NAKSYS

OPERATOR & MAINTENANCE MANUAL

-BEAMSNAP lddn System-

THE WORKSHOP/LAB EQUIPMENT FOR PHOTOMETRIC MEASUREMENT OF THE AIRFIELD GROUND LIGHTING (AGL) SYSTEM.

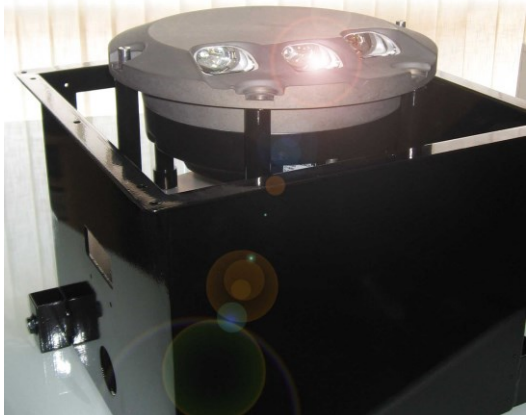

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Table of Content

1./ Introduction

Airport ground lighting systems (AGL) are networks of lights and circuits which help guide aircraft in take-off, landing and taxiing along the runway, and are easily overlooked by air travellers.

AGL system performs a significant role in safe air travel at night and under unfavourable conditions of visibility.

AGL must meet internationally agreed standards set by International Civil Aviation Organization (ICAO), the Federal Aviation Authority (FAA) and local Civil Aviation Authorities.

In fact, Airfield Ground Lighting system shall be designed, installed, tested and maintained regularly against the latest standards minimum photometric requirement in order to deliver safety assurance and photometric performance as specified in the ICAO Annex 14 Edition 2013 and the FAA Circular AC 150/5345-46D.

For establishing and maintaining an effective preventive maintenance program for airport visual aid facilities under category I, II and/or III, the measurement of light intensity, beam spread and orientation of the runway and taxiway lights, should be undertaken regularly and systematically in the workshop after refurbishment or maintenance of lights and before reinstalling the light units on site.

In order for the airport operators to maintain efficiently the Airfield Ground Lighting installations compliant with ICAO/FAA minimum mandatory photometric requirements, the engineers of NAKSYS, pioneers and leaders in the development of the airfield photometric measurement equipments, have developed the Beamsnap ^{Iddn} system, the new generation of workshop or laboratory photometry measurement equipment integrating dedicated functionalities for airfield maintenance purposes.

2./ Design and development of the BEAMSNAP iddn system

The Beamsnap Iddn system integrates, advanced controls and functions providing easiness for operators while making a workshop measurement.

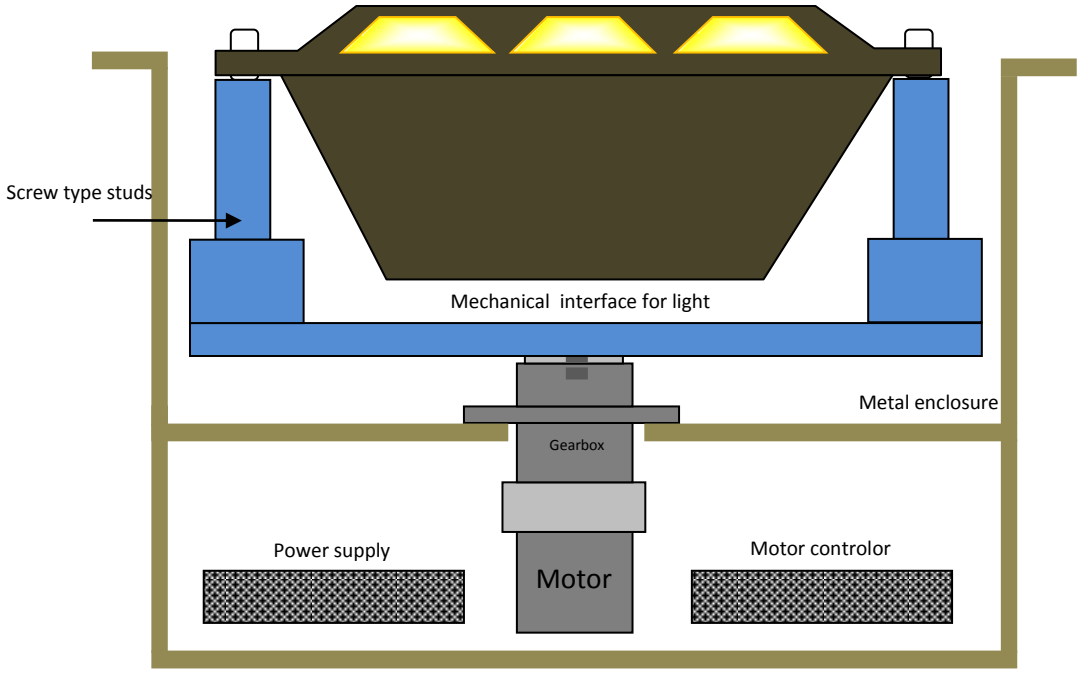


Fig.1 Bench - Overall view of rotating plate

It has been designed as an ergonomic, easy and reliable product providing accurate photometric measurement and storage information for trending and analysing the performance of each individual light source.

It measures in one click the photometric performance of either a unidirectional light source or a bi directional lights sources. After each light source measurement, the light returns to its reference home position automatically and provides a printable result report to the operator.

3./ General specifications of the BEAMSNAP ^{iddn} system

The BEAMSNAP is the advanced workshop photometry equipment offering the following capabilities and performance to the airport users:

a./ The Beamsnap ^{Iddn} uses a dynamic measurement bench that can be easily and steadily installed in the maintenance workshop area of the airport.

b./ The system measures the photometric performance of all inset and elevated aeronautical ground light fittings.

c./ It measures the photometric performance of each individual light sources compared to the operational requirements as specified by the ICAO in the Annex 14 Edition 2013 and by the FAA in the Advisory Circular AC 150/5345-46D.

d./ The system uses accurate photometric sensors to measure precisely the illuminance of light beams.

e./ The system allows light measurements to be conducted at an average speed of 30 seconds per light.

f./ The systems allows the operator to stop the light measurement process at any point using an emergency push button.

g./ The system can be easily transferred from one place to another without assistance from the manufacturer.

h./ The system provides facilities to view and print the measurement reports instantly.

i./ The system provides guidance to operators to rectify the anomaly(ies) of the faulty light fittings.

j./ The system provides the main following data in the measurement reports and not limited to:

-the average value in candelas

-maximum and minimum values in candelas

-position of the light beam in V° and H° angles

-the color of the light beam

-a high resolution iso-candela graphical diagram

-the compliance percentage according to the FAA/ICAO specification

-status passed/failed

-others relevant details, graphical displays.

k./ The system is demonstrated to provide measurement values with a precision of ± 2%

l./ The system is demonstrated to provide a good repeatability and reproducibility of ± 2%

Note A: *The Beamsnap ^{Iddn} equipment can be easily converted into the mobile photometry control equipment by including additional components.*

4./ Technical specifications of the BEAMSNAP ^{iddn} system

4.1./ Hardware components

The BEAMSNAP equipment comprises the following modules:

Description of components	Quantity
Sensors array integrating accurate photometric sensors	1
Data Logger unit integrating the real-time data acquisition unit and the communication module	1
Dynamic measurement bench using stepper drive/step motor	1
Laptop or Desktop computer running the real-time software	1
Interconnecting cables kit	1
Real-time light measurement software program with instant reporting and printing facilities	1

Note B: *The above list provides the hardware equipments and software constituting the standard version of the Beamsnap ^{iddn} system. Naksys company, manufacturer of the Beamsnap ^{iddn} system reserves the right to replace and modify any component with the latest product available in the market without prior notice. The system quantity provided in the above table varies depending the configuration installed or supplied on site.*

4.1.1. Sensor Array Module

4.1.1.1. Sensor array

The sensors array integrates accurate photometric sensors using photodiodes technologies.

Fig.2 Sensor Array

These sensors have been pre calibrated and sorted to be connected in numerical order at a dedicated place inside the metallic box.

Fig 3 : Sensor array views

Legend:
: Lux sensors

Note C: *The Beamsnap [Iddn] sensor array is a simplified version of the mobile sensor array equipment.*

4.1.1.2. Photometric sensors Photometric (Lux) sensors

Fifteen photodiodes have been used and combined with their electronic circuits to measure the illuminance intensity while scanning the light beam.

Fig 5 Lux Sensor

These sensors reacting as CLASS A Luxmeter have been used to capture the variations of the light beam intensity accurately and steadily.

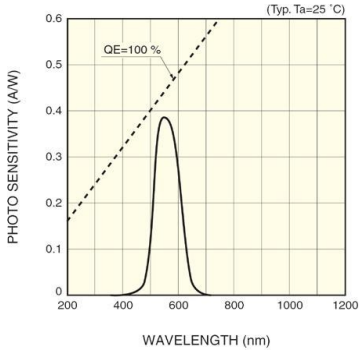


Fig. 5.1: Spectral response

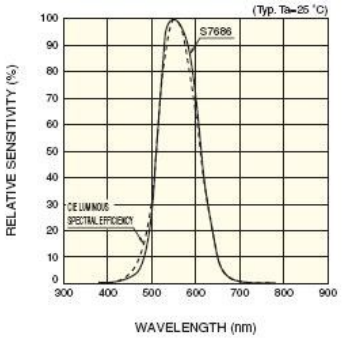


FiG. 5.2: Spectral response - Relative value

It can be seen in the above figures, the typical spectral response characteristic of these sensors are close to the human eye sensitivity and analogous to the CIE (International Commission on Illumination) spectral luminous.

Photometric photodiode Key specification:

Spectral response min (λ)	480 nm
Spectral response max (λ)	660 nm
Photo sensitivity (Sλ)	0.38 A/W
Peak sensitivity wavelength (λ_p)	550 nm
Rise time (tr)	0.5 µs
Dark current (ID)	2 pA

The sensors use photodiodes integrated into a compact electronic circuits protected by a black epoxy (resin) encapsulated into rigid plastic box.

4.1.2. Data logger module

The Data Logger unit integrate the following items:

- A real-time high speed data acquisition board is used to fetch in real time the data collected from the sensor array component.
- A signal conditioning has been designed to enhance the performance and accuracy of the system while collecting the data.
- Interconnection via an USB cable to laptop/PC (communication module)
- Protected fuses with led indicator

The data logger offer different inputs connectivity's such as the connectivity to the sensor array.

Fig. 6.1 Data logger - Front Panel view

Fig. 6.2 Data logger - Back panel view

It is aimed to record the data of the luminous intensity of light being measured over the time acquired by the sensor array in order to compute in real time the data collected by the Laptop/ PC and on top of that to post process these data through the Beamsnap [lddn] Software.

Fuses have been integrated with their led indicator to protect the sensor array (Sensors) and the data acquisition card (DAQ).

Note D: *The Beamsnap Data logger is a simplified version of the mobile sensor array equipment.*

4.1.3. Dynamic measurement bench

The dynamic bench unit integrate the following items:

- Stepper Drive / Controller XLi 50
- Step Motor
- Gearbox

4.1.3.1 Stepper Drive / Controller

The XL50i stepper drive with indexer has been used to controls the stepper motor in order to perform accurate control of moves and sequences using a mix of parameter driven and event driven commands.

Fig. 7.1 Stepper Drive - different view

The communication is established using an USB RS232 serial port connection to a computer/Laptop unit. The drive has been powered from the XL_PSU module which provides the necessary power supply. It has been set giving an output current less than the motor rating.

Key specification:

continuous current	3.5A RMS
Motor Peak current	2.5A – 5A at 80V
Limits	Switch normally closed
Drive resolution	4000 steps/rev
Interface	EASI code
Input power D.C.	24V & 48V-80V
Communication RS232 at 9600 baud	8 data bits, 1 start/stop bit, no parity
Automatic Standby Current Reduction	50%
Motor current	Set at 50%
Axis	Set at 1 (single Axis)
Protection motor against	short circuit, over/under voltage, over temperature
XL_PSU module	220 Vac Input/ 75Vdc output
Weight	0.4 to 0.6kg
Ambient Temperature range	0° to 50°C Max

4.1.3.2. High performance Stepping Motor HS200-2221

This stepping motor connection has been made directly between the drive and the motor.

It is a bipolar motor used to control via the stepper drive Xli 50 the scanning of the light source accurately. It has been chosen for the following characteristic: Perform high torque, accuracy and speed during the measurement.

It can run clockwise or counter clockwise direction depending of the commutation.

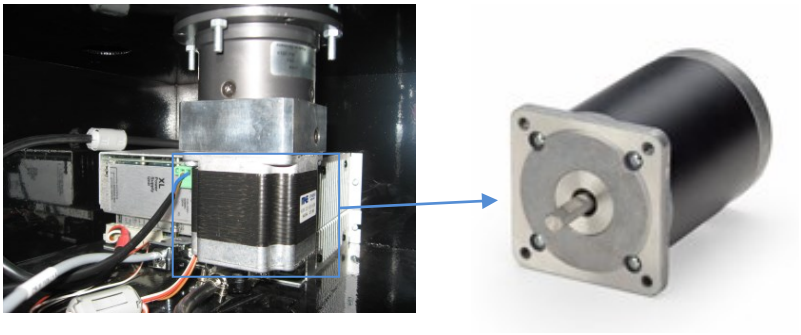


Fig. 7.2 Stepper Drive - different view

The motor is set by the system at default value being 50% of peak drive current.

It is an electromechanical transducer that converts electrical pulses into programmable mechanical movements driven by the Xli 50 controller. Also, it delivers its own characteristics with extremely low values of voltage and current ratings.

Key Specifications

step angle	1,8°
step angle accuracy (%	5
rated phase current (A	2,1
phase resistance (Ω	1,4
phase inductance (mH	3,9
holding torque bipolar * Ncm	98
detent torque (Ncm	4
rotor inertia (g cm2	220
mass (Kg	0,7
max. length (mm	55
shaft dia (mm	6.35
max. applicable voltage V	75
insulation class	B (0210)

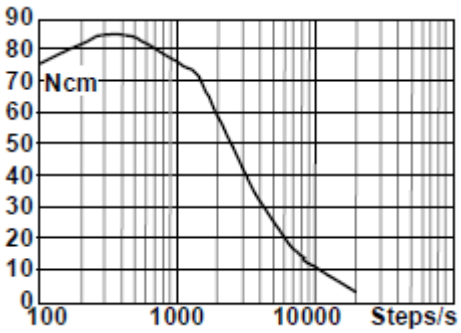


Fig. 7.3 Torque vs speed characteristics, Bipolar chopper, 36V, 2.1A/Phase)

4.1.3.3 Gearbox PLFE 64 1/64

It is an in-Line Planetary Servo Gearhead with EN ISO 9409 Rotating Output Flange. The gearbox has a high output torque rating/ torque density, high tilting rigidity and moderate backlash. It is compact, high value economy planetary gear- head with rotating flange (disc) output.

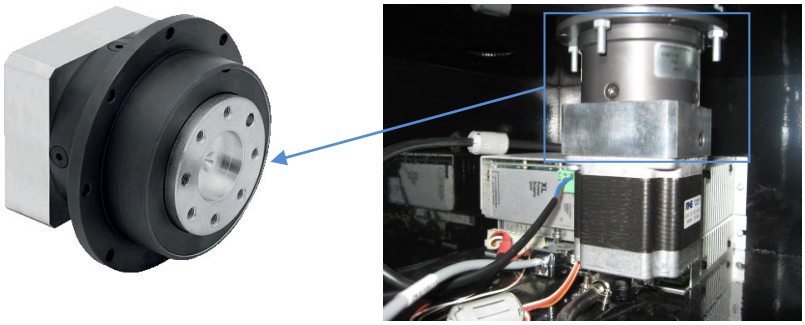


Fig. 7.3 Gearbox - different view

With its smaller size and lower weight, it increase efficiency, reduces noise and on top of that it has a higher allowable rpm s as a benefit.

Gearbox Key specification:

highest output torques
high efficiency (96%)
ratio i=64
low noise (< 65 dB(A))
any mounting position
easy motor mounting
Direction of rotation equidirectional

4.1.4. Overall diagram

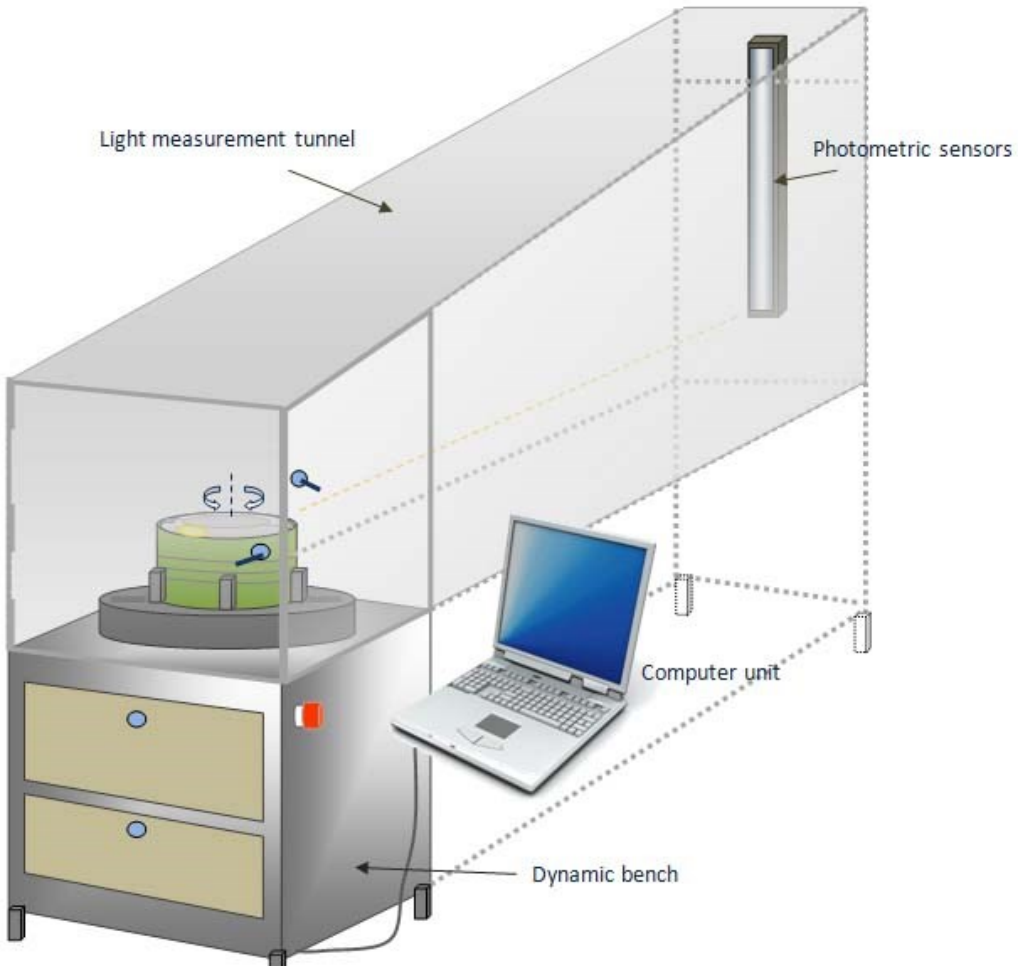


Fig. 8. Overall diagram

The above diagram illustrates the optional version of the the Beamsnap ^{Iddn} system and is non contractual. The open architecture in the design of the system allows different types of material configurations offering the airport users all desirable operating methods and ways on site.

Kindly refer to the manufacturer for any type of requirements.

4.1.5. Light measurement theory

In order to measure luminous intensity output of a light fitting, the AGL system must be operating at full brightness (6.6 amperes).

Each photometric surface sensor is striked by the illuminance at any distance of the light beam (source of intensity) being measured given by the following equation:

$$\mathbf{E\ (lx) = I \div D^{2}}$$

Where:

E (lx): lluminance resulted in Lux, **I:** luminous Intensity of light source in Candela and, **D:** Distance in meter

Then:

illuminance (lux)= luminous Intensity of light source (candela) ÷ distance ^{2} (meter^{2})

$$\mathbf{Lux = Candela \div meter^{2}}$$

As defined above, the candela is the unit of the luminous intensity of light beam being measured in a specified direction represented by:

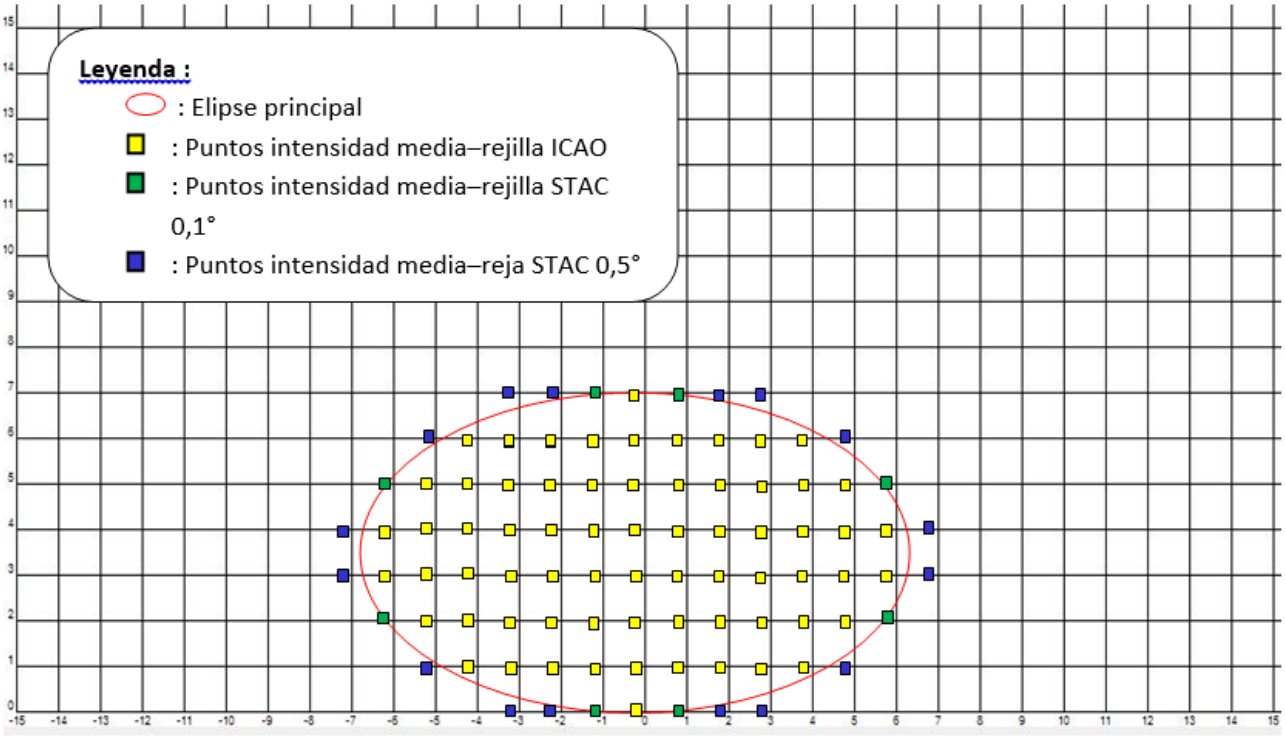
Luminous Intensity = illuminance x distance ^{2}

$$\mathbf{Candela = Lux \times meter^{2}}$$

The arithmetic average of the lights intensities value of the light beam being measured is computed within the main ellipse area using the following formulae:

$$\mathbf{Average\ Intensity = \sum Candela \div number\ of\ data\ collected\ in\ the\ grid}$$

The arithmetic average is computed by averaging the candela values of the grid points within the main ellipse of the light beam as shown below.



4.1.6. Light measurement method

The Beamsnap[iddn] system has been designed in order to match and suit the harsh working conditions in the maintenance workshop area. The tunnel creates a dark space without requiring an entire dark room area. The complete system can be steadily installed in the workshop area without special requirements or arrangements. The operator can remove and re-install easily the new lights for measurement without having to re-align the optical reference line.

Once the light is positioned on the bench, the operator presses the 'START' command to begin the measurement process. The bench rotates the light fitting on both positive and negative angle (clockwise and counter clockwise) directions, and while rotating, the photometric sensors record the relevant illuminance values automatically for each vertical angle position. The bench returns to the initial light position and on the computer appears the measurement results in graphical form.

The software shall guide the operator to select the type of light and the distance at which the sensor bar should be set/ placed from the light fitting before launching and performing an accurate photometry measurement.

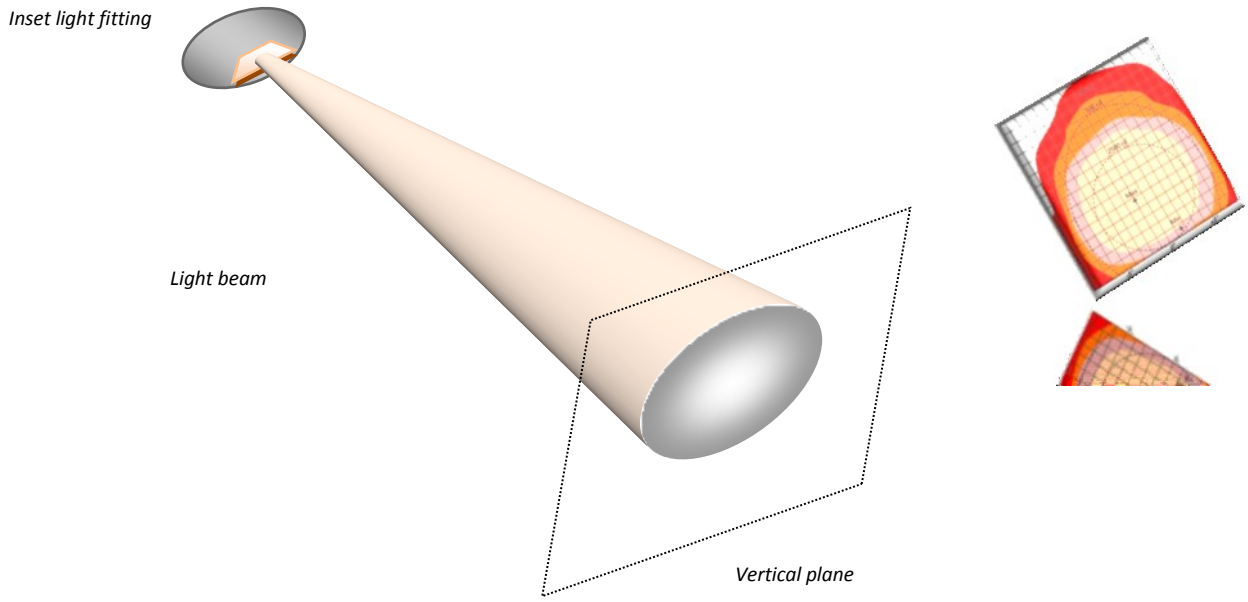


Fig 9. Vertical scan of the light beam

The measurement result displays the status of the light 'Passed or Failed' and in case the measurement failed, there are number of suggestions made in order to guide the operator to rectify the fault.

Fig 10. Light positioning unit

The following pages provide an overview of the Beamsnap[iddn] software package.

4.2. Software modules

This section has been written for users having some experience using computer in general under the Operating System Windows XP, Vista or 7.

The standard version of the Beamsnap^{iddn} software Interface includes all necessary functions to manage the following:

- The airport details including information on runways and taxiways
- The detailed list of the persons operating the system
- The complete lights data base
- The light measurement
- The hardware diagnostics
- Edition of measurement reports
-

However, it is possible to customize the software based on specific requirements from customers depending upon the type of license and the Beamsnap^{iddn} software interface version provided.

So now, let's start to familiarize the operator with the Beamsnap^{iddn} Software.

When the operator double - click in the Beamsnap^{iddn} icon shortcut from the Desktop window, the program will start loading.

Then, the main widow is displayed requesting to the operator to log in by entering identifier information provided by the manufacturer as part of the login security process to access the system.

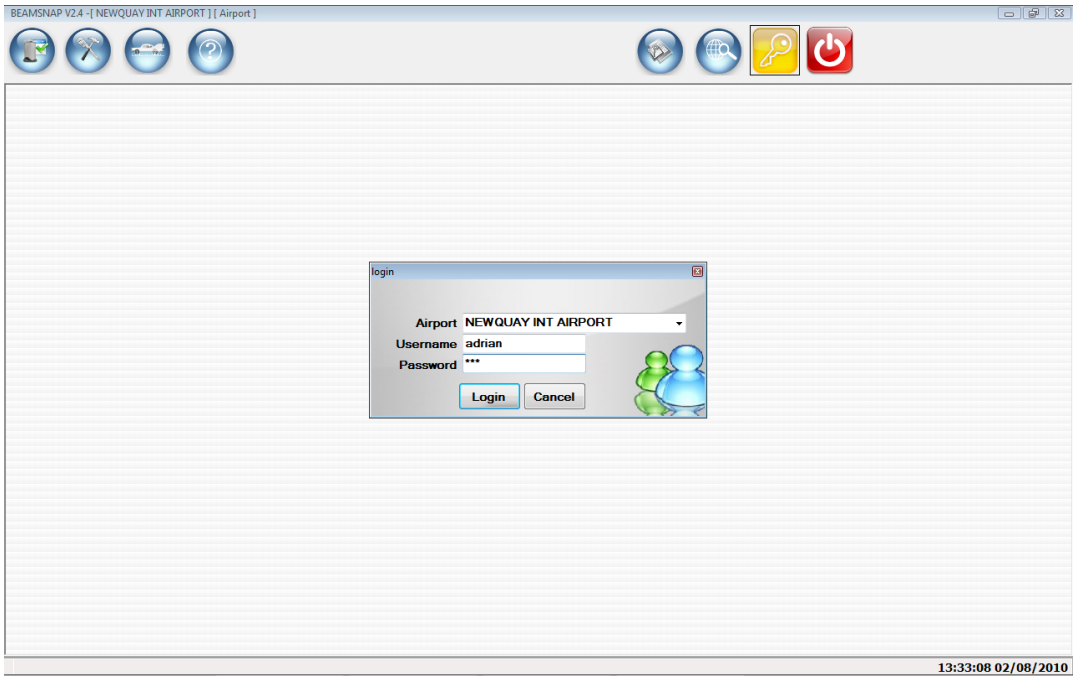


Fig 11 - Login Window

When the operator attempts to log in by entering invalid identifier information, a message dialog box will appears informing “invalid Username or Password”.

The Beamsnap^{iddn} software contains a main toolbar which is located at the top hand side and sub toolbars located at the left hand site to help the operator to select the often used application commands. In other words, the main toolbar gives to the operator quick access to the sub toolbar features that the operator will use most frequently. The functions of each feature are described in detail in the next section.

Once the operator has logged-in into the system, the following main toolbar is now activated.

Fig12 – Main menu

At this stage, it is useful to explore these themes in order to manipulate the different functionality of the software properly. To do so, the operator shall right click on one of the following theme:

- Database
- Settings
- Measurement

Database Theme

Use the Database sub toolbar feature to explore, insert, update or delete data from the database.

Right-click on any of the following subthemes button to load their container viewer:

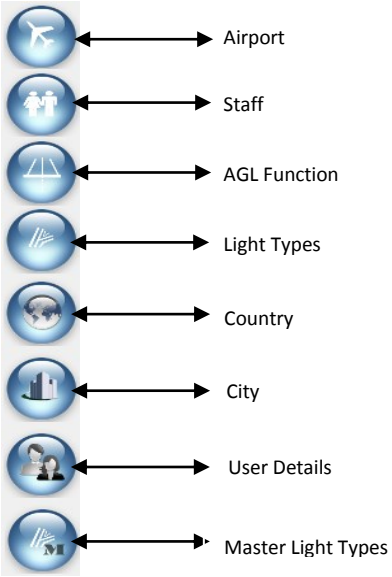


Fig 13 – Database menu

Note A: *The database of the Beamsnap^{iddn} software has been already pre-configured by the manufacturer. Therefore, the operator shall be ready to perform a photometry measurement without having to update the information from database.*

4.2.1.1/ Airport container

As shown in Figure 14, the airport and contact details fields have been already recorded by default in the database. These fields cannot be updated by the operator.

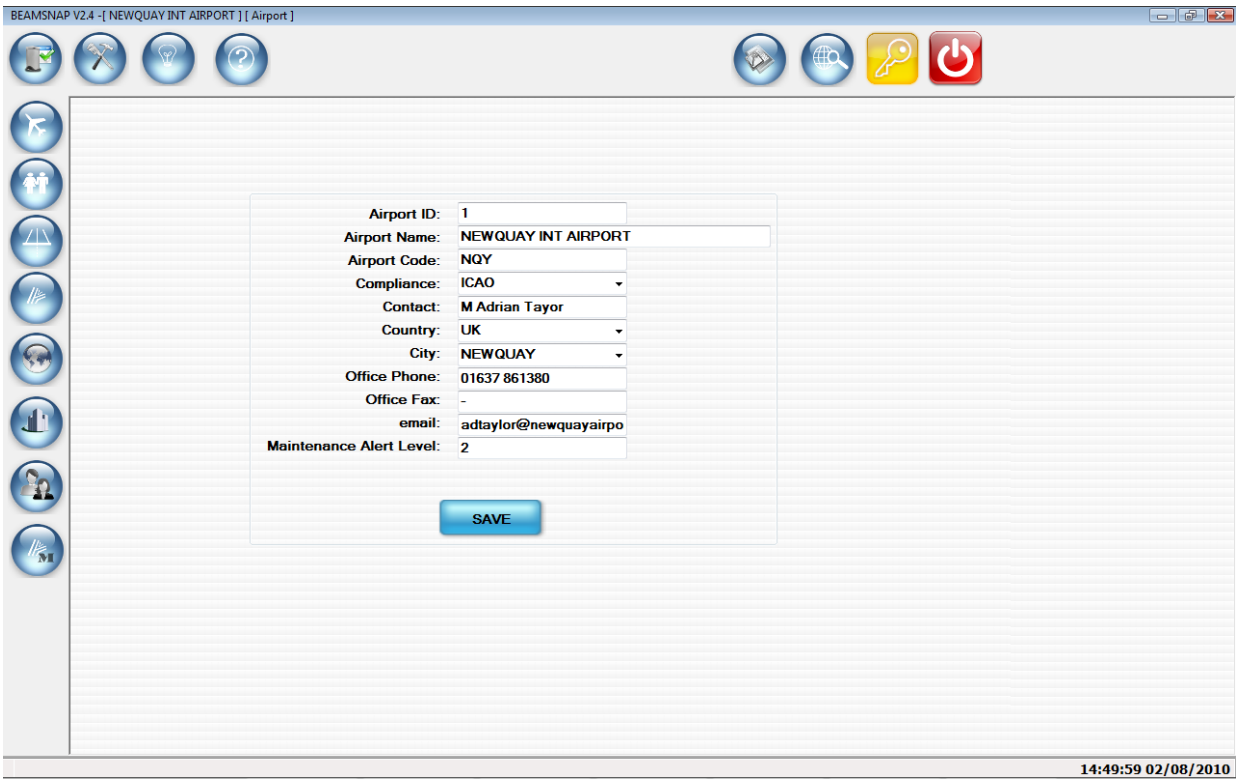


Fig 14 - Airport container

4.2.1.2/ Staff container

As shown in Figure 15, the area of this container has been split into two regions.

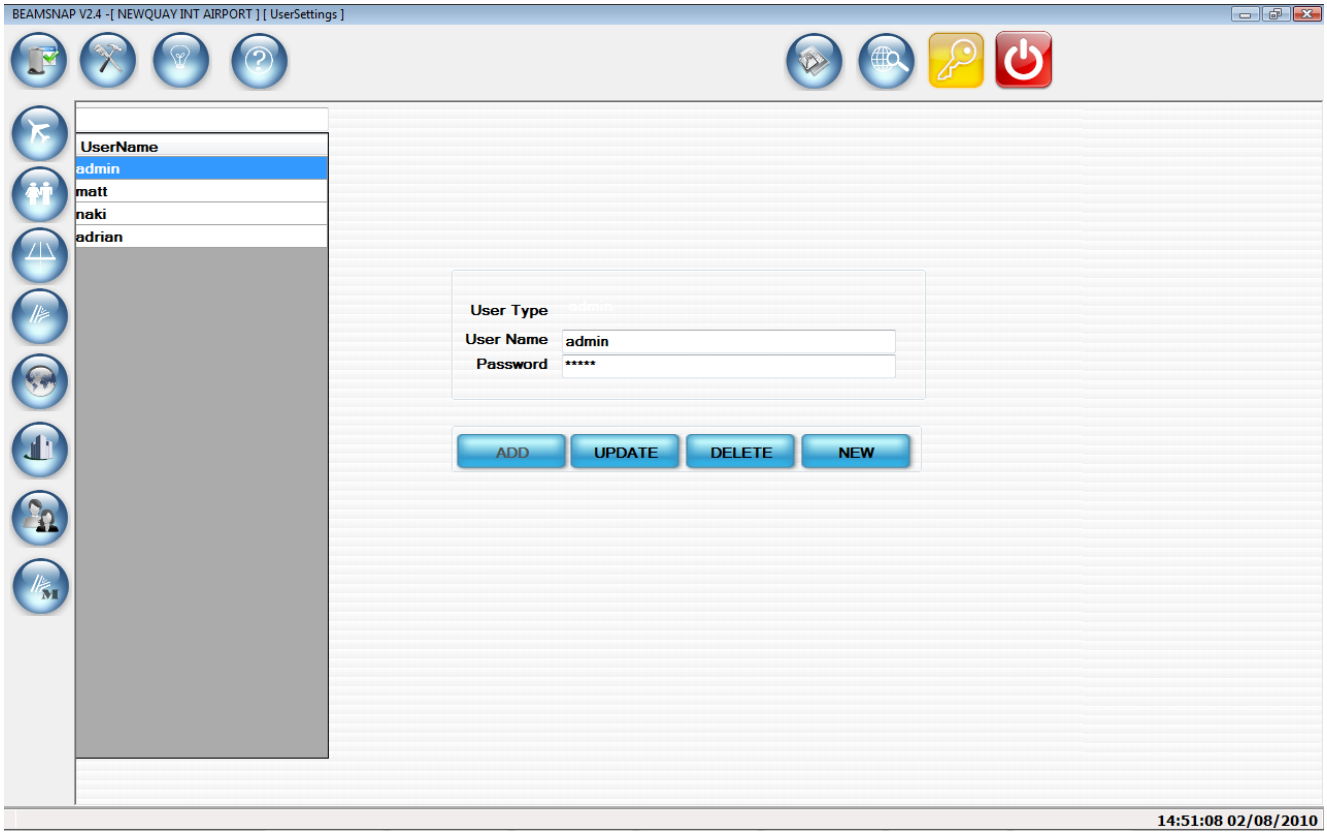


Fig 15 - Staff container

The left side of the container displays the authorized operators belonging to the Airport through the list viewer **Staff Name** whereas the right side of the container allows the operator to record a new agent into the database as follows:

1./ Right-click on **CLEAR** button.

2./ Select the appropriate field by right clicking to enter the new agent identity information

3./ Right-click on **ADD** button to record the new agent into the database

or to update the record information of an existing operator as follows:

1./ Select a Staff name from the list

2./ Select the appropriate field by right clicking to update the agent identity information

3./ Right-click on **UPDATE** button to update the information of an existing agent into the database

Make sure that the user details have been inserted through the User settings container.

4.2.1.3/ User Settings container

As shown in the Figure 16, the area of this container has been split into two regions.

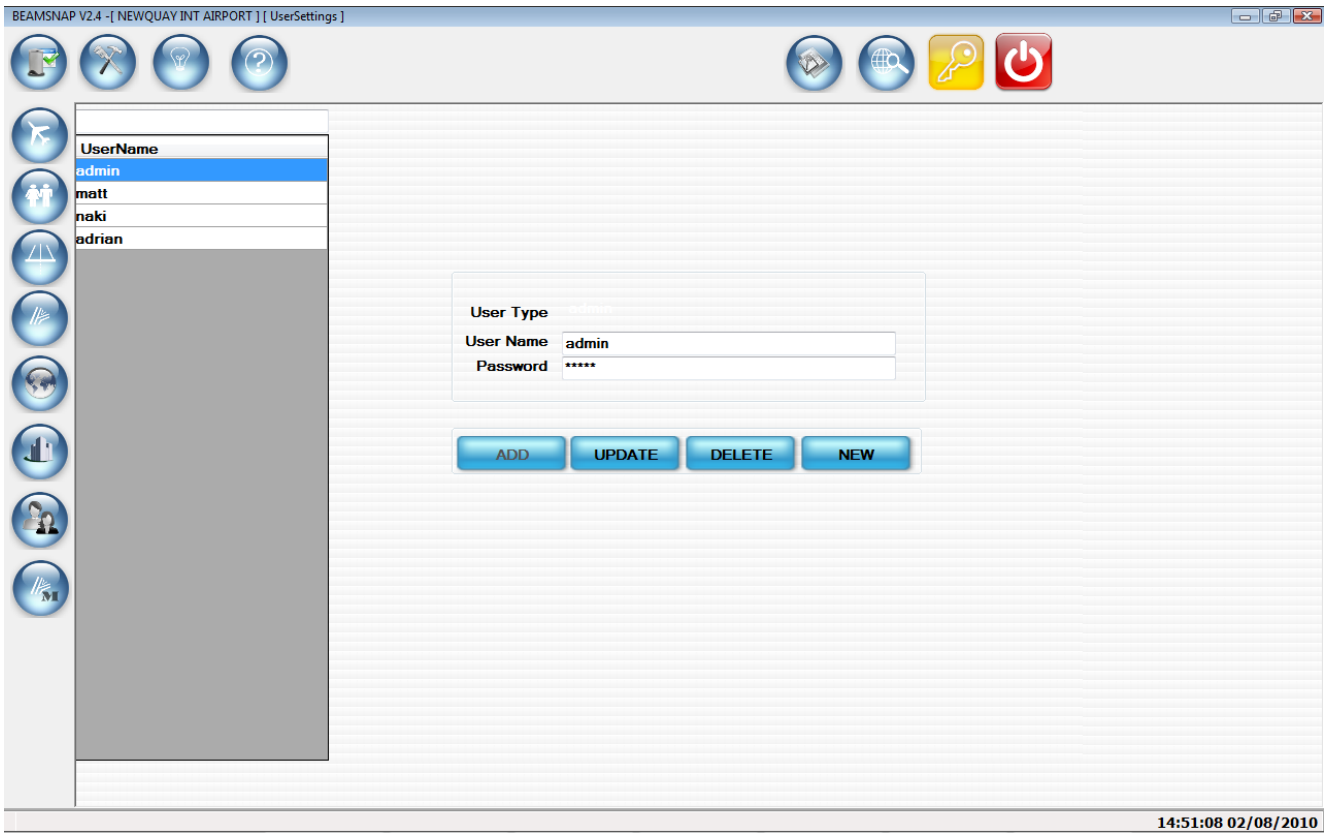


Fig 16 - User Settings container

The left side of the container displays the **User Name** logging of the authorized operator to perform a photometric measurement through a list viewer whereas the right side of the container allows the operator to record a new Agent logging into the database as follows:

1./ Right-click on **NEW** button

2./ Enter a new operator logging (User name and password)

3./ Right-click on **ADD** button to insert the logging into the database

To verify whether the operator logging has been well recorded or not into the database either write down the operator name in the blank field on top of the list viewer or right-click in the User Details button.

4.2.1.4/ Country container

The area of this container has been split into two regions as shown in the Figure 17.

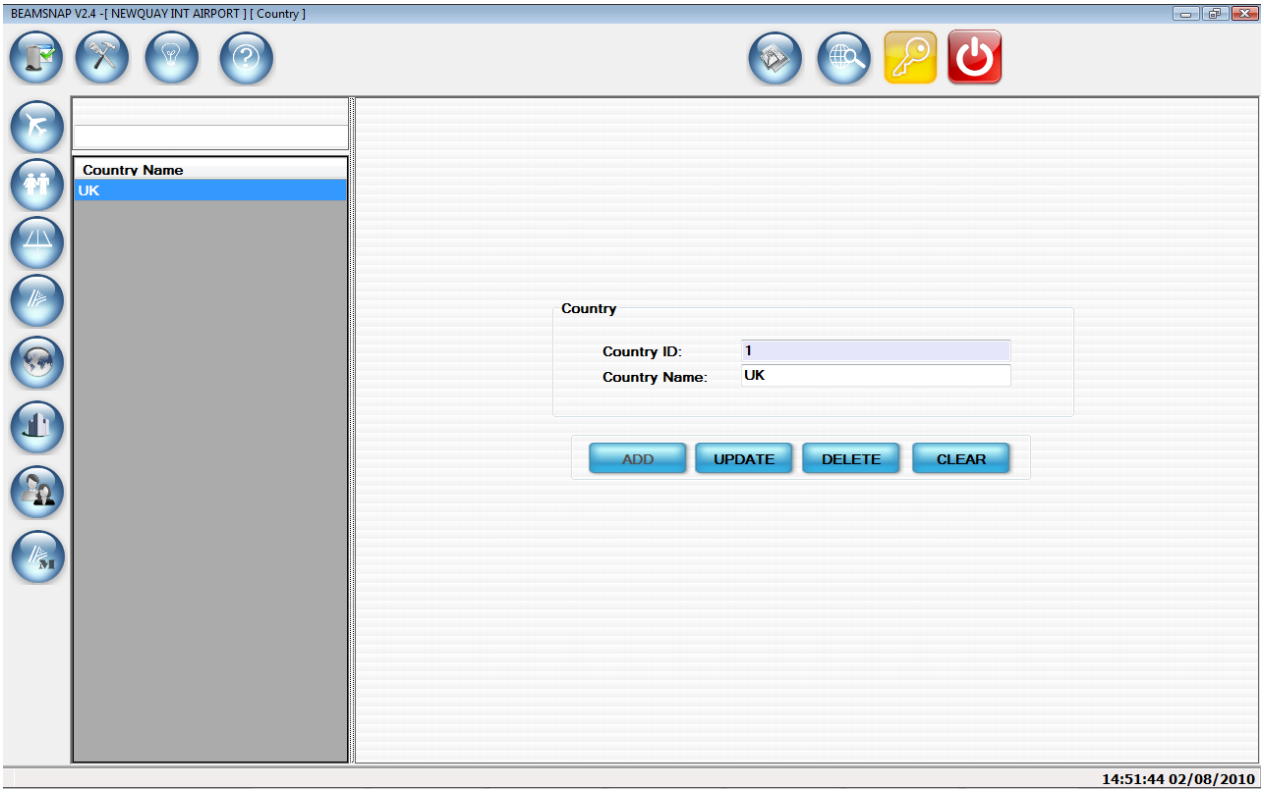


Fig 17 - Country container

The left side of the container displays the **Country Name** inserted into the database through a list viewer whereas the right side of the container allows the operator to insert a new country in the database as follows:

1./ Right-click on **NEW** button

2./ Enter a new country in the **Country Name** field

3./ Right-click on **ADD** button to record it into the database

4.2.1.5/ City container

The area of this container has been split into two regions as shown in the Figure 18.

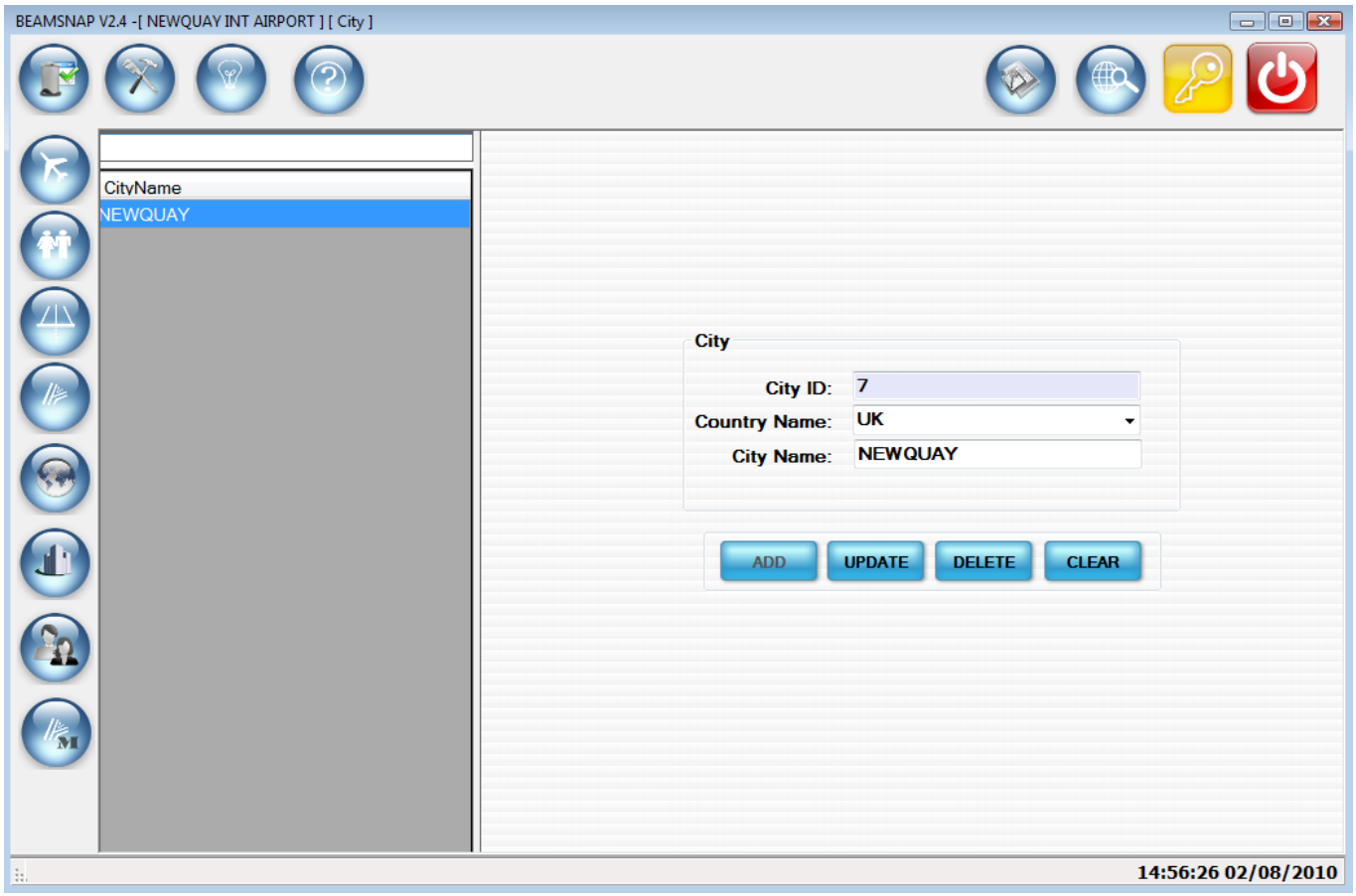


Fig 18 - City container

The left side of the container displays the **City Name** in the list viewer whereas the right side of the container allows the operator to insert a new city associated with an existing country name via the combo box in the database as follows:

1./ Right-click on **NEW** button

2./ Right-click on the combo box to select a **County Name** and insert a city in a the **City Name** field

3./ Right-click on **ADD** button to record it into the database

4.2.1.6/ Master Light Type container

The area of the Master light types container has been split into two regions as show in Figure 19.

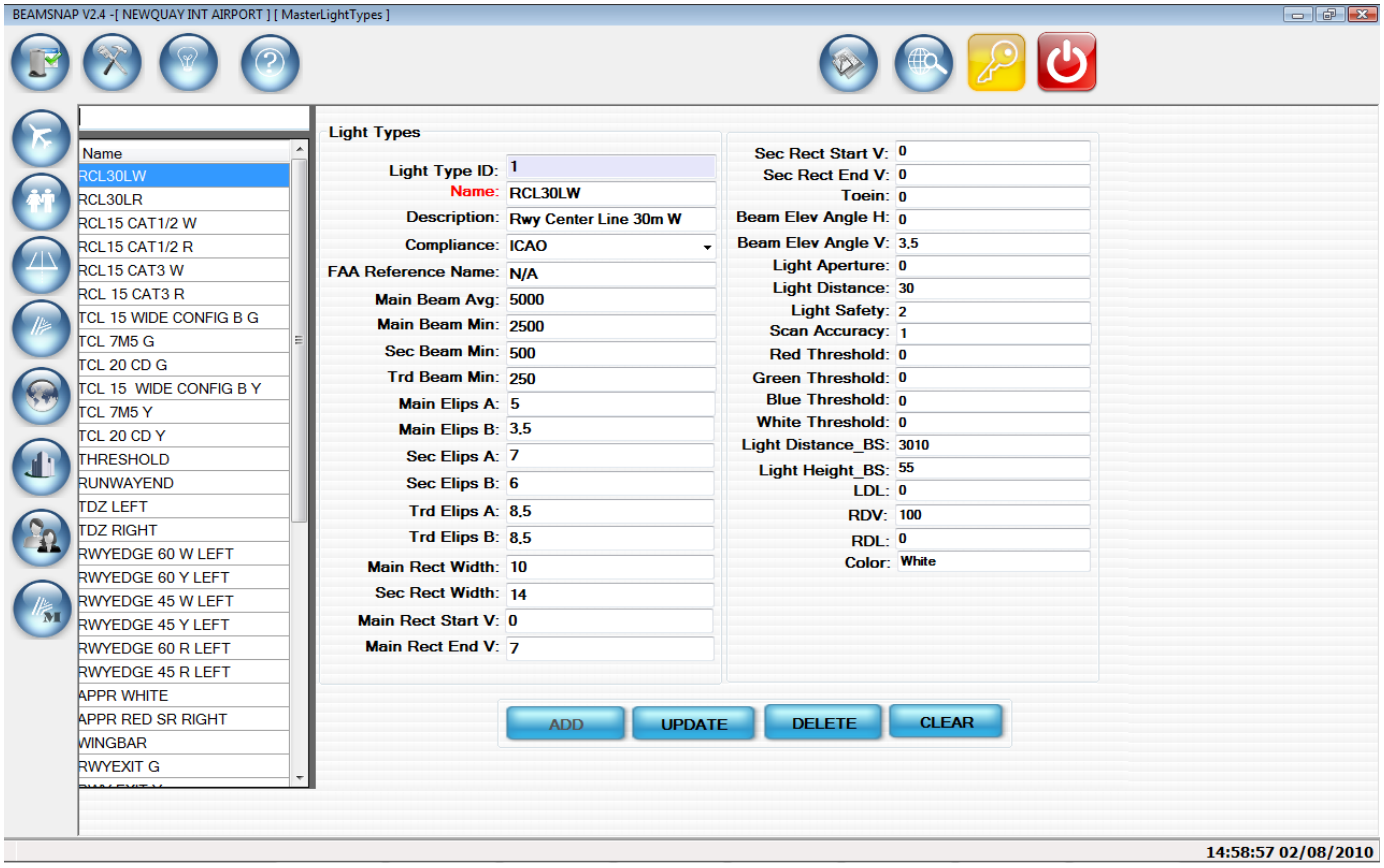


Fig 19 - Master light types container

The left side of the container displays the **Name** of the Aeronautical ground light (AGL) characteristics through the list viewer whereas the right side of the container allows the operator to record a new one into the database as follows:

1./ Right-click on **CLEAR** button

2./ Insert a new AGL characteristic into the database

3./ Right-click on **ADD** button to record it.

or to update the record information of an existing one as follows:

1./ Select a name from the list

2./ Select the field by right-clicking and then update the characteristic details

3./ Right-click on **UPDATE** button to modify the record of an existing one in the database

The main AGL characteristics have been already recorded in the database by the manufacturer.

4.2.1.7/ AGL Function container

The area of the AGL Function container has been split into two regions.

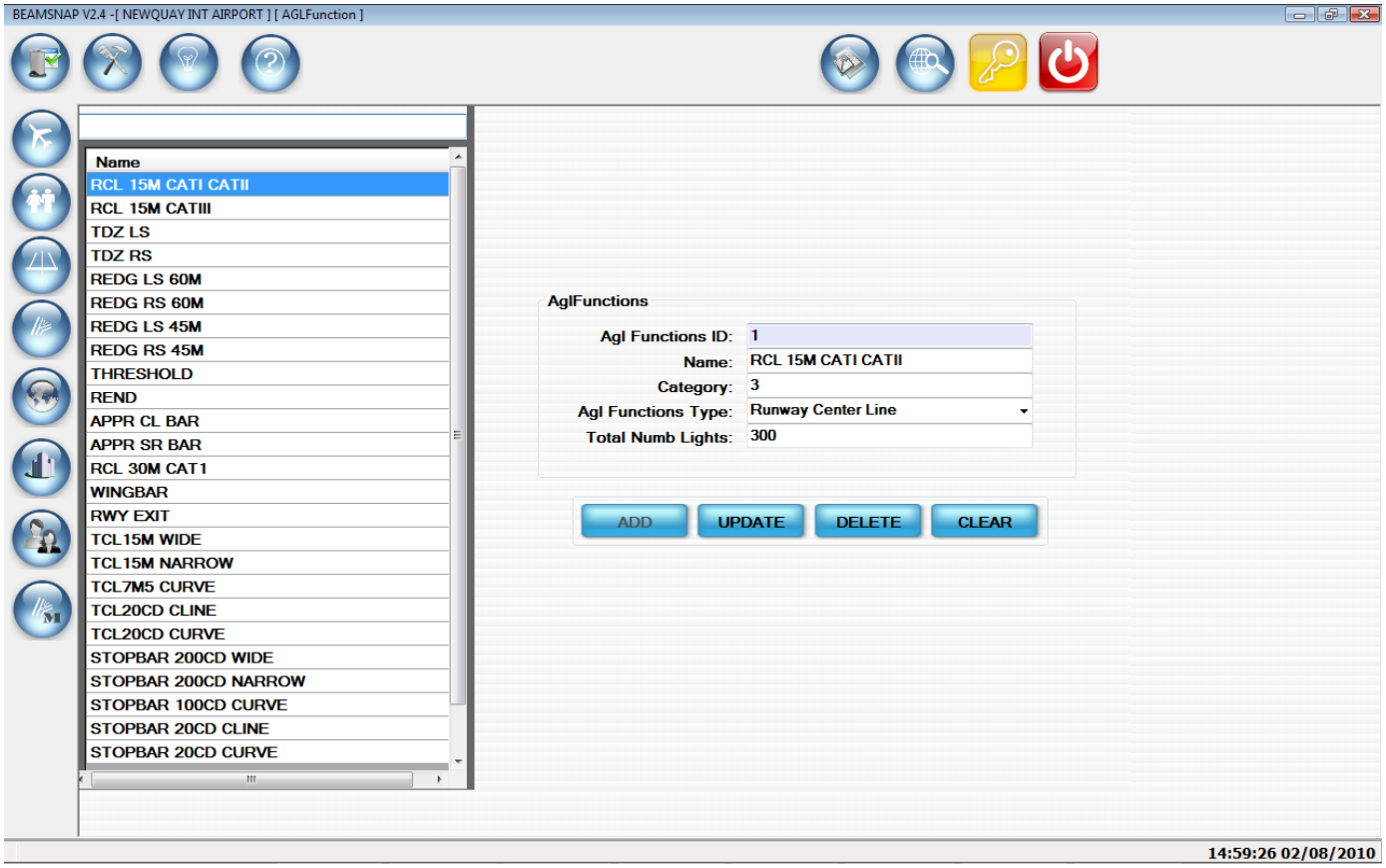


Fig 20- AGL Function container

The left side of the container displays the different AGL function **Name** related to the Airport Runway QFU (Aviation Q-code for Magnetic Heading of a Runway) as example or other suitable name as shown in Figure 11 above.

The right side of the container allows the operator to insert the new AGL function.

How to insert a default AGL function? For instance, let's insert the STOPBAR 20Cd Curve as follow:

1./ Right-click on **CLEAR** button

2./ Enter the AGL function details

3./ Right-click on **ADD** button to insert it in the database.

The following container will be displayed as shown in Figure 21.

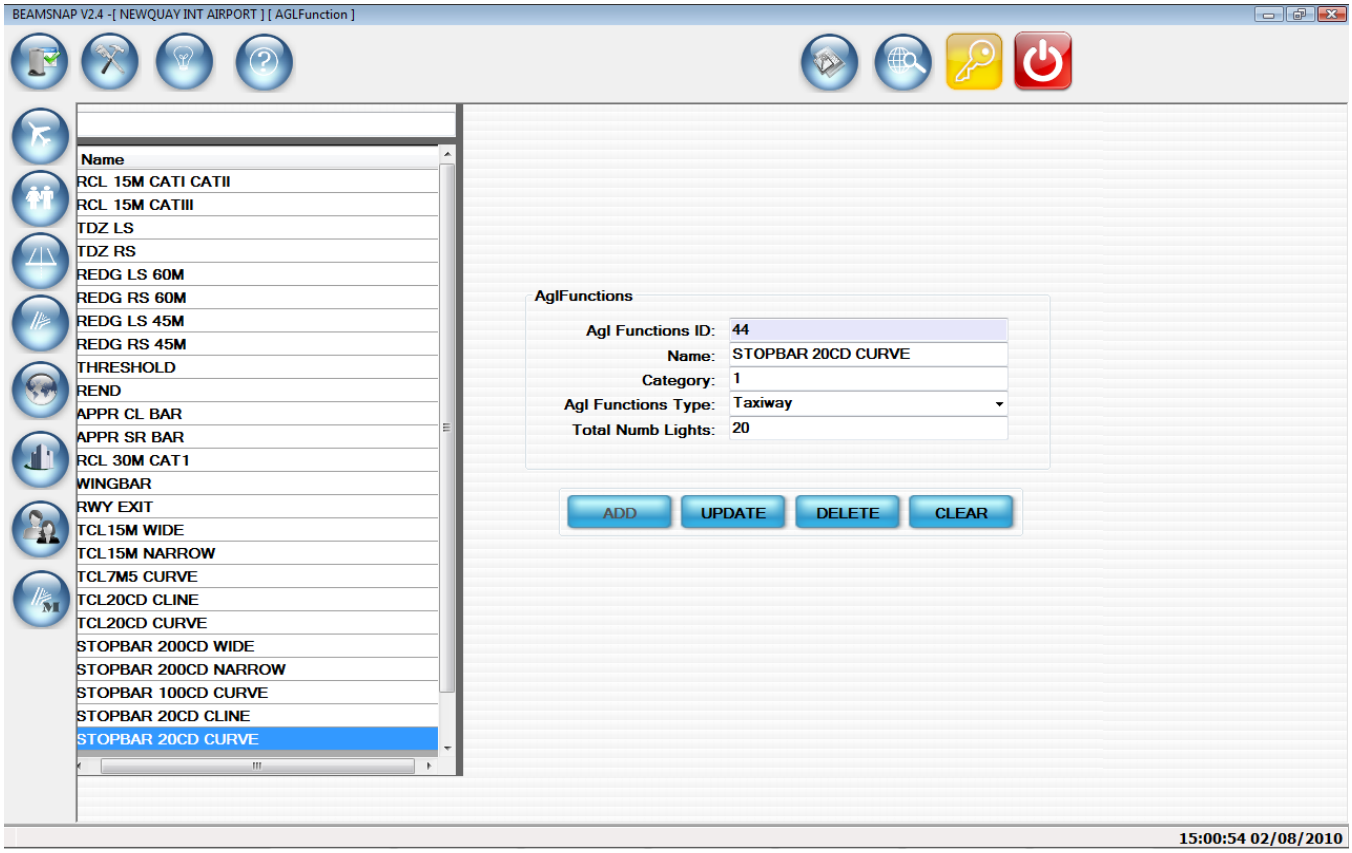


Fig 21 - New AGL function

Make sure that the AGL functions have been created before associating the light types through the **light types** container.

4.2.1.8/ Light Types container

The area of the light type container has been split into two regions as shown in Figure 22.

The left side of the container displays the different **Light Type ID** existing in the database for the AGL function that has been selected.

The right side of the container allows the operator to insert the AGL characteristics belonging to an AGL function/facility name existing in the database.

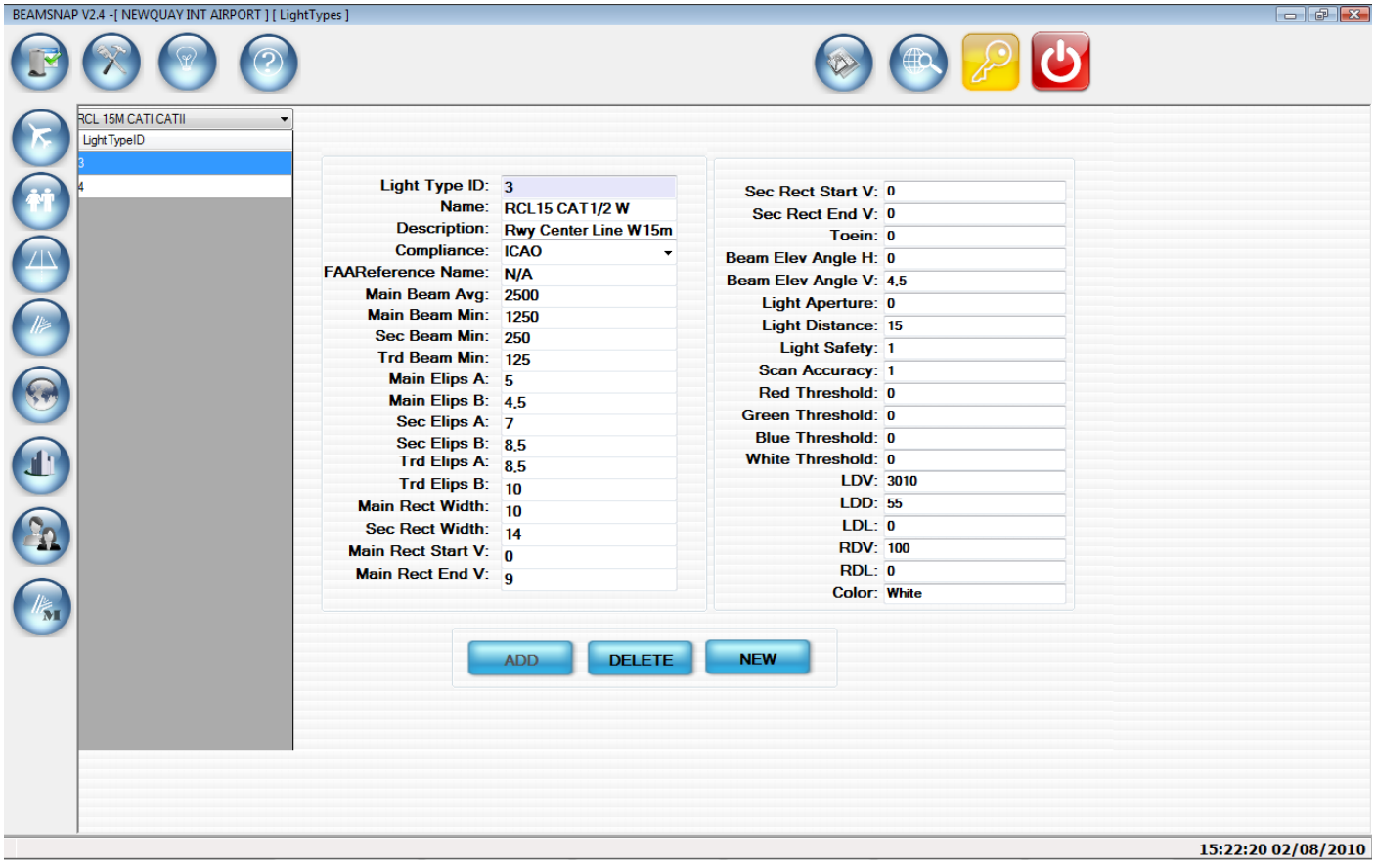


Fig 22 - Light types container

As per ICAO/FAA standards, a runway center line function is made of white and red color light fittings. Therefore, two light types ID shall be created and inserted in the database.

The following example described shows how to record the light types ID associated with a CAT I runway center line (RCL) function:

- Right-click on the combo box to select the **RCL 30M CAT I** as an AGL function.
- Right-click on NEW button to create and insert a new light type in the database

A refreshed container shall be displayed in the Figure 23

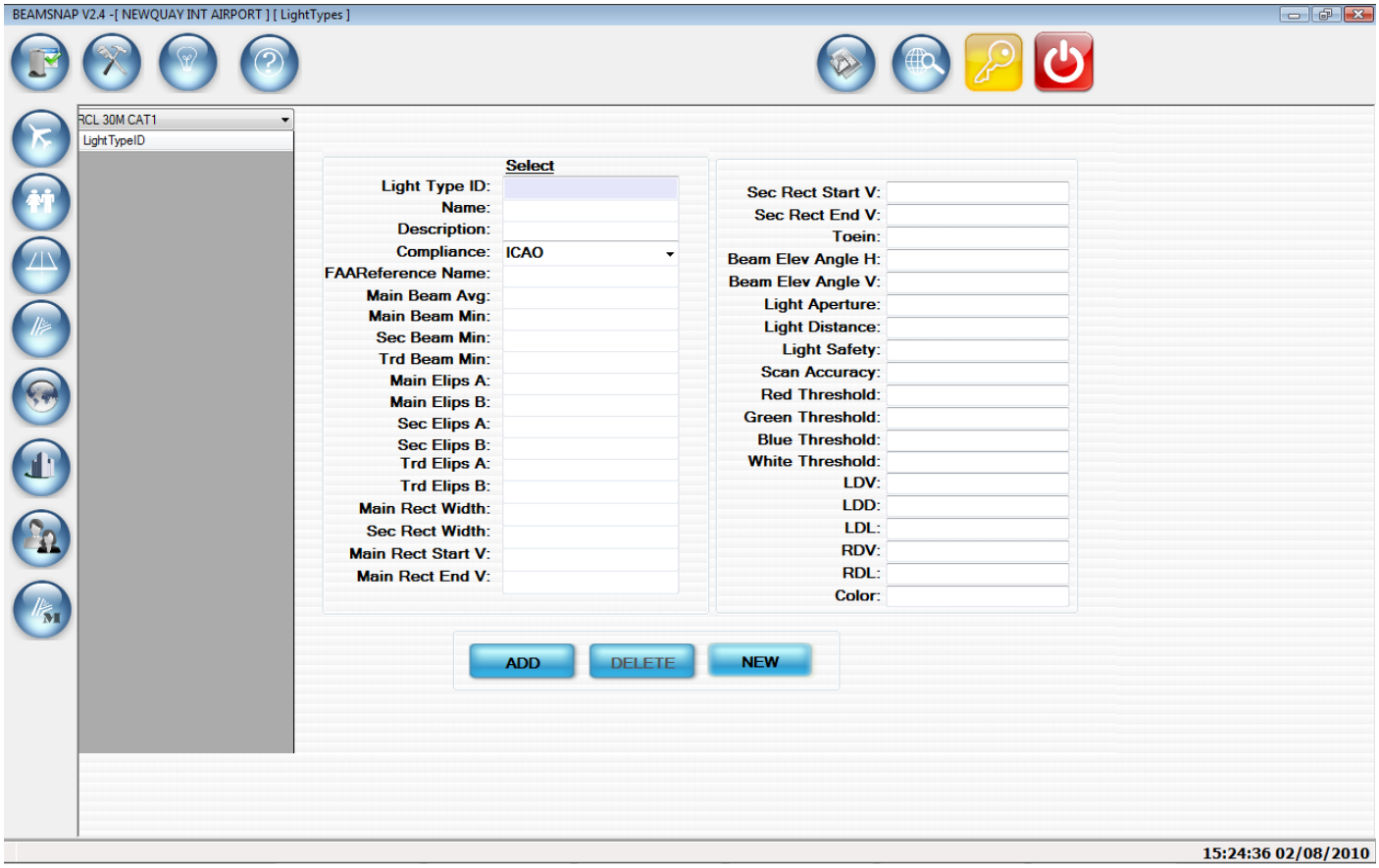
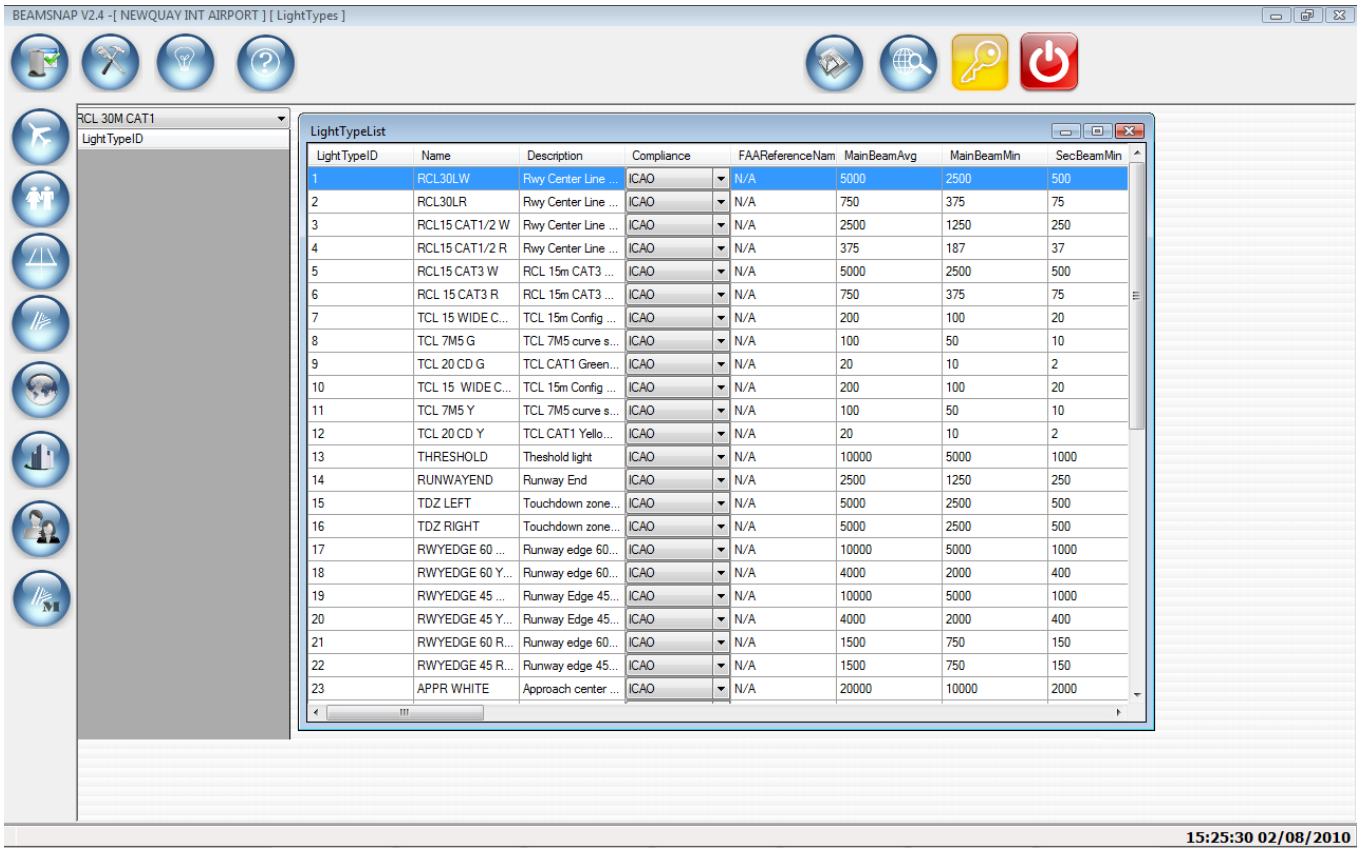


Fig 23 – Create a light type

- Now, right-click on **Select** label on top of the Light Type ID field.

A list of light types appears in a new window form as shown in the following figure.



LightTypeID	Name	Description	Compliance	FAAReferenceNam	MainBeamAvg	MainBeamMin	SecBeamMin
1	RCL30LW	Rwy Center Line ...	ICAO	N/A	5000	2500	500
2	RCL30LR	Rwy Center Line ...	ICAO	N/A	750	375	75
3	RCL15 CAT1/2 W	Rwy Center Line ...	ICAO	N/A	2500	1250	250
4	RCL15 CAT1/2 R	Rwy Center Line ...	ICAO	N/A	375	187	37
5	RCL15 CAT3 W	RCL 15m CAT3 ...	ICAO	N/A	5000	2500	500
6	RCL 15 CAT3 R	RCL 15m CAT3 ...	ICAO	N/A	750	375	75
7	TCL 15 WIDE C...	TCL 15m Config ...	ICAO	N/A	200	100	20
8	TCL 7M5 G	TCL 7M5 curve s...	ICAO	N/A	100	50	10
9	TCL 20 CD G	TCL CAT1 Green...	ICAO	N/A	20	10	2
10	TCL 15 WIDE C...	TCL 15m Config ...	ICAO	N/A	200	100	20
11	TCL 7M5 Y	TCL 7M5 curve s...	ICAO	N/A	100	50	10
12	TCL 20 CD Y	TCL CAT1 Yello...	ICAO	N/A	20	10	2
13	THRESHOLD	Theshold light	ICAO	N/A	10000	5000	1000
14	RUNWAYEND	Runway End	ICAO	N/A	2500	1250	250
15	TDZ LEFT	Touchdown zone...	ICAO	N/A	5000	2500	500
16	TDZ RIGHT	Touchdown zone...	ICAO	N/A	5000	2500	500
17	RWYEDGE 60 ...	Runway edge 60...	ICAO	N/A	10000	5000	1000
18	RWYEDGE 60 Y...	Runway edge 60...	ICAO	N/A	4000	2000	400
19	RWYEDGE 45 ...	Runway Edge 45...	ICAO	N/A	10000	5000	1000
20	RWYEDGE 45 Y...	Runway Edge 45...	ICAO	N/A	4000	2000	400
21	RWYEDGE 60 R...	Runway edge 60...	ICAO	N/A	1500	750	150
22	RWYEDGE 45 R...	Runway edge 45...	ICAO	N/A	1500	750	150
23	APPR WHITE	Approach center ...	ICAO	N/A	20000	10000	2000

Fig 24 - White light characteristic

Now, the operator has the choice to select one of the different light type characteristics to associate it with the AGL function selected.

The RCL 30M CAT I W name has been selected from the list viewer for a CAT I runway center line white light with 30 m longitudinal spacing and press "↵" *(Enter)* button on the keyboard.

- Right-click on *Add* button to record it.

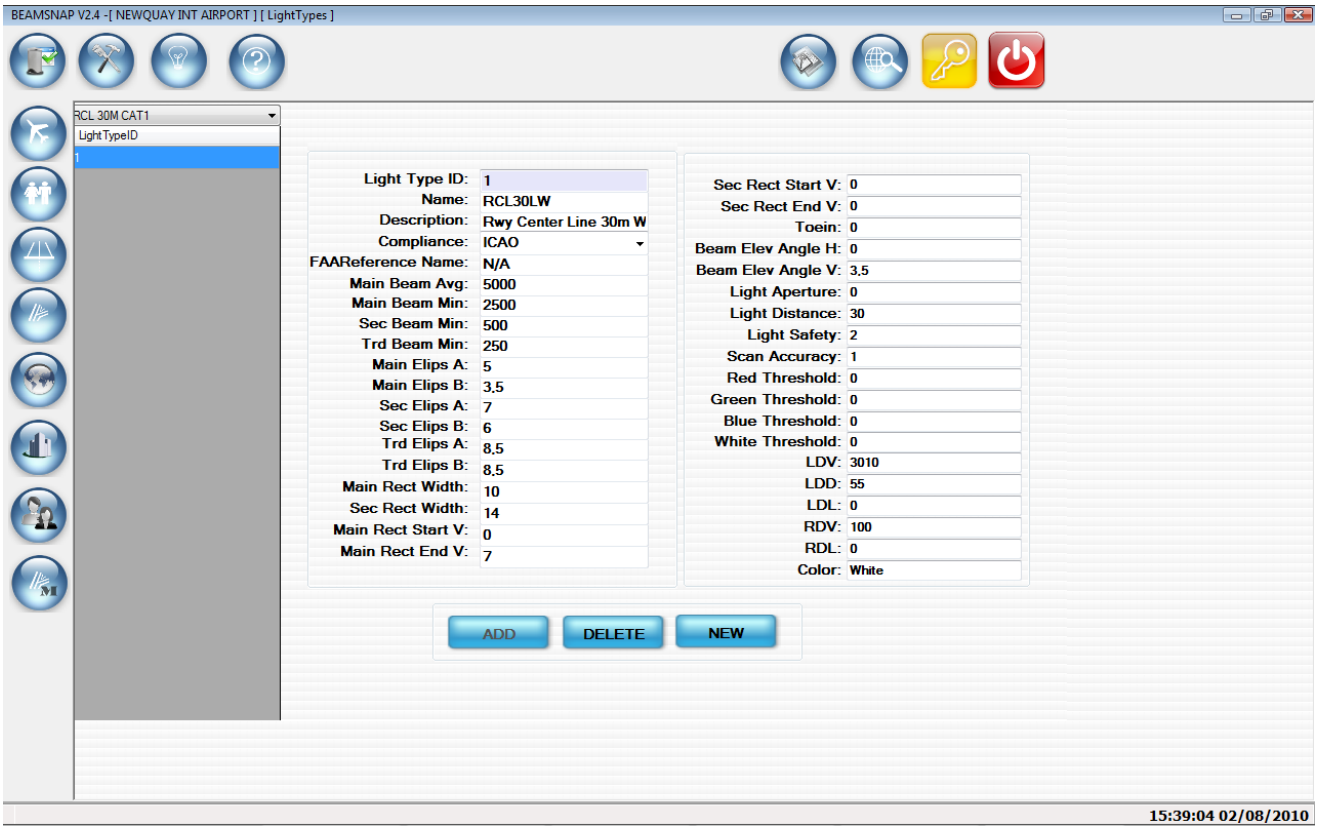


Fig 25 - Record the CAT I white light

Repeat the same procedure to record the RCL 30M CAT I R from the list viewer for a CAT I runway center line Red light with 30 m longitudinal as shown in the following figure.

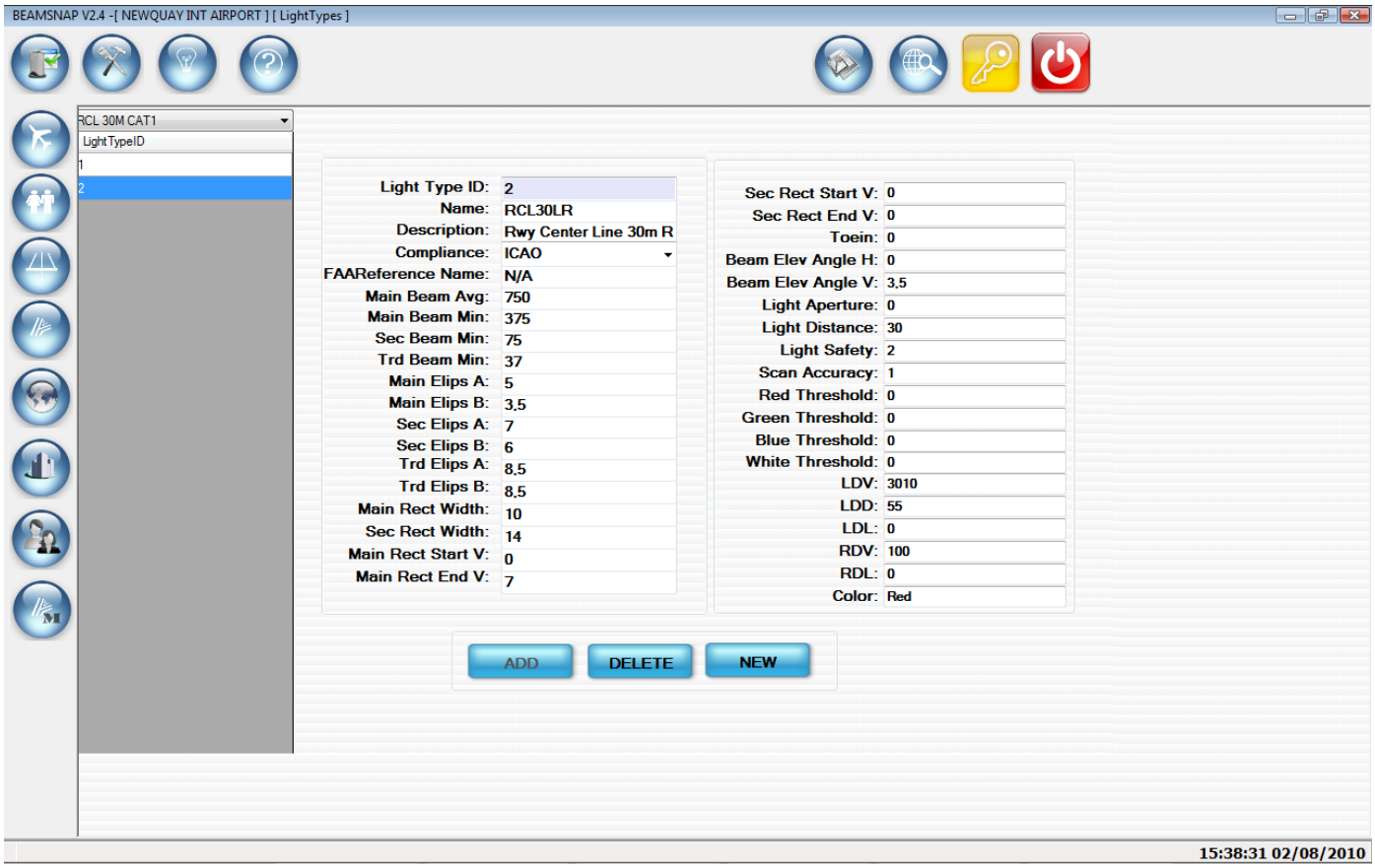


Fig 26 - Record a CAT I red light

4.2.2/ Settings

Use the settings sub toolbar feature to verify and test the interconnections between the sensors bar and the data logger and, the communication between the stepper drive and the step motor before conducting a photometry measurement. Right-click on any of the following sub theme button to launch their dialog box:

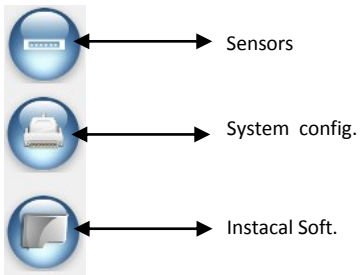
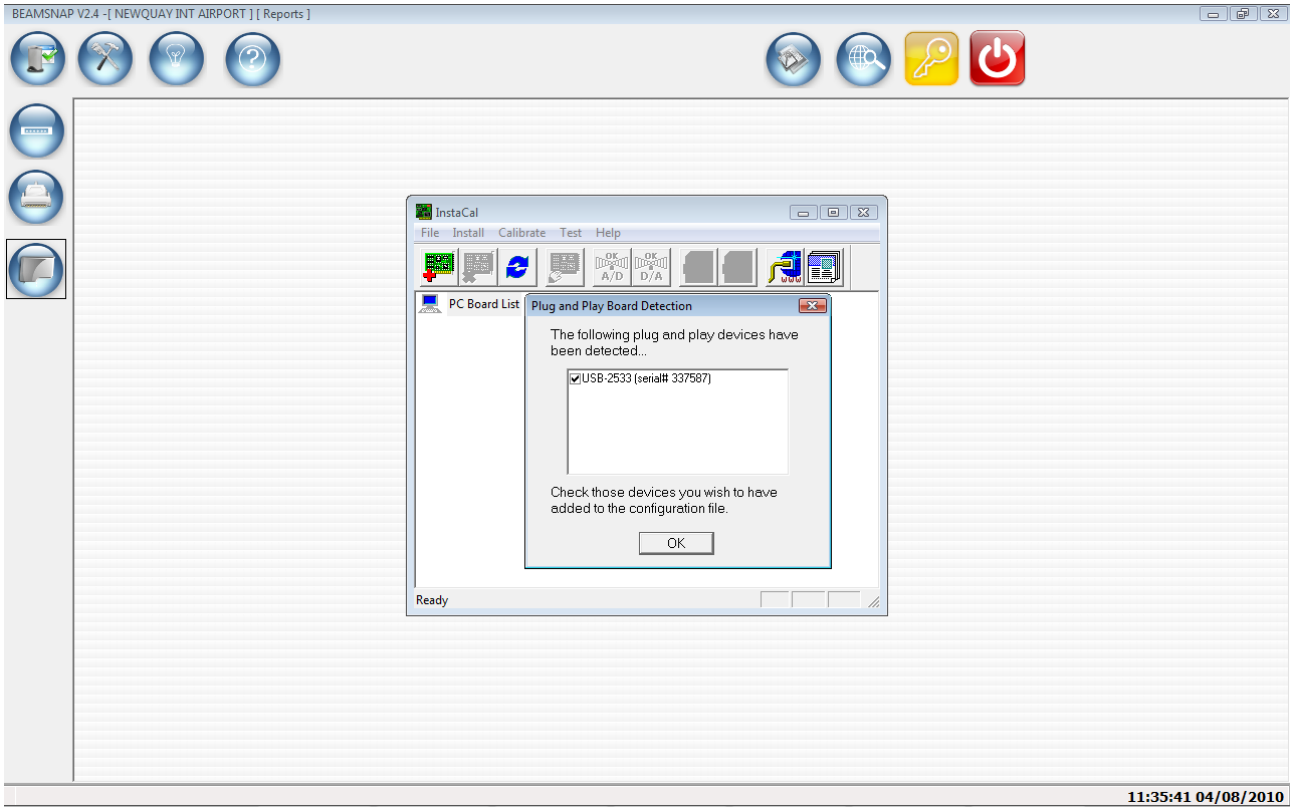


Fig 27 – Settings menu

This section will familiarize the operator on how to check the response of each Beamsnap[iddn] components visually.

Note A: *The configuration of the system has been already pre-set by the manufacturer. Therefore, the operator shall be ready to perform a photometry measurement.*
Please do not change the configuration setting.

Note B: *During the stating phase, it is recommended to click on the "Instacal soft." button in order to check whether or not the data logger has been connected properly to the laptop/PC.*



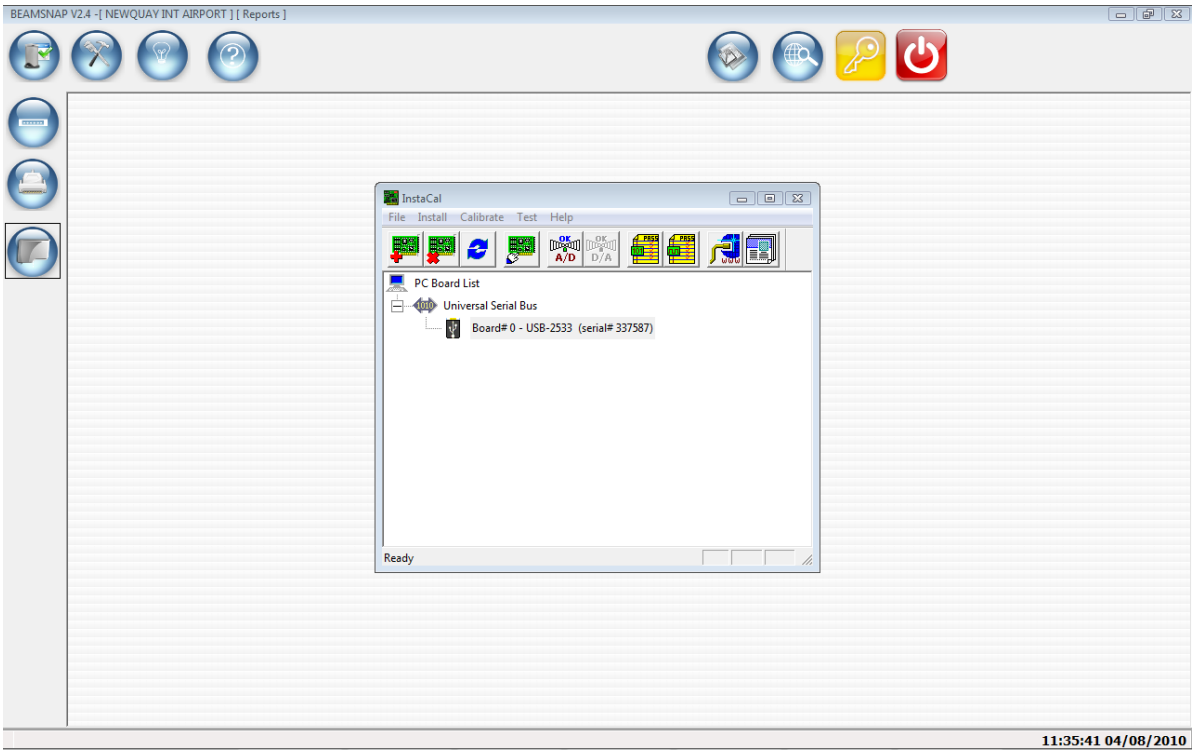


Fig 28 – Instacal driver software.

By clicking on the sensor sub theme button, the panel testing dialog box will appears. And by clicking on the ***start Acquisition*** button, it fetches the data from the data logger in order to verify the light response value from the photometric sensors array.

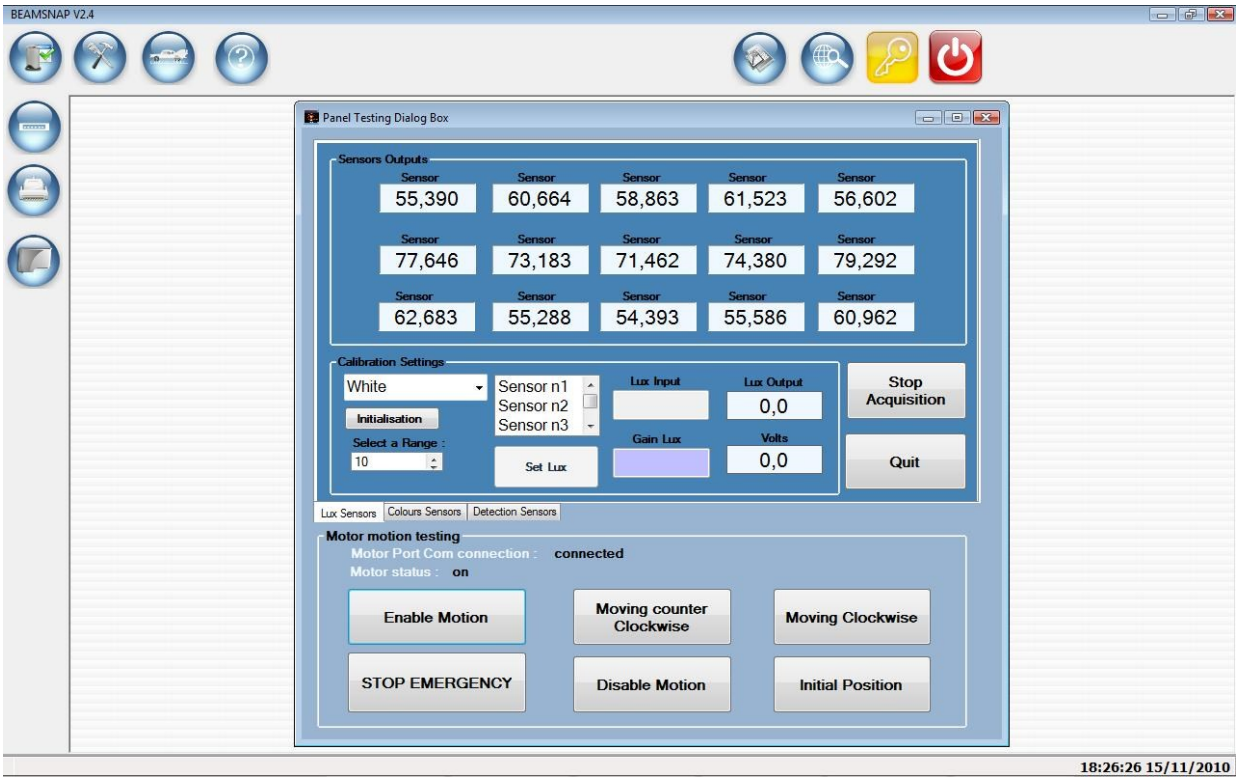


Fig 29 – Panel testing dialog box

This dialog box is aimed to verify the following:

- The output light response value from the photometric sensors as described above.
- The step motor motions via the stepper drive communication.

By default the lux output value sensors will be displayed.

1./ Right-click on **Launch Acquisition** button

2./ Select the light color.

3./ Verify the sensors response output value

4./ Right-click on **Enable** button to start the communication with the stepper drive in order to control the motor.

5./ Right click on Moving counter or Initial position as example in order to check the motor motion response.

6./ Right click on **Stop** button for emergency.

7./Right-click on **Quit** button to exit the dialog box, but before make sure that the motor connection has been disabled.

4.2.3/ Start a light measurement

Use the Measurement sub toolbar feature to perform a real time measurement and get access to the reports.

Right-click on either the measurement sub theme button to proceed for a measurement process or on the Report subtheme to analyze the data:

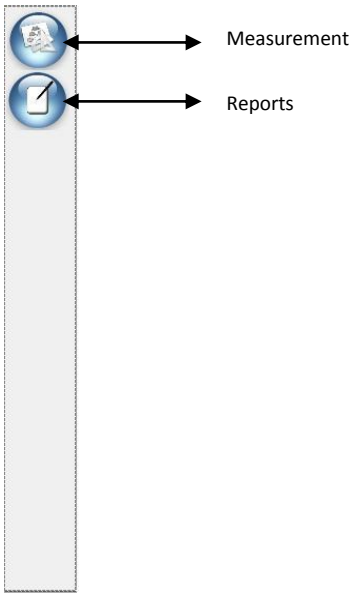


Fig 30 – Light measurement menu

This section will familiarize the operator on how to perform a precise workshop/ Lab photometric measurement using the dynamic bench.

The Reports and iso-candela diagram shall be generated to provide the results of the light fitting allowing the operator to identify any defect on the fitting and decide what corrective action should be taken.

4.2.3.1/ Measurement process Dialog Box

At this stage, the operator is now ready to perform a photometric measurement for any inset or elevated light fittings by clicking on the measurement button placed on the left side of the screen.

The operator shall verify first that the lights fittings have been switched on to full brightness before starting the measurement in order to obtain the nominal values of the light luminous intensity output and to get the correct light beam angle elevation.

The “The Lights Acquisition Processing Dialog Box” shall be displayed.

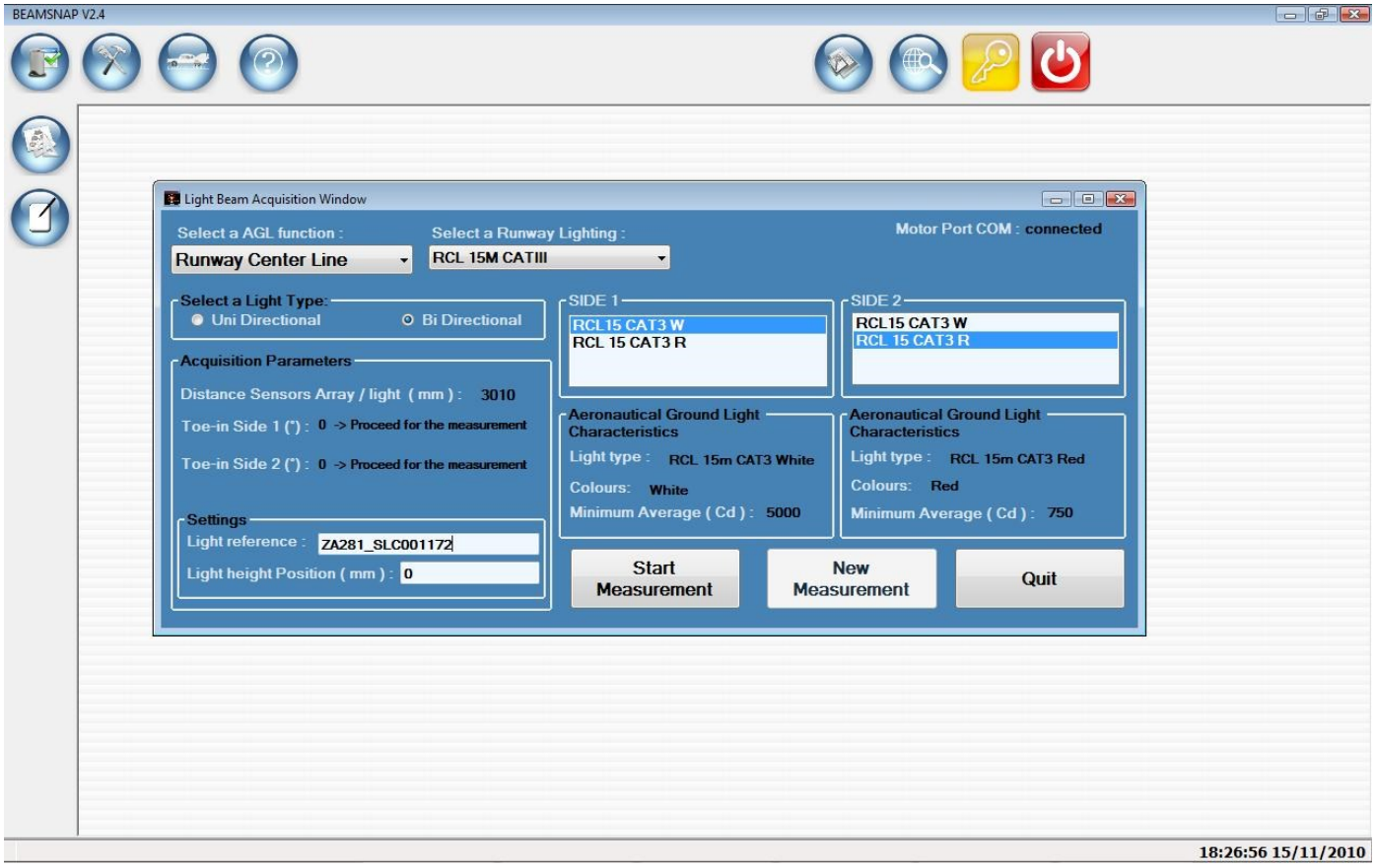


Fig 31 – Lights Acquisition Processing Dialog Box

The measurement accuracy is set to 1° by default which meant that the light beam is scanned every degree in accordance with the ICAO grid spacing.

Setting the measurement accuracy at 0.5° allows obtaining a higher precision result.

The operator is able to select either a unidirectional or a bi directional light type fitting to conduct the photometric measurement as depicted in the following figures Fig 32 and Fig 33.

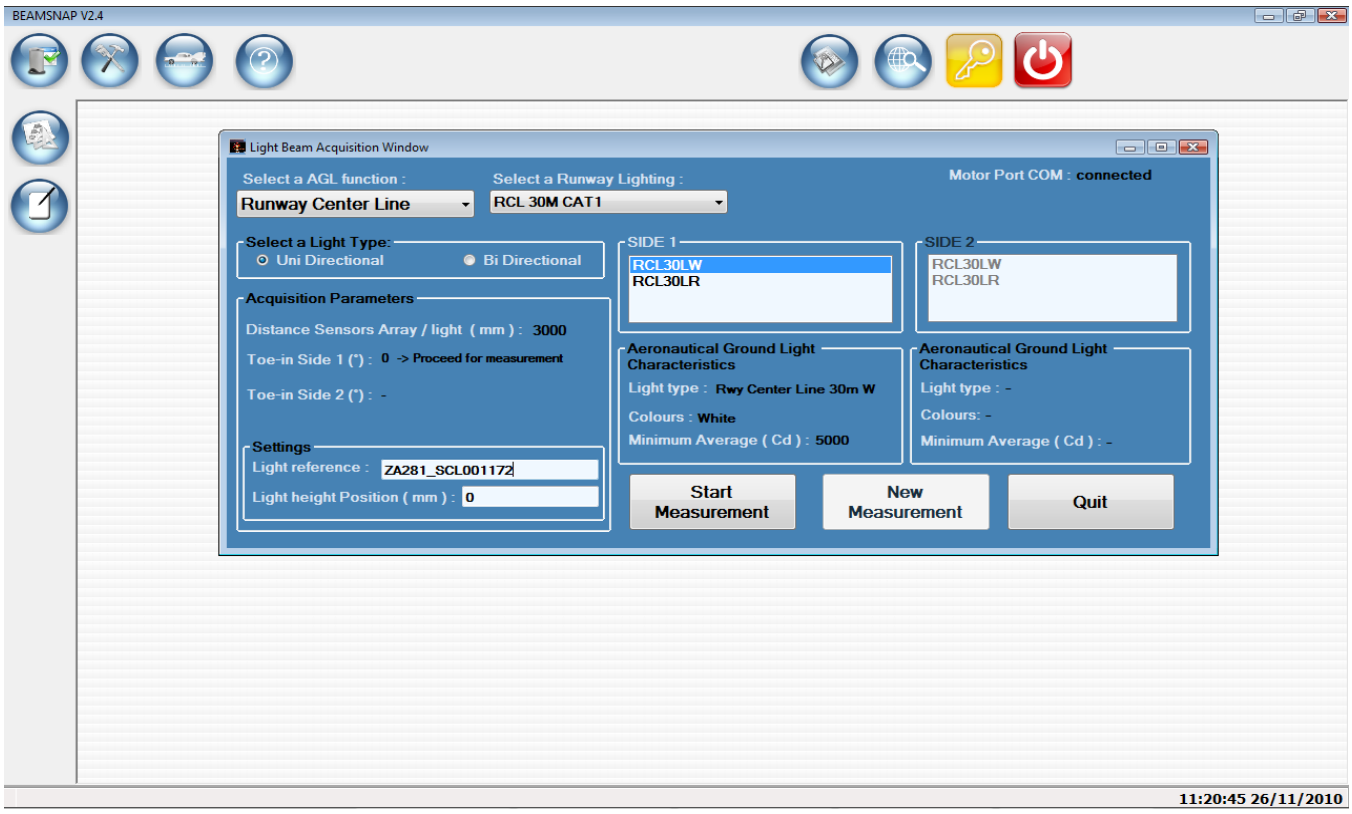


Fig 32 – Uni directional light fitting

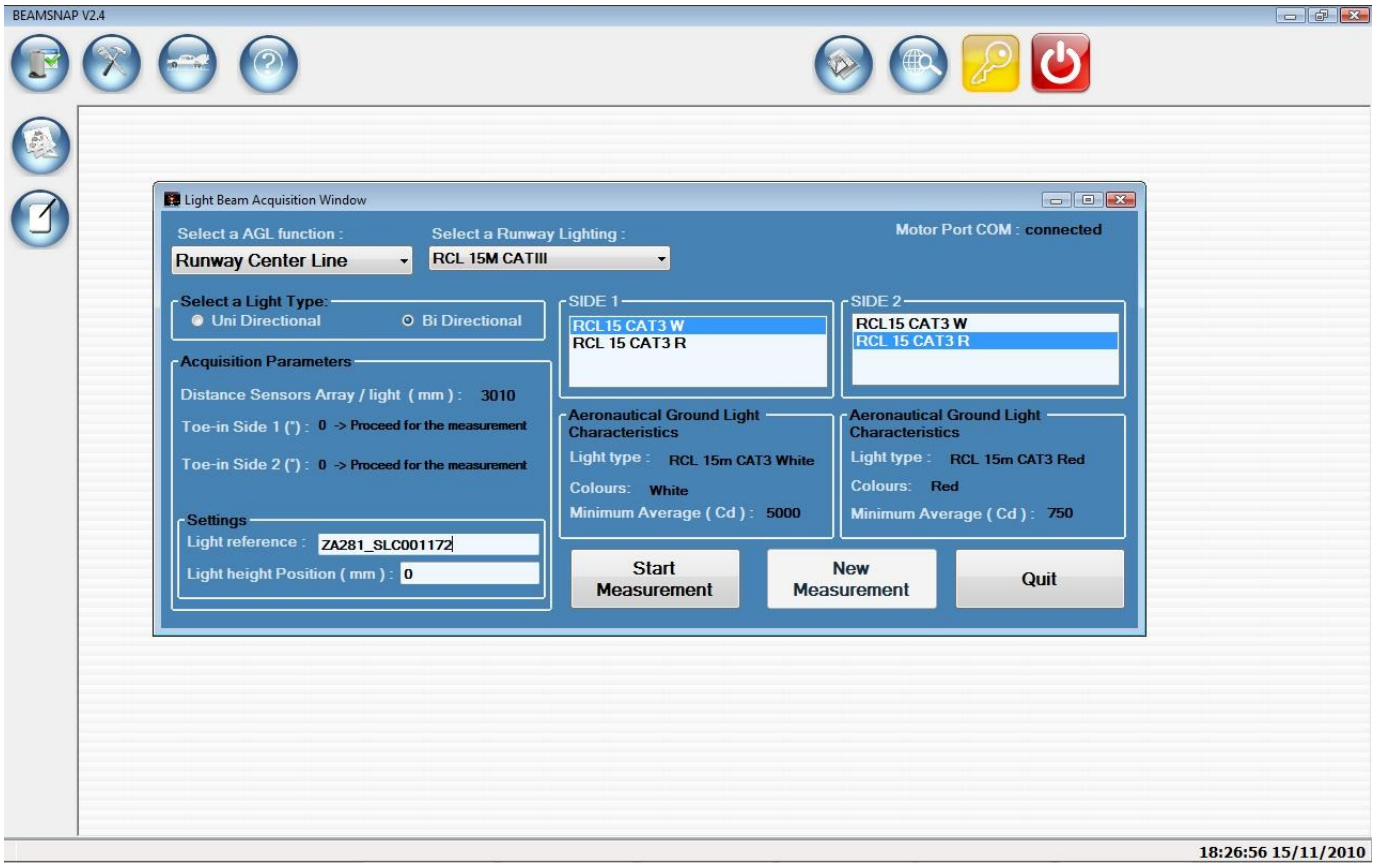


Fig 33 – Bi directional light fitting

In order to undertake a real time light intensity measurement, the operator must follow the following procedure:

1./ Select an AGL function from the combo box. The runway center line function has been selected.

2./ Select runway lighting. The RCL 15m CAT III has been selected.

3./ Select the light type fitting. The Bi directional light fitting has been selected

4./ Enter the light reference name of the generated report name in the field. The light reference ZA281_SCL001172 has been entered.

5./ Select the measurement accuracy .

7./ The operator shall start the real time acquisition of the light luminous intensity by click on the **Start Measurement** button.

8./ When the light measurement has been completed, click on **New Measurement** button to proceed for another AGL function light measurement process or click on the Quit button to exit this dialog box.

4.2.3.2/ Reports Dialog Box

A report is generated automatically after each light source measurement run.

With regard to the unidirectional light fitting measurement, only one report is generated after being measured. Otherwise, two reports are generated when the bidirectional light type has been selected.

The area of the report panel has been split into two regions.

The left side of the container displays the list of the **Report Name** associated with its AGL function **Agl** and Light type **LType** selected in the combo boxes.

The right side of the container provides instantaneously further details to the operator relevant to the report selected on the list viewer such as the report date; start and end scan time of the measurement. In this case, the ZA281_SCL001172_SideN1 and ZA281_SCL001172_SideN2 reports have been generated while making a measurement of an RCL light fitting.

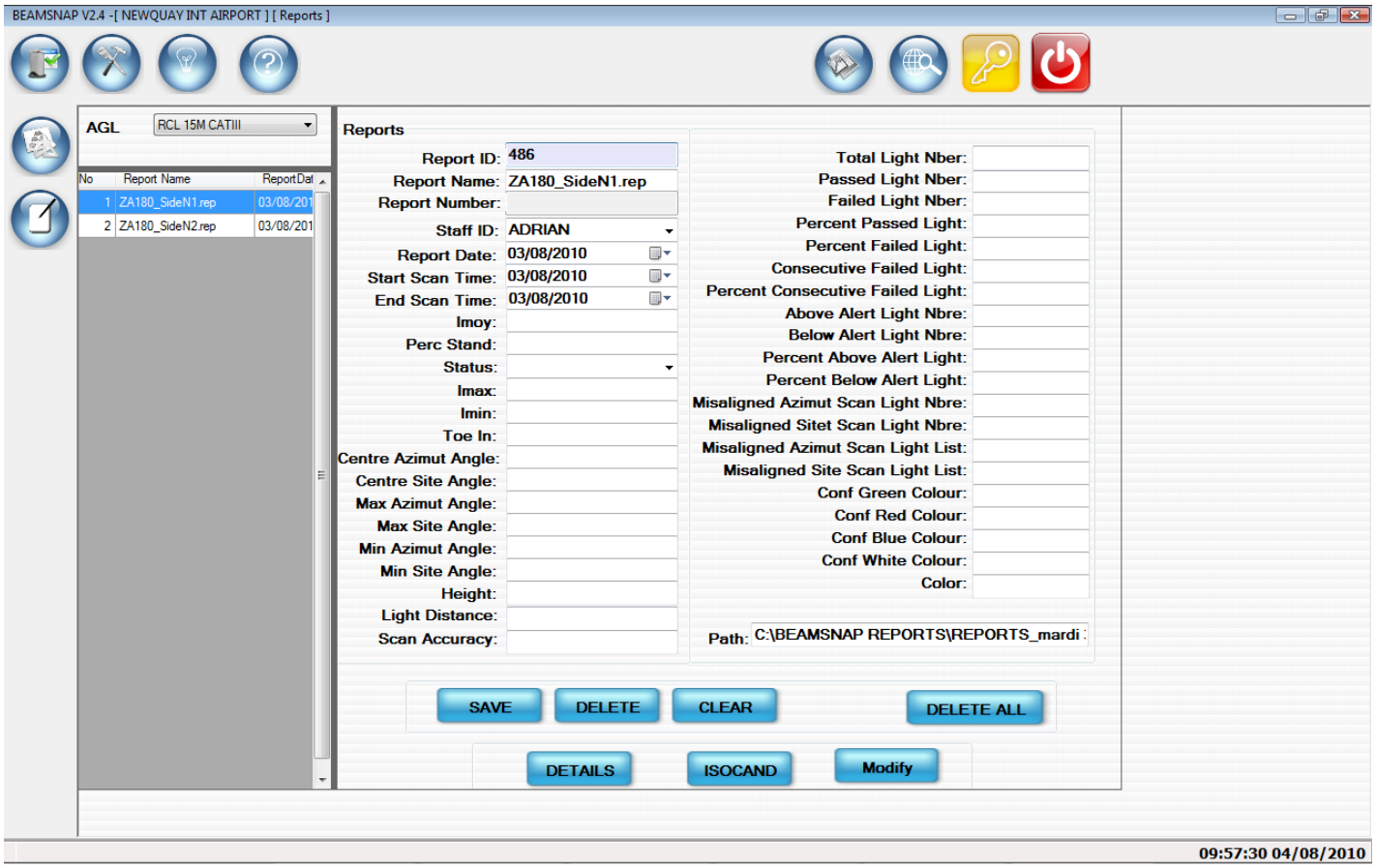


Fig 34 – Report dialog box

All report folders containing files and images will be stored in the following directory “C:\BEAMSNAP REPORTS”, the folder directory path of a selected report appears in the path text box as shown above.

The manufacturer might ask to the operator to send them the reports folder for technical support.

It is recommended to back up the reports on external drive data storage after each photometry measurement services.

The report can be deleted or its details information updated as follows:

1./ Click on the **DELETE** button to delete the report.

2./ Click on **ADD** button to insert further details information in the empty field or right-click on **UPDATE** button to update and existing record.

The operator shall click on the **DETAILS** button to explore and print out the diagnostics of the light fitting being measured.

The iso candela diagram so called halo shall be displayed to verify the light beam spread orientation as well as the quality of the light source when the operator click on the **ISOCAND** button.

4.2.3.3/ Report list Viewer

Once the light measurement process has been completed and before performing a new measurement if requested, the operator shall be able to diagnostics the result of the fitting as described below:

1./ Select a report name from the list viewer

2./ Click on the Details button to load the report viewer of the light

3./ Take a few moment to analyze the light beam measured.

The report viewer shown in Fig.35 provides a lab measurement data of the light fitting.

It can be seen the following parameters to allow the operator to analyze accurately the light characteristic and verify whether they meet ICAO/ FAA requirement:

- Computed Average values in candela,
- Maximum and Minimum points values in candela detected in the light beam,
- Position of the maximum points in V° and H° in the main beam
- Ratio
- Compliance percentage according to the FAA/ICAO specification
- Status of the light to define whether the luminous intensity of each light passed or failed.
- Color

This report light list viewer shall be displayed:

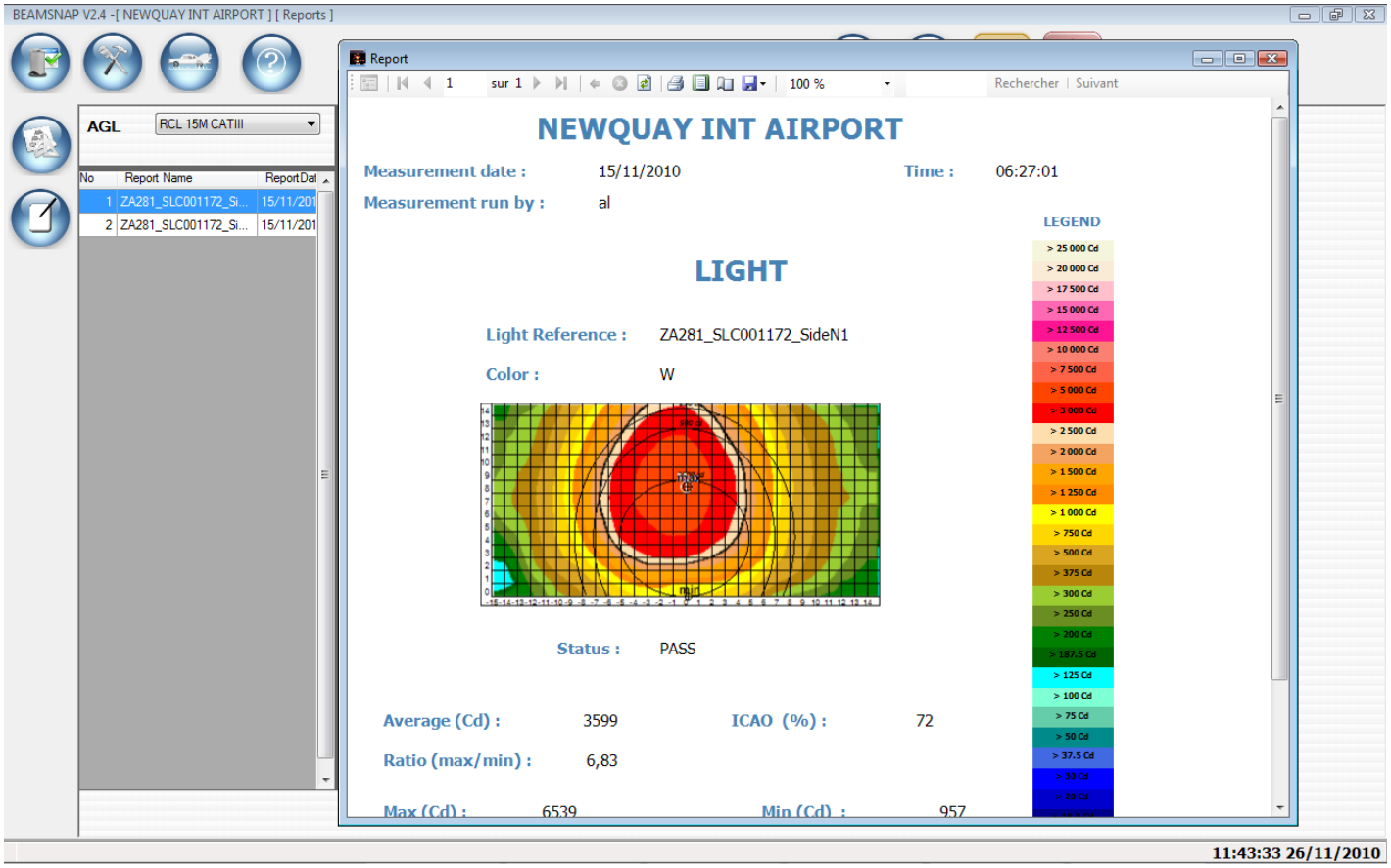


Fig 35– Report Viewer

- Click on the print bButton icon on the top of the viewer to print out the light report.
- Click on the **red cross icon** to exit from the report viewer.

The operator has also the possibility to load the light report in PDF format as shown in the following figure Fig 36.

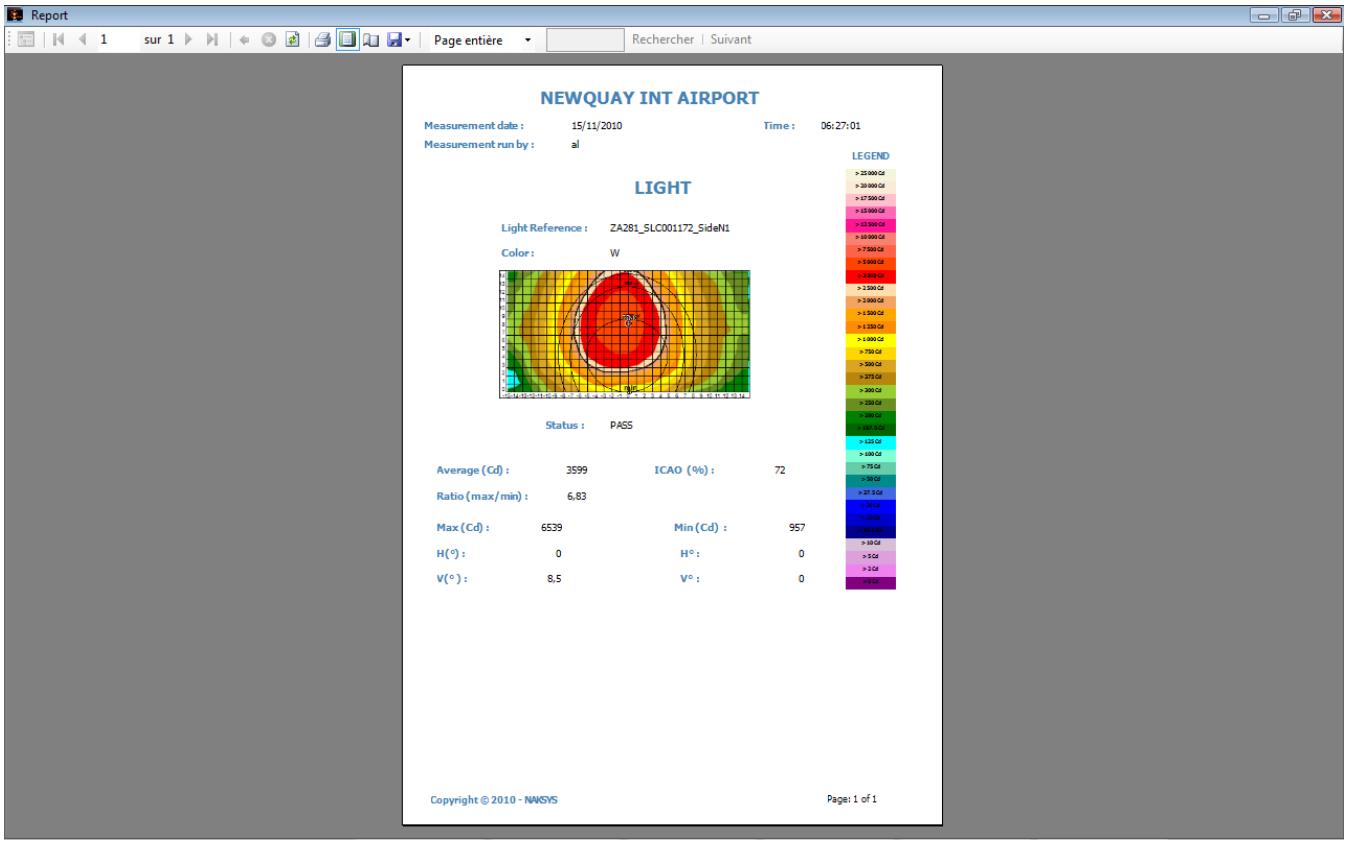


Fig 36– PDF format

The operator has also the possibility to print out the lights report as shown below.

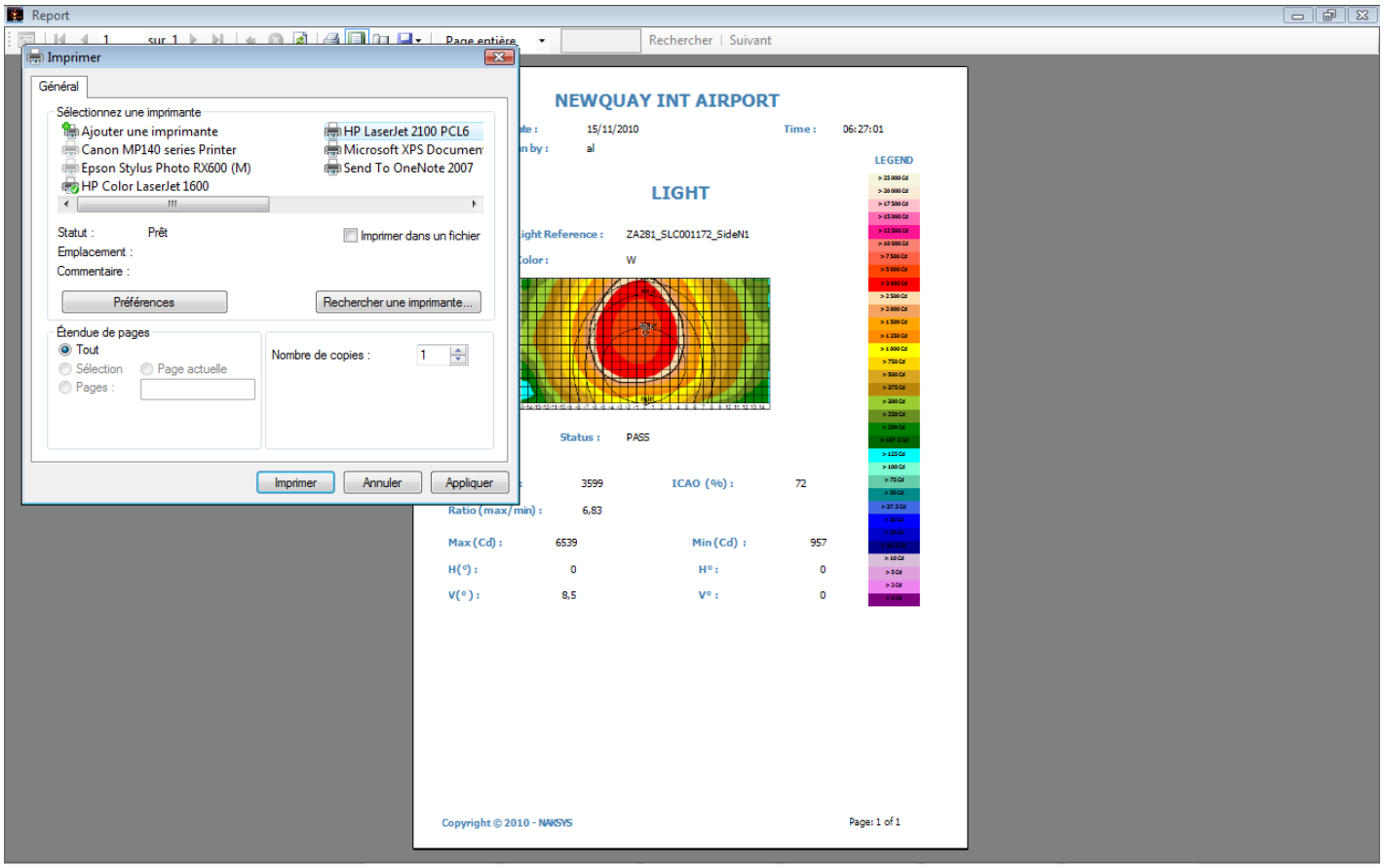


Fig 37 – Report printed out

4.2.3.5/ Iso candela diagram Dialog Box

The iso candela diagram of each the light fittings will be displayed allowing the operator to analyze and compared the performance of the light beam.

Typical anomalies (lamp ageing, slackening of the filament …) shall be identified visually on an unserviceable light.

In this case, the following figures Fig 38 and 39 shows good beam spread and bad orientation of the both lights beam belonging to the ZA281_SCL001172 RCL Bi-directional light fitting.

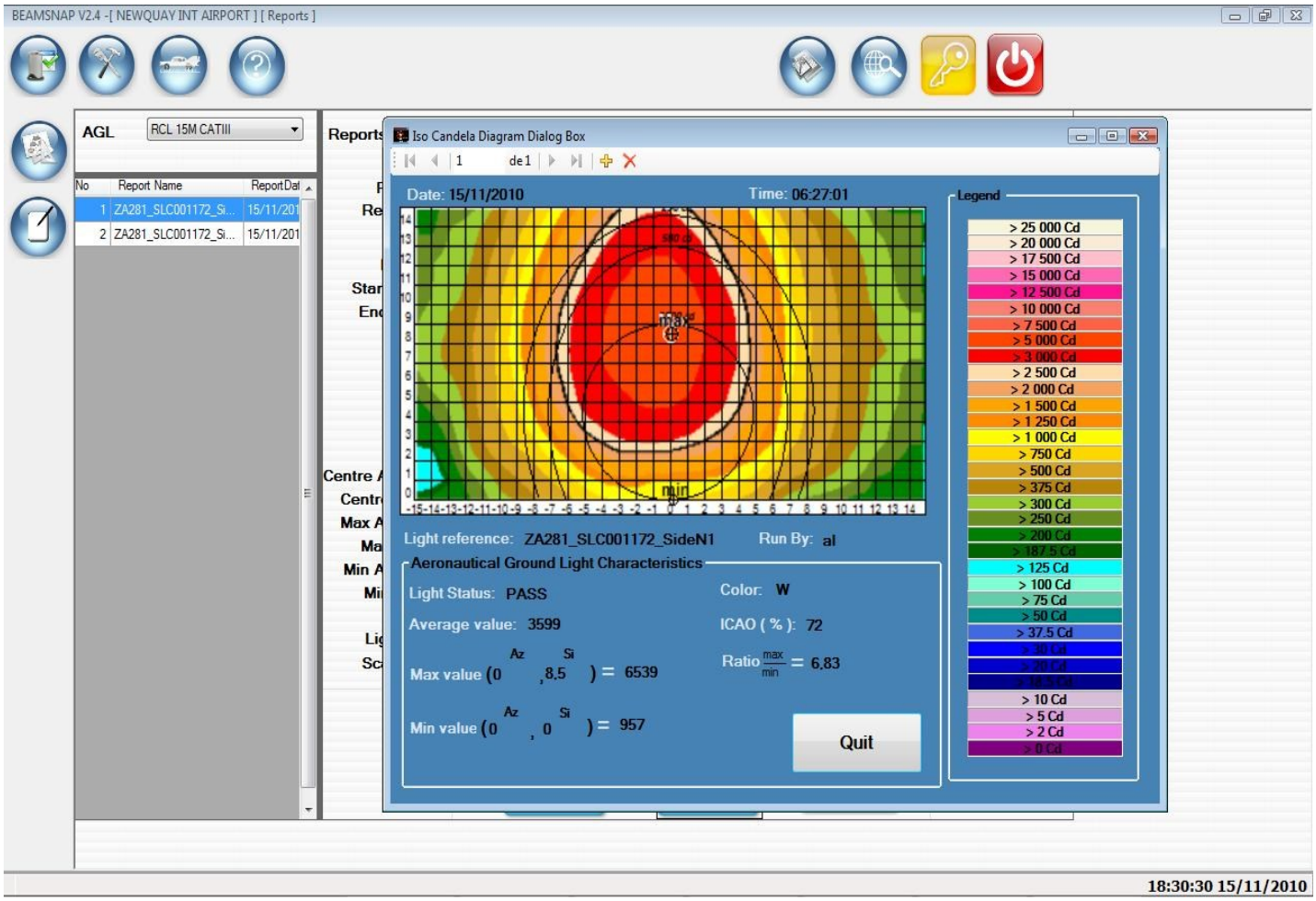


Fig 38– White light source – Side N1

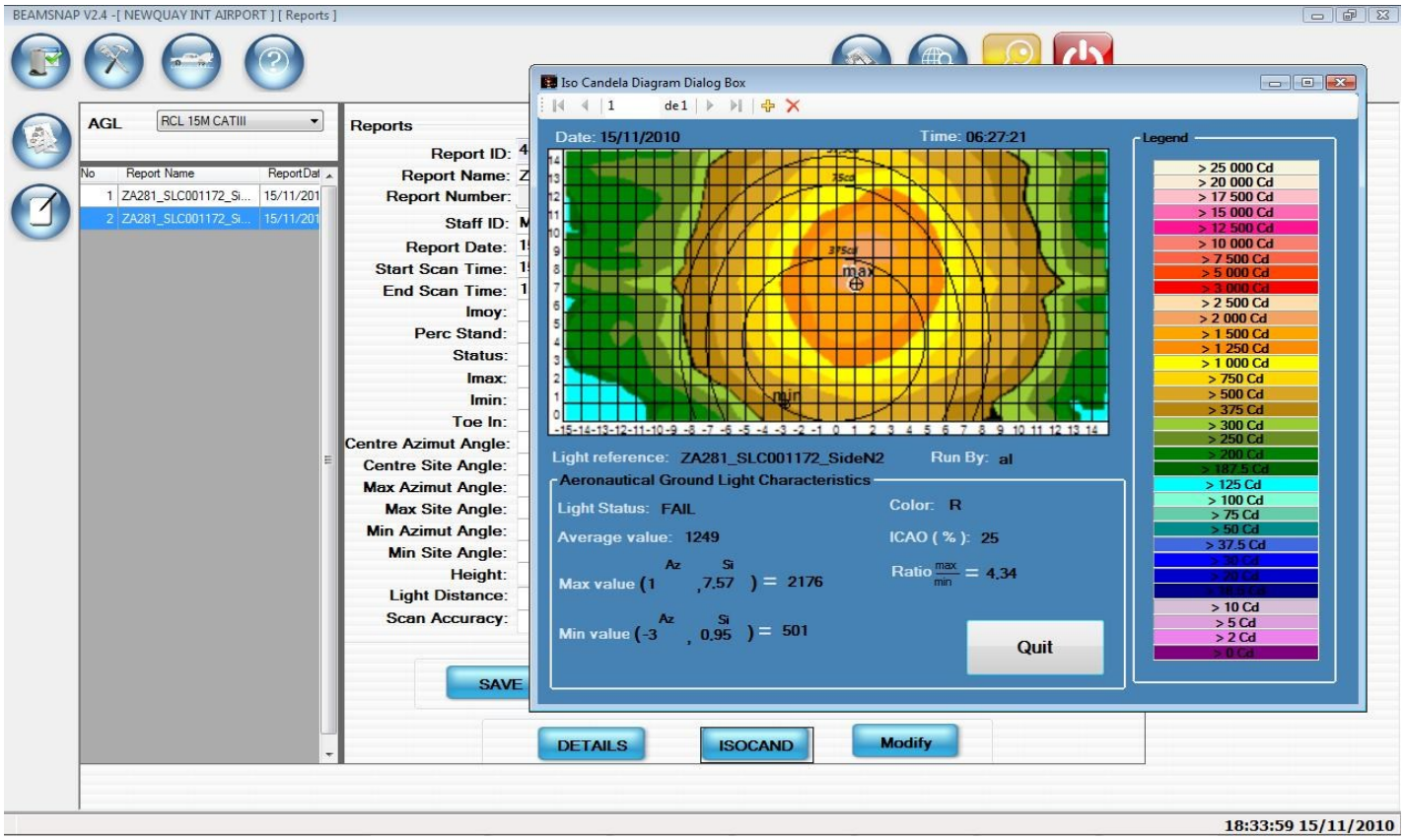


Fig 39 – Red light source – Side N2

For instance, a bad reflector lamp positioning may result to fall the luminous intensity photometric performance due a bad light beam orientation in azimuth and/or site angles.

5./ MAINTENANCE

This manual is aimed to provide the operators on guidance on how to conduct varieties of operating procedures and maintenance to perform safely a photometric measurement using the Beamsnap lab equipment.

Also, it is intended to provide the operators with adequate knowledge to undertake properly the following actions:

- Starting phase of the system
- Test procedure
- Safety procedure
- Troubleshooting procedure
- Maintenance operation

5.1/ starting phase of the System

The operator must proceed as follow:

- Turn on the computer/laptop
- Turn on the data logger
- Switch on the Dynamic measurement bench.
- Launch the Beamsnap ^{Iddn} software
- Carry out the test procedure
- Check if the AGL function lights have been turn on to the full brightness (6.6 A)
- Perform a photometric measurement

The operator must proceed in a reverse way to switch off the Beamsnap ^{Iddn} equipment.

5.2/ Test procedure

A test procedure shall be carried out by the operators in order to check and ensure the functioning of the Beamsnap [lddn] equipment before performing a photometric lab measurement.

5.2.1 / Interconnection

Ensure that the serial port and data logger cables are connected to the Laptop/ PC In order to verify the proper functioning of the dynamic bench and the proper response of the sensor array.

Ensure that the Sensor array is placed at the right distance from the light.

5.2.2/ Sensors

This verification shall be undertaken by two Agents as follow:

The first Agent will go through the sensors by exposing a light beam provided by a torch while the second Agent simultaneously checks for a suitable output light response value via the Sensors dialog box.

The operators shall expect that the illuminance intensity provided by each lux sensor output response shall vary linearly as the intensity of a light beam increases to higher level.

Comparison shall be made by the operator to verify the illuminance intensity output response fetch by each sensor thought the sensor dialog box with the illuminance intensity output response from a calibrated class A lux meter instrument.

5.3/ Safety procedure

The following safety procedure requirement must be undertaken by the operator to protect the Beamsnap [Iddn] equipment and shall be in addition to the airfield safety requirement to meet.

A diagnostics panel has been implemented in order to check the whole Beamsnap [Iddn] equipment functionality.

The operator must push the Emergency button when:

- The motor make a weird noise.
- Checking any cables interconnection.
- Ensuring interventions on the dynamic bench.

5.4/ Maintenance operation

This section is aimed to provide the operator on how to proceed with an operation check, to troubleshooting issues and maintain the system to operate efficiently.

5.4.1/ Operation check

Ensure that lights has been switched on to full brightness (6.6 Amperes) at least during 10 minutes in order the average intensity maintain a steady value.

5.4.2/ Troubleshooting tips to resolve issues

A checklist has been provided to troubleshoot each of the Beamsnap [Iddn] system components whilst common problems encountered.

5.4.2.1/ Troubleshooting tips of the sensor

A possible sensor defect shall be detect with help to the sensors dialog box and a torch.

Possible problem:

- A sensor response value is permanently higher than 10 or,
- A sensor response value is permanently equal to zero or,
- A sensor response value is permanently fluctuating even in a dark area.

Possible solution:

- Turn off the data logger and the Beamsnap [Iddn] software
- Disconnect from the sensors bar, the sensor “A” that does not respond properly to a light beam and connected to connector “A”.
- Check the pin of the sensor “A” connecter.

- Disconnect from the sensor bar the sensor “B” that responds properly to a light beam and connected the connector “B”. Generally, the sensor “B” is placed closer the sensor “A”.
- Reconnect the sensor A in the connector “B” and sensor “B” to the A connector in the sensors bar
- Switch on the data logger and Beamsnap lddn software.
- Launch the Sensors dialog box, if the sensor “A” still responds not properly to light beam through “B” connector, it means that this sensor has to be replaced.

6. / TECHNICAL DETAILS

6.1 Beamsnap equipment

The Beamsnap equipment meets the following specifications:

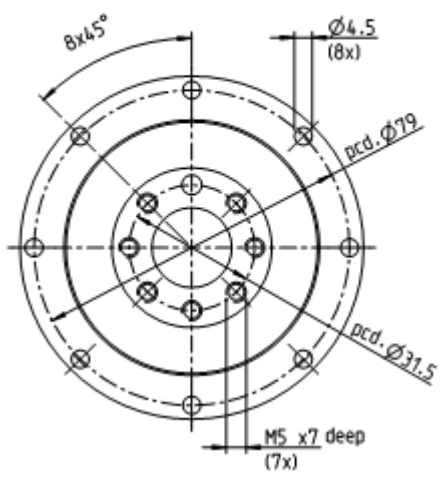
Compliance to standards	-ICAO in the Annex 14 Edition 2013 -FAA in the Advisory Circular AC 150/5345-46D -CENELEC -STAC
Airfield Lights covered	-Runway centre line -Runway inset/elevated edge -Runway inset/elevated threshold -Runway inset/elevated end -Runway inset/elevated guard -Inset/elevated Wing bar -Touch down -Approach inset and elevated -Taxiway centre line and curve -Stop bar
Photometric data provided for each light fitting	-Average value in candelas -Maximum and minimum point values in candelas -Position of the light beam in V° and H° -Color of the light beam -High definition Iso-candela diagram -ICAO/FAA compliance % -Status Pass/Failed -Measurement samples
Precision of measurements	± 5%
Repetition of measurements	± 5%

Average measurement speed	Within 30 seconds per light. Lamp pre-heating time not taken in account.
Measurement conditions	Measurements conducted inside a tunnel providing dark space. Tunnel dimensions: 350 long x 150 height x 60cm width Tunnel inner surface coated with black mat paint
Measurement bench	Power supply: 220Vac/ 7 A Motor peak current: 7 A Temperature range: -20° to +80°C Protection against humidity
Photometric sensors	IP: 64 Wave length bandwidth : 400-700 nm Detection angle: 180° Temperature range: -20° to +80°C Illuminance reading: 0 to 50 000 Lux
Operating system	Windows XP/Vista platform/ Windows 7

6.2 Gearbox specification

High output torque, high tilting rigidity and moderate backlash

- lowest backlash
- highest output torques
- highest tilting stiffness
- PCS-2 System
- high efficiency (96%)
- honed geared parts
- ratio i=64
- low noise (< 65 dB(A))
- high quality (ISO 9001)
- any mounting position
- easy motor mounting
- life time lubrication
- output flange according to EN ISO 9409
- direction of rotation equidirectional
- balanced motor pinion



i	max. middle input speed at normal conditions and S1 duty (1) ⓗ n_1 at 50% T_{2N}	n_1 at 100% T_{2N}	i	n_1 at 50% T_{2N}	n_1 at 100% T_{2N}
3	3600	3000	9	4500	4150
4	4450	3200	12	4500	4500
5	4500	3650	15	4500	4500
8	4500	4500	16	4500	4500
			20	4500	4500
			25	4500	4500
			32	4500	4500
			40	4500	4500
			64	4500	4500

	1.stage		2.stage	
L1	69.5		82	
L2	45		57.5	
	i	T_{2N} ⓐ	i	T_{2N}
	3	28	9	44
	4	38	12	44
	5	40	15	44
	8	18	16	44
			20	44
			25	40
			32	44
			40	40
			64	18

Technical Specifications:
planetary gear: straight-toothed
lifetime: 30.000h
output shaft bearing: grooved ball bearing
- max. axial load: 1200N by Fr=0 /Lh=20.000h
- max. radial load: 550N by Fa=0 /Lh=20.000h
- max. axial load: 1200N by Fr=0 /Lh=30.000h
- max. radial load: 500N by Fa=0 /Lh=30.000h
- related to the face of the flange output shaft
- T=30°C / n2=100 1/min
backlash: 1.stage<=16 arcmin / 2.stage<=20 arcmi
- ref. on output shaft
max. input speed: n1=13000 1/min(1)
lubrication: life grease lubrication
Operating temperature: -25°C...+90°C
efficiency: by rated load (ratio dependently)
- ca. 96% 1.stage, ca.94% 2.stage
nominal output torque: by n2=100 1/min
sealing: bearing 2RS
motor mounting: M2 (stocked driving pinion)
- torque of clamping screw: 4.5Nm
method of working: S1
operation ratio: cB=1
protective system: IP 54
max.motor weight static: 3.5 kg

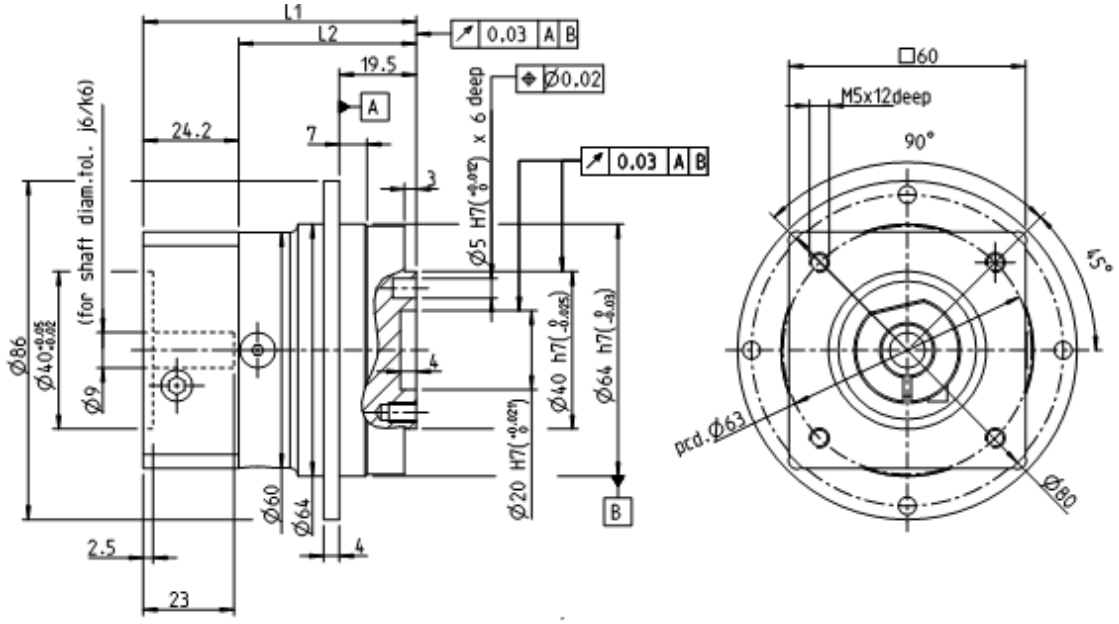
Material:
housing: Steel - black
input flange: Aluminium - untreated
output shaft: steel

flange according EN ISO 9409
with additional threads

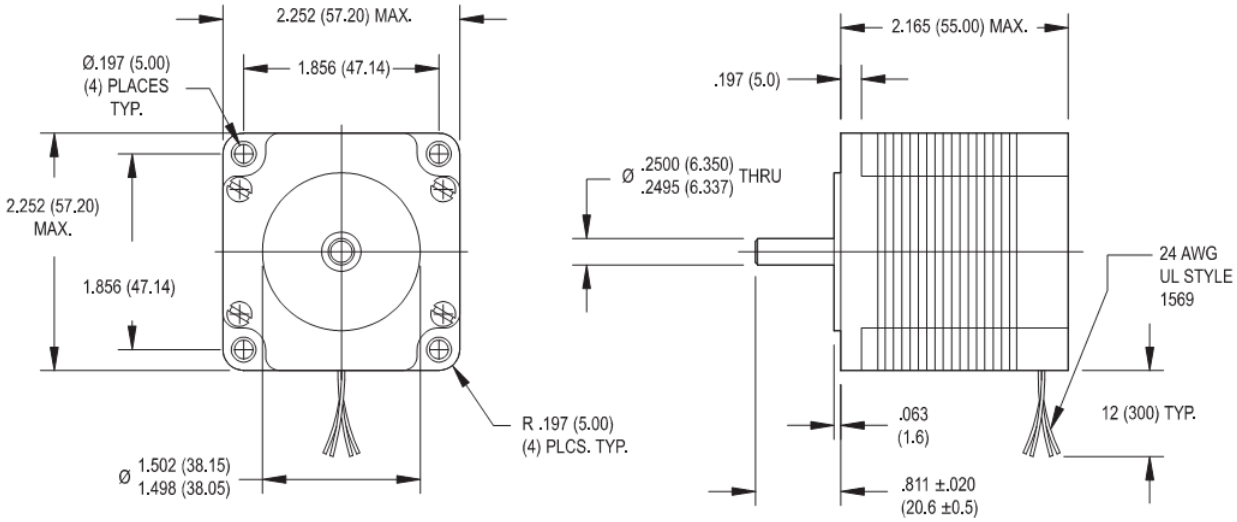
(1) Operating temperature may not be exceeded!

T_{2N} = nominal output torque at flange output shaft [Nm]
emergency stop torque: 2 times T_{2N}

Modification reserve!
Consider motor fitting instructions



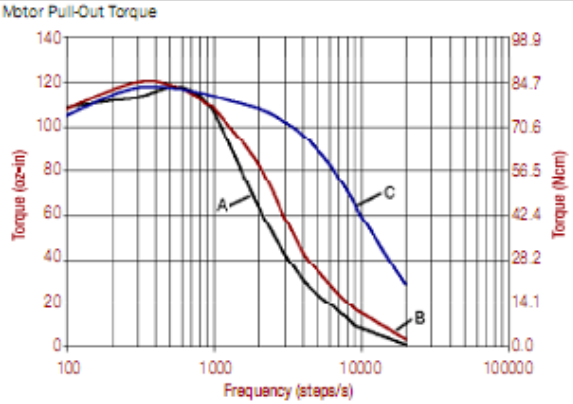
6.3 Step Motor specification



Specification	Units	HS 200 2221		
		0100	0210 ✓	0300 ✓
Rated Phase Current	A	1.00	2.10	3.00
Phase Resistance	Ω	6.2	1.4	0.7
Phase Inductance	mH	8.8	3.9	0.9
Holding Torque Unipolar	oz-in	106	—	106
	Ncm	75	—	75
Holding Torque Bipolar	oz-in	139	139	139
	Ncm	98	98	98
Detent Torque	oz-in	5.7	5.7	5.7
	Ncm	4.0	4.0	4.0
Rotor Inertia	oz-in-s^{2}x10^{-4}	31	31	31
	g-cm^2	220	220	220
Motor Weight (Mass)	lb	1.5	1.5	1.5
	kg	0.70	0.70	0.70
Maximum Voltage	V	75	75	75
Std. No. of Leads	—	8	4	8

✓ Available through the MotionExpress program.

Performance

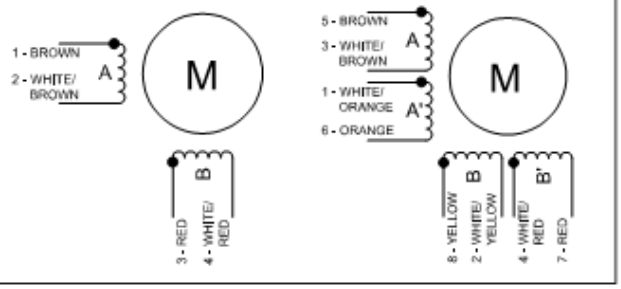


A - 0100, Bipolar chopper, Parallel, 36V, 1.4A/Phase
B - 0210, Bipolar chopper, 36V, 2.1A/Phase
C - 0300, Bipolar chopper, Parallel, 60V, 4.2A/Phase

Standard Features

- Step angle: 1.8˚
- Step angle accuracy: 5%
- Insulation class: B (130˚C)
- Optimized for microstep operation
- NEMA 23 mounting configuration
- AlNiCo magnets
- Additional windings and customization options available
- CE approved

Standard Leadwire Configuration



Complementary Products

- Gearboxes
- Encoders

6.4 Drive XL50i specification

Parameter Value
Amplifier type MOSFET chopper
Motor resolution: 4000 steps/rev
Maximum stepping rate 200kHz at 4000 steps/rev
Nominal chopping frequency: 20kHz
Protection circuits Short circuit (phase-to-phase, across phases and phase to ground), motor overcurrent, over/under voltage, logic supply fault, over temperature, ext. 24V reversed

Maximum output current:
XL50i: 5.0A peak +/-10%
Output current adjustment 50% to 100% of maximum current, software selectable in 10% increments
Standby current reduction 50% or 70% selected by software
Standby reduction time 30mS from last step pulse
Nominal motor bus voltage 80V DC +5%
Supply voltage, DC : 48-80V +5%
Indexer logic supply input 24V DC +10% -15%
Logic supply current 800mA max. (all outputs ON at max. current)
LED status indicators (tri-colour) HV OK/zero phase, drive OK/energised/fault, comms OK/fault
Motor inductance range 0.5 - 10mH (0.8 - 10mH preferred range)

XLi & XLCAN intelligent drives

Communication RS232, 9600 baud, 8 data bits, 1 start bit, 1 stop bit, no parity

CANopen interface (XLCAN only) Communications profile based on DS301; device profile based on DS402

PDO : 2 Tx/2 Rx; SDO : 1 Tx/1 Rx; communication rates up to 1MHz

Addressing 1 - 255, selected by software

Digital I/O 8 configurable I/O ports, 24V DC operation

Max. load per output 200mA

Max. total output load 400mA

Positioning range ±2,147,483,647 steps

Velocity range 0.01 to 50 revs/sec

Acceleration range 0.1 to 1024 revs/sec2

Positioning modes Incremental, absolute, registration, continuous run

XLI & XLCAN Intelligent drives

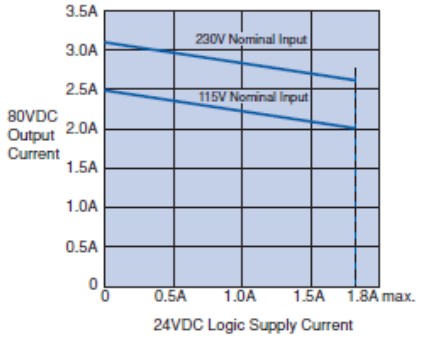
Communication	RS232, 9600 baud, 8 data bits, 1 start bit, 1 stop bit, no parity
CANopen interface (XLCAN only)	Communications profile based on DS301; device profile based on DS402 PDO : 2 Tx/2 Rx; SDO : 1 Tx/1 Rx; communication rates up to 1MHz
Addressing	1 - 255, selected by software
Digital I/O	8 configurable I/O ports, 24V DC operation
Max. load per output	200mA
Max. total output load	400mA
Positioning range	±2,147,483,647 steps
Velocity range	0.01 to 50 revs/sec
Acceleration range	0.1 to 1024 revs/sec²
Positioning modes	Incremental, absolute, registration, continuous run

XL-PSU specification

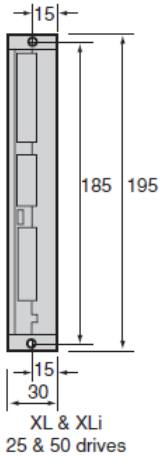
AC input voltage, nominal	115V to 230V AC, 1ϕ
absolute limits	95 to 264V AC
Main DC output	80V DC, 3.1A max. cont.*
Logic supply output	24V DC, 1.8A max.
Rated total output power	250W cont. @ 230VAC in
Peak power (1-sec rating)	600W
Power factor at full load	0.9
Power dump resistor (if required)	10R, 100W
Weight	1kg

*Dependent on supply voltage and 24V power drawn, as shown in performance graph above

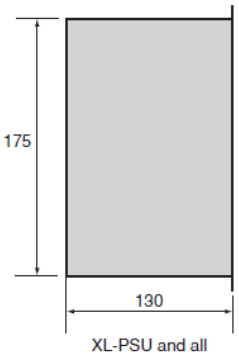
XL-PSU power supply performance



Drive & power supply dimensions



XL & XLi
25 & 50 drives



XL-PSU and all
XL & XLi drive types