Enlighten the Unseen

ECN100 H6 / H12 / N20

User's manual

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Revision

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1. GENERAL PRESENTATION

1.1. INTRODUCTION

Thanks to different optical systems (cameras, scanners, radiometers, thermal imaging systems...), infrared thermography allows the measurement of the emitted power of an object and possibly its temperature.

The ECN100 reference IR source allows calibrating and testing the performances of these optical systems.

The ECN100 may also be used to measure the atmospheric transmission or the gas concentration in a chamber.

The ECN100 blackbodies are extended area infrared reference sources delivered in two parts: a compact emissive head and an electronic controller. The emissive head includes an exclusive emissive surface made of micro-grooves. The emissivity and thermal uniformity of these blackbodies are thus particularly high. Moreover, since the surface is made of such micro-cavities, these sources can be used over a wide range of wavelengths from near-IR to far IR.

The robust structure of the emissive head enables lab or field condition operation.

Figure 1: ECN100H6 and ECN100 H12 heads

The reference name of the blackbody corresponds to its surface size and its absolute temperature range:

	ECN100 H6	ECN100 H12	ECN 100 N20
T° range	[50°C ; 600°C]	[50°C ; 550°C]	[50°C ; 300°C]
Reference surface	150 x 150 mm²	300 x 300 mm²	500 x 500 mm²

The ECN100 can also be equipped with a target for spatial tests of IR cameras such as MTF or spatial resolution.

The ability to connect the ECN100 controller to an external PC allows integrating the ECN100 onto test benches and to automate most measurements.

1.2. FEATURES

- High display resolution to 10 mK for temperature measurements and set point,
- High emissivity,
- Very high uniformity,
- High speed heating
- Very wide temperature range,
- Supplied with International Primary Standards traceable radiometric calibration certificate over MWIR and LWIR range and valid for 1 year,
- User selectable display of true temperature or radiometric temperature,
- Remote control through Ethernet, IEEE488 or RS232 communication links,
- Delivered with ready-to-use remote control software Infratest-LT,
- Exclusive drivers for LabVIEW v8 or higher for all communication types.

2. DESCRIPTION

The system consists in 2 different components:

- The Electronic Controller
- The Blackbody Head

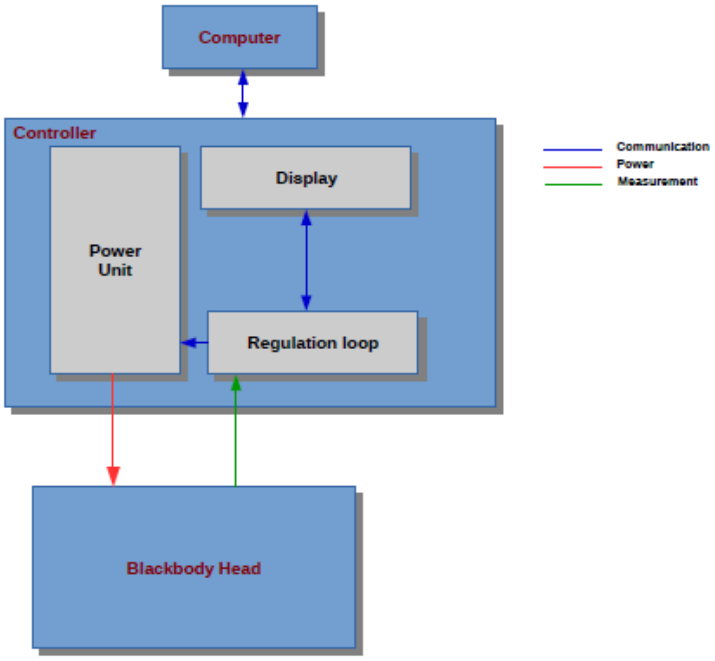

Figure 2: Synoptic scheme

2.1. ELECTRONIC CONTROLLER

The electronic controller processes the output data of the temperature sensors and controls the power supply and the temperature regulation of the blackbody.

Figure 3: Electronic Controller front panel

The front panel entails:

- a mains button,
- a touchscreen

The mains button allows switching ON or OFF the controller. In user mode, the ambient temperature, the blackbody absolute temperature or the differential temperature are displayed on the screen in real time.

The mains button is lighted when the power switch at the rear panel is ON.

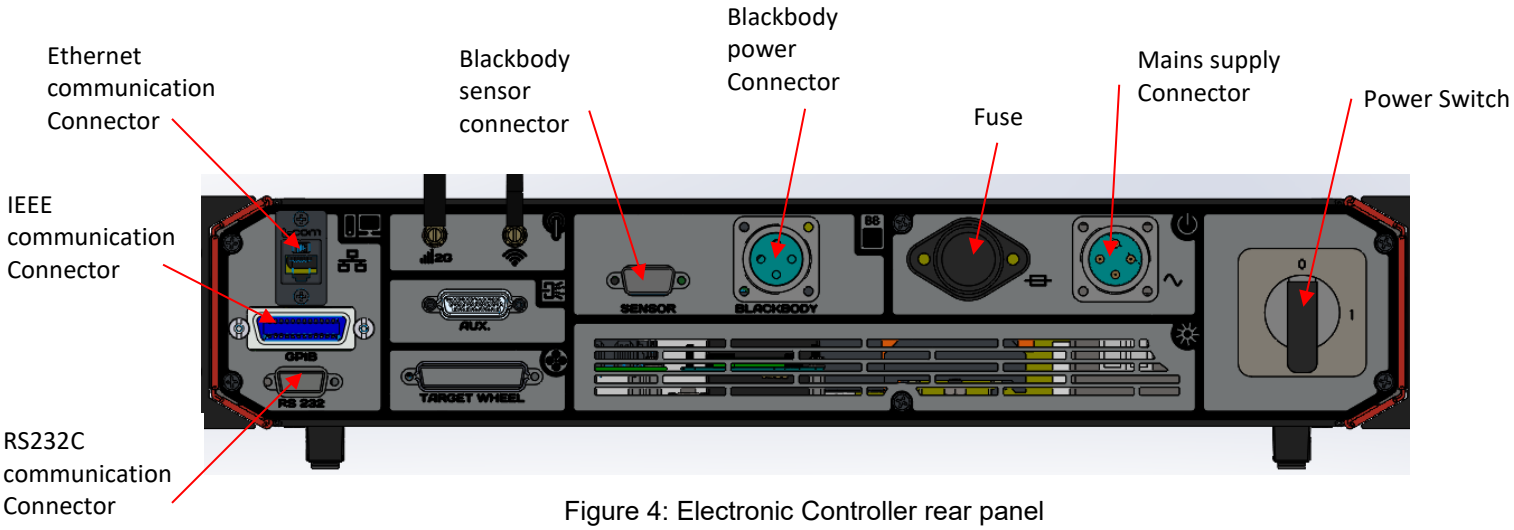

Figure 4: Electronic Controller rear panel

The Mains Supply connector, the power switch, the Blackbody Connector and the communication connectors are located on the rear panel.

The Power Switch allows the voltage supply of the controller.

2.2. BLACKBODY HEAD

The blackbody head of the ECN 100 entails a temperature controlled large emitting dark surface.

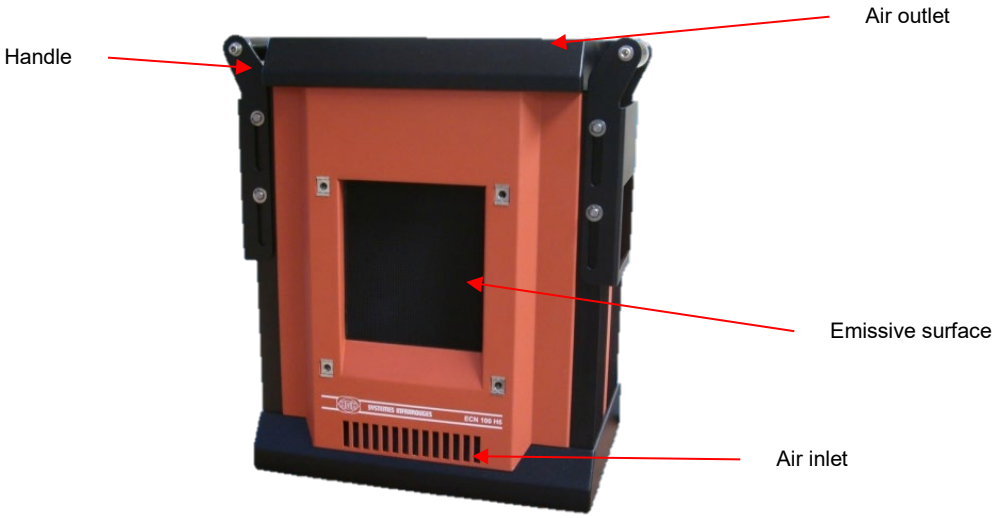

Figure 5: ECN100 head

The temperature of the emissive surface is measured with a high precision Platinum sensor.

The coating of the emissive surface is emissive and it is heated at a very high temperature using high performance heating resistances. The back and the side faces are maintained cooled thanks to a set of fans and a thermally insulating shell.

During the cooling phases, the amount of power is reduced or stopped. The heat is evacuated thanks to natural convection.

The constant operation of the fans is absolutely necessary to ensure the equipment safety. It ensures a moderate temperature heating of the external surface of the insulating shell.

The Blackbody Head is connected to the Electronic Controller using:

- The Power Cable
- The Sensor Cable

2.3. SUPPLY

The ECN100 blackbodies are delivered in one transport case including:

– Blackbody head with protective cover,

– Electronic controller,

– Main power cable,

– Head to controller cables (power and sensor),

– A USB key including remote control software Infratest-LT, the operating manual of the communication protocols and this operating manual,

– A Quick Start sheet,

- Ethernet to PC cable,
- Calibration certificates,
- Control sheet,
- HGH Declaration of Conformity.

In option :

- Target

3. OPERATION

3.1. PREPARATION OF THE BLACKBODY

First, keep the packaging used for sending the blackbody. It must be used if the blackbody is sent back to HGH for maintenance or calibration purposes. If HGH Customer Support receives a blackbody not properly packed, the cost of a new packaging may be charged at that time.

Before connection, check on the electronic controller that both switches (power and mains) are *OFF*.

Set the blackbody head on a stable surface. Don't hesitate to fix it using the dedicated holes in its base plate.

Check that air inlets and fans outlets are not obstructed.

Check on the identification labels that both head and electronic controller have the same type (example: ECN 100 H6). Never try to connect a head that has not the same type as the Electronic controller.

Correctly connect the cables in the following order:

High voltage, do not put your fingers into the connectors.

1. Connect the communication cable if required.
2. Connect the Sensor Cable and the Power Cable.
3. Check that the mains supply is correct (230 V, 50/60 Hz), and that the line is able to deliver the maximal current (refer to paragraph 6.1.1) and make the connection.

Remove the protective cover and switch the POWER and MAINS buttons *ON*.

The main screen is then displayed. This is the screen on which the temperatures are displayed.

Important remark: the accuracy performance of the ECN100 blackbody is fully reached after a 30-minute warm up (MAINS button on *ON*).

In case of target option, the target is mounted on the four same holes as the protective cover.

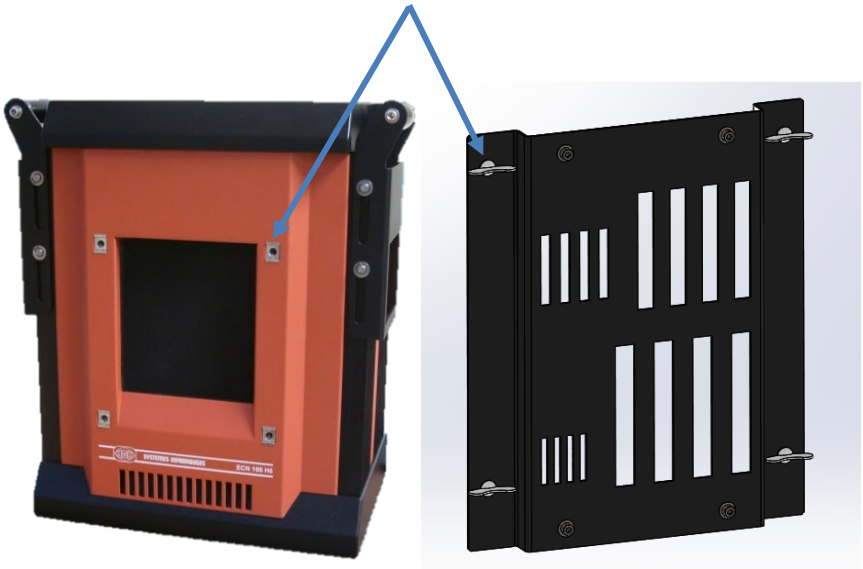

Figure 6 : ECN 100 and target

3.2. USER INTERFACE

3.2.1. Starting procedure

Switch on the power switch at the rear panel of the controller. The main button at the front panel of the controller becomes red. Then turn on this main button. During the starting procedure this button is blinking blue. This procedure may last a few seconds before the HGH logo appears.

Some tests are set up in the controller. The result of these tests is displayed. Please refer to the Quick Start Sheet supplied with the blackbody or to the paragraph 5.3.2.

By validating the result screen the main screen is displayed.

3.2.2. Main screen

From this screen, the user can read the actual blackbody temperature:

Figure 7: Main screen

ABS : indicates the absolute temperature in °C of the emissive surface of the blackbody.

Temperature set point (*30.00* in the above example): indicates the current temperature set point.). Press this button to get to set point modification keypad (refer to paragraph 3.2.3).

C : indicates if the temperature is displayed in °C, °F or K. Press the button to change the temperature unit.

SET : This button gives access to predefined set-points.

 : This button gives access to protected parameters (administrator only) and user parameters.

TARGET : This button gives access to the screen in which the external target (option) can be selected.

STEP : Press this button to choose the value of the step between two set points.

 : Press these buttons to move on the previous or the next set point. The gap is the STEP value or ten times the STEP value  .

●: The temperature set point is characterized by the red circle. The second circle (which can be either green or white as on the screen) describes the state of the blackbody. It appears in green when the temperature of the blackbody has reached the set point and is stabilized (blue circle around the setpoint - this default value can be modified in the administrator menu, refer to paragraph 3.2.5.2). The circle remains white until the blackbody temperature reaches the setpoint.

3.2.3. Numeric keypad

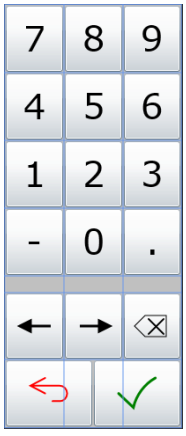

Figure 8: Numeric keypad

This screen is the numeric keypad that appears anytime the user presses a numerical value he wants to modify or the temperature set point button in the main screen. It allows

entering a new value for the corresponding variable. When a new value is entered, the user must press  to take it into account and then press Return () to get back to the screen from which the keypad was called. If different values can be changed in the same screen, press  to get from one value to the next.

 Press this button to suppress the previous variable.

 Press these buttons to select any variable in the number.
Press the variable anywhere you want to set the cursor at this position.

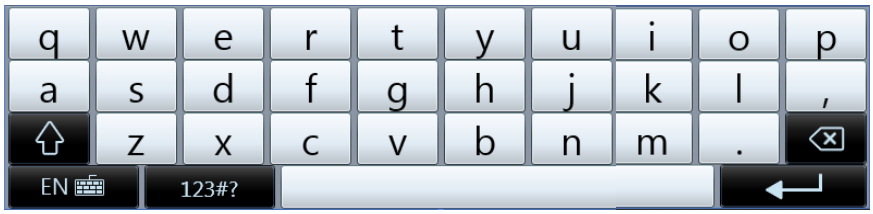

Figure 9: Letter keypad

This screen is the keypad that appears anytime the user presses a not-only numerical value like a password. When a new value is entered, the user  must press to take it into account.

 Press this button to suppress the previous variable.
Press the variable anywhere you want to set the cursor at this position.

3.2.4. Predefined set-points

In this screen, there are predefined temperature set points that can be chosen by the user instead of entering them manually from the main screen. Its purpose is to make it faster and more convenient for the user to select the temperature set points that he often uses.

Figure 10: Predefined temperature table

The different predefined temperature set points can be changed by the user:

Press  to select the temperature set-points. Press one of these temperatures to change the temperature set point to the corresponding value. In the above example, pressing a temperature changes the temperature set point from 30.00°C to the value on the button.

Press X to get back to the main screen.

3.2.5. Advanced menu

This menu gives access to protected parameters such as calibration parameters. Some can't be modified (user menu), some can be modified by an advanced customer administrator, others are factory parameters and only HGH has an access to them.

Click on the  button of the main screen to get to the administrator selection screen:

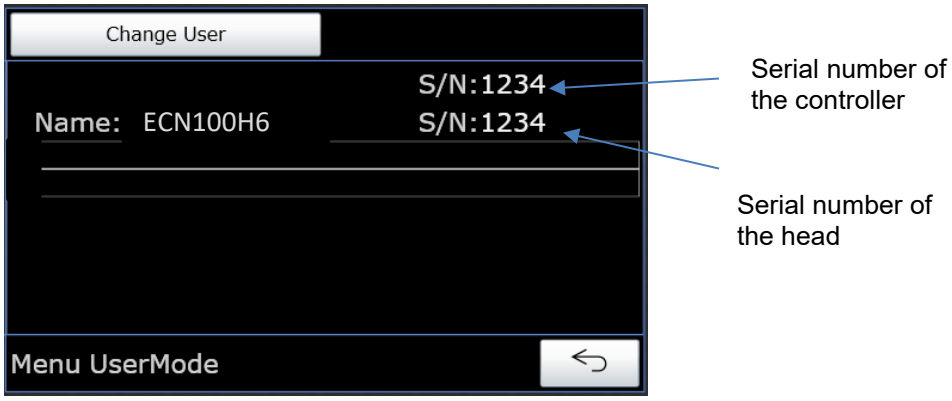

Figure 11: Selection screen (1/2)

The menu by default is the user menu. To switch on Advanced menu click on *Change User* to display the following screen.

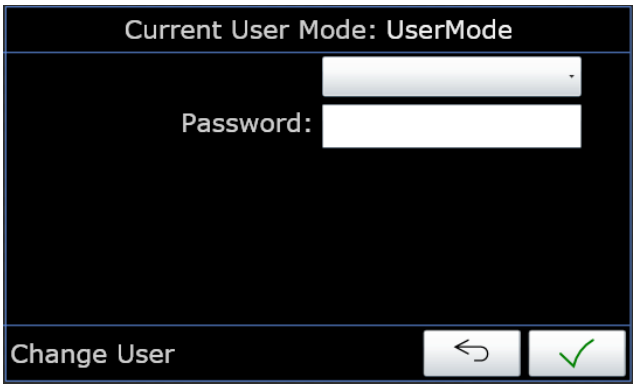

Figure 12 : Selection screen (2/2)

Choose Advanced in the drop menu. Then enter the customer password using the numeric keypad. The Advanced password is provided in the control sheet of the blackbody.

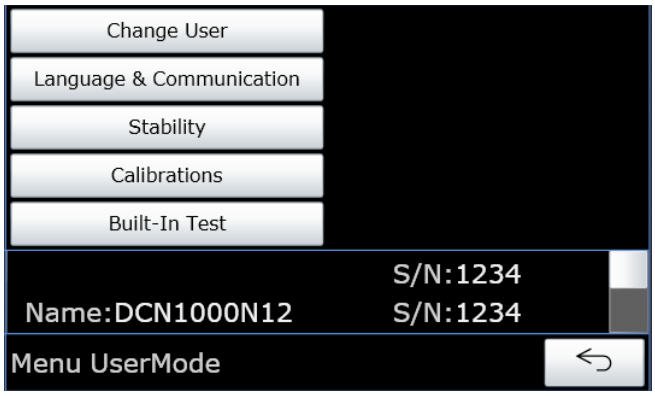

Figure 13: Customer administrator menu screen

3.2.5.1. Language & communication menu

Click on *Language & communication* on the advanced menu to display the following screen.

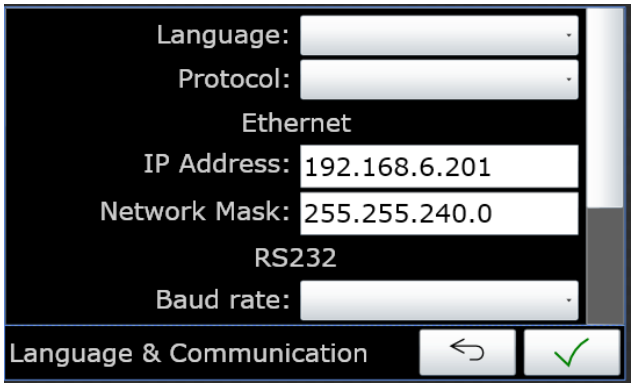

Figure 14 : Language & communication menu

Language : Choose the operation language of the controller (English or French).
Protocol is the communication protocol of the controller.
Ethernet, RS232, GPIB are the configurations of each remote control interface.
Default values are described in paragraph 4.

3.2.5.2. *Stabilization menu*

Click on *Stabilization* on the advanced menu to display the following screen:

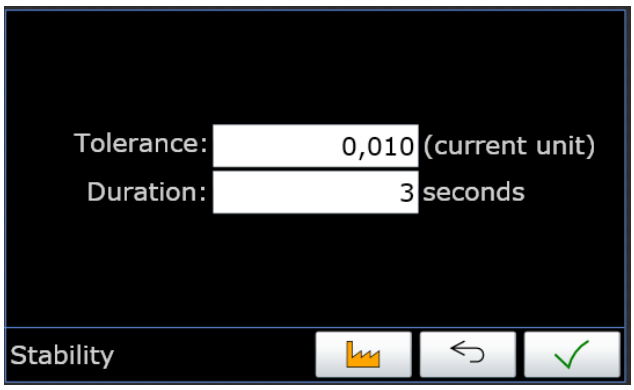

Figure 15: Stabilization menu screen

This menu allows modifying the stabilization criteria.

Tolerance is the temperature tolerance into which the blackbody is considered as stabilized.

Duration is the time in seconds during which the temperature error needs to be into the tolerance range so that the blackbody is considered as stabilized.

In the case both criteria are satisfied the circle at the top of the main screen becomes green and remains in the blue area stabilization.

Default values are:

Stabilization tolerance: 0.2°C

Stabilization counter: 10s

 : Press this button to validate the new parameters and get back to the advanced menu.

 : Press this button to get back to the advanced menu.

 : Press this button to get back to the default values.

3.2.5.3. *Calibration parameters menu*

Click on *Calibration* on the advanced menu to display the following screen.

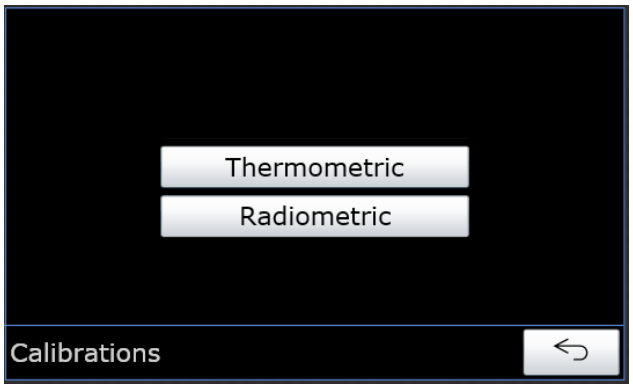

Figure 16 : Main calibration menu

3.2.5.3.1. Radiometric calibration menu

Click on Radiometric on the calibration menu to display the following screen.

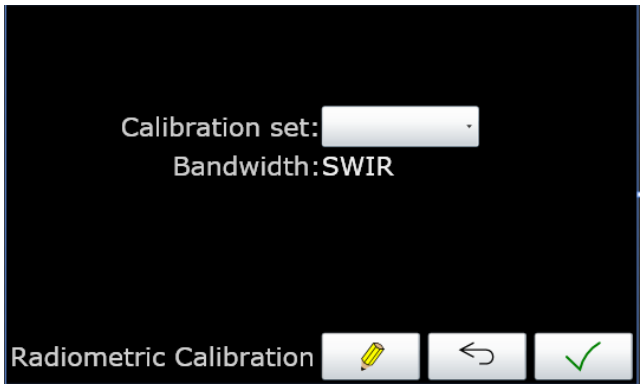

Figure 17 : Radiometric calibration menu

This menu gives access to parameters allowing calibrating the whole blackbody system so that the radiance temperature corresponds to the actual displayed temperature.

On the drop menu choose the calibration set. When no calibration set, the displayed value is the physical temperature of the emissive surface. But as the emissivity can't be exactly 100%, it is possible to select a calibration set.

Each calibration set adjusts the radiance temperature in one spectral bandwidth. The selected bandwidth is written below the calibration set.

You can find the corrected radiance in the calibration certificate provided with the BlackBody.

4. REMOTE CONTROL

The remote communication with HGH's blackbody is available through several communication links:

- Ethernet,
- RS232,
- IEEE488,

Ethernet, RS232 and IEEE488 protocols are available through dedicated user manuals. Moreover, a dedicated remote control freeware Infratest-LT is available for Ethernet, IEEE488 and RS232 links. Please refer to the Infratest-LT user manual to configurate and use your blackbody using one of this communication link.

LabVIEW drivers are also available for Ethernet, RS232 and IEEE488 communication links.

4.1. ETHERNET INTERFACE

Ethernet interface is the standard communication link. It enables to connect several blackbodies on a network and to control them from a distant PC.

The communication protocol is defined in the user's manual of the DCN, ECN and RCN Ethernet protocol.

The freeware INFRATEST - LT is available to configure and control the blackbody using Ethernet interface

The blackbody is delivered with IP address **192.168.1.201**. You can change this IP address using INFRATEST – LT.

4.2. RS232C INTERFACE

RS232C interface enables to connect one blackbody and to control it from a distant PC.

The communication protocol is defined in the user's manual of the DCN, ECN and RCN RS232C protocol.

The freeware INFRATEST - LT is available to configure and control the blackbody using RS232 interface.

4.3. IEEE488 INTERFACE

The communication protocol is defined in the user's manual of the DCN, ECN and RCN RS232C protocol.

The configuration of the converter is the following;

- IEEE address: default 10,
- IEEE configuration: no SRQ,
- Mode: device,

The address by default is 10. It is accessible in the Language and communication menu.

In the case Infratest software is used, make sure the NI IEEE488.2 drivers are installed.

4.4. LABVIEW DRIVERS (OPTION)

These LabVIEW drivers of the blackbody are compatible with LabVIEW v8 or higher and for all available communication links Ethernet, RS232 and IEEE.
The supply includes all the required VIs directly available from the LabVIEW menu. These functions allow the operator to send a temperature setpoint, read the current temperature, check the stabilization status and many other functions.
The supply also includes an example program built from all the available VIs.
Refer to dedicated LabVIEW drivers operating manual for further information.

5. PRECAUTIONS OF USE AND MAINTENANCE

5.1. ELECTRONIC CONTROLLER

High voltage, do not put your fingers into the connectors.

Connect the Electronic controller on a mains plug equipped with a **ground** terminal.

Never switch ON the Electronic Controller if the head is not connected to it.

Control the correct connection of the connectors on back panel.

Do not cover the aeration holes.

Clean the controller once unplugged, with a humid soft cloth. Do not use solvent or alcohol.

Do not press the touch switches of the screen with a force greater than 30N.

Do not use benzene, paint thinner or other volatile solvents and do not use chemically treated cloths to clean the screen.

Never try to open the controller without HGH advice.

5.2. BLACKBODY HEAD


Danger OF HEAT BURN

WARNING: Never touch the emissive surface when the emissive surface temperature is higher than 40°C: this may cause burns

WARNING: The blackbody radiation is so intense at high temperatures that it may cause damage to flammable objects placed within 3 meters around the source (clothes, furniture, papers, etc.).

The blackbody fan is permanently active, and provide the AC as long as the cable remains connected to the main supply. It is forbidden to unplug the AC cable from the main supply during or after the blackbody has been heated above 300°C. Wait long enough for complete cool down before unplugging main cable. The advised mean cooling time lap is one hour for every hundred °C (i.e. 5 hours from 550°C to ambient).

Avoid shocks to preserve the heating elements.

Do not touch the surroundings of the emissive surface : it may be very hot.

In the general case, avoid touching the external housing of the blackbody when in operation. In the case it is necessary to change the aperture selection or to displace the head, it is advised to wear gloves.

Do not cover aeration holes.

Don’t use the blackbody in a wet or dusty environment.

Clean the head of the blackbody with a humid soft cloth. Do not use solvent.

Never pack the Blackbody head if its temperature (the one displayed on the Electronic Controller) exceeds 60°C.

5.3. TROUBLE SHOOTING

5.3.1. The main button remains off

– When the user switches ON the POWER switch a red light appears around the MAIN button. If not, the controller may be misconnecting from the main supply. Press the MAIN button. If nothing happen, the system remains silent and the screen off, Check that the mains line is correctly powered. Try again.

– Unplug the mains of the controller. Remove the fuse and check its status thanks to an ohmmeter. If required, replace the faulty fuse by a delayed fuses according to the type of blackbody:

Type of blackbody	Type of fuse
ECN100 H6	T16A Ø10,3x38
ECN100 H12	T32A Ø10,3x38
ECN100 N20	T25A Ø10,3x38

– Re-plug and restart the controller.

– If the light indicator still remains off, please contact HGH.

5.3.2. Autotest

Startup and continuous tests are set up in the controller. Press the *Built-in-test* button in the Advanced menu to display the following screen.

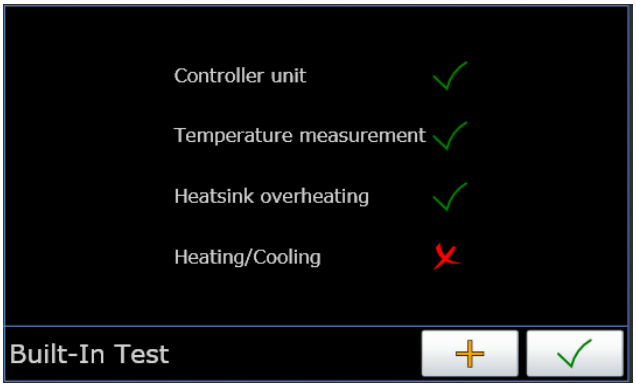

Figure 18 : Built-in-test result

Controller unit :

- If an error appears on this part, turn the blackbody off and on. If the error remains, please contact HGH.

Temperature measurement : Sensor failure (Emissive Surface Temperature Sensor (TSES)).

- Check that the blackbody cable (between the Electronic controller and the head) is correctly connected. Try again. If the error remains, please contact HGH.

Heatsink overheating :

- Check that the fans are working, and that the fans inlets and outlets are not obstructed. Try again. If the error remains please contact HGH.

Heating/cooling :

PWR0 : Power failure

- Check that the blackbody cable (between the Electronic controller and the head) W01 is correctly connected. Try again. If the error remains, please contact HGH.

ID0 : Wrong head connected. If so, please connect the good head.

5.3.3. Inactive touchscreen

You switched on the controller and its touch screen remains inactive, it remains empty or the display is fixed, the measured temperatures don't change.

- The touchscreen communication may be interrupted. Switch OFF and ON the controller, then the operation may be normal.
- The measured temperatures display seems to be normal but when you touch the screen it doesn't react.
- The touch screen may be locked. Actually, the touch screen can be locked by INFRATEST - LT through the computer interface. You can unlock the touch screen through the same interface (refer to INFRATEST - LT manual). Anyway, if you switch OFF then ON the controller, the touch screen will be unlocked.

5.3.4. Limited temperature range

You tried to set an extreme value in the specified working range but the blackbody can't reach this temperature.

- Check that the blackbody head is in a quiet environment protected from wind.
- If the temperature range is still limited, refer to the following table and use an ohmmeter to measure the resistance between the pins of the Power Cable:

Type of blackbody	ECN100 H6	ECN100 H12
R between pins :	2 and 3	2 and 3
Default if :	>35Ω	>13.5Ω

If the resistance exceeds the limit value, it means that the heating elements may be damaged. Please contact HGH.

– If the values are normal, the Power circuit may be checked. Please contact HGH.

5.3.5. The blackbody is unstable

You switched on the blackbody and set a temperature, the blackbody reaches the temperature but the stability is not good.

– Check that the blackbody head is in a quiet environment protected from wind.

– Check that the cables are correctly plugged and locked.

– Check that cables path is not near from a powerful electromagnetic emitter (unprotected electronic device).

– Check that ground is effectively connected to the controller.

– For perturbed atmospheric conditions (climatic chambers with circulating air), HGH offers different solutions like shelters or lens to blackbody head sleeve interface. Please contact HGH.

6. MAIN CHARACTERISTICS

6.1. CONDITIONS OF USE

6.1.1. Electronic controller

PARAMETER		RANGE OF REFERENCE	RANGE OF USE	RANGE OF STOCKING
Climatic conditions	Ambient temperature Relative humidity without condensation	20°C ± 5°C 45% to 75%	+5°C to +45°C 20% to 80% (70% at 45°C)	-20°C/+70°C 10% to 80%
Supply	Mains voltage Frequency	230VCA ± 1% 50Hz	Standard :198 VAC to 250 VAC 45Hz to 65 Hz	- -

6.1.2. Emissive head

PARAMETER		RANGE OF REFERENCE	RANGE OF USE	RANGE OF STOCKING
Climatic conditions	Ambient temperature Relative humidity without condensation	20°C ± 5°C 45% to 75%	-10°C to +70°C 20% to 80% (70% at 45°C)	-20°C/+70°C 10% to 80%

6.2. MAIN SPECIFICATIONS

6.2.1. Mechanical characteristics

6.2.1.1. Electronic controller

- Description: 2U rack case, 19 inches (84 F) according CEI 297.3
- Dimensions: H 85 x L 450 x P 412 mm with19" fixation braces.
- Weight: 6.5 kg
- Waterproofness: IP 20 according CEI 529

6.2.1.2. Blackbody head

Minimum radius of curvature of cables: R = 110 mm

Weight: 23 kg (ECN 100 H6)/ 40 kg (ECN100 H12)/ 55 kg (ECN100 N20)

Standard cable meters (sensor and power) length: 2 or 5 meters (other dimensions available on option)

Minimum radius of curvature: R = 110 mm

6.2.1.3. Main cable

Length: 2 meters / 5 meters

Main plug reference: Legrand 502 52 – 16A (ECN 100 H6) / Legrand 558 02 – 32A (ECN 100 H12 and ECN 100 N20)

Minimum radius of curvature: R = 110 mm

Important remark: If the 32A main plug does not match the client main socket it is possible to replace the plug of the main cable. This operation does not modify the warranty period if the modification is done properly and according to the following wiring drawing.

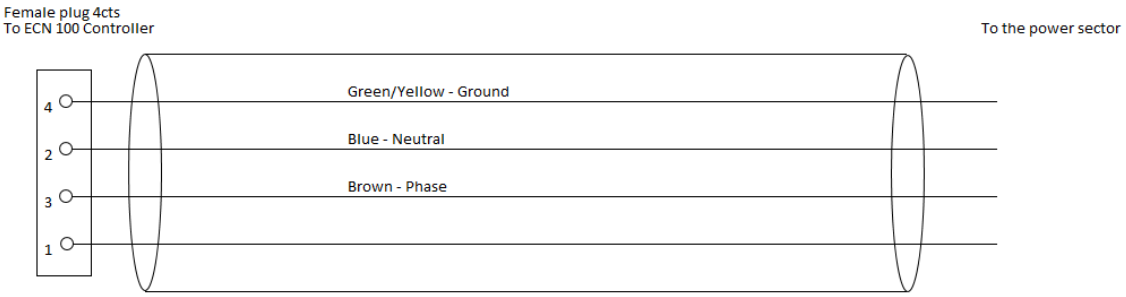

Figure 19 : 32A main cable wiring drawing

6.2.2. Electrical characteristics

– Main supply: 230V 50/60 Hz

– Suppressor: according to VDE 0871-A

Blackbody type	ECN100 H6	ECN100 H12	ECN100 N20
Power	2000 VA	4500 VA	5000 VA
Fuse	T16A Ø10.3x38	T32A Ø10.3x38	T25A Ø10.3x38

6.2.3. Functional characteristics

6.2.3.1. Electronic controller

– Temperature measurement: 1 input for Pt sensor, 4 wires (compensation of the resistance of the wires). Linearization according to CEI 751 (NFC 42330)

– Resolution: 0.01°C

– Display range: 0°C to 600.00°C

– Temperature measurement accuracy: ±(0.1°C+0.17%T), with T in °C

– Resolution of the temperature set points: ± 0.01°C

– Regulation: PID adapted to the set point temperature

– Stabilisation time :

Blackbody type	ECN100 H6	ECN100 H12	ECN100 N20
Gap	from 20°C to 600°C	from 20°C to 550°C	From 20°C to 300°C
Stability criterion	± 0.2 °C	± 0.2°C	± 0.2°C
Duration	<45min	<60min	<60min

– Long term stability at 300°C: ± 0.02°C RMS

6.2.3.2. Blackbody

Temperature range (for a 20°C ambient temperature) :

Blackbody type	ECN100 H6	ECN100 H12	ECN100 N20
Range	[50°C ; 600°C]	[50°C ; 550°C]	[50°C ; 300°C]

Emissivity:

Spectral range	3-5 µm	8-14 µm
Range	96% ± 2%	98% ± 2%

Typical thermal uniformity

Blackbody type	ECN100 H6	ECN100 H12	ECN100 N20
Uniformity RMS at 300°C	< 0.5	< 1°C	< 1°C