



RELIANCE PAPI, Precision Approach Path Indicator

L-880(L)/PAPI and L-881(L)/APAPI

User Manual

DM00012-000-01, Rev. L, 2025-11-20


**ADB
SAFEGATE**

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The equipment listed as CE certified means that the product complies with the essential requirements concerning safety and hygiene. The European directives that have been taken into consideration in the design are available on written request to ADB SAFEGATE.

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Note

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Replaced or repaired equipment under warranty falls into the warranty of the original delivery. No new warranty period is started for these replaced or repaired products.

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- Failing to make sure that auxiliary equipment complies with approval agency requirements, local codes, and all applicable safety standards if not in contradiction with the general rules.
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1.0 Safety

Introduction to Safety

This section contains general safety instructions for installing and using ADB SAFEGATE equipment. Some safety instructions may not apply to the equipment in this manual. Task- and equipment-specific warnings are included in other sections of this manual where appropriate.

1.1 Safety Messages

HAZARD Icons used in this manual

For all HAZARD symbols in use, see the Safety section. All symbols must comply with ISO and ANSI standards.

Carefully read and observe all safety instructions in this manual, which alert you to safety hazards and conditions that may result in personal injury, death or property and equipment damage and are accompanied by the symbols shown below.

	<p>WARNING Failure to observe a warning may result in personal injury, death or equipment damage.</p>
	<p>DANGER – Risk of electrical shock or ARC FLASH Disconnect equipment from line voltage. Failure to observe this warning may result in personal injury, death, or equipment damage. ARC Flash may cause blindness, severe burns or death.</p>
	<p>WARNING – Wear personal protective equipment Failure to observe may result in serious injury.</p>
	<p>WARNING – Do not touch Failure to observe this warning may result in personal injury, death, or equipment damage.</p>
	<p>CAUTION Failure to observe a caution may result in equipment damage.</p>
	<p>ELECTROSTATIC SENSITIVE DEVICES This equipment may contain electrostatic devices.</p>

Qualified Personnel

	<p>Important Information</p> <p>The term qualified personnel is defined here as individuals who thoroughly understand the equipment and its safe operation, maintenance and repair. Qualified personnel are physically capable of performing the required tasks, familiar with all relevant safety rules and regulations and have been trained to safely install, operate, maintain and repair the equipment. It is the responsibility of the company operating this equipment to ensure that its personnel meet these requirements.</p> <p>Always use required personal protective equipment (PPE) and follow safe electrical work practice.</p>
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1.1.1 Introduction to Safety



CAUTION

Unsafe Equipment Use

This equipment may contain electrostatic devices, hazardous voltages and sharp edges on components

- Read installation instructions in their entirety before starting installation.
- Become familiar with the general safety instructions in this section of the manual before installing, operating, maintaining or repairing this equipment.
- Read and carefully follow the instructions throughout this manual for performing specific tasks and working with specific equipment.
- Make this manual available to personnel installing, operating, maintaining or repairing this equipment.
- Follow all applicable safety procedures required by your company, industry standards and government or other regulatory agencies.
- Install all electrical connections to local code.
- Use only electrical wire of sufficient gauge and insulation to handle the rated current demand. All wiring must meet local codes.
- Route electrical wiring along a protected path. Make sure they will not be damaged by moving equipment.
- Protect components from damage, wear, and harsh environment conditions.
- Allow ample room for maintenance, panel accessibility, and cover removal.
- Protect equipment with safety devices as specified by applicable safety regulations
- If safety devices must be removed for installation, install them immediately after the work is completed and check them for proper functioning prior to returning power to the circuit.

Failure to follow these instructions can result in serious injury, death or equipment damage

Additional Reference Materials



Important Information

- IEC – International Standards and Conformity Assessment for all electrical, electronic and related technologies.
- IEC 60364 – Electrical Installations in Buildings.
- CSA – C22.2 No.180:13 (R2018), series isolating transformers for airport lighting.
- FAA Advisory: AC 150/5340-26 (current edition), Maintenance of Airport Visual Aid Facilities.
- Maintenance personnel must refer to the maintenance procedure described in the ICAO Airport Services Manual, Part 9.
- ANSI/NFPA 79, Electrical Standards for Metalworking Machine Tools.
- National and local electrical codes and standards.

1.1.2 Intended Use



CAUTION

Use this equipment as intended by the manufacturer

This equipment is designed to perform a specific function, do not use this equipment for other purposes

- Using this equipment in ways other than described in this manual may result in personal injury, death or property and equipment damage. Use this equipment only as described in this manual.

Failure to follow this instruction can result in serious injury or equipment damage

1.1.3 Material Handling Precautions : Storage



CAUTION

Improper Storage

Store this equipment properly

- If equipment is to be stored prior to installation, it must be protected from the weather and kept free of condensation and dust.

Failure to follow this instruction can result in equipment damage

1.1.4 Operation Safety



CAUTION

Improper Operation

Do Not Operate this equipment other than as specified by the manufacturer

- Only qualified personnel, physically capable of operating the equipment and with no impairments in their judgment or reaction times, should operate this equipment.
- Read all system component manuals before operating this equipment. A thorough understanding of system components and their operation will help you operate the system safely and efficiently.
- Before starting this equipment, check all safety interlocks, fire-detection systems, and protective devices such as panels and covers. Make sure all devices are fully functional. Do not operate the system if these devices are not working properly. Do not deactivate or bypass automatic safety interlocks or locked-out electrical disconnects or pneumatic valves.
- Protect equipment with safety devices as specified by applicable safety regulations.
- If safety devices must be removed for installation, install them immediately after the work is completed and check them for proper functioning.
- Route electrical wiring along a protected path. Make sure they will not be damaged by moving equipment.
- Never operate equipment with a known malfunction.
- Do not attempt to operate or service electrical equipment if standing water is present.
- Use this equipment only in the environments for which it is rated. Do not operate this equipment in humid, flammable, or explosive environments unless it has been rated for safe operation in these environments.
- Never touch exposed electrical connections on equipment while the power is ON.

Failure to follow these instructions can result in serious injury, death or equipment damage.

1.1.5 Maintenance Safety



DANGER

ELECTRIC SHOCK HAZARD

THIS EQUIPMENT MAY CONTAIN ELECTROSTATIC DEVICES

- DO NOT OPERATE A SYSTEM THAT CONTAINS MALFUNCTIONING COMPONENTS. IF A COMPONENT MALFUNCTIONS, TURN THE SYSTEM OFF IMMEDIATELY.
- DISCONNECT AND LOCK OUT ELECTRICAL POWER.
- ALLOW ONLY QUALIFIED PERSONNEL TO MAKE REPAIRS OR REPLACE MALFUNCTIONING COMPONENTS ACCORDING TO INSTRUCTIONS PROVIDED IN MANUAL.

FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN DEATH OR EQUIPMENT DAMAGE

1.1.6 Material Handling Precautions, ESD



CAUTION

Electrostatic Sensitive Devices

This equipment may contain electrostatic devices

- Protect from electrostatic discharge.
- Electronic modules and components should be touched only when this is unavoidable e.g. soldering, replacement.
- Before touching any component of the cabinet you shall bring your body to the same potential as the cabinet by touching a conductive earthed part of the cabinet.
- Electronic modules or components must not be brought in contact with highly insulating materials such as plastic sheets, synthetic fiber clothing. They must be laid down on conductive surfaces.
- The tip of the soldering iron must be grounded.
- Electronic modules and components must be stored and transported in conductive packing.

Failure to follow this instruction can result in equipment damage

2.0 About this manual

This document includes system information for the ADB SAFEGATE RELIANCE™ Precision Approach Path Indicator type L-880(L) PAPI and type L-881(L) APAPI, style A (voltage-powered) and style B (current-powered) systems with a focus on safety, installation, and maintenance procedures.

For more information, see www.adbsafegate.com.



Note

It is very important to read this document before any work is started.

2.1 How to work with the manual

1. Become familiar with the structure and content.
2. Carry out the actions completely and in the given sequence.

3.0 RELIANCE PAPI Overview

This manual provides instructions for installation, operation and maintenance of the RELIANCE™ Precision Approach Path Indicator (PAPI) LED system.

The RELIANCE PAPI systems provide visual approach path guidance to pilots of landing aircraft.

Figure 1: PAPI System



3.1 LED PAPI

Compliance with Standards

FAA	L-880(L) / L-881(L) AC 150/5345-28 (Current Edition). ETL Certified.
ICAO	PAPI Annex 14, Volume 1 (Current Edition)
T/C	PAPI / APAPI Transport Canada TP 312 par. 5.3.16.12 and Appendix 5B, Figure B-19
EASA	CS ADR-DSN.M.645
MOS	Part 139, para. 9.9.4.6
CE	DIRECTIVE 2014/35/EU: LVD annex IV & with DIRECTIVE 2014/30/EU: EMC annex IV

Uses

The RELIANCE™ LED PAPI (Precision Approach Path Indicator) system uses a multi-LED array to form a single light channel on each light unit to provide the pilot precise visual information, enabling the approach procedure to be performed with the utmost accuracy and safety.

Type L-880(L) PAPI system consists of four light units located at the side of the runway adjacent to the origin of the glide path. The nominal glide slope angle is midway between the angular settings of the central pair of the four units. If an aircraft is on the correct approach path, the pilot will see two red and two white light indicators. If the aircraft approach is too high, an increased number of white light indicators will be seen. If the approach is too low, the pilot will note an increased number of red light indicators.

Type L-881(L) APAPI system is an abbreviated PAPI system. It is identical to the L-880(L) PAPI system, except it consists of only two light units (instead of four). The nominal glide slope is midway between the angular settings of the two units, and when the pilot is on or close to the correct approach path, the unit nearest the runway will be seen as red and the other unit as white.

Style A (voltage powered) system is for use with 120 VAC or 240 VAC, 50/60 Hz voltage input. Style B (current powered) system is for use with 6.6 A or 20 A, 50/60 Hz series current input from a CCR.

Each ADB SAFEGATE LED PAPI light unit is equipped with a built-in mercury-free digital inclinometer aiming tool as part of the light unit. The digital inclinometer displays the glide slope angle and horizontal level of the light unit. FAA certified PAPIs are designed to de-energize all light units if the optical pattern of any light unit is raised more than 0.5° or lowered more than 0.25° with respect to the set aiming angle of the light unit (refer to AC 150/5345-28H). For ICAO and TP312 compliant units, this feature is factory disabled, but can easily be enabled if desired.

Power Supply

For Style A (Voltage Powered) systems, power is supplied to the primary light unit. For Style B (Current Powered) systems, power is supplied individually to each light unit via a 6.6A 200 W isolation transformer. When used on a 20 A series lighting circuit, a 20A/6.6A isolation transformer must be used to step the current down to 6.6 A.

Style A (Voltage Powered)		
Input Voltage	240 VAC ±10%, 50/60 Hz or 120 VAC ±10%, 50/60 Hz ¹	
L-880(L) PAPI (4 box)	528 VA max	
L-881(L) APAPI (2-box)	264 VA max	
Style B (Current Powered)		
Input Current	6.6 A or 20 A Series Circuit	
L-880(L) PAPI (4-box) Total CCR Load	630 VA max ²	4 kW CCR min ³
L-881(L) APAPI (2-box) Total CCR Load	330 VA max	2.5 kW CCR min ³

Notes

1. Factory preset for 240 VAC ±10%, easily field modified for 120 VAC ±10%. Source power maximum 305 m (1000 ft) away using 6 mm² (AWG 10) wire.
2. Includes PAPI light units and isolation transformers.
3. For circuits with two L-880(L) PAPI (4-box) systems, a minimum 7.5 kW CCR is required. For circuits with two L-881(L) PAPI (2-box) systems, a minimum 4 kW CCR is required.

Power Cord

The power cord is available in 8 ft (2.4 m) or 18 ft (5.5 m) length. The 8 ft (2.4 m) length is adequate for most installations. For installations that require a longer power cord, the 18 ft (5.5 m) length can be supplied and cut-to-length on-site during installation.

When the longer power cord and Contractor Kit Items are specified together, a longer length conduit is provided to accommodate the longer length power cord.

Monitored Fail-Open

The Monitored Fail-Open option is for use with ILCMS equipped circuits only. It requires an external remote device and a separate isolation transformer. A 6.6A 30/45W isolation transformer is typically used. However a 10/15W or 20/25W isolation transformer may also be used. The system only requires a remote device and isolation transformer to be connected to the primary light unit. Compatible with ADB SAFEGATE and other remote monitoring systems. This ordering option does not provide CCR monitoring functionality.

Baffles

Baffles modify the horizontal light beam from the PAPI light unit for obstacle avoidance in the approach area. ADB SAFEGATE LED PAPI baffles provide an adjustment capability to reduce the light beam from a full-width beam down to ±4.0 degree of visible light. Note: FAA Engineering Brief No.95 cautions that a light beam of less than ±3.0 degrees of visible light may not satisfy flight inspection criteria.

PAPI systems specified with baffles will include factory installed left and right side baffles on all light units. Each side can be adjusted independently. The baffles cannot be installed in the field, they are factory installed only.

Contractor Kit Materials

Items specified as "Contractor Supplied" are not included with the light unit. These items are typically provided by the contractor. However, as a convenience these items are available from ADB SAFEGATE as an option within the ordering code or they can be provided as an optional "Contractor Kit". See the user manual for more information on contractor kit items.

The following items are considered contractor supplied:

- EMT for legs
- Flexible conduit
- Conduit fittings
- Reducer bushings

Optional Touchpad Cover

The optional touchpad cover provides added protection for the LED display.

Touchpad Cover	44A7564
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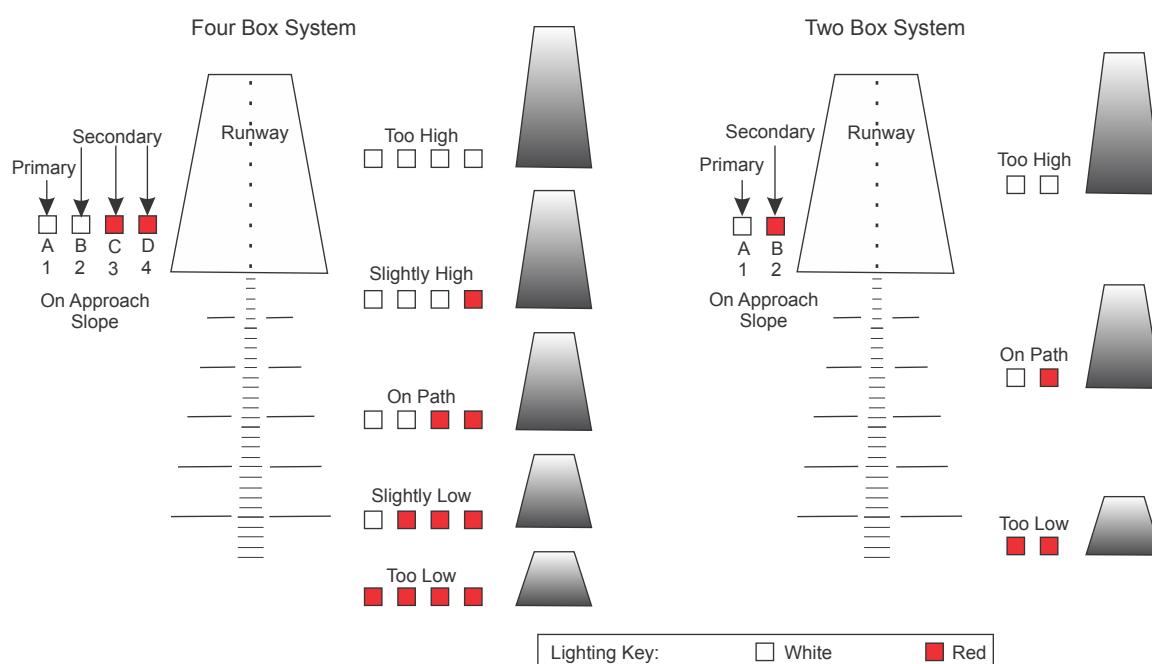
Packaging

Weight per 2 Box System	199-209 lb (90-95 kg)
Weight per 4 Box System	356-375 lb (161-170 kg)
Pallet Dimensions 2 Box System (LxWxH)	65 x 42 x 27 in (1651 x 1067 x 686 mm)
Pallet Dimensions 4 Box System (LxWxH)	65 x 42 x 48 in (1651 x 1067 x 1219 mm)

If contractor kit items are supplied with the PAPI system, the contractor kit items will be included within each PAPI light units packaging. Contractor kit items add approximately 25 lb (11.3 kg) per light unit.

3.2 Signal Display

Figure 2: Signal Display - L-880(L) PAPI (4 Light Unit) and L-881(L) APAPI (2 Light Unit) Systems



3.2.1 Type L-880(L) PAPI (4 Light Unit) System

The L-880(L) PAPI system consists of four identical light units installed in a line perpendicular to the runway centerline. The units are usually installed on the left side of the runway viewed from the approach end.

The units should be aimed so that pilots during a landing approach will see the signal format shown in [Figure 2](#):

- If the aircraft is **too high above** the approach slope, **all four units are white**.
- If the aircraft is **slightly above** the approach slope, **three units are white** (farthest from the runway); the other is red.
- If the aircraft is **close to or on** the approach slope, **two units are red and two are white**.
- If the aircraft is **slightly below** the approach slope, **three units are red** (closest to the runway); the other is white.
- If the aircraft is **too far below** the approach slope, **all four units are red**.

3.2.2 Type L-881(L) APAPI (2 Light Unit) System

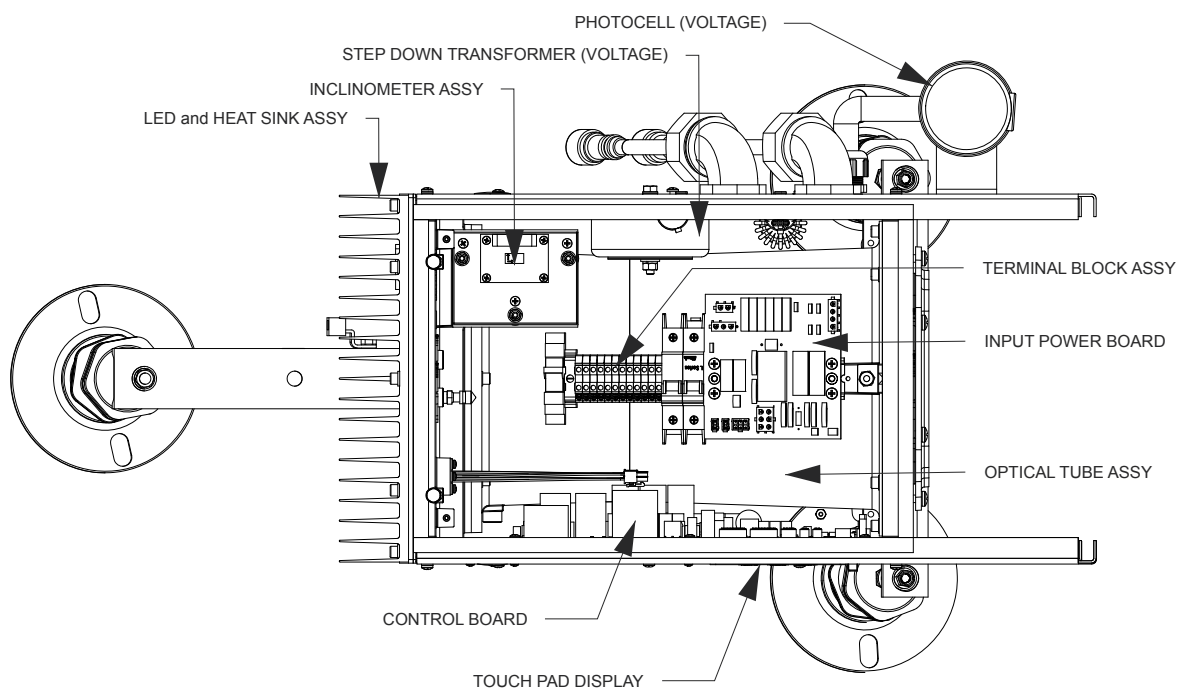
The L-881(L) APAPI system consists of two identical light units installed in a line perpendicular to the runway centerline. The units are usually installed on the left side of the runway viewed from the approach end. The units should be aimed so that pilots during a landing approach will see the signal format shown below right in [Figure 2](#):

- If the aircraft is **too high above** the approach slope, **both units are white**.
- If the aircraft is **close to or on** the approach slope, **one unit is red and one is white**.
- If the aircraft is **too far below** the approach slope, **both units are red**.

3.3 RELIANCE PAPI Light Unit

A RELIANCE PAPI light unit contains one LED light assembly, optical unit, front glass, input power board, control board, and inclinometer board. Each PAPI light unit is mounted on three adjustable legs. See [Figure 9](#). Each component is discussed below. See [Figure 3](#).

Figure 3: RELIANCE PAPI light unit



LED Light Assembly

An LED light assembly is located in the rear of the unit, aligns to pin located on the heat sink.

Optical Unit

A sealed optical unit that contains the optics and is designed to prevent dew, frost and dust from interfering with the light output and transition.

Front Glass

The heated front glass is designed to protect the optical unit and ensure that the front glass is kept free of dew and frost.

Digital Display

A unique digital display indicating the vertical angle can be read from outside the light unit. This eliminates the need to manually use an aiming device during initial installation and for routine verification of vertical angle setting, minimizing maintenance time.

Tilt Detection Electronics

The tilt measurement/control electronics, built into the Control Board and Inclinometer Board, are designed to de-energize the LEDs if the optical pattern is raised more than $\frac{1}{2}$ degree or lowered more than $\frac{1}{4}$ degree from the proper setting angle or if the optical pattern is tilted horizontally in either direction more than 1.75 degrees. If any Light Unit is moved from proper vertical or horizontal alignment, all PAPI light units will de-energize after about 25 seconds.



Note

For ICAO/TP312 PAPIs, the tilt/de-energizing LEDs function is optional.

3.4 Operation Overview - Voltage Powered Systems

This section provides an overview of operation for the Style A voltage powered RELIANCE PAPI system.

3.4.1 Primary Enclosure

Input voltage (Figure 45) is supplied to the Primary Enclosure at circuit breaker, Terminals 1 and 2 on the DIN rail. The Earth Ground connection attaches to the input power board on the DIN rail at J10 from the internal panel ground lug. The circuit breaker provides overcurrent protection. When the circuit breaker is turned on the voltage is fed to the input power board, which is used for lightning protection, then to the switch located on the front bulkhead, giving the user the ability to turn the system on and off externally. The switch feeds the input voltage back to the input power board which passes the voltage on to the secondary units and also fuses the voltage prior to feeding the power transformer. The power transformer steps the incoming voltage (120/240VAC) down to various internal operating voltages (0V, 24V, 48V). These voltages are fed to the control board via the input power board along with signals used for photocell control and remote operation control. The primary enclosure will turn the system on and off if any errors are detected on secondary units. This error detection is done through the use of CAN bus communications.

3.4.2 Local/Remote Operation

DIP switch (SW3-1 on PCU-1) on the control board in the primary unit enables remote or local mode operation. When set to LOCAL the system can be operated locally. When the switch is set to remote (REM) and the remote wires are connected to terminals 3 & 4 on the DIN rail, the PAPI system can be turned on or off from a remote location using a dry-switch contact closure across Terminals 3 & 4 of the DIN rail.

If the switch is in LOCAL, the PAPI system then turns ON to either the 100% level (if Daytime) or to the 5% or 20% level (if Nighttime) as controlled by the photocell.

If the switch is in REMOTE and there is a Remote ON command via a contact closure across Terminals 3 & 4 on the DIN rail. The PAPI system then turns ON to either the 100% level (if Daytime) or to the 5% or 20% level (if Nighttime) as controlled by the photocell.

3.4.3 Daytime Operation

The photocell is powered with 24VAC via the input power board feeding the control board from the power transformer after it has been stepped down from 120VAC or 240VAC. The photocell connects to the input power board via connector J2. When illumination on the photocell rises to 50-60 foot-candles, the photocell is de-energized. A delay of 45-75 seconds is incorporated in the photocell circuit to prevent switching because of stray light or temporary shadows. Zero volts is then present on J2-2 on the input power board, which the control board interprets as a Daytime signal and will control the secondary units using CAN bus communication to all turn on to the 100% level.

3.4.4 Nighttime Operation

When the illumination drops to 25 to 35 foot-candles (270-377 lux), the photocell energizes. 24VAC is then present on J2-2 on the input power board. The control board interprets this signal as a Nighttime signal. A delay of 45-75 seconds is incorporated in the photocell circuit to prevent switching because of stray light or temporary shadows. If the photocell control circuitry fails, the system reverts to high intensity. Two night-intensity settings, 5% and 20% of full intensity, can be set by using DIP switch (SW3-2 PCU-2). This allows the user to select either of the two settings to accommodate local site conditions. The primary unit will control the secondary units using CAN bus communication to all turn on to the selected intensity level.

3.4.5 Output to LED Light Assembly

Each individual unit has a control board with LED drivers which control the light engine of each individual unit.

3.4.6 Optional Interlock Relay

This option provides ON/OFF control through current sensing of the runway series circuit during nighttime operations when operated by remote control.



Note

A 6.6 A secondary, 30/45W isolation transformer is typically used. However, a 10/15W or 20/25W isolation transformer may be used.

If DIP switch (SW3-1 PCU-1), is in LOCAL, the PAPI system then turns ON to either the 100% level (if Daytime) or to the 5% or 20% level (if Nighttime) as controlled by the photocell. Therefore, in this situation, the current sensing input has no effect on operation.

If DIP switch (SW3-1 PCU-1), is in REMOTE and there is a Remote ON command via a contact closure across Terminals 3 & 4 on the DIN rail and it is Daytime, the PAPI system then turns ON to 100% level as controlled by the photocell. Therefore, in this situation, the current sensing input has no effect on operation.

If DIP switch (SW3-1 PCU-1), is in REMOTE and it is Nighttime, and the current in the series circuit is greater than 2.8A (as provided by an external isolation transformer connected to Terminals 3 & 4 on the DIN rail, with a wire passing through CT1 on the control board that is attached to Terminals 3 & 4 on the DIN rail), the PAPI system then turns ON to either the 5% or 20% level. If current in the series circuit is less than 2.8A, the PAPI system turns off.

3.5 Operation Overview - Current Powered Systems

This section provides an overview of operation for the Style B current powered RELIANCE PAPI system.

3.5.1 Style B Series Circuit Current Powered

The PAPI Style B is designed to operate from an L-828 Constant Current Regulator (CCR) with a maximum output current of 6.6 A. A single 200 W isolation transformer is connected to each Light Unit. Current from the secondary of the isolation transformer supplies power to the LED Light Assembly. When used on a 20 A series lighting circuit, a 20A/6.6A isolation transformer must be used to step the current down to 6.6 A. The CCR controls the brightness of the PAPI system. The CCR may have three or five brightness steps.

An ordering option is available for a current-powered style B LED PAPI with redundant series circuit input power capability. With this system there will be two independently fed circuits both simultaneously connected to the LED PAPI input power PCB [see wiring diagram Dual-Power Source]. Under normal operation the primary input power source will be the preferred source. If the primary input power source fails, the PAPI will automatically switch to the redundant input power source. If the primary input power source is re-energized then the PAPI will automatically switch back to the primary input power source.

Refer to one of the following wiring diagrams in [Wiring Diagrams](#).

3.6 Operation Overview - RELIANCE PAPI Light Unit

Style A - Voltage Powered

The light units used in Style A systems contain the following components; Control Board, Inclinator Board, Power Transformer, DIN rail with terminals and Input Power Board, Light Engine, Front Glass Defroster and Display Board. In Style A systems the Primary unit also contains a Photocell, Circuit Breaker and External ON/OFF switch.

Style B - Current Powered

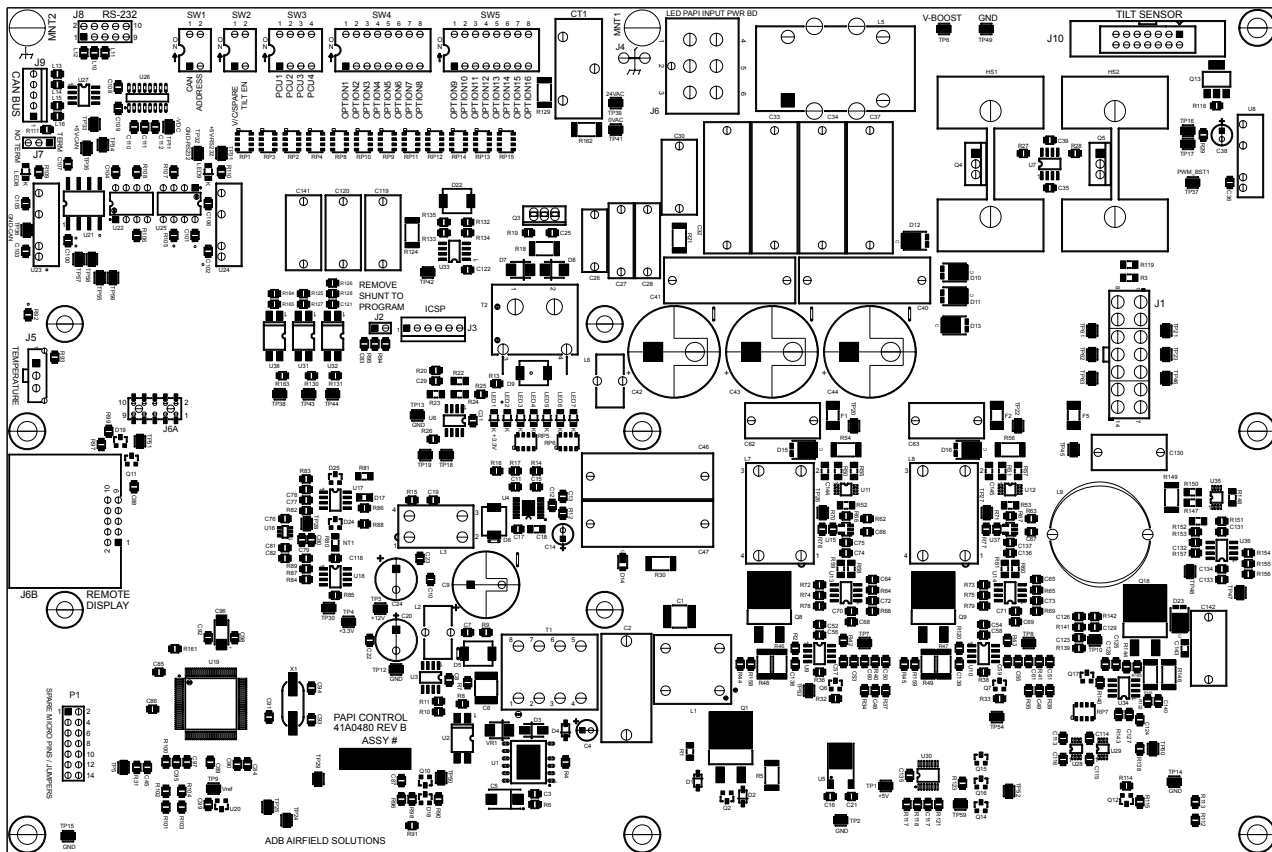
The light units used in Style B systems contain the following components; Control Board, Inclinometer Board, DIN rail with terminals and Input Power Board, Light Engine, Front Glass Defroster and Display Board.

If your PAPI system is configured with TILT enabled, if any PAPI light unit is tilted for more than 25 seconds, the tilt electronics are activated and the LEDs are de-energized for all light units to indicate a system failure. The PAPI system LEDs cannot be re-energized until all the light units are in proper alignment.

3.6.1 RELIANCE PAPI Control Board Overview

The Control Board has a micro controller that controls all operations of the PAPI Light Unit as follows:

Figure 4: RELIANCE PAPI Control Board



Dip Switches

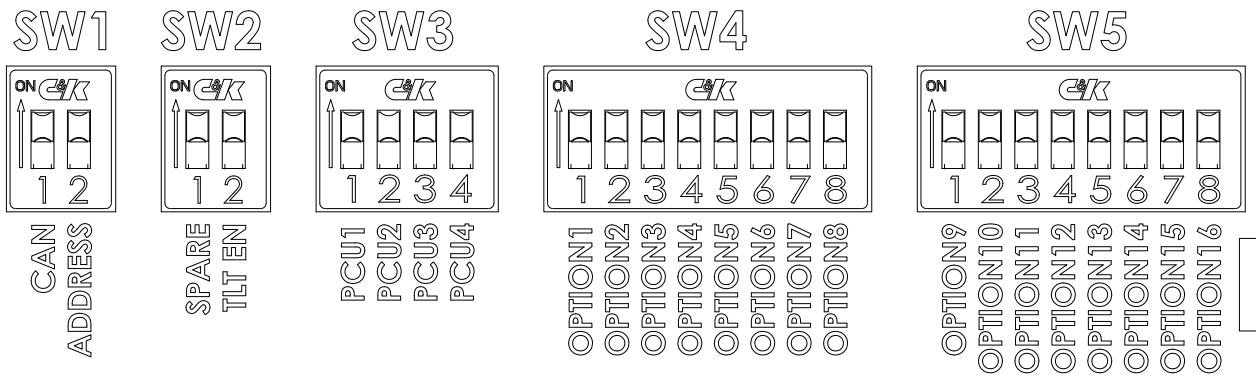
The Control Board contains many DIP switches which are used for configuring each PAPI light unit.



Note

DIP switches must only be changed while the PAPI is powered OFF. To avoid damage to the electronics and ensure correct operation, DIP switch changes will only take effect after the PAPI is powered back ON.

Figure 5: LED PAPI Control Board Dip Switches



The tables below outline the function of each DIP switch.

Table 1: Light Unit Position - Switch SW1

Dash Number	Light Unit	CAN / ADDRESS	
		SW1-1 (CAN)	SW1-2 (ADDRESS)
/XXXXXX1	Position 1	ON	ON
/XXXXXX2	Position 2	OFF	ON
/XXXXXX3	Position 3	ON	OFF
/XXXXXX4	Position 4	OFF	OFF

Table 2: Function of the DIP Switches

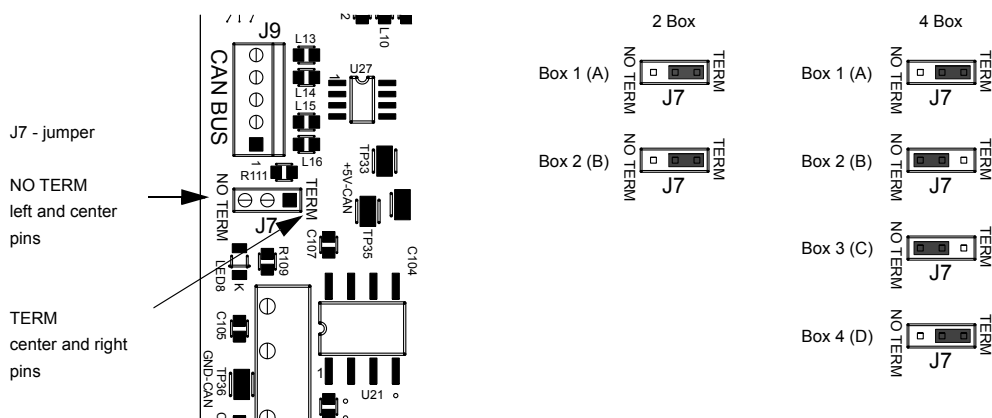
SW	PCB LABEL	ON Position	OFF Position	DEFAULT
2-1	SPARE	N/A	N/A	OFF
2-2	TLT EN	Tilt disabled	Tilt enabled	Pre-Configured
3-1	PCU1	Local	Remote	Pre-Configured
3-2	PCU2	5% Night intensity	20% Night intensity	Pre-Configured
3-3	PCU3	Current sensing for night only	Current sensing for day and night	Pre-Configured
3-4	PCU4	2 box system	4 box system	Pre-Configured
4-1	OPTION1	LEDs are OFF for B1 and B2	LEDs are ON for all steps B1-B5	OFF
4-2	OPTION2	LEDs stay ON when HEAT FAIL is detected	LEDs turn OFF when HEAT FAIL is detected	OFF
4-3	OPTION3	LEDs turn OFF on all PAPI light units when a HEAT FAIL is detected on any light unit. (SW4-2 and 5-7 must be OFF)	LEDs turn OFF on only the light unit with a HEAT FAIL. All other PAPI light units remain ON.	OFF

Table 2: Function of the DIP Switches

SW	PCB LABEL	ON Position	OFF Position	DEFAULT
4-4	OPTION4	LEDs turn OFF on all PAPI light units when a LED FAIL is detected on any light unit. (SW5-7 must be OFF) (has no effect in ICAO mode)	LEDs turn OFF on only the light unit with a LED FAIL. All other PAPI light units remain ON.	OFF
4-5	OPTION5	N/A	N/A	OFF
4-6	OPTION6	Control Board Calibration Mode	Normal Operation Mode	OFF
4-7	OPTION7	FAA Mode	ICAO Mode	Pre-Configured
4-8	OPTION8	N/A	N/A	OFF
5-1	OPTION9	N/A	N/A	Pre-Configured
5-2	OPTION10	N/A	N/A	Pre-Configured
5-3	OPTION11	N/A	N/A	Pre-Configured
5-4	OPTION12	N/A	N/A	Pre-Configured
5-5	OPTION13	N/A	N/A	Pre-Configured
5-6	OPTION14	N/A	N/A	Pre-Configured
5-7	OPTION15	Communication disabled between boxes	Communication enabled between boxes	OFF
5-8	OPTION16	Defrost Timer disabled (instant ON)	Defrost timer enabled (180 seconds)	ON

2-box and 4-box Termination Setup at J7

Figure 6: Control Board - J7 jumper setting



2 Box setup: The jumper position on J7 for Box 1 (A) and Box 2 (B) will be on the Center and Right pins (TERM).

4 Box setup: The jumper position on J7 for Box 1 (A) and Box 4 (D) will be on the Center and Right pins (TERM); Box 2 (B) and Box 3 (C) will be on the Center and Left pins (NO TERM).

Light Engine Control

LED driver circuitry is used in combination with the micro controller to control the brightness levels of the light engines in the RELIANCE PAPI. This circuitry will alter the brightness levels of the LEDs when attached to a CCR according to the FAA Engineering Brief 67 (current rev).

Lamps Out

A micro controller monitors the voltage and current across each LED string (white and red). An LED string consists of all LEDs of the same color.

If one of the LEDs in either of the strings goes out or fails as an open circuit, the micro controller recognizes the abnormal voltage and will shut down the LED string. As a result both red and white LEDs are de-energized.

If one of the LEDs in either of the strings goes out or fails as a closed circuit, it is possible for the remaining LEDs to continue operating. The micro controller recognizes the abnormal voltage and will de-energize the LEDs if a maximum 25% of the LEDs in a string goes out or fails as a closed circuit. As a result both red and white LEDs are de-energized.

In the event of the LEDs de-energizing due to an LED failure, the display on the light unit will show a corresponding error, RED -> LED -> FAIL or WHT -> LED -> FAIL, on the unit that has the error. In order to fix this issue the light engine may have to be replaced.

Defroster Control

LED driver circuitry is used in combination with the micro controller to control the operation of the front glass defroster. The circuitry will change the amount of current passing through the front glass defroster. When initially turned on, the RELIANCE PAPI has a delay where the front glass is powered in order to properly clear the front glass before turning the light engines on. During normal operation, when the light engines are operating, the front glass defroster will be operating in the range between 10 and 50W, depending upon ambient temperature. The micro-controller monitors the power to the front glass defroster. If the micro-controller detects that the front glass defroster is opened or shorted the unit will shut down and display the following error on the display: **HEAT -> FAIL**.



Note

FAA systems will be shipped to activate lighting at the requested intensity within 5 seconds after the activation of power or current, per FAA AC 150/5345-28 (latest revision). This has been mandated by the testing authority for certification. Note that dew/frost on the lenses may obscure the well defined transition of the PAPI, as noted in FAA CertAlert 02-08 in the front of this manual. It is recommended at this time that PAPI light units on active runways be kept in at least a minimal light output to apply heat to the outer lens to keep it clear of dew/frost at all times, per the FAA CertAlert.

The preset configuration for the heater function can be overridden through switch SW 5-8 (OPTION16) on the Control Board to prevent light output until the outer lens is clear, typically three-five minutes after power/current has been applied. Note that this is not an approved option for FAA installations, and applying this option will place the PAPI installation to be non-compliant with the FAA Advisory Circular.

Tilt Measurement

The micro controller reads the tilt sensor angle from the Inclinometer Board 20 times per second through a digital interface via the ribbon cable that connects the Control Board to the Inclinometer Board. The angle is displayed on the four-digit LED display and compared to the set angle from the last time the SET ANGLE button was pushed. A tilt situation can occur in two situations. First, if the measured vertical (Glide) angle either 0.25 degrees less than the desired glide angle or 0.50 degrees greater than the desired vertical (Glide) angle. Second, if the measured horizontal (Level) angle is either less or greater than 1.75 degrees. The micro controller will then turn all the lamps off within the Light Unit and will also display the error, BOXn -> TILT, where n = 1, 2, 3 or 4, whichever unit is tilted. The remaining boxes in the system will all display the same error so the user knows which unit is titled.

CAN Bus Communications

Each RELIANCE PAPI system communicates using CAN bus protocol. The individual light units are set up to know which box position they are, 1 (A), 2 (B), 3 (C) or 4 (D). The primary light unit, box 1 (A), sends a command to all secondary units that will respond to the primary unit. The CAN messaging allows the RELIANCE PAPI system to share information between each of the light units.

- The voltage powered Style A intensity is controlled via CAN bus communication.

- Both Style A and Style B share fault conditions and tilt situations via CAN bus communications.

Photocell (Primary Light Unit Only)

The primary light unit in each voltage powered system has a photocell attached. The photocell input is read by the micro controller and will relay this signal to the secondary units using the CAN bus communication link. During daylight the intensity of the light output will be 100%. During nighttime operation the intensity of the light output will be 5% or 20% as selected on the DIP switches, shown previously.

Circuit breaker & External ON/OFF switch (Voltage Powered Primary Light Unit Only)

The primary light unit in each voltage powered system has a circuit breaker and external ON/OFF switch. The circuit breaker protects the entire system from overload or short circuit. The external ON/OFF switch allows the user to turn the entire system ON or OFF from the primary light unit. The circuit breaker is located next to the Input Power PCB, and the external ON/OFF switch is located on the front panel.

Remote/Local Switch (Voltage Powered Primary Light Unit Only)

The local/remote switch (SW3-1) determines if external control signals will be used to remotely control the PAPI system. In local operation, only the photocell is active.

3.6.2 RELIANCE PAPI Display Board Overview

Startup

At startup, the PAPI display board will show the following message:

ADB -> LED -> PAPI -> VER -> V.VV -> GGGG -> BOXn -> OFn -> COLD -> XXX -> SEC.

- V.VV** corresponds to the current control board firmware version
 - If **V.VV** = 1.47 or earlier, use heated glass spare kit 94A0674/1.
 - If **V.VV** = 1.50 or later, use heated glass spare kit 94A0674/1 or AK00054-000-01.
- XXX -> SEC** will be repeated until the light output is activated, if the defrost timer (SW 5-8) is enabled.

Errors

The following errors can be displayed by the four-digit LED display, if error messages are enabled:

- COMM -> LOST** (Communications Lost)
- HEAT -> FAIL** (Defroster Error)
- RED -> LED -> FAIL** (Red LED Error)
- WHT -> LED -> FAIL** (White LED Error)
- PHOT -> FAIL** (Photocell Error)
- BOXn -> TILT** (Unit Tilt Error)

Normal Operation

Under Normal Operating conditions the four-digit LED display will show the following information:

When the GLIDE LED is on, the glide angle will be displayed or MIN if the glide angle is less than 0. If the readout shows 9.99, this indicates that the glide slope is equal to or greater than 9.99 degrees from horizon.

When the LEVEL LED is on, the level angle will be displayed. Level readings between -0.01° and -0.99° will show the angle with a negative sign (sign takes the position of the leftmost zero). If the angle is less than -1.00° (all digits used by the angle reading) it will show the angle alternating with the word NEG. The decimal dot eats up one of the characters in the display. The display is a 4-Character not a 4-Digit.

When the SET LED is on, SAVE will be displayed if the SET button is pushed for more than five seconds to store the GLIDE angle.

3.6.3 Inclinometer Overview

The Inclinometer assembly contains a dual axis inclinometer device that provides instrumentation grade performance for leveling applications and regular maintenance checks of the glide slope. It contains a silicon-based chip that measures the tilt angle and transmits it to the PAPI main control board over a digital interface. A digital display on the side of the PAPI light unit displays the glide slope aiming angle and the horizontal level of the light unit in degrees.

The inclinometer device and digital display is considered to be a built-in aiming tool, capable of measuring the vertical angle of the light beam center from 2 to 8 degrees in graduated increments of 10 minutes of arc with a repeatable accuracy of ± 3 minutes of arc (0.05° on the digital display). If it is suspected that the vertical glide slope (aiming angle) on the digital display is incorrect or out of tolerance, please first refer to the [Standards and Tolerances](#) section for operating tolerances. If necessary, refer to the [Troubleshooting](#) section of this user manual, or the [Appendix A](#) section to contact ADB SAFEGATE Technical Support.

Regular calibration services for the inclinometer aiming tool should be performed to ensure accurate performance of the LED PAPI system. It is the users' responsibility to determine an appropriate calibration service schedule. It is important to note that although a calibration service is not required, ADB SAFEGATE recommends a calibration service interval of no longer than two years. Contact ADB SAFEGATE Technical Support for assistance with a calibration service.

4.0 Siting the RELIANCE PAPI System (FAA)

This section provides guidance on how to determine the physical location for each light unit for an FAA system. Refer to FAA AC 150/5340-30 (current edition) for additional information.

Only FAA siting guidance is explained here after For ICAO siting, please refer to [section 5](#).

4.1 Siting Considerations

When viewed from the approach end, the PAPI system should normally be located on the left-hand side of the runway. The PAPI may be located on the right side of the runway if siting problems exist, such as conflicts with runways or taxiways. The PAPI must be sited and aimed so that it defines an approach path with adequate clearance over obstacles and a minimum threshold crossing height.

If the runway has an established ILS glideslope, refer to [Siting a PAPI with an FAA ILS Glideslope](#). The PAPI must be installed so that the visual glideslope coincides (as much as possible) with the electronic glideslope. If there is no ILS on the runway, refer to [Siting PAPI on FAA Runways Without ILS](#). The PAPI's glideslope must be chosen to ensure the on-course signal of the PAPI provides adequate clearance over obstacles.

4.1.1 Distance of the PAPI from the Runway Edge

For 4-Box L-880(L) and 2-Box L-881(L) systems, the light unit nearest the runway must be 50 ft (+10, -0 ft) or 15.2 m (+3, -0 m) from the runway edge. This distance may be reduced to 30 ft or 10 m for small general aviation runways used by non-jet aircraft. Refer to FAA and ICAO document for further information.



Note

For all installations, the distance between runway and light unit is measured runway edge to center of light unit.

4.1.2 Lateral Spacing of the PAPI Light Units

The PAPI light units must have lateral separation of between 20 and 30 ft (± 1 ft) or 6 to 9 m (± 0.3 m). Refer to FAA and ICAO document for further information.



Note

For all installations, the distance between light units is measured center to center.

4.2 Siting a PAPI with an FAA ILS Glideslope

When a runway has an established ILS electronic glideslope, the PAPI on-slope signal should coincide, as much as possible, with that for the ILS. To accomplish this, place the PAPI at the same distance (tolerance of ± 30 feet or ± 9.1 m) from the threshold as the virtual source of the ILS glideslope and aim at the same angle as the ILS glideslope.

Refer to [Table 3](#). This procedure must be modified for runways that serve aircraft in height group 4 because of the eye-to-antenna distance. For these runways, the distance of the PAPI from the threshold must equal the distance to the virtual source of the ILS glideslope plus an additional 300 feet (91 m) (+50 feet, -0 feet) (+15.2 m, -0 m). Calculations should be performed to ensure that the site chosen provides adequate obstacle clearance and threshold crossing height. See also FAA AC 150-5340-30 diagram (current edition).

4.3 Siting a PAPI Without an FAA ILS Glideslope

When the runway does not have an ILS glideslope, the PAPI must be sited and aimed so that it defines an approach path which will produce the required threshold crossing height and clearance over any obstacles in the approach area.

4.3.1 Threshold Crossing Height (TCH)

The Threshold Crossing Height (TCH) is the height of the lowest on-course signal at a point directly above the threshold and the runway centerline. The minimum allowable TCH depends on the height group of the aircraft using the runway, and is shown in [Table 3](#). The glideslope of the PAPI must provide the proper TCH for the most demanding aircraft height group using the runway.

Table 3: FAA Threshold Crossing Height

Type of Aircraft	Cockpit-to-Wheel Height	Visual Threshold Crossing Height	Remarks
Height Group 1 (General aviation, small commuters, corporate turbojets)	10 feet (3.0 m) or less	40 feet (12 m) (+5 ft, -20 ft) (+1.5 m, -6.1 m)	Many runways less than 6,000 ft (1828.8 m) long with reduced widths and/or restricted weight bearing which would normally prohibit landings by larger aircraft
Height Group 2 (F-28, CV 340/440/580, B-737, DC 8/9)	15 feet (4.6 m)	45 feet (13.7 m) (+5 ft, -20 ft) (+1.5 m, -6.1 m)	Regional airport with limited air carrier service
Height Group 3 (B 707/720/727/757)	20 feet (6.1 m)	50 feet (15 m) (+5 ft, -15 ft) (+1.5 m, -4.6 m)	Primary runways not normally used by aircraft with ILS glideslope-to-wheel heights exceeding 20 ft (6.1 m)
Height Group 4 (B-747/767, L-1011, DC-10, A-300)	Over 25 feet (7.6 m)	75 feet (23 m) (+5 ft, -15 ft) (+1.5 m, -4.6 m)	Most primary runways at major airports.

4.3.2 Glideslope Angle

The standard visual glideslope angle for the PAPI is 3 degrees. For non-jet runways, this may be raised to 4 degrees maximum if required to provide obstacle clearance.

4.3.3 Calculating Distance of the PAPI Units from the Runway Threshold

Calculate the distance of the PAPI units from the runway threshold using the following equation:

$D1 = TCH \times \cotangent(\text{angle of lowest on-course signal})$

D1 = calculated distance of the PAPI unit from the runway threshold

TCH = threshold crossing height

The TCH is determined by the height group of aircraft that primarily use the runway. Refer to [Table 3](#) to determine the recommended TCH.

Determine the lowest on-course signal. The angle of the lowest on-course signal will be the aiming angle of the Light Unit minus 1.5 minutes or arc.



Note

The subtraction of 1.5 minutes of arc takes into account the width of the transition sector (3 minutes of arc) between the white and red part of the PAPI light beam. The 1.5' is one-half the width of the transition sector of the light beam therefore the lowest possible on-course signal is 1.5' lower than the aiming angle. Hence the additional 1.5' must be taken into account in calculating D1.

For L-880 (4 Box) with a 3° glide slope, this is the aiming angle of the third light unit from the runway edge (2°50') minus 1.5 minutes. For L-881 (2 Box) with a 3° glide slope, this is the aiming angle of the farthest light unit from the runway edge (2°45') minus 1.5 minutes.

Example L-880 (4 Box):

The aiming angle of the third light unit is: 2° 50' therefore the lowest on-course signal is 2° 50' - 1.5' = 2° 48.5'.

Determine the distance of the PAPI from the runway threshold (Example: Height Group 2) TCH = 45 ft.

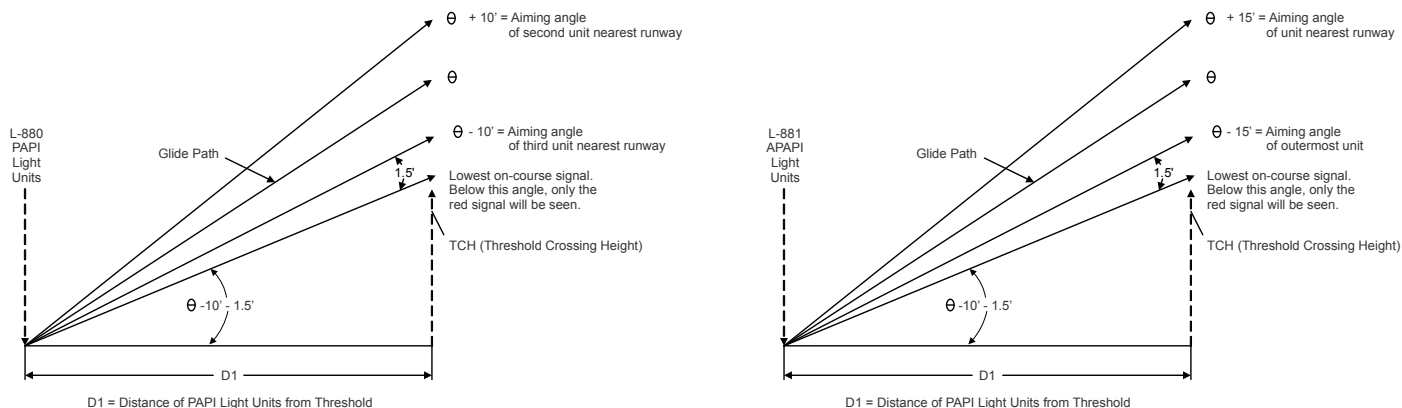
$D1 = 45 \times \cotangent 2^\circ 48.5'$ (convert minutes to degrees, 2° 48.5' = 2.8083°)

$D1 = 45 \times \cotangent 2.8083^\circ$ (cotangent = 1/tan)

$D1 = 45 \times 20.38595$

D1 = 917.37 ft from the runway threshold

Figure 7: Distance of PAPI Light Units from Threshold



4.3.4 Obstacle Clearance Surface (OCS)

The PAPI obstacle clearance surface is established to provide the pilot with a minimum clearance over obstacles during approach. See [Figure 8](#).

Position and aim the PAPI so that no risk exists of an obstruction being located in an area where the PAPI signals can be observed. Make a survey of the site to determine if an obstruction is present in the area where you can observe the PAPI signals.

See [Figure 8](#). This obstacle clearance surface begins 300 feet (91 m) in front of the PAPI Light Units (closer to the threshold) and proceeds outward into the approach area at an angle of 1 degree less than the lowest on-course signal. This surface extends 10 degrees on either side of the runway centerline to a distance of 4 miles (6 km) from the point of origin.

If an obstruction penetrates the obstacle clearance surface and cannot be removed, increase the glideslope angle or move the PAPI system further from the threshold to provide an increased TCH equal to the obstacle penetration height. To move the PAPI system, use the following formula to determine D1:

$$D1 = TCH + H \times \cotangent \theta$$

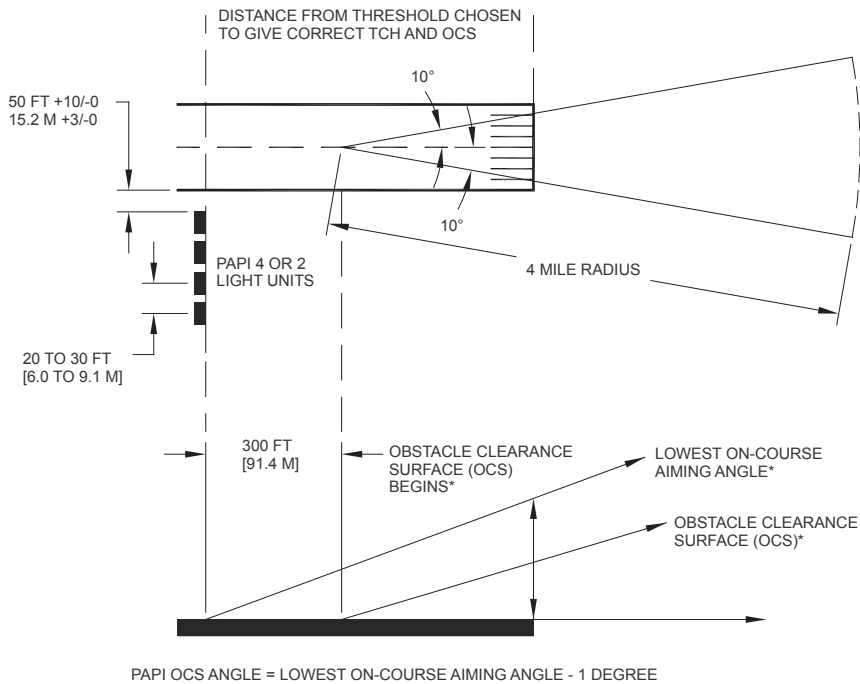
D1 = calculated distance of the PAPI from the runway threshold

TCH = threshold crossing height

H = the height of the object above the OCS

θ = PAPI lowest on course signal

Figure 8: FAA PAPI Obstacle Clearance Surface



4.3.5 Reduction of Beam Coverage for Obstacle Avoidance

A PAPI system may require a reduction of the horizontal beam coverage because of an obstacle in the approach area. If this is the case, special consideration should be given to the following factors when determining the required system cutoff angle(s):

- Type and location of the obstacle with respect to the area where the PAPI signals can be observed.
- Wingspan of aircraft using the runway.
- Vertical pitch of the glideslope.
- Installation tolerances.
- Position of the PAPI system.
- Additional safety considerations.
- Origin of the cutoff angle should be either the outermost or innermost unit (whichever is closest in azimuth to the obstacle).
- Cutoff angles should be FAA approved.

If a reduction in the horizontal beam coverage is required, contact the ADB SAFEGATE sales department for further details.

4.4 Siting Tolerances

Siting tolerances involve azimuth aiming, mounting height tolerance, PAPI tolerance along a line perpendicular to the runway, and correction for the runway longitudinal gradient.

4.4.1 Azimuth Aiming (Horizontal Alignment with Runway Centerline)

Each Light Unit shall be aimed outward into the approach zone on a line parallel to the runway centerline within a tolerance of $\pm 0.5^\circ$. ADB SAFEGATE recommends azimuth aiming to be within a tolerance of 0° to 0.5° towards centerline, if possible.

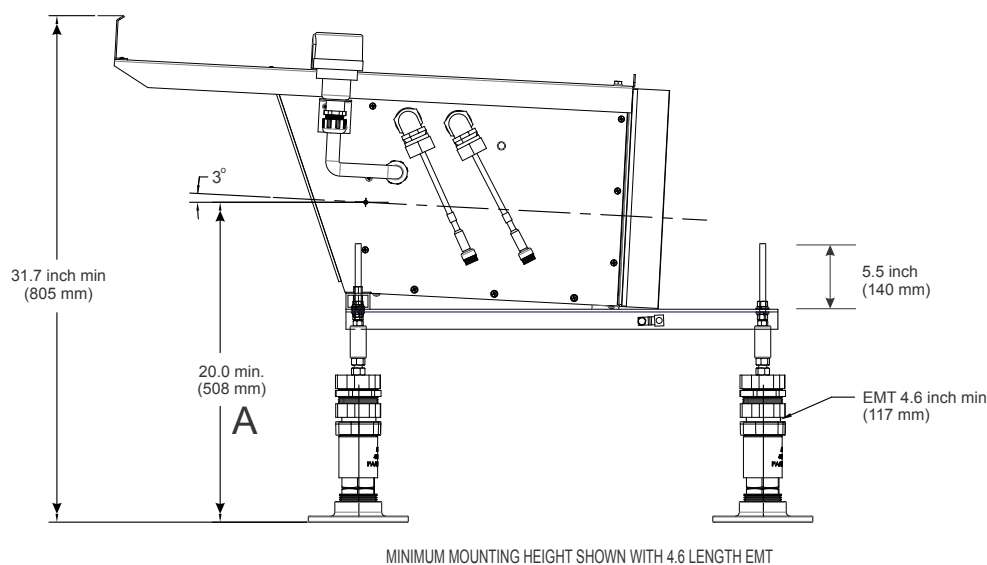
4.4.2 Mounting Height Tolerance

The beam centers of all Light Units shall be within ± 1 inch (25 mm) of a horizontal plane. The beam center is located at the Beam Center Mark (+) as depicted on [Figure 9](#). This plane shall be within ± 1 foot (300 mm) of the elevation of the runway centerline at the intercept point of the visual approach angle with the runway except for additional siting considerations. Refer to [Additional Siting Considerations](#). The Light Unit EMT leg length is chosen by the installer to ensure the proper mounting height is achieved. Refer to FAA AC 150/5340-30 (current edition) for additional information on installation requirements.

Figure 9: Light Unit Mounting Height

EMT Length	A (min)	A (max)	Height (min)	Height (max)
4.6 (117)	20 (508)	25.5 (648)	31.7 (805)	37.2 (945)
10.1 (257)	25.5 (648)	31 (787)	37.2 (945)	42.7 (1085)
13.0 (330)	28.4 (721)	33.9 (861)	40.1 (1019)	45.7 (1161)
14.5 (368)	29.9 (760)	35.4 (900)	41.6 (1057)	47.2 (1200)

Dimensions: inch (millimeter)



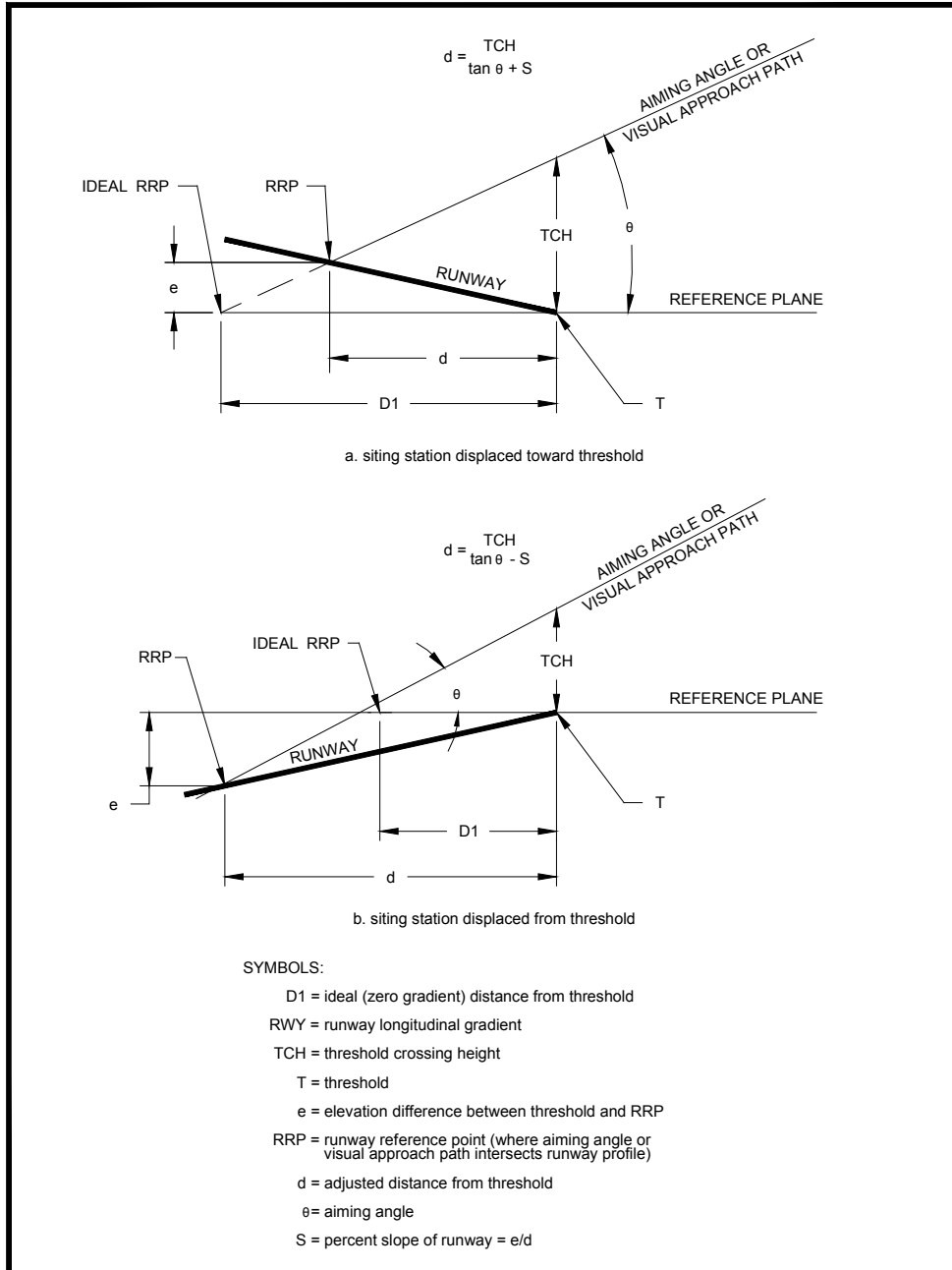
4.4.3 PAPI Tolerance Along Line Perpendicular to Runway

The front face of each Light Unit in a bar shall be located on a line perpendicular to the runway centerline within ± 6 inches (150 mm).

4.4.4 Correction for Runway Longitudinal Gradient

See Figure 10. Refer to AC 150/5430-30 (current edition). On runways where a difference exists in elevation between the runway threshold and the elevation of the runway centerline adjacent to the PAPI, you may need to adjust the location of the Light Units with respect to the threshold to meet the required obstacle clearance and TCH.

Figure 10: Correction for Runway Longitudinal Gradient



If the condition exists, perform the following steps to compute the change in the distance from the threshold required to preserve the proper geometry:

1. Obtain the runway longitudinal gradient. This can be done by survey or obtained from airport obstruction charts or as-built drawings.
2. Determine the ideal (zero gradient) distance from the threshold in accordance with the preceding instructions.
3. Assume a level reference plane at the runway threshold elevation. Plot the location determined in Step 2.
4. Plot the runway longitudinal gradient.

5. Project the visual glideslope angle to its intersection with the runway longitudinal gradient. Then solve for the adjusted distance from the threshold either mathematically or graphically. Refer to [Mounting Height Tolerance](#).
6. Verify the calculated location gives the desired threshold crossing height.

4.5 Additional Siting Considerations

Below are additional siting considerations.

- Where the terrain drops off rapidly near the approach threshold and severe turbulence is experienced, locate the PAPI farther from the threshold to keep the aircraft at the maximum possible threshold crossing height.
- On short runways, the PAPI should be as near the threshold as possible to provide the maximum amount of runway for braking after landing.
- Contact your ADB sales representative for additional guidance if the PAPI Light Units must be installed at locations where snow is likely to obscure the light beams.
- Since the effectiveness of the PAPI system is dependent on the optical red and/or white signal pattern from the Light Units, make sure that no other lights are close enough to confuse the pilot.

5.0 Siting the RELIANCE PAPI System (ICAO)

This section provides guidance on how to determine the physical location for each light unit for an ICAO system. Refer to Annex 14 (current edition) paragraphs 5.3.5.24 to 5.3.5.46 and in the Aerodrome Design Manual, Part 4 – Visual aids (current edition), section 8.3.

Only ICAO siting guidance is explained hereafter. For FAA siting, please refer to [section 4](#).

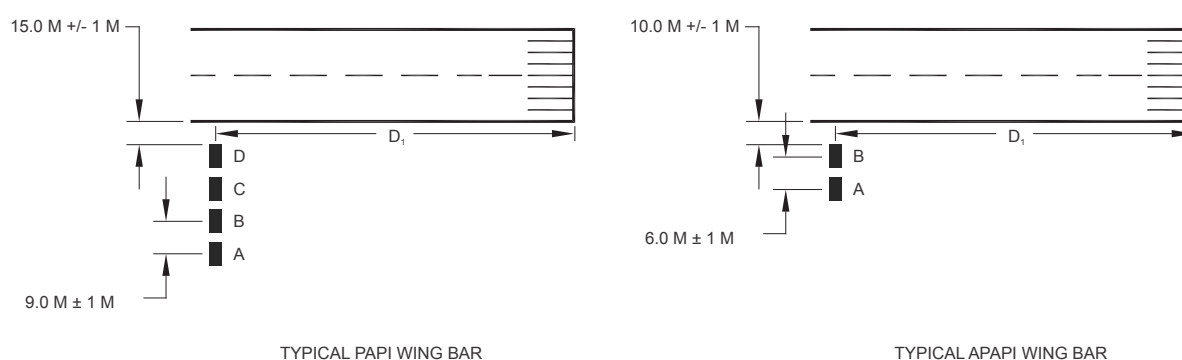
5.1 Siting Considerations

The PAPI must be sited and aimed so that pilots making an approach:

1. see the two units nearest the runway as **red** and the two units farthest from the runway as **white** when on or close to the approach slope
2. see the one unit nearest the runway as **red** and the three units farthest from the runway as **white** when above the approach slope; and see all the units as **white** when further above the approach slope
3. see the three units nearest the runway as **red** and the unit farthest from the runway as **white** when below the approach slope; and see all the units as **red** when further below the approach slope.

When viewed from the approach end, the PAPI system should normally be located on the left-hand side of the runway as shown in [Figure 11](#).

Figure 11: ICAO PAPI System - Siting Example for Runways Code 3 or 4



- A spacing of 9 m (± 1 m) between PAPI units should be used on code numbers 3 and 4, the inner PAPI unit shall be located not less than 15 m (± 1 m) from the runway edge.
- A spacing of 6 m (± 1 m) between PAPI units should be used on code numbers 1 and 2. In such an event, the inner PAPI unit shall be located not less than 10 m (± 1 m) from the runway edge.



Note

Reducing the spacing between light units results in a reduction in usable range of the system.

The system shall be located on the left side of the runway unless it is physically impracticable to do so. The PAPI may be located on the right side of the runway if siting problems exist, such as conflicts with runways or taxiways. Where a runway is used by aircraft requiring visual roll guidance which is not provided by other external means, then a second wing bar may be provided on the opposite side of the runway.

The light units shall be located as in the basic configuration illustrated in [Figure 11](#), subject to the installation tolerances given therein. The units forming a wing bar shall be mounted to appear to the pilot of an approaching aircraft to be substantially in a horizontal line. The light units shall be mounted as low as possible and shall be frangible.

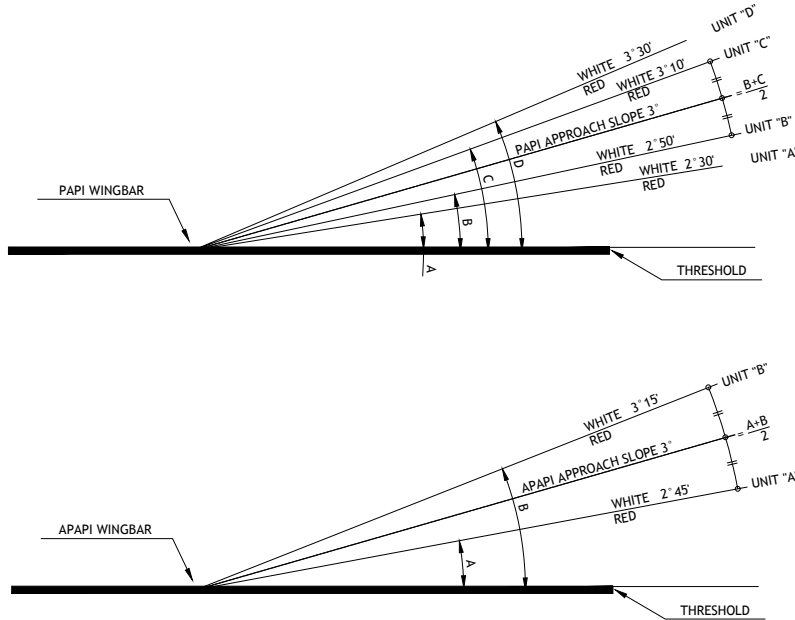
To ensure that units are mounted as low as possible and to allow for any ground transverse slope, small height adjustments of up to 5 cm between units are acceptable. A lateral gradient not greater than 1.25 per cent can be accepted provided it is uniformly applied across the units.

5.2 Siting a PAPI Without ILS or MLS Glide Slope Non-Visual Aid

Where a PAPI is installed on a runway not equipped with an ILS or MLS, the distance D1 shall be calculated to ensure that the lowest height at which a pilot will see a correct approach path indication provides the wheel clearance over the threshold specified in ICAO Annex 14 Table 5-2 for the most demanding amongst aircrafts regularly using the runway.

The elevation setting angles of each unit shall be as defined by ICAO Annex 14 Figure 5-20.

Figure 12: ICAO PAPI System - Light beams and angle of elevation setting for a 3° approach



Where wing bars are installed on each side of the runway to provide roll guidance, corresponding units shall be set at the same angle so that the signals of each wing bar change symmetrically at the same time.

5.3 Siting a PAPI With an ILS or MLS Glide Slope Non-Visual Aid

Where a PAPI is installed on a runway equipped with an ILS and/or MLS, the distance D1 shall be calculated to provide the optimum compatibility between the visual and non-visual aids for the range of eye-to-antenna heights of the aircrafts regularly using the runway. The average height of the pilot's eye above the aircraft's ILS glide path/MLS antenna will be used to determine the average eyes height above the threshold to determine the ideal harmonization of the PAPI system with the ILS and/or MLS.

Additionally, the distance D1 shall be such that in no case will the wheel clearance over the threshold be lower than that specified in column (3) of ICAO Annex 14 Table 5-2.

When the runway is equipped with an ILS and/or MLS, the siting and the angle of elevation of the light units shall be such that the visual approach slope conforms as closely as possible with the glide path of the ILS and/or the minimum glide path of the MLS, as appropriate. The height of the pilot's eye above the aircraft's ILS glide path/MLS antenna varies with the type of aircraft and approach attitude. Harmonization of the PAPI signal and ILS glide path and/or MLS minimum glide path to a point closer to the threshold may be achieved by increasing the on-course sector from 20 to 30.

As an example, the PAPI elevation setting angles on a runway with a 3° ILS glide slope would be:

- Unit A: 2°25
- Unit B: 2°45
- Unit C: 3°15
- Unit D: 3°35

Where wing bars are installed on each side of the runway to provide roll guidance, corresponding units shall be set at the same angle so that the signals of each wing bar change symmetrically at the same time.

5.4 Distance from the Threshold

The optimum distance of PAPI from the runway threshold may be determined by:

1. the requirement to provide adequate wheel clearance over the runway threshold for all types of aircraft landing on the runway;
2. the requirement to provide the optimum compatibility between the visual and non-visual aids for the range of eye-to-antenna heights of the aircrafts regularly using the runway;
3. any difference in elevation between the PAPI units and the runway threshold.

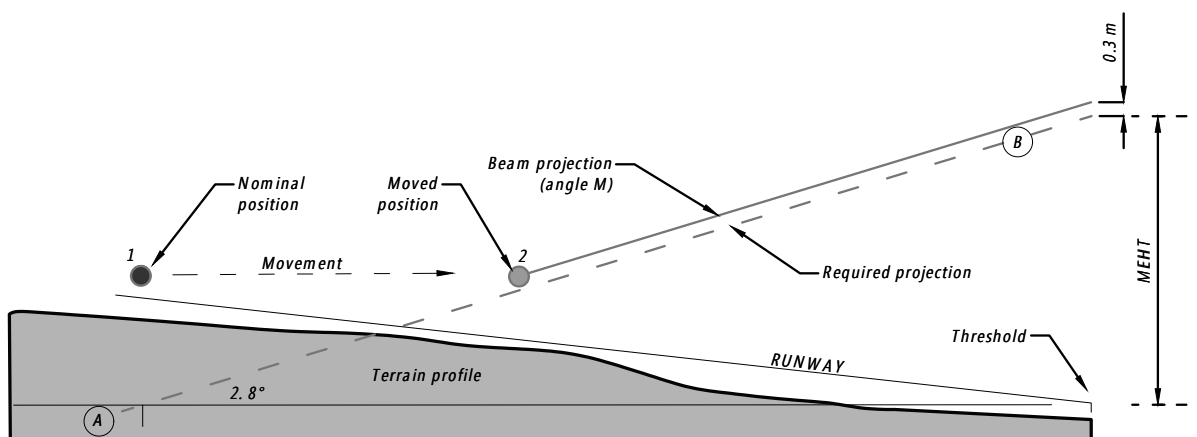
The distance of the PAPI units from the runway threshold may require modification from the optimum after consideration of:

1. the remaining length of runway available for the aircraft's landing roll;
2. obstacle clearance.

The angle M, that is 2 minutes of arc lower than the angle set to the unit B, is used to determine the minimum wheel clearance when computing the distance calculations of the PAPI system.

Regarding the difference in elevation between the PAPI units and the runway threshold, the D1 distance will be increased if the lens centre at the proposed site is lower than the runway threshold elevation and will be decreased if it is higher. The displacement is determined by dividing the difference in elevation by the tangent of angle M, see example in [Figure 13](#).

Figure 13: Example of PAPI location displacements due to ground elevation differences



The first option to envisage is to locate all units along a line that is horizontal and perpendicular to the runway centre line. However, in case the ground levels do not allow such ideal siting, it is possible to use a transverse slope of maximum 1.25% to compensate the transverse ground slopes at the location of the PAPI units. When this is not sufficient, other options exist such as reshaping the ground profile in the vicinity of the PAPI system, installing units in a line that is not perpendicular to the runway center line, or misaligning wingbars (in case of bilateral PAPI systems) or units within a wingbar. In any case, the location of the units forming a PAPI system must always appear to the pilot of an approaching airplane as to be in a horizontal line.



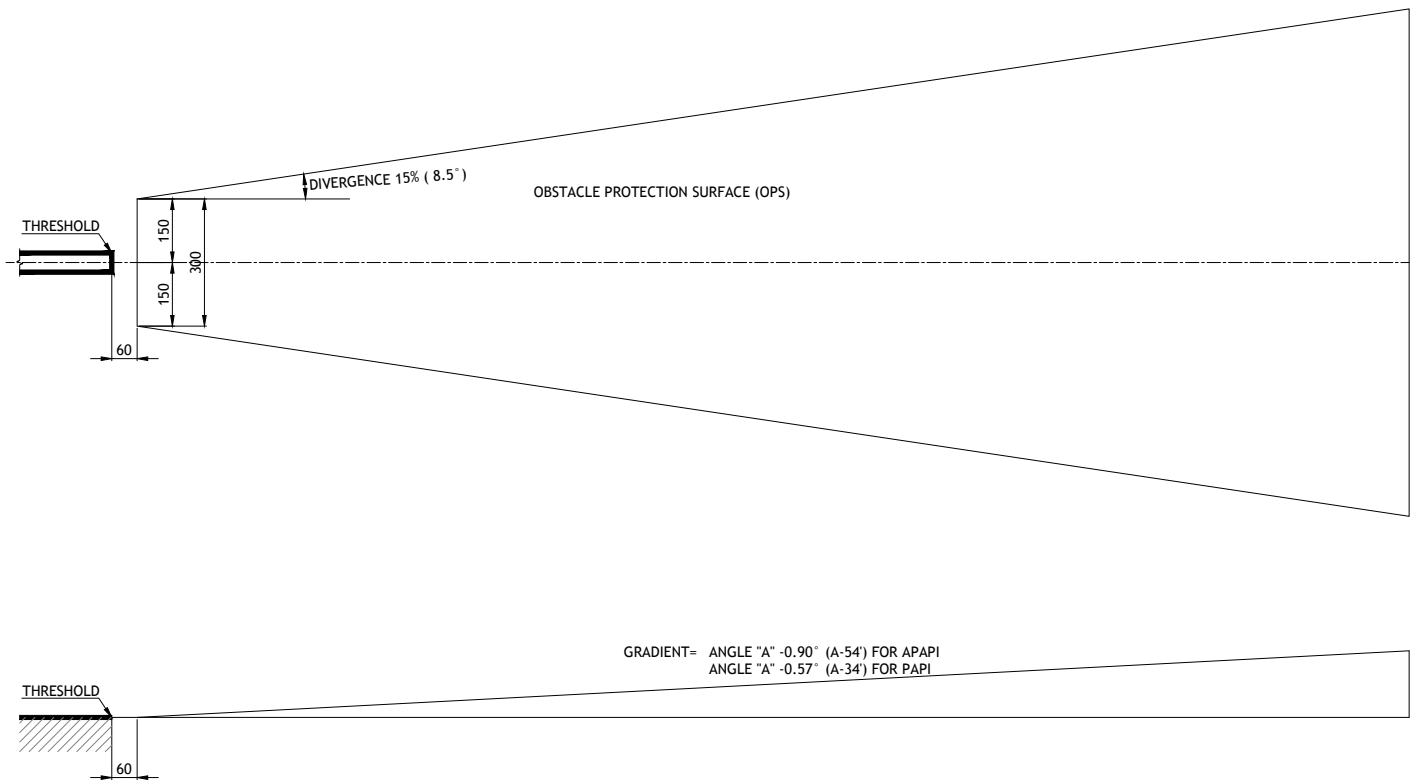
Note

Please contact your ADB SAFEGATE representative if you need assistance for the determination of the PAPI siting calculation, as well as the associated aiming point location.

5.5 Obstacle Protection Surface

The characteristics of the obstacle protection surface are defined in ICAO Annex 14, specifically in the relevant column of Table 5-3 and in Figure 5-21.

Figure 14: ICAO PAPI Obstacle Protection Surface Characteristics



Where an aeronautical study indicates that an existing object extending above an obstacle protection surface (OPS) could adversely affect the safety of operations of aircrafts, one or more of the following measures shall be taken:

1. remove the object;
2. suitably raise the approach slope of the system;
3. reduce the azimuth spread of the system so that the object is outside the confines of the beam;
4. displace the axis of the system and its associated obstacle protection surface by no more than 5°; and
5. suitably displace the system upwind of the threshold such that the object no longer penetrates the OPS.



Note

The displacement of the system upwind of the threshold reduces the operational landing distance.

If a PAPI system requires a reduction of the horizontal beam coverage because of an obstacle in the approach area, the following factors should be considered when determining the required system cutoff angle(s):

- Type and location of the obstacle with respect to the area where the PAPI signals can be observed.
- Wingspan of aircraft using the runway.
- Vertical pitch of the glideslope.
- Installation tolerances.
- Position of the PAPI system.
- Additional safety considerations.
- Origin of the cutoff angle should be either the outermost or innermost unit (whichever is closest in azimuth to the obstacle).
- Cutoff angles should be approved by the Airport Authority.

5.6 Siting Tolerances

PAPI units siting tolerances involve azimuth aiming, angle setting, mounting elevation tolerance and tolerance on their designed distance from the threshold.

5.6.1 Azimuth Aiming (Horizontal Alignment with Runway Centerline)

Each Light Unit shall be aimed outward into the approach zone on a line parallel to the runway centerline within a tolerance of $\pm 0.5^\circ$. ADB Safegate recommends azimuth aiming to be within a tolerance of 0° to 0.5° towards centerline.

5.6.2 Mounting Height Tolerance

The beam centres of all Light Units shall be within ± 1 inch (25 mm) of the designed elevations. The beam centre is located at the Beam Centre Mark (+) as depicted on Figure 9. The Light Unit EMT leg length is chosen by the installer to ensure the proper designed mounting height is achieved.

We recommend cutting the EMT at the adequate length on site once the final foundation elevation has been measured.

This tube will vary in length from 117 to 370 mm enabling to set the units with a beam height above foundation varying from 508 to 900 mm, thus with a top height not exceeding 1.2 m. Fine height adjustments are done with the threaded rods.

5.7 Additional Siting Considerations

Below are additional siting considerations.

Where the terrain drops off rapidly near the approach threshold and severe turbulence is experienced, locate the PAPI farther from the threshold to keep the aircraft at the maximum possible threshold crossing height.

On short runways, the PAPI should be as near the threshold as possible to provide the maximum amount of runway for braking after landing.

Contact your ADB representative for additional guidance if the PAPI Light Units must be installed at locations where snow is likely to obscure the light beams.

Since the effectiveness of the PAPI system is dependent on the optical red and/or white signal pattern from the Light Units, make sure that no other lights are close enough to confuse the pilot.

6.0 Baffle for Obstruction

Baffles modify the horizontal light beam from the light unit for obstacle avoidance in the approach area. ADB SAFEGATE LED PAPI baffles provide an adjustment capability to reduce the light beam from a full-width beam down to ± 4.0 degree of visible light. Note: FAA Engineering Brief No.95 cautions that a light beam of less than ± 3.0 degrees of visible light may not satisfy flight inspection criteria.

PAPI systems specified with baffles will include factory installed left and right side baffles on all light units. Each side can be adjusted independently. The baffles cannot be installed in the field, they are factory installed only.

Contact ADB SAFEGATE for more information or if you are not sure about the cut-offs required for your particular application.



Note

The estimated time required is 60 minutes per light unit.

To modify the horizontal light beam coverage of the light unit, perform the following procedure:

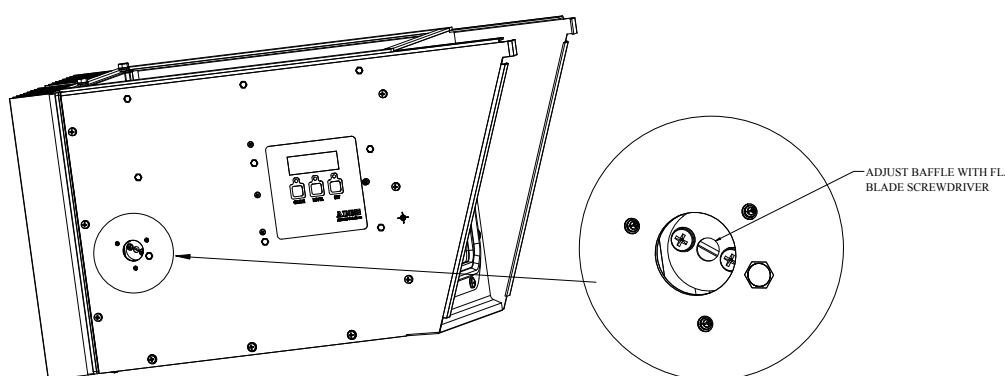
Depending on the location of the obstruction in the approach area (right or left side), adjust the baffle rod on the opposite side bulkhead. If both sides are obstructed, adjust one side completely first, then do the other side.



Note

The baffle adjustment rod is mounted on either the left or right side on the bulkhead.

Figure 15: Baffle Adjustment Rod



IF the obstacle is on the LEFT side of the approach area, then adjust the baffle adjustment knob on the RIGHT side. -OR- IF the obstacle is on the RIGHT side of the approach area, then adjust the baffle adjustment knob on the LEFT side. See [Figure 15](#).

Baffling right or baffling left requires adjusting the baffle on the opposite side of the light unit as the PAPI optics invert and flip the beam image. Each full rotation of the adjusting rod will change the amount of baffling by approximately 0.157 degree (9.4 minutes).



Note

It may be necessary to lower the light unit in elevation for the individual to see the light beam.

If this is the case, and the TILT function activates and turns the LEDs off, disable the TILT switch to restore power to the unit.

To disable the TILT switch, place the DIP switch SW2-2 on the control board to the ON (or UP) position. See [RELIANCE PAPI Control Board Overview](#) section for further explanation.

To meet FAA specification requirements, the TILT switch must be enabled.

Position someone equipped with a radio at the edge of the obstacle or as far out from the edge the beam where cutoff is desired. Move the baffle along the aperture of the baffle mounting plate until the light beam cut-off is seen by the individual who is standing in front of the obstacle. See [Figure 15](#).

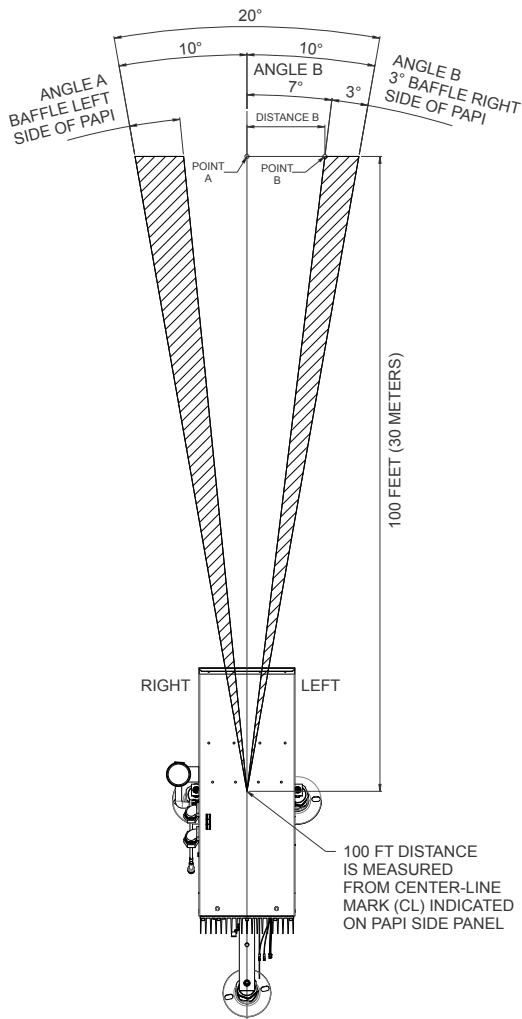


Note

To meet FAA specification requirements, the LED PAPI should be shipped with the baffle in the minimum baffle position. This can be verified by rotating the adjusting rod clockwise until resistance is felt. This indicates that the baffle is fully retracted. Movement of the baffle plate can be observed by looking through the front window of the PAPI.

6.1 For an Angle of 3 Degrees Baffle

Figure 16: Angle 3° Baffle



For the amount of baffling desired (in this instance 3 degrees), calculate the distance B required to provide visual indication of the angle. Base the calculation on the 100 foot (30.5 m) distance measured from the PAPI beam CL. Angle B will be the difference between the full PAPI beam angle (10 degrees) and the angular amount that is desired to be cut off.

1. Establish Point A: Measure 100 feet (30.5 m) from the CL mark on the side of the PAPI. Sight along the edges of the PAPI to determine the CL of the horizontal beam.

2. Establish Point B: Starting at point A, measure perpendicular to beam the distance calculated for the desired baffle angle (in this case, 12.3 feet (3.7 m) for 3° baffle).
The adjusting rod can now be rotated counterclockwise to baffle the PAPI. As the rod is rotated counterclockwise, the baffling will slowly increase. This can be observed directly by an observer on a ladder, or by vertically standing a painted pole at point B and watching for the beam edge to pass that point.



Note

If the terrain drops rapidly in front of the PAPI, the observer will require a ladder.



Note

Setting the baffle angle during the day will require the direct observation method (observer on a ladder). For a 3° elevation setting, the beam will rise a little over 5 feet (1.5m) in the 100 foot (30.5 m) distance. Setting the baffle angle at night allows for the use of a white painted pole to determine where the edge of beam is located.

For an Angle of 3 Degrees Baffle, the Angle B will be 7 degrees and for an observation distance of 100 feet (30.5 m).

- Distance B = 100 ft (30.5 m)
- Angle B = 7°
- Distance B = 100 Tan 7° = 12.28 Feet (3.7m)

3. Remove small cover plate from the side of the PAPI to expose the baffle adjustment rod.



CAUTION

Failure to follow these warnings may result in equipment damage. The adjusting rod should rotate with little torque required. There are hard stops at minimum baffle and maximum baffle. DO NOT attempt to force the adjustment beyond these stops.

- To rotate the baffle adjusting rod, it is not necessary to loosen the adjusting rod fitting.
- Do not loosen the adjusting rod fitting or actuator fitting as this can compromise the seal integrity of the system.

4. Using a flathead screwdriver, rotate the adjusting rod as follows:
 - a. Counter-clockwise to increase amount of baffling.
 - b. Clockwise to decrease the amount of baffling.
5. Replace the cover plate.

7.0 Installation

This section provides instructions for installing the PAPI Light Units. Refer to airport project plans and specifications for specific installation instructions. The installation must conform to the applicable sections of the National Electric Code and local codes.

7.1 Safety Considerations

Read this installation section thoroughly before installing the equipment. A thorough understanding of system components and their requirements will promote safe and efficient installation. See FAA AC 150/5340-30 (current edition) and site plans and specifications for additional guidance on PAPI installation.



WARNING

Failure to follow these safety procedures can result in personal injury or death.

- Allow only qualified personnel to install ADB SAFEGATE and auxiliary equipment. Use only approved equipment. Using unapproved equipment in an approved system may void agency approvals. Observe the safety instructions in this document and all related documentation.
- Make sure all equipment is rated and approved for the environment where it is being used.
- Follow all instructions for installing components and accessories.
- Install all electrical connections in compliance with local and national codes and regulations.
- Use only electrical wire of sufficient gauge and insulation to handle the rated current demand. All wiring must meet local and national codes.
- Route electrical wiring along a protected path. Make sure it will not be damaged by moving equipment.
- Protect components from damage, wear and harsh environmental conditions.
- Allow ample clearance for maintenance, panel accessibility and cover removal.
- Protect equipment with safety devices as specified by applicable safety regulations.
- If safety devices must be removed for installation, reinstall them immediately after the work is completed and check them for proper functioning.
- The Light Unit cord set must be protected prior to installation.

7.2 Inspect the Equipment

Upon receipt of the PAPI system and before unpacking it, verify that the labeled equipment matches the bill of lading. Inspect all items for damage. Report any damage immediately to the carrier and send a copy to ADB SAFEGATE.

7.2.1 What's Included

Table 4: Components Supplied by ADB SAFEGATE

Component	L-880(L)/PAPI (4-box)				L-881(L)/APAPI (2-box)			
	Style A (Voltage)	Style B (Current)	Style B (Redundant)	Style B (Monitored)	Style A (Voltage)	Style B (Current)	Style B (Redundant)	Style B (Monitored)
Light Unit Assembly	4	4	4	4	2	2	2	2
Mounting Flange 62B0107-2	12	12	12	12	6	6	6	6
Frangible Coupling 44B0180	12	12	12	12	6	6	6	6
EMT Compression Coupling 77A0009	12	12	12	12	6	6	6	6
Electrical Frangible Coupling 62A0711	7	10	10	10	3	4	4	4
40 ft 6 Pin Inter-Box Cable 73A0178/40	3	3	3	3	1	1	1	1

Table 4: Components Supplied by ADB SAFEGATE

Component	L-880(L)/PAPI (4-box)				L-881(L)/APAPI (2-box)			
	Style A (Voltage)	Style B (Current)	Style B (Redundant)	Style B (Monitored)	Style A (Voltage)	Style B (Current)	Style B (Redundant)	Style B (Monitored)
6 Pin Female Power Cord If 8 ft 73A0176 If 18 ft 73A0176/18	3	3	3	3	1	1	1	1
6 Pin Male Power Cord If 8 ft 73A0180 If 18 ft 73A0180/18	4	3	3	3	2	1	1	3
2.5ft 6 Pin Female Power Cord 73A0175	1	-	-	-	1	-	-	-
16/2 Power Cord If 8 ft 73A0107/98 If 18 ft 73A0107/216	-	4	-	3	-	2	-	1
14/4 Power Cord If 8 ft EW00067-2.5-01 If 18 ft EW00067-6.0-01	-	-	4	1	-	-	2	1
6ft 16/2 L-823 Ext Cord 73A0108/6	-	-	-	1	-	-	-	1
Wye Connector EW00068-000-01	-	-	4	1	-	-	2	1
Cable Clamp 961-X 63A0563	7	6	6	6	3	2	2	2
Cable Clamp L804RGL (Wye) 63A0563/1	-	-	4	1	-	-	2	1

Note: 16-14 AWG butt splices and heat shrink provided for field circuit splicing for voltage powered light units, see [Field Cabling Diagrams](#) for details.

For Installations That Require A Longer Power Cord:

The power cord is available in 8 ft (2.4 m) or 18 ft (5.5 m) length. The 8 ft (2.4 m) length is adequate for most installations. For installations that require a longer power cord, the 18 ft (5.5 m) length can be supplied and cut-to-length on-site during installation.

When the longer power cord and Contractor Kit Items are specified together, a longer length conduit is provided to accommodate the longer length power cord.



Note

Power cord length is specified within the LED PAPI ordering code. See Ordering Code.

7.2.2 Required Materials Supplied by Others

Installing either the L-880(L)/APAPI or the L-881(L)/PAPI requires the following items, which must be supplied by others:

- 3/8-16 anchor bolts, 2 per leg; either expansion bolts and sleeves or J-bolts (M-12 is an expectable substitute)
- Aviation orange paint (used to paint the 2 in EMT legs); 12 oz. spray cans of orange paint are also available from ADB SAFEGATE (P/N 95A0008)
- Contractor supplied materials (See section Contractor Kit Items for details).

Base plates are available as optional sales order line item. Base plates are machined with 2in-11.5 NPS threads to match the threads of the provided 62A0711 Frangible Couplings. See [Field Cabling Diagrams](#) for details.

Contractor Kit Items

Items specified as "Contractor Supplied" are not included with the light unit. These items are typically provided by the contractor. However, as a convenience these items are available from ADB SAFEGATE as an option within the ordering code or they can be provided as an optional "Contractor Kit":

AK00031-XX1-01 for 8 ft power cord (see [Table 5](#) to choose your configuration).

AK00031-XX2-01 for 18 ft power cord (see [Table 5](#) to choose your configuration).

Table 5: Contractor Kit Items

Component	L-880(L)/PAPI (4-box)			L-881(L)/APAPI (2-box)		
	Style A (Voltage)	Style B (Current)	Style B (Redundant)	Style A (Voltage)	Style B (Current)	Style B (Redundant)
Contractor Kit Part No.	AK00031-A4X-01	AK00031-B4X-01	AK00031-R4X-01	AK00031-A2X-01	AK00031-B2X-01	AK00031-R2X-01
2 in x 13 in EMT Leg 60A4516	12	12	12	6	6	6
1-1/4 in x 8 ft Liquid-Tight Conduit If 8ft 60A4620/8 If 18ft 60A4620/18	7	10	10	3	4	4
1-1/4 in Liquid-Tight Fitting 77A0265	7	10	10	3	4	4
1-1/2 in x 1-1/4 in Bushing 77A0266	7	10	10	3	4	4

2-inch diameter EMT tubing (2-3/16 in OD) to be provided and installed by contractor. Length to be determined at installation to adjust for uneven terrain and to mount optical box at correct elevation above the runway. To ensure stable installation, the EMT tubing shall extend 3-1/4 inches into the frangible coupling and full insertion into compression coupling.

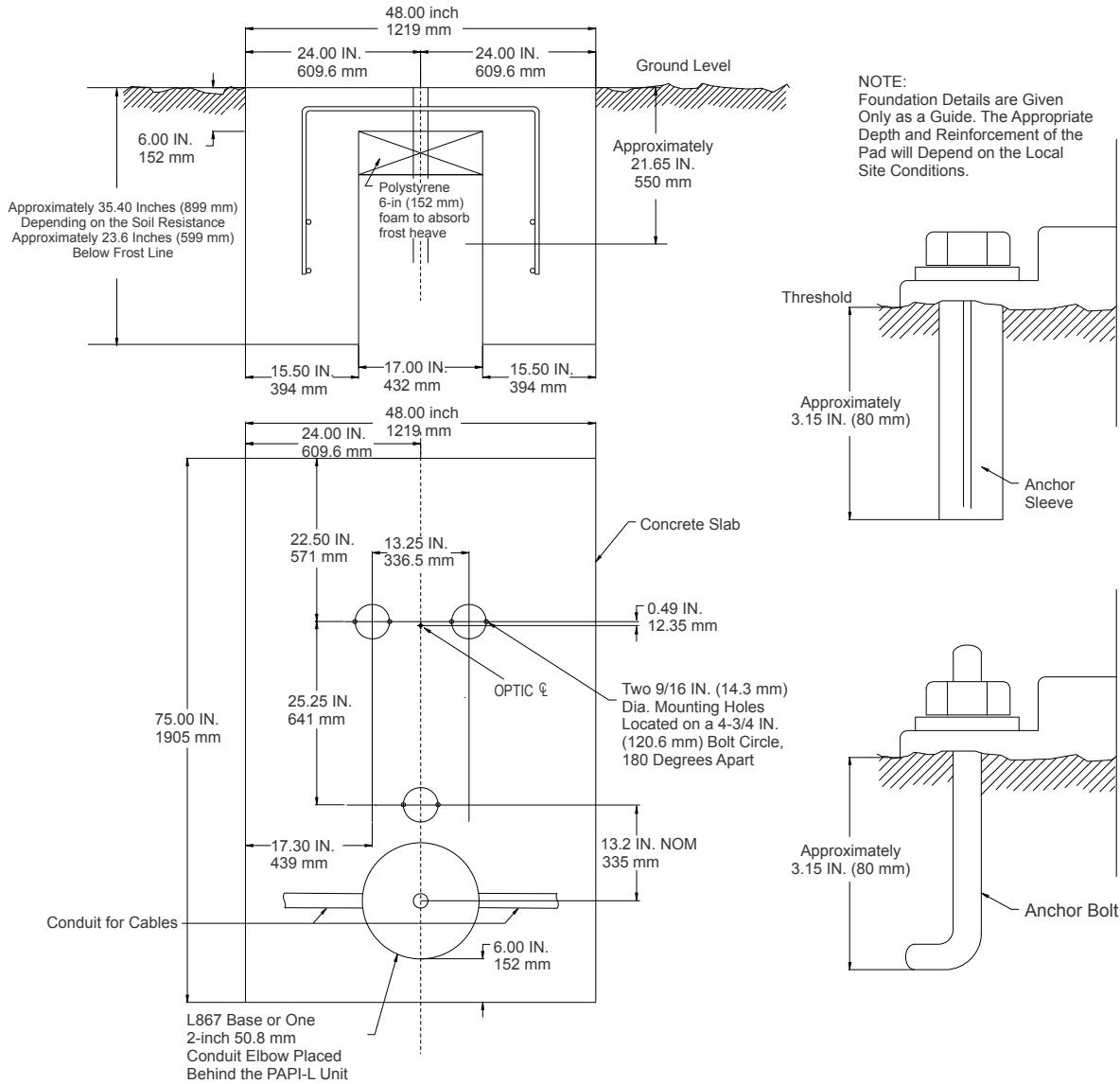
The EMT tubing must be painted international orange per FED-STD-595, color 12197 to provide corrosion protection.

7.3 PAPI Foundations

The PAPI light units shall be installed on concrete pads at ground level with frangible couplings. The foundation should extend at least 12 inches (300 mm) below the frost line and at least 1 foot (300 mm) beyond the light unit to minimize damage from mowers. Figure 17 through Figure 18 show dimensions that are generally acceptable for the concrete pad for the LED PAPI.

For series circuit (Style B) applications, high voltage field cables and low voltage communication cables must have separate conduit runs. See Figure 79.

Figure 17: Installation on Concrete Pad



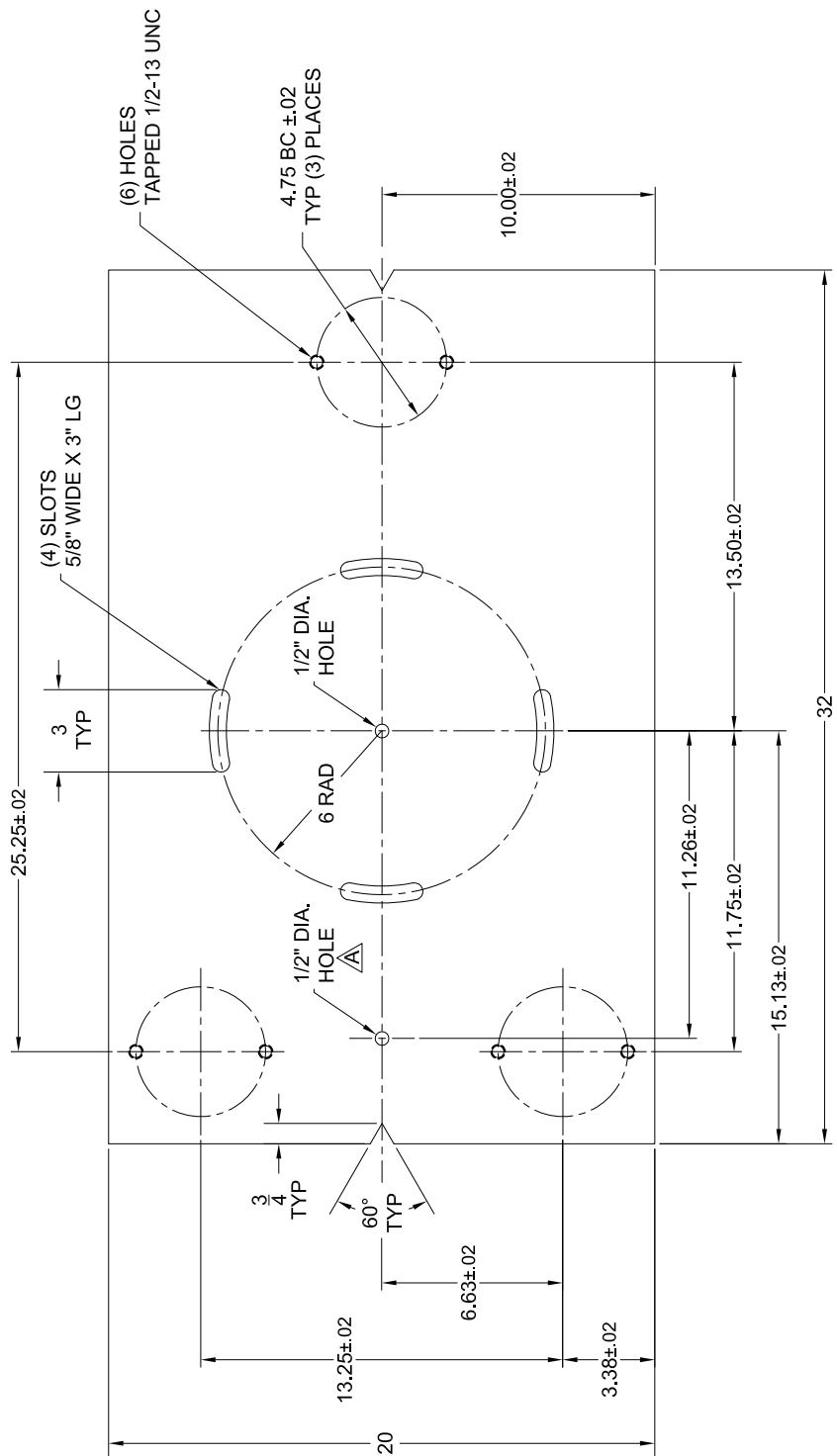
Installation on Concrete Pad (LED, Three-Leg PAPI-L)

To cast the concrete pad and anchor the support fixtures, perform the following procedure:

1. Stake out the longitudinal axis of the light units parallel to the runway centerline.
2. Dig the foundation hole per Figure 17.
3. Place polystyrene foam in pit to absorb frost heave below the central part of the slab. Place L-867 light base/conduit elbows or pipes for cables. Place bars for reinforcement of concrete.
4. Pour in concrete and allow it to harden for at least one day.
5. After concrete sets up, using chalk draw a longitudinal axis (in accordance with the axis staked out on the ground) on the upper surface of the pad. Draw a transverse axis perpendicular to the other axis.

6. See Figure 18. Lay a positioning plate on the pad; center it by positioning the central hole at the intersection of both axes; align the plate along the longitudinal axis using the V-notches in the plate.
7. Mark the six locations of the screws on the slab; drill the six holes to the diameter and depth required for the expansion sleeves and insert the sleeves.
8. See Figure 18 to locate flanges using mounting templates. Place and fasten the flanges with two screws.

Figure 18: Positioning Plate



NOTES:

- 1) MATERIAL IS 1/2" THICK ASTM A36 HOT ROLLED STEEL
- 2) FINISH IS HOT DIP GALVANIZE

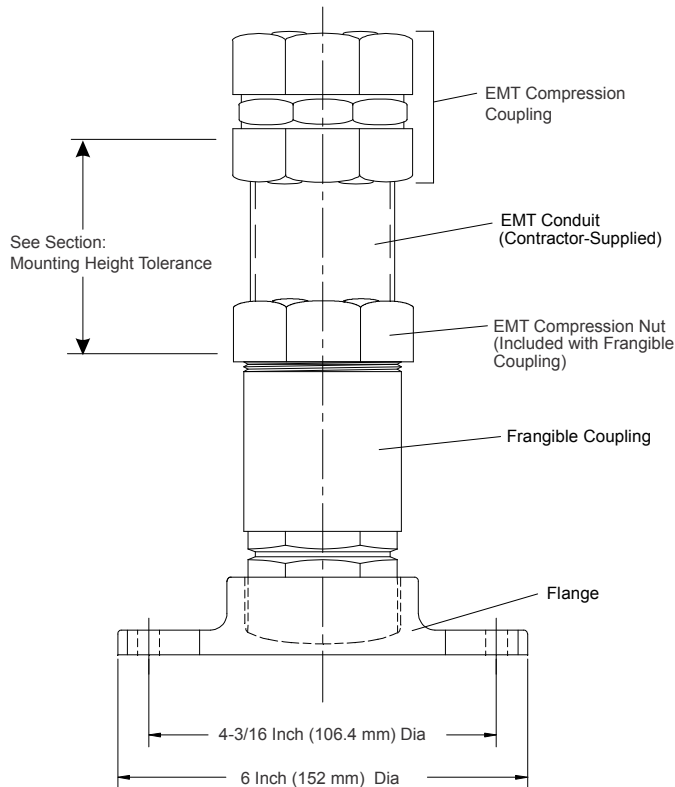
9. Install the frangible couplings. Make sure to place the second nut, ferrule compression joint, and ferrule ring on the bottom of the EMT tube first before screwing the tube with nuts, joints, and rings onto the frangible coupling. See [Figure 19](#).



Note

The contractor supplies and installs the 2-inch (50.8 mm) diameter (2-3/16 in OD) EMT tube. Determine length at installation to adjust for uneven elevation above the runway. See [Figure 9](#). The 2-inch EMT tube (2 3/16 in OD) extends into the frangible coupling ([Figure 19](#)) 3.25 in (82.55 mm) and 1-1/2 in (38.1 mm) into the nut and ferrule compression joint to ensure stable installation. Paint the tube according to Federal standard 595A, color #12197, international orange, to reduce corrosion. Instead of expansion sleeves, cast 3/8-16 x 6-inch anchor j-bolts into the concrete at the proper locations on a 4-3/16 in. (106.36 mm) diameter bolt circle, in two places.

Figure 19: Frangible Coupling

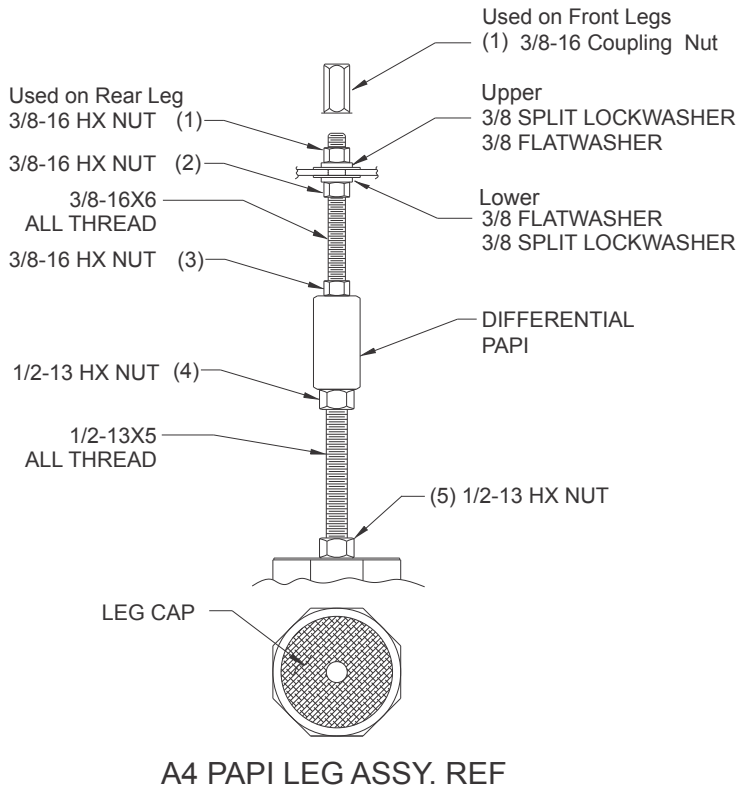


7.3.1 Adjustable Mounting Legs

See [Figure 20](#). The three adjustable mounting legs are each made up of two screw rods connected by a differential sleeve. The upper (smaller diameter) rod is fitted with nuts and locking nuts designed for coarse height setting of the unit.

The differential sleeve is used for the fine adjustment setting of the unit. The lower (larger diameter) rod is inserted into a conduit column with frangible coupling held in place by a flange bolted on a concrete pad.

Figure 20: Adjustable Mounting Legs



7.3.2 Assembling Adjustable Legs

Assemble the legs for each light unit as follows:

1. See [Figure 20](#). Screw threaded rods into differentials and assemble each leg.



Note

Do not assemble upper hex nut (1), upper split lockwasher, and upper flatwasher. These items will be installed after the light unit is mounted on the legs. The threaded rods should only be threaded in $\frac{1}{4}$ of the length of the differential so there will be room for adjustment.

2. Screw front and rear leg assemblies into the frangible couplings installed on concrete pad.

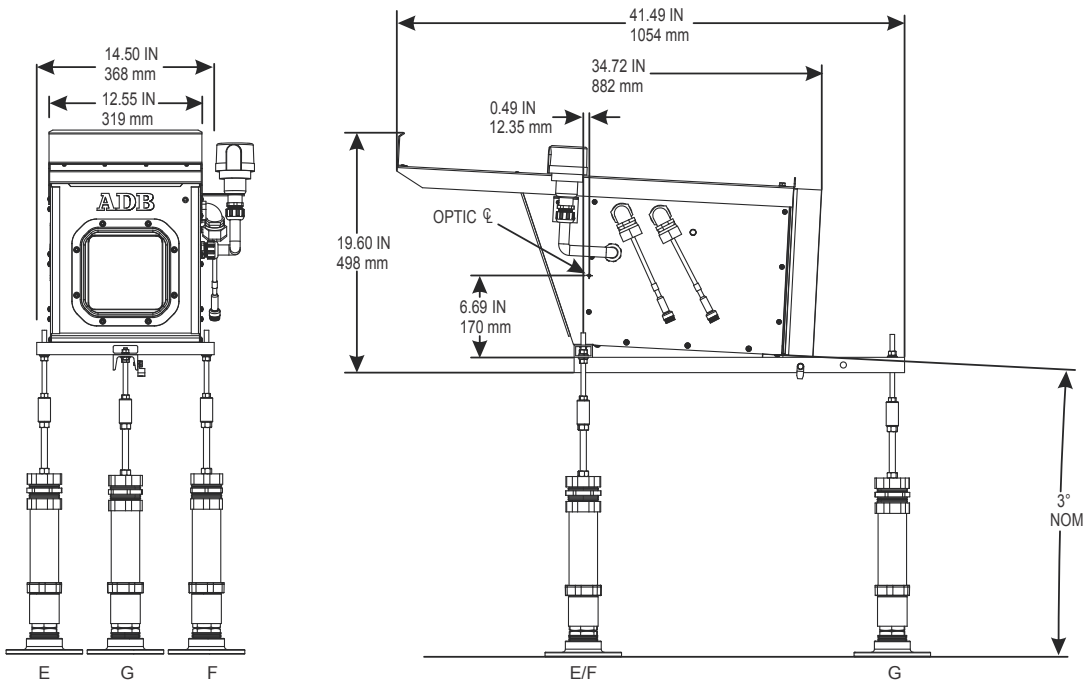
7.3.3 Mounting Unit

To mount the unit, perform the following procedure:

1. See [Figure 20](#). Gently mount the light unit on the three legs so that the unit rests on the top of the lower flatwasher, lockwasher, and hex nut (2).
2. Install the upper flatwasher, lockwasher, and hex nut (rear leg) (1) (coupling Nut for front legs) on the threaded rod. Do not tighten nuts.
3. Make sure the bottom of the light unit is resting on the top of the lower flatwasher of the right front leg F.

4. Make sure all locking nuts on the frangible couplings are tightened.

Figure 21: Mounting the PAPI-L Assembly to the Leg Assembly



7.4 System Wiring Connections



WARNING

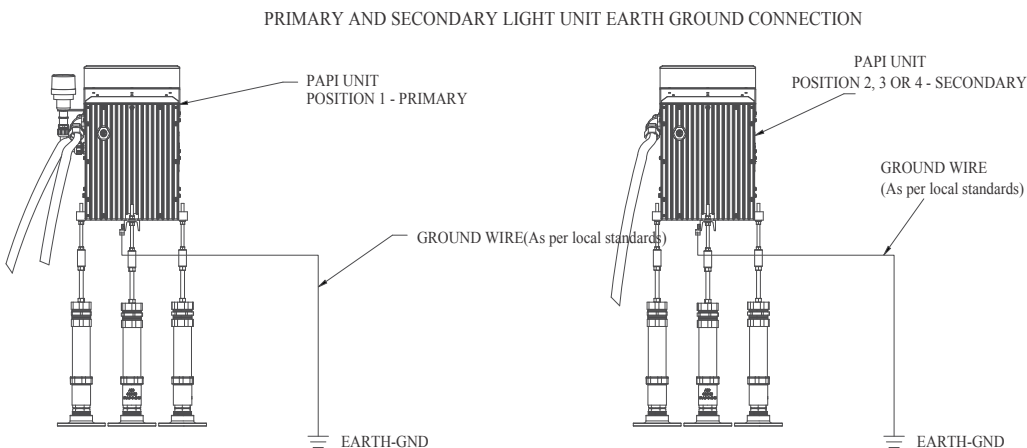
Before making any wire connections, make sure that you turn off all incoming power sources. Failure to observe this warning may result in personal injury, death, or equipment damage.

7.4.1 External Wiring Connections

External Grounding Connection for Each Light Unit

Each light unit must be grounded. To ground each light unit, attach a ground wire (with cross section as per local standards) to the ground lug located on the rear bottom side of each light unit. Connect ground wire to appropriate earth ground.

Figure 22: External Grounding Diagram



Field Cabling Connections Between Light Units

All installation wiring should conform to the applicable sections of the National Electric Code (US), other national and local codes.

Reference [Field Cabling Diagrams](#).

Field splice kit(s) are for use with attaching interconnection wiring. They are ordered as a separate line item than the PAPI system.



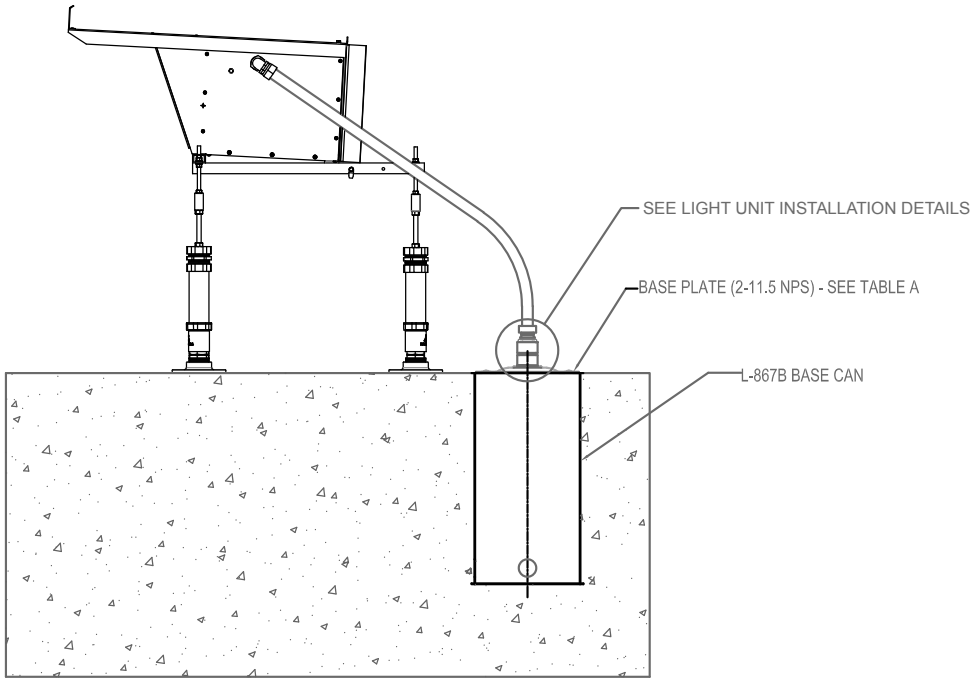
Note

All external wiring must be a minimum 16 AWG (15 mm²) 600 V wire.

Each electrical connection to the light unit must have frangibility. Frangible couplings are provided with the light unit. See [Figure 23](#) and [Figure 24](#) for details.

Each conduit entry into the PAPI enclosure should be sealed with duct seal or appropriate methods to prevent moisture from entering the PAPI enclosure.

Figure 23: One Hub Installation



ONE CONDUIT
SEE TABLE B FOR USAGE

TABLE A - 12" NOM DIA BASE PLATES - SYSTEM REQUIREMENTS					
SYSTEM	QTY	JAQUITH	MILLERBERND	ALE	DESCRIPTION
2 BOX PAPI A	1	AP1932G	1932G	ALE1932G	L-867B BASE PLATE 1/8"TH 1 HUB 2" NPS 12" DIA
	1	AP1832-2G	1832G/2	ALE1832/2G	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA
4 BOX PAPI A	1	AP1932G	1932G	ALE1932G	L-867B BASE PLATE 1/8"TH 1 HUB 2" NPS 12" DIA
	3	AP1832-2G	1832G/2	ALE1832G/2	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA
	2	AP1832-3G	1832G/3	N/A	L-867B BASE PLATE 3/8"TH 3 HUB 2" NPS 12" DIA
2 BOX PAPI B	2	AP1832-2G	1832G/2	ALE1832G/2	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA
4 BOX PAPI B	2	AP1832-2G	1832G/2	ALE1832G/2	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA
	2	AP1832-3G	1832G/3	N/A	L-867B BASE PLATE 3/8"TH 3 HUB 2" NPS 12" DIA
2 BOX PAPI B REDUNDANT	2	AP1832-2PG	N/A	N/A	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA 1 WYE THR
4 BOX PAPI B REDUNDANT	2	AP1832-2PG	N/A	N/A	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA 1 WYE THR
	2	AP1832-3PG	N/A	N/A	L-867B BASE PLATE 3/8"TH 3 HUB 2" NPS 12" DIA 1 WYE THR
2 BOX PAPI B MONITORED	1	AP1832-2PG	N/A	N/A	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA 1 WYE THR
	1	AP1832-2G	1832G/2	ALE1832/2G	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA
4 BOX PAPI B MONITORED	1	AP1832-2PG	N/A	N/A	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA 1 WYE THR
	2	AP1832-3G	1832G/3	N/A	L-867B BASE PLATE 3/8"TH 3 HUB 2" NPS 12" DIA
	1	AP1832-2G	1832G/2	ALE1832/2G	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA

TABLE B - NUMBER OF CONDUITS				
POSITION	PAPI A 2 BOX	PAPI A 4 BOX	PAPI B 2 BOX	PAPI B & R 4 BOX
BOX 1	2	2	2	2
BOX 2	1	2	2	3
BOX 3		2		3
BOX 4		1		2

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Figure 24: Two Hub Installation

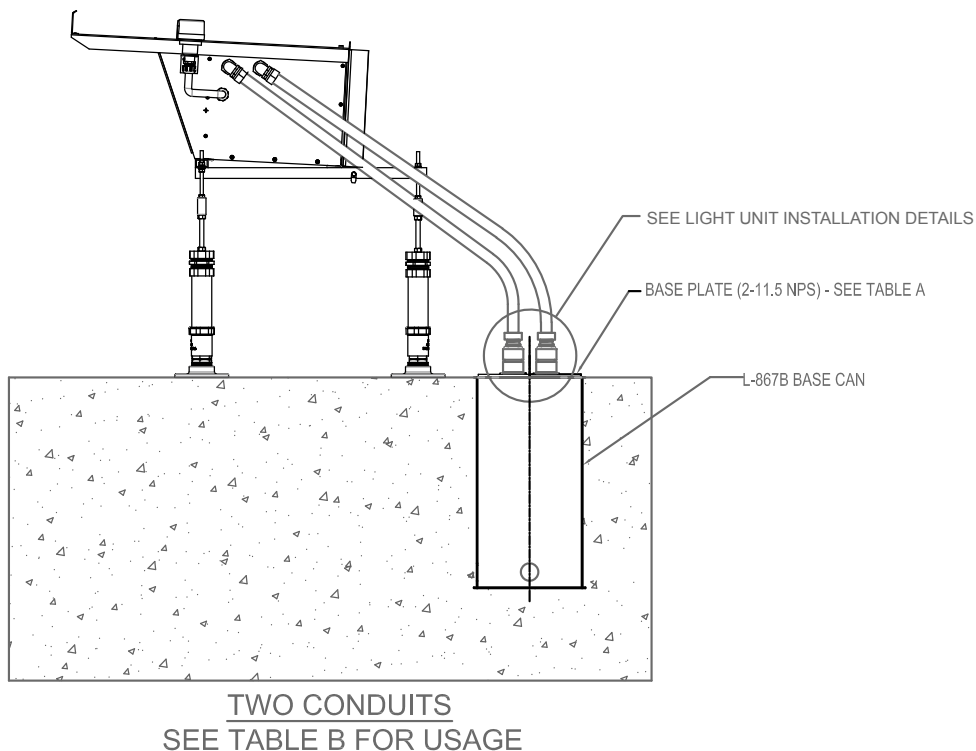


TABLE A - 12" NOM DIA BASE PLATES - SYSTEM REQUIREMENTS					
SYSTEM	QTY	JAQUITH	MILLERBERG	END ALE	DESCRIPTION
2 BOX PAPI A	1	AP1932G	1932G	ALE1932G	L-867B BASE PLATE 1/8"TH 1 HUB 2" NPS 12" DIA
	1	AP1832-2G	1832G/2	ALE1832/2G	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA
4 BOX PAPI A	1	AP1932G	1932G	ALE1932G	L-867B BASE PLATE 1/8"TH 1 HUB 2" NPS 12" DIA
	3	AP1832-2G	1832G/2	ALE1832G/2	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA
	2	AP1832-3G	1832G/3	N/A	L-867B BASE PLATE 3/8"TH 3 HUB 2" NPS 12" DIA
2 BOX PAPI B	2	AP1832-2G	1832G/2	ALE1832G/2	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA
4 BOX PAPI B	2	AP1832-2G	1832G/2	ALE1832G/2	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA
	2	AP1832-3G	1832G/3	N/A	L-867B BASE PLATE 3/8"TH 3 HUB 2" NPS 12" DIA
2 BOX PAPI B REDUNDANT	2	AP1832-2PG	N/A	N/A	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA 1 WYE THR
4 BOX PAPI B REDUNDANT	2	AP1832-2PG	N/A	N/A	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA 1 WYE THR
	2	AP1832-3PG	N/A	N/A	L-867B BASE PLATE 3/8"TH 3 HUB 2" NPS 12" DIA 1 WYE THR
2 BOX PAPI B MONITORED	1	AP1832-2PG	N/A	N/A	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA 1 WYE THR
	1	AP1832-2G	1832G/2	ALE1832/2G	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA
4 BOX PAPI B MONITORED	1	AP1832-2PG	N/A	N/A	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA 1 WYE THR
	2	AP1832-3G	1832G/3	N/A	L-867B BASE PLATE 3/8"TH 3 HUB 2" NPS 12" DIA
	1	AP1832-2G	1832G/2	ALE1832/2G	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA

TABLE B - NUMBER OF CONDUITS				
POSITION	PAPI A 2 BOX	PAPI A 4 BOX	PAPI B 2 BOX	PAPI B & R 4 BOX
BOX 1	2	2	2	2
BOX 2	1	2	2	3
BOX 3		2		3
BOX 4		1		2

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Figure 25: Three Hub Installation

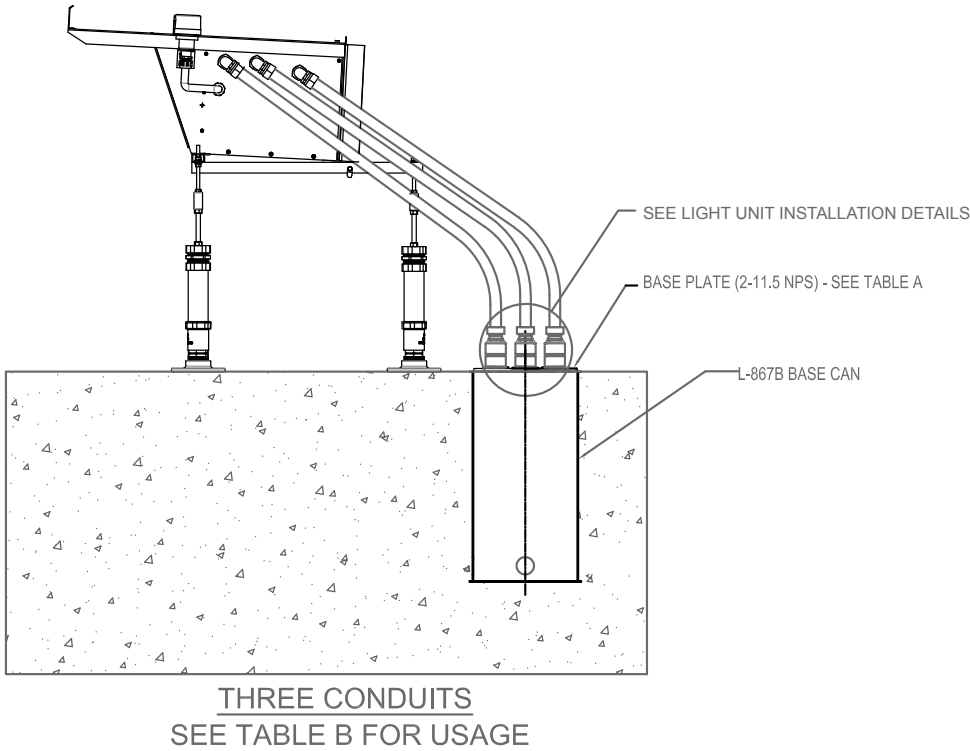


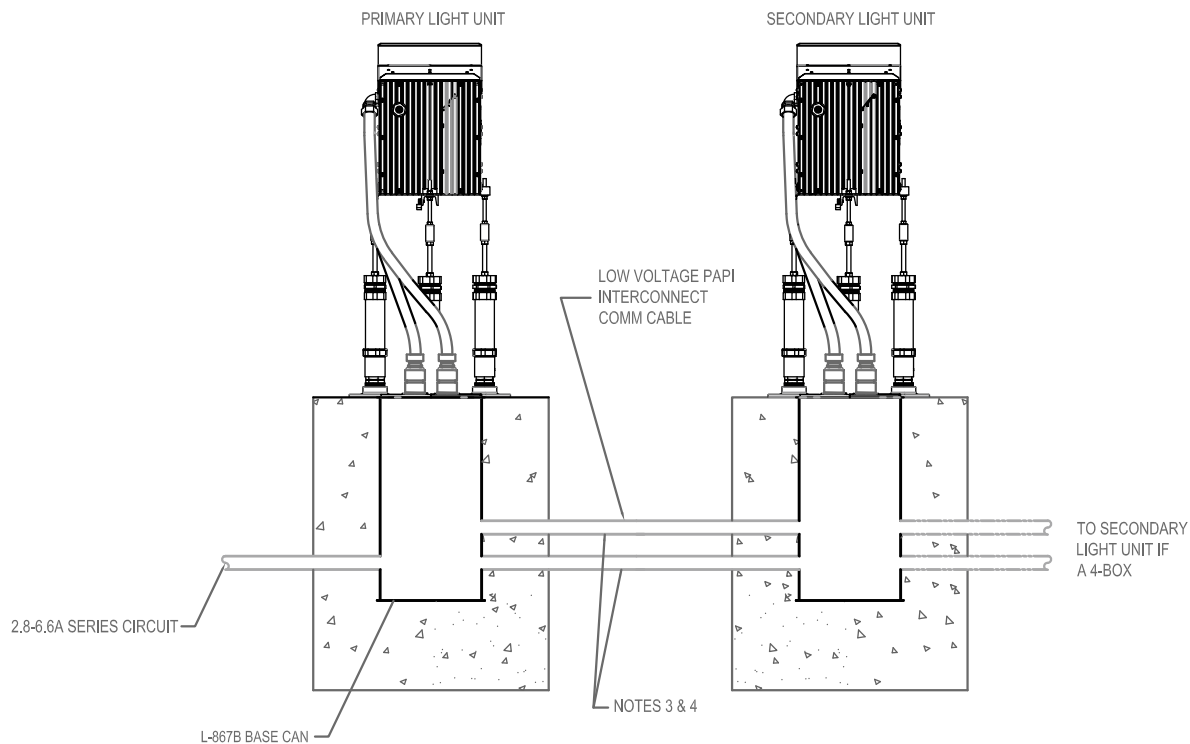
TABLE A - 12" NOM DIA BASE PLATES - SYSTEM REQUIREMENTS					
SYSTEM	QTY	JAQUITH	MILLERBERND	ALE	DESCRIPTION
2 BOX PAPI A	1	AP1932G	1932G	ALE1932G	L-867B BASE PLATE 1/8"TH 1 HUB 2" NPS 12" DIA
	1	AP1832-2G	1832G/2	ALE1832/2	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA
4 BOX PAPI A	1	AP1932G	1932G	ALE1932G	L-867B BASE PLATE 1/8"TH 1 HUB 2" NPS 12" DIA
	3	AP1832-2G	1832G/2	ALE1832G/2	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA
2 BOX PAPI B	2	AP1832-2G	1832G/2	ALE1832G/2	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA
4 BOX PAPI B	2	AP1832-2G	1832G/2	ALE1832G/2	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA
	2	AP1832-3G	1832G/3	N/A	L-867B BASE PLATE 3/8"TH 3 HUB 2" NPS 12" DIA
2 BOX PAPI B REDUNDANT	2	AP1832-2PG	N/A	N/A	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA 1 WYE THR
4 BOX PAPI B REDUNDANT	2	AP1832-2PG	N/A	N/A	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA 1 WYE THR
	2	AP1832-3PG	N/A	N/A	L-867B BASE PLATE 3/8"TH 3 HUB 2" NPS 12" DIA 1 WYE THR
2 BOX PAPI B MONITORED	1	AP1832-2PG	N/A	N/A	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA 1 WYE THR
	1	AP1832-2G	1832G/2	ALE1832/2	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA
4 BOX PAPI B MONITORED	1	AP1832-2PG	N/A	N/A	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA 1 WYE THR
	2	AP1832-3G	1832G/3	N/A	L-867B BASE PLATE 3/8"TH 3 HUB 2" NPS 12" DIA
	1	AP1832-2G	1832G/2	ALE1832/2	L-867B BASE PLATE 3/8"TH 2 HUB 2" NPS 12" DIA

TABLE B - NUMBER OF CONDUITS				
POSITION	PAPI A 2 BOX	PAPI A 4 BOX	PAPI B 2 BOX	PAPI B & R 4 BOX
BOX 1	2	2	2	2
BOX 2	1	2	2	3
BOX 3		2		3
BOX 4		1		2

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B

Figure 26: Conduit Installation



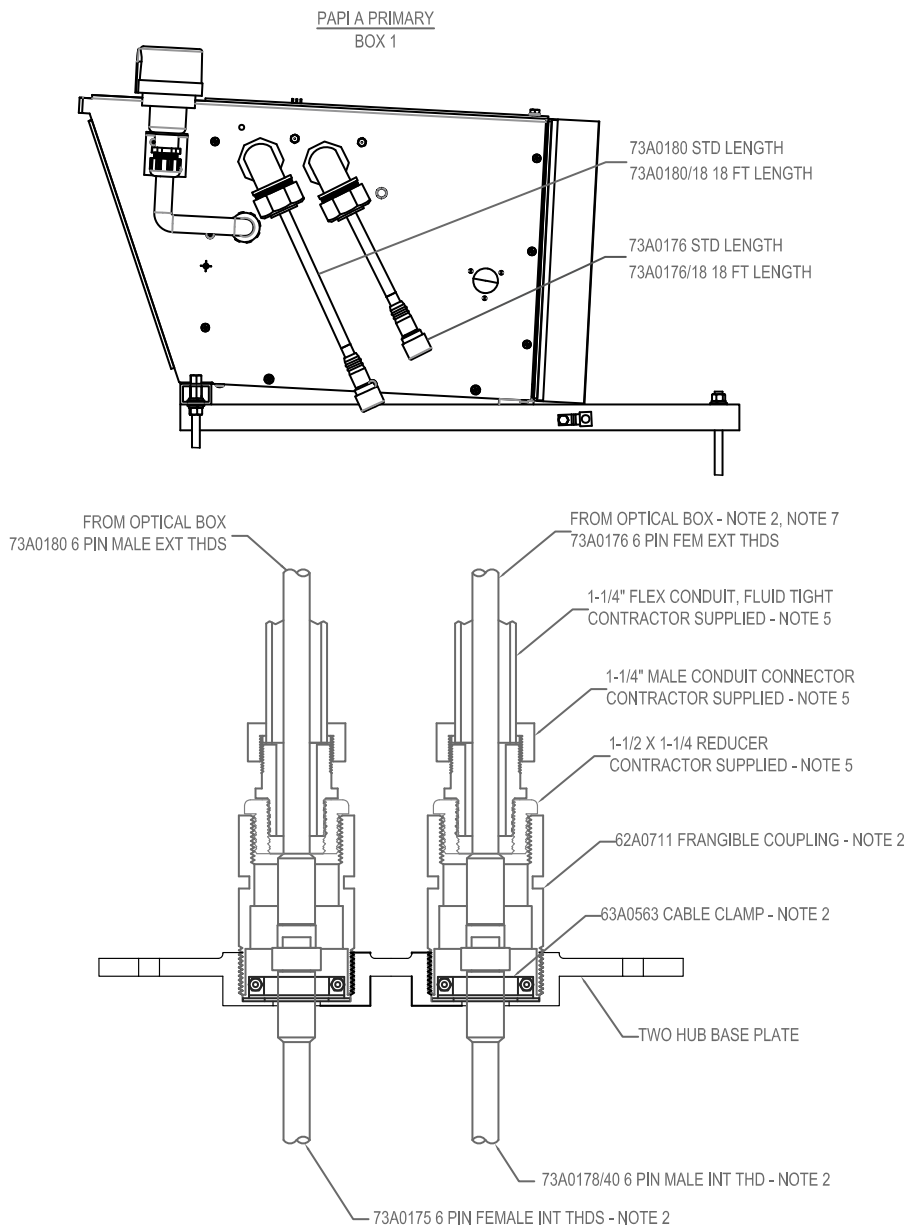
NOTES:

- 3. FOR SERIES CIRCUIT (TYPE B) APPLICATIONS, HIGH VOLTAGE FIELD CABLES AND LOW VOLTAGE COMMUNICATION CABLES MUST HAVE SEPARATE CONDUIT RUNS. SEE 43A4151 FOR LED PAPI STYLE B EXTERNAL WIRING DIAGRAM.
- 4. FOR VOLTAGE POWERED (TYPE A) APPLICATIONS, A SEPARATE HIGH VOLTAGE CONDUIT IS NOT REQUIRED.

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B

Figure 27: PAPI A Primary Light Unit Installation (Box 1)



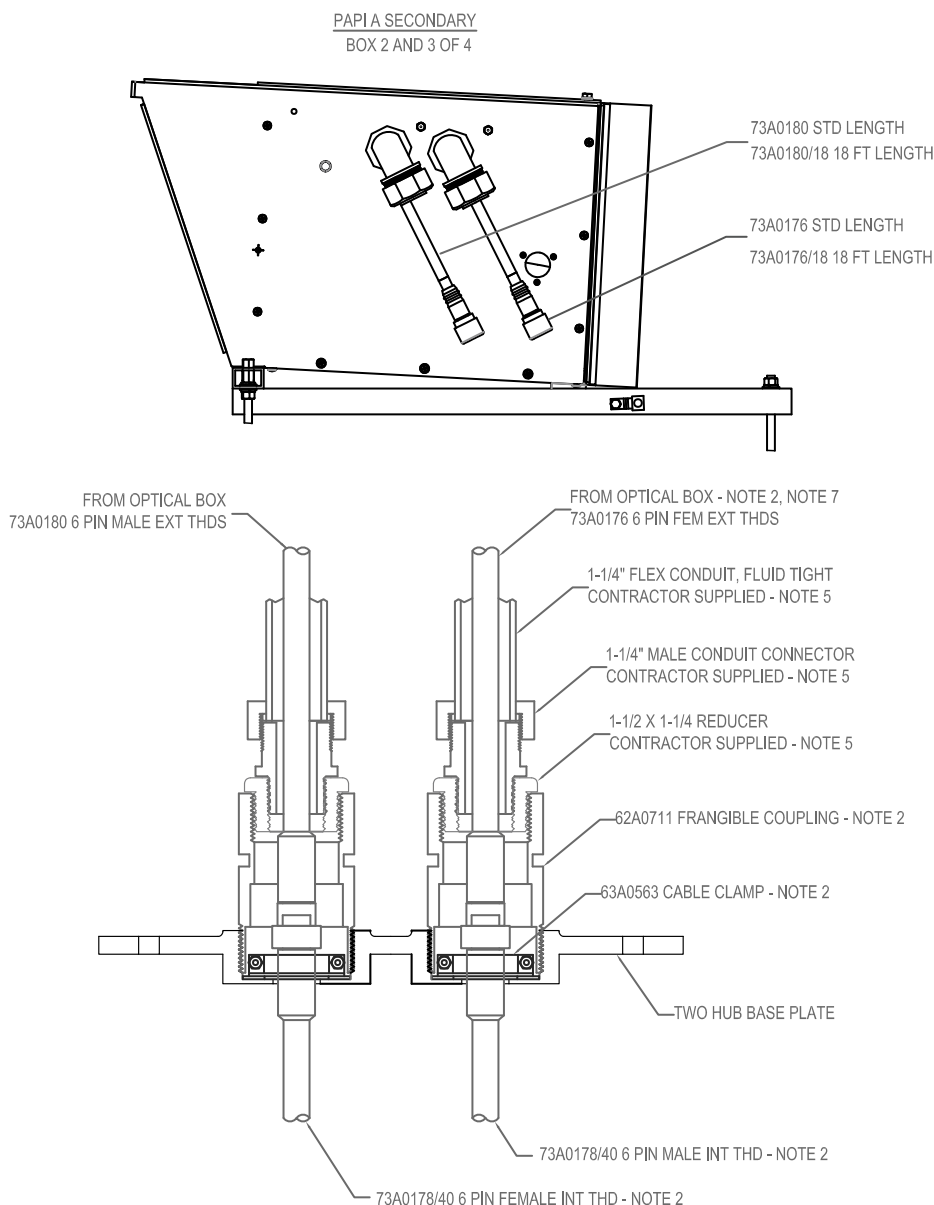
NOTES:

- 2. ITEMS PROVIDED WITH OPTICAL ENCLOSURE.
- 5. ITEMS SPECIFIED AS CONTRACTOR PROVIDED ARE AVAILABLE AS AN OPTION WHEN SPECIFYING THE TOP RPXXXXXXXXXX01 SYSTEM PART NUMBER.
- 7. THE STANDARD CORD LENGTH IS 8 FT LONG WITH 7 FT EXTENDING OUTSIDE THE ENCLOSURE. FOR THE CANADIAN MARKET, OPTIONAL (10 FT LONGER) CORDS ARE AVAILABLE AS AN OPTION WHEN SPECIFYING THE TOP RPXXXXXXXXXX01 SYSTEM PART NUMBER.

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B

Figure 28: PAPI A Secondary Light Unit Installation (Box 2 and 3 of 4)



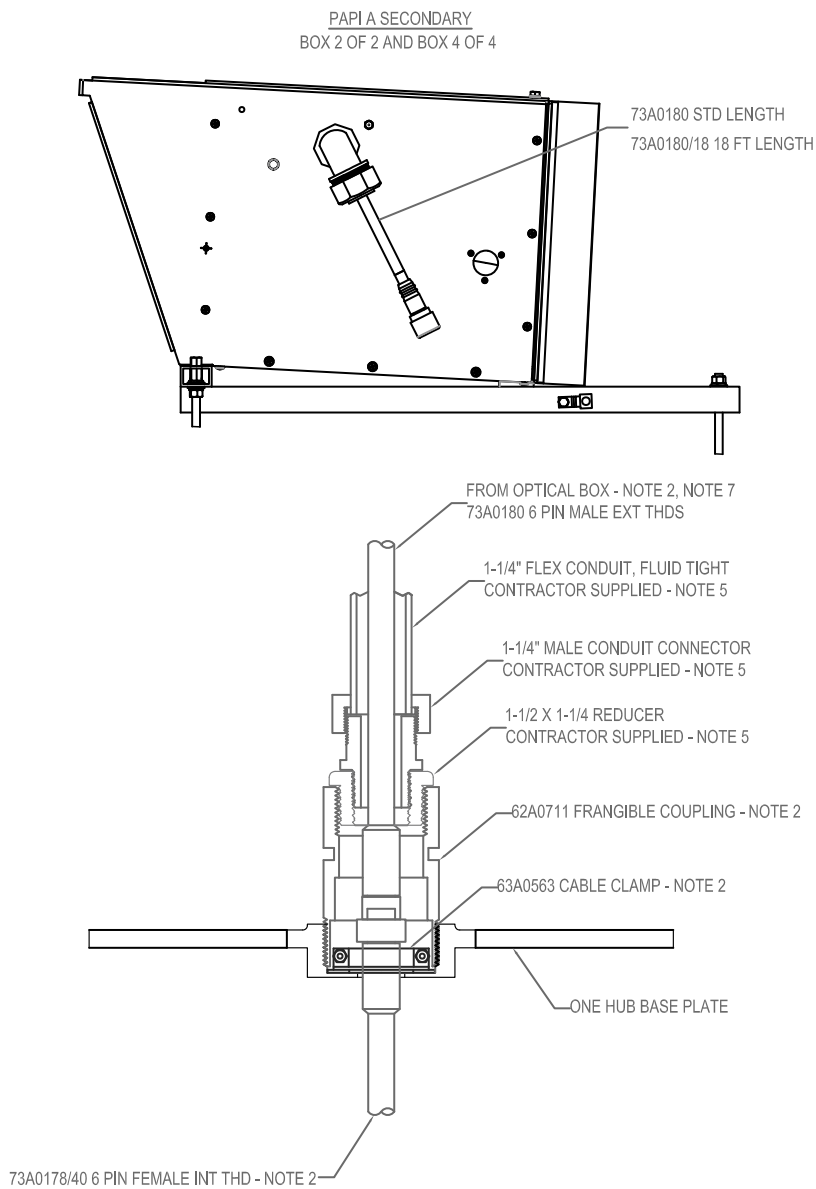
NOTES:

- 2. ITEMS PROVIDED WITH OPTICAL ENCLOSURE.
- 5. ITEMS SPECIFIED AS CONTRACTOR PROVIDED ARE AVAILABLE AS AN OPTION WHEN SPECIFYING THE TOP RPXXXXXXXXXX01 SYSTEM PART NUMBER.
- 7. THE STANDARD CORD LENGTH IS 8 FT LONG WITH 7 FT EXTENDING OUTSIDE THE ENCLOSURE. FOR THE CANADIAN MARKET, OPTIONAL (10 FT LONGER) CORDS ARE AVAILABLE AS AN OPTION WHEN SPECIFYING THE TOP RPXXXXXXXXXX01 SYSTEM PART NUMBER.

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Figure 29: PAPI A Secondary Light Unit Installation (Box 2 of 2 and 4 of 4)



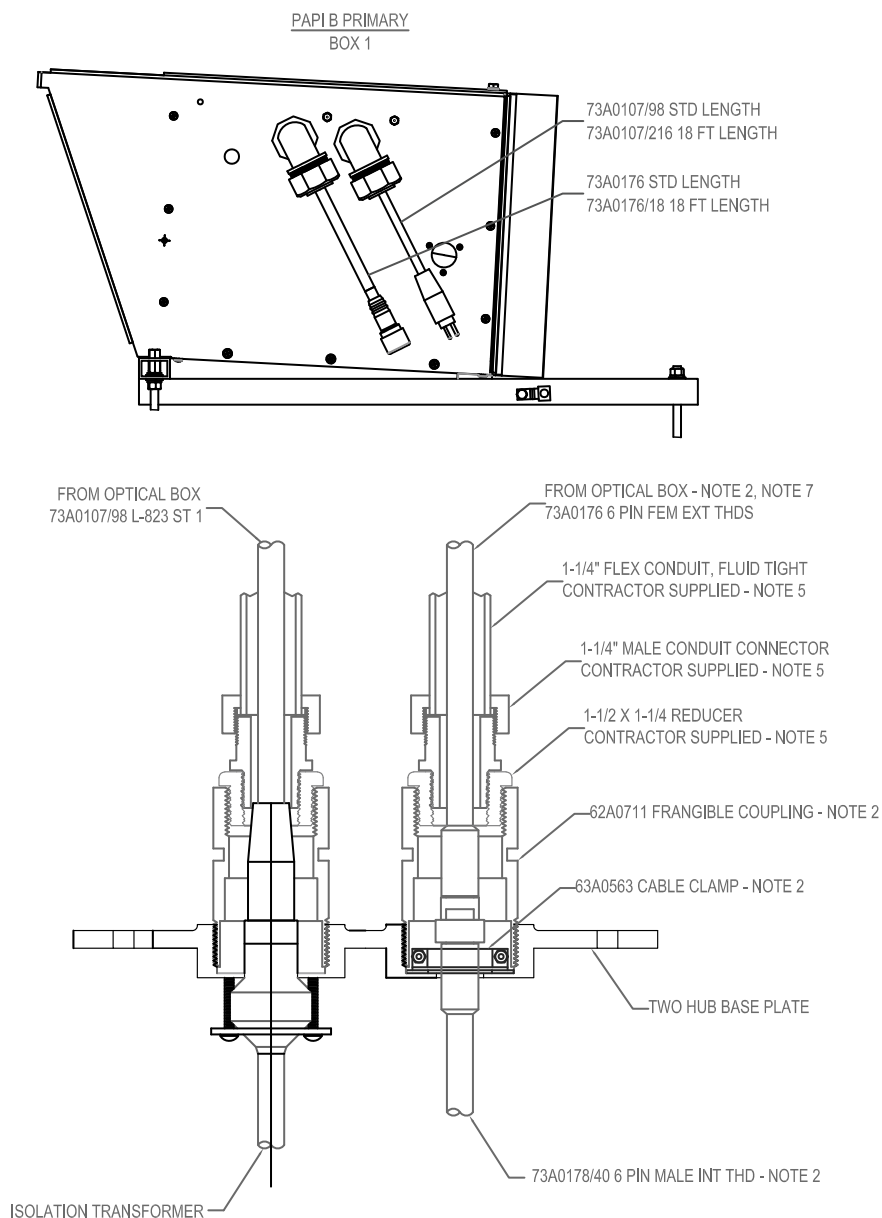
NOTES:

2. ITEMS PROVIDED WITH OPTICAL ENCLOSURE.
5. ITEMS SPECIFIED AS CONTRACTOR PROVIDED ARE AVAILABLE AS AN OPTION WHEN SPECIFYING THE TOP RPXXXXXXXXXX01 SYSTEM PART NUMBER.
7. THE STANDARD CORD LENGTH IS 8 FT LONG WITH 7 FT EXTENDING OUTSIDE THE ENCLOSURE. FOR THE CANADIAN MARKET, OPTIONAL (10 FT LONGER) CORDS ARE AVAILABLE AS AN OPTION WHEN SPECIFYING THE TOP RPXXXXXXXXXX01 SYSTEM PART NUMBER.

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B

Figure 30: PAPI B Primary Light Unit Installation (Box 1)



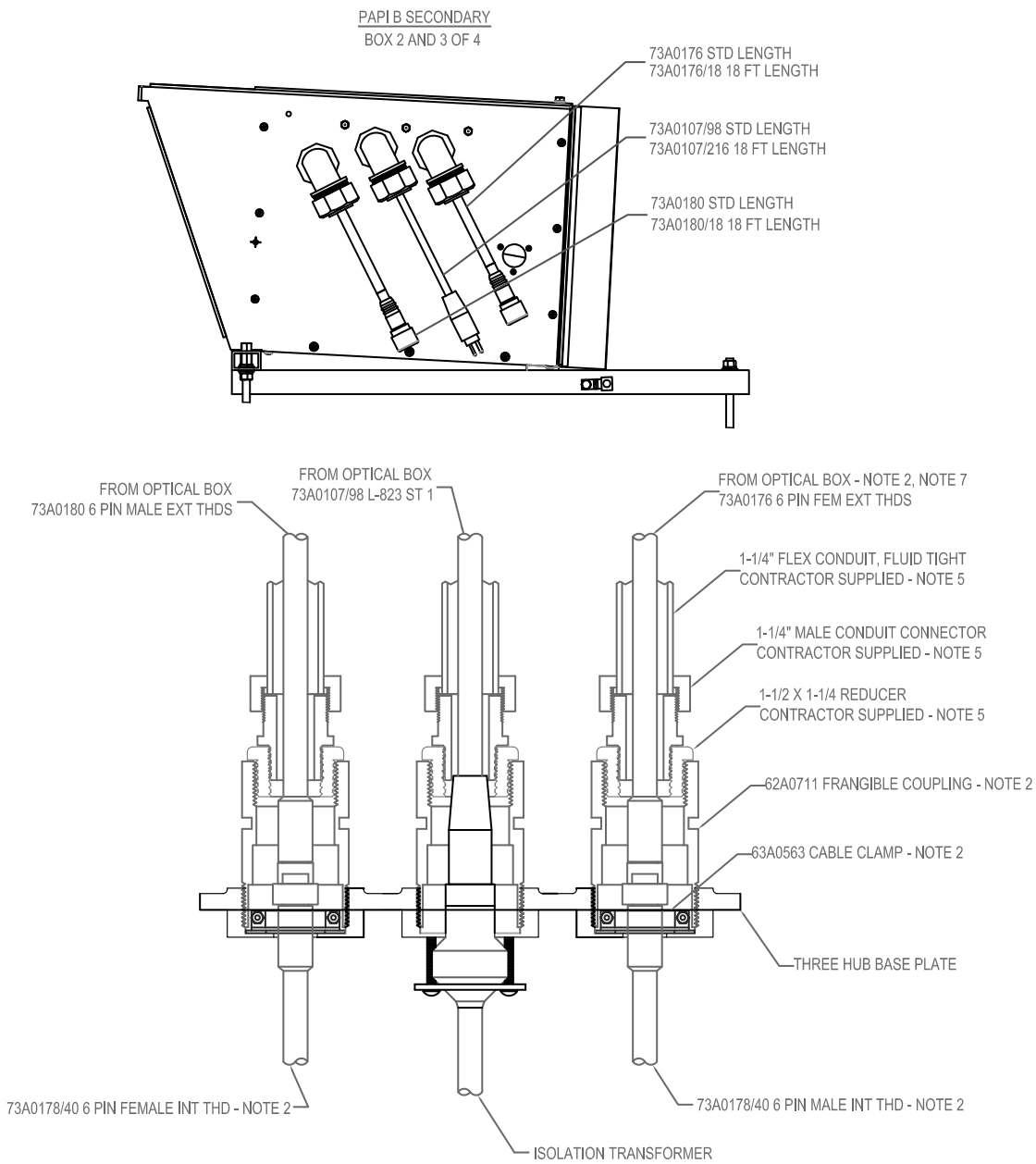
NOTES:

- 2. ITEMS PROVIDED WITH OPTICAL ENCLOSURE.
- 5. ITEMS SPECIFIED AS CONTRACTOR PROVIDED ARE AVAILABLE AS AN OPTION WHEN SPECIFYING THE TOP RPXXXXXXXXXX01 SYSTEM PART NUMBER.
- 7. THE STANDARD CORD LENGTH IS 8 FT LONG WITH 7 FT EXTENDING OUTSIDE THE ENCLOSURE. FOR THE CANADIAN MARKET, OPTIONAL (10 FT LONGER) CORDS ARE AVAILABLE AS AN OPTION WHEN SPECIFYING THE TOP RPXXXXXXXXXX01 SYSTEM PART NUMBER.

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B

Figure 31: PAPI B Secondary Light Unit Installation (Box 2 and 3 of 4)



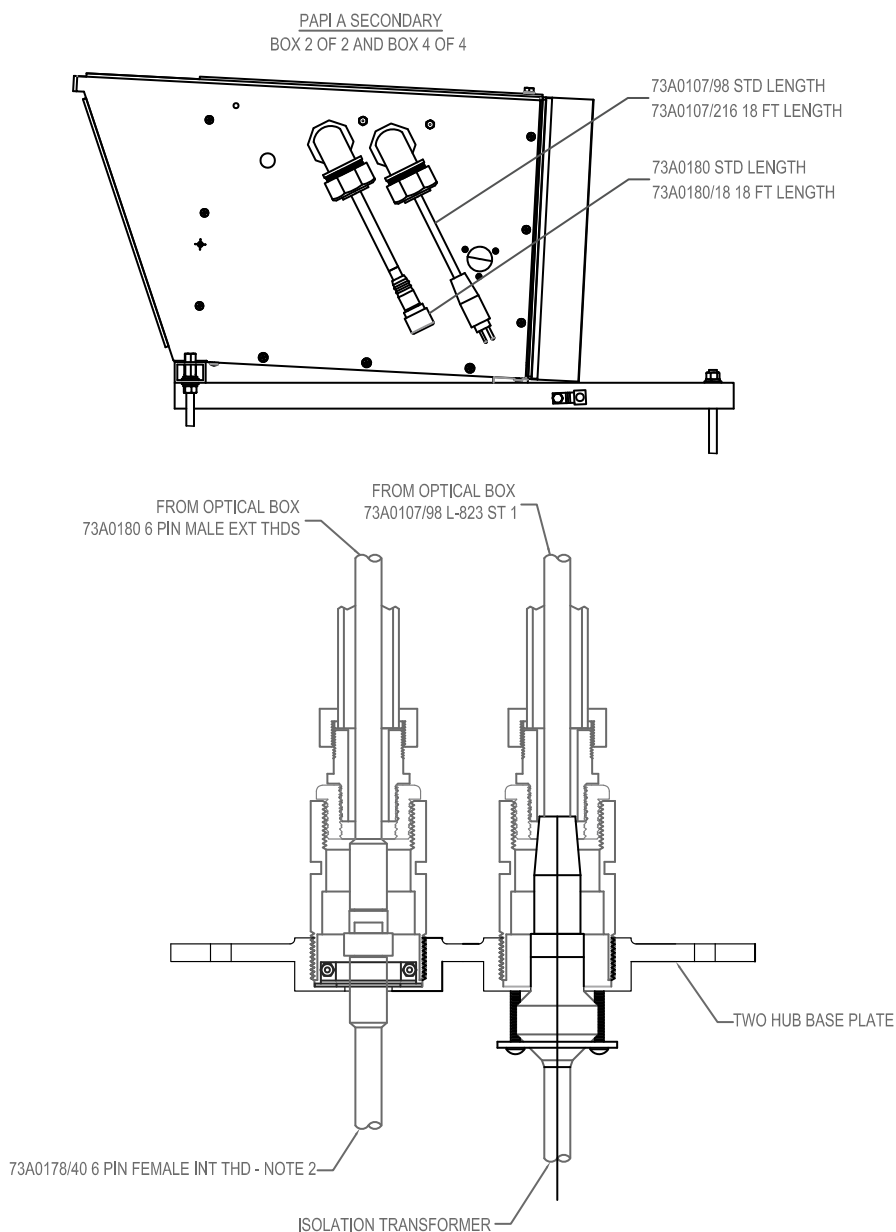
NOTES:

2. ITEMS PROVIDED WITH OPTICAL ENCLOSURE.
5. ITEMS SPECIFIED AS CONTRACTOR PROVIDED ARE AVAILABLE AS AN OPTION WHEN SPECIFYING THE TOP RPXXXXXXXXXX01 SYSTEM PART NUMBER.
7. THE STANDARD CORD LENGTH IS 8 FT LONG WITH 7 FT EXTENDING OUTSIDE THE ENCLOSURE. FOR THE CANADIAN MARKET, OPTIONAL (10 FT LONGER) CORDS ARE AVAILABLE AS AN OPTION WHEN SPECIFYING THE TOP RPXXXXXXXXXX01 SYSTEM PART NUMBER.

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B

Figure 32: PAPI B Secondary Light Unit Installation (Box 2 of 2 and 4 of 4)



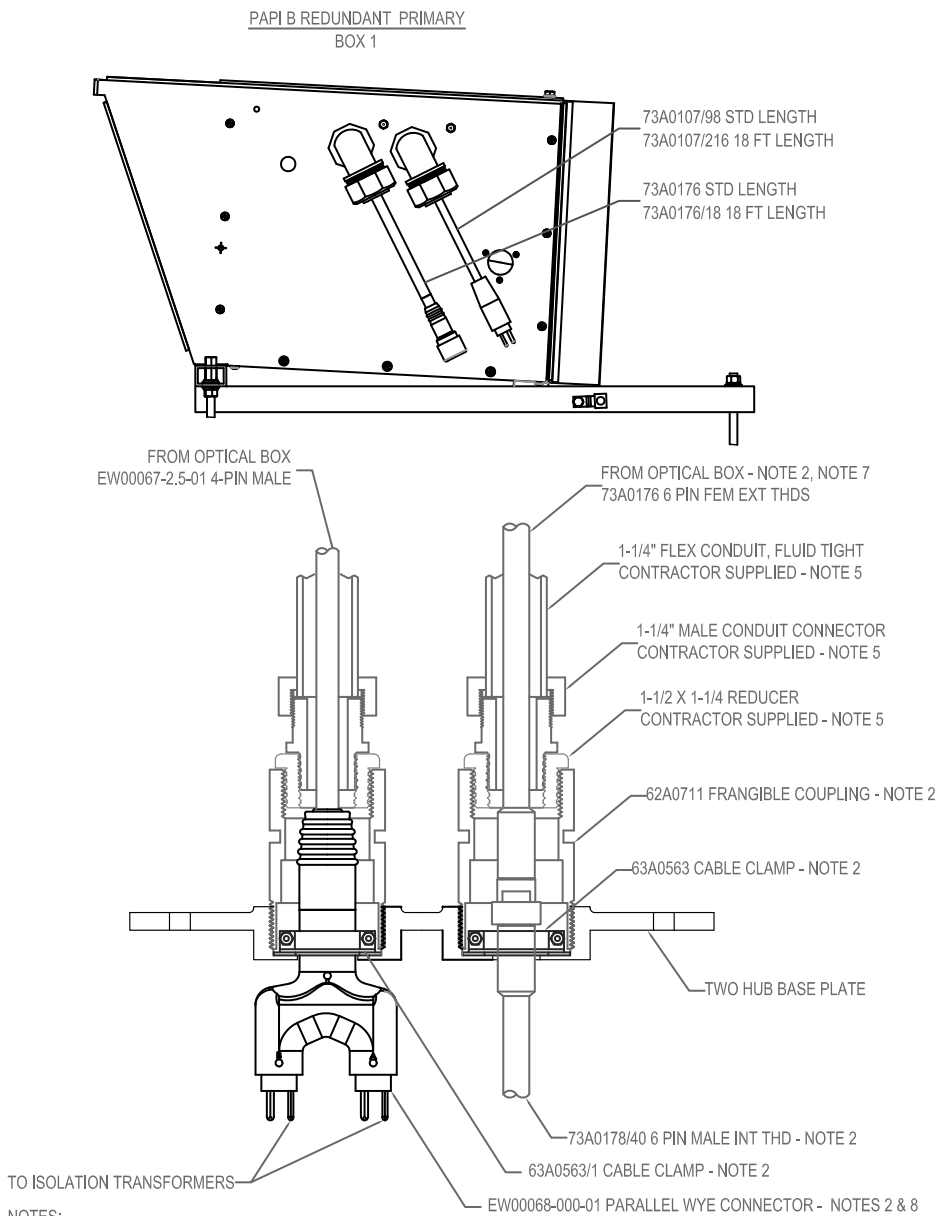
NOTES:

- 2. ITEMS PROVIDED WITH OPTICAL ENCLOSURE.
- 5. ITEMS SPECIFIED AS CONTRACTOR PROVIDED ARE AVAILABLE AS AN OPTION WHEN SPECIFYING THE TOP RPXXXXXXXXXX01 SYSTEM PART NUMBER.
- 7. THE STANDARD CORD LENGTH IS 8 FT LONG WITH 7 FT EXTENDING OUTSIDE THE ENCLOSURE. FOR THE CANADIAN MARKET, OPTIONAL (10 FT LONGER) CORDS ARE AVAILABLE AS AN OPTION WHEN SPECIFYING THE TOP RPXXXXXXXXXX01 SYSTEM PART NUMBER.

DA00026-XXX-01

B

Figure 33: PAPI B Redundant Primary Light Unit Installation (Box 1)



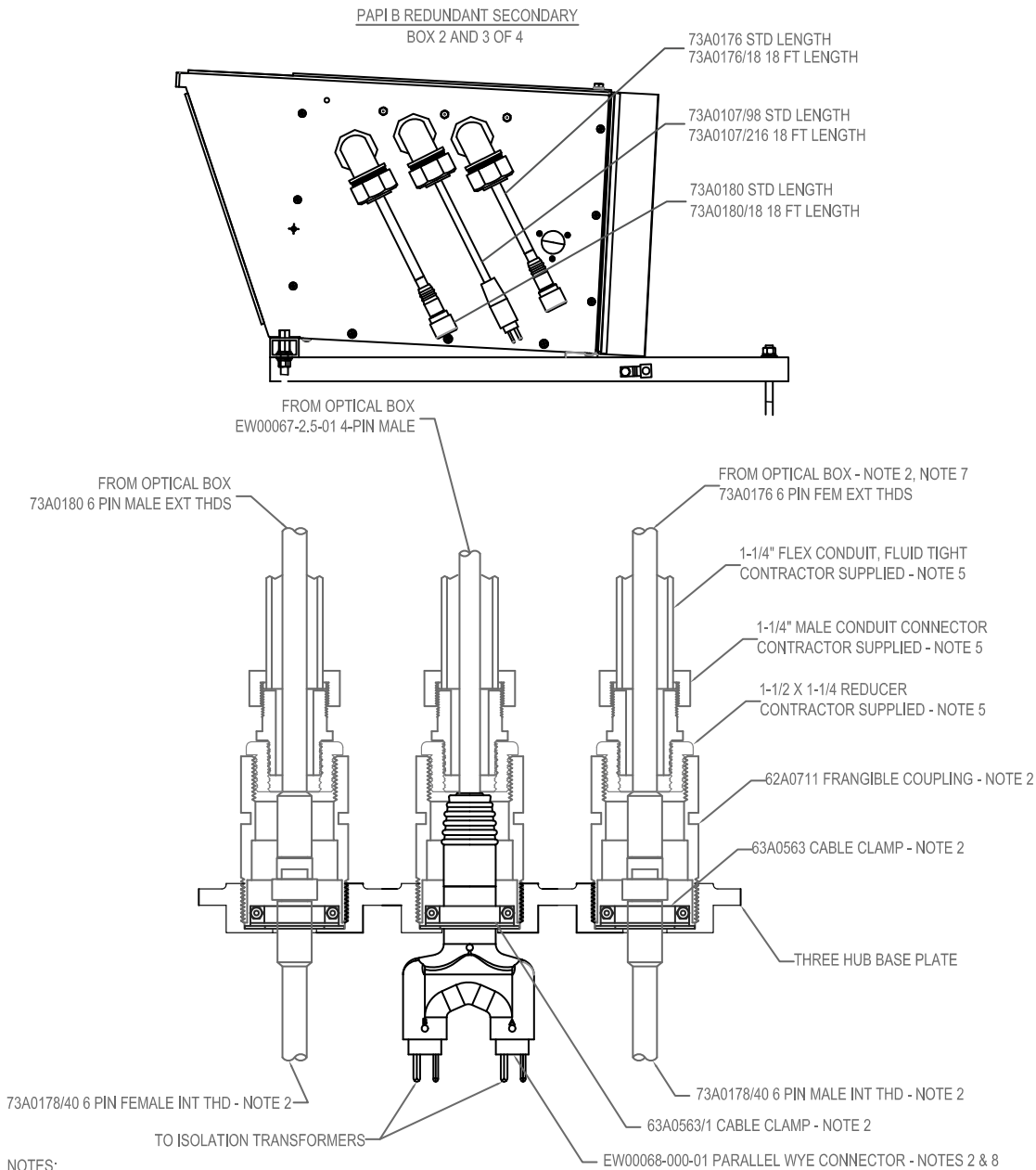
NOTES:

2. ITEMS PROVIDED WITH OPTICAL ENCLOSURE.
5. ITEMS SPECIFIED AS CONTRACTOR PROVIDED ARE AVAILABLE AS AN OPTION WHEN SPECIFYING THE TOP RPXXXXXXXXXX01 SYSTEM PART NUMBER.
7. THE STANDARD CORD LENGTH IS 8 FT LONG WITH 7 FT EXTENDING OUTSIDE THE ENCLOSURE. FOR THE CANADIAN MARKET, OPTIONAL (10 FT LONGER) CORDS ARE AVAILABLE AS AN OPTION WHEN SPECIFYING THE TOP RPXXXXXXXXXX01 SYSTEM PART NUMBER.
8. PAPI B REDUNDANT SYSTEM REQUIRES A 1.25" DIA THRU HOLE TO MOUNT THE EW00068-000-01 PARALLEL WYE CONNECTOR. THE BASE PLATES NOTED IN TABLE A FOR PAPI B REDUNDANT SYSTEMS HAVE THE REQUIRED 1.25" DIA THRU HOLE.

DA00026-XXX-01

B

Figure 34: PAPI B Redundant Secondary Light Unit Installation (Box 2 and 3 of 4)



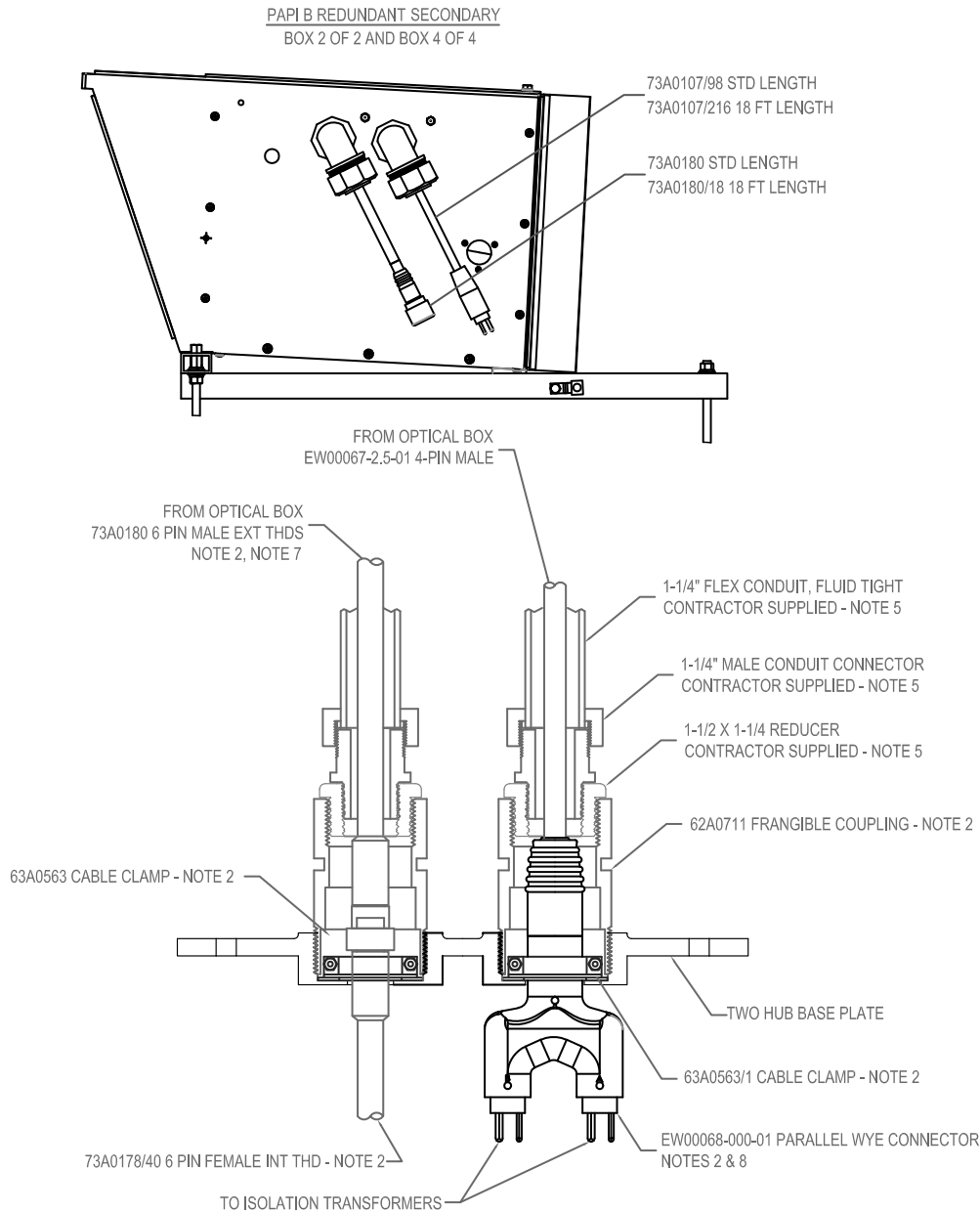
NOTES:

2. ITEMS PROVIDED WITH OPTICAL ENCLOSURE.
5. ITEMS SPECIFIED AS CONTRACTOR PROVIDED ARE AVAILABLE AS AN OPTION WHEN SPECIFYING THE TOP RPXXXXXXXXXX01 SYSTEM PART NUMBER.
7. THE STANDARD CORD LENGTH IS 8 FT LONG WITH 7 FT EXTENDING OUTSIDE THE ENCLOSURE. FOR THE CANADIAN MARKET, OPTIONAL (10 FT LONGER) CORDS ARE AVAILABLE AS AN OPTION WHEN SPECIFYING THE TOP RPXXXXXXXXXX01 SYSTEM PART NUMBER.
8. PAPI B REDUNDANT SYSTEM REQUIRES A 1.25" DIA THRU HOLE TO MOUNT THE EW00068-000-01 PARALLEL WYE CONNECTOR. THE BASE PLATES NOTED IN TABLE A FOR PAPI B REDUNDANT SYSTEMS HAVE THE REQUIRED 1.25" DIA THRU HOLE.

DA00026-XXX-01

B

Figure 35: PAPI B Redundant Secondary Light Unit Installation (Box 2 of 2 and 4 of 4)



NOTES:

2. ITEMS PROVIDED WITH OPTICAL ENCLOSURE.
5. ITEMS SPECIFIED AS CONTRACTOR PROVIDED ARE AVAILABLE AS AN OPTION WHEN SPECIFYING THE TOP RPXXXXXXXXXX01 SYSTEM PART NUMBER.
7. THE STANDARD CORD LENGTH IS 8 FT LONG WITH 7 FT EXTENDING OUTSIDE THE ENCLOSURE. FOR THE CANADIAN MARKET, OPTIONAL (10 FT LONGER) CORDS ARE AVAILABLE AS AN OPTION WHEN SPECIFYING THE TOP RPXXXXXXXXXX01 SYSTEM PART NUMBER.
8. PAPI B REDUNDANT SYSTEM REQUIRES A 1.25" DIA THRU HOLE TO MOUNT THE EW00068-000-01 PARALLEL WYE CONNECTOR. THE BASE PLATES NOTED IN TABLE A FOR PAPI B REDUNDANT SYSTEMS HAVE THE REQUIRED 1.25" DIA THRU HOLE.

DA00026-XXX-01

B

Flexible Conduit Installation

Each PAPI light unit is shipped with multi-conductor cable connected to the unit. For installation this cable must be disconnected from the light unit and cut to length and enclosed within liquid-tight conduit (contractor supplied). Follow the procedure to install the flexible conduit.

1. Disconnect the multi-conductor cable from inside of the light unit enclosure.
2. Slide the multi-conductor cable through the liquid tight flexible conduit and the elbow on the Light Unit until the proper length is achieved.
3. Check the flexible conduit to the Light Unit, tightening the fittings securely, if necessary.

4. Cut the multi-conductor cable to the desired length. Remove 8 inches (200 mm) of insulation from the end of the cable. Strip the end of each wire 0.3 inches (8 mm).
5. Re-secure the multi-conductor cable internally with strain-relief ties.
6. Reattach the multi-conductor cable wires to the respective terminal blocks from which they were removed.

7.4.2 Input Power Connections



WARNING

Before making any wire connections, make sure that you turn off the Constant Current Regulator. Failure to observe this warning may result in personal injury, death, or equipment damage.

Voltage Powered Connections

The RELIANCE LED PAPI will accept both input voltages 240 VAC and 120 VAC $\pm 10\%$. Voltage is supplied to the primary light unit through a dedicated multi-conductor cable.

See [External Wiring Diagrams](#) section for connecting the source power supply to the multi-conductor cable.

See [Internal Wiring Diagrams](#) section for connecting the multi-conductor cable to the input power board.

Current Powered Connections

One 200 W L-830 (60 Hz) or L-831 (50 Hz) isolation transformer is required to connect the series lighting circuit to each light unit.

See [External Wiring Diagrams](#) section for connecting the source power supply to the multi-conductor cable.

See [Internal Wiring Diagrams](#) section for connecting the multi-conductor cable to the input power board.

7.5 Aligning and Aiming the LED PAPI

Before aligning or aiming the LED PAPI light units, please thoroughly read [Operation](#) of this manual to familiarize yourself with the digital display and push buttons operation.

On the side of each LED PAPI Light Unit there is a digital LED readout display. This display is used to observe and set the horizontal level and vertical glide angle of each Light Unit. See [Understanding the LED Readout](#) for additional details. The glide angle varies by location, always refer to site-specific documents to determine the correct glide angle to aim each light unit. For standard installation aiming angles refer to [Table 6](#) for L-880(L) PAPI and [Table 7](#) for L-881(L) APAPI.

Table 6: Aiming Angles for L-880(L) PAPI Light Units

L-880(L) PAPI (4 box)	Aiming Angle (Minutes of Arc) (Standard Installation)	Aiming Angle (Minutes of Arc) (Height Group 4 Aircraft on Runway with ILS)
Unit nearest runway	30' (0.50°) above glide path	35' (0.58°) above glide path
Next adjacent unit	10' (0.17°) above glide path	15' (0.25°) above glide path
Next adjacent unit	10' (0.17°) below glide path	15' (0.25°) below glide path
Unit farthest from runway	30' (0.50°) below glide path	35' (0.58°) below glide path

Table 7: Aiming Angles for L-881(L) APAPI Light Units

L-881(L) APAPI (2 box)	Aiming Angle (Minutes of Arc) (Standard Installation)
Unit nearest runway	15' (0.25°) above glide path
Unit farthest from runway	15' (0.25°) below glide path



Note

60 minutes of arc = 1 degree. (60' = 1°)

The PAPI's LED display shows the angle in decimal degrees with one hundredth of a degree resolution (x.xx).

The conversion from minutes to decimal and decimal to minutes is calculated by the following formulas:

$$\text{DECIMAL} = \text{MINUTES} / 60$$

$$\text{MINUTES} = \text{DECIMAL} \times 60$$

Refer to [Table 8](#) to help convert decimal degrees to minutes.

Examples:

If a glide angle of 3°10' is desired, adjust the Light Unit's glide angle to 3.17 on the digital readout.

If a glide angle of 3°15' is desired, adjust the Light Unit's glide angle to 3.25 on the digital readout.



Note

If the readout shows **MIN**, this indicates that the glide slope is negative (PAPI aimed toward the ground). If the readout shows **9.99**, this indicates that the glide slope is equal to or greater than 9.99 degrees from horizon.

Table 8: Conversion Table for Decimal Degrees to Minutes

Decimal Degrees	Minutes	Decimal Degrees	Minutes
0.02	1	0.52	31
0.03	2	0.53	32
0.05	3	0.55	33
0.07	4	0.57	34
0.08	5	0.58	35
0.10	6	0.60	36
0.12	7	0.62	37
0.13	8	0.63	38
0.15	9	0.65	39
0.17	10	0.67	40
0.18	11	0.68	41
0.20	12	0.70	42
0.22	13	0.72	43
0.23	14	0.73	44
0.25	15	0.75	45
0.27	16	0.77	46
0.28	17	0.78	47
0.30	18	0.80	48
0.32	19	0.82	49
0.33	20	0.83	50
0.35	21	0.85	51
0.37	22	0.87	52
0.38	23	0.88	53
0.40	24	0.90	54

Table 8: Conversion Table for Decimal Degrees to Minutes

Decimal Degrees	Minutes	Decimal Degrees	Minutes
0.42	25	0.92	55
0.43	26	0.93	56
0.45	27	0.95	57
0.47	28	0.97	58
0.48	29	0.98	59
0.50	30	1.00	60

7.5.1 Adjusting Azimuth Aim (Horizontal Alignment with Runway Centerline)

Make sure that the rod at 164 feet (50 m) from the light unit is still properly aligned with the side of the PAPI-L light unit. If not, loosen the fasteners securing the flanges to the concrete foundation and make adjustments as necessary to align the light unit.

Each Light Unit shall be aimed outward into the approach zone on a line parallel to the runway centerline within a tolerance of $\pm 0.5^\circ$. ADB SAFEGATE recommends azimuth aiming to be within a tolerance of 0° to 0.5° towards centerline.



Note

It is not necessary for the alignment to be absolutely perfect. An error of 20 inches (500 mm) at 164 feet (50 m) yields an error of 0.5° , which is within FAA required tolerance.

7.5.2 Adjusting the Horizontal Level and Setting Rough Elevation Glide Slope Angle

The following instructions require the Light Unit's circuit board to be powered by the system input power. When the PAPI is initially powered on there will be a delay in which the display will show the following sequence;

ADB -> LED -> PAPI -> VER -> V.VV -> GGGG -> BOXn -> OFn -> COLD -> XXX -> SEC

After the initial delay the light engines may come on and then go off and the display will show an error explaining why the unit is in an alarm state.

Referring to [Figure 20](#) and [Figure 21](#) perform the following procedure:

1. Loosen the hex nuts (1) and (2) on all three legs (E), (F), and (G). Hex nuts (3), (4) and (5) should be finger tight.
2. With the unit powered, press the LEVEL button on the display pad to display the horizontal level angle.
3. Level the light unit by adjusting the hex nuts (1) and (2) on the left front leg. The LEVEL angle on the display pad should read $0.00^\circ \pm 0.07^\circ$.
4. Tighten hex nuts (1) and (2) simultaneously.
5. Press the GLIDE button on the display pad to display the elevation level angle (glide slope).
6. Set glide slope by adjusting hex nut (5) of the rear leg (G).
7. Position upper hex nut (1) on leg (G) against the upper flat washer. Simultaneously tighten the hex nuts on leg (G).
8. Tighten lower hex nut (4) on leg (F).

7.5.3 Adjusting Fine Elevation Glide Slope Angle

To adjust the fine elevation settings using the differential for the LED PAPI-L, perform the following procedure:

Figure 36: Elevation Setting Sequence

Elevation Setting Sequence (LED, Three-Leg PAPI-L)

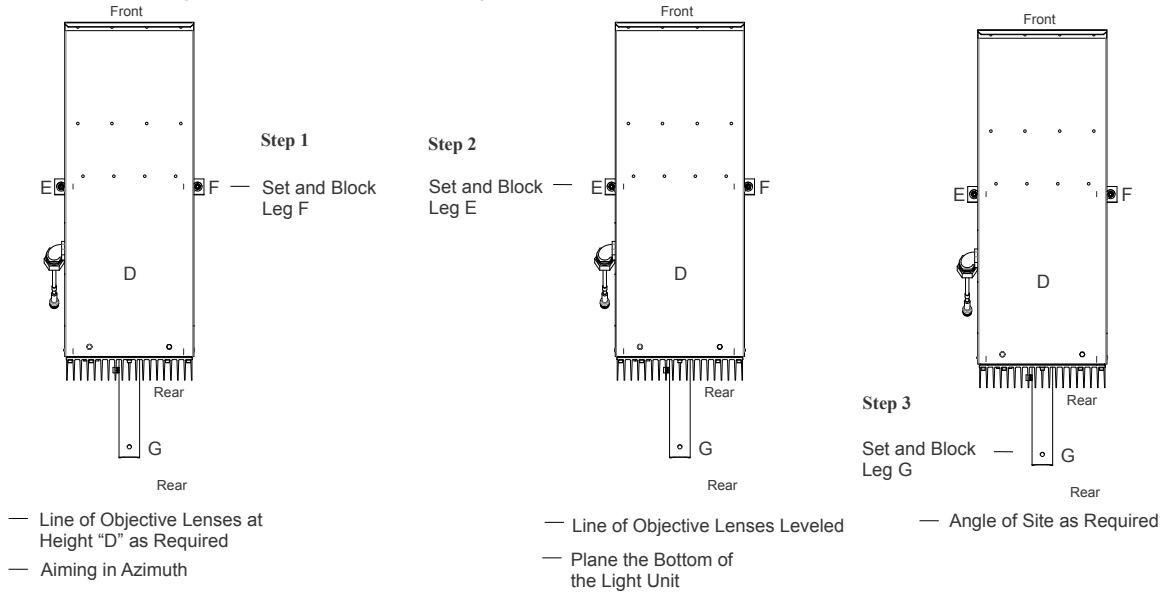
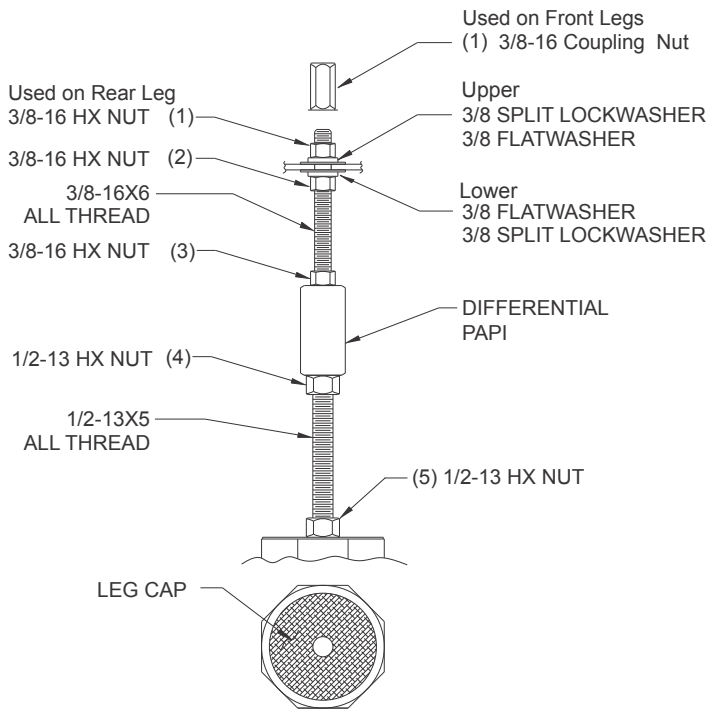


Figure 37: Adjustable Mounting Legs



A4 PAPI LEG ASSY. REF

1. Press the LEVEL button on the display pad to display the horizontal level angle.
2. Refer to [Figure 36](#) STEP 1. Make sure the locking hex nuts (3) and (4) for the differential on the right front leg (F) are tightened. The locking hex nuts (3) and (4) for the differentials on the other legs should remain loose.
3. Refer to [Figure 36](#) STEP 2. While watching the displayed LEVEL angle on the display pad, level the front of the PAPI by turning the differential left front leg (E) in the proper direction. Tighten locking hex nuts (3) and (4) on the differential on left front leg (E) when leveled.

4. Press the GLIDE button on the display pad to display the longitudinal angle (glide slope).
5. Refer to [Figure 36](#) STEP 3. While watching the displayed GLIDE angle on the display pad, adjust the differential on the rear leg (G). When leveling is complete, tighten the locking hex nuts (3) and (4) on legs (E), (G), and (F) and the differential of leg (G). Tighten the hex nuts to a torque of 132 in-lb. (15 n·m) and the GLIDE angle is displayed within ± 0.03 degrees.
6. Check the settings by pressing the LEVEL button to display the horizontal level angle.
If it is incorrect, repeat steps 1 to 5 of this section.
7. When all the readings are correct, continue installation.

7.5.4 Saving the Glide Angle to Memory

1. After all adjustments are complete, press the **SET** push-button for five seconds until **SAVE** is displayed. This stores the current glide angle in memory so that if a Light Unit becomes vertically misaligned, the inclinometer circuitry will disable the Light Unit. The horizontal (Level) angle is hard coded to disable the Light Unit if the unit is tilted more than 1.75 degrees in either direction.
2. Repeat the alignment procedure for each of the Light Units.

8.0 RELIANCE PAPI Ground Check Procedure

This procedure describes the steps to ground-check the light beam angles of the RELIANCE PAPI.

The RELIANCE PAPI incorporates an advanced optics system to create a crisp transition sector at the required evaluation distance of 300 m. However, because of the advanced optics system, the RELIANCE PAPI displays a non-linear wave-shaped pattern at the ground verification distance than that of conventional incandescent-lamp PAPI. The reason for this difference is attributed to the optical effects not producing a fully developed beam until after a distance of about 200 m. The concept of near-field vs. far-field optical effects is important to understand as this complicates the ground alignment procedure and introduces variables in the measurement of the elevation aiming process.

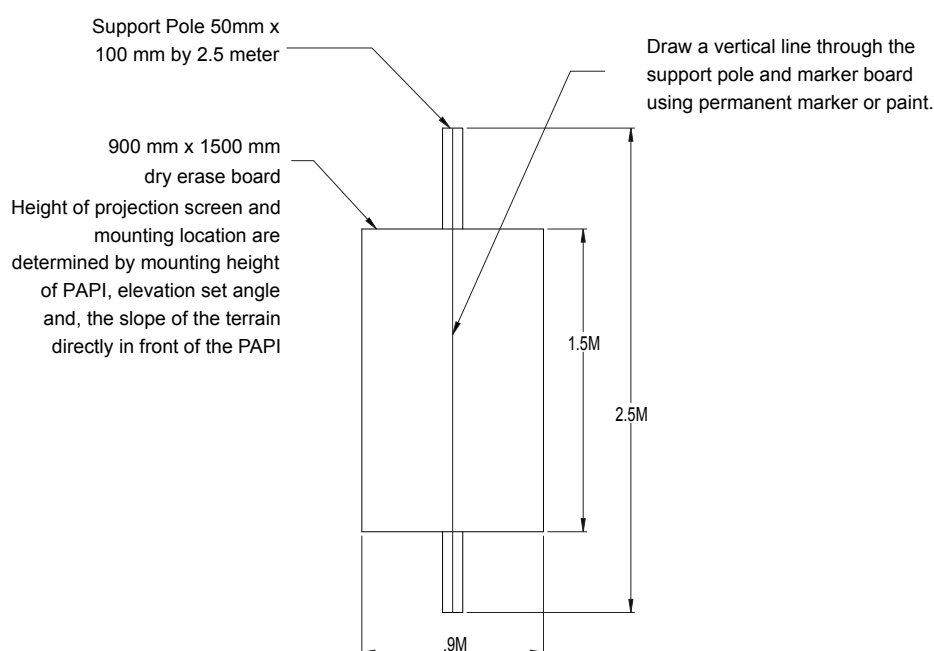
The three largest sources of variability are the measurement of the 18 m distance to target, accuracy of the placement of the laser level line to the cross-hairs of the side of the PAPI, and determine the precise center of the beam between the non-linear areas of the red and white boundaries. All of these introduce uncertainty that must be accounted for. These are the uncertainties that have led to the acceptance criteria of +/- 6 minutes of arc given in [Table 15](#) of the LED PAPI manual. This translates to a maximum allowable difference between "H" and "H1" of 31.4 mm during operational ground checks.

8.1 Equipment Needed to Perform a Ground Check

The following equipment is used to perform the ground check (list does not include LED PAPI adjustment tools):

1. Self-Leveling Line Laser, Accuracy +/-0.2 minutes. Ref: Spectra Precision LL300S.
2. Camera Tripod with bubble level and vertical adjustment mechanism
3. Measuring Tape – 20m
4. Steel rule – 30cm
5. Marker, Dry-erase Black.
6. Carpenter's Level (2)
7. Bright Spray Paint (or other method) for marking line in grass.
8. Projection screen or marker board. Recommend dry erase board (0.9m x 1.5m) mounted on a post (50mm x 100mm). See [Figure 38](#).

Figure 38: Projection Screen



8.2 Prior to Performing A Ground Check

1. Set up and aim PAPI light units as described in the section [Aligning and Aiming the LED PAPI](#) to the Site Specific elevation angles required by the Airport.
2. Prepare and fill out columns (2), (3), and (4) of [Table 9](#) (Blank Record of PAPI Changes to Elevation from "H1" to "H"), which will be used throughout this procedure. Rows A and B are populated for 2-box systems and rows A, B, C, and D will be populated for 4-box systems.
 - a. Fill out the required elevation angles in degrees and minutes in column (2) for the installed units.
 - b. Calculate the conversion and fill out the required elevation angles in decimal degrees in column (3) for the installed units.
 - c. Calculate and record dimension "H" in column (4) by using the formula: $H = [\text{distance of observation in mm}] \times \tan[\text{angle in column 3}]$.



Note

Example: 18 m observation distance and an aiming angle of 2.50 degrees, $H = 18000 \times \tan[2.50] = 786$ mm.

Table 9: Blank Table: Record of PAPI Changes to Elevation from "H1" to "H"

Light Unit (1)	Required Elevation Angle in Minutes (2)	Required Elevation Angle in Degrees (3)	Dimension "H" Calculated Millimeters (4)	Dimension "H1" Measured Millimeters (5)	Difference Between H and H1 Millimeters (6)	Adjust Angle (7)	Adjust Up/Down (8)
A							
B							
C							
D							

Table 10: Sample Table: Record of PAPI Changes to Elevation from "H1" to "H"

Light Unit (1)	Required Elevation Angle in Minutes (2)	Required Elevation Angle in Degrees (3)	Dimension "H" Calculated Millimeters (4)	Dimension "H1" Measured Millimeters (5)	Difference Between H and H1 Millimeters (6)	Adjust Angle (7)	Adjust Up/Down (8)
A	2° 30'	2.50	786				
B	2° 50'	2.83	890				
C	3° 10'	3.17	997				
D	3° 30'	3.50	1101				



Note

Sample values shown are an example of for a nominal 3 degree approach glide slope. Actual site specific elevation angles required by the airport must be used.

8.3 Setup and Ground Check Procedure

Setup and Ground Check procedures are to be performed at night.

Figure 39: Ground Check Setup

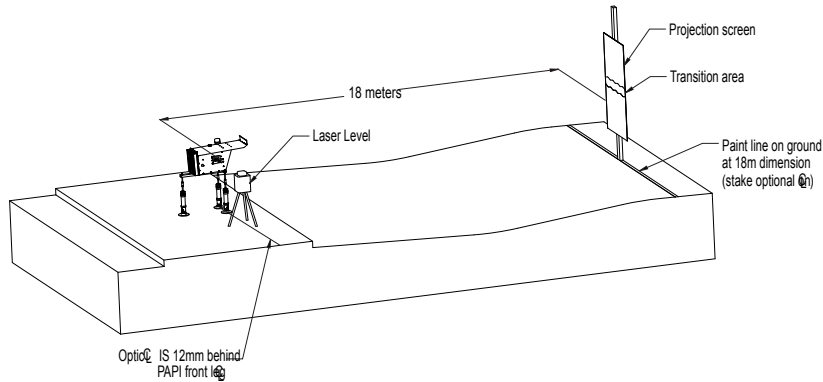


Figure 40: LED PAPI Light Beam Centerline Mark

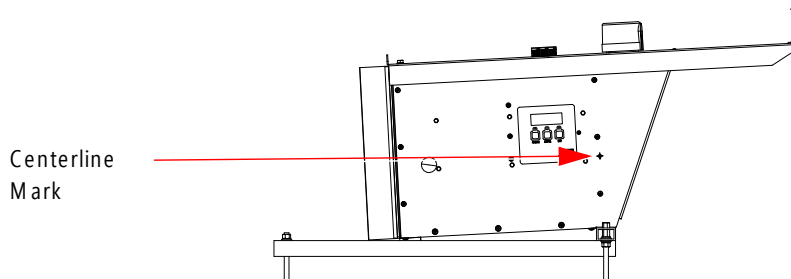


Figure 41: Laser Level



1. Place the laser level adjacent to the touchpad side of the PAPI light unit.

2. Turn on and adjust height of the laser level so the beam intersects the LED PAPI Light Beam Centerline Mark. See [Figure 40](#).
-



Note

Mount the Self-Leveling Line on the tripod as close to level as possible. Note that a tripod with a bubble level will assist with leveling the laser. The Self-Leveling Laser needs to be mounted within +/- 5 degrees of level for the self-leveling feature to function.

3. Mark the specified observation distance.
 - a. Measure 18 m from the centerline mark on the PAPI side panel along the light path. Note: the centerline mark is 12 mm behind the PAPI leg centerline. Mark the 18m distance with a spray paint line. Optional to install a mounting stake at the CL of the beam on the 18m line.
 - b. This is the location at which the projection screen will be located. The dry erase board can be permanently attached to the support pole by placing the pole at this location and making sure that the beam transition and the laser level indicator are both visible on the dry erase board. This step is necessary due to variations in PAPI mounting height and the slope of the terrain directly in front of the PAPI light units.
4. Place the projection screen on the paint line 18 m in front of the PAPI, see [Figure 39](#). Sight along the side of the PAPI as shown in [Figure 39](#).

- Lock the vertical movement of the tripod holding the laser level. With the PAPI turned off, mark the projection screen at the location where the laser level crosses the permanent vertical line on the projection screen. See Transition Boundary Figure 42. This will be used as the baseline from which to measure distance "H1".



Note

It is important not to move the marker board once this mark has been made. It is also important that the marker board remain within 3° of and vertical during this process.



Note

Use a carpenter's level to help maintain the vertical position.

Figure 42: Transition Boundary

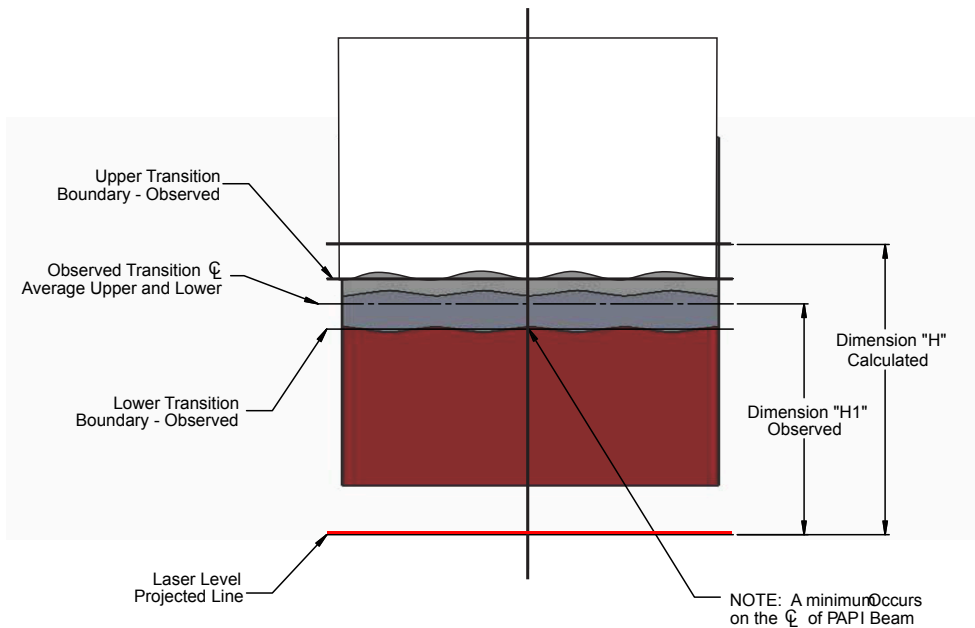
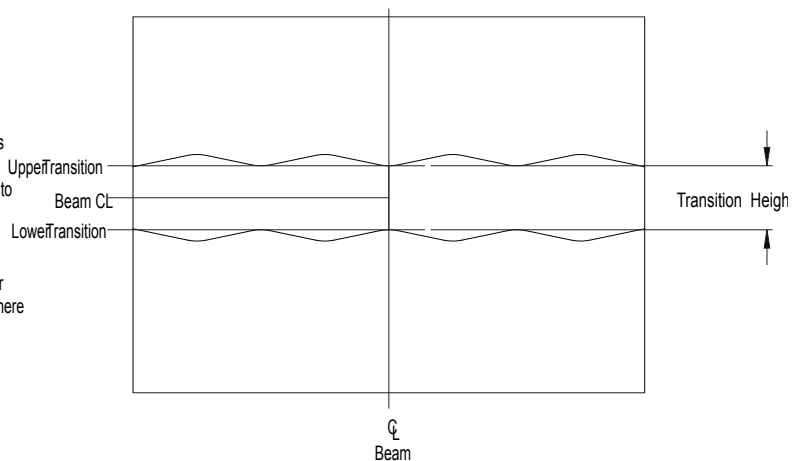


Figure 43: Transition Boundary Explanation

Notes:

- The upper and lower transitions at 18m distance will appear as wavy lines that produce maximums and minimums. There is always a minimum on the center of the beam - this is where the measurement is to take place. Exact location of the maximum and minimum is a judgement call, consistency among PAPI units is critical to this procedure.
- Mark the upper transition at the location where the beam color appears as all white. Mark the lower transition at the location where the beam color appears as all red.
- Locate and mark the Beam CL located mid point of the upper and lower transition marks.



- Turn on the LED PAPI and adjust the brightness in order to provide the greatest contrast between the red colored area and the dark transition sector. Regulator Step 5 is recommended for the 18 m distance.

- Determine the upper and lower transition lines and mark these with dry erase markers on the board.



Note

There are peaks and valleys to the transition area – see [Figure 43](#) for additional detail. Center the minimum area found at 0 degrees Level. See [Figure 42](#).

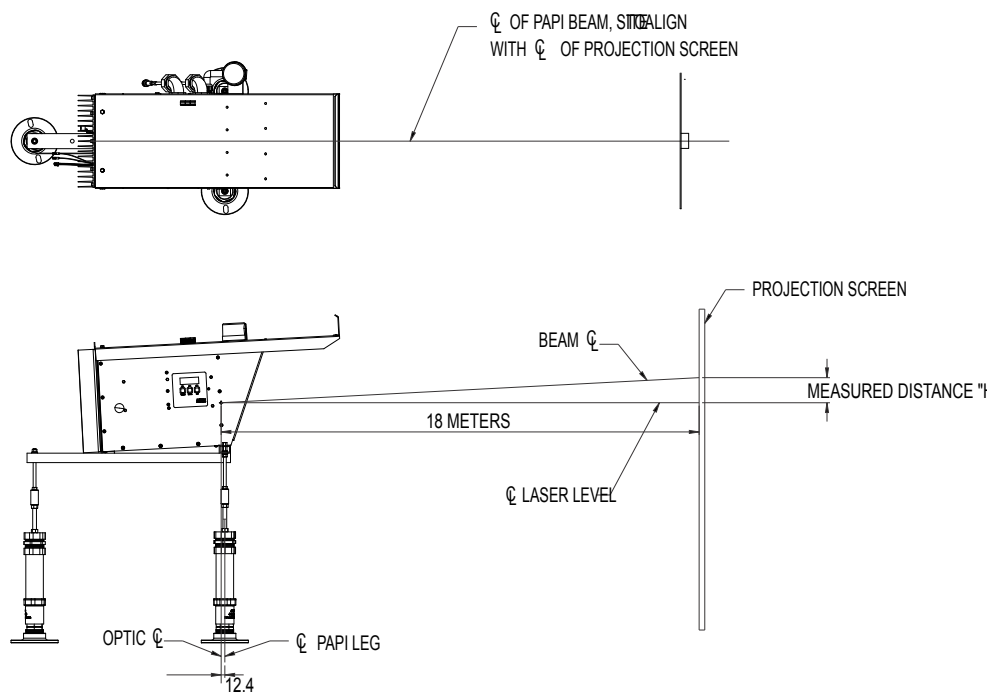
- Mark the observed transition centerline. It is located mid-way between the upper and lower transition boundaries. See [Figure 42](#).
- Complete [Table 9](#) by performing the following measurements and calculations.
 - Measure the distance between the laser level projected line and the marked beam centerline. Record this value in the "Dimension "H1" Measured" column in [5].
 - If "H" and "H1" are not equal, subtract the smaller from the larger value and record this difference in "Difference between H and H1" column [6].
 - If H1 is greater than H the PAPI is aimed too high, record "Down" in column (8). Then using the formula $\text{ADJUSTMENT ANGLE} = \text{ARCTAN} [(H1-H)/18000]$, calculate the adjustment angle in decimal format and record it in column (7).
 - If H1 is less than H the PAPI is aimed too low, record "Up" in column (8). Then using the formula $\text{ADJUSTMENT ANGLE} = \text{ARCTAN} [(H-H1)/18000]$, calculate adjustment angle in decimal format and record it in column (7).
- Using the inclinometer display, adjust each PAPI up or down by the amount recorded in column (7) of [Table 9](#).
- Check PAPI observed transition centerline again to verify that the transition area is now centered at the laser level reference.



Note

There is no adjustment necessary if the calculated difference between H and H1 is less than 10 mm. An adjustment of 10 mm results in an angular change of less than 2 minutes of arc.

Figure 44: Calculate adjustment in the PAPI inclinometer elevation setting



9.0 Operation

This section provides operating information for the PAPI system, including important guidelines for normal operation, preparation for heavy snowfall and criteria for system deactivation.

- For **voltage powered** PAPI systems, follow the steps for initial startup using local control, remote control operation and optional interlock relay in [Initial Startup Using Local Control—Voltage Driven](#) through [Set Up and Test Optional Interlock Relay](#).
- For **current powered** PAPI systems, follow the steps for initial startup discussed in Section [Initial Startup Using Local Control—Voltage Driven](#).

9.1 Operation Safety Considerations



CAUTION

- Only qualified personnel, physically capable of operating the equipment and with no impairments in their judgment or reaction times, should operate this equipment.
- Read this manual completely before operating the equipment. A thorough understanding of system components and their operation will help you operate the system safely and efficiently.
- Before starting this equipment, check all safety interlocks, fire-detection systems and protective devices such as panels and covers. Make sure all devices are fully functional. Do not operate the system if these devices are not working properly. Do not deactivate or bypass automatic safety interlocks or locked-out electrical disconnects.
- Never operate equipment with a known malfunction.
- Do not attempt to operate or service electrical equipment if standing water is present.
- Use this equipment only in the environments for which it is rated. Do not operate this equipment in humid, flammable or explosive environments unless it has been rated for safe operation in these environments.
- Never touch exposed electrical connections on equipment while the power is ON.

9.1.1 Normal Operation

The PAPI system must operate continuously as long as the runway is in service.

- The **voltage powered** system is controlled by a photocell that automatically sets the system to 100% intensity during daytime and either 5% or 20% intensity at night.
- The **current powered** system operates at any intensity selected by the CCR. It is recommended that a five-step CCR be used to power the Style B PAPI system.

9.1.2 Preparation for Heavy Snowfall

The LED PAPI should operate continuously at normal standby brightness even when the runway is not in use, permitting any snow, ice or condensation to melt and drain off.

If snowfall is expected to bury the Light Units, mark the location of the Light Units with sticks or flags — approximately 7 ft. (2.1m) high — to prevent damage by snow removal equipment.

Should the system show more serious defects, it must be taken out of service.

9.2 Understanding the LED Readout

Figure 45: LED Display



9.2.1 Four-Segment LED

The four-digit LED display indicates the Level (horizontal level), the Glide slope (vertical angle), and additional information regarding unit and system errors.

If GLIDE button is pushed, displays degrees of glide slope (0.00 to 9.99). If LEVEL button is pushed, displays degrees of horizontal level (0.00 to 9.99).

SAVE: Displays after the SET button is held in order to set a new glide angle.

COMM -> LOST: Indicates there is a comm error within the box displaying the error.

HEAT -> FAIL: Indicates there is an error with the defrost heater within the box displaying the error.

RED -> LED-> FAIL: Indicates there is an error with the red LED string within the box displaying the error.

WHT -> LED -> FAIL: Indicates there is an error with the white LED string within the box displaying the error.

PHOT -> FAIL: Indicates there is an error with the photocell (will only be displayed on the voltage powered primary unit).

BOX X -> TILT: Indicates the particularly box in the system that has the tilt error.



Note

(__ -> XXX) = A pause then the time in seconds remaining in the initial power sequence - the delay time where the front glass is being cleared of frost before the PAPI lights up. It takes 15 seconds for the display to warm up in cold weather. ICAO PAPI systems do not require tilt/detection shutdown, but may optionally be enabled if desired.

9.2.2 Push Button Functions

The GLIDE, LEVEL and SET push buttons determine the display as follows:

GLIDE

- When the GLIDE push button is pressed the four-digit LED display will show the current glide angle or LOW is the tilt angle is less than 0.00.

LEVEL

- When the level push button is pressed the four-digit LED display shows the horizontal level angle.

SET

- The SET push button stores the **glide angle** that defines proper vertical alignment for the PAPI Light Unit. If any PAPI Light Unit is raised more than ½ degree or lowered more than ¼ degree from this angle, the inclinometer circuitry will de-energize all PAPI Light Unit lamps, if TILT is enabled.
- Push and hold the SET push button for about 5 seconds until SAVE is displayed on the four-digit LED display for the Control Board to memorize the glide angle.

9.3 Initial Startup Using Local Control - Voltage Powered

To turn ON the voltage powered RELIANCE PAPI system using local control:

- Turn the external ON/OFF switch on the primary unit to the OFF position and circuit breaker CB1 to OFF and set DIP SW3-1 to ON, the unit will read this input and translate it to mean it is in local mode operation.
- Select the desired intensity for nighttime operation by switching DIP SW3-2 ON for 5% and OFF for 20%.
- Ensure that all light units are aligned properly and that the glide angle settings are memorized in each unit. See [Align the PAPI](#) for the Light Unit setting procedure.
- Turn CB1 to on in the primary Unit.
- Switch the external ON/OFF switch on the primary unit to the ON position. The system should energize and all lamps should turn on after the initial countdown.

9.4 Set Up and Test Remote Control Operation

To set up and test remote control operation:

- Turn the external ON/OFF switch on the primary unit to the OFF position and circuit breaker CB1 to OFF.

2. Set DIP SW3-1 to OFF for remote operation and connect remote control wiring to Terminals 3 & 4 on the DIN rail (The remote control should be shorted for initial testing). Disconnect the photocell.
3. Turn CB1 to on in the primary Unit.
4. Switch the external ON/OFF switch on the primary unit to the ON position. The system should energize and all lamps should turn on after the initial countdown.
5. Open the remote control connection that is connected to terminals 3 & 4 on the DIN rail. The light output should go OFF.
6. Short the remote control connection that is connected to terminals 3 & 4 on the DIN rail. The light output should come back ON.
7. The PAPI system is now ready for operation, the lights are turned on and off via the remote switch that was wired in.

9.5 Set Up and Test Optional Interlock Relay

To set up and test the operation of the interlock relay:



Note

Before verifying this operation insure the unit is wired for the optional interlock relay as described in [Optional Interlock Relay](#).

1. Turn the external ON/OFF switch on the primary unit to the OFF position and circuit breaker CB1 to OFF.
2. Ensure that the primary of a low-wattage isolation transformer is connected to the series circuit. Ensure that the secondary is connected to Terminals 3 & 4 on the DIN rail. A 6.6A secondary, 30/45W isolation transformer is typically used. However, a 10/15W or 20/25W isolation transformer may be used.
3. Set DIP SW3-1 to OFF for remote operation.
4. Cover the photocell to simulate the nighttime operation.
5. Turn CB1 to on in the primary Unit.
6. Switch the external ON/OFF switch on the primary unit to the ON position. The unit should remain OFF.
7. Turn on the CCR that controls the interlock relay. The unit should turn on and all PAPI Light Unit lamps should illuminate to the 5% or 20% intensity level as selected using DIP SW3-2.
8. Turn off the CCR. All light units should turn off.
9. Turn the external ON/OFF switch on the primary unit to the OFF position and circuit breaker CB1 to OFF.

9.6 Understanding the Fail-Open Monitoring Feature

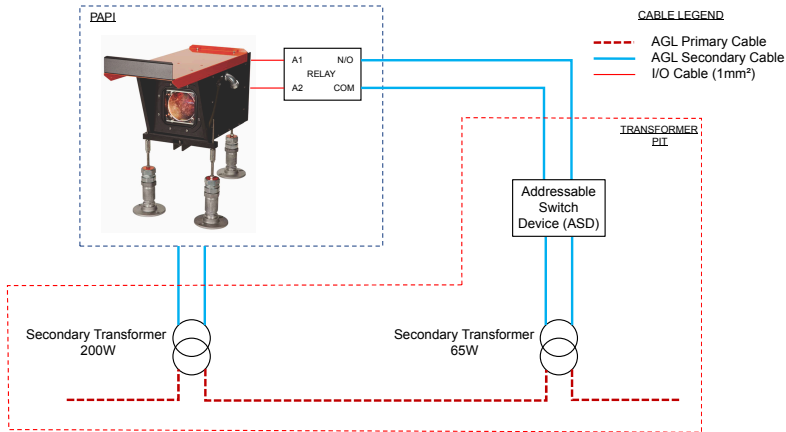
The Monitored Fail-Open ordering option is for ILCMS installations and required an external remote for fail-open monitoring. Requires use of a remote monitor and a separate 65 W auxiliary isolation transformer for the primary light unit only. The Monitored Fail-Open feature is only available with the PAPI B Current Powered Non-Redundant systems. Compatible with ADB SAFEGATE and other remote monitoring systems. This ordering option does not provide CCR monitoring functionality.



NOTICE

The optional Fail-Open feature is provided with the light unit when specified (see ordering codes). Available with the Current-Powered non-redundant system only. Installed on the primary light unit only.

Figure 46: Fail-Open Monitoring System Layout (Primary Light Unit Only)

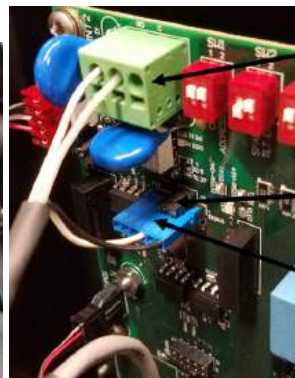


During normal operation of the LED PAPI, the fail-open relay is closed. In the event of a failure or alarm condition of the LED PAPI, the Control Board will trigger the fail-open relay to open allowing a remote monitoring system to identify a fail-open circuit type failure.

LED PAPI Alarm conditions that will result in a fail-open condition include: Heater failure, Red LED failure, White LED failure, Tilt failure (if enabled), or Comm failure (if enabled). a Photocell failure will not trigger a fail-open condition. All failure modes will indicate failure type on the digital display.

The fail-open relay is DIN rail mounted along side of the terminal block of the Input Power PCB of the primary light unit only (see Wiring Diagrams).

Figure 47: Fail-Open Relay



Connect loose wires
To J11-NO and J11-C
(polarity irrelevant)

Install Jumper on J8

Plug in connector J12
(Black wire on pin #1)

9.7 Set Up the Alarm Contact on the Control Board (for Systems without Fail-Open Monitoring)

Maximum capacity for the alarm contact is 48V@1A or 230V@2A.

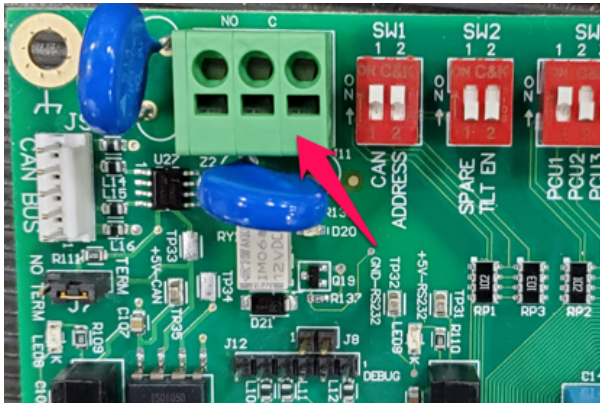
To set up the Alarm contact, follow these steps:



Note

Remote monitoring point can be added to an LED PAPI light unit (primary light unit only or one per light unit). The contacts are normally open (N.O.) and are closed during normal operation when the PAPI is on. A failure will open the relay of the failed light unit and communicate a failure condition to the primary light unit (if COMM is enabled).

Figure 48: Alarm Contact on the Control Board



1. Disconnect power from the PAPI-L.
2. Connect the wires to the Alarm Contacts 1 (NO) and 2 (C). If connecting all the units, the circuit will be in series.
3. Inset a small flathead screwdriver into the rectangular slot to open the circular opening to inset the wire into. Check that the wires hold when lightly tugged on.



CAUTION

If there is risk of external wires being pulled out of the PAPI, do not connect the incoming alarm wire directly to the PCB. Anchor a connector or terminal strip to the frame or side of the PAPI-L to allow strain relief and frangibility if the external wire gets caught on something and pulled out of the PAPI-L unit.



Note

A failure will open the circuit and all PAPI-L units in the circuit will show an alarm. To isolate the alarm cause, close the circuit inside each PAPI-L unit until the alarms clear on the other units.

9.8 Initial Startup of the Current Powered System

Each Light Unit is energized following an initial delay to clear the front glass when the constant current regulator (CCR) is activated, assuming that no Light Unit is in a tilt situation.

9.8.1 Check Light Unit Alignment

Ensure that all Light Units are aligned properly and that the glide angle settings are memorized in each Light Unit. See [Align the PAPI](#) for the Light Unit setting procedure.

9.8.2 Verify Correct Input Current in Each Light Unit

Verify that the input current from the series circuit is correct in each of the Light Units.

To check this, perform these steps for each Light Unit:

- Turn the CCR OFF.
- Remove the lid from the Light Unit closest to the input side of the series circuit.
- Connect a true RMS amp meter current clamp around one of the wires connected to terminal 1 or 2 on the DIN rail.
- Turn the CCR ON to the lowest step (2.8A for a five-step CCR or 4.8A for a three-step CCR).
Verify that the current is correct.
- Verify that the current is correct in each of the remaining current steps.
Troubleshoot or repair the external wiring if the current is incorrect.

9.9 Commissioning the PAPI System

After the PAPI system setup is complete, perform a flight check prior to commissioning the system, if required.

10.0 Maintenance

This section provides maintenance information and procedures for L-880(L)/PAPI (4-box) and L-881(L)/APAPI (2-box) systems.

10.1 Maintenance and Repair Safety Considerations



CAUTION

Electric Shock

- Allow only qualified personnel to perform maintenance, troubleshooting and repair tasks. Only persons who are properly trained and familiar with
- ADB SAFEGATE equipment are permitted to service this equipment.
- Always use safety devices when working on this equipment.
- Follow the maintenance procedures recommended in equipment manuals.
- Do not service or adjust any equipment unless another person trained in First Aid and CPR is present.
- Connect all disconnected equipment ground cables and wires after servicing equipment. Ground all conductive equipment.
- Use only approved ADB SAFEGATE replacement parts. Using unapproved parts or making unapproved modifications to equipment may void agency approvals and create safety hazards.
- Check CCR interlock systems periodically to ensure their effectiveness.
- Do not attempt to service electrical equipment if standing water is present. Use caution when servicing electrical equipment in a high-humidity environment.
- Use tools with insulated handles when working with electrical equipment.
- Also review and follow safety guidelines in FAA AC 150/5340-26 (current edition), Maintenance of Airport Visual Aid Facilities.

10.2 Maintenance Schedule

To keep the PAPI system operating efficiently, follow the preventive maintenance schedule in [Table 11](#).

Table 11: LED PAPI Periodic Maintenance Schedule

Interval	Maintenance Task	Action
After installation and before operational use	Make flight check of system.	Readjust if needed.
After installation (first few weeks)	Check elevation angle glide slope of Light Units.	Readjust if needed. Refer to Additional Siting Considerations for Light Unit alignment. To independently check the elevation aiming angle, refer to Siting Considerations
Daily	If Light Units are not operated continuously, check for frost or dew on the outer lens.	Remove frost or dew and check airport lighting circuitry per CertAlert 02-08
	Visually check LEDs for operation.	Repair or replace any damaged components.
Monthly	Check for any apparent damage to any Light Unit.	Repair or replace any damaged components.
	Check for water damage or insect infestation.	Remove insect infestation (if present). Repair or replace any damaged components.
	Check for presence of rodents.	Remove rodents (if present). Repair or replace any damaged components
	Check all control equipment for proper operation - including photocell for voltage powered systems.	Repair or replace any damaged components.

Table 11: LED PAPI Periodic Maintenance Schedule

Interval	Maintenance Task	Action
	Clean the outer surface of the front glass.	Use a soft cotton cloth moistened with alcohol.
	Check the glide slope and alignment angle of each Light Unit.	Use the onboard digital display. Refer to Standards and Tolerances and readjust if necessary.
	Check level and operation of tilt switch.	Repair or replace any damaged components.
	Inspect housing, LEDs, electrical connections, filters and front glass for damage, breakage or a warped shape.	Repair or replace any damaged components..
	Clean the interior of the housing.	Remove any foreign matter. Also check for water damage, insect infestation and presence of rodents.
	Make sure mounting is rigid and sturdy.	Tighten any loose hardware, nuts, screws, etc. Realign the Light Unit if hardware has loosened.
	Make sure no vegetation obscures the light beams.	Remove vegetation. Use weed killer to prevent any regrowth
	Check whether the lightning arresters and/or surge suppressors are scorched or show other signs of failure. Also check after electrical storms.	Replace as necessary.
	Record output current and input voltage of adapter (if used).	Repair or replace equipment if input is abnormal.
	Check Humidity Indicating Plug. A lavender (pink/purple) color indicates a presence of humidity in the optical chamber.	If humidity plug indicates 20% or more, a seal may be compromised. Inspect the front glass seal and the rear LED heat-sink assembly seal for damage. Replace components as necessary.
Quarterly	Check the obstacle-free approach plane for clearance from tree growth, new towers, pole lines or other obstacles. The obstacle-free plane is four miles long and extends 10 degrees on either side of the runway centerline.	Remove obstacles as necessary.
Semiannually	Check the insulation resistance of underground cables and record the results.	Remove obstacles as necessary.
	Check the resistance of the grounding system and record the results.	Remove obstacles as necessary.

10.3 Standards and Tolerances

Standards and Tolerances for Precision Approach Path Indicator (PAPI)

The standards and tolerances in this section are specified by FAA Advisory Circular AC 150/5340-26C, and define tolerance requirements for new installations, maintenance, and inspections. Current revisions of AC 150/5340-26 and/or applicable local standards and tolerances should always be observed. ADB SAFEGATE has adopted these standards and tolerances as a manufacturer's recommendation for all LED PAPI installations, maintenance, and inspections, globally.

Table 12: Standards and Tolerances for Precision Approach Path Indicator (PAPI)

Parameter	Standard	Tolerance / Limit	
		Initial ¹	Operating ²
Vertical aiming ³	3°		
▪ Unit closest to runway	3° 30'	±2' (0.03°)	±6' (0.1°)
▪ Unit second from runway	3° 10'	±2' (0.03°)	±6' (0.1°)
▪ Unit third from runway	2° 50'	±2' (0.03°)	±6' (0.1°)
▪ Unit farthest from runway	2° 30'	±2' (0.03°)	±6' (0.1°)
Horizontal alignment	Parallel to runway centerline	±30' (0.50°)	±30' (0.50°)
Tilt Detection	0.25° below to 0.50° above established Light Unit angle	Same as standard	Same as standard
Obstructions due to vegetation, etc.	No obstruction	Same as standard	Same as standard

Standards and Tolerances for a Vertical Angle Aiming Tool

The standards and tolerances in this section are specified by FAA Advisory Circular AC 150/5345-28H, and define the accuracy requirements for PAPI aiming tool. The aiming tool is used to measure glide slope (vertical angle) and horizontal level during new installations, maintenance, and inspections. Current revisions of AC 150/5345-28 and/or applicable local standards and tolerances should always be observed. ADB SAFEGATE has adopted the FAA PAPI aiming tool accuracy requirements as a manufacturer's operating tolerance.

Table 13: FAA Standards and Tolerances for a Vertical Angle Aiming Tool

Parameter	Tolerance / Limit	
	Initial	Operating
Vertical aim and level	±3' (0.05°)	±3' (0.05°)

The inclinometer device and digital display on the LED PAPI is considered to be a built-in aiming tool. If it is suspected that the vertical glide slope (vertical angle) on the digital display is incorrect or out of tolerance, please refer to the [Troubleshooting](#) section of this user manual or the [Appendix A](#) section to contact ADB SAFEGATE Technical Support.

Regular calibration services for the inclinometer aiming tool should be performed to ensure accurate performance of the LED PAPI system. It is the users responsibility to determine an appropriate calibration service schedule. It is important to note that a calibration service is not required, however ADB SAFEGATE does recommend a calibration service interval of no longer than 2 years. Contact ADB SAFEGATE Technical Support for assistance with a calibration service.

¹ Initial tolerances for installation.

² Operating tolerances for maintenance and inspection.

³ Unless a different standard is established locally, angles shown are for a 3-degree glide path.

11.0 Troubleshooting



WARNING

Electric Shock

Allow only qualified personnel to perform the following tasks. Observe and follow the safety instructions in this document and all related documentation.

- Before attempting to service the fixture, de-energize the circuit and lock out the circuit or regulator so that the circuit cannot be energized by remote means.

11.1 Troubleshooting Tips

Refer to [Wiring Diagrams](#) for general troubleshooting procedures. This guide covers only the most common problems. The following paragraphs provide specific details on troubleshooting and repair of PAPI subsystem components. For additional help, contact your local ADB SAFEGATE representative.

11.2 Troubleshooting the Field Circuit First

To identify a faulty section, follow the guidelines given below, along with a drawing and a meter:

- Check the incoming supply power first.
- Check for voltages at the specific test points in circuit.
- While the circuit is OFF test, check for continuity of circuits, as intended, and check for insulation resistance.
- If it's not possible to perform a power OFF test, connect the supply to the circuit and do a live test of circuit.

Generally, any electrical circuit can be differentiated in two sections:

- Power circuit (voltage of current).
- Control circuit.

It is always advisable to first check the power circuit. So, if the power circuit works, as it should, then troubleshoot the control circuit.

Power circuit check list:

- Incoming power to circuit and its integrity
- Check for correct functioning of protection devices
- Check visual cable continuity
- Check for any signs of flash or burning smell of devices.

Control circuit check list:

- Control circuit power first
- Check for proper functioning of relays, timers, and switches
- Check visual cable continuity
- Check for wire interconnections and terminal connections of circuit
- Check logical operational sequence of contactor switching
- Check for timer duration settings.

If the above criteria are checked and the ADB product is still not working, then go to [Table 14](#).

11.3 Detailed Troubleshooting and Repair Procedures

This section describes procedure for troubleshooting or repairing parts in the RELIANCE PAPI enclosure.

Table 14: General PAPI System Troubleshooting Guide

Problem	Possible Cause	Solution
Voltage Powered: Current Sensing not operating	Control Board Issue	Continue to Repair section.
	Bad Isolation Transformer	Change the Isolation transformer to a known good transformer.
	Regulator Outputting incorrect current	Low input current from series circuit. Repair CCR or series circuit wiring (if an open circuit is present on the series circuit).
LEDs Dim	Dirt on Outer Glass	Clean with a soft cotton cloth moistened with alcohol.
	Current Powered: Current Level too low	Low input current from series circuit. Repair CCR or series circuit wiring (if an open circuit is present on the series circuit).
	Light Unit improperly aligned	Realign and recalibrate light unit.
LEDs OFF	PAPI Light unit tilts	Realign PAPI Light Unit(s) that have tilted
	LEDs Failed	Check the local display on the PAPI where the Light Engine has failed and continue to Repair section.
	No power input	Voltage Powered: Measure the voltage between fuses F3 and F4 on the input power board 44A7392, if either fuse is blown replace the fuse, if it does not measure what the desired input voltage should be verify the system wiring or the power source is working properly (Style A Primary unit, verify the operation of the local ON/OFF switch). If the desired power is measured, replace the step down transformer. Current Powered: Measure the input current using a current clamp in either the conductor going to TB-1 or TB-2. If the desired output current is not present verify the Isolation transformer is good, the series circuit is properly connected and the Regulator is properly calibrated.
	Bad Inclinometer Board	See section Troubleshooting the Inclinometer PCB .
	Communications lost	Determine which box has the communication error but looking at the display on the side of each PAPI, then continue to Repair section.
Display Reported Error: COMM -> LOST	CAN communication lost on the unit	See section Troubleshooting COMM LOST Error .
Display Reported Error: HEAT -> FAIL	Front glass defroster error	See section Troubleshooting HEAT FAIL Error .
Display Reported Error: RED -> LED -> FAIL	Red LED string error	See section Troubleshooting RED LED FAIL Error .
Display Reported Error: WHT -> LED -> FAIL	White LED string error	See section Troubleshooting WHT LED FAIL Error .
Display Reported Error: PHOT -> FAIL	Photocell failure, only displayed on the Style A Primary unit.	See section Troubleshooting PHOT FAIL Error .
Display Reported Error: BOXn -> TILT	PAPI Light unit tilts	Realign PAPI Light Unit(s) that have tilted
	Bad Inclinometer	Replace the Inclinometer Assembly
Display Error: No Glide or Level Angle Displayed	Inclinometer Board Disconnected	Check inclinometer ribbon connector, ensure it is connected to the Inclinometer Board and the Control Board.
	Bad Inclinometer Board	Replace the Inclinometer Assembly

Table 14: General PAPI System Troubleshooting Guide

Problem	Possible Cause	Solution
Voltage Powered: Remote mode operation not working	Bad switch	Replace the remote switch and all wiring to the LED PAPI system
	Blown fuse	Check Fuse F2 on the power board, if it is blown, replace the fuse.
	Bad Step Down Transformer	Measure the voltage between pin 2 on J7 and pin 1 on J2 of the power board, verify it is 48VAC (±15%). If it is not measuring the correct voltage, replace the step down transformer
	Control Board Issue	Continue to Repair section.

11.3.1 Troubleshoot and repair the RELIANCE PAPI

Follow these steps to troubleshoot and repair the RELIANCE PAPI:

- Visually examine all areas of the RELIANCE PAPI.
- Check for burnt or loose connections and parts.
- Check all fuses and the circuit breaker (where applicable).

If the RELIANCE PAPI does not energize at all:

Voltage Powered LED PAPI

1. Check fuses F3 and F4 on the input power board, if either fuse is blown replace the fuse.
2. Measure the voltage between fuses F3 and F4 on the input power board, if it does not measure desired input voltage, verify the system wiring or the power source is working properly.
3. Style A primary light unit, verify the operation of the local ON/OFF switch.
4. If the desired power is measured, replace the step down transformer.

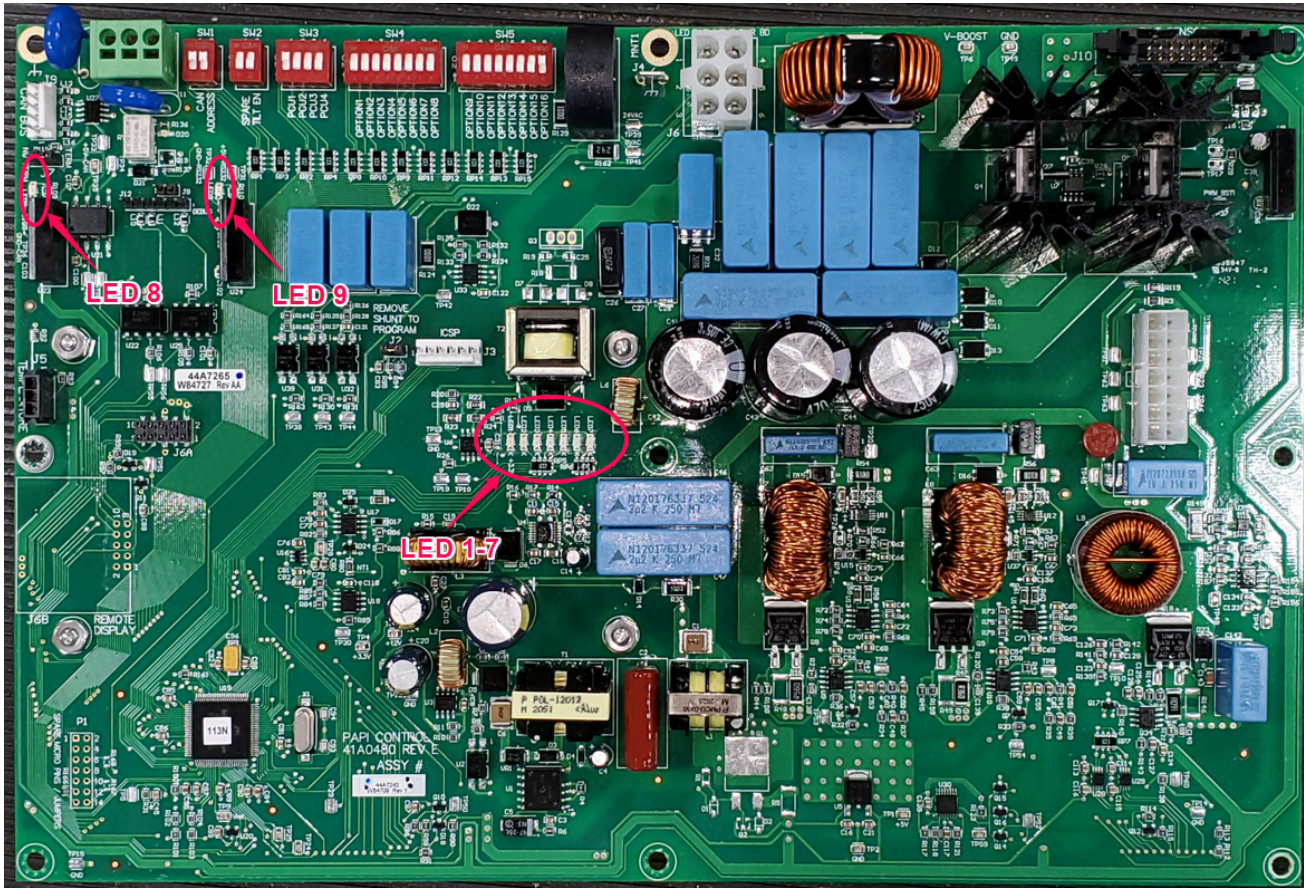
Current Powered LED PAPI

1. Measure the input current using a current clamp on either the conductor going to TB-1 or TB-2. If the desired output current is not present verify the Isolation transformer is good, the series circuit is properly connected and the Regulator is properly calibrated.
2. Verify status of the indication LEDs on the Control Board.
3. Replace the Control Board as noted in [Table 15](#).

Table 15: Indication LEDs on the Control Board

LED	ON (GREEN)	OFF
LED1	+3.3V OK	+3.3V ERROR, replace Control Board
LED2	HEARTBEAT (blinking)	ERROR (fast blinking), replace Control Board
LED3	N/A	N/A
LED4	Current Powered	Voltage Powered
LED5	CAN OK	CAN ERROR
LED6	+12V OK	+12V ERROR, replace Control Board
LED7	BOOST OK	BOOST ERROR, replace Control Board
LED8	+5V CAN OK	+5V CAN ERROR, replace Control Board
LED9	+5V SERIAL OK	+5V SERIAL ERROR, replace Control Board

Figure 49: Control Board Indication LEDs



11.3.2 Troubleshooting COMM LOST error

1. Check position of DIP switch SW5-7, ensure COMM is enabled for all light units. Reference [Table 2](#).
2. Check CAN Address DIP switches SW1-1 and SW1-2 to make sure each box has a unique address.



Note

Each box will display it's box number (address) during boot up.

3. Check LED8 "+5V CAN OK" Indication LED on the Control Board, ON (GREEN) indicates Control Board is okay. Reference [Table 15](#) and [Figure 49](#). If LED is OFF, replace Control Board.
4. If no error is found in the Control Board then there is likely to be faulty wiring between boxes. Check and/or repair connections at the terminal block. Reference [Table 16](#) and [Internal Wiring Diagram](#) section.
5. If no faulty wiring is found at the terminal block, check communication cord sets for faulty connections. Reference [Table 16](#).

Table 16: COMM LOST Troubleshooting Wiring Between Boxes

Box 1 Display	Box 2 Display	Box 3 Display	Box 4 Display	Possible Cause
COMM LOST		COMM LOST	COMM LOST	Break in communication cable between Box 2 and Box 3.
COMM LOST			COMM LOST	Break in communication cable between Box 3 and Box 4, or problem with Control Board in Box 4.
COMM LOST	COMM LOST	COMM LOST	COMM LOST	Break in communication cable between Box 1 and Box 2 or problem with Control Board in Box 1.

11.3.3 Troubleshooting HEAT FAIL error

1. Turn the PAPI light unit off, and disconnect the J1 connector from the Control Board.
2. Using a multimeter measure the resistance between pins 12 & 5.
3. Confirm the heated glass resistance specification for your LED PAPI. The specification is indicated by the firmware version, which is displayed during startup.
 - a. For LED PAPIs with firmware version 1.47 or earlier, verify the resistance reads between 13Ω and 21Ω.
 - b. For LED PAPIs with firmware version 1.50 or later, verify the resistance reads between 13Ω and 25Ω.
4. If the measurement is outside this range, there is a problem with the heated glass and it needs to be replaced.
5. If the measurement is inside this range, there is a problem with the Control Board.
6. Verify fuse F5 on the Control Board. If blown replace it. See [Figure 85](#).

11.3.4 Troubleshooting RED LED FAIL error

1. Turn the PAPI light unit off and disconnect the J1 connector from the Control Board.
2. Using a DC voltage supply limited to 65VDC and 300mA, apply voltage to pins 3(+) and 10(-) on the wire harness connector.
3. If the Red LEDs do not come on there is an error with the Light engine and it needs replaced.
4. If the Red LEDs came on in the previous step there is an error with the Control Board and it needs replaced.

11.3.5 Troubleshooting WHT LED FAIL error

1. Turn the PAPI light unit off and disconnect the J1 connector from the Control Board.
2. Using a DC voltage supply limited to 65VDC and 300mA, apply voltage to pins 4(+) and 10(-) on the wire harness connector.
3. If the White LEDs do not come on there is an error with the Light engine and it needs replaced.
4. If the White LEDs came on in the previous step there is an error with the Control Board and it needs replaced.

11.3.6 Troubleshooting PHOT FAIL error

1. Check to see if Fuse F1 on the Input Power Board is blown, replace fuse F1 if it is blown.
2. Measure the voltage between pins 1 and 3 on J2 of the Input Power Board, verify it is 24VAC.
3. If 24VAC is not measured, the step down transformer needs replaced.
4. If 24VAC is measured, replace the photocell.
5. After replacing the photocell if the problem persists then the problem is with the Control Board and it needs replaced.

11.3.7 Troubleshooting the Inclinometer Board

Refer to the [Table 14](#).

11.3.8 Troubleshooting the Control Board

If a problem is suspected with the control board, refer to drawings in [Figure 50](#) and check the following indicators and test points.

1. Remove the screws and washers holding the top cover.
2. Set the top cover aside.

3. Verify operation of Control Board LEDs. See [Table 15](#).

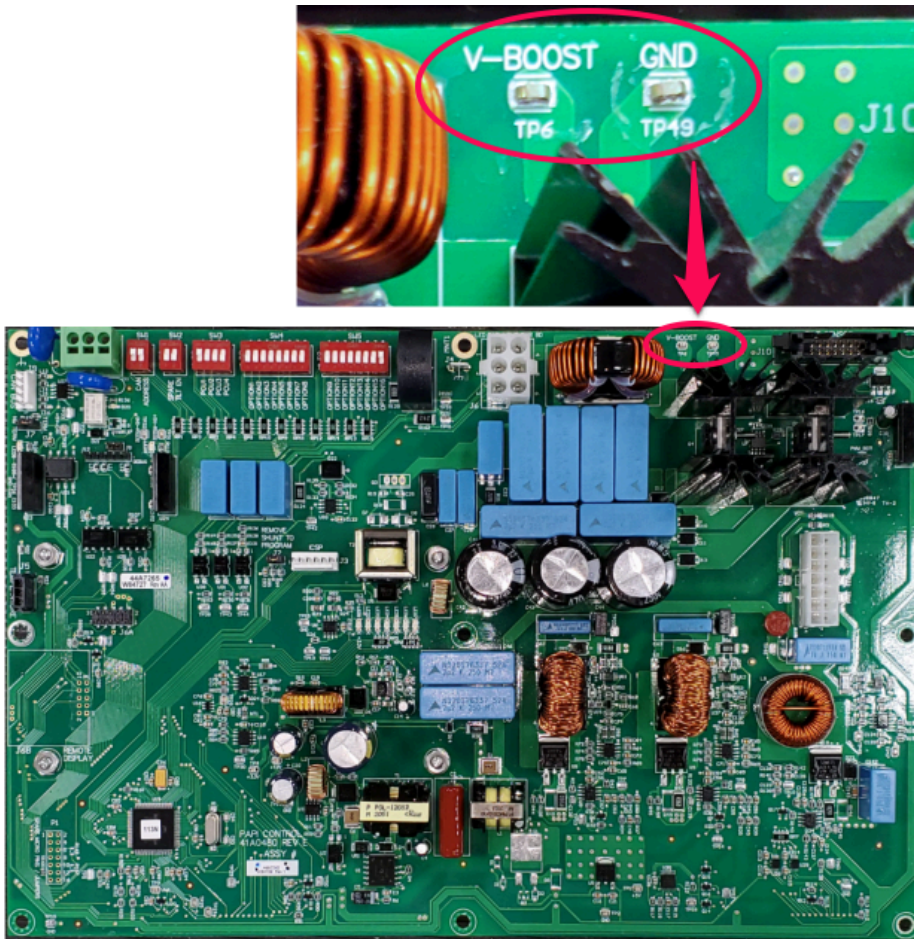


Note

Use a non conductive inspection mirror to perform the LED checks.

4. Verify DC power supply voltage of 90 VDC \pm 5% between TP6 to TP49. Reference [Figure 50](#).

Figure 50: LED PAPI Control Board DC Power Supply Test Point



5. If 90 VDC \pm 5% is not measured, replace the Control Board.
6. Check for loose wires and disconnected Molex plugs for the board and power supply.
7. If the Control Board is found to be faulty, power down the PAPI and replace the Control Board.
8. Go to [Control Board Replacement](#) to make certain you get the correct replacement kit to proceed. Read all of the following replacement procedures before performing any other steps.
9. Re-attach plugs to new LED PAPI control board. Reference the [Wiring Diagrams](#).



Note

With each control board assembly, the corresponding input power control board (44A7392/X) is provided and must be replaced.

10. Disconnect wiring from the 44A7392/X input power board.
11. Remove 44A7392/X input power board by lifting the Din Rail mount tabs to release it from the Din Rail.
12. Replace with 44A7392/X input power board provided with the kit. Install by snapping the mounting tabs onto the Din Rail.

13. Re-connect wiring to 44A7392/X Input power board. Ref to [Wiring Diagrams](#).
14. Replace the top cover gasket if necessary. Attach the top cover.
15. Go to [Understanding the LED Readout](#) and complete the setup and alignment procedures.

12.0 Repair

To troubleshoot and repair a PAPI Light Unit, follow these steps:

1. Check the display on each light unit and see if any errors are displayed. The following errors are displayed on the specific unit that is having an issue:

Display	Error
COMM -> LOST	CAN communication lost on the unit
HEAT -> FAIL	Front Glass defroster error
RED -> LED -> FAIL	Red LED string error
WHT -> LED -> FAIL	White LED string error
PHOT -> FAIL	Photocell failure, only displayed on the voltage powered Primary Unit.

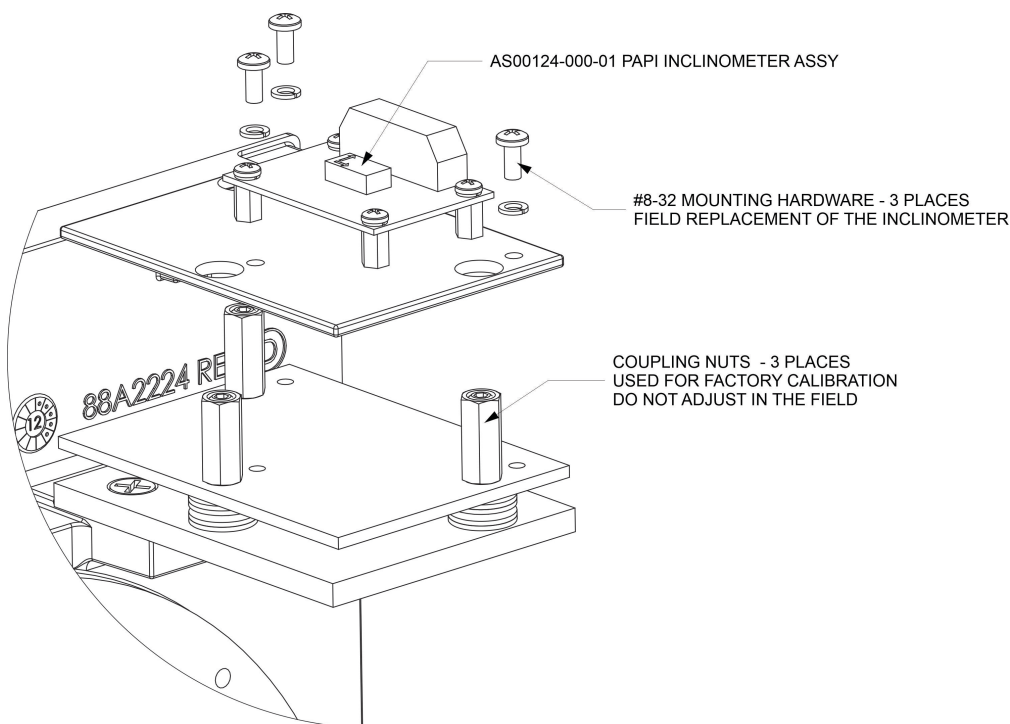
2. If one of the light units is tilted all units in the system will display which box is tilted: BOX X -> TILT (Where X is the number of the tilted box).
Depending on the information read on the Display, take corrective actions to repair the light unit. Details on further troubleshooting/repair are detailed in the paragraphs below.

12.1 Inclinometer Assembly Replacement

If a problem is suspected with the inclinometer board, first verify the following voltage is present on the board. Refer to [Troubleshooting The Inclinometer PCB](#).

If the inclinometer needs to be replaced, install new inclinometer assembly AS00124-000-01.

Figure 51: Top Inside View



Procedure for replacing the inclinometer assembly AS00124-000-01

1. Remove the (2) top cover screws, washers and the top cover and set them aside for later reuse.
2. Disconnect the ribbon cable connector from the Inclinometer Board.
3. Remove the (3) mounting screws while insuring the coupling nuts DO NOT MOVE.

4. Replace the inclinometer assembly and replace the (3) screws, (torque to 10 to 12 in-lbs) again insuring the coupling nuts DO NOT MOVE.
5. Reconnect the ribbon cable connector to the new Inclinometer Board.
6. Replace the top cover gasket if necessary.
7. Reinstall the top cover, screws and washers.
8. Verify the glide slope angle on the digital display is within satisfactory operating standards/tolerances as defined by FAA AC 150/5340-26C (± 6 minutes of arc or $\pm 0.10^\circ$ on the digital display). If it is suspected that the glide slope angle on the digital display is incorrect or out of tolerance, please first refer to the [Standards and Tolerances](#) section for standard operating tolerances. If necessary, refer to the [Troubleshooting](#) section of this user manual, or the [Appendix A](#) section to contact ADB SAFEGATE Technical Support.

12.2 LED Light Engine Replacement

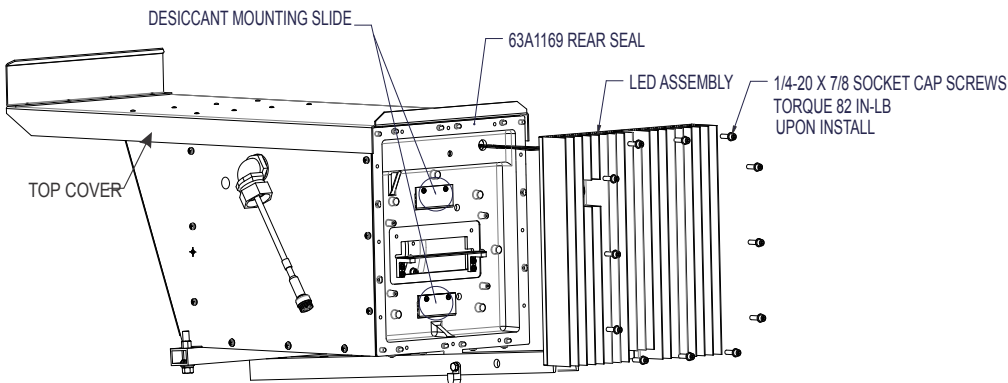
If there is a problem with the LED Assembly and it needs to be replaced, replace with AK00030-200-01 RELIANCE PAPI LED Light Engine Replacement Kit.



Note

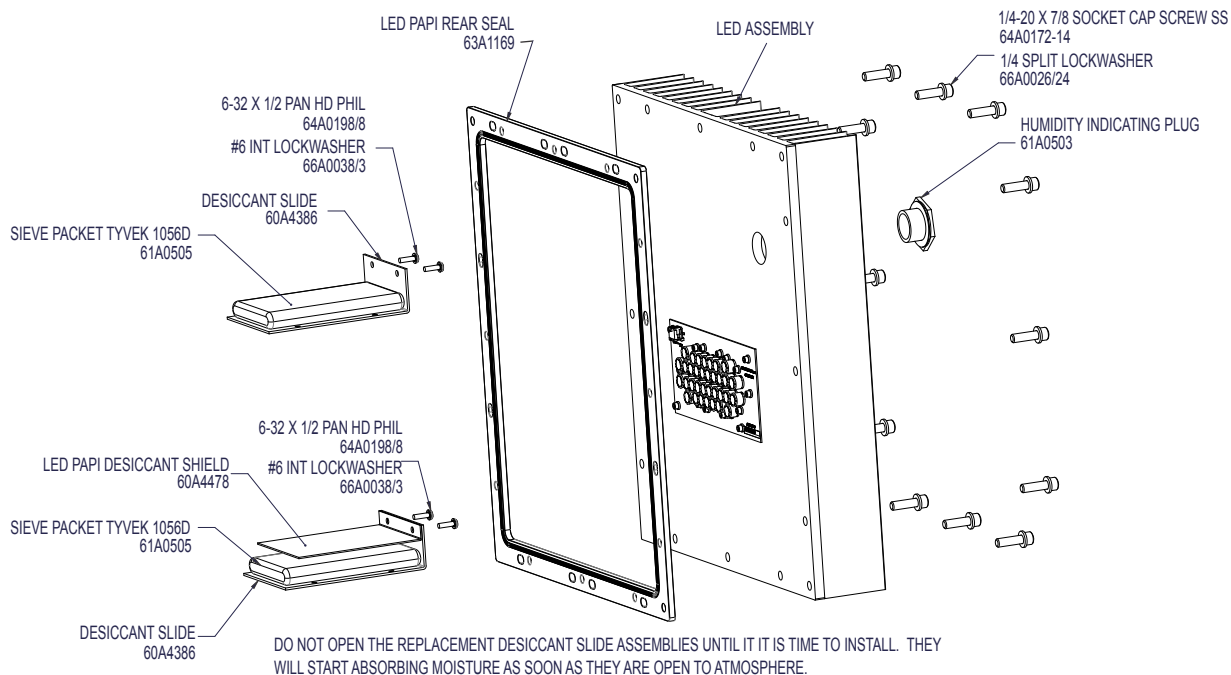
When replacing the LED Light Engine, the desiccant packs must also be replaced. The required desiccant packs and mounting hardware are included in the LED Light Engine replacement kit AK00030-200-01.

Figure 52: Replace the LED Assembly



1. Remove the (12) 1/4-20 SHCS from the rear of the LED assembly. Remove the LED assembly.
2. Disconnect the wire connector from the LED assembly and discard the non-working LED assembly.
3. Remove and discard the rear seal gasket.
4. Replace the (2) desiccant packs. (only in dry conditions and not until ready to reassemble). See [Replace the Desiccant Packs](#).
5. Replace the rear seal gasket.
6. Connect the wire connector to the replacement LED assembly.
7. Mount the LED assembly onto the PAPI light unit.
8. Replace the (12) 1/4-20 SHCS and washers to the rear of the LED assembly, torque to 82 in-lb.
9. Perform the [LED PAPI Control Board Calibration Procedure](#).

Figure 53: Desiccant Packs and Rear Seal



12.3 Control Board Replacement

Kit 94A0666/XXX, Reliance PAPI Control Board Replacement Kit.



Note

Read the following sections prior to performing any tasks.

Follow these procedures carefully and call ADB SAFEGATE for assistance, if required.

Use the following matrix to identify the compatible kit for your LED PAPI.

Ordering Code

94A0666/

Power
Series Option
Input Power PCB Option

Power

- 1 = Voltage-Powered Primary PAPI
- 2 = Voltage-Powered Secondary PAPI
- 3 = Current-Powered PAPI

Series Option

- 0 = LPL Series PAPI (PN begins with LPL)
- 2 = RP Series PAPI (PN begins with RP)

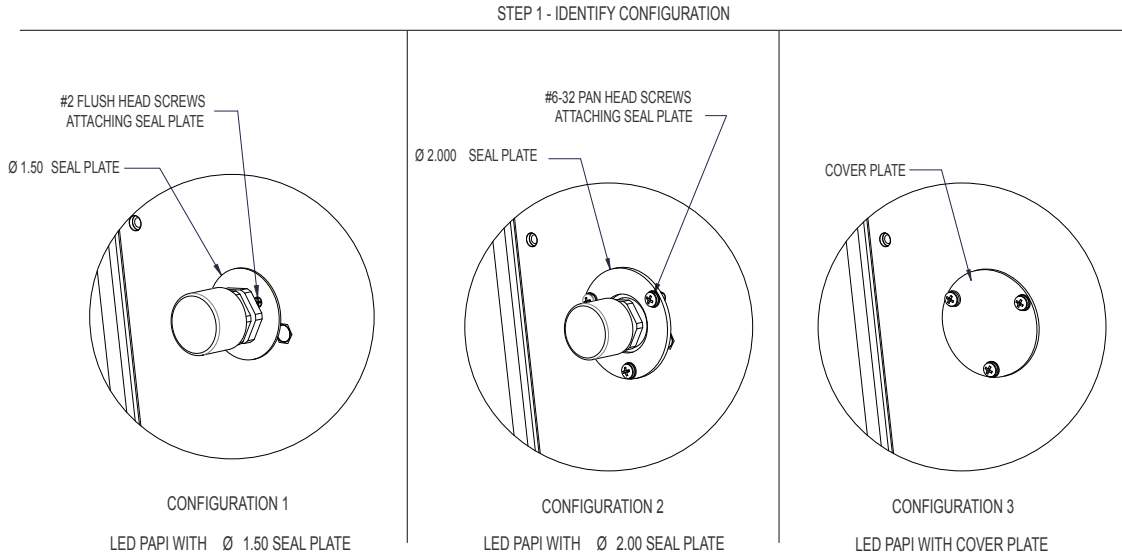
Input Power PCB Option

- 0 = Input Power PCB Not Included
- = Input Power PCB Included

12.3.1 Replacing the Control Board/Display Side Panel Assembly

1. Identify the configuration of your RELIANCE PAPI enclosure.
 - a. If the enclosure is not equipped with a baffle, proceed to step 4.
 - b. If the enclosure is identified as Configuration 1, proceed to step 2.
 - c. If the enclosure is identified as Configuration 2, proceed to step 3.
 - d. If the enclosure is identified as Configuration 3, proceed to step 4.

Figure 54: Identify the Side Panel Configuration



2. Configuration 1 Baffle Plate removal instructions.

RELIANCE PAPI WITH Ø 1.5-in SEAL PLATE.

- a. Slightly loosen the sealing gland nut on the 77A0263 cord grip. Do not allow the Actuator fitting to rotate as this will break the seal.
- b. Remove the 77A0263 cord grip from the 60A4575 actuator fitting. It is necessary to secure the 60A4575 actuator fitting to prevent rotation.

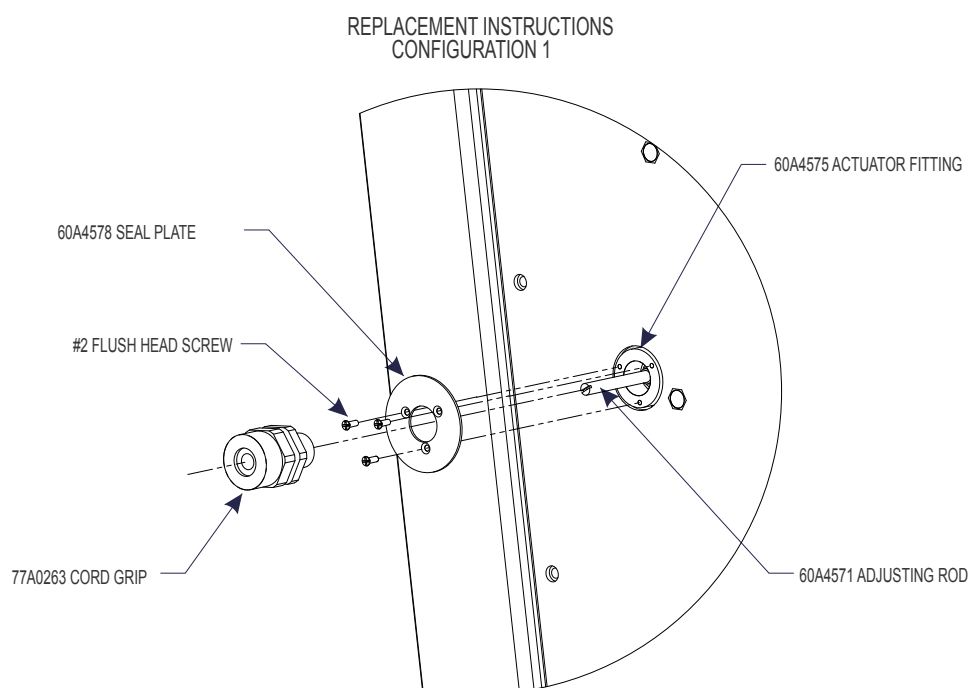


Note

Do not allow the 60A4571 adjusting rod to rotate as this will change the baffle setting.

- c. Remove the three #2 flush screws and 60A4578 seal plate - discard.
- d. Proceed to step 4

Figure 55: Remove the baffle closeout (configuration 1)



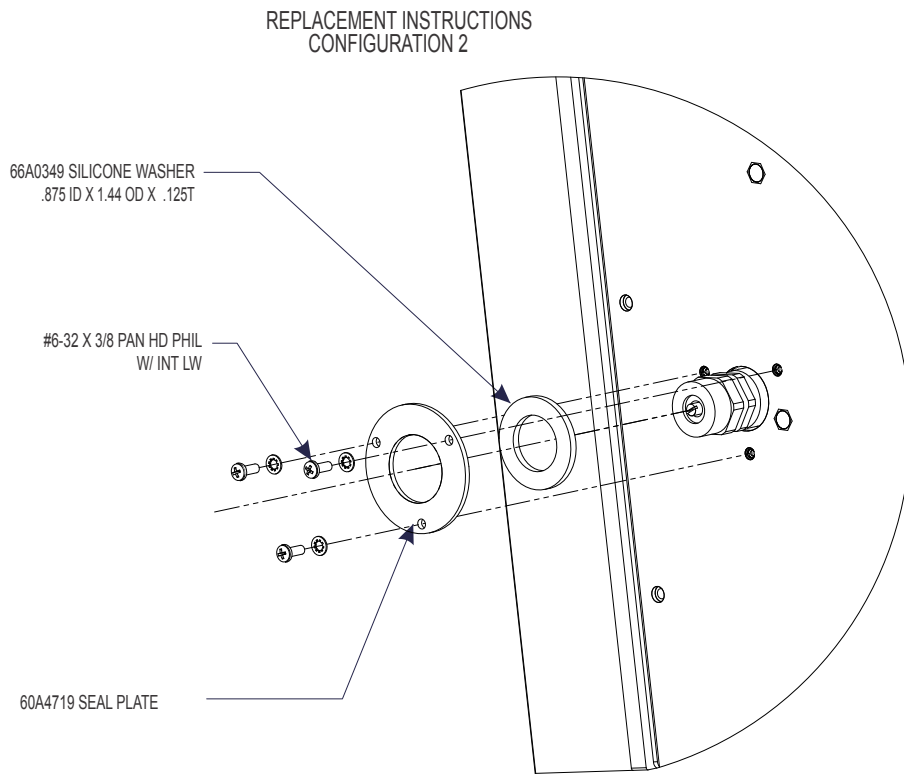
3. Configuration 2 Baffle Plate removal instructions.
 - a. Remove the #6 hardware attaching the 60A4719 closeout plate.
 - b. Remove the 66A0349 silicone washer.
 - c. Proceed to step 4, Side Panel Removal.



Note

Do NOT loosen the Gland Nut (77A0263), or threaded connection to the Actuator Fitting (60A4575).

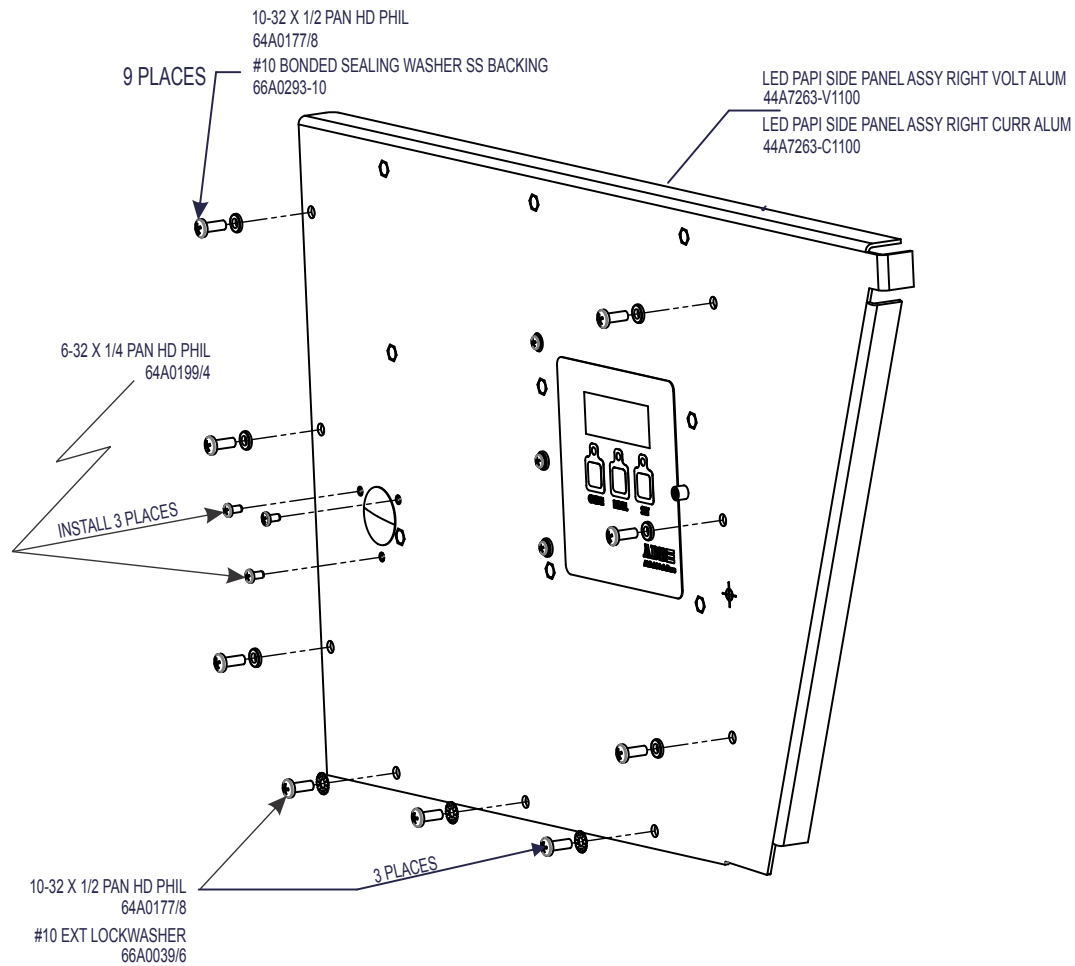
Figure 56: Remove the baffle closeout (configuration 2)



4. Side Panel Removal - all configurations.

- a. Disconnect from the control board all of the internal wire/cable attachments necessary to remove the control board side panel assembly from the LED PAPI chassis.
- b. Remove the (9) #10-32 x 1/2 pan head Phillips screws and sealing washers that are attaching the side panel assembly to the LED PAPI chassis. Refer to [Figure 57](#).

Figure 57: Side Panel Removal/Replacement



- Set DIP switches on the replacement Control Board assembly to match the DIP switches on the removed Control Board assembly. Refer to [Figure 58](#) for location of the DIP switches on the Control Board.



Note

If the removed Control Board switch settings are unavailable or damaged, the DIP switch settings can be found in user manual 96A0446 for the LPL series PAPI and DM00012-000-01 for the RP series PAPI. See section RELIANCE PAPI Control Board Overview.



Note

For the RP series PAPI only, ensure DIP switch SW5-7 is configured for proper site specific operation of the LED PAPI system. The default position of this switch is "OFF" for communication between boxes to be "enabled". To "disable" communication between boxes, this switch must be changed to the "ON" position. For previous versions of firmware, this switch may have been unused.

For the LPL series PAPI, this switch was unused.



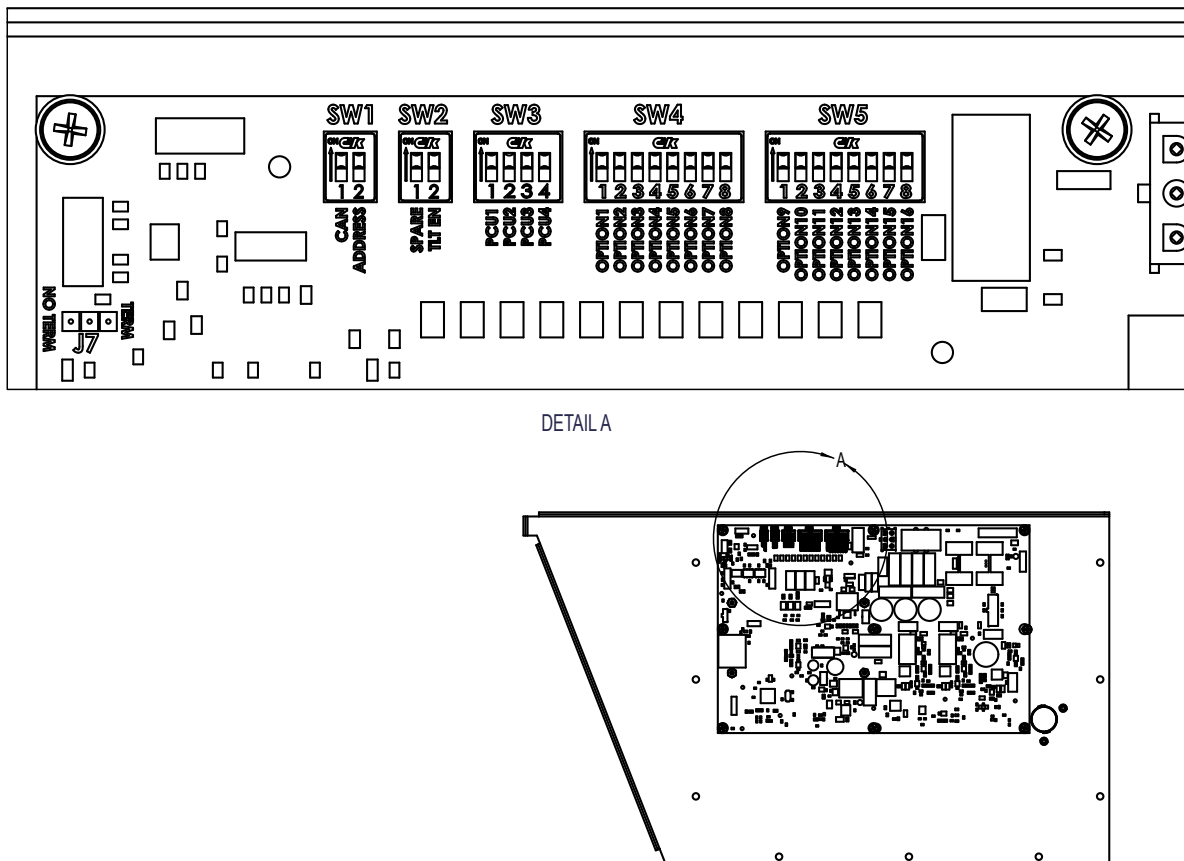
Note

For the RP series FAA PAPI only, ensure DIP switch SW4-7 is in the "ON" position for FAA operation. For previous versions of firmware, this switch may have been unused.

For ICAO operation, this switch will be in the "OFF" position.

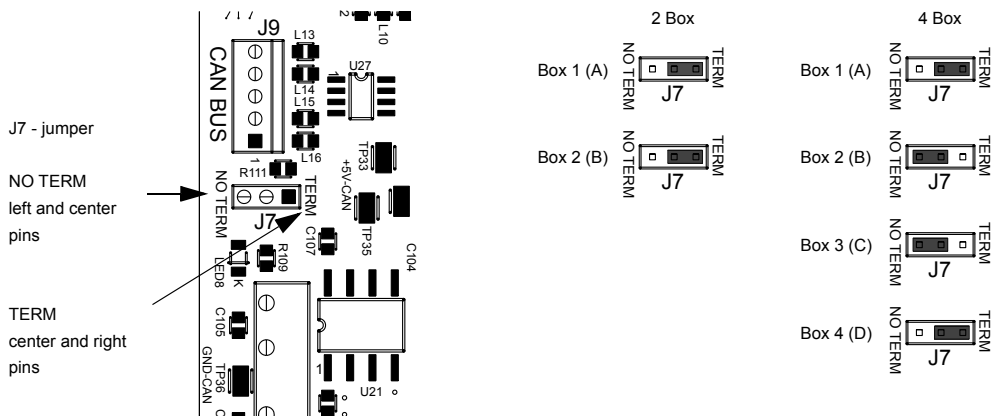
For the LPL series PAPI, this switch was unused.

Figure 58: Control Board DIP Switch Location



6. Configure the jumper position on J7 of the Control Board.
 - a. 2 Box setup: The jumper position on J7 for Box 1 and Box 2 will be on the Left and Center pins (TERM).
 - b. 4 Box setup: The jumper position on J7 for Box 1 and Box 4 will be on the Left and Center pins (TERM); Box 2 and Box 3 will be on the Center and Right pins (NO TERM).

Figure 59: Control Board - J7 jumper setting



7. Reassembly of Side Panel Assembly.

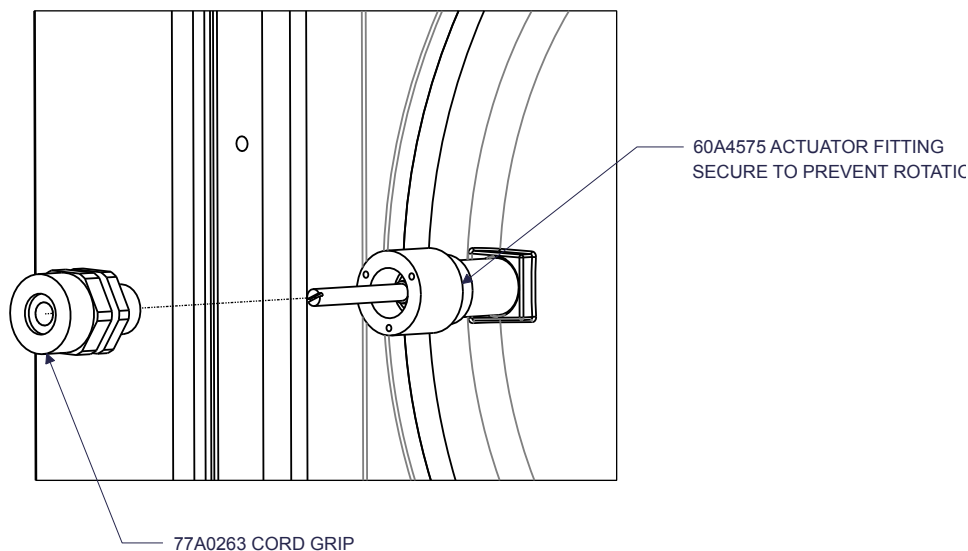
a. Enclosure without a baffle and configuration 3 Side Panel Replacement.

- Install the replacement side panel using the provided hardware - (9) # 10-32 screws.
- Re-attach cable-plugs to new RELIANCE PAPI control board. Reference the user manual 96A0446 for the LP series PAPI and DM00012-000-01 for the RP series PAPI for applicable wiring diagrams.

b. Configuration 1 Side Panel Replacement instructions.

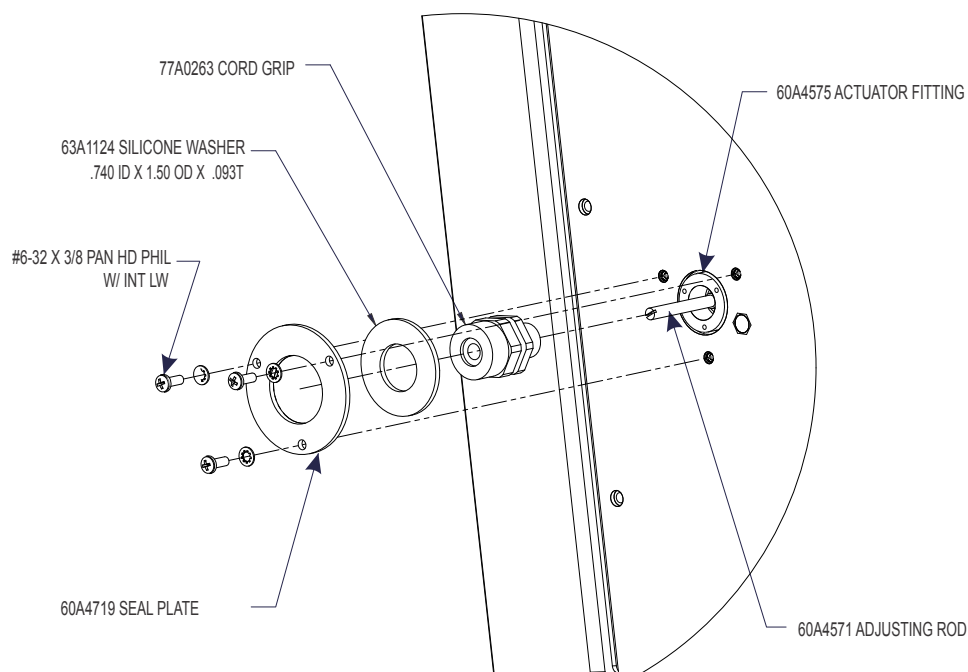
- Apply a light coating of lubricant to the protruding 60A4571 adjusting rod.
- Install the 77A0263 cord grip using pipe thread sealant. It is necessary to secure the 60A4575 Actuator Fitting to prevent rotation. Do not allow the 60A4571 Adjusting Rod to rotate as this will change the baffle setting.

Figure 60: Reassembly of the Baffle Actuator Fitting (configuration 1)



- Install replacement side panel using provided hardware - (9) #10-32 screws.
- Stretch the 63A1124 Seal Washer over the cord grip fitting and install the 60A4719 Closeout Plate using the #6 hardware provided.
- Re-attach plugs to new RELIANCE PAPI control board. Reference the user manual 96A0446 for the LP series PAPI and DM00012-000-01 for the RP series PAPI for applicable wiring diagrams.

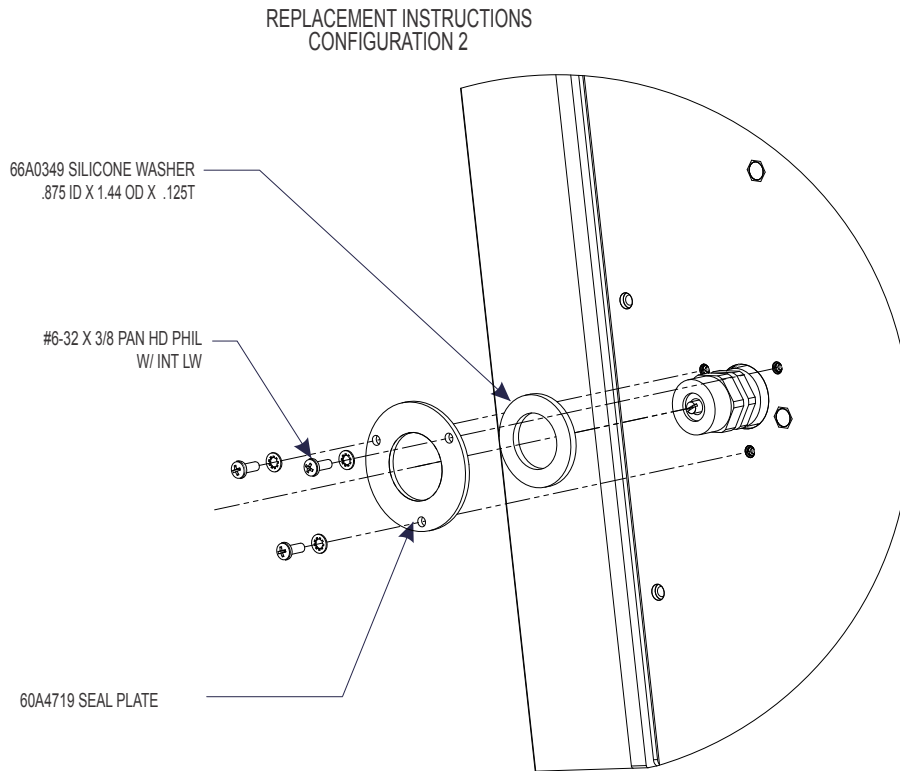
Figure 61: Reassembly of the Baffle Seal Washer and Seal Plate (configuration 1)



c. Configuration 2 Side Panel Replacement instructions.

- Install the replacement side panel using provided hardware - (9) #10-32 screws.
- Install the 66A0349 Seal Washer over the cord grip fitting and install the 60A4719 Seal Plate using the #6 hardware provided.
- Re-attach plugs to new RELIANCE PAPI control board. Reference the user manual 96A0446 for the LP series PAPI and DM00012-000-01 for the RP series PAPI for applicable wiring diagrams.

Figure 62: Reassembly of the Baffle (configuration 2)



8. Replace the input power board as necessary. If input power board is not replaced, proceed to the next step.
-



Note

With each control board assembly, the corresponding input power board (44A7392/X) is provided and must be replaced.

- a. Disconnect wiring from the 44A7392/X input power assembly.
 - b. Remove 44A7392/X input power assembly by lifting the DIN Rail mount tabs to release it from the DIN Rail.
 - c. Replace with 44A7392/X input power assembly provided with the kit. Install by snapping the mounting tabs onto the DIN Rail.
 - d. Re-connect wiring to 44A7392/X Input power assembly. Reference manual for applicable internal wiring diagram.
9. Perform the [LED PAPI control board calibration procedure](#).

12.3.2 LED PAPI Control Board Calibration

The LED PAPI Control Board Calibration procedure synchronizes the LED Engine with the Control Board. This calibration procedure is performed in the factory for all new production LED PAPIs. However, if an LED engine or control board is replaced in the field, a re-calibration should always be performed.



Note

A spare control board will not have factory calibration. After installation of a spare control board, factory calibration is necessary for operation. The LEDs will not illuminate until the regulator is set to step B5 (6.6A) for series current-powered PAPIs or power is supplied for parallel voltage-powered PAPIs.

1. On the Control Board change DIP switch SW4-6 to the "ON" position.
2. For series current-powered PAPIs, turn Regulator on to step B5. For parallel voltage-powered PAPIs, apply power to the PAPI.
3. Upon startup, observe the digital display for the firmware version. If the digital display reads firmware version 1.33, there is no calibration procedure to follow, skip to step 5. If the firmware version is 1.34 or newer, continue with the next step.
4. Allow time for PAPI to execute the calibration process. When the calibration process is complete, the PAPI light output will blink 1x per second.
5. Turn regulator off, or disconnect power to the PAPI.
6. Change DIP switch SW4-6 to the "OFF" position.
7. Turn regulator on or reconnect power, and verify the PAPI produces light at each intensity, (all steps or day/night operation).
8. If necessary, replace the top cover gasket.
9. Attach the top cover.
10. The LED PAPI is safe for operation.

12.4 Front Glass Replacement

To ensure proper operation of the LED PAPI, it is important that the correct version of heated glass is installed. To determine what heated glass is needed, you must first confirm the heated glass resistance specification for your LED PAPI. The specification is indicated by the firmware version, which is displayed during startup.

At startup, the PAPI display board will show the following message:

ADB -> LED -> PAPI -> VER -> V.VV -> GGGG -> BOXn -> OFn -> COLD -> XXX -> SEC.

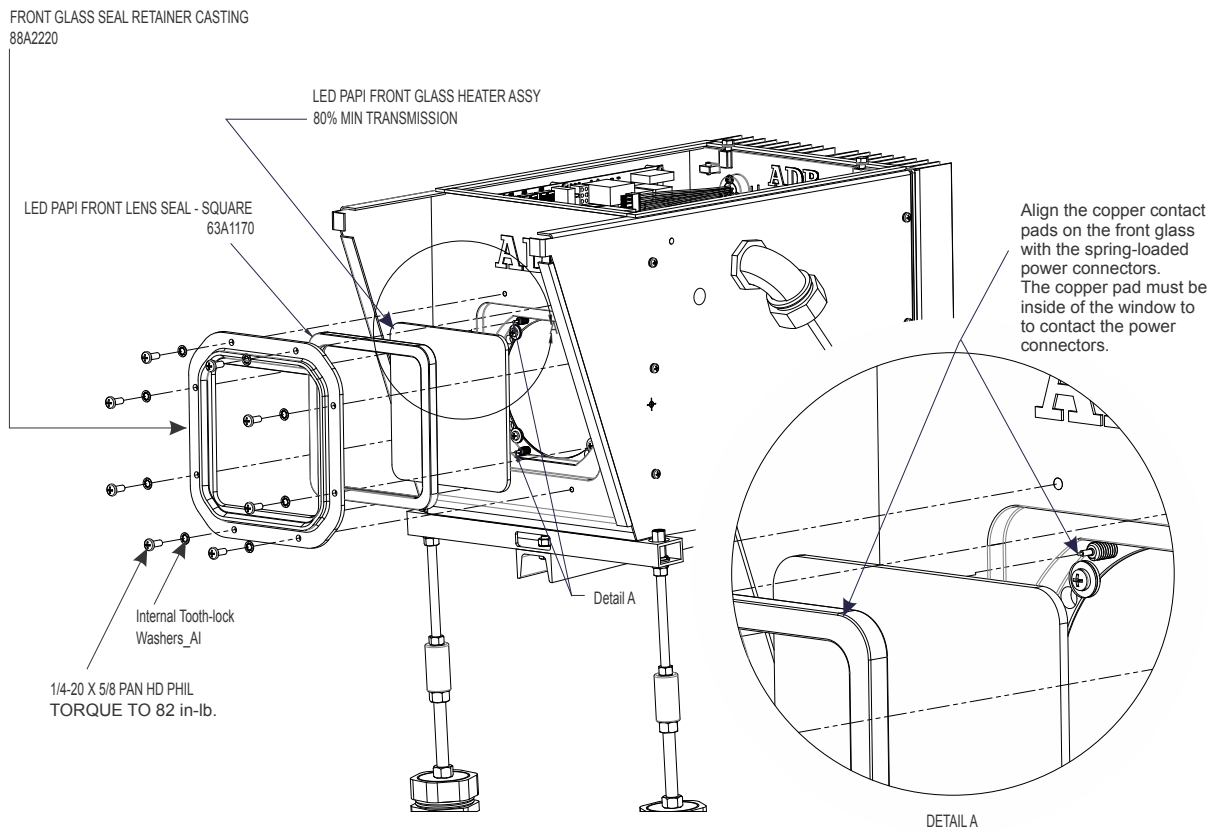
- **V.VV** corresponds to the current control board firmware version
 - If **V.VV** = 1.47 or earlier, use heated glass spare kit 94A0674/1.
 - If **V.VV** = 1.50 or later, use heated glass spare kit 94A0674/1 or AK00054-000-01.
- **XXX -> SEC** will be repeated until the light output is activated, if the defrost timer (SW 5-8) is enabled.



Note

When replacing the LED PAPI front glass, the desiccant packs must also be replaced. The required desiccant packs and mounting hardware are included in the front glass replacement kits 94A0674/1 and AK00054-000-01.

Figure 63: Front Glass Replacement

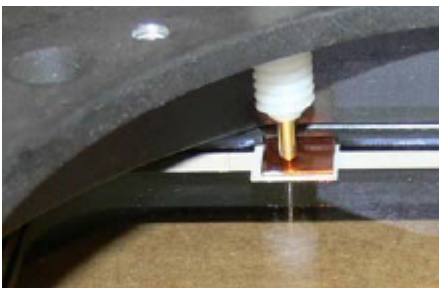


12.4.1 Replace the LED PAPI Front Glass

Instructions for replacing the front glass using heated glass kits 94A0674/1 and AK00054-000-01.

1. Remove and discard the (8) 1/4-20 fasteners and washers attaching the 88A2220 seal retainer.
2. Remove and discard the defective front glass and seal.
3. Install the new 63A1170 front lens seal by wrapping around the new front glass.
4. Align the copper contact pads on the front glass with the spring loaded power connectors.

Figure 64: Copper Tab and Spring Loaded Power Connector



Note

The copper pad must be inside of the window (facing the PAPI) to contact the power connectors.

5. Install 88A2220 seal retainer with new (8) 1/4-20 fasteners and washers, torque to 82 IN-LB.
6. Replace the desiccant packs. See [Replace the Two Desiccant Packs](#).

7. Verify fuse F5 on the control board.

12.5 Replace the Two Dessicant Packs

1. Remove and discard the (12) 1/4-20 SHCS and washers from the rear of the LED assembly heat sink.
2. Disconnect the wire connector from the LED assembly.
3. Discard the rear seal gasket.

4. Replace the two desiccant packs (only in dry conditions and not until ready to reassemble).
 - a. Remove and discard the two screws holding each desiccant slides.
 - b. Remove and discard the desiccants, slides and shield.
 - c. Insert the (2) new pre-assembled desiccant packs with slides and attach each with the two fasteners and washers. Ensure the new desiccant shield is installed with the lower slide only.

Figure 65: LED Assembly

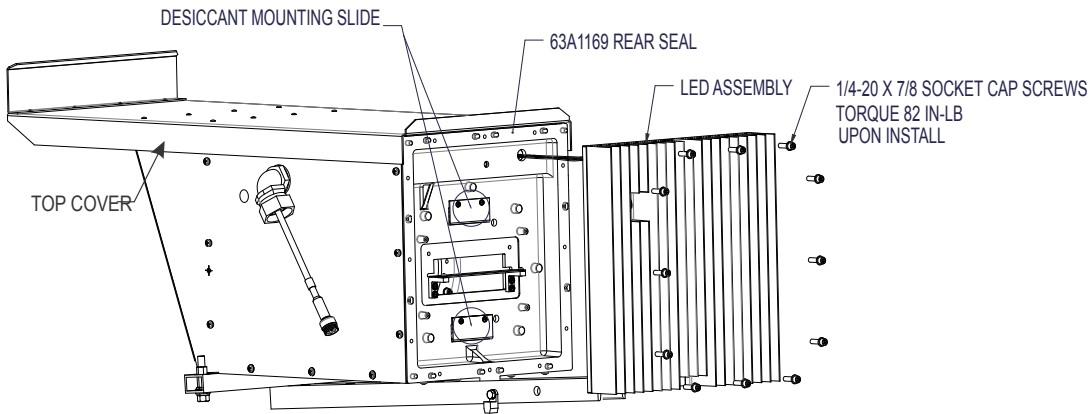


Figure 66: Desiccant Packs and Rear Seal

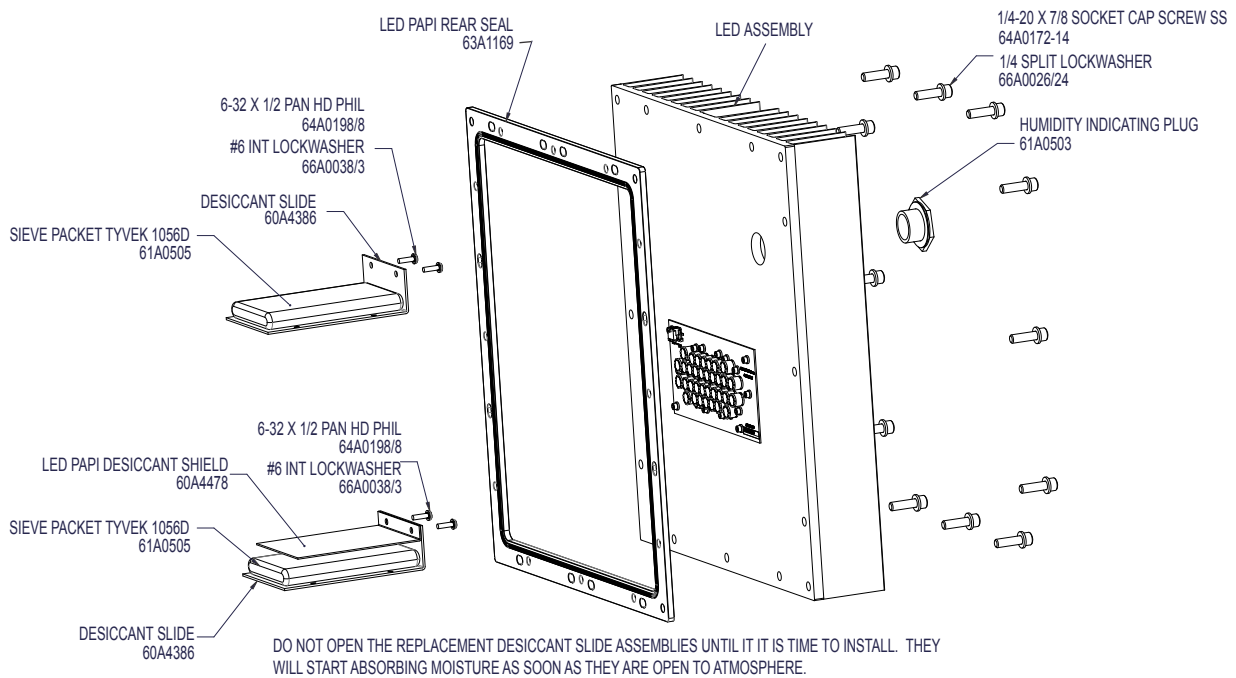
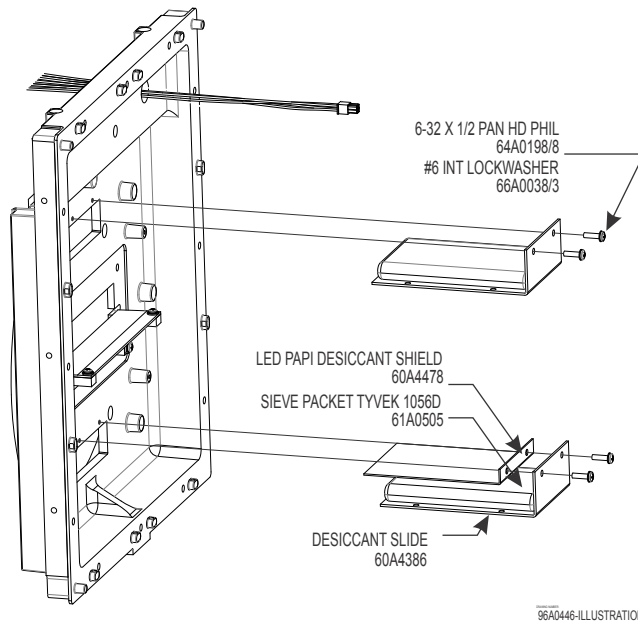


Figure 67: Desiccant Packs

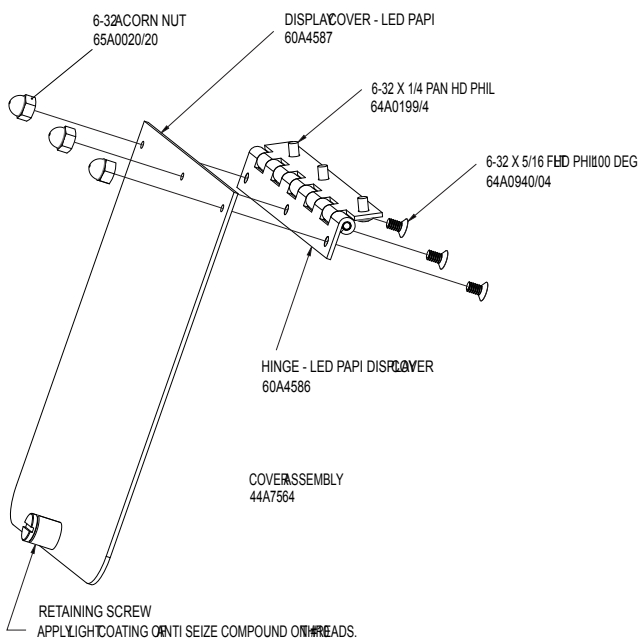


5. Replace the rear seal gasket.
6. Connect the wire connector to the LED assembly.
7. Replace the (12) 1/4-20 SHCS to the rear of the LED assembly, torque to 82 in-lb.

12.6 Optional Touchpad Cover

Unpack the optional touchpad cover assembly. Ensure all components are in the package.

Figure 68: Touchpad Cover Assembly 44A7564



Install the optional touchpad cover assembly using the three holes to the left of the display.

1. Apply a drop of Loctite to the supplied screws.

2. Line up the touchpad cover assembly with the holes and attach with the supplied 6-32 screws.
3. Close the touchpad cover and lock closed with the retaining screw.

Figure 69: Touchpad Cover Assembly Installed

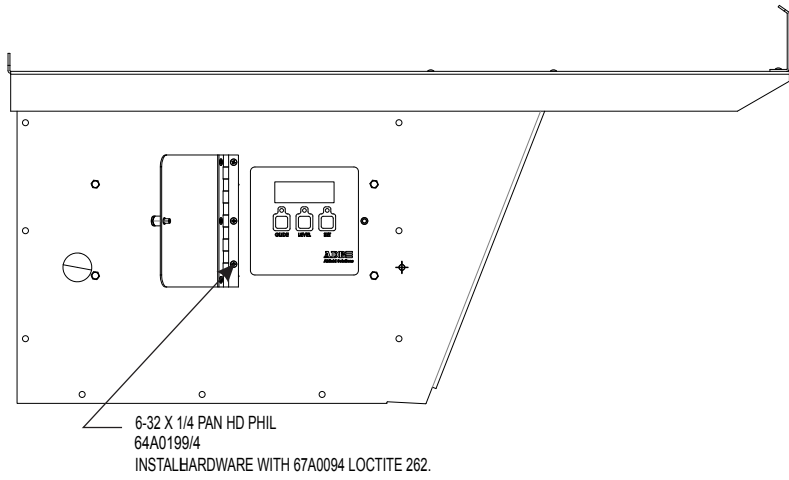
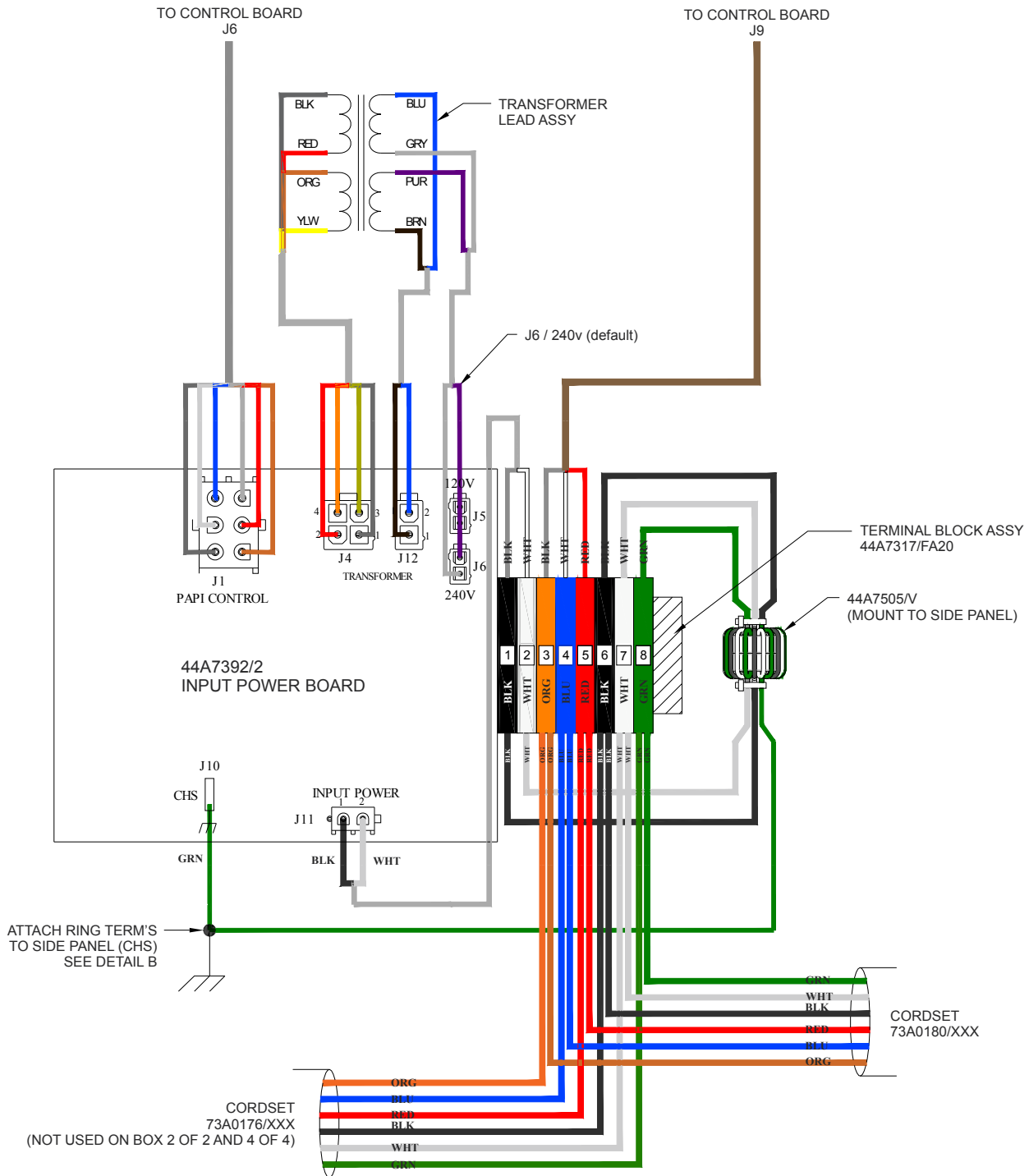
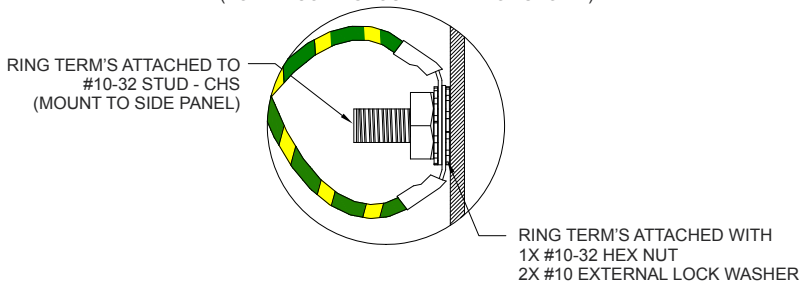


Figure 71: Input Power Wiring Diagram - Voltage Powered (Secondary Light Unit)

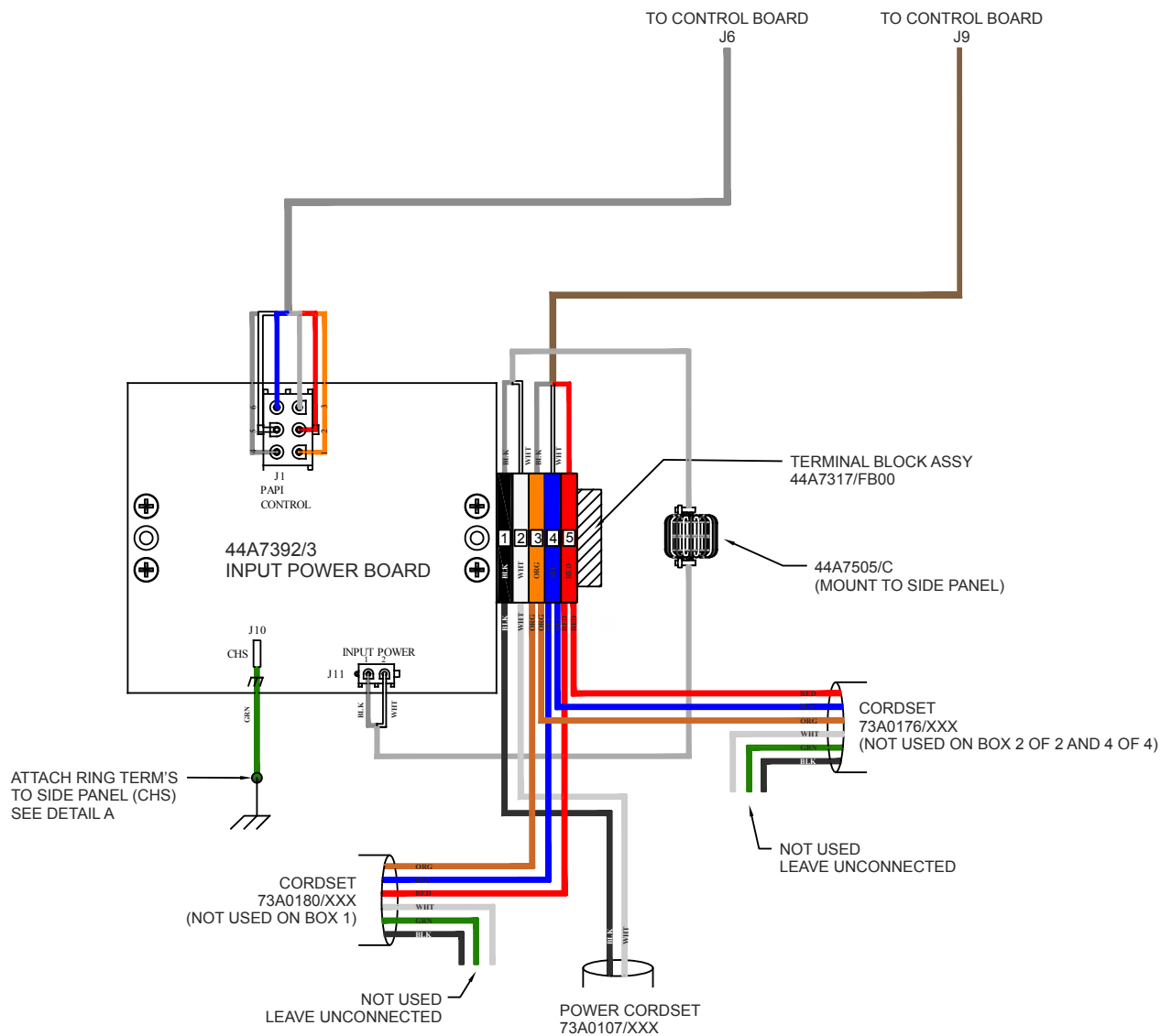


DETAIL B:
CHASSIS GROUND RING TERM'S CONNECTION, TYP.
(POWER CORD GROUND LEAD NOT SHOWN)

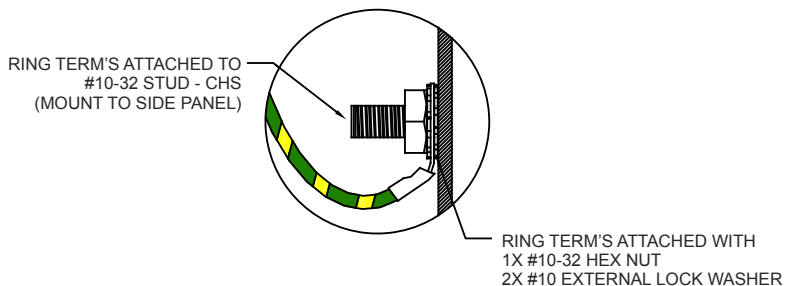


43A4144-XXXX REV.D

Figure 72: Input Power Wiring Diagram - Current Powered (Primary and Secondary Light Unit)

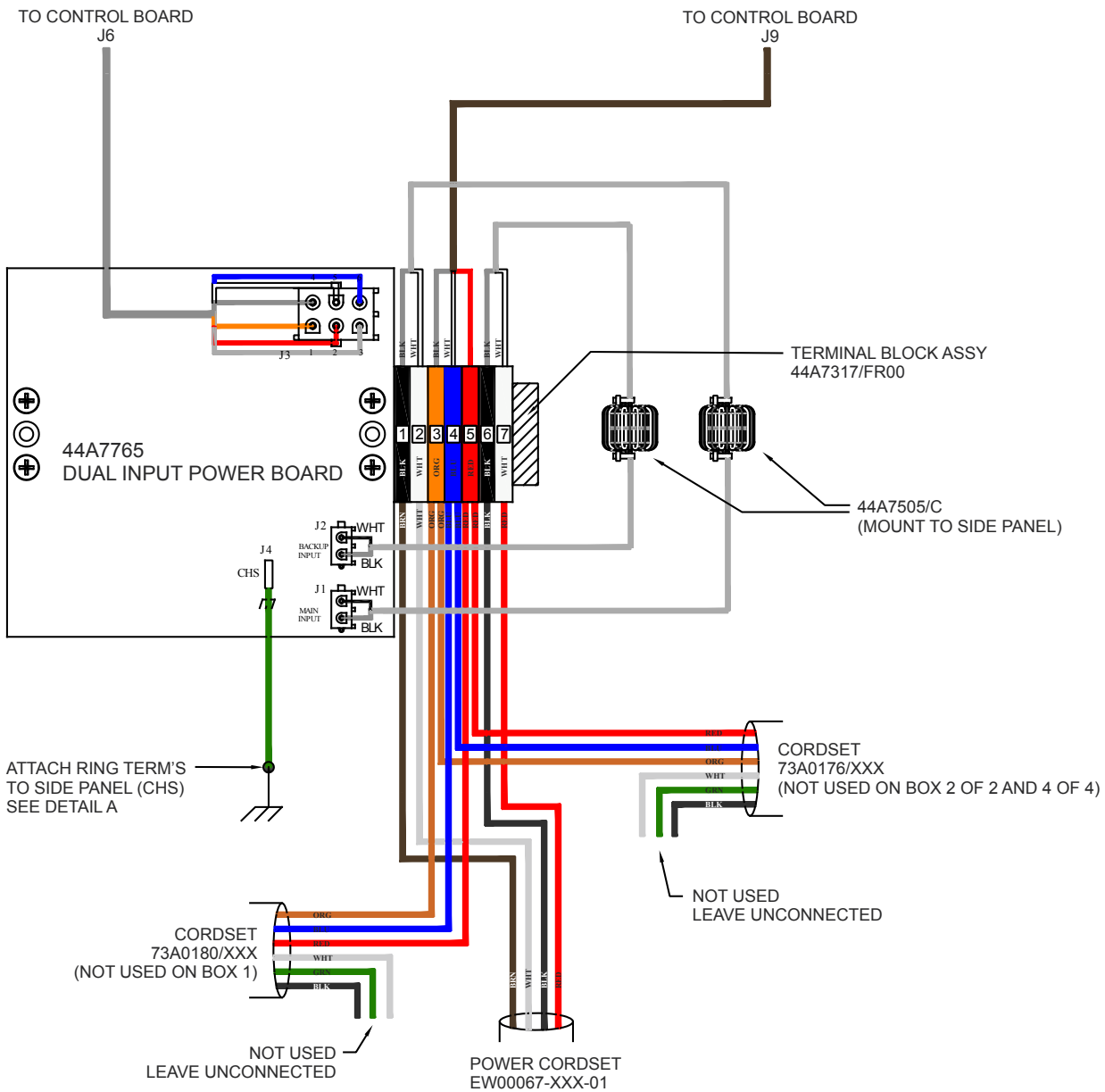


DETAIL A:
CHASSIS' GROUND RING TERM'S CONNECTION, TYP.
(POWER CORD GROUND LEAD NOT SHOWN)

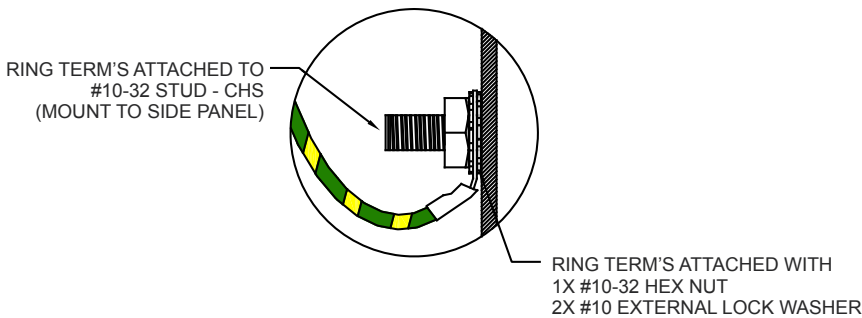


43A4165-XXXX REV.J

Figure 73: Input Power Wiring Diagram - Current Powered with Redundant Circuit (Primary and Secondary Light Unit)



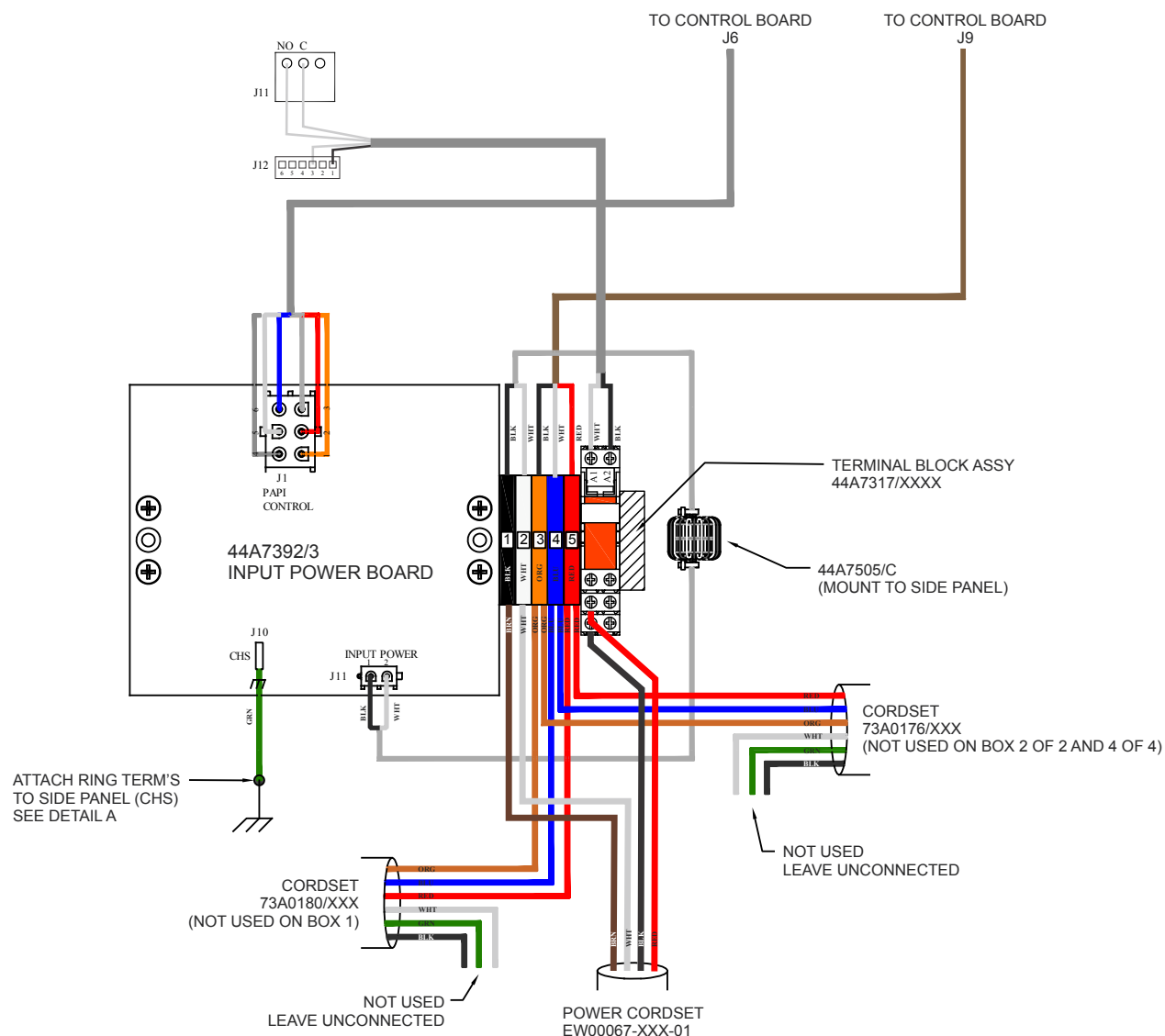
DETAIL A:
CHASSIS GROUND RING TERM'S CONNECTION, TYP.
(POWER CORD GROUND LEAD NOT SHOWN)



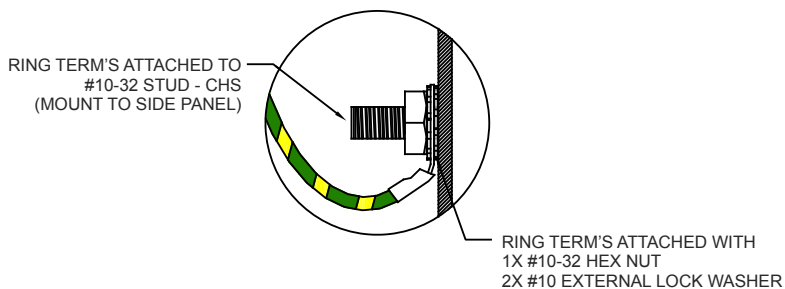
43A4165-XXXX REV.J

Figure 74: Input Power Wiring Diagram - Current Powered with Fail-Open Relay (Primary Only)

For Secondary Light units, see [Figure 72](#)



DETAIL A:
CHASSIS GROUND RING TERM'S CONNECTION, TYP.
(POWER CORD GROUND LEAD NOT SHOWN)



43A4165-XXXX REV.J

Figure 75: Control Board Wiring Diagram

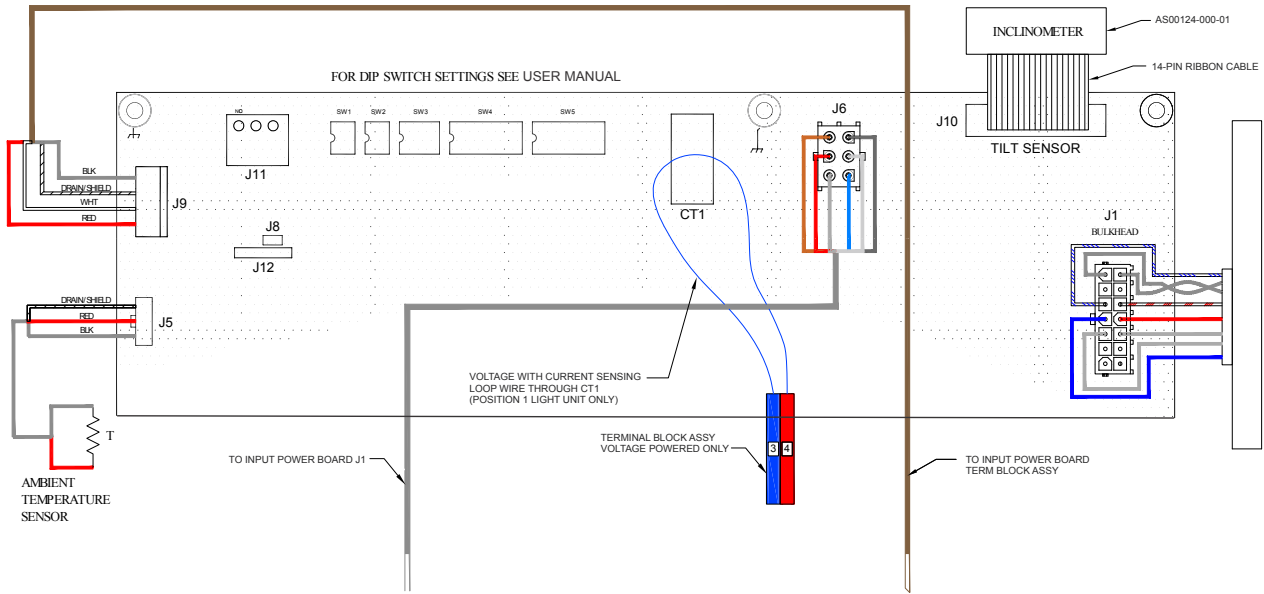
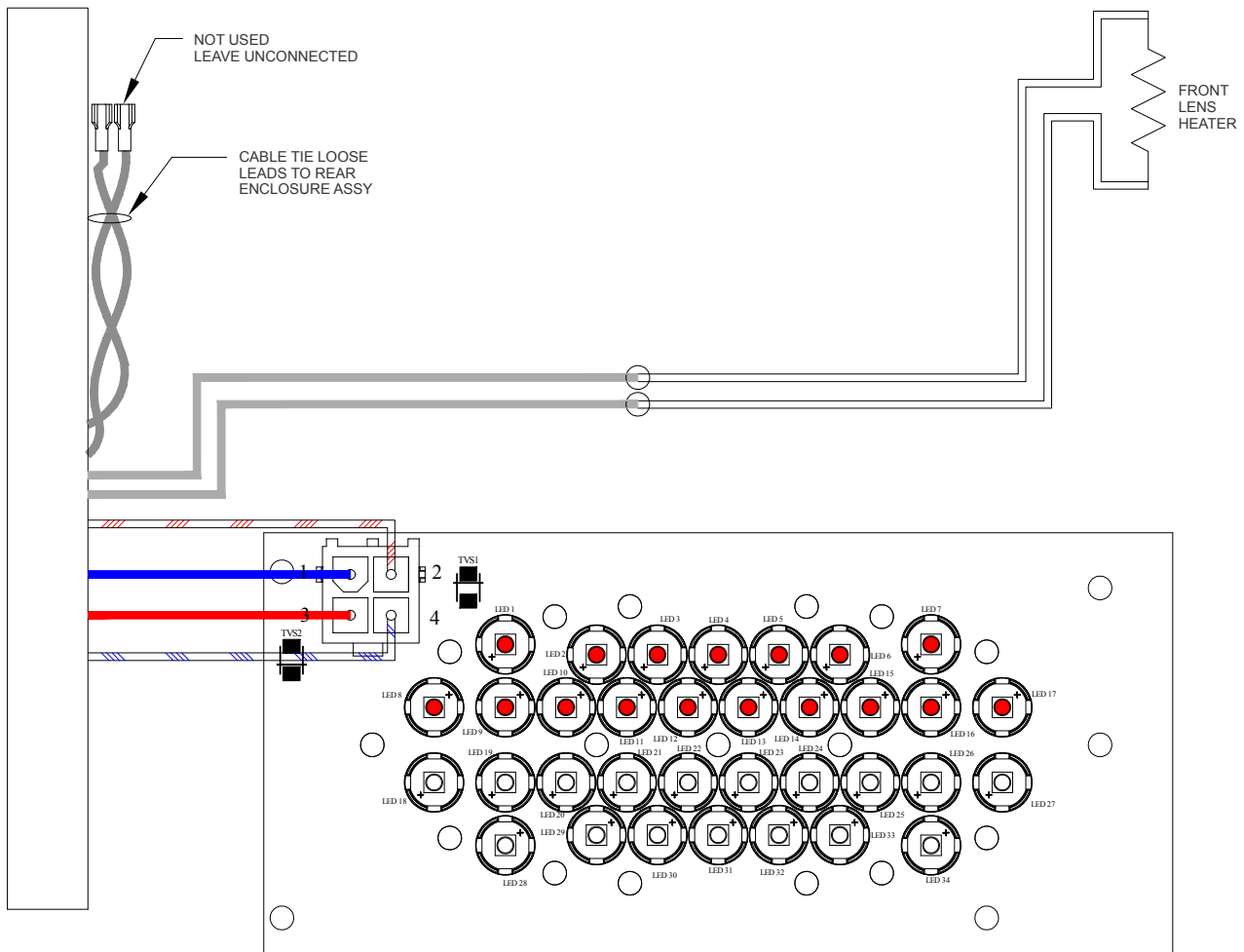
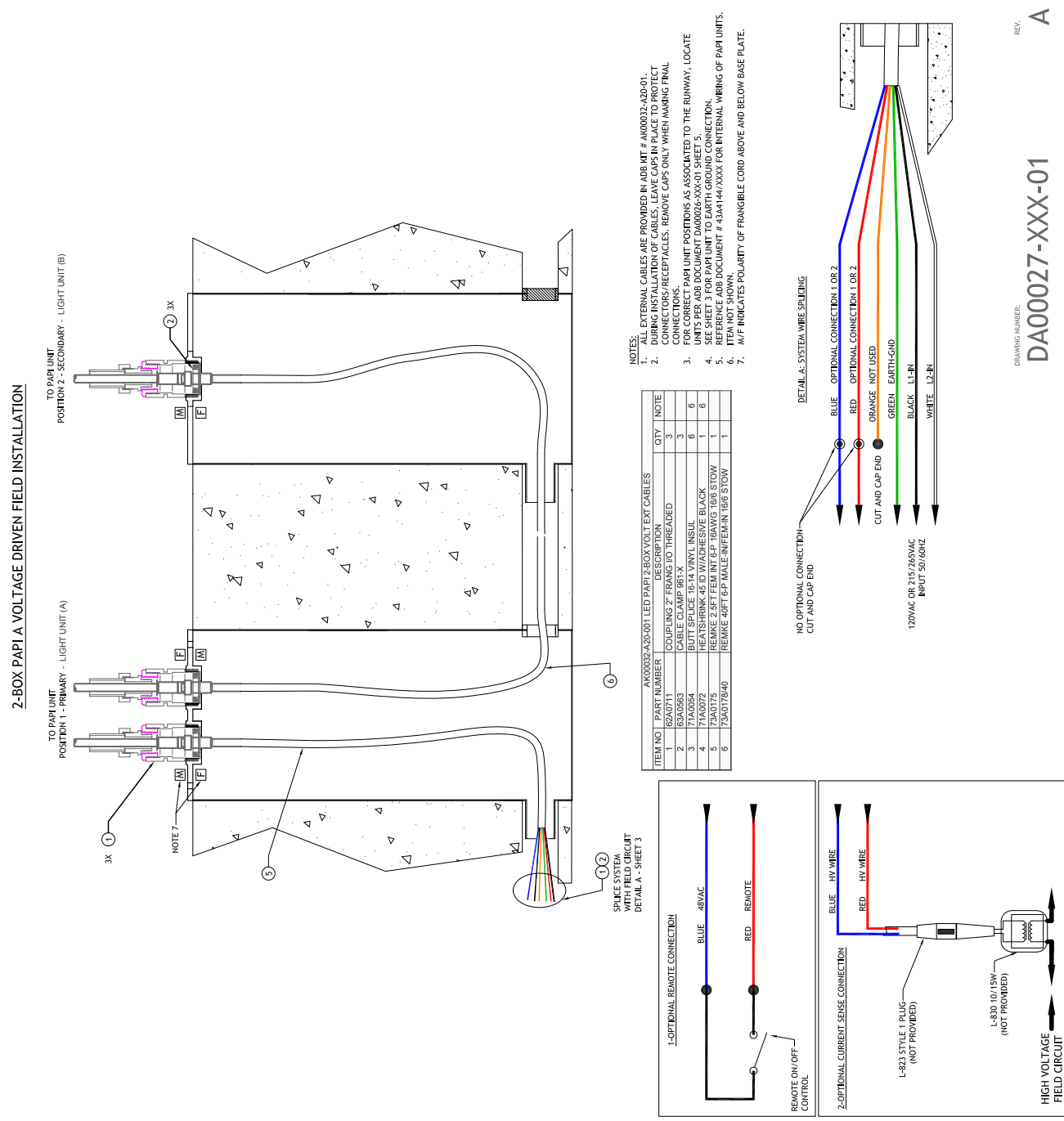


Figure 76: LED Assembly and Front Lens Heater Wiring Diagram



13.2 Field Cabling Diagrams

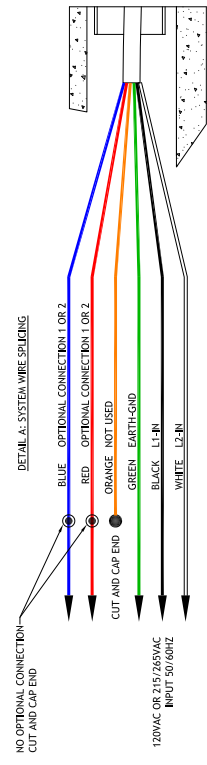
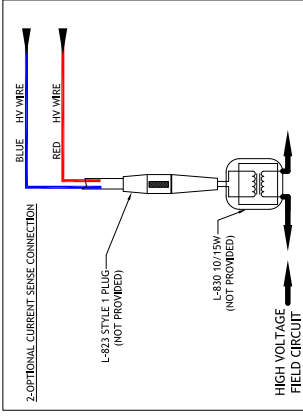
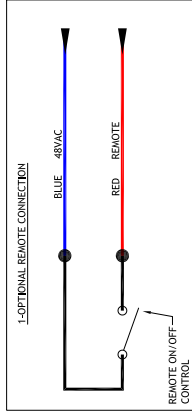
Figure 77: Field Cabling Diagram - Voltage Powered (2 Box)



2-BOX PAPI A VOLTAGE DRIVEN FIELD INSTALLATION

- NOTES:
1. ALL EXTERNAL CABLES ARE PROVIDED IN ADB KIT # AK00032-A20-01. DURING INSTALLATION OF CABLES, LEAVE CAPS IN PLACE TO PROTECT CONNECTORS/RECEPTACLES. REMOVE CAPS ONLY WHEN MAKING FINAL CONNECTIONS.
 2. PAPI UNIT POSITIONS AS ASSOCIATED TO THE RUNWAY, LOCATE UNITS PER ADB DOCUMENT DA00026-XX-01 SHEET 5.
 3. SEE SHEET 3 FOR PAPI UNIT TO EARTH GROUND CONNECTION.
 4. REFERENCE ADB DOCUMENT # 434144/XXXX FOR INTERNAL WIRING OF PAPI UNITS.
 5. ITEM NOT SHOWN.
 6. M/F INDICATES POLARITY OF FRANGIBLE CORD ABOVE AND BELOW BASE PLATE.
 - 7.

ITEM NO.	PART NUMBER	DESCRIPTION	QTY	NOTE
1	B2A0711	COUPLING 2" FRANG TO THREADED	3	
2	B3A0583	CABLE CLAMP 8B1-X	3	
3	71A0054	BUTT SPLICE 16-14 VINYL INSUL	6	
4	71A0072	HEATSHRINK 45 ID W/ADHESIVE BLACK	1	
5	73A017840	FRANGIBLE CORD 16B STD/0V	1	
6	73A017840	FRANGIBLE CORD 16B STD/0V	1	



REV. A
DRAWING NUMBER: DA00027-XXX-01

Figure 78: Field Cabling Diagram - Voltage Powered (4 Box)

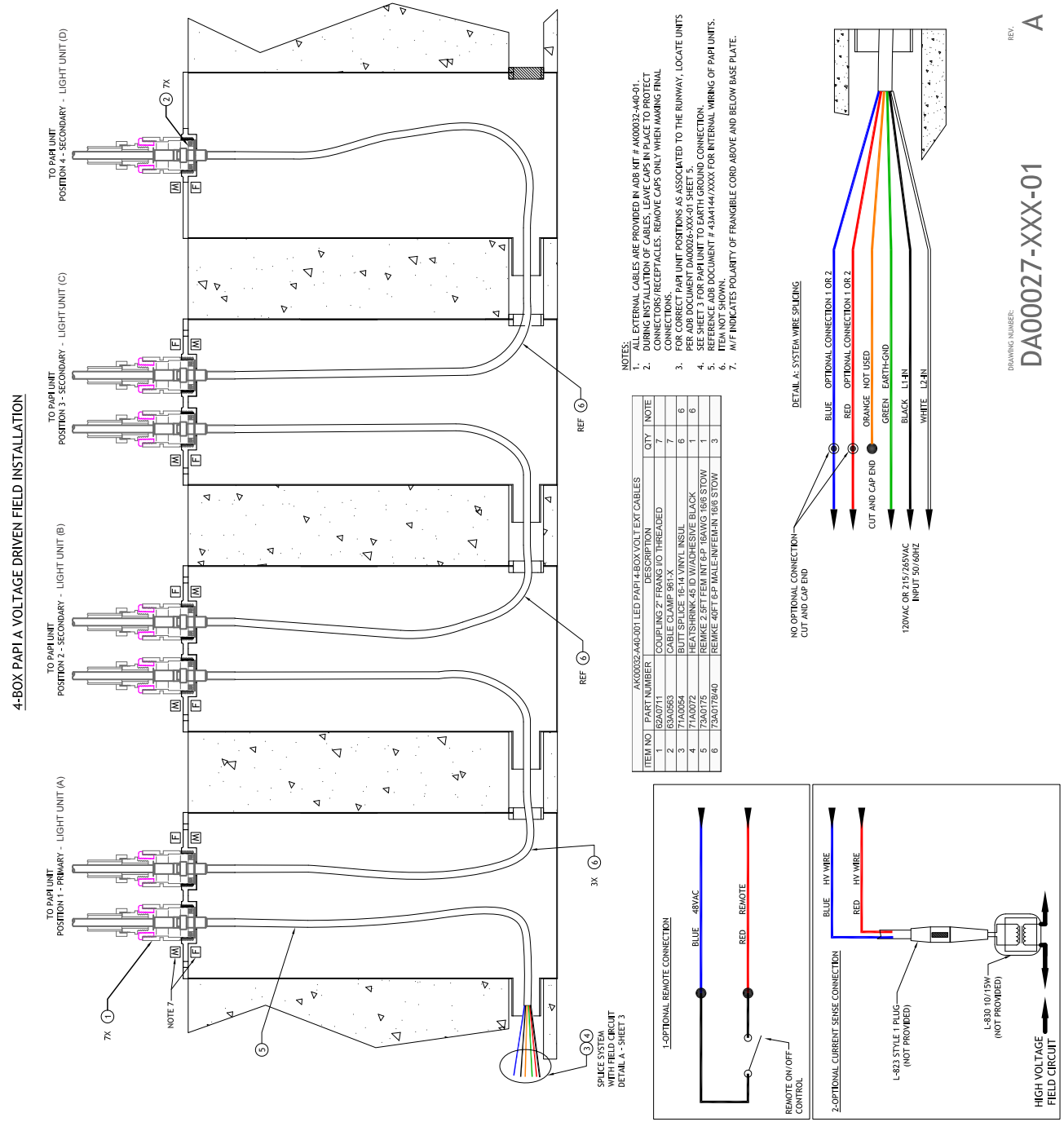
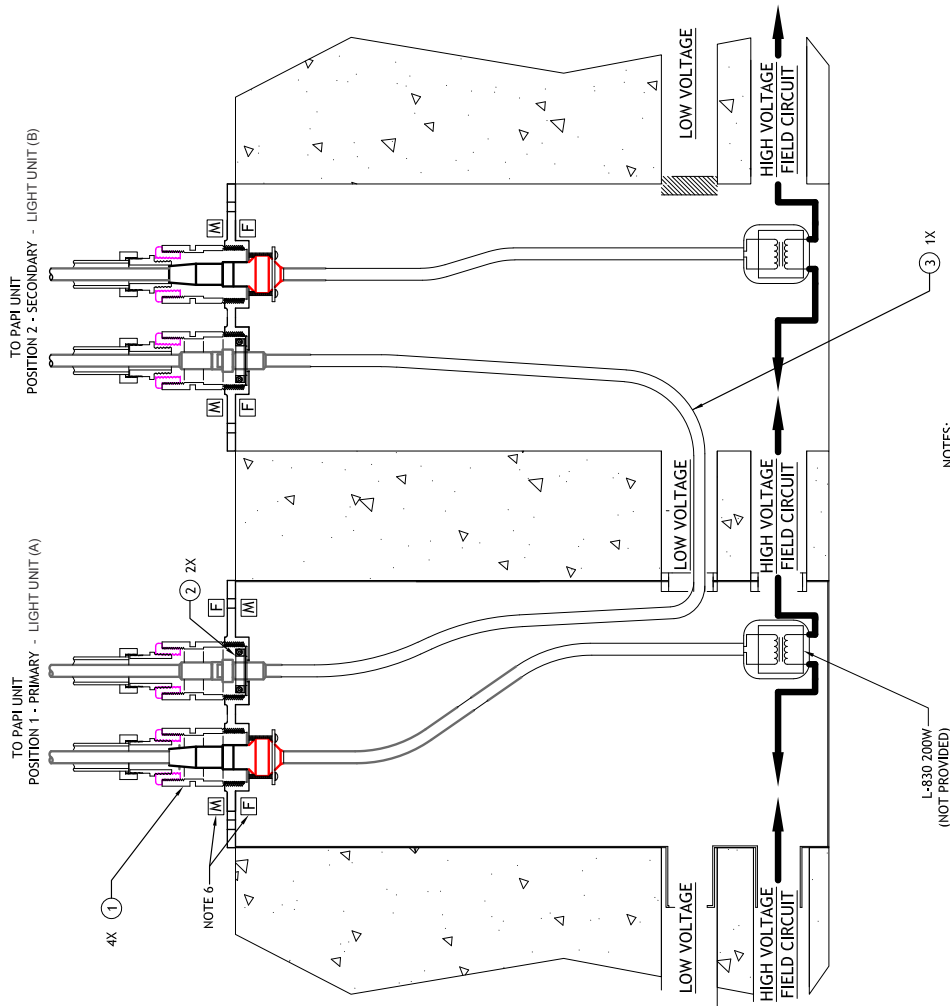


Figure 79: Field Cabling Diagram - Current Powered (2 Box)

2-BOX PAPI B CURRENT DRIVEN FIELD INSTALLATION (NON-REDUNDANT)

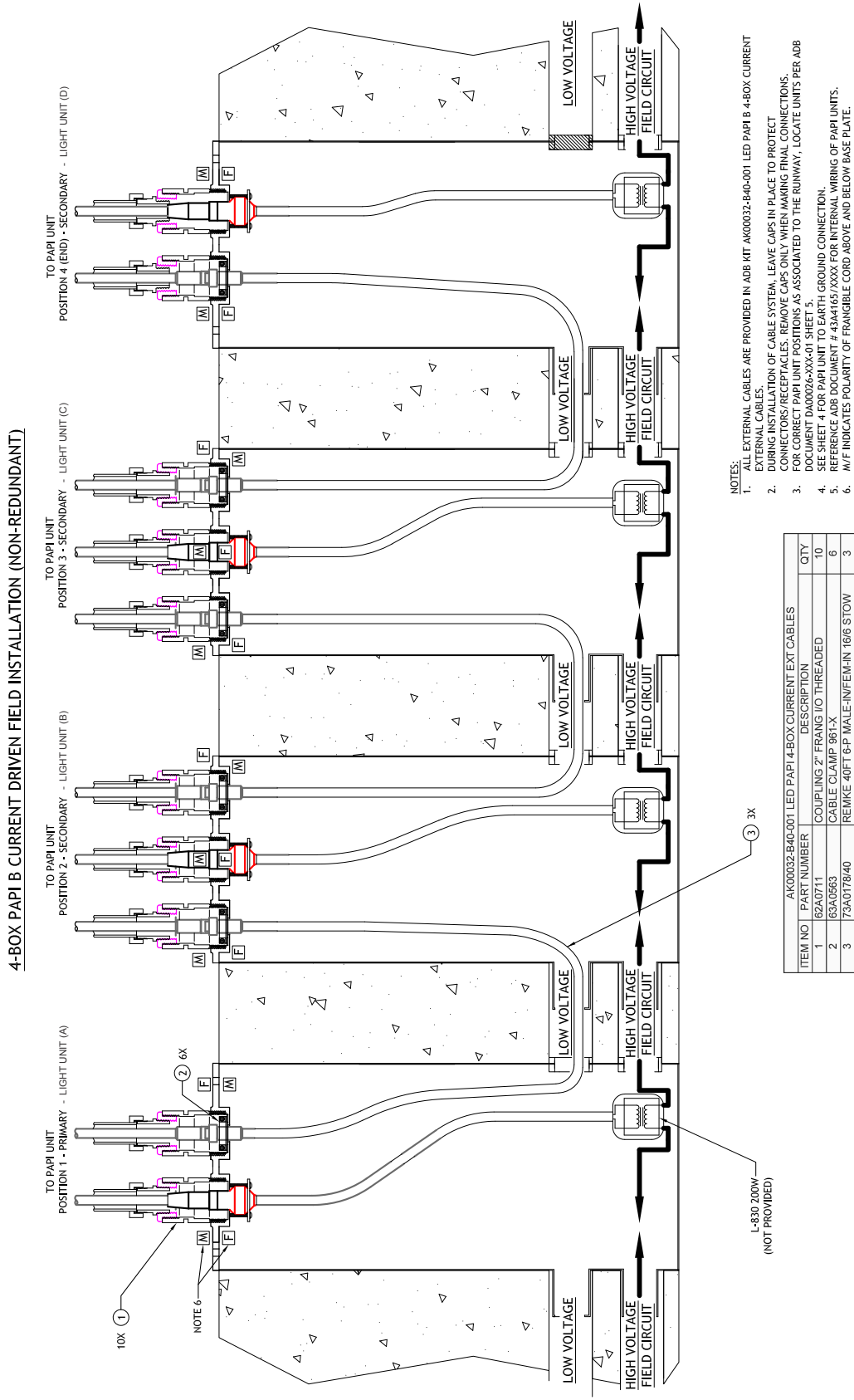


- NOTES:
1. ALL EXTERNAL CABLES ARE PROVIDED IN ADB KIT AK00032-B20-001 LED PAPI 2-BOX CURRENT EXTERNAL CABLES.
 2. DURING INSTALLATION OF CABLE SYSTEM, LEAVE CAPS IN PLACE TO PROTECT CONNECTORS/RECEPTACLES. REMOVE CAPS ONLY WHEN MAKING FINAL CONNECTIONS.
 3. FOR CORRECT PAPI UNIT POSITIONS AS ASSOCIATED TO THE RUNWAY, LOCATE UNITS PER ADB DOCUMENT DA00026-XXX-01 SHEET 5.
 4. SEE SHEET 4 FOR PAPI UNIT TO EARTH GROUND CONNECTION.
 5. REFERENCE ADB DOCUMENT # 43A4165/XXXX FOR INTERNAL WIRING OF PAPI UNITS.
 6. M/F INDICATES POLARITY OF FRANGIBLE CORD ABOVE AND BELOW BASE PLATE.

ITEM NO	PART NUMBER	DESCRIPTION	QTY
1	162A0711	COUPLING 2" FRANG I/O THREADED	4
2	162A0563	CABLE CLAMP 96T-X	2
3	72A0178/40	REMKE 40FT 6-P MALE-INFEM-IN 16/6 STOW	1

AWING NUMBER: DP
REV. B
DA00028-XXX-01

Figure 80: Field Cabling Diagram - Current Powered (4 Box)

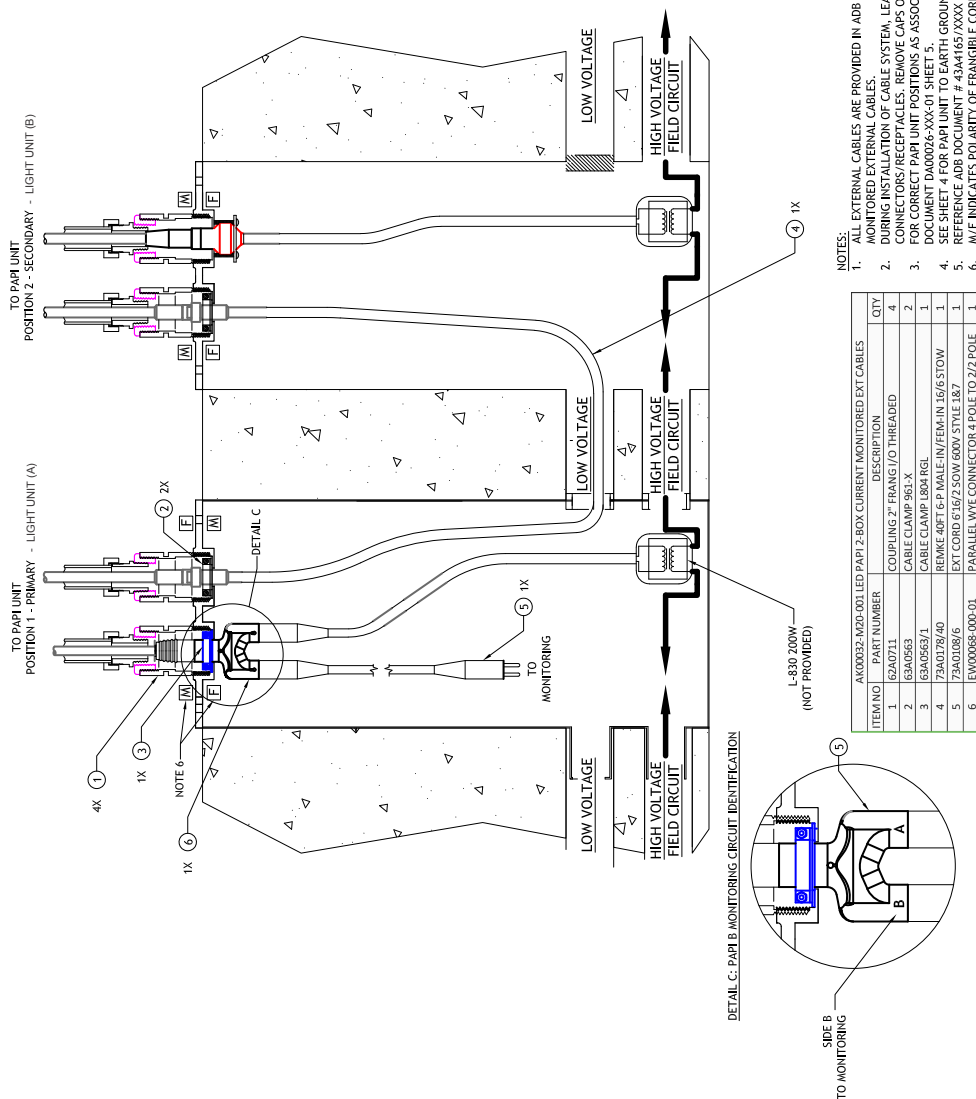


- NOTES:
1. ALL EXTERNAL CABLES ARE PROVIDED IN ADB KIT AK00032-B40-001 LED PAPI B 4-BOX CURRENT EXTERNAL CABLES.
 2. DURING INSTALLATION OF CABLE SYSTEM, LEAVE CAPS IN PLACE TO PROTECT CONNECTORS/RECEPTACLES. REMOVE CAPS ONLY WHEN MAKING FINAL CONNECTIONS.
 3. FOR CORRECT PAPI UNIT POSITIONS AS ASSOCIATED TO THE RUNWAY, LOCATE UNITS PER ADB DOCUMENT DA00028-XXX-01 SHEET 3.
 4. SEE SHEET 4 FOR PAPI UNIT TO EARTH GROUND CONNECTION.
 5. NOTE POLARITY OF PAPI UNIT FOR INTERNAL WIRING OF PAPI UNITS.
 6. M/F INDICATES POLARITY OF FRANGIBLE CORD ABOVE AND BELOW BASE PLATE.

AWING NUMBER: DP
DA00028-XXX-01
REV: B

Figure 83: Field Cabling Diagram - Current Powered with Fail-Open Monitoring (2 Box)

2-BOX PAPI B CURRENT DRIVEN FIELD INSTALLATION (MONITORED, NON-REDUNDANT)

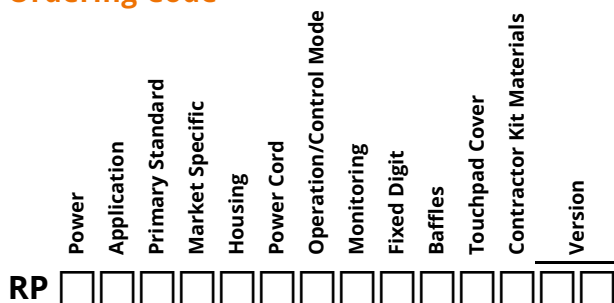


REV. B
DA00028-XXX-01
DRAWING NUMBER: DP

14.0 RELIANCE PAPI Parts

14.1 Ordering Codes

Ordering Code



Power

A = Style A (Voltage) 240 VAC or 120 VAC

B = Style B (Current) 2.8-6.6 A

R = Style B (Current) 2.8-6.6 A, with Redundant Circuit¹

Application

2 = L-881(L)/APAPI (2 Light Units)

4 = L-880(L)/PAPI (4 Light Units)

Primary Standard

2 = FAA

3 = ICAO

Market Specific

1 = BAP²

Housing

A = Aluminum (Standard)

S = 316 Stainless Steel³

Ordering Code Notes

1. Requires a complete redundant airfield circuit for redundant power operation.
2. Meets Buy American Preference.
3. Not ETL certified configuration.
4. Only available with Style B non-redundant systems.

Power Cord

The power cord is available in 8 ft (2.4 m) or 18 ft (5.5 m) length. The 8 ft (2.4 m) length is adequate for most installations. For installations that require a longer power cord, the 18 ft (5.5 m) length can be supplied and cut-to-length on-site during installation.

When the longer power cord and Contractor Kit Items are specified together, a longer length conduit is provided to accommodate the longer length power cord.

Monitored Fail-Open

The Monitored Fail-Open option is for use with ILCMS equipped circuits only. It requires an external remote device and a separate isolation transformer. A 6.6A 30/45W isolation transformer is typically used. However a 10/15W or 20/25W isolation transformer may also be used. The system only requires a remote device and isolation transformer to be connected to the primary light unit. Compatible with ADB SAFEGATE and other remote monitoring systems. This ordering option does not provide CCR monitoring functionality.

Power Cord

1 = 8 ft (2.4 m) (standard)

2 = 18 ft (5.5 m)

Operation/Control Mode

1 = Style A, with Current Sensing Night Control Mode

2 = Style A, with Current Sensing Day/Night Control Mode

3 = Style A, with External On/Off Control Mode

4 = Style A, with no Control Mode or Style B with CCR Control

Monitoring

S = Non-Monitored

M = Monitored Fail-Open⁴

Fixed Digit

0 = 0

Baffles

N = No Baffles

B = Baffles on Both Sides

Touchpad Cover

0 = No Cover

1 = With Cover

Contractor Kit Materials

0 = Not Included

1 = Included

Version

01 = Version 1

Baffles

Baffles modify the horizontal light beam from the PAPI light unit for obstacle avoidance in the approach area. ADB SAFEGATE LED PAPI baffles provide an adjustment capability to reduce the light beam from a full-width beam down to ± 4.0 degree of visible light. Note: FAA Engineering Brief No.95 cautions that a light beam of less than ± 3.0 degrees of visible light may not satisfy flight inspection criteria.

PAPI systems specified with baffles will include factory installed left and right side baffles on all light units. Each side can be adjusted independently. The baffles cannot be installed in the field, they are factory installed only.

Optional Touchpad Cover

The optional touchpad cover provides added protection for the LED display.

Touchpad Cover

44A7564

Contractor Kit Materials

Items specified as "Contractor Supplied" are not included with the light unit. These items are typically provided by the contractor. However, as a convenience these items are available from ADB SAFEGATE as an option within the ordering code or they can be provided as an optional "Contractor Kit". See the user manual for more information on contractor kit items.

The following items are considered contractor supplied:

- EMT for legs
- Flexible conduit
- Conduit fittings
- Reducer bushings

Contractor Kit Ordering Code

Power
Application
Power Cord

AK00031- **-01**

Power

A = Style A (Voltage) 240 VAC or 120 VAC, 50/60 Hz

B = Style B (Current) 2.8-6.6 A 50/60 Hz

R =

Style B (Current) 2.8-6.6 A 50/60 Hz with Redundant Circuit

Application

2 = L-881(L) / APAPI (2 Light Units)

4 = L-880(L) / PAPI (4 Light Units)

Power Cord

1 = 8 ft (2.4 m) (standard)

2 = 18 ft (5.5 m)

14.2 Spare Parts

This section provides schematic drawings, along with part numbers. Refer to the [Wiring Diagrams](#).

Table 17: Spare Parts

Description	Part No.
Mounting Flange (For Leg Assembly)	62B0107/2
Frangible Coupling (For Leg Assembly)	44B0180
EMT Compression Coupling (For Leg Assembly)	77A0009
PAPI Leg Adjustment Assembly 18-8 SS	44C2362/SS
Electrical Frangible Coupling	62A0711
Complete PAPI Light Unit Assembly	Contact ADB SAFEGATE
Control Board Replacement Kit	94A0666/XXX ¹
Terminal Block Assembly	44A7317/XXXX ²
LED Light Engine Replacement Kit - FAA/ICAO (See Table 20)	AK00030-200-01 ³
Heated Glass Replacement Kit (for firmware version 1.47 or earlier)	94A0674/1 ³
Heated Glass Replacement Kit (for firmware version 1.50 or later)	AK00054-000-01 ³
Inclinometer Assembly	AS00124-000-01
LED PAPI Rear Seal	63A1169
Humidity Indicating Plug	61A0503
Desiccant Pack Replacement (includes QTY (2) desiccant packs, mounting hardware and seal)	61A0505S
Top Cover Silicone Gasket (1 ft)	RM0212
40 ft 6-Pin Inter-Box Cable	73A0178/40
6-Pin Female Power Cord (8 ft) – Typically used with FAA Installations	73A0176
6-Pin Female Power Cord (18 ft) – Longer length is typically used with Transport Canada TP312 and ICAO Installations	73A0176/18
6-Pin Male Power Cord (8 ft) – Typically used with FAA Installations	73A0180
6-Pin Male Power Cord (18 ft) – Longer length is typically used with Transport Canada TP312 and ICAO Installations	73A0180/18
Cable Clamp (961-X)	63A0563
Ground Lug	72A0134
Control Board Fuse (F1, F2) 800mA 125VAC Radial Box Fast Blow	47A0243
Control Board Fuse (F5) 3.15A 250VAC Radial Can Fast Blow	47A0242
Top Cover – ICAO (Yellow)	44A7231/21
Top Cover – FAA (Orange)	44A7231/11

¹ See Control Board Replacement section.

² See Spare Part Drawings section.

³ Kit includes the desiccant pack assemblies required for repair. Always replace the desiccant packs if the sealed optical tube is opened

Table 18: Voltage Powered Style A Only

Description	Part No.
Photocell (24 VAC/VDC)	31A0022
Photocell Receptacle	44A7397
Input Power Board (Voltage Powered) (Primary)	44A7392/1
Input Power Board (Voltage Powered) (Secondary)	44A7392/2
Input Power Board Fuse (F1, F2) 3A 250VAC 3AB 3AG 1/4x1-1/4 Slow Blow	47A0233
Input Power Board Fuse (F3, F4) 500mA 250VAC 5x20mm Slow Blow	47A0234
Step Down Transformer with Lead Assembly	44A7396
6-Pin Female Power Cord, For Field Circuit Splice (2.5 ft)	73A0175

Table 19: Current Powered Style B Only

Description	Part No.
Input Power Board (Current Powered)	44A7392/3
16/2 Power Cord (8 ft) - Typically used with FAA Installations	73A0107/98
16/2 Power Cord (18 ft) - Longer length is typically used with Transport Canada TP312 and ICAO Installations	73A0107/216
14/4 Power Cord (8 ft) - Used with Redundant Circuits and Monitored Systems	EW00067-2.5-01
14/4 Power Cord (18 ft) - Used with Redundant Circuits and Monitored Systems	EW00067-6.0-01
Wye Connector - Used with Redundant Circuits and Monitored Systems	EW00068-000-01
Cable Clamp L804RGL - Used with Wye Connector	63A0563/1

Table 20: LED Light Engine Replacement Kit AK00030-200-01 Parts

Description	Qty
LED Engine/Heat Sink Assembly (FAA/ICAO)	1
LED Desiccant Mounting Slide	2
LED PAPI Desiccant Heat Shield	1
Humidity Indicating Plug	1
56 G Molecular Sieve Packet TYVEK 1056D	2
LED PAPI Rear Seal	1
1/4-20 X 7/8 Socket Head Cap Screw (SHCS) Stainless Steel (SS)	12
6-32 X 1/2 PAN HD PHIL	4
1/4 SPLIT LOCKWASHER	12
#6 INT LOCKWASHER	4
Wire Tie 0.13x8.5 inch Black UV Resistant	4

14.2.1 Spare Part Drawings

Figure 85: RELIANCE PAPI Exploded View - Parts

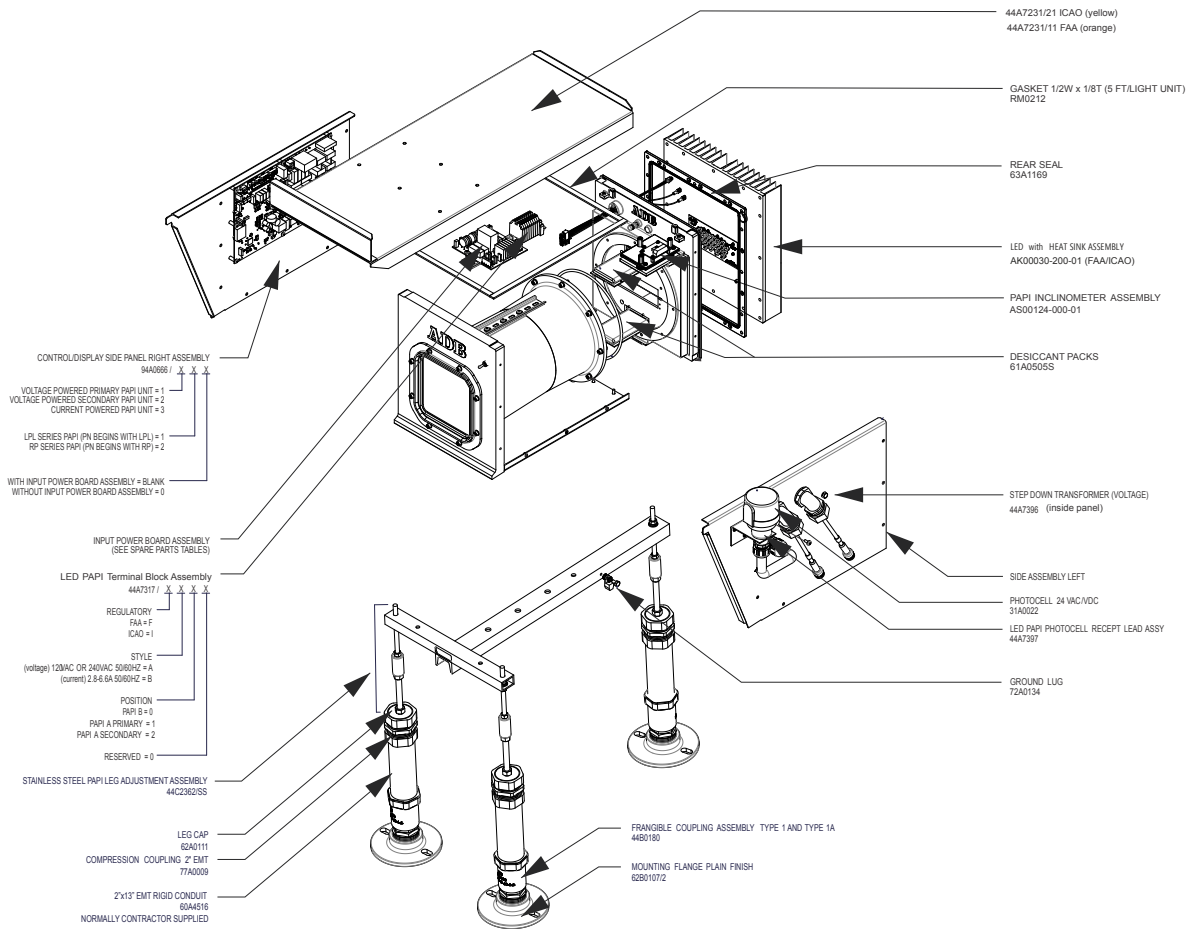


Figure 86: RELIANCE PAPI Exploded View - Hardware

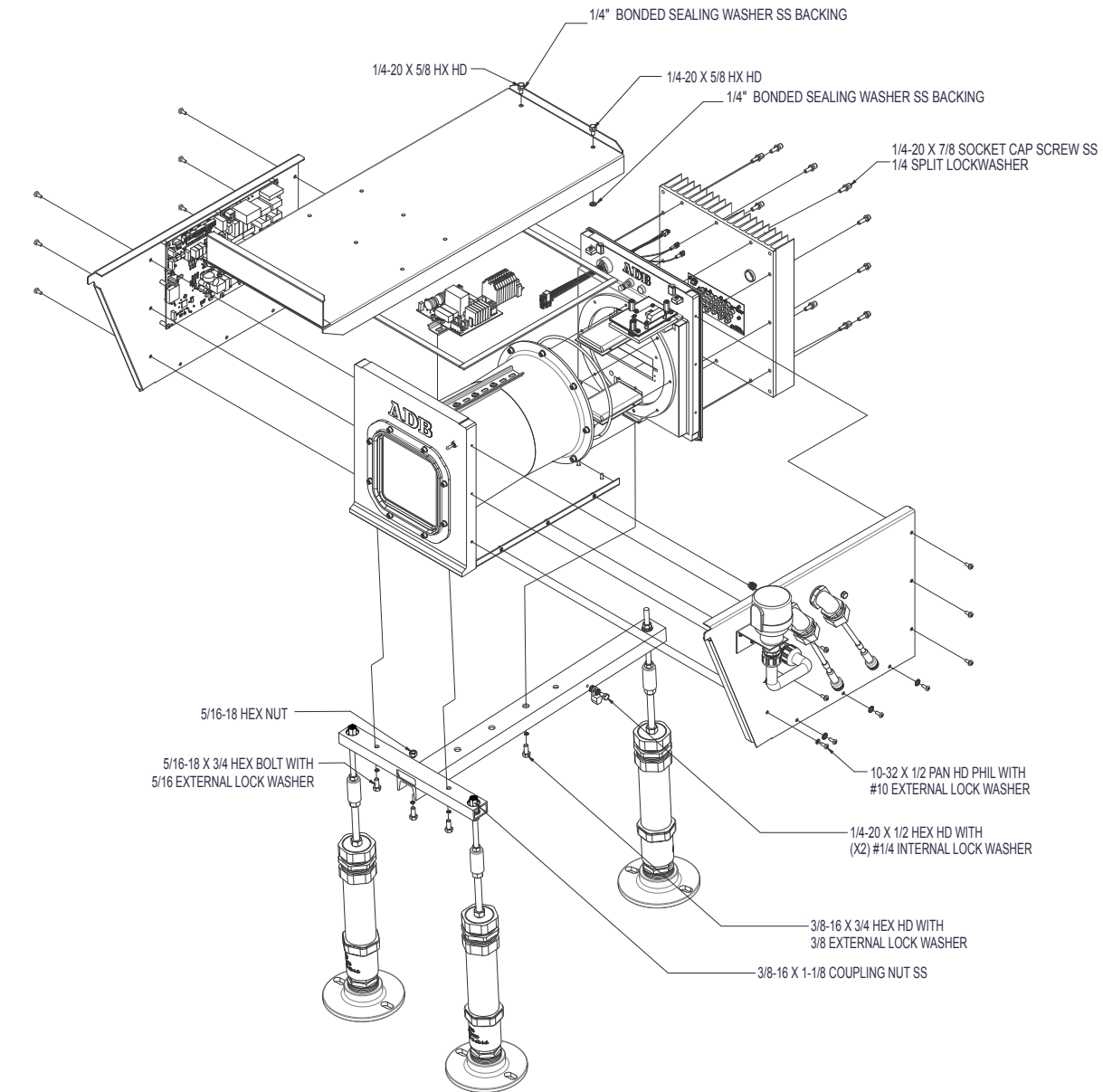


Figure 87: RELIANCE PAPI Side View Assembly

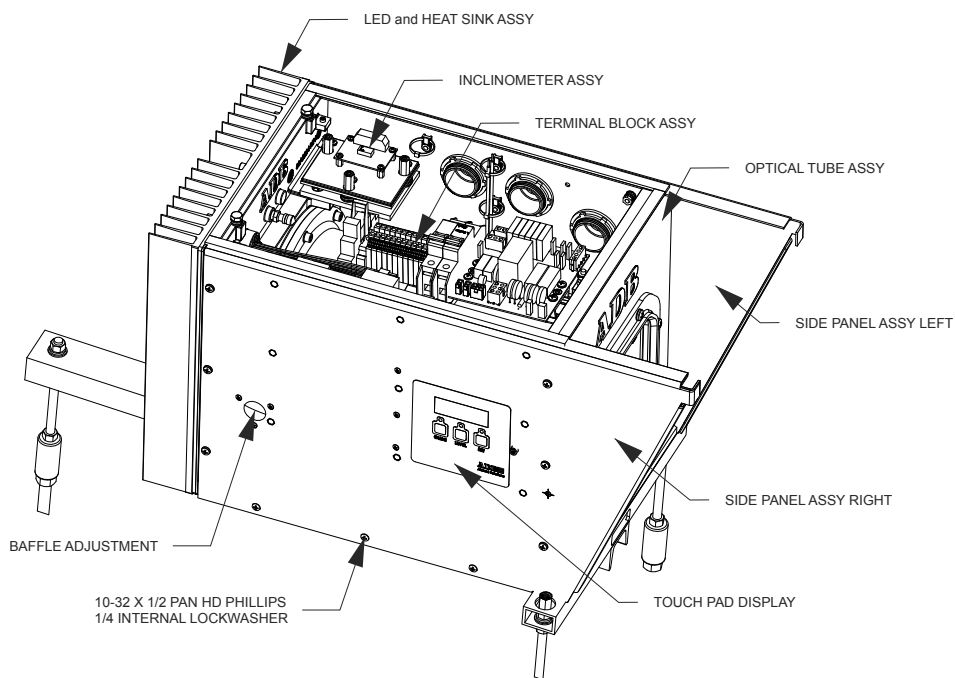
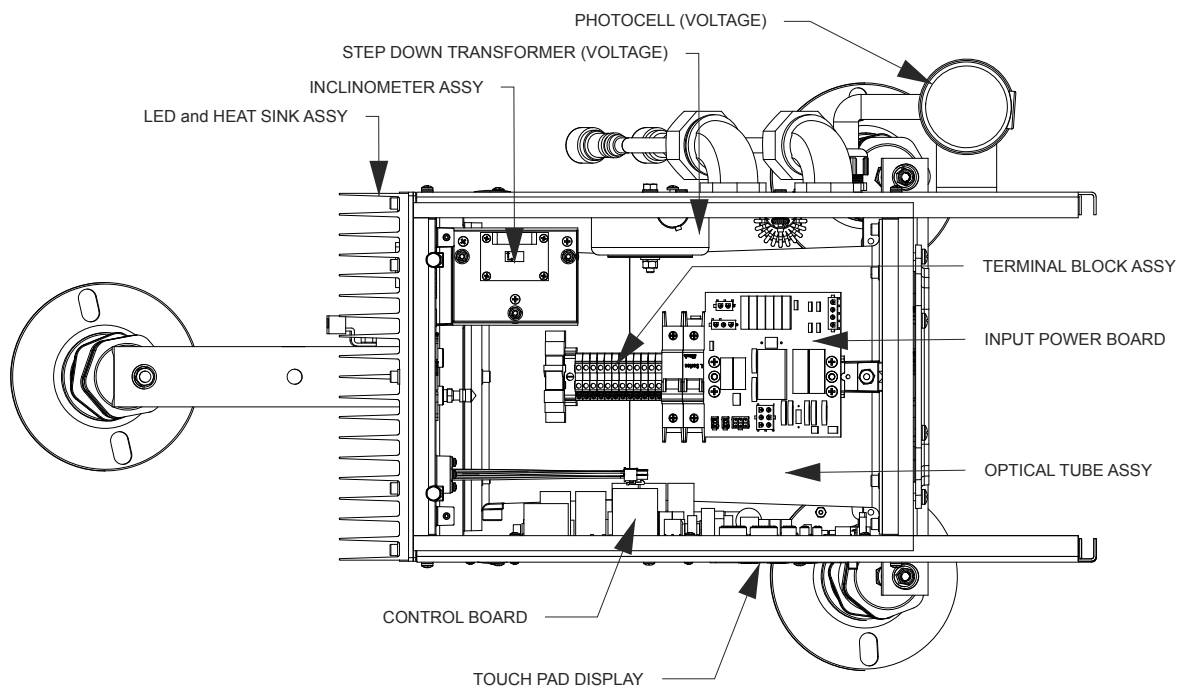


Figure 88: RELIANCE PAPI Assembly Top View



Appendix A: SUPPORT

Our experienced engineers are available for support and service at all times, 24 hour/7 days a week. They are part of a dynamic organization making sure the entire ADB SAFEGATE is committed to minimal disturbance for airport operations.

ADB SAFEGATE Support

Technical Support – Global

Customers in Europe, the Middle East, Africa or Asia Pacific are more than welcome to our portal for technical support. Trained in all areas of system issues, troubleshooting, quality control and technical assistance, our highly experienced Technical support specialists are available 24 hours a day, seven days a week to provide assistance over the phone. In the Americas, we also offer live technical support.

Live Technical Support – Americas

If at any time you have a question or concern about your product, contact ADB SAFEGATE's US-based technical support specialists, available 24 hours a day, seven days a week, to assist you via phone.

ADB SAFEGATE Americas Technical Service & Support (US & Canada) :+1-800-545-4157

ADB SAFEGATE Americas Technical Service & Support (Canada): +1-905-631-1597

ADB SAFEGATE Americas Technical Service & Support (International): +1-614-861-1304

We can also be reached via email during regular business hours:

Airfield and Gate: techservice.us@adbsafegate.com

Gate: gateservice.us@adbsafegate.com

We look forward to working with you!

Before You Call

When you have an airfield lighting or system control system problem, prior to calling, please ensure the following:

- Review the product's manual and troubleshooting guide.
- Be located with the product ready to troubleshoot.
- Have all necessary information available: airport code/company name, customer id number, contact phone number/email address, product/part number.
- Have a True RMS meter available and any other necessary tools.

When calling about an issue with Safedock A-VDGS, we can serve you better if you collect the following information before you call:

- Relevant information regarding the issue you are calling about, such as gate number, flight number, aircraft type and time of the event.
- What, if any, actions have been taken to resolve the issue prior to the call.
- If available, provide a CCTV recording of the incident to aid in aligning the information from the Safedock log file.



Note

For more information, see www.adbsafegate.com, contact ADB SAFEGATE Support via email at support@adbsafegate.com or Europe: +32 2 722 17 11

Americas: +1 614 861 1304. Press 3 for technical service or press 4 for sales support.

China: +86 (10) 8476 0106

Middle East and Africa: +971 4 452 7575

A.1 ADB SAFEGATE Website

The ADB SAFEGATE website, www.adbsafegate.com, offers information regarding our airport solutions, products, company, news, links, downloads, references, contacts and more.

A.2 Recycling

A.2.1 Local Authority Recycling

The disposal of ADB SAFEGATE products is to be made at an applicable collection point for the recycling of electrical and electronic equipment. The correct disposal of equipment prevents any potential negative consequences for the environment and human health, which could otherwise be caused by inappropriate waste handling. The recycling of materials helps to conserve natural resources. For more detailed information about recycling of products, contact your local authority city office.

A.2.2 ADB SAFEGATE Recycling

ADB SAFEGATE is fully committed to environmentally-conscious manufacturing with strict monitoring of our own processes as well as supplier components and sub-contractor operations. ADB SAFEGATE offers a recycling program for our products to all customers worldwide, whether or not the products were sold within the European Union (EU).

ADB SAFEGATE products and/or specific electrical and electronic component parts which are fully removed/separated from any customer equipment and returned will be accepted for our recycling program.

All items returned must be clearly labeled as follows:

- For Restriction of Hazardous Substances (RoHS)/Waste Electrical and Electronic Equipment (WEEE) Recycling
- Sender contact information (Name, Business Address, Phone number).
- Main Unit Serial Number.

ADB SAFEGATE will continue to monitor and update according for any future requirements for EU directives as and when EU member states implement new regulations and or amendments. It is our aim to maintain our compliance plan and assist our customers.

Company Addresses

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