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SensPro® Protective gloves for firefighters

SensPro® Electronics for glove
with implemented sensors

Contents:

1 Introduction

Congratulations on your purchase of SensPro® protective gloves for firefighters. You are now the owner of a globally unique type of gloves with technology to measure the temperature of the surface of the glove and the temperature of remote objects by means of sensors.

Your purchase includes:

SensPro® gloves
Accumulator box SG-AB-01
Password for setting limit values of bar graphs
Cloth bag for gentle washing of gloves
Instructions for operation and maintenance – Material composition
– Instructions for the SensPro® application

The charging adapter is not included, however it can be purchased separately.

Please read the following instructions before using the gloves for the first time.

2 General description

The all-textile protective gloves are designed for use in extinguishing fires. The gloves allow users to read temperatures on the surface of the gloves and to measure the temperature of remote objects.
The glove electronics are composed of the electronics module and a removable accumulator (**7**), which are connected by a conductor. The electronic module contains a temperature sensor (**1**), IR sensor (**2**) with a laser pointer (**3**), switches (**4**), status LEDs (**6**), an LED bar graph (**5**), and enables wireless communication. The accumulator is charged away from the danger of explosion with a charger that conforms to IEC 60950, IEC 61010-1 or other equivalent standards.

3

Description of functions

3.1. Location and description of elements

1 Temperature sensor
2 IR sensor
3 Laser pointer
4 Switch (Power switch/Mode switch)
5 Bar graph
6 Status LEDs
7 Accumulator box

Fig. 1: Location of functional elements on the back of the glove

Fig. 2: Location of accumulator box inside glove

3.2. Sensors

The temperature sensor (**1**) for reading the temperature on the surface of the glove is located on the ring ringer and is protected by a cover made of DuPont™Nomex® material while also being in contact with the surrounding air. The maximum measured temperature range of the sensor is -50 °C to +500 °C.

The IR sensor [infrared sensor] (**2**) for measuring temperatures of remote objects is located beneath a silicon cover on the back of the glove. The maximum measured temperature range of the IR sensor is -70 °C to +380 °C. The accuracy of the measured temperature of the remote point depends on the distance between the glove and the measured point (Fig. 3 and 4). The measured surface increases as the distance grows, possibly distorting the results. The laser pointer (**3**) located next to the IR sensor shows the user the measured area of the remote object. The pointer is functional only when using the IR sensor [mode 2].

3.3. LED bar graph

The LED bar graph (**5**) is located on the back of the glove and is protected by a clear silicon cover. The bar graph is made up of five LEDs in various colours: one green, two orange and two red (Tab. 2). The colour changes when set temperature limits are exceeded and the user is visually informed of the current measured value. At any given moment, the bar graph displays values measured from only one of the sensors – either the temperature sensor or the IR sensor.

The temperature resistance of the silicon case: -50 °C to +230 °C, short-term up to +300 °C.

3.4. Switch (Power switch/Mode switch)

The glove is switched on by pressing the button on its back (**4**). The glove is switched off by pressing the same button and holding it down for 4s. While running, the mode of the device can be switched by quickly pressing the button. In basic mode 1, the device is set to read temperatures on the surface of the glove using the temperature sensor. The level of the measured temperature is indicated by the LED colours on the bar graph. By pressing the button again, the device is switched to mode 2 to measure the temperature of remote objects using the IR sensor. The level of the measured temperature is again indicated by the LED colours on the bar graph. The laser pointer is activated when the IR sensor is in use. Another short press of the button returns the device to mode 1.

3.5. Status LEDs

The status LEDs (**6**) inform the user of the charge status of the glove accumulator and the wireless connection with the smartphone. If the glove accumulator is adequately charged, the blue light is on. A red light indicates that the accumulator charge is less than 30%. A blinking red light indicates that the accumulator charge is critically low at less than 10%. The moment the glove is paired with a smartphone, the blue light blinks 5 times.

Status	Visual display
The accumulator is sufficiently charged (100-30%)	Blue
The accumulator must be charged soon (30-10%)	Red
The accumulator is almost dead (10% -0%)	Blinking red
The glove is connecting to a smartphone	Blue diode blinks 5 times

Table 2: Individual status of LEDs

3.6. Accumulator box

The accumulator box (**7**) contains a 3.7 V 1450mAh Li-ion accumulator; the box is held in an inner pocket of the glove. A USB micro-B connector is used to connect the device to the accumulator and to connect to the charger. A mechanically damaged accumulator must be replaced. Use only an SG-AB-01 accumulator from the glove manufacturer – Holík International.

The accumulator is certified for explosive environments.

3.7. Control unit

The control unit is located on the back side under the second layer of the glove. This unit collects data from sensors and transfers data to external devices using wireless communication technology.

4

Start-up

4.1. Charging the accumulator

The accumulator is charged using the adapter in the temperature range of 0 °C do +30 °C. The charger must comply with IEC 60950, IEC 61010-1 or other technically equivalent standards. Do not charge the accumulator in a space where is a threat of explosion! First connect the adapter to a 230 V outlet and then attach the accumulator box to the adapter. The charging process is indicated on the accumulator box by a coloured LED, which then switches off once the accumulator is fully charged. Charging takes about 2 hours. The length of charging depends on the type of charging adapter used.

4.2. Switching on of the glove

After connecting the accumulator to the control unit, the glove is switched on by a short press of the button on the back of the glove (**4**). Switched on, the glove is set to mode 1 for measuring temperatures on the surface of the glove using the temperature sensor. When the glove is connected properly, the accumulator is charged and the ambient temperature is under 100 °C, the bar graph shines green and the status LED (**6**) is blue.

4.3. Wireless pairing with the glove

The glove can be paired using wireless communication with the SensPro® application installed on a smartphone or tablet. Precise pairing instructions are provided in the application instructions. The blue status LED blinks 5 times in rapid succession when pairing is successful.

4.4. Switching off the glove

The glove is switched off by pressing and holding the button on the back of the glove (**4**) for four seconds. If the gloves is not going to be used for a longer period of time, it is better to disconnect the accumulator.

5   Reading temperatures and light signals

5.1. Display of measured values

Visual display gives a possibility to divide the temperature range into 6 levels. Besides the first range, in which only one green LED shines, two LEDs always shine at the same time. Five limit values can be set separately for the temperature sensor and the IR sensor. Table 3 shows the factory settings for limit values.

BAR GRAPH		Temperature range	
		Temperature sensor	IR sensor
green		<100 °C	<100 °C
green	orange	from 100 °C to 125 °C	from 100 °C to 150 °C
orange	orange	from 125 °C to 150 °C	from 150 °C to 200 °C
orange	red	from 150 °C to 175 °C	from 200 °C to 250 °C
red	red	from 175 °C to 200 °C	from 250 °C to 300 °C
red LEDs blink		>200 °C	>300 °C

Tab. 2: Factory settings for limit values

The customer can change these values based on their specific needs. To do so, it is necessary to download the SensPro® application, which is available for Android and Apple systems. Uncontrolled and frequently reset limit values present a safety risk for professional fire brigades. For this reason, a password (provided with the gloves) is required to make changes. The customer must set their own internal rules as to who is authorised to change values. More information is available in the instructions for the SensPro® application.

5.2. Measuring

When the glove is switched on, both the temperature sensor (1) and the IR sensor are immediately functional, and temperatures are measured while the glove remains switched on. Switching between mode 1 (measuring with the temperature sensor) and mode 2 (measuring with the IR sensor) only impacts the display of measured temperatures on the bar graph. In mode 1, the bar graph displays the temperatures measured with the temperature sensor; in mode 2, the bar graph displays temperatures measured with the IR sensor.

5.3. Measuring with the temperature sensor

The range of measuring with the temperature sensor is from -50 °C to +500 °C. The temperature sensor (1) is located in the ring finger and is protected by a cover. The head of the temperature sensor is in direct contact with the surrounding air at the edge of the cover. To prevent distorted readings, it is necessary to keep this area clean and free from dust and dirt.

5.4. Measuring with the IR sensor

The range of measuring with the IR sensor is from -70 °C to +380 °C. The laser pointer next to the IR sensor shows the user the middle of the measured area of the remote object. The pointer is functional only when using the IR sensor in mode 2.

The precision of measuring the temperature of a remote object depends on the size of the measured surface and the distance from which this object is measured. The measured part of the surface always forms a circle. Radiation strikes the IR sensor at an angle of 5°. The measured surface increases as the distance grows.
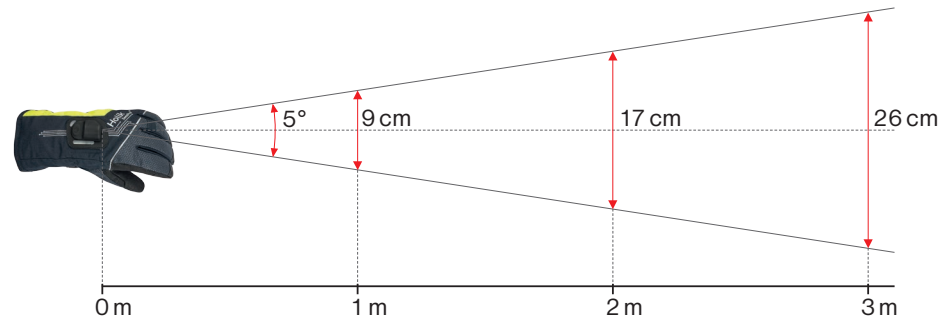

Fig. 3: The relationship between the surface measured by the IR sensor and the distance from which the surface is measured

Distance of IR sensor from measured surface (m)	0,1	0,5	1	2	3	4	5	6	7	8	9	10	20
Diameter of measured surface (cm)	1	4	9	17	26	35	44	52	61	70	79	87	175

Tab. 3: The relationship between the surface measured by the IR sensor and distance

The appropriate measurement distance must be chosen for various surface sizes. The measured object must always be the same size or larger than the measured surface (Fig. 4).

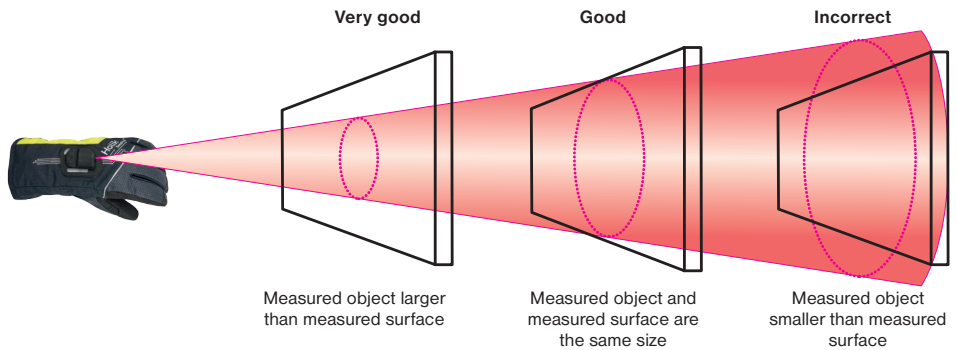|	**Very good**	**Good**	**Incorrect**
	Measured object larger than measured surface	Measured object and measured surface are the same size	Measured object smaller than measured surface

Fig. 4: Size of the surface of the measured object and measured surface

Measuring precision is also influenced by the emissivity of the measured material, i.e. its ability to radiate heat. The set emissivity of the IR sensor is 1, which corresponds to the emissivity of an absolutely black object. The emissivity of real objects is naturally lower and depends on the colour and the structure of the surface. As a result of this effect, the glove does not enable the precise measurement of the temperature of the surface of materials with low emissivity, i.e. those with a light colour and a glossy surface, glass, mirrors and polished metal. The glove will show a temperature that is lower than the actual temperature for these materials. Common materials such as wood, plastic, rubber, stone, concrete, brick wall, plaster and organic materials have a higher value of emissivity closer to 1, which means that temperature measurements of these materials will be more precise. The glove will signal a temperature for these materials that is closer to reality.

6

Accumulator charge and discharge time

The operating time of the glove is 24–32 hours, depending on the use of the laser pointer.
It takes approximately 2 hours to charge the accumulator, depending on the type of charger used.
We suggest disconnecting the accumulator when the glove is not in use.

7

Size assortment

The gloves are manufactured in sizes 7 – 8 – 9 – 10 – 11 – 12.

Glove size	Hand circumference (cm)
7	16,7 – 19,2
8	19,2 – 21,7
9	21,7 – 24,2
10	24,2 – 26,7
11	26,7 – 29,2
12	29,2 – 31,7

8

Certification

The gloves are certified according to the Protective gloves for firefighters standard EN659:2003+A1:2008. Glove electronics are certified according to the standard Explosive atmospheres – Device (general requirements) ČSN EN 60079-0:2013 and the standard Explosive atmospheres – Equipment protection by intrinsic safety ČSN EN 60079-11:2012

9 Maintenance

9.1. Washing

Remove heavy soiling after each use. Before washing, remove accumulator from glove and close the zipper of the inner pocket. Wash the gloves in the protective textile bag that came with the gloves in the packaging. Place the back of the left glove with the electronics in the palm of the right glove so that the IR sensor is protected by the palm of the right glove (Fig. 5).
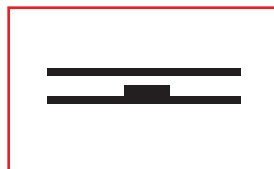

Fig. 5

Place the gloves arranged in this manner in the washing bag and close the bag. Wash the gloves at a temperature up to 60 °C. Do not use bleach or detergent. After washing and prior to drying, insert your hand into the gloves to shape them. Open the pocket for the accumulator box and move the end of the connector out of the pocket.

9.2. Drying

When drying, do not place gloves directly on the heat source. Dry slowly. Do not dry in a dryer or microwave oven. Under ideal conditions, we recommend the use of a circulating air dryer with air temperature of 45 °C to 50 °C – with air circulating into the gloves and the surrounding area.

After drying, once again insert your hand into the gloves to shape them. Make sure the connector is dry. After each washing and drying, check the functionality of the electronics; make sure the IR sensor and laser pointer are unobstructed and that the head of the temperature sensor is clean and has direct contact with the air. The SensPro® application is ideal for checking glove functionality.

9.3. Regular control and maintenance

After each use, conduct a visual inspection of the gloves, especially the accumulator, all parts of the electronics and the sensors. Keep the cover of the temperature sensor on the ring finger clean, and make sure that the IR sensor and the laser pointer remain clean and unobstructed. Clean the area around the sensors gently. Should you discover any damage or change in the volume of the parts, do not use the gloves. At the same time, check the seams and look for any tears in the material. If you determine that the gloves are damaged to an extent that prevents proper protection of the hands, do not use the gloves. These inspections are made by the user. No gloves can provide 100% protection. Perform all work with caution!

10 Storage

Store the gloves in a dry and dark space at temperatures of 5 °C to 25 °C.
Store the accumulator in a dry and dark space at temperatures of -20 °C to +50 °C.

11 Disposal

Dispose of gloves that are no longer used in an environmentally-friendly manner. The product must not be discarded with common household waste. The gloves with an electronic device and accumulator should be taken for recycling to a collection location designated for this purpose, or the gloves can be sent back to the manufacturer, Holík International, where they will be liquidated in the prescribed manner. Further information on product recycling can be found at local government offices or at waste management companies.

12 Please note – instructions for safe use

- **The electronics are built into the glove, and their casing provides coverage of at least IP 20. The mechanical integrity of the entire glove is important for the safe use of the product.**
- **Do not charge the accumulator in a space where there is a threat of explosion!**
- **Use only an SG-AB-01 accumulator from the glove manufacturer – Holík International.**
- **The accumulator charger must meet the IEC 60950, IEC 61001-1 or other technically equivalent standards.**
- **While charging, keep the accumulator out of the reach of children.**
- **If the electrical device suffers mechanical damage, it must be exchanged.**
- **Never try to remove the electronic device from the glove on your own.**
- **Device repairs are performed by the manufacturer – Holík International.**
- **Do not use or leave the gloves in the vicinity of a device producing a strong magnetic field.**
- **Avoid hitting the eyes of a human or an animal with the laser beam.**
- **Do not puncture the gloves with a needle, safety pin or any other object.**

13 Technical parameters

Name: . . . . . SensPro® protective gloves for firefighters

Glove electronics with implemented sensors

Type: . . . . . SensPro®

Manufacturer: . . . Holík International s.r.o.

Za Dvorem 612, 763 14 Zlín, Czech Republic

info@holik-international.cz

Type of protection: . . . II 2G Ex ib op is IIC Gb

Electronics standards: . . EN 60079-0:2013, EN 60079-11:2012

Glove standards: . . . EN 659:2003+A1:2008

Electronics certificates: . . FTZU 17 ATEX 0054U, IECEx FTZU 17.0014U

Glove certificates: . . . 17 0412 T/NB

Ambient temperature: . . -20 to +50 °C

Operating humidity: . . . 0 to 95%

Wireless communication: . . Texas Instruments CC2540 2.4 GHz version 4.0, max. output 10 mW

Temperature resistance of the silicon case: -50 °C to +230 °C, short-term up to 300 °C.

The electronics are built into the glove, and their casing provides coverage of at least IP 20.

Accumulator box SG-AB-01:

Rated voltage: . . . . Panasonic UF703450F Lithium Ion 3.7 V accumulator

Rated current: . . . . 170 mA

UM charging: . . . . 5.5 V

Voltage range for charging: . 5 – 5.5 V DC

Max. charging current: . . 860 mA

Temperature when charging: . 0 to 30°C

Weight: . . . . . 50 g

14   Intellectual property, trademarks:

SensPro® – a registered trademark of Holík International s.r.o.

> PATENT PENDING

HiPro® – a registered trademark of Holík International s.r.o.

> PATENT PENDING

Compact – EU industrial design – No. 001597147-0001 of Holík International, s.r.o.

DuPont™, Kevlar® and Nomex® are trademarks or registered trademarks of E.I. du Pont de Nemours and Company.

XRD® Extreme Impact Protection is a registered trademark of the Rogers Corporation or its affiliate.

Material composition of SensPro® gloves

Upper material:
Back:
DuPont™ Nomex® fabric with ceramic coating
Palm:
50% DuPont™ Kevlar®/50% DuPont™ Nomex® knitted fabric with silicon coating

Reinforcement – back:
HiPro® – Hidden Protection
- special construction of inner reinforcement of the back
- the basic layer in the reinforcement is structurally undulating PORON® XRD™ impact-absorption material
- high protection against radiant heat (58.5 s), high area-wide shock protection, improved glove maintenance

Reinforcement in fingertips:
Para-aramid fabric

Intermediate layer:
Aramid non-woven fabric

Membrane:
Membrane Porelle® FR

Lining:
Aramid lining with increased grammage /Lining with self-cooling effect

Wristband:
Compact

Other information:
Anatomic glove cut
Reflective elements, high-visible Nomex®
Snap hook for hanging gloves to clothing
Tightening strip with velcro fastening

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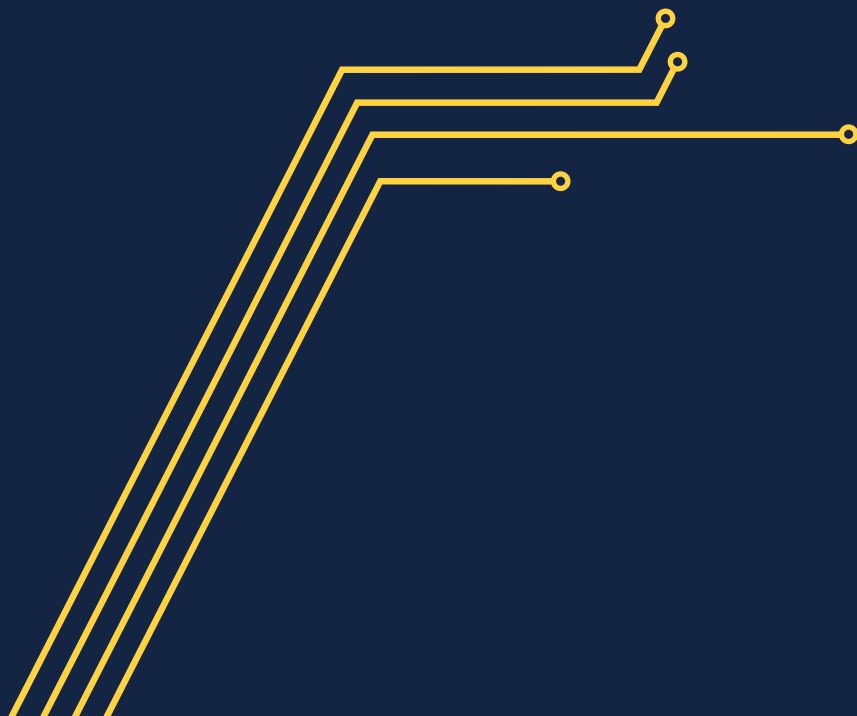
Instructions for the SensPro® application

EN

1 Downloading the application

The SensPro® application can be downloaded to your mobile device from Google Play or the App Store. You will find the application under the name SensPro®.

Your mobile device must have these minimum HW parameters:
- Wireless Bluetooth communication at version 4.0 or higher
- OS Android 4.4 and higher (Android 5.x or Android 6.x recommended)
- OS IOS 8 and higher (iPhone 4s, 5, 5c, 5s, 6, 6 Plus with Bluetooth 4.0 wireless communication)

2 Connecting the application with the glove
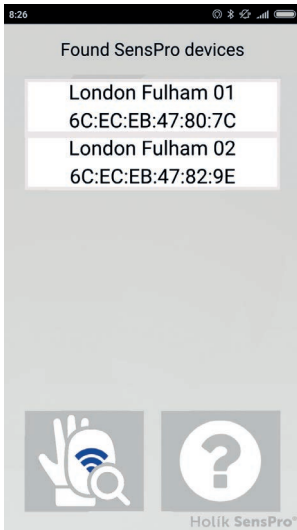
2.1.

Switch on the SensPro® glove and the SensPro® application on the mobile device.

Switch on wireless communication on your mobile device. After a short search for SensPro® gloves in the vicinity, the application will offer one or more available gloves. Click on one of the gloves to establish a connection.

2.2.

If you are unable to connect to your glove:
- Click on the icon to repeat the search.
- Restart the application and the glove.
- Check to make sure the glove has a sufficiently charged accumulator.
- Make sure your mobile device has wireless communication switched on.
- Make sure your mobile device meets the HW requirement for wireless communication, version 4.0 and higher, and that you own a device with a supported mobile Android or IOS operating system; if not, request an upgrade from the manufacturer.
- A problem can occur with the application after updating the mobile device. In this case, uninstall the SensPro® application and then reinstall it.

3 Main screen

3.1.
Access to settings

≡

Clicking on this icon gives the user access to application settings.

3.2.
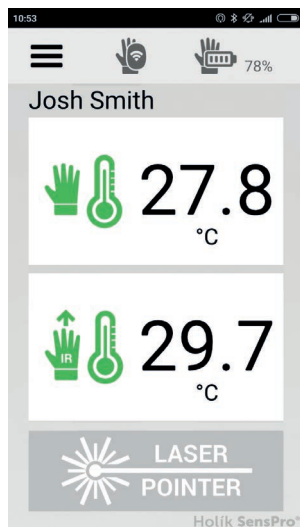Status of wireless communication with the glove

- A grey icon indicates successful wireless connection.

- An orange icon indicates that the glove is currently disconnected.

- A red icon indicates that wireless communication is switched off on the mobile device or that the gloves have been disconnected for a longer period time.

3.3.
Glove accumulator status

- A grey icon indicates that the glove accumulator is sufficiently charged (**30%–100%**).

- An orange icon indicates that the glove accumulator is low (**10%–30%**).

- A red icon indicates that the glove accumulator will soon be discharged (**0%–10%**).

3.4.
Name and surname of glove user

The name and surname of the user registered in the user settings is displayed.

3.5.

Temperature values measured by the temperature sensor are displayed

The current temperature measured by the temperature sensor is displayed. This is the temperature on the surface of the glove. The user can choose between °C or °F in the main settings. The icon or parts of the icon are colour-coded in the same way as the LED of the glove bar graph.

3.6.

Temperature values measured by the IR sensor are displayed

The current temperature measured by the IR sensor is displayed. This is the temperature of a remote object at which the IR sensor is pointed. The user can choose between °C or °F in the main settings. The icon or parts of the icon are colour-coded in the same way as the LED of the glove bar graph.

3.7.

Laser Pointer

Click on this icon to change the bar graph display mode on the glove. The first mode of the glove bar graph displays the measurement of the temperature sensor (inactive icon); the second mode of the glove bar graph displays the measurement of the IR sensor (active sensor), and the laser pointer is activated. Please note that this icon controls the glove, not the application. It is also possible to hide this icon: see basic settings – IR button.

4

Graphs of measured temperatures

Click on the window with the current measured temperature value to display the relevant graph.

4.1.

X axis

The X axis displays the time. This is absolute time, as the graph is redrawn every 60 seconds and the data is then shifted. Roll to display historical data. The current time set by the mobile device is displayed below the X axis. Ten minutes of data from the history can be displayed.

4.2.

Y axis

The Y axis displays temperature. The user can choose between °C or °F in the main settings.

4.3.

Magnifier + and Magnifier -

- By clicking on Magnifier+, the values from a longer period of time (the previous 10 minute) are displayed on the X axis of the graph.
- By clicking on Magnifier-, the values from the shorter period of time are displayed in greater detail on the X axis of the graph.

4.4.

Clicking on AutoY OFF and AutoY ON

- Click on AutoY ON to automatically change the scale of the Y axis so that the graph contains minimum and maximum measured values.
- When AutoY OFF is displayed, the scale of the Y axis does not change but is set by the user (Main settings/Graph step). The display in the direction of the Y axis is sliding depending on the currently measured temperature
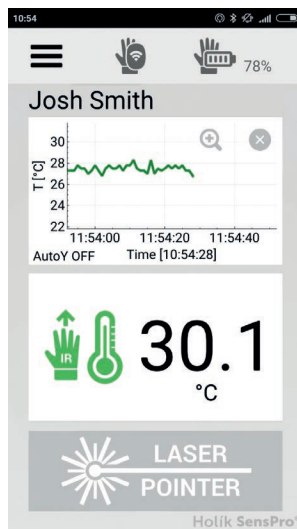
4.5.

Cross

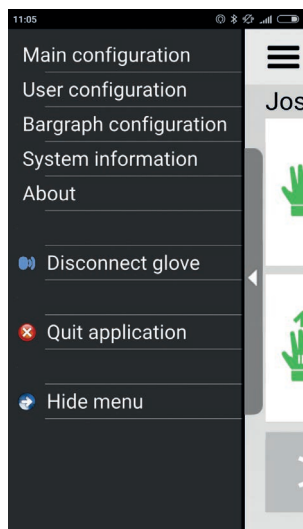Click on the cross to close the graph window.

4.6.

Graph availability

Graph data is available only until the application is switched off. If the application is switched off and then on again, the graph starts from the beginning. However, data is preserved if the glove is accidentally disconnected (without application restart).

5

Application settings

5.1.
Main configuration

– Basic settings
- Language
  Select application language
- Units
  Select °C or °F. Changing the temperature unit is best performed prior to measurement, as changes during measurement distort the graph.
- IR button
  Choose to display or hide the large lower 'Laser pointer' icon on the main screen.
- Vibration
  When this function is switched on and the last set limit is exceeded (LED blinks red), the mobile device reports this circumstance by vibrating and emitting an acoustic signal.
- WakeLock
  When the WakeLock function is switched on, the device's screen will not go to sleep with the SensPro® application in the ON mode.

– Graph settings
- Colour of TC graph and IR graph
  Colours can be chosen for both graphs.
- TC graph and IR graph step
  Stepping on the Y-axis can be set on both graphs. The graph will display detailed growth by 2 °C (or 2 °F) when the minimum size of step 2 is chosen. The graph clearly shows even large measured temperature differences when the maximum size of step 40 is selected.

5.2.
User settings

- Name and Surname
  The user's name is displayed on the main screen of the application.
- SensPro® name
  This name will be displayed when the glove is connected to the application.

5.3.
Bar graph settings

- IR limits and TC limits

This window shows both numerically and visually at what limit temperatures the glove bar graph changes LED colours. Limit temperatures can be independently set for measuring with the IR sensor (IR limits) and measuring with the temperature sensor (TC limits).

- Unlock menu

These limits can be changed by the user. After clicking on Unlock Menu, you must enter the password provided with the gloves. Five values must be entered consecutively from the smallest to the greatest. Limits are entered separately for the IR sensor and the temperature sensor. Values can only be entered in °C, while the corresponding value in °F is displayed next to it. After entering the security code, the application limits can be changed at any time while one glove is connected. The security code must be re-entered if the glove is disconnected or the application is closed. If you lose the security code, send the manufacturer the MAC address found in the System Information file.

- Bar graph and security limits

When using the gloves in professional conditions, the safety of the user is extremely important; therefore, each customer determines who is authorised to change limits and who has access to the security code. The unsystematic setting of limits can threaten the health of the user. Each user must be certain that the limits have not been randomly changed by anyone. In most cases, it is important that one squad has one fixed setting.
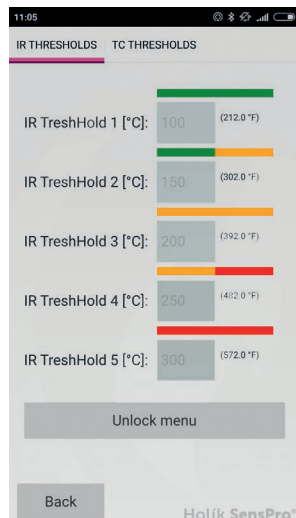
5.4.
System information

- MAC address

  Displays the MAC address of the electronics of the currently connected glove.
- System temperature

  Displays the current temperature of the electronic model in the glove.
- Operating period

  Displays the number of hours the glove device has been in operation (the total time since the glove was first switched on). Application connection has no bearing on this figure.
- Minimum and maximum IT and TC temperature

  Displays the minimum and maximum temperatures measured by both sensors throughout the entire life of the gloves.

5.5.
About the application

- Application version
- Application instructions

5.6.
Disconnect glove

The application can only be connected to one glove at a time. If one application is intended to consecutively serve multiple pairs, click this icon to disconnect the current gloves and to connect the next pair.

5.7.
Close application

Click here to end the connection with the glove and close the application.

5.8.
Hide menu

Click to display the application's main screen.

SensPro® application was developed by the RICE centre
at the University of West Bohemia.

The electronic version of the updated Instructions is available
on our website under 'Download'.

www.holik-international.com

NOTES:

NOTES:

Holík

Be careful in all activities! No glove can provide a hundred-per-cent protection!
Please, read carefully our maintenance instructions after purchasing. Storage the gloves in the dark and dry environment.

ISO 14001
TÜV
SÜD
ISO 9001

EN 659:2003
+A1:2008

EN 388:2016

EN 407:2004

IECEx

ČSN EN ISO 14001:2005
ČSN EN ISO 9001:2009

CE

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