FLASH TECHNOLOGY

FTS 400/800-4A

Approach Lighting Systems
Reference Manual
Part Number 7914008004A

SERIAL NUMBER

Flash Technology, 332 Nichol Mill Lane, Franklin, TN 37067
(615) 261-2000

Front Matter

Abstract

This manual contains information and instructions for installing, operating and maintaining the FTS 400/800-4A system.

Copyright

Trademark Acknowledgments

Flash Technology® is a registered trademark name.

All trademarks and product names mentioned are properties of their respective companies, and are recognized and acknowledged as such by Flash Technology.

Applicable Specifications

This equipment meets or exceeds requirements for an FAA Type L-849 / L-859.

Disclaimer

While every effort has been made to ensure that the information in this manual is complete, accurate and up-to-date, Flash Technology 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 reserves the right to revise this manual without obligation to notify any person or organization of the revision.

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

Warranty

Flash Technology warrants all components, under normal operating conditions, for two years.

Parts Replacement

This equipment is tested and certified by a third party testing laboratory to ensure compliance with FAA Advisory Circular 150/5345-51B for Type L-849 (Style A - F) and Type L-859 (Style B, D and F) lighting units for three-intensity, white, sequential flashing lights for use in approach lighting systems (ALS). The certification is valid as long as the system is maintained in accordance with FAA guidelines (doc. filed 9-08-10). The use of parts or components, in this equipment, not manufactured or supplied by Flash Technology voids the warranty and invalidates the certification.

Personnel Hazard Warning

Dangerous Voltages

Dangerous line voltages reside in certain locations in this equipment. Also, this equipment may generate dangerous voltages. Although Flash Technology 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. Check voltage at the flashhead output (Terminal Block 2, Terminals 1 & 3) 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.

UV Hazard Warning

Avoid eye and skin exposure to unshielded product.

UV radiation, whether from natural sunlight or artificial UV rays, can damage eye and skin tissue. Light output from this product is classified as "Risk Group 3" for actinic ultraviolet hazard (Es) and "Exempt Group" for all other hazard categories per Table 1 of IEC 62471-2/TR:2009. Flash Technology recommends the use of Personal Protective Equipment (PPE) such as UV blocking eyewear and protective clothing when servicing this product. Ultimately, viewer related risk is dependent on how the end user installs and uses this product.

Table of Contents

Front Matter ii
Abstract ii
Copyright ii
Trademark Acknowledgements ii
Applicable Specifications ii
Disclaimer ii
Warranty ii
Parts Replacement ii
Personnel Hazard Warning iii
Dangerous Voltages iii
Avoid Touching Live Circuits iii
Dangerous Voltages Can Persist with Power Disconnected iii
Do Not Depend on Interlocks iii
UV Hazard Warning iii
Table of Contents iv
List of Figures vi
List of Tables vi
Section 1 – Introduction and Operation 1
Introduction 1
Specifications 2
Lighting Unit Operation 2
Lighting Unit Intensity 3
Timing & Trigger Board (PCB 1) 3
Section 2 – Outline, Mounting, and Installation 5
Unpacking 5
Tools 5
Access 5
System Configurations 5
Mounting 6
Wiring 6
Installation Checklist 7
Section 3 – Maintenance and Troubleshooting 19
Preventive Maintenance 19
Storage 19
RFI Problems 19
Operation Checkout 19
Mode Control for Manual Operation 20
Troubleshooting 20
Component Testing 22
Inspection 22
Power Converter 22
Flashhead 23
Component Removal and Replacement 23
High Voltage Transformer (T1) 23
Trigger Coupling Transformer (T3) 23
Timing and Trigger Board (PCB1) 23

HV Rectifier Board (PCB2) 24
Energy Storage Capacitors 24
Section 4 – Replaceable and Spare Parts 25
Customer Service 25
Ordering Parts 25
Power Converter Parts and Spare Parts 25
Flashhead Parts 25
Returning Equipment 25
Repackaging 25
Section 5 – Programming PCB 1 (P/N 2904411) 31
Connecting the Handheld 31
Using the Handheld Programmer 32
Setup 32
Parameters 33
INFO 33
Mode Change 34
Return Material Authorization (RMA) Policy 35

List of Figures

Figure 1-1 PCB1 Timing and Trigger Board Pictorial 4
Figure 2-1 Recommended External Power Switching.. 8
Figure 2-2 Installation Wiring of an FTS 400/800A System with Four Lighting Units................. 9
Figure 2-3 PC 400/800A Power Converter Mounting and Outline 10
Figure 2-4 FH 400 Flashhead Mounting and Outline 11
Figure 2-5 FH 800 Flashhead Mounting and Outline 12
Figure 2-6 PC 400 and FH 400 Comounted Unit Mounting and Outline.................................... 13
Figure 2-7 PC 800 and FH 800 Comounted Unit Mounting and Outline.................................... 14
Figure 2-8 FH 400A or FH 800A Internal Wiring.. 15
Figure 2-9 FH 83F-2 Outline and Wiring.. 16
Figure 2-10 FH 83F-2 Sample Installation.. 17
Figure 2-11 Power Converter Internal Wiring..18
Figure 4-1 Power Converter Component Locations 27
Figure 4-2 FH 400 Flashhead Component Location.. 29
Figure 4-3 Flashhead Component Locations 30
Figure 5-1 Handheld Programmer 31

List of Tables

Table 1-1 PCB1 Board LEDs and Lamps.. 3
Table 3-1 Mode Control.. 18
Table 3-2 Observed Behavior 19
Table 3-3 Defective Component Locator Code from Table 3-2... 19
Table 3-4 T1 Transformer Voltages 20
Table 4-1 Power Converter Major Replaceable Parts.. 24
Table 4-2 Flashhead Replaceable Parts 26
Table 5-1 DB9 Connector.. 29

Section 1 – Introduction and Operation

Introduction

The FTS 400-4A and FTS 800-4A are white flashing systems for runway approach lighting applications. Each system consists of two or more lighting units and an FTC 183 controller. Each lighting unit consists of a power converter (PC) and its associated flashhead (FH). The power converter contains the circuitry necessary to convert input power to the voltages needed to operate the flashhead and other internal circuits. It also contains the timing and trigger board which communicates with the FTC 183 controller and directs operation of the flashhead. The flashhead contains the flashtube and minimal additional components required to generate the flash.

The **FTS 400-4A**, FAA Type L-849V / L-859V, is comprised of a PC 400-4A and an FH 400. The power converter flashes the flashhead at a rate of 60 flashes per minute and produces a beam covering 360 degrees horizontally and 8 degrees or more vertically. The lens directs the main part of the beam upward toward the airways while limiting stray light toward the ground. The flashhead is attached to the PC by a two inch threaded pipe. Leveling provisions for the flashhead are provided by 3 screws located on its base near the attachment point.

The **FTS 800-4A**, FAA Type L-849V, is comprised of a PC 800-4A and an FH 800. The power converter flashes the flashhead at a rate of 60 or 120 flashes per minute and produces a beam 30 degrees horizontally and 10 vertically. The flashhead is attached to a two-inch threaded pipe by a yoke that has provisions for horizontal and vertical aiming and locking.

The **FTC 183** controller directs the timing and flash intensity for up to 23 lights in a 50 Hz system and 28 lights in a 60 Hz system. It can be located up to 2500’ from the most distant lighting unit without additional consideration.

The **FH 83F-2** is used in MALSR or ALSF sequenced flashing approach lighting systems, or wherever inset lights are preferred over elevated lights. It is available for both voltage and current-driven applications and is compatible with all Flash Technology FTS 800 Series Unidirectional Approach Systems. It may be remotely controlled and monitored with the FTC 183 Airport Approach Lighting System Controller.

Note: See FTC 183-1 Reference Manual (Part Number F7911831) for additional details regarding system limits and controller location.

Specifications

		FTS 400-4A[1]	FTS 800-4A[1]	FH 83F-2[1]
Dims. [2], Weight: H x W x D, lbs. (mm, kg)	Co-mounted	29 x 25 x 14 in., 25 lbs 724 x 635 x 356 mm, 11.5 kg.	25 x 25 x 14 in., 25 lbs. 622 x 635 x 356 mm, 11.53 kg.	6.1 x 12 in. 16.5 lbs. (7.5kg)
	FH	16.5 x 13.5 x 13.5 in., 10 lbs. 419 x 343 x 343 mm., 4.5 kg	10.8 x 7.80 in., 4 lbs. 226 x 198 mm, 1.82 kg.	
	PC	12.3 x 19.5 x 13.5 in., 21 lbs. 311 x 494 x 341 mm, 9.53 kg.		
Power Requirements	Voltage/Frequency (Factory Set)	120/240 VAC 60 HZ 230 VAC 50 HZ		
	Volt-Amperes	300 VA Peak		
	Power at 60 FPM	105 W (High Mode) 65 W (Med. Mode) 50 W (Low Mode)	135 W (High Mode) 65 W (Med. Mode) 50 W (Low Mode)	
	Power at 120 FPM	NA	190 W (High Mode) 75 W (Med. Mode) 55 W (Low Mode)	
Flash Rate (Flashes Per Minute)		60	60/120	
Flash Intensity	High Medium Low	5,000 cd 1,500 cd 300 cd	15,000 cd 1,500 cd 300 cd	
Flash Coverage	Vertical Horizontal	8 degrees (minimum) 360 degrees	10 degrees (minimum) 30 degrees (minimum)	
CE Environmental Temperatures	Operational Range Capacitor Max. T1 Trans. Max.	-40^{o} to $+45^{o}$ C 80^{o} C 80^{o} C		

1. Call the Sales Department at 1-800-821-5825 for available options and system variations.
2. Heights include dimensions of the units only and do not include the distance from the bottom of each unit to the ground.

Lighting Unit Operation

The controller communicates with each lighting unit via two twisted pair cables; one for monitoring system operation and one for system control. A signal containing intensity and timing information is distributed by the controller to each lighting unit in the system. Each lighting unit contains a timing and trigger board (PCB 1) which receives the signal and initiates the flash at its programmed delay based on the lighting unit's position in the system.

The monitor lines transmit a signal back to the system controller indicating to the controller that the lighting unit has either flashed or failed to flash. LEDs located on the front of the controller indicate the status of each lighting unit in the system.

Lighting Unit Intensity

The intensity level of the lighting units is determined by the switch setting on the FTC 183 system controller. To manually change the intensity of the lights, move the rotary switch labeled CONTROL to the **L** (low mode), **M** (medium mode) or **H** (high mode) position. Setting the Control switch to **FLASH INHIBIT** stops the units from flashing but does not interrupt input power. Setting the Control switch to **REMOTE** allows control of system intensity by a remote device.

Timing & Trigger Board (PCB 1)

The timing and trigger board controls all functions of the lighting unit based on information received from the FTC 183 controller. The board is configured by the factory for flash rate and the lighting unit's position in the system. Seven LEDs and one neon lamp are provided to indicate the status of the lighting unit. Table 1-1 lists a description of each status indicator and Figure 1-1 provides a pictorial of PCB 1.

Each timing and trigger board requires two location numbers; one for light number and one for confirm. Light number determines where the light will flash in the sequential system. Number one (1) flashes first then number two (2) and so on. Lights that flash simultaneously, such as REILs A & B are programmed for the same light number.

Confirm number determines where in the sequence the light sends its flash confirm signal to the system controller monitoring the lights. Typically, the light number and confirm numbers are the same. Unlike the light number, the confirm number must be unique. Lights that flash simultaneously, such as REILs A & B must be programmed for different confirm numbers. For example if REIL lights A and B both flash at position 5, A should be assigned confirm number 5 and B should be assigned confirm number 6.

Note: When replacing PCB1, the replacement board must be configured to match the original board. Verify that the Board Selection jumper (JP2 – JP11) is set to the 4988 position before installation. Use the handheld programmer to configure the light and confirm numbers (see Section 5) or provide this information to the factory when requesting a replacement.

Table 1-1 PCB1 Board LEDs and Lamps

LED / Lamp	Name	Color	Indication
ALARM	I1	Red	Main alarm; follows alarm relay.
SYNC	I2	Green	A valid sync signal was received on the Control terminal (Pin 6).
CONF	I3	Green	A flash confirmation signal is present on the Monitor terminal (Pin 5).
NITE	I4	Green	NIGHT mode operation (low intensity) is active.
TWI	I5	Green	TWILIGHT mode operation (medium intensity) is active.
DAY	I6	Green	DAY mode operation (high intensity) is active.
Neon Lamp	I9	Clear	120 VAC trigger voltage. This lamp may flicker.
CONTROL	I10	Green	Flashes on and off when communicating with the controller.

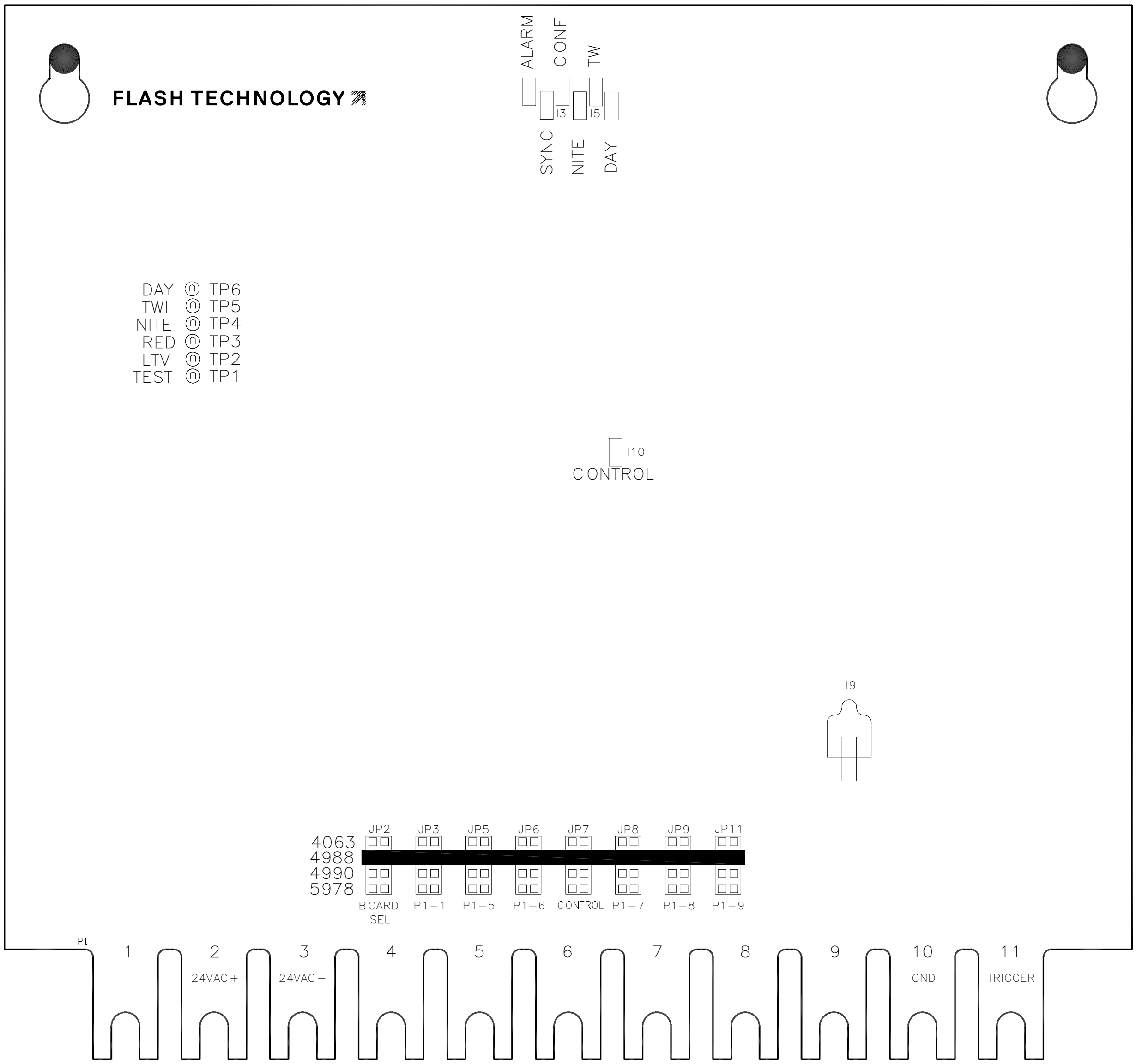


Figure 1-1 PCB1 Timing and Trigger Board Pictorial

Section 2 – Outline, Mounting, and Installation

The information in this section describes a typical installation only.

> **Note:** This section may not contain all installation information required for your site. Flash Technology 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.
>
> If installation drawings prepared specifically for your site disagree with information provided in this manual, the installation drawings should take precedence. Consult any site-specific installation wiring diagram supplied with your equipment.

Unpacking

Inspect shipping cartons immediately for signs of damage. Damage claims should be reported promptly to the freight handler. Verify the received equipment against the packing list to ensure completeness. Inspect each item for visible damage.

> **ATTENTION:** Each carton contains one light. The position at which the light is to be installed is marked on the shipping container and on the product data label located inside the power converter.

Tools

No special tools are necessary. The following hand tools are suggested for installation and maintenance:

- #2 Phillips-head screwdriver
- 9- or 12-inch (# 2 – 3/16"), flat-blade screwdriver
- 9- or 12-inch (# 3 – 5/16"), flat-blade screwdriver
- Medium, slip joint pliers
- 8-in. adjustable wrench
- Long-nose pliers
- Set of combination wrenches
- Assorted nut-drivers or sockets (1/4", 5/16", 3/8", 7/16")
- Universal terminal crimping tool
- Spanner wrench for 2-inch conduit locking nut
- Triplett™ Model 630-NA or equivalent analog voltmeter, or a digital meter with an averaging function.

Access

Wing-handle fasteners attach the power converter cover to its base plate. Rotate the handle counterclockwise to loosen the clamp.

System Configurations

The main configuration for an FTS 400/800-4A system is:

- A number of approach lights (ALS), also referred to as Runway Alignment Indicator Lights or RAIL lights. Each light consists of a flashhead and a power converter.
- An FTC 183 System Controller.

Each system configuration requires one FTC 183 Controller. See *Figure 2-2* for more information.

The product data label, located on the inside of the power converter, is numbered at the factory to indicate the lighting unit's position in the system. Light Number 1 is installed farthest from the runway threshold, and the highest numbered light is closest to the runway threshold. Pay particular attention to match the number indicated on the product data label to the correct location in the system.

Mounting

Each lighting unit consists of a power converter and a flashhead. The components may be mounted together forming a single chassis as shown in Figures 2-6 and 2-7 or separate if required. A mounting hole is provided in the base of the flashhead for a 2" NPT threaded pipe. If the installation requires the flashhead to be mounted separate from the power converter, the flashhead should be mounted utilizing this method. Frangible couplings, suitable for a comounted assembly, are available from Flash Technology.

Wiring

Figure 2-2 provides wiring guidelines for the system. This figure is for reference only and may not exactly agree with details in your installation. If installation drawings prepared specifically for your site disagree with information provided in this manual, the installation drawings should take precedence. Consult any site-specific installation wiring diagram supplied with your equipment.

> **ATTENTION:** This equipment is power phase sensitive. L1 and L2 must be wired to F1 and F2 in a consistent manner throughout the entire lighting system.

The wiring diagrams define minimum requirements and may not comply with all applicable electrical codes. It is your responsibility to comply with all prevailing electrical codes.

Use the following wiring guidelines:

- Flash Technology recommends 600V insulation on all wires that interconnect the system.
- Determine the wire gauge by considering service voltage, length of the wire run, and total load (number of lighting units). Use a value of 300 volt-amperes per lighting unit and do not permit the voltage drop caused by wire resistance to exceed 5% at any lighting unit. The FTC 183 Controller adds 25 watts to the total load.
- Use the value of 300 volt-amperes per lighting unit to determine the circuit breaker or the slow-acting fuse rating at the service disconnect box.
- Wire the primary power of the system through an external circuit breaker and power switch (see Figure 2-1).
- Control and monitor wires from the controller connect to the lighting units.
  a. Wire control lines to all Lighting Units in the system by using two #14 AWG (minimum) conductors twisted together at 6 turns per foot for control (Flash Technology part number 5993100).
  b. Wire monitor lines to all Lighting Units in the system by using two #14 AWG (minimum) conductors twisted together at 6 turns per foot for monitoring (Flash Technology part number 5993100).
- Flash Technology recommends a counterpoise consisting of solid copper.
- Flash Technology does not recommend grounding to the counterpoise for lightning protection.
- Ground all cases to a grounding rod. Flash Technology provides a grounding lug on each power converter base.

For more information, see *Figure 2-2*.

Installation Checklist

Complete the following steps before applying power:

1. Power Converter Mounting:

- Verify that the power converter is installed in the correct location.

  Note: The position at which the light is to be installed is marked on the shipping container and on the product data label located inside the power converter.

- Ensure that adequate clearance exists to open the cover and service the unit.
- Check hardware inside the enclosure to ensure that the chassis mounting screws and nuts are tight.
- Mount the power converter away from radio frequency interference (RFI).

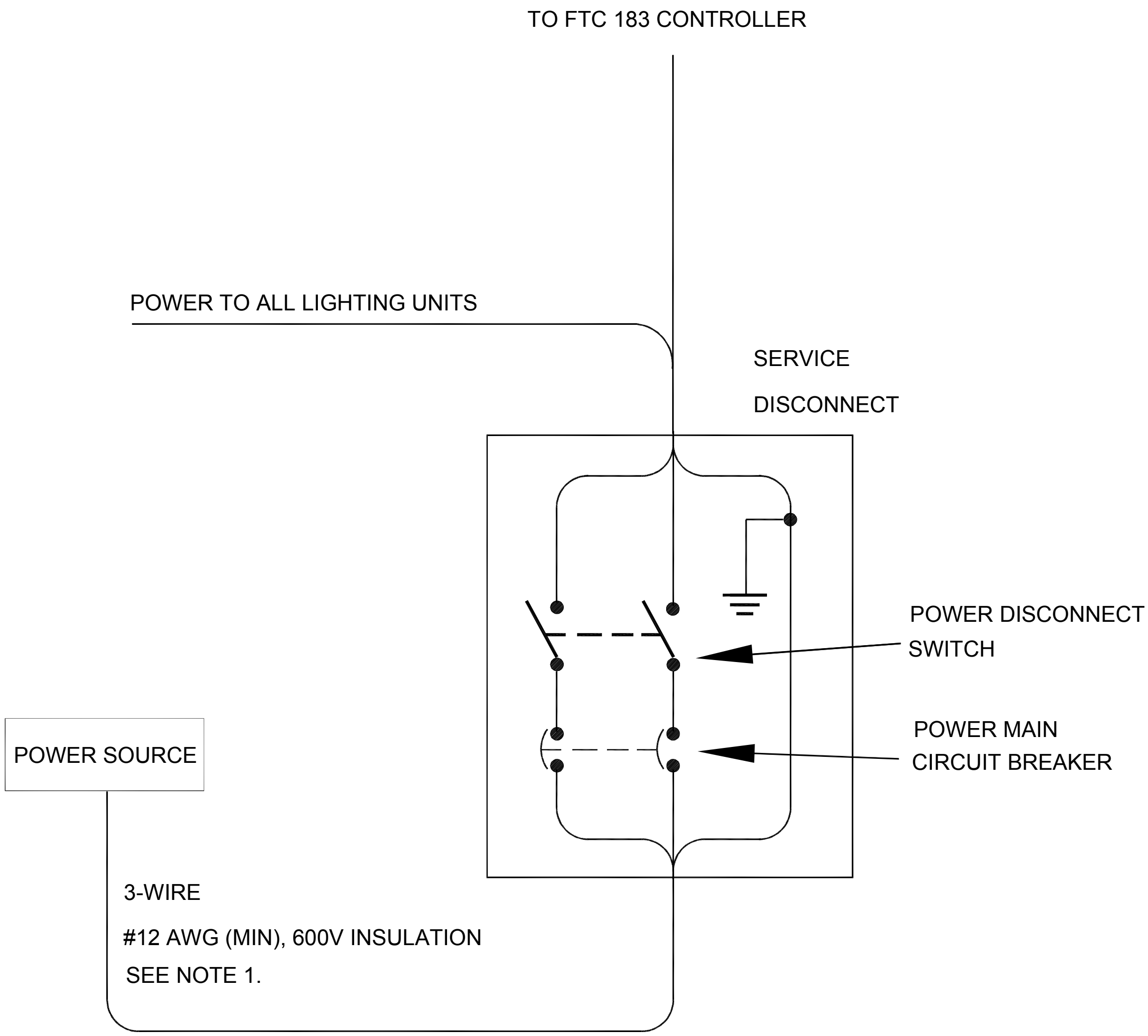
2. Power Converter Installation:

Examine the installation drawings and use the following guidelines:

- Check for proper incoming service power.
- Wire each unit according to the instructions.
- Ground the power converter to a grounding rod.
- Check all electrical connections for tightness.
- Check all terminal strip connections for tightness.

3. Flashhead Installation:

- Check the wiring of the flashhead cable to the flashhead.
- Check the aim of the flashhead (FH 800).
- After completing all the steps listed above, turn on the power and perform an operational checkout from procedures in Section 3 of this manual.



1. CONNECT ALL UNITS WITH THE SAME POWER PHASING:

   LINE 1 (HIGH) CONNECTS TO TB501 TERMINAL 1 IN THE CONTROLLER

   AND TO FUSE 1 IN THE POWER CONVERTERS OF ALL LIGHTING UNITS.

   DETERMINE POWER WIRE GAUGE:

   EACH LIGHTING UNIT = 200 VOLT-AMPERES

   EACH CONTROLLER = 25 WATTS

Figure 2-1 Recommended External Power Switching

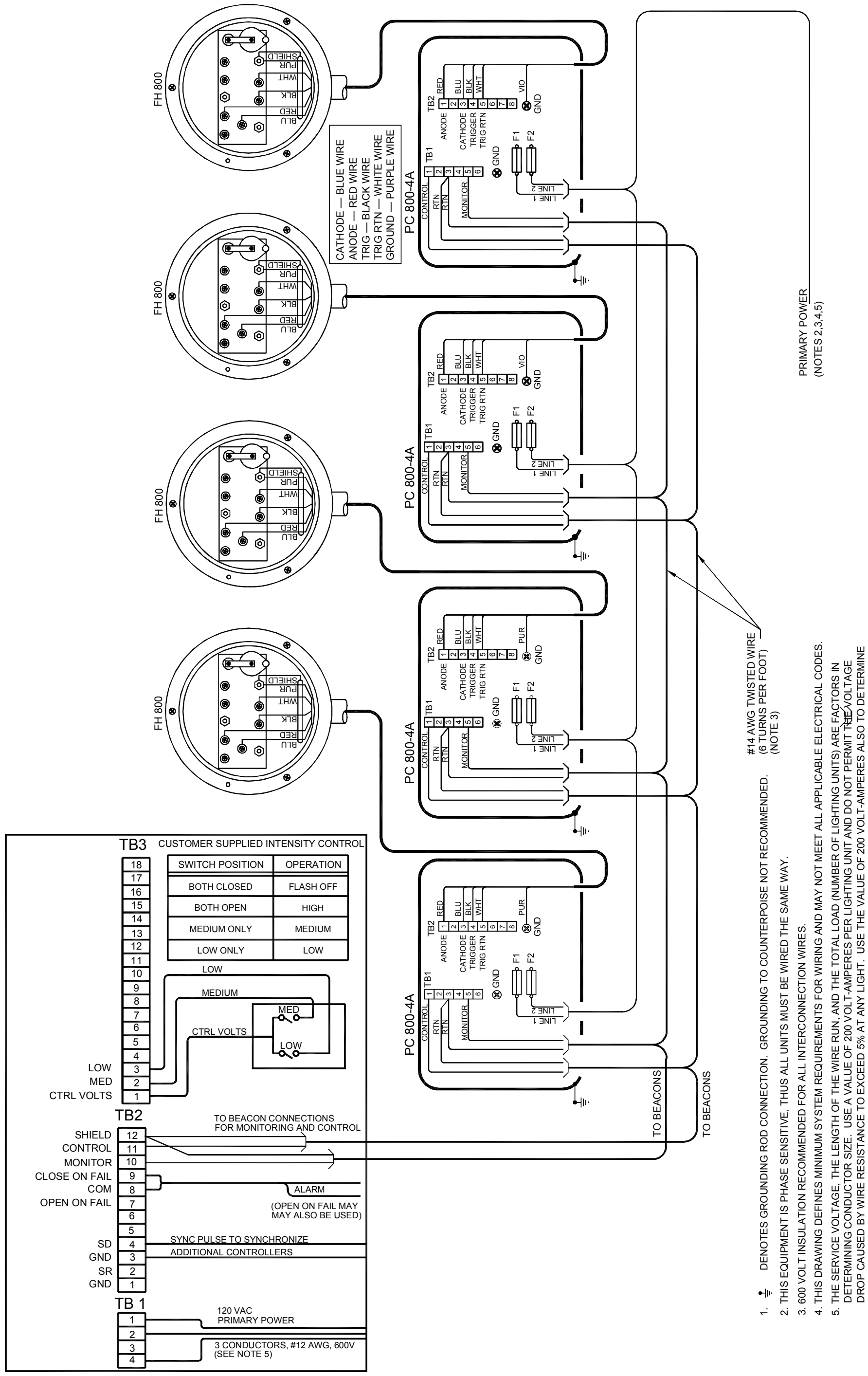


Figure 2-2 Installation Wiring of an FTS 400/800A System with Four Lighting Units
(FTS 800A shown)

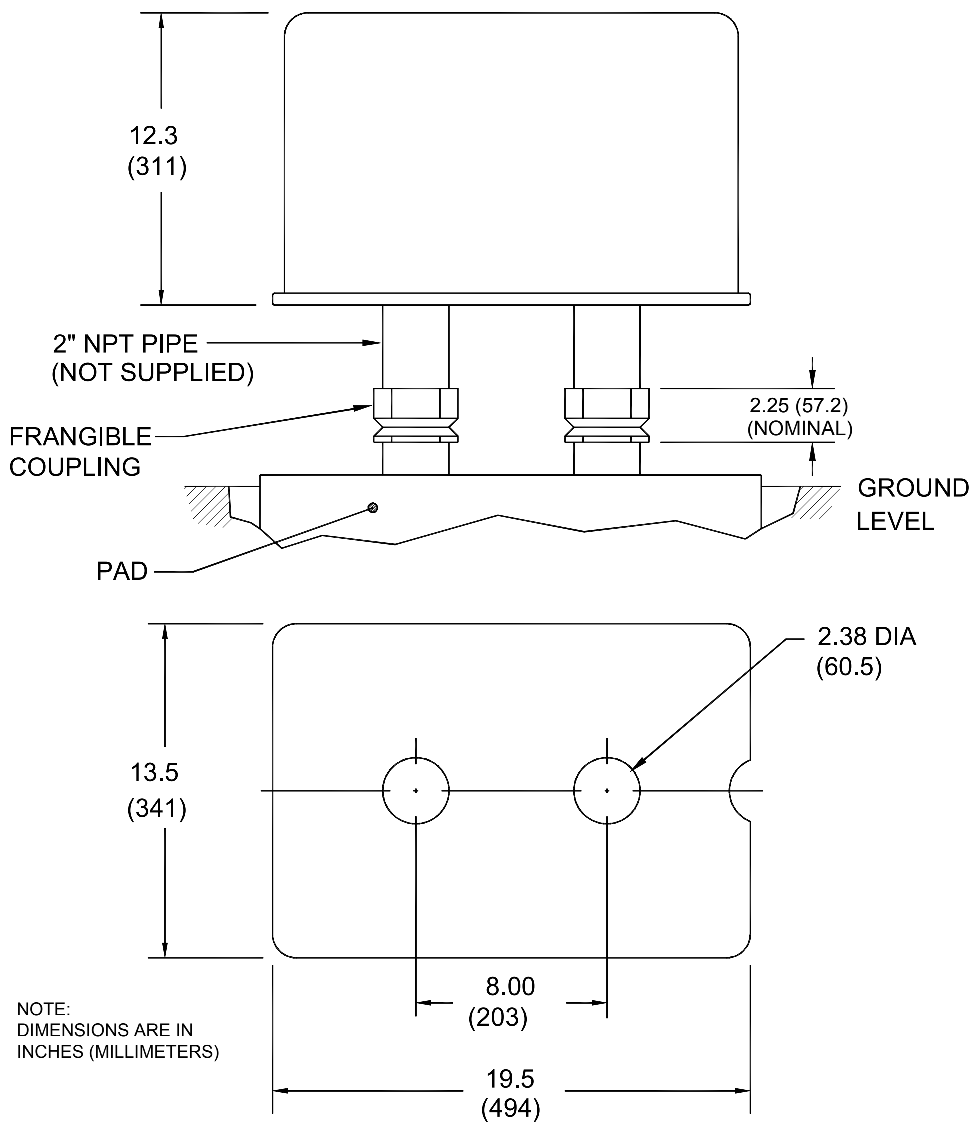


Figure 2-3 PC 400/800A Power Converter Mounting and Outline

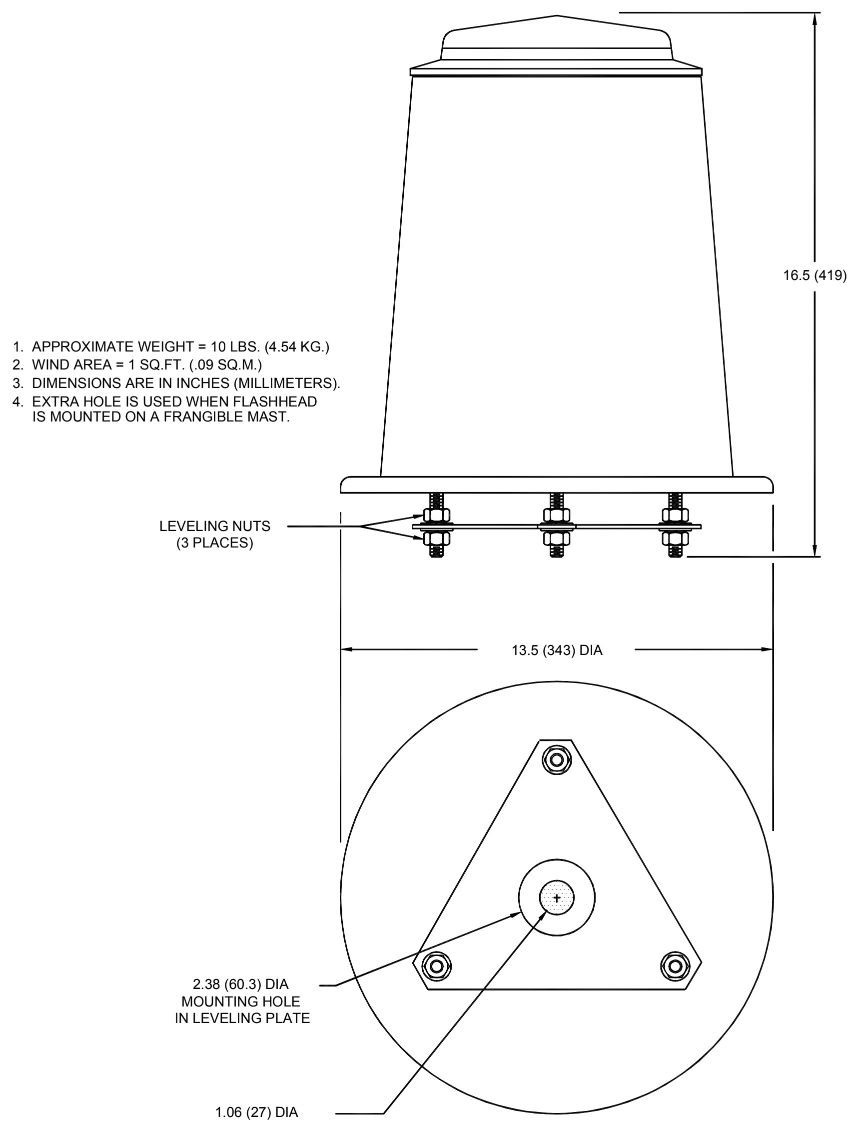


Figure 2-4 FH 400 Flashhead Mounting and Outline

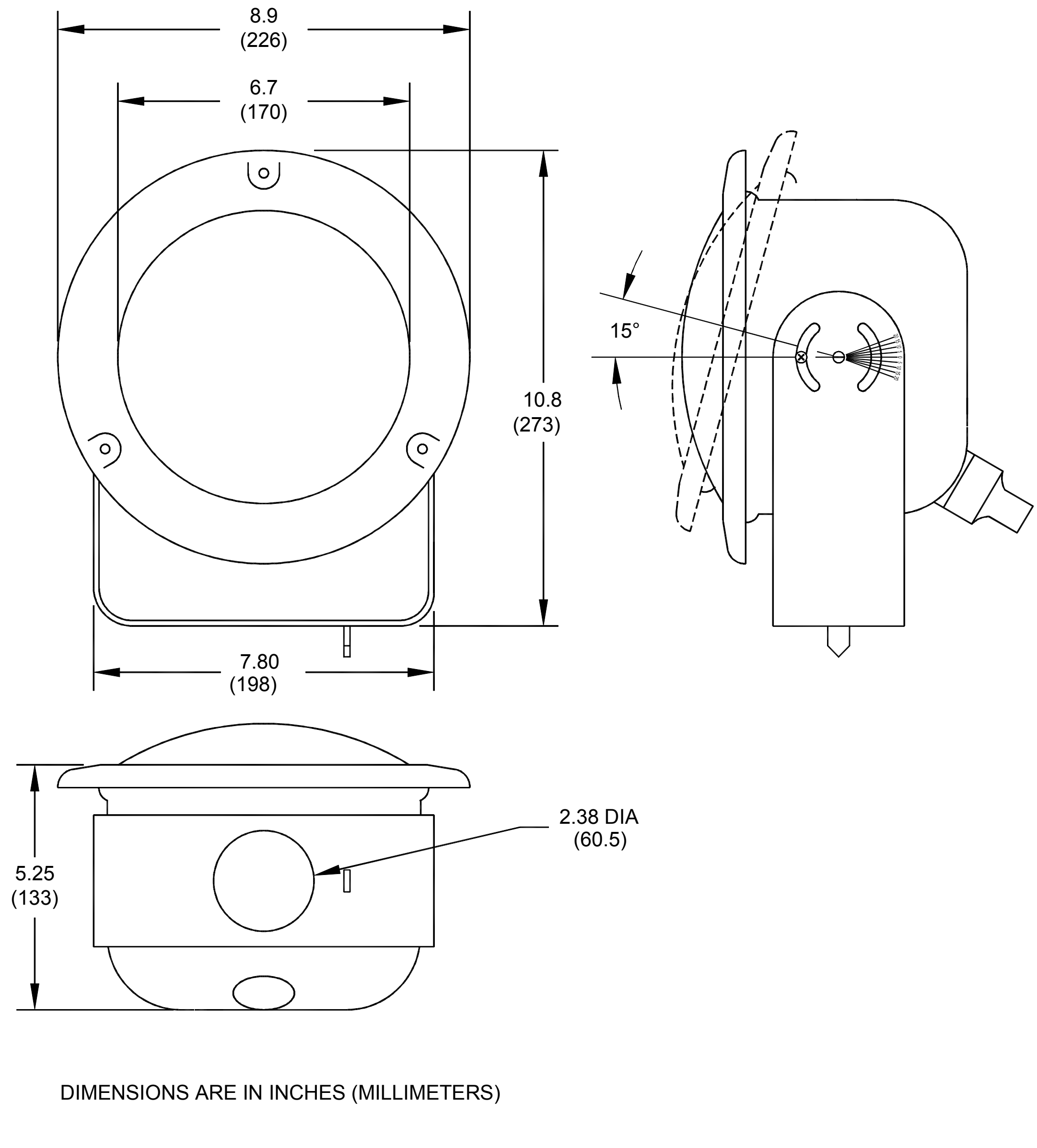


Figure 2-5 FH 800 Flashhead Mounting and Outline

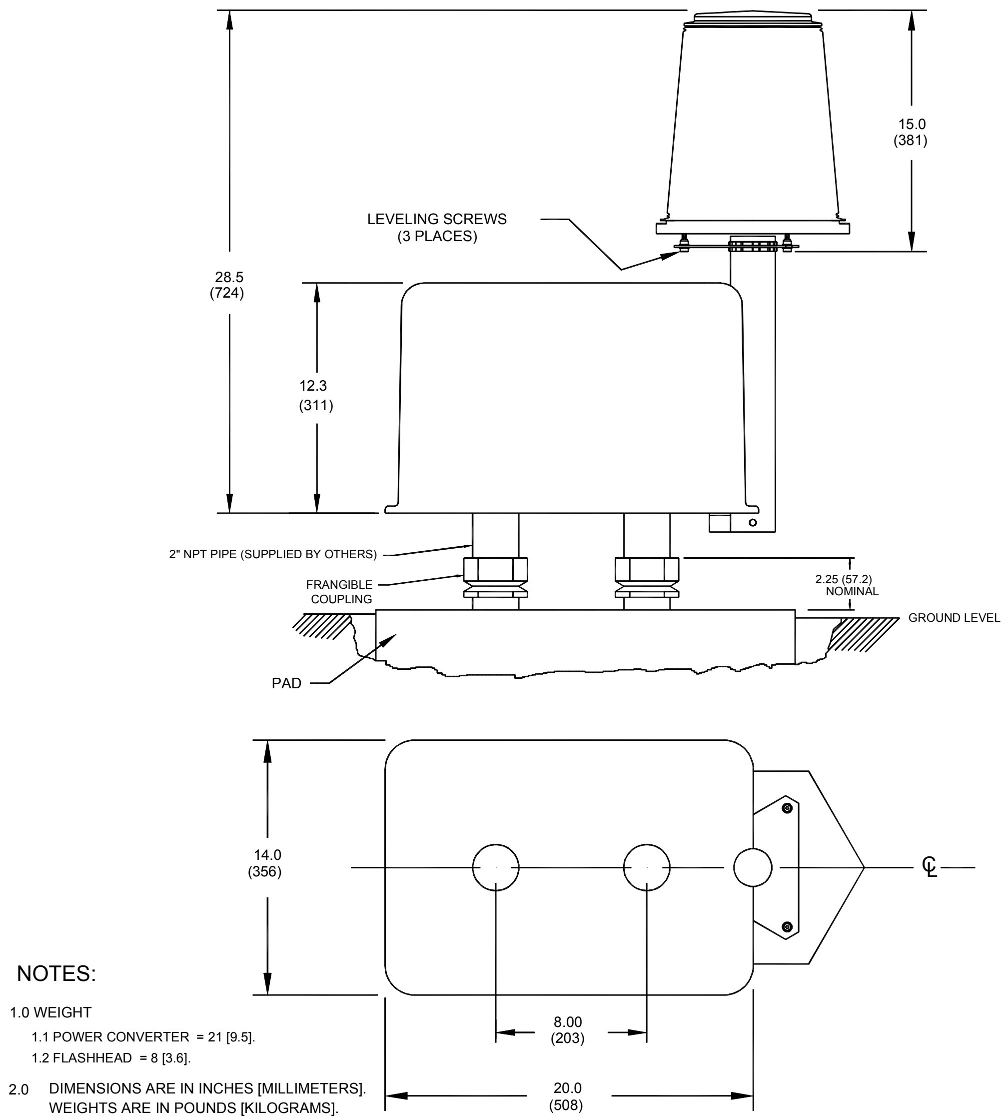


Figure 2-6 PC 400 and FH 400 Comounted Unit Mounting and Outline

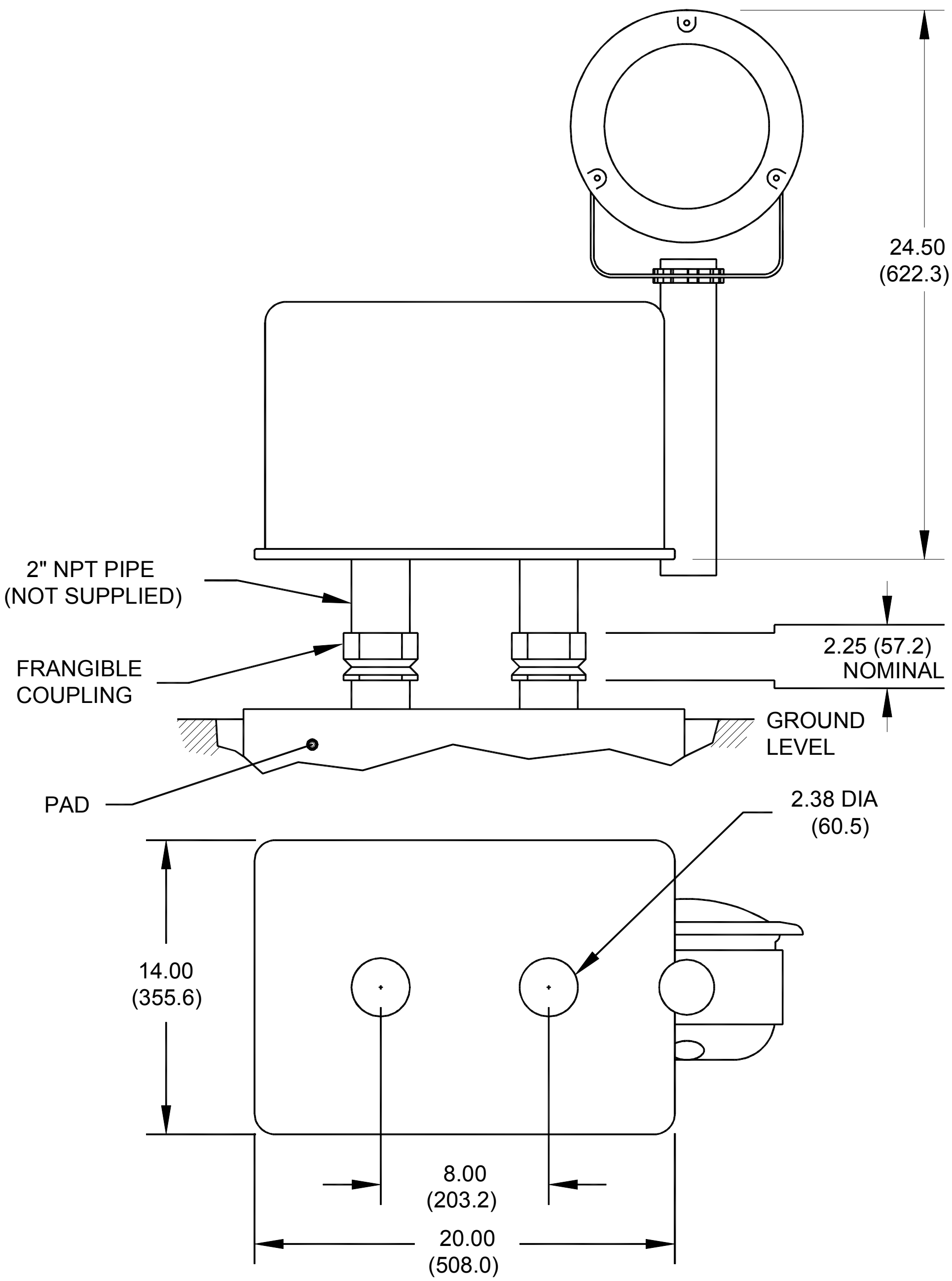


Figure 2-7 PC 800 and FH 800 Comounted Unit Mounting and Outline

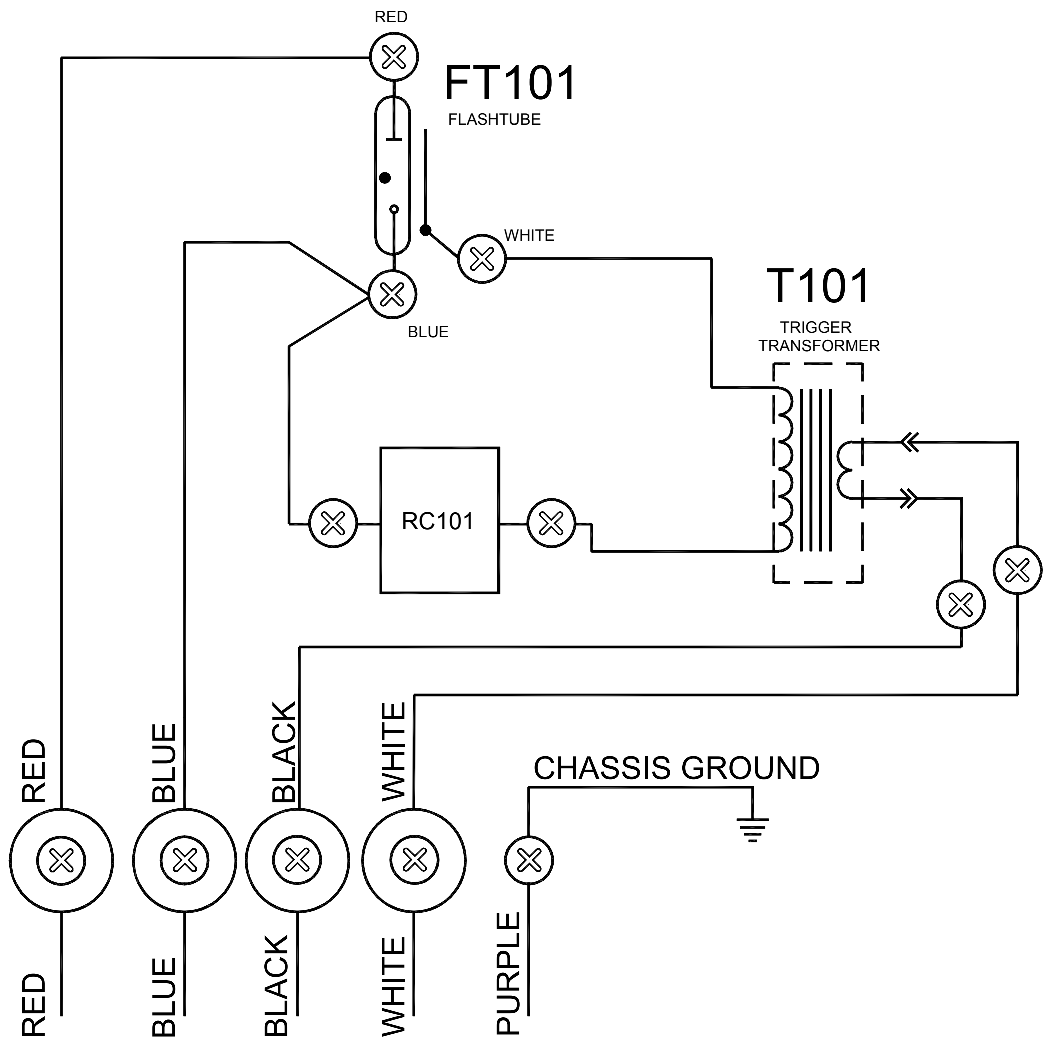
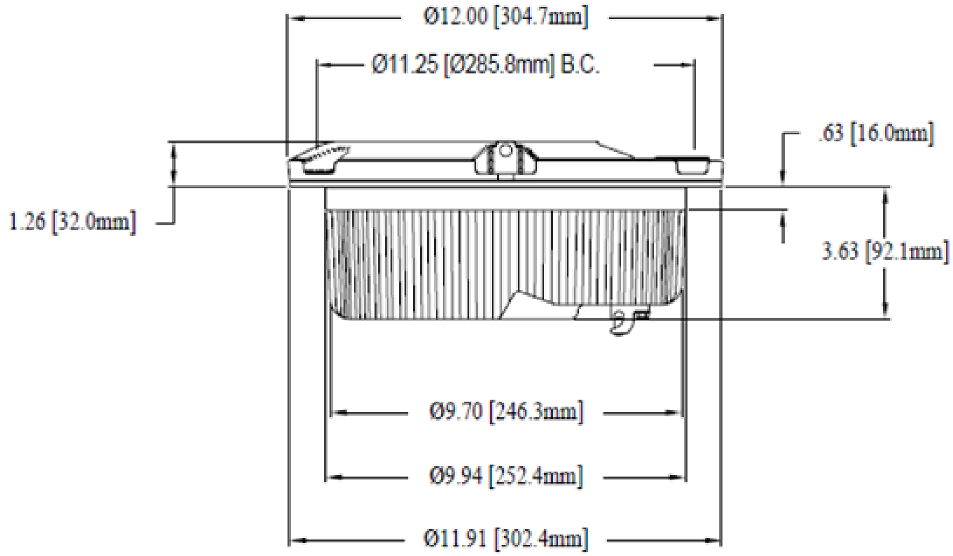


Figure 2-8 FH 400A or FH 800A Internal Wiring



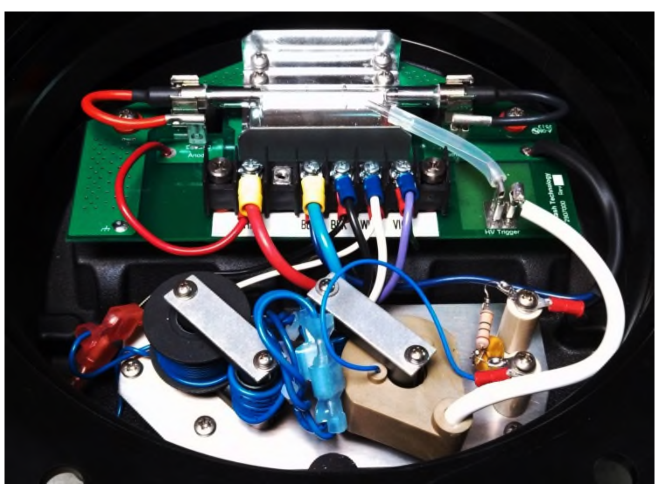
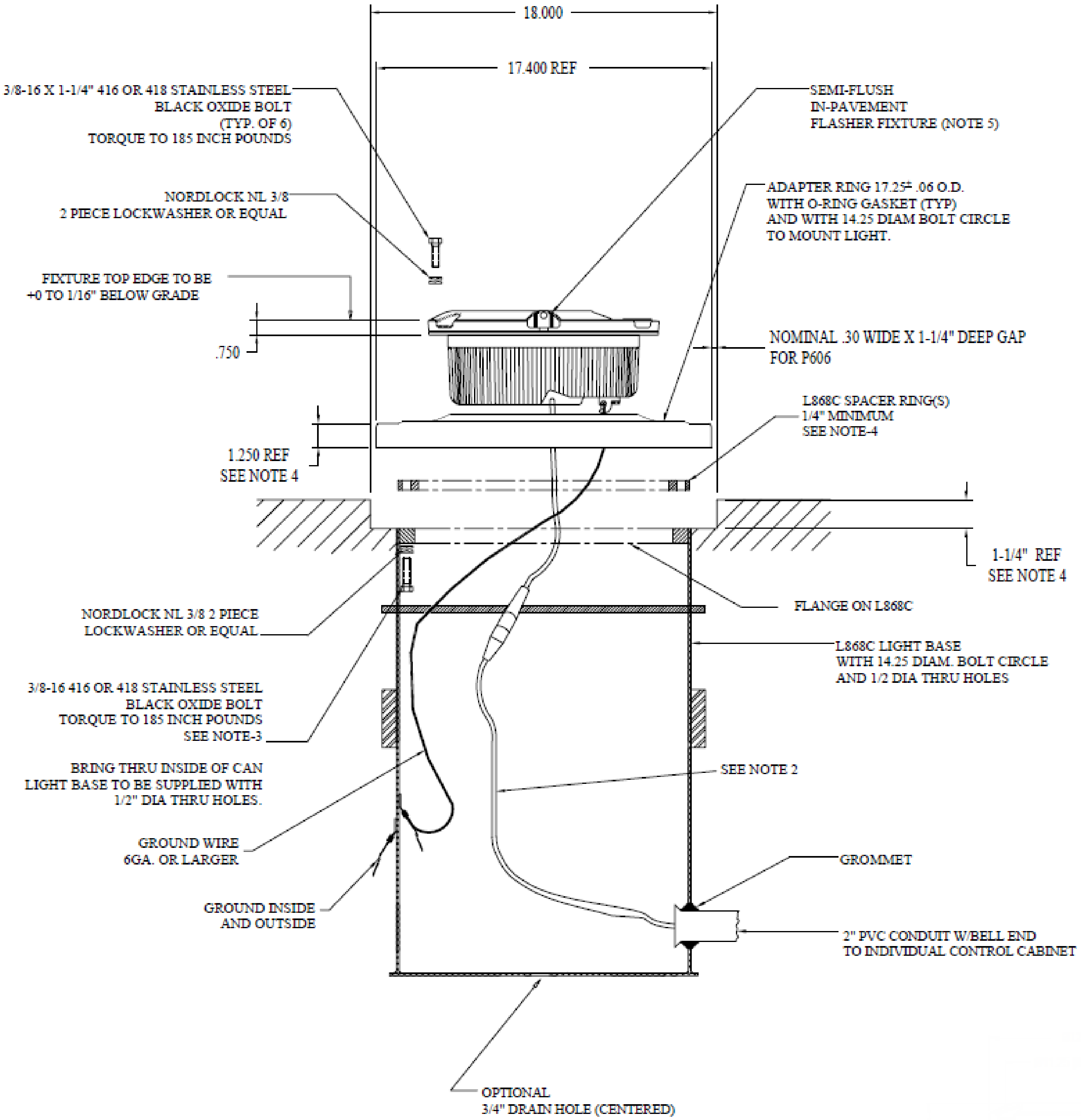


Figure 2-9 FH 83F-2 Outline and Wiring



ATTENTION!

THIS DRAWING IS ONLY INTENDED FOR USE AS GENERAL AIRFIELD SYSTEM DESIGN GUIDANCE. THE DESIGNER MUST VERIFY DESIGN WITH LOCAL CODES AND VARYING CHARACTERISTICS FOR EACH UNIQUE AIRFIELD APPLICATION.

Figure 2-10 FH 83F-2 Sample Installation

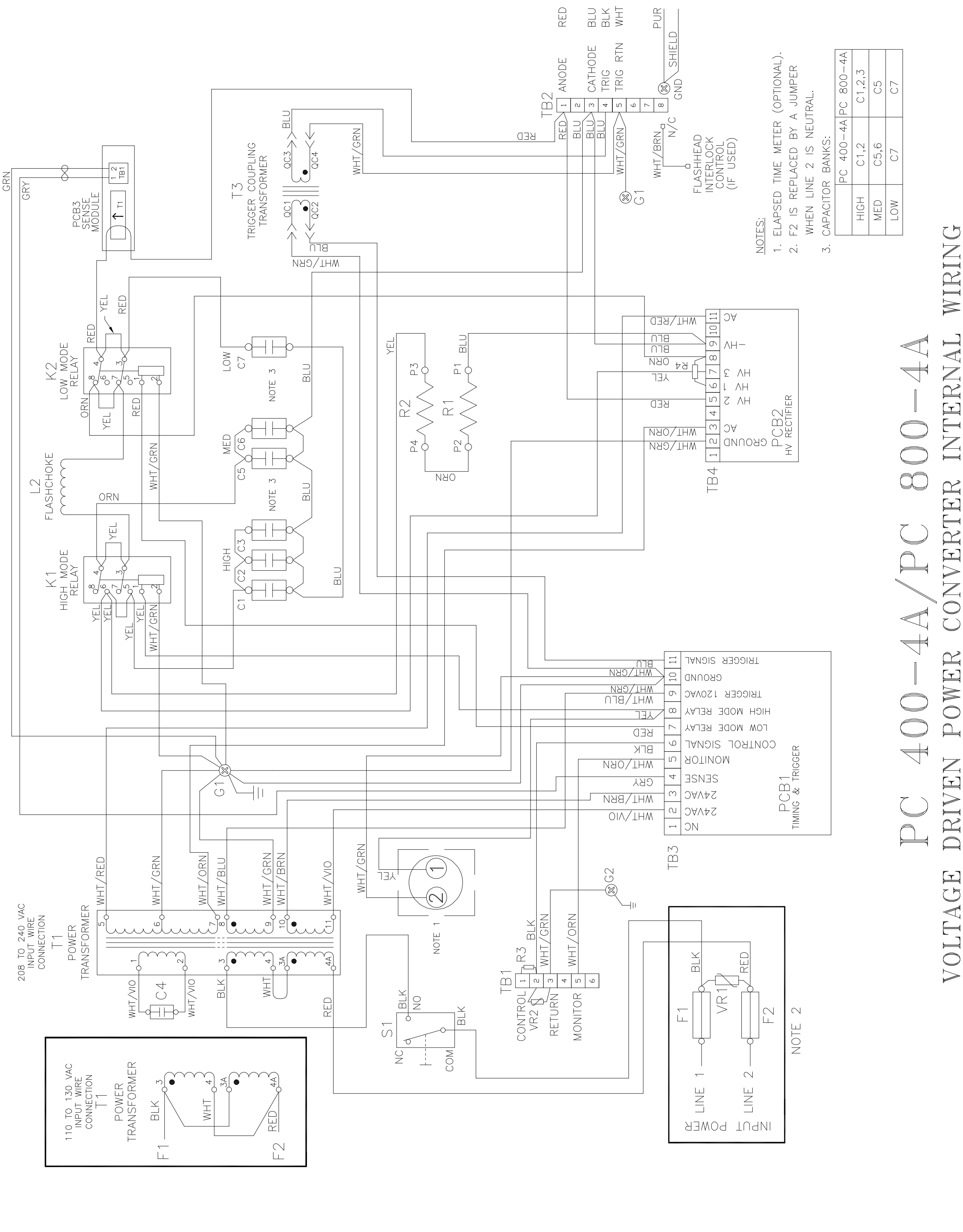


Figure 2-11 Power Converter Internal Wiring

Section 3 – Maintenance and Troubleshooting

Preventive Maintenance

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

1. Verify that moisture has not accidentally entered the equipment through gaskets or seals, or collected inside 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 that shows evidence of high-voltage damage.
4. Check flash tube 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.

Storage

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

RFI Problems

Presence of radio frequency interference (RFI) can cause a light to flash intermittently, at the wrong rate, or at the wrong intensity. RFI can enter the light 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.
- Strong RFI could burn out PCB1 components.

While Flash Technology designed the 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.

Operation Checkout

Use the controller and the following procedure:

- Ensure that power is applied to the entire system.

Note: During each of the following tests, check the LIGHT POSITION confirmation lights on the front panel of the FTC 183 controller. All active positions should be green for each light position flashing correctly. A red position indicates a failing light.

- Turn the intensity switch on the controller to **L**. The lights should all flash sequentially at low intensity.
- Turn the intensity switch on the controller to **M**. The lights should all flash sequentially at medium intensity.
- Turn the intensity switch on the controller to **H**. The lights should all flash sequentially at high intensity.
- Turn the intensity switch to **FLASH INHIBIT**. The lights should not flash.
- Observe the lights visually. The entire system should flash sequentially.
- If any light is failing, see “Troubleshooting”.

Mode Control for Manual Operation

Table 3-1 Mode Control explains how to force a single light to operate continuously at a fixed flash intensity (mode), information that is useful for troubleshooting the light to check its operation at all three flash intensities. You can also use the handheld programmer. See Chapter 5 for additional information regarding the handheld programmer.

Table 3-1 Mode Control

Intensity	Jumper Placement
HIGH	Between Test Point 1 (TP1) labeled Test and TP6 labeled DAY
MEDIUM	Between Test Point 1 (TP1) labeled Test and TP5 labeled TWI.
LOW	Between Test Point 1 (TP1) labeled Test and TP4 labeled NITE.
LTV	Factory use only. Causes continuous triggering. **Do not use.**

Note: See Figure 1-1 for the location of the Test Points referenced in Table 3-1. Be certain to remove any installed jumpers after all tests have been completed.

Troubleshooting

PERSONNEL HAZARD WARNING

Read the warning on Page iii.

Attention: Flash Technology recommends the use of PPE such as UV blocking eyewear and protective clothing when servicing this product. Viewer related risk is dependent on how the end user installs and uses this product.

Typically, failures can be divided into two categories:

- System-level malfunctions, where all lighting units exhibit the same abnormal behavior.
- Symptoms applying to one or more individual lighting units, but not to all of them.

Effective troubleshooting begins by observing the overall operation of the system. This often leads directly to a faulty component or other abnormal condition. System level malfunctions may be the result of a failed component or wiring related to the FTC 183 controller. Refer to the FTC 183 manual (Part Number 7911831) for troubleshooting information regarding the controller and overall system malfunction.

Table 3-2 lists many of the symptoms that a malfunctioning lighting unit might exhibit. In Table 3-3 these symptoms are correlated with components, assemblies, or conditions that, if defective or abnormal, could cause the lighting unit to behave as observed.

For example, assuming that the lighting unit does not flash at all but some of its circuits are still operating; that is, fuses are not blown, relays operate, and so forth. This behavior is symptom C in *Table 3-2*. *Table 3-3* indicates that a defective timing and trigger board would most likely cause symptom C behavior. The next most likely cause would be a defective rectifier board. The third would be the LOW mode capacitor, and so forth. Each item in *Table 3-3* is listed in the order of its likelihood of causing the failure.

Note: See Component Testing (this section) for test procedures regarding individual system components.

Table 3-2 Observed Behavior

OBSERVED BEHAVIOR			
Symptom Code	**Flash Observation**		**Comments**
	High / Med Intensity	**Low Intensity**	
A	No	No	All circuits are dead.
B	No	No	Repeatedly blows line fuses.
C	No	No	Some circuits are functioning.
D	No Flash	No Flash	No flash.
E	OK	OK	Out of sequence.
F	Weak	OK	Sometimes skips a flash.
G	OK	OK	Erroneous fail.

Table 3-3 Defective Component Locator Code from Table 3-2.

Item No.	**Component**	**Codes**						
		A	**B**	**C**	**D**	**E**	**F**	**G**
C1	Main Capacitor Bank			5	5			
C2	Low Mode Capacitor			4	4			
C3	Tuning Capacitor						1	
F1, F2	Fuse	1						
FT 101	Flash tube			7	6		2	
K2	Mode Relay							
PCB1	Timing and Trigger Board			3	2	3		2
PCB 2	HV Rectifier Board			2	3			
S1	Interlock Switch	2						
T1	Power Transformer	3	2	6				
T2	Sense Transformer							1
T101	Trigger Transformer			8	7		3	
VR1	Suppressor Assembly		1					
-	Open Control Line				1			
Footnote 1						1		
Footnote 2					8	2		
Footnote 3			3	1				

1. Boards not installed in the assigned locations for the correct sequence.
2. Check for RFI (see Section RFI Problems).
3. Check for a short circuit in the 24 VAC or 120 VAC secondary windings of the power transformer.

Component Testing

Always make resistance measurements with the power turned off. Voltage measurements require power to be on; 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.

PERSONNEL HAZARD WARNING

Read the warning on Page iii.

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

Inspection

Closely inspect the units and check the connections against the installation instructions. Also, a close inspection may reveal insulation breakdown, an overheated component, corrosion, loose connections, faulty relays, incorrect connections, and so forth.

Wires or cables that move repeatedly will ultimately break. Ensure that all cables (the flashhead cable in particular) are securely fastened at short intervals to the structure or other supports.

Power Converter

Capacitors (C1, C2, C3)

Test capacitors with an ohmmeter capable of measuring one megohm or greater, using the following procedure.

Resistance measured between the terminals of a fully discharged capacitor is initially zero and increases steadily with time if you leave the ohmmeter leads connected across the terminals. Eventually, an open circuit condition occurs. The time it takes for the complete transition from zero to maximum depends on the total amount of capacitance.

A capacitor disconnected from other circuitry is defective if it does not exhibit this behavior. Manually discharge the capacitor before repeating this measurement. This procedure may not detect a failure that occurs at high voltage only. Please note that the final measured resistance across C1 is limited to 100K ohms unless you disconnect the safety bleed resistor R1.

Relays (K1, K2)

A malfunctioning relay may have faulty contacts, a sticky mechanism, or a defective coil. You may determine the first two possibilities by inspection and by manually exercising the armature. Perform the following resistance measurement to confirm a defective coil:

1. Remove PCB1.
2. Measure coil resistance between TB3-7 and the chassis to test Low Mode Relay K2.
3. Measure coil resistance between TB3-8 and the chassis to test High Mode Relay K1.

The measured coil resistance in either case should be approximately 290 ohms.

High Voltage Rectifier Board (PCB2)

Replace PCB2 with one known to be in good condition.

High Voltage Transformer (T1)

To test this transformer, first remove PCB1 and PCB2. Apply power to the unit and measure secondary winding voltages at the terminals indicated.

Table 3-4 T1 Transformer Voltages

Terminals	Voltage Range
TB4-3 to TB4-11	900-1050 VAC[1]
TB3-9 to chassis	100-120 VAC
TB 3-2 to TB3-3	22-28 VAC

1. Check tuning capacitor C4 if this AC voltage is substantially below the specified min. value.

Trigger Coupling Transformer (T3)

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.

Timing and Trigger Board (PCB1)

Replace this circuit board with one known to be in good condition. Program the replacement board to match the original board. The light and confirm number should be written on the original board. Be sure to write the numbers on the replacement board as well. Refer to chapters 1 and 5.

Bleed Resistor (R1)

The measured resistance of this component should be 100,000 ohms.

Interlock Switch (S1)

Try adjusting the switch bracket. The switch should clearly read zero ohms when it is closed and infinite ohms when it is open.

Flashhead

Flash tube (FT101)

Visually inspect the flash tube for broken electrodes, cracked glass, and the solder connections of the pins. A darkened envelope does not necessarily mean the light output would be unacceptable. Before concluding that a faulty flash tube is responsible for an inadequate flash, first rule out other possible causes such as weak or absent discharge voltage or triggering pulses.

Component Removal and Replacement

This section contains instructions for removal and replacement of most major replaceable components. Section 4 provides component location diagrams for assembly and disassembly. Section 2 provides an internal wiring diagram of the FH 400/800 flashhead and the PC 400/800-4A power converter.

High Voltage Transformer (T1)

Removal

1. Disconnect wires leading to the transformer.
2. Remove four screws holding the transformer to the chassis and remove the transformer from the chassis.

Replacement

Reverse the Removal procedure.

Trigger Coupling Transformer (T3)

Removal

1. Disconnect the wires to quick-connect QC1 and QC4. Note the orientation of the wires (top wire of the primary or secondary coil).
2. Remove the two 4-40 x 2" Phillips-head screws holding the transformer assembly to the bracket.
3. Remove the transformer.

Replacement

1. Reinstall the transformer assembly to the bracket using the two long screws. Ensure that the wires have the same orientation on the core.
2. Reattach the electrical wires. Verify that wiring is correct.

Timing and Trigger Board (PCB1)

Removal

1. Loosen, but do not remove, all eleven screws holding the circuit board to TB3.
2. Loosen, but do not remove, the screws at the top that hold the board to the front of the chassis and lift the board from TB3.

Replacement

1. Reverse the Removal procedure.
2. Program the new board. (See Section 5 for programming instructions).

HV Rectifier Board (PCB2)

Removal

1. Loosen, but do not remove, all eleven screws holding the circuit board to TB4.
2. Loosen, but do not remove, the screws at the top that hold the board to the front of the chassis and lift the board from TB4.

Replacement

Reverse the Removal procedure.

Energy Storage Capacitors

Removal

1. Disconnect the wires leading to the capacitors.
2. Remove the hold-down screws. Lift capacitors from their receiving holes and away from the chassis.

Replacement

Insert capacitors into their respective receiving holes. Replace hold-down screws to secure capacitors to the chassis. Reconnect wires to capacitors and verify that wiring agrees with the internal wiring diagram in Section 2. Wires must be replaced exactly as removed. In some instances, a quick-connect wire terminal does not seat properly if it is not placed on the terminal cluster exactly as it was before removal. Sometimes the insulation on the wire terminal interferes with the insulation surrounding the terminal cluster on the capacitor.

Section 4 – Replaceable and Spare Parts

Customer Service

Technical Assistance	(800) 821-5825
Telephone:	(615) 261-2000
Facsimile:	(615) 261-2600

Shipping Address:
Flash Technology
332 Nichol Mill Lane
Franklin, TN 37067

Ordering Parts

To order spare or replacement parts, call the Flash Technology Parts Department @ 1-800-821-5825.

Power Converter Parts and Spare Parts

Table 4-1 lists the major replaceable and recommended spare parts for the power converter.

Flashhead Parts

Table 4-2 lists the major replaceable and recommended spare parts for the flashhead.

Returning Equipment

A Return Material Authorization (RMA) number is required for all equipment returned to Flash Technology. See Return Material Authorization, located at the end of this document, for complete details regarding the RMA process.

To obtain an RMA number, please have the equipment serial number and/or sales order number available and call Technical Support @ 1-800-821-5825.

Repackaging

Equipment must be returned in a container that provides maximum protection during shipping and handling. If the original cartons and packaging material are no longer available, package the lighting unit as follows:

Power Converter

Package and ship the power converter in an upright position; that is, with the base downward. Pad the power converter so that corners cannot penetrate the box during shipment. Each power converter should be packaged separately using a double thickness cardboard container and adequate padding. Do not drop. Use appropriate warning labels on the outside of the container.

Flashhead

If sent separately from the power converter, the flashhead should be packaged in a strong, corrugated cardboard box with enough firm padding surrounding it to prevent damage.

Table 4-1 Power Converter Major Replaceable Parts

Unit	Description	Part Number	Quantity
All	Capacitor, Low Intensity, C1, 15 mfd	6731301	1
PC 400A	Capacitor, High Intensity, C2, 40 mfd	6386504	1
PC 800A	Capacitor, High Intensity, C2, 70 mfd	6720401	1
PC 800A	Capacitor, High Intensity, C3, 8 mfd	6731201	1
All	Capacitor, Tuning, C4, 3 mfd.	6577903	1
All	Capacitor, High Intensity, C5, 15 mfd	6731301	1
PC 400A	Capacitor, High Intensity, C6, 15 mfd	6731301	1
PC 400A	Capacitor, Medium Intensity, C7, 8 mfd	6731201	1
PC 800A	Capacitor, Medium Intensity, C7, 4 mfd	6534702	1
All	Choke, Flash, L2	4175200	1
All	Timing and Trigger Board, PCB1	2904411	1*
All	Enclosure	3727901	1
All	Fuse, Power (F1, F2)	4900303	1
All	HV Rectifier Board, PCB2	2458002	1*
All	Interlock Switch, S1	4901220	1
All	Resistor, R1	6900541	1
All	Resistor, R2	6900542	1
All	Resistor, R3 & R4	8435211	2
All	Relay, Mode (K1, K2)	8900494	2*
All	Sense Module, PCB3	2811101	1
All	Suppressor, VR1	8250803	1
All	Suppressor, VR2	8250801	1
All	Transformer, Power, T1 60 Hz, 120 VAC Transformer, Power, T1 60 Hz, 230/240 VAC	8841203 8841204	1 1
All	Transformer, Power, T1 50 Hz, 230/240 VAC	8842903	1
All	Transformer, Trigger Coupling, T3	8336701	1
All	Terminal Strip, 6-position, TB1	8721006	1
All	Terminal Strip, 8-position, TB2	8721008	1
All	Terminal Strip, 11-position, TB3, TB4	8721011	2

*Recommended as a spare part.

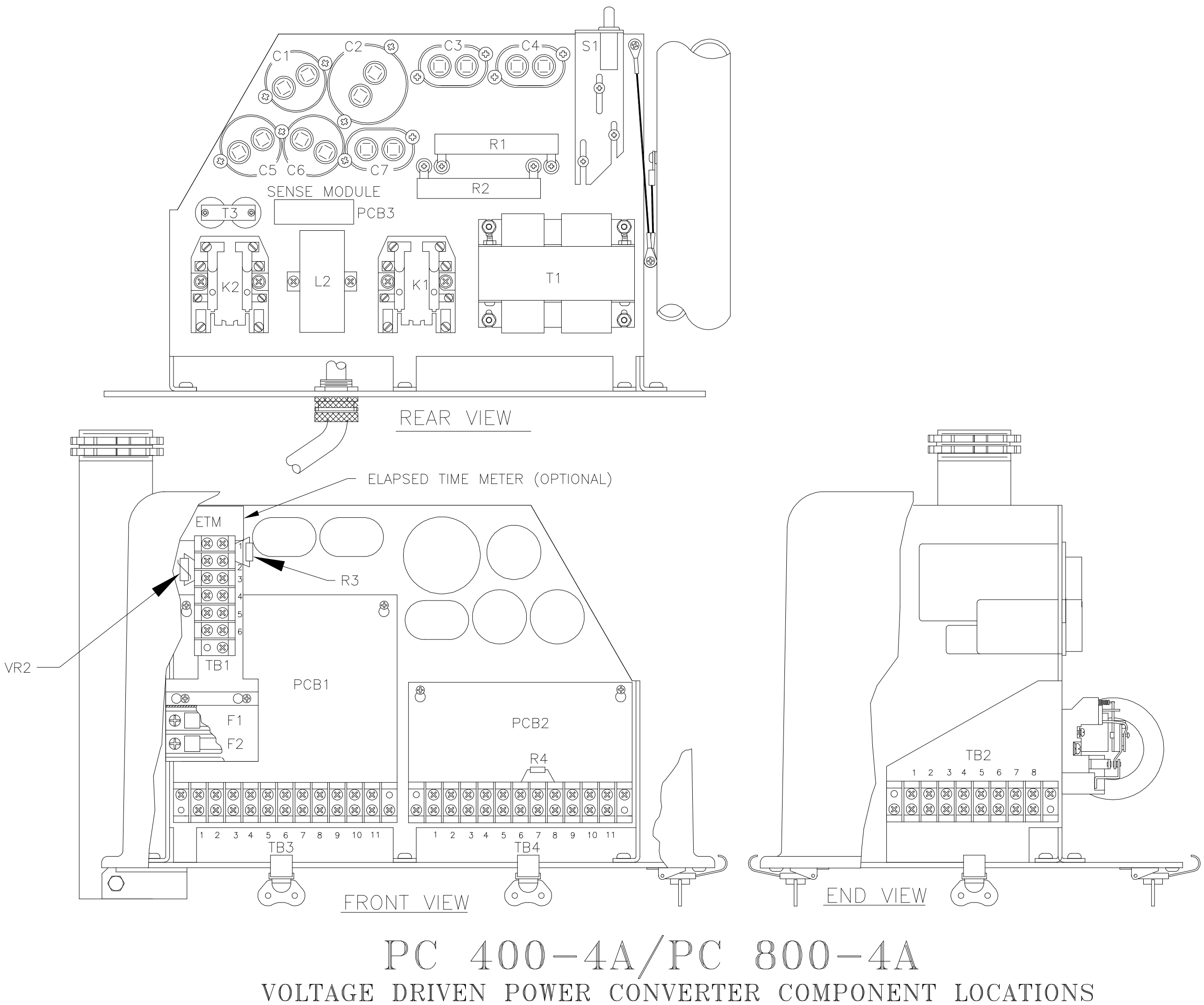


Figure 4-1 Power Converter Component Locations

Table 4-2 Flashhead Replaceable Parts

Flashhead	Description	Part No.	Qty.
ALL	RC Network RC101	1403411	1
ALL	Trigger Transformer	8288201	1
FH 400	Flashtube FT 101	8384329	1*
FH 400	Terminal Screw Lug	3379102	3
FH 400	Spacer, Ceramic	5900844	4
FH 400	Spacer, Ceramic	5900842	4
FH 400	Lens	8743701	1
FH 400	Clamp, Lens	3893201	3
FH 400	Coupling Transformer 7/50 wrap	8336701	1**
FH 800	Flashtube FT101	4901700	1*
FH 800	Post, Ceramic	5900842	6
FH 800	Retaining Bezel	3735202	1
FH 800	Coupling Transformer 7/50 wrap	8336701	1**
FH 83F-2	Flashtube Linear FH83F-2	8675309	1 *
FH 83F-2	Terminal Block / 6 Position	4997031	1
FH 83F-2	Coupling Transformer 7/50 wrap	8336701	1
FH 83F-2	Spacer, Ceramic	5900842	2

*Recommended as a spare part.
**Only used if the FH 400A or FH 800A is mounted more than 40 Feet from it's associated PC.

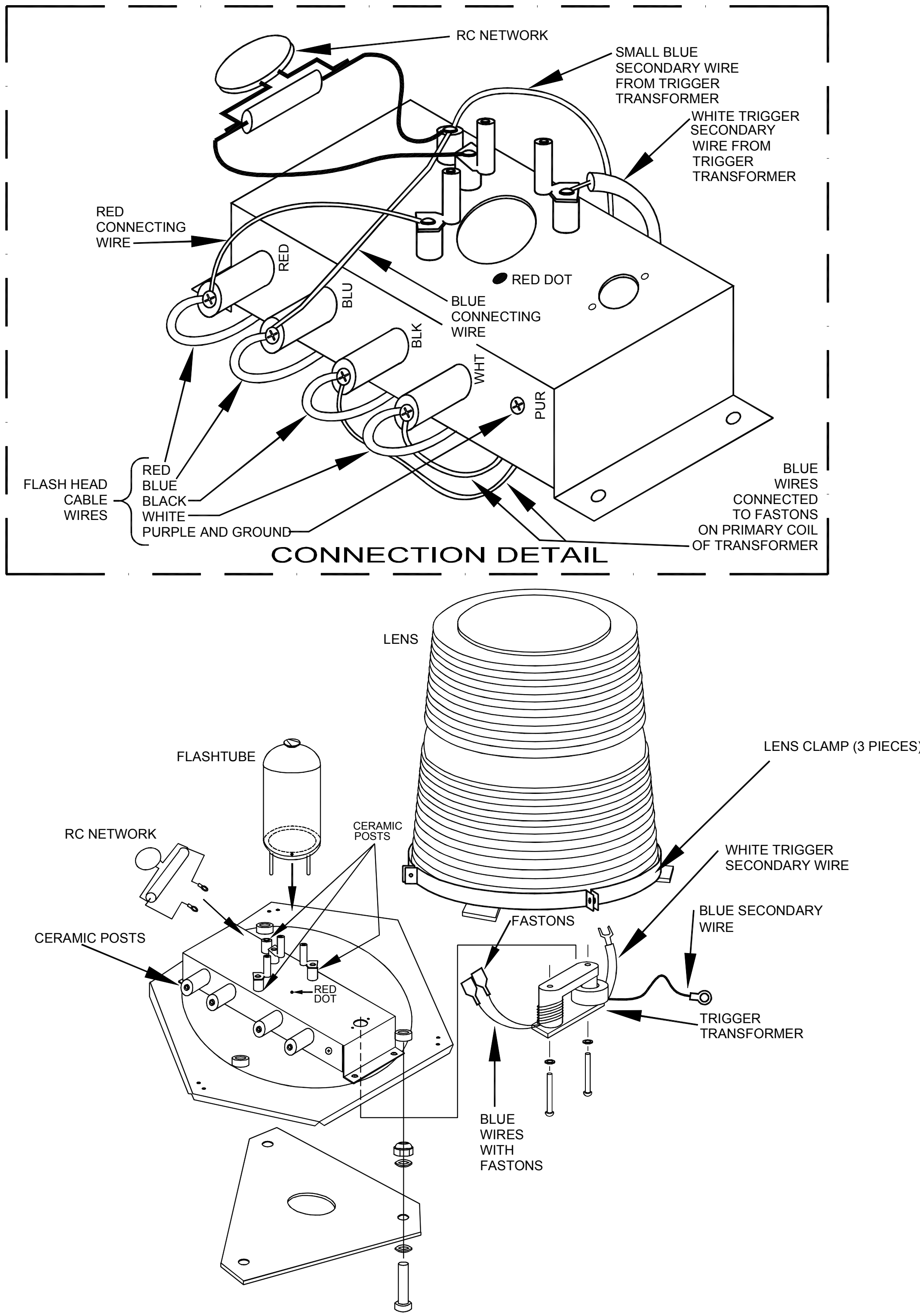


Figure 4-2 FH 400 Flashhead Component Location

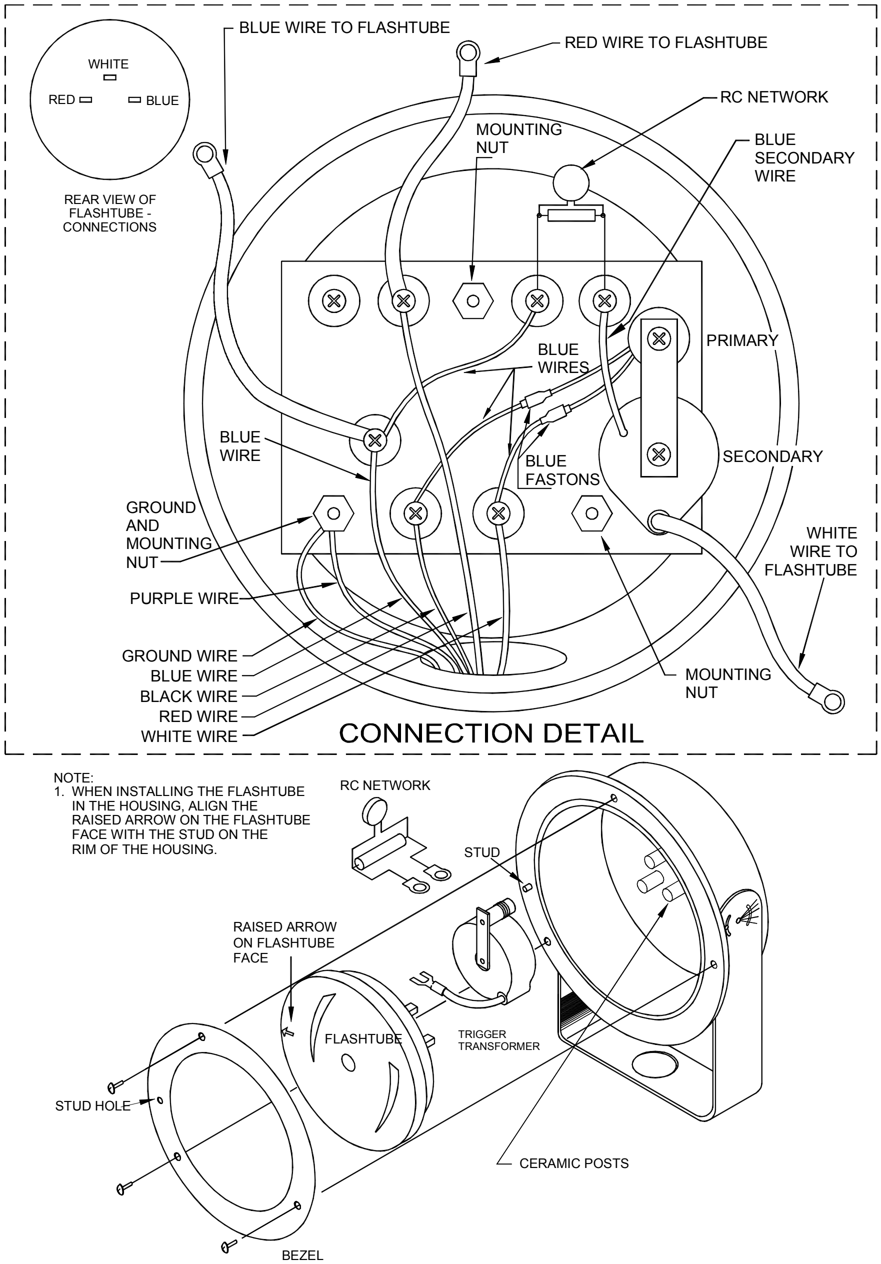


Figure 4-3 Flashhead Component Locations

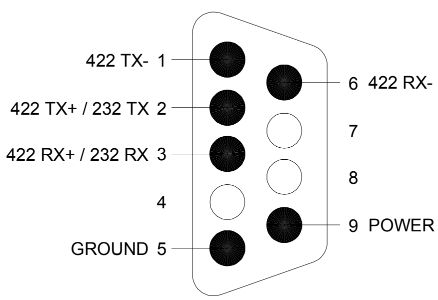
Section 5 – Programming PCB 1 (P/N 2904411)

Connecting the Handheld

Table 5-1 shows the connector pin assignments for the handheld. Transmit and receive directions shown in the table are with respect to the handheld. The DB9 connector is located at the top of the handheld programmer.

Table 5-1 DB9 Connector

DB9 Female	EIA-232 Function
3	Receive +receive
6	No connection -receive
2	Transmit +transmit
1	No connection -transmit
9	Power
5	Ground



DB9 FEMALE

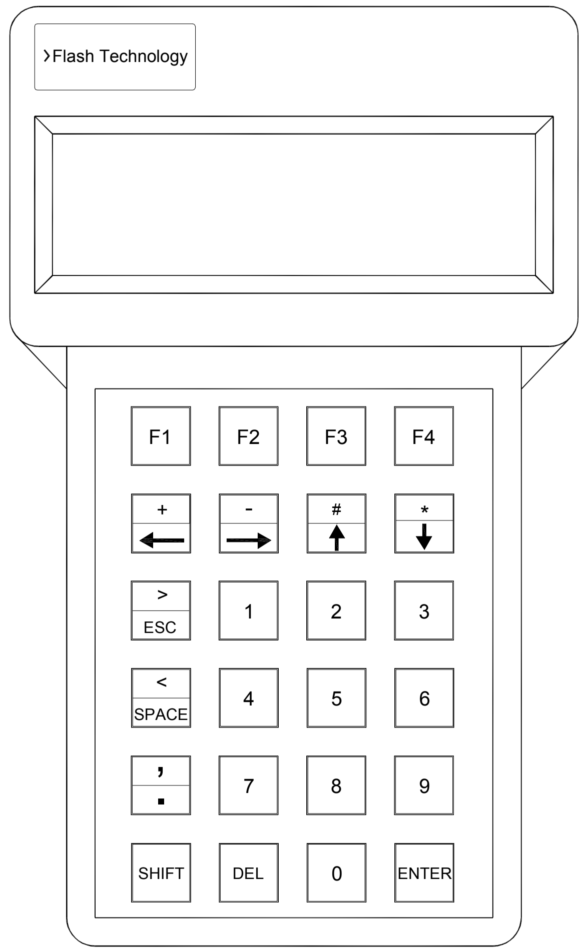


Figure 5-1 Handheld Programmer

A 9-pin RS-232 cable is used to connect the handheld to the 9044-01 controller board at connector J2 (9 pin Male connector). Power and ground is provided by this connector.

Using the Handheld Programmer

The handheld programmer, hereafter referred to as the programmer, has a four line LCD display and 24 keys as shown in Figure 5-1. The following is a general discussion of how the programmer works. See Parameters under the SETUP section for additional details. In the discussions to follow the 4 line LCD display will be represented as shown:

L1: **********
L2: **********
L3: **********
L4: **********

> **Note:** All messages displayed on the LCD will be in capital letters. The display does not show the L1: etc. This is used to represent line 1, 2, 3 and 4 on the LCD.

Once the handheld programmer is connected to PCB 1, and power is applied, it will automatically sense the programmer is connected and will display the sign on message. Only programmers provided by Flash Technology will work with PCB 1.

The general format of the sign on message is:
L1: FLASH TECHNOLOGY
L2: BOARD 4988
L3: (Blank or further information)
L4: ENTER TO CONTINUE

Once enter is pressed the first menu is displayed as follows:
L1: PRESS A FUNC KEY
L2: F1. SETUP F2. INFO
L3: F3. SHORTTEST
L4: F4. MODE CHANGE

To continue further, a function key must be pressed. The function keys are on the top row of the programmer.

F1: Enters the setup menus used to configure the 9044-01.

F2: Enters the information menu, used to show a limited amount of useful operating information.

F3: Causes the 9044-01 to perform the short test.

F4: Enters the mode change menu, used to manually change the operating mode (DAY, TWI, and NITE). For this configuration, DAY equals HIGH, TWI equals MED and NITE equals LOW intensity.

> **Note:** The programmer will return to the sign on message from any other menu if no key is pressed within two minutes.

Setup

The setup menu has the following format:
L1: SETUP
L2: 0-1-1
L3:
L4: OK NEXT BACK EXIT

The first line displays the current menu. The second line displays the current setup. The numbers correspond to the selected parameters. The third line is blank. The fourth line displays what functions the keys F1 thru F4 will perform if pressed; the words are spaced to be over the corresponding function key. So, to move to the next menu you would press F2 (NEXT).

F1: OK- is used to enter data.
F2: NEXT- moves to the next item.
F3: BACK- moves to the previous item.
F4: EXIT- exits the setup menu.

Parameters

Pressing the NEXT or BACK function key from the SETUP menu takes you to the Parameters menu. The general format is:
L1: SETUP
L2: SYSTEM
L3: 0- Std. 1- Air. 2- Cat
L4: OK NEXT BACK EXIT

The currently selected option will have the cursor under it. For example:
0-Std 1-Air 2-Cat shows that the currently selected option for the parameter is one (1) which in this case means Airport system.

If the board is not programmed as described, press 1 and F1 (OK) to program the board for "Air" mode.

> **Note:** Regardless of the current configuration, you will need to press 1 and F1 (OK) to access the light number and confirmation number programming.

The display will change to:
L1: SETUP
L2: AIRPORT # 1
L3: Enter Light #
L4: OK NEXT BACK EXIT

Press the number keys to select the light number you wish this board to be and then press F1 (OK). The Airport number displayed will change. The display will change to:

L1: SETUP
L2: CONFIRM # 1
L3: Enter Confirm #
L4: OK NEXT BACK EXIT

Press the number keys to select the confirm number you wish this board to be and then press F1 (OK). The Confirm number displayed will change. When you are done, press NEXT. Be sure to write the numbers on the white space provided on the board.

To change the Flash rate press NEXT until the LCD shows:
L1: SETUP
L2: FPM 1-60 2-30
L3: 3-20 4-100 5-120
L4: OK NEXT BACK EXIT

Press the number corresponding to the desired flash rate and press F1 (OK).

> **Note:** The valid flash rate for an FTS 400-4A is 60 fpm. The valid flash rates for an FTS 800-4A are 60 and 120 fpm.

INFO

The information menu has the following format:
L1: INFO
L2: BOARD 4988
L3:
L4: NEXT BACK EXIT

This menu is used to show a limited amount of information about the current PCB 1 operation and configuration.

The first line displays the current menu. The second and third lines display board information. The fourth line displays what functions the keys F2 thru F4 will perform if pressed; the words are spaced to be over the corresponding function key. So, to move to the next item you would press F2 (NEXT).

F2: NEXT- moves to the next item.
F3: BACK- moves to the previous item.
F4: EXIT- exits the setup menu. Items like energy, trigger voltage, flash rate and operating mode are displayed.

Mode Change

The Mode Change menu item is used to manually change the operating modes and functions just like the test jumpers on the board.

The Mode Change menu has the following format:

L1: MODE CONTROL
L2: CURRENT DAY
L3:
L4: DAY TWI NITE EXIT

F1: DAY- Changes the mode to DAY.
F2: TWI- Changes the mode to TWI.
F3: NITE- Changes the mode to NITE.
F4: EXIT- exits the mode change menu and returns the mode to automatic.

Return Material Authorization (RMA) Policy

IF A PRODUCT PURCHASED FROM FLASH TECHNOLOGY MUST BE RETURNED FOR ANY REASON (SUBJECT TO THE WARRANTY POLICY), PLEASE FOLLOW THE PROCEDURE BELOW:

NOTE: An RMA number must be requested from Flash Technology prior to shipment of any product. No returned product will be processed without an RMA number. This number will be the only reference necessary for returning and obtaining information on the product's progress. Failure to follow the below procedure may result in additional charges and delays. Avoid unnecessary screening and evaluation by contacting Technical Support prior to returning material.

1. **To initiate an RMA: Call Flash Technology's National Operations Center (NOC) at (800-821-5825) to receive technical assistance and a Service Notification number. The following information is required before a Service Notification number can be generated:**
    - Site Name/Number / FCC Registration number/ Call Letters or Airport Designator
    - Site Owner (provide all that apply – owner, agent or subcontractor)
    - Contractor Name
    - Contractor Company
    - Point of Contact Information: Name, Phone Number, Email Address, Fax Number and Cell Phone (or alternate phone number)
    - Product's Serial Number
    - Product's Model Number or part number
    - Service Notification Number (if previously given)
    - Reason for call, with a full description of the reported issue

2. **The Service Notification number will then serve as a precursor to receiving an RMA number if it is determined that the product or equipment should be returned. To expedite the RMA process please provide:**
    - Return shipping method
    - Shipping Address
    - Bill to Address
    - Any additional information to assist in resolving the issue or problem

3. **Product within the Warranty Time Period**
    a. If to be returned for repair;
    - RMA # is generated
    - Once product is received and diagnosed;
        - Covered under warranty – product is repaired or replaced
        - Not covered under warranty – quote is sent to the customer for a bench fee of **$350 plus parts** for repair
            - If the customer does not want the product repaired, a **$50 test fee** is charged before being returned

    b. If advance replacement;
    - Purchase order may be required before the advance replacement order is created
    - RMA # is generated and the advance replacement order is created
    - Once product is received and diagnosed;
        - Covered under warranty – credit given back if PO received
        - Not covered under warranty – credit **will not** be applied to PO
    - Flash Technology has sole discretion in determining warranty claims. Flash Technology reserves the right to invoice for parts advanced if the associated failed parts are not returned within 15 days of issue or if product received is diagnosed to be non-warranty.
    - Advance replacements will be shipped ground unless the customer provides alternative shipping methods.

4. Product outside the Warranty Time Period

a. For Xenon System board repair; a purchase order is required at time of request for a RMA # for a standard **$350 repair bench fee**
   - RMA # is generated with the PO attached
   - If the board is deemed non-repairable after diagnosis, the customer is notified. If the customer purchases a new board, the repair bench fee is waived. If the customer does not buy a new board, a **$50 test fee** is charged before being returned or scrapped.

b. For all other products; no purchase order is required to return the product for diagnosis
   - RMA # is generated
   - Once product is diagnosed, quote is sent to the customer for a bench fee of **$350 plus parts** for repair
   - Once the purchase order is received, the product will be repaired and returned
     - If the customer does not want the product repaired, a **$50 test fee** is charged before being returned or scrapped.

5. After receiving the Flash Technology RMA number, please adhere to the following packaging guidelines:

- All returned products should be packaged in a way to prevent damage in transit. Adequate packing should be provided taking into account the method of shipment.
  Note: Flash Technology will not be responsible for damaged items if product is not returned in appropriate packaging.

6. All packages should clearly display the RMA number on the outside of all RMA shipping containers. RMA products (exact items and quantity) should be returned to:

Flash Technology
Attn: RMA #XXX
332 Nichol Mill Lane
Franklin, TN 37067

7. All RMA numbers:

- Are valid for 30 days. Products received after 30 days may result in extra screening and delays.
- Must have all required information provided before an RMA number is assigned.

~~ End of Document ~~