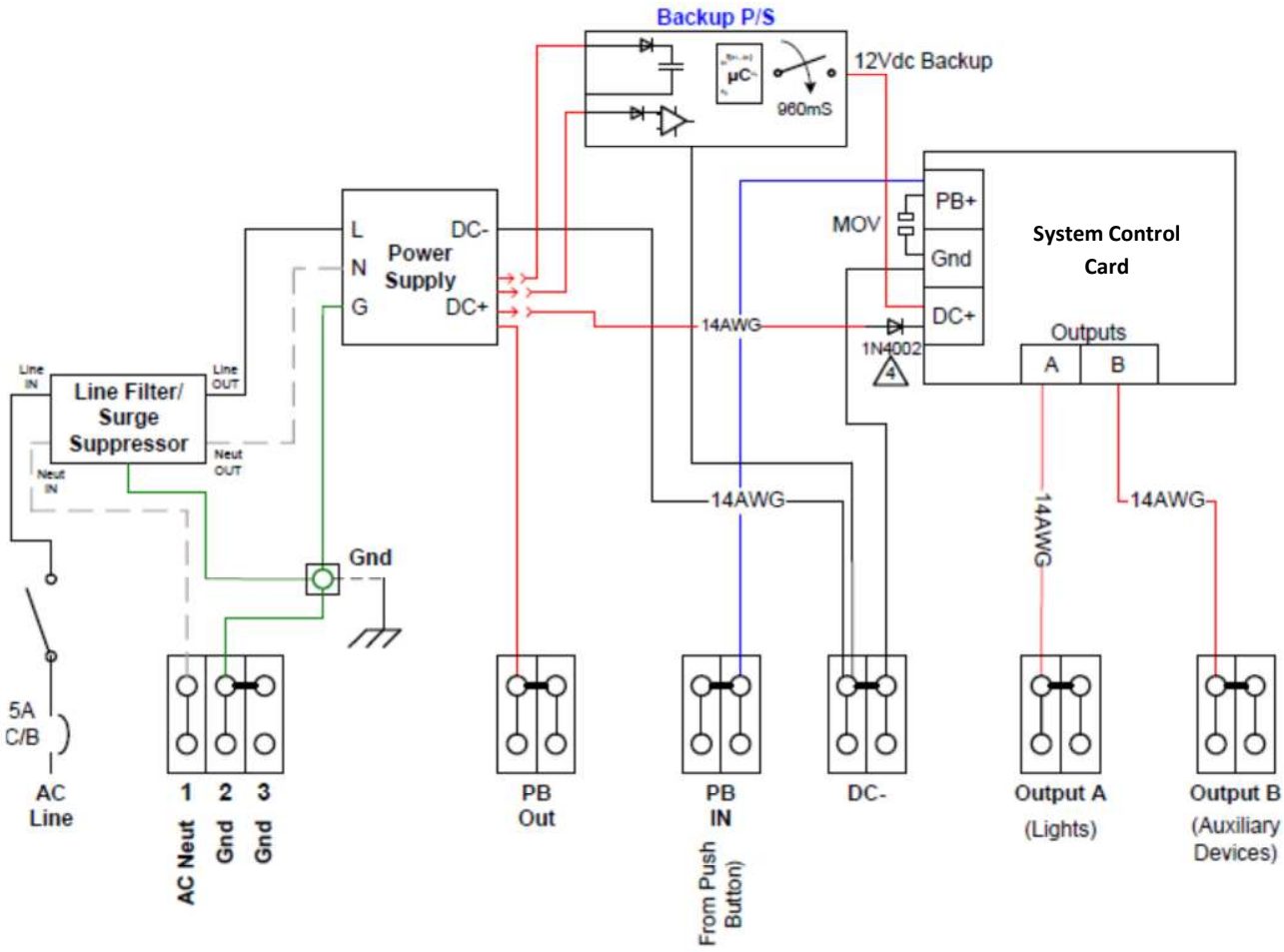
Figure 3 – Main Back Panel Component Layout (Option 2)



Section 4 – System Controller

A. Control Panel Layouts and Wiring Diagrams

Figure 4 – Back Panel Wiring (Option 2)



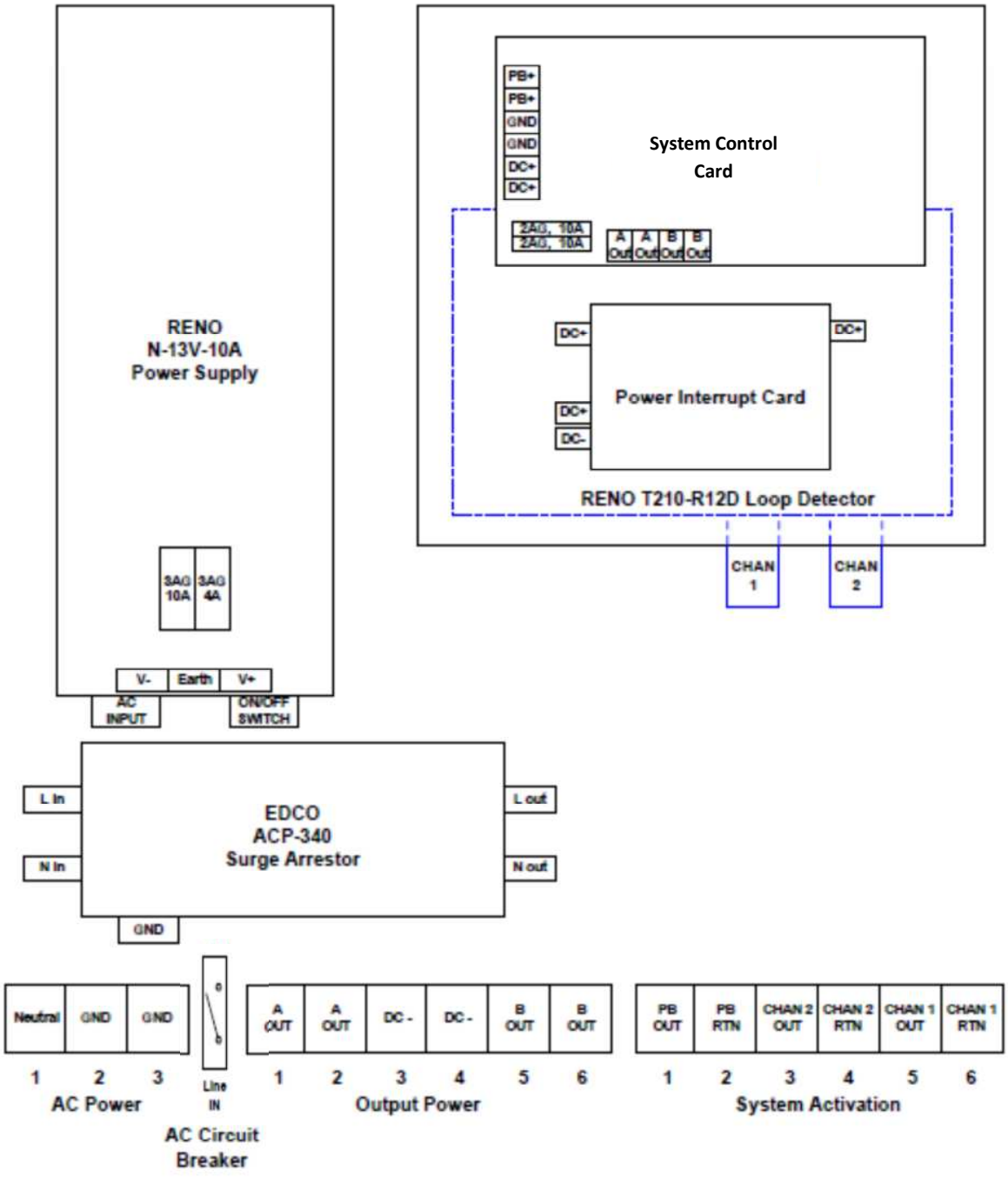
NOTE:

1. All interconnect wires shall be Teflon, rated for 105°C minimum.
2. AC wiring is 14AWG, DC is 18AWG unless otherwise noted.
3. Dashed lines indicate white wires or terminal blocks.
4. The diode must be enclosed by heat shrink tubing.

Section 4 – System Controller

A. Control Panel Layouts and Wiring Diagrams

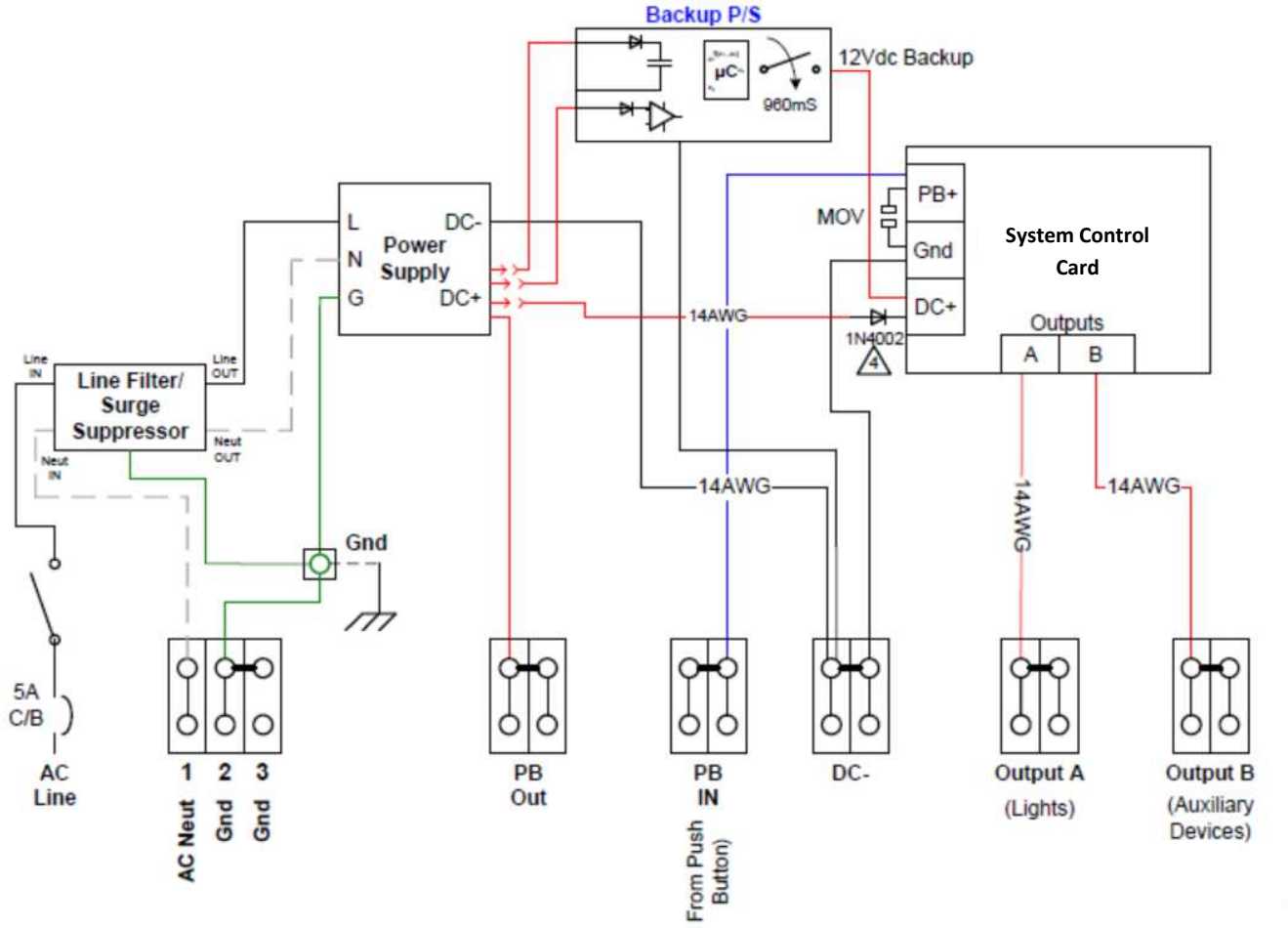
Figure 5 – Main Back Panel Component Layout (Options 3 and 4)



Section 4 – System Controller

A. Control Panel Layouts and Wiring Diagrams

Figure 6 – Main Back Panel Wiring (Option 3 and 4)



NOTE:

1. All interconnect wires shall be Teflon, rated for 105°C minimum.
2. AC wiring is 14AWG, DC is 18AWG unless otherwise noted.
3. Dashed lines indicate white wires or terminal blocks.
4. The diode must be enclosed by heat shrink tubing.

Section 4 – System Controller

B. Controller External (Street) Wiring

1. Mount control system in its proper location, as specified in the design plans.

2. Set the circuit breaker to the OFF position.

> **Caution:** Always ensure the system circuit breaker is in the OFF position before servicing the system wiring.

3. Connect the ground wire (green) to AC Input Ground terminal. Connect the neutral wire to the AC neutral terminal and the line wire to the AC circuit breaker input.

> **Note:** To provide maximum protection from surges, ensure that the system ground rod is tested and provides less than 25 ohms to ground resistance.

4. Before connecting any loads to the controller, set the circuit breaker to the ON position and power up the controller. Verify that system control board powers up and all indicators appear normal. Press the Activation Call Button on the control board to check for proper system response. If all is well, set the circuit breaker to the OFF position and proceed to the next step.

5. Connect the fixture street wire (positive) to the Output A terminal. Connect the return wire to the DC Return (DC-).

> **Note:** Power output is limited to 120 Watt maximum on Output A or Output B, and the combined output of A and B is limited to 120 Watts.

6. Connect the sign street wire (positive) to the Output B terminal. Connect the return wire to the DC Return (DC-).

7. If using an AC-BDL3 push-button with LED, use the connection instructions below:

Push-button Cabling Jacket Color	**Terminal Block Connection**
Connection 1	PB-Out
Coinnection 2	PB-in

Section 4 – System Controller

B. Controller External (Street) Wiring

8. If using an AC-XAV2E-LED Push-button, connections are made to the push-button interface card terminals located on the upper back panel. Direct burial, 8 conductor, 18 AWG stranded wire is recommended (Beldon 27601A).

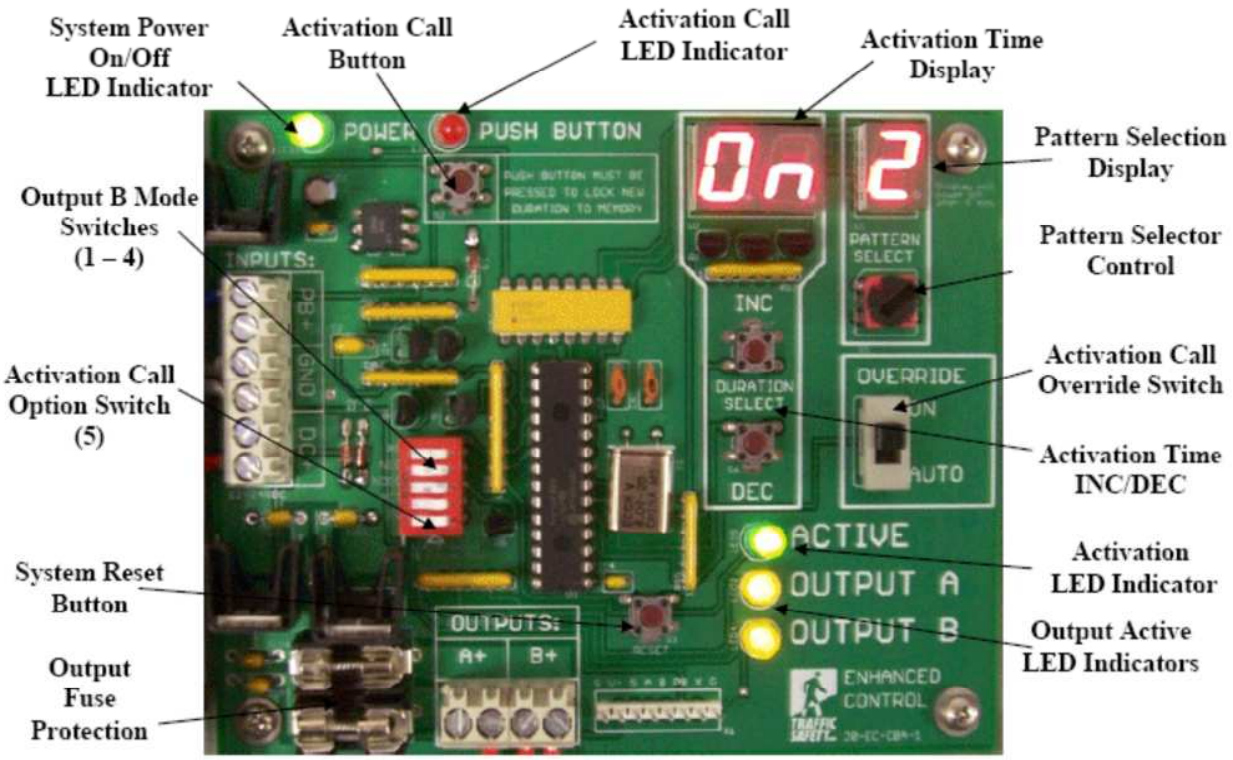
9. If using PEDXPADs are used connect each side of the crosswalk to a separate channel of the loop card. The loop detector terminals are located on the upper back panel. Loop wire is generally use. Direct burial, 18 AWG, twisted loop wire is recommended. Where multiple pads are used on each side of the crosswalk the pads on each side are generally connected in series and routed to a single channel input.

10. Ensure all wiring conforms to all federal, state, and local codes.

11. Set the circuit breaker to ON position, setup the controller card suing the instructions in the following sections, and test the system operation using the external activation devices.

C. Control Card Description

Figure 11 - System Control Card Layout



Section 4 – System Controller

C. Control Card Description

Description of the System Control Card Controls, LED Displays, and Indicators

1. **Pattern Selector – Flash pattern is selected by ten position pattern selector switch.**
   a. Position 0: 50 FPM Solid Flash Pattern (standard MUTCD flash pattern)
   b. Position 1: 60 FPM Solid Flash Pattern (standard MUTCD flash pattern)
   c. Position 2 – 8: Enhanced Flash Patterns (solid flash period is broken into a series of pulses)
   d. Position 9: Sequences through each enhanced flash pattern, changing pattern each activation period.

2. **Pattern Selection Display**
   a. Displays selected pattern option number (1 – 9).

3. **Activation Time INC/DEC**
   a. Used to set activation time period. Activation time may be increased or decreased in one second increments over a range of one second to ninety-nine seconds.

4. **Activation Time Display**
   a. Displays, digitally, the activation time in seconds over the range of from one to ninety-nine seconds.
   b. Pattern and time displays will dim after 5 minutes of inactivity to conserve power.

5. **Output B Mode Switches**
   Output B pattern output is selected by the top four slide switches. Note: C = CLOSED, O = OPEN
   a. Switch 1 (1=C, 2=O, 3=O, 4=O): Same flash period and pattern as Output A.
   b. Switch 2 (1=O, 2=C, 3=O, 4=O): Same flash period as Output A, but pattern is solid
   c. Switch 3 (1=O, 2=O, 3=C, 4=O): Same flash period as Output A, but complementary duty cycle. Pattern is non-enhanced (solid pattern).
   d. Switch 4 (1=O, 2=O, 3=O, 4=C): Output B always active while Output A is flashing.
   e. Switch 1-4 (1=O, 2=O, 3=O, 4=O): Output B always inactive

> **Caution:** Only one slide switch may be positioned in the CLOSED position at any given time. Having more than one switch positioned in the CLOSED position will result in improper system operation.

6. **Activation Call Option Switch**
   a. Activation call option is selected by the bottom slide switch, Switch #5. When closed, allows activation period to be reset by activation call. When open, ignores activation calls during the activation period (does not reset and begin a new activation cycle).

7. **Activation Call Override Switch**
   a. When switch is in AUTO position (normal operation), allows activation call to initiate activation period.
   b. When switch is in ON position, allows continuous flashing during periods of continuous pedestrian traffic (activation calls are not required to activate system).

Section 4 – System Controller

C. Control Card Description

Description of the System Control Card Controls, LED Displays, and Indicators

8. System Power On/Off LED Indicator
   a. LED on when power is applied to the system.

9. Activation Call Button
   a. Sends activation call to initiate activation flash period.

10. Activation Call LED Indicator
   a. Flashes when activation call is sent from activation call button.

11. Activation LED Indicator
   a. LED indicator is on during activation period.

12. Output Active LED Indicators
   a. Indicate the flash pattern being sent to Output A and Output B.

13. System Reset
   a. Resets the control card system program.

D. Control Card Set-up (Typical Configuration)

1. Refer to design engineer's set-up requirements for the installation.

2. Set desired pattern using the Pattern Selection Control and Display (Typically in position 9).

3. Set activation period using the INC/DEC push-buttons and Activation Time Display (Typically 20 to 30 Seconds for a two lane crosswalk).

4. Set the Output B mode using the four Output B Mode Switches, Typically set to OOCO, (B- timing below).

5. Set the activation call option using the Activation Call Option Switch (Typically set to C).

6. Set the activation call override switch to auto, for normal mode, or on for continuous flashing mode (Typically set to Auto).

7. System should now be ready for final testing. Press the Activation Call Button to send a call and monitor the fixtures and other warning devices for proper operation.

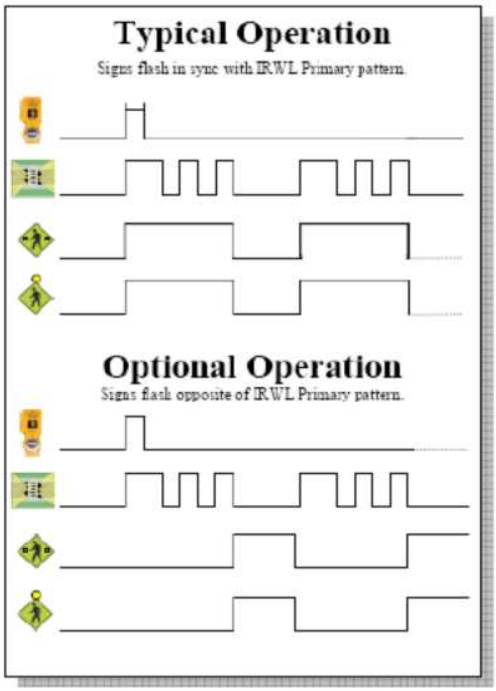
Section 4 – System Controller

E. Control Card Output Timing (Typical Configuration)

Figure 12 – Output Timing Diagram

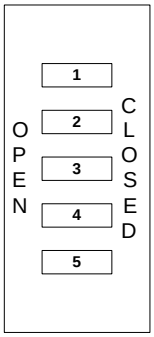
A – System set-up to flash outputs in sync with enhanced pattern applied to fixtures and standard MUTCD pattern applied to pre-warning devices.

B – System set-up to flash with outputs in complementary flashing mode, enhanced pattern applied to fixtures and standard MUTCD pattern applied to pre-warning devices.



F. Control Card Configuration Switch Settings

Figure 13 - System Configuration Switch Settings

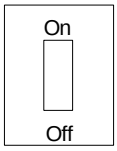


Output B Mode Switches

1	2	3	4	Output B
O	O	O	O	No Output (Inactive)
C	O	O	O	Same Pattern as Output A
O	C	O	O	Same Pattern as Output A, but Non-enhanced
O	O	C	O	Complementary to Output A, but Non-enhanced
O	O	O	C	Output High (Steady Burn) while Output A is Flashing

Activation Call Option Switch

5	
O	Ignores Activation Call During Activation Cycle
C	Activation Cycle Reset by Activation Call



Activation Call Override Switch

On Continuous Operation of System
Off **(**Auto Mode), Accepts Activation Calls

Section 5 – Maintenance

A. Fixture Housing

Fixtures are made from corrosion resistant anodized aluminum or corrosion resistant stainless steel that can withstand salt and other chemicals. Fixtures are rated to withstand static loads up to 44,000 lbs. without sustaining permanent deformation or cracking of materials. Leads and gaskets are rated to withstand up to 300 ˚F. Under normal conditions, only a minimal amount of maintenance is required. Fixtures are water proof. However, fixtures subjected to standing water in the base cans for long periods of time will eventually take in water, resulting in an electrical short and damage to the fixture. As part of a maintenance program periodically check the integrity of the base can drainage system. Any standing water should be removed immediately.

B. Base Can

Traffic Safety base cans are designed for minimum field maintenance. If properly installed, the base cans should not require any maintenance. However, standing water in the base can that is subject to cold temperatures may damage the base can, fixture and, or connectors due to repeated expansion and contraction of the water as it freezes and melts. As part of a maintenance program, base cans should be periodically checked to ensure the integrity of the drainage system. Any standing water should be removed immediately.

C. Fixture Lens

The TS400, TS500 and TS600 series fixtures all feature a self-cleaning lens design. If the fixtures are installed properly cleaning will not be required for long periods of time. If needed, lens cleaning can be done periodically using pressure or hand washing.

D. LED Lamp

The long lasting LED arrays have an estimated ten year average life expectancy under normal use. If replacement is necessary, in order to keep the fixture warranty in effect all LED lamp replacements should be serviced at the TSC facility. At our facility we complete a comprehensive inspection and evaluation of the fixture; replace the LED unit(s), replace the sealing components, gaskets and, or O-Rings; verify the seal and burn-in the LED unit(s). A process is in place to make the lamp replacement easy for our customers. Once a request is received, a refurbished replacement fixture is immediately sent out with a return tag. When the customer's fixture is received, it will be evaluated. If repairs are covered by the warranty, the customer will receive a full credit for the fixture. If repairs are not covered by the warranty, or the fixture is out of warranty, the customer will be credited for the return minus the cost of the refurbishment or repair service.

E. Control System Enclosure

The control system enclosure is NEMA 3R compliant and should offer protection from the ingress of dirt and water. As part of a standard maintenance program, the enclosure should be checked once every six months to a year to ensure the integrity of the security lock and to check for the ingress of dirt, water, and, or insects. If necessary, sweep-out the enclosure and seal-up any areas where water has entered the enclosure

Section 6 – Trouble Shooting

A. General Guidelines

- Refer to the Installation Manual for the In-pavement Warning Light system.
- Refer to the street wiring diagrams for the project.
- Start the trouble shooting procedure with knowledge of how the control card configuration switches are set (record settings).

Fault Conditions

1. System is operational, but part of the System is Non-Functional
2. Entire System is Non-Functional

B. Fault Condition 1 – System Operational, but Part of the System is Non-Functional

Possible Situations: (a) When the system is activated some of the fixtures begin flashing, but one or more fixtures do not flash. (b) When the system is activated the fixtures begin flashing, but one of the pre-warning devices does not flash. (c) One of the activation devices does not function, but the system can be activated by other activation devices in the system.

- **(a) Fixture Failure:**
  Check the non-functional fixture using the MI-AFTA-IS vehicle accessory adapter supplied with the system controller. If a fixture does not light then the problem is with the fixture itself and will need to be replaced. If the fixture lights then the problem is in the wiring to the fixture. Inspect the fixture connector and the splice from the street cabling to the fixture connector. If wiring is open or reversed the fixture will not light. Make the necessary repairs and retest.

- **(b) Pre-warning Device Failure:**
  Check to see that the control voltage is reaching the inputs of the pre-warning device, when the system is activated. If voltage is present when the system is activated then the problem is in the pre-warning device. Test the pre-warning device and repair or replace, as needed. If the control voltage signal is not present at the input terminals to the pre-warning device, then the problem may be with the wiring from the control system to the pre-warning device. First, check to make sure that the system control card fuses (two) are not blown (replace, if needed) and that the Output LEDs flash when the activation button on the system control card is depressed. If the output LED for the output channel that drives the pre-warning device is not flashing, check the DIP switches (1-4) on the system control card to make sure they are set properly. If everything is in order begin the wiring check at the output terminals of the system control card (usually output B) and proceed to the terminal block. Continue the check from the terminal block out to the street wiring, and on to the pre-warning device. Correct or repair the wiring as needed.

Section 6 – Trouble Shooting

B. Fault Condition 1 – System Operational, but Part of the System is Non-Functional

- **(c) Activation Device Failure:**
  Check the wiring at the failed activation device and correct any wiring problems that are found. Retest the activation device. If the system fails to activate properly the problem is either with the activation unit, or the wiring from the activation unit to the controller terminal block. Momentarily short the Push-button contacts at the AC-BDL3 Push-button station, or the Push-button BTN (orange) and PWR - (black) conductors at the AC-XAV2E Push-button station. If the wiring from the activation device is OK the system should activate. If the system activates, most likely the activation device is defective and will need to be repaired replaced. If the system fails to activate, check the wiring from the terminal block inside the controller enclosure to the activation device. Repair any wiring problems and retest.

C. Fault Condition 2 - Entire System is Non-Functional

In this situation the system has completely failed. The In-pavement fixtures and pre-warning signs do not flash when the system is activated from any of the activation devices.

- Begin by checking to see that all system controls (DIP Switches) are set in their proper position as specified for the installation and the output fuses (two) on the system control card are not blown. Make any replacements or corrections that are necessary.

- Check to see if the green power indicator LED on the top left of the control card and is lit and red power indicator LED on the push button control card (if used) is flashing. If either card indicates a no power condition, go to the last point in this section.

- If power indicators show that power is reaching the card(s), press the Reset button on the system control card. Activate the system using the Activation Call button on the control card. The red Activation Call LED indicator should flash once, the Activation LED should turn on, Output Active LEDs A and B should begin flashing (per the DIP switch setting), and the timer duration should begin its count down. This indicates that the control card is functioning properly.

- If the control card if functioning properly, check to see if the in-pavement lights and pre-warning devices are flashing. If system operates properly then repeat test using an activation call from the each external activation device. If the system not functioning, then verify that the Activation Call LED on the control Card receives the call when the system is activated by the external activation devices. If no calls are received (Activation Call LED does not flash) then the problem is either in the wiring from the control card itself. Check and repair any wiring problems between the system control card and terminal block and retest. If no problems are found then the problem is in the street wiring or activation device. If the activation call is received, but the system does not function properly then the control card may be defective and need to be replaced.

Section 6 – Trouble Shooting

C. Fault Condition 2 - Entire System is Non-Functional

- If the system control card does not operate properly (as described) disconnect the main harness, reset the control card, and activate the system using the Activation Call button on the card. If the card still does not function properly then the card may be defective and need to be replaced. If the card now functions properly the problem is with the wiring from the card to the terminal block, or with the street wiring. Check the wiring to the terminal block, correct any wiring problems, and retest. If no wiring problems are found check the street wiring, correct any wiring problems, and retest.

- If the system operates as expected when activated from the control card Activation Call button, but not when activated from the external activation device, check to see than an activation signal is being received by the control card when the activation device is used. The Activation Call LED should momentarily light when the external activation device is used. If the Activation LED on the control card does not flash on check the activation signal wiring from the control card to the terminal block.

- If the continuity of wiring is good then the problem is with either the wiring from the activation device to the controller terminal block, or the activation device itself. If the activation call LED flashes on then the problem is with the system control card and the card will need to be replaced.

- If the green power indicator is not lit or red power indicator is not flashing, check to see if +12 VDC is being applied to the control card. Measure the voltage between the GND and DC+ of each card. Check to see that the power conductors attached to the system control card and Push Button control card (used with an AC-XAV2E-LED push button) are connected properly to the Load terminals of the charge controller. Make any wiring corrections or repairs that are necessary. If the Power indicator LED was off, but +12 VDC is measured on either card then the card may be defective and need to be replaced. If + 12 VDC is not measured, the problem is in the solar power supply portion of the system.

Appendix A - Limited System and Product Warranty

1-Year Limited Product Warranty

For all products manufactured by TSC, but not purchased as part of a complete system, TSC provides a 1-year limited product warranty which warrants them to be free of material defects for a period of one year from the date of shipment.

5-Year Limited System Warranty

TSC supplies fully integrated and factory tested in-roadway warning light systems. TSC's systems are backed by a 5-year limited system warranty on all core components of the system purchased from and integrated by TSC. Core components are defined as the system controller, fixtures, base cans, fixture connectors, LED signs, and activation devices that are set forth in the TSC Price Book. Core components covered by the system warranty are warranted to be free of material defects for a period of five years from the date of shipment. The warranty excludes all non-core components, and components not purchased from TSC including, but not limited to, signs, beacons, lamps, batteries, solar panels, and activation devices. To avoid invalidating the TSC 5-year limited system warranty all components of the system which are connected to the system controller must be listed on the Order Submittal Form and be approved by TSC for connection to the system controller. Adding components not listed in the Order Submittal Form, without approval from TSC, voids the 5-year system warranty and the 1-year product warranty on the system controller. Breaking the security seal on a fixture voids all warranties on the fixture. System components that are approved by TSC for integration into the system, but not purchased from TSC, are excluded from TSC's 5-year system warranty and 1-year product warranty programs.

Warranty Limitations

TSC makes no warranties, express or implied, other than those stated herein. TSC does not warranty the workmanship of the installer, damage caused by acts of nature, vandalism, improper installation, or damage caused by improper maintenance. The warranty period of fixtures covered under the 5-year system warranty is reduced to two years when fixtures are subjected to abrasive materials or chemicals. TSC reserves the right to either repair or replace any defective component covered under the terms of any of its warranties. SC is not an engineering firm and makes no expressed or implied warranty as to the applicability of its products or systems in any specific situation, application or location: such decisions are the responsibility of the owner, design engineer and/or others. Therefore, as to all goods sold by TSC, TSC hereby disclaims any implied warranty of merchantability or implied warranty of fitness for a particular purpose and Buyer agrees that TSC shall not be liable for any special, indirect, incidental, consequential or liquidated damages of any kind, whether the Buyer's or any other claim is based upon contract, tort or any other legal theory.

Appendix B – Core Drill and Saw Cut Installation Pictures

Figure 1 – Fixture Placement

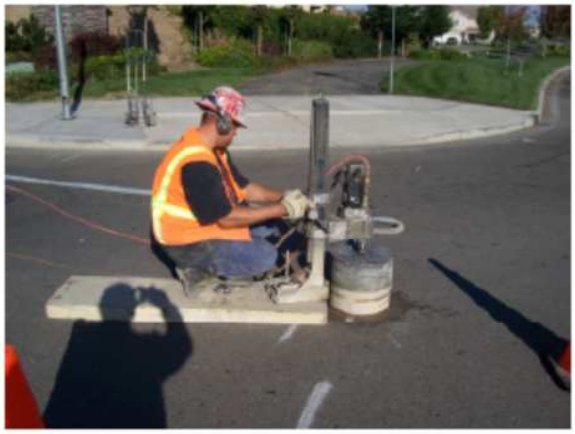


Figure 2 – Core Drill Process

Figure 3 – Saw Cut Process

Figure 4 – Drainage Provision

Figure 5 - Mounting Jig Setup

Figure 6 - Base Can Alignment

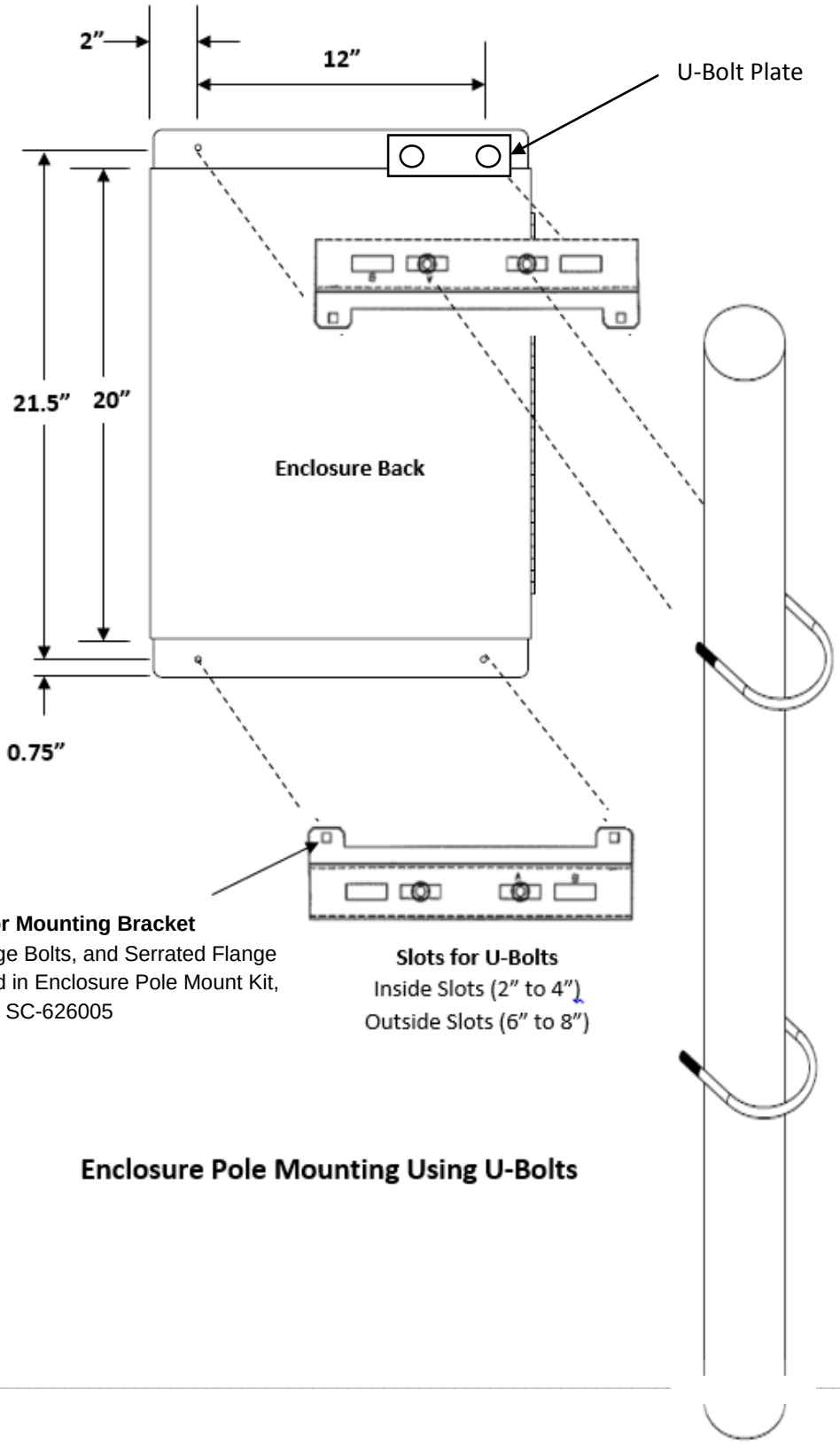
Appendix B – Core Drill and Saw Cut Installation Pictures

Figure 7 – Concrete Work around Base Can

Figure 8 – Protective Plywood Cover

Figure 9 – Fixture Bolted to Base Cans

Appendix C – Enclosure Pole Mount Bracket Assembly



Enclosure Pole Mounting Using U-Bolts

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