Rincent Minidyn

Lightweight Deflectometer
User manual

Version 12: August 2026

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Table of content

1 Minidyn description

1.1 Hardware description

The lightweight deflectometer (LWD) Minidyn is available in different versions depending of the fabrication date:

- Up to 2013 : Minidyn version 1 (A)
- Up to 2016 : Minidyn version 2 (B)
- Up to 2017 : Minidyn version 3 (C)
- Up to 2019 : Minidyn version 4 (D)
- Up to 2020 : Minidyn version 5 (E)
- Up to 2021 : Minidyn version 6 (F)
- Since 2024 : Minidyn version 7 (G)

Figure 1: Lightweight deflectometer. Version 3 (left), 2 (middle) and 1 (right).

Versions 2 and 3 improve the ergonomic and aesthetic of the Minidyn. The use of the Minidyn both software and hardware are the same regardless of the version. Performances and results are also the same.

Since version 4, the rod is made in two parts that can be fitted into one transport case.

The latest version of the Minidyn (V7) features no major changes, only aesthetic improvements.

Figure 2 : Minidyn Version 7.

The measurement plate contains all the electronics and sensors of the instrument:

- Load cell
- Displacement sensors
- Acquisition unit
- Data transmission system

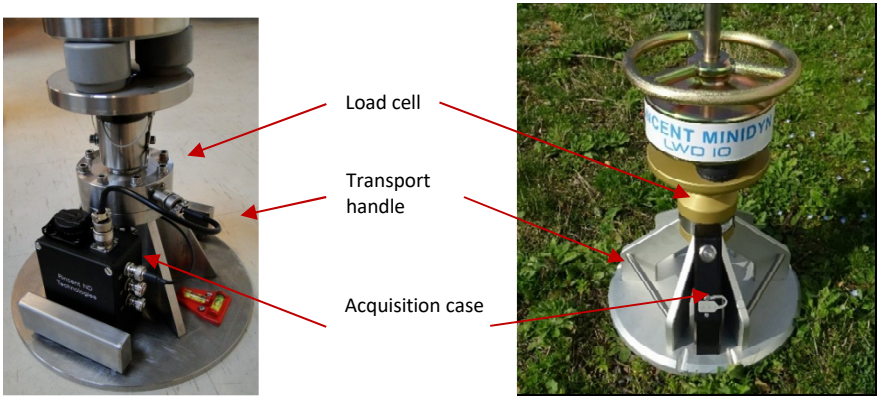


Figure 3 : Measurement plate.

The acquisition case is autonomous and sends measurement data via Bluetooth using an Android smartphone.

Transferring measurement data from the smartphone to a Windows PC can be done by:

- Sending an email containing the data
- Connecting the smartphone to a computer using a USB cable

The following options are available:

- Extension of the measurement range to 120 MPa:
  - 200 mm rod extension
  - 20 kg falling weight
  - additional buffers
- Transport case

The Minidyn instrument is divided into two parts:

- Measurement plate with sensors and acquisition unit
- Guiding rod with falling weight and elastomer buffer

Assembling the Minidyn is done by sliding the rod onto the top of the plate and securing both with the safety pin.

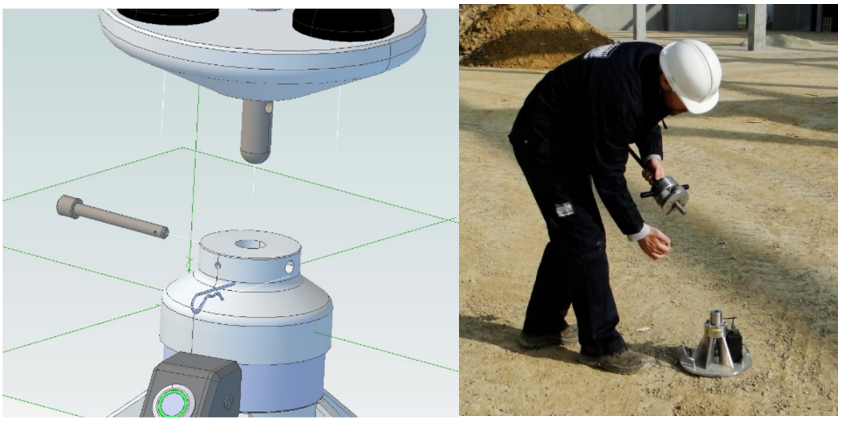


Figure 4 : Assembling the Minidyn using the safety pin.

1.2 Specifications

Specifications	Value
Hardware	Minidyn
Loading plate weight	7 Kg
Falling weight	10 Kg or 20 Kg
Plate diameter	300 mm
Materials	Anodized aluminum
Falling height	75 cm to 100 cm
Environment	IP65 -20°C to +40°C
Load cell	Strain gauge Max load: 25 kN Error: < 0.3% FS
Displacement sensor	Vertical geophone Frequency range: 4.5Hz…2500Hz Resolution: 1µm
Modulus range	10 Kg weight : 10MPa to 80 MPa 20 Kg weight : 20MPa to 120 MPa
Power	Battery powered USB charger (5 V, 0.5 A)
Data transfer	USB or Bluetooth
Autonomy	30 h on standby 5 h on measurement Automatic shutdown after 15 min

Table 1: Minidyn hardware specification.

Specifications	Value
Type	Rugged Android smartphone
Resistance	IP67 rating Shock resistant
Screen	4 ‘’WVGA
Data transfer	Email using Wi-Fi or 3G Direct transfer using USB
Storage capacity	> 100 000 measures
Software installed	Minidyn Android
Functions	Acquisition and review
Connection	Bluetooth
Stiffness method	Max
Correlation method	Boussinesq, Linear and Exponential

Table 2: Minidyn software specification.

1.3 Transport

It is recommended to transport the Minidyn in two parts and take one part in each hand.

Figure 5 : Minidyn transport.

Transport Case:

As an option, the Minidyn can be delivered in a reinforced Pelicase-type transport case designed to withstand harsh jobsite conditions. The case securely holds the device and all its accessories in custom-cut foam, ensuring optimal protection.

Figure 6 : Transport case

Transport Dolly:

A transport dolly is available for on-site use.

Figure 7 : Field Transport Dolly

The Minidyn is mounted onto the dolly using the central hook, which fits beneath one of the handles of the loading plate. The guide rod is then secured with the locking screw.

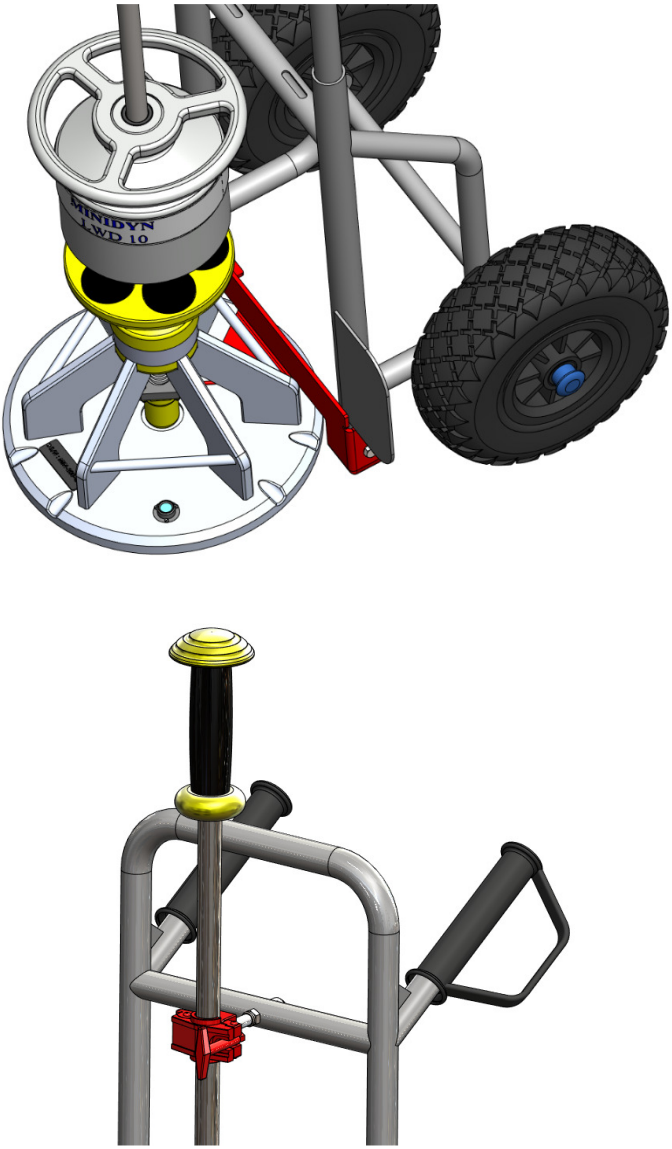


Figure 8 : Minidyn installation on the dolly.

1.4 Drop weight swap

The following steps are required to switch from a 10 kg to a 20 kg configuration:

1. Install the additional 10 kg weight on top of the primary weight using the handles.
2. Install the additional buffer.
3. Install the rod extension.

Installing the Additional Weight:

The supplementary 10 kg weight is secured to the primary weight using four hex screws. Both the screws and the Allen key are provided in the transport case.

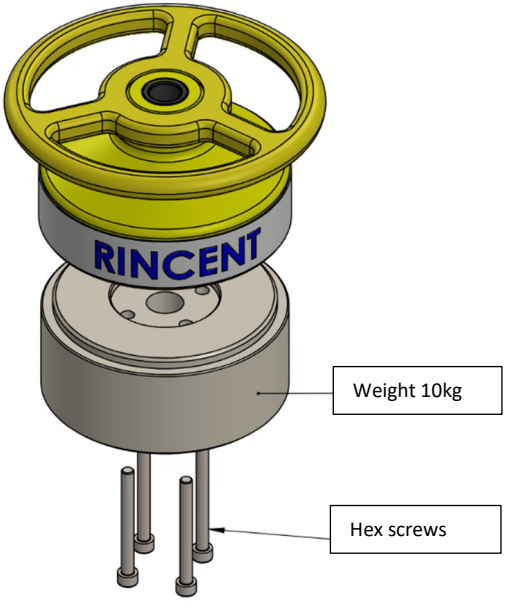


Figure 9 : 20kg assembly.

Starting from Minidyn version 4, the rod can be unscrewed at its midpoint to change the drop weight. Therefore, it is no longer necessary to remove the handle for this operation.

For versions 1 to 3, the upper handle must be unscrewed to change the drop weight.

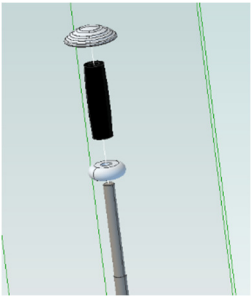


Figure 10 : Top handle removal.

Installation of Additional Buffers:

The number of buffers differs between the two drop weights. The following pictures show the arrangement for each weight.

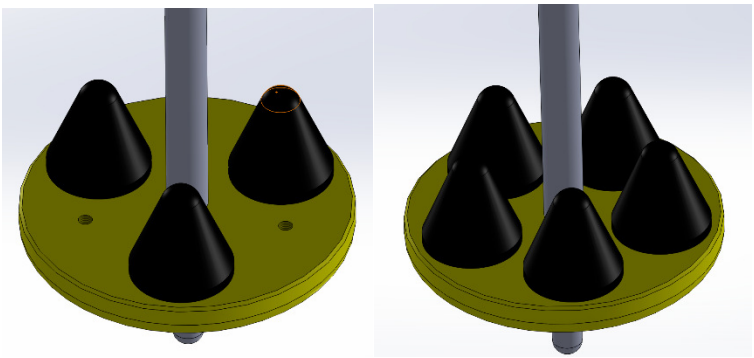


Figure 11 : 10 kg configuration with 3 buffers (left), 20kg config with 5 buffers (right).

1.5 Acquisition case

1.5.1 Description

The acquisition cases for all Minidyn versions have the same functionalities and are used in the same way.

The case consists of:

- A power-on/power-off button with:
- Blue LED for Minidyn status
- Red LED for battery status
- USB type B port for charging only
- Bluetooth antenna (integrated since version 2)

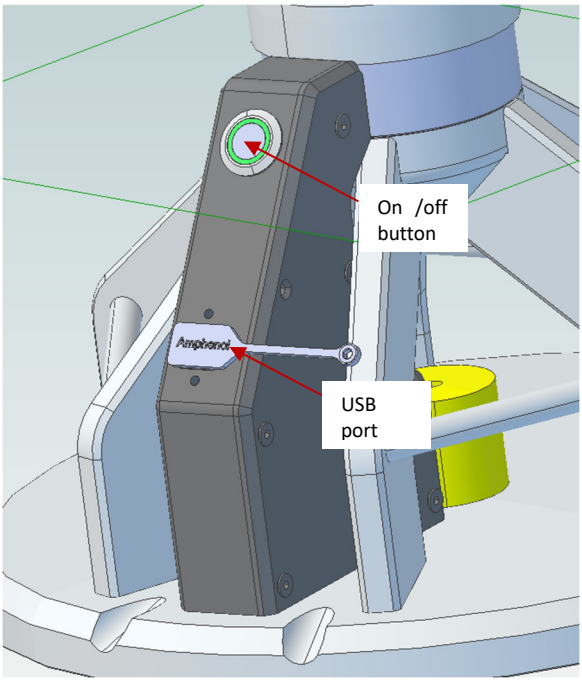


Figure 12 : Acquisition case Minidyn.

1.5.2 Power-on and power-off

Press the button briefly to power on the Minidyn.

Press and hold the button for at least 2 seconds to power off the Minidyn.

If unused, the Minidyn will automatically power off after 15 minutes.

The Minidyn status LED has several states:

- Short blink: The Minidyn is powered on and waiting for a Bluetooth or USB connection
- Slow blink: The Minidyn is connected to acquisition software
- Steady on: The Minidyn is in measurement mode and waiting for a drop
- Fast blink: The Minidyn is sending measurement data over Bluetooth

The battery status red LED indicates:

- During normal use:
    - Slow blink: Battery is low. The Minidyn will shut down in about 15 to 30 minutes
    - Fast blink: Battery is depleted
- During charging:
    - Slow blink: Charging in progress
    - LED off: Charging completed

Charging :

The Minidyn can be charged using:

- A USB charger for a car or an AC wall plug
- A USB port on a computer

1.6 Measurement

1.6.1 Preparation

The ground where the Minidyn is placed needs to be homogeneous. It is recommended to add a fine layer of sand to level the surface.

When the plate is on the ground, rotate the Minidyn back and forth using the handles to ensure uniform contact with the ground.

Figure 13 : Moving the plate to make good contact.

1.6.2 Make a test point

Use the Minidyn software to start an acquisition.

Place the palm of one hand on the upper handle while raising the weight with the other hand. Drop the weight when it reaches its maximum height. Repeat as needed to complete one point (6 drops by default in UK).

Figure 14 : Before a drop.

A few steps need to be checked to ensure correct measurements:

- Press down on the top of the Minidyn using the palm of your hand. Otherwise, the plate may bounce off the ground and produce erroneous measurements.
- Do not take two measurements at the same spot. The first measurement will compact the ground, and the second will show a higher modulus than the actual value.
- Drop the weight from the maximum possible height to achieve the highest load on the ground.

1.7 Precaution of use

1.7.1 Load cell

The load cell can withstand up to 40 kN (4 tons) along the vertical axis. However, it is more fragile along the other axes and can only withstand 1 kN (100 kg) in those directions.

It is recommended to transport the Minidyn in two parts, one in each hand.

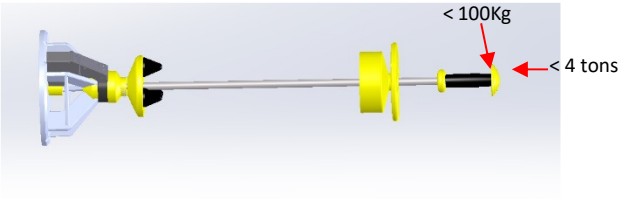


Figure 15 : Maximum stress for load cell.

1.7.2 Center Rod

Do not step on the loading plate during testing. This places excessive stress on the center rod and may cause it to bend.

1.7.3 Weather

You can use the Minidyn in light rain. The acquisition box and sensors are waterproof, but the USB connector is not protected when the rubber cap is removed.

It is not recommended to use the Minidyn in heavy rain. In any case, measurements taken on water-soaked ground are not representative of the modulus.

2 Modulus calculation

The modulus calculation algorithm for the platform can be modified at any time in the Minidyn software. Each time the algorithm or its parameters are changed, the modulus for all measurements is recalculated.

The result can be expressed in stiffness K (K in MN/m), in LWD modulus (E_{lwd} in MPa) or in static bearing plate modulus (E_{V2} in MPa) or Dynaplaque dynamic modulus (E_{dyn2} in MPa).

2.1 Modulus calculation steps

The following figure explains the different steps used for modulus calculation.

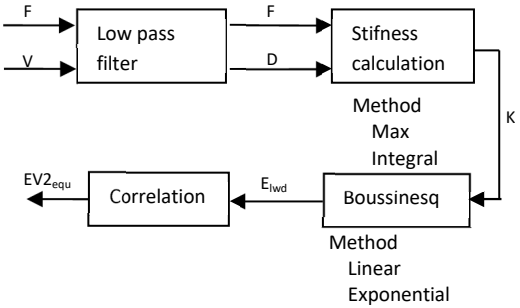


Figure 16 : Modulus calculation steps.

The digitized load and speed measurements from the sensors are filtered using a low-pass filter of about 500 Hz. The speed is then integrated to obtain the deflection d.

Stiffness K is then calculated using either the maximum or the integral algorithm.

The next two steps are optional and can be deactivated to obtain only stiffness.

The first step is to use the Boussinesq formula to obtain the E_{LWD} modulus, as described, for example, in the ZTVE-STB-94 standard.

The last step is a correlation process that converts E_{LWD} into the equivalent modulus E_{V2} or E_{DYN2}.

2.2 Stiffness calculus algorithms

2.2.1 Max method

The Max method is a simple stiffness algorithm that uses a quasi-static ground approximation (ground dynamic parameters are ignored).

Under this assumption, the ground is equivalent to a simple spring, and the stiffness is given by the ratio of the maximum load to the maximum deflection.

$$\boldsymbol{k = \frac{f_{max}}{x_{max}}}$$

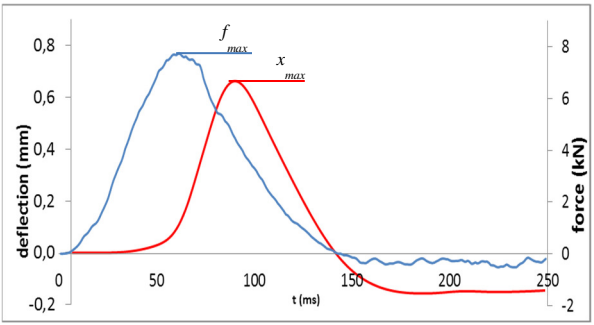


Figure 17 : Max method.

2.2.2 Integral method

The integral method takes into account the dynamic parameters of the ground. This method is inspired by the modulus calculation described in the French standard NFP-94.117-2 for dynamic modulus determination.

The ground is modeled as a system comprising a mass m, a spring k, and a damper c. An inversion algorithm is used to determine the m, c, and k parameters, removing the bias introduced by the mass and damping

$$\boldsymbol{m\ddot{d} + c\dot{d} + kd = f(t)}$$

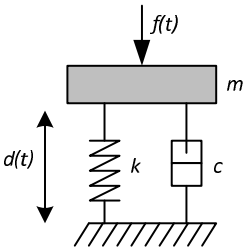


Figure 18 : Ground modeling using masse, spring and damping.

The inversion algorithm is currently available only in the Windows Maxidyn software due to its high processing power requirements.

Quality index:

The integral method can also calculate a quality index (*Iq*) for the measurement.

This quality index is obtained by calculating the difference between the measured signal and the simulated signal using the retrieved m, c, and k parameters.

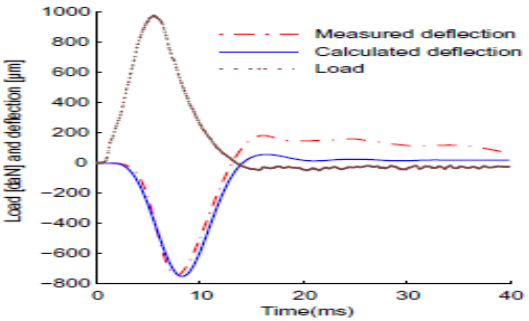


Figure 19 : Quality index calculation.

A 100% quality index corresponds to a perfect match between the simulation and the measurement data.

A measurement is considered acceptable when its quality index is above 50%.

A very good measurement has a quality index above 90%.

2.2.3 Method comparison

Both methods are summarized below.

Parameter	Method Max	Method Integral
Ground modeling	Static Spring only	Dynamic Spring, weight, damping
Quality index	No	Yes
Measurement bias	Around 10%	Non biased
Processing time	Fast	Slow
Algorithm rugness	Very high Work every time	Need a good quality measurement

Since the Max method incorporates the dynamic behavior of the ground into the stiffness calculation, the resulting stiffness is lower than that calculated using the Integral method. A bias of 10% to 20% is observed and must be taken into account during the correlation.

2.3 Boussinesq formulae

Minidyn software uses the Boussinesq equation to calculate the ground ELWD modulus.

$$E = \frac{2(1-v^2)}{\eta r}k$$

Where:

- v is the Poisson coefficient of the ground material.
- η is the plate form factor.
- r is the radius of the plate
- k is the stiffness of the ground.

All these parameters, except K that is previously calculated, are modifiable in the Minidyn software in the configuration panels.

Here are the parameters commonly used in different standards.

Parameters	France NFP 94-117-1 NFP 94-117-2	Germany ZTVE-StB 94
Plate radius	300 mm	150 mm
Poisson coefficient	0,25	0,30
Form factor	4,00	3,81
Resulting equation	E = 3,13 * K (converted or a 300 mm plate radius)	E = 3,18 * K

2.4 Correlation algorithms

2.4.1 Linear correlation

Linear correlation is used primarily to obtain an equivalent modulus on a restrained modulus value range and for a given platform.

$$E_{equ} = K * E_{lwd}$$

Coefficient K typically ranges between 1 and 2.

The user must determine the K coefficient. A common procedure is to perform correlation trial tests to determine the K value best suited to a particular ground material, thickness, and treatment.

Figure 20 : Correlation test between E_{lwd} and E_{V2}.

The linear correlation is often used in large platform or road site where material and thickness does not change.

2.4.2 Exponential correlation

Exponential correlation is used to obtain an equivalent modulus over a wider range of values and platform types. Since this correlation is applied in multiple different situations, the uncertainty in the measurement is higher than with linear correlation.

$$E_{equ} = K * {E_{lwd}}^{\alpha}$$

ZTVE-STB-94 standard use the following table to obtain an equivalent static modulus.

ELWD	15	25	30	40	70	80
EV2	20	40	60	80	150	180
K	1.33	1.60	2.00	2.00	2.14	2.25

Table 3 : Correlation table ZTVE-STB-94.

The Minidyn software includes an exponential correlation with the EDYN2 equivalent modulus (NFP 94-117-2 standard). The details of the correlation and the algorithm used to obtain the k and α parameters are explained in the following reference:

> C. Asli, Z. Feng,G. Porcher,JJ Rincent**, Homogenous elastic modulus back-calculation from Portable Falling Weight Deflectometer: correlation study**, Laboratoire de Mécanique et Energétique d'Evry, Entretiens du RGCU 2011.

Parameter	EDYN2 Equ	ZTVE-StB 94
K	2,34	1,05
Alpha	0,85	1,17

Table 4 : Default parameters for exponential correlation .

3 Minidyn software for Android

3.1 Installation and first launch

3.1.1 Installation

The Minidyn software is installed searching for the app “Minidyn” in the Google Play Store.

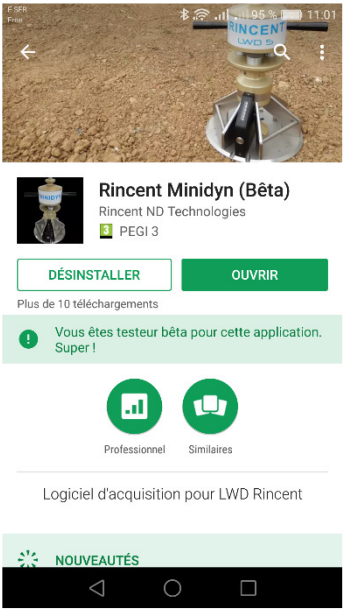


Figure 21 : Minidyn software in the google play store.

The application is available in the following languages: French, English, Spanish, Italian, Polish and German. The language used is the one set on your phone.

3.1.2 Bluetooth pairing

Pairing must be done between your smartphone and the Minidyn before taking measurements.

The steps may vary depending on the Android version. For example, here is the procedure for Android version 4.4:

- Go to the settings and connections tab
- Activate Bluetooth, then press and hold to access the Bluetooth configuration

- The “Rincent Minidyn BT” device should appear in the list
- Check the box “PIN code contains letters or symbols”
- Pair the device using the code below

The pairing code for Minidyn Bluetooth is, in majuscule and without space:

RNDTBT

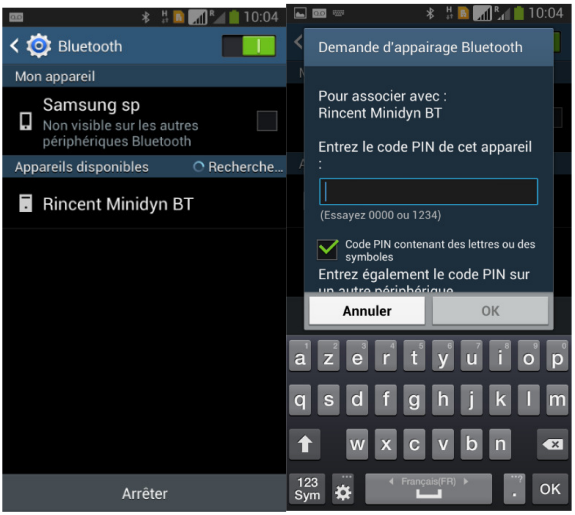


Figure 22 : Pairing the Minidyn.

Note: From version 6 onwards, pairing is done without a code.

Note: If several Minidyn devices are paired, the application will cycle through all of them until it finds the first one powered on.

3.1.3 First launch

At first launch, it is recommended to change:

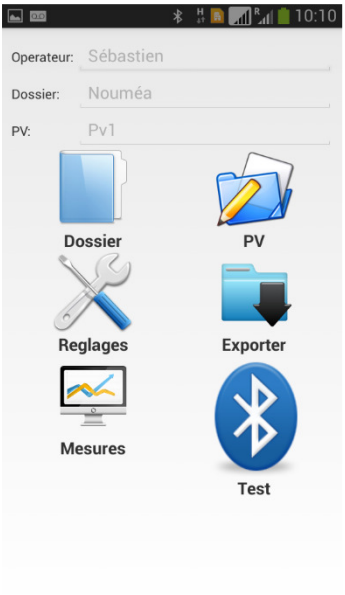
- The default operator name
- The modulus calculation parameters

These actions are described in the configuration tab below.

3.2 Main interface

The main interface is composed of two sections:

- Information about the current project
- Navigation buttons.



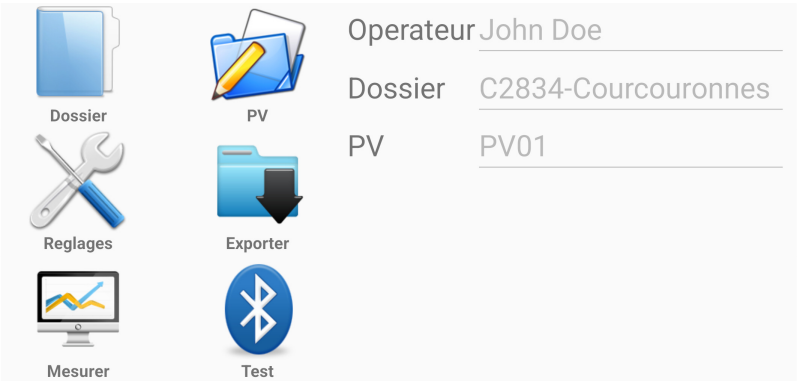


Figure 23: Main interface.

3.3 Settings

Settings are changed using the “Settings” button. If a project is already loaded, a window will pop up to choose between the default configuration (which will be used for future projects) and the configuration for the current project.

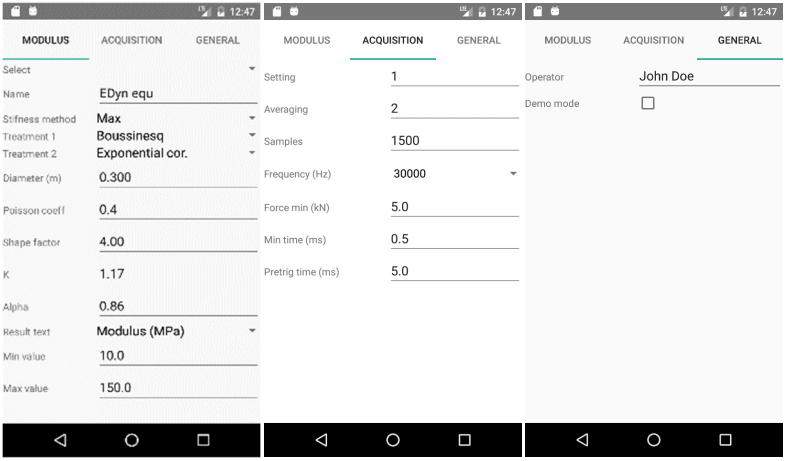


Figure 24 : Configuration tabs.

3.3.1 Modulus tab

This tab is used to choose the different algorithms and their parameters for obtaining the modulus.

Use the select button to choose a predefined configuration.

Once a project is open, you can change the modulus calculation method, and all the measurements will be reprocessed accordingly.

The Minidyn application offers the following configurations, in compliance with the standards of various countries:

Country	Standard	Stiffness Method	Processing 1	Processing 2
FR Minidyn Version AB (for Minidyn V1 and V2)	Equivalent to NFP 94-160-4	Max	Boussinesq r = 300 mm ν = 0.35 η = 4.0	Exponential K = 1.17 α = 0.860
FR NFP 94-160 equivalent	Equivalent to NFP 94-160-4	Max	Boussinesq r = 300 mm ν = 0.35 η = 4.0	Exponential K = 2.34 α = 0.860
UK	BS 1924-2	Max	Boussinesq r = 300 mm ν = 0.35 η = 3.14	None
UK CBR (%)	TRL LR1132	Max	Boussinesq r = 300 mm ν = 0.35 η = 3.14	Exponential K = 1.132E-8 α = 1.563
US / IT	ASTM E2583-07 / UNI 11531-1	Max	Boussinesq r = 300 mm ν = 0.35 η = 4.0	None
DE / CH	STB 8.4 / VSS 70313	Max	Boussinesq r = 300 mm ν = 0.30 η = 3.81	None

The last two parameters, Min and Max values, define the display range of the instrument. For example, if the measured modulus is 200 MPa and the Max value is set to 120 MPa, the software will display “>120 MPa”.

3.3.2 Acquisition configuration

Number of drops per point:

By default, the software uses one seating drop followed by two measurement drops, the moduli of which are averaged.

Seating drops are recorded but not used in the bearing capacity calculation.

Only the measurement drops are used for calculating the bearing capacity, and their individual values are averaged to determine the final bearing capacity at the test point.

Parameter	Default value France	Default value UK
Set-up drops	1	3
Measurement drops	2	3

Table 5: Default values for the number of drop per point.

Acquisition parameters:

These parameters are, by default, valid for normal use of the Minidyn and do not need to be modified.

Parameter	Default values
Number of samples	1500 (750 V6)
Acquisition frequency	30 000 Hz (15 000Hz V6)
Minimum load to trig	5 kN
Minimum time to trig	1 ms
Pretrig time	5 ms

Table 6: Acquisition parameters by default.

3.3.3 Software Configuration

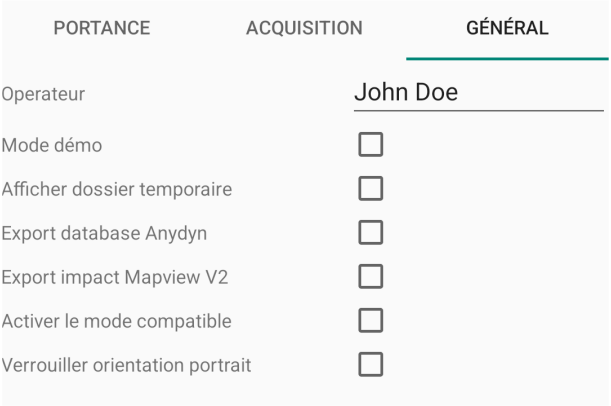


Figure 25 : General application settings.

Operator: Enter the name of the operator or the company performing the tests.

Demo Mode: Enables simulation of a Minidyn device. The generated drops are fictitious.

Show Temporary Folder: Provides access to measurements taken without creating a project folder.

Export Anydyn Database: Exports data for use with the Anydyn software on Windows.

Export Impact Mapview V2: Exports time-series data of force and displacement.

Enable Compatibility Mode: Uses the calculation methods of the application prior to 2026. Enable it if you want results to match exactly those of an older project.

Lock Portrait Orientation: Forces the application to keep its orientation even when the phone is rotated.

3.4 Data management

Every measurement drop, modulus, and related data is saved in an internal database that is not directly accessible. The export button can be used to transfer the data to another computer.

The number of measurements that can be saved depends on the memory capacity of your device. However, with modern smartphones, you would need more than 100,000 drops to reach the memory limit..

3.5 Project and report

3.5.1 Project

The “Project” button can be used to create a new project or load a previous one.

Only the name of the project is mandatory in the information tab.

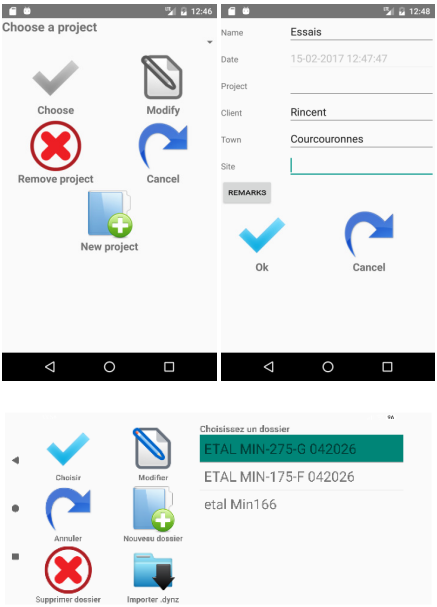


Figure 26 : Projects tabs

3.5.2 Report

The “Report” button is activated when a project is selected. As with projects, you can select or create a report in the “Report” tab.

Only the report name is mandatory, but it is recommended to fill in the platform information (type, etc.) for future reference.

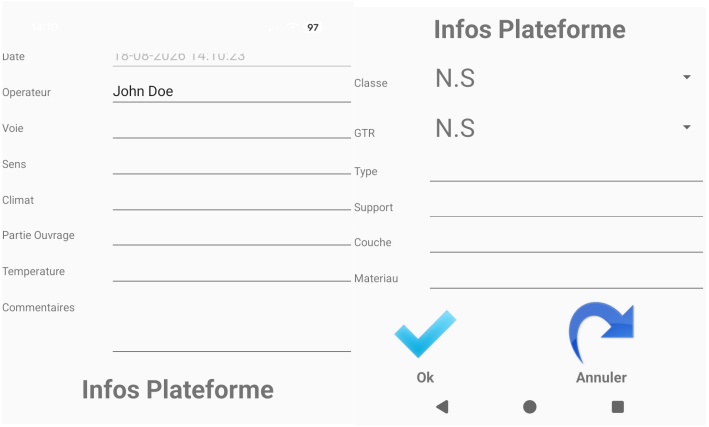


Figure 27 : Report and platform information.

3.6 Make measurements

3.6.1 Test measurements

It is possible to make a test point without selecting a project or report. This is useful for quickly checking that your hardware is functioning normally. However, in this mode, the results and measurements are not saved, and you will not be able to export them.

To perform test points, simply touch the “Measure” button, and a temporary project and report will be created..

3.6.2 Project and report selection

To save measurements, you must create a PV and a report.

3.6.3 Make a measurement

Each measurement point consists of several drops (6 by default).

Once in acquisition mode, you can make as many drops as you wish. Each group of drops (6 by default) will be used to create a new point.

Each time a new point is created, the modulus is calculated and displayed

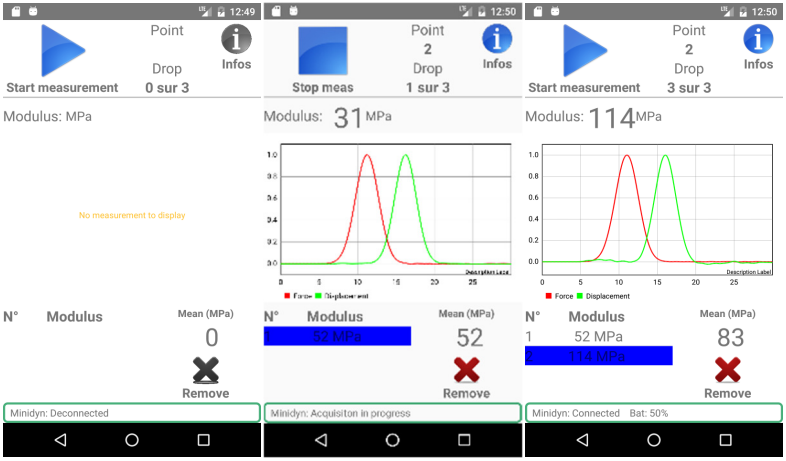


Figure 28 : Acquisition, before (left), during (middle), after (right).

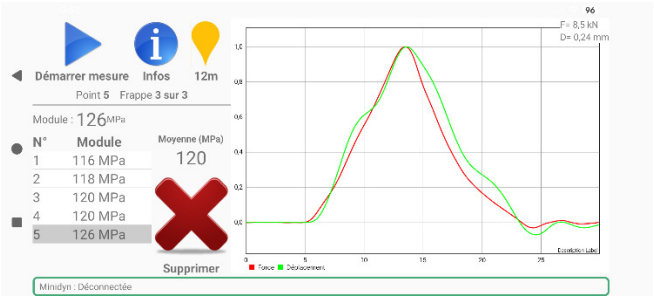


Figure 29 : Acquisition in landscape mode.

Note that the orientation of the acquisition window can no longer be changed while a measurement is being taken.

To perform a measurement, once the Minidyn is on the ground:

- Use the start button to initiate the measurement
- The blue status LED will turn steady to indicate that it is ready to capture drops
- Perform several drops
- The blue status LED will blink at each drop to indicate that it is transmitting the data
- When finished, use the stop button to end the measurement

3.6.4 GPS Positioning

The Minidyn application uses your phone's GPS to geolocate test points.

The positioning accuracy depends on GPS signal coverage and the quality of your phone's GPS receiver.

The value displayed below the location icon indicates the current accuracy level.

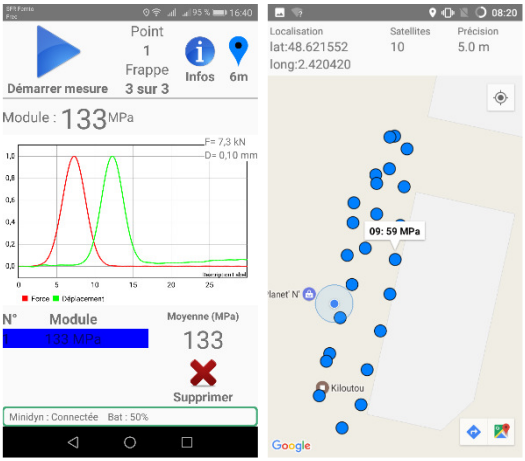


Figure 30 : GPS Positioning

The colour and shape indicate the GPS accuracy. Please note that accuracy depends on the GPS receiver installed in your phone.

<10 m: good GPS accuracy

> 10 m: average accuracy

No GPS signal: points will have no coordinates

3.7 Exportation

Exporting is used to send all project information and measurements by email or save them to a file for later reading in the Minidyn software on Windows.

- To perform an export:
- Select a project and a report
- Use the “Export” button and choose between email or file export
- If you choose email export, the software will ask you which email program to use
- If you choose file export, the file will be saved to your SD card memory under the “Minidyn” directory.

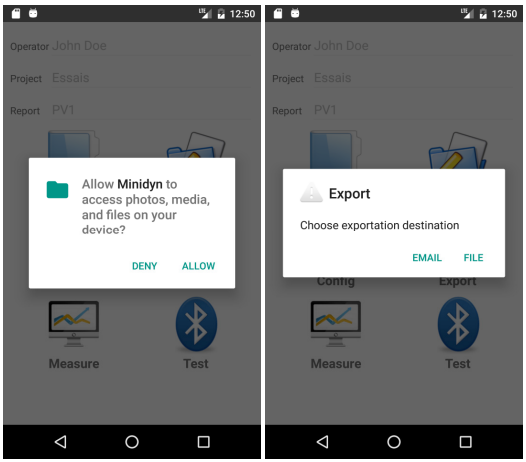


Figure 31 : Exporting a project.

The export file is a single file named “project name – export date.dynz” that can be opened in Mapview Web Application.

4 Mapview reporting software

Data analysis is performed using the Mapview™ web application, available for free and without an account at the following address: https://mapview.fr

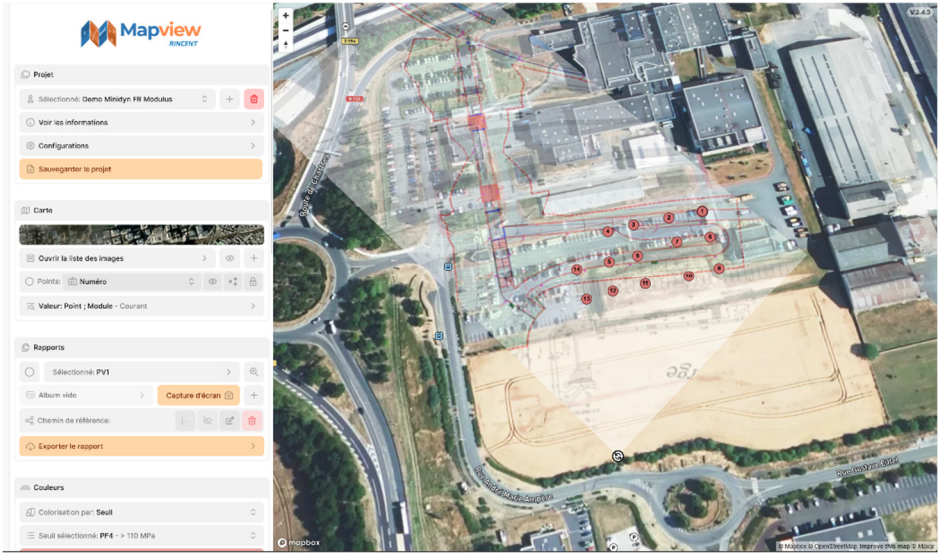


Figure 32: Mapview Web Application

Mapview allows you to prepare your data for export into a customized Excel report with your own logos.

The Mapview user manual is available on the website via the help icon located at the bottom of the page.

5 Troubleshooting

5.1 Minidyn Does Not Power On

There are three main possible causes if the Minidyn does not turn on after a short press of the on/off button:

- Faulty button
- Faulty charging circuit
- Faulty batteries

In many cases, the issue is related to the charger used. It is important to use only the charger provided with the device.

Please contact Rincent NDT technical support for assistance in troubleshooting the issue.

5.2 Drop Detection Issue

The data transfer for a single drop can take one to two seconds.

If a drop is performed during this transfer, it will not be recorded.

5.3 No Drop Triggering

On the hardware, drop triggering is indicated by a short, rapid blinking of the power button for 1 to 2 seconds. If the light stays steady blue during a drop, the load cell zero may have drifted.

To correct this, go to “Test”, then “Connection”, then “Load cell zero” to reset the sensor to zero.

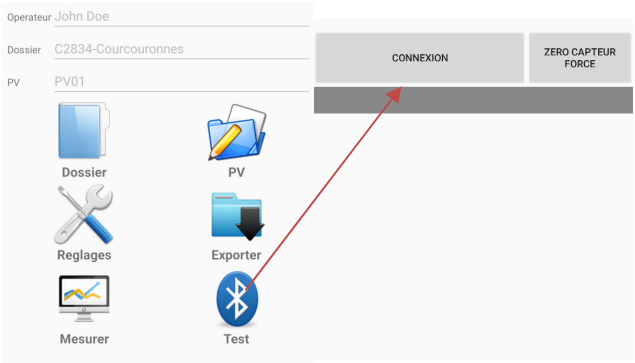


Figure 33 : Steps to reset the load cell to zero.

6 Warranty

The Minidyn instrument and all its accessories have a one-year warranty.

Any damage resulting from improper use of the instrument or its accessories is not covered by the warranty. Examples include, but are not limited to:

- Damage caused by a fall
- Damage caused by improper storage
- Any damage resulting from excessive mechanical or environmental stress

Any repair, modification, or opening of the instrument without the written consent of Rincent ND Technologies is prohibited and will void the warranty.

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