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LED-155

NAVIGATION LANTERN
PRODUCT MANUAL



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1. INTRODUCTION

Standard features

- Designed for both fixed and floating applications
- Narrow or Wide vertical divergence
- Up to 450 cd peak intensity at 6 W power per tier with narrow lens
- Very low overall power consumption
- Flasher with free programmable character
- Programmable Intensity
- Programmable Solar Charger up to 16 amps
- Daylight sensor (lux)
- Wire Synchronisation
- Accurate integrated power measurement system
- Wireless IR-Programming using standard PDA

Optional features

- Dated Shut-down
- GSM LightGuard Monitoring & Control
- GPS Synchronisation
- GPS Position Check-up
- Optical Feed-back
- Event-log with records from up to 3 years
- Shock and Tilt Sensor
- Standby Battery

2. TECHNICAL DETAILS

2.1. Optical Performance

The luminous intensity is adjustable between full intensity (100%) and minimum intensity (5%). The effective visual range is from 2 to 6 nautical miles depending on light colour and flash character and numbers of tiers. The lantern is available with narrow or wide lens. The maximum luminous intensity and power consumption for the two different lenses are listed in the tables below:

Narrow Lens	Nominal Luminous Intensity and Power Consumption ($\pm 10\%$) per tier
5° FWHM	
Color	
Green	270 cd @ 6W
Red	140 cd @ 6W
White	450 cd @ 6W
Yellow	200 cd @ 6W
Blue	100 cd @ 6W

Wide Lens	Nominal Luminous Intensity and Power Consumption ($\pm 10\%$) per tier
10° FWHM	
Color	
Green	180 cd @ 6W
Red	120 cd @ 6W
White	250 cd @ 6W
Yellow	100 cd @ 6W
Blue	60 cd @ 6W

(FWHM = Full Width, Half Maximum)

The actual visual range of the lantern is depending on the effective intensity, flash length and intensity setting of lantern. The effective intensity and hence the range of a single flash character should be calculated by means of Schmidt-Clausen as recommended in the IALA recommendation E-200 Part 4 (Dec 2008 edition 1) section 6.1.

In the lantern configuration device (Sabik PDA) the visual range will be automatically calculated and displayed depending on settings selected by user. The base for this calculation is the luminous intensity

stored in the lantern at the factory test at Sabik's in-house photometric range.

The main optical specifications are listed in the table below:

Specification	Value
Narrow lens divergence	$\pm 2.5^\circ$ @ 50% of peak intensity
Wide lens divergence	$\pm 5^\circ$ @ 50% of peak intensity
Production tolerances of divergence	$-1^\circ + 2^\circ$
Lens material	UV stabilized polycarbonate
Light colours	Red/Green/Yellow/White/Blue in accordance with IALA recommendation

2.2. Energy Consumption

The lantern is designed for a wide range of power supplies including solar power, primary battery and other DC supplies. A high overall efficiency is maintained over a wide range of supply voltages, and daytime idle consumption and consumption between flashes is minimized.

Specification	Value
Standard configuration	
Input voltage range	9...30 volts
Max power consumption/tier	6 W ($\pm 10\%$) at full intensity
Daytime idle consumption	1.5 mW (less than 0.125 mA @ 12 VDC)
Consumption between flashes	12 mW (less than 1.0 mA @ 12 VDC)
Options	
GPS module installed	+ 12mW (less than 1 mA @ 12 VDC)
GSM module installed	+ 12mW (less than 1 mA @ 12 VDC)
OFBS module installed / tier	+ 25mW (less than 2 mA @ 12 VDC)
Standby battery card installed	+12 mW (less than 1 mA @ 12 VDC)
Tilt angle monitoring	+12 mW (less than 1 mA @ 12 VDC)
Shock sensor	+12 mW (less than 1 mA @ 12 VDC)

The lantern intensity and hence power consumption can be adjusted between 5% and 100% depending on range required. The overall daily power consumption is depending on duty cycle of character, intensity setting and setting of daylight sensor (when to turn on/off).

When calculating the daily power consumption also the consumption between flashes and the consumption of any of the options installed should be considered.

Example of daily power consumption, no options:

Q: Lantern set to 50% intensity and a Fl 3s (0.3+2.7=3s), 14 hours operation

A: Daily consumption = 50% x 6W x (0.3/3s) x 14h = 4.2 Wh (0.35 Ah @ 12V)
+ [(3-0.3)/3s x 0.012W x 14h] + [0.0015W x 10h] = 0.1512 Wh + 0.015 Wh = 0.17Wh

Total daily consumption = 4.2 Wh + 0.17Wh = 4.37 Wh

2.3. Mechanical

The LED 155 unit is designed for both fixed and floating applications. The mounting flange is designed to be compatible with the 3-4 bolt mounting pattern at a bolt diameter of 200mm, a common mounting arrangement for incandescent lanterns. The mounting bolt holes are equipped with plastic insulators, to prevent galvanic contact with the mounting platform as well as protect the painting on the mounting flange during installation.

The standard mounting flange also supports 3 bolts at a 150mm mounting diameter, but these holes are not equipped with the plastic insulators. There are no serviceable parts inside the lantern.

Specification	Value
Weight of unit	3.9 kg single tier add 1.0 kg for additional tiers (max is 3 tiers)
Base material	Marine grade die cast aluminium, anodized and powder painted gray RAL 70
Total height above surface	144 mm (excluding bird spikes)
Total height (incl. bird spikes)	340 mm with stainless steel bird spikes
Lantern diameter	170 mm (230 mm including base flange)
Mounting of base	3-4 pcs M12 bolts at radius 200mm, or 3 pcs M8 bolts at radius 150mm (bolts not included)

The lantern is fully waterproof and pressure tested at factory before shipment. Breathing is arranged through a PTFE membrane mounted on the underside of the lantern, enabling the lantern to equalize

pressure without the risk of letting the moisture into the lantern.

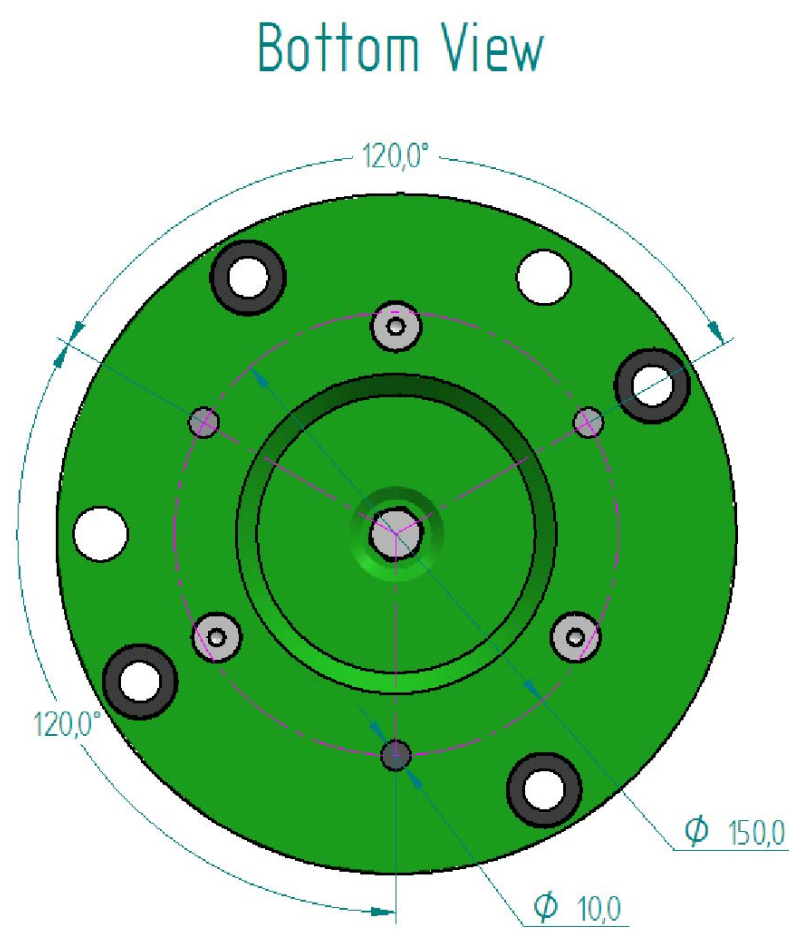
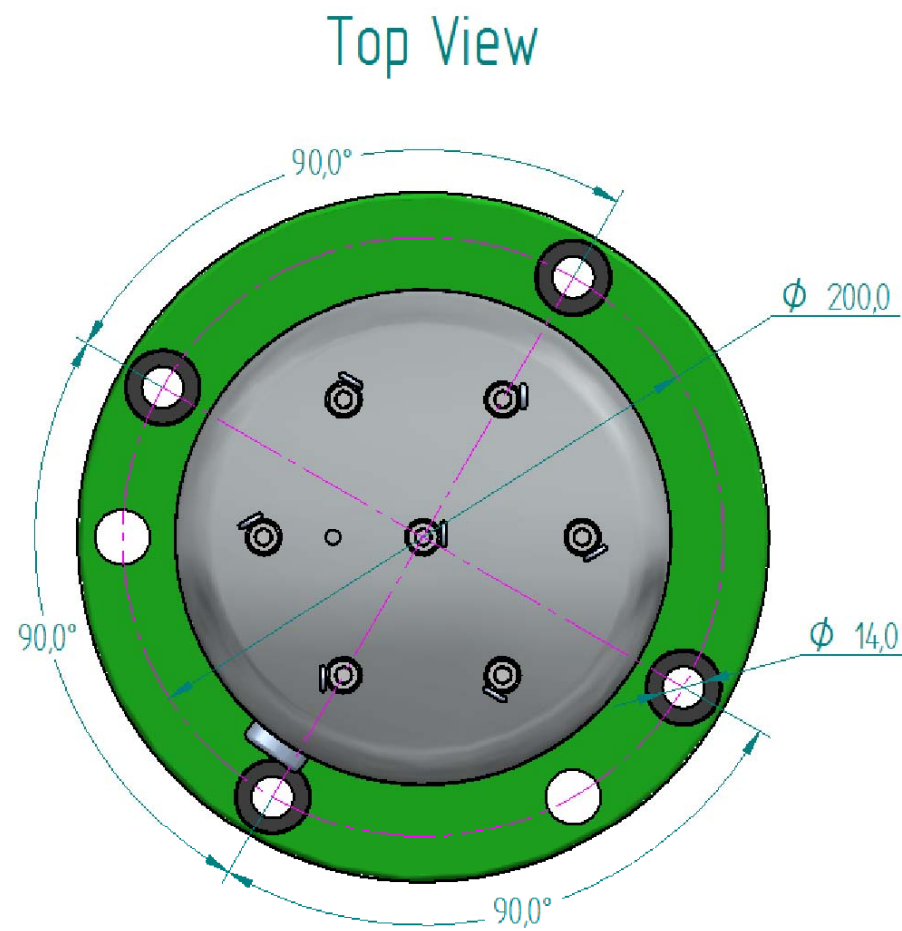


Figure 1- Mounting details of light

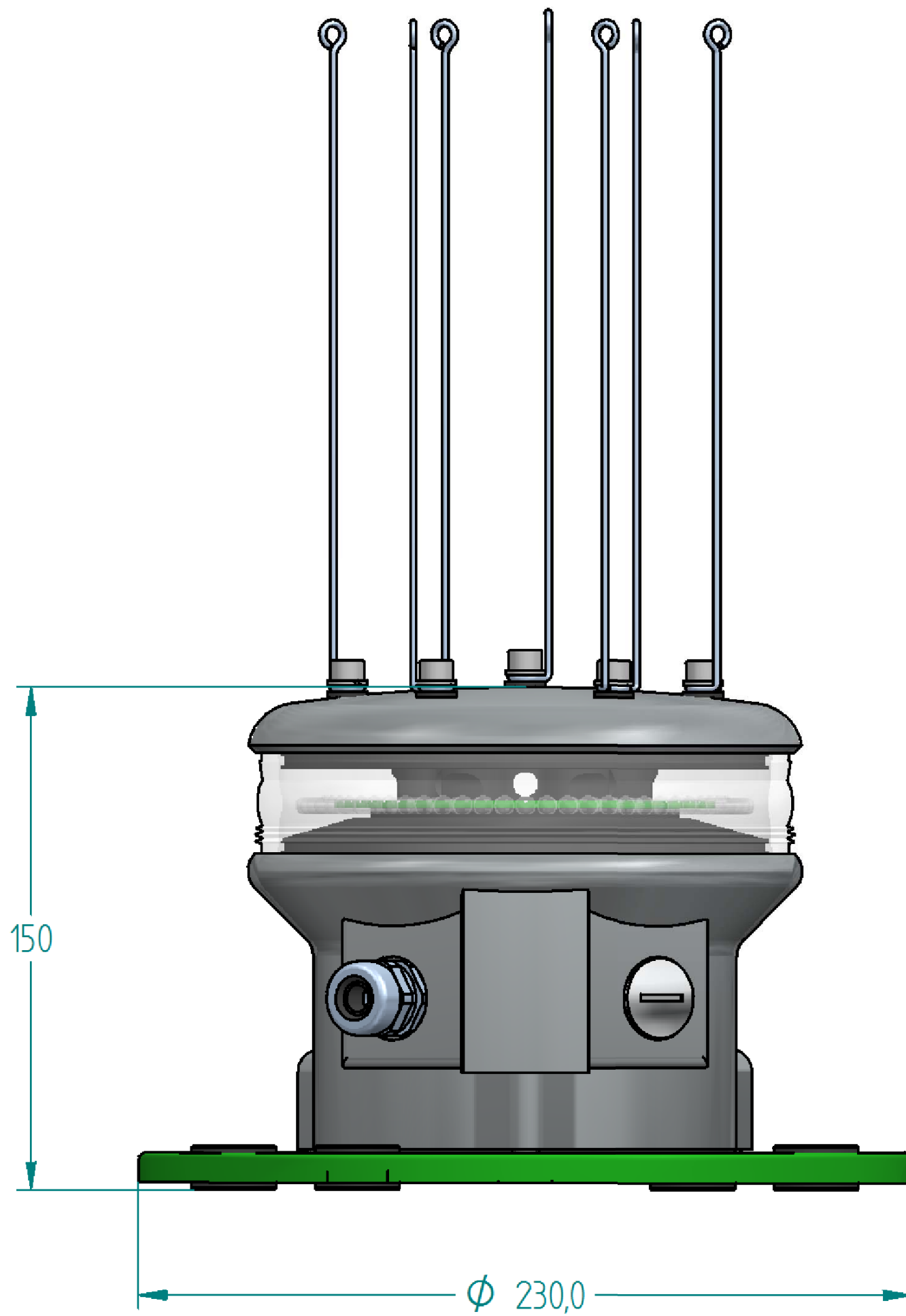


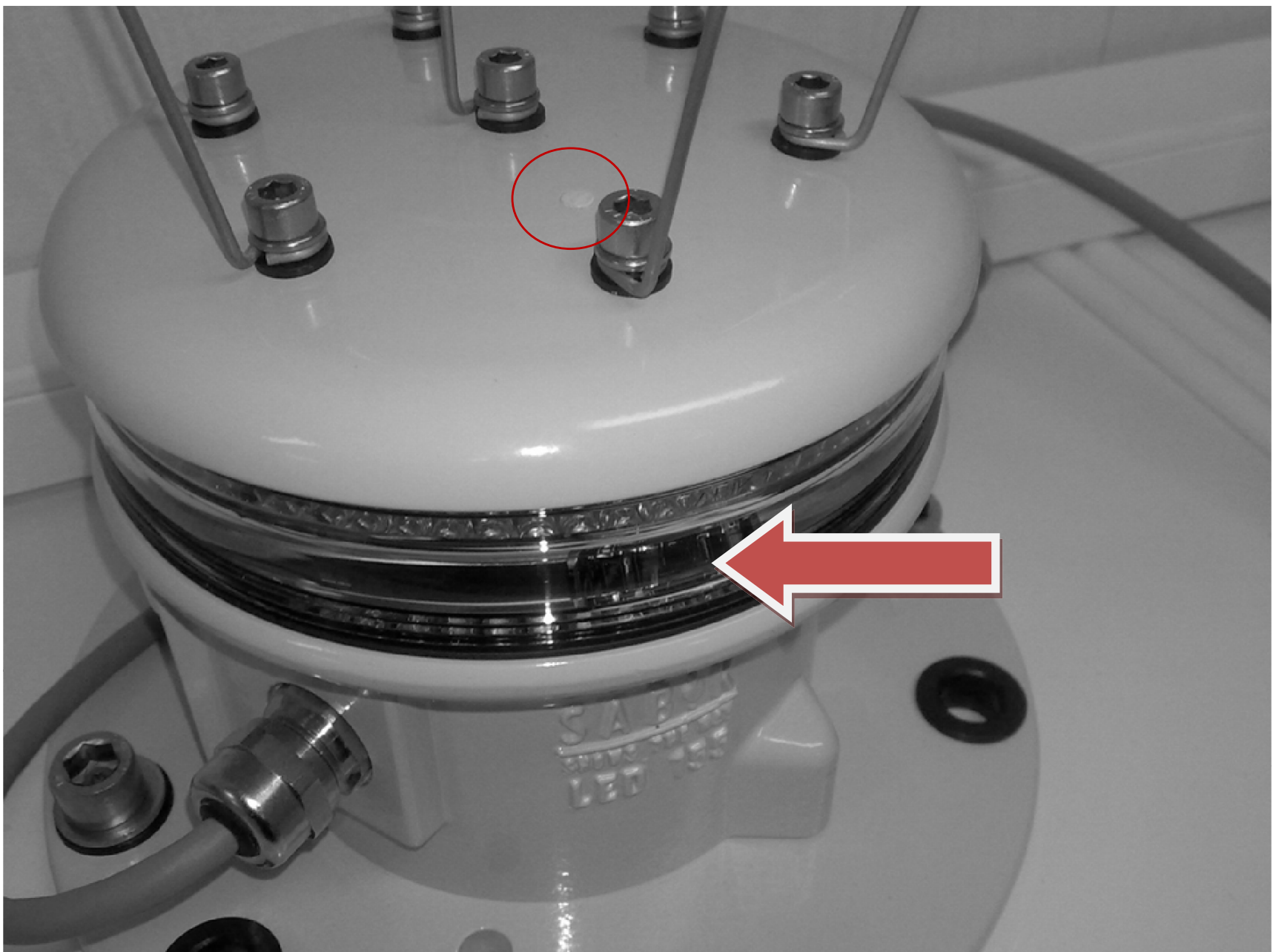
Figure 2 - General dimensions of lantern

2.4. Electrical

The LED155 lantern can be operated on primary battery, solar system or mains power system. The built-in solar panel regulator makes it easy to use solar power for the lantern. In section 4.2 the connection of various type of power supplies are explained. To utilize the solar facility a 3 wire system is required.

2.5. Light Sensor

The light sensor is located inside the optical lens, and located in the direction that is indicated by the colour marking stud in the hat of the lantern.



The light sensor is configured to ambient luminance level (lux) and the user can also program the hysteresis between turning ON and turning OFF the light. The factory default setting is to switch on the light at 15 lux and off at 60 lux. The built-in light sensor can also be utilized even if the lantern is set to fixed light, as it is able to get a reading between two light pulses (the LED's are powered using pulse width modulation). However, if the full 100% intensity is required, the lantern will automatically reduce

this by 5% in order to enable the light sensor to get a reading between the PWM pulses.

2.6. EMC

The lantern is tested for EMC in accordance with 89/336/EEC Electromagnetic Compatibility Directive, amended by 92/31/EEC & 93/68/EEC, and meets the following standards:

- IEC 61000-4-2/7.1
- IEC 61000-4-3
- IEC 61000-4-4/7.2
- IEC 61000-4-5/7.8
- IEC 61000-4-6/7.2
- IEC 61000-4-11/7
- EN 55022

On plastic buoys special care should be taken to ground the top of the buoy in order to prevent a high static charge to build up over time. By adding grounding cable from lantern mounting to the submerged part of the buoy this can be prevented.

2.7. Cable Synchronisation

The lantern comes with a cable sync port as standard. The sync line is a two-way signal enabling multiple lanterns to be synchronized to flash simultaneously or in sequences by connecting all lanterns to the same sync line. The user needs to enable this function in the lantern if he wants to utilize this function. The sync interface is not compatible with the LEDFlasher / SmartFlasher two-wire sync interface, and hence units cannot be mixed at same location.

The user can set sync offsets in order to enable running light patterns or flip-flop alternating lights.

2.8. Solar Charger

A programmable solar panel regulator capable of handling up to 16 amps is integrated in the lantern, enabling the lantern to control solar panel charging directly without the need to install external chargers. The charger settings are programmable by the user enabling the lantern to be connected to various types of batteries and also battery voltages.

The solar panel charger is a series charging regulator with temperature compensation (built-in sensor). The solar panel output is controlled by Pulse Width Modulation (PWM) in order to optimize the charging

process.

In the table below you can find the typical settings for both lead acid and open cell nickel cadmium types of batteries in 12 volt systems. For other types of batteries and other types of nominal voltages, please consult your battery manufacturer for the corresponding values:

Charger Setting	Recommended settings, 12 V system	
	VR Lead Acid	Nickel Cadmium
Cut In Voltage	13.8 V	14.8 V
Cut Out Voltage	14.4 V	15.2 V
Temperature compensation	-30 mV/°C	-30 mV/°C

Because the built-in charger is fully programmable, other types of battery chemistry's, like Nickel Metal Hydride, can also be charged safely by the lantern.

2.9. Environmental

The lantern is designed for the marine conditions and is able to withstand temporary submersion if the buoy gets hit by a wave. The robust aluminium housing and the special polycarbonate lens is designed to survive the dynamic forces present in the marine environment by wind and waves.

Specification	Value
Temperature range	-40°C to +60°C ambient temperature
Ingress protection	Certified to IP66 Each lantern is pressure tested at factory prior to shipment

3. OPTIONAL MODULES

3.1. Dated shut-down

The dated shut-down feature is a software dependent option, which can be enabled with the Sabik PDA Programmer. By setting a shut-down date and a start-up date in the controller, the lantern can be switched off to save power during times when channels/fairways are closed.

For detailed instruction on how to enable this function please refer to the "SABIK PDA Programmer Manual".

3.2. GSM LightGuard Monitoring & Control

With the LightGuard module Remote Monitoring and Control features are integrated in the lantern. The LightGuard Module uses the GSM Network to send Status messages (SMS) either to the Sabik WebSCADA system or directly to a mobile phone. A SIM card will be required.



The following key monitoring features are available:

- **Alarm and Status reporting** – The LightGuard Module can be setup to report on Day/Night change or at a certain time of day e.g. at midnight. The report is sent automatically to a WebSCADA server and includes all data available from the lantern e.g. battery voltage, consumption, production, error status, temperature, operating hours, daylight-sensor status. In case of a fail: low battery voltage, collision etc. the LightGuard module will report immediately.
- **Status Report on Request** – Using a normal mobile phone status reports can be requested by SMS to the requesting mobile phone or to the requesting WebSCADA Server.
- **Light On Demand** – By SMS command the light can be activated remotely independent on the daylight sensor

In combination with the optional GPS module additional features becomes available:

- **Out of Position Alarm** – LightGuard will monitor the GPS position and report if the buoy moves outside the position. An acceptable moving radius of the buoy can be defined.
- **High Accuracy Position Determination** – Once per day LightGuard will determine the actual position with an accuracy of +/- 1 meter and add the result to the status report.
- **Synchronizing** – the light can be synchronized with other lights equipped with same option.

Commands

The following basic commands can be used by user to request status information about the lantern. The commands are sent to the module as SMS using a normal mobile phone, and the lantern will respond directly to the user's own GSM by an SMS message.

Command	Possible response
TEL	The modem sends a message that displays the basic status of the SMC: SMC STATUS ACT.TIME: 1526 LIGHT: OFF FLASH CODE: 1.00+(1.00) BAT.LOADED: 0.0 BAT.UNLOADED: 12.3 SOLAR CURR.: 0.0 SOLAR AH: 0 TEMP.: 25
TEL1	The modem sends a message that displays the basic configuration of the SMC. SMC CONFIG ACT.TIME: 0911 LED CURR.: 0.75 LED INT.: 015 FIXED LIGHT: NO FORCED: OFF CUT IN: 14.50 CUT OUT: 14.50 DUTY CYCLE: 50 PERIOD LEN: 2.0

Command	Possible response
TEL2	The modem sends a message that displays the basic status of the modem: REMOTE SYSTEM ACT.TIME: 1548 SUNRISE: 0547 SUNSET: 2036 DAYTIME: DAY ACT.LAT: 53.600656 ACT.LONG: 11.417861 DISTANCE: 1.68 LIFETIME: 1211
TEL3	The modem sends a message that displays the GPS monitoring data: GPS POSITION FIXED LAT: 53.600712 FIXED LONG: 11.417939 ACT. LAT: 53.600601 ACT. LONG: 11.417790 VALID FIXES: 178 CALC DIST: 15.89 m OLI: FALSE

The LightGuard unit and all antennas are fully integrated in the design of the lantern. For detailed information on the LightGuard functionality and configuration please refer to the "SMC LightGuard Command" manual.

3.3. GPS synchronization only

The GPS synchronization feature is an additional hardware and a software dependent option. By adding the GPS module, an integrated GPS antenna and by enabling the synchronization with the Sabik PDA Programmer in the controller, lanterns can be synchronized via satellite. By altering the synchronization offset parameter in the controller, a running light or sequential light pattern can be created. If LightGuard remote monitoring option is installed, the GPS will also be utilized for the position monitoring.

For detailed instruction on how to enable this function please refer to the "SABIK PDA Programmer Manual".

3.4. Optical Feedback

The Optical Feedback feature is a hardware dependent option. Light sensors are installed in the lantern

and calibrated at the factory. If the LEDs are degrading or the LEDs fails, a value in % of initial intensity can be read. When the light output falls below a pre-defined level, an alarm will be set.

For detailed instruction on how to enable this function please refer to the "SABIK PDA Programmer Manual".

3.5. Event-log

The lantern can be configured to also store main events which can be retrieved by service technician using the Sabik PDA programmer. All day / night transitions as well as any malfunction will be stored in the lantern, and can be download over the infrared port at any point. The lantern has room for a about three years of events. The data is stored in a non-volatile memory independent on external power supply.

3.6. Shock and Tilt Sensor

When equipped with the LightGuard remote monitoring unit as described in section 3.2, this optional shock- and tilt sensor can be enabled. The sensor comprises of a three axis G-sensor that has three main functions:

- **Tilt switch function** – switches off the light if it stays outside the programmed tilt angle more than one minute. If value set to 0° the function is disabled. The power consumption is not affected with this setting.
- **Tilt angle monitor** – registers the max and average tilt angle (absolute value) the buoy has experienced during the last 24h. When this function is enabled it will register the tilt angle once per second.
- **Shock sensor** – when enabled the G-sensor is activated all the time and will generate an alarm if the preset shock value (G-value) is exceeded.

3.7. Secondary Battery Interface

In some installations, a dual battery system may be desired. One main battery acting as the primary power supply source and one secondary battery, only to be utilized in case of main battery failure. For these applications an optional Secondary Battery interface unit is available, enabling the connection of a second battery to the lantern.

With the secondary battery module inserted, the lantern controller will automatically switch to the secondary battery when the main battery fails or voltage drops below preset value. If powered by solar system, the controller will still keep on charging the main battery while consuming from the back-up battery. As soon as battery voltage in the main battery has recovered or the battery has been replaced, the controller will switch back to the main battery. The lantern also logs separately how many hours of operation have been consumed from the secondary battery, in order to determine if the secondary battery needs to be replaced. By using for example Lithium primary batteries with a very low self discharge rate the secondary battery can have a useful lifetime of many years, if no power is consumed by the light.

A second cable entry or a 5 core cable needs to be fitted to the lantern for this functionality. The lantern detects when the module is present and enables this functionality automatically.

4. COMMISSIONING

This chapter describes how to install, configure and test the lantern.

4.1. Product Identification

Reading the product label will provide information about the type of lens (Narrow/wide) as well as which of the optional modules are provided with the product.

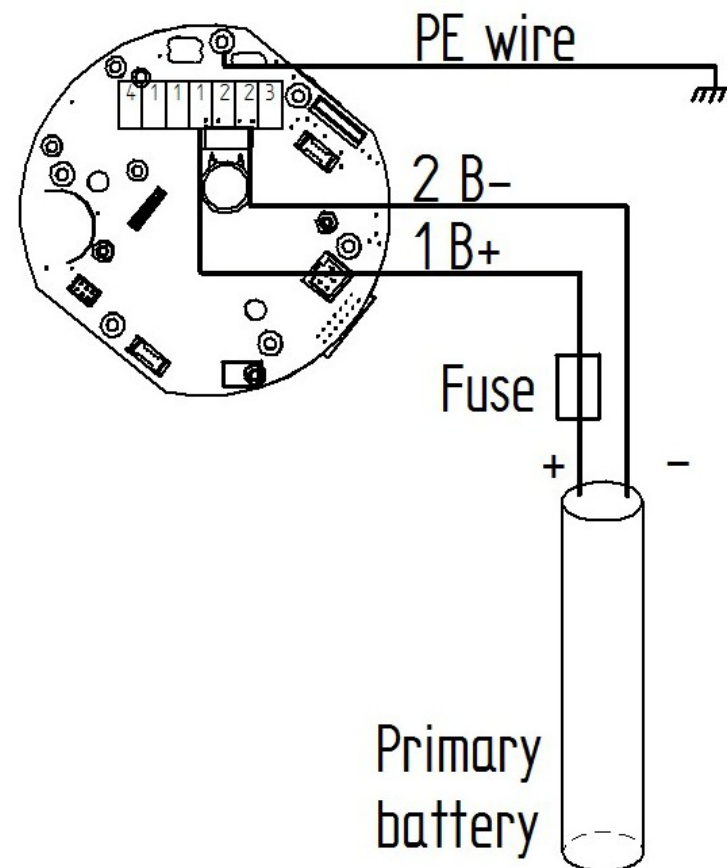


The product identification label may vary with customer requirement.

4.2. Various Power Supplies

In this section a number of application examples are provided to assist choosing the right configuration.

4.2.1. Primary Battery



Even though the minimum operating voltage of the lantern is 9V, it should not be connected to a primary battery with a nominal voltage of less than 12V to allow for voltage drop when being discharged.

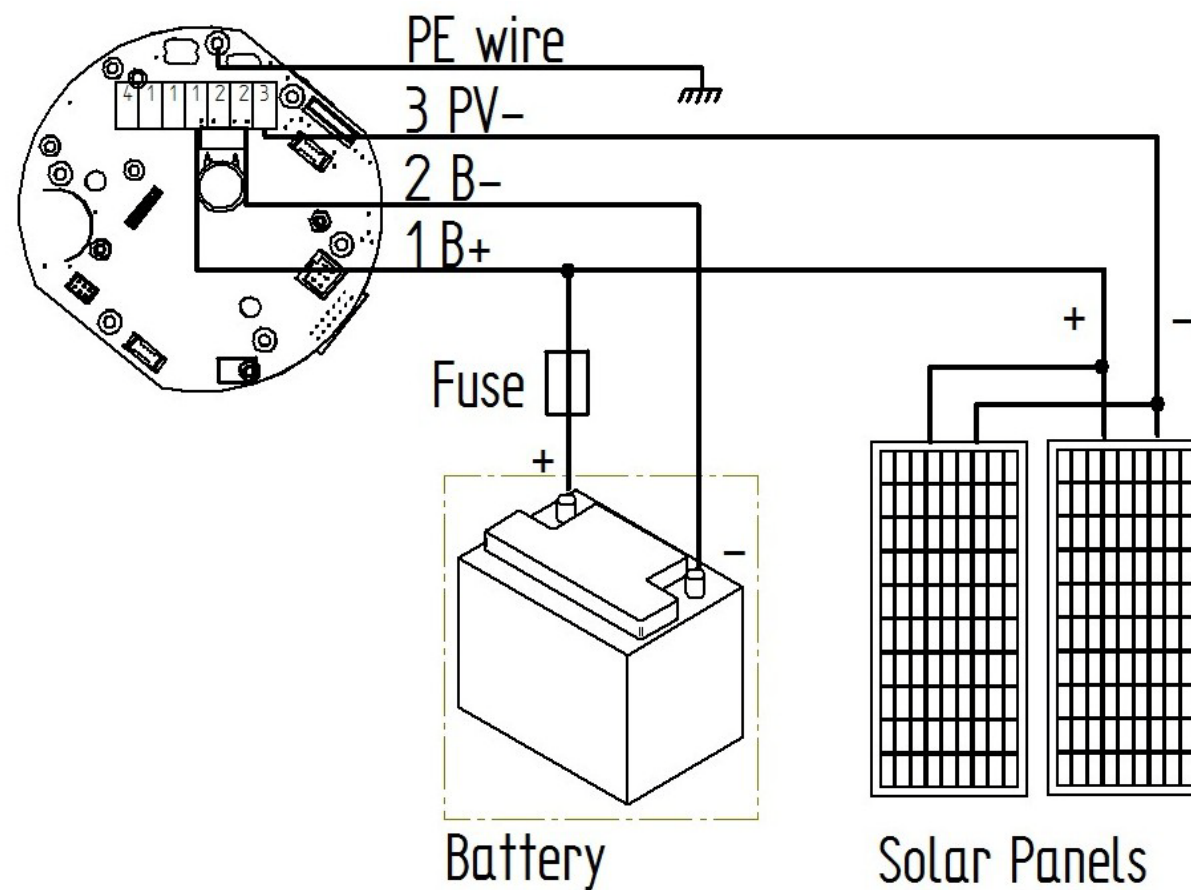
If the primary battery used does not have an internal fuse an external one must be included in the system.

4.2.2. Solar Battery with Photovoltaic

The maximum allowed solar panel current is 16A and must not be exceeded.

It is recommended to install a 16 A fuse as close to the battery as possible.

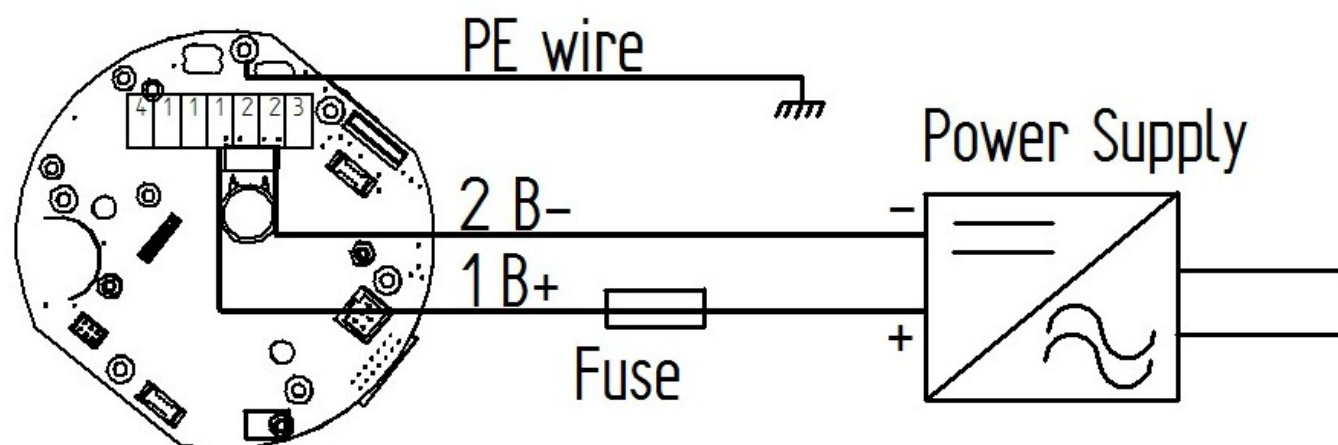
Long cables will result in an energy loss due to the voltage drop in the cable.



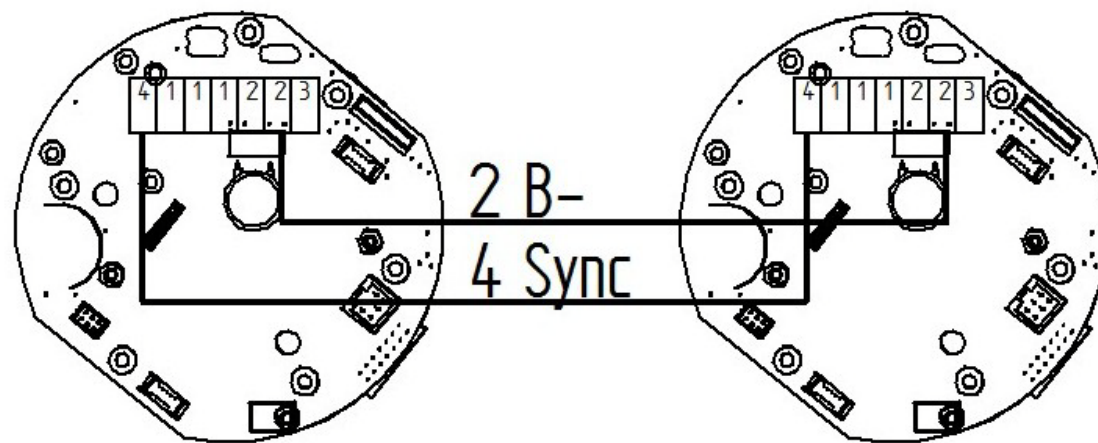
For correct charging functionality, the corresponding solar panel charging parameters should be set in the lantern as described in section 2.8 of this document.

4.2.3. Other DC power supply

When using AC/DC main operated power supplies, special attention should be paid to make sure that the power supply selected is capable of powering the unit. Especially the ripple, the transient current capability and inductance should be checked against the requirement of the lantern.



4.2.4. Wire Synchronisation



Even though the sync signal is a single wire solution, the units need to be connected to common battery minus in order for the units to work. If the lanterns are running on the same power system then the second battery lead (B-) is not required.

4.3. Insert SIM Card (only lanterns with GSM Module)

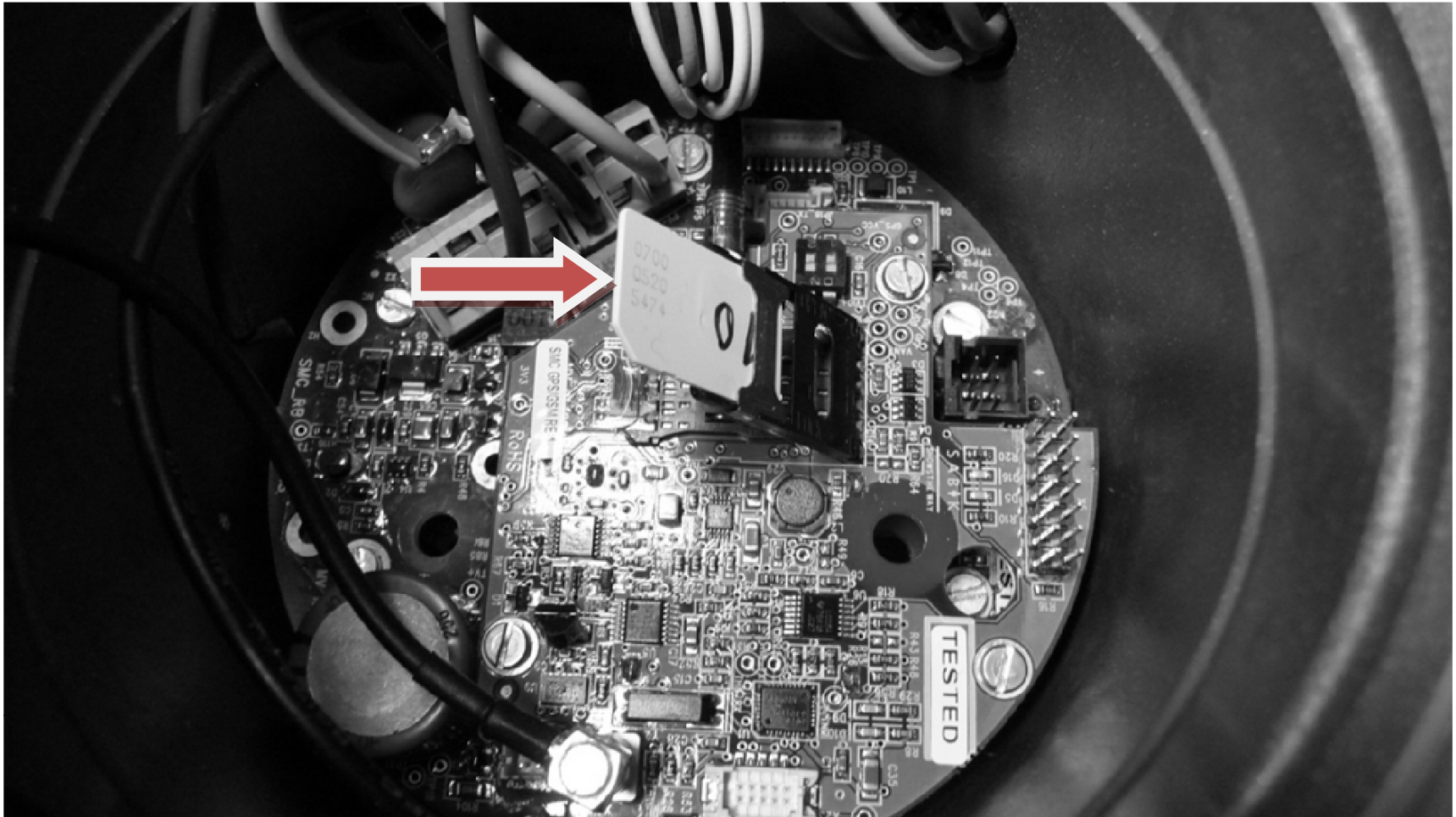


Figure 3 - Lift up the SIM card holder and place the SIM card in the holder

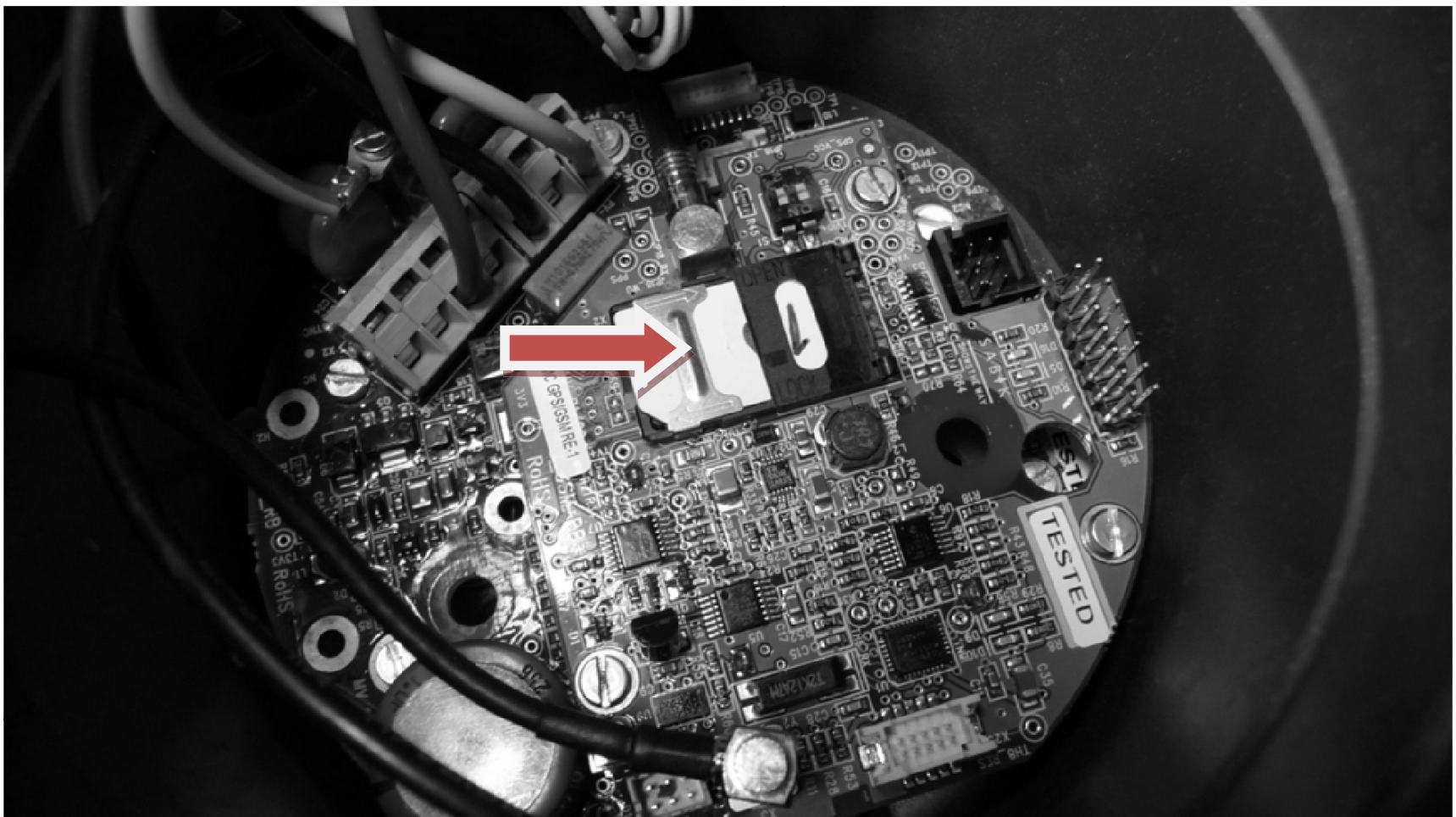






Figure 4 – Slide the SIM card lock to the left in order to secure the SIM card

4.4. Configuration Step by Step Instruction

Before programming the lantern the following basic data must be available:

Data	Description		<input checked="" type="checkbox"/>
Flash Character	The flash code for the location.		<input type="checkbox"/>
Intensity Setting (and/or) Range	The Intensity in % of the nominal max. intensity The range in nautical miles, normally defined at $T_c=0.74$ or $T_c=0.85$		<input type="checkbox"/>
Photocell Threshold Level	The daylight level in Lux at which the light will turn on or off. Default Value is 15 Lux for turning on the light and 60 Lux for turning off the light.		<input type="checkbox"/>
Parameter Profile	The lantern has many settings to control the built-in functions. In order to simplify the configuration, most of these can be pre-set and grouped into a Parameter Profile. One profile will normally represent a specific application, like a 5 M buoy lantern. The user can store his own parameter profiles to suit his needs. <ul style="list-style-type: none"> ■ Primary Battery ■ Solar VRLA ■ Solar NiCd ■ Solar NiMH Other profiles can be made available or configured directly by the end user. For further description of the profiles please refer to the "SABIK PDA Programmer Manual"		<input type="checkbox"/>

STEP 1 - Apply Power

Install and wire the lantern as described in one of the application examples above and apply power.

STEP 2 – Identify IR Interfacing point

The figure (right) shows the location of the IR-Interfacing Point, which is located inside the lens in the same direction as the colour marking stud in the hat. When working with the PDA-Programmer, always point the IR-Sensor of the PDA at the IR-Interfacing Point and make sure that the distance between the PDA and the lantern is never more than one meter indoors and directly at the IR-sensor when outdoors.

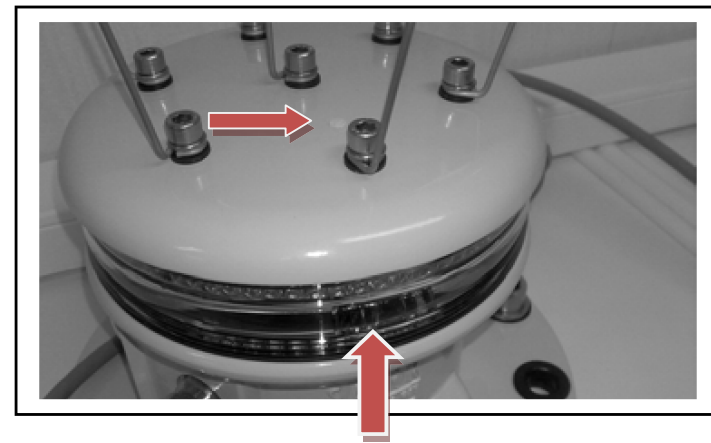
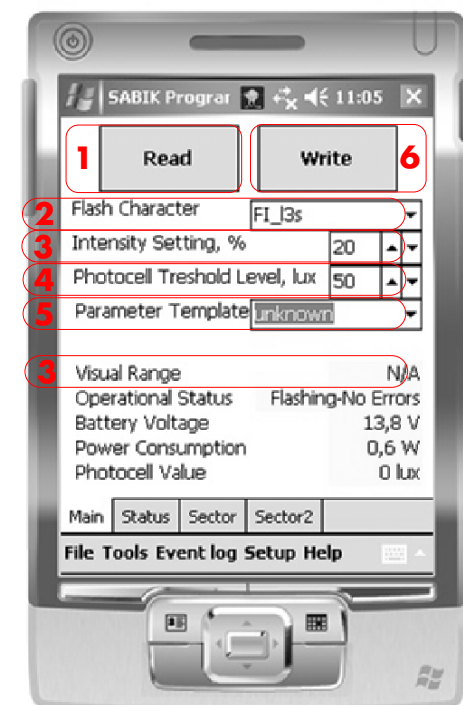


Figure 5 - Position of IR and Photo sensor

STEP 3 – Writing first setting with the SABIK Programmer

Start the SABIK Programmer on your PDA

- (1) Read the lantern by pressing the Read button. The unit will notify when parameters are uploaded
- (2) Select the flash character from the drop-down list. Verify that the Flash character is the correct one.
- (3) Set the intensity in % if you know the luminous intensity value (candela) that you need for the station, or select the visual range display by the PDA for the selected intensity and character. By changing the intensity % setting you can see how the range changes in the Visual Range box.
- (4) Set the Photocell Threshold level
- (5) Select the Parameter Profile from the drop-down box.
- (6) Write the setting to the lantern

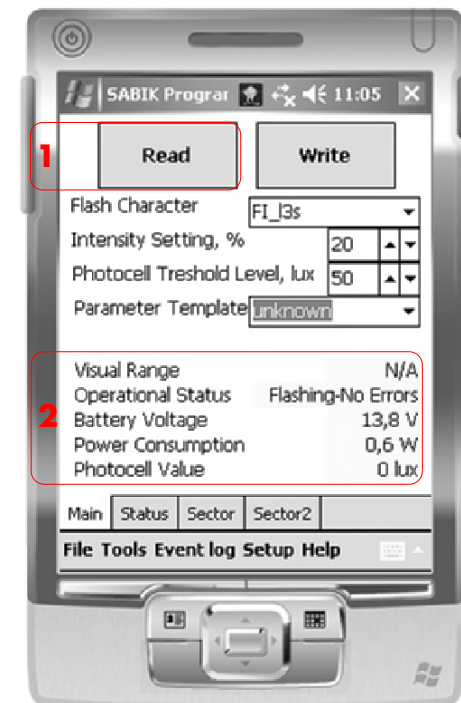


The Programmer will respond with “Device write success” when the new setting has been stored successfully in the lantern. Otherwise you will get the message “Device write failure”.

STEP 4 – Verifying the lantern setting

After successful writing of the setting to the lantern, the setting and the status of the lantern should be verified.

- (1) Read setting from Lantern
- (2) Now verify the readings one-by-one.
- (3) The **Operational Status** should indicate “No Errors”. The **Battery Voltage** indicates the actual measured battery voltage level and the **Photocell Value** indicates the actual measured daylight level in Lux.
Power Consumption is the power in Watt when the LEDs are on. The power level shown in the PDA is the actual measured power value for the lantern. The value is only updated when the lantern flashes, so the photocell may need to be covered before the lantern is interrogated with the PDA programmer.



Hint The value can be used to exactly calculate the daily consumption as:

$$\text{Daily Consumption [Wh]} = \text{Power Consumption [W]} \times \text{Duty-Cycle [\%]} \times \text{Operational Hours per Day [h]}$$

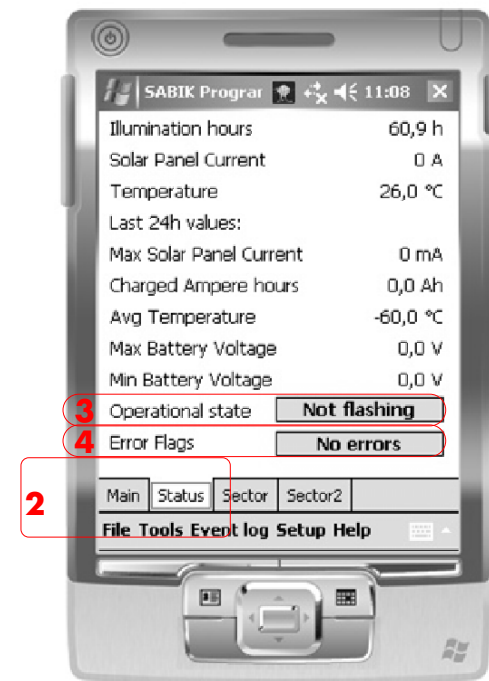
STEP 5 – Check the lantern function

Cover the lantern for at least 2 sec. – the light should now turn on and flash with the set character for at least 20 sec. after uncovering the lantern again.

Also on power-up the lantern should at least run for 20 sec. with the set character.

4.5. Reading the Status of lantern on site with the SABIK PDA Programmer

- (1) Point the programmer at the IR-Interfacing Point on the lantern and Read out from the lantern.
- (2) Click on the **Status** tab to check the logged data in the lantern
- (3) By clicking on the **Operational State** button more details from the lantern can be displayed.
- (4) By clicking on the **Error Flags** button further details about any errors can be displayed
- (5) The status data displayed for the lanterns are:



Actual Values	
Illumination log	h, total amount of operating hours on lantern. Will not be set even if power is cut off, so figure is real figure for lifetime of product
Solar Panel Current	Ah, amount of production since system was started
Temperature	°C, at time of interrogation
Last 24h Values	
Max. solar panel current	A, highest current recorded during last day
Charged Ampere hours	Ah, Amount of new energy produced in one day
Avg. Temperature	°C, average over the last 24 hours
Max. Battery Voltage	V, may vary if solar powered system
Min. Battery Voltage	V, the lowest value the battery had during last night
Actual Status	
Operational State	State of lantern, real time clock, power resets, etc
Error Flags	Displays errors discovered by lantern

The values listed in the PDA Programmer and in the table above are subject for changes without notice, as the PDA software may be updated from time to time.

5. PERIODIC MAINTENANCE

The LED 155 is a robust lantern designed to withstand heavy abuse and requires no maintenance, except for periodical lens cleaning and possible replacement of bird spikes. To maintain a good light output and achieve a long service life, it is advisable to inspect the lantern whenever visiting the buoy.

Mechanical inspection and maintenance:

- Clean the metal parts on the lantern
- Check the lens and clean it with a damp cloth (Do NOT use any solvents!)
- Check the mounting bolts and the plastic washers for damage and replace if necessary.
- Check and replace bird spikes if necessary
- Check the lantern for leakage (condensation through the lens) and replace gaskets if necessary

Functional inspection and maintenance:

- Check that the lantern turns on by covering the lens (photocell location as in Figure 5 - Position of IR and Photo sensor)
- Check visually that the LEDs are equal and uniform intensity when lit
- Check that the lantern turns off by removing the cover
- Read controller values with the programmer and check the status (note that values can also be saved in the PDA programmer)
- Check battery voltage with the programmer. If battery voltage is low, replace the battery

6. TROUBLESHOOTING

Q: I covered the lens, but the lantern does not turn on.

A1: Read controller values with the programmer and check status. The battery voltage is below the minimum programmed value. Replace the battery.

A2: The dated shut-down feature may be enabled. Re-programme to disable shut-down feature

A3: Read controller values with the programmer and check status. The day light sensor setting or read value is abnormal. Re-programme if setting is wrong. Return the lantern for service if the read value is wrong.

A4: Read controller values with the programmer and check status. There is a LED failure error. Return the lantern for service.

Q: I covered the lens, but the lantern does not turn on and I cannot read controller values with the programmer.

A: Check the battery cables for damage or short-circuit. Replace the battery.

Q: I covered the lens, but the lantern does not turn on and I cannot read controller values with the programmer even though I replaced the battery.

A: Return the lantern for service.

Q: The lantern seems to work normally, but I cannot read it with the programmer.

A1: Locate the IR on your programmer and on the lantern. Face them against each other.

(see Figure 5 - Position of IR and Photo sensor)

A2: Try to shade out the sun and put the programmer close to the lens during read process.

A3: Try different angles when reading, the light beam might block out the IR sensor of the PDA.

Q: There is moisture inside the lantern. Where is the leakage?

A1: Check the PTFE vent is free and not blocked with bird droppings. Replace vent if required.

A2: Open the lantern and check for damage on the mounting flange O-ring and surface. Replace the O-ring if there are signs of damage.

7. APPENDIXES

7.1. Explosion diagram

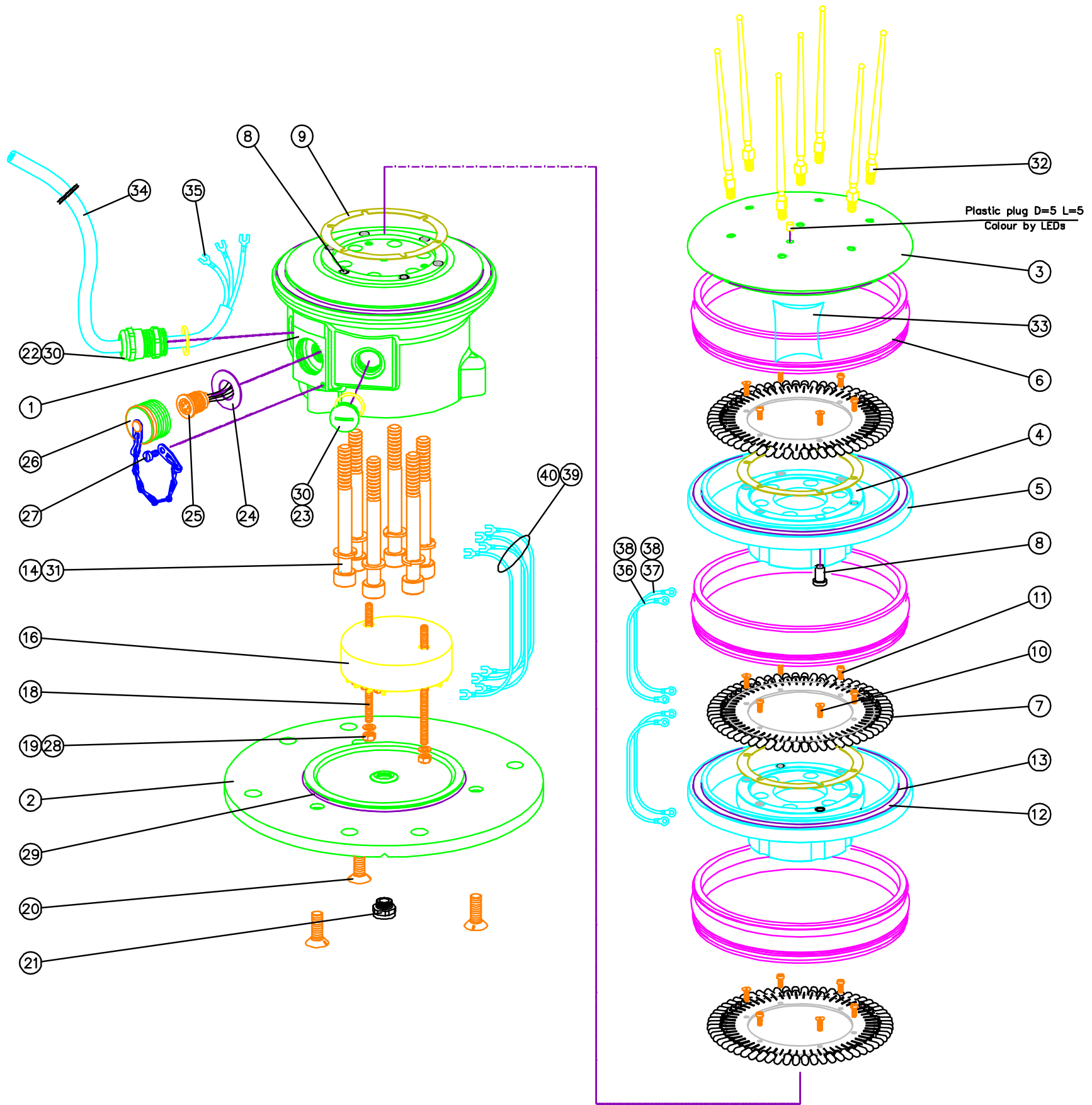


Figure 6 – The lantern assembly exploded into parts



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