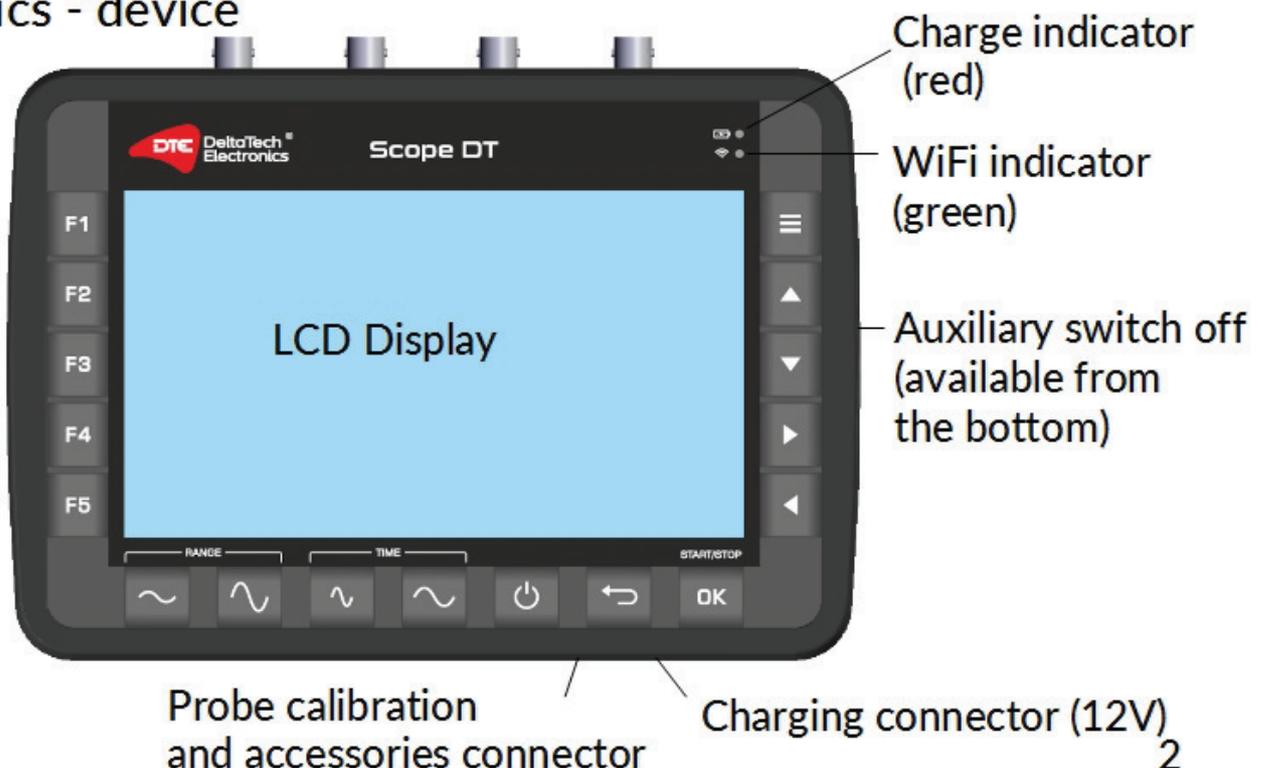# Basics – how to use the manual

Scope DT has two separate manuals
- <u>User manual</u> concerns the operation of the device itself, e.g. taking measurements, changing settings, etc. Help can be called by pressing F1 from the main menu (after switching the device on) or during oscilloscope measurements (after selecting the Oscilloscope)
- <u>Diagnoscope manual</u> contains information about car components, their operation and waveform interpretation. The diagnoscope help can be selected by pressing the F1 button from the component menu (after selecting Diagnoscope) or from the oscilloscope screen (in the Diagnoscope mode).

Use the ► and ◄ arrow keys to change the help page and the back button to exit help. When selecting device help, select first a chapter, then a subchapter. You can use the arrows to browse through the help, not limited to a specific chapter.
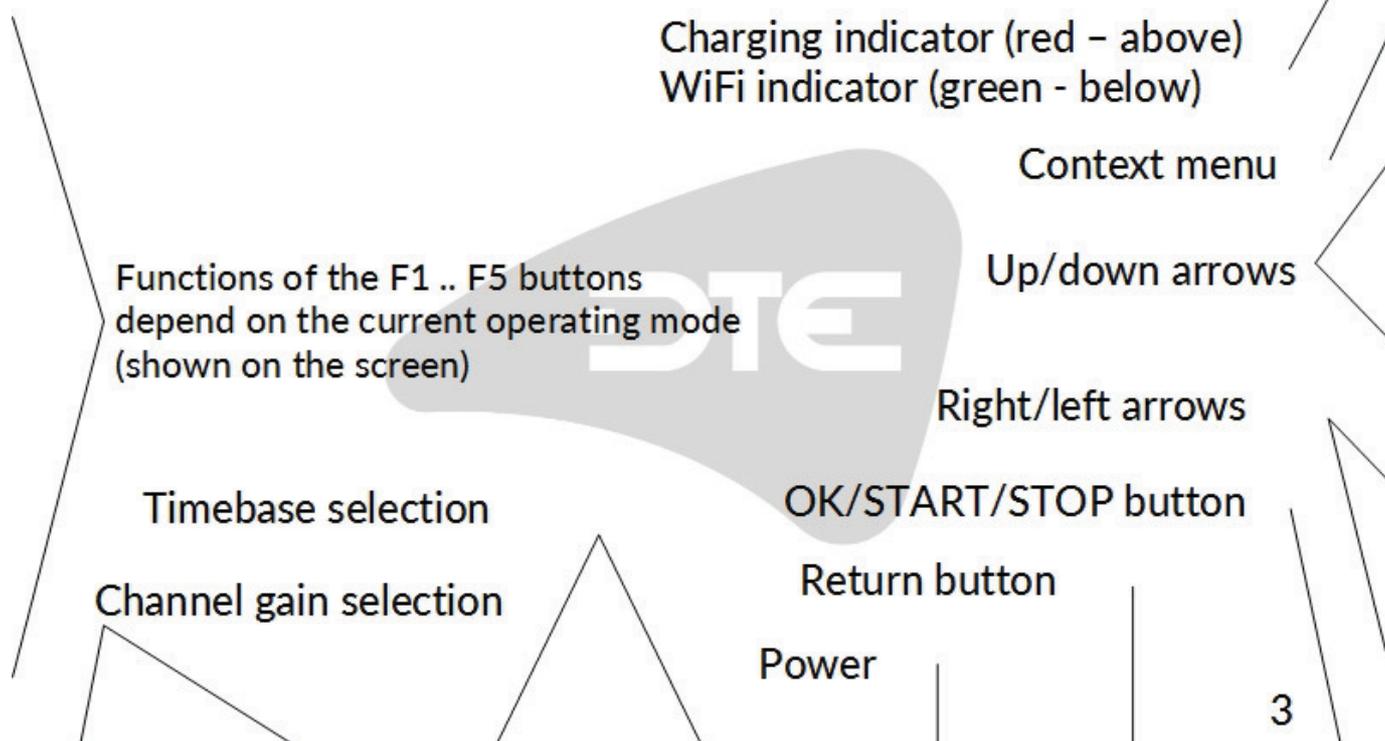
Basics - device

Charge indicator (red)

WiFi indicator (green)

Auxiliary switch off (available from the bottom)

Probe calibration and accessories connector

Charging connector (12V)

Basics - interface

Charging indicator (red – above)
WiFi indicator (green - below)

Context menu

Functions of the F1 .. F5 buttons
depend on the current operating mode
(shown on the screen)

Up/down arrows

Right/left arrows

Timebase selection

OK/START/STOP button

Channel gain selection

Return button

Power

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Basics - power

The internal Li-ion battery is charged by connecting to a 12V power supply. Use the attached 12V stabilized power supply with a current capacity of min. 2A, with a 5.5 / 2.5mm connector (plus in the middle).
- The red indicator light (1) lights up during charging.
- Full charging time is approx. 2 hours.
- You can use the device while it is charging.
- Charging can only take place in the range from 0 to 50°C.

Use the button (2) to turn the device on or off. If the auto-off option is selected (enabled by default), the device will automatically turn off after a preset time from the last button press.

In case of no reaction or problems with turning off the oscilloscope, you can force turn off by pressing a small button on the back of the housing (under the silicone cover, on the right).

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Basics – inputs

The location and numbering of the input channels (BNC connectors) are shown above. The colors are permanently linked to the channel numbers.

Channels 1 and 2 are galvanically isolated from the rest of the device (up to 1kV). This means that the grounds of the BNCs are completely separated and can be connected to different voltage levels within the allowable range. Due to the isolation, the channels have a smaller bandwidth (1.5MHz). Continuous input voltage -100 .. 100V (-200 .. 200V at peak). DC and AC modes are available.

Channels 3 and 4 are differential. They are connected to each other with a high resistance (1MΩ). The grounds of connectors can be connected to different voltage levels, but a large difference may distort the measurement. Using a charger increase the risk of interference. The channels have a larger bandwidth (up to 5MHz) and are suitable for e.g. CAN network measurements. Input voltage -50 .. 50V. DC mode is available.

Basics – safety

- Always follow the vehicle service manual and applicable safety regulations in the first place.
- Place the oscilloscope in a safe place, preventing it from moving as a result of vibrations or the connection cables being pulled in by the moving parts of the drive.
- Do not disconnect the plugs of electrical components (including the battery) when the engine is running or with the ignition on - this may cause overvoltages and damage the controller or components.
- Do not connect constant voltage with voltage higher than 100V (channels 1 and 2) or 50V (channels 2 and 3) to the measuring inputs. Higher voltages can only be measured with suitable probes.
- Be especially careful when diagnosing 48V systems.
- Do not expose the device to temperatures above 50°C.
- Protect the device from water and corrosive substances.

Basics – specifications

Scope DT

- Internal memory: 8GB
- Internal battery: Li-ion 7,2V
- Charging: external power supply 12V 2A
- Charging time: up to 2,5h
- Operating time: do 8h (depending on settings and usage)
- Operating conditions: temperature 0 – 50°C, RH < 95%
- Maximum sampling rate: 25 Msps
- ADCs: 12bit + 8bit
- Probe calibration output: 1kHz / 3,3V Vpp

Channels 1 i 2

- Input voltage -100 .. 100V (-200 .. 200V in peak)
- Input parameters: 1MΩ, 18pF, DC and AC mode
- Galvanic isolation: up to 1kV DC
- Bandwidth: 1,5MHz

Channels 3 i 4

- Input voltage: -50 .. 50V
- Input parameters: 1MΩ, 18pF (differential input), DC mode
- Bandwidth: 5MHz

For beginners – introduction

An oscilloscope measures voltage, just like a multimeter, but usually does so much faster, from thousands to millions of times per second. The results are presented in the form of an oscillogram, i.e. a graph of voltage (vertical axis) against time (horizontal axis). The device requires setting how fast the next points on the graph are to be recorded (time base) and the voltage range to be measured (gain - similar to a multimeter).

Oscilloscope measurements help visualize fast (and slow) voltage changes such as sensor signals or control signals.

The oscilloscope inputs are in the form of BNC connectors, where the outer part of the connector is ground and the inner pin contains the signal.

To perform the measurement, it is necessary to connect the ground of the connector to the ground of the component being measured (often to the ground of the vehicle) and the input to the tested point of the system. Scope DT requires a ground connection for each channel used.

For beginners – measurement settings

Timebase
In order to perform the measurement, it is necessary to set how quickly successive points on the plot are to be acquired We define the timebase as time per division. In the case of Scope DT, the total time shown on the graph is 14x the time per division. By setting 100ms/div, we get 1.4s simultaneously visible on the screen. You can change the timebase using the buttons labelled TIME below the screen.

Gain
Additionally, the measurement range should be indicated, shown as voltage per division. The full range in the graph is 8x the voltage per division. When selecting the 5V/div scale, the voltage is visible from -20V to 20V (if the graph is in the centre of the screen). The channel gain can be changed with the RANGE buttons at the bottom of the screen. Note that only the active channel is changed (the active channel can be changed by pressing the F2 button).

For beginners – trigger

Since the oscilloscope can measure quickly, it generates a lot of data. Measuring a million times per second, we will get a million points on the graph after just one second. Such waveform will fill 12,500 Scope DT screens.

The trigger settings (available under F4) allow you to define the conditions under which the device should start recording the waveform. The triggering criterion is most often a specific voltage value and the direction of its crossing (up or down). Note that trigger applies to only one selected channel.

- **Auto mode** allows you to record a waveform whether or not triggered. It is perfect for initial signal testing as it will always show the waveform.
- **Normal mode** records the waveform only when a trip occurs. It allows you to keep synchronization (the signal does not jump on the screen), but will show the waveform only when triggered - it must be set.
- **Single mode** works like Normal mode, but it stops recording after the first screen, so we not overwrite the data after first trigger occurred

For beginners – waveform measurements

It is possible to measure the parameters of the signal in two ways:

- Automatic measurements, in which the device itself determines parameters set by the user, e.g. maximum voltage, minimum voltage or signal frequency.
- Manual measurements, in which by manually moving the cursors on the screen, you can determine, for example, the time between two points or the voltage value at a given point.
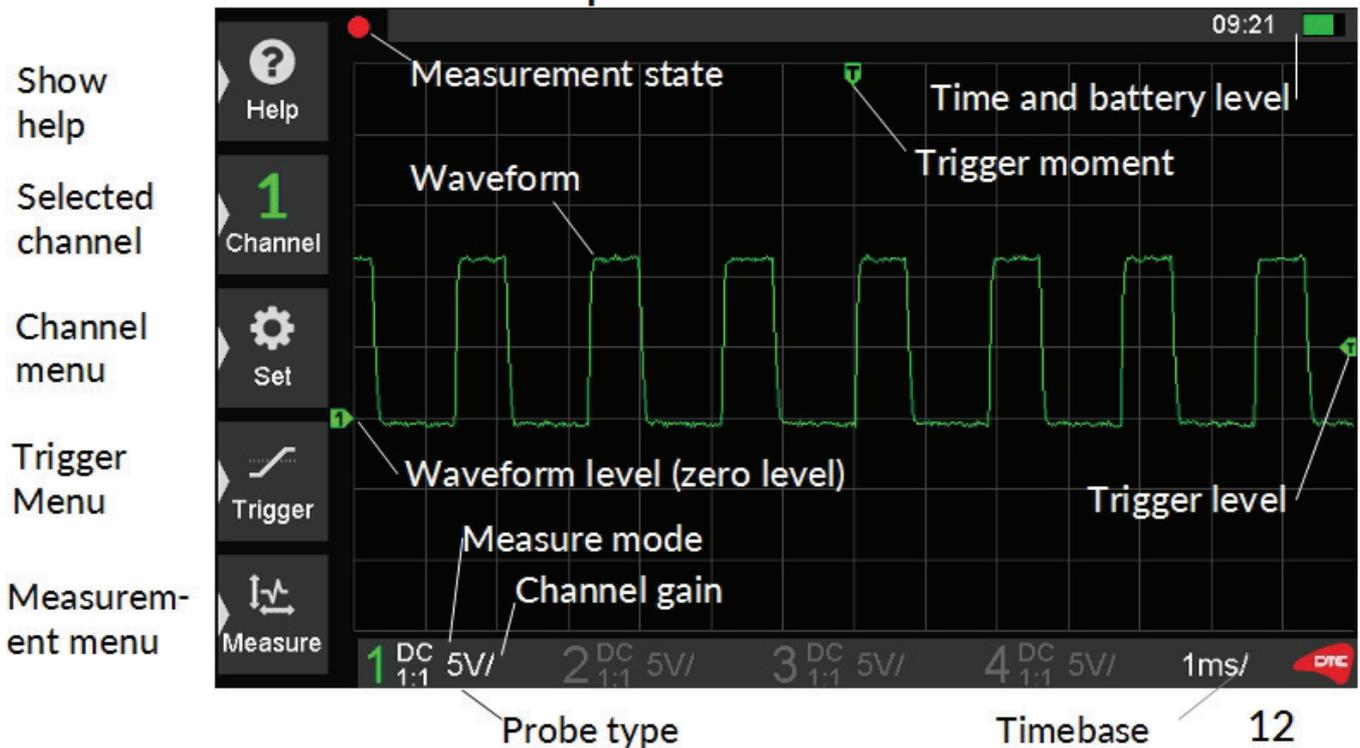
Quick measurements
By calling the measurements menu (F5) on the oscilloscope screen, we get immediate access to the list of quick automatic measurements for the channel selected (change using F2).
To display specific measurements (up to 8 at a time) or to perform measurements manually using cursors, use the menu displayed (details later in this Manual).

Measurement – oscilloscope screen

Measurement – settings

Channel selection (F2)
Allows you to change the selected channel. Changes to gain, channel settings (F3) and measurements (F5), as well as waveform position apply to the currently selected channel.

Gain (voltage per division) is selected using the RANGE buttons below the screen. The possible range is different for channels 1 and 2, and 3 and 4. The screen has 8 vertical divisions.

Timebase (time per division) is changed with the TIME buttons below the screen. The screen shows 14 horizontal divisions at a time.

Measurement - channel, waveform position

The channel menu (F3) allows you to turn on / off the channel, set the probe divider (1: 1, 1:10) and the AC / DC measurement mode (for channels 1 and 2). The menu position is changed using the ▲ and ▼ buttons. Select a specific option with the ▶ and ◀ buttons.

To change the vertical position of the waveform use the ▲ and ▼ buttons. The change affects the currently selected channel. For isolated channels with the maximum voltage scale selected, vertical shift of the waveform is limited.

The horizontal position of the waveform is changed by pressing the ▶ and ◀ buttons. In all operating modes, except for scan mode, additional data is available before and after the waveform visible on the screen.

Measurement - trigger

Trigger menu (F4) allows you to configure the trigger. The menu position is changed using the ▲ and ▼ buttons. Select a specific option with the ▶ and ◀ buttons.

- <u>Channel</u> - selection of the trigger channel (1 .. 4)
- <u>Slope</u> - Determines whether the trigger occurs on increasing signal value (↑) or on decreasing (↓).
- <u>Mode</u> - sets the type of triggering. *Auto* - triggering when the condition is met, or automatically if the triggering condition is not met. *Normal* - only triggered when the condition is true. *Single* - Similar to Normal, except that the waveform is recorded only once. For the next trigger press *START / STOP (OK)*.
- <u>Level</u> - sets the level at which the trigger occurs. Use the ▶ and ◀ buttons to set the required level (indicated by the horizontal line on the waveform).

Measurement - trigger

<u>Scan mode</u>

If the trigger is set to *Auto* and the time base is 100ms or more, the scan mode is enabled automatically.

In scan mode, the device does not wait for a trigger condition, and recording is carried out continuously. To facilitate the observation of the waveform, it is limited to one screen. In this way, recorded data is constantly visible on the screen.

When the recording reaches the end of the screen, the device gradually overwrites the beginning of the waveform as it collects new data.

To disable the scan mode, change the trigger mode to *Normal*, and then provide a trigger condition.

Measurement – measure menu

The measure menu (F5) offers waveform measurement. The menu position is changed using the ▲ and ▼ buttons. Select a specific option with the ▶ and ◀. On the right there is a list of quick measurements for the channel selected.

- **Type** allows to choose whether the measurement applies to the vertical (Voltage) or horizontal (Time) axis in the case of automatic measurements. The *Voltage-Cursors* and the *Time-cursors* allow you to measure manually with the cursors. This menu allows to enable or disable the 1kHz probe calibration signal
- **List** contains a list of available measurements to choose from or allows the user to select a cursor to move in manual measurement mode.
- **State** allows the user to enable or disable a given measurement (applies to both automatic and manual measurements) or to enable the 1kHz signal output. You can select up to 8 automatic measurements at a time, shown at the top of the waveform. The selection applies to the active channel.
- **Options** – *Clear list* allows you to disable all measurements (automatic or manual).

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Measurement – measure menu

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Measurement – context menu

The context menu can be accessed by pressing the menu button (≡). It includes the following options:

- <u>Save Waveform</u> is used to store waveforms in device memory. By default, the file name begins with the date and time of measurement, after which additional characters can be entered using the on-screen keyboard. The waveforms are automatically grouped in folders grouping the measurements from a given month.
- <u>Open Waveform</u> allows you to select a waveform file from the list and open it.
- <u>Screenshot</u> - Saves the screen image to a file. The name of the file contains the date and time of the snapshot. Screenshots are grouped in folders by month.
- <u>Setup</u> - allows you to choose one of five configurations including channel settings, time base, etc. Then you can save the current configuration to the selected location or restore previously saved configuration.

Measurement - diagnoscope

The diagnoscope function is designed to facilitate the basic measurements made by beginners and provide them with basic information about the tested components.

The diagnoscope mode is started from the main menu (after switching on). Then a list of components is displayed, which can be selected with the F1 - F5 buttons. The list is scrolled with the ▲ and ▼ buttons. After selecting a component, the device displays the available options: Help and named measurement settings, e.g. Signal. After selecting the help option, short information about the component is displayed along with information about the interpretation of waveforms. Selecting a specific item loads the settings selected for a specific measurement.

Settings and functions – on-screen keyboard

The on-screen keyboard allows you to enter characters using the buttons around the screen. The principle of operation is based on selecting a character from the list with the arrow buttons ▲, ▼, ▶ and ◀, and then entering the character with the OK button.

- The ← (≡) screen button clears the last character entered.
- The buttons at the bottom (abc), (ABC) and (@ # :) allow you to choose whether to enter uppercase or lowercase letters, or special characters.
- The (_) button at the bottom of the screen enters a space.
- Pressing the Save (F1) button saves the entered text.
- Pressing the back button allows you to return to the previous menu without saving the changes.

Settings and functions – settings menu

The following menu items allow you to change the settings. The selection of the option to be changed is carried out by means of the buttons: ▲ and ▼. The options are changed using the ▶ and ◀ buttons (except for the time and date settings).

- <u>Language</u> - allows you to select the language of the device
- <u>Time and date</u> - used to set the date and time in the device clock. The values are changed with the ▲ and ▼ buttons, and the field to be edited is selected with ▶ and ◀. The clock is supported by an internal CR2032 battery.
- <u>WiFi</u> - allows you to set the configuration of the wireless network.
- <u>Device</u> - changes settings related to the operation of the device.
- <u>Autoset</u> - enables automatic calibration of channel offsets.

Settings and functions - device

Selecting the option to change is done using the buttons ▲ and ▼. You can change the value using the ▶ and ◀ buttons.

- <u>Backlight level</u> allows you to limit the brightness of the display backlight. Lowering the maximum brightness increases the battery life. Range 1 - 31.
- <u>Backlight time</u> determines the time after which the brightness is additionally reduced to save energy. The time is counted from the last button press. Choice: 2 minutes, 10 minutes, Permanent (no brightness reduction).
- <u>Auto power off</u> allows the device to turn off automatically if no button has been pressed. Choice: 5 minutes, 15 minutes, Off.
- <u>Key sounds</u> - *Yes* or *No* - defines whether pressing buttons is accompanied by a sound. Even if No is selected, the sound is always present when the device is turned on / off.

Settings and functions - WiFi

The selection of the option to be changed is carried out by means of the buttons: ▲ and ▼. The options are changed using the ▶ and ◀ buttons. Editing the text value is possible after pressing the OK button.

- <u>State</u> (*Enabled* / *Disabled*) determines the WiFi connection status.
- <u>Network name</u> - sets the name (SSID) of the network to which Scope DT is to connect.
- <u>Password</u> - Sets the password for the wireless network.
- <u>Get IP address</u>: *Automatic* - the IP address is obtained by DHCP, *Manual* - enter the IP configuration manually.
- <u>IP address</u> - set only in manual mode.
- <u>Subnet mask</u> - set only in manual mode.
- <u>Default gate</u> - set only in manual mode.
- <u>DNS server</u> - set only in manual mode.

The MAC address of the device is displayed on the bottom right.

Settings and functions - autoset

This function allows you to automatically calibrate the input channel offsets and trigger level. The slight shift of the zero levels is a phenomenon caused by temperature fluctuations and, to a limited extent, by the aging of the components. The phenomenon is most visible at higher amplification (with low voltage values per division).

To counteract this, the zero level can be calibrated if necessary. To do this, short-circuit the inputs of all input channels (it is also acceptable to leave them disconnected, but without the measuring probes).
Before starting the auto-calibration, disconnect the device from the charger.
Select the *Autocalibration* option from *Settings* menu and wait for the end of the process.

Settings and functions - update

The device has the ability to automatically update the software. To use this functionality it is required to connect with Internet enabled WiFi network. The device uses the Internet connection to check the version and download the necessary files.

If the device, after logging into the network, detects the presence of a newer software version, *Update now* will appear in the last position of the main menu.

- Make sure your device has a working and charged battery.
- Start the update by selecting *Update now* (F5).
- After the data is downloaded and processed, the device turns off.
- Turn on the device to use the device. The version information is located in the lower right corner of the home screen.

Settings and functions – web interface

Web interface (http)

The device has a built-in wireless functionality that allows you to read data from the device.

Access to data is possible from any browser of any device (regardless of the operating system) logged in to the same WiFi network (it can be a PC, smartphone, tablet).

To open the device page, enter the device's IP address in the address bar of the browser. The IP address (obtained automatically or set manually) can be checked in the *Settings* -> *WiFi* menu, *IP address*.
The requirement for using the functionality is the correct configuration of the WiFi connection.

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