
VINCILAB DATA-LOGGER 001

USER'S GUIDE



CENTRE FOR MICROCOMPUTER APPLICATIONS

<https://cma-science.nl>

For our international users

Check the CMA website <https://cma-science.nl> for the latest version of this manual and updates of Coach programs and apps.

Aan onze Nederlandse gebruikers

VinciLab wordt standaard uitgeleverd met Engelse handleiding.

U kunt de laatste versie van de Nederlandse handleiding en de nieuwste updates van Coach programma's en app's downloaden van de CMA-website <https://cma-science.nl>.

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I. VINCI LAB AT A GLANCE

1. Introduction

VinciLab is a modern and advanced mobile graphic data acquisition system, which can be used in a variety of ways, standalone and with a computer and tablet, in the classroom and in the field. It is a handheld Linux device equipped with two processors: a main processor to control the device's operating system and screen, and a measurement processor to control the measurement and control processes. It has 8 GB of internal memory 5.5 GB of which is available for user files.

VinciLab has a 5" capacitive color touch screen that provides a high-resolution display (800 x 480 pixels) offering easy control of the device. For wireless connectivity VinciLab is equipped with Wi-Fi and Bluetooth. The dedicated desktop applications, pre-installed on VinciLab, offer tools for setting up the device, setting up wireless connections, managing user files, browsing the web, watching video files, playing audio files, etc.

For connecting sensors VinciLab has four analog BT inputs, which allow very fast data collection up to 1000000 samples per second, and two digital BT inputs for Motion Detectors. It also has built-in a 3-axis accelerometer and a microphone. Additionally VinciLab can output DC and AC voltage signals between -5 V and 5 V via the 3.5 mm audio connector¹.

The powerful Coach Application, pre-installed on VinciLab, offers live sensor data displays, real-time graphing, tools for data processing and possibilities to create new or open ready-to-go Coach activities enriched with texts, images and web-pages.

VinciLab can also be used as a lab interface connected (via USB or Wi-Fi) to computers (Mac and Windows), tablets (iPad, Android) and Chromebooks. Coach 7 and Coach 7 Lite programs and apps support such measurements.

By using wireless connectivity and the VNC protocol 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.



¹ Not present on VinciLabs purchased before February 2019

2. VinciLab overview

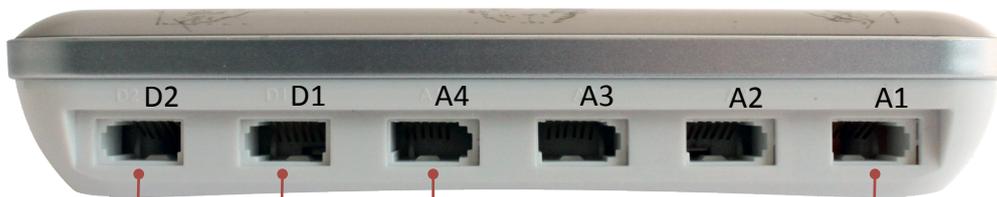


Internal Microphone
for recording sound signals

Capacitive Color Touch Screen
for viewing and controlling



Power Button
for turning VinciLab On or Off and for turning the screen On when it is timeout



Digital Inputs D1, D2
for connecting digital
Motion Detectors

Analog Inputs A1, A2, A3, A4
for connecting
analog sensors

USB Port

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



Mini USB Port

for connecting a USB cable for charging or for communication with computer

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)

* For VinciLab's purchased starting from February 2019, in the VinciLab's sold before the Audio Out Port (green connector) was used for connecting headphones or an external speaker.

II. GETTING STARTED

1. Turning VinciLab On and Off

To turn VinciLab On

- Press the Power Button once.
- While VinciLab is booting the message 'VinciLab is starting. Please wait.' is displayed.
- Wait until the device finishes its booting procedure and displays its starting Home Screen as shown on the image.



Note:

- The minimum battery level to start VinciLab is **1%**.
-

To turn VinciLab Off

- Tap  **Shut Down** in the status bar.
 - On the new screen tap:
 -  **Shut Down** to shut down VinciLab.
 -  **Reboot** to restart VinciLab.
 -  **Screen Off** to turn the screen off. Pressing the Power button turns the screen on again.
 -  **Cancel** to cancel the operation and return to the Home Screen.
-

Note:

- Holding the Power button for about 8 seconds causes VinciLab to shut down. Use this possibility only in case of emergency when your VinciLab does not respond anymore.
-

2. Powering VinciLab

An internal rechargeable battery (Li-Poly 3.7 V, 4000 mAh, located in the back compartment), powers VinciLab. The battery icon on the status bar of the Home Screen indicates the current power level.

VinciLab is delivered with its battery partially charged. The device will work as long as the battery provides 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 up to 8 hours of charge time.

To charge battery

Only use the USB cable and USB power adapter delivered with your VinciLab.

- Connect the USB cable to the mini USB port of VinciLab.
- 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 mini USB port of VinciLab.
- Connect the other end of the USB cable into a USB port of your computer. Notice, that 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 at least 4 hours without recharging it. To save power dim the brightness of the screen or turn off the screen when you do not need it. See also *III. VinciLab Applications, 3. Settings*.

The long-time life of the battery is more than 300 full (0 to 100%) charging cycles. If charging cycle is not full e.g. 30% to 60% it will last more charging cycles. Exposure to temperature over 35°C will significantly reduce battery life. A replacement battery can be ordered separately (CMA art. code 001bat).

Notes:

- *VinciLab can be used while the battery is being charged by the power adapter.*
 - *VinciLab typically consumes about 450 mA. If you run some videos, set the screen brightness to the maximum level, do a lot of data transferring via Wi-Fi, connect many sensors and external USB devices then power consumption will be much higher.*
 - *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 simultaneous operating of VinciLab and charging its battery.*
 - *When VinciLab discharges fully it will not turn on until a minimum charge of 1% is reached.*
-

3. Home Screen

The Home Screen is the starting point for using your VinciLab and provides shortcuts to applications. The status bar is always present at the bottom of the Home screen and offers information about the device's current status.

3.1. Applications

The following applications are available on VinciLab:



Coach: Handling sensors, collecting, graphing and processing data.



My Files: Managing user and Coach files on VinciLab.



Settings: Configuring the device to your preferences.



Connections: Configuring the wireless connections.



Web Browser: Accessing the Internet.



Images: Browsing and displaying images.



Media Player: Playing audio and video files.



Calculator: Performing simple mathematical calculations.

- Tap an application's icon to launch the application.
- Tap  **Back** to return to the previous screen or option.
- Tap  **Home** to display the Home Screen.

Detailed descriptions of applications are given in *III. VinciLab Applications*.

3.2. Status bar

The icons in the status bar at the bottom of the Home screen give information about VinciLab:

Icon	Name	Operation
	Coach active	Appears when Coach is running Tap to switch back to Coach
	Volume	Shows the status of Volume, On or Mute Tap the icon to change the Volume level
	Wi-Fi	Shows the Wi-Fi connection Blue: There is a Wi-Fi connection Gray: No Wi-Fi connection Tap the icon to change the Wi-Fi configuration
	Battery	Shows the battery level or charging status Tap the icon to check the battery status
13.40	Time	Shows the current time Tap the icon to change the time settings
	USB device	Appears when a USB device is detected Tap the icon to safely remove the connected USB device
	Bluetooth active	Appears when Bluetooth is turned on White icon: Bluetooth is on and paired with a device

3.3. Navigation

WARNING! Touch screen best responds to a light 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

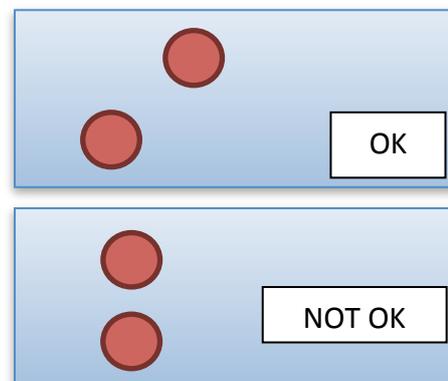
Tap items to select or launch them. For example tap an item to select it, tap an application's icon to launch the application or tap the on-screen keyboard to enter text or numbers.

Flick or drag

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

Pinch

Using two fingers, such as your index finger and thumb, to make a pinch motion on the screen. The fingers should be located as shown on the picture. For example pinch in to zoom in on images and pinch out to zoom out on images.



Touch, hold and release

Activate onscreen items at the moment of releasing.

For example used in Coach, tap a sensor digital display, hold and release to open its menu.

4. Sensor inputs

4.1 Analog sensor inputs

VinciLab has four analog BT (right-handed) sensor inputs A1, A2, A3, A4 with a maximum sampling rate of 1 MHz (four inputs simultaneously). CMA BT sensors² (with exception of the CMA digital Motion Detector) can be directly connected to the analog sensor inputs.

All analog inputs can be (simultaneously) used as counter inputs. Sensors such as the CMA Photogate (art. code 0662i or BT633i) or CMA Radiation sensor (art. code 0666i or BT70i) are by default defined as counters. Other analog sensors can be used as counters after defining the counter conversion settings in Coach e.g. defining a heartbeat sensor to count heartbeats.

² Analog Vernier BT sensors can be directly connected to VinciLab as well. Older (4-mm) versions of CMA sensors can be connected via a 4mm to BT adapter (art. code 0519).

4.2. Digital sensor inputs

VinciLab has two digital BT (left-hand) sensor inputs D1 and D2. The CMA BT digital Motion Detectors can be directly connected to these sensor inputs.

4.3. Sensor detection

VinciLab supports sensor recognition and tries to identify sensors connected to inputs.

- When Coach **identifies** the connected sensor then its name is automatically displayed in the Activity Screen tree and its digital display appears on the Sensors Screen. When the sensor is then disconnected its name and digital display disappear automatically.
- When Coach does **not identify** the connected sensor then its name and digital display does not appear. This happens for some older CMA sensors or sensors connected via the CMA 4-mm to BT adapter art. code 0519. The user has to manually choose and select the correct sensor from Coach Sensor Library. This is done via the option Sensor Settings available in the Tool menu of the Sensors Screen. When the sensor is disconnected then Coach keeps displaying the sensor name and its digital display. The sensor can be removed by selecting the option **None** or selecting another sensor from the Sensor Library.
- When a predefined sensor is already set up in an Activity/Result and Coach:
 - **identifies** the connected sensor as a different sensor then the sensor name becomes red, tap **Exchange** to change the sensor to the connected one.
 - **does not** identify it then its name remains grey, tap **Confirm** to accept the pre-defined sensor or tap **Clear** to remove the connection.

See also 'IV. Coach Application, 5. Sensors Screens'.

5. Built-in sensors

VinciLab is equipped with two internal sensors:

- A **Microphone**, which measures sound waveforms. This sensor can be used as:
 - a single sensor, this is possible only when working with a Coach Result for Sound only, or a Coach Activity for the Internal microphone.
 - in combination with other sensors, the sound sensor will be then connected for measurements via input A2. To make the sensor ready for measurement open the Sensor Settings dialog and tap the **Enabled Internal sensor** button. When the sensor is enabled no other measurements can be done via input A2 even if there is a sensor connected to this input.

If an external microphone is connected via Audio In port then the internal microphone is disconnected and the external microphone is used instead.

- A **3-axis Accelerometer**, which measures acceleration in 3 ranges: $\pm 20 \text{ m/s}^2$, $\pm 40 \text{ m/s}^2$ and $\pm 80 \text{ m/s}^2$ in the x, y and z directions. This sensor can be used in combination with other external sensors.

To make the sensor ready for measurement tap X, Y or Z tab in the Sensor Settings and tap the checkbox **Enabled**. The X, Y, Z tabs are used for the acceleration components respectively in x, y and z direction.

See also 'IV. Coach Application, 5.1. Sensor Settings'.

For the directions of x, y and z axes of the accelerometer see the image. Holding the VinciLab in the shown position should give the following values of the component accelerations:

- x-component $\approx 0 \text{ m/s}^2$
- y-component $\approx 0 \text{ m/s}^2$
- z-component $\approx -9.81 \text{ m/s}^2$.



6. Signal generator

Via the 3.5 mm Audio Out port VinciLab outputs DC and AC voltage signals between -5V and 5V. This functionality is present only on VinciLabs sold starting from February 2019 (the Audio Out port of these models has a blue connector). There are two channels available³.

7. Using VinciLab with computers and tablets

VinciLab can be used with computers:

1. As a lab interface to collect data, the Coach 7 or Coach 7 Lite program running on a MAC or Windows computer controls the data collection via USB or Wi-Fi.
2. To transfer files between the 'My Files' folder on VinciLab and the computer (only via USB).
3. To display the VinciLab's screen in a VNC Viewer Program (using VNC protocol via Wi-Fi or USB).

VinciLab can be used with tablets:

1. As a lab interface to collect data, the Coach 7 or Coach 7 Lite app running on an iPad (only via Wi-Fi), an Android Tablet (via USB and Wi-Fi) and a Chromebook (only via Wi-Fi) controls the data collection.
2. To display the VinciLab's screen in a VNC Viewer Program (using VNC protocol via Wi-Fi).

For more detailed description see '*V. Using VinciLab with a computer and a tablet*'.

³ This functionality will be supported starting from March 2020.

III. VINCILAB APPLICATIONS

Read this chapter to learn how to use VinciLab's applications.

1. Coach

Use Coach to create new Results, open pre-defined Activities, to setup experiments, collect data, display and process the collected data, save the results.

- To start tap  **Coach**.

The detailed description of Coach is given in *IV. Coach Application*.



2. My Files

Use My Files to manage your files on VinciLab, to copy and delete folders and files, to send files by e-mail.

- To start tap  **My Files**.

The **My Files** Screen displays folders and files located in the My Files folder. This folder is meant to store user's files.

Note that in the folder Coach > DataRecovery you can find backups of measurements. This allows you to find the measurement results of long measurements stopped unexpectedly.



To browse through folders

- Tap  or the name of the folder you want to open.
- Tap  to return to the previous folder.

To create a new folder

- Browse to a location where you want to create a new folder.
- Tap  to add a folder.
- Type in a name and confirm with .

To open a file

- Browse to the file you want to open.
- Tap its icon e.g.  or its file name. The associated application will open, e.g. Media Player if you tap an audio file.

To select folders/files

- Tap to select desired folders/files.
- Check marks appear in the check boxes and additional icons appear in the bottom bar.

To copy selected items

- First select items as described above.
- Tap  to copy the selected items.

The clipboard icon changes into  to indicate that something is placed on the clipboard.

- Browse to the location where you want to copy the items and tap  to paste the items in the selected location.

To move selected items

- First select items as described above.
- Tap  to cut the selected items.

- Browse to the location where you want to move the selected items and tap  to paste the items in the selected location.

To delete selected items

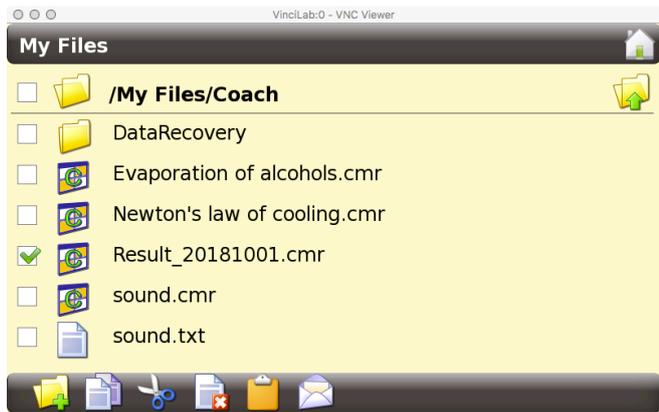
- First select items as described above.
- Tap  to delete the selected items and confirm with .

To work with a USB memory stick

- Insert your USB stick into the USB port of VinciLab.
- The icon  appears on the bottom bar when the device is detected.
- In My Files the USB folder is added. Now you can copy or move files between VinciLab and the USB memory stick.
- Tap the icon  and confirm with . Remove the stick.

To e-mail selected items

- First select items as described above.
- Tap  to open a mail screen. The selected items will be added as attachments.
- In the **To** field type in an e-mail address.
- Fill in **Subject** and **Message**.
- Confirm with .



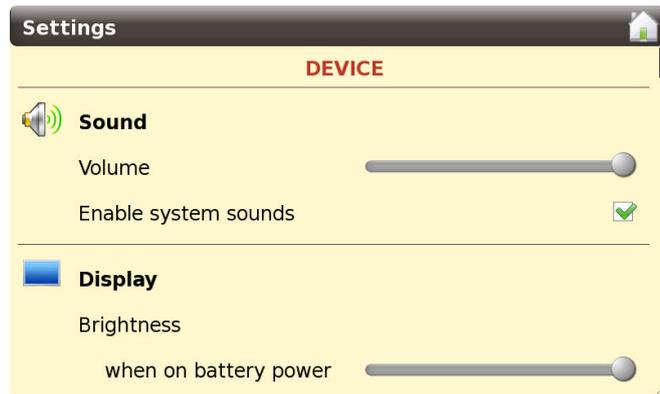
3. Settings

Use the Settings application to configure your VinciLab.

- To start tap  **Settings**.
- Scroll down to see all options.

3.1. Device Settings

Device settings include Sound and Display settings and Battery information.



To set the sound level and enable system sounds

- Tap and drag the **Volume** slider to set the volume level.
- To play system sounds check **Enable system sounds**.

To save power

- Lower the brightness of the screen. Tap and drag the sliders to set the screen brightness when on battery power and when on external power. These settings become effective after leaving Settings.
- Select a screen timeout - the length of time delay between the last key press or screen touch and the automatic screen timeout. Tap  and select the desired time interval.

Note:

- *To reactivate the screen press VinciLab's Power button.*
-

To change the wallpaper of the Home Screen

- Tap a Wallpaper thumbnail or .
- The Wallpaper Screen appears. Select a new image.
- Tap  to accept and return to the Settings Screen.

Battery displays the battery level and estimated working time.

3.2. System Settings

System settings include Language, Time and Date settings, Home-page setting, Software update and Device information.

To set VinciLab's language

- Tap **Language** or .
- The Language Screen appears. Select the desired language, a check mark appears in the check box.
- Tap  to accept and return to the Settings Screen.

Note:

- This language setting is **only** for the Desktop Applications, not for Coach. Language of Coach has to be set via the option Switch Language in the Main Tool menu of Coach.
-

To set the date and time

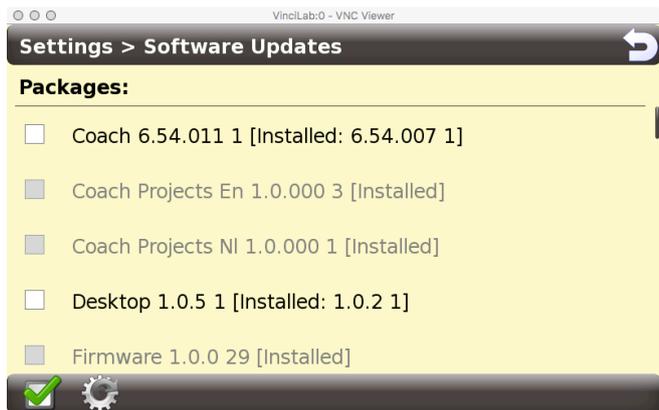
- Enter the current date/time by tapping ▲ and ▼.

To set the homepage

- Tap **Homepage** or ►.
- Type in a webpage address you like to use as the Homepage for VinciLab Web Browser.
- Confirm with .

To update VinciLab system and its applications

- Connect to a Wi-Fi network. See 'III. VinciLab Applications, 4.1. Wi-Fi'.
- Tap  **Software Update** or ►.
- The Software Update screen appears and automatically lists all installed software packages (grey) and new available updates (black).
- Tap an update package to select it or tap  to select all available new packages.
- Tap  to start the update.
- The selected updates will be downloaded and installed on the device. The progress of this process is displayed on the Screen. Wait until the message *Update is finished* appears, it may take a few minutes.
- Tap  to return to the Settings Screen.
- Reboot your device.

**To view Information about VinciLab**

- Tap  **About**.
- On the About Screen the information about VinciLab is displayed.
- Tap  to return to the Settings Screen.

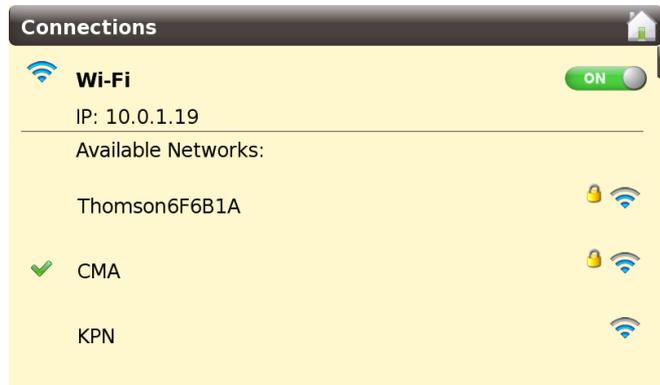
4. Connections

Use the Connections application to connect VinciLab to the Internet and to other wireless devices.

- To start tap  **Connections**.

4.1. Wi-Fi

Wi-Fi is a wireless networking technology that provides access to local area networks. VinciLab supports the 802.11 /b/g/n Wi-Fi protocol.



To turn Wi-Fi On and Off

- To turn the Wi-Fi services on drag the **Wi-Fi** slider to the position **ON**.
- VinciLab automatically scans for available Wi-Fi connections. The Wi-Fi icon at the right shows the signal strength; the more bars are displayed, the stronger the signal is.
- When the scan is completed, tap a Wi-Fi network to connect to. If the Wi-Fi network is open, you will be connected automatically. If the Wi-Fi network is secured, enter the password.
- If you want to manually join a network (connect to a closed network) select **Join other**, and enter the network name, security type and password, and confirm with .
- When VinciLab is successfully connected to the selected network the assigned to VinciLab IP address appears in the Connections screen.
- To turn the Wi-Fi services off drag the **Wi-Fi** slider to the position **OFF**.

Note:

- *VinciLab remembers the preferred network and its settings.*
-

4.2. Data Share

Turning Data Share on will start a Virtual Network Computing (VNC) server on VinciLab. VNC is a technology for remote desktop sharing; it enables the screen display of a device to be remotely viewed and controlled over a network connection.⁴ To allow this a VNC viewer program needs to be installed on the controlling device (client) and remote connection has to be established between the two devices. Such VNC viewer programs are freely available for all platforms.

See also *V. Using VinciLab with a computer and a tablet, 5. Displaying VinciLab's screen on a computer or a mobile device.*

⁴ VNC works in a similar way to Windows' Remote Desktop but allows connections to Linux operated machines.

To turn Data Share On and Off

- Make sure that VinciLab is connected to a network.
- To allow data sharing drag the **Data Share** slider to the position **ON**.
- VinciLab shows that VNC is running and displays its IP address.
- Now you can use another device connected to the same network to view and control your VinciLab. To do so, start a VNC Viewer installed on such device and connect to VinciLab by providing its IP address.
- To stop the data sharing drag the **Data Share** slider to the position **OFF**.

Note:

- *VinciLab remembers the Data Share slider setting.*
-

4.3. Bluetooth

Bluetooth is a short-range wireless communications technology for exchanging information over a distance at most 100 m. VinciLab supports Bluetooth® 4.1.

To turn Bluetooth On or Off

- To turn Bluetooth On drag the **Bluetooth** slider to the position **ON**.
- 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 with .
- When paired, the Bluetooth icon appears in the System Bar.
- To turn Bluetooth off drag the **Bluetooth** slider to the position **OFF**.

Bluetooth communication can be used e.g. to connect a wireless Bluetooth keyboard or mouse to VinciLab.

5. Web Browser

Use the Web Browser application to access the Internet.

- To start tap  **Web Browser**.

VinciLab is equipped with a very simple HTML Browser.

To type a URL or other text

- Tap the URL field at the top of the screen or a text field to display the virtual QWERTY keyboard to enter text.
- Tap  **Enter** to accept the text.
- Tap  **Close** to hide the virtual keyboard.

To navigate

- Tap  **Back** in the window header to return to the previous page.
- Tap  **Forward** to go forward to a recent page.
- Tap  **Refresh** to refresh the connection.
- Tap and drag your finger on the screen to navigate pages, and to reposition pages within the screen.
- Tap a hyperlink to follow the link.

To zoom

- Use two fingers, such as your index finger and thumb, to make a pinch motion on the screen.

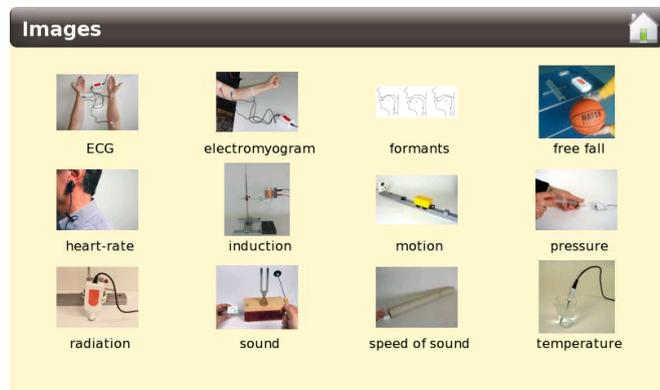
See also 'II. Getting Started, 3.3. Navigation'.

6. Images

Use the Images application to view images stored on your device in the folder My Files/Media/Images.

- To start tap  **Images**.

The Images Screen displays the thumbnails of images located in My Files/Media/Images.



To browse and display an image

- Tap a desired image thumbnail to select it.
- The selected image is displayed in its original size or zoomed to fit the screen.
- Tap and slide across the screen to move the image.
- Pinch in to zoom in and pinch out to zoom out the image.
- Swipe left or right to browse through images.

7. Media Player

Use the Media Player application to play music and video files stored on VinciLab in the folder My Files/Media /Audio and MyFiles/Media/Video.

- To start tap  **Media Player**.

To play a media file

- Tap an audio file  or a video file  to begin playback.
- During playback, use the media controls:



 **Stop** to stop playback.

 **Play** to resume playback.

 **Pause** to pause playback

 **Mute** to mute the sound.

- Tap and drag the Volume slider to set the playback sound volume.

8. Calculator

Use the Calculator application to perform simple mathematical calculations.

- To start tap  **Calculator**.



IV. THE COACH APPLICATION

Read this chapter to learn how to work with the Coach Application on VinciLab.



To start Coach

- Tap  **Coach** on the Home Screen.
- The Main Screen of Coach opens.

1. Main Screen

The Main Screen displays the Coach Title image, the Toolbar and the bottom bar. The Toolbar offers the following icons:

Icon	Tap this icon to:
	Exit Coach
	Open a Coach Activity or Result
	Create a new Coach Result
	Display the Main Screen Tool menu
	Exit Coach

MAIN SCREEN TOOL MENU

- **New** - to create a new Result.
- **New (Sound Only)** - to create a new Result for collecting data via the internal sound sensor.
- **Open ...** - to open a Coach Activity/Result (*.cma/*.cmr).
- **Open CMA Project...** - to open a CMA Coach Activity/Result (*.cma/*.cmr).
- **Switch Language** - to change the language of Coach User Interface. To reflect this language setting first close Coach and open it again.
- **Quit Coach** - to quit Coach Application.

Across the bottom bar the Coach version number, the Home Screen icon and time information are shown.

- Tap  to go to the Home Screen of your VinciLab, tap  to switch back to Coach.

2. Coach Activities and Results

Coach works with Activities (*.cma files) and Results (*.cmr files). Coach Activities and Results contain experiment settings, diagrams and tables, data, texts, images, web pages, and student notes.

Coach Activities are Coach documents created in the Author mode of the Coach 7

program (such activities have to be saved via the option **File > Save for MoLab/VinciLab**). Student users can open such Activities in the Coach application but cannot overwrite them. Instead Student users save the results of their work in Coach Results. Exemplary CMA Coach Activities and Results are stored in the CMA Coach Projects folder. This folder can be opened directly via the menu option **Open CMA Project** available in the Main and Activity Screen Tool menus. Coach Activities and Results can be stored in the VinciLab's user folder My Files > Coach.

To open an Activity/Result (*.cma/*.cmr file)

- Tap  or tap  and select **Open CMA project** to open a CMA Coach Activity/Result or tap  and select **Open** to open any Activity/Result.
- The **Open an Activity** dialog opens. Browse and select the desired Activity/Result file and tap .

To create a new Result (*.cmr file)

- Tap  or  and select **New** or **New (Sound Only)** if you want to collect data only via the internal sound sensor.

After opening an Activity or Result, the Coach Toolbar changes. Each Activity or Result has a few Screens, which are displayed after tapping its respective icon:

Icon	Screen:
	Activity
	Sensors
	Diagrams
	Tables
	Texts not displayed in Results created on VinciLab and in Activities/Results in which Texts are not included.
	Images
	Web-pages
	Student Texts

- Tap an icon to display a respective screen.
- When the new screen appears it has a tab with two icons:
Screen icon - this icon now has a different function, it lists all items available in the selected Screen, e.g. a list of Activities/Results, a list of connected sensors, a list of

available diagrams, etc.

 - tap this icon to open the Tool menu with specific options.

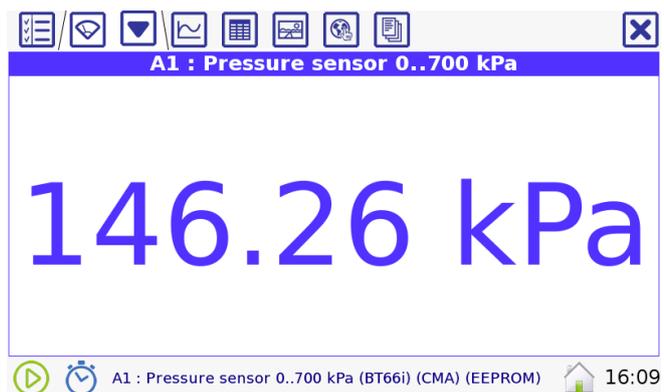
In the bottom bar the following icons may be present:

Icon	Tap this icon to:
	Start the measurement Grey when no sensor(s) connected/selected
	Interrupt the measurement at any time Appears after the measurement is started
	Take a manual measurement Appears in the manual measurement mode
	Stop manual measurement Appears in the manual measurement mode
	Open the Measurement Settings
	Go to the Home Screen Tap  to switch back to Coach

3. Typical measurement procedure in the Coach Application⁵

- Turn VinciLab on by pressing its power button. Wait until the Home Screen appears.
- Ensure VinciLab has sufficient battery power or is connected to a power supply.
- On the Home Screen tap  to open Coach.
- Connect the desired sensor(s) to the sensor input(s) of VinciLab.
- Open a new Coach Result:

- Tap  or Tap  and select **New**. If you only want to work with the internal sound sensor select **New (Sound Only)**.
- A new Result opens and displays the **Activity** Screen.
 1. When a connected sensor is detected and identified then its name appears in the Activity Screen and its live readings are displayed on the Sensors Screen.



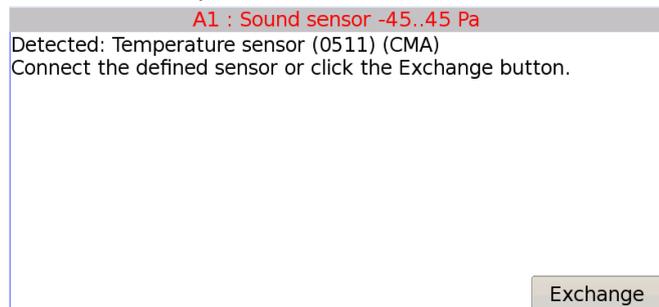
⁵ This procedure does not describe the Event-based type of measurement, use Tutorial 'Event-based measurement' to learn how to perform this type of measurement.

- When a sensor is not identified then it has to be manually selected from the Sensor Library: go to **Sensors Screen**, tap  and select **Sensor Settings**, tap the sensor input tab to which the sensor is connected, tap **Choose** (or **None**) and select the desired sensor from the list.



or

- Open a ready-to-go Coach Activity or Result:
 - Tap  or Tap  and select **Open** or **Open CMA Project...**
 - Browse to select the desired Activity/Result or tap  and select the desired Activity/Result from the list. Tutorials and examples of Activities are available in the CMA Projects.
 - Confirm with .
 - The Activity/Result opens. Coach automatically detects and identifies the connected sensor(s). If the identified sensor is different from the sensor defined in the Activity/Result then the sensor listed on the Activity Screen is displayed in red. The sensor digital display shows information about the sensor defined in the Activity (red) and the sensor identified by VinciLab. Connect the defined sensor or change it into the detected sensor by tapping **Exchange**. This feature is not available for sensors, which cannot be identified.
- Tap  to display live readings of the connected sensors. The live displayed data are not stored in VinciLab's memory.
- You are ready to start a measurement. The measurement will be executed according to the given measurement settings. Tap  **Measurement Settings** to check these settings, modify if needed. Note that the max. sampling frequency is 1 MHz and the max. number of collected measurement points is 50 000 per input.
- 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.
 - When the type of measurement is set to **Manual** then the **Manual Start** icon  appears in the bottom bar. Tap this icon to collect a single measurement. When keyboard input is specified then the value of one or more quantities has to be typed in the dialog, which will pop-up.



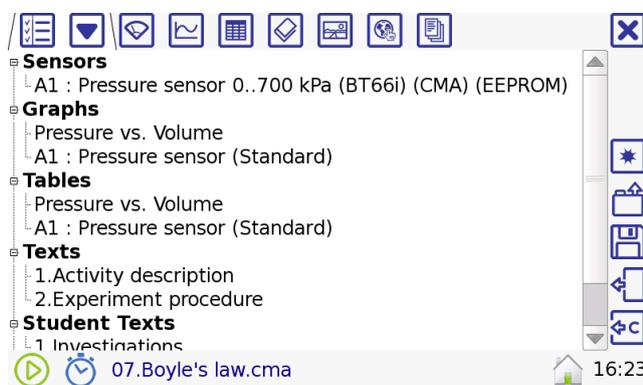
- **WARNING!** When tapping  and starting a new data collection run, existing data is overwritten by the new data without any warning. To avoid losing any data always save your Result first.
- The measurement stops when the specified measurement time (time-based measurement mode) or specified number of samples (manual measurement mode) has been reached. If you want to interrupt the measurements process tap .
- To save your result go to the , tap  or tap  and select **Save** or **Save As....**

Note:

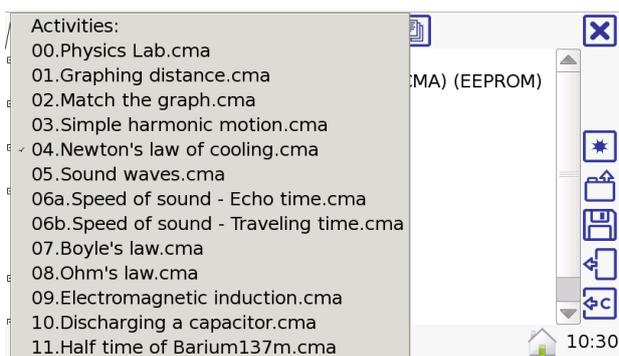
- To avoid loss of data, for instance in case of empty battery, the Coach Application will save intermediate results during measurements longer than 10 minutes. Saving of the Result file, will be done each minute (in case of new data). The last saved file can be found in My Files/DataRecovery/last_result.cmr.

4. Activity Screen

The Activity Screen gives an overview (in the form of a tree) of all items available in the opened Activity/Result. Each tree branch corresponds to one of the Coach Screens.



- Tap  to go to the Activity Screen.
- Tap a tree branch to show all available items or to close it. If there are no items available then the branch is not shown.
- Tap, hold and release an item listed under a branch to display this item in its respective Screen. For example tap, hold and release diagram 'A1: Pressure sensor (Standard)' to open the Diagram Screen and display the 'A1: Pressure sensor (Standard)' diagram.
- Tap  again to directly display the list of activities present in the currently opened folder. Tap an Activity/Result to open it.
- Tap  to display the Tool menu.



ACTIVITY SCREEN TOOL MENU

- **New** - to open a new Result.
- **New (Sound Only)** - to open a new Result with the internal sound sensor.
- **Open ...** - to open a Coach Activity/Result.
- **Open CMA Project...** - to open a CMA Coach Activity/Result.
- **Save ...** - to save the existing Result.
- **Save as ...** - to name and save the existing Result.
- **Delete ...** - to delete a current Activity/Result (*.cma/*.cmr file).
- **Activity Options** - to set the Activity options.
- **Close** - to close the existing Activity/Result and return to the Main Screen.
- **Quit Coach** - to quit Coach Application.

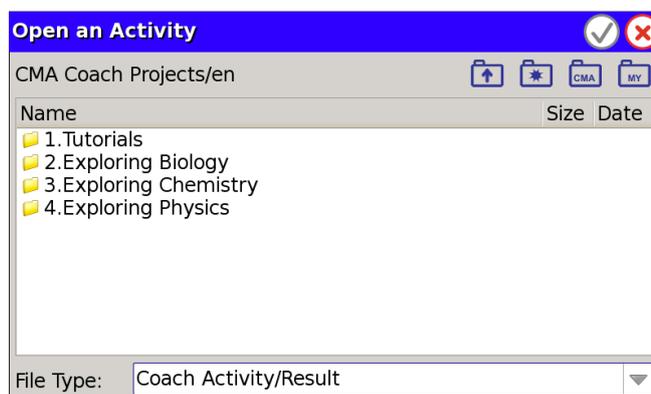
At the right the following icons are present:

Icon	Tap this icon to:
	Open a new Result
	Open an Activity/Result, see below
	Save the current Result
	Close the current Activity/Result
	Exit Coach

After you have chosen the **Open** option the **Open an Activity** dialog is displayed.

In this dialog tap:

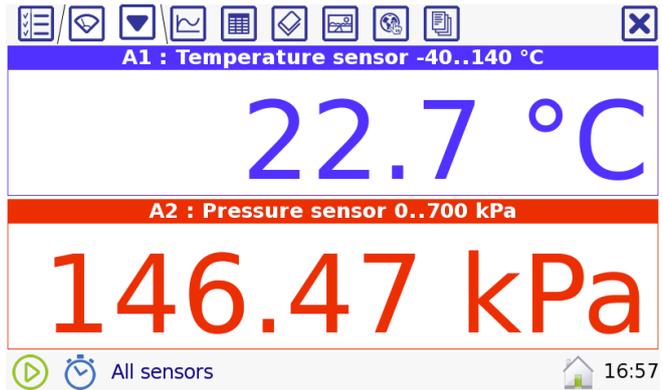
-  to go one level up,
-  to create a new folder(s),
-  to open the folder with the CMA Projects and Activities,
-  to open the My files > Coach folder.



5. Sensors Screen

The Sensors Screen is used to show live data measured by the connected sensor(s) and to set up the measurement and sensors.

A digital display appears automatically when VinciLab identifies the sensor. For a sensor, which is not identified, a digital display will be created only after selecting a sensor from the VinciLab Sensor Library. The live sensor readings are **not stored** in VinciLab's memory.



- Tap  to go to the Sensors Screen.
- Tap  again and select a sensor to maximize its digital display (when more than one sensor is connected).

SENSORS SCREEN TOOL MENUS

Tap  to display the tool menu:

- **Sensor Settings...** – to open a dialog to define sensor settings.
- **Measurement Settings** – to open a dialog to define a measurement type and its specific settings.

Touch, hold and release a sensor digital display to open the sensor Tool menu:

- **Sensor Settings...** – to open a dialog to with sensor settings.
- **Set to Zero** – to set the current measured value to zero.
- **Set to Value** – to set the current measured value to another value.
- **Reset Calibration** – to reset the **Set to** operation.

5.1. Sensor Settings

The **Sensor Settings** dialog displays the sensor information and allows sensor setup. The dialog has tabs: A1, A2, A3, A4 - for analog sensor inputs, D1, D2 - for digital sensor inputs, and X,Y,Z - for the internal 3-axis Accelerometer.

- Tap a tab e.g. **A1** to display the current settings of the sensor connected to this input.

As long as a sensor is not automatically identified by Coach or manually selected from the Sensor Library the Sensors Screen remains empty and the Sensors Settings dialog shows **None** behind the sensor.



A. Automatically recognized sensors

When the connected sensor is identified its information appear in the respective tab of the Sensor Settings dialog.

B. NOT automatically recognized sensors

When a connected sensor is not identified (an older type of sensor or a sensor whose EEPROM memory cannot be read) then the sensor has to be set up manually.

- Tap **Choose** or tap **None**.
- Tap the name of the desired sensor to select it and confirm with .

C. 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, between 0 .. 5 V or -10 .. 10 V, it is important to indicate which voltage range is used by a new sensor.

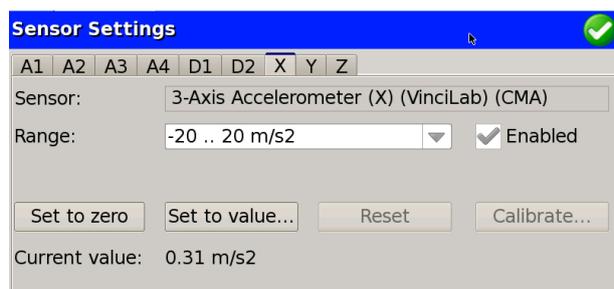
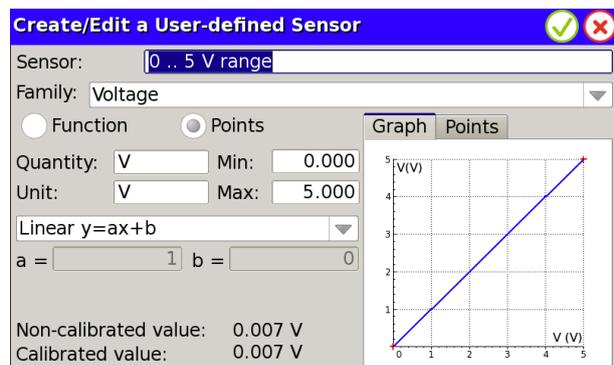
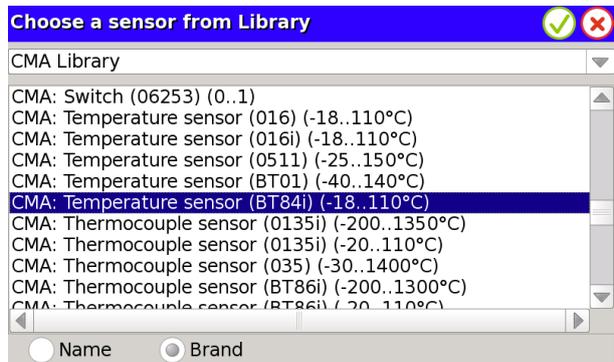
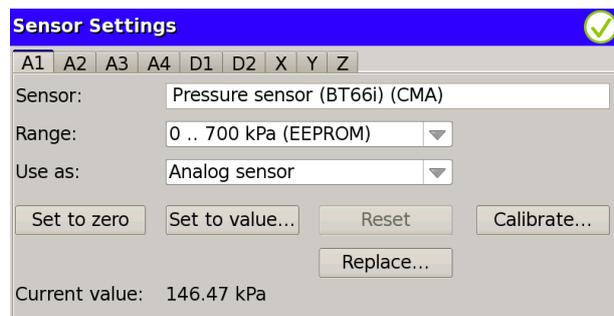
- Tap **Create New**.
- Select the voltage range of your new sensor.
- By default the sensor settings are filled like for a Voltage sensor. Enter the sensor information adequate to your sensor.
- Perform the sensor calibration by providing a function or by typing/measuring the calibration points in the same way as described for the standard calibration. See below 5.2. *Sensor Calibration*.
- Tap  to save the new sensor. If you save it in the User Library then it will be available globally and you can use it in any Coach Activity.
- To remove the user sensor tap **Delete sensor**.

D. Built-in sensors

In the Sensor Settings dialog you can also enable and disable the internal sensors.

Internal accelerometer

The **X**, **Y**, **Z** tabs in this dialog are used for the acceleration components respectively in x, y and y direction. Tap



X, Y, or Z and tap the checkbox **Enabled** to make the sensor ready for measurement.

Internal microphone

Tab **A2** has additional button **Enable Internal microphone**, which switches this output to measure via the Internal microphone. This allows using internal microphone with combination with other sensors.⁶

The Activity **Sound only** allows to measure only with the internal microphone. It has only tab **Internal**, which displays settings of the internal microphone. Note that if an external microphone is connected via Audio In port then the internal microphone is disconnected and the external microphone is used instead.

Options of the Sensor Settings dialog:

Sensor: displays the sensor's name, number and brand.

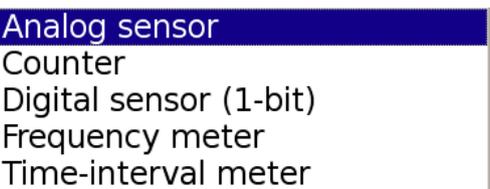
Range: displays the sensor range, for sensors with the EEPROM memory this is the range stored in the EEPROM (selected by default). Most sensors have more measurement ranges.

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



0 .. 700 kPa
0 .. 700 kPa (EEPROM)
0 .. 7000 hPa

Use as: displays the mode in which the sensor works. Most sensors are used by default in the Analog mode.



Analog sensor
Counter
Digital sensor (1-bit)
Frequency meter
Time-interval meter

- Tap the selected mode to choose another mode.
- Specify the conversion settings for Counter, Digital sensor (1-bit), Frequency meter and Time-interval meter.

Use **Set to zero** or **Set to value** to shift the provided sensor calibration. Use **Reset** to reset the **Set to ...** operation.

Use the **Calibrate** button to open the calibration, which belongs to the current 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.

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 settings of the new selected sensor. Use **Remove** to remove such sensor from the input.

5.2. Sensor calibration

Most CMA sensors do not need to be calibrated. Their calibrations are provided by the sensors themselves (stored in the sensor's EEPROM memory) and by the Coach software (included in the CMA Sensor Library). For even better accuracy these calibrations can be improved or new calibrations can be made and added as new sensor input ranges.

The sensor calibration in Coach provides the sensor name, its measurement range and

⁶ Only for VinciLab's purchased starting from February 2019

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 has to be connected to the active interface. Such a calibration is the most accurate calibration.
 - Keyed in, both the sensor voltage value and the value of the corresponding quantity are typed.

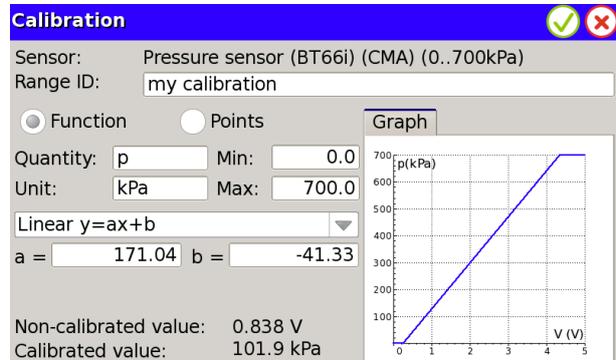
The best function fit, through the calibration points, is calculated according to the least-squares method.

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 by 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 a sensor or choose a sensor from the CMA Library.
- Select a range from the CMA Library but **NOT** EEPROM and User range.
- 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  to save the new range. If you save it in the User Library then it will be available globally and you can use it in any Coach Activity.
- Use the **Delete range button** In the Sensor Settings dialog to remove a user range.

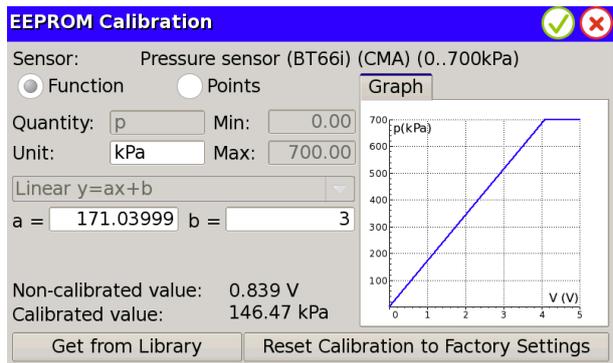


To replace the calibration in the sensor's EEPROM memory

- Connect a sensor equipped with EEPROM memory.
- Check if the range is set to EEPROM, if not tap the range and select the EEPROM range (the word EEPROM is displayed in brackets).
- 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 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 an existing calibration from CMA Sensor Library.
- Tap  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** button to restore the original EEPROM calibration.

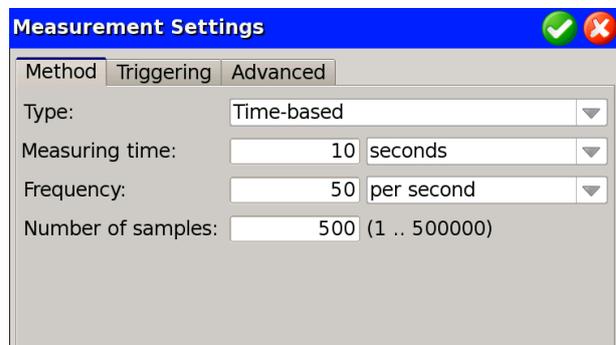


To edit a self-defined sensor

- Choose a self-defined sensor from the User Library.
- Tap **Edit**. The Calibration dialog opens and shows the sensor name, calibration settings and the calibration graph. If desired modify the calibration settings.
- Tap  to accept. The sensor can be overwritten or added as a new self-defined sensor.

5.3. Measurement Settings

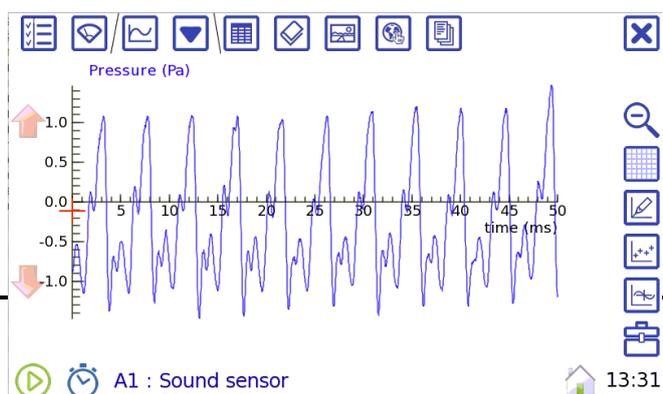
The **Measurement Settings** dialog specifies how VinciLab has to measure. Select the measurement type (time-based, event-based or manual) and set the respective measurement settings. If you want to start your measurement automatically enable triggering and define trigger conditions in the Triggering tab. In the Advanced tab it is possible to repeat the measurement process a number of times.



6. Diagrams Screen

The Diagrams Screen is used to display measured or calculated data in diagrams. Here you can also adjust graph settings, create new diagrams and perform data processing and analysis.

A standard diagram, the sensor quantity vs the clock (time), is created automatically after a sensor has been identified or selected from the Sensor Library. Changing of any diagram style options, such as removing the grid or changing the diagram color, removes



the suffix '(Standard)' from the diagram's name and makes it a user-defined diagram. On starting a measurement graph(s) are drawn in pre-defined diagrams. Notice that when starting a new measurement run, the existing data is overwritten by the new data without warning. You can collect several measurement runs for comparison by using the **Copy column** option from the Tool menu.

- Tap  to go to the Diagrams Screen.
- Tap  again to see all available diagrams and to select another diagram.
- Tap  to open the Tool menu.

DIAGRAMS SCREEN TOOL MENU

- **Zoom to Fit** (*only for a diagram with data*) - to optimally zoom in the graph.
- **Zoom Out** (*only when in zoomed state*) - to return to the previous zoom state.
- **Scan** (*only for a diagram with data*) - to read co-ordinates of points in the graph. When scan is started use **Stop Scan** - to stop the scan.
- **Erase all Values** (*only for a diagram with data*) - to remove all data.
- **Sketch** - to draw a prediction graph or a graph, which can be converted to real data. After the sketched graph is created use:
 - **Convert Sketch to Table** - to convert the sketch to real data, or
 - **Erase Sketch** - to remove the sketch.
- **New Diagram...** - to create a new diagram.
- **Delete Diagram** - to delete the displayed diagram.
- **Graph Properties ...** - to edit the displayed diagram.
- **Graph Style** - to change the display settings of the diagram.
- **Import Background Graph** - to import a graph with data from another Coach Activity/Result and place as background graph.
 - **Shift Background graph** – to move the background graph horizontally, use **Stop Shifting Background Graph** when you are ready.
- **Delete Background Graph** - to delete the background graph.
- **Process/Analyze** - to select data processing and analysis tools.
- **Copy column** (*only for a diagram with data*) - to keep previous run(s) active.

At the right the following icons are present:

Icon	Tap this icon to:
	Re-scale the horizontal and vertical axes to optimally display the graphs
	Return to the original scale. Active only after a zoom
	Switch the grid on and off
	Draw a prediction graph or a graph, which can be converted to real data (toggle)
	Stop drawing a sketch graph (toggle)
	Change the display settings of the diagram
	Scan - read co-ordinates of points in the graph (toggle) <i>(Active only for a diagram with data)</i>
	Stop scanning (toggle)
	Go directly to the data processing and analysis tools

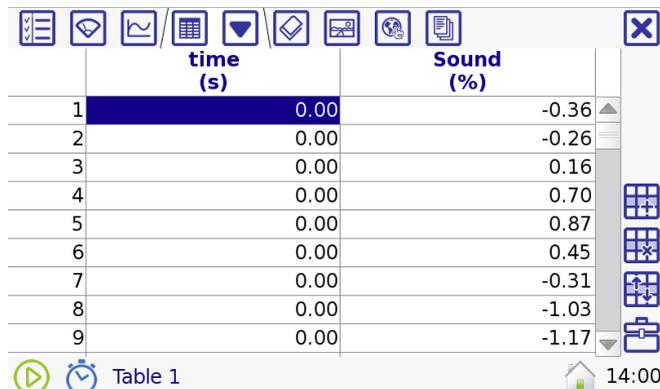
7. Tables Screen

The Table Screen is used to display measured or calculated data in tables. Here you can also manage table rows, create new tables, import data from and export data to csv file and perform data processing and analysis.

Tables are synchronized with diagrams and share a number of settings (among which their name): irrespective where these settings are changed, they are reflected both in the diagram and the table. The standard table is the table corresponding to the standard diagram.

On starting a measurement all table(s) are filled with data values. When starting a new measurement run, the existing data is overwritten by the new data without any warning.

- Tap  to go to the Tables Screen.
- Tap  again to see all available tables and to select another table.
- Tap  to open the Tool menu.



	time (s)	Sound (%)
1	0.00	-0.36
2	0.00	-0.26
3	0.00	0.16
4	0.00	0.70
5	0.00	0.87
6	0.00	0.45
7	0.00	-0.31
8	0.00	-1.03
9	0.00	-1.17

Table 1 14:00

TABLE SCREEN TOOL MENU

- **Erase all Values** (*only for a table with data*) - to remove all data from the activity.
- **Import Table** - to import data from csv (text) file, after this action a new table with data will be added.
- **New Table...** - to create a new table.
- **Delete Table** - to delete the displayed table.
- **Edit Table ...** - to edit the displayed table.
- **Process/Analyze** - to select data processing and analysis tools.
- **Import CSV File** - to import data from csv (text) file, after this action new columns with data will be added to the existing table.
- **Export CSV File** - to export data into csv (text) file
- **Data Rows** - to add, delete and sort table rows.
- **Edit** - to edit table cells.
- **Copy column** (*only for a table with data*) - to keep previous run(s) active.

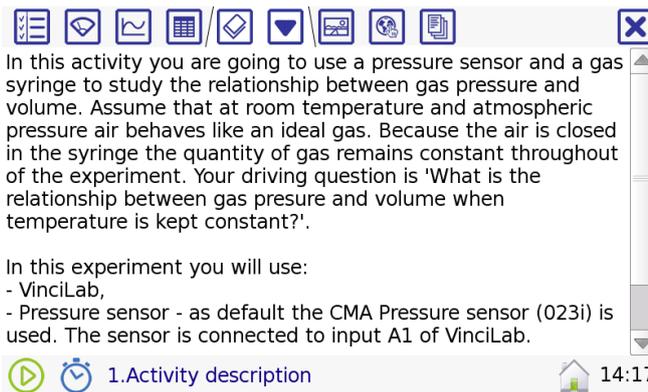
At the right the following icons are present:

Icon	Tap this icon to:
	Add a table row
	Delete a table row
	Sort table rows
	Go directly to the data processing and analysis tools.

8. Texts Screen

The Texts Screen is used to display texts that are prepared by Authors in the Coach 7 program. Student users cannot edit these texts. New Results created on VinciLab do not include Texts Screen since Student users can write and edit only Student Texts.

- Tap  to go to the Texts Screen.
- Tap  again to see all available texts and to select another text.
- Tap  to open the Tool menu.



In this activity you are going to use a pressure sensor and a gas syringe to study the relationship between gas pressure and volume. Assume that at room temperature and atmospheric pressure air behaves like an ideal gas. Because the air is closed in the syringe the quantity of gas remains constant throughout of the experiment. Your driving question is 'What is the relationship between gas pressure and volume when temperature is kept constant?'.
In this experiment you will use:
- VinciLab,
- Pressure sensor - as default the CMA Pressure sensor (023i) is used. The sensor is connected to input A1 of VinciLab.

1. Activity description 14:17

TEXTS SCREEN TOOL MENU

- **Copy** - to copy a piece of text.
- **Text size** - to select the font size used in (all) Texts.

9. Images Screen

The Images Screen is used to display photos and images (bmp, gif, jpg and png files). By default there is no image in a new Result created on VinciLab; the Image Screen is empty.

- Tap  to go to the Images Screen.
- Tap  again to see all available images and to select another image.
- Tap  to open the Tool menu.



IMAGES SCREEN TOOL MENU

- **New Image** - to add a new image.
- **Delete Image** - to delete the displayed image.
- **Edit Title ...** - to edit the title of the Image.
- **25% / 50% / 75% / 100%** - to display the image in 25% / 50% / 75% / 100 % of its original size or to **Fit** it into the screen.

10. Web-pages Screen

The Web-pages Screen offers a simple browser that can be used to add and to browse to web pages. This browser works only when VinciLab is connected to a Wi-Fi network. By default there is no web page in a new Result created on VinciLab; the Web-pages Screen is empty.

- Tap  to go to the Web-pages screen.
- Tap  again to see all pre-defined web pages or to select a new pre-defined web page.
- Tap  to open the Tool menu.



WEB PAGES TOOL MENU

- **New Web Page...** - to add a new web page via http link.
- **Delete Web Page** - to delete a pre-defined web page.
- **Edit Title ...** - to edit the title of the pre-defined web page.
- **Home Page** – to set the displayed web page as the Home page (only one per Activity/Result).
- **Back** – to return to the last viewed web page.
- **Forward** - to forward again to the viewed web page.
- **Home** - to return to the Home page.
- **Refresh** - to refresh a web page.
- **Copy URL** - to copy URL address.

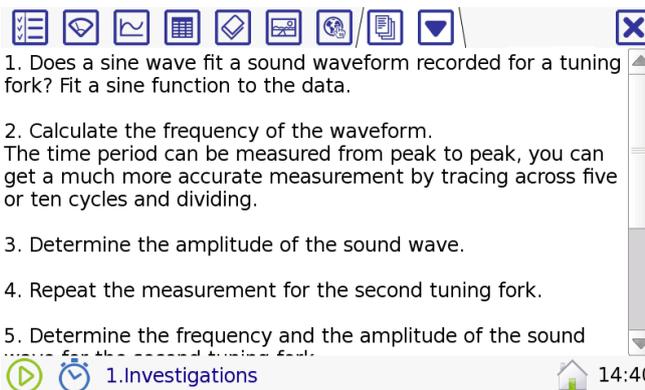
At the right side of the Web-pages Screen the following shortcuts are available:

Icon	Tap this icon to:
	To return to the last viewed web page
	To forward again to the viewed web page
	To return to the Home page
	To refresh a Web page
	To stop loading the current Web page (toggle)
	To zoom in a Web page
	To zoom out a Web page

11. Student Texts Screen

The Student Texts Screen is used to display texts, which can be edited by student users. Student users can also add their own texts. By default an empty Student Text is included in a new Result, allowing direct typing of student notes.

- Tap  to go to the Student Texts Screen.
- Tap  to see all available texts and to select another text.
- To type in notes tap the Text Screen, a virtual, on-screen keyboard appears. Enter your text. Tap the key with the language code (e.g. EN for English) to select a keyboard in another language.



The screenshot shows a toolbar at the top with various icons for editing and navigation. Below the toolbar is a list of text items:

1. Does a sine wave fit a sound waveform recorded for a tuning fork? Fit a sine function to the data.
2. Calculate the frequency of the waveform.
The time period can be measured from peak to peak, you can get a much more accurate measurement by tracing across five or ten cycles and dividing.
3. Determine the amplitude of the sound wave.
4. Repeat the measurement for the second tuning fork.
5. Determine the frequency and the amplitude of the sound wave for the second tuning fork.

At the bottom of the screen, there is a navigation bar with a play button, a clock icon, the text "1. Investigations", a home icon, and the time "14:40".

- Tap  to open the Tool menu.

TEXTS SCREEN TOOL MENU

- **New Student Text...** - to add a new Student text.
- **Delete Student Text** - to add a new Student text.
- **Edit Title...** - to edit the title of the selected Student text.
- **Cut** - to cut a selection of text.
- **Copy** - to copy a selection of text.
- **Paste** - to paste a selection of text.
- **Undo** - to undo the last action.
- **Text size** - to select the font size used in (all) Students Texts.

12. Processing and analysis tools

Data collected in measurements can be processed and analyzed with the advanced data processing tools of the Coach Application. These tools are available under the option **Process/Analyze** in the Tool menu of the Diagrams and Tables Screens or via the shortcut icons.

The Process/Analyze options all work in a similar way. After selecting an option a dialog that includes the data diagram is shown. Above and below the diagram the specific parameters can be specified. The drop-down list located in the left upper corner is used to select the quantity to be analyzed.

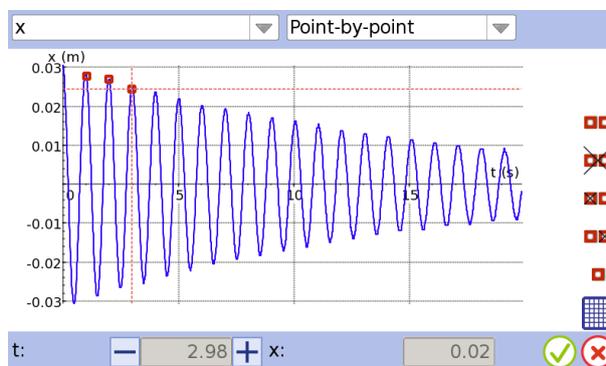
WARNING! To prevent data loss from a wrong processing **save your data** before starting a processing tool.

12.1. Select/Remove Data

With the **Select/Remove Data** tool either a range of data or single points can be selected for removal or retention.

To select/remove data

- Select **Process/Analyze** > **Select /Remove Data**.
- In the top left drop-down list select the quantity for which you want to select/remove data.
- In the next drop-down list select the selection method.
- For the **Range** method: select the range by dragging the boundary lines, or type in the boundary values in the **Begin** and **End** fields.



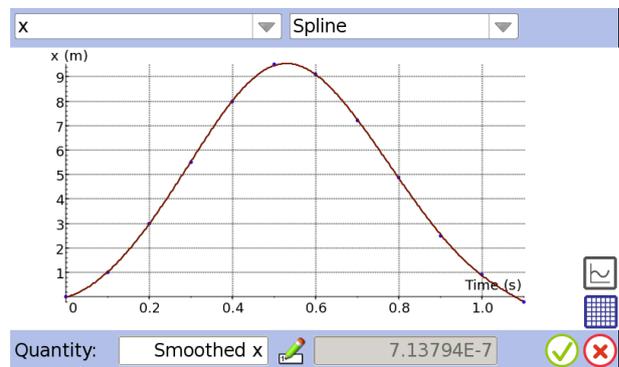
- For the **Point-by-point** method: select points by tapping a point in the graph or by using the small icons:  select all,  deselect all,  select even,  select odd,  select/deselect a point. Use **-** and **+** buttons to accurately select points.
- Tap  to confirm or  to close the dialog without changes.
- In the next dialog select **Keep selected** or **Delete selected** and confirm with .

12.2. Smooth

The **Smooth** tool is used to create a smooth curve that fits a rough or limited set of measured points. The smoothed graph may consist of (much) more points than the original data set and can successively be processed.

To execute smoothing

- Select **Process/Analyze > Smooth**.
- In the top left drop-down list select the graph you want to smooth.
- In the next drop-down list select the smooth method.
- Specify the smoothing parameters:
 - For **Moving average** enter the desired **Filter width**.
 - For **Spline** leave the automatically calculated **Smoothing factor** or tap the  icon and type in the desired value.
- If desired, change the name of the **Quantity**.
- Tap  to create the smoothed graph. If you are not satisfied with the result, change parameter settings and tap  again.
- Tap  to confirm or  to close the dialog without changes.
- Choose between **Add graph**, **Replace graph**, **New graph** or **Replace data** and confirm with .



12.3. Derivative

The **Derivative** tool is used to produce a graph of the first or second derivative of the original quantity.

To calculate a derivative graph

- Select **Process/Analyze > Derivative**.
- In the top left drop-down list select the graph of which you want to calculate the derivative.
- In the next drop-down list select the derivative order.
- In the third drop-down list select the



method of calculating the graph of the derivative (**Differences** or **Smooth**).

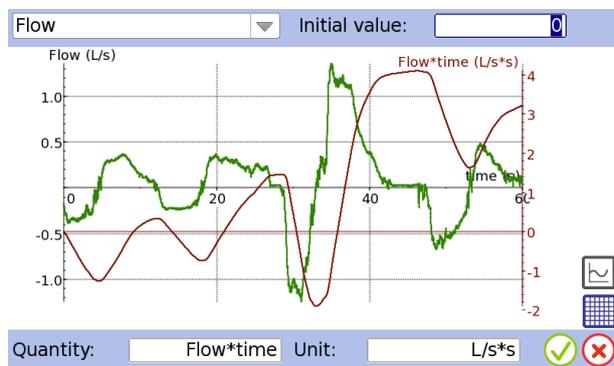
- When desired, edit the **Quantity** and **Unit**.
- Tap  to calculate the derivative graph.
- Tap  to confirm or  to close the dialog without changes.
- Select either **Add graph** or **New diagram** and confirm with .

12.4. Integral

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

To calculate an integral graph

- Select **Process/Analyze > Integral**.
- In the top left drop-down list select the graph of which you want to calculate the integral.
- In the **Initial value** field type in the constant of integration. This is the value assigned to the quantity along the vertical axis for $x=0$.
- When desired, change the name of the **Quantity** and/or **Unit**.
- Tap  to calculate the integral graph.
- Tap  to confirm or  to close the dialog without changes.
- Select either **Add graph** or **New diagram** and confirm with .

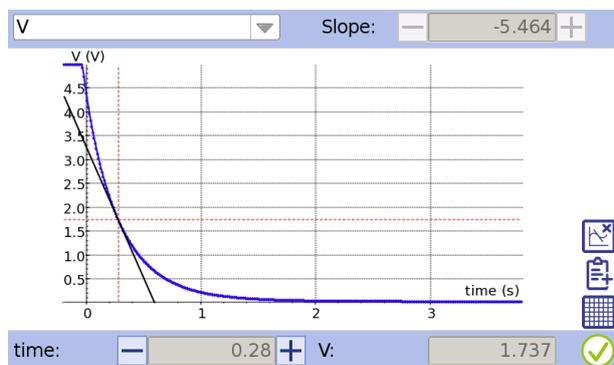


12.5. Slope

The **Slope** tool is used to determine the slope of the tangent at any point of a displayed graph.

To determine a slope

- Select **Process/Analyze > Slope**.
- In the top left drop-down list select the graph in which you want to determine a slope.
- The diagram in the dialog is in scan mode. The co-ordinates of the scanned point, indicated by the cross-hairs, are displayed in the fields below the graph.
- To find a slope manually tap the point in which you want to determine the



slope. Use **-** and **+** buttons to accurately select the point. A line appears in the diagram. Rotate the line until it is positioned correctly along the graph.

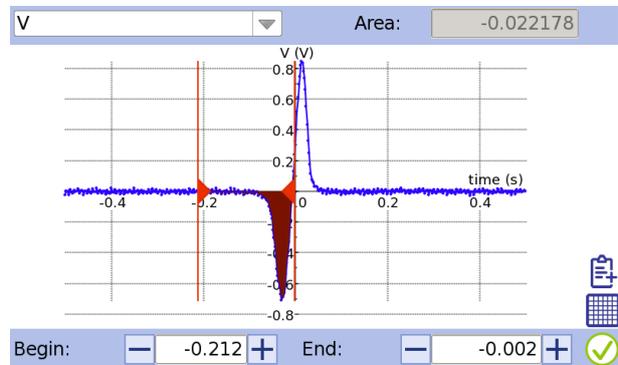
- To find a slope automatically tap . Tap the point in which you want to determine the slope, the slope is calculated and displayed in the graph.
- Read the value of the slope in the **Slope** field. You can copy the value of the slope to the clipboard by tapping .
- Tap  to close the dialog.

12.6. Area

The **Area** tool is used to determine an area between the displayed graph, the horizontal axis and two boundary lines.

To determine an area

- Select **Process/Analyze > Area**.
- In the top left drop-down list select the graph from which you want to determine an area.
- The diagram shows two boundary lines between which the area is calculated. Drag the boundary lines to the required position, or type the x-values for the boundary lines in the **Begin** and **End** fields. Use **-** and **+** buttons to accurately place the boundary lines.
- Read the area displayed in the **Area** field. You can copy the value of the area to the clipboard by tapping .
- Tap  to close the dialog.

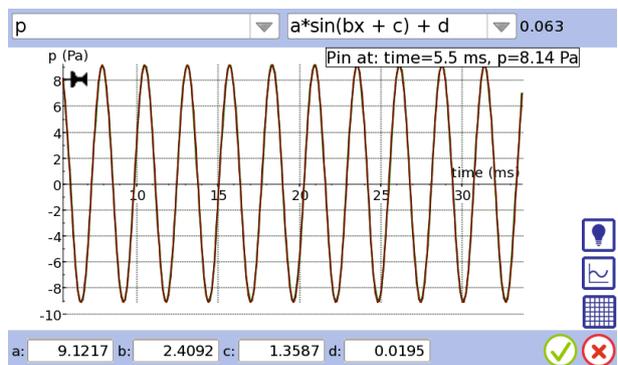


12.7. Function Fit

The **Function fit** tool is a procedure to approximate the data in the graph with a standard mathematical function. You can choose from a large number of function types. The coefficients of the fit function are determined using a least-squares method. Fitting can be done manually or automatically.

To determine a function fit

- Select **Process/Analyze > Function Fit**.
- In the top left drop-down list select the quantity which data you want to fit.
- In the next drop-down list select the function type that will be used.



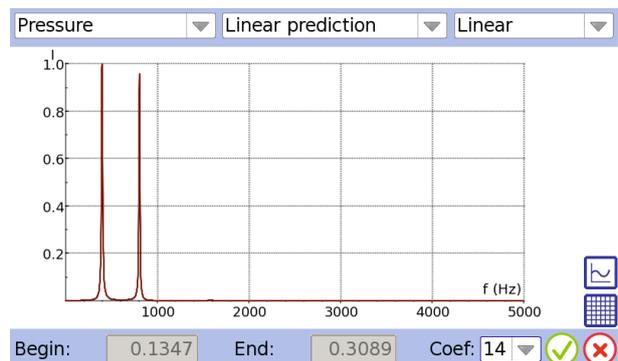
- To automatically determine the fit:
 - tap , Coach automatically estimates the best initial parameter values of the fit function; in some cases this is already the optimal fit.
 - tap  to refine the suggested fit.
- To manually determine the fit:
 - When the pin “is opened” you can shift the fit-function around. Touch the fit-function and move up/down and left/right.
 - When the pin “is closed” you can shape the fit-function around the fixed pinpoint. Tap the pin to close it, touch the fit-function and stretch up/down and left/right.
 - Repeat the above steps until a satisfying result is obtained.
- Tap  to confirm.
- Select **Add graph** or **Replace graph**.
- Tap  to confirm or  to close the dialog without changes.

12.8. Signal Analysis

The **Signal Analysis** tool is used to find the frequency spectrum of a periodical signal. The resulting values are presented as amplitudes plotted versus the frequency.

To determine a frequency spectrum

- Select **Process/Analyze > Signal Analysis**.
- In the top left drop-down list select the graph of which you want to calculate the frequency spectrum.
- In the next drop-down list select the method: **Fourier transform** or **Linear prediction**.
- In the third drop-down list select **Linear** or **Logarithmic** for the intensity scale along the y-axis.
- The diagram shows two boundary lines between which the spectrum is calculated. Drag the boundary lines to the required position, or type the x-values for the boundary lines in the **Begin** and **End** fields.
- For **Linear Prediction** enter the number of coefficients. This number determines the maximum number of peaks (formants), which will be found in the spectrum.
- Tap  to display the frequency spectrum of the signal.
- Tap  to confirm.
- Tap **OK** again to confirm creating a new diagram or **Cancel** to return to Signal Analysis.



12.9. Statistics

The **Statistics** tool displays statistical information about the diagram/table as a whole or about a selection of data in the table.

To display statistics

- For the whole data set: select **Process/Analyze > Statistics**.
For a selection of data: with your finger drag a selection in the table and then select **Process/Analyze > Statistics**.
- You can copy the statistics information to the clipboard by Tapping . Click  to close the dialog.

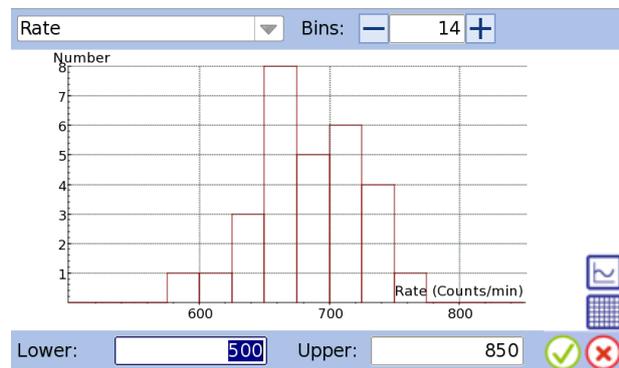
Statistics				
	time	V		
	s	V		
Number:	401	401		
Max:	3.80	4.976		
Min:	-0.20	0.011		
Average:	1.80	0.603		
Sum:	721.80	241.927		
Sum sqr:	1836.58	787.460		
s(n):	1.16	1.265		
s(n-1):	1.16	1.266		

12.10. Histogram

The histogram tool is used to create a statistical histogram - a graphical representation of the data distribution. The range of the variable (column) is divided into equal size bins for which the frequency of occurrence is counted. The height of the diagram bar is equal to the frequency of occurrence within the bin.

To determine a histogram

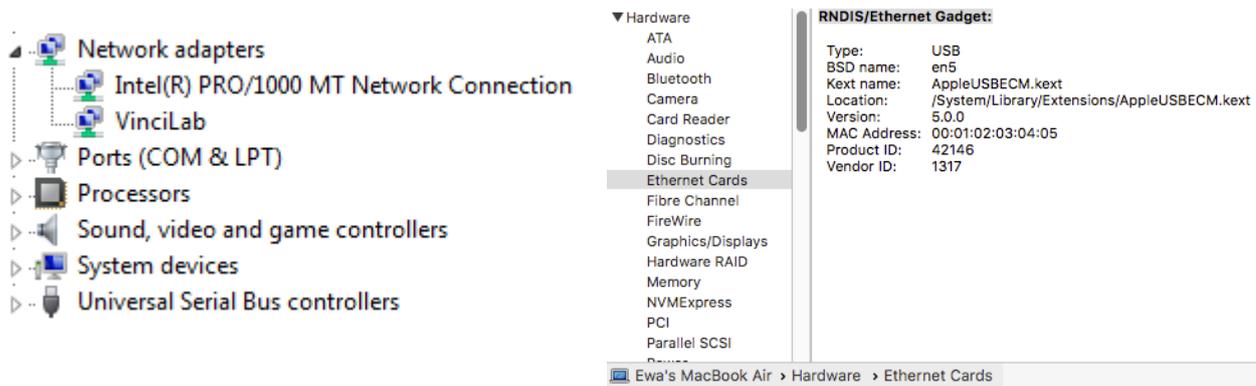
- Select **Process/Analyze > Histogram**.
- In the top left drop-down list select the column for which you want to create the histogram.
- Specify the **Lower** and **Upper boundary** values.
- Type the number of bins (default 5) or use **-** and **+** buttons to set the number of bins.
- Tap  to create a histogram. If you are not satisfied with the result, change parameter settings and tap  again.
- Tap  to confirm your histogram or  to close the dialog without changes.
- Tap **OK** again to confirm creating a new diagram or **Cancel** to return to Histogram.



V. USING VINCI LAB WITH A COMPUTER AND A TABLET

1. Connecting VinciLab via the USB cable

Before you start using VinciLab with a computer via the USB cable we recommend to first install the latest version of the Coach 7 or Coach 7 Lite software on your computer. In most cases the VinciLab installation is automatically executed the first time VinciLab is connected to the USB port of the computer. After successful installation VinciLab is shown under Network adapters (Windows)/Ethernet cards (MAC).



Windows Device Manager

Mac System Information

If the installation process is not successfully performed in Windows (VinciLab is marked by yellow exclamation sign) then the driver has to be installed manually.

- Go to **Control Panel** and start Windows **Device Manager**.
- Under network adapters right-click VinciLab and select **Update Driver Software**.
- Select **Browse my computer for driver software**.
- Browse to Program Files (x86)\CMA\Coach7\Common\EthernetCableDriver location⁷.
- Click **Next**. The driver software will be installed. After successful installation the message **Device driver software installed successfully** will appear.

2. Problems communicating with VinciLab

If after correct installation of VinciLab on your computer you experience problems with communication between VinciLab and computer and the Coach 7 program there can be a couple reasons for this.

1. A **computer firewall** may cause communication problems (as well via USB as via Wi-Fi). Make sure that the Coach executable (Coach7.exe) has permission to use the IP-address of VinciLab, and ports 22 and 1111 – 1116 are opened. If connected through USB, the VinciLab gets an IP-address in the range 169.254.200.1 – 169.254.200.255. For a wireless connection, the address depends on your network configuration. Please note that when using the USB cable, it may take a while before VinciLab gets its final IP-address.
2. An **anti-virus program** can block communication between Coach 7 and VinciLab.

⁷ During the Coach installation the USB VinciLab driver setup files are copied to your computer.

Give Coach (Coach7.exe) permission for such communication.

3. VinciLab makes use of Microsoft RNDIS drivers, some older versions of the RNDIS software may give problems on Windows computers. There is a hotfix available at: <http://support.microsoft.com/kb/2477042>) for Windows 7, Vista Windows Server 2008 R2, Windows Vista or Windows Server 2008. After installation of the hotfix use the Device Manager to uninstall the VinciLab driver while VinciLab remains connected to the computer via the USB cable. Then disconnect the USB cable from the computer and connect it again to use the new Microsoft RNDIS driver.

WARNING! Always **restart** VinciLab after a failed attempt to connect VinciLab in Coach or after you change the hardware settings in Coach.

3. Transferring files between VinciLab and a computer

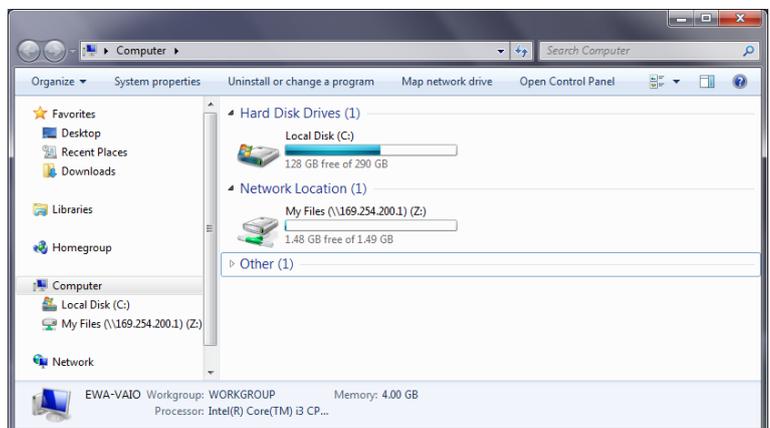
Transferring files between VinciLab and a computer are only possible via the USB connection. To get access to the VinciLab's user folder 'My Files' in Windows Explorer and Mac Finder, VinciLab needs to be first mounted as a network location.

To mount VinciLab

- Connect VinciLab to the computer via the provided USB cable.
- Please note that each time VinciLab is connected to a computer via its USB cable it may take up to 2 minutes before VinciLab gets its final IP address. Be sure that you have successfully installed VinciLab on your computer.

Windows

- Click the Windows **Start** button and select **Programs**.
- Then go to **CMA Coach 7 > Utilities** and select **Mount VinciLab**.
- The VinciLab's user folder 'My Files' appears in Windows Explorer under Network Location.
- To disconnect the 'My Files' folder go to **CMA Coach 7 > Utilities** and select **Unmount VinciLab**.



Mac

- Open Finder and select **Go > Connect to server** (cmd K).
- Use as the Server Address: `smb://169.254.200.1` and click **Connect**.
- If the system asks for password select **Guest**.



After mounting VinciLab files can be copied or

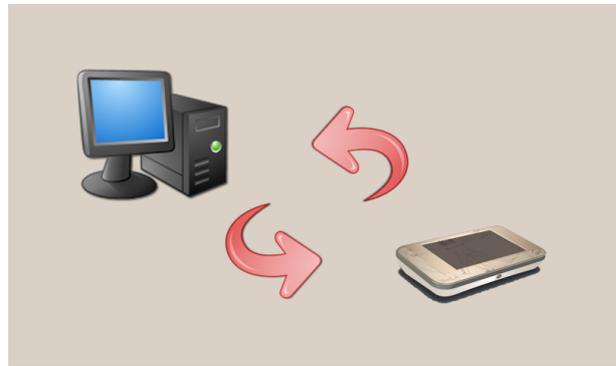
moved between the 'My Files' folder on VinciLab and the computer. The 'My files' folder consists of some pre-defined folders:

- **Coach** - the default folder used for storing user's Coach Activities and Results files. This is the default folder used in the Coach Application for saving User's files.
- **Media** - with folders Audio, Images, Video used for storing audio, images and video files. Files from Images subfolder are by default displayed in the Images Application and files from Audio and Video are by default displayed in the Media Player Application.

WARNING! Be careful when deleting files or folders in the 'My files' folder and **do not remove** the predefined folders 'Coach' and 'Media'. Removing these folders may cause some of VinciLab applications to not work properly.

4. Using VinciLab for data collection with computers and tablets

Coach 7 and Coach 7 Lite for both desktops and tablets support measurements with VinciLab. During such measurement VinciLab stays connected to the computer/tablet via a USB cable or communicates wirelessly via Wi-Fi. The collected data are transferred in real-time to the computer/tablet and the course of the measurement can be followed directly on the computer/tablet screen. The VinciLab screen is inactive and displays the image shown here. The recorded data are not stored in the VinciLab's memory and should be saved in the Coach 7 program.



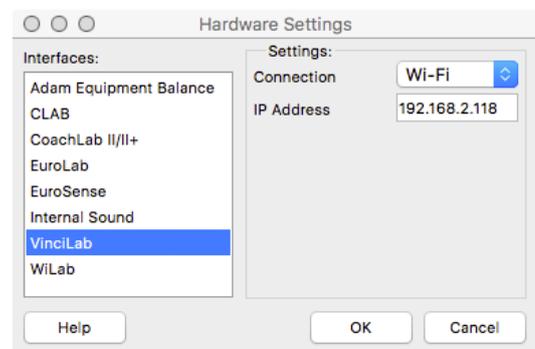
4.1. Communication with Coach 7

The Coach 7 program running on the computer/tablet can communicate with VinciLab via:

- the USB port when VinciLab is connected via the provided USB cable (not possible for iPad, Chromebook and some Android tablets), or
- via Wi-Fi when devices are in the same network.

To select the connection for VinciLab communication

- Start **Coach 7** or **Coach 7 Lite**.
- Click  or select the menu option **Tools > Hardware Settings** (Author mode only).
- In the Hardware Settings dialog click **VinciLab**. By default the connection is set to USB. To change it to the wireless communication, under **Connection** select **Wi-Fi**. Be sure that Wi-Fi and Data Share are turned on on VinciLab⁸.
- Type the IP Address of your VinciLab (provided



⁸ On VinciLab go to **Connections**, the **Wi-Fi** and **Data Share** sliders should be set **ON**.

in **Connections** on VinciLab). Accept with **OK**.

4.2. Typical measurement procedure in Coach 7⁹

- Turn VinciLab on by pressing its power button. Wait until the Home Screen appears.
- Start Coach 7 (or Coach 7 Lite) on your computer/tablet.
- If needed set the connection for VinciLab communication, see the previous chapter 4.1. *Communication with Coach 7*.
- In Coach open an Activity/Result for measurement or create a new measurement Activity/Result (Author mode only).
- Connect sensor(s) to the sensor input(s) on VinciLab.
- VinciLab automatically detects the connected sensor(s) and displays the sensor icons of the identified sensors on the VinciLab screen panel. The sensors, which are not automatically identified, have to be selected from the Coach Sensor Library.
- The measurement is executed according to the given measurement settings. Click  to check these settings: measurement type, measuring time, sampling frequency and number of collected samples. Notice that the max. sampling frequency is 1 MHz and the max. number of collected measurement points is 500 000 per input.
- Follow the instructions in the Activity or directly start the measurement by clicking the **Start** button .
 - 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** button  appears in the Toolbar. Click this button to collect a single measurement. When keyboard input(s) is specified then the value of one or more quantities have to be typed in.



⁹ This procedure does not describe the Event-based type of measurement.

- The measurement is stopped when the specified measurement time (time-based) or specified number of samples (manual) has been reached. If you want to interrupt the measurements process, click the **Stop** button  or press <Esc>.
- Save your result via the **File** menu options **Save** or **Save As....** The file will be saved in cma7/cmr7 format.

WARNING! Coach on VinciLab does not read cma7/cmr7 files. If you want to use your Activity/Result on VinciLab you have to save the file via the menu option **Save for MoLab/VinciLab**.

4.3. Activities for VinciLab

The Coach 7 program or Coach 7 App offers more features than the Coach Application on VinciLab. One of the most important is the Author mode with the possibility of creating Coach Activities and Results for VinciLab. Such Activities (*.cma files) and Results (cmr.* files) can be copied to the VinciLab folder 'My Files/Coach' or a USB flash memory and opened in the Coach Application on VinciLab.

Any features in the Activities/Results not existing in the Coach Application, such as images embedded in texts, videos, diagram annotations, etc., will be ignored when opened on VinciLab and will be not shown. Tutorials and examples of Activities are available as well in the Coach Application as in the Coach 7 program.

5. Displaying VinciLab's screen on a computer or a mobile device

VinciLab offers Data Share via Virtual Network Computing (VNC) which makes it possible to monitor the VinciLab screen and to control VinciLab from any computer or a mobile device, such as an iPad, an Android tablet, Chromebook, or a smart phone, connected to the same network as VinciLab. The VNC protocol can run via a network connection but also via a USB connection.

To display VinciLab's screen via a network connection

- Install a VNC Viewer program on your computer or mobile device. Such VNC viewer programs are freely available for all platforms, e.g. TightVNC Software (www.tightvnc.com) or VNC® Viewer (www.realvnc.com).
- **Wi-Fi connection:**
Make sure that VinciLab is connected to the same network as your computer or mobile device. On VinciLab go to **Connections > Data Share** and allow data sharing by dragging the **Data Share** slider to **ON**. VinciLab shows that VNC is running and displays its IP address. Run the VNC client program on your computer or mobile device and connect to VinciLab by using the IP address provided by VinciLab.
- **USB connection:**
Connect VinciLab to your computer or mobile device via the provided USB. Run the VNC Viewer program on the device and connect to VinciLab by using an IP address assigned to the USB port: 169.254.200.1.
- After connection between the two devices is successfully established the VinciLab's screen is shown in the VNC Viewer program. You can simply view the screen or control it remotely.

VI. TECHNICAL SPECIFICATIONS

1. Key features

OPERATING SYSTEM	Linux
DISPLAY	5" (800 x 480 pixel) capacitive color touch screen
PROCESSORS	Main and Measurement processors ARM Cortex A8 1000 MHz and DSP 120 MHz
MEMORY	8 GB, of which 5.5 GB user memory in the 'My Files' folder Expandable with a USB flash drive
POWER	Rechargeable battery Li-ion 3.7 V, 4000 mAh USB Power Adapter (100-240 V AC, DC 5V/2A)
CONNECTIVITY	Wi-Fi 802.11 b/g/n Bluetooth® 4.1
COMPUTER CONNECTION	Mini USB port also used for powering
USB PORT	Full USB for USB peripherals
OTHER PORTS	Audio In: for external microphone Audio Out: DC and AC voltage signals between -5 .. 5V (only on VinciLabs sold starting February 2019)
SENSOR INPUTS	4 analog BT (right-hand) inputs, each can work as a counter 2 digital BT (left-hand) inputs
BUILT-IN SENSORS	Microphone, max. frequency 44 100 Hz 3-axis Accelerometer ($\pm 20 \text{ m/s}^2$, $\pm 40 \text{ m/s}^2$, $\pm 80 \text{ m/s}^2$), max. frequency 400 Hz
ADC RESOLUTION	12 bits
SAMPLING FREQUENCY	Max. 1 MHz, 4 inputs simultaneously
SOFTWARE ON BOARD	Dedicated Desktop Applications Coach Application for data collection, graphing and analysis
SOFTWARE ON COMPUTER (WINDOWS, MAC)	Coach 7 Lite (free) Coach 7 (license needed), includes Author mode to create Activities for VinciLab, and work with Data-Video, Modeling and Animations
SOFTWARE ON TABLET (IPAD, ANDROID)	Coach 7 Lite (free) Coach 7 (license needed), includes Author mode to create Activities for VinciLab, and work with Data-Video and Modeling

2. Working conditions and maintenance

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

- ✓ Your VinciLab is designed to be operated on a desk or hand-held.
- ✓ Your VinciLab is not waterproof. Precautions must be taken to ensure that liquid cannot enter the unit.
- ✓ Do not expose VinciLab to extreme heat or cold sources and to direct sunlight for extended periods of time.
- ✓ Operating VinciLab 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, 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.
- ✓ When replacing the battery, only use a VinciLab 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:

- 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.
- **DO NOT** turn off the device during the recovery. The recovery process may take up to 10 minutes.

4. Warranty

VinciLab 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 has been damaged by accident or misuse.

The VinciLab battery is a 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 screen is made of glass and could break if your device is dropped or if it receives significant impact. Do not use VinciLab 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 fire, on stoves or 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 is developed and produced in conformity with CE regulations.

This product shall be handed over to your local community waste collection point for recycle of the products.



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