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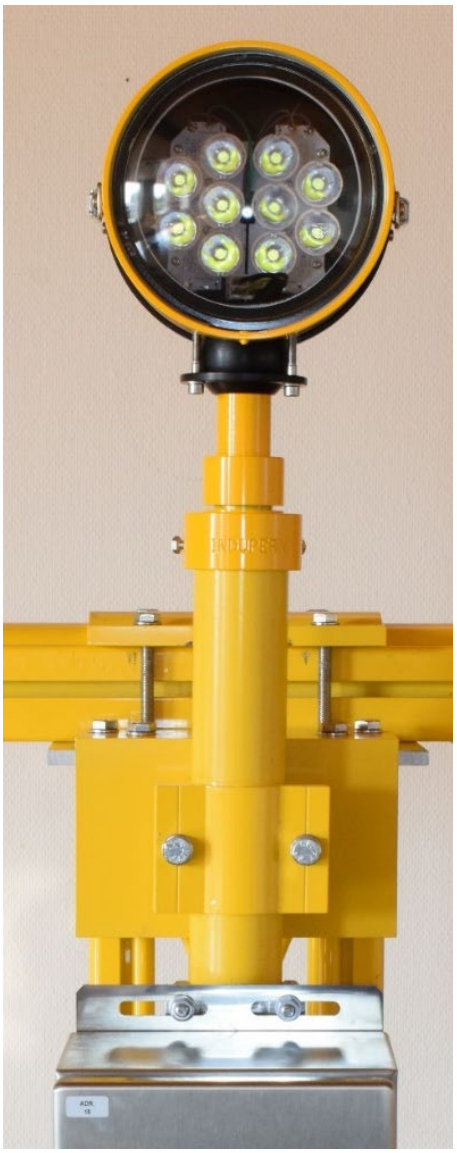

Installation, Operation and Maintenance Manual

Sequential Flash Light System – SFL 971

LED AGL

Airfield Ground Lighting

03-71098
V1.3

Preface

- Please read carefully and understand the contents of this manual.
- Failure to read the manual may result in serious injury, or serious damage to equipment.
- Make sure these instructions are always accessible for all users and ensure that you have read and understood the contents

Document Information

Name : ***05_LED_AGL_Installation_Manual_Sequential_Flash_Light_System_SFL971_03-71098_EN_V1_1.pdf***

Version	Date	Description
1.0	17-09-2024	First Release
1.1	03-07-2025	Updated drawings and spare parts list
1.2	09-09-2025	Updated control interface documentation
1.3	22-04-2026	Updated maintenance instructions

For the latest version of this document see https://www.tkh-airportsolutions.com/airfield-products/ or scan:

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1. About this manual

This manual includes technical information about the TKH Airport Solutions Sequential Flash Light System SFL 971 for Approach (AFL) and Threshold Identification Light (TIL).

The manual is intended to be used for installation, operation, maintenance of SFL systems supplied from 2025 onwards, as well as for purchase of spare parts.

1.1 Symbols used

The following marking conventions are used in this manual to draw attention to specific topics or actions:

DANGER! - This sign indicates a hazardous situation that, if not avoided, will result in death or serious injury.

WARNING - This sign indicates a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION - This sign indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

NOTICE - is used in this manual to indicate a situation that could result in damage to property or equipment.

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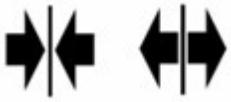
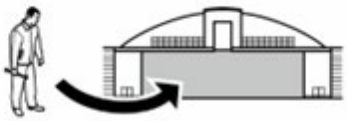
The following symbols are used in pictures for explanation or an action:

Correct / Incorrect	Look / See	Location / position	Movement
Connect / Disconnect	**Photobiological safety**	**ESD warning**	
			
Work carried out on runway		**Work carried out in workshop**	
			

The following symbols are used on equipment and in this manual to warn of potential hazards:

DANGER of electrical shock or arc flash. Failure to observe this warning will result in serious injury or death.

WARNING or **CAUTION**: where this symbol is used on the equipment, it is mandatory to consult the manual to find out the nature of potential hazards and any actions which have to be taken to avoid them.

1.2 Storing the manual

- This manual is a part of your product. Store the manual in a location that can be easily accessed by personnel working on the product.
- It is the responsibility of the company operating this equipment to ensure that its personnel is provided with a copy of this manual.

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1.3 Limitations of the Document

TKH Airport Solutions reserves the right to revise this document without notification.

The data provided in this document is based on the most recent information at the time of publication. TKH Airport Solutions is continually seeking to ensure that its products are developed to the latest technological standards. As a result, it is possible that there may be some differences between the product and the information in this manual.

For further information regarding adjustment, maintenance or repair which is not described in this document, please contact the Customer Service department of TKH Airport Solutions on service@tkh-airportsolutions.com.

The information in this document concentrates solely on use of the products as intended by the manufacturer.

1.4 Terms and Abbreviations

This document may include the terms and abbreviations as listed below.

AGL	Airfield Ground Lighting
EASA	European Aviation Safety Agency
ICAO	International Civil Aviation Organization
IEC	International Electrotechnical Committee
LED	Light Emitting Diode
SFL	Sequential Flash Light

1.5 Liability and Warranty

TKH Airport Solutions cannot be held responsible for injuries or damage resulting from non-standard, unintended use, faulty or improper installation of its equipment, or failure to follow the instructions and safety guidelines in this manual. The safety of any system incorporating the Sequential Flash Light System - SFL 971 is the responsibility of any site installation, commissioning, maintenance, and operational personnel using the system.

NOTICE Disregarding the safety instructions in this manual will result in the loss of warranty in case of damage.

Refer to the general TKH Airport Solutions Terms and Conditions document supplied with your sales order contract for a complete liability and warranty description.

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1.6 Component Reuse and Recycling

Extending the service life of components typically requires significantly less energy than manufacturing equivalent new parts. As a result, prioritizing re-use can help lower lifecycle greenhouse gas emissions by avoiding energy- and carbon-intensive primary production.

Our products are engineered to support component re-use and recycling to reduce waste and conserve resources throughout its lifecycle. Key design and end-of-life considerations include:

- **Design for re-use**: Components are intended to be recoverable and suitable for re-use where appropriate, helping retain material value and reduce replacement demand.
- **Design for recycling**: Material selection and product documentation are aligned to enable efficient separation and recycling at end of life, supporting higher recovery rates and better material quality.
- **Reduced disposal impacts**: Proper recycling and re-use reduce disposal volumes and the corresponding environmental impacts.
- **Lower demand for virgin materials**: By increasing re-use and recycling, lifecycle impacts can be reduced through decreased reliance on virgin raw materials and minimized end-of-life burdens.

By enabling practical re-use and recycling pathways, our products support progress toward internal sustainability targets and helps customers meet ESG expectations related to waste reduction, resource efficiency, and circular economy performance.

1.7 Manufacturer Details

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2. Safety

2.1 Safety

This section contains general safety instructions for using your TKH Airport Solutions equipment. Some safety instructions may not apply to the equipment in this manual. Note all warnings and follow all instructions carefully. Failure to do so may result in personal injury, death, or property damage.

To use this equipment safely,

- Refer to the International Standard IEC 61820, Electrical installation for lighting and beaconing of aerodromes - Constant current series circuits for aeronautical ground lighting - System design and installation requirements, and to the International Standard IEC 61821, Electrical installations for lighting and beaconing of aerodromes - Maintenance of aeronautical ground lighting constant current series circuits for instructions on safety precautions.
- Observe all safety regulations. To avoid injuries, always remove power prior to making any wire connections and touching any live part. Refer to the International Standards IEC 61820 & IEC 61821.
- Read and become familiar with the general safety instructions provided in this section of the manual before installing, operating, maintaining, or repairing this equipment.
- Read and carefully follow the instructions given throughout this manual for performing specific tasks and working with specific equipment.
- Store this manual within easy reach of personnel installing, operating, maintaining, or repairing this equipment.
- Follow all applicable safety procedures required by your company, industry standards, and government or other regulatory agencies.

2.2 Qualified Personnel

The term "qualified personnel" is defined here as a person who thoroughly understands the equipment and its safe installation, operation, maintenance, and repair. Qualified personnel are physically capable of performing the required tasks, familiar with all relevant safety rules and regulations, and have been trained to safely install, operate, maintain, and repair the equipment. It is the responsibility of the company installing, operating, or maintaining this equipment to ensure that its personnel meet these requirements.

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2.3 Intended use

Use of this equipment in ways other than described in the datasheet and this manual may result in personal injury, death, or property damage. TKH Airport Solutions cannot be held responsible for injuries or damage resulting from non-standard, unintended application of its equipment. This equipment is designed and intended only for the purpose described in this manual. Uses not described in this manual are considered to be unintended use. Unintended use may result from taking the following actions:

- making changes to equipment that have not been recommended or described in this manual or using parts that are not genuine TKH Airport Solutions replacement parts or accessories
- using materials or auxiliary equipment that are inappropriate or incompatible with your TKH Airport Solutions equipment
- allowing unqualified personnel to perform any task

2.4 Installation

A thorough understanding of system components and their requirements will help you install the system safely and efficiently. Failure to follow these safety procedures can result in personal injury or death.

Read the safety and installation sections of all system component manuals before installing your equipment.

- Allow only qualified personnel to install TKH Airport Solutions equipment and auxiliary equipment. Use only approved equipment. Using unapproved equipment in an approved system may void agency approvals and will void the warranty.
- Make sure all equipment is rated and approved for the environment in which you are using it.
- Follow all instructions for installing components and accessories.
- Do not hold or carry the light assemblies by the cables.
- Install all electrical connections according to local codes and regulations, provided they are not in contradiction with the general rules.
- Use only electrical wire of sufficient gauge and insulation to handle the rated current and voltage demand. All wiring must meet local codes.
- Route electrical wiring along a protected path. Make sure the wires will not be damaged by moving equipment and animals (e.g. rodents).
- Protect components from damage, wear, and harsh environmental conditions.
- Allow sufficient room for maintenance, panel accessibility (power products), and cover removal (power products).
- Protect equipment with safety devices as specified by applicable safety regulations.
- If safety devices must be removed for maintenance, re-install them immediately after the work is completed and check them for proper functioning.

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2.5 Operation

Only qualified personnel (see section Qualified Personnel) should operate this equipment. Read all system component manuals before operating this equipment. A thorough understanding of system components and their operation will help you operate the system safely and efficiently.

- Before starting this equipment, check all safety interlocks, fire-detection systems, and protective devices such as panels and covers. Make sure all devices are fully functional. Do not operate the system if these devices are not working properly. Do not deactivate or bypass automatic safety interlocks or locked-out electrical disconnects or pneumatic valves.
- Never operate equipment with a known malfunction.
- Do not attempt to operate or service electrical equipment if standing water is present.
- Use this equipment only in the environments for which it is rated. Do not operate this equipment in humid, flammable, or explosive environments unless it has been rated for safe operation in these environments.
- Never touch exposed electrical connections on equipment while the power is ON.
- Never look directly in the light source while the power is ON.

2.6 Action in the event of a system or component malfunction

Do not operate a system that contains malfunctioning components. If a component malfunctions, turn the system OFF immediately.

- Disconnect and lock out electrical power.
- Allow only qualified personnel to make repairs. Repair or replace the malfunctioning component according to instructions provided in its manual. Allow only qualified personnel to perform maintenance, troubleshooting, and repair tasks. Only persons who are properly trained and familiar with TKH Airport Solutions equipment are permitted to service this equipment.
- Follow the recommended maintenance procedures in your equipment manuals.
- Connect all disconnected equipment ground cables and wires after servicing equipment. Ground all conductive equipment.
- Use only approved TKH Airport Solutions replacement parts. Using unapproved parts or making unapproved modifications to equipment may void agency approvals, impair specified performance, and create safety hazards.
- Check interlock systems periodically to ensure their effectiveness.
- Do not attempt to service electrical equipment if standing water is present. Use caution when servicing electrical equipment in a high-humidity environment.
- Use tools with insulated handles when working with electrical equipment.

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3. About the SFL 971

The LED based SFL system from TKH Airport Solutions is designed to meet the requirements in ICAO Annex 14 for flashlights used in a center line approach system (AFL), as runway threshold identification light (TIL), or in a combination of both light systems.

The system offers control and monitoring of up to 64 approach flash lights (AFL) and threshold/runway identification lights (TIL/RIL).

3.1 The System

A system will include:

- An SFL 971 Flash controller unit to be placed in the power station. The controller unit is supplied in a wall mount cabinet.
- Between 1 and 32 Approach flashlights and Threshold/Runway identification lights
- A Terminal Box for each light fixture
- 2 Lightning arrestors
- Primary SFL cables from the controller to the lights
- Secondary SFL cables between the lights and the terminal boxes

The connection between the components is shown on the following pages.

Standard input voltages are 1 x 220V-240V - 50Hz/60Hz (± 2 Hz), max. 6A.

Controller unit

The controller supplies power for flashing, heating, and communication via a 5x4mm^2 standard installation cable connected in one loop to all fixtures. The power line communication includes the following information to each light fixture:

- Requested light intensity (7 steps)
- Flash speed (one or two flashes per second)
- Heater active
- Start signal for each new sequence.

The Controller unit is supplied as a wall mounted unit. More information can be found in the Controller details.

To power off the system please remove the mains supply, or by other means disconnect the power lines in front of the system.

The protective earthing is done via the mains supply, by connecting the yellow/green terminal inside the Controller near the power switch.

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Flashlight fixture SFL 793

The elevated Flashlight fixtures are based on the 792-LED approach light fixtures, but with new electronic including features for:

- LED protection
- LED temperature measure

Besides elevated fixtures, inset fixtures are available as well (depending on project requirements).

More information in the SFL fixture details.

The protective earthing is done via the cable to the terminal box.

Terminal box

The cable from Controller (1 phase, 1 communication, neutral and ground) is connected in a terminal box near each fixture. The terminal box includes terminals for connection to the next terminal box, as well as the connection to the light fixture via a safety transformer (230 V / 24 V), which means that no voltage above 24 VDC will be present in the light fixtures and secures safe service and adjustments.

- Power line communication with Controller unit
- Intensity regulation according to received command from Controller.
- Each light fixture is assigned with an address, set in the terminal box.

More information in the Terminal box details.

The protective earthing is done, via the cable to the connector.

3.2 Standards

The SFL 971 system is constructed, manufactured, and tested to meet the relevant ICAO and FAA standards. The performance of the light fixtures SFL 793 has been verified in tests by independent laboratory for use as a steady burning Approach light fixture.

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3.3 Key Features

Key features of the SFL 971:

- Fully digital control and monitoring
- 7 intensity steps in low and high speed
- Lamp supervision
- Hour meters for 100% intensity and for total time
- All control and monitoring performed over the power cable
- Heater can be switched on independent of the flashing system
- Individual monitoring of the RIL fixtures, and automatic shutdown in case of lamp failure
- Wall mount cabinet
- Remote control through:
    - RS-485 serial communication
    - Parallel interface
- Digital display showing:
    - Selected intensity step
    - Selected configuration
    - “The running” lights
    - Input voltage
    - Time/date through built-in watch
    - Number of faulty lamps
- Built-in lightning protection

3.4 Specifications

Temperature range:

- Controller: Within substation: 0°C - 40 °C
- Terminal box and lamp: -40°C - +55°C

Humidity, max: 95% (not condensing)

Cubicle is electro-plated and coated in light grey RAL 7035.

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4. Installation

4.1 Unpacking the SFL shipment

Unpack carefully and check that all parts are included.
After unpacking, the controller must be stored indoor.

4.2 Before the installation

Check the planned installation location. The room must be ventilated and free air circulation around the controller must be secured

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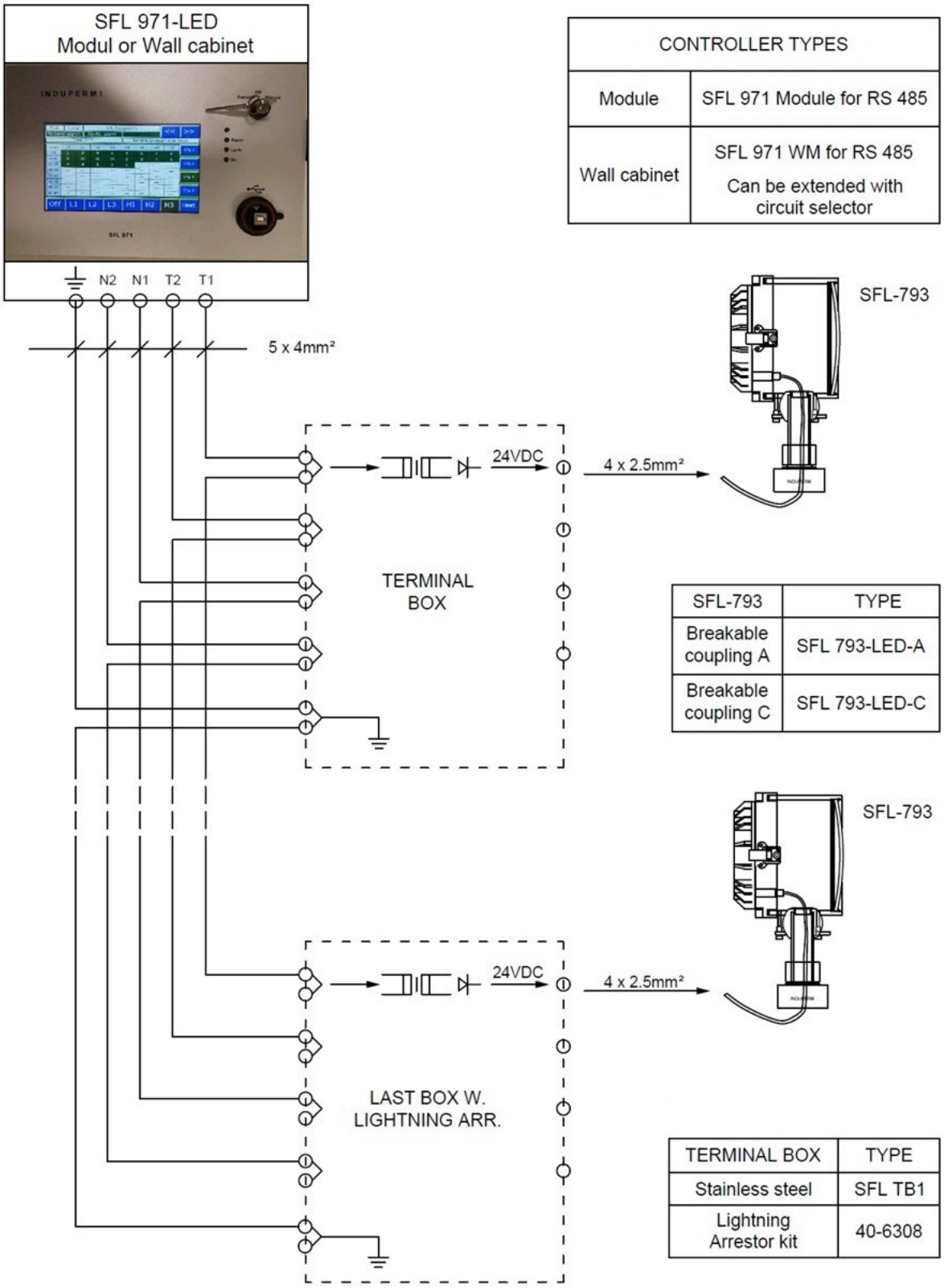
4.3 Installation Principle



CONTROLLER TYPES	
Module	SFL 971 Module for RS 485
Wall cabinet	SFL 971 WM for RS 485 Can be extended with circuit selector

SFL-793	TYPE
Breakable coupling A	SFL 793-LED-A
Breakable coupling C	SFL 793-LED-C

TERMINAL BOX	TYPE
Stainless steel	SFL TB1
Lightning Arrestor kit	40-6308

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5. Operation

The AFL light fixtures will start flashing at the beginning of the approach line towards the threshold. If the TIL/RIL lights are programmed, they will flash simultaneously in one sequence.

The flash frequency can be selected as 1 or 2 flashes / second. The system can be set to 1 to 7 intensity steps in low and high speed. 64 lamps can be connected, max 32 in operation at any time, selected with 1 of 4 programmable configurations. Any nos. of TIL/RIL of the 64.

The controller output is two lines, T1, T2 (and N), where T1 (230V) is only for power supply, while T2 (24V) line is for communication. The controller makes a start pattern on the communication line, which are seen by the terminal box as a start signal for a new sequence, and the terminal box starts a timer, with a time accordingly to the setup from the controller - when the timer expires the light flash.

The communication includes information of the required light intensity and length, as there is back information to the controller about the state of each light fixture.

As no voltage above 24VDC is present in the light fixtures, the safety is increased drastically compared to service on traditional discharge flash types. To avoid the high intensity flashes when working with a fixture, the address 00 in the terminal box turns off the flash. As all supply to the light fixtures is low voltage via transformers in the terminal box, lightning arrestors are only needed in each end of the supply cable that is in the power station and in the last terminal box in the approach.

The Power line, T1, is 230V - but in the Controller is mounted an Isolation transformer to improve safety. The terminal box measures the flash power when a flashlight fixture is activated, and the back communication to the controller reports a fault to the controller, the controller indicates locally and remotely the faulty light fixtures.

The light fixtures are supplied with a small heater to keep the internal free from dew. The heating can be on and is powered from the same cable as the flashing, even without the flashing being activated.

Each terminal box is given an address and this address is used by the controller to identify eventual lamp failure(s) and setup of flash parameters.

The controller display has an overview of each terminal box, with status. From the controller, the setup of each terminal box can be set:

- When to flash
- Length of flash
- Is the lamp a TIL/RIL?

In each Terminal box there is a label of information on how to set the actual address by means of two 10-position rotary switches, one for tens and one for ones.

Special attention to:
Address 65 – Calibration: with power on (key in manual, lights off) set the terminal box to address 65 and

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the box will cycle all the intensities, so lamp supervision is working correct. Must be done at installation and if Lamps/cable is repaired/changed. Please check, that also the heater is switched ON.

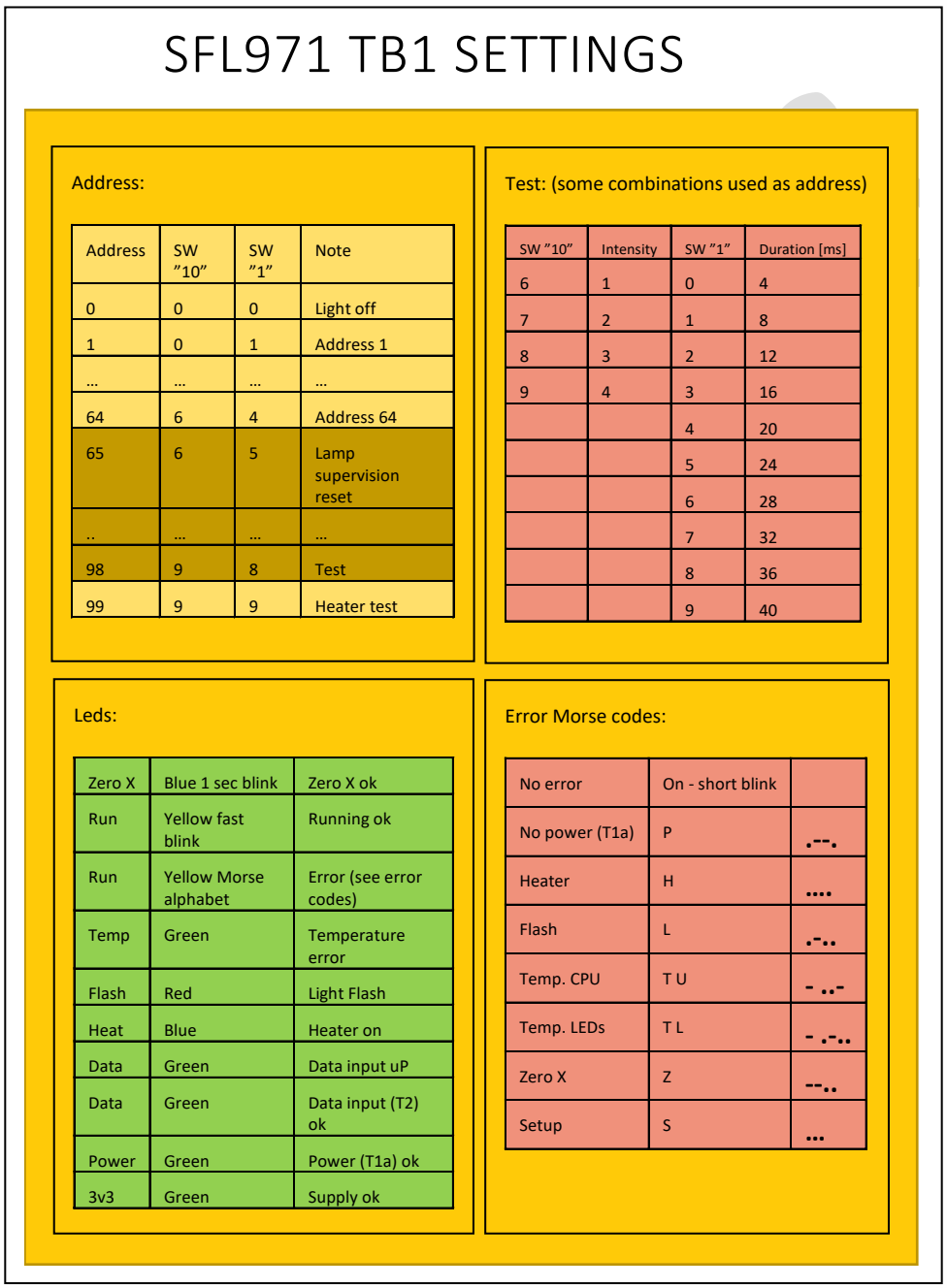
Address 98: Turns on lamp - for test at the field.

Address 99: Turns on heater, for test.

Address 66-97: Tests lamp in different intensities. (For manufacturing)

The label also tells the functions of the LED signal lamps in the terminal box.

The label is as follows:



SFL971 TB1 SETTINGS

Address:

Address	SW ”10”	SW ”1”	Note
0	0	0	Light off
1	0	1	Address 1
…	…	…	…
64	6	4	Address 64
65	6	5	Lamp supervision reset
..	…	…	…
98	9	8	Test
99	9	9	Heater test

Test: (some combinations used as address)

SW ”10”	Intensity	SW ”1”	Duration [ms]
6	1	0	4
7	2	1	8
8	3	2	12
9	4	3	16
		4	20
		5	24
		6	28
		7	32
		8	36
		9	40

Leds:

Zero X	Blue 1 sec blink	Zero X ok
Run	Yellow fast blink	Running ok
Run	Yellow Morse alphabet	Error (see error codes)
Temp	Green	Temperature error
Flash	Red	Light Flash
Heat	Blue	Heater on
Data	Green	Data input uP
Data	Green	Data input (T2) ok
Power	Green	Power (T1a) ok
3v3	Green	Supply ok

Error Morse codes:

No error	On - short blink	
No power (T1a)	P	.--.
Heater	H	....
Flash	L	.-..
Temp. CPU	T U	- ..-
Temp. LEDs	T L	- .-..
Zero X	Z	--..
Setup	S	...

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6. Controller Unit

The TKH Sequential Flash Light Controller System is based on a digital controller and monitoring system. The SFL 971 is designed to meet the requirements in ICAO Annex 14 for flashlights used in an Approach Centre line system (AFL) with belonging runway Threshold Identification Light (TIL).

6.1 Application

The system offers control and monitoring of a system with up to 64 approach flashlights (AFL) and threshold/runway identification lights (TIL/RIL), without the use of separate control cables.

The AFL light fixtures start flashing at the beginning of the approach line towards the threshold. If TIL/RIL lights are installed, they will flash simultaneously in one sequence. The flash frequency can be selected as one or two flashes per second. The system is supplied for 7 intensity steps, and the intensity regulation is digital controlled in the SFL terminal boxes.

6.2 Mechanical Layout

The controller can be built as a wall mounted cabinet.

SFL Controller Parts	**Type No.**
Wall mount Cabinet for RS 485	SFL971-WM-RS485
Wall mount Cabinet for Parallel	SFL971-WM-PARALLEL

Wall mount cabinet:	400 x 600 x 250 mm
Input power:	1 x 230VAC + N + G, 50/60 HZ, 6A
Temperature range:	0 - 40°C, non-condensing.

Controller Wall Mount:

Outer measures:
H x W x D = 500 x 400 x 200 mm

Weight: 15 Kg

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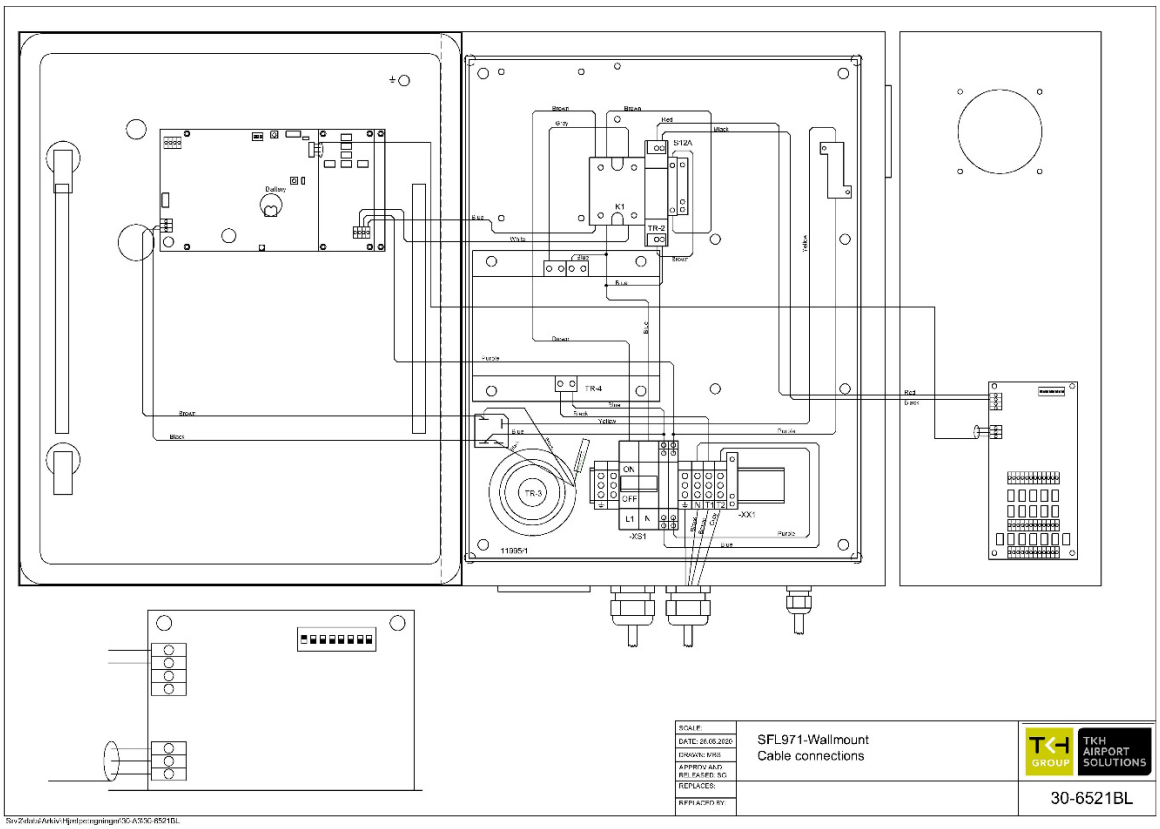

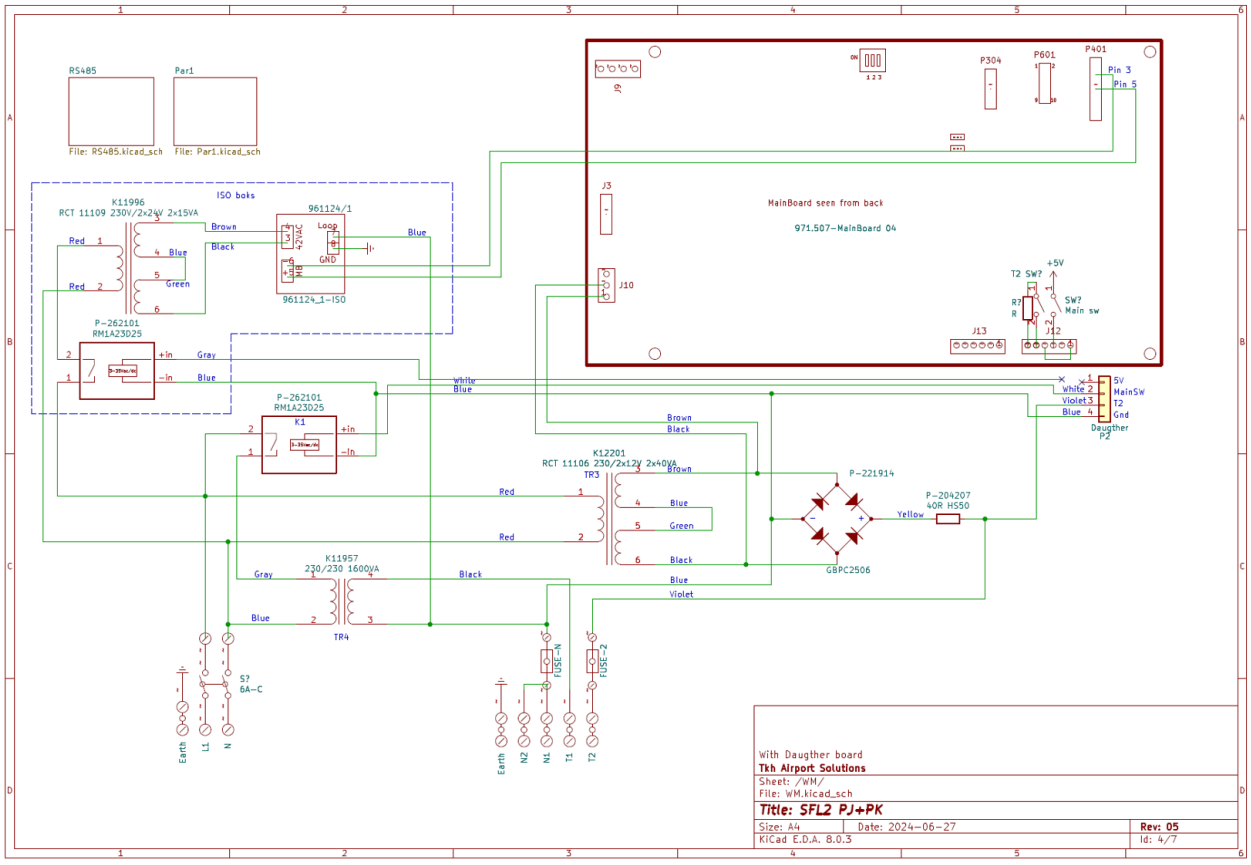

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7. SFL Fixture

The high-intensity LED fixture, available as elevated or inset light, is intended to be used instead of discharge-type flashlight in barrette centre line approach system and/or as threshold/runway identification lights.

The required intensities are reached with LEDs as used in our standard LED Approach light fixture. All communication and control via the power cables.

7.1 Operation

Brilliancy control by means of PWM regulation in terminal box, based on step command received via Power cable. The flashing frequency can be one or two flashes / second.

The first unit is located at the beginning of the approach, and the last unit is closest to the threshold. The units are flashing in sequences, and the pilot sees the light moving towards the runway. The threshold/runway identification lights (TIL/RIL) are flashing simultaneously.

The TILs are connected to same supply cable as the approach sequential flashlight system. Any number of insert lights can be mounted, to extend the SFL into the overrun area.

7.2 Elevated Lights

- The design conforms to the photometric requirement of ICAO, Annex 14, Vol. 1 Fig. 2-1 with 40 W LED module in steady state.
- Front glass according to FAA spec. CAA-1199a.
- Easy levelling and adjustment due to patented ball joint.
- The shape, the small size and weight (3 kg. – 6lb.) are favorable features in respect to wind load and mast construction.
- The outside surface of the glass is smooth and needs no cleaning.
- No adjustment after re-lamping.
- Mounting on tube, pole, or base plates.
- Fully corrosion proof components are used.
- Finished in aviation yellow.
- Lamp power, heating supply and synchronization signals via only low voltage power supply.

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Breakable Coupling

TKH elevated light fixtures can be delivered with breakable coupling type A (with 2” European standard thread or 11,5 NPT or NPS) or type C (for 2” pole mounting).

TKH breakable coupling is calculated and tested to break at 45 Kgm ± 4 Kgm which is in accordance with FAA AC 150/5345-46E and ICAO Annex 14, Vol. 1.

7.3 Inset Lights

- 12" outer diameter
- 12.5 mm height above surface
- Depth below flange: 50 mm
- Light outlet size 49 mm x 10 mm
- Dust and water tightness: IP68, IP69
- Overall lifetime apart from wear parts > 20 years
- Useful lamp life (LED) up to 50,000 h
- Ambient temperature: -40 °C (-40 °F) / + 75 °C (+167 °F)
- De-icing kit (additional min. 14 W while in operation)
- Optional sapphire coated prism

7.4 Fixture Installation

For installation and maintenance instructions of the SFL 793 fixtures, please refer to the below manuals which can be found on our website https://www.tkh-airportsolutions.com/service/mounting-instructions

- **LED Inset Lights 12”**
- **792 Elevated LED Lights**

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8. SFL Terminal Box

A Terminal box is placed within a distance of 1 to 30 m from each Flashlight fixture. The Terminal box is for the connection of the cable from the Controller unit to each Flashlight fixture. An incoming and an outgoing cable, each 5 x 4mm^2, is used to supply power and communication signals to the Flash Light fixture via one isolating transformer 230VAC / 24VDC, placed in the Terminal box.

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8.1 Description

The Terminal box is made of stainless steel, and can be mounted in many ways, on poles, on a wall etc.

Size:	H x W x D: 360x200x120mm
Weight:	approximately 6.6Kg
Standard Type (in stainless steel):	SFL TB1
Ingress Protection:	IP 66
Lightning arrestor block Type nr:	40-6308
Mounting kit for 60mm pole type:	MT 60mm

Lamps calibration is advised at any new/altered installation, by selecting address 65 and switched on Heater. This compensates for any cable resistance, in the lamp Supervision.

Selecting address 65, will turn on the yellow led on the PCB in the terminal box- the program will then cycle through all intensities and measure the power consumption, when done the yellow led will go off, and the values measure is store internally.

8.2 Installation

The power cables are connected to the two groups of terminals marked Ground – Neutral1 – T1 – Neutral2 and T2 (one set of terminals for incoming cable and one set for outgoing cable to the next Terminal box).

On the farthest away Terminal box, the terminals for the outgoing cable are used for the connection of a lighting arrestor module.

Cable dimensions from Controller to Terminal box:
The system is very tolerant to voltages, so as a guide calculate - max 6 ohms to last box from controller.

Distance from Controller to last Box (m) Standard copper	**Cable dimension**
Less than 2500	5 x 4mm^2 (including earth)

Do not intermix T1 and T2, as it will destroy the electronics, triple check before first power on.

N, neutral on controller power input is DIFFERENT from N on controller lamps output, due to internal safety transformer. Neither is N the same as E Earth.

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The cable for the light fixture is to be connected to:

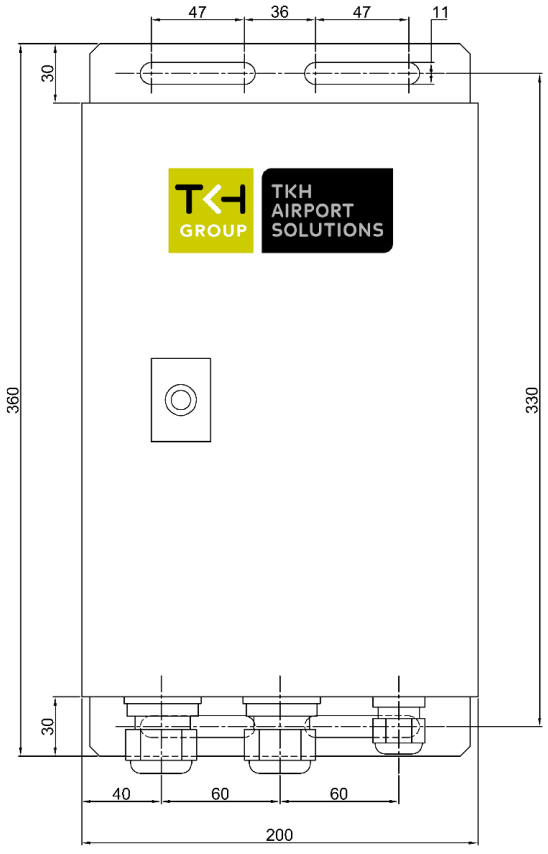
In terminal box	Blue connector on lamp
Earth	4 Earth
1	1
2	2
3	3 0V

Input line voltage is 220V-240V, and the supply cable is connected to the fixture via Transformer in a Terminal box (see separate chapter).

The supply includes flashing power, synchronization of the flashing sequence as well as power for heating element in the fixture.

The address of each fixture is set by means of a built-in rotary switch.

SFL-TB1/1 (Stainless)



Height: 120 mm.
Total weight: 6.6 kg.

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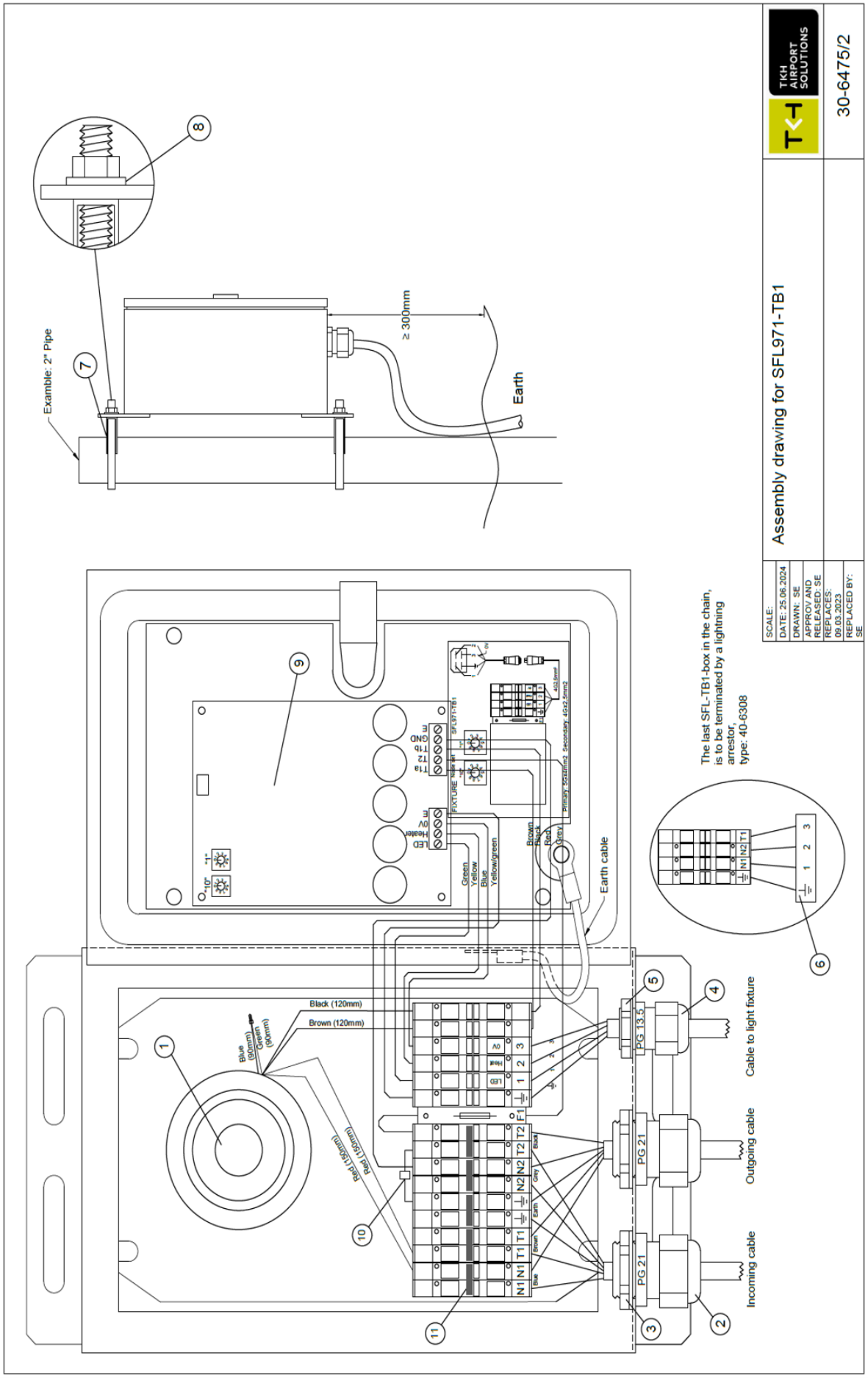

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9. Cables

Required cables supplied with the system:

SFL Primary cable:	**P-242400**	YMvK Dca 0,6/1 kV, 5 G 4 rm
SFL Secondary cable:	**P-242401**	MarineLine + YZp 0,6/1 kV, 4 G 2,5 mm2

NOTICE

SFL 971 has only been released using the above mentioned cables. For using SFL 971 with other cable types, please contact TKH Airport Solutions for advice and technical approval.

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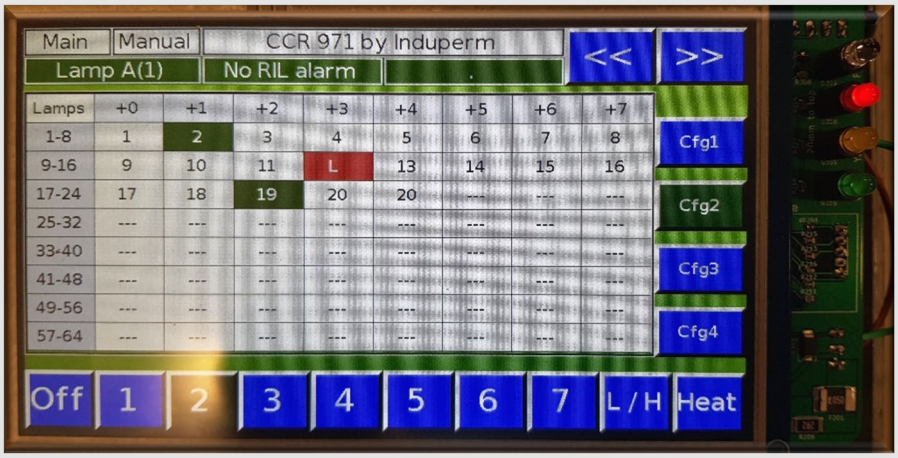
10. SFL 971 Module

(Seen from the front)



TKH SFL 971

- LEDs
- Communications port
- LCD display
- Key Switch

LEDs: Light sensor (Top) - RED (top1) – YELLOW (middle) – GREEN (lower)

RED: Flashing: Key on “Manual” or off
Steady Light: Alarm.

YELLOW: Earth measure, if is equipped.

GREEN: Flashing with synchronization speed

LCD display:

Several several parameters are shown, such as Menu, Key position, Runway name, Alarms.

10.1 General information

The Key Switch has 3 positions: Remote – Off – Manual

- REMOTE
  In this position the SFL system can be controlled only via the Remote-Control System.
- OFF
  The SFL Controller is off.
- MANUAL
  In this position the SFL system can only be controlled locally. Back-indications and Alarms are still transmitted to the Remote-Control System.

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Changing the Key position between Remote and Local must be done in a swift manner to prevent the SFL from being turned off.

When changing from Remote to Manual, the SFL will maintain the from Remote selected intensity step.
In manual and off-Key position, the arrow keys can be used to go through the menus.

The buttons 1-7 can be used to switch-on the SFL in one of the intensity steps.

Off is used to switch-off the SFL.
L/H toggles between low/High speed.
Heat turns on heating.

If the system is used with configuration selection the buttons Cfg1 – Cfg4 are used for this.

The Module have a light sensor on the front. That turns off the display when the light in the room is off. In case of lamps fail the LCD is always on.

Communication port:
Can be used to download new SW to the controller, with a special program.

10.2 The SFL Menus

In all menus: The topline: menu, here “Main,” key position, here “Manual,” runway name Menu buttons. Left & Right Line 2: Lamp alarms – how many lamps defect RIL alarms – how many RIL lamps defect Right: Buttons for selecting of active configuration Bottom: Buttons for selecting Off, 1..7, L/H, Heater	

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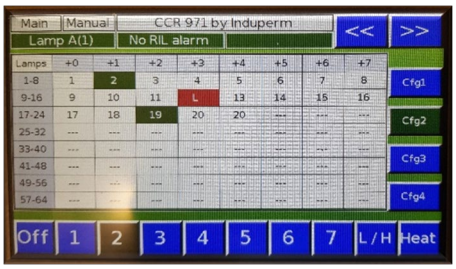
Menu Main: The box shows all lamps, left and top is the addresses of the lamps i.e., 9-16 (9+top row). The number in the cells is the sequence number, i.e., when to turn on the lamp. Distinct colors and letters give information about the state of the lamp (not all shown on picture)	
Menu setup: Address: Address of lamp to setup Sequence: Sequence number of lamp. 0=disable RIL: Is RIL active on this lamp. Dur.: Duration of flash, (all lamps in this configuration). Password: key in password. (Default 0751) resetting when key is in Remote. New password: key in a new password.	
Menu Time: Year, Month, Day: Press to key in date. Hour, Min, Sec: Press to key in time. Default: Press to load default values (key must be in off and correct password). Rwy. Name: Press to key in Runway name. UIn: Calibration of UIn.	
Menu Display: Contrast, Situation, Brightness: LCD params. Language: Press to change language (need SD card mounted.) Calibration: Calibrate LCD touch area. “Back door”: in main menu, Key to manual. Press display. key to off	

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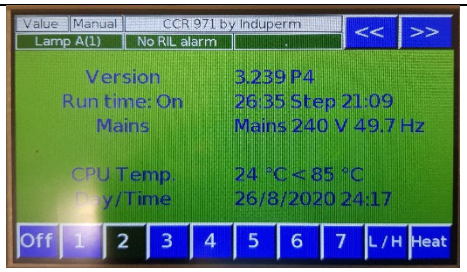
Menu Values: Show various information.	

10.3 Main menu, Cells/Lamps

On the main menu the cells display information about the state of the lamps.

SFL971 WM LEGENDS

TB: Terminal box at lamp
WM: Wall mount controller
SEQ: Sequence number in SFL

Text	Colour text on back	State	Explanation
[SEQ]	White on Green	Ok	☺
[SEQ]	White on Greenery	OK RIL	☺
[SEQ] N	White on Green	Ok	New setup to TB
[SEQ] N	White on Greenery	OK RIL	New setup to TB
---	Red on Grey	Not enabled	[SEQ] = 0
---	Red on White	Not enabled RIL	[SEQ] = 0
[SEQ]	Black on Yellow	Status check	WM need to ask TB for state
U	White on Red	Error	TB needs update
L	White on Red	Error	Lamp fail
H	White on Red	Error	Temperature lamp to high
T	White on Red	Error	Temperature TB to high
N	White on Red	Error	New setup to TB
U	White on Pink	Error RIL	TB needs update
L	White on Pink	Error RIL	Lamp fail
H	White on Pink	Error RIL	Temperature lamp to high
T	White on Pink	Error RIL	Temperature TB to high
N	White on Pink	Error RIL	New setup to TB
[SEQ]	Black on White	Enabled not exist	Enabled but no TB answer
---	Black on White	Not enabled not exist	Not enabled no TB answer

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11. How it works

The SFL system can manage up to 64 lamps, but no more than 32 can be on at any time. Any of the lamps can be TIL/RIL (threshold/runway indication lights). The address is set in the terminal boxes, each address must be unique.

The sequence of the flashlights is set up in the controller, the flash sequence does NOT depend on the address. Any address can be set to a sequence number 1 – 32; 0 is disabled.

In case of RIL - give the different addresses, the same sequence number and mark them as RIL. There can be “holes” in the sequence, i.e. a lamp is not possible to mount (maybe there is a road where the lamp should be). The sequence will then run smoothly through the missing “lamps” without jumps.

It is possible to set up 4 different Configurations, Cfg. 1- 4. Each configuration can flash up to 32 lamps. This way it is possible to have one controller to both landing directions, and/or have short - long APH, also with “holes.”

In case of lamp fail, the lamps will report it back to the controller and this will result in a Lamp fail on the display and an Alarm on the remote system. If the failing lamp are marked as RIL all RIL lamps will stop flashing.

The communication is made on the 50/60Hz frequency (100 bit/sec), so it can take some time for new setup to reach the lamps. And it can take up to approx. 5 Sec (if all setup is done) for a fail to be reported. Speed and Intensity can be changed fast, 1 Sec.

The length of a lamps flash can be set between 10 – 50 mSec, all lamps in a configuration will have the same flash length. Default flash length is set as 0 and needs to be configured before the first use. Usually configuration is done in the factory.

The controller will calculate the flashing times so a “run” always takes 1 sec (low speed) from lowest sequence number to highest number, including “holes” - i.e. 10 lamps will have a flash space of 100mSec, 21 lamps will have 48mSec, 32 lamps have 31mSec. There is one flash delay between last lamp and the start over again.

11.1 Possible error conditions and clearance

The error system is designed to report all possible errors, that can interfere with the correct function of the SFL system. Errors can come from 3 sources.

- Lamp not flashing
- Heater not heating
- No lamp communication

The lamp alarm is a combination of these 3 error types. A lamp alarm is “active” until all error conditions is not there anymore. One bit, lamp alarm, is send on the remote communication, but on the local display a letter combination shows the alarm in more detail. See 10.3

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A lamp error, or lamp ok, can only be measured while the lamp is energized, so a previous lamp error detected can only be cleared if the System is flashing and normal flash is detected. If flashing is turned off, with a lamp error it will be “active” until a normal flash is again measured.

A heater error/ok can also only be detected while energized. Heater cannot be active when the System is flashing - Flash is priotized, so heater is only active if heater on and no flashing, but a previous heater error is there until heater is energized (heater on, not flashing) and no error is detected. (SW >= 5.06 clears heater error when heater is activated from controller).

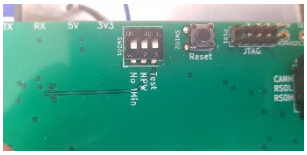
There can be several reasons for lamp communication errors, defect cables, defect electronic in terminal box or signal noise/weak/distorted.

There is also communication going on in flash off mode, so communication errors can appear even if the flash is turned off, due to bad communication signal. In the worst case it can come and go in a random pattern if the communication is partial.

Combinations where internal errors can come or go. (Lamp Alarm is the combination)

	Flash off Heater off	Flash on Heater off	Flash off Heater on	Flash on Heater on
Lamp error		On/off possible		On/off possible
Heater error			On/off possible	On/off possible
Com. Error	On/off possible	On/off possible	On/off possible	On/off possible
Lamp Alarm	On/off possible	On/off possible	On/off possible	On/off possible

System diagnostics. (SW 1342 and above)



There is a test switch on the back of the mainboard (printed circuit). Moving this to “on”, activates several things. (Activation can degrade normal operation, use only for diagnostic!)

- The key indicator in main menu turns violet.
- All menus accessible when key in remote.
- An extra menu is enabled, Logs, with a list of events.

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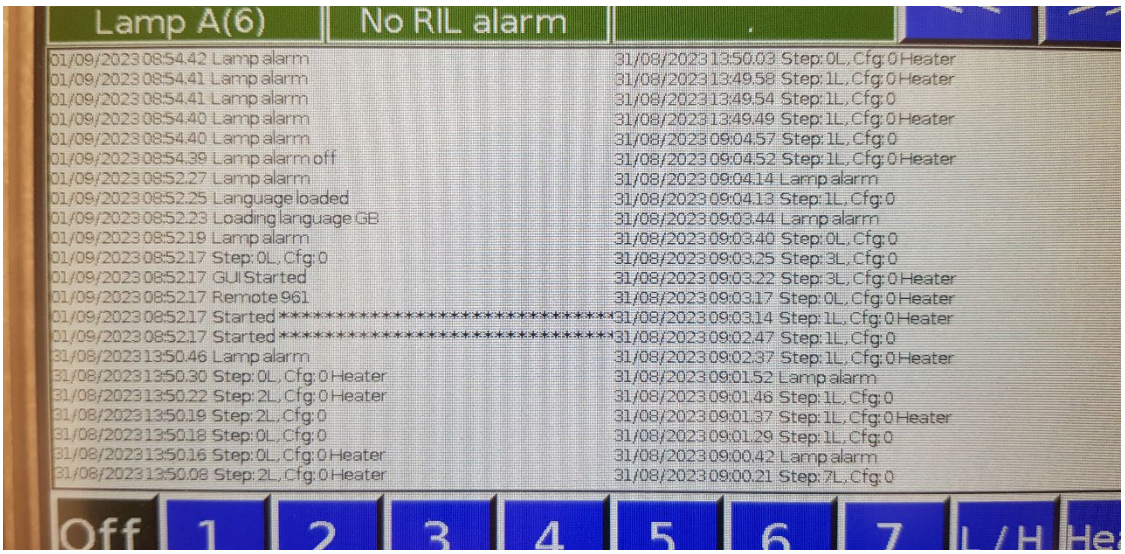

The log shows the startup sequence, alarms, and what is activated.

- Started******, System start from power on.
- Start sequence, GUI, Language, etc.
- Lamp alarm, on/off
- Step x, Cfg x, (heater)

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12. Setup examples

Set the addresses starting from 1 - the box far from the runway - ending with the box near the runway.

Simple: 21 lamps, no RIL.

Set the sequence number in the controller setup, starting from 1 at address 1 to 21 at address 21. All other addresses to 0 (disabled).

Adr. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 …
Seq. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 0 0 …

Simple: 21 lamps, RIL.

Set the sequence number, in the controller setup, starting from 1 at address 1 to 19 at address 19. Address 20 and address 21 is set to sequence 20 and marked as RIL. All other addresses to 0 (disabled).

Adr. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 …
Seq. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20R 20R 0 0 …

Holes: 21 lamps RIL.

Same as 21 lamps RIL, but we make a hole between address 17 and 18

Adr. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 H 18 19 20 21 22 23 …
Seq. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 19 20 21R 21R 0 0 …

Short/Long: 21/26 lamps RIL.

Here we have 21 lamps for short APH and 26 for long APH. We use 2 Cfg's. Cfg1 for short and Cfg2 for long.

CFG1:
Adr. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 ..
Seq. 0 0 0 0 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25R 25R 0..

Or CFG1:
Adr. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 ..
Seq. 0 0 0 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21R 21R 0..

CFG2:
Adr. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 ..
Seq. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25R 25R 0..

2 landing directions.

Same as above but use Cfg3 and Cfg4 for the other end, use addresses 33 to 64 for the lamps, and sequence numbers is still 1 to xx. i.e., address 33 is sequence 1 etc.

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13. Commissioning

Commissioning and adjustment normally must be certified in a protocol.

A. Conditions for a correct adjustment:

- The SFL is wired for correct supply voltage (1 x 230VAC)
- Remote control address is set to correct value.
- The power lines are controlled for acceptable isolation value and continuity.
- The remote-control cable is connected.

B. Assembling:

- The Key switch is set in position “OFF.”
- Power is switched on.
- No blinking must occur in the display.
- The Key - switch is turned to position “Manual” (local operation)

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14. Remote Control

14.1 Standard RS485

The Mainboard includes all hardware and software for direct communication with a remote-control system via RS485. The connection in the cubicle is as standard a set of terminals (-XX1) or a set of RJ45 connectors.

Description of the RS485 communication protocol

General information:

19200 Baud, 8bit, no parity, 1 stop bit.
SFL971 will only transmit after receiving a command or status inquiry.

Commands to SFL971

1	2	3	4	5	6	7	8	9	10	11
Start	ID-High	ID-Low	CMD	Step	Cfg	Heater	spare	CRC high	CRC low	End
@	0..9	0..9	S, W	0..6	0..3	0..1	1.. F	0.. F	0.. F	*

Byte 1: Start character @
Byte 2 and 3: Node number, decimal figure 0-32.
Byte 4: Command = W. Status request = S
Byte 5: Step command, decimal figure 0-3 low speed, 4-6 high speed
Byte 6: Configuration selector 0-3
Byte 7: Heater 0 not active, 1 active
Byte 8: not used.
Byte 9 and 10 CRC hexadecimal figure between 00 and FF
Byte 11: Stop character *

Back indications from SFL971:

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Start	ID-High	ID-Low	CMD	Step	Cfg	Err1	Heater	Key	Spare	Spare	Spare
#	0	0	S, W	0..6	0..3	0.. F	0.. F	0..2	0.. F	0.. F	0.. F

13	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	CRC High	CRC low	End
0.. F	0.. F	0..F	0..F	0..F	0..F	0..F	0..F	0..F	0..F	0..F	*

Byte 1: Start character #
Byte 2 and 3: SFL node number, decimal figure 0 - 32.

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Byte 4: Answer to command = R. Answer to status request = S
Byte 5: Step indication, decimal figure 0-3 low speed, 4-6 high speed
Byte 6: Configuration selector 0-3
Byte 7: Error status 1: sum (0-F) of Lamp = 1, RIL = 2, Emin1 = 4, Emin2 = 8
Byte 8: Heater 0 not active, 1 active
Byte 9: Key switch position: Remote = 2, Off or local = 0
Byte 10-12: Spare
Byte 13-15: Spare
Byte 16-18: Spare
Byte 19-21: Spare
Byte 22-23: CRC hexadecimal figure between 00 and FF
Byte 24: Stop character *

Command to CCR971 CRC calculation:

^ = Xor
crc = data,1(start character)
crc = crc ^ data,2
crc = crc ^ data,3
etc. (until all bytes are included)
crc value, in Hex, is converted to 2 bytes Ascii.

Example:

	Ascii:	Decimal:	Xor crc:
Start	@	64	64
ID high	0	48	64 ^ 48 = 112
ID low	9	57	112 ^ 57 = 73
Command	W	87	73 ^ 87 = 30
Step	3	51	30 ^ 51 = 45
Cfg.	1	49	45 ^ 49 = 28
Heater	0	48	28 ^ 48 = 44
Time	0	48	44 ^ 48 = 28

28 decimals = 1C Hex

1	2	3	4	5	6	7	8	9	10	11
Start	ID-High	ID-Low	CMD	Step	Cfg	Heater	Time	CRC high	CRC low	End
@	0	9	W	3	1	0	0	**1**	**C**	*

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Back indication examples:

Byte 7:
No failures = ascii 0 = decimal 48
Lamp failure 1 = ascii 1 = decimal 49
Lamp failure 2 = ascii 2 = decimal 50
ISO failure 1 = ascii 4 = decimal 52
ISO failure 2 = ascii 8 = decimal 56
Lamp failure 1 and ISO failure 2 = 1+8 = decimal 57
Lamp failure 2 and ISO failure 2 = 2+8 =ascii a = decimal 65

Byte 8:
No failures = ascii 0 = decimal 48
I min failure = ascii 1 = decimal 49
I max failure = asci 2 = decimal 50

Byte 9(Key switch position)
Remote = ascii 2 = decimal 50
Off or Local = ascii 0 = decimal 48
Connections on terminals –XX1 for RS485 based remote control communication with the above-described protocol.

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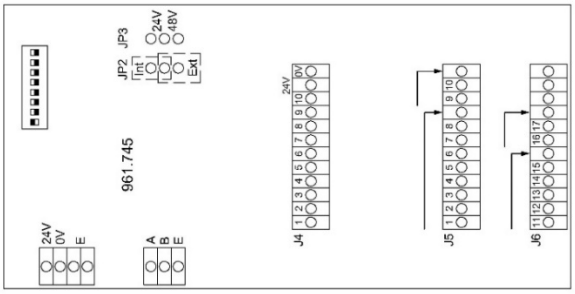
14.2 Parallel control

(961 HW or Interface board 971751/Parallel)

When a parallel interface is required, a separate parallel interface board is placed in the SFL cubicle, and 961 HW board will communicate with the SFL mainboard via the RS485 serial bus. And 971751/Parallel will use CAN bus to mainboard.

Preliminary Wiring:

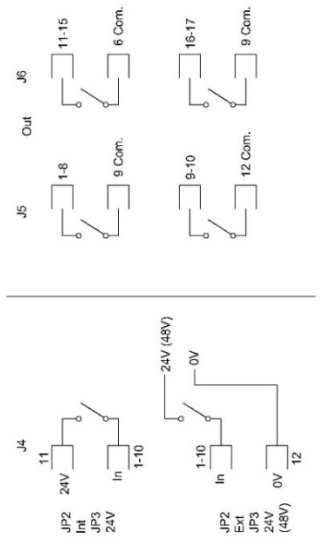
I/O no.	Function	Comment
I1	Step 1 low speed	
I2	Step 2 low speed	
I3	Step 3 low speed	
I4	Heater active	
I5	Step 1 high speed	
I6	Step 2 high speed	
I7	Step 3 high speed	
I8	Bit 0 of cfg	00=cfg1 01=cfg2
I9	Bit 0 of cfg	10=cfg3 11=cfg4
I10		
O1	Step 1 low speed	
O2	Step 2 low speed	
O3	Step 3 low speed	
O4	Bit 0 of cfg	00=cfg1 01=cfg2
O5	Bit 1 of cfg	10=cfg3 11=cfg4
O6	Remote	
O7	Lamp alarm	
O8	RIL alarm	
O9	Step 1 high speed	
O10	Step 2 high speed	
O11	Step 3 high speed	
O12	Heater active	
O13	Earth warning	
O14	Earth Error	
O15		
O16		
O17		



Out	Pin	Common
11	1	6
12	2	6
13	3	6
14	4	6
15	5	6
	6	
16	7	9
17	8	9

Out	Pin	Common
1	1	9
2	2	9
3	3	9
4	4	9
5	5	9
6	6	9
7	7	9
8	8	9
	9	
9	10	12
10	11	12
	12	

In	Pin
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
24V	11
0V	12



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15. Maintenance and Trouble shooting

15.1 Preventive Maintenance

There is no direct demand for specific maintenance to be done on the SFL, but this chapter states a few recommendations which could improve both MTBF, lifetime of the equipment as well as safety for maintenance personnel.

Frequency	Preventive maintenance activity
Daily	• Check the correct operation of the fixture; repair in case of any malfunction
Weekly	• Visually inspect each light fixture for signs of damage, loose parts, or abnormal condition • Clean the front glass and remove dust/dirt from the fixture • Remove any vegetation around the fixture
Monthly	• Inspect the optical window/prism for cleanliness, mechanical damage, and any moisture or condensation inside the prism • Check whether the fixture is properly fixed in its base; re-secure if required
Yearly	• Perform a detailed inspection of the light fixture • Check for mechanical damage such as prism cracks • Clean the optical windows • Inspect the lights for alignment and toe-in adjustment if applicable
Every 2 years	• Disconnect all power lines from the SFL, and measure the isolation level (Megger) • Clean inside the SFL with a vacuum cleaner (ensure the SFL Cubicle is powered OFF!), and visually inspect all components • Inspect all power connections by means of a thermo camera
As needed (incidentally)	• After any abnormal weather events, inspect fixtures for damage. Replace any damaged fixtures, and return them for investigation and repair. Remove debris obstructing the light beam

15.2 Safety instructions

WARNING: Switch the main power off at the location of the SFL Cubicle when any installation, maintenance or replacement is done on the SFL system.

Before any work is done on the series circuit:

- The key selector on the SFL is set to “OFF”
- The SFL front door is clearly marked with a sign “Work is done on the circuit.”

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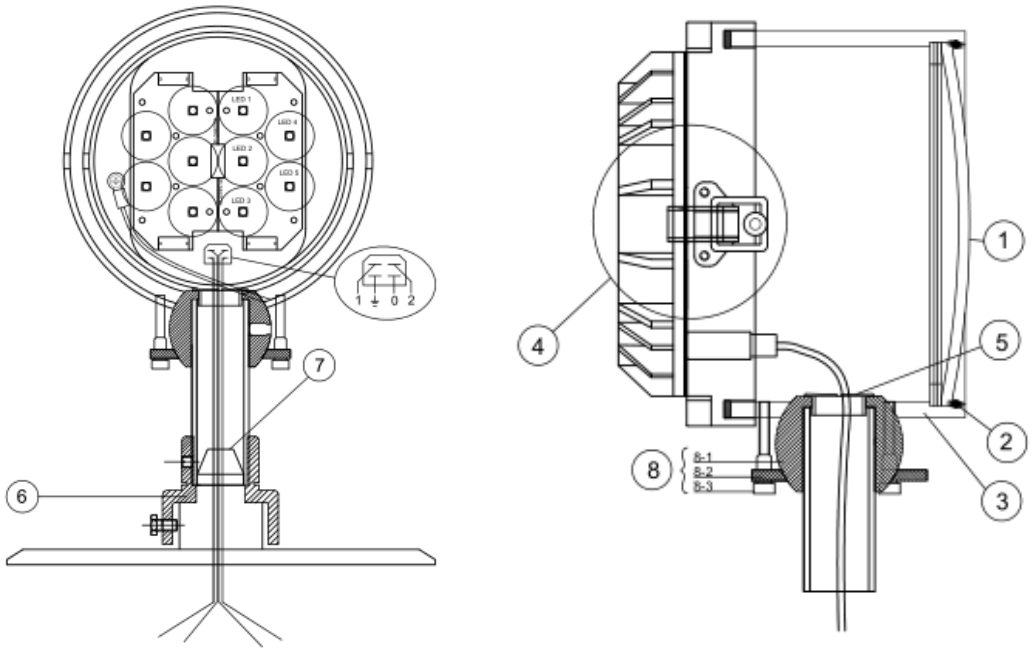
15.3 List of spares

Elevated light 793-Family



Pos.	Name	Product Number
1	Frontglass, clear	P-382300
2	Spring for frontglass	792006/1
	Sealing for front glass	230.085-00
	Aluminum ring for front glass	230.086-00
3	Alu housing	792011
4	Light unit for 793 SFL	793892/4
6a	Breakable coupling Type C (pole mounting)	790901/2
6b	Breakable coupling Type A (with 2” thread)	790518/2
	SFL connector 4-pole male	P-241243
8	Upper assembly ring	790021
	Assembly ring	790022
	Screw for fixing assembly	P-902841

Inset Fixture for SFL

Pos.	Name	Product Number
	Electronic Housing Group 12 inch	205.954-997
	LED Module	216.076-007
	APH Prism incl gasket	216.073-007
	APH Sapphire Prism incl gasket	216.073-017
	SFL inset cable spare	790036600

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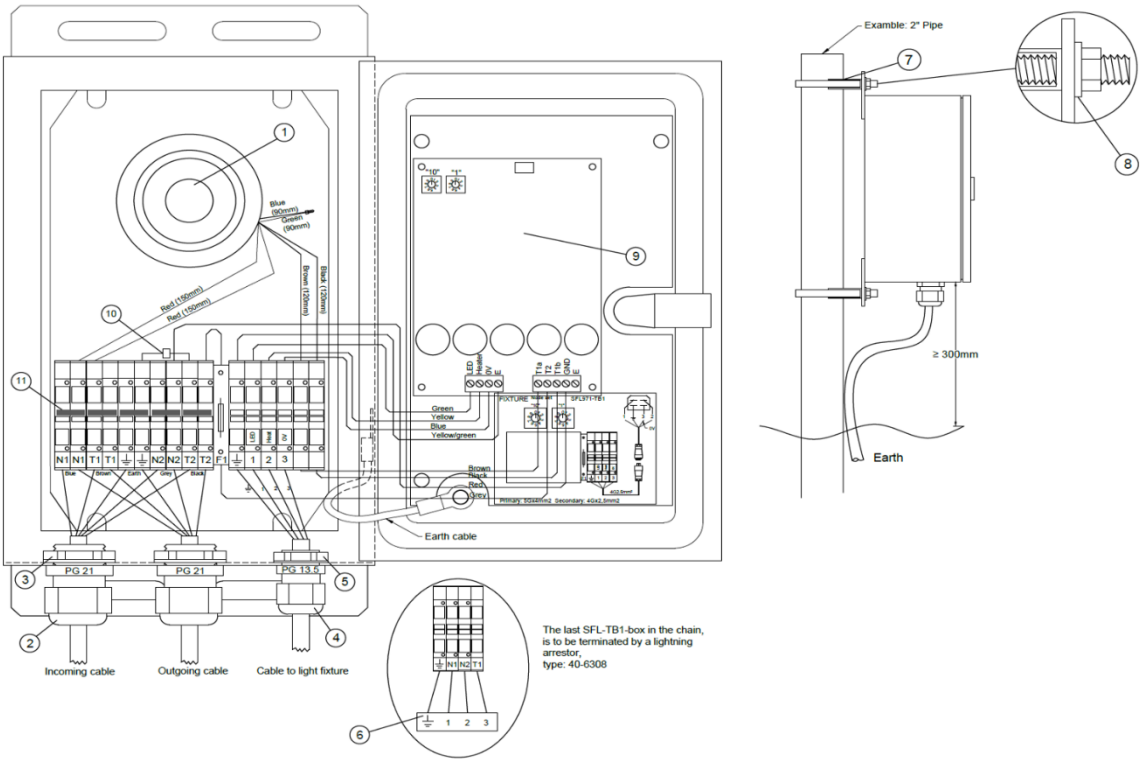
SFL Controller

Pos.	Name	Product Number
	SFL 971 Main Board	971509
	SFL 971 Daughter Board	971508
	SFL 971 LCD display	P-384002
	Solid state relay	P-262102
	Isolating transformer	K11957
	6A auto fuse	P-249046
	Lightning arrestor	P-360110

SFL 971 Terminal Box



Pos.	Name	Product Number
1	SFL 971 LED Trafo	K12200
7	U-clamp 2” 60,8 mm	P-855534
6	Lightning arrestor	40-6308
9	PCB for SFL 971 TB	971770
	SFL connector 4-pole female	P-241244
	1A fuse	P-249114

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Company profile:

TKH Airport Solutions is an innovator in airfield ground lighting, offering a complete range of LED AGL products. We build upon the know-how from a long and successful tradition of pioneering developments in the AGL and connectivity industry. Being part of the TKH Group, our company can build on a history of more than 95 years in smart connectivity, energy distribution and AGL.

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