FLASH™ TECHNOLOGY

SN

FTB 317 Medium Intensity Catenary Beacon
FAA Specification No. L-866

Reference Manual

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Front Matter

Abstract

This document briefly describes all models of the FTB 317 Medium Intensity Catenary Beacon.

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Applicable Specification

This equipment meets or exceeds requirements in Advisory Circular 150/5345-43 for an FAA Type L-866 medium intensity white flashing obstruction light.

While every effort has been made to ensure that the information in this manual is complete, accurate and up-to-date, Flash Technology Corporation of America assumes no liability for damages resulting from any errors or omissions in this manual, or from the use of the information contained herein. Flash Technology Corporation of America reserves the right to revise this manual without obligation to notify any person or organization of the revision.

In no event will Flash Technology Corporation of America be liable for direct, indirect, special, incidental, or consequential damages arising out of the use of or the inability to use this manual.

Warranty

All components are fully warranted, under normal operating conditions, for two years.

Parts Replacement

The use of non-OEM parts or unauthorized modification of this equipment will void the warranty and could invalidate the assurance of complying with FAA requirements as published in Advisory Circular 150/5345-43.

Pub. No. 0594-317-0001

PERSONNEL HAZARD WARNING

DANGEROUS VOLTAGES

Dangerous line voltages reside in certain locations in this equipment. Also, this equipment may generate dangerous voltages. Although FTCA has incorporated every practical safety precaution, exercise extreme caution at all times when you expose circuits and components, and when you operate, maintain, or service this equipment.

Avoid Touching Live Circuits

Avoid touching any component or any part of the circuitry while the equipment is operating. Do not change components or make adjustments inside the equipment with power on.

Dangerous Voltages Can Persist with Power Disconnected

Under certain conditions, dangerous voltages can be present because capacitors can retain charges even after the power has been disconnected.

Protect yourself — always turn off the input (primary) power and wait for one minute for storage capacitors to drain their charge. Then check between the red and blue wires on the TB2 terminal block with a voltmeter for any residual charge before touching any circuit element or component.

Do Not Depend on Interlocks

Never depend on interlocks alone to remove unsafe voltages. Always check circuits with a voltmeter. Under no circumstances remove or alter any safety interlock switch.

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Section 1 — Introduction and Operation

System

A single system consists of a flashhead, a power converter, a photocell, and a connecting cable from the power converter to the flashhead.

The power converter supplies the controlling circuitry to convert main AC power to the required voltages for internal operation and the discharge energy for the flashhead. It also controls the flash rate.

The photocell senses changes in lighting conditions from day to night and from night to day thus signalling the power converter to change its operation appropriately. Also, a provided switch can override the photocell if required.

A summary of features of each model of the FTB 317 is given in *Table 1-1*.

Specifications

Physical:

PC 317 Power Converter:

(H x W x Depth, Wgt)	24 x 16 x 10 in., 70 lbs.
	61 x 41 x 26 cm., 30 kg.

FH 308 Flashhead:

(H x Diam, Wgt)	17 x 18.25 in., 17 lbs.
	43.2 x 46.4 cm., 7.7 kg.

PEC 510 Photocell:

(H x W x Depth)	3.06 x 2.58 x 1.02 in.
	7.77 x 6.6 x 2.6 cm.

Note that dimensions are nominal. See outline drawing in Section 2 for mounting dimensions.

Performance Characteristics:

Application: L-865

Flash Intensity (nominal)**:**

(Medium) Day/Twilight Intensity 20,000 ± 25% ECD

(Low) Night Intensity (standard) 2,000 ± 25% ECD

Beam Spread: Horizontal: 360º (omnidirectional); Vertical: 5º

Flash Rate: 60 flashes per minute

Electrical:

AC Voltage	sine wave, 120 Volt ± 10%, 60 Hz ±1%, single phase
Volt-Amperes	250 VA peak; 175 VA avg.
Watts	130 (at 20,000 ECD)

Aerodynamic Wind Area:

Flashhead:	.93 sq. ft.
	.0864 sq. m.
Power Converter:	2.2 sq. ft.
	.2 sq. m.

Environmental: Complies with AC 150/5345-43.

Monitoring:

Electrically isolated relay contacts close on fail. .5 A, 120 VAC contact rating.

Operation

The PC 317 Power Converter operates a white flashhead. It monitors flashhead operation and signals an alarm if a failure occurs. The flashhead begins to operate as soon as power is applied. A photocell controls intensity for the system.

In daylight, lights flash white at a rate of 60 flashes per minute (FPM) at an intensity of 20,000 candelas. At night they flash at a rate of 60 FPM at an intensity of 2,000 candelas.

Several interconnected PC 317 Power Converters (typically three) operate the corresponding number of flashheads on a structure. See *Section Master/Slave Operation*.

If the PC 317I or PC 317AI operates an external red light controller, at night the white lights go off and the power converter switches on the external red light controller.

Photocell

The photocell changes resistance as ambient light changes from day to night or from night to day. The Timing and Trigger Board (PCB1) in the power converter converts the changes to flash the lights at the appropriate intensity for day or night operation.

Alarms

The transfer of electrically isolated relay contacts in the power converter indicates alarms. The type of alarm depends on the type of system (See *Table 1-1* for system configurations.) A system using a red external controller senses an alarm received from that controller. Alarm contact rating is 120 V, 1 A.

Master/Slave Operation

A pair of twisted wires interconnect multiple PC 317 units at TB202-1 and -2. The *master* unit is the power converter to which the photocell is connected. Power converters without a photocell are called *slaves.* Refer to *Figure 2-6*.

All units send a *sync pulse* to the pair of twisted wires. Slave units always send a day pulse because they have no connected photocell. (*Slave units must have a jumper between TB 201-1 and TB 201-2.*) A master unit sends either a day or night pulse on the twisted wire pair depending on the state of the photocell. A night pulse from the master causes all units to switch to night mode. The master's sync pulse synchronizes the units.

White Night Backup

A failure of a top light in night mode causes the master power converter that drives that failing light to signal backup mode to all power converters. All flashheads on the structure flash in backup mode (correct night intensity white back-up).

NOTE

For correct operation, JP8 jumpers on all PCB1 boards must be cut. TB201-1 and TB201-2 on the *master unit* are connected to the photocell. TB201-1 and TB201-2 on the *slave units* must have a jumper between these two connections.

System Configurations

Systems may be combined to form a multiple lighting scheme for structures. The operation of the various available FTB 317 Systems is described in *Table 1-1*.

Table 1-1 System Configurations

FTB System	Alarms	Lights	Flashes per Minute (FPM)	Operation	White-light Backup
317 Standard	White	L-865 White 20,000 candelas day 2,000 candelas night	60 60	Photocell control for day or night White during daylight White low intensity at night	No
317A‡ extended monitoring	White, intensity, PEC, day mode, night mode	L-865 White 20,000 candelas day 2,000 candelas night	60 60	Photocell control for day or night White during daylight White low intensity at night	No
317I‡ controls an external red light controller	White, red	L-865 White 20,000 candelas day 2,000 candelas night† L-864 Red Beacon L-810 Red Markers	60 60† On On	Photocell control for day or night White during daylight Turn on red external controller at night for beacons and markers	White night intensity backup for red system failure†
317AI‡ extended monitoring and controls an external red light controller	White, red, intensity, PEC, day mode, night mode	L-865 White 20,000 candelas day 2,000 candelas night† L-864 Red Beacon L-810 Red Markers	60 60† On On	Photocell control for day or night White during daylight Turn on red external controller at night for beacons and markers	White night intensity backup for red system failure†

† White light is off when red beacon is on. Values are for white backup operation.

Jumpers, Controls, and Indicators

The system is pre-set at the factory according to the Purchase Order Requirements. Its operation can be altered by the use of programming jumpers on PCB1 (see *Figure 1-1*). PCB1 governs all the functions pertaining to automatic operation. Only authorized service personnel should modify these settings. *Table 1-3* describes the jumper settings on PCB1 and their usage. Cuttable jumpers JP1 to JP9 are for factory use only.

Manual Intensity Control Switch

A manual intensity control switch (SW2) is located on the main chassis panel. (See *Figure 4-1*).

PCB1 Indicators

Nine indicator LEDs and one neon lamp on PCB1 monitor equipment operation during checkout and troubleshooting. A name imprinted on PCB1 adjacent to the indicator identifies each one. To monitor operation, *Operational Checkout* in *Section 3* instructs you to observe specified LEDs. *Figure 1-2* shows the location of these indicators on the board. *Table 1-4* describes the LED indicators.

Operating Modes

Table 1-2 describes operating modes.

Table 1-2 Operating Modes

Operating Mode	Flash Characteristics		Red System Operation	Operating Alarms[2] [3]
	Day	Night		
White: PC 317	Flash white at day intensity	Flash white at night intensity	No red light system.	White alarm
White: PC 317A (“A” models)	Flash white at day intensity	Flash white at night intensity	No red light system.	“A” Models — Extended Alarms: • White Alarm — Three or more consecutive missed flashes. • Intensity Error Day or Night — Light intensity does not agree with photocell signal: - Insufficient day energy in the power converter. - Too much energy during white night operation. - Insufficient night energy. - Missed flashes during daylight or at night. White alarm may operate also, if more than three consecutive flashes are missed. - Photocell Error — Photocell failed to switch state during a 19-hour period. Alarm remains until repaired unit switches state. • Day Mode — Operating in day mode. • Nite Mode — Operating in night mode.
Dual System: PC 317I (“I” models)	Flash white at day intensity	White backup available if red system fails	For “I” Models The optional “I” Model turns off the white lights and turns on red lights by starting an external red light controller supplied by others. Electrically isolated relay contacts, rated at 120 V, 1 A, close at night and open during daylight to turn the controller on or off. Also, “I” models can sense a red alarm condition from electrically isolated contacts in the external controller. Can operate in back-up mode, resuming white flashing at night intensity if the red light system fails.	“I” Models: • White Alarm — Three or more consecutive missed flashes. • Red Alarm — The external red light controller sends its red alarm to the PC 317I or PC 317AI. Indicates a red light controller failure if so wired to the controller[1].
Dual System: PC 317AI	Flash white at day intensity	White backup available if red system fails	Red system operation as described for PC 317I above.	Operating alarms as described for PC 317A, above.

1. Normally, only alarms of red beacons are wired to the “I” model from the external red light controller. Marker (L-810) failures are not specifically wired to the “I” model nor do they activate back-up mode.
2. All alarms are activated if PCB1 loses its power. Normally open (N/O) contacts close and normally closed (N/C) contacts open. Alarms clear (except PEC alarm) when you remove the condition that caused the alarm.
3. See alarm connections in *Figure 1-1 PCB1 and Connection Panel* .

Table 1-3 PCB1 Jumper Settings and Use

Jumper	Name	Cutting Purpose	Use in Power Converter
JP1	2X	Factory use only	Cut in all models.
JP2	OPEN	Used in the PC 317I.	Jumper for the external red light controller alarm signal. *Cut* if the external red light controller alarms by opening contacts. *Uncut* if the controller alarms by closing contacts.
JP3	NOBK	Used in the PC 317I.	*Uncut* in PC 317I to *support* white night backup operation for the external red light controller. *Cut* to *eliminate* white light backup.
JP4	DUAL	Used in the PC 317I.	*Cut* in PC 317I to support red light operation at night by the external red light controller interface.
JP5	CM	Factory use only.	Factory use only.
JP6	CT	Factory use only.	Factory use only.
JP7	None	Factory use only; sense transformer.	*Cut* if PCB1 is in a power converter with old-style sensing transformer. *Uncut* in all models.
JP8	None	Photo-resistive photocell.	*Cut* if the power converter uses a photoresistive cell instead of an AC voltage operated PEC. *Cut* in all models. Must be *cut* in master and slave units. Slave units require a jumper between TB201-1 and TB201-2.
JP9	None	Off-board alarm relay.	*Cut* for power converters using an alarm relay that is not mounted on PCB1. *Uncut* in all models.

Table 1-4 PCB1 LEDs and Lamps

LED/Lamp	Name	Color	Function
NITE	I 1	Red	*On* when the power converter is in white mode for night operation. Flashes if the external red light controller is operating.
DAY	I 2	Red	*On* when the power converter is in day mode.
SYNC	I 3	Red	Flashes for each sync signal.
CONF (Confirm)	I 4	Red	Flashes to confirm a valid flash was detected.
MODE	I 5	Red	*On* when day mode relay is active and the power converter is in day mode.
PEC (photocell alarm)†	I 6	Red	*On* when a the photocell fails to switch state and the mode failed to change within a period set by the factory. The default is 19 hours.
INT (Intensity alarm)‡	I 7	Red	*On* when the flashhead is flashing at the incorrect intensity for the light condition (day or night).
ALRM (White alarm)‡	I 8	Red	*On* when the flashhead misses three consecutive flashes.
DUAL	I 9	Red	*On* for Red Alarm signalled by the external red light controller system (PC 317I or 317AI).
I 10	I 10	Clear	*On* when trigger voltage is present. This lamp may flicker.

† The photocell error is stored. This allows service people to be aware that the photocell circuit is malfunctioning even though power was interrupted by opening the cabinet door. Otherwise, the error would be cleared and possibly not fail again for some time (until nineteen hours have passed without a mode change).

‡ All alarms are activated if the circuit board loses power. Upon power up, all alarms are cleared except for the PEC Alarm.

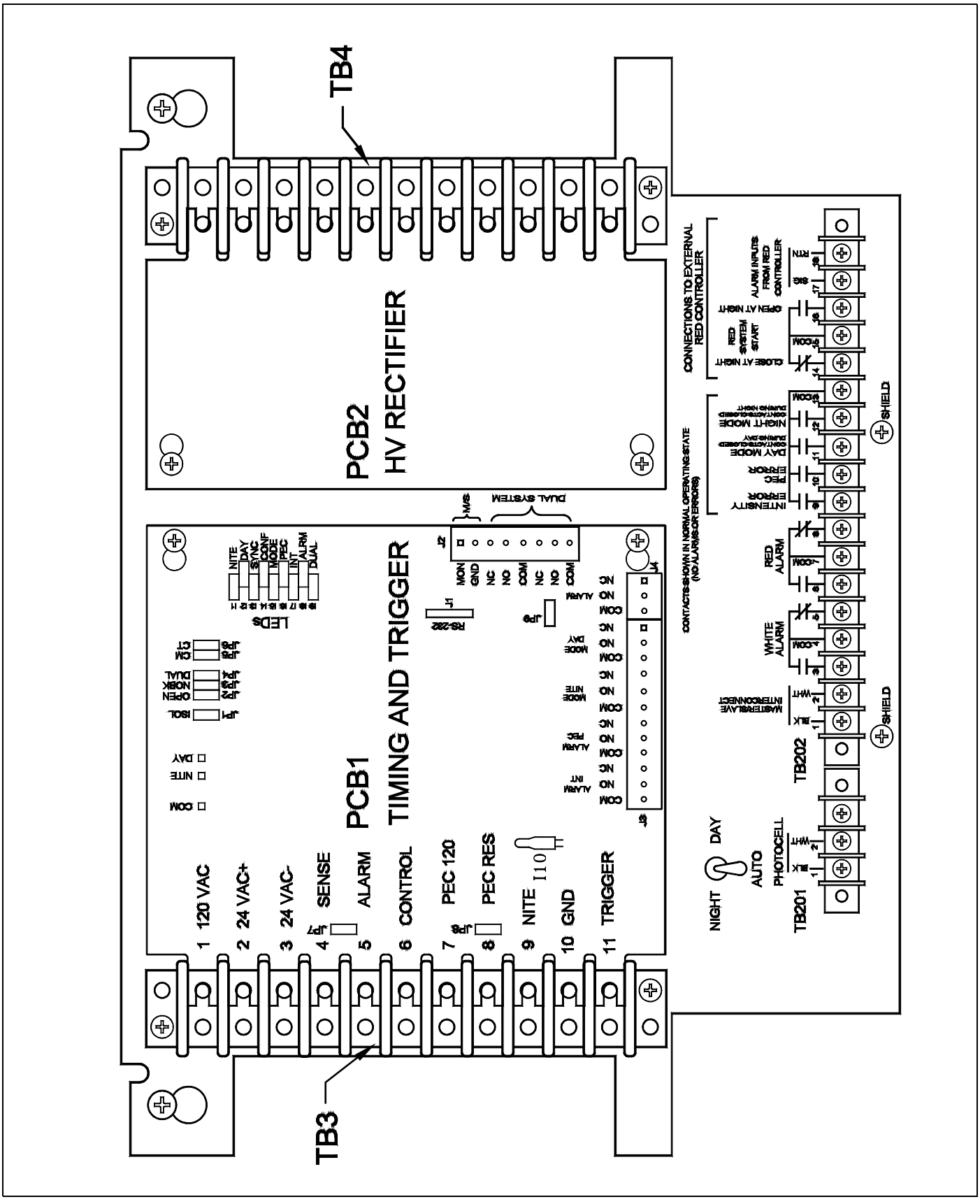

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Figure 1-1 PCB1 and Connection Panel

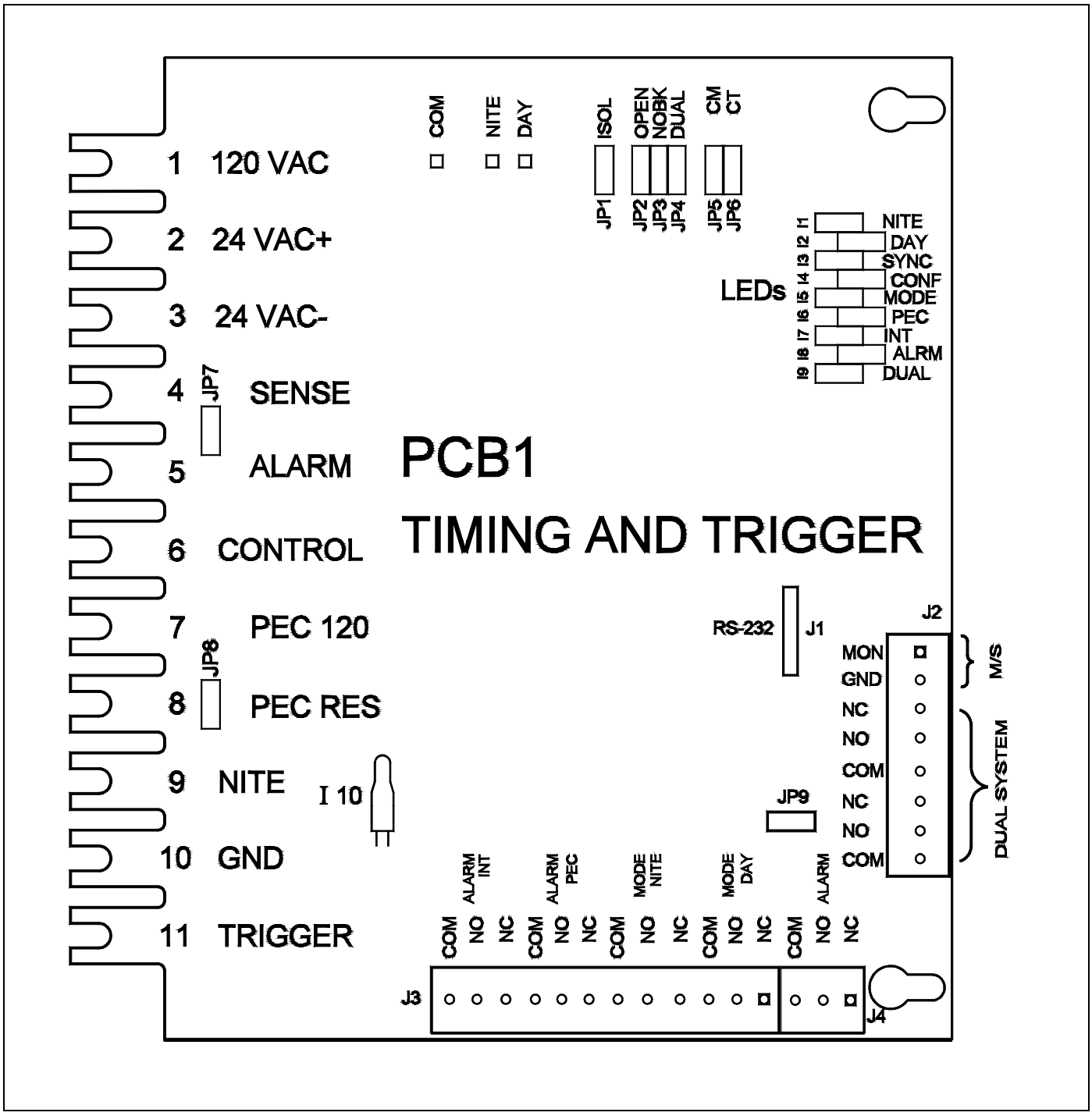

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Figure 1-2 PCB1 Timing and Trigger Board Pictorial

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Section 2 — Outline, Mounting, and Installation

Unpacking

Inspect shipping cartons for signs of damage before opening. Check package contents against the packing list and inspect each item for visible damage. Report damage claims promptly to the freight handler.

Tools

Although no special tools are necessary, the following hand tools are suggested for installation:

- Phillips-head screwdriver, #2
- Medium (# 2 - 3/16”), flat-blade screwdriver
- Medium (# 3 - 5/16"), flat-blade screwdriver
- Medium, slip joint pliers
- 8- or 10-inch adjustable wrench
- Hex nut driver or hex socket, 5/16"
- Hex nut driver or hex socket, 7/16"
- Hand tools for electrical wiring

Access

WARNING

STOP: Before proceeding, read the warning on Page iii. Disconnect the primary power before opening the power converter cover.

Power Converter

Latches secure the cover. When you release these, you can swing open the cover for internal access.

Flashhead

WARNING

The flashhead contains no interlock. Do not open the flashhead unless primary power has been disconnected from the power converter. Wait one minute for storage capacitors to drain down. Open the flashhead and use a voltmeter to ascertain that no high voltage exists between the red and the blue wires. Look for these wires on the ceramic terminal posts.

You may pivot the lens open by disengaging quick-release latches. Be careful that the lens clears nearby objects during opening and closing.

Mounting

Power Converter

Mounting and outline dimensions for the power converter are shown in *Figure 2-3*. FTCA does not furnish mounting hardware unless you order it as part of an installation kit. Use the following guidelines for mounting the power converter:

- Ensure that adequate space exists around the equipment for access during installation, maintenance and servicing.
- Allow space for air flow around the power converter.
- Use a bonding strap when installing a power converter to a painted or non-conducting isolated surface. Connect the strap to the site grounding system.

Flashhead

Mounting and outline dimensions for the flashhead are shown in *Figure 2-2*. The flashhead must be protected from lightning strikes. The flashhead may be mounted to painted or unpainted surfaces. One of the mounting holes in the base of the flashhead contains a built-in electrical ground connection. Use the following guidelines:

- Use a lightning rod extended above the flashhead to protect it when it is mounted at the uppermost part of the structure.
- Avoid locating a lightning rod where it would prevent tilting the lens open or interfere with access by maintenance or service personnel.
- Use a bonding strap when mounting the flashhead to the structure, and fasten the bonding strap to the flashhead with the mounting bolt that goes through the foot that contains the ground connection.

Leveling

The flashheads must be level for correct vertical beam alignment. Two leveling vials—aligned with the mounting feet—are permanently attached to the flashhead assembly. Typically, the mounting surface for the flashhead is level and no adjustments are required. When the flashhead is level, bubbles in both leveling vials are centered. For leveling, use the following guidelines:

- If adjustment is necessary, raise the appropriate mounting foot with shims or washers. Raising one foot by 1/16 inch (1.6 mm) tilts the beam about 1/2 degree.
- Take extreme care to ensure that all four legs rest snugly against a firm mounting surface before tightening the mounting bolts. ***Failure to do so may damage the base when you tighten the bolts.***

Photocell

Mounting and outline dimensions for the photocell are shown in *Figure 2-4*. The photocell uses a male ½" NPT for mounting. To mount the photocell, use the following guidelines:

- Locate the photocell where it has an unobstructed view of the polar sky.
- It must not view direct or reflected artificial light.
- The photocell may be supported directly by electrical conduit.
- *Ensure that the installation is watertight.*

Installation

This manual may not contain all the information about installation wiring required for your installation.

NOTE

If installation drawings prepared specifically for your site disagree with information provided in this manual, the site installation drawings should take precedence. *Consult any site-specific installation wiring diagram supplied with your equipment.*

Note: FTCA wiring diagrams define only minimum requirements recommended for satisfactory equipment operation. ***It is the responsibility of the installer to comply with all applicable electrical codes.***

You can find conduit and other distribution wiring details on electrical installation diagrams provided by FTCA or others. *Installation instructions concerning red light marker fixtures are not part of this manual.*

All installation wiring should have an insulation rating of 600 volts. Size power service wiring to satisfy the load demand of the red light system (if present) and the power converters. Read the notes on the installation wiring diagrams supplied both in this manual and with the equipment. See *Figure 2-8* for information about alarm connections to the main panel of the power converter.

Power Converter Wiring

Consult the installation wiring drawings. For service wiring, consider the voltage, length of the wire run, and the total load (number of lights). Assume a load of 175 volt-amperes per light, and do not permit the line voltage to drop by more than 5% cause by wire resistance. Assume a load of 175 volt-amperes per light to determine the *slow-acting* fuse rating at the power distribution panel. Use a value of 250 volt-amperes per light to determine *fast-acting* fuse rating at the power distribution panel and to select a system feeder transformer (if used).

In multiple-unit systems, the master unit and slave units communicate over the “master/slave” interconnect wiring. Twist the wires together at the rate of 12 twists per foot. The recommended minimum wire size for control and signal conductors is #16 AWG.

The voltage and frequency at which your beacon operates is imprinted on an external ID label and also inside the power converter near the fuse block. Internal fuses are sized according to the operating voltage. F2 is replaced by a jumper when Line 2 is neutral.

PHASING CAUTION

This equipment is phase sensitive when you use it in a system of two or more beacons. Line 1 and Line 2 must follow consistently to F1 and F2 in every power converter in a system.

Flashhead Wiring

The power converter and flashhead are interconnected by the flashhead cable. When FTCA Part Number 6340, or equivalent cable, is used, the two may be separated by a distance up to 600 feet. Consult the factory when a greater separation necessary. The cable between the power converter and flashhead requires five conductors with 600 volts (minimum) insulation. Two of the conductors must be #10 AWG. The other three may be #16 AWG (minimum, for mechanical strength) if you are cabling together individual wires.

To ensure long-term reliability, use continuous wiring between the power converters and their flashheads without intervening junctions or splices.

Securing the Cable

FTCA recommends the following procedure for securing the flashhead cable to a skeletal structure:

1. Wrap two full turns of two-inch Scotchrap #50 tape, or equivalent alternative, around the cables and tower member at regular intervals along one of the tower legs.
2. Wrap three full turns of one-inch Scotchrap Filament #890 tape, or equivalent alternative, over the Scotchrap #50 tape.
3. Wrap four full turns of two-inch Scotchrap #50 tape, or equivalent alternative, over the Filament #890 tape. Apply the last two turns without tension.
4. In steps 1 through 3 wrap the tape directly above and below tower leg flanges, and at intervals of approximately five feet.

Photocell Wiring

The photocell is supplied with pigtails for connection to wires that connect to the power converter. It is connected to the main panel of the power converter. It may be located any practical distance from the power converter. The recommended minimum wire gauge is #16 AWG.

The photocell terminals on the slave power converter must be jumpered from TB 201-1 to TB 201-2. Also, you connect the master unit (to which the photocell is directly connected) to the topmost flashhead and top tier of markers (if markers are present).

Installation Checklist

Complete the following steps before applying power:

1. Inspect all equipment for damage.

2. Verify the received equipment against the packing list to ensure completeness.

3. **Power Converter Mounting:**
   Position and mount each unit allowing adequate clearance for opening the covers. Also, use the following guidelines:

   - Ensure that the case is mounted upright and grounded.
   - Check hardware inside the case to ensure that the chassis mounting screws and nuts are tight.
   - Ensure that only the bottom of the case has drain holes and that they are clear.
   - Ensure that no holes are punched or drilled on the top surface of the case.
   - Ensure that air can flow around the case.
   - Mount the power converter away from radio frequency interference (RFI).

4. **Power Converter Wiring:**
   Examine the installation drawings and use the following guidelines:

   - Check for proper incoming service voltage.
   - Wire each unit according to the instructions.
   - Ensure that all three power converters are on the same voltage phase.
   - Check all electrical connections for tightness.
   - Check all terminal strip connections for tightness.
   - Ground the power converter.

5. **Alarm Wiring:**
   - If external alarm detection circuit responds to *closed* contacts, ensure that they are wired to the contacts on TB202-4 and -5

(white alarm) and TB202-7 and -8 that *close* on failure.

- If external alarm detection circuit responds to *open* contacts, ensure that they are wired to the contacts on TB202-3 and -4 (white alarm) and TB202-6 and -7 (red alarm) that *open* on failure.
- Protect alarm wiring by using shielded wires, grounding the shield, and placing wires in a conduit. See *Figure 2-8*.

6. Flashhead Mounting:

- Ensure that the flashhead lens can be opened without striking other objects.
- Level and aim the flashhead.

7. Flashhead Wiring:

- Protect the top flashhead against lightning strikes.
- Ground the flashhead.
- Check the wiring of the flashhead cable to the flashhead.
- Secure the flashhead cable to the tower. Support and tape the cable to prevent its movement by the wind.

8. Photocell:

- Locate photocell where it views unobstructed polar sky with no direct or reflected artificial lighting striking it.
- Mount the photocell vertically on the top end of a vertical length of conduit to prevent water from entering the unit.
- Connect the photocell to the power converter: the black wire to TB201-1 and the white wire to TB201-2.
- Ground the wire shield around the photocell wires, if one is present. Do not ground the shield to the photocell, but ground it at the power converter.
- After running the photocell wires, check for continuity and shorts.

After completing all the steps listed above, turn on the power and perform an operational checkout from procedures in *Section 3*.

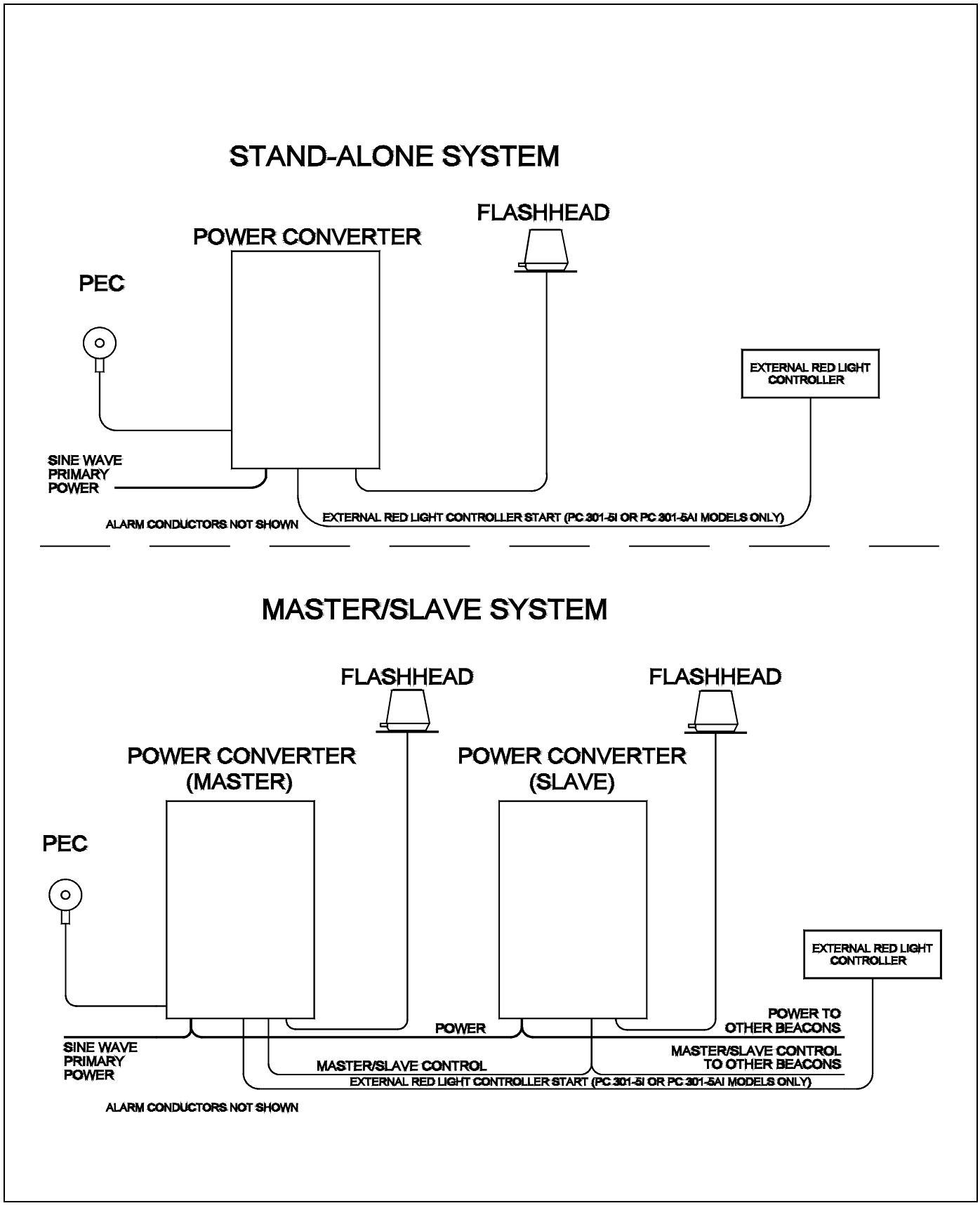

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Figure 2-1 System Configurations

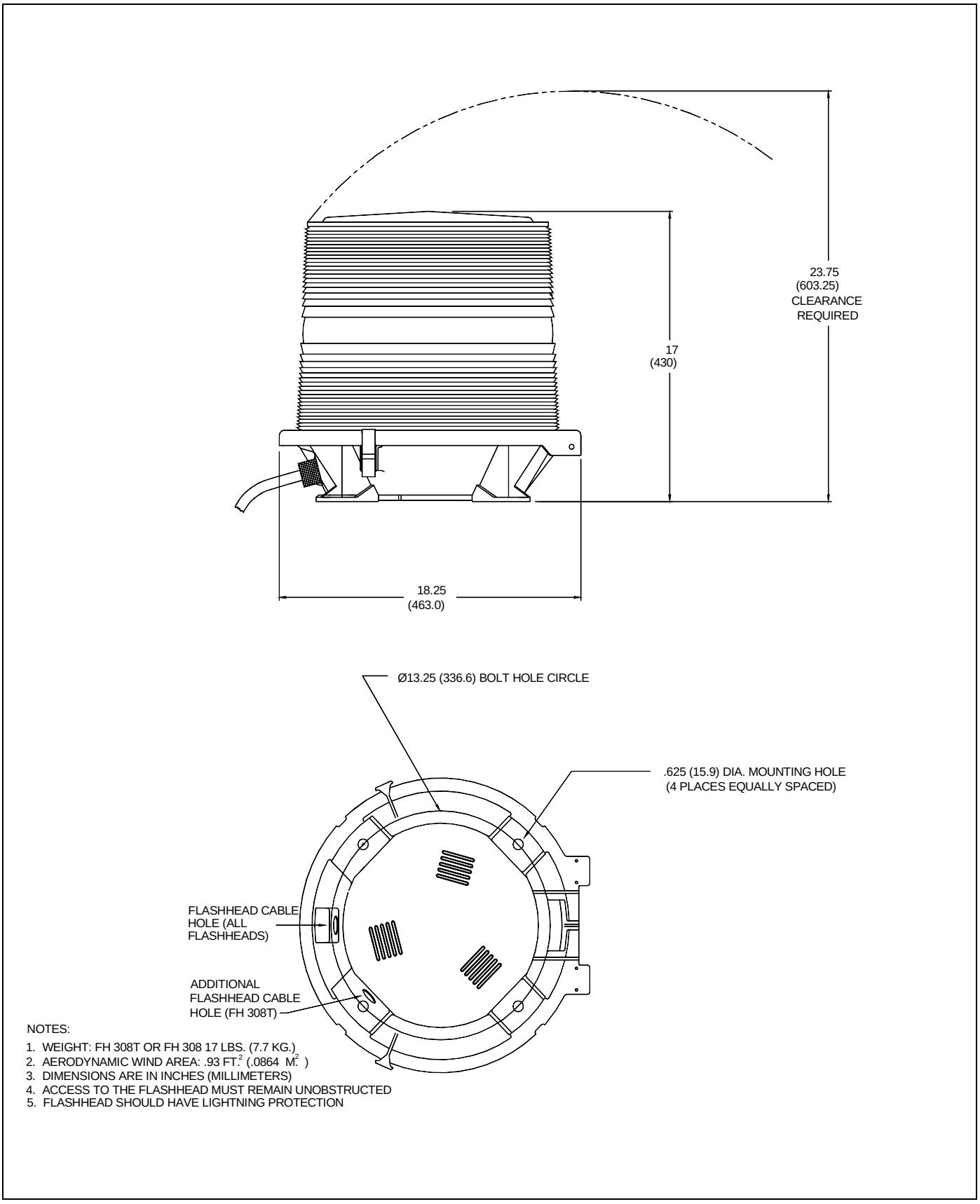

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Figure 2-2 Flashhead Mounting and Outline

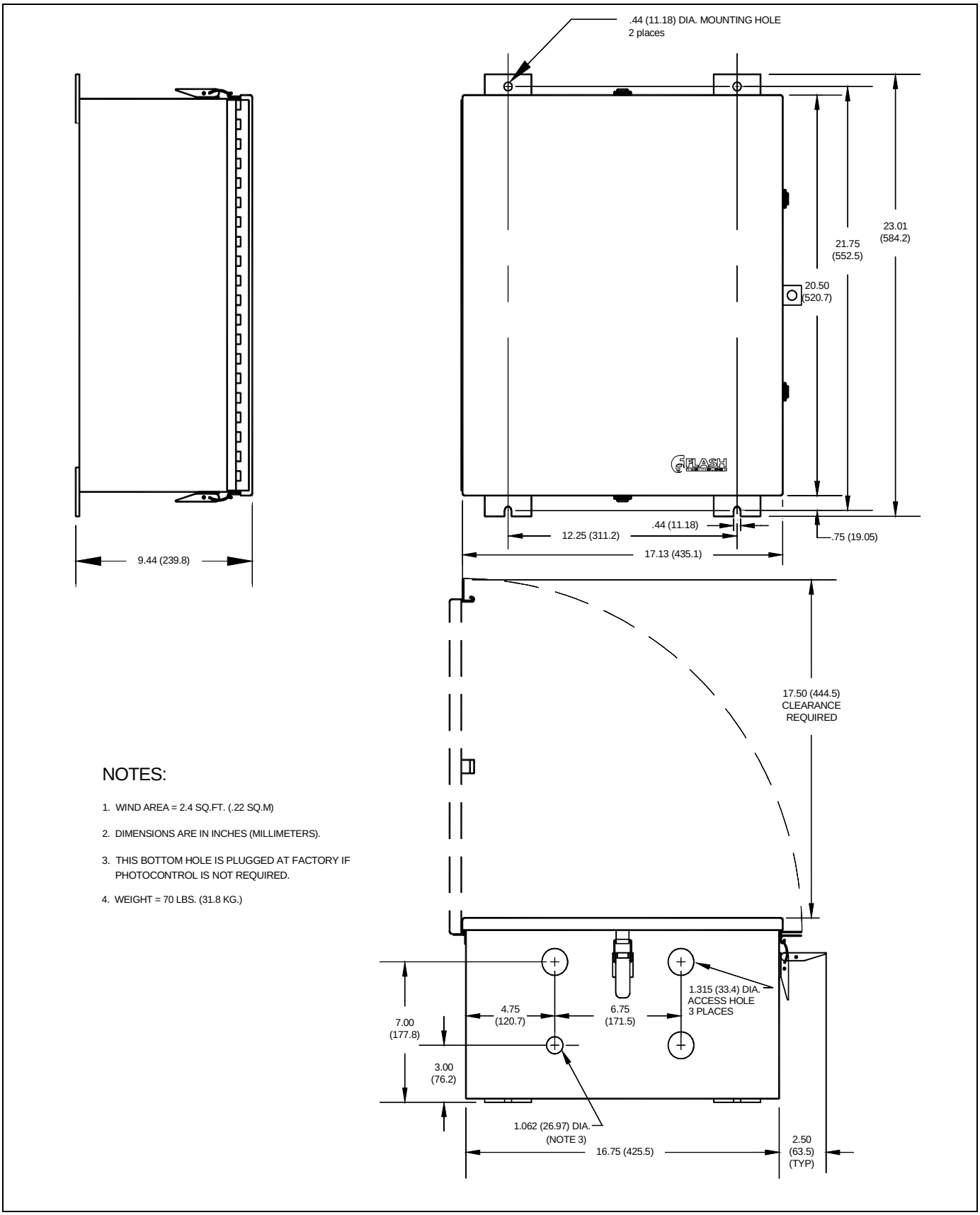

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Figure 2-3 Power Converter Mounting and Outline

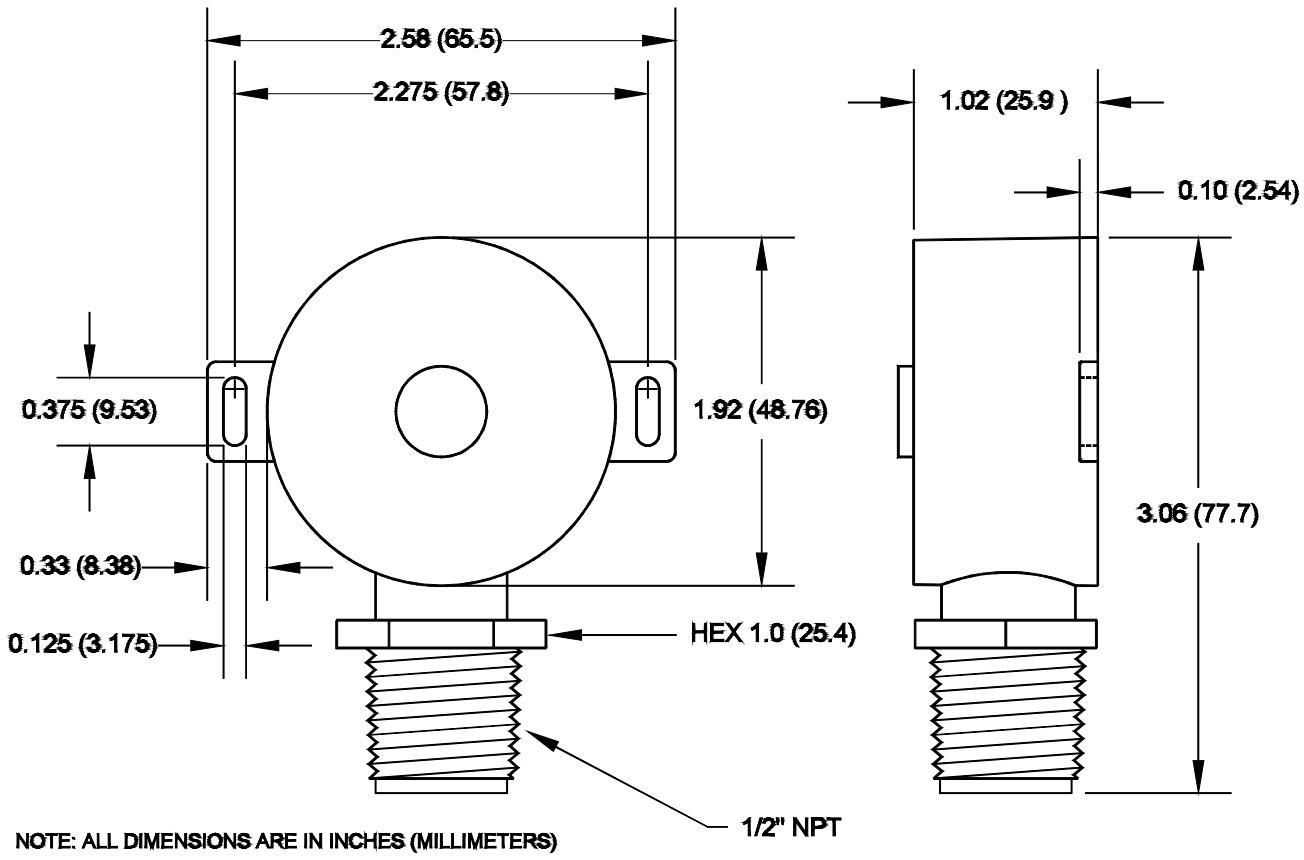

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Figure 2-4 Photocell Mounting and Outline

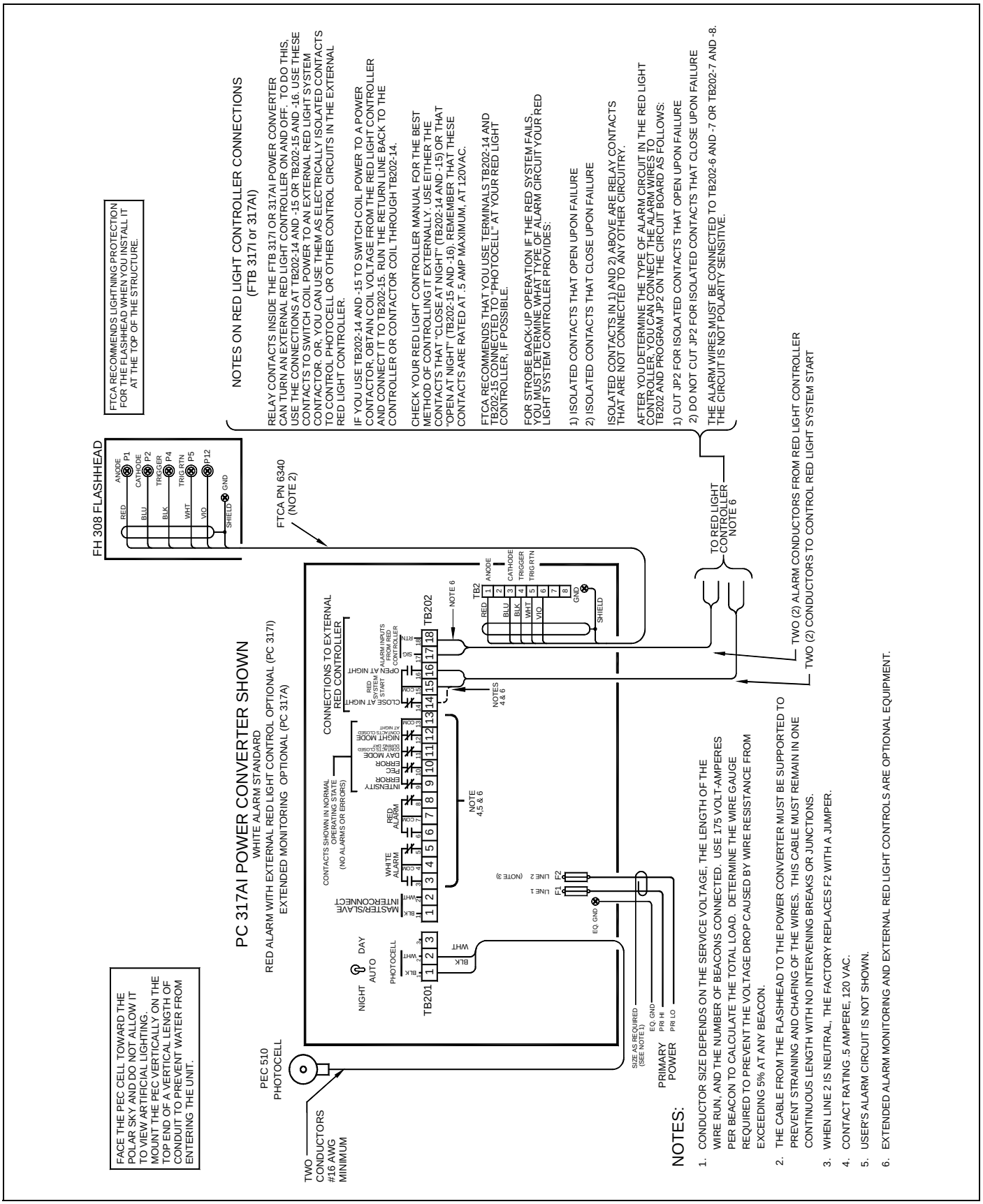

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Figure 2-5 Single Unit Installation Wiring

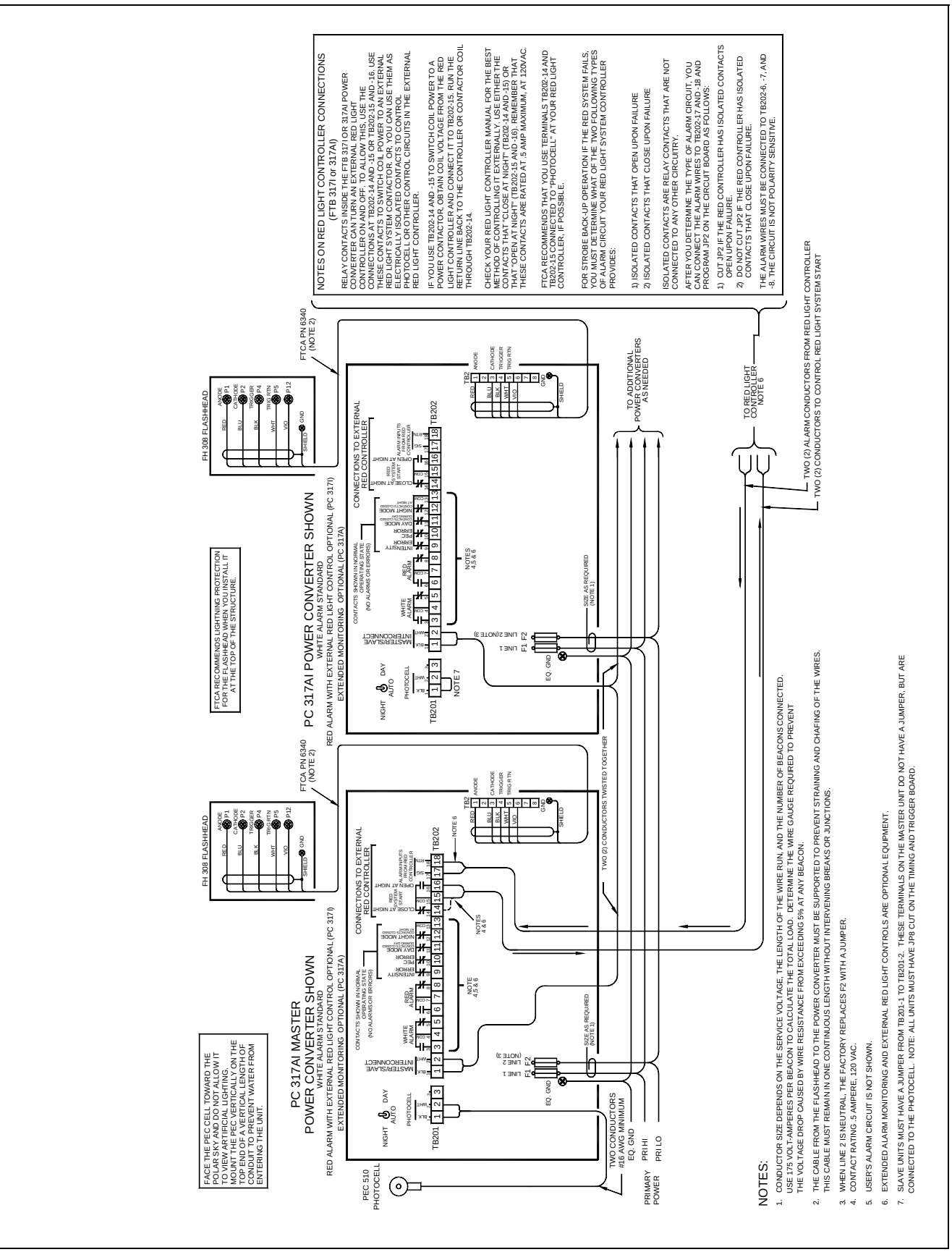

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Figure 2-6 Multiple Unit Installation Wiring

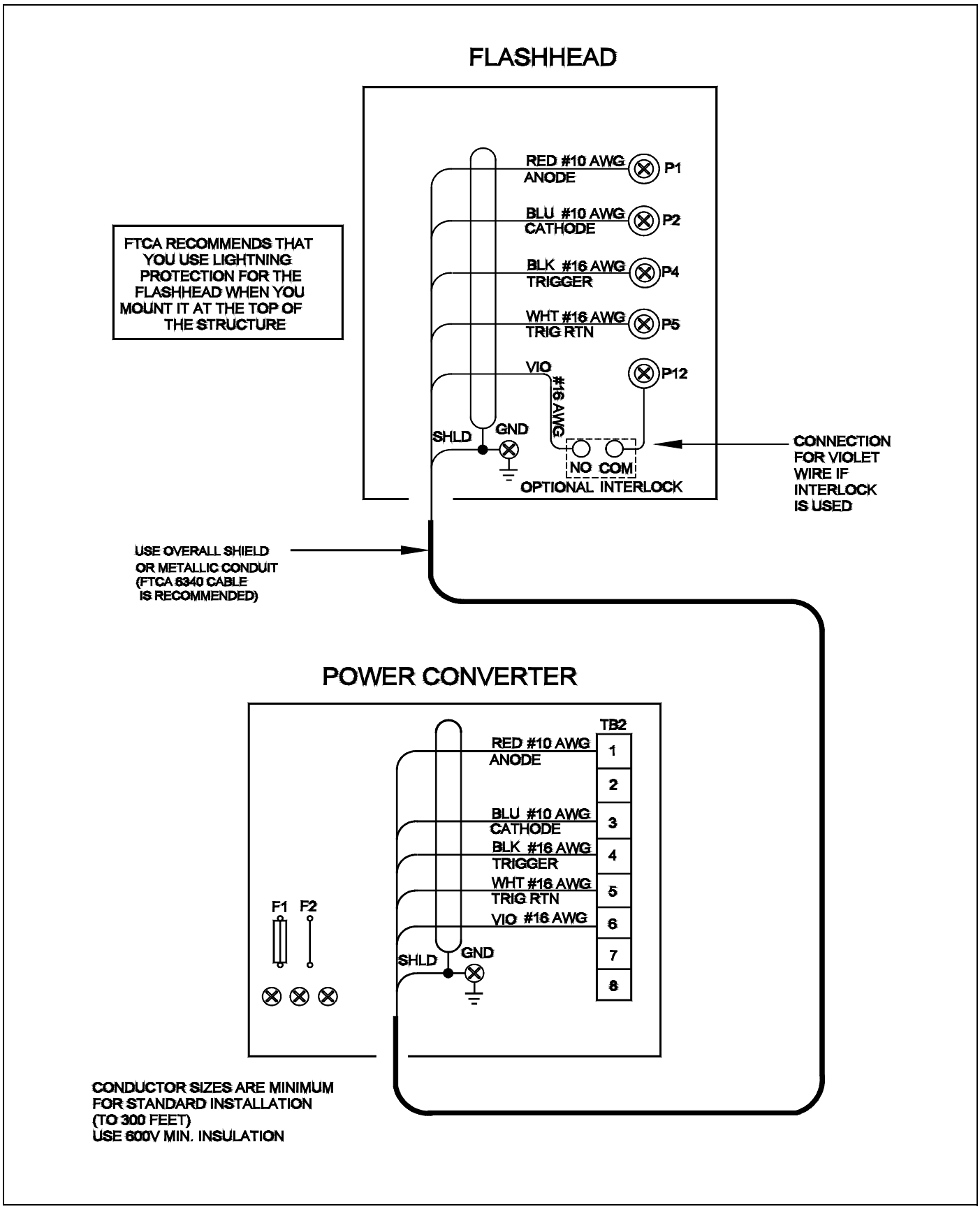

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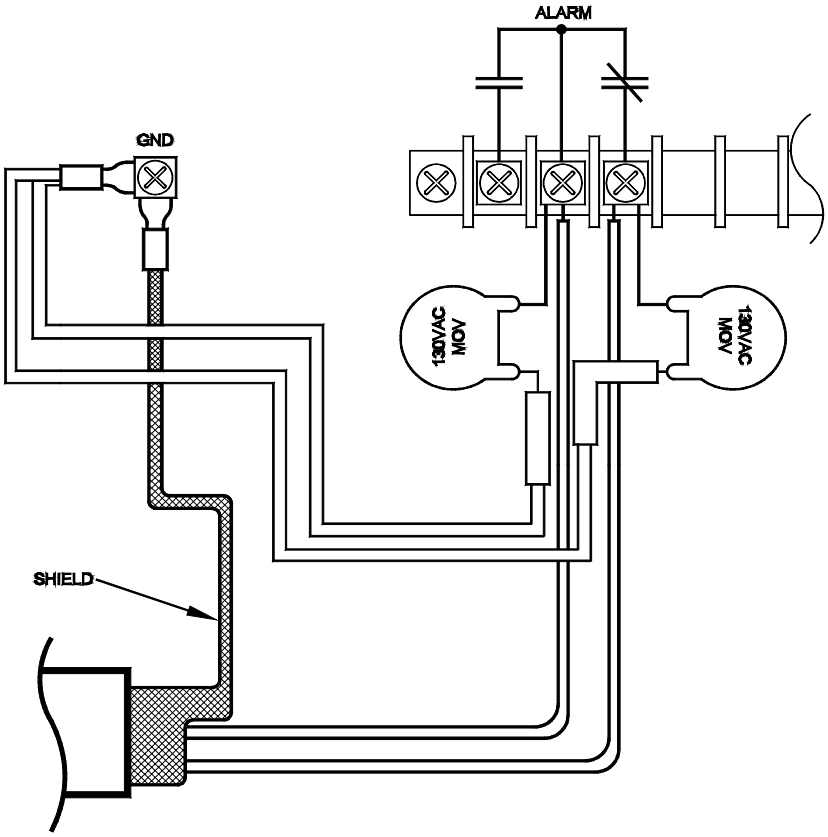
Figure 2-7 Flashhead Wiring Guideline



CUSTOMER
CONNECTION
TO ALARM
RELAY
CONTACTS

FLASH TECHNOLOGY ALARM RELAY CONTACTS ARE PROTECTED FROM VOLTAGE TRANSIENTS OF UP TO 1000 VOLTS. HOWEVER, WIRED ALARM CONTACTS CAN BE SUBJECTED TO VOLTAGES GREATER THAN 1000 VOLTS BECAUSE OF LIGHTNING. THE FOLLOWING RECOMMENDATIONS MINIMIZE THE POSSIBILITY OF DAMAGE CAUSED BY HIGH VOLTAGE TRANSIENTS ON THE ALARM RELAY CONTACTS OF FLASH TECHNOLOGY POWER CONVERTERS.

THE INSTALLER IS RESPONSIBLE FOR COMPLYING WITH ALL APPLICABLE ELECTRICAL CODES.

NOTES:

1. USE SHIELDED CABLE TO ATTACH FLASH TECHNOLOGY ALARM RELAY CONTACTS TO EXTERNAL EQUIPMENT.
2. ATTACH THE SHIELD WIRE TO A GND (GROUND) TERMINAL ON THE FLASH TECHNOLOGY POWER CONVERTER AS SHOWN.
3. WHEN POSSIBLE, ROUTE ALARM CONTACT WIRING IN METALLIC, GROUNDED CONDUIT.
4. FOR ADDITIONAL PROTECTION, ADD MOVs (VARISTORS) FROM EACH ALARM RELAY CONTACT TERMINAL TO A GND TERMINAL AT THE FLASH TECHNOLOGY POWER CONVERTER.

RAW

Figure 2-8 Recommended Alarm Wiring

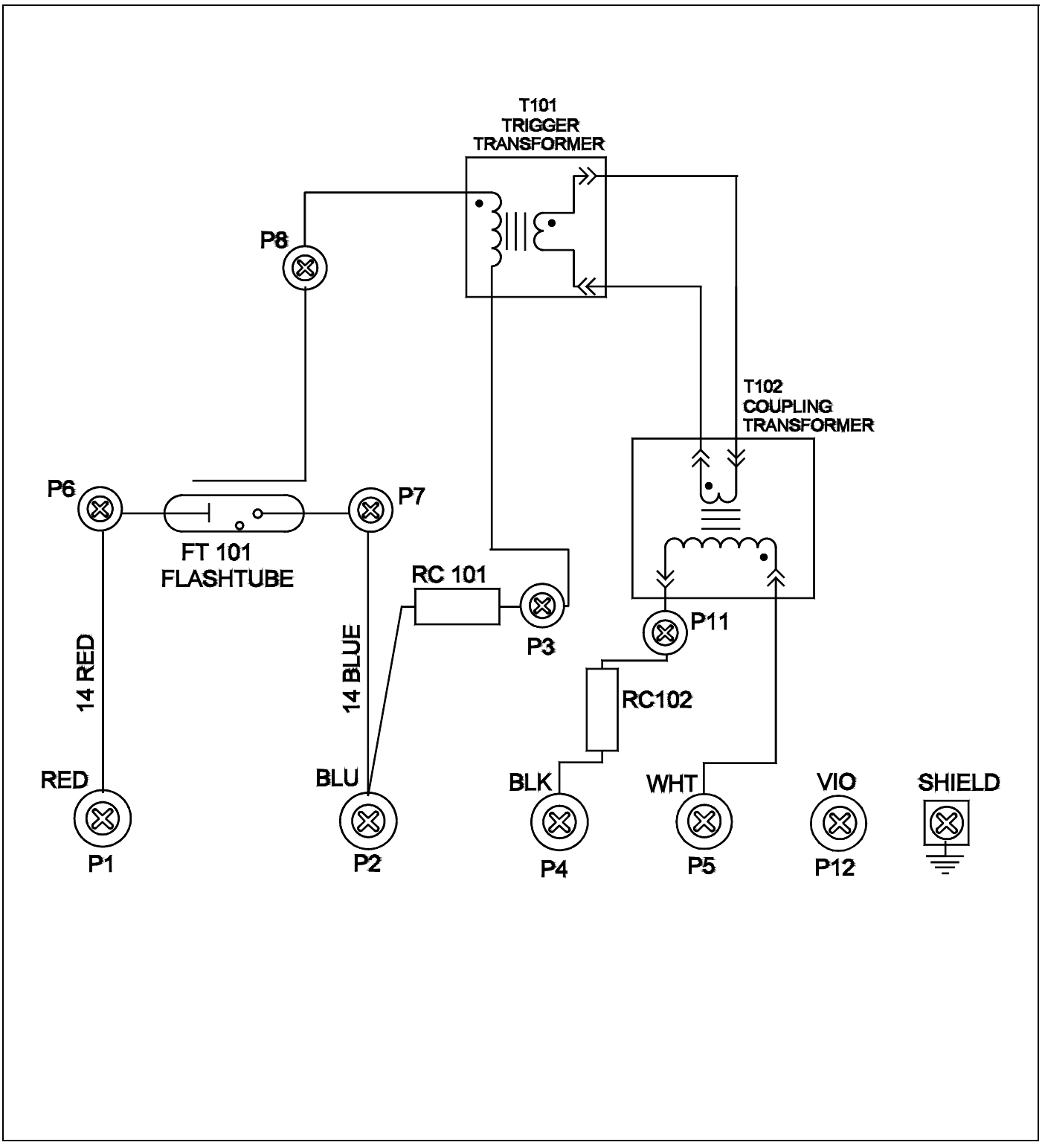


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Figure 2-9 Flashhead Internal Wiring

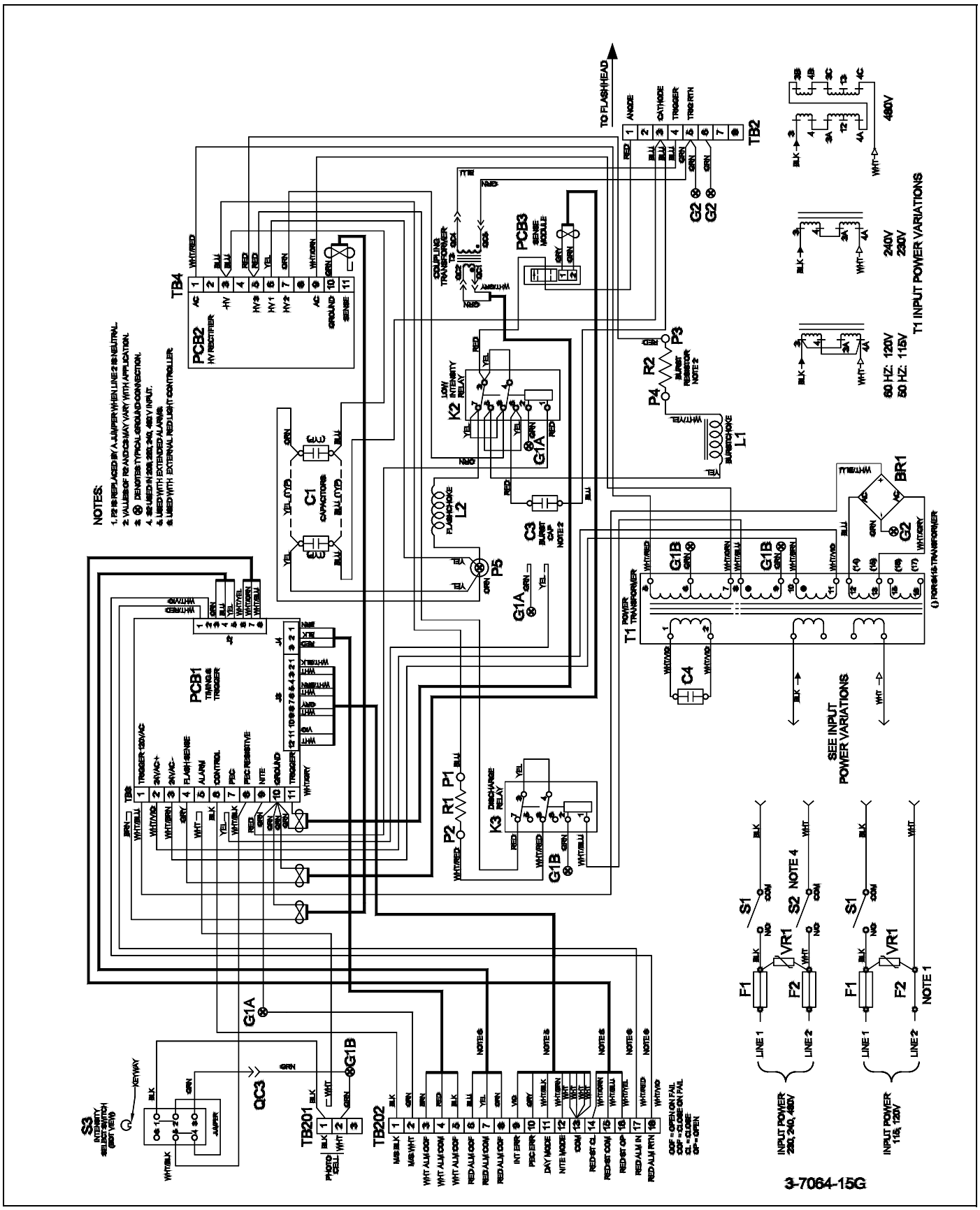

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Figure 2-10 Power Converter Internal Wiring

Section 3 — Maintenance and Troubleshooting

Safety

Warning

STOP: Before proceeding—read the warning on Page III.

Work safely, as follows:

1. Remove rings and watches before opening the equipment.
2. Shut off the equipment.
3. Remove the component or connect the test instruments.
4. Replace the component.
5. Turn on the power and test the system.
6. Turn off the power and disconnect the test equipment.

Preventive Maintenance

Carry out the following inspection and cleaning procedures at least once a year:

1. Verify that moisture has not entered the equipment accidentally through gaskets or seals, or collected as condensation.
2. Verify that all drain holes are clear.
3. Check terminal blocks and relays for evidence of corrosion and electrical arcing. Clean or replace any component showing evidence of high-voltage damage.
4. Check flashtube connections for signs of pitting or arcing. Verify that anode and cathode connections are firmly tightened.
5. Check all electrical connections for tightness and verify the absence of corrosion or electrical arcing.
6. Clean the outside surface of the lens with liquid detergent and water. Wipe it gently with a soft cloth.
7. Clean the inside surface of the lens with an FTCA-approved professional plastic cleaner. Wipe the lens with cheesecloth only. *Do not use regular cloth or paper towels.* A lens cleaning kit, PN 8630801, is available from FTCA. Contact Customer Service at 1-800-821-5825.

Storage

No special considerations are required for long-term storage of any major assembly, such as the power converter, flashhead, photocell or any internal component. Circuit boards, when not installed in the equipment, should be kept in anti-static bags or containers.

Diagnostic Testing

The only effective way to check out interconnected lights is to disconnect the master/slave interconnect wire that is connected between power converters and check the power converters as single units, as described in *Table 3-2 Stand-Alone or Master Unit Checkout*.

Sync Signal Evaluation

Refer to *Figure 2-6*. Note that, for each power converter, a master/slave interconnect line and its return line are connected to TB202-1 and TB202-2 respectively. All units place a sync pulse on the line, which causes the power converters to flash all the lights at the same time. PCB1 in each power converter generates a sync pulse. The first sync pulse to be placed on the line synchronizes the remaining lights. The width of the sync pulse controls the mode of operation.

In the event of a top-most red light failure at night, the master power converter places a back-up signal on the line that causes all connected units to flash the white lights at the correct night intensity.

The sync signal is difficult to evaluate with a meter. You can detect the sync pulse as an instantaneous movement of the meter indicator. A digital meter with a max-min function may capture part of the pulse. This is generally a sufficient indication of a pulse being present. (A 24 V pulse of 16 ms. width might read 12 V on a 100 ms. capture time of max-min function.)

RFI Problems

Radio frequency interference (RFI) can cause a light to flash intermittently, at the wrong rate, or at the wrong intensity. RFI can enter the unit by way of *any* wire to or from the unit. For example:

- RFI on primary power wires could cause errors in flash rate and intensity.
- RFI on the control wire could cause a light to stay at night intensity.
- RFI on the photocell line could cause a light to stay at night intensity. RFI would not normally cause a light to stay at day/twilight intensity.
- Strong RFI could burn out PCB1 components.

While FTCA designed circuits to reject or bypass RFI, complete immunity cannot be guaranteed beforehand. It may be necessary after installation to add external filters or use other methods to reduce RFI entering the equipment.

Component Testing

The following procedures describe how to check most of the major electrical components. Always make resistance measurements with the power turned off. However you must apply power for voltage measurements. However, perform all preliminary steps, such as connecting test leads or circuit jumpers, or disconnecting existing circuit connections, with the power turned off and storage capacitors discharged.

Refer to *Section 4 — Parts Lists* for component locations.

PERSONNEL HAZARD

Dangerous voltages are present. Read the warning on Page iii.

Capacitor Testing General

Evaluate the condition of a capacitor with an analog volt-ohmmeter operating in the resistance mode. The following method assumes an instrument with a X100 resistance scale.

Place the meter leads across the terminals of an isolated (no electrical connections to other circuits) and fully discharged capacitor, and observe the subsequent needle movement.

If the capacitor is OK, the needle initially indicates zero ohms, but soon begins to rise higher indicated values. A capacitor that is disconnected from other circuitry is defective if it does not exhibit this behavior.

Manually discharge the capacitor before repeating this measurement. ***This test may not detect a malfunction that occurs only at high voltage***.

A bank of capacitors connected in parallel may be checked as a single unit. For example, four 70-microfarad capacitors connected in parallel may be checked as a single capacitor of 280 microfarads. The ohmmeter response is 4 times longer for the entire bank than for one 70-microfarad unit. If a short circuit is indicated, the individual capacitors have to be disconnected and checked separately. A shorted capacitor is indicated if the resistance does not rise above zero after several seconds of measurement.

C1 — Main Capacitor Bank

The main capacitor bank is an energy storage bank consisting of several capacitors wired in parallel.

To test this bank, remove the PCB2 HV rectifier board and disconnect the large blue and yellow wires from C1 to the external discharge circuits. If the meter indicates a short circuit, you must isolate the individual capacitors and check them one at a time until you locate the defective capacitor.

C3 — Capacitor

Remove both leads from one terminal cluster of this capacitor.

C4 — Tuning Capacitor, 3 mfd

Remove the lead from one terminal of this 3 mfd capacitor.

K2 — Low Intensity Relay, 24-volt DC Coil

Prepare to measure the resistance of this coil by removing one of the coil wires. The measured resistance across the coil should be approximately 290 ohms.

K3 — Discharge Relay, 120-volt AC Coil

Prepare to measure the resistance of this coil by removing one of the coil wires. The measured resistance across the coil should be approximately 290 ohms.

L1 — Burst Choke

The measured resistance of this choke from K2-5 to the P4 ceramic post (at the R2 burst resistor) should be approximately 7 ohms.

L2 — Flash Choke

Check the flash choke for overheating and continuity.

PCB1 — Timing and Trigger Board

Replace this circuit board with one known to be in good condition.

PCB2 — HV Rectifier Board

Replace this circuit board with one known to be in good condition.

R2 — Burst Resistor

The measured resistance of this component is 500 ohms.

R1 — Discharge Resistor

The measured resistance of this component between ceramic posts P1 and P2 should be 35000 ohms.

T1 — Power Transformer

Prepare to test this transformer by removing the PCB1 timing and trigger board and the PCB2 HV rectifier board. Energize the unit and measure secondary winding voltages:.

Table 3-5 Power Transformer Voltage Test

Test Points	Voltage
TB4-1 to TB4-9	950 - 1100 VAC[1]
TB3-1 to chassis	110 - 120 VDC[2]
TB3-2 to TB3-3	22- 26 VAC

1. If this AC voltage is substantially less than the specified minimum value, check the C4 tuning capacitor.
2. Full-wave rectified by BR1.

PCB3 — Sense Module

Replace this circuit module with one known to be in good condition.

T3 — Coupling Transformer

Visually observe the transformer for damage. Check the transformer for open windings by measuring the primary and secondary windings with an ohmmeter. An open winding indicates infinite ohms on the ohmmeter. A normal winding should indicate zero ohms.

VR1 — Suppressor Assembly

Prepare to check this component by removing one of its leads from a fuse block terminal. The measured resistance on the X100K ohm scale should be infinite.

FT101 — Flashtube

A visual inspection tells little about the working condition or performance of a flashtube. A darkened envelope does not necessarily mean the light output would be too low. Do not change the flashtube until you are certain that the problem is not the lack of a discharge potential or a triggering pulse.

T101 — Trigger Transformer

Check for burning or arcing. Check continuity. If you are still in doubt, replace it with one known to be in good condition.

T102 — Coupling Transformer

Check for burning or arcing. Check continuity. If you are still in doubt, replace it with one known to be in good condition.

Component Removal and Replacement

PERSONNEL HAZARD
The fuses have line voltage applied to them. Red the Warning on Page iii.

Refer to *Figure 2-9* and *Figure 2-10* for internal wiring, and *Figure 4-1* and *Figure 4-2* for component locations.

Capacitors — High Voltage

Removal
1. Remove the fuses for this procedure to prevent accidental application of power if the interlock switch is unintentionally pressed.
2. Remove PCB1 and PCB2 for access to the capacitors.
3. Loosen four #10 screws at the outermost corners of the plate assembly that supports the PCB1 and PCB2 and lift the assembly upward to clear the screw heads.
4. Let the assembly hang while supported by the wiring harness.
5. Disconnect the wires to the capacitors.
6. Remove the hold-down screws.
7. Lift the capacitors away from the chassis.

Replacement
Replace the wires exactly as you removed them. In some cases, a quick-connect wire terminal does not seat properly if it is not placed on the terminal cluster exactly as it was before removal. This misfit occurs because of interference between insulation on the wire terminal and the insulation surrounding the terminal cluster on the capacitor.

PCB1 — Timing and Trigger Board

Removal
1. Loosen but do not remove all eleven screws holding the circuit board to TB3.
2. Loosen but do not remove the corner support screws.
3. Disconnect the plug-in connectors at the circuit board J2, J3, and J4 locations.
4. Slide the circuit board away from the terminal block and lift it away from the corner supports as soon as the large end of the keyhole slots permit.
5. The board can now be lifted completely away from the chassis.

Replacement
Replace the board in the reverse order of removal.

PCB2 — HV Rectifier Board

Removal
1. Loosen but do not remove all eleven screws holding the circuit board to TB4.
2. Loosen but do not remove the corner support screws.
3. Slide the circuit board away from the terminal block and lift it away from the corner supports as soon as the large end of the keyhole slots permit.
4. The board can now be lifted completely away from the chassis.

Replacement
Replace the board in the reverse order of removal.

T1 — Power Transformer

Removal
1. Disconnect the connecting wires while noting the terminals to which they are connected.
2. Loosen, but do not remove two Phillips-head screws on the right side of the transformer nearest the chassis bottom.
3. Remove the two Phillips-head screws on the left side of the transformer and remove the transformer.

Replacement
Replace the transformer in the reverse order of removal.

T3 — Trigger Coupling Transformer

Removal
1. First remove the PCB1, PCB2, and the mounting bracket that supports them.

2. Disconnect the primary and secondary wires at the connectors. *Note the position of these wires.*
3. Remove the screws that hold the transformer to the side of the power converter.
4. Lift the transformer free of the power converter.

Replacement

1. Replace the transformer in the reverse order of removal.
2. Connect the disconnected wires to the same wires from which they were removed.

FT101 — Flashtube

Removal

1. Loosen the three screws (on screw lugs)—this enables you to disengage the flashtube.
2. Carefully lift the flashtube upward from the assembly.

Replacement

1. Align the pins on the flashtube base with the clamps of the terminal screw lugs, making sure that the *red dot* on the flashtube base coincides with the *red dot marked on the bracket directly under it.*
2. Carefully insert the flashtube and settle it into place, making sure the ceramic base is resting directly on the tops of the screw lugs. Secure the flashhead by tightening the three screws on the screw lugs.

T101 — Trigger Transformer

Removal

1. At the trigger wire post adjacent to the flashtube, remove the large diameter wire coming from the trigger transformer.
2. At one of the smaller, side-mounted ceramic posts, remove the small wire to the trigger transformer. Do not disconnect the primary winding wires.
3. Remove the two 4-40 x 2" phillips head screws holding the transformer assembly to the bracket. Note the orientation of the molded secondary winding with respect to fixed features on the bracket, because it must be reinstalled with this same orientation.
4. Remove the outer half of the core and lift off the molded secondary winding. The primary winding remains hanging in place.
5. Remove the inner half of the core.

Replacement

1. Reassemble the primary and secondary windings over the two halves of the core. Attach the core to the bracket using the two long screws.
2. Reattach the electrical wires. Verify that wiring is in accordance with *Figure 2-9.*

T102 — Coupling Transformer

Removal and replacement are similar to the procedure for the coupling transformer in *Section T3 — Coupling Transformer.*

Operational Checkout

Use steps in *Table 3-1* and *Table 3-2* to checkout the operation and observe the response of the equipment.

If the system contains more than one light, and the lights are interconnected for master/slave control, perform the checkout steps described in Table 3-1 and Table 3-2 only at the master unit. However, observe all lights for responses. The procedures in these tables assume that the following conditions are present:

1. The photocell is subjected to normal outdoor daylight.
2. All installation steps have been completed.
3. The PCB1 board is correctly programmed.

Table 3-1 describes the operational checkout of only the white lights in a system. Consult the manuals for your red light system supplied by others to check out red lights.

Stand-Alone or Master Unit

A stand-alone unit is a single FTB 317 operating independently. Such a stand-alone unit operates the same as a master unit because the photocell is connected to it. The photocell controls intensity

changes. For testing a stand-alone or a master unit, the photocell should be exposed to normal outdoor daylight.

Units in a system of multiple units, other than the master unit, are slave units. These are tested as stand-alone units with the master/slave sync wire disconnected, but you use the Intensity Select Switch to change the operating mode. *Figure 1-2* gives the locations of the indicator lamps on the board. *Table 3-1* and *Table 3-2* describe the checks.

Table 3-1 Operational Checkout Procedures

Check	Correct Responses
Daytime Operation: 1. Apply primary power with the photocell exposed to light.	• NITE LED (I 1) is not lit. • DAY LED (I 2) is lit. • CONF LED (I 4) flashes. • SYNC LED (I 3) flashes. • MODE LED (I 5) is on for day mode. • PEC Alarm LED (I 6) is *not* lit. • INT LED (I 7) is *not* lit. • ALRM LED (I 8) is *not* lit. • DUAL LED (I 9) is *not* lit. • TRIGGER POWER (I 10) flickers. • The white light flashes at daytime intensity (observe flashes directly).
Nighttime Operation: 1. Cover the photocell so that it is completely dark (it may take several minutes to change state).	• NITE LED (I 1) is lit. • DAY LED (I 2) is *not* lit. • CONF LED (I 4) flashes. • SYNC LED (I 3) flashes. • MODE LED (I 5) is *off* for night mode. • PEC Alarm LED (I 6) is *not* lit. • INT LED (I 7) is *not* lit. • ALRM LED (I 8) is *not* lit. • DUAL LED (I 9) is *not* lit. • TRIGGER POWER LED (I 10) is *on*. • The white light flashes at nighttime intensity (observe flashes directly). If your system uses an external red light controller for red lights at night, the white light will not flash at night unless the red system has a failure and white night backup is enabled on the PC 317 (JP3 is *not* cut). • *Remove the cover from the photocell.*
Alarm Sensing: 1. Remove primary power. 2. Temporarily disconnect the *black* wire on TB2-4. 3. Apply primary power and verify the following:	• The white light does not flash. • The ALRM LED I 9 is lit after three missed flashes. • The INT LED I 7 is lit. • The CONF LED I 4 is not lit or flashing. • Remove power. • Reconnect the black wire on TB2-4. • Reapply power.

Table 3-2 Stand-Alone or Master Unit Checkout

Check	Correct Responses
For all checks, disconnect the twisted-pair sync lines connected to TB202-1 and TB202-2 to operate the power converter as a stand-alone unit.	
Daytime Operation: 1) For a slave unit, set the Intensity Select Switch to DAY mode 2) For a master unit, test in daylight or shine a light upon the photocell.	• NITE LED (I 1) is not lit. • DAY LED (I 2) is lit. • CONF LED (I 4) flashes. • SYNC LED (I 3) flashes. • MODE LED (I 5) is on for day mode. • PEC Alarm LED (I 6) is not lit. • INT LED (I 7) is not lit. • ALRM LED (I 8) is *not* lit. • DUAL LED (I 9) is *not* lit. • TRIGGER POWER (I 10) flickers. • The white beacon flashes at daytime intensity (observe flashes directly). • *For a slave unit, restore the Intensity Select Switch to AUTO.*
Nighttime Operation: 1) For a slave unit, set the Intensity Switch to NIGHT mode. 2) For a master unit, cover the photocell so that it is completely dark (it may take several seconds to change state) and verify the following responses: **NOTE** Several seconds may pass before the photocell responds to the darkened condition.	• NITE LED (I 1) is lit. • DAY LED (I 2) is not lit. • CONF LED (I 4) flashes. • SYNC LED (I 3) flashes. • MODE LED (I 5) is off for night mode. • PEC Alarm LED (I 6) is not lit. • INT LED (I 7) is not lit. • ALRM LED (I 8) is *not* lit. • DUAL LED (I 9) is *not* lit. • TRIGGER POWER LED (I 10) is on (may flicker). • The white light flashes at nighttime intensity (observe flashes directly). • *For a slave unit, restore the Intensity Select Switch to AUTO.* • *For a master unit, uncover the photocell.*
Photocell: 1) Disconnect the photocell wire from TB201-1. PCB1 responses should correspond to those described in Procedure 2 (night operation).	• Responses should be the same as those previously in *Nighttime Operation*. • Reconnect the photocell wire.

If Responses are Not Normal:

- If *all* of the responses are incorrect in the three preceding Procedures, replace PCB1.
- If steps NITE (I 1), DAY (I 2), and MODE (I 5) are incorrect in Daytime Operation, but Photocell is correct, replace the photocell.
- If all responses are correct in Daytime Operation and Nighttime Operation, except for the Alarm LED (I 8) response, and the light does not flash, check the flashtube or the trigger transformer.
- If the Alarm LED (I 8) is lit during these procedures, but the white light flashes properly, replace PCB1.
- If an open circuit exists at TB202-3 to TB202-4 with wires disconnected when the Alarm LED is not lit, replace PCB1.
- Disconnect the sync wires at TB202-1 and TB202-2.
  - Check the sync signal at the *black* TB202-1 *master/slave interconnect* terminal with a voltmeter as described in *Section Sync Signal Evaluation.* Step the unit from one intensity to the other by using the Intensity Select Switch. If the sync signal appears to be absent, and RFI has been ruled out, replace PCB1.
  - Check the signal on the *black master/slave interconnect* ***wire*** with a voltmeter as described in *Section Sync Signal Evaluation*. It should exhibit a response. If it does not, there could be a problem in another unit.
  - Reconnect the *black master/slave interconnect* wire.

Troubleshooting the Beacon

The most effective troubleshooting procedure begins with observing the behavior of the light. This often leads directly to a faulty component or other abnormal condition. Carefully observe all symptoms of the failure. Good troubleshooting is frequently good observation.

- Are all or only one structure light failing?

  All lights failing is likely caused by a problem common to all. Wiring may have failed or have loose connections, or the master power converter may be driving the system incorrectly.

  A single failing light is likely caused by its associated power converter or the flashhead itself.

- Are *all* structure lights at the appropriate intensity?

  For the entire system, a photocell connected to the master power converter, and working with it, should operate the system at the correct intensity. The photocell or master power converter may have a problem.

  A single beacon at the incorrect intensity is likely to have a failing power converter component.

  Check the intensity select switches—they all should be on AUTO.

- Are all LEDs on PCB1 operating properly?

  Check operation as in *Table 3-1* or *Table 3-2*. LEDs indicate correct operation and alarms, or possible PCB1 failures if they are flashing inappropriately for day or night lighting conditions.

- Are all Neon lamps on PCB2 lit?

  Failing Neon lamps may indicate a power problem, usually a high-voltage problem in PCB2. Also, check the capacitors.

- Are relays transferring appropriately?

  The K2 Relay must be energized at night. Sometimes, relays are sluggish, or the contacts are dirty, or the coil is open.

- Are components overheated (discolored) or burned?

  An overheated component may indicate that the components that precede it or follow it in the circuit path may have also failed. Remember also to check the components on PCB1 and PCB2.

Alarms

PCB1 activates the intensity alarm if any of the following occur:

- Insufficient day energy in the power converter, which may indicate a stuck NITE relay or defective storage capacitors.
- Too much energy during night operation of the white flashhead, which may indicate an unswitched NITE relay. The relay may be stuck or otherwise inactive.
- Insufficient night energy (check storage capacitors) or missing flashhead flicks.
- Flashes were missed during night or day flashes. The white alarm may operate also, if more than three consecutive flashes are missed.

Troubleshooting Charts

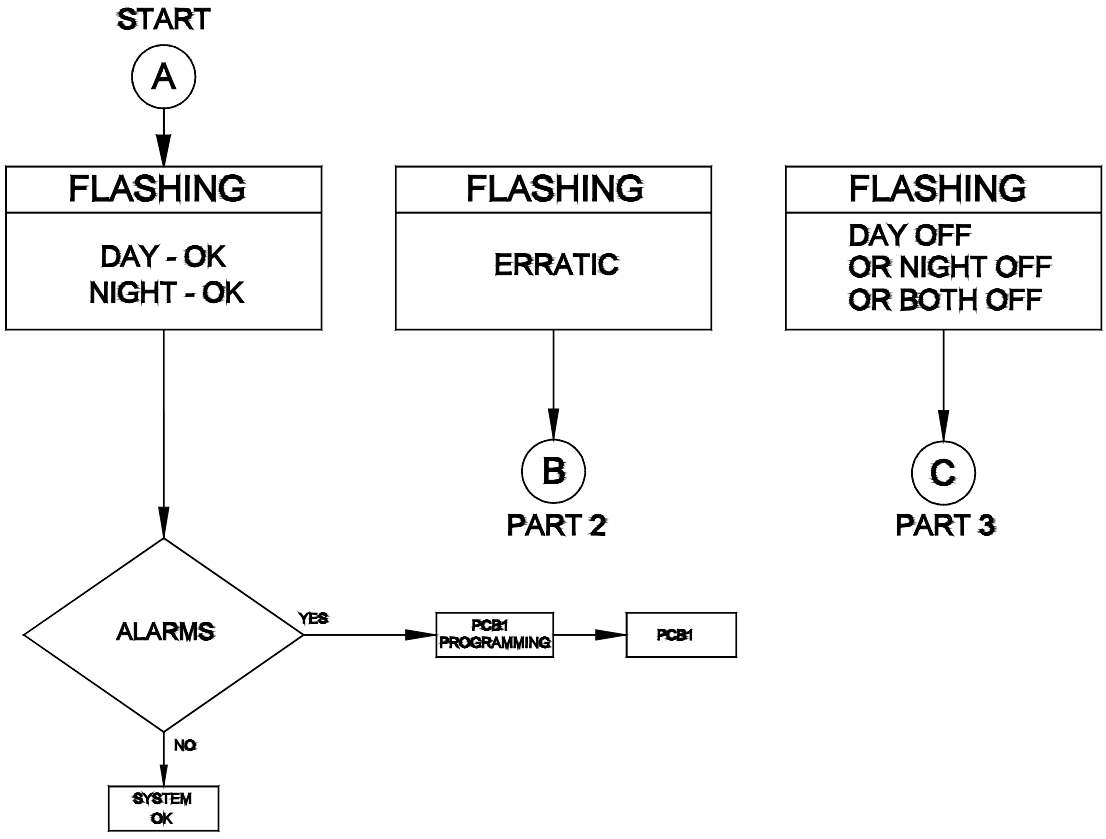
The following charts provide an approach and some solutions to troubleshooting problems that you may encounter with the lighting systems.

TROUBLESHOOTING CHARTS PART 1

NOTES:

SYSTEM ERRORS AFFECT THE ENTIRE SYSTEM. FOR THESE CHECK EXTERNAL WIRING AND MASTER/SLAVE CONNECTION.

IN GENERAL: CHECK FOR OVERHEATED OR BURNED COMPONENTS, LOOSE CONNECTIONS, OBVIOUS SHORTS, OR OPEN WIRES OR COMPONENTS.



TC1

Figure 3-1 Troubleshooting Chart (Part 1 of 3)

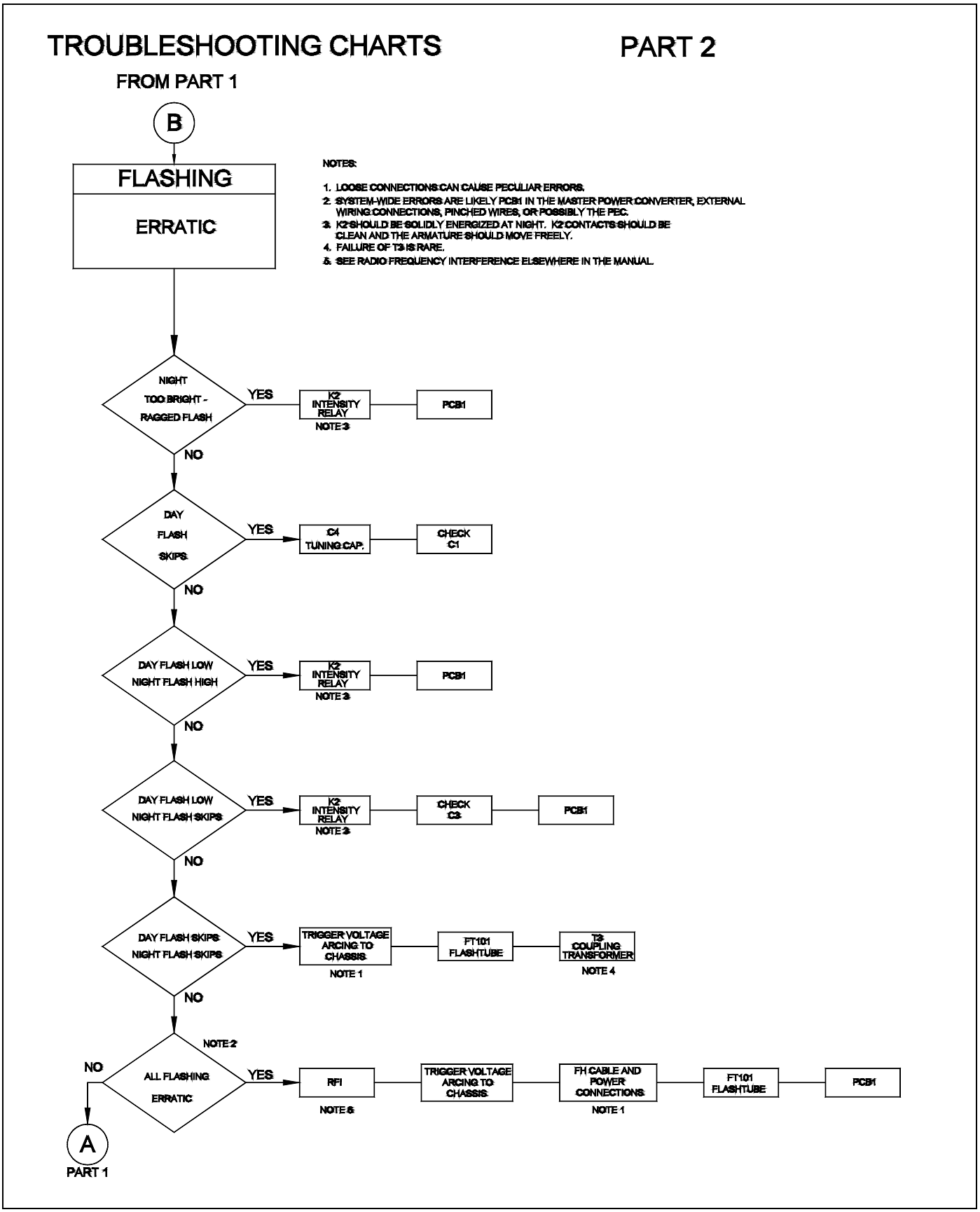


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Figure 3-2 Troubleshooting Chart (Part 2 of 3)

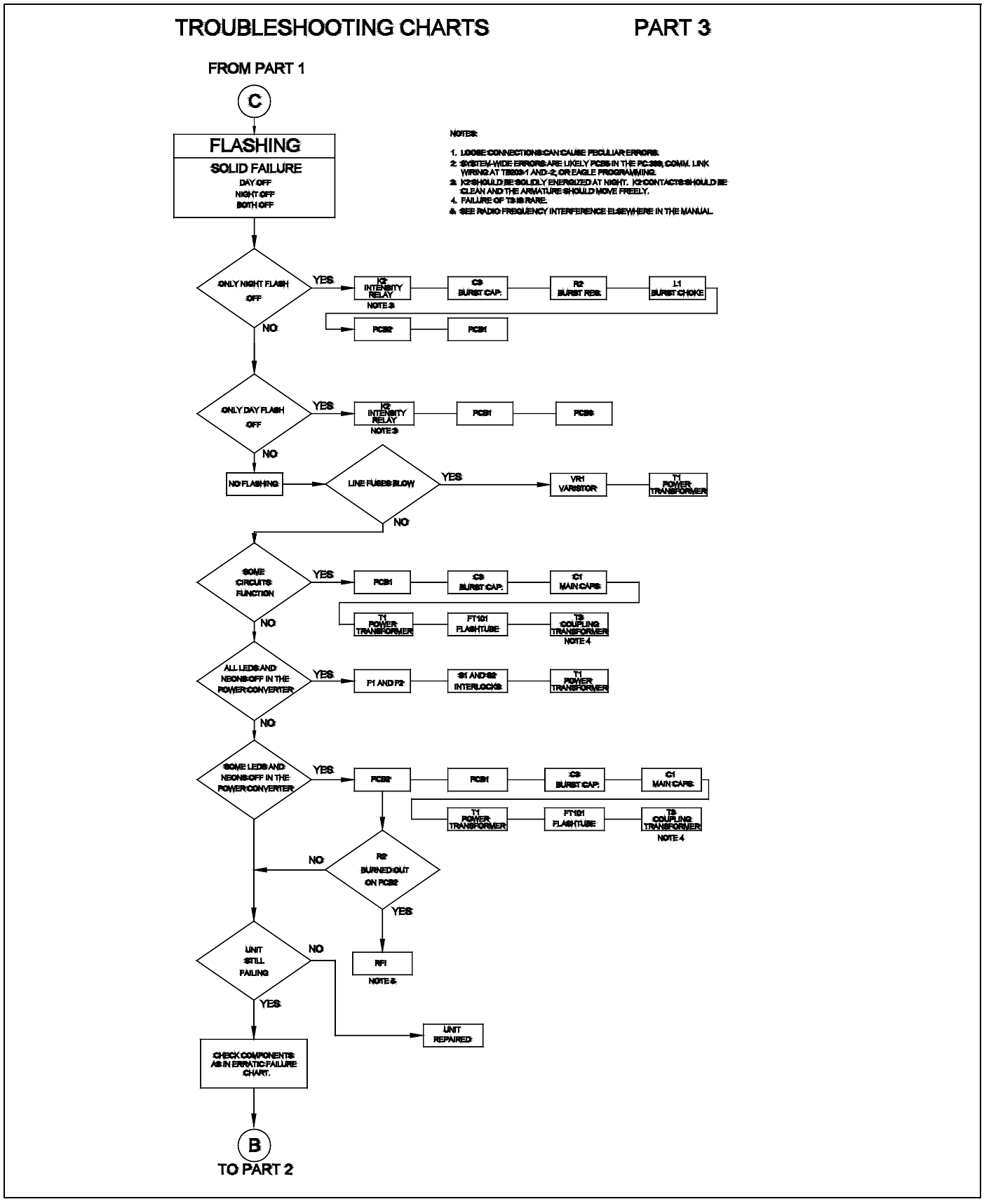

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Figure 3-3 Troubleshooting Chart (Part 3 of 3)

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Section 4 — Parts Lists

Customer Service

Customer Service:	1-800-821-5825
Telephone:	(615)-261-2000
Facsimile:	(615)-261-2600

Internet Address:

http:\\www.flashtechnology.com

Shipping Address:

Flash Technology Corporation of America
332 Nichol Mill Lane
Franklin TN 37067

Ordering Parts

To order spare or replacement parts, contact FTCA Customer Service at 1-800-821-5825.

Power Converter Parts

Table 4-1 lists the major replaceable parts for the power converter. Refer to *Figure 4-1*.

Flashhead Parts

Table 4-2 lists the major replaceable parts for the flashhead. Refer to *Figure 4-2*.

Photocell Parts

The PEC 510 Photocell, is a single assembly PN 1855001.

Returning Equipment

If it is necessary to return equipment to FTCA, contact Customer Service at 1-800-821-5825 for a Return Material Authorization (RMA) number.

Repackaging

You must return the equipment in a container that provides maximum protection during shipping and handling. If the original cartons and packaging material are no longer available, package the power converter and flashhead *separately* as described in the following subsections.

Power Converter

Package and ship the power converter on its back; that is, with the mounting plates downward against the bottom of the box. Pad the power converter so that the plates cannot penetrate the box during shipment. Box each power converter separately using a double thickness cardboard container and adequate padding. Do not drop. Use appropriate warning labels on the outside of the container.

Flashhead

Package and ship the flashhead in an upright position. Box each flashhead separately and use adequate padding. Attach the flashhead base to a plate measuring 20 inches square (e.g., 3/8” plywood). Use a double thickness cardboard (or wood) container that is 20 inches square by about 26 inches high (inside dimensions). Use soft packing or a cardboard collar around the lens to prevent tipping inside the container. Do not drop. Use appropriate warning labels on the outside of the container.

Table 4-1 PC 317 Power Converter Major Replaceable Parts

Item	Description	Part Number†
C1	Capacitor, 70 mfd	6727401
C3	Burst Capacitor, .5mfd	6848201
C4	Tuning Capacitor, 3mfd	6577903
F1, F2	Fuse, Power, 115V, 120V, FNM 8	‡4900307
F1, F2	Fuse, Power, 208V, 220V, 240V, FNM 4	4900303
F1, F2	Fuse, Power, 480V, KTK 8	4900335
K2	Mode Relay, 24 Volt	‡8328801
K3	Discharge Relay 120 Volt	‡8328802
L1	Burst Choke	4850601
L2	Flash Choke	4175200
BR1	Diode Bridge	6902806
PCB1	Timing and Trigger Board	†‡24063xx
PCB2	HV Rectifier Board	‡2458005
PCB3	Sense Module	2811101
R2	Burst Resistor 500 ohm, 50W	6900532
R1	Discharge Resistor 35K, 50W	6900541
S1, S2	Interlock Switch; 120V, 208V, 220V, 240V	4901220
S1, S2	Interlock Switch, 480V	8205501
TB2	Terminal Strip, 8 pos.	8721008
TB3, TB4	Terminal Strip, 11 pos.	8721011
TB201	Terminal Strip, 3 pos.	4902157
TB202	Terminal Strip, 18 pos.	4901930
T1	Power Transformer; 230V 50Hz	8842901
	Power Transformer; 120V	8841201
	Power Transformer; 240V	8841202
	Power Transformer; 480V	8841504
T3	Trigger Coupling Transformer	8336701
VR1	Suppressor Assembly, VARISTOR, 120V	†‡8250801
VR1	Suppressor Assembly, VARISTOR, 220V/240V	†‡8250802
VR1	Suppressor Assembly, VARISTOR, 480V	†‡8250804

† Call Customer Service for the questions about the correct part number for your equipment.
‡ Recommended as a spare part.

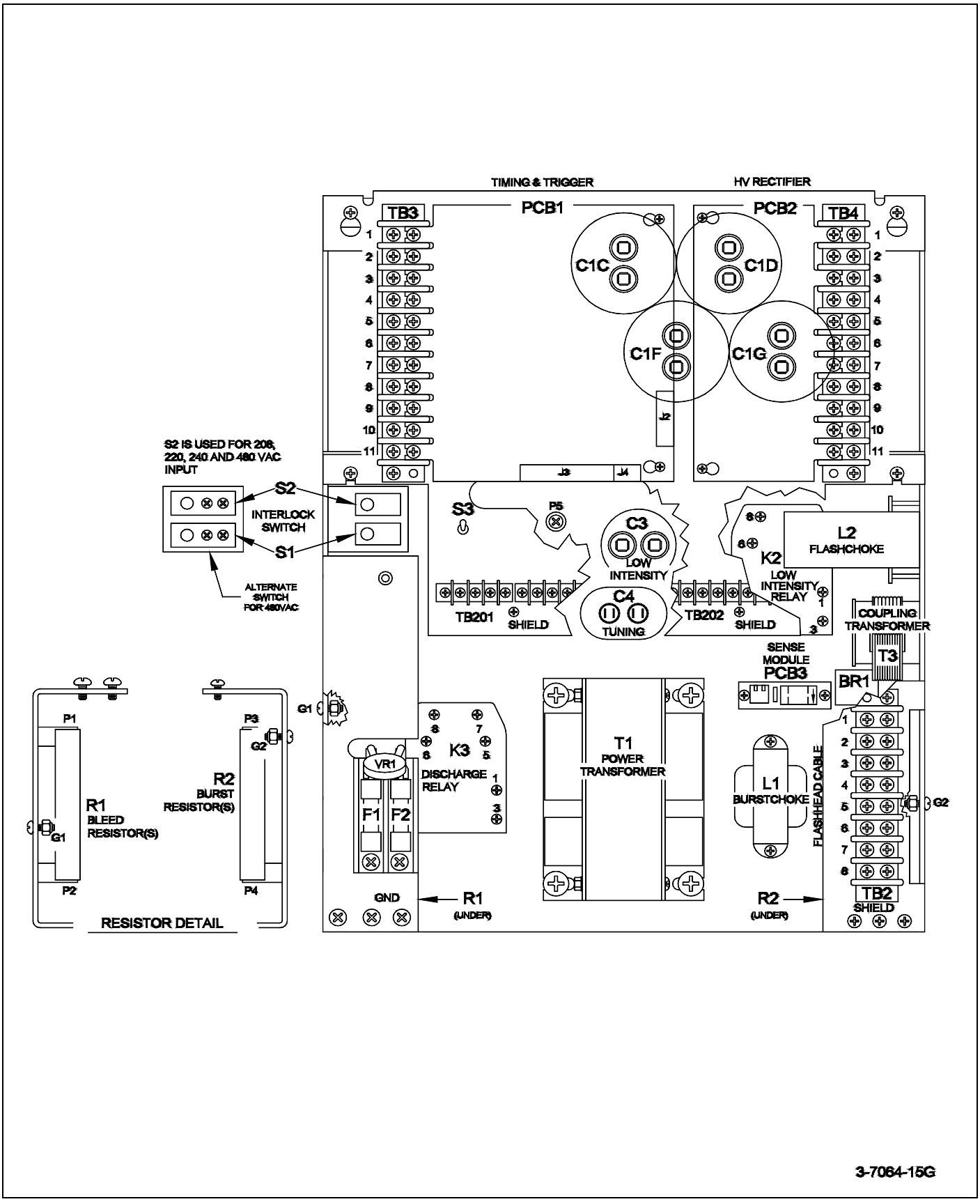

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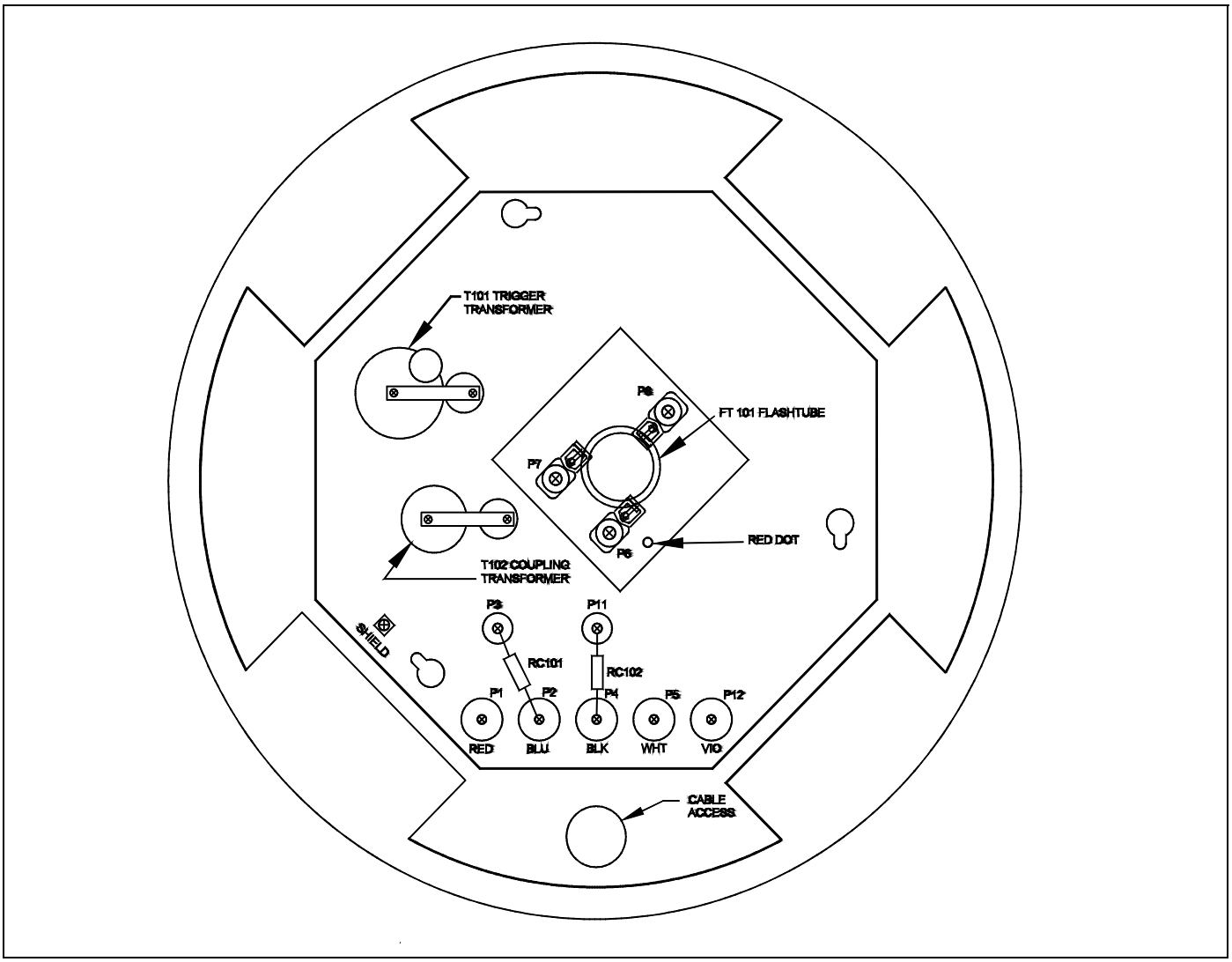
Figure 4-1 Power Converter Component Locations

Table 4-2 FH 308 Flashhead Major Replaceable Parts

Item	Description	Part Number
P1, P2, P4, P5, P12	Ceramic Spacer	5900844
P3, P11	Ceramic Spacer	5900842
P6, P7, P8	Ceramic Spacer	5900843
FT101	Flashtube	†8384329
-	Lens Cleaning Kit	8630801
RC101	R.C. Network	1403411
RC102	R.C. Network	1403412
T101	Transformer, Trigger	8288201
T102	Transformer, Coupling	8336701

† Recommeded as a spare part.



308CL

Figure 4-2 Flashhead Component Locations

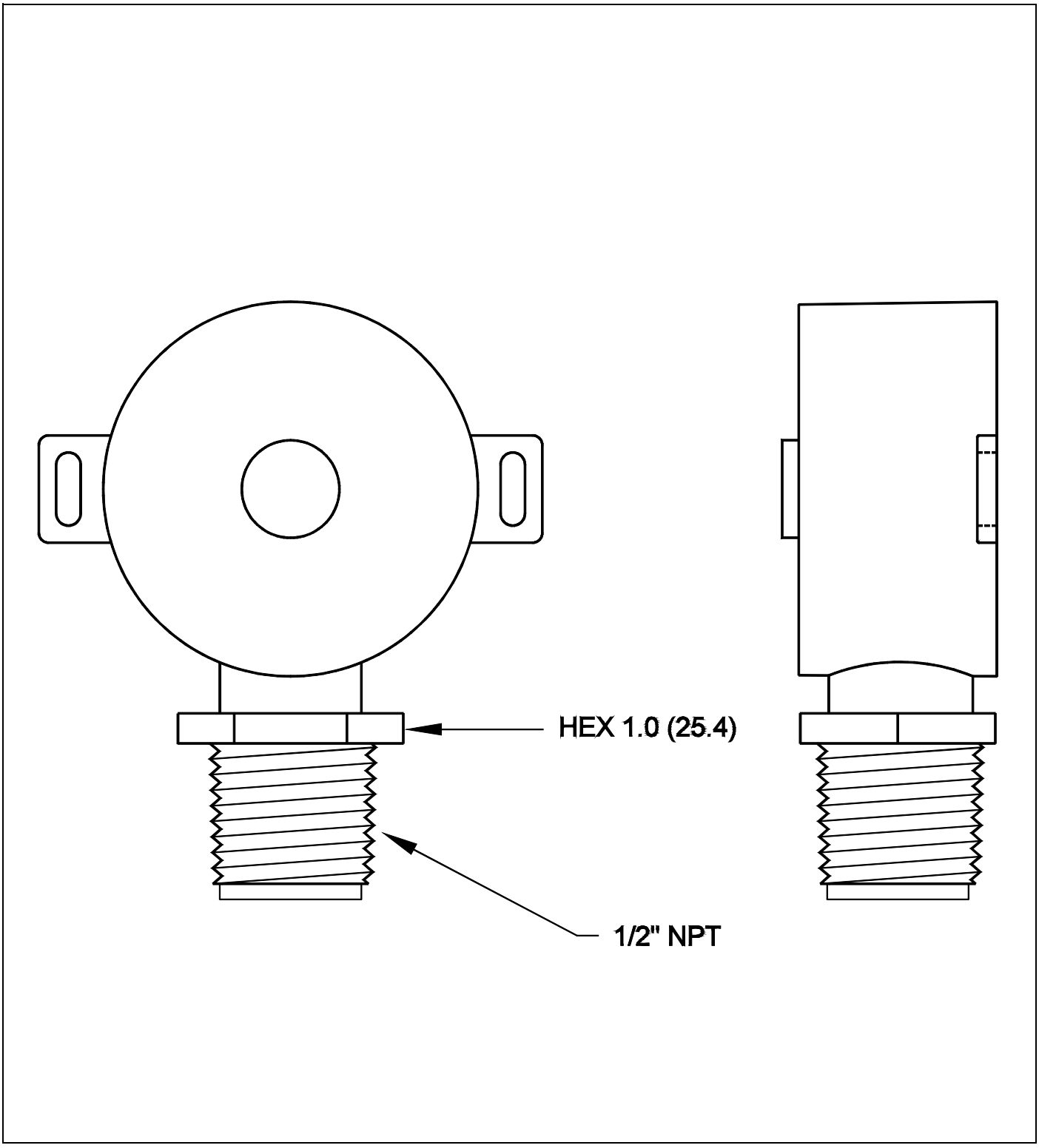


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Figure 4-3 Photocell Component Locations

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