ADB
Airfield Solutions

Users Manual

Single-Channel PAPI, Precision Approach Path Indicator

Type L-880 & L-881, Style A (Voltage-Powered) & B (Current-Powered)

96A0379, Rev. K, 11/10/15

A.0 Disclaimer / Standard Warranty

A.1 CE certification

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

A.2 ETL certification

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

A.3 LED Product Guarantee

Where applicable, per FAA EB67(applicable edition), ADB L858(L) Airfield Guidance Signs are warranted against electrical defects in design or manufacture of the LED or LED specific circuitry for a period of 4 years. ADB LED light fixtures (with the exception of obstruction lighting) are warranted against mechanical and physical defects in design or manufacture for a period of 12 months from date of installation; and are warranted against electrical defects in design or manufacture of the LED or LED specific circuitry for a period of 4 years per FAA EB67 (applicable edition).

NOTE: See your sales order contract for a complete warranty description. In some specific cases, deviations are (to be) accepted in the contract, which will supersede the standard warranty.

A.4 Standard Product Guarantee

Products of ADB manufacture are guaranteed against mechanical, electrical, and physical defects (excluding lamps) which may occur during proper and normal use for a period of one year from the date of installation or 2 years from date of shipment and are guaranteed to be merchantable and fit for the ordinary purposes for which such products are made. ADB L858 Airfield Guidance Signs are warranted against mechanical and physical defects in design or manufacture for a period of 2 years from date of installation per FAA AC 150/5345-44 (applicable edition).

NOTE: See your sales order contract for a complete warranty description.

A.5 All Products

LED Products of ADB, manufactured and sold by ADB or its licensed representatives, meets the corresponding requirements of FAA, ICAO and IEC.

ADB will correct by repair or replacement per the applicable guarantee above, at its option, equipment or parts which fail because of mechanical, electrical or physical defects, provided that the goods have been properly handled and stored prior to installation, properly installed and properly operated after installation, and provided further that Buyer gives ADB Airfield Solutions written notice of such defects after delivery of the goods to Buyer. Refer to the Safety section for more information on Material Handling Precautions and Storage precautions that must be followed.

ADB reserves the right to examine goods upon which a claim is made. Said goods must be presented in the same condition as when the defect therein was discovered. ADB Airfield Solutions furthers reserves the right to require the return of such goods to establish any claim.

ADB's obligation under this guarantee is limited to making repair or replacement within a reasonable time after receipt of such written notice and does not include any other costs such as the cost of removal of defective part, installation of repaired product, labor or consequential damages of any kind, the exclusive remedy being to require such new parts to be furnished.

ADB's liability under no circumstances will exceed the contract price of goods claimed to be defective. Any returns under this guarantee are to be on a transportation charges prepaid basis. For products not manufactured by, but sold by ADB Airfield Solutions, warranty is limited to that extended by the original manufacturer.

This is ADB's sole guarantee and warranty with respect to the goods; there are no express warranties or warranties of fitness for any particular purpose or any implied warranties of fitness for any particular purpose or any implied warranties other than those made expressly herein. All such warranties being expressly disclaimed.

A.6 Liability

WARNING

Use of the equipment in ways other than described in the catalogue leaflet and the manual may result in personal injury, death, or property and equipment damage. Use this equipment only as described in the manual.

ADB cannot be held responsible for injuries or damages resulting from non-standard, unintended uses of its equipment. The equipment is designed and intended only for the purpose described in the manual. Uses not described in the manual are considered unintended uses and may result in serious personal injury, death or property damage.

Unintended uses includes the following actions:

- Making changes to equipment that have not been recommended or described in this manual or using parts that are not genuine ADB replacement parts or accessories.
- 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.
- Using materials or auxiliary equipment that are inappropriate or incompatible with your ADB equipment.
- Allowing unskilled personnel to perform any task on or with the equipment.

A.7 © ADB BVBA

This manual could contain technical inaccuracies or typographical errors. ADB BVBA reserves the right to revise this manual from time to time in the contents thereof without obligation of ADB BVBA to notify any person of such revision or change. Details and values given in this manual are average values and have been compiled with care. They are not binding, however, and ADB BVBA disclaims any liability for damages or detriments suffered as a result of reliance on the information given herein or the use of products, processes or equipment to which this manual refers. No warranty is made that the use of the information or of the products, processes or equipment to which this manual refers will not infringe any third party's patents or rights. The information given does not release the buyer from making their own experiments and tests.

A.8 FAA CertAlert on PAPI Operation

Read the following FAA CertAlert issued by the National Transportation Safety Board regarding signal interruption from PAPI.

CERTALERT

ADVISORY CAUTIONARY NON-DIRECTIVE

FOR INFORMATION, CONTACT AIRPORT SAFETY SPECIALIST, AAS-310 (202) 267.8729

DATE: December 12, 2002 **No. 02-08**

TO: Airport Operators, Airline Operators, FAA Airport Certification Safety Inspectors

TOPIC: PAPI OPERATION

This is to advise airport operators of the possibility of light signal interruption from PAPI units not operated continuously, e.g., those units activated through the use of pilot-controlled-lighting (PCL) systems.

Because external PAPI lenses, used to improve light signals, are exposed to ambient weather conditions, the possibility of dew and/or frost forming on the outside of the glass becomes a concern when the units are not operated continuously. In particular, a PAPI unit operating in the "off" mode for an extended period of time during the evening hours could accumulate a level of environmental contaminants (e.g., dew or frost), which may not dissipate sufficiently to ensure correct light signals after pilot activation.

To preclude environmental contamination of PAPI lenses along with possible lighting signal interruption associated with limited dissipation of any dew/frost FAA recommends the following:

- At airports where PAPI units are activated when needed and thus are not operated continuously, change airport lighting circuitry to ensure PAPI's are preset to operate continuously on a low power setting, either 5 percent or 20 percent of full intensity as necessary for local site conditions.
- Airport operators must submit changes as per the front cover of the Airport/Facility Directory removing the PAPI reference.

OSB
Benedict D. Castellano
Airport Safety and Operations

12/12/2002
Date

TABLE OF CONTENTS

1.0 Safety

This section contains general safety instructions for installing and using ADB Airfield Solutions 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 HAZARD Icons used in the 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 symbol shown below.

	**WARNING** • Failure to observe a warning may result in personal injury, death or equipment damage.
	**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.
	**WARNING - WEAR PERSONAL PROTECTIVE EQUIPMENT** • Failure to observe may result in serious injury.
	**WARNING - DO NOT TOUCH** • Failure to observe this warning may result in personal injury, death, or equipment damage.
	**CAUTION** • Failure to observe a caution may result in equipment damage.

1.1.1 Qualified Personnel

IMPORTANT INFORMATION

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.

Always use required personal protective equipment (PPE) and follow safe electrical work practices.

1.2 To use this equipment safely:

WARNING

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 warnings may result in serious injury or equipment damage.

1.2.1 Additional Reference Materials:

IMPORTANT INFORMATION

- IEC - International Standards and Conformity Assessment for all electrical, electronic and related technologies
- IEC 60364 - Electrical Installations in Buildings
- FAA Advisory: AC 150_5340_26 (current edition) Maintenance of Airport Visual Aid Facilities
- ANSI/NFPA 79, Electrical Standards for Metalworking Machine Tools.
- National and local electrical codes and standards.

1.2.2 Intended Use

WARNING

IMPROPER USE

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.

THESE WARNINGS MAY RESULT IN SERIOUS INJURY OR EQUIPMENT DAMAGE.

1.2.3 Fasteners

WARNING

FOREIGN OBJECT DAMAGE - FOD

- Only use fasteners of the same type as the one originally supplied with the equipment.
- Always tighten the fasteners to the recommended torque. Use a calibrated torque wrench and apply the recommended adhesive type.
- Obey the instructions of the adhesives necessary for the fasteners.

Failure to follow these warnings may cause the fasteners to loosen, damage the equipment, potentially to loosen the equipment. This can lead to a highly dangerous situation of FOD, with potential lethal consequences.

1.2.4 Operation

CAUTION

IMPROPER OPERATION

- 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 this instruction can result in equipment damage.

1.2.5 Storage

CAUTION

IMPROPER STORAGE

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.

1.2.6 Material Handling Precautions

CAUTION

ELECTROSTATIC SENSITIVE DEVICES

This equipment may contain electrostatic sensitive 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 should 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.

WARNING

UNSTABLE LOAD

- Use extreme care when moving heavy equipment.
- Verify that the moving equipment is rated to handle the weight.
- When removing equipment from a shipping pallet, carefully balance and secure it using a safety strap.

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

1.2.7 Action in the Event of a System or Component Malfunction

DANGER

ARC FLASH AND ELECTRIC SHOCK HAZARD

- Do not operate a system that contains malfunctioning components. If a component malfunctions, turn the system OFF immediately.
- An open airfield current circuit is capable of generating >5000 Vac and may appear OFF to a meter.
- Never unplug a device from a constant current circuit while it is operating. Arc flash may result.
- Disconnect and lock out electrical power.
- Allow only qualified personnel to make repairs. Repair or replace the malfunctioning component according to instructions provided in its manual.

Failure to follow these warnings will result in death or equipment damage.

1.2.8 Maintenance

WARNING

ELECTRIC SHOCK HAZARD

- 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. Repair or replace the malfunctioning component according to instructions provided in its manual.

Failure to follow these warnings will result in death or equipment damage.

1.2.9 Maintenance and Repair

DANGER

ARC FLASH AND ELECTRIC SHOCK HAZARD

Allow only qualified personnel to perform maintenance, troubleshooting, and repair tasks.

- Only persons who are properly trained and familiar with ADB Airfield Solutions equipment are permitted to service this equipment.
- An open airfield current circuit is capable of generating >5000 Vac and may appear OFF to a meter.
- Never unplug a device from a constant current circuit while it is operating. Arc flash may result.
- Disconnect and lock out electrical power.
- Always use safety devices when working on this equipment.
- Follow the recommended maintenance procedures in the product 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 Airfield Solutions replacement parts. Using unapproved parts or making unapproved modifications to equipment may void agency approvals and create safety hazards.
- Check the 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 airfield electrical equipment.

Failure to follow these warnings will result in death or equipment damage.

2.0 Single-Channel PAPI, Precision Approach Path Indicator

Type L-880 & L-881, Style A (Voltage-Powered) & B (Current-Powered)

2.1 About this manual

The manual shows the information necessary to:

- Install
- Carry Out Maintenance
- Carry Out Troubleshooting on the Single-Channel PAPI.

2.1.1 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.

2.1.2 Record of changes

PAGE	REV	DESCRIPTION	CHECKED	APPROVED	DATE
All	A	New Advanced Power Supply	ER	RS	03/24/08
	B	Updated for testing	ER	RS	05/24/08
	C	Updated for ETL	ER	RS	07/24/08
All	D	Updated intro, install, maintenance and parts	ER	GM	12/04/09
All	E	New Setting Instructions and Drawings	ER	JR	3/5/2010
All	F	Updated to global format			
All	G	Updated parts, drawings and schematics	JC	DR	9/12/11
All	H	Reorganized layout after quality review	DR	JC	11/18/11
All	I	Added PAPI Baffles, updated Parts	DR	JC	1/17/12
All	J	format update			6/20/13
	K	updated parts / updated format	RW	JC	11/23/15

2.2 Overview

This manual provides instructions for installation, operation and maintenance of the ADB Airfield Solutions Single-Channel Precision Approach Path Indicator (PAPI) system.

Single-Channel PAPI systems provide visual approach path guidance to pilots of landing aircraft.

2.2.1 Compliance with Standards

- **FAA**: L-880 & L-881 AC 150/5345-28
  (Current Edition)
  ETL Certified
- **ICAO**: Annex 14, Vol. 1, para. 5.3.5.23 to 5.3.5.45
- **NATO**: STANAG 3316

2.2.2 Uses

The PAPI system uses a one light channel unit to provide the pilot precise visual information enabling the approach procedure to be performed with the utmost accuracy and safety.

The Type L-880 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.

The Type L-881 PAPI system is identical to the L-880, except only two light units (instead of four) are used. 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.

The Style A system is for use with an AC voltage input. The Style B system is for use on 6.6A or 20A series circuits. A tilt switch assembly is provided on each PAPI unit to de-energize all light units if the optical pattern of any light unit is raised between 0.5° and 1.0° or lowered between 0.25° and 0.5° with respect to the setting angle of the light unit.

2.2.2.1 Packing Data for Single Channel PAPI

Weight		Volume
Net	**Gross**	**(In cardboard box)**
44lb	46lb	25.6 x 13 x 40.2 in
20kg	21kg	65 x 33 x 102 cm

2.2.2.2 Adjustment of the beam elevation

The light beam angle is quickly determined by means of an LED display on the internal control board, allowing for very precise and stable elevation adjustment. No separate aiming device is needed.

2.2.2.3 Electrical supply

Each Type A PAPI system is powered form a Master Control box that supplies the light units with 2.8-6.6A constant current. Each Type B PAPI light unit is powered with an existing 2.8-6.6A constant current circuit via a 6.6A/6.6A or 20A/6.6A 300W isolation transformer. A field splice kit is supplied with each light unit to provide for external electrical connections between PAPI system components.

- Style A[1]
  - — Input Voltage: 240V AC, ±10%, 50/60Hz
    L-880 (4-box) 3-lamps/light unit – 1,700VA max.
  - — Input Voltage: 208/220/240V AC, ±10%, 50/60Hz
    L-881 (2-box) 3-lamps/light unit – 1,612VA max.
- Style B[2]
  - — Three Lamps – 6.6A through one 300W isolation transformer (each light unit)
    L-880 (4-Box) – Total CCR Load: 1,448VA max.
    L-881 (2-Box) – Total CCR Load: 724VA max.

1. As seen at input of PAPI Master.
2. Includes PAPI light units and isolation transformers.

2.2.3 Specifications

Single Chanel PAPI systems are designed to operate under the conditions shown in Table 1.

Table 1: Specifications

PAPI Style:	Style A	Style B
Lamps	Three 6.6 A, 105 W tungsten-halogen lamps per PAPI Light Unit	
• Rated lamp life	1000 hours	
• Luminous intensity (red light)	~20,000 cd maximum 15,000 cd minimum over +7° horizontal angle and 0-4° vertical angle	
• Photometrics	Each Light Unit used in the L-880/L-881 PAPI systems has three lamps and provides a beam of light split horizontally to produce white light in the top sector and red light in the bottom sector. When viewed by an observer at a distance of 1000 ft. (304.8m), the transition from red light to white light occurs within an angle of three minutes of arc at the beam center and within an angle of five minutes of arc at the beam edges.	
Transmission Factor of Red Sector	At least 15%	
Visual Acquisition Range	7.1 miles within an approach envelope of ±5 degrees from the approach axis	
Transient Suppression	The PAPI system is capable of withstanding lightning transient consisting of a 10 x 20 microsecond current surge of 15,000 amperes with the subsequent power-follow current and voltage surge of 10 kV/microsecond. System also will withstand without damage the repeated application of an overvoltage transient on the input power lines equal to 500 volts peak for a duration of 50 milliseconds.	
Tilt Detection	De-energizes all lamps in the PAPI system if optical pattern of any Light Unit is raised more than ½ degree or lowered more than ¼ degree or if any light unit is tilted horizontally more than +/-1.75 degrees.	
Environmental Operating Conditions		
Operating Temperature Range (PAPI system meets both Class 1 and Class 2 temperature ranges)		
• Class 1	-31°F to +131°F (-35°C to +55°C)	
• Class 2	-67°F to +131°F (-55°C to +55°C)	
Humidity	0 to 100%	
Wind	Velocities up to 100 mph (161 km/h)	
Mounting Provisions	Two mounting legs	

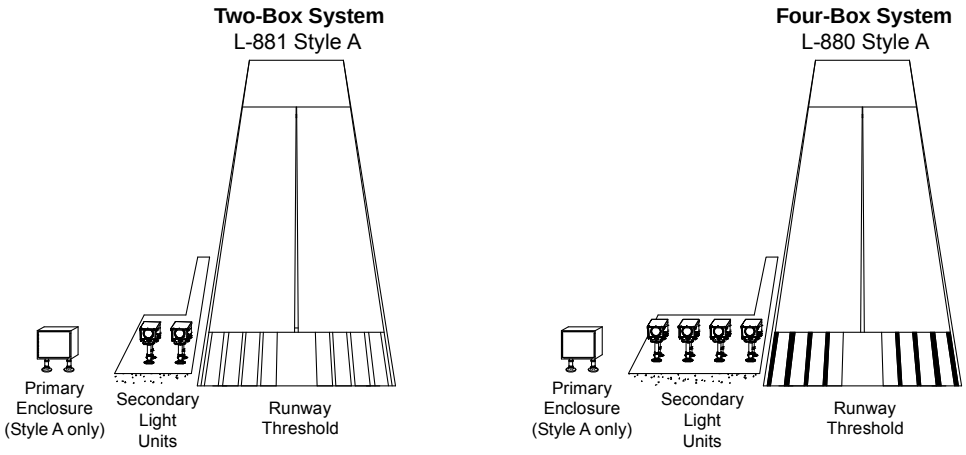
2.2.3.1 System Options

The Single-Channel PAPI system is available in two configurations, as shown in Figure 1

- **L-880 - Four-Light Unit system** (see “Type L-880 PAPI System” on page 10)
- **L-881 - Two-Light Unit system** (see “Type L-881 PAPI System” on page 10)

Both configurations use the same PAPI Light Units; the primary difference is the signal display options based on the number of units (see “Signal Display” on page 10).

Figure 1: Two-Light Unit System (L-881) and Four-Light Unit System (L-880) Components



Each type is available with either of two power sources:

- **Style A - Voltage-powered** (see “Operation Overview - Style A Primary Enclosure” on page 12)

  Voltage-powered, single-channel PAPIs are designed to operate either from an input voltage of 240VAC ±10%, 50/60Hz (L-880 four-Light Unit) or

  208/220/240VAC ±10%, 50/60Hz (L-881 two-Light Unit).

- **Style B - Current-powered** (see “Operation Overview - Style B System” on page 15)

  Either L-880 or L-881 current-powered, single-channel PAPIs are designed to operate from a three-step (4.8A-6.6A) or a five-step (2.8A-6.6A), 50/60Hz constant current regulator (CCR). It is recommended that a five-step CCR be used to power the Style B PAPI system.

2.2.4 Signal Display

2.2.4.1 Type L-880 PAPI System

The L-880 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 below left 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**.

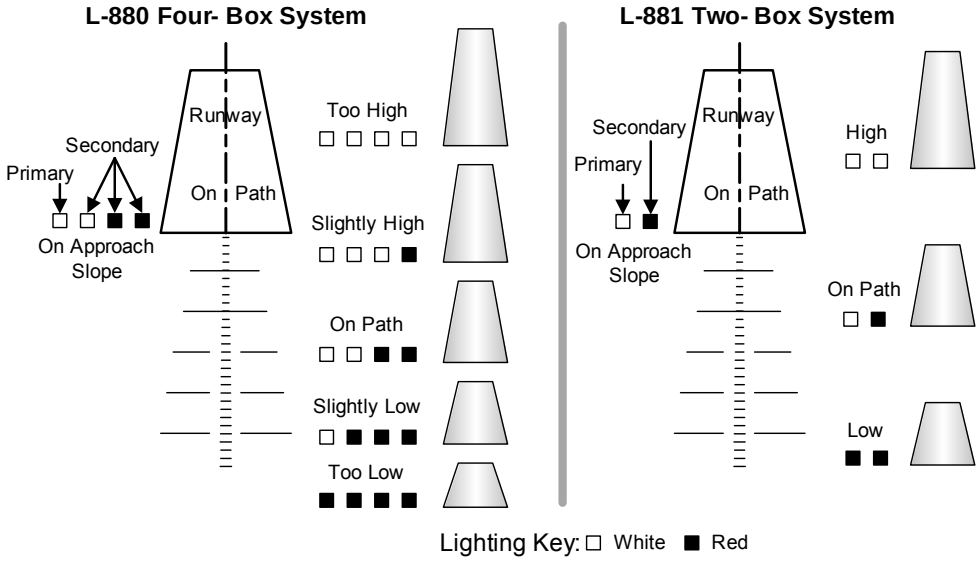
2.2.4.2 Type L-881 PAPI System

The L-881 PAPI 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**.

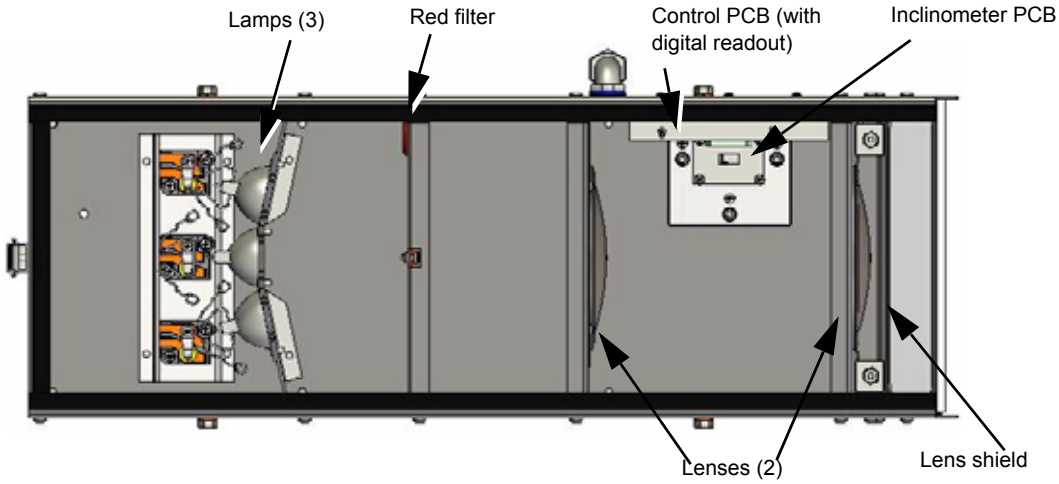
Figure 2: Signal Display - L-880 and L-881 Systems



2.2.5 PAPI Light Unit

A single PAPI Light Unit contains three 6.6 A, 105W lamps, a red filter, two lenses, a lens shield, a Control PCB and an Inclinometer PCB. The PAPI unit is mounted on two adjustable legs. See Figure 7. Each component is discussed below.

Figure 3: PAPI Light Unit



Lamps

Three 6.6A, 105W tungsten-halogen lamps are located in the rear of the unit, each lamp is individually secured in a fixed mounting bracket. Slip-on type electrical connections permit easy replacement of failed lamps.

Red Filter

The red filter is housed in a filter panel.

NOTE: The filter has a precision ground edge for sharp color transition. DO NOT REMOVE THIS FILTER. Improper mounting will adversely affect the performance of your PAPI light unit.

Lenses

Two high optical quality objective lenses are housed in two lens panels.

Lens Shield

The flat glass shield (protective glass) is designed to reduce reflections and protect the front lens against small particles such as sand, stone and debris.

Alignment System

A digital readout on the Control PCB eases setting the glide and azimuth of the PAPI units for proper function. Three threaded adjustment rods—two along the front edge and one in the rear—raise, lower and allow leveling of the Light Unit. The glide angle is shown on the digital readout—and can be read when looking through the front of the Light Unit when power is ON.

The horizontal (Azimuth) angle can be displayed via a push button on the circuit board.

Tilt Detection Electronics

The tilt measurement/control electronics, built into the Control PCB and Inclinometer PCB, are designed to de-energize the lamps if the optical pattern is raised more than ½ degree or lowered more than ¼ 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 Canadian PAPIs, the tilt/de-energizing lamps function is not present.

2.2.6 Operation Overview - Style A Primary Enclosure

This section provides an overview of operation for the Style A Single-Channel PAPI system.

2.2.6.1 Primary Enclosure

See Figure 4 and the drawing in “Schematics” on page 61. Input voltage is supplied to the Primary Enclosure at TB1-1 and TB1-3. The Earth Ground connection may be input directly into the Primary Enclosure with the incoming power wiring (and connected to the internal panel ground lug) or alternately, externally connected to the external ground lug on the enclosure. Note: No incoming power wiring is connected to TB1-2. Incoming voltage at TB1-1 and TB1-3 is fed through VR1 and VR2 for protection from lightning. Input voltage is then fed through circuit breaker CB1 and contactor K1. CB1 provides overcurrent protection. When CB1 is turned on, input voltage is fed to transformer T3 via protective fuses F1 and F2. Transformer T3 steps the incoming voltage (208VAC, 220VAC or 240VAC) down to various internal operating voltages as defined in Table 2.

Table 2: T3 Secondary Voltages

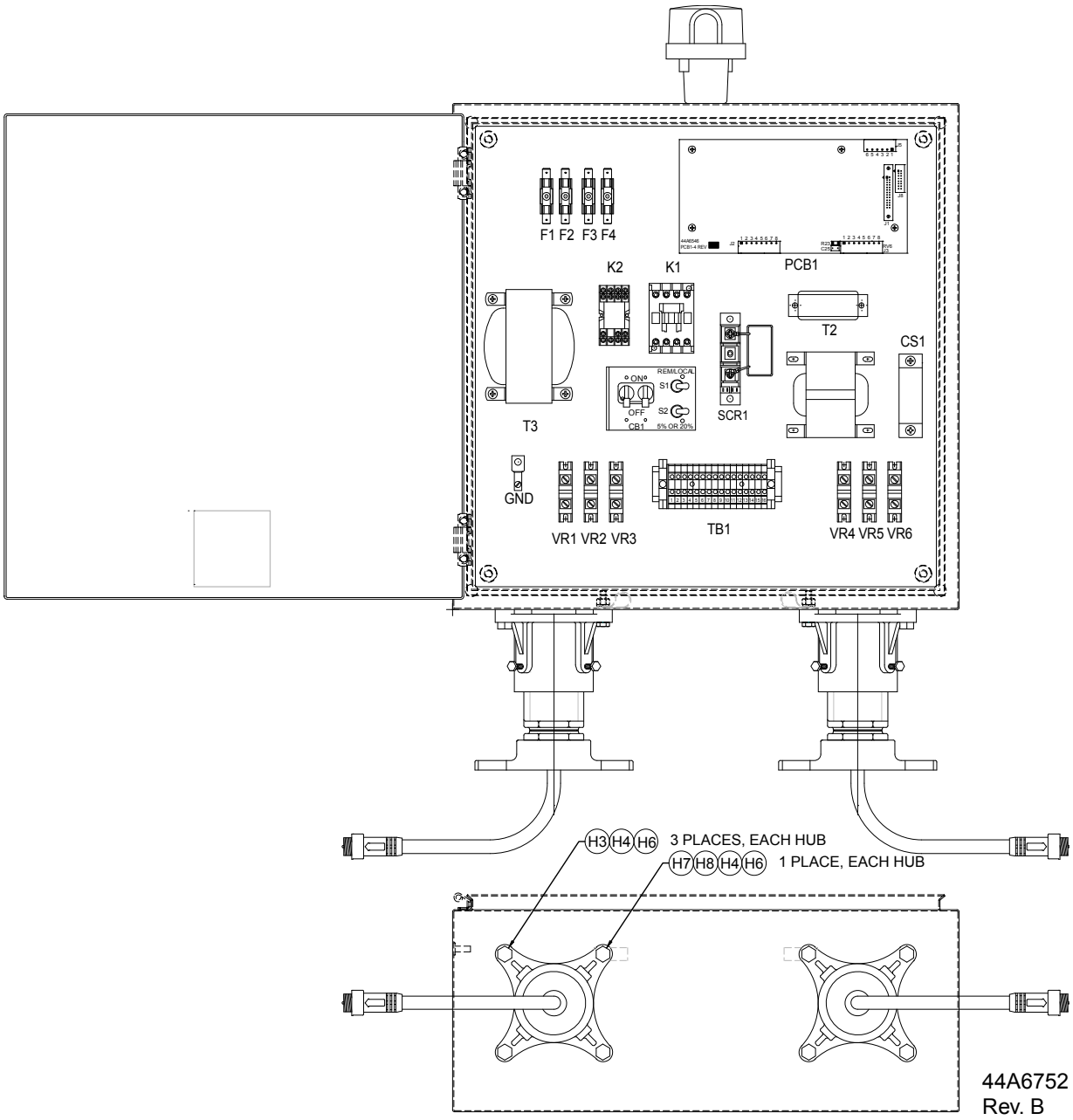
Primary Enclosure Input Voltage (nominal)	208VAC	220VAC	240VAC
Terminal 5-6	15.6VAC	16.5VAC	18VAC
Terminal 7-6	15.6VAC	16.5VAC	18VAC
Terminal 8-10	104VAC	110VAC	120VAC
Terminal 13-14	104VAC	110VAC	120VAC

The 18Vac (if 240Vac is supplied on the Primary input) at T3 terminals 5-6 and 7-6 is input into the CCT Control Board at J3 pins 1, 2 and 3 and provides power for the CCT Control Board internal DC power supplies. The 120Vac at T3 terminals 8-10 is input into the CCT Control Board at J3 pins 4 and 6 to provide power for contactor K1. If a fault is not detected, 120VAC is output from the CCT Control Board at J3 pins 7 and 8 to energize contactor K1 via fuse F4. The 120Vac at T3 terminals 13-14 is output, via Fuse F3, for various remote and local control signals.

When contactor K1 is energized, input voltage is fed to inductor L1, and the dual SCR block**.** The CCT Control PCB1 turns the SCRs on (via the dual SCR gate drive signals at terminal block J4) and provides regulated current to the lamps at TB1-13 and TB1-14, similar to that provided by a Constant Current Regulator. VR4, VR5 and VR6 provide lightning protection at the output.

The CCT Control Board PCB1 de-energizes contactor K1 if either an open circuit or overcurrent is detected on the series circuit output at TB1-13 and 14.

Figure 4: Primary Enclosure Components



2.2.6.2 Local/Remote Operation

Toggle switch S1 enables local or remote mode operation. When set to LOCAL, the unit can be operated locally. When the switch S1 is set to remote (REM) and the remote wires are connected to TB1-7 and TB1-8, the PAPI system can be turned on or off from a remote location using a dry-switch contact closure across TB1-7 and TB1-8.

If S1 is in LOCAL, 120Vac is directly connected to the CCT-Control PCB J2-2 (the CC or ON input). 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 S1 is in REMOTE and there is a Remote ON command via a contact closure across TB1-7 and 8 and it is Daytime, 120Vac (via TB1-8) is directly connected to the CCT-Control PCB J2-2 (the CC or ON input and J2-5 (the B3 or 5% command). This turns the PAPI ON to the 5% level. If switch S2 is set to 20%, 120Vac is also connected to J2-6 (the B4 or 20% command). This then turns the PAPI ON to the 20% level. If it is daytime, the photocell de-energizes K2. 120Vac is then connected, via the de-energized K2 pins 9-1, to the CCT-Control PCB J2-7 (the B5 or 100% input). The PAPI system then turns ON to the 100% level.

2.2.6.3 Daytime Operation	See the “Standard Wiring” section of the drawing in “Schematics” on page 61. Photocell PC1 is powered with 120Vac via the white and black wires at TB1-4 and 5. When illumination on the photocell rises to 50-60 foot-candles, photocell PC1 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 the red wire at TB1-6. This de-energizes relay K2. The normally closed contact at K2 pins 9-1 then provides 120VAC to J2-7 (the B5 or 100% input) on CCT-Control Board PCB1 and turns on the PAPI system to full intensity (6.6A to each lamp).
2.2.6.4 Nighttime Operation	When the illumination drops to 25 to 35 foot-candles, photocell PC1 energizes. 120VAC is then present on the red wire at TB1-6. This energizes relay K2 and removes 120VAC from J2-7 on CCT Control Board PCB1, shifting the PAPI system to low-intensity operation. 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 toggle switch S2. This allows the user to select either of the two settings to accommodate local site conditions.
2.2.6.5 Output to Light Units	Power is provided to the lamps in the Light Units via TB1-13 and TB1-14 in the Primary Enclosure. All lamps in each Light Unit are connected in series.
2.2.6.6 Optional Interlock Relay	See the “Alternate Wiring with Optional Interlock Relay (CS1)” section of the drawing in “Schematics” on page 61. This option provides ON/OFF control through current sensing of the runway series circuit during nighttime operations when operated by remote control. If S1 is in LOCAL, 120Vac is directly connected to the CCT-Control PCB J2-2 (the CC or ON input). The PAPI system then turns ON to either the 100% level (if Daytime) or to the 5% or 20% level (if Nighttime). Therefore, in this situation, the current sensing input has no effect on operation. If S1 is in REMOTE and there is a Remote ON command via a contact closure across TB1-7 and 8 and it is Daytime, 120Vac is directly connected to the CCT-Control PCB J2-2 (the CC or ON input) and J2-5 (the B3 or 5% command) via the closed contacts at K2 pins 9-1 and 10-2. Therefore, in this situation, the current sensing input has no effect on operation. If S1 is in REMOTE and there is a Remote ON command via a contact closure across TB1-7 and 8 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 TB1-15 and TB1-16), contact CS1 is closed, which connects 120Vac to the CCT-Control PCB J2-2 (the CC or ON input) and J2-5 (the B3 or 5% command) and turns the PAPI ON to the 5% level. If switch S2 is set to 20%, 120Vac is also connected to J2-6 (the B4 or 20% command). This then turns the PAPI ON to the 20% level. If current in the series circuit is less than 2.8A, the CS1 contacts open, turning OFF the PAPI system.

2.2.7 Operation Overview - Style B System

This section provides an overview of operation for the Style B Single-Channel PAPI system.

2.2.7.1 Style B Power

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 300 W isolation transformer is connected to each Light Unit. Current from the secondary of the isolation transformer supplies power to all three 105 W, 6.6 A lamps and both PC boards in each Light Unit. 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.

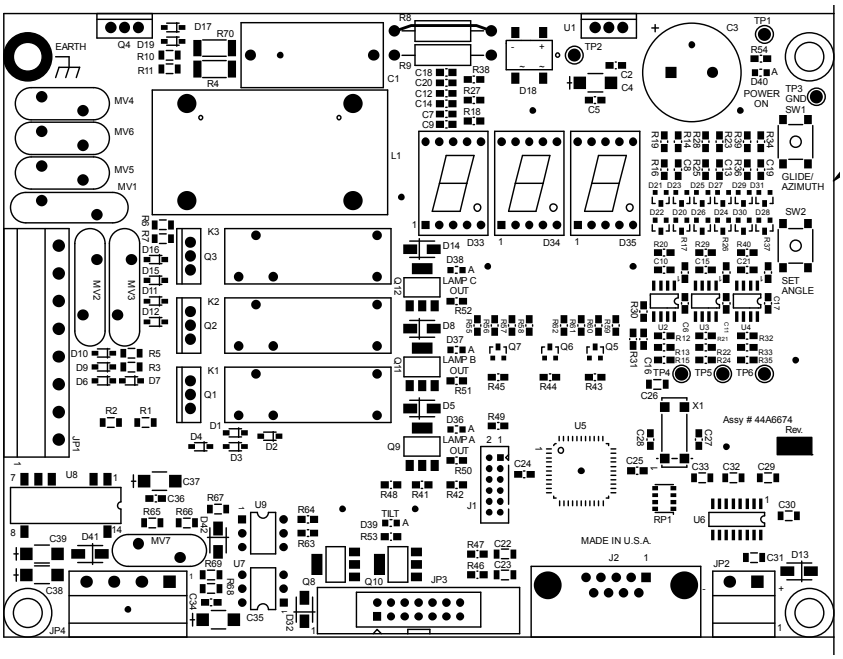
Refer to one of the following wiring diagrams in: “Schematics” on page 61.

2.2.8 Operation Overview - Style A and Style B Light Unit

The Light Units used in both the Style A and Style B systems are exactly the same. There are two boards in each Light Unit: the Control Board and the Inclinometer Board.

If any PAPI Light Unit is tilted, the tilt electronics are activated, de-energizing all Light Unit lamps after about 25 seconds. The PAPI system cannot be re-energized until all the PAPI units are in proper alignment.

2.2.8.1 Single Channel PAPI Control Board Overview



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

Lamps Out Feature

The micro-controller monitors the voltage across each lamp. If a lamp burns out, the micro-controller recognizes that an abnormal voltage is present and then energizes a relay that will short out the lamp. This allows the remaining lamp(s) to continue to operate. The associated red lamp-out LED will also be lit. After replacing the lamp, cycle power to the Light Unit to re-enable lamp-out monitoring for that lamp.

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 three-digit 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 (Azimuth) angle is either less or greater than 1.75 degrees. The micro-controller will then turn all the lamps off within the Light Unit by energizing all three of the lamp relays

and will also light the red **TILT** LED D39, the actual measured angle will be displayed. The red **LAMPS OUT** LEDs for all three lamps will also light.

External Tilt Signal

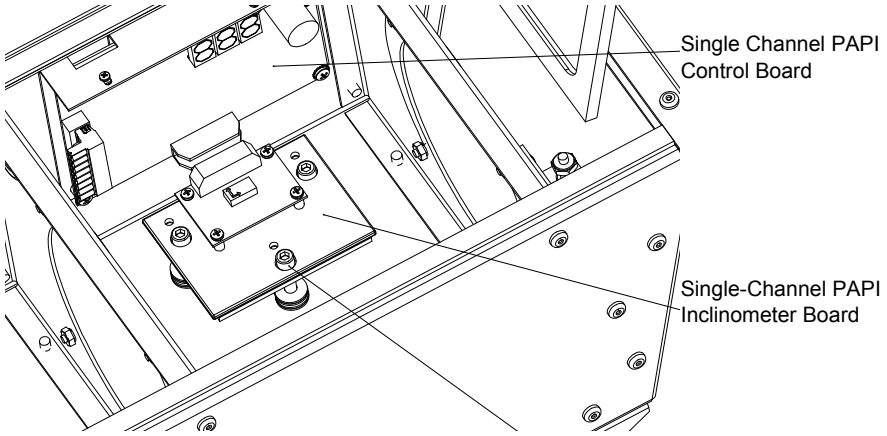
This is a parallel connected, two-wire signal that goes between all PAPI Light Units in the system. Normally, the Single-Channel PAPI Control Board will supply a voltage signal at connector JP4 as follows- pins 1 and 4: +8 to +12VDC; pins 3 and 4: Signal Common. If any PAPI Light Unit goes into a tilt situation, a relay on the Control Board will short the interconnecting Light Unit tilt signal (causing less than 2VDC to be present at JP4 pins 1 and 4) to inform the other PAPI Light Units to shut down. The other Light Units will display “EEE” to indicate they are being shut down by another Light Unit in a tilt situation.

NOTE: Connector JP4 may be momentarily removed from any Light Unit to isolate problems while troubleshooting. Disconnecting the JP4 plug from a light box will simulate that box NOT being in a tilt condition and the rest of the system’s light units should turn on after about 25 seconds.

The tilt signal shutdown function is not used in Canadian applications.

2.2.8.2 Single-Channel PAPI Inclinometer Overview

The Inclinometer Board contains a dual axis inclinometer that provides instrumentation grade performance for leveling applications. It contains a silicon-based chip that measures the tilt angle and transmits it to the Single-Channel PAPI Control board over a digital interface.



2.3 Siting the PAPI System

This section provides guidance on how to determine the physical location for each Light Unit and the Primary Enclosure for the Style A system.

2.3.1 Siting Considerations

When viewed from the approach end, the PAPI system must be located on the left-hand side of the runway as shown in Figure 5. 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 ILS Glideslope” on page 17. 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 Runways Without ILS” on page 18. The PAPI’s glideslope must be chosen to ensure the on-course signal of the PAPI provides adequate clearance over obstacles.

2.3.1.1 Distance of the PAPI Light Units from the Runway Edge

See Figure 5. The Light Unit nearest the runway must be no closer than 50 feet (15.24 m) (+10, -0 feet) (+3.048, -0 m) from the runway edge or to other runways or taxiways. This distance may be reduced to 25 feet (7.62 m) for small general aviation runways used by non-jet aircraft. Heliports or military airports may require steeper angles. An optional elevation kit is available for glide angles greater than 5 degrees.

2.3.1.2 Lateral Spacing of the PAPI Light Units

The PAPI Light Units must have a spacing between Light Units of 20 to 30 feet (6.096 to 9.144 m). Regardless of the actual spacing chosen, the distance between Light Units must not vary by more than 1 foot (304.8 mm).

2.3.2 Siting a PAPI with an 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 ±9.144 m) from the threshold as the virtual source of the ILS glideslope and aim at the same angle as the ILS glideslope.

Refer to Figure 5. 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 (91.44 m) (+50 feet, -0 feet) (+15.24 m, -0 m). Calculations should be performed to ensure that the site chosen provides adequate obstacle clearance and threshold crossing height.

Figure 5: PAPI Obstacle Clearance Surface

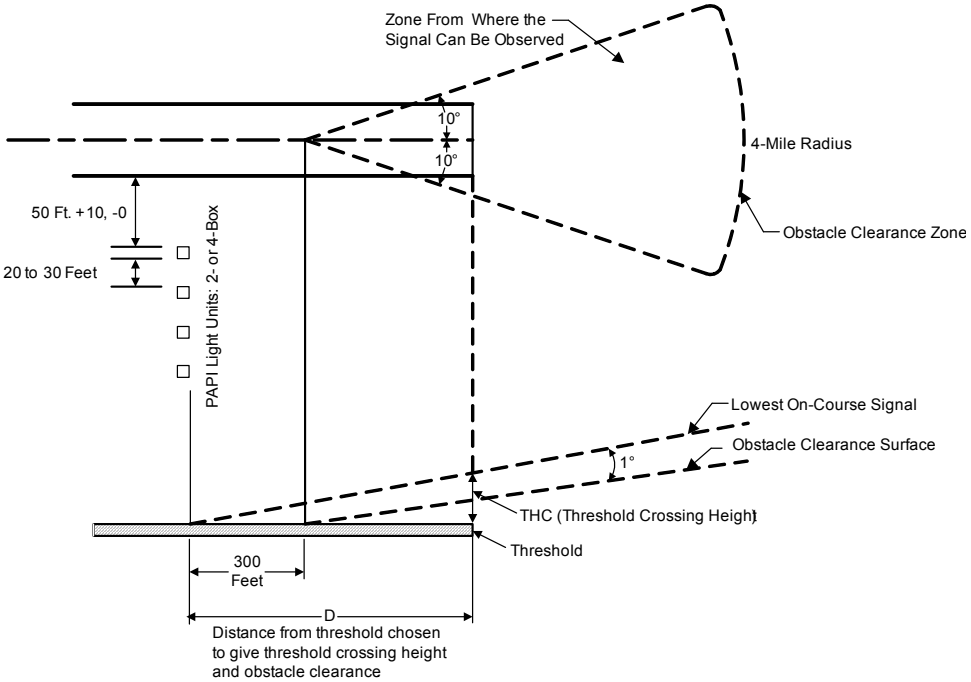


Table 3: Threshold Crossing Height

Type of Aircraft	Cockpit-to-Wheel Height	Visual Threshold Crossing Height	Remarks
Height Group 1 (General aviation, small commuters, corporate turbojets)	10 feet (3.048 m) or less	40 feet (12.2 m) (+5 ft, -20 ft) (+1.524 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) (+1.524 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 (15.24 m) (+5 ft, -15 ft) (+1.524 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 (22.9 m) (+5 ft, -15 ft) (+1.524 m, -4.6 m)	Most primary runways at major airports.

2.3.3 Siting PAPI on Runways Without ILS

When the runway doesn't 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.

2.3.3.1 Threshold Crossing Height (TCH)

See Figure 5. The 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.

2.3.3.2 Glideslope Angle

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

2.3.3.3 Distance of PAPI from Threshold

The following method can be used to determine the PAPI installation distance from the runway threshold provided there are no obstacles in the area from which the PAPI signals can be observed, no differences in elevation between the threshold and the installation zone of the PAPI or between the units, or reduced length of runway. The distance of the PAPI Light Units from the threshold (D1) can be calculated from the equation:

D1 = TCH x cotan (angle of lowest on-course signal)
where the TCH is the threshold crossing height for the most demanding aircraft using the runway.
Refer to Table 3. The angle of the lowest on-course signal is determined as follows:

- For the L-880 PAPI system the angle of the lowest on-course signal will be the aiming angle of the third Light Unit from the runway 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 lowest possible on-course signal is 3'/2 = 1.5' lower than the aiming angle.

- For the L-881 PAPI system this angle will be the aiming angle of the outside Light Unit minus 1.5 minutes of arc.

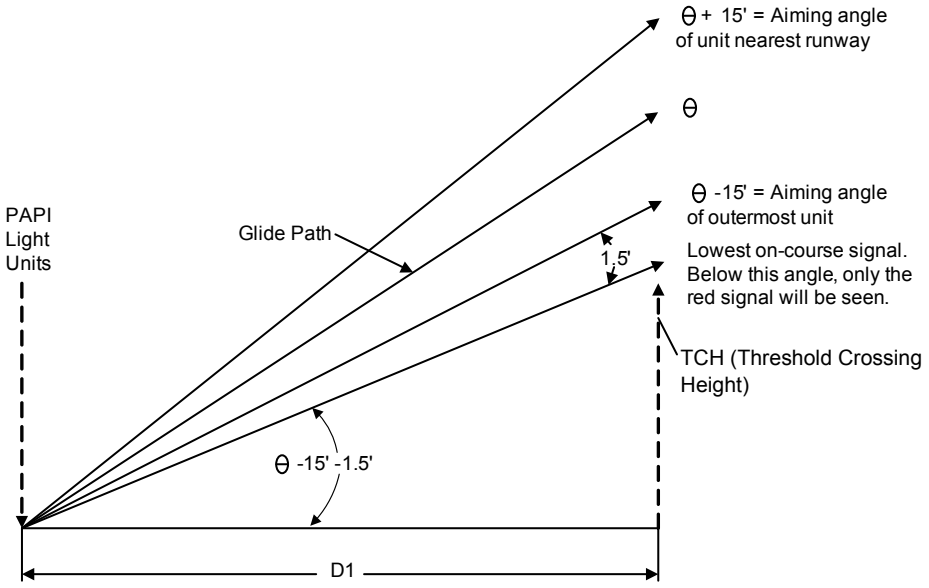
2.3.3.4 Obstacle Clearance Surface

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 obstacle is present in the area where you can observe the PAPI signals.

See Figure 5. This obstacle clearance surface begins 300 feet (91.44 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 (6.44 km) from the point of origin.

If an obstruction penetrates the obstacle clearance surface and cannot be removed, then the re-aim the glideslope angle or move the PAPI system further from the threshold. By moving or re-aiming the PAPI, re-position the obstacle clearance surface so that it will not be penetrated by an obstruction. See Figure 6.

Figure 6: Obstacle Clearance Surface



D1 = Distance of PAPI Light Units from Threshold

The 1.5’ is one-half the width of the transition sector of the light beam. The transition between the white to red part of the beam is 3 minutes of arc (3’). Hence the additional 1.5’ must be taken into account in calculating D1.

- For L-881: D1 = TCH x cotan (Θ - 15’ - 1.5’)

NOTE: For the L-880 PAPI system, the lowest on-course signal will be the aiming angle of the third Light Unit from the runway minus 1.5’. For a standard L-880 installation the lowest on-course signal will be Θ -10’ - 1.5’. For Height Group 4 aircraft this angle will be Θ - 15’ - 1.5’.

- For L-880 (Standard Installation): D1 = TCH x cotan (Θ - 10’ - 1.5’)
- For L-880 (Ht. Group 4 aircraft): D1 = TCH x cotan (Θ - 15’ - 1.5’)

2.3.3.5 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 Airfield Solutions sales department for further details.

2.3.4 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.

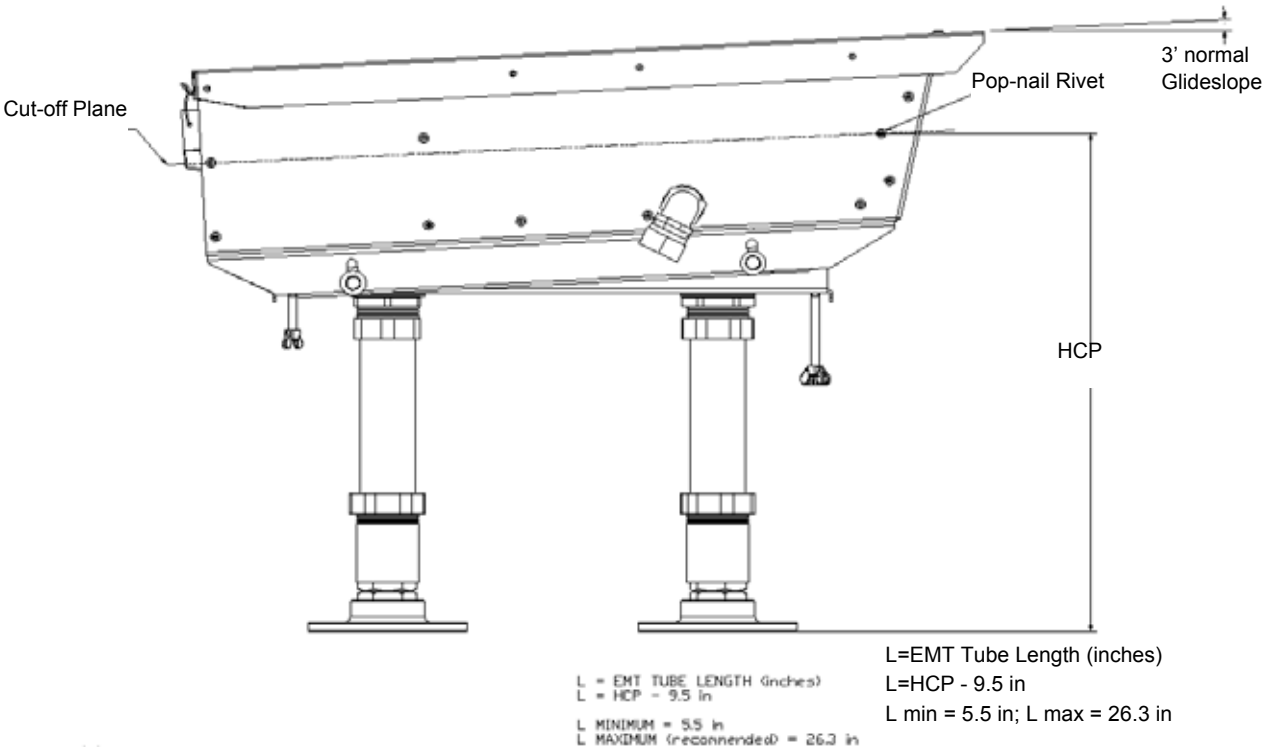
2.3.4.1 Azimuth Aiming

Each Light Unit shall be aimed outward into the approach zone on a line parallel to the runway centerline within a tolerance of ±1/2°.

2.3.4.2 Mounting Height Tolerance

The beam centers of all Light Units shall be within ±1 inch (25.4 mm) of a horizontal plane. The beam center is located at the front pop-nail (rivet) as depicted on Figure 7. This plane shall be within ±1 foot (304.8 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” on page 23. The Light Unit EMT leg length is chosen by the installer to insure the proper mounting height is achieved.

Figure 7: Light Unit Mounting Height



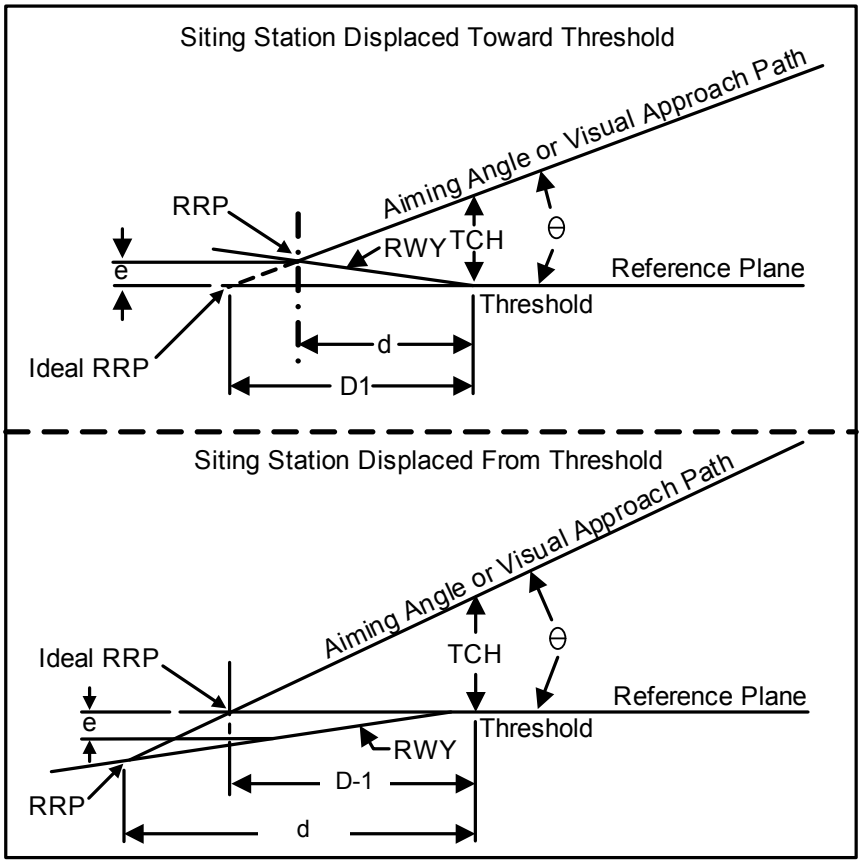
2.3.4.3 PAPI Tolerance Along Line Perpendicular to Runway

The front face of each Light Unit in a bar shall be located on a line perpendicular to the runway centerline within ±6 inches (152.4 mm).

2.3.4.4 Correction for Runway Longitudinal Gradient

See Figure 8. Refer to AC 150/5435-30 (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 8: Correction for Runway Longitudinal Gradient



LEGEND

RWY = Runway Longitudinal Gradient
THC = Threshold Crossing Height
RRP = Runway Reference Point (where aiming angle or visual approach path intersects runway profile)
D1 = Ideal (zero gradient distance of PAPI Light Units from threshold)
d = Adjusted Distance of PAPI Light Units from Threshold
e = Elevation Difference Between Threshold and RRP
θ =Aiming Angle

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

3. Obtain the runway longitudinal gradient. This can be done by survey or obtained from airport obstruction charts or as-built drawings.
4. Determine the ideal (zero gradient) distance from the threshold in accordance with the preceding instructions.
5. Assume a level reference plane at the runway threshold elevation. Plot the location determined in Step 2.
6. Plot the runway longitudinal gradient.
7. 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” on page 21.
8. Verify the calculated location gives the desired threshold crossing height.

2.3.5 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.

Figure 9: Example PAPI Installation

2.4 Installation

This section provides instructions for installing the PAPI Light Units and the Style A Primary Enclosure. 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.

2.4.1 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

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 warnings may result in serious injury or equipment damage.

2.4.2 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 Airfield Solutions.

2.4.2.1 What's Included

Table 4: Components Supplied by ADB

Component	L-880		L-881	
	Style A	Style B	Style A	Style B
Lighting Unit Assembly	4	4	2	2
Mounting Flange	8	8	4	4
Mounting Spacer	8	8	4	4
Frangible Coupling	8	8	4	4
Compression Coupling	8	8	4	4
Field Splice Kit (Quantity)	94A0235/3 (1)	94A0255/1 (4)	94A0235/4 (1)	94A0255/1 (2)

2.4.2.2 Required Materials Supplied by Others

Installing either the L-880 or the L-881 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
- 2" EMT pipe, one length per leg (two legs per PAPI Light Unit)
- AWG 16, 600V interconnecting wire between Light Units and Primary Enclosure (Style A only)
- Shrink tubing
- Butt splices
- Aviation orange paint (to paint 2" EMT pipe); 12 oz. spray cans of orange paint are also available from ADB Airfield Solutions (P/N 95A0008)
- 9V or 12V battery (optionally used to power Light Unit PC boards during alignment)

2.4.3 Installing the Master Control Box (Style A only)

Refer to site plans and contractor documents to determine where the Master Control Box will be installed and where and how to route the wiring. See “Schematics” on page 61. The Master Control Box must be installed on a concrete slab that extends at least 23” (584mm) below the frost line and 14” (356mm) beyond the Master Control Box’s housing to minimize damage by mowers and similar equipment. The PAPI Master Control Box is secured to the concrete base with four bolts, two for each leg.

NOTE: Instead of using expansion bolts, it is permissible to insert 3/8–16 x 6-inch anchor J-bolts into the concrete before it sets. See the frangible coupling dimensions on the drawing in “Schematics” on page 61, to determine the proper locations for the bolts.

2.4.4 Installing the Light Units (Style A and B)

Refer to site plans and contractor documents to determine where the Light Units will be installed and where and how to route the wiring.

Each PAPI Light Unit must be installed on a concrete slab that extends at least 12” (305mm) below the frost line and 12” (305mm) beyond the Light Unit’s housing to minimize damage by mowers and similar equipment. The PAPI Light Units are secured to the concrete base with four bolts, two for each leg. The bolt-hole pattern must be parallel to the runway centerline for proper orientation of the PAPI.

NOTE: See “Mounting Height Tolerance” on page 21 and Figure 7. The contractor supplies and installs the EMT tube—2” (50.8mm) diameter (2-3/16” OD); minimum length, 5.5” (140mm); maximum recommended length, 26.3” (670mm). Determine exact length at installation to compensate for uneven elevation above the runway. The 2” EMT tube extends into the frangible coupling 3-1/4” (82.55mm) and 1-1/2” (38.1mm) into the nut and ferrule compression joint to ensure stable installation. An EMT cut length of 11” (279mm) will result in a beam height of 20.5” (521mm) when set at a nominal 3° slope.

Instead of using expansion bolts, it is permissible to insert 3/8–16 x 6-inch anchor J-bolts into the concrete before it sets. See the frangible coupling dimensions on the drawing in “Schematics” on page 61 to determine the proper locations for the bolts.

To cast the concrete pad and install anchors:

1. Stake out the longitudinal axis of the Light Units parallel to the runway centerline.
2. Dig the foundation hole as shown on the drawing in “Schematics” on page 61.
3. Place foam in the pit to absorb frost heave below the central part of the slab.
4. Style B installation only: Place L-867 light base/conduit elbows (to separately house each isolation transformer) or conduit for cables.
5. Place rebar to strengthen concrete.
6. Pour the concrete and allow it to harden for at least 24 hours.
7. After the concrete sets up, draw a longitudinal axis (in accordance with the axis staked out on the ground) on the upper surface of the pad.
8. Draw a transverse axis perpendicular to the other axis.
9. Using plywood or other equivalent material, construct a positioning guide according to the Positioning Plate Detail on the drawing in “Schematics” on page 61.
10. Lay the positioning plate on the pad; center it by positioning the central hole at the intersection of both axes.
11. Align the plate along the longitudinal axis using the V-notches in the plate.
12. Mark the locations for the four bolts (2 for each leg) required for the PAPI base.
13. Drill the holes to the diameter and depth required for the expansion sleeves and insert the sleeves.
14. See “Schematics” on page 61 to install the mounting flanges (Item 3) to the concrete slab.
15. Install the frangible couplings by fully threading them into the mounting flanges. THE USE OF AN ANTI-SEIZE COMOUND IS STRONGLY RECOMMENED
16. Remove the nut and ferrule compression ring from each of the frangible couplings. For each section of EMT, first slide on the nut and then the ferrule compression ring. Insert the EMT at least 3 1/4 inches into the frangible coupling to insure a stable installation. Thread the nut onto the frangible connector and hand tighten the compression fitting. This will be fully tightened later.

17. To reduce corrosion, paint the EMT tube international orange, color #12197, according to Federal Standard 595A. International orange paint is available from ADB Airfield Solutions in 12 oz. (0.3kg) cans (P/N 95A0008).

2.4.5 Attach the PAPI Light Unit Housing to the Legs

DO NOT DISASSEMBLE THE PAPI LIGHT UNIT FROM IT'S BASE MOUTNING PLATE. The light unit and it's base plate are integrally matched for optimum performance. The compression couplings are factory tightened to the base and do not require assembly in the field.

1. Turn the light unit upside down. Remove the EMT compression fitting nuts and ferrule compression rings. For each section of EMT, first slide on the nut and then the ferrule compression ring. Place the Light Unit onto the two sections of EMT. Insure that the EMT is fully inserted into the compression fitting to insure a stable installation. Thread the nuts onto the compression fittings and hand tighten the compression fitting.
2. Fully tighten the Light Unit compression fittings and the frangible coupling compression fittings. The Light Unit should now be rigidly mounted and should not sway or rock back and forth.
3. Tighten the connection assembly.

2.4.6 System External Wiring Connections

2.4.6.1 Style A Wiring Between Primary Enclosure and the Secondary Light Units

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.

Grounding Units

Each PAPI unit must be grounded. To ground each unit: Attach a AWG 14 (minimum) ground wire to the ground lug located on the Primary Enclosure and the rear bottom of each Light Unit**.** The Earth Ground connection may be input directly into the Primary Enclosure with the incoming power wiring (and connected to the internal panel ground lug) or alternately, externally connected to the external ground lug on the enclosure.

Connecting External Wiring

All installation wiring should conform to the applicable sections of the National Electric Code and Local Codes. Make wire connections as shown in the appropriate drawing:

- “Schematics” on page 61 for the L-881 PAPI
- “Schematics” on page 61 for the L-880 PAPI

Input voltage is supplied to the box at TB1-1 and TB1-3. Note: No input wire is connected to TB1-2. Route cable through the flexible conduit assemblies.

NOTE: All external wiring must be a minimum of 16 AWG/600V.

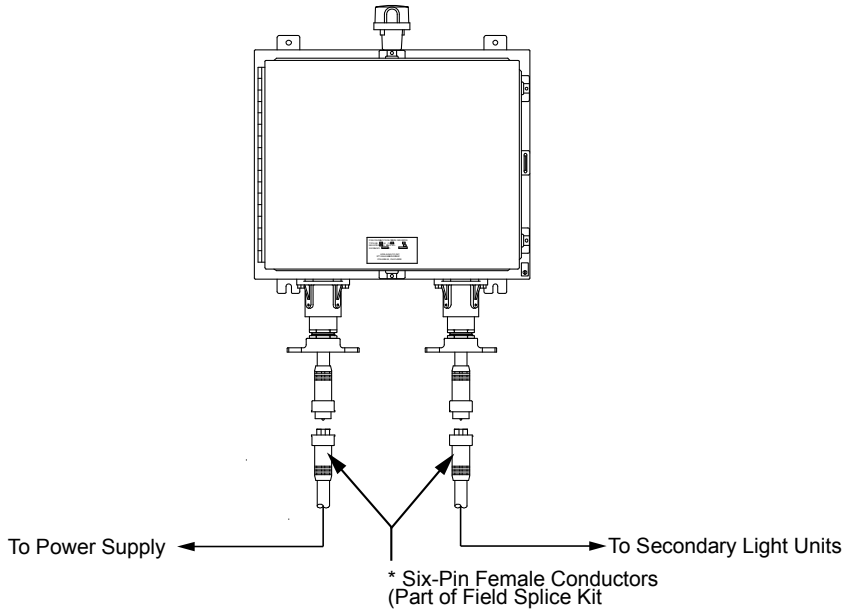
See the drawings in “Schematics” on page 61, and Figure 11 for a suggested method of connecting the wires between the Primary Enclosure and the Secondary Light Units and equipment supplied by others. See Table 4. Field splice kit(s) are separately provided with the PAPI system for use in attaching interconnecting wiring.

2.4.6.2 Connecting Wiring Between the PAPI Light Units - Installing Conduit

Each PAPI Light Unit is shipped with multi-conductor cable connected to the unit. This cable must be disconnected from the Light Unit and cut to length before it can be pulled through the protective flexible conduit required for installation. This is also because the factory-installed connector is too large to fit through the conduit. To install the flexible conduit:

1. See Figure 14. Disconnect the individual multi-conductor cable wires from the Control Board by first removing terminal blocks JP1 and JP4.
2. Note wire colors and terminal numbers for each wire. Loosen the screws holding the wires to the terminal blocks and pull the wires free.
3. Temporarily plug the terminal blocks back into the Control Board.

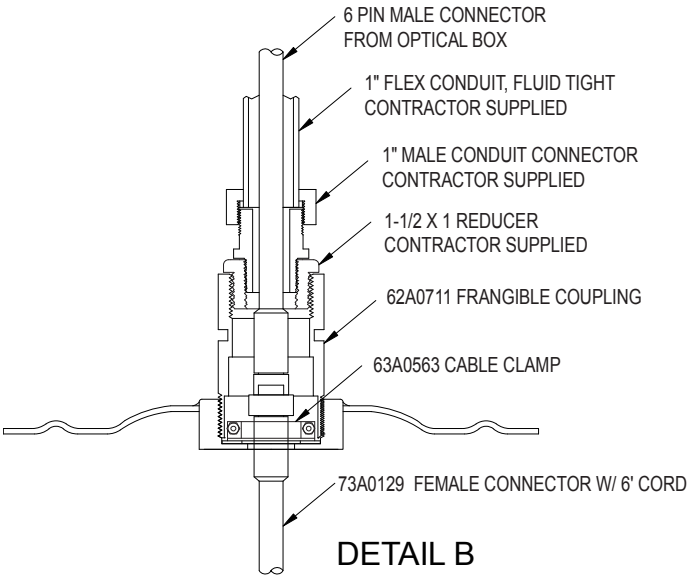
Figure 10: L-880/L-881 Primary Enclosure External Connections



4. Use a pair of wire cutters (or a similar tool) to cut the strain-relief bindings inside the Light Unit. Take care not to nick the insulation or wires.
5. Pull the multi-conductor cable out of the Light Unit enclosure, bending the cable if necessary as it enters the conduit elbow on the side of the enclosure.
6. Slide the multi-conductor cable through the appropriate length of flexible conduit necessary to attach the flexible conduit to the elbow on the Light Unit. Pull the multi-conductor cable back into the Light Unit.
7. Attach the flexible conduit to the Light Unit, tightening the fittings securely.
8. Remove 8 inches (203mm) of insulation from the end of the cable. Strip the end of each wire 0.3 inches (7.6mm).
9. Re-secure the multi-conductor cable internally with strain-relief ties**.**
10. Reattach the multi-conductor cable wires to terminal blocks JP1 and JP4. Refer to Figure 15.
11. Reinsert the terminal blocks onto the Control Board.

NOTE: Canadian PAPI use a 2-conductor cable that is directly attached to the secondary of a 300W isolation transformer.

Figure 11: L-880/L-881 Primary Enclosure External Connections



2.4.6.3 Style B Wiring Between Each Light Unit

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.

This subsection describes series circuit wiring requirements.

Grounding the Light Units

Each PAPI Light Unit must be grounded. To ground each unit, attach a AWG 14 (minimum) ground wire to the ground lug located at the rear bottom of each Light Unit.

Using Isolation Transformers

One 300W L-830 or L-831 isolation transformer is required to connect the series lighting circuit to each PAPI Light Unit.

Connecting External Wiring

All installation wiring should conform to the applicable sections of the National Electric Code and Local Codes. Make wire connections as shown in the appropriate drawing:

- Figure 10 or Figure 12 for the L-881 PAPI
- Figure 11 or Figure 13 for the L-880 PAPI

NOTE: All external wiring must be a minimum of 16 AWG/600V.

See the drawings in “Schematics” on page 61 and Figure 11 for a suggested method of connecting the wires between each Light Unit and the equipment supplied by others. See Table 4. Field splice kit(s) are provided for both L-880 and L-881 PAPI installation.

Light Unit Wiring

Install the multi-conductor cable on each Light Unit as described in “Connecting Wiring Between the PAPI Light Units - Installing Conduit” on page 28.

2.4.7 Align the PAPI

NOTE: The Control Board display reads directly in degrees with one hundredth (.XX) of a degree resolution. Table 7 is provided to convert the readout, which is in decimal degrees, to minutes:

Examples:
Suppose that an angle of 3°35' is desired. To obtain this setting, adjust the Light Unit's glide angle until 3.58 is displayed on the readout.
Suppose that an angle of 3°15' is desired. To obtain this setting, adjust the Light Unit's glide angle until 3.25 is displayed on the readout.

NOTE: If the readout shows **LO**, this indicates that the glide slope is negative (PAPI aimed toward the ground). If the readout shows **HI**, this indicates that the glide slope is greater than 9.99 degrees from horizon.

Before aligning the PAPI Light Units, Please thoroughly read "Operation" on page 35 of this manual to familiarize yourself with the digital display and push buttons operation of the PAPI control board.

Each PAPI Light Unit contains a digital LED readout. This display is used to set the vertical glide angle and to horizontally level each Light Unit. See "Understanding the LED Readout" on page 36 for additional details. The glide angle varies by location. To determine the correct angle, refer to site-specific documents, Table 5. and Table 6.

The PAPI's LED display shows three digits representing degrees, tenths of a degree and hundredths of a degree.

NOTE: For elevation angles above 5 degrees, order an elevation extension kit (P/N 94A0496) for each Light Unit. See "Parts" on page 69 for location where elevation extension kit brackets are added.

After determining the proper angle for the PAPI light box:

2.4.7.1 Initial Setup

If field power is available, connect input power to the PAPI. If power is not available, connect a 9V or 12V battery to the Control PCB as shown in Figure 12. Connect the battery to terminal block JP2; positive to Pin 1 and negative to Pin 2.

NOTE: If the battery is not connected correctly the Light Unit boards will not operate. This will NOT damage the Light Unit circuit board due to polarity protection on the input of terminal block JP2.

1. Loosen, but DO NOT REMOVE, the four (4) base bolts (Figure 10).
2. Finger tighten the four (4) base bolts.
3. Lower the single rear threaded adjusting rod completely and make sure the bottom of the light box is resting on the base.

CAUTION

- During this step, do not apply excessive torque to the threaded rods. this may bend or damage the rods or the light unit box.

4. Raise the two (2) front threaded adjusting rods until the front of the Light Unit is raised from the base as far as possible. At this point, the Light Unit should be set at maximum glide angle, with the back of the Light Unit lowered as far as possible and the front of the unit raised as far as possible.
5. Lower the two (2) front threaded adjusting rods three (3) full turns and gently press the front of the Light Unit down until it rests on the tips of the adjusting rods.

NOTE: Initial setup is complete.

2.4.7.2 Adjusting the Azimuth Angle

The following instructions require the Light Unit's circuit board to be powered either by the system input power or by use of a battery as described in the previous section.

If powered by the system input power, the Light Unit's three 105W lamps may initially light and then extinguish after 30 seconds. This is normal and can be ignored. The LED display on the Light Units' circuit board should be displaying an angle.

1. With the Light Unit powered as explained above, cycle the LED display to show the AZIMUTH angle.
2. Torque the one (1) FRONT base bolt below the circuit board to 132 in-lb.
3. Lower the one (1) front threaded adjustment rod nearest to this bolt so that it's tip is not touching the Light Unit bottom.
4. Adjust the opposite FRONT threaded adjustment rod (near the power cord entry) until the AZIMUTH angle on the LED display reads 0.00 degrees +/- 0.07 degrees.
5. Torque the one (1) FRONT base bolt near the power cord entry to 132 in-lb.
6. If the AZIMUTH angle is not correct after the base bolt has been tightened, loosen the one (1) front base bolt on the circuit board side by ¼ to ½ turn and use the front circuit board side threaded adjustment rod to fine tune the angle. Re-torque the base bolt and re-adjust if necessary until the AZIMUTH angle is within +/- 0.07 degrees.
7. Lower the two (2) front threaded adjustment rods until their tips are about ½ inch below the Light Unit.

2.4.7.3 Adjusting the Glide Angle

1. Cycle the LED display to show the GLIDE angle.
2. Adjust the REAR threaded adjustment rod until the desired GLIDE angle is displayed on the LED display within +/-0.03 degrees.
3. Tighten each of the two rear base bolts ¼ turn and re-check the angle. Re-adjust if necessary.
4. Repeat the previous step until the bolts are tightened to a torque of 132 in-lb. and the GLIDE angle is displayed within +/- 0.03 degrees.
5. Cycle the LED display to show the AZIMUTH angle. Re-adjust if necessary.

2.4.7.4 Saving the Glide Angle to Memory

1. See Figure 13. After all adjustments are complete, press the SET ANGLE pushbutton for five seconds until **CAL** 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 (Azimuth) angle is hard coded to disable the Light Unit if the unit is tilted more than 1.75 degrees in either direction.
2. When alignment is complete, remove the battery from terminal block JP2 (if used).
3. Repeat the alignment procedure for each of the Light Units.

Table 5: Aiming Angles for L-880 PAPI Light Units

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

A. Refer to Table 3. **Note:** 60 minutes of arc = 1 degree (60' = 1°)

Table 6: Aiming Angles for L-881 PAPI Units

L-881 (2 box) PAPI	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°)

Figure 12: Light Unit Control Board

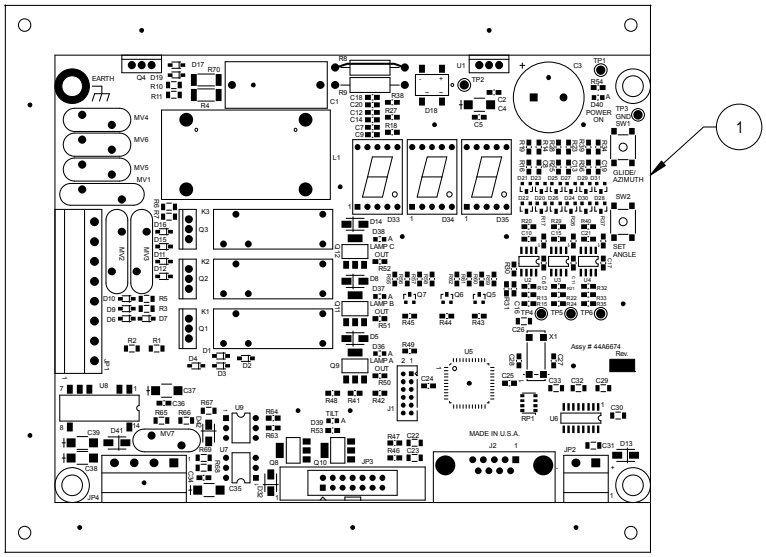
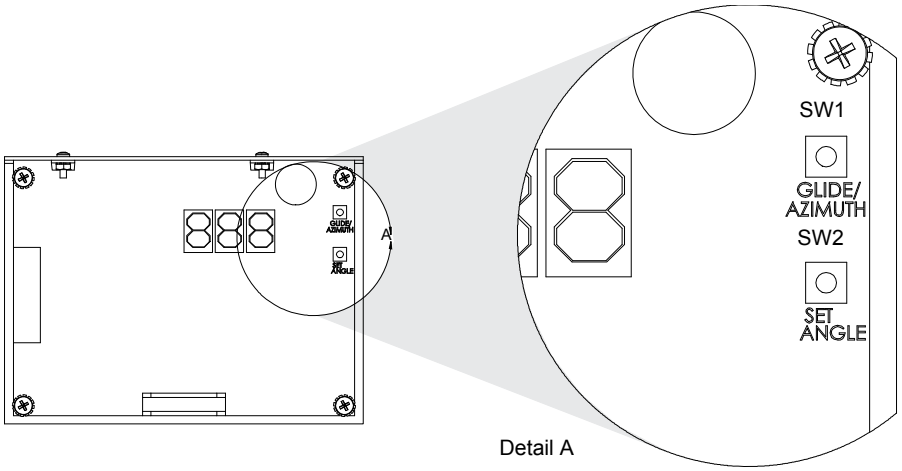


Figure 13: Control Board Pushbuttons



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Detail A, Rev. A

Table 7: Conversion from 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
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

2.5 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 **Style A** PAPI units, follow the steps for initial startup using local control, remote control operation and optional interlock relay in “Initial Startup Using Local Control—Style A” on page 38 through “Set Up and Test Optional Interlock Relay” on page 40.

— For **Style B** PAPI units, follow the steps for initial startup discussed in Section “Adjusting the Over Current Detection Level” on page 40.

2.5.1 Operation Safety Considerations

WARNING

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.

2.5.1.1 Normal Operation

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

— The **Style A** 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 **Style B** 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.

2.5.1.2 Preparation for Heavy Snowfall

The single-channel 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.

2.5.1.3 Criteria for System Deactivation

Any Light Unit in which one or two of the three lamps have failed can still be regarded as operational, pending repair and provided the Light Unit is continually monitored.

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

2.5.2 Understanding the LED Readout

2.5.2.1 Seven-Segment Display

The three-digit, seven-segment LED display indicates either the azimuth (horizontal level) or the glide slope (vertical) angle measured from the horizon. The angle is displayed on the LEDs as follows:

Display Value	Description
0.00 to 9.99[1]	• Displays degrees of glide slope if push button SW1 (Glide/Azimuth) **is not** pushed • Displays degrees of azimuth (horizontal level) if push button SW1 (Glide/Azimuth) **is** pushed.
ON	• Normal operation (systems shipped after February 2011)
CLd	• Inclinometer is warming up (Initially on 15 seconds - 3 minutes for systems shipped after February 2011)
LEL	• Indicates you are adjusting/reading the Level (Horizontal/Azimuth).
gLI	• Indicated you are adjusting/reading the GLIDE (or vertical) angle.
LO	• Indicates glide slope is negative (PAPI aimed toward the ground).
HI	• Indicates glide slope is greater than 9.99 degrees from horizon.
EEE	• Shutdown due to external tilt signal from another PAPI.
CAL	• Indicates the glide slope (vertical) angle is being stored in memory.

[1] During alignment for 15 minutes, systems shipped after February 2011

NOTE: It takes 15 seconds for the display to warm up in cold weather.

NOTE: ICAO PAPI systems do not require tilt/detection shutdown, but may optionally be supplied if desired. A versionn of the system can be supplied without the tilt detection but with the digital display.

2.5.2.2 Push Button Functions

The SW1 and SW2 push buttons determine the display as follows:

SW1—Glide/Azimuth

SW1—Glide/Azimuth, there are 3 modes of display as follows:

- — Push SW1 one time, display will momentary show 'LEL' and then display the horizontal or Azimuth angle until SW1 is pushed again.
- — Push SW1 one more time, display will toggle back and forth between the glide angle and the Vertical Glide angle until SW1 is pushed again.
- — Push SW1 one more time, display will momentary show 'gLI' and them display the glide angle until pushed again.

SW2—Set Angle

The SW2 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.

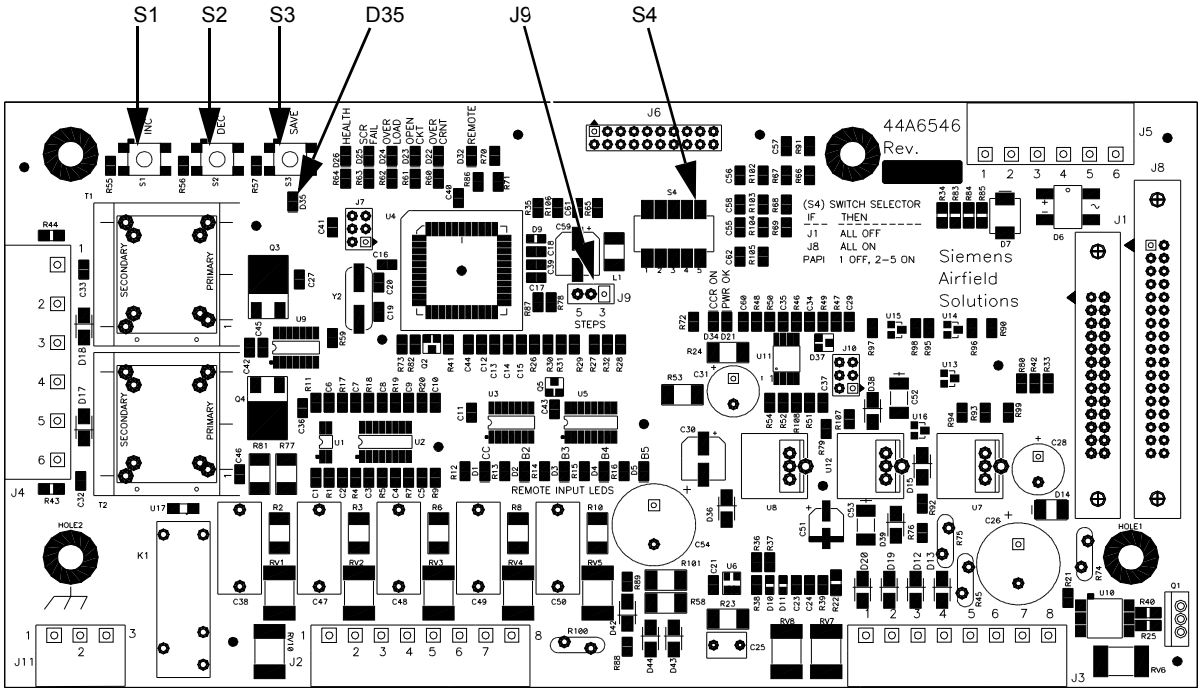
— Push and hold the SW2 push button for about 5 seconds until the letters CAL are displayed on the three-digit, seven-segment display for the Control Board to memorize the glide angle.

2.5.3 Initial Startup Using Local Control—Style A

To turn ON the Style A PAPI system using local control:

4. See Note 1 in the drawing in Figure 14. On the Primary enclosure CCT Control Board, verify that switch S4-1 is set to OFF and that S4-2 to 5 is set to ON.
   Also, verify that jumper J9 is set to the three-step setting. See Figure 14 (J9) for an example.
5. Turn circuit breaker CB1 to OFF and set Switch S1 to LOCAL.
6. Place a jumper across the output of the Primary enclosure at TB1-13 to TB1-14 using 10 AWG/600V wire, minimum. Using a true RMS amp meter, connect a current clamp around this wire.
7. Remove the photocell. This will force the PAPI to activate at 100%. Turn circuit breaker CB1 to ON. The true-RMS ammeter should read 6.6 amps.
8. See Figure 14. If the reading is not 6.6 A, adjust the output current with buttons S1 “increase” (INC) and S2 “decrease” (DEC) on the CCT Control Board until the correct current is obtained. Press and hold the SAVE button for two seconds to save the setting. The Green SAVE LED D35 will turn ON when the reading is memorized by the CCT Control Board.

Figure 14: CCT Control Board



9. Turn circuit breaker CB1 to OFF.
10. Re-install the photocell and remove relay K2. This will force the PAPI to activate at either 5% or 20%.
11. Turn CB1 to ON.
12. Set Switch S2 to 20%. The true RMS amp meter should read 5.08A (see Table 8). If the reading is not 5.08A, adjust the output current with buttons INC and DEC on the CCT Control Board until the correct current is obtained. Press and hold the SAVE button for two seconds to save the setting. The Green SAVE LED D35 will turn ON when the reading is memorized by the CCT Control Board.

Table 8: Output Current

Intensity	Output Current
100%	6.6 A
20%	5.08 A
5%	4.09 A

13. Set Switch S2 to 5%. The true RMS amp meter should read 4.09A (see Table 8). If the reading is not 4.09A, adjust the output current with buttons INC and DEC on the CCT Control Board until the correct current is obtained. Press and hold the SAVE button for two seconds to save the setting. The Green SAVE LED D35 will turn ON when the reading is memorized by the CCT Control Board.
14. Turn circuit breaker CB1 to OFF.
15. Reinstall relay K2, then select the desired intensity for nighttime operation by turning Switch S2 to 5% or 20%.
16. Remove the wire between TB1-13 and TB1-14 and reapply the field load.
17. Ensure that all Light Units are aligned properly and that the glide angle settings are memorized in each Light Unit. See “Align the PAPI” on page 31 for the Light Unit setting procedure.
18. Turn CB1 to ON and Switch S1 to LOCAL. The system should energize and all lamps should turn on.
19. With the load applied, verify the current levels are correct at the output of the Primary enclosure by connecting a true RMS amp meter to either of the output wires. Readjust the CCT Control Board, if necessary.
20. Verify that the current levels are correct inside each Light Unit. To check this:
    - Turn circuit breaker CB1 in the Primary Enclosure to OFF.
    - Remove the lid from the closest secondary Light Unit.
    - Connect a true RMS amp meter current clamp around one of the wires connected to one of the lamps.
      (**Note**: The three lamps are connected in series.)
    - Turn circuit breaker CB1 in the Primary Enclosure to ON.
    - Verify that the current is correct in each of the current steps. Troubleshoot or repair the external wiring if the current is incorrect.
    - Repeat for each remaining Light Unit.

2.5.4 Set Up and Test Remote Control Operation

To set up and test remote control operation:

1. Turn circuit breaker CB1 to OFF.
2. Set Switch S1 to REM and connect remote control wiring to TB1-7 and TB1-8. Disconnect the photocell.
3. Turn circuit breaker CB1 to ON. The system should energize and the true RMS amp meter should read 6.6 A. All lamps should illuminate.
4. Turn circuit breaker CB1 to OFF. Reinstall the photocell and remove relay K2. Set Switch S2 to the desired nighttime intensity setting (5% or 20%).
5. Turn circuit breaker CB1 to ON. The system should energize and all lamps should come on. The true RMS amp meter reading should correspond to the setting of Switch S2 (see Table 8).
6. Turn circuit breaker CB1 to OFF and reinstall relay K2.
7. The PAPI system is now ready for operation.

2.5.5 Set Up and Test Optional Interlock Relay

To set up and test the operation of the interlock relay (if present):

1. Ensure that the primary of a low-wattage isolation transformer is connected to the series circuit. Ensure that the secondary is connected to TB1-15 and TB1-16. A 6.6A secondary, 30/45W isolation transformer is typically used. However, a 10/15W or 20/25W isolation transformer may be used.
2. Set Switch S1 to REM and circuit breaker CB1 to OFF. Remove relay K2.
3. CS1 has the following activation ranges:
   - — No jumper: 1 to 6 A
   - — Mid jumper: 6 to 40 A
   - — High: 40 to 200 A
     Ensure that no jumper is used on CS1.
4. Turn circuit breaker CB1 to ON. The unit should remain off.
5. Turn on the CCR that controls the interlock relay. The unit should turn on and all PAPI Light Unit lamps should illuminate. The true RMS amp meter reading should correspond to the selected Switch S2 setting (see Step 12 in “Initial Startup Using Local Control—Style A” on page 38).
6. Turn off the CCR. All Light Units should turn off.
7. Turn circuit breaker CB1 to OFF and reinstall relay K2.
8. Turn circuit breaker CB1 to ON.

2.5.6 Adjusting the Over Current Detection Level

NOTE: The Over Current setting is pre-set and normally does not need to be adjusted.

Before adjusting the Over Current detection level, insure the output current levels are adjusted per the instructions above. To adjust the overcurrent, perform the following procedure:

- Turn circuit breaker CB1 to OFF and set Switch S1 to LOCAL.
- To insure that the Light Unit lamps cannot be damaged by an over current situation during the adjustment, place a jumper across the output of the Primary enclosure at TB1-13 to TB-14 using 10 AWG/600V wire, minimum. Using a true RMS amp meter, connect a current clamp around this wire.
- Remove the photocell. This will force the PAPI to activate at 100%. Turn circuit breaker CB1 to ON. The true-RMS ammeter should read 6.6 amps.
- Press and hold for three seconds both the INC and DEC buttons on the CCT Control Board. The Green LED D35, next to the SAVE button, will illuminate to indicated that you are in the Over Current Adjustment Mode.

NOTE: The CCR output current will increase to the level previously set as the Over Current level. This will be above 6.6 amps.

- Press the INC or DEC buttons until you reach the desired Over Current detection level.
- Press and hold the SAVE button for two seconds. The SAVE LED will briefly turn off and then back on to indicate the reading is memorized by the CCT Control Board. Also, the CCR output will then go back to the top step setting (6.6 A).
- Turn circuit breaker CB1 to OFF, re-insert the photocell, remove the short from the PAPI output and re-apply the field load.

2.5.7 Initial Startup of the Style B System

Each Light Unit is automatically energized when the constant current regulator (CCR) is activated, assuming that no Light Unit is in a tilt situation.

2.5.7.1 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” on page 31 for the Light Unit setting procedure.

2.5.7.2 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 one of the lamps.
  (**Note**: The three lamps are connected in series.)
- Turn the CCR ON to the lowest step (2.8A for a three-step CCR or 4.8A for a five-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.

2.5.8 Commissioning the PAPI System

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

2.6 Maintenance

This section provides maintenance information and procedures for L-880 and L-881 PAPI systems.

2.6.1 Maintenance and Repair Safety Considerations

WARNING

Allow only qualified personnel to perform maintenance, troubleshooting and repair tasks. Only persons who are properly trained and familiar with ADB Airfield Solutions 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 Airfield Solutions 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.

2.6.2 Maintenance Schedule

To keep the PAPI unit operating efficiently, follow the preventive maintenance schedule in Table 9.

Table 9: Single-Channel PAPI Maintenance

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 of Light Units using the onboard inclinometer.	Readjust if needed. Refer to “Additional Siting Considerations” on page 23 for Light Unit alignment. To independently check the elevation aiming angle, refer to “Checking Slope Angles of PAPI Unit” on page 46.
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 (see “FAA CertAlert on PAPI Operation” on page iv).
	Check to ensure all lamps are illuminating and illuminated evenly.	Replace burned-out lamps. Clean any dirty lenses and shields.
	Visually check for any apparent evidence of damage to the Primary (Style A systems) or any Light Unit.	Repair or replace any damaged components.

Interval	Maintenance Task	Action
Monthly	Check all control equipment—including photocell (Style A systems)—for proper operation.	Repair or replace any damaged components.
	Clean the outer surface of the protective glass.	Use a soft cotton cloth moistened with alcohol.
	Check the glide slope and azimuth angle of each Light Unit.	Use the onboard Light Unit digital readout. Readjust if necessary.
	Inspect housing and closure system, lamps, electrical connections, filters and protective glass for damage, breakage or warpage.	Repair or replace any damaged parts.
	Clean the interior of the housing.	Remove any foreign matter. Also check for water damage, insect infestation and presence of rodents. Clean both sides of the protective glass, color filters, lenses and reflectors. Use a soft cotton cloth moistened with alcohol.
Monthly	Make sure mounting is rigid.	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 true RMS input current to each Light Unit and input voltage to Primary (Style A systems).	Repair or replace equipment if input is abnormal.
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.	Repair or replace as necessary.
	Check the resistance of the grounding system and record the results.	Repair or replace as necessary.

2.6.3 Standards and Tolerances

Table 10: Precision Approach Path Indicator (PAPI) Standards and Tolerances

Parameter	Standard	Tolerance / Limit	
		Initial	Operating
Lamps burning			
• PAPI	All	All	No more than two lamps out per Light Unit
Vertical aiming[1]			
• 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	±2 ‘ (0.03°)	±30 ‘ (1/2°)
Tilt Detection	0.25° degree below to 0.50° degree above established Light Unit angle	Same as standard	
Lamp current (current-regulated)	Rated current of lamps	See AC 150/5345-10 (current edition) for CCR output current tolerances.	
Obstructions due to vegetation, etc.	No obstruction	Same as standard	

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

2.6.4 Maintenance Procedures

2.6.4.1 Replacing a Lamp

All lamps should be replaced after a service period of approximately 800 hours at the 100% brightness level. For a Style B system, an elapsed-time recorder connected to the constant current regulator may be used to determine the time for replacement.

CAUTION

Wear cotton gloves when handling the lamps. Touching the quartz bulb with bare fingers may seriously shorten lamp life. If the quartz bulb has been touched, wipe it carefully with lens cleaning tissue or similar material moistened with isopropyl alcohol.

To replace a lamp:

9. Depending on the type of PAPI:
   - **Style A:** De-energize the main input power breaker. Turn off circuit breaker CB1.
   - **Style B:** Turn off and lock out the CCR that powers the PAPI system.
10. Remove the cover from the Light Unit.
11. Disconnect the electrical slip-on fitting from the burned-out lamp.
12. Swing the spring-loaded fork back and remove the lamp.
13. Replace the lamp and reverse steps to complete installation. The lamp shorting circuit is automatically reset when power is restored.

2.6.4.2 Replacing Objective Lenses

Never attempt to replace an objective lens. Objective lenses are precisely positioned in the Light Unit and are not field-repairable because the optical center of the lens must be realigned after replacement.

If an objective lens is damaged, return the PAPI Light Unit to the factory for repair and adjustment. Contact the ADB Airfield Solutions Sales Department for details.

2.6.4.3 Replacing the Red Filter

The red filter must be perfectly clean. Use a soft cotton cloth moistened with alcohol to clean the filter. Wear cotton gloves when handling a filter.

The filter is held in place in the filter holder by a filter-retaining spring.

NOTE: When cleaning filters in multiple units, make sure each filter is returned to the same filter holder from which it was removed.

To remove or replace a filter:

1. Remove the filter-retaining spring.
2. Remove the filter by sliding it upward out of the holder.
3. To reinstall the filter, reverse the removal steps. The filter must be installed in the holder so that the lower edge (dull edge) of the filter is down. The top edge has 0.08" x 45° bevels on each corner.

2.6.4.4 Replacing an Inclinometer PCB Mounting Assembly

Refer to the drawings in "Maintenance" on page 42 when performing these steps:

1. Remove three (3) #8-32 x 3/8 pan head Phillips screws attaching the 44A6813 inclinometer PCB Mounting Assembly to the 60A3325 Mounting Plate.

NOTE: Do not attempt to remove the ¼-28 x 1 socket cap screws attaching the 60A3325 Mounting Plate to the enclosure bottom plate.

2. Install new 44A6813 inclinometer PCB Mounting Assembly and replace the three (3) #8-32 x 3/8 pan head Phillips screws.

NOTE: Upon initial replacement of either of the older PAPI Control Boards (44A6674 or 44A6674-1) or the inclinometer mount assembly (44A6813), you must replace both items with (44A7122 or 44A7122-1, and 44A6813-INSL).

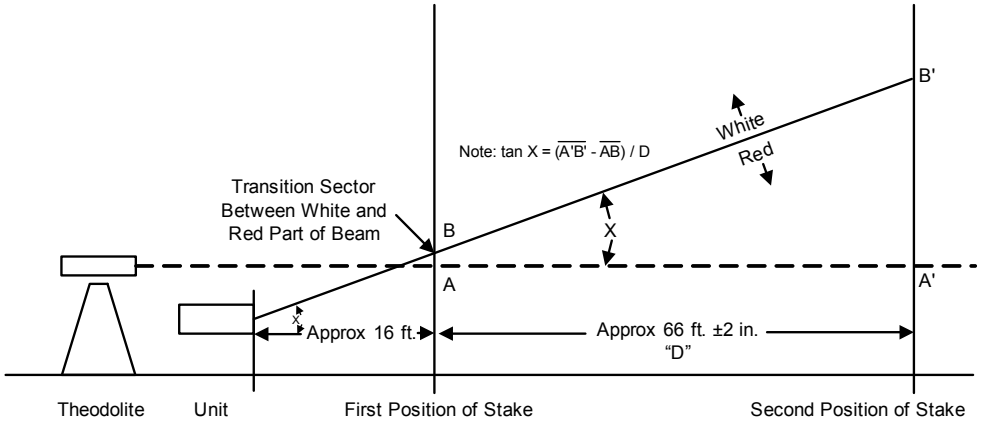
2.6.4.5 Checking Slope Angles of PAPI Unit

It may be requested that when the equipment is put initially into operation and at regular intervals thereafter, the cut-off angle of the Light Units be checked. To make this measurement, it will be necessary to use a surveying instrument or a bubble level with telescope and a surveyor's stake.

To check the slope angles of the PAPI Light Units, perform the following procedure:

1. See Figure 1. Place the surveying instrument 6 to 10 feet (1.83 to 3.05 m) behind the Light Unit pointing down beam.

Figure 1: Checking Slope Angles



2. A surveyor's stake is held by an assistant approximately 16 feet (4.88 m) in front of the Light Unit.
3. Take reading A for the intersection of the horizontal of the telescope with the stake.
4. Take reading B for the intersection of the cut-off plane of the light beam with the surveyor's stake.
5. The assistant should now move a precisely measured distance of about 66 feet (20 m) ±0.25% down beam and take the same measurements A' and B', as in Steps 3 and 4 above.

6. The angle x of the beam cut-off to the horizontal is found from the following formula:

$$\tan x = \left(\overline{A'B'} - \overline{AB}\right) / D$$

NOTE: The overline (—) denotes length where D is the horizontal distance between the two stake positions.

If similar checks are to be scheduled in the future, a small concrete pad holding a galvanized pipe may be installed in front of each Light Unit at the distances used above.

2.7 Field Installation of Adjustable PAPI Baffles

2.7.1 Introduction

This service bulletin provides instructions for modifying the horizontal light beam coverage of the PAPI unit for obstacle avoidance in the approach area for the ADB Airfield Solutions' 1-lamp Single Channel PAPI.

2.7.1.1 References

Refer to Table 11 for references.

Table 11: References

Reference Description	ADB Airfield Solutions's Part Number
USER MANUAL: Single-Channel PAPI, Precision Approach Path Indicator Type L-880 & L-881, Style A (Voltage-Powered) & B(Current-Powered)	96A0379

2.7.1.2 Special Tools and Equipment Required

Refer to Table 12 for the special tools and equipment. This equipment is not supplied.

Table 12: Required Equipment Not Supplied

Description	Quantity
Walkie-talkies or other form of communication	2
Small Phillips screwdriver	1
Combination square or machinist's square	1
Instruction manual for PAPI *part number 96A0379*	1

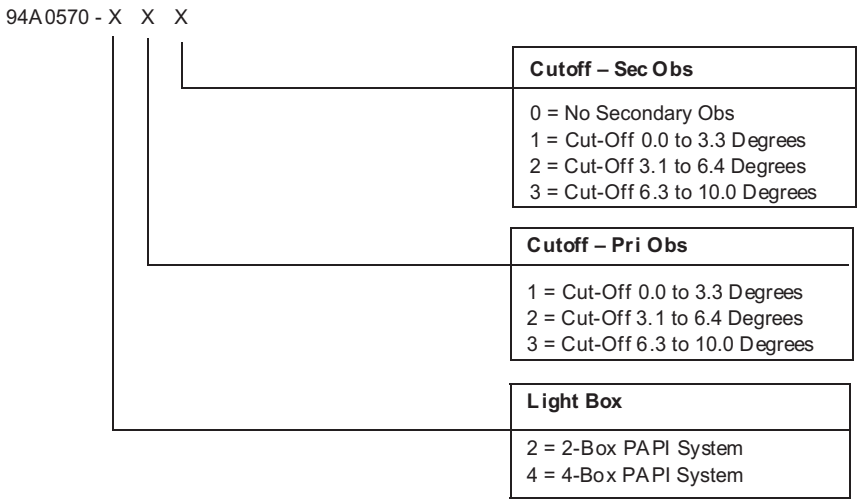
2.7.1.3 Items Included in PAPI Baffle Retrofit Kits

This subsection provides the PAPI Baffle Retrofit Kit ordering code, and a parts list for 2-box and 4-box baffle kits.

2.7.1.4 PAPI Baffle Retrofit Kit Ordering Code

See Figure 2 to determine the part number for a particular PAPI Baffle Retrofit Kit.

Figure 2: PAPI Baffle Retrofit Kit Part Ordering Code



2.7.1.5 Baffle Kit Parts List for 2/4-Box PAPI

Refer to Table 13 for the Baffle Kit parts list.

Table 13: Baffle Kit 94A0570-XXX, Parts per Unit

	Part Number	One Obstruction	Two Obstructions
Baffle Mounting Plate	60C1672	1	1
Baffle (0.0 -3.3)	60B1673-1	1	2
Baffle (3.1 – 6.4)	60B1673-2		
Baffle (6.3 – 10)	60B1673-3		
Pan head screws, 6-32 x 0.75 long	64A0198-12	2	4
Lockwasher, Split #6	66A0026-11	2	4
Hex Nut, 6-32	65A0015-11	2	4
Pan head screws, 8-32 x 0.38 long	64A0966/06	2	4

2.7.2 Modification Procedure

NOTE: One baffle is required for EACH PAPI Light Box. Each set of baffles are to be the same cut-off range. More than one baffle type (cut-off range) can be ordered depending upon the application. Contact ADB Airfield Solutions if you are not sure about the cut-offs required for your particular application.

NOTE: The estimated time required is 60 minutes per PAPI Light Box.

NOTE: WARNING: Only personnel authorized to work on high voltage equipment should make the modifications described in this service bulletin.

NOTE: WARNING: Disconnect equipment from line voltage. Failure to observe this warning may result in personal injury, death, or equipment damage.

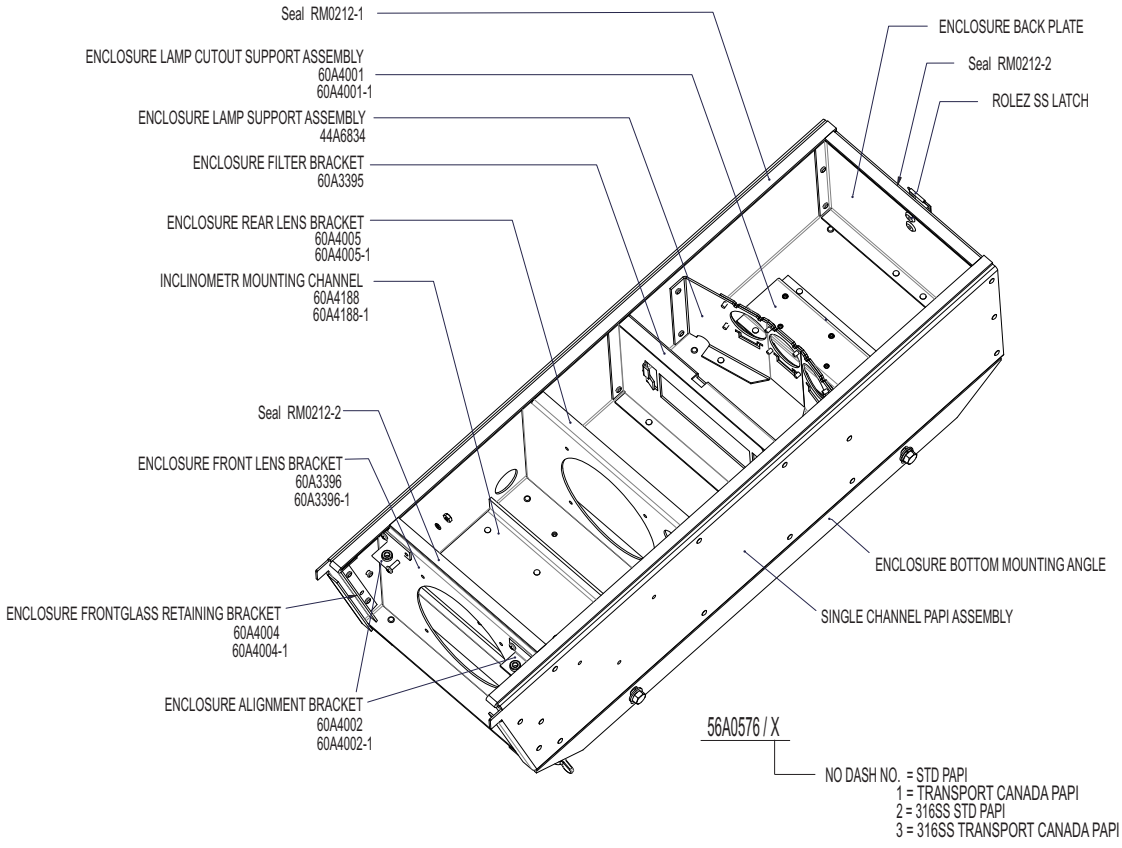
NOTE: Coordinate a power outage for the PAPI system with Air Traffic personnel.

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

1. De-energize the PAPI system.

   Depending on the location of the obstruction in the approach area (right or left side), attach the baffle mounting plate on the back side of the enclosure filter bracket.

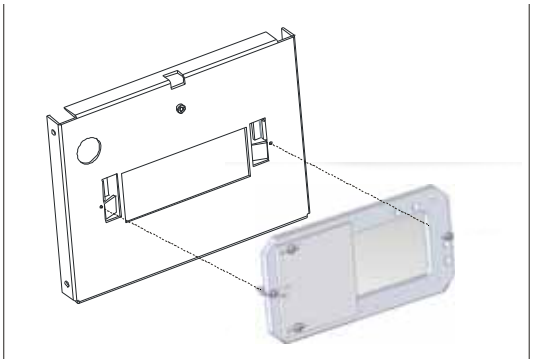
Figure 3: Single Channel PAPI Box Assembly



NOTE: The baffle mounting plate is mounted on either the left or right side of the enclosure filter bracket by flipping the plate over.

2. Fasten the Baffle Mounting Plate to the enclosure filter bracket by using the #6-32 x 0.75 long pan head screws, hex nuts, and split lock washers provided.

3. Insert the #6 screws through the plate and the mating slots in the enclosure filter bracket located at the end of the filter slot.



4. IF the obstacle is on the LEFT side of the approach area, then install the baffle over the filter slot on the RIGHT side. See Figure 4. **-OR-**

   IF the obstacle is on the RIGHT side of the approach area, then install the baffle over the filter slot on the LEFT side. See Figure 5.

Figure 4: Baffle Located on Right Side of Enclosure Filter Bracket for Obstacle Located on Left Side

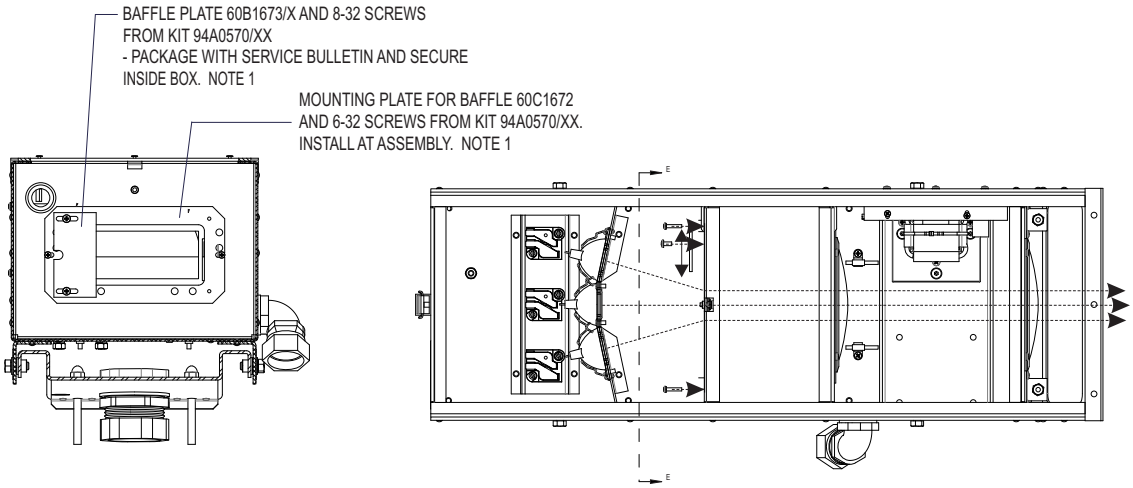
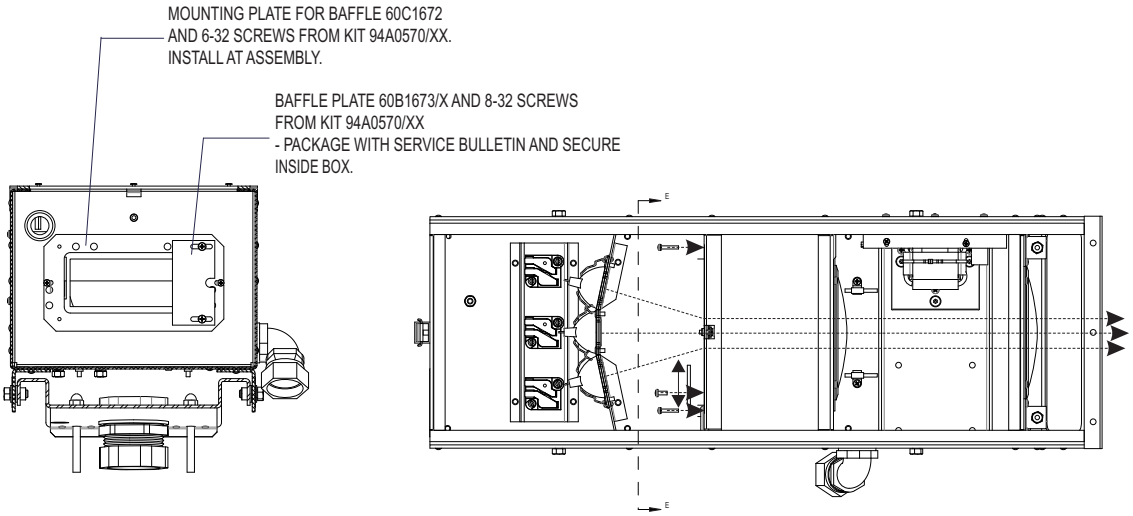
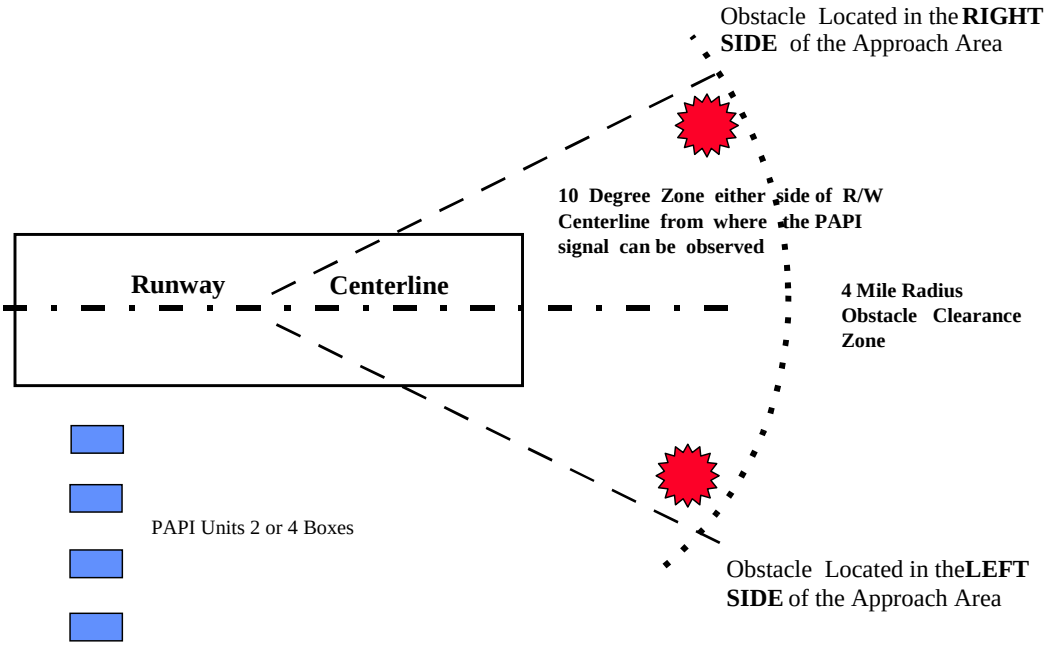


Figure 5: Baffle Located on Left Side of Enclosure Filter Bracket for Obstacle Located on the Right Side



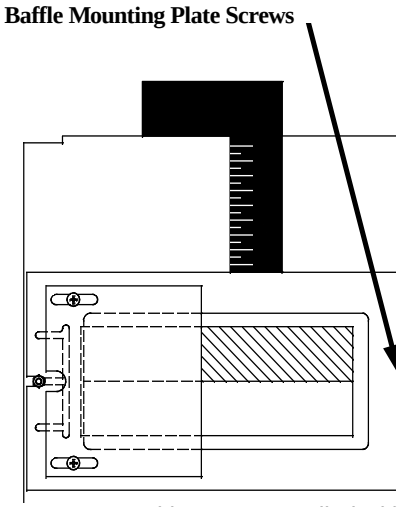
NOTE: If both sides are obstructed, complete one side at a time.

Figure 6: PAPI Signal Viewing Zone



5. Take a combination square or machinists' square of appropriate length, and square the Baffle Mounting Plate with the top edge of the filter Enclosure Filter Bracket. See Figure 7.

Figure 7: Squaring Top Edge of Baffle Mounting Plate



6. Using the #10-32 x 0.38 large screws, and hex nuts supplied with the baffle, install baffle as required for the application. Two #10-32 tapped holes are located in the Baffle Mounting Plate.

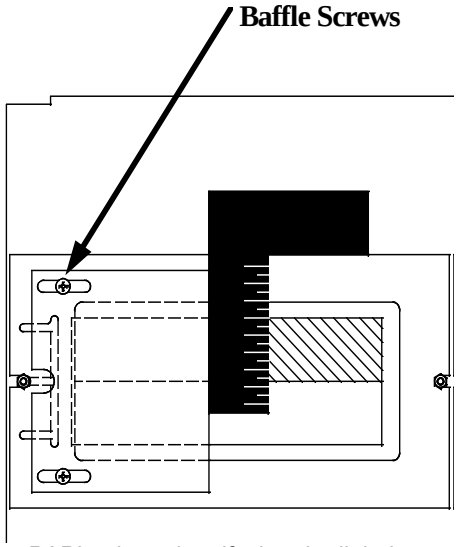
NOTE: Until the cutoff has been confirmed, the two screws should only be finger tight.

7. Apply power to the lamp.

NOTE: It may be necessary to lower the PAPI unit in elevation for the individual to see the light beam. See manual 96A0379 for any required alignment adjustment.

8. Position someone equipped with a walkie-talkie 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. Use a combination square to make sure the machined edge on the baffle is perpendicular to the top edge of the Baffle Mounting Plate. Tighten the two screws on the baffle. See Figure 8.

Figure 8: Squaring Baffle Plate with Top Edge of Baffle Mounting Plate



9. Energize the lamp in the PAPI unit, and verify that the light beam cannot be seen by the individual stationed at the obstacle. If the light beam is visible, repeat Step 8.
10. Disconnect power from the PAPI unit, remove the jumper from tilt switch (if installed), and reinstall the red filter. The red filter's **ground edge must be installed facing down**. If the filter is dirty, use a soft cotton cloth moistened with alcohol to clean the filter.

    After the filter has been reinstalled, recheck the cutoff to make sure it is correct for each PAPI Light Box. If the settings are correct, remove ONE SCREW AT A TIME AND PLACE A DROP OF LOCTITE 242, or equal, thread locking compound on the threads. Retighten the screws. Repeat this process for each screw used to secure the baffle.
11. Repeat Steps 1 through 13 for the remaining PAPI units in the system. The individual observing the horizontal cutoff for the PAPI units should remain at the same position for all observations.
12. If the PAPI units were lowered in elevation, the units will require realignment and the tilt switches will need to be leveled. Consult the subsection *Aligning Units* in the *Installation* sections of instruction manual 96A0379 for instructions to align the PAPI and level the tilt switches.

    Before putting the PAPI system into service, a flight check of the PAPI system is required to determine if all horizontal cutoffs of the PAPI beams are properly located relative to the obstacle(s).
13. **After the cut-off angle has been verified, remove jumpers** from the Tilt Switch by reversing the procedure as outlined in Step 8. In addition, see instruction manual 96A0379 to verify that the Tilt Switch is wired correctly **BEFORE PLACING PAPI IN SERVICE**.

NOTE: These adjustable baffles have been designed to be used in ADB Airfield Solutions' PAPI light boxes to alter the horizontal cut-off angle avoidance of obstacles. **The customer is responsible for the proper installation and verification that the horizontal cutoff produced by the baffles meets the requirements set by the FAA for obstacle avoidance.** Therefore ADB Airfield Solutions asserts that it be held harmless for the end use of the ADB Airfield Solutions PAPI in this special baffle application.

2.8 Troubleshooting and Repair

WARNING

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.

2.8.1 Troubleshooting Tips

Refer to Figure 9 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 Airfield Solutions representative.

Table 14: General PAPI System Troubleshooting Guide

Problem	Possible Cause	Solution
All lamps out	PAPI Light Unit tilts.	Realign PAPI Light Unit(s) that have tilted.
	Style A: No power input or Primary enclosure failed.	Style A: See troubleshooting procedure in “Troubleshooting and Repairing the Style A Primary Enclosure” on page 56. Style B: No input from series circuit. Repair CCR or series circuit wiring (if an open circuit is present on the series circuit).
	All lamps failed.	Replace lamps. Verify current level into Light Units is correct. Recalibrate CCT Control Board (Style A) or CCR (Style B) if necessary.
	Style A: CCT Control Board in Primary Enclosure failed.	Replace CCT Control Board. Calibrate board after replacement. See troubleshooting procedure in “Troubleshooting and Repairing the Style A Primary Enclosure” on page 56.
	Style A: SCRs failed.	Replace SCRs. See troubleshooting procedure in “Troubleshooting and Repairing the Style A Primary Enclosure” on page 56.
	Style A: CCT Control Board has detected an open circuit or overcurrent in the output series circuit.	See troubleshooting procedure in “Troubleshooting and Repairing the Style A Primary Enclosure” on page 56.
Lamp(s) dim	Dirty lens shield.	Clean with a soft cotton cloth moistened with alcohol.
	Lamp not properly seated in reflector.	Re-seat lamp in the lampholder.
	Current level too low.	Style A: Recalibrate CCT Control Board, if necessary. See calibration procedure in “Initial Startup Using Local Control—Style A” on page 38 Style B: Low input current from series circuit. Repair CCR or series circuit wiring (if an open circuit is present on the series circuit).
	Red filter broken.	Replace if necessary. See “Red Filter Replacement” on page 60.
	Lens improperly aligned.	Replace lens if loose in ring. **NOTE:** To replace lens, Light Unit must be returned to factory.
	Light Unit improperly aligned.	Realign and recalibrate Light Unit.
Signal Interruption when PAPI unit is not operated continuously	Frost or dew on outer lens.	Change airport circuitry to ensure PAPIs are preset to operate continuously on a low power setting of either 5% or 20%. See “FAA CertAlert on PAPI Operation” on page iv.
Short lamp life	Current level too high.	Check true RMS current into lamps. Re-calibrate the CCT Control Board (Style A) or CCR (Style B) if necessary. See calibration procedure in “Initial Startup Using Local Control—Style A” on page 38.

Problem	Possible Cause	Solution
Style A: Current sensing not operating	CCR is OFF.	Turn CCR ON.
	Current sensing jumper not set properly.	Set current sensing jumper on CS1 in Primary Enclosure. CS1 has the following activation ranges: • No jumper: 1 to 6A; Mid jumper: 6-40A; High: 40-200A Ensure that no jumper is used on CS1.

2.8.2 Detailed Troubleshooting and Repair Procedures

This section describes procedures for troubleshooting or repairing parts in either the Style A Primary enclosure or the Light Unit.

2.8.2.1 Troubleshooting and Repairing the Style A Primary Enclosure

To troubleshoot and repair the Style A Primary enclosure, follow these steps:

14. Visually examine all areas of the Primary enclosure. Check for burnt or loose connections and parts.
15. Check all fuses and the circuit breaker. See Table 15.
16. If the PAPI does not energize at all, check for undervoltage. If an undervoltage exists, correct the undervoltage problem. The input voltage must be within +10% to -5% of nominal.
17. Verify that all LED indications on the CCT-Control PCB1 are correct. See Figure 9 and Table 15.
18. Measure for the presence of correct voltages as detailed in the theory of operation information in “Primary Enclosure Components” on page 13. Correct/repair as needed.
19. Check whether a tilt situation has shut down all PAPI Light Units. You can verify this in the Primary by measuring the voltage at TB1-10 (TILT SWITCH +) to TB1-9 (TILT SWITCH COM). The voltage should be +8 to +12VDC if no Light Units are tilted and less than +2VDC if any Light Unit has tilted. The red **TILT** LED will be lit on the Light Unit that is the source of the trouble.
20. If the PAPI works in LOCAL but not in REMOTE, check the remote control command LED indications on CCT-Control PCB1 and, if suspected as a problem, the actual voltage on the remote control lines. Check fuse F3. If voltage on remote control lines is correct and fuse F3 is normal, replace the CCT-Control PCB1.
21. If the PAPI turns on for a few seconds and then shuts off, then either an open circuit or overcurrent may be present. Manually set circuit breaker CB1 to OFF momentarily and then to ON. If the system momentarily re-energizes and then shuts off again, and either the Red LED D23 “OPEN CKT” or the Red LED D22 “OVER CRNT” illuminates, this verifies the cause of the problem is likely an open circuit or overcurrent. Turn the PAPI OFF and short the PAPI Primary output with an AWG 10/600V (minimum) wire across TB1-13 and TB1-14. Turn ON the PAPI. If the PAPI operates normally, the problem is likely load-related. Using an ohmmeter, check the output wiring for continuity. Repair the PAPI output wire from the Primary enclosure output to the individual Light Unit, if needed. If the output wire is continuous with no opens, recalibrate the overcurrent setting on CCT-control PCB1. See “Initial Startup Using Local Control—Style A” on page 38. Reconnect the Light Units and re-energize the Primary. If this does not solve the problem, replace the CCT-Control PCB1. If this does not solve the problem, replace the dual SCR block. If this does not solve the problem, check all wiring connected to current transformer T2. If OK, replace T2.

Table 15: Style A Primary Panel Protection Devices

Device	Designation	Value	Function
Circuit Breaker	CB1	15A	Incoming power protection
Fuse	F1	2A, Slow Blow	Transformer T3 and Auxiliary Power output protection
Fuse	F2	2A, Slow Blow	Transformer T3 and Auxiliary Power output protection
Fuse	F3	0.25A, Slow Blow	Remote and Local signal protection
Fuse	F4	1A, Slow Blow	Contactor K1 protection

2.8.2.2 CCT-Control PCB1 Replacement in Primary Enclosure

If a problem is suspected with the CCT-Control PCB1, check the following LED indications:

Table 16: CCT-Control PCB1 LED Indications

Description	Reference	Indication	Notes
CC	D1	Green	If ON, either a remote or local command has been input into the board to turn the PAPI ON. If OFF, neither a remote nor local command has been input into the board to turn the PAPI ON.
B2	D2	Green	For PAPI applications, this LED is always OFF.
B3	D3	Green	If ON, either a remote or local command has been input into the board to turn the PAPI ON to the 5% setting. If OFF, neither a remote nor local command has been input into the board to turn the PAPI ON to the 5% setting.
B4	D4	Green	If ON, either a remote or local command has been input into the board to turn the PAPI ON to the 20% setting. If OFF, neither a remote nor local command has been input into the board to turn the PAPI ON to the 20% setting.
B5	D5	Green	If ON, either a remote or local command has been input into the board to turn the PAPI ON to the 100% setting. If OFF, neither a remote nor local command has been input into the board to turn the PAPI ON to the 100% setting.
PWR OK	D21	Green	If ON, input voltage is present and the internal unregulated DC power supply voltage is OK. If OFF, no input voltage is present on the board or the internal unregulated DC power supply voltage is not OK.
OVER CRNT	D22	Red	If ON, an over current has been detected on the Primary output series circuit wiring. If OFF, an over current has on the Primary output series circuit wiring has not been detected.
OPEN CKT	D23	Red	If ON, an open circuit has been detected on the Primary output series circuit wiring. If OFF, an open circuit has on the Primary output series circuit wiring has not been detected.
OVERLOAD	D24	Red	If ON, an overload on the Primary output may be present. This can also be caused by shorts or other faults in the Primary output series circuit wiring. If OFF, an overload on the Primary output series circuit wiring has not been detected.
SCR FAIL	D25	Red	If ON, the microprocessor on the board has determined that either of the two SCRs (in the SCR block) is not operating correctly. If OFF, the microprocessor on the board has determined that either of the two SCRs (in the SCR block) is operating correctly.

HEALTH	D26	Green	If ON, the microprocessor on the board is operating correctly. If OFF, the microprocessor on the board is not operating correctly.
REMOTE	D32	Green	For PAPI applications, this LED is always OFF.
CCR ON	D34	Green	If ON, no fault has been detected and the command to turn on contactor K2 (via J4-4 and 6) is activated. If OFF, a fault (open circuit or overcurrent) has been detected or the Primary has been switched OFF and contactor K2 is deactivated.
SAVE	D35	Green	This LED is normally OFF. It turns ON during various output current and over current setting procedures.

- To replace the CCT-Control PCB1, turn power OFF and remove all connectors and mounting screws.
- Replace with a new CCT-Control PCB1. Verify S4 and J9 are set to the correct positions. Calibrate the board according to the directions in “Initial Startup Using Local Control—Style A” on page 38.

2.8.3 Troubleshooting and Repairing the Light Unit

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

1. With the Light Unit powered, look in the front glass of the Light Unit.
2. Check the LED indications on the Control Board. See Table 17.
3. Check the information on the display.
4. Depending on the information read on the Control Board, take corrective actions to repair the Light Unit. Details on further troubleshooting/repair are detailed in the paragraphs below.

Table 17: Light Unit Control Board LED Troubleshooting Guide

LED	Name	Description
D36	LAMP A OUT	Lighted (red) if Lamp A is burned out*
D37	LAMP B OUT	Lighted (red) if Lamp B is burned out*
D38	LAMP C OUT	Lighted (red) if Lamp C is burned out*
D39	TILT LED	Lighted (red) if a tilt condition is detected
D40	Power ON	Lighted (green) if +5 VDC power is on

*If looking at the Light Unit from the front:

- Lamp A is on the right
- Lamp B is on the middle
- Lamp C is on the left

2.8.3.1 Light Unit Control Board Replacement

CAUTION

ELECTROSTATIC SENSITIVE DEVICES

This equipment may contain electrostatic sensitive 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 should 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.

If a problem is suspected with the Light Unit Control board, refer to drawings in “Schematics” on page 61 and check the following indicators and test points.

Figure 9: Light Unit Control Board Indicators and Test Points

1. Power Supply LED

- Verify **D40**, the Power ON LED is lit (Green). If lit, this verifies that the on-board +5 VDC power is ON and operational.

2. DC Power Supply Measurements

- **TP1:** +5VDC power supply ±0.25V. Reference: **TP3**, Ground.
- **TP2:** This is the unregulated input DC voltage. It should be +12VDC ±2V. Reference: **TP3**, Ground.

NOTE: Test points TP4, TP5 and TP6 are not used.

3. Tilt Signal Voltage Measurements

- **JP4, Pin 1:** Red wire, tilt signal
- **OK:** +8 to +12VDC. Reference: **JP4, Pin 3:** Green wire, tilt signal return.
- **Light Unit Tilted:** < +2VDC. Reference: **JP4, Pin 3:** Green wire, tilt signal return.
  - — To replace the Light Unit Control Board, turn power OFF and remove all connectors and mounting screws.
  - — Replace with a new Light Unit Control Board.
  - — Calibrate the Light Unit Control Board according to the procedure in “Initial Startup Using Local Control—Style A” on page 38.

2.8.3.2 Light Unit Inclinometer Board Replacement

If a problem is suspected with the inclinometer board, first verify the following voltage is present on the board (refer to the figure at right):

- **TP1:** +5VDC ±5%. Reference: **TP2**, Ground (GND)

NOTE: Test points TP3 and TP4 are not used.

The inclinometer board is precision-mounted on the Light Unit. If this board needs to be replaced, contact the ADB sales department for details.

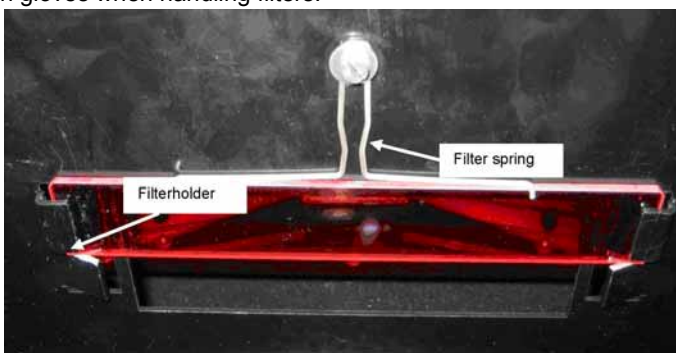
2.8.3.3 Red Filter Replacement

Before replacing the red filter, review the following precautions.

CAUTION

The red filter must be perfectly clean.

- Use a soft cotton cloth moistened with alcohol to clean the red filter.
- Wear cotton gloves when handling filters.



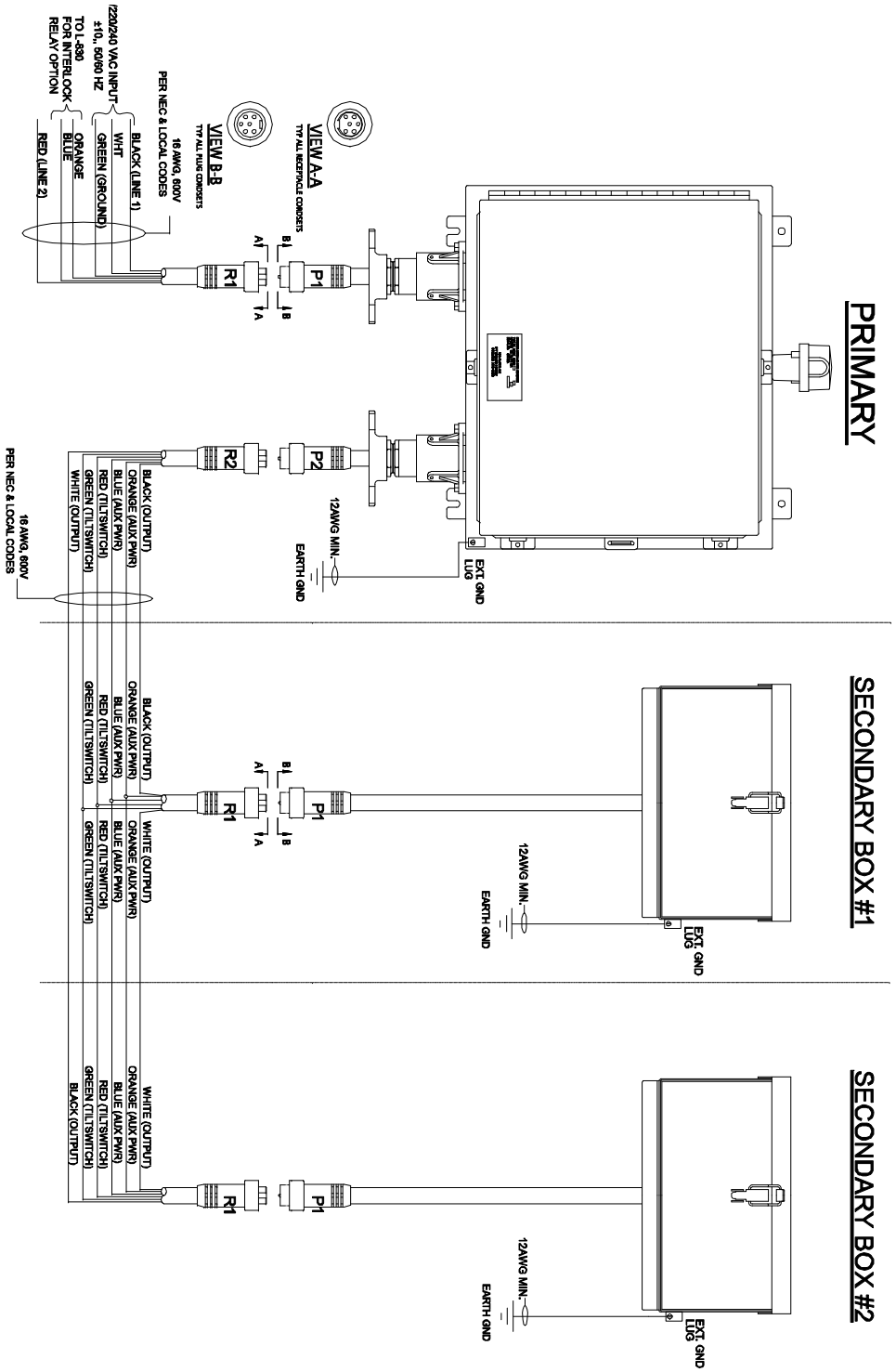
To replace a filter (see figure at right):

1. De-energize the circuit.
2. Open the Light Unit.
3. Unscrew the screw retaining the filter spring.
4. Lift the filter out of its holders.
5. Remove the broken filter.
6. Place a new filter in its holder with the side without the chamfer in the corners of the filter up.
7. Reverse this procedure.

2.9 Schematics

2.9.1 Drawings

Figure 10: External Wiring, SCP Style A, L-881 - Two-Box System



2-BOX (L-881) WIRING 43A3377 E

Figure 11: External Wiring, SCP Style A, L-880 - Four-Box System

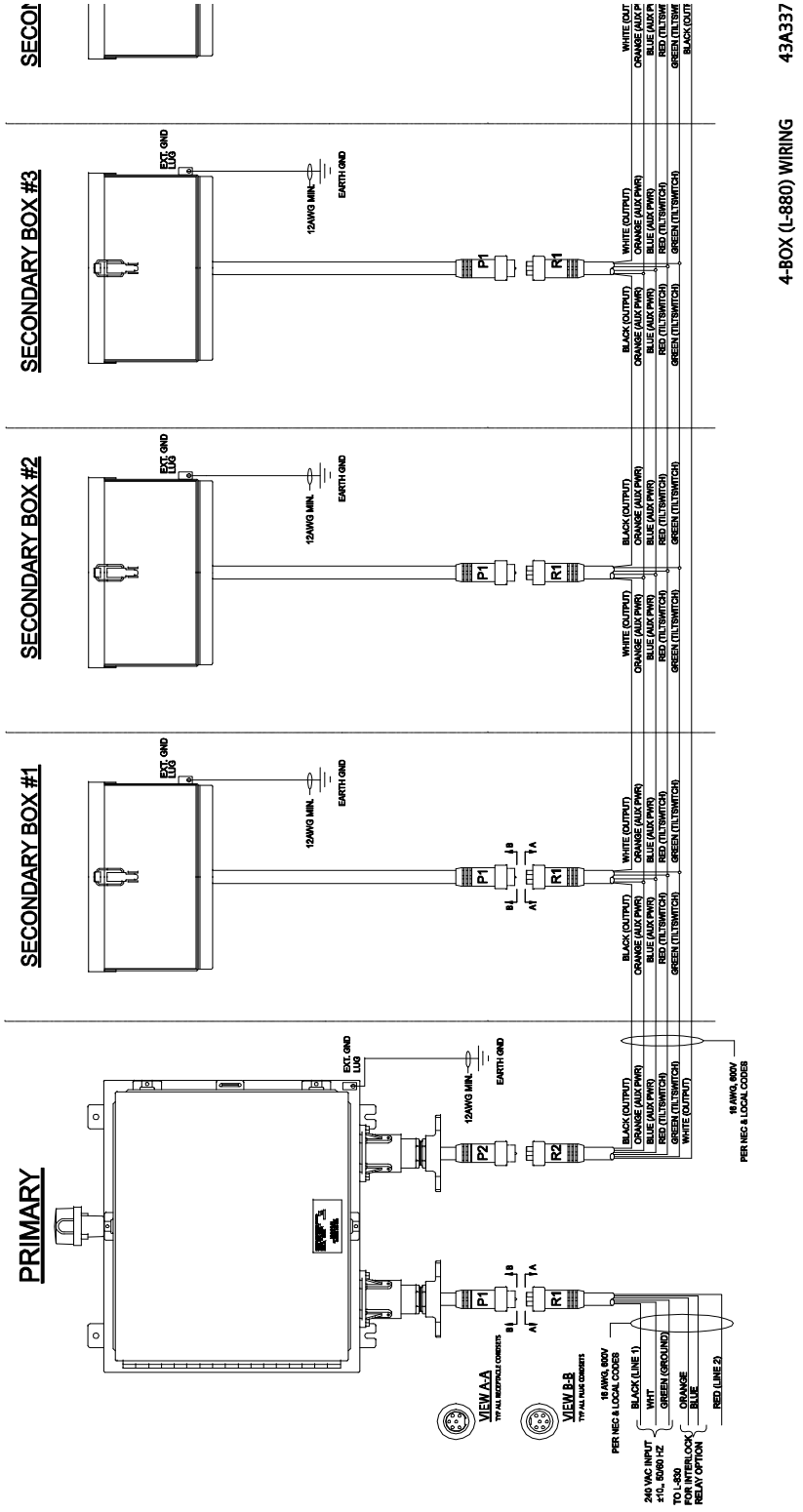


Figure 12: External Wiring, SCP Style B, L-881 - Two-Box System

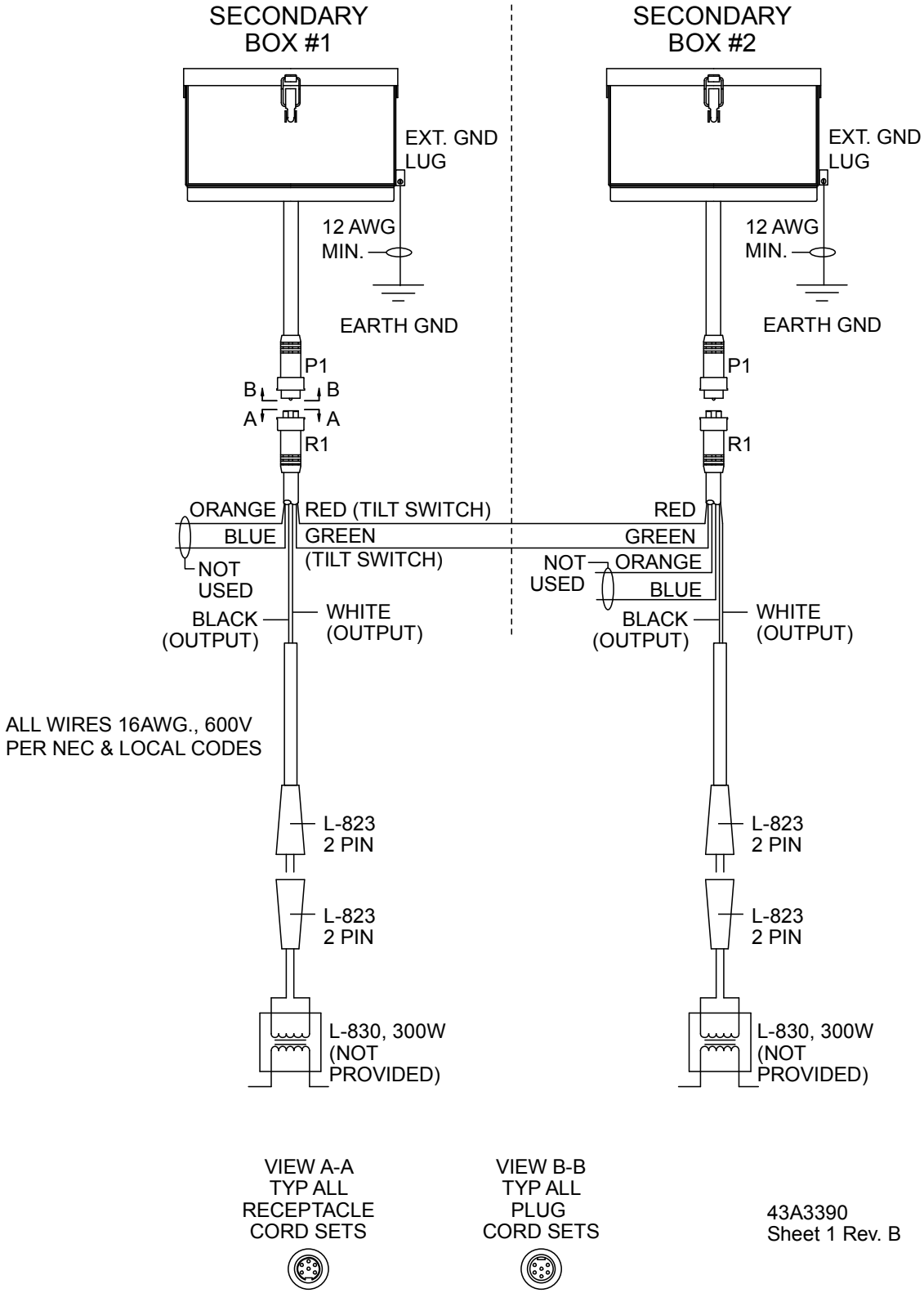


Figure 13: External Wiring, SCP Style B, L-880 - Four-Box System

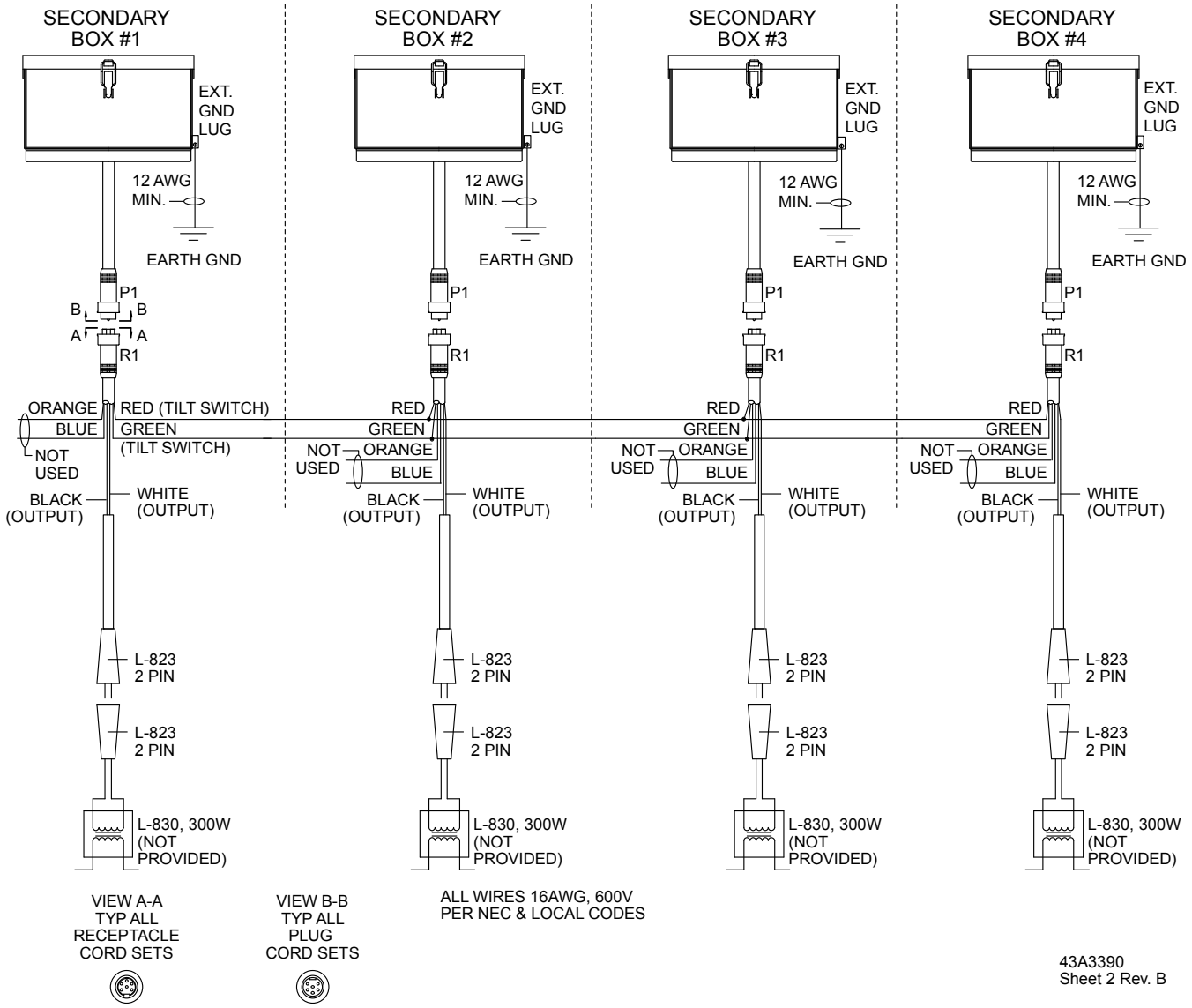


Figure 14: Primary Enclosure Schematic, Style A, 43A3292

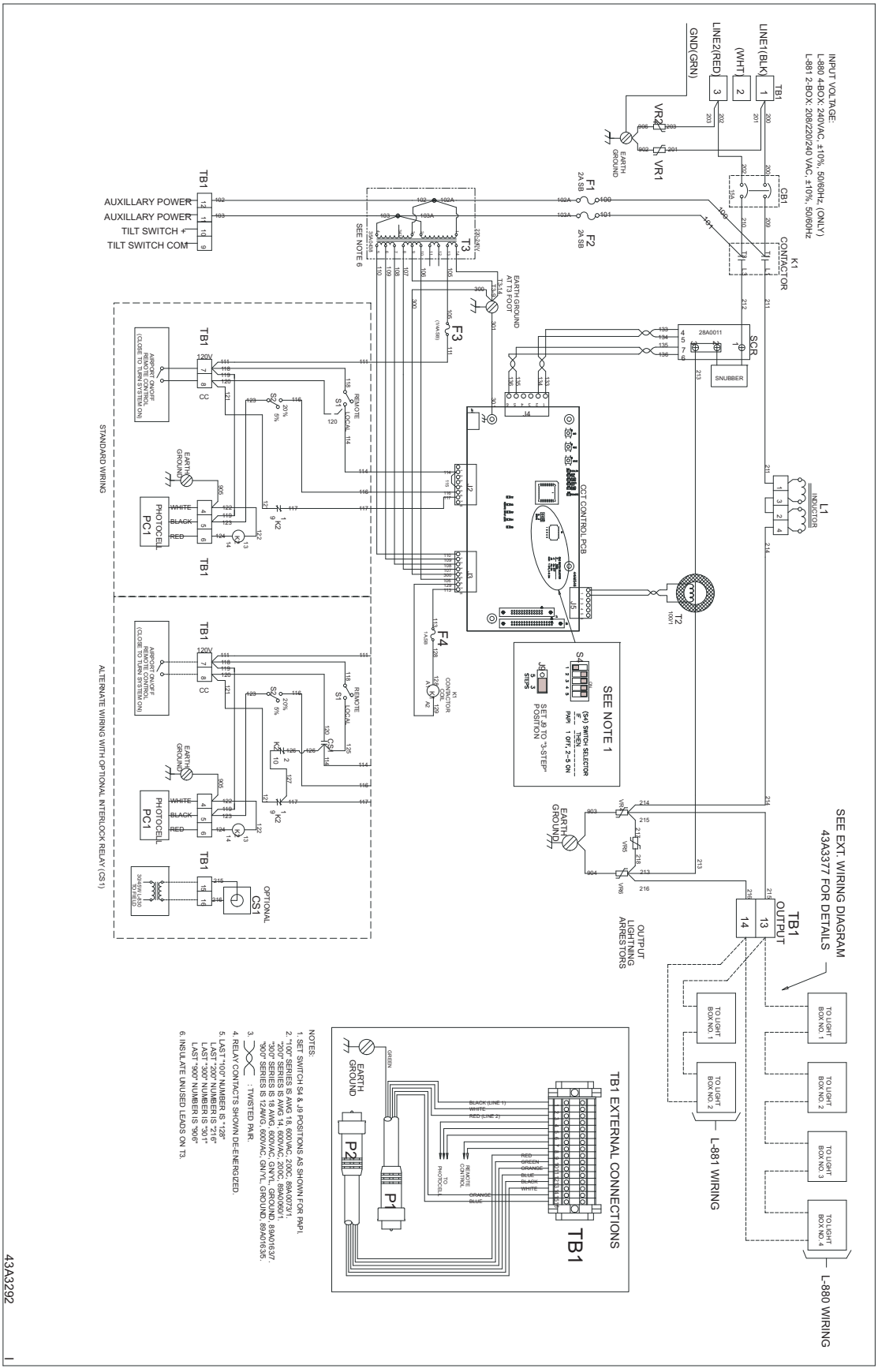


Figure 15: 43A3282 - Connection Diagram

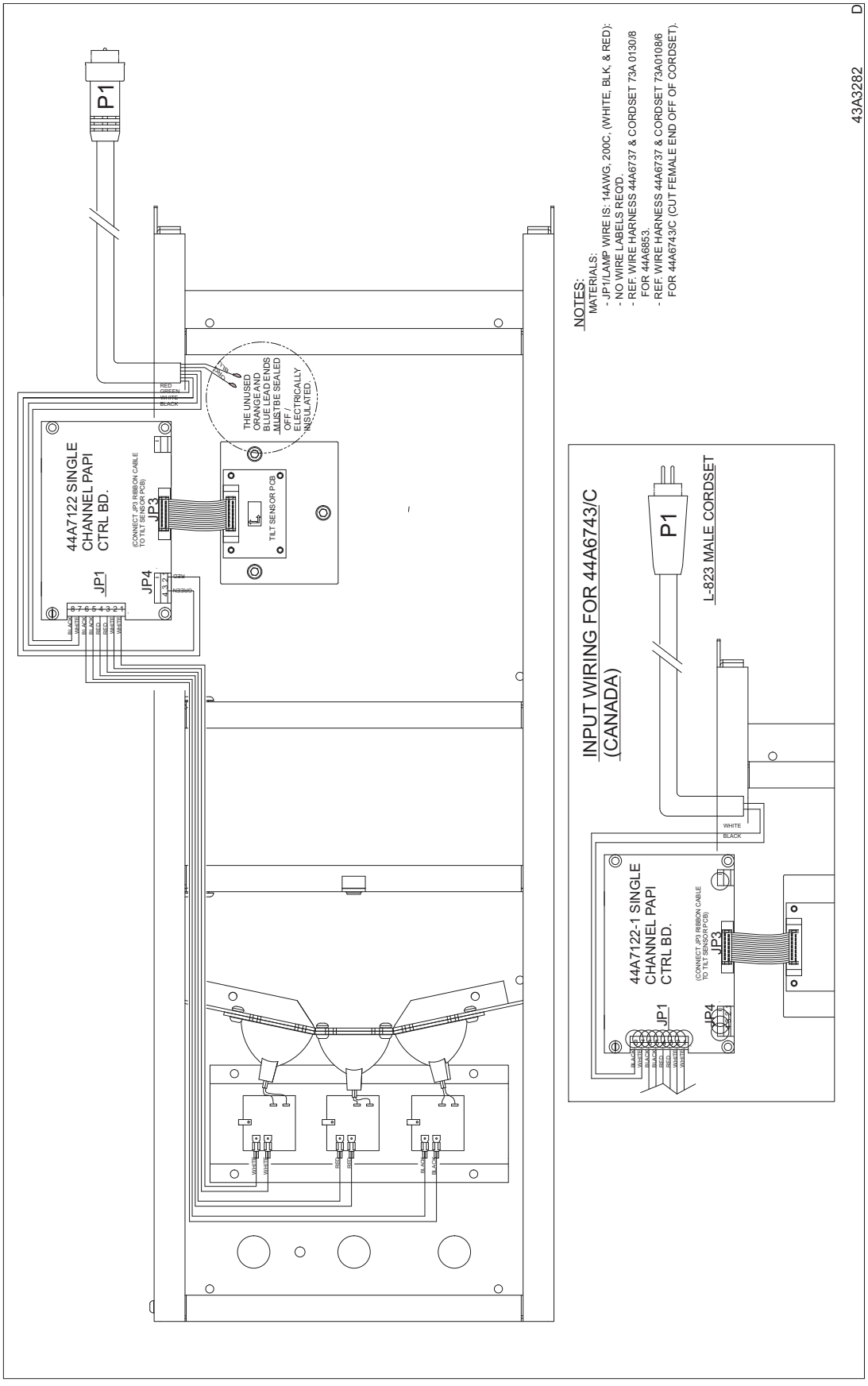
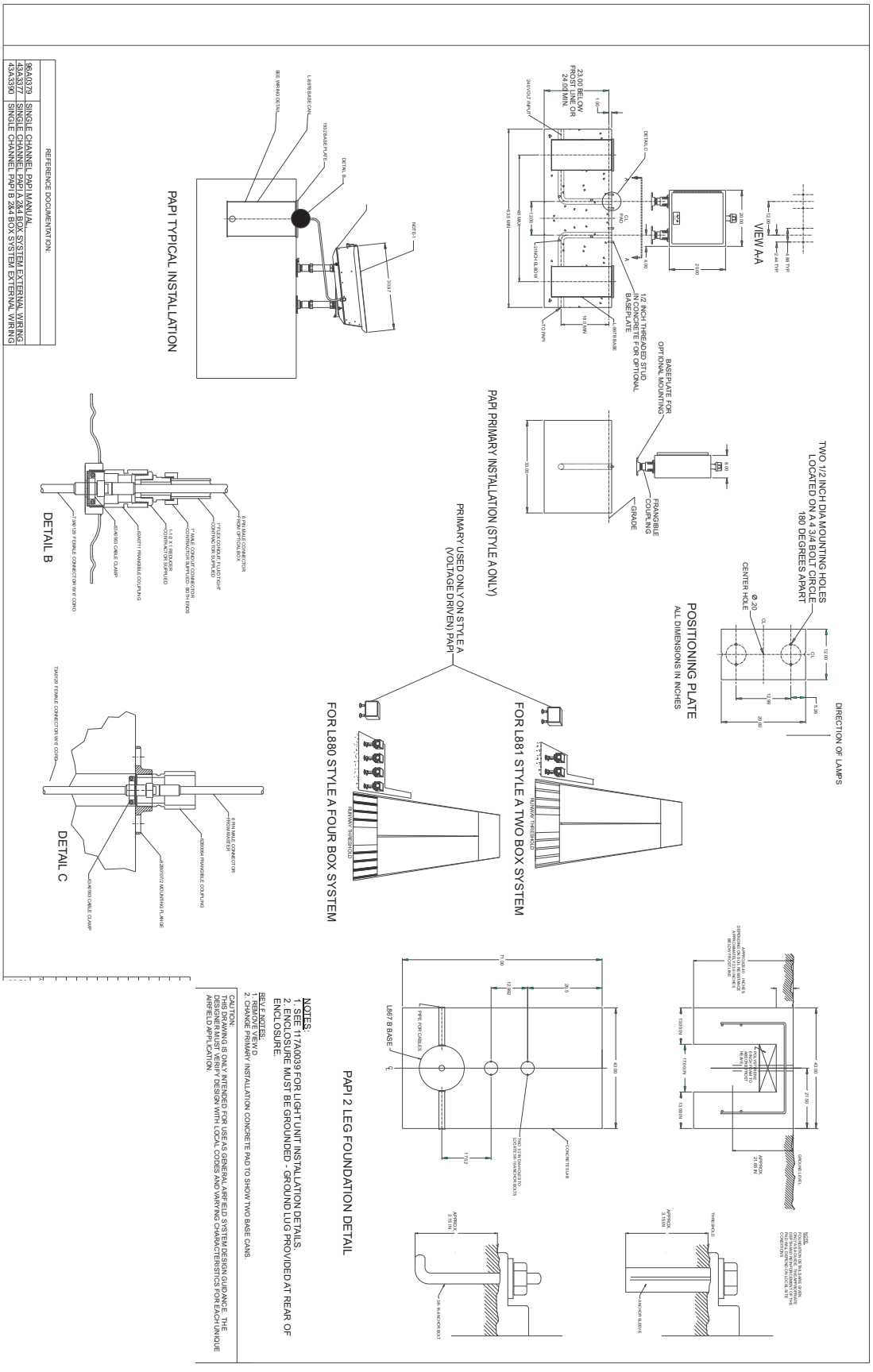


Figure 16: 117A0047 - Typical Installation



3.0 Parts

To order parts, call ADB Airfield Solutions Customer Service or your local representative.

This section provides parts drawings, along with part numbers. Refer to the “Schematics” on page 61 for connections and wiring information.

3.1 Ordering Code

Figure 17: Ordering Code

Single Channel PAPI Baffle — 94A0570-

Light Box
2 = Two box Single Channel PAPI
4 = Four box Single Channel PAPI

Cut-off Angle (Primary)
1 = 0 to 3.3 degrees
2 = 3.1 to 6.4 degrees
3 = 6.3 to 10 degrees

Cut-off Angle (Secondary)
1 = 0 to 3.3 degrees
2 = 3.1 to 6.4 degrees
3 = 6.3 to 10 degrees

Note
The SC PAPI Baffle allows airports to modify the horizontal light beam coverage of the PAPI unit for obstacle avoidance in the approach area. See Service Bulletin ALN152 for field installation details.

Ordering Code — PAP[ ]-[ ][ ][ ]0

Power
A = PAPI A (voltage)[1]
B = PAPI B (current)

Style
2 = L-881 (2 Box)
4 = L-880 (4 Box)

Housing
0 = Aluminum Light Units (Standard)
1 = 316 Stainless Steel[3]

Interlock (PAPI A Only)[2]
0 = Without
1 = With

Notes

[1] L-881 input voltage is 208/220/240 VAC. L-880 input voltage is 240 VAC only.

[2] Interlock Relay Option provides ON/OFF control through current sensing of the runway series circuit during nighttime operations. During daytime, the PAPI is activated at the 100% step.

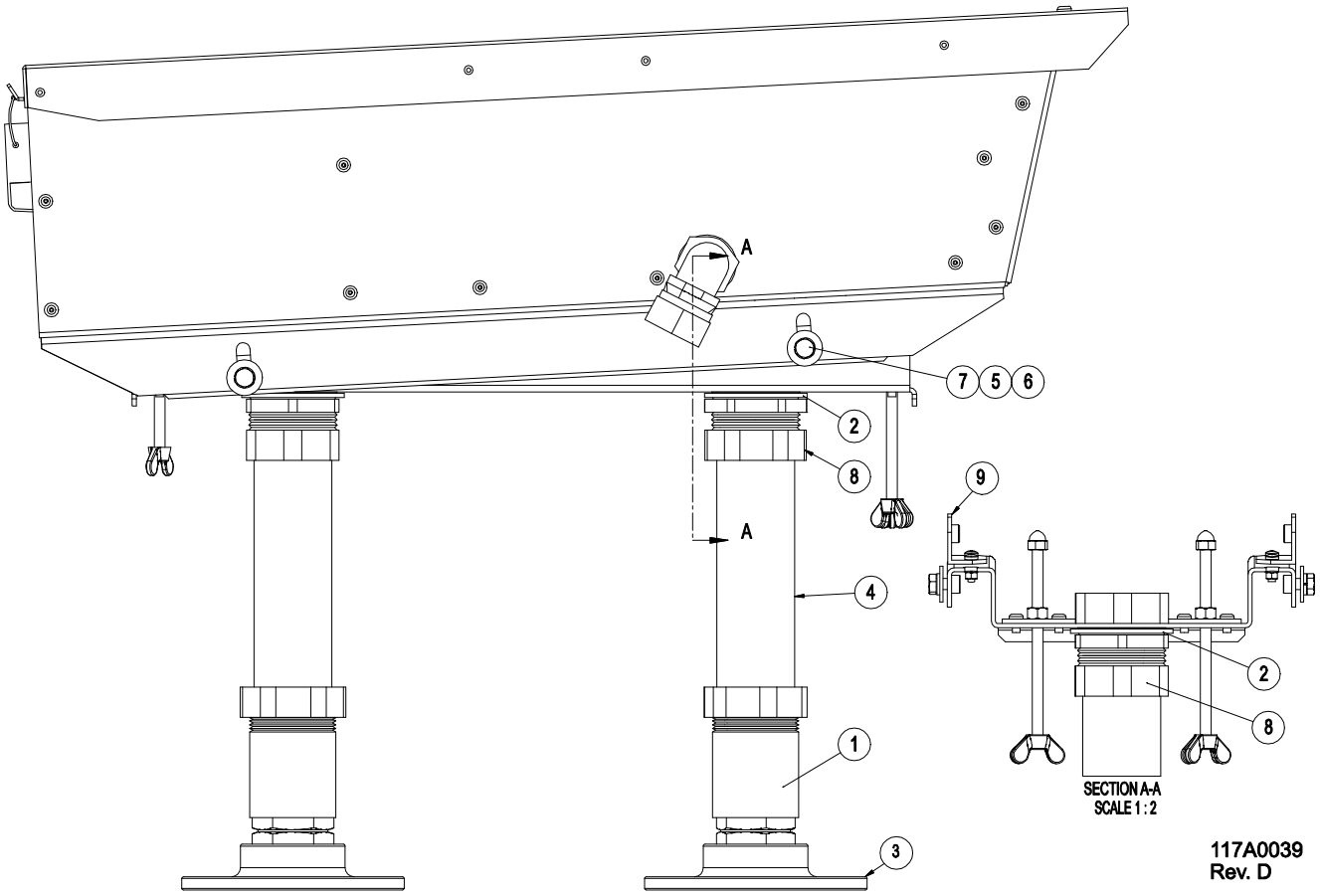
[3] For both the Style A and Style B PAPI, the light unit housing is stainless steel. For the Style A PAPI, the master control box housing is also stainless steel.

- Reference FAA Cert Alert No. 02-08 dated Dec. 12, 2002 regarding prevention of the possibility of dew or frost forming on the light unit optics: At airports where PAPI units are activated when needed and thus are not operated continuously, change airport lighting circuitry to ensure PAPIs are preset to operate continuously on a low power setting, either 5 percent or 20 percent of full intensity as necessary for local site conditions.
- If aiming angle is greater than 5.1°, order an Elevation Extension Kit (Part No. 94A0496) for each light unit.
- For non-FAA applications that do not require a tilt switch, use Part No. 44A6853-C.

2-inch EMT Kit — 94A0616-

Type
2 = 2 Light Units (FAA L-881)
4 = 4 Light Units (FAA L-880)

Figure 18: Installation Parts - 117A0039



See Figure 18

Item No.	Part Number	Description	Qty.	Notes
1	44B0180	Coupling, Frangible 2” EMT MS-17814-1 [2]	2	1
2	60A3346	Single-Channel PAPI Mounting Spacer [1]	2	1
3	62B0107-2	Mounting Flange Plain Finish [1]	2	1
4	2-inch EMT	2-inch EMT 2 3/16 OD [2]	2	2
5	Flat Washer	M8 Flat Washer [1]	4	1
6	Lockwasher	M8 Split Lockwasher [1]	4	1
7	Hex Bolt	M8 X 16 Hex Bolt [1]	4	1
8	77A0009	Compression Coupling 2” EMT [2]	2	1
9	94A0496	Optional Single-Channel PAPI Extended Elevation Kit [3]	1	3

NOTES:

1. Items provided with optical enclosure.
2. 2-inch diameter EMT tubing (2-3/16 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. 2-inch EMT tube to extend 3-1/4” into frangible coupling and full insertion into compression coupling to ensure stable installation. Tube must be painted international orange per FED-STD-595, Color 12197 to provide corrosion protection.
3. 94A0496 extended elevation kit is optional for elevations in excess of 5 degrees.

Figure 19: Optical Enclosure

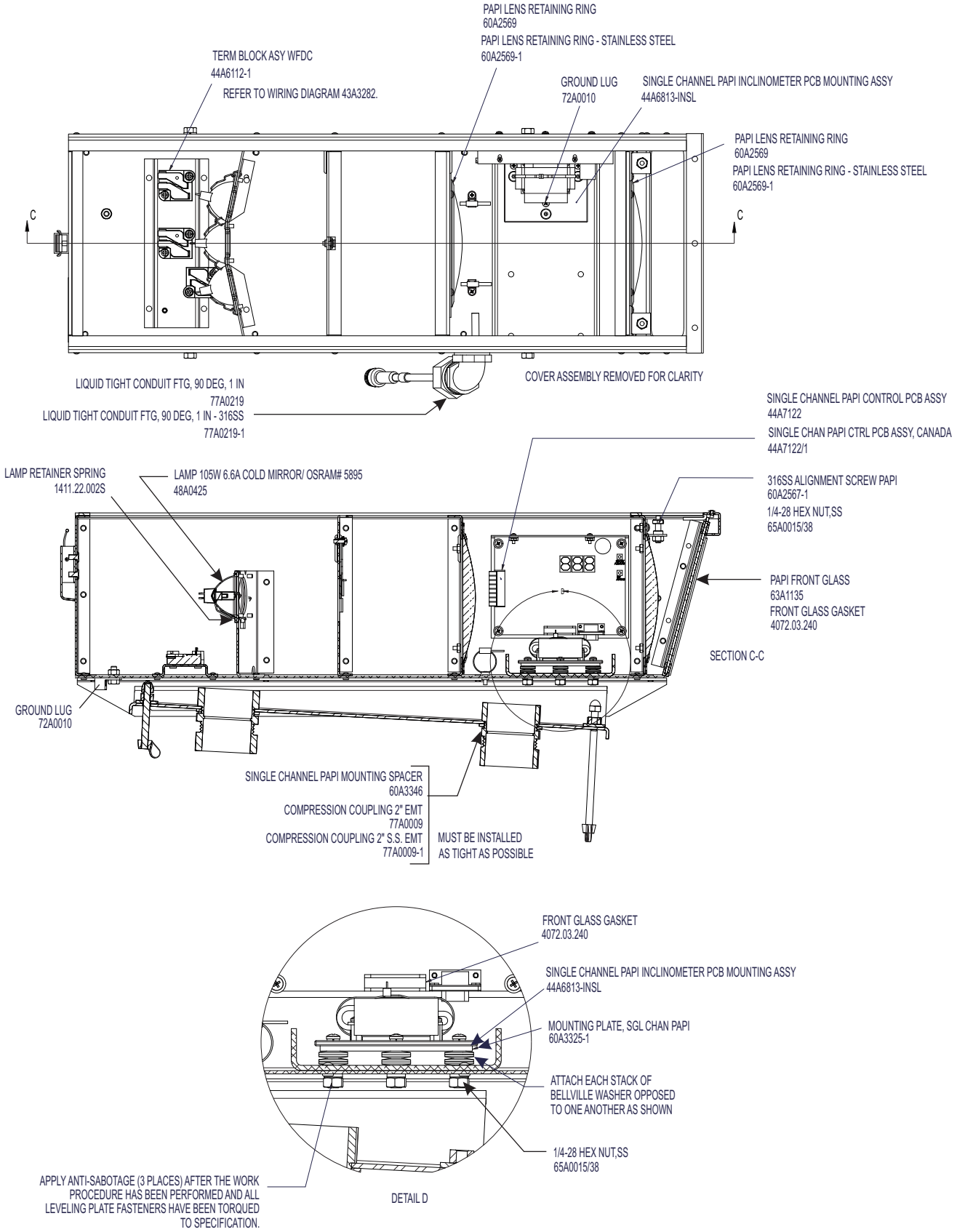


Table 18: PAPI Enclosure Parts - See Figure 19 and Figure 20

Part Number	Description	44A6743	44A6743-C	Note
42A0307	Label PAPI	1	1	Not Shown
44A7122	Single-Channel PAPI Control PCB Assembly (Standard Version) [1]	1	-	See Figure 21 note 4
44A7122-1	Single-Channel PAPI Control PCB Assembly, Canada [1]	-	1	See Figure 21 note 4
44A6737	Single-Channel PAPI Wire Harness Assembly	1	1	
44A6813-INSL [2]	Single-Channel PAPI Inclinometer PCB Mounting Assembly	1	1	
60A3318	Nut Plate, Single-Channel PAPI, Inclinometer Mounting	1	1	
60A3325-1 [2]	Mounting Plate, Single-Channel PAPI	1	1	
63A0255	Cable Tie Mount Metal	2	2	
63A1102	Sil. Rub Grommet, ¾ Thru, 3/32 Pnl	2	2	
64A0173-10	¼-20 X 5/8 Hex Head	1	1	
64A0191-6	#8-32 X 3/8 Pan Head Phillips	5	5	
64A1098-6	6-32 X 3/8 Pan Head Phillips	3	3	
64A0978/16	¼-28 X 1 Socket Head Cap Screw	3	3	
65A0015-15	8-32 Hex Nut	2	2	
65A0015/24	¼-20 Hex Nut, SS	1	1	
66A0026/15	#8 Split Lockwasher	6	6	
66A0026/24	¼ Split Lockwasher	1	1	
66A0039-4	#6 Ext Lockwasher	3	3	
66A0249-4	¼ Belleville Washer	12	12	
72A0010	Ground Lug	1	1	
77A0219	Liquid Tight Conduit Fitting, 90 Degrees, 1 Inch	1	1	
89A0267-02	14-Pin Ribbon Cable, 2” Long	1	1	

NOTES:

1. Refer to wiring diagram Figure 21.
2. Attach 44A6813-INSL assembly to 60A3325 plate 3 places.
3. PAPI enclosure assembly. Ref 117A0039 (Figure 18) for installation details.
4. Upon initial replacement of either of the older PAPI Control Boards (44A6674 or 44A6674-1) or the inclinometer mount assembly (44A6813), you must replace both items with (44A7122 or 44A7122-1, and 44A6813-INSL).

Figure 20: PAPI Enclosure

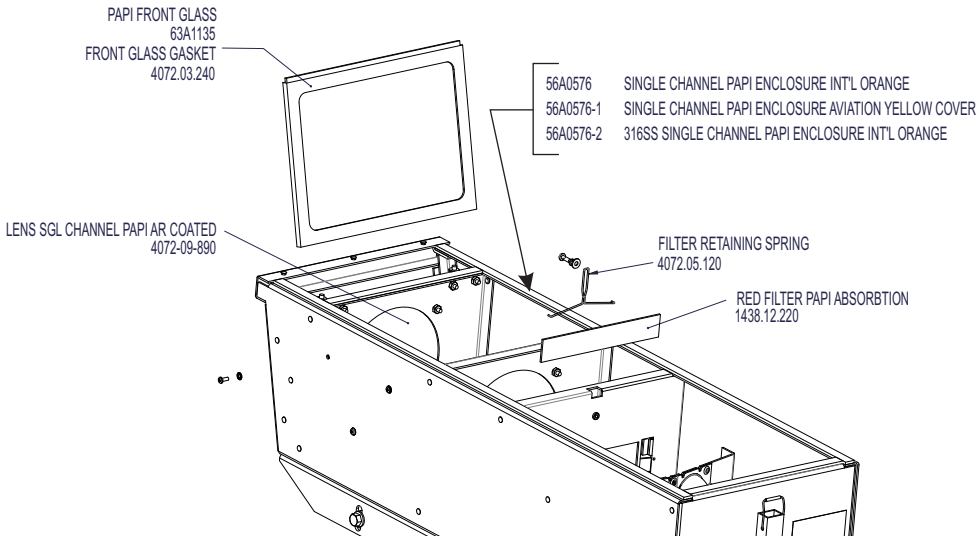
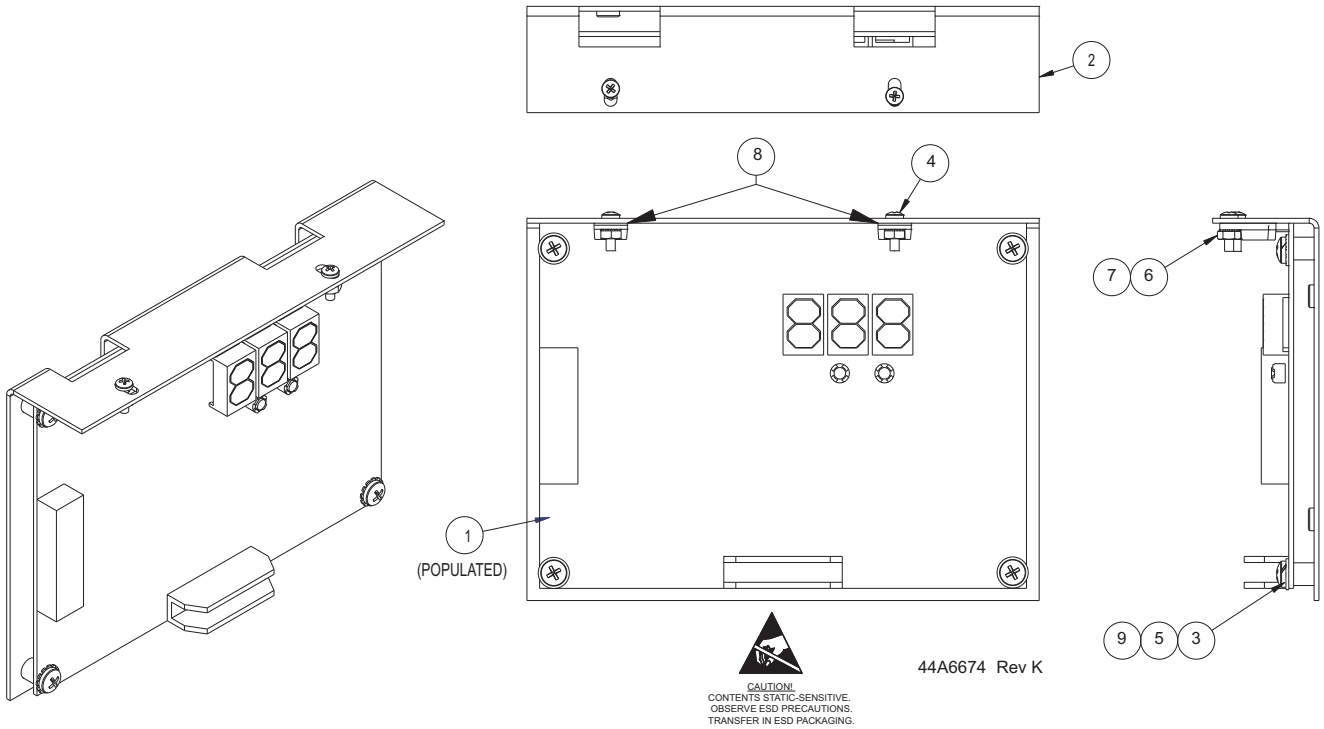


Figure 21: Control Board Assembly 44A7122 (Canada use: 44A7122-1)



no.	Part Number	Description	Units	Qty.
1	44A7122	Control Board Assembly[1]	Ea.	1
2	60A3270	Single-Channel PAPI Control PCB Bracket	Ea.	1
3	64A0191/4	Screw, 8-32 X ¼, Pan Hd, Phil, SS	Ea.	4
4	64A0169/6	Screw, 4-40 X 3/8, Pan Hd, Phil, SS	Ea.	2
5	66A0039/5	#8 Ext. Lockwasher, SS	Ea.	4
6	65A0015/7	Hex Nut, 4-40, SS	Ea.	2
7	66A0039/2	#4 Ext. Lockwasher, SS	Ea.	2
8	63A0857	TO-220 Sil Pad	Ea.	2
9	66A0015/15	#8 FLAT WASHER	Ea.	4

[1] For Canada: order 44A7122-1

Figure 22: Primary Enclosure Assembly, Style A, 44A6752 XXX

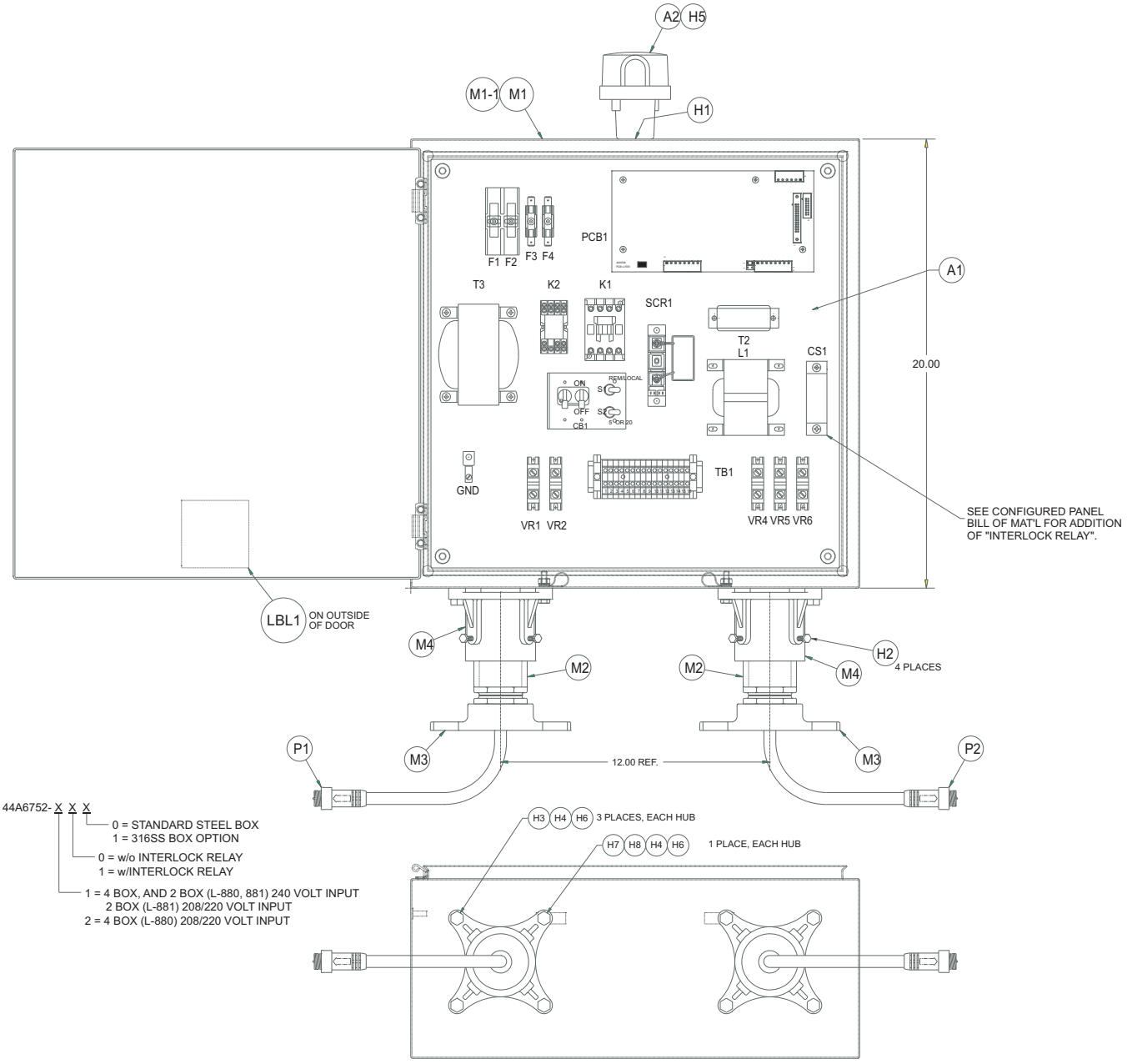
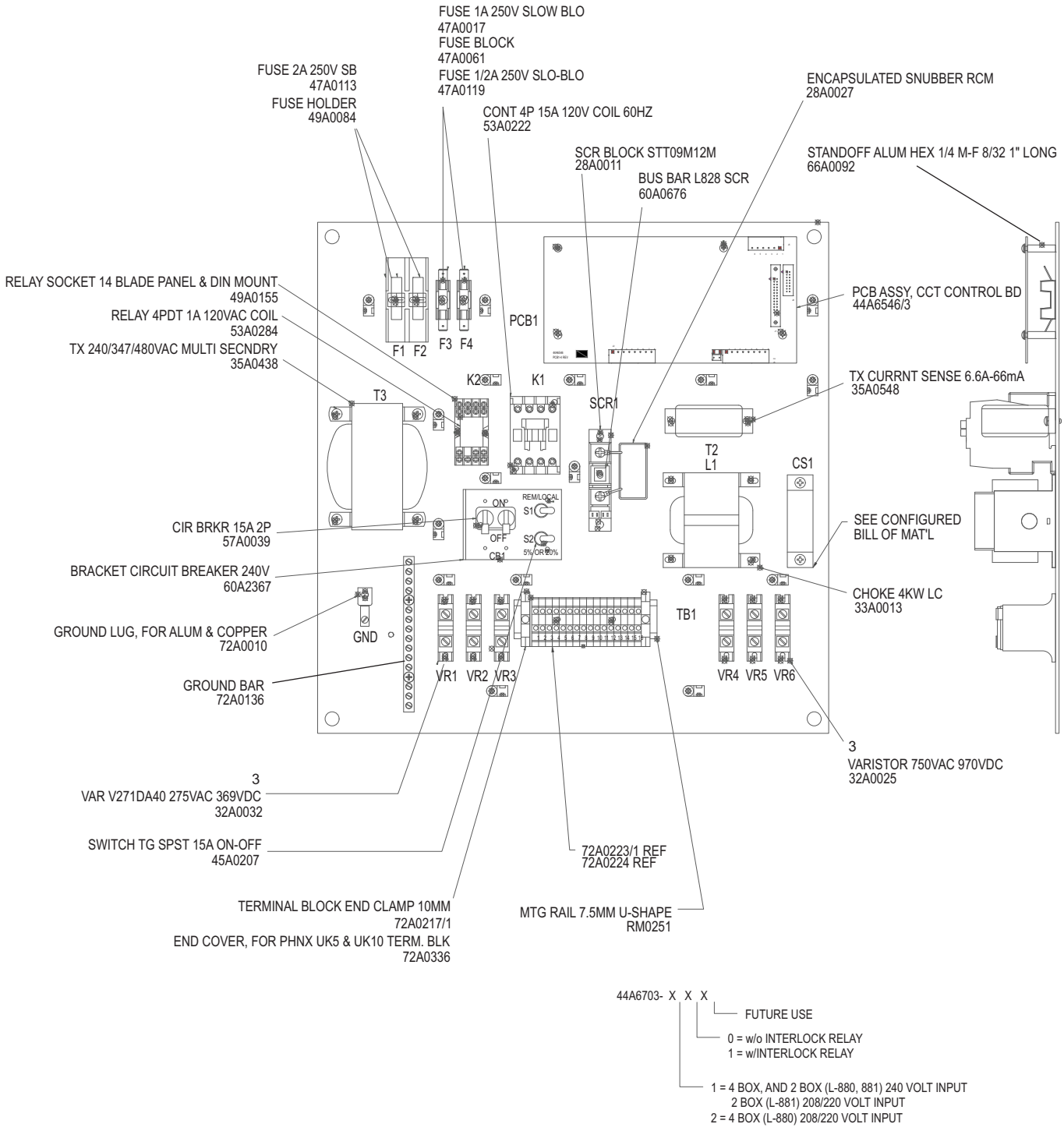


Table 19: Primary Enclosure Assembly - See Figure 22

Item No.	Part Number	Qty.	Part Name/Description	Notes
LBL1	42A0307	1	Label PAPI	
A1	44A6703/XXXX	1	PAPI A Panel Assembly	See Figure 22
A2	48A0089	1	Photocell 120VAC	
H1	49A0095	1	Photocell Socket	
M1	60A3324	1	PAPI Master Enclosure, SGL CHAN	
M1-1	60A3324/1	1	PAPI Master Enclosure, SCP 316SS	
M2	62B0064	2	Coupling 2” Frangible, Black, Threaded 1 End	
M3	62B0107/2	2	Mounting Flange	
M4	62C0068	2	Hub Mounting	
H2	64A0173/12	4	Bolt, ¼-20 X ¾ Hex Head	
H3	64A0173/16	6	Bolt, ¼-20 X 1 Hex Head	
H4	64A0015/24	8	¼-20 Hex Nut	
H5	65A0117	1	½-14 Sealing Nut	
H6	66A0026/24	8	¼ Split Lockwasher	
P1, P2	73A0130/8	2	Male Plug w/8’ Cord, 6 Conductor/16AWG	
H7	62A0138/1	2	Cable Clamp	
H8	64A0173/20	2	Bolt, ¼-20 X 1-1/4”Hex Head	

Figure 23: Primary Panel, Style A, 44A6703



3.2 Spare Parts

It is recommended to create a sufficiently large stock of spare parts to maintain the Single Channel PAPI in the field. Consider acquiring approximately 10% spare final assemblies (with a minimum quantity of 1) for the total amount of equipment in the field. This allows for repairs to be made in the shop. Components that are less likely to need replacement, such as lenses, filters, gaskets and PCB subassemblies should be stocked in smaller quantities. For the Single Channel PAPI unit, it is highly recommended to have a least one entire Single Channel PAPI unit as a spare for larger installations.

For the Single Channel PAPI see the table below for spares.

- Consider acquiring 10% spares for critical components noted as (A) in the table below. If only a small number of PAPI units are installed, consider acquiring at least 1 of each of the components noted as (A) below.
- Also consider acquiring 1% spares for parts noted as (B) in the table below. If it is important to have a robust level of spare parts on hand, and only a small number of PAPI units are installed, consider acquiring 1 of each of the components noted as (B) below.

Table 20: Light Unit Spare Components

Part No.	Description	Location	Notes	Spares
44B0180	Frangible Coupling, 2-inch EMT	Figure 18		A
44A6813-INSL	Inclinometer PCB	Figure 19		B
48A0425	Lamp, 105W, 6.6A	Figure 19		A
1438.12.220	Red Filter	Figure 20		B
44A7122	Single Channel PAPI Control Board	Figure 19		B
94A0570/XXX	Baffle Kit	Figure 17		

NOTE: Upon initial replacement of either of the older PAPI Control Boards (44A6674 or 44A6674-1) or the inclinometer mount assembly (44A6813), you must replace both items with (44A7122 or 44A7122-1, and 44A6813-INSL).

Table 21: Master Spare Components

Part No.	Description	Location	Notes	Spares
44A6546-3	CCT Control Board	Figure 22		B
62B0064	Frangible Coupling, Master	Figure 22		B
47A0017	Fuse, 1A, SB (F4)	Figure 23		A
47A0049	Fuse, 2A, SB (F1, F2)	Figure 23		A
47A0119	Fuse, 0.5A, SB (F3)	Figure 23		A
48A0089	Photocell	Figure 22		A
44A6853	SC PAPI Optical Box	Figure 19		B
44A6853-1	SC PAPI Optical Box, Stainless Steel	Figure 19		B
44A6853-C	SC PAPI Optical Box, Tilt Switch Disabled	Figure 19		B
28A0011	SCR	Figure 23		B
28A0027	Snubber, SCR	Figure 23		A
32A0028	Varistor, 575V AC, Input	Figure 23		A
32A0025	Varistor, 750V AC, Output	Figure 23		A

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