# VINCILAB 2

## USER'S GUIDE


https://cma-science.nl

**For our international users**

The latest version of this guide can be downloaded at the CMA website: https://cma-science.nl/resources/en/interfaces/007.pdf

**Aan onze Nederlandse gebruikers**

VinciLab 2 wordt standaard uitgeleverd met Engelse handleiding. U kunt de laatste versie van de Nederlandse handleiding vinden en downloaden van de CMA-website: https://cma-science.nl/resources/nl/interfaces/007.pdf

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# I. INTRODUCTION

VinciLab 2 is a modern and versatile data-logging and control solution for STEM Education. It can be used as a standalone device or as a lab interface connected, via USB or Wi-Fi, to computers (Mac and Windows), mobile devices (iPad, Android), and Chromebooks.

VinciLab 2 runs on Android 11 and is preloaded with several applications. The Coach 7 application is the main application for data collection and control when using VinciLab 2 standalone. Other applications, present on the device, offer many other useful functionalities such as setting up the device and its wireless connections, managing user files, remote desktop control, etc.

VinciLab 2 is equipped with two processors: the main processor to control the device's operating system and screen, and a measurement processor to control the measurement and control processes. It has 2 GB RAM memory and 8 GB flash memory for applications and user files. The 5" capacitive color touch screen provides an 800 x 480 pixels display offering easy control of the device.
For connecting sensors, VinciLab 2 has four BT (right-handed) sensor inputs A1, A2, A3, and A4, which support CMA sensors. Additionally, it has two built-in sensors: a 3-axis accelerometer and a microphone.
An output D1 is meant for connecting the CMA ControlBox for controlling its outputs or generating analogue signals. An output D2 is a dedicated HDMI output allowing to present the VinciLab's screen on a big screen.

For wireless connectivity VinciLab is equipped with Wi-Fi and Bluetooth. By using wireless connectivity and the RustDesk application the Vinci-Lab's screen can be remotely viewed and controlled from any computer or mobile device connected to the same network.

VinciLab is delivered with:

- USB cable for connecting to the USB port or USB power adapter,
- USB power adapter for powering and charging,
- User's Quick Start Guide and User's Guide.

This guidebook is intended to provide instructions for the basic operations of VinciLab 2.

## II. GETTING STARTED

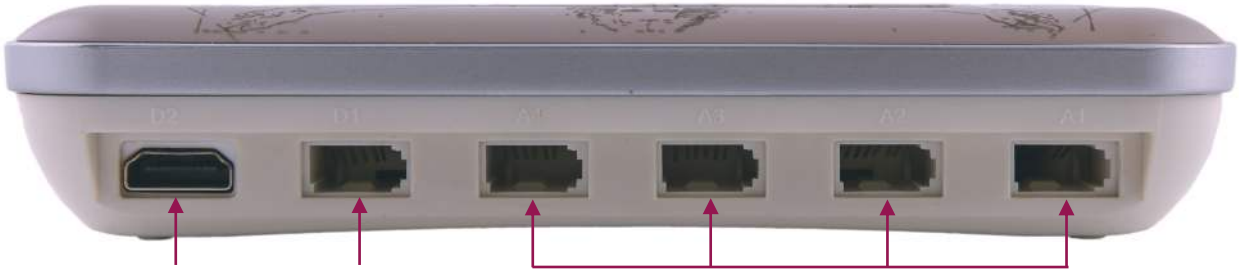
### 1. VinciLab 2 overview

**Internal Microphone**
for recording sound signals

**Capacitive Color Touch Screen**
for viewing and controlling



**Power Button**
for turning VinciLab on or off (long press) and for turning the screen on and off (short press)



**D2**
HDMI port

**D1**
for ControlBox

**Sensor Inputs A1, A2, A3, A4**
for connecting sensors

**USB C Port**
for connecting a USB cable for charging or for communication with computer

**USB Port**
for connecting any USB peripherals like a mouse, keyboard, USB flash drive, USB hub, etc.

**Audio Out Port**
output for AC and DC voltage signals, for connecting to a power amplifier

**Audio In Port**
for connecting an external microphone

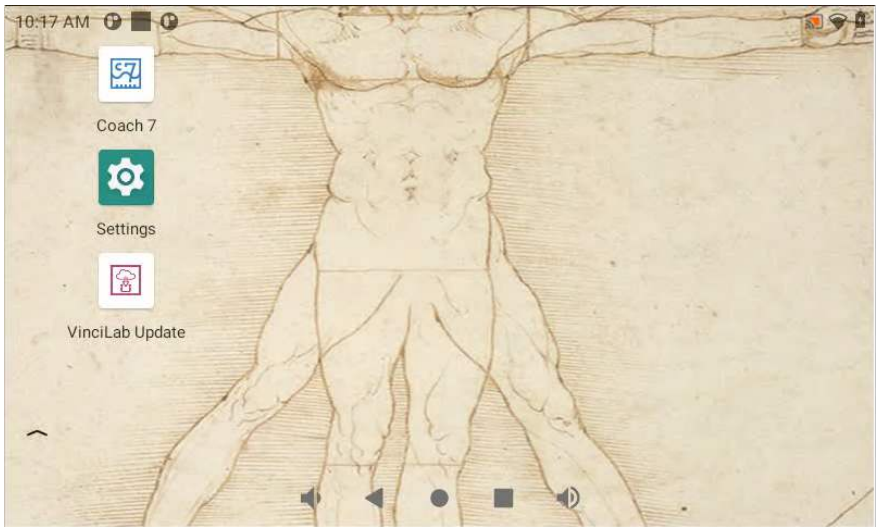
**Speaker**
for playing audio

**Battery Compartment**
for the internal, lithium-ion rechargeable battery (supplied with VinciLab 2)

## 2. Turning VinciLab 2 on and off

### *To turn on*

- Press and hold the Power button until the VinciLab's screen turns on.
- While VinciLab 2 is booting the message '*VinciLab is starting. Please wait.'* is displayed.
- Wait until the device finishes its booting procedure and displays its Home screen as shown in the image below.




***Note:***

- *The minimum battery level to start VinciLab 2 is 5 **%**.*

### *To turn off*

- Press and hold the Power button until the shutdown menu opens.
- Tap **Power off** to shut down the device.
- Tap **Restart** to start the device again.

The table below shows all the functions of the Power button.

| VINCILAB 2 IS | POWER BUTTON | ACTION |
|---|---|---|
| OFF | Short press (less than 2 s) | **Only** when connected to power:<br>battery level <= 5% then it shows battery empty screen<br>battery level > 5% then it shows the charging status |
| OFF | Long press (more than 2 s) | Turns VinciLab 2 on |
| ON | Short press (less than 2 s) | Turns the screen off<br>To turn the screen on again briefly press the Power button |
| ON | Long press (longer than 2 s) | Start the shutdown procedure |

## 3. Powering VinciLab 2

An internal rechargeable battery (Li-Poly 3.7 V, 4000 mAh, located in the back compartment), powers VinciLab 2. The battery icon on the status bar of the Home Screen indicates the current power level.
VinciLab 2 is delivered with its battery partially charged. The device will work as long as the battery provides enough power, or it is powered via the power adapter. Before the battery becomes too low for operating the device a warning will appear on the screen. If you continue working without charging, the device will shut down. A fully discharged battery requires circa 3 hours of charge time.

***To charge battery***

- Connect the USB cable to the USB C port of VinciLab 2.
- Connect the other end of the USB cable to the USB power adapter.
- Plug the USB power adapter into a standard power outlet.

- or -

- Connect the USB cable to the USB C port of VinciLab 2.
- Connect the other end of the USB cable to the USB port of your computer. The efficiency of charging via a USB port is limited by the maximal current provided by a USB socket (500 mA for USB 2.0 and 800 mA for USB 3.0).

Battery life will depend on the screen brightness and on the sensors and features used, but typically you can expect to use VinciLab for at least 4 hours without recharging it. To save power in the Settings app dim the brightness of the screen (Display > Brightness level) or set the screen timeout (Display > Screen timeout). You can also press shortly the Power button to turn off the screen when you do not need it.

The long-time life of the battery is more than 300 full (0 to 100%) charging cycles. If the charging cycle is not full e.g., 30% to 60%, it will last more charging cycles. Exposure to temperatures over 35$^{o}$C will significantly reduce battery life. A replacement battery can be ordered separately (CMA art. code 007bat).

***Notes:***

- *VinciLab can be used while the battery is being charged by the power adapter.*
- *VinciLab typically consumes about 700 mA. If you set the screen brightness to the maximum level, do a lot of data transferring via Wi-Fi, or connect many then power consumption will be much higher.*
- *When VinciLab discharges fully it will not turn on until a minimum charge of 5% is reached. This minimum level will arise when your battery gets older.*
- *For the proper functioning of VinciLab 2 for sensor recognition and measurement, we recommend having the battery level not lower than 20%.*
- *When the USB port does not provide enough power, VinciLab will not be charged, or charging will be significantly slower.*
- *On most computers, USB ports do not provide enough power for the simultaneous operation of VinciLab and charging its battery.*
- *VinciLab can work without a battery when connected to power.*

## 4. Using the touchscreen

**WARNING!** The touchscreen best responds to a tap from the pad of your finger. Using excessive force or a metallic object when pressing the touch screen may damage the glass surface and void the warranty.

***Tap***

Tap the item to select or launch them. For example, tap an item to select it, tap an application's icon to launch the application, or tap the on-screen keyboard to enter text or numbers.

***Flick or drag***

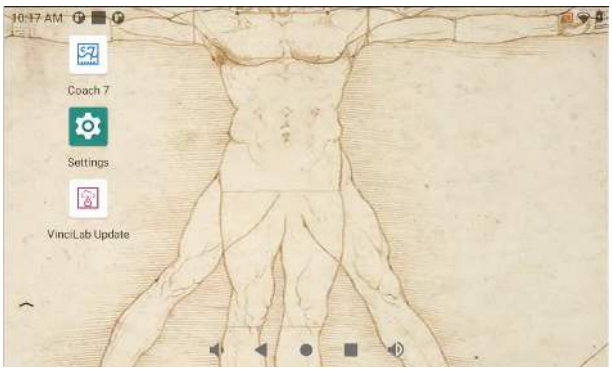
Flick or slide your finger vertically or horizontally across the screen. For example, browse through images or scroll a long screen.

***Zoom***

Place two fingers on the screen at once and pinch them together (to zoom out) or spread them apart (to zoom in).

## 5. Home Screen

The Home Screen is the starting point for using your VinciLab. The shortcuts to three applications are already present on the Home screen: Coach 7, Settings, and VinciLab Update.




The items in the bottom bar are always available for quick access.

- Make the sound volume higher
- Go step back
- Go to the Home screen
- Browse through opened applications
- Make a sound volume lower

When not visible drag the bottom upwards to display the bottom bar and drag the bar downwards to hide it.

The status bar on top of the Home screen displays additional information such as time, connectivity status, battery level, etc.

You can customise your Home screen with widgets and shortcuts to additional applications preloaded on your VinciLab.

### *To add a widget*

Tap the **Home** screen, tap **Widgets,** and select the widget that you want to have on your Home screen. For example, the Digital clock.

### *To add a shortcut to an application*

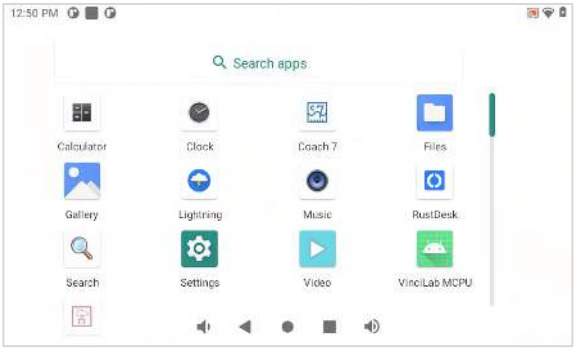
Open the Application screen, touch and hold an application icon then drag it a bit until it appears on your Home screen. Drag it further to the desired location. To remove the shortcut touch and hold an application icon on your Home screen then drag it out of the screen.

### *To change the wallpaper*

Tap the **Home** screen, tap **Wallpaper,** and select the image that you want to have on your Home screen.

## 6. Application screen

The Application screen, which you open from your Home screen, contains the applications that come installed with your VinciLab 2.




### *To open the Application screen*

- Drag a small arrow on the Home screen upwards.

### *To open an application*

- From your Home screen or the Application screen, tap the application icon.
- Most applications keep running in the background until they are closed. The next time you open the application, you can continue where you left off.
- You can view and access recently used applications by pressing in the bottom bar.

### *To close an application*

- Press in the bottom bar. An overview of recently opened applications is given.
- Swipe through the applications and select the application you want to close.
- Drag it out of the screen.

A more detailed description of apps you can find in **III. Applications**.

## 7. Sensor inputs A1, A2, A3, A4

VinciLab 2 has four BT (right-handed) sensor inputs A1, A2, A3, and A4. CMA BT sensors[1] (with exception of the CMA Digital Motion Detector 0664) can be directly connected to these sensor inputs. VinciLab 2 supports sensor recognition and automatically identifies sensors connected to inputs.
VinciLab 2 can sample up to 4 sensors simultaneously. The sampling rate depends on the number of channels used during the data collection. For measurement via one channel maximum sampling frequency is 1 MHz, for measurement via two channels simultaneously 500 kHz, and via three and four channels simultaneously 200 kHz.
All sensor inputs can be (simultaneously) used as counter inputs. Sensors such as the CMA Photogate (art. code 0662i or BT63i) or CMA Radiation sensor (art. code 0666i or BT70i) are by default defined as counters. Other analogue sensors can be used as counters after defining the counter conversion settings in Coach e.g., defining a heart-beat sensor to count heartbeats.

## 8. Built-in sensors

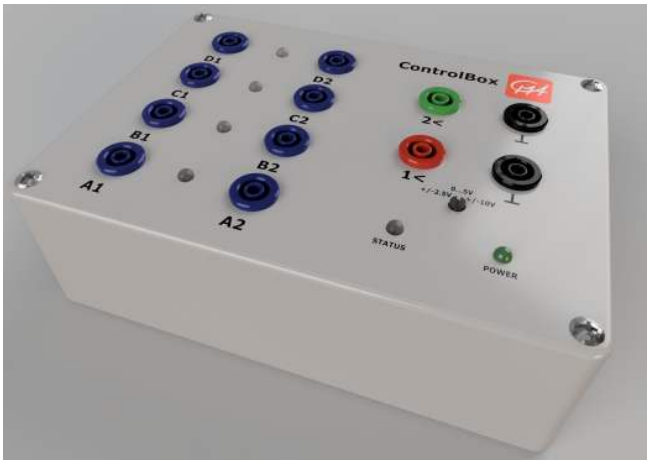
VinciLab 2 has two built-in sensors:

- A **Microphone**, which measures sound waveforms.
- A **3-axis Accelerometer**, which measures in 4 ranges: $\pm$ 20 m/s$^2$, $\pm$ 40 m/s$^2$, $\pm$ 80 m/s$^2$, and $\pm$ 160 m/s$^2$ acceleration, in the x, y, and z directions. The image shows the directions of x, y and z axes of the accelerometer.


Both internal sensors are connected to the measurement processor of VinciLab 2 and can be used in combination with sensors connected to sensor inputs.

## 9. Output D1 and D2

The output D1 is a right-handed BT socket meant for connecting the CMA ControlBox.
The Output D2 is an HDMI port that allows direct connection to a larger display. Connect VinciLab 2 and a monitor with an HDMI cable, then start up VinciLab 2.




[1] Older (4-mm) versions of CMA sensors can be connected via a 4mm to BT adapter (art. code 0519).

## 10. The ways of using VinciLab 2

VinciLab 2 can be used in the following ways:

### 10.1 Standalone

VinciLab 2 can be used as a standalone data collection device. By using Coach 7 application on the device measurements with connected sensors can be performed. Data can be collected, graphed, processed, and stored in the device's memory. This is very useful for remote data collection e.g., outside the school or in a lab where no computers or tablets are available.
Other applications, preloaded on the device, offer additional functionalities such as setting up the device, watching videos and images, using the timer or stopwatch, and browsing websites.

For a more detailed description of how to work with VinciLab standalone read **IV. VinciLab 2 standalone: working with Coach 7 app**.

### 10.2 With computers

VinciLab 2 can work as a lab interface with computers such as Mac and Windows computers. In such a case the Coach 7 or Coach 7 Lite program on the computer is used to control the data collection. The collected data are transferred to the computer and the measurement can be followed and analyzed on the computer.
The device can communicate via the USB port (USB C port on VinciLab 2) or wirelessly via Wi-Fi. The type of communication should be set beforehand in the Coach 7 app on your VinciLab and Coach 7 program via the Hardware Setting button present on the Coach 7 dashboard.
Additionally, VinciLab 2 can be used with the computer to:

- transfer files between VinciLab 2 and the computer (via USB).
- display the VinciLab's screen and transfer data by using the RustDesk application (via Wi-Fi).

### 10.3 With mobile devices

VinciLab 2 can work as a lab interface with mobile devices such as Android and iOS. In such a case the Coach 7 or Coach 7 Lite app on the tablet is used to control the data collection. The collected data are transferred to the mobile device and the measurement can be followed and analyzed on its screen. When working with mobile devices VinciLab communicates via Wi-Fi.

For a more detailed description of how to work with VinciLab with computers and mobile devices read **V. Using VinciLab as lab interface with Computers and Mobile devices.**

# III. APPLICATIONS

VinciLab 2 runs on Android 11 and is preloaded with several applications. The shortcuts to three important applications are already located on the Home screen.

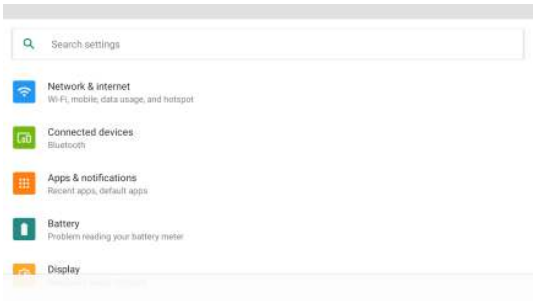
## 1. Coach 7

The Coach 7 application is used for data collection and control when using VinciLab 2 standalone. It allows you to open Activities and Results, set up experiments, collect, display, and process the collected data, and save the Results. If you are familiar with working with Coach 7 on computers or tablets you will recognise a lot of similarities in functionality. However, there are some changes, especially in the user interface making it possible to work on a small VinciLab 2 screen. Many of these changes are described in the chapter **III. VinciLab 2 standalone: working with Coach 7 app.**

- Tap  to start **Coach 7**.

## 2. Settings

The **Settings** application is used to configure your VinciLab 2.



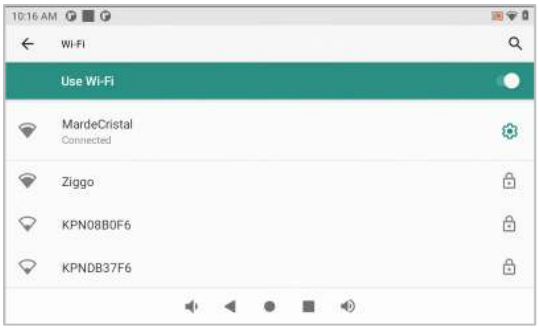

- Tap  to open **Settings**.
- Scroll down to find the desired options.
- The most important settings are described below.

### 2.1 Network & Internet

Here you can connect your VinciLab to a Wi-Fi network. VinciLab 2 supports the 802.11 /b/g/n Wi-Fi protocol.

***To turn Wi-Fi On and Off***

- In **Settings** select **Network & internet**, tap **Wi-Fi** and turn the **Use Wi-Fi** on by setting the slider to the position **On**.
- VinciLab 2 automatically scans for available Wi-Fi connections and lists the available networks.
- When the scan is completed, tap a Wi-Fi network to connect to. Enter the password when needed.
- When VinciLab is successfully connected it shows that the selected network is **Connected** and shows the name of the selected network under Wi-Fi.
- To turn the Wi-Fi services off drag the **Wi-Fi** slider to the position **Off**.



## 2.2 Connected devices

Here you can pair your Bluetooth devices. VinciLab 2 supports Bluetooth® 4.1. Bluetooth communication can be used e.g. to connect a wireless Bluetooth keyboard or a mouse.

***To pair a Bluetooth device***

- In **Settings** select **Connected devices** and tap **Pair new device**.
- VinciLab automatically searches for Bluetooth devices nearby.
- From the list of scanned devices, tap the target device, then follow the prompts to complete the pairing.
- If the target device requires a PIN, enter a PIN for the target device and confirm.
- After successful pairing, the device is listed below Other devices.

***To use USB for file transfer[2]***

- Connect the USB cable to the USB C port of VinciLab 2.
- Connect the other end of the USB cable to the USB port of your computer.

| WINDOWS | MAC |
|---|---|
| When VinciLab 2 is automatically recognized then you can use it like any other external storage device.<br>You can transfer files between your computer and VinciLab 2 by using Windows Explorer. | An Android device is not automatically recognized on Mac. You need to install first a special app such as Android App Transfer (https://www.android.com/filetransfer). After installation and connecting VinciLab 2 to your Mac computer, you will be able to transfer the files between the two devices. |

## 2.3 Display

Here you can set the settings of the screen display.

***To save power***

- In **Settings** select **Display** and tap **Brightness.** Lower the brightness of the screen by dragging the slider.
- In **Settings** select **Display** and tap **Screen timeout**. Select a screen timeout - the length of time delay between the last screen touch and the automatic screen timeout.

***Note:***

- *To reactivate the screen after it has been turned off press briefly the Power button.*

[2] This is only possible when VinciLab 2 is working standalone.

### 2.4 System

Here you can configure the Language, Date and Time.

***To set the VinciLab's language***

- In **Settings** select **System** and tap **Language & input**.
- Tap **Languages.** The English language is installed as default.
- To add another language tap **Add language** and select the desired language from the list.
- The selected language appears in the list of languages after English. To make this language your default language, tap, hold it and move to the first position of the list. The system language changes now to the selected language.


***Note:***

*This language setting is **only** valid for standard Android Applications, not for the Coach 7 app. The language of Coach 7 must be set via the dashboard button **Switch Language**.*

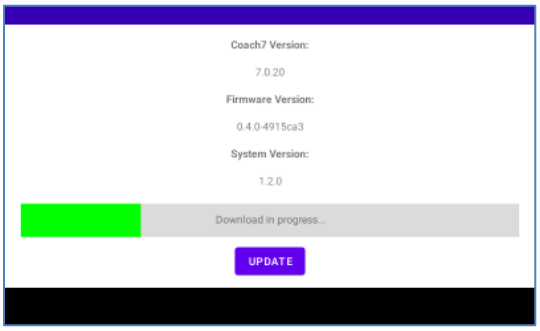
***To set date and time***

- In **Settings** select **System** and tap **Date & time**.
- Tap **Date** to select the date.
- Tap **Time** to select the time.

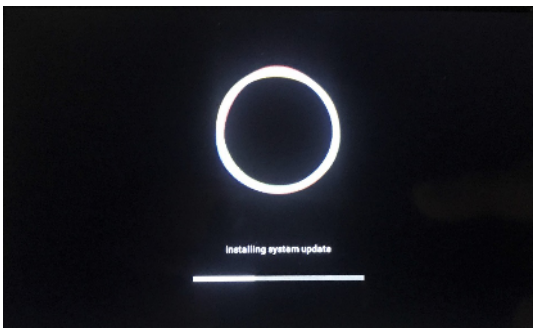
## 3. Update

The **VinciLab Update** application is used to update your VinciLab 2, its operating system, measurement firmware, and pre-loaded applications. The update does not delete the user-installed applications and the user data.

- Plug your VinciLab 2 into power and connect to the internet via Wi-Fi.
- Tap  **VinciLab Update**.
- The Update screen shows the installed system, firmware, and Coach 7 versions.
- Tap the **UPDATE** button to start the update.
- The app checks and informs you if there is a new update available. If this is the case confirm to proceed with the update.
- The update file will be first downloaded. During this process, a message is displayed and the green bar below the message shows the progress of downloading.
- Depending on your internet connection the download may take up to 15 minutes.
- Once the download process is finished the VinciLab 2 is restarted, and the update



process starts.




- The progress of the update is displayed on the screen.
- Wait until the update is completed. It takes a few minutes.
- When the update is finished VinciLab 2 is restarted again. Then it is ready to use.
- In case something goes wrong during the system update and VinciLab 2 does not work anymore contact CMA to get information on how to perform the **USB Recovery Update**.

## 4. Other applications

All applications pre-loaded on VinciLab 2 can be accessed via the Application screen.

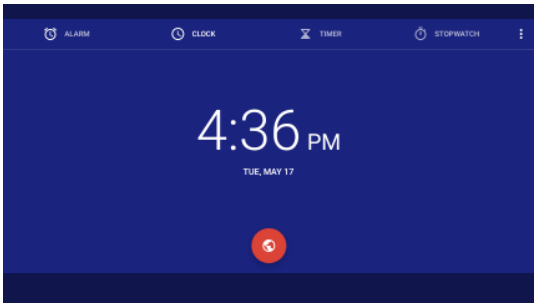
### 4.1 Calculator

The Calculator application is used to perform simple mathematical calculations.

- Tap  to start **Calculator**.

### 4.2 Clock

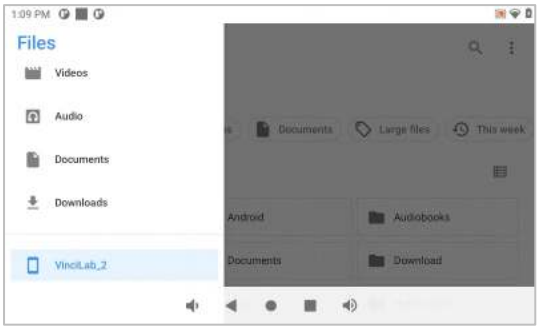
The Clock application is used to set the time, and alarm, use the timer and stopwatch.




- Tap  to start **Clock**.
- You can use this app to set an alarm, clock, timer, and stopwatch.

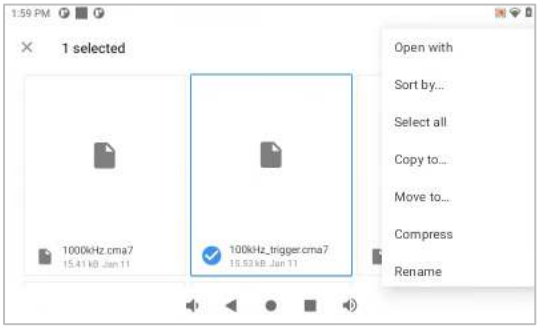
### 4.3 Files

The **Files** application is used to manage files on your VinciLab 2. It allows browsing through the internal memory of the device and USB flash memory when connected.




- Tap  to start **Files**.
- Press  to find links to the selected locations like Images, Videos, Audios, Documents, Downloads etc.
- Tap VinciLab_2 to open the VinciLab's 2 memory.
- Browse through it by tapping a folder to open it and by using  to return to the previous location.

### *To copy/move a file*

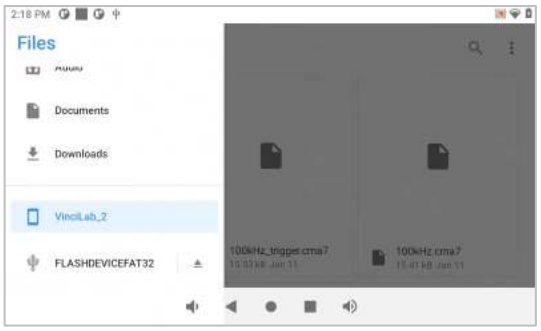



- Go to the location of your file.
- Long-tap a file to select it.
- Use ⋮ and select **Copy to/Move to**.
- Browse to the location you want to copy/move your file and tap **COPY/MOVE**.

### *To delete a file*

- Go to the location of your file.
- Long-tap a file to select it.
- Press 🗑 to delete the file and confirm with **OK**.

### *To transfer files between VinciLab 2 and a USB memory stick*



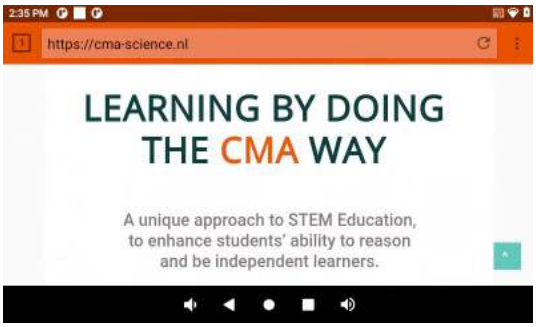

- Insert your USB memory stick into the USB port of VinciLab 2. When detected its name (here on the right image FLASHDEVICEFAT32) appears below the VinciLab_2 name.
- Tap the device name to see the folders and files on the memory stick.
- Now you can copy or move files between the two devices.
- To remove the USB memory stick first tap ⏏ next to its name. When the name will disappear, you can safely disconnect it.

## 4.4 Gallery


The **Gallery** application is used to display the images located in the Images folder on your VinciLab 2.

- Tap  to start **Gallery**.
- Tap an album to open it.
- Tap an image to enlarge it.
- Pinch in/out to zoom in/out the image.

## 4.5 Lightning




The **Lightning** application is a simple Internet browser that lets you view web pages on your VinciLab 2.

- Tap  to start **Lightning**.
- Use the browser in a similar way as any other browser.

### 4.6 Music

The **Music** application is used to play mp3 applications.

- Tap  to start **Music**.
- Use the app as any other music player.

### 4.7 RustDesk

The **RustDesk** app is an open-source remote desktop software that can be used to show the VinciLab 2 screen on a computer or a mobile device and transfer files between the VinciLab 2 and other devices via a Wi-Fi connection.

- Tap  to start **RustDesk**.
- More information on the use of RustDesk can be found at https://rustdesk.com/docs/en/manual/.

For a more detailed description of the RustDesk app see also Appendix I.

### 4.8 Search

The **Search** application is used to perform an internet search with the Internet browser.

- Tap  to start **Search**.
- Type in the term you are searching for and confirm with Go.

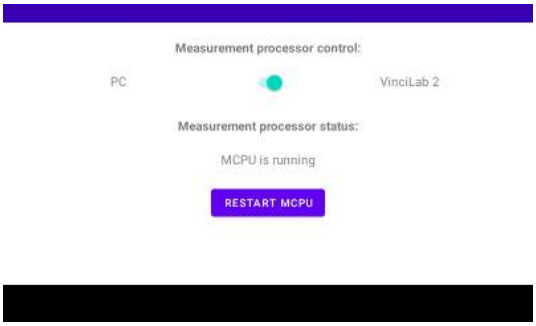
### 4.9 Video

The **Video** application is used to display the videos located in the Videos folder on your VinciLab 2.

- Tap  to start **Video**.
- Use the app as any other video player.

### 4.10 VinciLab MCPU

The **VinciLab MCPU** application is used to manually set the communication to the VinciLab 2 Measurement processor (called also MCPU).




- Tap  to start **VinciLab MCPU**.
- By default, the communication to the Measurement processor is set to VinciLab 2.
- Set the slider to PC if you want to use VinciLab 2 as a lab interface with a computer or a mobile device.
- Note, that each time you start the Coach 7 app on VinciLab 2 the communication to MCPU is automatically set to VinciLab 2.

### 5. Installing custom applications on VinciLab 2

VinciLab 2 does not offer access to the Google Play store, but users may install a custom application manually[3]. This can be done by using a USB memory stick.

***To install your own application***

1. Copy the .apk file of the application you want to install to a USB memory stick.
2. Plug the USB memory stick into the VinciLab's USB-A port.
3. Open the **Files** app. The USB memory should be now displayed below VinciLab2.
4. Tap on it. Browse through the files to locate your .apk file.
5. Tap the .apk file and select **Package installer**.
6. When a warning popups tap **Continue**.
7. Confirm that you want to install the application.
8. The application will be installed. When ready tap **Open** to start the installed application or **Done** to return to **Files**.
9. The new application should be present on the Application screen.

## IV. VINCILAB 2 STANDALONE: WORKING WITH COACH 7 APP

When using VinciLab 2 standalone the Coach 7 app preloaded on VinciLab 2 is used for data collection and control.

### 1. Starting and stopping Coach 7

***To start Coach 7***

- Tap  to start **Coach 7**.

***To stop Coach 7***

---

***Warning:***
*There is no **Quit** button present in the Coach 7 app. You **must** close Coach 7 in the way described below.*

---

- Display the bottom bar by dragging it upwards.
- Tap ■.
- Swipe through the opened apps and select **Coach 7**.
- Drag it out of the screen.

[3] CMA does not take any responsibility of the proper functionality of installed custom applications.

## 2. Coach 7 Dashboard

After opening Coach 7 displays its Dashboard which offers several buttons.


| | |
|---|---|
| **Measurement**<br>**Time-based Measurement**<br>**Event-based Measurement**<br>**Manual Measurement** | To open a measurement Activity with the predefined measurement type: time-based, event-based and manual, respectively |
| **Activity or Result** | To open an Activity (*.cma7) or Result (*.cmr7) file |
| **CMA Projects** | To open an Activity or Result from CMA Projects |
| **Switch Language** | To switch the Coach interface language |
| **Wi-Fi Measurement** | To allow Coach on other devices to control data collection via Wi-Fi |

***To open a Coach Activity/Result***

A. Press and select the desired measurement type from the menu. Activities opened in this way are set by default into the selected measurement type but do not offer any learning content.

B. Press to open an Activity or Result file from the VinciLab's memory. Browse to locate the desired Activity (*.cma) or Result (*.cmr) and tap the file to open it.

C. Press to open an Activity provided by CMA. Browse through the folders to locate the file and tap the activity to open it.
Note that the Tutorials folder offers Activities which teach you step-by-step a certain functionality of the Coach 7 program.

## 3. Activity screen

After the Coach 7 file is opened the Activity screen is displayed. Its toolbar consists of the following icons:

| Icon | Tap this icon to: |
|---|---|
|  | Return to Dashboard |
|  | Open a Coach file (*cma7 and *.cmr7) |
|  | Open Activity or Result, CMA Projects, Recent Activity or Result |
|  | Save the Coach 7 file (only *.cmr7) |
|  | Select the angle unit used in this activity |

The buttons below the toolbar give an overview of all elements present in the Activity and allow to open predefined elements on their respective screens. In case an element is not predefined the menu item **Add new** allows to create and add a new element.

| Icon | Tap this button to: |
|---|---|
|  | Open the Interface screen |
|  | Open the Data Table screen |
|  | Get a list of the “ready” graphs<br>Selecting a graph from the list opens the Graph screen<br>Use the **Add new** option to create a new graph |
|  | Get a list of the “ready” meter displays<br>Selecting a Meter from the list opens the Meter screen<br>Use the **Add new** option to create a new meter |
|  | Get a list of the “ready” value displays<br>Selecting a Value from the list opens the Value screen<br>Use the **Add new** option to create a new value |
|  | Get a list of the Texts present in this activity<br>Selecting a Text from the list opens the Text screen<br>If not Text present then the cions is not shown |
|  | Get a list of the Images present in this activity<br>Selecting an Image from the list opens the Image screen<br>Use the **Add new** option to add an image<br>Use the **Overview** option to manage images in this activity |
|  | Get a list of the Web pages present in this activity<br>Selecting a Web page from the list opens Web-page screen<br>Use the **Add new** option to add an image<br>Use the **Overview** option to manage webpages in this activity |

Get a list of the Student Text present in this activity
Selecting a Student Text from the list opens Student Text screen
Use the **Add new** option to add a Student Text
Use the **Overview** option to manage Student Texts in this activity

All the buttons present in the Activity screen are also present in the vertical toolbar on all screens of Coach 7.

## 4. Typical time-based measurement procedure[4]

1. Turn VinciLab 2 on by pressing its Power button. Wait until the Home Screen appears.
2. Ensure VinciLab 2 has sufficient battery power (at least 20%) or is connected to a power supply.
3. On the Home screen tap **Coach 7**.
4. Tap the dashboard button **Measurement** and select **Time-based Measurement**.
5. A new activity opens and displays the **Activity** Screen.
6. Tap  **Interface**.
7. Connect the desired sensor(s) to the sensor input(s) of VinciLab.
   - When a connected sensor is detected its sensor icon appears and its live readings are displayed.
   - In rare situations a sensor may be not detected. Then tap an empty sensor input to which the sensor is connected and select **Choose a sensor** and select the correct sensor from the list.
8. The sensor icons on the Interface screen show the current values measured by the sensor. The live displayed data are not stored in VinciLab's 2 memory.
9. Tap the toolbar button  **Settings** to check the measurement settings, and if desired to modify them.
10. Tap the sensor icon and select **Display as > Graph**. The Graphs screen opens and shows the standard graph.
11. Tap  to start data collection.
    - In most cases, Coach directly starts the measurement.
    - If triggering is enabled, then the measurement is started automatically when the trigger conditions are met.
12. The measurement is finished when the specified measurement time has been reached.
13. Graphs are automatically updated during the data collection and for each new measurement run, a new run is added to the graph(s). Runs are distinguished by means of a shade of the variable color; the latest Run gets the darkest shade. The Run numbers, displayed on the right side of the Graph Toolbar, indicate the number of available Runs.

[4] This procedure does not describe the Event-based type and manual measurement, use Tutorial 'Event-based measurement' and 'Manual measurement' to learn how to perform these types of measurement.

- Tap on the Run number to hide its data on the graph. Tap again to show it.
- To delete a measurement run:

**In the Graph screen:**

Tap and select the run you would like to delete. Options **All** and **All Except Newest** allow deleting all runs or all runs with exception of the latest run.

**In the Data Table screen:**

Tap a run number in the table and select **Delete**.

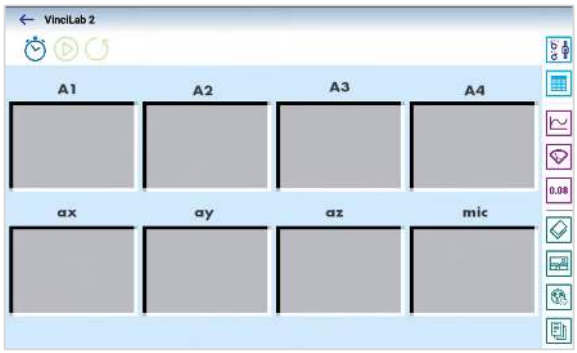
The selected run(s) will be removed from the table and graphs, and the remaining runs are renumbered. Note that this action cannot be undone, and the data of the deleted run are lost.

14. To save your Result file exit the **Graph** screen ← and confirm that you want to save it or to use in the Activity Toolbar. Name the file and tap **SAVE.**

## 5. Working with sensors on the Interface screen

Tap to open the Interface Screen. There is only one Interface screen in the Coach Activity/Result. This screen offers options to work with sensors and shows the status of:

- the sensor inputs A1, A2, A3 and A4,
- built-in accelerometer, values of ax, ay and az respectively, and
- built-in microphone.




By default, the sensor inputs are empty and built-in sensors are disabled.

### 5.1 Toolbar and menus

Depending on the selected type of measurement the following icons may be present in the toolbar of the Interface screen:

| Icon | Tap this icon to: |
|---|---|
| | Open the Measurement Settings |
| | Start the measurement<br>Inactive when no sensor(s) connected |
| | Interrupt the measurement at any time |
| | Take a manual measurement<br>Only in the manual measurement mode |
| | Replay the measurement |

### THE INTERFACE SCREEN MENUS

#### HOTSPOT: EMPTY SENSOR INPUT

Tap an empty sensor input to display the tool menu:

- **Display as > Graph, Meter, Value** – to create a standard Graph, Meter or Value.
- **Sensor Settings** – to open the Sensor Settings dialog.
- **Choose a Sensor** – to manually select a sensor from the Sensor Library.
- **Create a New Sensor > 0 .. 5 V, -10 .. 10 V** – to create a new user sensor, the correct sensor voltage range should be selected.

#### HOTSPOT: EMPTY INTERNAL SENSOR INPUT

Tap an empty ax, ay, az or mic input to display the tool menu:

- **Display as > Graph, Meter, Value** – to create a standard Graph, Meter or Value.
- **Sensor Settings** – to open the Sensor Settings dialog.
- **Enable …** – to enable the sensor.

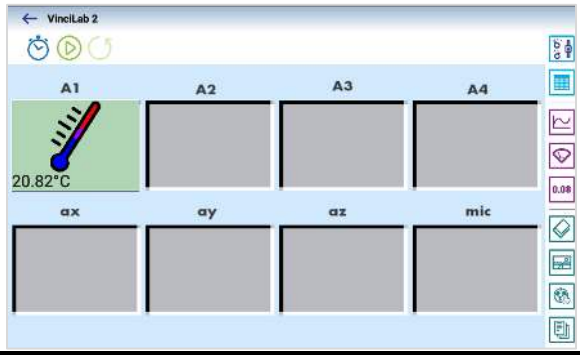
#### HOTSPOT: SENSOR ICON

Tap a sensor icon to display the tool menu:

- **Display as > Graph, Meter, Value** – to display the measured by the sensor values on a standard Graph, Meter or Value.
- **Sensor Settings** – to open the Sensor Settings dialog.
- **Set Input Range** – to set a sensor input range (calibration).
- **Set to > Zero** or **Value** – to set the actual measured value to zero or to another value.
- **Calibrate (EEPROM)** – to calibrate a detected sensor and store the new calibration in the sensor's EEPROM memory, or
- **Calibrate** – to calibrate a manually selected sensor and store the new calibration in the Sensor Library.
- **Replace** (present only for a detected sensor) – opens the Coach Sensor Library to allow selecting a sensor from the library.
- **Remove** (present only for a manually selected sensor) – to remove a sensor.
- **Exchange** (present only when another than predefined sensor is detected) – to change a predefined sensor to a detected sensor.
- **Disable** (present only for a built-in sensor) – to disable the sensor.

## 5.2 Connecting and detecting sensors

After connecting a sensor to a sensor input of VinciLab 2, the device tries to identify the connected sensor.

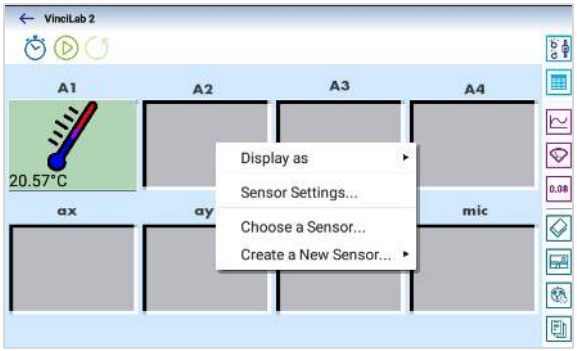



- When the sensor is detected its sensor icon appears on the respective input on the screen. The live data measured by the sensor are displayed on the icon.
  When such a sensor is disconnected its icon

disappears automatically.

- When the sensor is not automatically detected the sensor icon does not appear on the screen. This happens for example for older CMA sensors or sensors connected via the CMA 4-mm to BT adapter art. code 0519. The correct sensor must be manually chosen from the Sensor Library.
  - Tap an empty input on the screen to which the not detected sensor is connected.
  - Select **Choose a sensor**.
  - Select a sensor from the list and confirm with **OK**.

  When such a sensor is disconnected then its icon remains on the screen. To remove it tap the icon and select the option **Remove**.



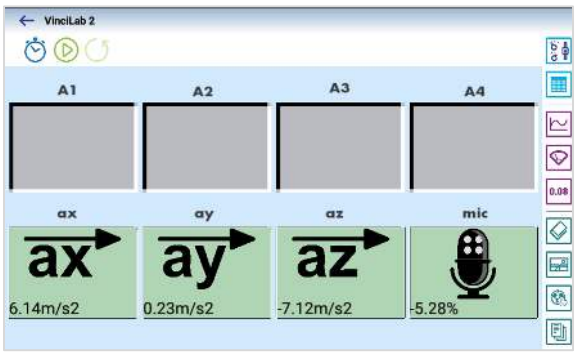

In many activities provided by CMA, an icon of the predefined sensor is already present on a sensor input. As long as there is no sensor connected to an input on which the sensor icon is present the icon is inactive. After connecting a sensor to such input, the following can happen:

- if the connected sensor is detected as the same as the predefined sensor, then the icon becomes active, and Coach starts to measure.
- if the connected sensor is detected as different than the predefined sensor, then the displayed icon gets red background and remains inactive. Tap the sensor icon and select **Exchange** to change the sensor to the connected one.
- if the connected sensor is not detected at all then the displayed icon remains inactive. Tap the icon and select **Confirm** to accept the pre-defined sensor or tap **Clear** to remove the connection.

### 5.3 Using the built-in sensors

To be able to use built-in sensors they must be enabled.

- To make the accelerometer ready for measurement tap the empty ax, ay, or az input and select **Enable accelerometer**. The ax, ay, az inputs are used for the acceleration components respectively in x, y and z directions.
- To enable the microphone, tap the empty mic input and select **Enable Internal microphone**.




- To disable the sensor, tap a sensor icon and select **Disable**.

### 5.4 Creating own sensors

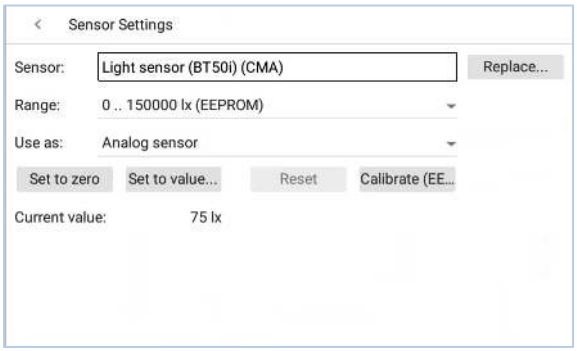
Users can create their own sensors and add them for use in Coach. Since analog inputs of VinciLab measure voltage signals in two ranges, it is important to indicate which voltage range is used by a new sensor.

- Tap **Create New**.
- Select the voltage range of your new sensor.
- By default, the sensor settings are filled like for a Voltage sensor. Enter the sensor information adequate to your sensor.
- Perform the sensor calibration by providing a function or by typing/measuring the calibration points in the same way as described for the standard calibration.
- Confirm to save the new sensor. Confirm with **Yes** if you want to save the new sensor in the Sensor Library then it will be available globally and you can use it in any Coach Activity. The sensor is indicated by the label **Self-made**.
- To remove the self-made sensor from the sensor input, tap the sensor icon and select **Remove**.
- If you want to remove the sensor from the Sensor Library, open the Sensor Library, select the sensor, and tap **Delete**.

### 5.5 Sensor Settings

The **Sensor Settings** dialog displays the sensor information and allows sensor setup. When a sensor is automatically detected or selected from the Sensor Library then all its settings are automatically loaded and displayed in the Sensor Settings.

- Tap an empty sensor input or a sensor icon and select **Sensor Settings**.




The following options may appear in the Sensor Settings dialog:

**Sensor:** displays the name of the connected sensor or **None** if there is no sensor connected or detected. To manually set up the sensor click **Choose** and select a sensor from the Sensor Library.

**Enabled**: (appears only for internal sensors)
Select Enabled when you want to activate the sensor. Deselect **Enabled** when you do not want to use the sensor.

**Range:** displays the sensor range. For sensors with EEPROM memory, this is the range stored in the EEPROM (selected by default). Many sensors have multiple ranges.

- Tap a measurement range to choose another range. The calibration stored in the sensor's memory is indicated by 'EEPROM'.

**Use as:** displays the mode in which the sensor has to work. Most sensors are used by default as Analog sensors.

- To change the sensor mode tap the selected mode and select another mode.
- For Counter, Digital sensor (1-bit), Frequency meter and Time-interval meter you

have to specify the conversion settings.

Use **Set to zero** or **Set to value** to shift the provided sensor calibration through zero or the given value.

Via **Reset** the user calibration will be reset to the original calibration.

Use the **Calibrate** button to open the calibration, which belongs to the currently selected range, and modify it if needed. The new calibration can be added as a new range, or when the EEPROM range is selected, can be stored in the sensor's memory (see further for more details).

**Current value:** displays the actual value measured by the sensor.

Use **Replace** to choose another sensor from the Sensor Library and replace the currently selected sensor. This action can be performed even when the automatically identified sensor is selected, then its settings are overruled by the settings of the newly selected sensor.

Use **Exchange** to replace the pre-defined sensor with the detected sensor.

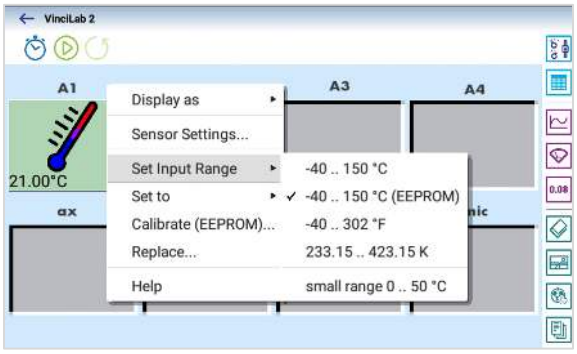
Use **Remove** to remove such a sensor from the input.

### 5.6 Sensor Input Ranges

Modern sensors are equipped with EEPROM memory, which stores the factory calibration of the sensor. For these sensors, Coach uses as default this EEPROM calibration. A similar calibration is stored in the Sensor Library allowing to manually set up of the sensor. For many sensors also a few more calibrations, so-called sensor input ranges, are offered, e.g. the temperature sensor BT05 by default uses the °C range but it can also be set to measure in °F.

***To change the input range of the sensor***

- Tap a sensor icon and tap **Set Input Range**.
- A list of all available sensor ranges appears. The abbreviation 'EEPROM' indicates the calibration stored in the sensor memory.
- Select the desired range. The readings of the sensor will be adjusted accordingly.




The provided calibrations can be improved for better accuracy or new calibrations can be made and added as new input ranges. The sensor calibration in Coach provides the sensor name, its measurement range, and the mathematical relation between the voltage values produced by the sensor (in most cases) and the values of the physical quantity measured. There are two ways to perform a calibration:

- By providing a calibration function: method **Function.**
- By providing calibration points in the calibration table: method **Points** (not possible for the EEPROM memory).
  These points can be:

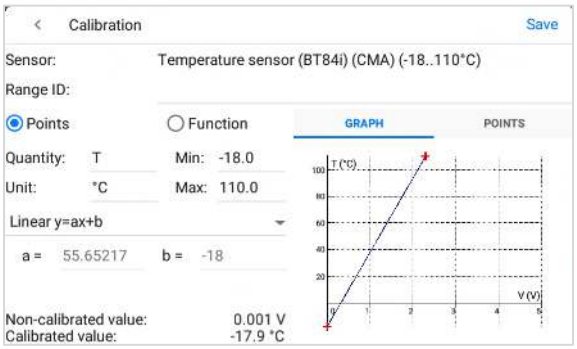
- **measured**: the sensor voltage value is measured, and the value of the corresponding quantity is typed. In this case, the sensor must be connected to VinciLab 2. Such calibration is the most accurate calibration.
- **keyed in**: both, the sensor voltage value and the value of the corresponding quantity, are typed.

The best function fit, through the calibration points, is calculated according to the least-squares method. The calibration function will be then extrapolated to cover the whole range.

For sensors equipped with EEPROM memory, it is also possible to replace the factory calibration with a new calibration. This allows making an accurate calibration per physical sensor. Next time such a sensor will be connected and detected its new calibration will be used.

***To add a new calibration (range) for a predefined sensor***

- Connect the sensor to your VinciLab 2.
- If the sensor is not detected choose it manually from the CMA Sensor Library.
- Tap the sensor icon, tap **Set Input Range** and select a range you want to calibrate but **not** the EEPROM range.
- Tap the sensor icon again and tap **Calibrate**. The Calibration opens and shows the sensor name, calibration settings, and the calibration graph.
- In the **Range ID** enter the range name.
- Select the calibration method: **Function** or **Points**. When the method Points is selected the tab **Points** with the calibration table is added.

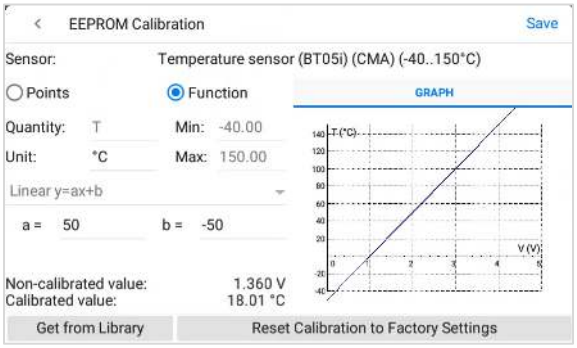



- If desired change: **Quantity**, **Unit**, **Minimum** and **Maximum**.
- Select the desired function-fit type.
- Perform the calibration. Key in the function coefficients (Function) or fill the calibration table by adding calibration points (Points).
- Tap **Save** to save the new range. To store your new calibration with the sensor, tap **Yes**. Then this range will be available globally in Coach 7 and you can use it in any Coach Activity. When you answer **No** the new calibration will be available locally only in this Activity.
- Use the **Delete range button** In the Sensor Settings dialog to remove a user range.

***To replace the calibration in the sensor's EEPROM memory***

- Connect a sensor equipped with EEPROM memory to your VinciLab 2.
- Tap the sensor icon, tap **Set Input Range** and check if the range is set to EEPROM. If not select the EEPROM range.
- Tap **Calibrate**.
- Key in new coefficients and if needed a new unit. The calibration graph will be adjusted accordingly. It is not possible to edit the quantity, minimum, and maximum of the

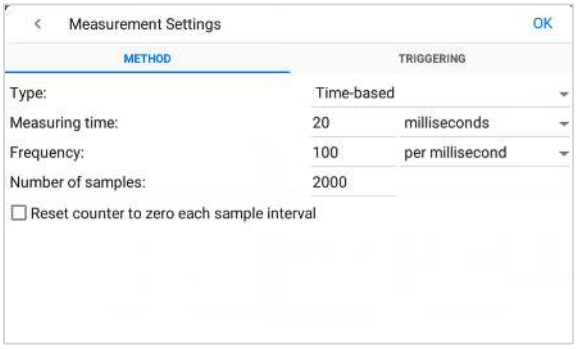
sensor range and function type. This is because the EEPROM calibration has a specific (fixed) format.




- You may use the **Get from Library** button to load the existing calibration from the Sensor Library.
- Tap **Save** to store the new calibration in the sensor memory. Tap **OK** to accept. The new calibration replaces the old EEPROM calibration.
- Use the **Reset Calibration to Factory Settings** button to restore the original EEPROM calibration.

### 5.7 Measurement Settings

The **Measurement Settings** dialog specifies how VinciLab has to measure.




For **Time-based** measurement:

- Type in the duration of the measurement and select the unit (default 10 s).
- Type in the frequency and select the unit (default 50 per s).
- The Number of samples is automatically calculated from the settings of the fields above. The actual measured number of samples is usually the shown number plus 1, because the measurement starts at time t=0. It is also possible to enter the desired number of measurements. In this case, the measuring time will be adapted. The maximum number of points in Coach is 500,000.

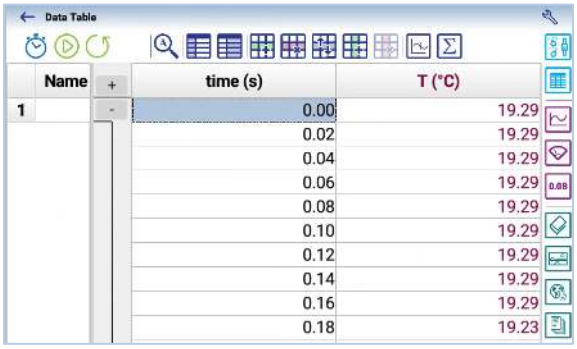
For **Event-based** measurement:

- Enter the **Number of samples**.
- If needed re-define the **threshold** and the **direction** of the signal.

For **Manual** measurement:

- Enter the **Number of samples**.
- Tap **Input** and define the keyboard input(s).

## 6. Data Table screen




The Data Table screen displays the table with measured and calculated data. There is only **one** Data Table in an Activity/Result. On starting a data collection the Data Table is filled with data; a new Run is added after each new measurement run.

- Tap  to open the Data Table screen.

The Data Table is organized as follows:

**LEFT** displays Run Series, by default the run number and its name.

**RIGHT** displays Data Series, often Time Series.

**MIDDLE** links the left and right parts of the table and visualizes the connection between the Run and its Data Rows. Tap **+** and **-** to open and close the data series.

The toolbar of the Data Table screen, next to the measurement icons, has the following icons:

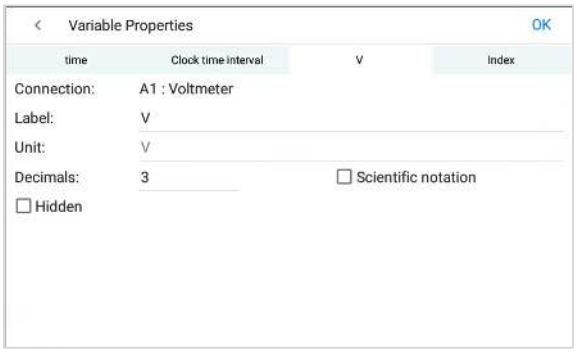
| Icon | Tap this icon to: |
|---|---|
|  | Zoom text and digits displayed in the table |
|  | Display properties of variables used in Run Series (the left side of the table) |
|  | Display properties of variables used in Data Series (the right side of the table) |
|  | Insert an empty Run in Run Series or empty Data Rows in Data Series |
|  | Delete Runs in Run Series or Data Rows in Data Series |
|  | Sort Data Rows |
|  | Add a Variable (column) into Run Series or into Data Series |
|  | Delete a Variable (column) in the Data Table |
|  | Scan on/off data in the Data Table |
|  | Display Statistics |

### 6.1 Variable Properties

Each variable displayed as a column on the table has its default properties.

#### *To change Variable Properties*

- Tap a Variable name (column header) in the table and select **Properties**.
- The **Variable Properties** dialog opens.
- Specify the variable properties.




**Connection**: the connection shows to which data source the variable is coupled.

**Label**: The unique variable name.

**Unit:** The unit, defined via connected data. In some cases, like for sensor data cannot be edited.

**Decimals**: The number of decimals used to display data in the table.

**Scientific notation:** If checked then data in the table are displayed in scientific notation.

**Color**: The color applies to the column header, variable data in the table, graph labels, markers, and line width used in graphs. Runs of the same variable are indicated by different shades of the selected color.

**Hidden**: check to hide or show the variable in the table.

### 6.2 Run Properties

The **Run Properties** dialog displays information about Run, its number and name, and the number of Data Rows. It also allows overruling the default color of a Run.

#### *To change Run Properties*

- Tap the Run number and select **Properties**.
- Type in a name of the Run.
- Select **Use special color** and select the color. This color will be used for graphs of all variables in this run.


#### DATA TABLE SCREEN MENUS

**TOOL MENU**

- **Show Variable** - to show/hide a Variable in Run or Data Series.
- **Runs** - to delete, import, export and insert new Runs.
- **Scan** - to data in the Data Table.
- **Clipboard copy** - to copy the image of the visible part of the Data Table.

**HOTSPOT: VARIABLE HEADER**

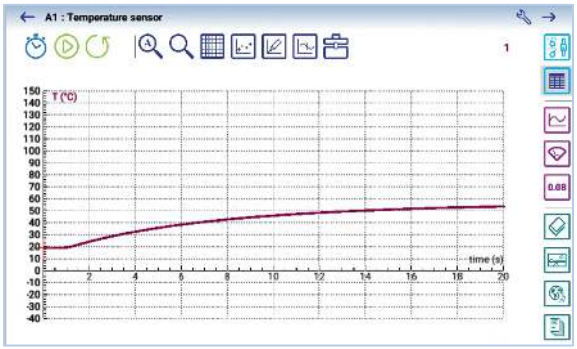
- **Properties** – to open the Variable Properties dialog.
- **Delete** – to delete the Variable (only possible for variables added by users).
- **Hide** – to hide the Variable.
- **Add a New** - to add a new Variable into Run Series or Data Series, depending on which side of the table the option is selected.

**HOTSPOT: RUN NUMBER**

- **Properties** – to open the Run Properties dialog.
- **Delete** – to delete a Run.
- **Insert** – to insert an empty Run.
- **Move Up** - to move the selected Run up.
- **Move Down** - to move the selected Run down.

## 7. Graph screen

A graph is used to graphically display the collected data. Variables can be displayed along the horizontal and left/right vertical axes.




- Tap  to get a list of the "ready" graphs.
- Selecting a graph from the list opens the Graph screen.
- Use the **Add new** option to create a new graph.

The toolbar of the Graph screen, next to the measurement icons, has the following icons:

| Icon | Tap this icon to: |
|---|---|
|  | Set the fonts size of graph labels and scales |
|  | Auto-zoom the graph |
|  | Return to the previous zoom state |
|  | Place or remove a grid on the graph |
|  | Open the Graph Properties dialog |
|  | Turn on/off the sketching tool to draw a graph manually |

| | |
|---|---|
|  | Turn on/off the scanning mode displaying selected points |
|  | Open Analyze/Process Data tools |
|  | Delete a measurement run(s) |
| 1 | Display/hide a run# |

There can be many graphs in a Coach Activity/Result. Browse through the "ready" graph by using → on the top bar.

**GRAPH SCREEN TOOL MENU** 

- **Show Run** – to display and hide a selected run on a graph.
- **Delete Run** – to delete a selected run.
- **Import Background Graph** – to import a Coach Activity/Result file and place it in the graph as a background graph. When a graph is inserted as a background graph then the options to **Shift Background Graph** and **Delete Background Graph** are added.
- **Clipboard Copy** – to copy the Graph pane to the clipboard for use for example in Student text.

Graphs are automatically updated during the data collection and for each new data collection, a new run is added to the graph(s). Runs are distinguished by means of a shade of the variable color (specified in the Variable or Graph Properties). The latest Run gets the darkest shade. The Run numbers, displayed at the right side of the Graph Toolbar, indicate the number of available Runs.

- To hide a measurement run tap on the Run number. Tap again to show it.
- To delete a measurement run, tap  and select a run you want to delete it.

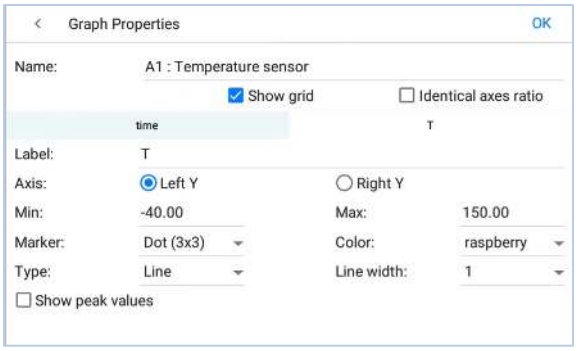
### 7.1 Graph Properties

Each graph has its own style; you can change it via the Graph Properties option.

***To edit graph properties***

- Tap the toolbar icon **Graph Properties**  .
- Adapt the Graph properties.

**Name**: The graph name used in the caption of the Graph pane.




**Show grid**: When marked, the grid is displayed in the graph.

**Identical axes ratio**: When marked, the units along the horizontal and vertical axis in the graph use the same number of screen pixels. For example, with the Identical axes ratio marked, a circle will be displayed as a real circular shape on the screen (rather than an ellipse).

Variables used along the graph axis are displayed via tabs.

- Tap a tab to edit the variable properties.

**Label**: A unique variable name. This name is shared in graphs and Data Table.

**Axis:** indicates the selected axis which can be X, Left Y, or right Y.

**Min/Max**: The minimum and maximum values limit the scale of the graph. Notice that the duration of measurement is only determined by the measurement settings, not by the maximum of the time axis in the graph.

**Marker**: A marker used to mark the individual data points. Notice if Marker = Small dot and Connection type=Line, the small dot is not visible (the dots are overlapped by the line). The same may apply to other markers when the line width is set to a thicker line.

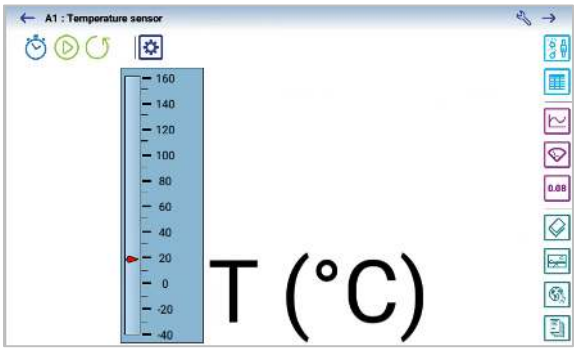
**Color**: The color applies to the markers and line style used in the graph. The same color is also used for the name of the variable label and unit along the axes and for the Data Table.

**Line width**: The thickness of the graph line. The setting of line width does not apply when Connection type = None.

**Show peaks values**: When checked the peaks of the variable showed in the graph are labeled with their respective values.

## 8. Meter Screen

A Meter is a scaled analog display; its pointer indicates the values generated by a variable.




- Tap  to get a list of the “ready” Meters. Selecting a Meter from the list opens the Meter screen.
- Use the **Add new** option to create a new Meter.
- There can be many Meters in a Coach Activity/Result. Browse through the “ready” Meters by using → on the top bar.

The toolbar of the Meter screen, next to the measurement icons, has only  that allows editing properties of the displayed meter.

### *To edit Meter properties*

- Tap  to open the **Edit a Meter** dialog.
- Modify a default Meter to create your own.

**Name**: The name of the Meter.

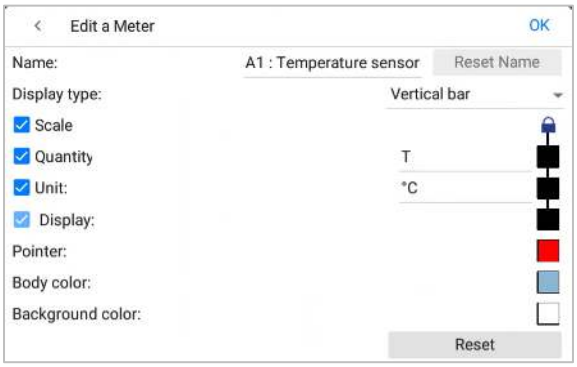
**Display type**: The type of meter, following types are available: Horizontal bar, Vertical bar, Quarter circle (90°), Half circle (180°), Full circle (360°).

**Quantity**: the label shown, uncheck when you do not want to display.

**Unit**: the unit shown, uncheck when you do not want to display.

**Scale**: the scale shown, uncheck when you do not want to display.

**Min., Max.**: minimum and max values of the meter's scale.




For Quantity, Unit and Display colors can be set. When the lock is closed (default) then the same color is used for all.

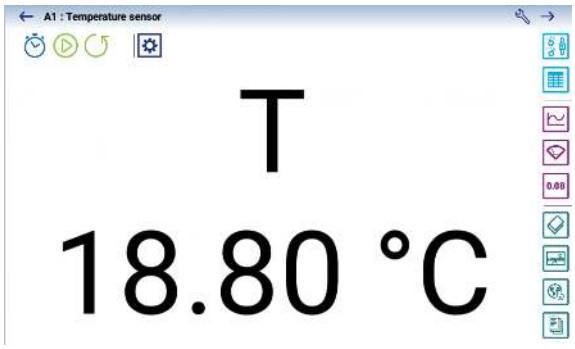
The options **Pointer**, **Body color** and **Background color**, define the meter's colors.

Use the **Reset Name** button to reset the Meter name to its default name.

Use the **Reset** button to reset your new Meter into a standard Meter.

## 9. Value screen

Value is a digital display, which displays values generated by a variable in large-sized numbers.




- Tap  to get a list of the "ready" Values. Selecting a Value from the list opens the Value screen.
- Use the **Add new** option to create a new Value.
- There can be many Values in a Coach Activity/Result. Browse through the "ready" Values by using → on the top bar.

The toolbar of the Value screen, next to the measurement icons, has only  that allows editing properties of the displayed meter.

### *To edit Value Properties*

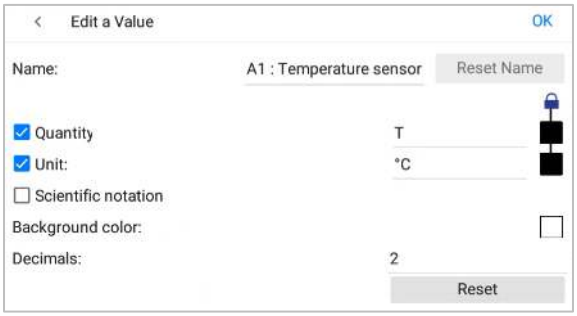
- Tap  to open the **Edit a Value** dialog.
- Modify a default Value to create your own Value.

**Name**: The name of the Value.

**Quantity**: the label shown, uncheck when you do not want to display.

**Unit**: the unit shown, uncheck when you do not want to display.

For **Quantity** and **Unit** labels colors can be set. When the lock is closed (default) then the same color is used for both.




**Decimals**: the number of decimals used in the display. For very large or very small values the **Scientific notation** can be turned on.

**Background color**: defines the background color used in the Value pane.

Use the **Reset Name** button to reset the Value name to its default name.

Use the **Reset** button to reset your new Value into a standard Value.

## 10. Data Analysis and Processing Tools

The collected data can be processed with the help of simple and advanced tools, which are available on the Data Table and Graph screens.

### 10.1 Simple Analysis Tools

The Graph screen has a range of simple tools available directly via the Toolbar icons. Note that some tools and options can be used **only when there are data available**.

***To zoom in & out a graph***

- Tap  to auto-scale the graph.
- Drag a rectangle area to zoom in, the area will be enlarged to fill the whole pane.
- Place two fingers on the screen at once and pinch them together (to zoom out), or spread them apart (to zoom in).
- Tap  to return to the previous zoom stage.

***To sketch a graph***

- Tap  .
- Draw a smooth curve by dragging to the right (erase by dragging to the left) or tap several points to draw a point-to-point graph.
- If you want to erase the sketch tap the Tool menu and select **Erase**.
- Tap  to turn off the sketching tool.
- A new set of data (run and variable column) is added to the table. The Sketch is a manual type of data that may be edited in the Data Table. By default, the sketch graph is drawn in black colour.

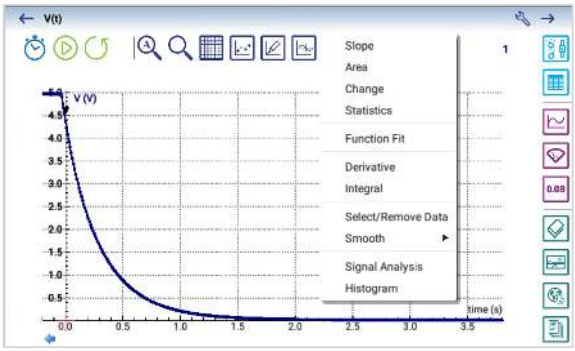
***To scan a graph***

- Tap  .

- Tap a point of the graph or move the red lines to indicate a point. Its coordinates are shown in the yellow box. You can drag this box to any position on the graph.
- Tap  to stop displaying the coordinate box.
- It is not possible to store the coordinates values, when needed these values must be written down.

### 10.2 Advanced Analysis and Processing Tools

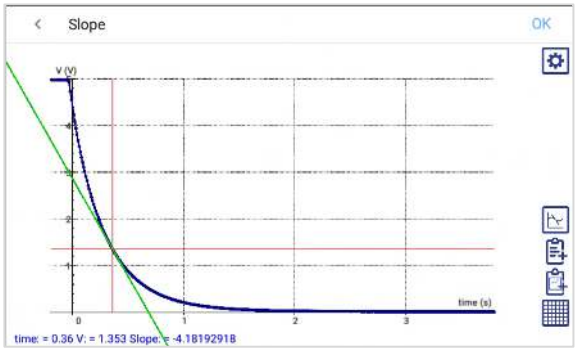
Advanced tools are available on the Graph screen.




- On the Graph screen tap the toolbar icon  **Analyse/Process**.
- Select the desired tool from the list.

All tools (with exception of Statistics) work in a similar way. After selecting a tool an extensive dialog that includes the graph, specific parameters and the vertical toolbar is shown.

- Tap  to hide the settings and enlarge the graph.
- Tap  to display the settings and reduce the graph again.


- Tap  to copy specific information into the Clipboard as text.
- Tap  to copy the graph into the Clipboard as an image.
- Tap  to turn on/off the grid.

Information stored in the Clipboard can be used in the Student Text.

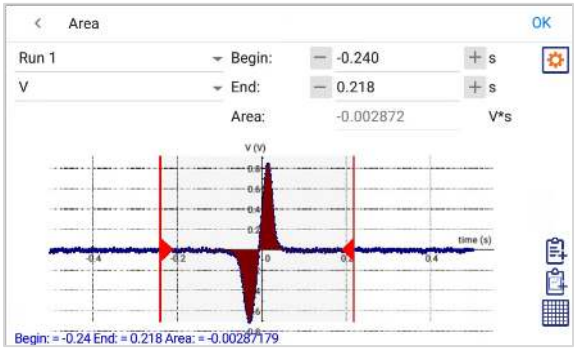
### Slope

Use **Slope** to determine the slope of the tangent at any point of the graph.


- Select a Run and Variable to define a graph you want to analyse.
- Select the point at which you want to determine the slope
- To find the slope **manually** rotate the green line to approximate the tangent.
- To find a slope **automatically**, tap  .
- The slope value is displayed in the **Slope** field.

### Area

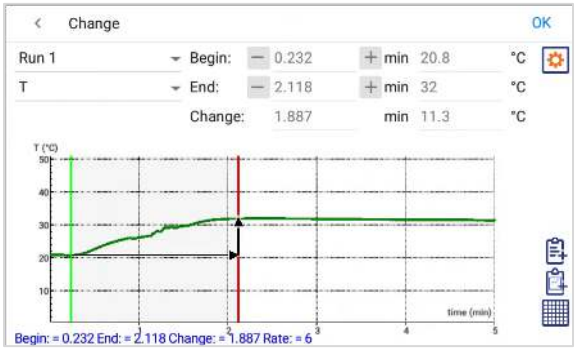
Use **Area** to determine an area between the graph, the horizontal axis and the two boundary lines.




- Select a Run and Variable to define a graph you want to analyse.
- Drag the red boundary lines to the required positions.
- The area value is displayed in the **Area** field.

### Change

Use **Change** to determine changes in data values in horizontal and vertical directions.




- Select a Run and Variable to define a graph you want to analyse.
- Drag the lines, the Begin green line and the End red line, to the required positions. The black vectors show the horizontal and vertical changes.
- The value changes in both directions are displayed in the **Change** fields.

### Statistics

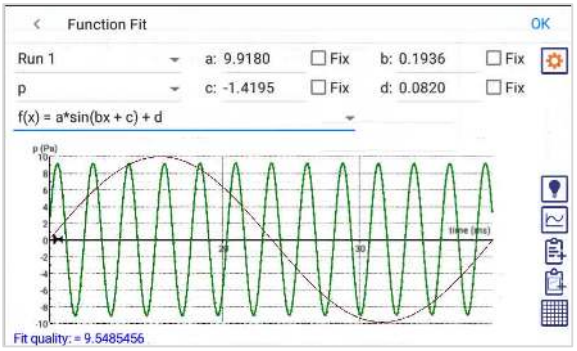
Use **Statistics** to display statistical information.


| | age (yr) | boys height (cm) | girls height (cm) |
|---|---|---|---|
| Number: | 21 | 21 | 21 |
| Max: | 21 | 184.0 | 170.6 |
| Min: | 1 | 76.6 | 75.1 |
| Average: | 11 | 144.9 | 140.4 |
| Sum: | 231 | 3042.6 | 2947.9 |
| Sum sqr: | 3311 | 464648.2 | 432911.8 |
| s(n): | 6 | 33.7 | 30.2 |
| s(n-1): | 6 | 34.5 | 30.9 |

- Select a Run to define the data you want to analyse.
- The statistical information is given per each variable.

### Function Fit

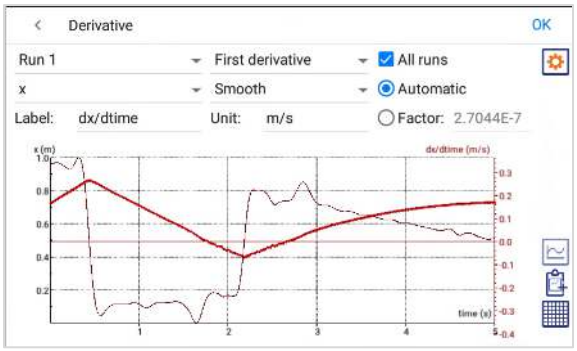
Use **Function-fit** to approximate the data in the graph with a standard mathematical function.




- Select a Run and Variable.
- Select the Function type that will be used.
- Tap  to automatically estimate the best initial parameter values of the function fit. In some cases, this is already an optimal fit e.g., in the case of linear regression.
- Tap  to refine the suggested fit to find the best fit based on initial parameters.
- The quality of the fit, the standard deviation of the fitted function from the original data, is indicated behind **Fit quality**. The lower the deviation, the better the quality.
- The fitting can also be done manually in a similar way as in Coach 7 on the computer.

### Derivative

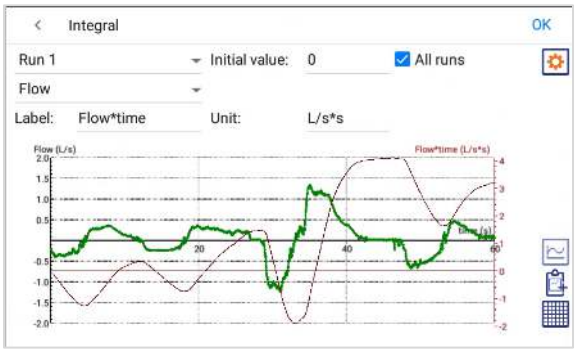
Use the **Derivative** option to plot the graph of the first or the second derivative.




- Select a Run and Variable.
- Select a derivative order: **First** or **Second**.
- Select a method of calculating the derivative: **Differences** or **Smooth.**
- If desired change the **Label** and **Unit**.
- Tap  to calculate the Derivative graph.
- Select **All runs** if the derivative should be calculated for all runs of the variable.
- Note that on the next measurement run the original data will be measured and its derivative will be calculated and displayed in real time.

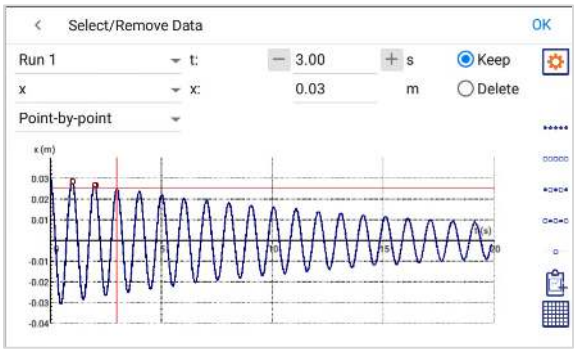
### Integral

Use **Integral** to calculate the function (the primitive function) whose derivative is equal to the displayed graph. Such an integral function can be determined but for a constant (the constant of integration).




- Select a Run and Variable.
- Enter **Initial value** (the constant of integration). This is the value assigned to the quantity along the vertical axis for 0.
- If desired change the **Label** and **Unit**.
- Tap  calculate the integral graph.
- Select **All runs** if the derivative should be calculated for all runs of the variable.
- Note that on the next measurement run the original data will be measured and its integral will be calculated and displayed in real time.

**Select and Remove Data**

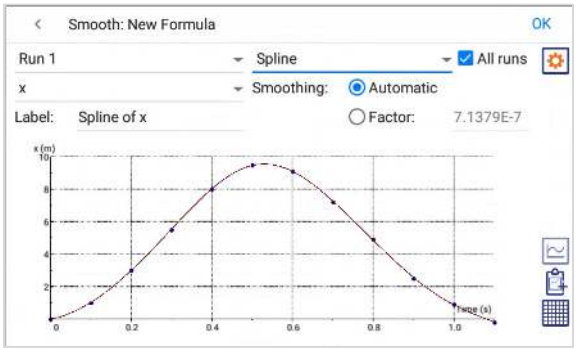



- Select a Run and Variable.
- Select the selection method: **Range** or **Point-by-point**.
- For the **Range** method: drag the red boundary lines to select the range.
- For the **Point-by-point** method: select points by tapping a point in the graph or by using the small icons: deselect all, select all, select even, select odd, select/deselect a point.
- Select between **Keep** – the non-selected points will be removed or **Delete** – the selected points will be removed.
- After confirmation, a new run with the selected data rows will be added.

**Smooth**

Use **Smooth** to create a smooth curve that fits (interpolates) a rough or limited number of points. This option offers three approximations: Moving average, Spline and Bezier.

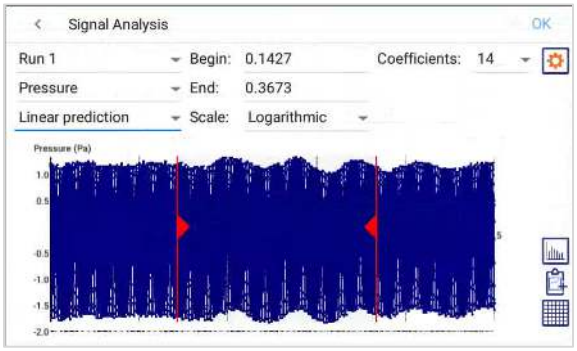
| **New Formula** | **New Run** |
|---|---|
| As result, a new Variable, calculated based on the formula of the selected method (Filter, Spline or Bezier), is added to the existing run. The new graph displays the "smoothed" variable. | As result, a new Run with a modified set of data is added. The new data set may consist of more points than the original set (only for Spline and Bezier) and can successively be processed. |



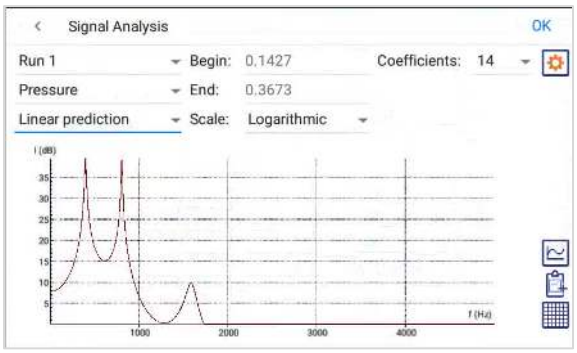

- Select a Run and Variable.
- Select the smooth method: **Moving average**, **Spline** or **Bezier**.
- Specify the smoothing parameters:
  - For Moving average enter the desired **Filter width**.
  - For Spline leave the **Smoothing factor** to **Automatic** or enter the factor manually by selecting **Factor**.
- Tap to calculate the smoothed graph.
- **New Formula** (only): select **All runs** then the same formula will be applied to all runs. Note that when you use Spline with the manually set factor then it may "not work well" for other runs. If you leave the factor on **Automatic** then it will be automatically chosen for each run based on the data of that run.
- **New Run** (only): after confirmation, for the Spline and Bezier methods, the **Compute Data Points** dialog appears. Specify the number of points to compute. By default, the number in the original run is given.

**Signal Analysis**

Use **Signal Analysis** to find the frequency spectrum of a time-based periodical signal. The resulting values are presented as amplitudes of spectral components plotted against the frequency.



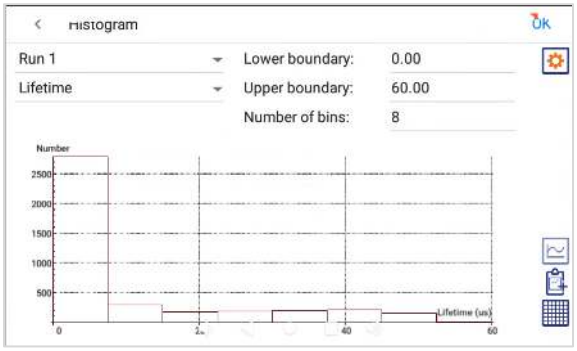

- Select a Run and Variable.
- Select the method of signal analysis: **Fourier transform, Linear prediction, R-ESPRIT** or **Prony**.
- Select **Linear** or **Logarithmic** for the intensity scale along the y-axis.
- Where needed specify signal analysis parameters.




- Tap  to calculate and display the frequency spectrum for the specified settings. You can limit your time range by dragging the red boundary lines.
- If needed tap  to return to the original graph and repeat the procedure.

**Histogram**

Use **Histogram** to create a statistical histogram, a graph representing the distribution of the data. The range of the variable is divided into equal size bins, for which the frequency of occurrence is counted. The height of the graph bar is equal to the frequency of occurrence within the bin.



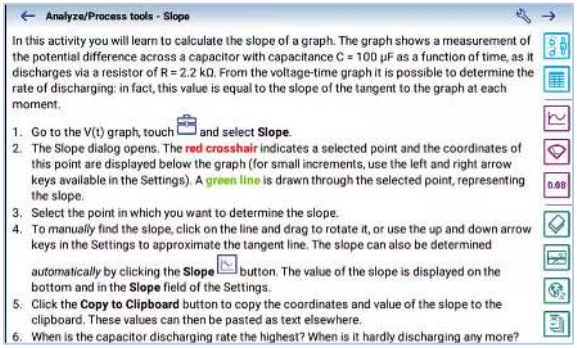

- Select a Run and Variable.
- If needed enter the **Lower** and **Upper** boundary values. The initially displayed boundaries are computed from the data.
- Enter the number of bins (by default 5).
- Tap  calculate and display the histogram bar-graph.
- If you are not satisfied with the result, change the parameters, and tap  again.

## 11. Learning Content

Coach Activities can be enriched with multimedia learning content. Such learning content can be presented via the following objects: Texts, Images, Webpages and Student texts.

### 11.1 Text screen

Texts are made by Author users in Coach 7 on a computer or a tablet (a software license is needed). They can consist of experiment descriptions, instructions for students, or explanations. The Texts cannot be edited in Coach 7 on VinciLab 2.




- Tap  to get a list of the texts present in the opened Coach activity/result.
  Selecting a Text opens the Text screen.
  Note that if there are no Texts in the Activity then this icon is not present.
- Browse through the Texts by using → on the top bar of the Text screen.

### 11.2 Image screen

Images are useful to illustrate phenomena, experiments, or equipment.


- Tap  to get a list of Images present in the opened Coach activity/result.
  Selecting an Image from the list opens the Image screen.
- Use the **Add new** option to add a new Image.
- Use **Overview** to add, edit or delete an Image.
- Browse through the Images by using → on the top bar of the Image screen.
- Tap the Toolbar icon  to auto-fit the image (by default the autofit is on  ).
- Tap the Toolbar icon  to open or add a new Image.

### 11.3 Web Page screen

The Web-page Screen offers a simple browser that can be used to direct open web pages and to browse through them.


- Tap  to get a list of "ready webpages" in the opened Coach activity/result. Selecting a Web page from the list opens the Web-page screen.
- Use the **Add new** option to add a webpage.

- Use **Overview** to add, edit and delete a webpage or to set it as a Home page.
- Once the web page is successfully opened the toolbar offers a range of icons for selecting and browsing through the web pages.
- Browse through the Web pages by using → on the top bar of the Web-page screen.

### 11.4 Student Text screen


Student texts can be used by students for writing their notes, answers, and reports, etc.

- Tap  to get a list of Student texts present in the opened activity/result. Note that by default an empty Student Text is present. Selecting a Student Text from the list opens the Student-text screen.
- Use the **Add new** option to add a new Student Text.
- Use **Overview** to create, edit or delete a Student Text.
- To type, the on-screen keyboard appears.
- Tap on the onscreen keyboard to switch between the installed languages.
- Enter your text. The toolbar offers a range of tools for creating and editing text.
- Use to lock the text; the toolbar and onscreen keyboard remain hidden.
- Browse through the Student Texts by using → on the top bar of the Student-text screen.

**STUDENT TEXT SCREEN TOOL MENU**

- **Edit title** – to edit the title used in the pane caption.
- **Paste** – to paste the content of the Clipboard.
- **Select all** – to select all text.
- **Undo** – undo last action.
- **Redo** – redo last action.

## V. USING VINCILAB AS A LAB INTERFACE WITH COMPUTERS AND MOBILE DEVICES

VinciLab 2 can also work as a lab interface with:

| Computers (Mac and Windows) | Mobile devices (Android and iOS) |
|---|---|
| wired via the USB, or wireless via Wi-Fi | wireless via Wi-Fi |
| During such measurement the Coach 7 or Coach 7 Lite program running on the computer, controls the data collection. The collected data are transferred to the computer and the measurement can be followed and analyzed on its screen. | During such measurement, the Coach 7 or Coach 7 Lite app running on a device, controls the data collection. The collected data are transferred to the mobile device and the measurement can be followed and analyzed on its screen. |

Note that the recorded data are not stored in the VinciLab's memory and should be saved in Coach 7 on the computer or mobile device.

### 1. Setting VinciLab 2 communication

***To work via USB (computers)***

- Connect the USB cable to the USB C port of VinciLab 2.
- Connect the other end of the USB cable to the USB port of your computer.
- Start **Coach 7** or **Coach 7 Lite** on your computer.
- In the Dashboard press  **Hardware Settings**.
- Below **Interfaces** select **VinciLab 2**.
- If needed set the **Connection** to **USB** (default settings).

***Warning:***
*Each time you start the Coach 7 app on your VinciLab 2 the communication to the computer will be lost and the measurement processor will be controlled again by the app on VinciLab 2.*

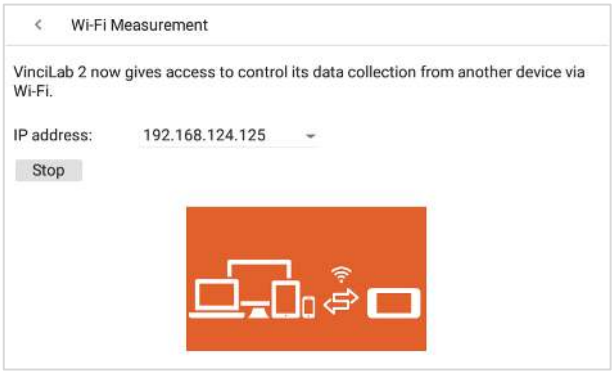
***To work via Wi-Fi (computers & mobile devices)***

Be sure that both devices are connected to the same network.

**Step 1: Allow to control data collection via Wi-Fi by Coach on other devices**:

- Start the **Coach 7** app on VinciLab 2.
- Tap  **Wi-Fi Measurement** under **Tools**.

- When VinciLab is connected to Wi-Fi its **IP address** appears**.**
- Press the **Start** button.
- The message appears:
  *VinciLab 2 now gives access to control its data collection from another device via Wi-Fi*.
- Pressing the **Stop** button closes the access.

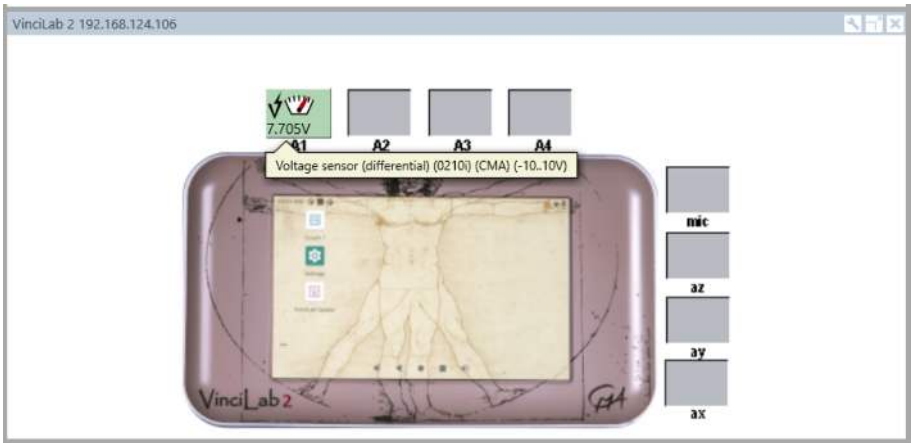



**Step 2. Choose the Wi-Fi communication in Coach on your computer or a mobile device:**

- Start **Coach 7** or **Coach 7 Lite** on your computer or mobile device.
- In the Dashboard press **Hardware Settings**.
- Below **Interfaces** select **VinciLab 2**.
- Set the **Connection** to **Wi-Fi**.
- Type the **IP address** of your VinciLab 2.
- Accept with **OK**.

Make sure Coach is allowed to approach the IP address at port 8888. I.e., if you have some firewall or security software allow Coach to approach this address.

After opening an Activity/Result for VinciLab 2 the Interface window shows the IP address of the VinciLab 2 you are connected to.

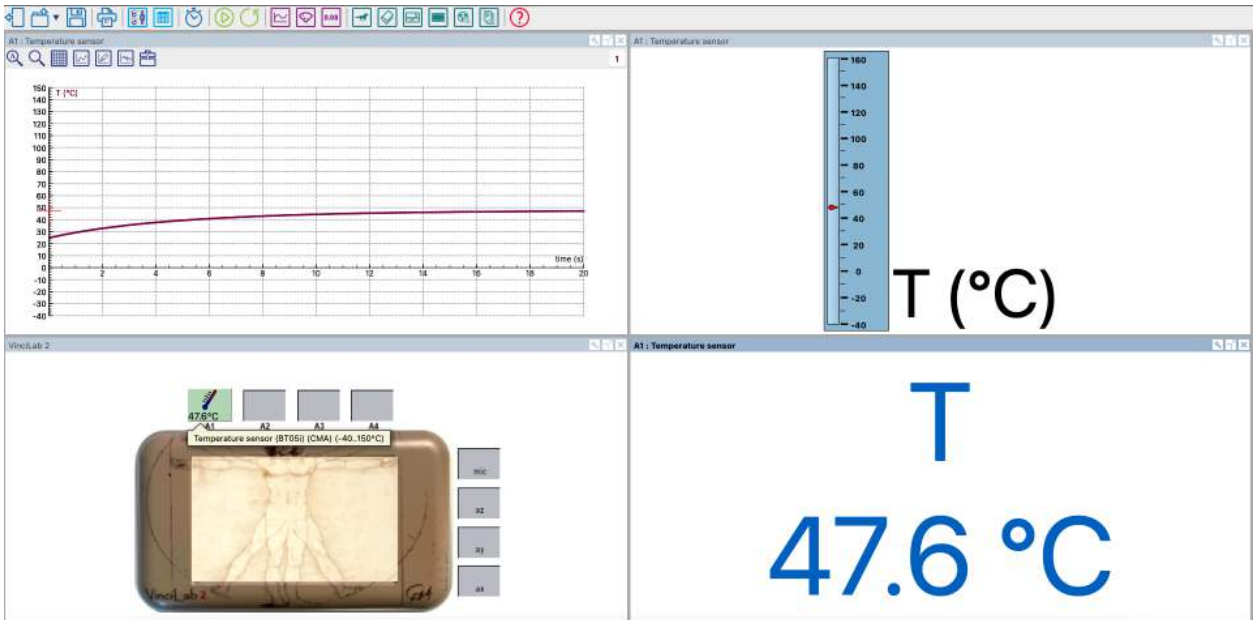



***Measurement limitations:***

*During the measurement via Wi-Fi, the data are stored first in the measurement (cyclic) buffer. This buffer can consist of up to 65 000 measurement points. Depending on the used sampling frequency and the quality of the Wi-Fi network, the measurement can be stopped earlier, in the worst scenario after reaching 65 000 points.*

## 2. Typical measurement procedure on computer/mobile device[5]

- Turn VinciLab 2 on.
- Select the communication mode. Follow the instruction given in **1. Setting VinciLab communication**.
- Start **Coach 7** or **Coach 7 Lite** program/app on your computer/mobile device.
- Open an Activity/Result for measurement.
- Connect sensor(s) to the sensor input(s) or enable internal sensor(s) of VinciLab 2.
- The device automatically detects the connected sensor(s) and displays the sensor icons of the identified sensors. The sensors, which are not automatically detected, must be selected from the Sensor Library.
- The measurement is executed according to the given measurement settings. Press the toolbar icon to check the settings.
- Start the measurement with .
  - In most cases, Coach automatically starts the measurement.
  - If triggering is enabled then the measurement is started automatically when the trigger conditions are met.
  - When the type of measurement is set to **Manual** then the **Manual Start** appears in the Toolbar. Use this button to collect a single measurement. When keyboard input(s) is specified then the value of one or more quantities must be typed in.
- The measurement is stopped when the specified measurement time (time-based) or a specified number of samples (manual) has been reached. If you want to interrupt the measurements process press or <***Esc***>.
- Save your result via the **File** menu options **Save** or **Save As…**.

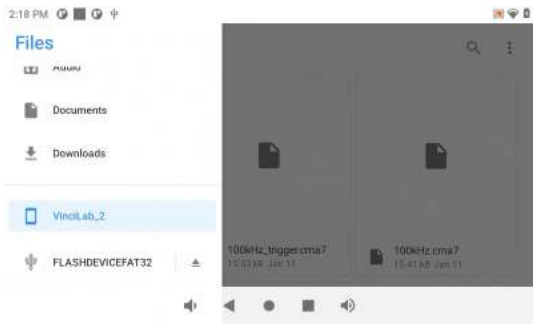



[5] This procedure does not describe the Event-based type of measurement.

## VI. TRANSFERRING FILES BETWEEN VINCILAB 2 AND THE COMPUTER

Users can store their files on VinciLab 2 in different folders. Dedicated folders like Images, Videos, and Documents are already present on VinciLab 2. Transferring files between VinciLab 2 and a computer is possible via a USB memory stick, a USB cable, or a Wi-Fi connection.

### *To transfer files via a USB memory stick*




- Insert your USB memory stick into the USB port of VinciLab 2. When detected its name (here on the right image FLASHDEVICEFAT32) appears in The Files app, below the VinciLab_2 name.
- Tap the device name to see the folders and files on the memory stick.
- Now you can copy or move files between the two devices.
- To remove the USB memory stick first tap ⏏ next to its name. When the name will disappear, you can safely disconnect it.

### *To transfer files via USB cable*

- Connect VinciLab to the computer via the provided USB cable.
- **WINDOWS**: When VinciLab 2 is detected then you can use it like any other external storage device. Use Windows Explorer to transfer the files between devices.
- **MAC**: Since MAC does not automatically works with an Android device you have to first install an app that makes this possible. For example, **Android App Transfer** (https://www.android.com/filetransfer).

### *To transfer files via Wi-Fi*

- Make sure that VinciLab 2 is connected to the same network as your computer.
- Start the **RustDesk** app on your VinciLab 2.
- Go to **Share screen** and press **Start Service**. A more detailed description of the RustDesk is given in Appendix 1.
- Depending on the brand of your computer install the PC or Mac **RustDesk** program. You can download the installation file from https://rustdesk.com/.
- Use the installed RustDesk program to make a connection to VinciLab 2 and transfer the files between the two devices.

## APPENDIX. WORKING WITH RUSTDESK

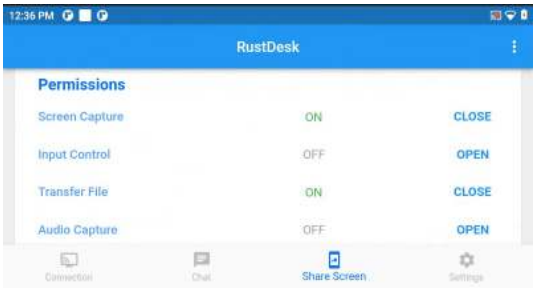
RustDesk is an open-source application that can be used to control VinciLab 2 remotely, and transfer files between VinciLab 2 and a PC or Mac computer. Before you start make sure that VinciLab 2 is connected to the same network as your computer.

### Starting RustDesk on VinciLab 2

- On your VinciLab 2 go to the **Application** screen and start **RustDesk**.

### Setting Permissions

- On the bottom navigation bar tap **Share Screen**.
- Configure various permissions as needed. Every time you start RustDesk, you need to request “Screen Capture” and “Input Control” permissions again.



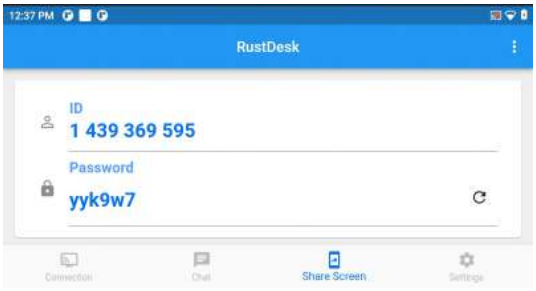

| Permissions | Description |
|---|---|
| Screen Capture | Whether to enable screen capture sharing permission, the monitoring service will be enabled at the same time as startup |
| Input Control* | Whether to allow the controller to control the input of VinciLab 2, such as virtual touch screen operation with the mouse |
| File transfer* | Whether to enable file transfer permission, after startup, you can remotely control the file system of this VinciLab 2 |

Above * represents special permissions. To obtain such permissions, you need to jump to the Android system settings page to obtain them manually.

### Starting service on VinciLab 2

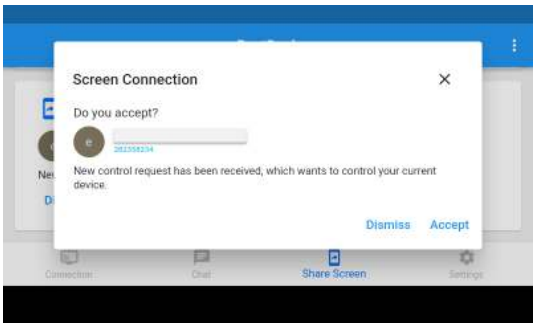
After obtaining the screen capture permission, the service will be automatically started. You can also tap the **Start service** button to start the service. After the service is started, it can accept desktop control requests from other devices. If the file transfer permission is enabled, it can also accept file control requests from other devices.

After the service is started, a unique ID and random password will be automatically obtained for this device. Other devices can control VinciLab 2 through the ID and password, or manually confirm when a new request is received. You can stop the service or close the specified connection at any time.



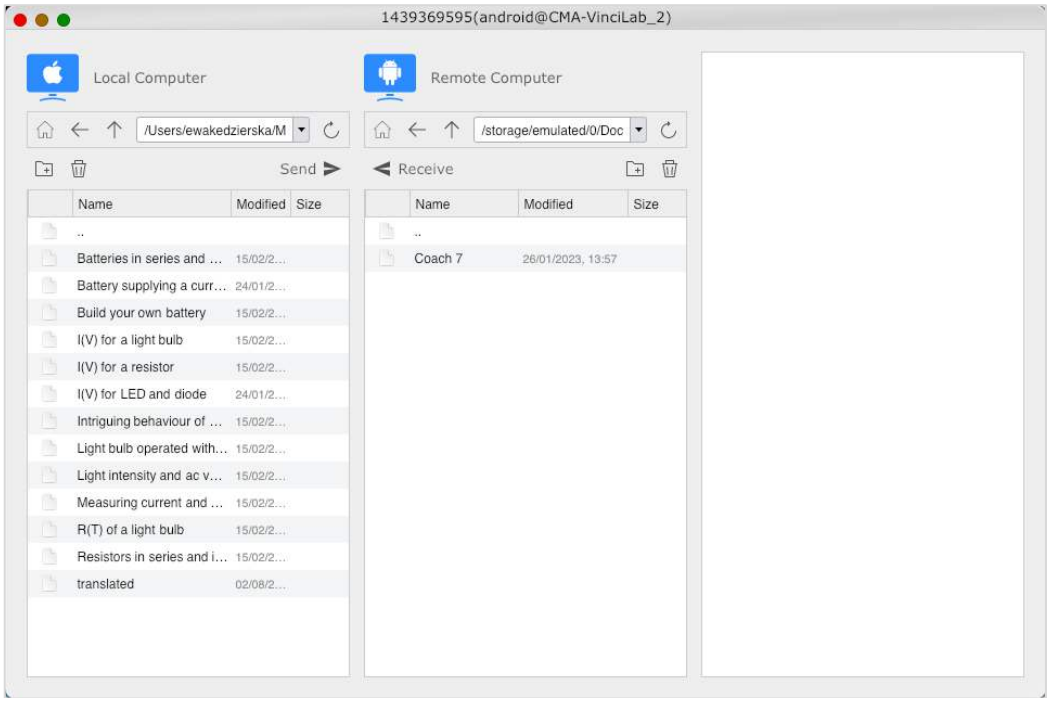
**Displaying the VinciLab 2 screen on the computer**

- Download **RustDesk** (https://rustdesk.com) and install it on your computer.
- Start **RustDesk**.
- Type the VinciLab 2 **ID** shown on the **Share screen** and press **Connect**.
- Type in the **Password** shown on VinciLab 2 below the ID or accept the connection on VinciLab 2.
- After a successful connection is established, the VinciLab 2 screen is shown on the computer screen.




**Using RustDesk for transferring files**

- Start **RustDesk** on your computer.
- Type the VinciLab 2 **ID** shown on the Share screen and press **Transfer**.
- If you already have made a contact with VinciLab 2 the Android device CMA_VinciLab_2 will be shown in the **Recent Sessions** screen. Then you can also press the menu icon displayed on the device and select **Transfer File**.
- Type in the **Password** shown on VinciLab 2 below the ID or accept the connection on VinciLab 2.
- After a successful connection is established the dialog appears showing the file system of your computer and VinciLab 2 allowing to transfer files between the two devices.




Transferring files between VinciLab 2 and computer via RustDesk running on Mac computer.

Consult the RustDesk manual at https://rustdesk.com/docs/en/manual/ to get more information on other functionalities of RustDesk.

## TECHNICAL SPECIFICATIONS

### 1. Key Features

| | |
|---|---|
| **OPERATING SYSTEM** | Android 11 |
| **DISPLAY** | 5” (800 x 480 pixel) capacitive color touch screen |
| **CPU** | Processor Rockchip RK3566 Quad-core Cortex-A55, 1.8 GHz |
| **MEASUREMENT PROCESSOR** | TMS320C5517 |
| **RAM MEMORY** | 2 GB (LPDDR4) |
| **USER MEMORY** | 8 GB EMMC - flash memory for applications and user files<br>Expandable with a USB flash drive |
| **POWER** | Rechargeable battery Li-ion 3.7 V, 4000 mAh<br>USB Power Adapter (100-240 V AC, DC 5V/2A) |
| **CONNECTIVITY** | Wi-Fi 802.11 b/g/n<br>for communication with computers and mobile devices<br>Bluetooth® 4.1<br>for connecting e.g. wireless Bluetooth keyboard or mouse |
| **COMPUTER CONNECTION** | Mini USB C port for communication and powering |
| **USB PORT** | Full USB for USB peripherals and USB flash drive |
| **OTHER PORTS** | Audio In: for external microphone<br>Audio Out: DC and AC voltage signals between -5 .. 5V,<br>two channels available |
| **SENSOR INPUTS A1 – A4** | 4 sensor inputs via the BT sockets<br>CMA BT sensors can be connected directly incl. Motion Detector BT55i. Each sensor input can also work as a counter. |
| **BUILT-IN** | Microphone<br>3-axis Accelerometer<br>Speaker |
| **ADC RESOLUTION** | 12 bits |
| **SAMPLING FREQUENCY** | Max. 1 MHz when one sensor input is used,<br>500 kHz when two sensor inputs are used, and<br>200 kHz vie three or four sensor inputs are used |
| **OUTPUT D1** | BT socket for connecting CMA Control Box |
| **OUTPUT D2** | HDMI port to connecting external display |
| **SOFTWARE ON VINCILAB 2 (ANDROID)** | Selected Android applications<br>Coach 7 application for data collection and analysis |
| **SOFTWARE ON WINDOWS, MAC, IOS AND ANDROID** | Coach 7 Lite (free), or Coach 7 (license needed) |

## 2. Working conditions and maintenance

For your safety and that of your equipment, follow these rules for handling, for cleaning VinciLab 2, and for working more comfortably.

- ✓ Your VinciLab 2 is designed to be operated on a desk or hand-held.
- ✓ Your VinciLab 2 is not waterproof. Precautions must be taken to ensure that liquid cannot enter the unit.
- ✓ Do not expose VinciLab 2 to extreme heat or cold sources and to direct sunlight for extended periods of time.
- ✓ Operating VinciLab 2 outside the following ranges may affect performance:
  - Temperature: 5° to 40° C.
  - Relative humidity: 0% to 90% (noncondensing)
- ✓ Never force a connector into a port. When connecting a sensor, make sure that the sensor cable connector matches the port, and that you have positioned the connector correctly.
- ✓ When cleaning VinciLab 2, first turn it off and unplug the connected sensors and USB cable. Then clean with a soft, lint-free cloth. Avoid getting moisture in any openings. Do not spray liquid directly on VinciLab 2.
- ✓ When replacing the battery, only use a VinciLab 2 replacement battery pack supplied by CMA.
- ✓ When charging the battery always use the provided USB power adapter.

## 3. Factory reset

To perform a factory reset of VinciLab 2:

- If VinciLab is on shut it down.
- Press and hold the power button until the recovery process starts by showing the message '*Preparing a factory data reset*'.
- Follow the instructions displayed on VinciLab 2.
- **DO NOT** turn off the device during the recovery. The recovery process may take up to 10 minutes.

## 4. Warranty

VinciLab 2 is warranted to be free from defects in materials and workmanship for a period of 24 months from the date of purchase provided that it has been used under normal laboratory conditions. This warranty does not apply if VinciLab 2 has been damaged by accident or misuse.

The VinciLab 2 battery is consumable and is warranted to be free from defects in materials and workmanship for a period of 12 months from the date of purchase.

The VinciLab 2 screen is made of glass and could break if your device is dropped or if it receives significant impact. Do not use VinciLab 2 if its screen is broken or cracked as this could cause injury too.

**WARRANTY DISCLAIMER: PROPER USE OF A TAP-SCREEN**

Please note that a touch screen responds best to a light tap from the pad of your finger or a special non-metallic stylus. Using excessive force or a metallic object when pressing on the touch screen may damage the glass surface and void the warranty.

## 5. Battery precautions

- Do not place the battery in or near a fire, on stoves, or in other high-temperature locations such as direct sunlight. Doing so may cause the battery to generate heat, explode or ignite, or generate a toxic gas if placed in contact with fire.
- In the event the battery leaks and the fluid gets into one's eye, do not rub the eye. Rinse well with water and immediately seek medical care. If left untreated, the battery fluid could cause damage to the eye.
- Discard batteries according to local regulations.

## 6. Safety Information

VinciLab 2 is developed and produced in conformity with CE regulations.
This product shall be handed over to your local community waste collection point for the recycling of the products.

*This product is to be used for educational purposes only.*
*It is not appropriate for industrial, medical, research, or commercial applications.*