

UNITED STATES COAST GUARD  
OCEAN ENGINEERING DIVISION  
WASHINGTON, D.C.

SPECIFICATION FOR  
UNIVERSAL 12 VDC PROGRAMMABLE FLASHER  
FOR MARITIME AIDS TO NAVIGATION

SPECIFICATION NO. 504

CHANGE 2

Please make the following changes to the specification:

1. Modify the third sentence in subparagraph **3.9.2** (Output Voltage), on page 8, to read as follows:

“The acceptable PWM frequency range for PWM-regulated flashers is 400 Hz to 600 Hz and the voltage of the entire PWM wave train shall be positive (+).”

2. Modify the last sentence in subparagraph **3.9.3**, on page 9, to read as follows:

“The flasher shall provide current to any resistive load that draws between 0.050 amperes and 10.0 amperes, inclusive.”

3. Modify the second sentence in subparagraph **3.9.8**, on page 13, to read as follows:

“If, while flashing, the current drawn from the "L" terminal falls below 0.050 amperes ±0.020 amperes, the flasher shall determine that the lamp filament has failed and deliver at the "F/r" terminal a positive periodic analog voltage signal between 8.0- and 18.0-volts DC, called an F-pulse, to operate a CG-6P lampchanger conforming to CG-43 Specification No. 195.”

4. Add the following sentence to the end of subparagraph **3.9.8** on page 13:

When driving an alternate electrical device with the “F/r” terminal (other than a standard lampchanger) as described in subparagraph 3.9.2, the “L” terminal will remain disconnected; as such, the resistance detected by the open “L” terminal circuit will be exceedingly high (i.e., 100K ohms or higher).

5. In the table on page 16, replace flash rhythm name “Iso 4” with “Occ 4.”

6. Modify the last sentence in subparagraph **4.7.3.5.a.1**, on page 27, to read as follows:

“The requirement is that the “F/r” terminal circuit shall not activate the F-pulse for any “L” terminal load that draws a current over 0.050 amperes (see 3.9.3).”

7. Add the following new test immediately after the third test listed under subparagraph **4.7.3.5.a** on page 28:
- “4. For both input voltages, verify that the lampchanging circuit actuates when the “L” terminal current falls below threshold 0.050 amperes  $\pm$  0.020 amperes. Specifically, this means that the lampchanger must actuate when the “L” current falls below 0.030 amperes, and that it must not actuate at any current above 0.070 amperes. However, when the “L” terminal current is within the 0.030- to 0.070-ampere tolerance band, the lampchanger may or may not actuate.”

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SPECIFICATION NO. 504

CHANGE 2

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3 Dec 2008

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SPECIFICATION FOR  
UNIVERSAL 12 VDC PROGRAMMABLE FLASHER  
FOR MARITIME AIDS TO NAVIGATION

SPECIFICATION NO. 504

CHANGE 1

Please make the following changes to the specification:

1. Modify the end of subparagraph **3.9.2**, on page 9, to read as follows:

“... voltage signal between 8.0- and 18.0-volts. This discussion applies to all flash rhythms *except* fixed. When the flasher is programmed to operate in the “fixed” mode, a periodic signal meeting the requirements of the F-pulse signal for fixed rhythms shall be available to operate the lampchanger during lamp-out (see 3.9.8 for the fixed-rhythm F-pulse requirement). In any case, with a PWM-regulated flasher, the PWM output voltage at terminal “L” shall be measurable with a True RMS (AC + DC) digital voltmeter to ensure compliance with the voltage requirements outlined below. The closed circuit output voltage (CCOV, 1.4.8) shall be regulated as follows: ...”

2. Delete the last sentence in subparagraph **3.9.7.2** on page 13 and insert the following new sentence to the discussion on page 12 as follows:

“... load down the master flasher and cause system problems. As such, and in order to meet the requirements of 3.9.8 below, each flasher configured to operate as a slave flasher shall consume no more than one (1) milliamp by its “S/Sy” sync input trigger terminal at any time. In Figure 1 the master flasher's flash rhythm is ...”

3. Add the following new test “e” to subparagraph **4.7.3.8** on page 28 immediately after test d:

e. While operating under any flash rhythm, verify that the maximum current consumed by the test slave flasher’s “S/Sy” sync terminal, driven by the master flasher’s “L” terminal, does not exceed one (1) milliamp at any time, during either flash or eclipse.

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7 May 2008

OFFICE OF CIVIL ENGINEERING  
UNITED STATES COAST GUARD  
WASHINGTON, D.C.

JANUARY 2008

SPECIFICATION FOR  
UNIVERSAL 12 VDC PROGRAMMABLE FLASHER  
FOR MARITIME AIDS TO NAVIGATION

CG-43 SPECIFICATION NO. 504

## 1. SCOPE.

1.1 General. This specification establishes the performance and test requirements for universal 12-volt, direct current (DC), solid-state programmable flashers, herein referred to as flasher or flashers. The flashers are to be used for flashing all standard marine aids to navigation lamps. In addition, the flashers shall regulate output voltage to the lamps, sense burnt-out lamps, control a 12-volt lampchanger as specified herein, be capable of functioning as a “slave” flasher in the sync mode, and provide daytime/nighttime illumination control (when coupled with a photoresistor) for a lighted aid to navigation.

1.1.1 Additional Information. Flashers are normally intended to flash lamps powered by DC voltage sources of 10- to 16-volts. Power is provided by: (1) secondary (rechargeable) lead-acid batteries; or, (2) transformer-rectified DC power supplies. In normal operational use, flashers will be contained in lantern assemblies on buoys or fixed structures in or around the navigable waters of the United States. Lamps will usually be 12-volt, incandescent, tungsten filament lamps rated from 0.55 to 3.05 amperes, or tungsten-halogen lamps rated up to 9.2 amperes (110 watts). The lamps will be mounted in lampchangers conforming to CG-43 Specification Nos. 195 and/or 478. Although the flashers are mounted in a lantern assembly, they will nevertheless be exposed to weather extremes including but not limited to temperatures ranging from -25°F through 140°F, relative humidity from 0% through 100%, and on occasion they will be immersed in water. The flashers may also be used to operate other types of aids to navigation equipment with high-input impedances.

1.2 Precedence. Any ambiguity or conflict between this specification, drawings, and/or applicable documents shall be resolved by using the following documents in the precedence shown:

- a. The wording of this specification.
- b. Drawings contained in or attached to this specification.
- c. Applicable documents.

1.3 Government Furnished Property (GFP). The following equipment will be loaned to the contractor for use in first article testing:

- (4 ea) CG-6PHW Lampchanger
- (4 ea) WK-681 Wiring Kit
- (4 ea) Type "C" Photoresistor
- (4 ea) Type "L" Photoresistor
- (10 ea) 12-volt, 0.55-ampere Marine Signal Lamp
- (10 ea) 12-volt, 3.05-ampere Marine Signal Lamp
- (10 ea) 12-volt, 110-watt Marine Signal Lamp

(1 ea) Sample programmable flasher with PWM voltage regulation

(1 ea) Sample programmable flasher with linear voltage regulation

Within 30 days of contract completion, all GFP items listed above, with the exception of the marine signal lamps and the wiring kit, shall be returned to the Coast Guard at the following address:

Commandant (CG-432A)  
1900 Half Street, S.W.  
Washington, DC 20593  
Attn: JR09-1506

1.4 Definitions. The following definitions shall apply to these terms whenever they appear in this specification.

1.4.1 Flasher, Solid-State. An electrical device with no moving parts that may interrupt the power to a lamp according to a specified time-based characteristic, causing the lamp to flash with a specified rhythm. It may also make the lamp burn fixed on. A flasher also performs accessory functions as specified herein and defined below.

1.4.2 Rhythm. The time-based characteristic of flashes of light alternating with eclipses of darkness exhibited by a lantern during one period.

1.4.3 Lantern assembly, DC-powered. A lantern assembly consisting of a lantern, a lens, a 12-volt lampchanger (containing one lamp in the "burning position" and at least one spare lamp capable of moving into the burning position when so controlled), a daylight control (or photoresistor), and a flasher.

1.4.4 Accessory Functions. There are four accessory functions in the flasher required by this specification. They are defined as follows:

- a. Lamp-out sensor and control. A circuit that senses lamp filament integrity during the rhythm period and, if the filament is open, causes the lampchanger to move a spare lamp into the burning position; or switches a transfer relay that transfers the power from the lantern with the burnt-out lamp to a spare lantern with an operable lamp.
- b. Illumination control. A circuit such that when a photoresistor conforming to CG-43 Specification No. 234 is connected to it, stops the flow of current to the lamp when the ambient illumination exceeds a certain value, and permits current to flow to the lamp when the illumination falls below a certain value.
- c. Voltage regulator. A circuit that limits the output voltage to a specified range of values. Both linear and pulse-width modulation voltage regulation techniques are permissible; however, if using pulse width modulation, then the output voltage measurements shall be made using a True RMS (AC + DC) digital voltmeter.

- d. Synchronization. A circuit within the flasher such that when the programming switch is set to the “Sy” position, the flasher becomes and operates as a “slave” flasher. In this configuration, the flasher is externally triggered by and operates under the flash rhythm command of a remote “master” flasher.

1.4.5 Self-protection features. There are two self-protection features in the flasher required by this specification. They are defined as follows:

- a. Reverse-polarity protection. An electrical circuit that ensures the flasher will not be impaired in any way if the input terminals are connected across a battery in reverse polarity, provided that the battery's open-circuit voltage does not exceed the maximum allowable input voltages specified for the flasher.
- b. Short-circuit protection. An electrical circuit that ensures the operation of the flasher will not be impaired in any way if either the "F/r," "L," "S," or "S/Sy" terminals are connected to the case, to the positive or negative power leads, or to each other.

1.4.6 12 volt battery. A secondary (rechargeable), lead-acid battery with a minimum rating of 75 ampere-hours.

1.4.7 Input voltage (CCIV). The closed-circuit voltage observed at the “+” and “-” power input terminals when the lamp is radiating at maximum incandescence.

1.4.8 Output voltage (CCOV). The closed-circuit voltage observed at the "L" and "-" terminals when the lamp is radiating at maximum incandescence.

## 2. APPLICABLE DOCUMENTS.

The following documents form a part of this specification to the extent specified herein:

### 2.1 Specifications (Current Revision).

U.S. Coast Guard:

CG-43 487	12-Volt Marine Signal Lamps
CG-43 195	12-Volt, Six-place Lampchanger for Maritime Aids to Navigation (Type CG-6P)
CG-43 234	Photoresistors for Solid-State Flashers
CG-43 478	12-Volt, 110-watt, Six-Place Lampchanger for Maritime Aids to Navigation (high-watt model)

Other Military Specifications:

MIL-DTL-15024F 28 Nov 1997	Plates, Tags, and Bands for Identification of Equipment, General Specifications of
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### 2.2 Standards.

Military:

MIL-STD-202G 18 Jul 2003	Test Method Standard for Electronic and Electrical Component Parts
MIL-STD-129P 10 Feb 2004	Military Marking for Shipment and Storage
MIL-STD-889B (3) 17 May 1993	Dissimilar Metals

### 2.3 Drawings.

U.S. Coast Guard Drawing (Current Revision)

G-EOE 120006 (attached to this specification)	12-Volt, Solid-State Flasher
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## 2.4 Publications.

### Bureau of Ships

NAVSHIPS 94501      Bureau of Ships Reliability Design Handbook

### Military

(NOTE: Military Handbooks are listed for information only, NOT as a requirement)

MIL-HDBK-454A      General Guidelines for Electronic Equipment  
30 Nov 2000

### Commercial

ANSI / ASQC C1-1996      American National Standard – Specification of General  
1996      Requirements for a Quality Program

ANSI / NCSL Z540-1      American National Standard – Calibration Laboratories  
1994      and Measuring and Test Equipment - General  
Requirements

### 3. REQUIREMENTS.

3.1 Design and Construction. The flasher shall be of solid-state design and construction, and shall be of quality that will ensure compliance with the requirements of this specification. All materials shall be compatible with each other under all conditions encountered in the use of flashers in Coast Guard aids to navigation.

3.2 Compliance. The contractor shall demonstrate through test and inspection that all flashers presented to the government (both first article and production) meet the requirements of this specification.

3.3 Standardization of Design and Certification. Production flashers that are furnished under this specification shall not differ in any way from those that are submitted for first article tests (FAT) (4.5.1.1) except for changes that have been described in detail to and approved by the KO (Contracting Officer). The manufacturer must submit a certification to this effect covering each lot of flashers furnished under this specification. In the event the manufacturer wishes to propose changes to correct design deficiencies, selection of marginal parts, or address other areas of concern, the SPA (Specification Preparing Activity) may require repetition of any or all of the first article tests before the proposed changes are approved.

3.4 Environment. Each flasher shall operate as specified under the following environmental conditions:

3.4.1 Ambient Temperature. From -25°F through 140°F.

3.4.2 Humidity. From 0% through 100% relative humidity.

3.4.3 Salt Air and Saltwater. Each flasher shall be constructed of materials so as to be resistant to corrosion from continuous exposure to salt air and immersion in saltwater.

3.4.4 Shock and Vibration. Each flasher shall be constructed to withstand the shock and vibrations incident in transport to and service on lighted buoys and fixed structures.

#### 3.5 Physical Requirements.

3.5.1 Size. The dimensions of each flasher case shall conform to those specified in Drawing G-EOE 120006, attached to this specification.

3.5.2 Mounting Holes and Mounting Surface. Four mounting holes shall be located on the mounting surface as specified in Drawing G-EOE 120006. The mounting surface shall be two bosses. The dimensions of the bosses shall not exceed those shown on Drawing G-EOE 120006. The top surfaces shall be co-planar. The mounting holes shall be made of threaded stainless-steel, nickel-plated steel, or nickel-plated brass inserts, or equivalent. It shall be possible for a 10-32 screw to enter to a depth of 5/16" or more.

3.5.3 Terminal and Terminal Insulators. There shall be six external, 8-32 clamp-washer screw

terminals located as specified in Drawing G-EOE 120006. There shall be clamping pressure plates on each side of the lug, each with a minimum conductive surface area of a 1 1/32"-diameter circle. The pressure plates, the terminal screws, and the threaded inserts shall be a common conductor to the flasher circuit. All terminals shall be enclosed in slotted insulators sized to accept three, 11/32"-wide spade and/or hook terminal lugs for a No. 8 stud. The insulators shall be sized to accept the terminal lugs from the front and the back. The terminal insulators shall be molded of colored dielectric materials in accordance with the color code given in paragraph 3.5.4. With one of the above terminal lugs in place, the top of the terminal screws shall not project above the top of the insulators. The six 8-32, 300-series stainless steel terminal screws shall be slotted or combination Phillips/slotted and be long enough so that they do not fall out when inserting three of the above terminal lugs. The top of the insulators shall not extend above the mounting surfaces.

3.5.4 Terminal Arrangement and Marking. Terminals shall be arranged and permanently labeled as shown in Drawing G-EOE 120006. Terminal "S/Sy" replaces the corresponding "S" terminal and "F/r" replaces the "F" terminal depicted in the drawing. Terminal markings may be incorporated in the nameplate. The terminal markings have the following meanings:

<u>Terminal</u>	<u>Meaning</u>	<u>Color</u>
"F/r"	Output terminal for positive voltage (F-pulse) to lampchanger's actuating mechanism, or for time-coded voltage control of various other AtoN devices, such as a solid-state relay. ("r" = relay).	Blue
"L"	Output terminal for positive, regulated, time-coded voltage, to be connected to lamp via lampchanger's lamp terminal.	Red
"S"	One of the terminals across which the photoresistor is connected.	Yellow
"S/Sy"	a. Normally the other terminal across which the photoresistor is connected; <u>OR</u> , when the programming switch is set to the "Sy" position: b. The input terminal at which a master flasher's signal is received for synchronization when the flasher is configured to operate as a slave flasher.	Yellow
"+"	Input terminal for positive battery lead.	Black
"-"	Input terminal for negative battery lead and negative lead to lampchanger via the lampchanger's negative terminal.	White

3.6 Flasher Case. The case shall be of suitable hardness and rigidity, and have low moisture absorption under the humidity and temperature conditions specified herein. The case shall retain its design contours without warping, crazing, cracking, or corroding in service or in storage. The case shall be sealed to ensure the watertight integrity of the encased electronic circuitry. The

case may be plastic, metal, or a combination of both.

3.6.1 Electrical Isolation. Each flasher terminal shall be electrically isolated from the case or mounting bracket by at least 500,000 ohms.

### 3.7 Materials.

3.7.1 Electronic Components. Solid-state components shall be used to accomplish all required electrical / electronic functions. There shall be no moving parts.

3.7.2 Potting. The electronic components shall be embedded in potting material to ensure that they are protected from moisture. The potting material shall be of suitable hardness and rigidity, and have low moisture absorption under the humidity and temperature conditions specified herein. The potting shall retain its design contour without warping, crazing, cracking, softening, or melting in service or in storage.

3.7.3 Dissimilar Metals. Materials used shall be galvanically compatible to minimize electrolytic action. Use of dissimilar metals, as defined in MIL-STD-889, shall not be in intimate contact, with the following exceptions:

- a. Use of stainless-steel threaded inserts in combination with an aluminum housing, and
- b. Use of stainless-steel, nickel-plated steel, or nickel-plated brass screws in tinned brass terminals.

3.8 Workmanship. Workmanship guidelines and recommendations are presented in MIL-HDBK-454.

3.9 Electrical. The flasher shall function as specified in this paragraph when operated within the extremes of the environmental conditions. The output voltage shall be applied to lamps conforming to CG-43 Specification No. 487

3.9.1 Input Voltage. The flasher shall be capable of being powered by primary and secondary batteries and transformer-rectified power supplies with less than 3% ripple. A steady-state voltage source of 21.0 VDC shall not damage the flasher. The flasher shall operate as specified with input voltages (CCIV, 1.4.7) ranging from 10.0 VDC to 18.0 VDC (maximum continuous CCIV of 16.0 VDC for 3.05 and 110-watt lamps). The flasher need not perform as specified for CCIV of less than 10.0 VDC; however, the flasher shall not be damaged by CCIV of less than 10.0 VDC.

3.9.2 Output Voltage. The flasher shall provide a positive, time-coded, regulated output voltage between the "-" and "L" terminals. Linear (analog) or PWM (pulse-width modulated) voltage regulation is acceptable. The acceptable PWM frequency range for PWM- regulated flashers is 400 Hz to 600 Hz. However, as required in paragraph 3.9.8 (Lamp-out Sensor and Lampchanger Control), whether linear or PWM voltage regulation is employed, an analog voltage signal matching the same flash characteristic as that selected by the program switch, except "fixed"

flash, shall be provided at the “F/r” terminal under lamp-out conditions (that is, either when the lamp has failed or when the “L” terminal has been left intentionally disconnected). (Hint: In these cases, this analog signal is used for F-pulse lampchanger control as well). In the case of “fixed” flash, a lamp-changing signal shall be activated at the “F/r” terminal to operate the lampchanger upon lamp failure, as described in subparagraph 3.9.8. For all flash rhythms other than “fixed,” the duplicated “F/r” terminal signal need not be in synchronization with the original time-coded “L” terminal signal that operates the lamp – they may run independent of each other. This requirement is needed to ensure continued compatibility with other external devices that will be controlled by the flasher but do not recognize a PWM input. These other external devices include mechanical relays, solid-state relays, AC Flash Controllers, LED Sync Modules, and several other hardware items. The duplicated flash signal at the “F/r” terminal shall be capable of safely driving a 2 ampere load minimum (this load may be resistive and/or inductive with varying impedances). The voltage of the duplicated flash signal at the “F/r” terminal does not have to be regulated; however, when on it shall be a smooth positive analog dc voltage signal between 8.0- and 18.0-volts. In any case, with a PWM-regulated flasher, the PWM output voltage at terminal “L” shall be measurable with a True RMS (AC + DC) digital voltmeter to ensure compliance with the voltage requirements outlined below. This discussion applies to all flash rhythms *except* fixed. When the flasher is programmed to operate in the “fixed” mode, a periodic signal meeting the requirements of the F-pulse signal shall be available to operate the lampchanger during lamp-out. The closed circuit output voltage (CCOV, 1.4.8) shall be regulated as follows:

**CCIV (Volts DC)**

10.0 - 12.4

**CCOV (Volts DC)**

With a maximum of 12.2, the difference between the input voltage and output voltage shall be no greater than 0.25-volts.

12.41 - 18.0

11.9 - 12.2

3.9.3 Output Current. In the “L” circuit (between the "L" and "-" terminals), the flasher shall flash any 12 VDC, tungsten filament, marine signal lamp with a current rating of 0.55 amps to 9.2 amps (110 watts). The lamps shall achieve full incandescence if the applied voltage time exceeds the lamp incandescence time. The flasher shall provide current to any resistive load that draws between 0.010 amps and 10.0 amps, inclusive.

3.9.4 Parasitic Current.

3.9.4.1 Daytime. The input current to the flasher when connected to a CG-6PHW lampchanger with a lamp in the operating position and a CG-234 photoresistor idling in daytime operation shall not exceed 20 milliamperes.

3.9.4.2 Nighttime. When operating under nighttime conditions (that is, the timing circuit enabled), the input current to the flasher (as configured in paragraph 3.9.4.1) exclusive of the lamp current, shall not exceed 30 milliamperes. The input current to the flasher when the lamp is not energized, but inclusive of the lamp current, shall not exceed 20 milliamperes.

3.9.5 Short-Circuit Protection. Each flasher shall have short-circuit protection so that

connecting the "F/r," "L," "S," or "S/Sy" terminals to the "+" or "-" terminals, to the flasher case, or to each other does no harm. The flasher shall resume all normal functions as soon as the short-circuit is removed without having to reset any device. This short-circuit protection shall function at the same time as the reverse-polarity protection.

3.9.6 Reverse-Polarity Protection. Each flasher shall have reverse polarity protection on the positive and negative terminals. The flasher shall resume proper operation as soon as the correct polarity is applied. The reverse-polarity protection shall function at the same time as the short-circuit protection.

3.9.7 Programmable Timing Rhythms. The output voltage at the "L" and "-" flasher terminals shall be time-coded as specified below. The voltage shall be applied to the lamp for flash intervals F#, and shall not be applied to the lamp during eclipse intervals E#. The time coding, or rhythm, is defined by continuous operation of these intervals. The duty cycle for a rhythm is the total lamp-on time (sum of F intervals) divided by the period of the rhythm (sum of all the F and E intervals). The period is defined as the total time of the rhythm.

3.9.7.1 Programmable Rhythms and Programming Methods. The following list of flasher rhythms is the minimum number of rhythms that shall be pre-programmed and available with each flasher. Each flasher rhythm shall be selectable by the user by some type of switch mounted on the top surface of the flasher. The switch shall be protected from the environment. The switch shall not interfere with mounting methods. No special tools or equipment shall be required to select a rhythm (that is, to program the flasher). Regardless of what type selector switch is chosen, measures shall be taken to ensure that the standard flasher/lampchanger/lantern mounting bracket does not interfere with the switch's placement and/or operation. The standard lampchanger/flasher assembly uses a 1¼ inch-wide solid plate-steel mounting bracket installed flat between them. If the switch is not positioned with enough clearance from the mounting bracket, normal switch operation and/or proper hardware assembly may be hindered. This requirement is especially important if using a rotary rhythm selector switch. If using a rotary rhythm selector switch, ensure that the top surface of its knob is lower than the top surfaces of the coplanar mounting bosses. Usually, the best location for the switch is offset from top center and away from the terminal side. If desired, please contact the COTR for a mounting bracket sample. If screws are used to secure a switch cover, programming plates, or other programming hardware, they shall be the same as the 8-32 300-series stainless steel terminal screws described in paragraph 3.5.3. The rhythm selection process (that is, "programming the flasher") shall preclude the removal of any and all hardware such as screws, plates, covers, jumpers, lenses, etc. The rhythm shall be changeable (re-programmable) at any time during the flasher's useful service life without the programming hardware having incurred any detrimental effects.

	Timing Rhythm	Timing Sequence (Sec)					Duty Cycle	
		F 1	E 1	F 2	E 2	F 3		E 3
<u>Buoys/Structures</u>	●FL 6 (.6)	0.60	5.40					0.10
	●FL 4 (.4)	0.40	3.60					0.10
	●FL 2.5 (.3)	0.30	2.20					0.12
	●Q	0.30	0.70					0.30
	●FL (2) 5	0.40	0.60	0.40	3.60			0.16
	●FL (2) 6	1.00	1.00	1.00	3.00			0.33
	●FL (2+1) 6	0.30	0.40	0.30	1.20	0.30	3.50	0.15
	●Mo (A)	0.40	0.60	2.00	5.00			0.30
<u>Lighthouses/Ranges</u>	●Iso 6	3.00	3.00					0.50
	●Occ 4	3.00	1.00					0.75
	●FL 6 (1)	1.00	5.00					0.17
	●FL 4 (1)	1.00	3.00					0.25
	●FL 2.5 (1)	1.00	1.50					0.40
	●Iso 2	1.00	1.00					0.50
	●FIXED	Continuous						1.00
	●Sy (Sync)							n/a

3.9.7.2 Synchronized Flashers. There may be times when a synchronized flasher system is required. In this system one or more flashers configured as slaves are driven by a single flasher configured as the master; and all slave flashers in the chain display the same rhythm at the same time. A flasher is configured to operate as a slave flasher by setting its programming switch to the “Sy” position. In this mode, the flasher is ready to accept the master flasher’s signal at terminal “S/Sy” and operate under its command. The daylight control (photoresistor) circuit shall be disabled when the flasher is configured to operate as a slave. As such, the “S/Sy” terminal shall be capable of accepting a time-coded 10 to 15 volt flash rhythm signal from the

master flasher's "L" terminal, whether it's linear or PWM, and duplicating the flash rhythm at its own regulated output at terminal "L." Universal 12VDC programmable flashers of all makes and models shall operate interchangeably as either master or slave flashers in any synchronized flasher system regardless of its lamp voltage regulation methodology. The "S/Sy" terminal's input impedance shall be sufficiently high such that five flashers operating as slaves connected in parallel in a single synchronized flasher system shall not load down the master flasher and cause system problems. In Figure 1 the master flasher's flash rhythm is sensed by the slave at its "S/Sy" terminal and the master's flash rhythm is duplicated by the slave. The photoresistor connected to the master flasher controls the nighttime activation of the entire system.

**Typical synchronized flasher systems:**

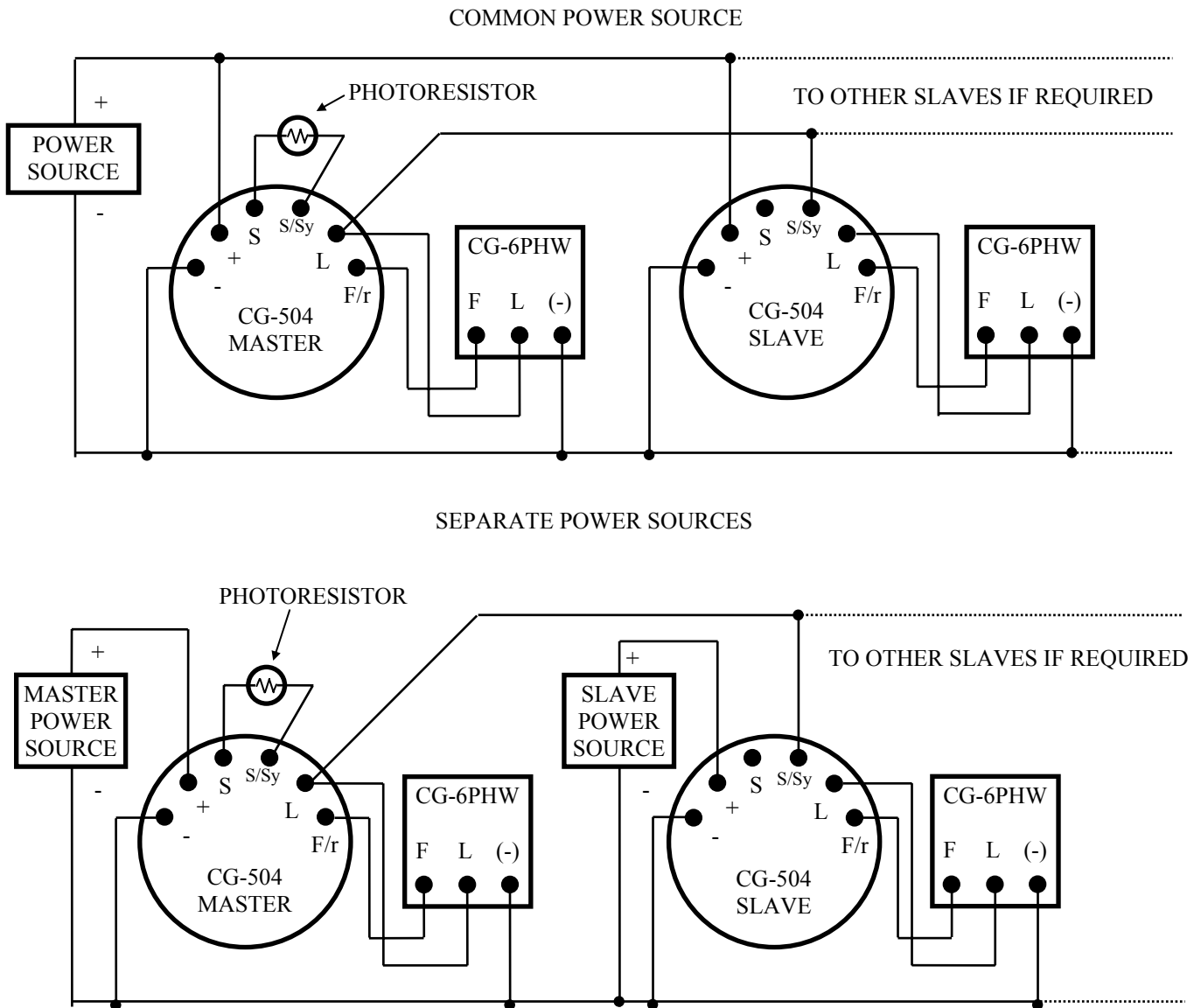


Figure 1



Each flasher, whether configured to be a slave or master, shall continue to monitor its own lamps and perform the lampchanging function (3.9.8) when necessary. As such, when up to five flashers are configured to operate as slaves in a single system, the slave flashers' collective impedance shall be sufficiently high so as not to load down the master flasher's "L" terminal's circuits into thinking the lamp is okay and rendering the master flasher's lampchanger inoperative under lamp-out conditions.

3.9.7.3 Timing Tolerance. The flash intervals, the eclipse intervals, the period, and the duty cycle shall be within 5% of the specified values.

3.9.8 Lamp-out Sensor and Lampchanger Control. The flasher shall contain circuitry which shall sense a filament failure of the operating lamp and shall actuate any lampchanger conforming to CG-43 Specification No. 195 (CG-6P). If, while flashing, the current drawn from the "L" terminal falls below 0.010 amps, the flasher shall determine that the lamp filament has failed and deliver at the "F/r" terminal a positive periodic analog voltage signal between 8.0- and 18.0-volts DC, called an F-pulse, to operate a CG-6P lampchanger conforming to CG-43 Specification No. 195. The "F/r" terminal's lampchanging circuitry shall be capable of driving a 2 ampere load minimum (this load may be resistive and/or inductive with varying impedances). For all rhythms other than "fixed" flash, the "F/r" terminal lamp-changing signal waveform shall match the flash characteristic of the flasher as that selected by its program switch. When operating in the "fixed" mode, the "F/r" terminal signal waveform shall be a 0.25 to 5.0 second pulse between 8.0- and 18.0-volts. The "F/r" terminal signal shall cause the lampchanger to advance only one position. If, within 15 seconds after the lampchanger advances, no current is drawn from the "L" terminal during the "on" portion of the flasher characteristic, the flasher shall repeat the "F/r" terminal signal. This process shall be repeated until a working lamp is advanced into the operational position of the lampchanger, or until the sixth-position of the lampchanger is reached. (Note: the CG-6P lampchanger has a 56 ohm 5% resistor in parallel with the lamp circuit in the sixth position to provide a current signal path for the lamp-out sensor circuit which prevents the "F/r" terminal signal from being applied indefinitely in case of failure of the lamp in that position). When the lamp-out control is not actuated the voltage between the "F/r" and "-" terminals shall not exceed 0.5-volts DC.

3.9.8.1 Lamp-out Sensor Operation for "Fixed" Characteristic Flashers. When a flasher is programmed to operate in the "fixed" rhythm mode (continuous burning) and the method of filament detection is by momentarily disrupting the "L" terminal voltage, this "off" period shall not exceed 15 milliseconds. Excessively long "off" periods for this purpose may be construed as a "flash rhythm" by the user. Additionally, the time interval between successive filament interrogation shall be more than 12 seconds.

3.9.8.2 Spurious Activation Prevention Due to Discontinuities. A single discontinuity of 10 milliseconds or less in the "L" and "-" circuit shall not cause activation of the "F/r" terminal circuit.

3.9.8.3 Prevention of Damage Due to Inductive Voltage Spikes. The flasher shall not be damaged by voltage spikes induced on the "F/r" terminal circuit by the lampchanger's stepping mechanism (solenoid coil).

3.9.9 Compatibility With Incandescent Lamps. When powered by a battery that provides input voltages between 12.4 VDC and 18 VDC, the flasher shall not limit the inrush current so as to reduce the intensity or shorten the flash length of a 12 VDC, 0.55 amp to 110-watt incandescent lamp. The output voltage shall reach 90% of the steady state value within 20 milliseconds after the voltage is applied. The voltage shall decay to 10% of the steady state value within 10 milliseconds after the applied voltage is removed.

3.10 Illumination Control. The flasher timing, regulating, and lamp-changing circuitry shall be controlled by a photoresistor conforming to CG-43 Specification No. 234. The photoresistor will be connected between the "S" and "S/Sy" terminals. The photoresistor will disable the timing, lamp-changing, and regulating circuitry during daylight hours (to conserve power) and enable this circuitry at night. If the photoresistor is removed from the flasher, all the other flasher circuits shall function as specified.

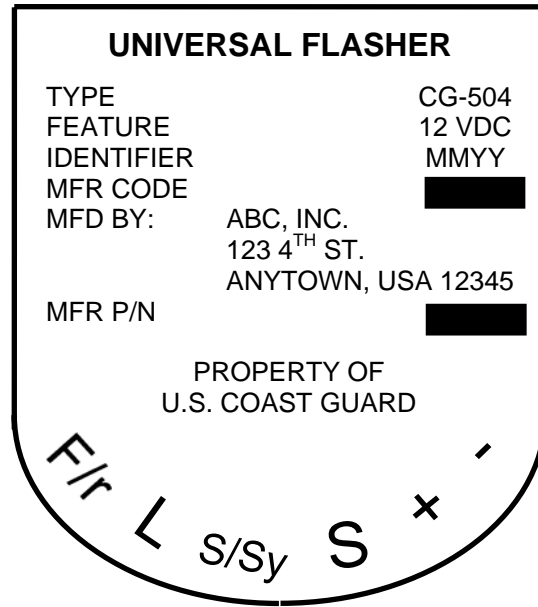
3.10.1 Photoresistors. The illumination control circuitry shall disable the flasher before the photoconductive resistance across "S" and "S/Sy" terminals falls below 10,000 ohms. The illumination control circuitry shall enable the flasher before the photoconductive resistance across "S" and "S/Sy" terminals exceeds 40,000 ohms. A hysteresis of at least 5,000 ohms shall separate the turn-on and turn-off resistance value points. The illumination control circuitry shall bias the external photoresistor no more than 6-volts such that the photoresistor dissipates no more than 40 milliwatts.

3.10.2 Prevention of Spurious Activation Due to Illumination Level. With a photoresistor conforming to CG-43 Specification No. 234 connected between the "S" and "S/Sy" terminals and pointed directly at the flashing lamp, the flashing lamp shall not spuriously activate the illumination control circuitry or cause the light to flash on a different rhythm when the ambient illumination level is less than the level at which the flasher is turned on. Spurious activation shall be prevented electronically and shall not depend on the physical shading of the flashing lamp. Consideration of the nigrescence of incandescent lamps and the response time of photoresistors indicates that the illumination-control circuit should be de-energized for a short time after termination of the flash; however, in the "fixed" characteristic, the illumination-control circuitry shall function continuously and the photoresistor will be located out of the line-of-sight of the lamp.

3.10.3 Effect of Ambient Illumination. The illumination control circuitry, in conjunction with a photoresistor conforming to CG-43 Specification No. 234, shall not cause the flasher to operate on a changed rhythm at any level of ambient illumination below its "turn-off" level.

3.10.4 Effect of Artificial Illumination. The flasher shall not malfunction when tested with a photoresistor conforming to CG-43 Specification No. 234 under ambient natural daylight, incandescent, or fluorescent lights. The flasher shall perform only as described in paragraphs 3.10 through 3.10.3 for ambient natural daylight, incandescent, and fluorescent light.

3.11 Nameplate. MIL-DTL-15024, TYPE G, or a two mil metallized silver coated polyester nameplate shall be affixed to the top of the flasher. The information required on the nameplate is illustrated in the example below (Figure 2):



Example of a typical Nameplate (3.11)

Figure 2

The manufacturer shall obtain the manufacturer's code from the SPA, which is usually the Ocean Engineering Division, COMDT (CG-432), upon contract award. The identifier field shall be the month and year the flasher is delivered. An example is 1106 for November 2006. (Note: The terminal markings have been incorporated into the nameplate in this example). Use of the entire address on the "MFD BY:" field of the nameplate is optional. Only the contractor's name is required in this field. Alternatively, the contractor's name may be located at the top of the nameplate.

3.12 Program Rhythm Marking. All the programmable rhythms, as specified in the list in paragraph 3.9.7.1, shall be incorporated into a simple "how to" programming guide and permanently affixed to either the top or side of the flasher, or incorporated into the nameplate. To avoid confusion and reduce the possibility of selecting an unintended rhythm, the rhythm-listings label shall be divided into two separate and distinct groupings – one headlined **Buoys/Structures** and the other **Lighthouses/Ranges**, as presented in the list in paragraph 3.9.7.1. An example of a possible way the standard rhythms can be presented on a Program Rhythm Marking label is shown below:

<u>Buoys/ Structures</u>		<u>Lighthouses/ Ranges</u>	
<u>Pos</u>	<u>Rhythm</u>	<u>Pos</u>	<u>Rhythm</u>
1	FL 6 (0.6)	9	Iso 6
2	FL 4 (0.4)	10	Iso 4
3	FL 2.5 (0.3)	11	FL 6 (1)
4	Q	12	FL 4 (1)
5	FL (2) 5	13	FL 2.5 (1)
6	FL (2) 6	14	Iso 2
7	FL (2+1) 6	15	FIXED
8	Mo (A)	16	Sy (Sync)

3.13 Bench Test Operation. A production flasher that does not perform as described by this specification is defective. A production flasher shall function as described below for any bench test condition prior to field installation. Flashers shall:

- a. Flash a lamp only at a definite, selected rhythm (3.9.7 through 3.9.7.2). However, this selectable rhythm shall be changeable (re-programmable) at any time during its useful service life;
- b. Regulate the output voltage (3.9.1 through 3.9.3);
- c. Have synchronization control (3.9.7.2);
- d. Sense a lamp failure (lamp-out sensor) and provide an F-pulse signal (3.9.8 through 3.9.8.3) to advance an external lampchanger; and
- e. Have illumination control (3.10 through 3.10.4).

Any other behavior is a malfunction and the flasher is defective.

#### 4. QUALITY ASSURANCE PROVISIONS.

4.1 Quality System. The contractor's quality assurance program shall meet the minimum requirements of ANSI / ASQC C-1.

4.2 Contractor's Calibration System. The contractor shall maintain a calibration and maintenance system conforming to the requirements of ANSI / NCSL Z540-1-1994 to control the accuracy of measurement and test equipment used in the fulfillment of this specification. The system shall include, as a minimum, prescribed calibration intervals and the source of calibration. A monitoring system to this requirement shall be readily available to the Coast Guard Inspector. Calibration shall be traceable to the National Institute of Standards and Technology.

4.3 Classification of Inspections. The inspection requirements specified herein are classified as follows:

- a. First Article: 4.5 through 4.8
- b. Production: 4.9

#### 4.4 Responsibility.

4.4.1 First Article Test and Inspection Responsibility. First article testing and inspection is the responsibility of the contractor and will be conducted at a facility acceptable to the government. Upon contract award, a First Article Test Plan shall be submitted to the KO within 30 days for approval. At a minimum this plan shall include:

- a. A chronological listing of the tests to be performed;
- b. Location of the test facility;
- c. A complete listing of all equipment to be used;
- d. Detailed test procedures for each test, including wiring diagrams of test setups and pass/fail criteria;
- e. All other pertinent information necessary to fully describe the test; and
- f. Test data sheets shall be provided with the test plan and shall be used to record observed performance data.

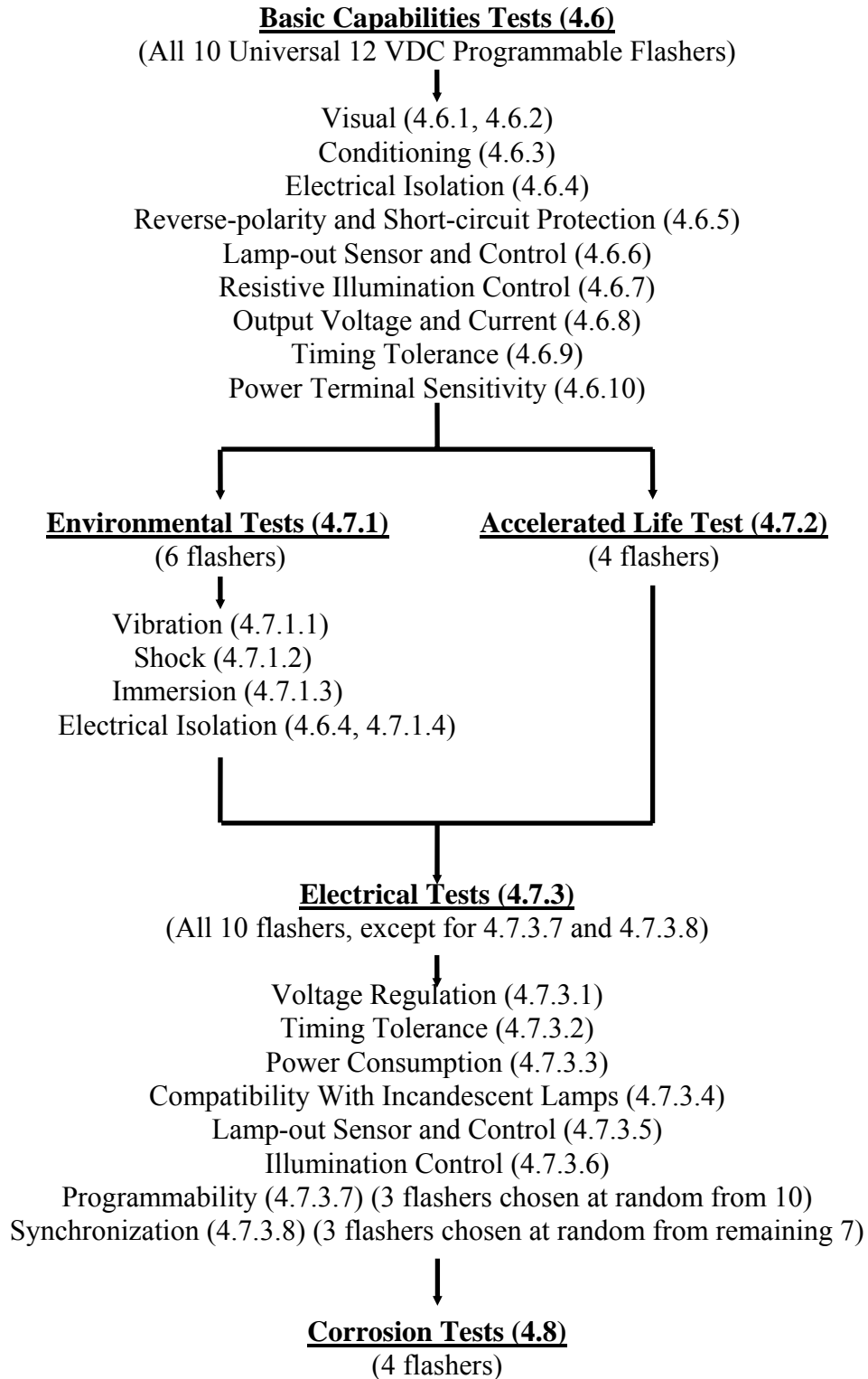
4.4.2 Production Inspection Responsibility. The contractor shall conform to all requirements of the Federal Acquisition Regulations (FAR) Part 52.246-1, Contractor Inspection Requirements, and Part 52.246-2, Inspection of Supplies, Fixed Price.

#### 4.5 First Article Inspection.

4.5.1 Inspection. Upon contract award, the contractor shall provide to the KO a detailed test plan of the first article testing, as mentioned in 4.4.1. After approval of the test plan by the KO, the contractor shall notify the KO three weeks prior to the commencement of the first article test (4.5.1.1). A government representative will monitor the tests.

4.5.1.1 First Article Test. Ten flashers shall be submitted for first article testing. All ten flashers shall be subjected to the Basic Capabilities Tests (4.6). At the conclusion of the Basic Capabilities Tests six flashers shall be subjected to the Environmental Tests (4.7.1) and the other four flashers shall be subjected to the Accelerated Life Test (4.7.2). At the conclusion of these tests, all ten flashers shall be subjected to the Electrical Tests (4.7.3) except Programmability (4.7.3.7) and Synchronization (4.7.3.8) tests for which three flashers shall be randomly chosen as follows: for the Programmability test (4.7.3.7) three flashers shall be chosen at random from the entire group of ten; and for the Synchronization test (4.7.3.8) three flashers shall be chosen at random from the remaining seven flashers). At the conclusion of the Electrical Tests, four flashers shall be subjected to the Corrosion Resistance test (4.8). Tests shall be performed on all of the flashers regardless of failures. Table 1 details the first article testing requirements.

**TABLE 1**  
**DETAILED FIRST ARTICLE TEST REQUIREMENTS**



4.5.1.2 Flasher Submission. Flashers submitted for first article testing shall be representative of the manufacturer's proposed normal production. The ten first article test flashers shall be programmed to provide two samples each of the Iso 6, FL4(.4), FL(2+1)6, and Mo(A) and one sample of the Q and FIXED rhythms as defined in 3.9.7.1. Flashers submitted for testing will become the property of the government.

4.5.1.3 Acceptance Level. All flashers submitted for first article testing must comply with the acceptance/rejection criteria for the Basic Capabilities Tests (4.6), Environmental Tests (4.7.1), Electrical Tests (4.7.3), and Corrosion Resistance (4.8) test.

4.5.1.4. Approval of First Article Flashers. The contractor shall submit a final test report along with the ten first article flashers to the KO within 15 days of the conclusion of first article testing. The report shall contain all information in the test plan and all data, including, but not limited to, data gathered from subcontractors used in first article testing. Upon receipt of the final test report, the SPA will review it for completeness and to ensure the flashers have met the requirements of the specification. Upon approval of the final test report by the SPA, the KO will officially accept the first article flashers and the final test report and allow production to commence.

4.6 Basic Capabilities Tests. Flashers shall be subjected to a series of initial tests to verify the basic capabilities of the flasher. Unless otherwise specified, the flashers shall be powered by a DC power supply set at  $12.0 \pm 0.1$  volts input for the Basic Capabilities Tests.

4.6.1 Visual Inspection. Each flasher shall be visually inspected to see that the terminals, terminal markings, and program rhythm markings are properly placed and legible (3.5.4)(3.11)(3.12).

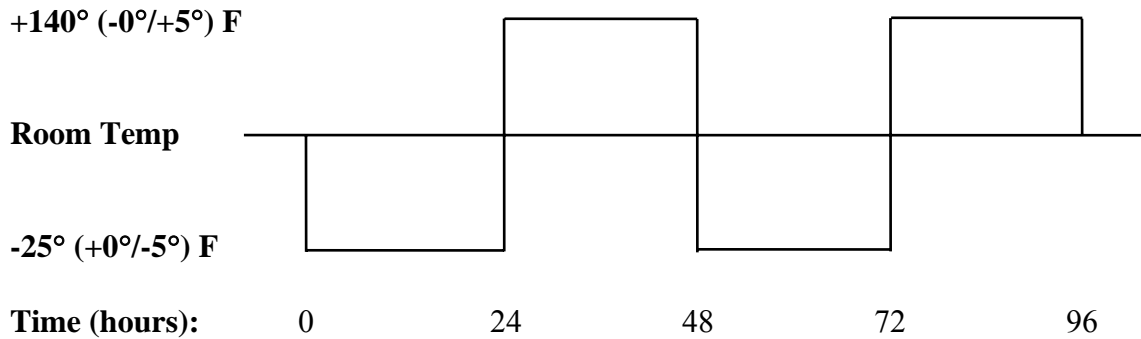
4.6.2 Mechanical Conformation to Specifications and Drawings. Measure the following features to ensure compliance with the specification:

- a. Dimensions (3.5.1);
- b. Number, location, and depth of screw entrance into mounting holes (3.5.2);
- c. Number, thread-type, location, and length of terminal screws (3.5.3); and
- d. Size of slotted terminal insulators and compatibility with three, 11/32" spade or hook wire terminal lugs. Sufficient height to insulate terminals with one lug in place. Terminal insulators not to extend above the mounting surfaces (3.5.3).

4.6.3 Conditioning. All flashers submitted for first article testing shall be conditioned by subjecting them to two (2) 48-hour cycles of temperature variation consisting of 24 hours at  $-25^{\circ}$  ( $+0^{\circ}/-5^{\circ}$ ) F and 24 hours at  $+140^{\circ}$  ( $+5^{\circ}/-0^{\circ}$ ) F. The transitions between temperature extremes shall be accomplished within a two hour period, which shall commence at the end of each 24 hour segment of the test. During the temperature cycling, each flasher shall operate a 3.05 amp lamp from a 14-volt DC power supply source. A 15 ohm resistor shall be connected between the



“F/r” and “-” terminals, and terminals “S” and “S/Sy” shall be left open.



4.6.4 Electrical Isolation. Connect +18-volts DC between each terminal and either one of the lampchanger mounting bracket holes if the case is plastic or the case itself if the case is metal for at least 5 seconds. However, if the case is metal and has a protective coating (e.g., painted or anodized), ensure the probe pierces the coating and makes good contact with the actual metal underneath. Note the current flow and calculate the resistance. The resistance shall not be less than 500,000 ohms between each terminal and the case (see 3.6.1).

4.6.5 Reverse-Polarity and Short-Circuit Protection. With a 15 ohm resistor connected between "F/r" and "-" and a 110-watt lamp between "L" and "-", verify that the flasher complies with 3.9.5 and 3.9.6 by:

a. Making the following connections, one terminal at a time, with normal input polarity and holding for 10 seconds:

1. "F/r", "L", "S", "S/Sy", "+", and "-" to the case
2. "F/r", "L", "S", and "S/Sy" to "+"
3. "F/r", "L", "S", and "S/Sy" to "-"
4. "F/r" to "L"
5. "S" to "S/Sy"

b. Repeat 4.6.5.a with reversed input polarity.

4.6.6 Lamp-out Sensor and Control. With the flasher connected to a lampchanger (GFP), remove the operating lamp and verify that the flasher activates the lampchanger's stepping mechanism to place the next lamp into the operating position (3.9.8). Insure that a momentary discontinuity in the lamp circuit does not activate the "F/r" terminal circuit with a 0.55 amp lamp (3.9.8.2).

4.6.7 Resistive Illumination Control. With a photoresistor conforming to CG-43 Specification No. 234 connected between "S" and "S/Sy" terminals, verify that the illumination-control

circuitry will turn the flasher on and off as required in 3.10. With the photoresistor aimed directly at the flashing lamp, verify that the flashing lamp does not spuriously activate the illumination-control circuitry or cause the light to flash on a changed rhythm (3.10.2). Using a variable resistor connected between “S” and “S/Sy” terminals, measure the turn on and turn off resistances and verify compliance with the requirements of 3.10.1.

4.6.8 Output Voltage and Current. For input voltages of 16.0 (18.0 for 0.55 amp lamp), 12.4, and 10.0 VDC verify conformance with the requirement for output voltage and output current (3.9.2 and 3.9.3 respectively) when flashing a 0.55 amp lamp, a 3.05 amp lamp, and a 110-watt lamp.

4.6.9 Flasher Rhythm Timing Tolerance. For all flashers, measure the flash and eclipse lengths of the pre-set timing rhythms. Measure the rhythms of each flasher while powering 0.55 amp, 3.05 amp, and 110-watt lamps using a digital timer triggering off the positive and negative slopes of the voltage pulse. Calculate the period and duty cycle to verify compliance with the requirements of 3.9.7.3.

4.6.10 Power Terminal Sensitivity. Connect the flasher to a 12-volt DC power source, a CG-6PHW lampchanger with 3.05 lamps, and a photoresistor. Turn on the power source and cover the photoresistor, causing the lamp to display the rhythm selected. Wait at least 4.5 seconds to allow the circuits to warm-up and stabilize. Next, mechanically disconnect and reconnect the positive terminal to the power source according to the following timing sequence: 0.5 seconds disconnected, 4.5 seconds connected (10% tolerance on timing). After each 4.5-second power reconnected phase, record the rhythm the flasher displays. Flashers displaying a rhythm different from that selected after the 4.5-second reconnect period has elapsed or which cause the lampchanger to advance position are defective. Disconnect and reconnect the positive terminal according to the sequence discussed above a minimum of ten times per flasher and record the flasher rhythm and lampchanger action as described above. As an alternative, the contractor may conduct this test consecutively without stopping and then record the flasher rhythm and lampchanger action after the tenth cycle has ended.

4.6.11 Acceptance/Rejection Criteria. Failure of any one flasher to comply with all aspects of the Basic Capabilities Tests (4.6) shall constitute a failure of the entire first article test procedure.

4.7 Laboratory Tests. After completion of the Basic Capabilities Tests (4.6), the ten flashers submitted for first article testing shall be subjected to a series of Laboratory Tests (4.7). Six flashers shall be subjected to Environmental Tests (4.7.1) concurrently with four flashers being subjected to the Accelerated Life Test (4.7.2). After completion of the Environmental Tests (4.7.1) and the Accelerated Life Test (4.7.2), all ten flashers shall be subjected to the Electrical Tests (4.7.3).

4.7.1 Environmental Tests. Six flashers shall undergo Environmental Tests. All six flashers shall be subjected to each test in the order listed below.

4.7.1.1 Vibration. Flashers shall be tested in accordance with MIL-STD-202, Method 204-D, Test Condition 'D', except that amplitude must be maintained at 10G's (not 20G peak) and with

duration reduced to three 20-minute cycles in each of three mutually perpendicular axes (x, y, & z) for a total of nine complete cycles (180 minutes total). The flasher shall be rigidly attached to a fixture capable of transmitting all of the vibration conditions.

4.7.1.2 Shock. Flashers shall be shock tested in accordance with MIL-STD-202, Method 213-B. Flashers shall be rigidly mounted prior to testing. Shocks shall be applied in only one direction for each of three mutually perpendicular axes (x, y, & z). A total of ten shock pulses of 11 milliseconds duration, 40G peak acceleration, sawtooth waveshape shall be applied to each flasher: three along one axis, three along another axis, and four along the final axis. The axis that receives four blows (instead of three) is chosen at random for each flasher. Use Test Condition 'G' reduced from 50G's to 40G's.

4.7.1.3 Immersion. Flashers shall be completely immersed in tap water at  $68^{\circ} \pm 18^{\circ}$  F for two hours. The flashers shall be immersed so that the uppermost portion of the case is at least six inches below the surface of the water. Air dry and inspect the exterior for separation of parts, dissolving of compounds, adhesives, or other deterioration which could cause the flasher to fail.

4.7.1.4 Environmental Test Evaluation. At the conclusion of the Environmental Tests, subject all six flashers to the Electrical Isolation Test (4.6.4).

4.7.1.5 Acceptance/Rejection Criteria. Two flashers with an isolation between the lampchanger mounting holes (or the metal case) and any terminal of less than 500,000 ohms at the conclusion of the Environmental Tests (4.7.1) shall constitute a failure of the entire first article test procedure.

4.7.2 Accelerated Life Test. The four flashers not subjected to the Environmental Tests (4.7.1) shall be subjected to two Accelerated Life Tests. Accelerated Life Test number 1 shall consist of operating the four flashers at  $140^{\circ} (+5^{\circ}/-0^{\circ})$  F and ambient relative humidity for a period of 360 hours (15 full days). The flashers, with a photoresistor conforming to CG-43 Specification No. 234, and a 15 ohm resistor connected between the "F/r" and "-" terminals, shall be cycled as follows while operating a 110-watt lamp and powered by an adjustable dc power supply.

The test procedure is as follows:

- a. In a darkened test chamber, with an input voltage of 14.0-volts DC, operate the flasher for 120 hours;
- b. Decrease the input voltage to 11.25-volts DC and operate in this condition for 120 hours;
- c. At the end of a 15-minute shut-down period, energize the flashers and operate at 12.4-volts DC for 120 hours; and
- d. From the 120th to the 132nd hour and the 240th to the 252nd hour of the test, the ambient illumination in the test chamber shall be raised to 100 foot-candles to insure that all flashers are turned off by their photoresistors.

Accelerated Life Test number 2 shall consist of operating the “F/r” terminal circuit of the flasher at 70° ± 5° F. The four flashers shall be operated with the “S,” “S/Sy,” and “L” terminals open, a 15-ohm, 250-millihenry load, such as the solenoid coil in a CG-6PHW lampchanger (GFP), connected between the “F/r” and “-” terminals, and 12.0-volts DC input to the “+” and “-” terminals. Voltage pulses between the “F/r” and “-” terminals shall be monitored with a voltmeter or pulse counter so that the resistive-inductive load is energized fifty (50) times.

4.7.2.1 Acceptance/Rejection Criteria. There are no pass/fail criteria for the Accelerated Life Test. Operation in the Electrical Tests (4.7.3) serves to verify post-test flasher performance.

4.7.3 Electrical Tests. All ten flashers shall be subjected to a series of electrical tests to verify their ability to function within specification at several temperatures with various loads and power source combinations. To simulate a primary battery, use a regulated, transformer-rectified DC power supply. This power supply shall be regulated such that the closed circuit input voltage to a non-fixed mode flasher, when operating a 110-watt lamp, remains within 0.1-volts of the no-load power supply voltage. It is recommended that the power supply be rated at more than 40-Amp, with an external capacitor bank of at least 68,000 microfarads connected across the output leads, be used to meet this requirement. Test the flashers using the following combinations:

<u>Combination</u>	<u>Closed Circuit Input Voltage</u>	<u>Lamp Load</u>
I	16.0 VDC	110 watts
II	12.4	110 watts
III	10.0	110 watts

To test the flashers' capability to operate with secondary batteries, use a 75-100 amp-hour lead-acid storage battery in the following combinations:

<u>Combination</u>	<u>Lamp Load</u>
IV	0.55 amps
V	110 watts

Unless otherwise specified each Electrical Test will be conducted under the following conditions: At two temperature levels [-25° (+0°/-5°) F and 140° (+5°/-0°) F] for all five power source and load combinations listed above, with terminals “S” and “S/Sy” open, and with a 15-ohm resistor connected between the “F/r” and “-” terminals.

4.7.3.1 Voltage Regulation. For all conditions, verify that the difference between the input voltage and the output voltage at the “L” and “-” terminal complies with the requirements of 3.9.2. There are 100 data points, given 10 flashers, 5 voltage/lamp combinations, and 2 temperatures.

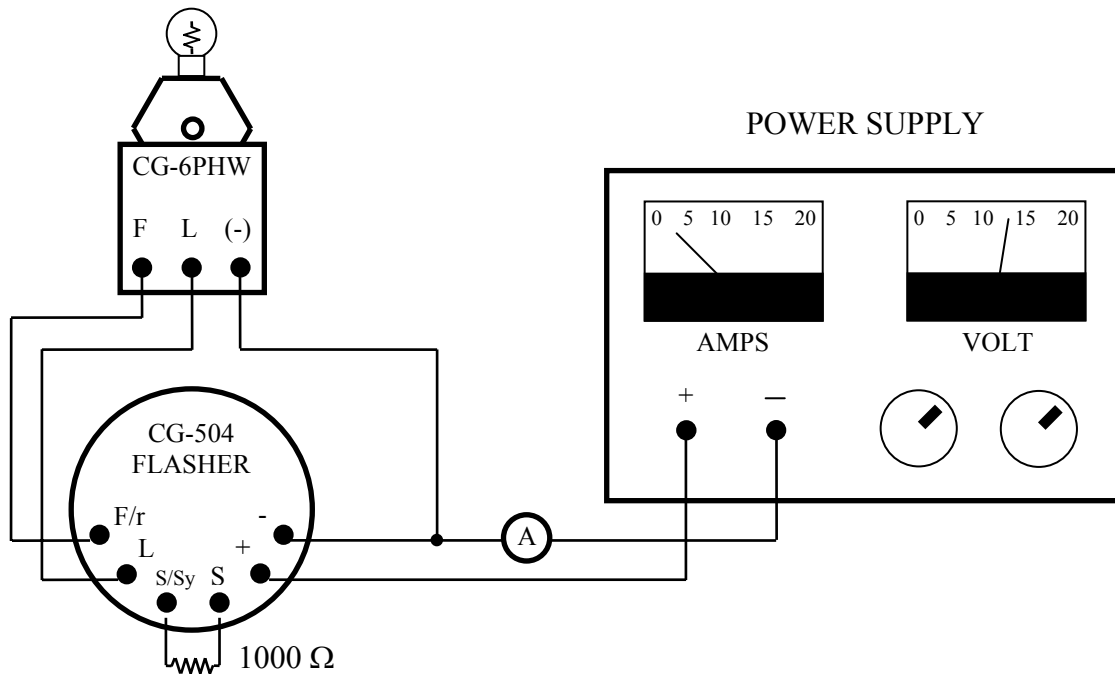
4.7.3.2 Timing Tolerance. For all conditions verify that the flash length, eclipse length, duty

cycle and period complies with the requirements of 3.9.7.3.

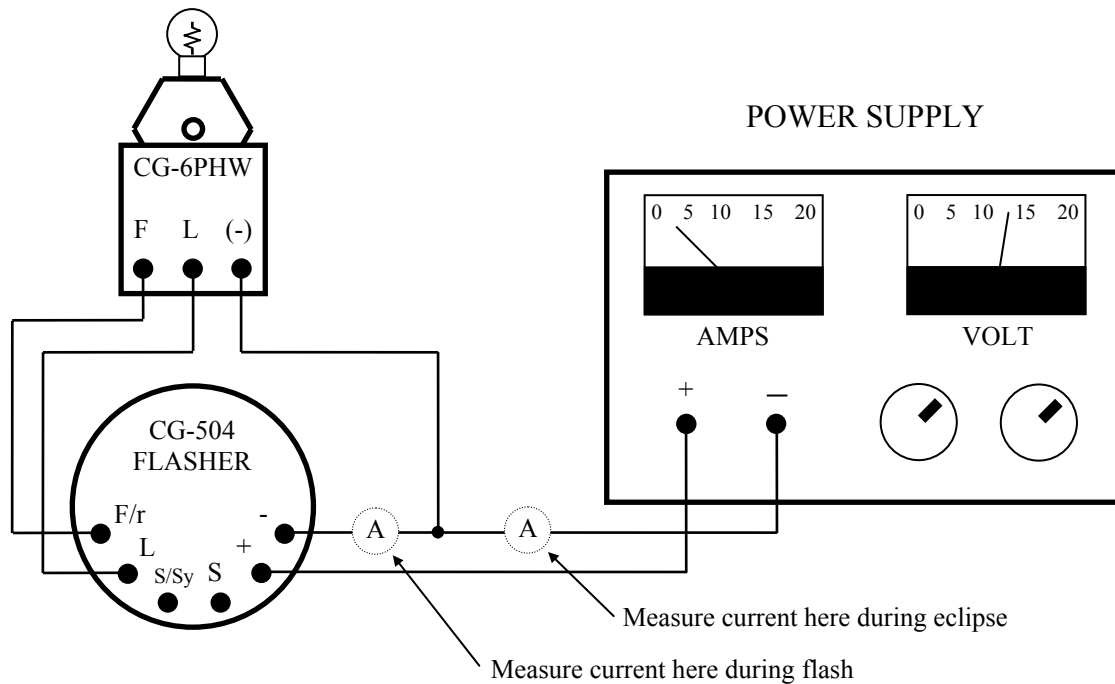
4.7.3.3 Power Consumption. For all conditions, verify that the flasher complies with the power consumption requirements of 3.9.4 by completing the following measurements:

- a. With a 1000 ohm resistor across terminals "S" and "S/Sy," measure the input current to the "idling" flashers, inclusive of the lamp load.
- b. With terminals "S" and "S/Sy" open, measure the parasitic current drawn by the flasher, exclusive of lamp load, with a lamp energized (during flash). Measure the parasitic current with the lamp off (during eclipse), inclusive of the lamp load.

It is recommended that the circuit shown in Figure 3 be used to make these measurements. There are 200 data points, given 10 flashers, 5 voltage/lamp combinations, 2 temperatures, and 2 "S" and "S/Sy" terminal states.



Test setup for Electrical Test 4.7.3.3.a



Test setup for Electrical Test 4.7.3.3.b

Figure 3

4.7.3.4 Compatibility With Incandescent Lamps. With voltage and lamp combinations IV and V, verify that the flashers comply with the voltage rise and decay times required in 3.9.9.

4.7.3.5 Lamp-out Sensor and Control. All Lamp-out Sensor and Control Tests are to be conducted with a 15-ohm resistive, 250-millihenry inductive load, such as the solenoid coil in a CG-6PHW lampchanger, connected across the "F/r" and "-" terminals as follows:

- a. "F/r" terminal Signal On. Unless otherwise specified, for each flasher and for input voltages of 18.0- and 10.0-volts DC supplied by a power supply and with terminals "S" and "S/Sy" open:
  1. Verify that the "F/r" terminal circuit is NOT activated with a 0.55 amp lamp or a 56 ohm resistor as the "L" load. The requirement is that the "F/r" terminal circuit shall not activate the F-pulse for any "L" load that draws a current over 0.010-amps (see 3.9.3).
  2. Verify activation of the "F/r" terminal circuit F-pulse with an open circuit as the "L" load using a normally-closed switch between the flasher and the lamp.
  3. Verify that the "F/r" terminal circuit voltage pulse is between 8.0- and 18.0-volts DC, 0.25 to 5.0 seconds in length, and at least one pulse every 15 seconds.
- b. No "Daytime" Functioning of Lamp-out Sensor and Control. For input voltages of 10.0- and 18.0-volts , a 1,000 ohm resistor across terminals "S" and "S/Sy," and an open-circuit between the "L" and "-" terminals, verify that the measured voltage across the "F/r" and "-" terminals is less than 0.5-volts DC.

4.7.3.6 Illumination Control. Illumination Control tests shall be conducted at two temperature levels [-25° (+0°/-5°) F and 140° (+5°/-0°) F] for voltage/lamp combinations I and III.

- a. "Turn-on" and "Turn-off" Resistance. With a variable resistor connected across terminals "S" and "S/Sy," gradually increase the resistance from 5,000 ohms, stopping at and noting the value at which the lamp begins flashing on rhythm. Gradually reduce the resistance from that value, stopping at and noting the value at which the lamp stops flashing altogether. The resistances shall comply with requirement of 3.10.1.
- b. Bias-voltage. Measure the bias voltage across a 1000 ohm resistor (daytime operation) and a 100,000 ohm resistor (nighttime operation) and verify compliance with the requirements of 3.10.1.
- c. Spurious Start Operation. Connect a type "L" photoresistor conforming to CG-43 Specification No. 234 between terminals "S" and "S/Sy" of each flasher. With the ambient illumination above the "turn-on" level, and the photoresistor positioned approximately six (6) inches from, and aimed directly at the lamp, verify that reducing the ambient illumination below the "turn-on" level activates the flasher and that the

additional illumination from the lamp does not cause it to operate on a different rhythm (3.10.2). Repeat the above procedure for a total of five times for each condition.

4.7.3.7 Programmability. Three flashers chosen at random from the ten first article units shall be subjected to the following programmability test:

With a 3.05 amp lamp installed in position one of a CG-6PHW lampchanger, the DC power supply set at  $12.0 \pm 0.1$  volts, “S” and “S/Sy” terminals open, and while operating at room temperature (about 25°C), each subject flasher shall be swept (programmed) through all fifteen required rhythms while checking for (a) timing tolerance discrepancies (ensure timing is within  $\pm 5\%$ ), and (b) lampchanging function discrepancies (simulate lamp failure by using a normally-closed switch as described in procedure in 4.7.3.5-a-2 and verify activation of the “F/r” terminal circuit).

4.7.3.8 Synchronization. Three flashers chosen at random from the remaining seven first article units shall be subjected to the following test to check the flasher’s sync operation (3.9.7.2) and its compatibility with both PWM and linear regulated flashers operating as master flashers:

Set up the test circuit shown in Figure 1 with separate power sources. Connect the programmable PWM flasher (GFP) in the system as the “master” flasher and the first article test flasher as the “slave.” Set the program selection switch in the test slave flasher to “Sy.” Place a 3.05 amp lamp in the first position of both lampchangers. With both power sources connected and turned on, and while operating at room temperature (about 25°C), each of the subject test slave flashers shall operate in sync with the flash rhythm of the master flasher. The test slave flashers shall be checked for the following items:

- a. With the photoresistor covered to simulate darkness, verify visually that the test flasher’s lamp is flashing in perfect unison with the master’s lamp for a period of at least five minutes for each of five (out of the standard fourteen) randomly selected flash rhythms with no discernable flicker or other discrepancy.
- b. While operating under any flash rhythm, uncover the photoresistor exposing it to sufficient light to simulate daytime and verify that both lamps stop flashing. Cover the photoresistor to simulate darkness once again and verify that both lamps resume flashing according to the correct flash rhythm.
- c. While operating under any flash rhythm, verify visually that the test slave flasher’s lampchanging function is operating normally (simulate lamp failure by using a normally-closed switch as described in procedure in 4.7.3.5-a-2 and verify activation of the “F/r” terminal circuit).
- d. Verify that the difference between the input voltage (CCIV) and the output voltage (CCOV) complies with the requirements of 3.9.2 for each test slave flasher.

Repeat this synchronization test using the linear voltage regulated programmable flasher (GFP) as the “master” and the same three first article test flashers as the slaves.



4.7.3.9 Acceptance/Rejection Criteria. Failure of any flasher to comply with all aspects of the Voltage Regulation (4.7.3.1), Timing Tolerance (4.7.3.2), Power Consumption (4.7.3.3), Compatibility With Incandescent Lamps (4.7.3.4), Lamp-out Sensor and Control (4.7.3.5), Illumination Control (4.7.3.6), Programmability (4.7.3.7), and Synchronization (4.7.3.8) Tests shall constitute a failure of the entire first article test procedure.

4.8 Corrosion Resistance. Four flashers, randomly chosen from the ten first article units, shall be subjected to the following test:

4.8.1 Salt Spray (Corrosion). Flashers shall be tested in accordance with MIL-STD-202, using Method 101, in a 5% salt solution with a 48-hour exposure time (Test Condition B). After exposure, exteriors of flashers shall be thoroughly inspected for evidence of susceptibility to corrosion.

4.8.2 Acceptance/Rejection Criteria. Any signs of corrosion or failure of the terminal markings (nameplate) to remain attached to the case on more than one flasher shall constitute failure of the entire first article test procedure and shall be reason for rejecting the flashers.

4.9 Production Inspections. The inspections required in this paragraph are not intended to supplant any controls, examinations, inspection, or tests normally employed by the contractor to assure the quality of this product. Each inspection lot shall be inspected for workmanship (3.8), nameplate (3.11), and programmable rhythm marking (3.12) and subjected to the Basic Capabilities Tests (4.6) with the exception of Conditioning (4.6.3), the Programmability test (4.7.3.7), and the Synchronization test (4.7.3.8). Prior to performing any production inspection, including the Basic Capabilities, Programmability, and Synchronization tests, each flasher in the production inspection sample shall be subjected to the following conditioning (or burn-in) procedure: while powered by a 14 VDC closed circuit input voltage and operating a 110-watt 12 VDC marine signal lamp under a randomly selected flash rhythm, each flasher shall be allowed to run for at least one hour in an environmental test chamber at an ambient temperature of 140°F (+5°/-0°) F.

4.9.1 Contractor's Inspection System and Responsibility. The contractor shall maintain an inspection system to ensure each item offered to the U.S. Coast Guard for acceptance or approval conforms to the contract requirements. The inspection system shall be documented and available for review by the KO's designated representative. All items shall meet all requirements of this specification. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility for ensuring that all deliverables submitted to the U.S. Coast Guard for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable process to ascertain conformance to requirements. However, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the U.S. Coast Guard to accept defective material.

4.9.2 Contractor's Calibration System. The contractor shall maintain a calibration and

maintenance system conforming to the requirements of ANSI / NCSL Z540-1-1994 to control the accuracy of measurement and test equipment used in the fulfillment of this specification. The system shall include, as a minimum, prescribed calibration intervals and the source of calibration. A monitoring system to this requirement shall be readily available to the Coast Guard Inspector. Calibration shall be traceable to the National Institute of Standards and Technology.

4.9.3 Inspection Lot. A lot shall be all of the flashers from an identifiable production period from one manufacturer and one plant and submitted for acceptance at one time.

4.9.4 Sampling. The inspection sample size shall be determined using the following table:

Inspection Lot Size	Sample Lot Size	Inspection Lot Size	Sample Lot Size
16 to 50	3	501 to 3,200	13
51 to 150	5	3,201 to 35,000	20
151 to 500	8		

4.9.5 Acceptance/Rejection Criteria. Failure of any flasher in the sample lot shall be cause for rejection of the entire lot.

4.9.6 Failure Responsibility. If a flasher lot fails to pass production inspection, the contractor shall take corrective action on the materials or process, or both as warranted, on all items or portions thereof which were similarly manufactured and which are subject to the same cause for failure. Depending on the type and number of failures, the inspection may be discontinued at the discretion of the Government inspector until all corrective action has been taken. After all corrective action has been taken the inspection shall be continued or repeated, depending on the reason for which the inspection was interrupted. Acceptance shall be withheld until re-inspection has shown that the corrective action was successful and the equipment or portion thereof satisfactorily passes all inspections.

4.9.7 Resubmitted Lots. If an inspection lot is rejected, the manufacturer may rework the lot or screen out defectives and resubmit it for inspection. Resubmitted lots shall be kept separate from new lots.

## 5. PREPARATION FOR DELIVERY.

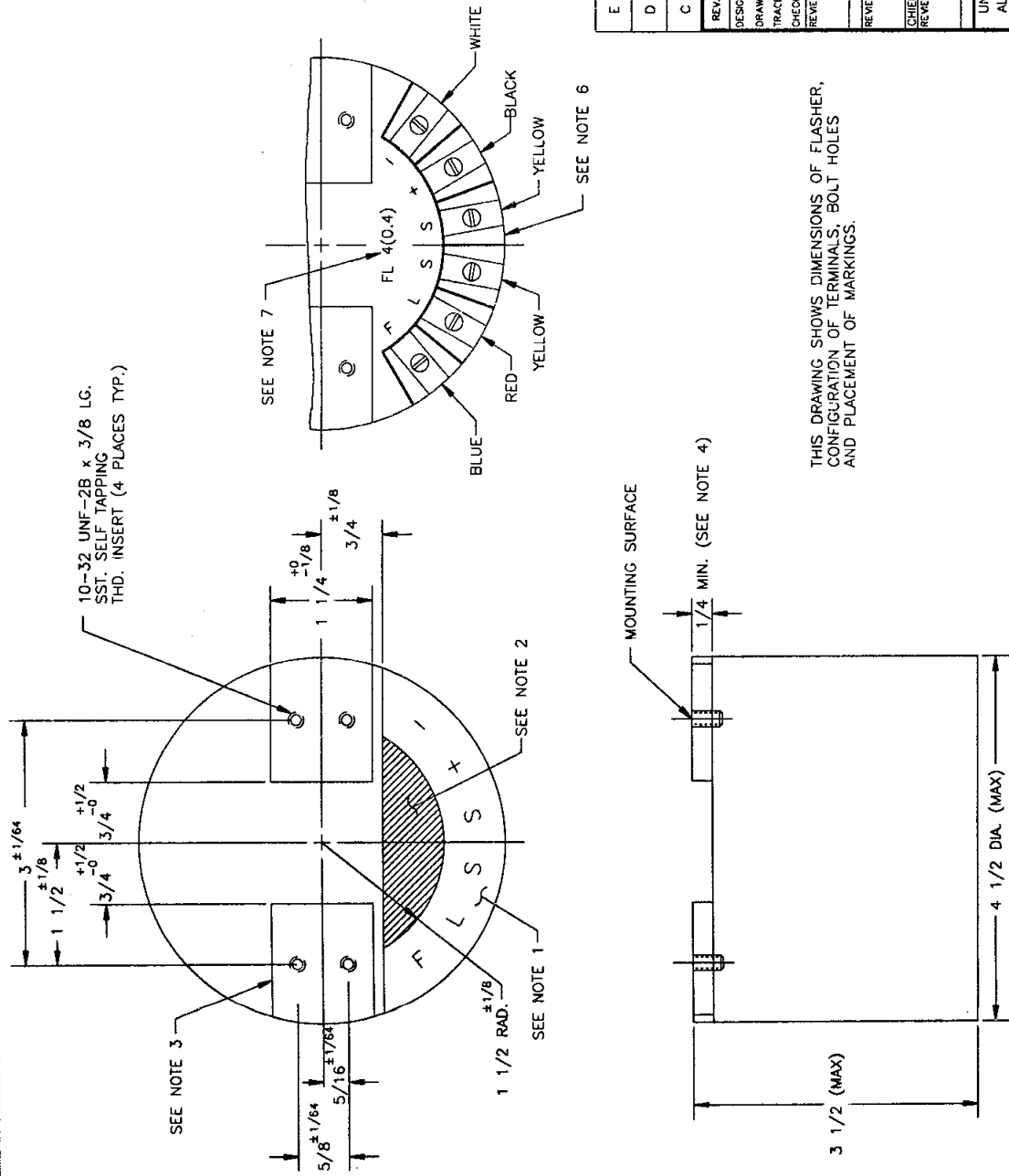
5.1 Packaging. Preservation and packaging shall conform to the requirements of ASTM D 3951, standard commercial practice.

5.2 Packing. The flashers shall be packed in accordance with the requirements of ASTM D 3951, standard commercial practice.

5.3 Marking. Interior and exterior containers shall be marked in accordance with MIL-STD-129. Bar codes are required in accordance with ANSI/AIM BC 1. Precautions necessary for full protection of the flashers shall be prominently located as specified in MIL-STD-129. A marking example is provided in MIL-STD-129 for unit packs, intermediate containers, and exterior shipping containers.

**NOTES:**

1. LOCATION, IDENTIFICATION AND ORDER OF TERMINALS AND TERMINAL INSULATORS.
2. LOCATION OF RHYTHM AND TERMINAL MARKINGS.
3. MAXIMUM SIZE OF MOUNTING SURFACE.
4. MINIMUM HEIGHT OF MOUNTING SURFACE ABOVE REMAINDER OF CASE.
5. MATERIAL TO MEET REQUIREMENTS OF SPECIFICATIONS.
6. EXAMPLE OF CORRECTLY LOCATED TERMINALS AND MARKINGS.
7. RHYTHM AND TERMINAL MARKINGS MAY BE INCORPORATED IN THE NAMEPLATE.



THIS DRAWING SHOWS DIMENSIONS OF FLASHER, CONFIGURATION OF TERMINALS, BOLT HOLES AND PLACEMENT OF MARKINGS.

E	4-26-93	REDRAWN USING AUTOCAD.	ADDED TOLERANCES.	S.M.
D	3-8-85	CHANGED NOTES		JTG
C	6-16-67	REDRAWN WITH CHANGES.		RAS
REV.	DATE	APPR.	DESCRIPTION	BY
DESIGNED:	W. W. W.		U.S. COAST GUARD	HEADQUARTERS
DRAWN:	RAS		<b>CIVIL ENGINEERING</b>	
TRACED:	S.M.		12-VOLT	
CHECKED:	M. J. B.		SOLID-STATE FLASHER	
REVIEWED BY:	KRS			
CHIEF:				
REVIEWED BY:	JEW			
CHIEF OF BRANCH:				
REVIEWED BY:				
APPROVED:	<i>J. Norman</i>			DATE 6-17-67
	CHIEF OF DIVISION			DRAWING NUMBER 120006
UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE IN INCHES. TOLERANCES: DIM. AS NOTED ANG. ±30'				SCALE: FULL
				SHEET 1 OF 1

SPECIFICATION FOR UNIVERSAL 12 VDC PROGRAMMABLE FLASHER FOR  
MARITIME AIDS TO NAVIGATION

CG-43 SPECIFICATION NUMBER: 504

JANUARY 2008

Prepared by:

/s/

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J. T. GRASSON  
Chief, Signal & Power Team

Approved by:

/s/

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S. D. WALKER  
Chief, Ocean Engineering Division

02/06/08

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Date