USER MANUAL

RastreCurve Lite

Fault tracer based on Analog Signature Analysis (Curve Tracer)



Figure 1 – RastreCurve Lite and the accessories supplied with the equipment

RastreCurve Lite software – reference version 1.92

RastreCurve Indústria de Equipamentos Eletrônicos Ltda • www.rastrecurve.com
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1. Introduction

The **RastreCurve Lite** is a fault locator and tracer for electronic boards and modules, also known as an **analog signature analyzer** (ASA) or **Curve Tracer**. In a single USB module, it combines the functions of a signal generator and an XY oscilloscope, making it possible to diagnose boards **without powering them** and, in most cases, **without a schematic or boardview**.

In short: the equipment injects a low-energy alternating signal into a point of the **powered-off** board, measures the resulting voltage and current and draws the **VI curve** – the "signature" of that point. By comparing the signature of the faulty board with that of a good board (physical or stored), the fault shows up as a difference in the drawing. It is painstaking, step-by-step work, but very rewarding. The complete theory is in **chapter 2**.

1.1 What the Lite offers

- Real-time comparison with **2 channels** (good board × faulty board), including in **full screen** (2 Channels FULL).
- **Independent channels**: two technicians can use the same equipment, each on one channel, or the two channels can test the conduction of transistors, MOSFETs, FETs and TRIACs.
- **Comparison with memory**: projects ("virtual boards") with a photo of the board, visual marking of components and curves stored pin by pin.
- **4 power profiles** for testing and comparison: Low, Normal, Automatic and Maximum.
- **Impedance Test** from the main menu, to distinguish low-impedance sections from shorts.
- Adjustable comparison tolerance and bad-pin list.
- Opens and tests projects created on the **2Plus**, including in the various power levels in which they were stored.
- Free access to the **Curve Cloud** and the **Unified Curve System** (2Plus and Lite curves), support and updates.
- Lifetime software license for Windows; comparison mode also on Linux, macOS and Android (via USB/OTG). Languages: Portuguese, Spanish, English, Italian, French and Slovak.

1.2 Lite and 2Plus: what is different

In the principle of **curve comparison** the two models are identical. The **2Plus** adds extra tests for active components (pulse, saturation, 3D and switching with a pulse terminal) and more storing features.

Function	Lite	2Plus
Power profiles for testing and comparison	4	4
Power profiles when storing	1 (Normal)	4
Test channels / pulse channel	2 / none	2 / 1
VI curves, 2-channel comparison, projects with photo, visual marking	Yes	Yes
Curve cloud, Unified System, support and updates	Yes	Yes
Open curves protected with password and serial number	Yes	Yes
Impedance test (from the menu)	Yes	Yes
Store impedance and test it in projects	No	Yes
Saturation, 3D (4 profiles), switching and pulse tests	No	Yes
Curve protection with password and backup	No	Yes

Function	Lite	2Plus
Open and test curves from the 10 Vpp and 20 Vpp models	No	Yes

1.3 Lite, Mini and Mini+

Characteristic	Lite	Mini / Mini+
Category	Bench, connected to the PC	Portable (the Mini+ also works on the PC)
Power supply	Computer USB 2.0	Internal battery + power supply (Mini+: also USB)
Test profiles	4 predefined	Free adjustment of voltage, frequency and impedance
Impedance	10 kΩ fixed	1 kΩ to 200 kΩ
Storing	By photo, point by point, on the PC	Internal: 50 components × 100 pins
Curve cloud	Yes, free	Mini: no / Mini+: limited
Ideal for	Bench workshops, beginners, standardized tests	Field work, experienced users, fine adjustments

1.4 Where it can be used

On practically any electronic board: automotive (ECU, ABS, instrument clusters, sensors), industrial (inverters, PLC, CNC), home appliances, air conditioning and inverter units, TV and audio, computing (motherboards, notebooks, video games, printers), telecommunications, medical and hospital equipment, agricultural, marine, aviation, scales, welding machines, among others.

2. How it works: the theory of signature analysis

This chapter explains **why** the RastreCurve finds faults without a schematic and without powering the board. Understanding the theory helps you choose the right profile, interpret the curves and avoid confusing a normal characteristic of the circuit with a fault.

2.1 The central idea: comparing signatures

Every point of a circuit has its own electrical behavior: it lets more or less current through, stores energy (capacitors and inductors) or only conducts above a certain voltage (diodes, transistor junctions, IC pins). When we apply a known signal and record **how that point responds**, we obtain a drawing that works like a **fingerprint** – the **analog signature** of the point.

- Two **identical, good** boards have the **same signature** at the same point.
- If a component in the net changes (burns, shorts, opens, loses capacitance, becomes leaky), **the drawing changes**.
- That is why you do not need to know how the circuit works: just compare point by point. It is painstaking, step-by-step work, but very rewarding – and once the good board has been stored, it never has to be done again.

2.2 The measuring circuit

Inside the RastreCurve there is a **sine-wave signal generator** connected to the test point through a **fixed 10 kΩ impedance**. The channel probe goes on the board point and the green lead on GND. The equipment measures **the voltage at the point (X axis)** and **the current (Y axis)**, which is calculated from the voltage drop across the 10 kΩ.

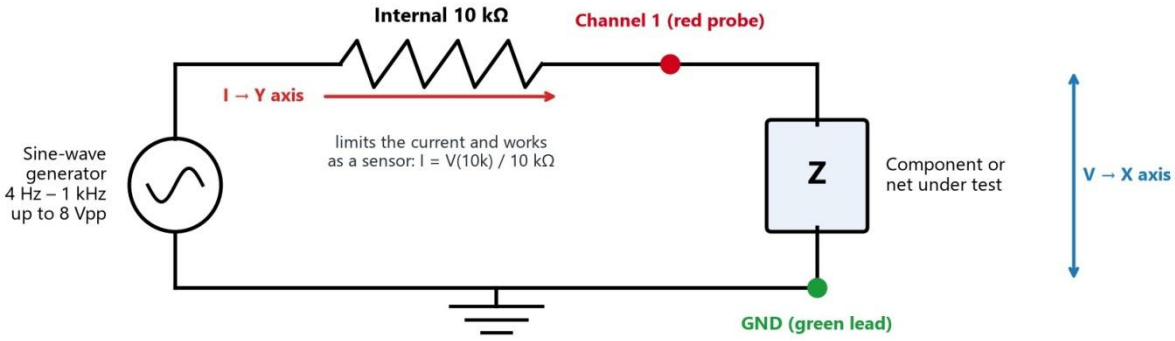


Figure 2 – Measuring circuit: generator, internal 10 kΩ and the component (Z) form a voltage divider

The 10 kΩ and the component form a **voltage divider**:

> **NOTE**
>
> **V(point) = Vgenerator × Z / (Z + 10 kΩ)**
>
> **I = Vgenerator / (Z + 10 kΩ)**
>
> The shape of the curve therefore depends on the relationship between the impedance of the point (Z) and the fixed 10 kΩ. The 10 kΩ also limits the current, protecting the circuit under test.

Impedance of the point (Z)	What happens in the divider	Resulting curve

Impedance of the point (Z)	What happens in the divider	Resulting curve
Z ≈ 0 (short)	Almost all the voltage drops across the 10 kΩ; the current is maximum and the voltage at the point is almost zero	**Vertical line**
Z = 10 kΩ	The voltage is split in half	Line tilted at ~45°
Very high Z (open)	Almost all the voltage stays at the point; current almost zero	**Horizontal line**
Reactive Z (C or L)	Voltage and current are shifted in time	Ellipse / spiral
Non-linear Z (diode, IC)	The impedance changes with the applied voltage	Curve with “knees”

2.3 From the sine wave to the drawing on the screen

In each cycle of the signal, the equipment records **more than 900 pairs of values (voltage, current)**. Each pair becomes a point on the XY graph – as on an oscilloscope in XY mode (Lissajous figure). The sequence of these points forms the curve. In the figure below, the colored dots show the same instant on the time graphs and on the VI curve: since in a capacitor the current **leads** the voltage, the drawing becomes an ellipse (here, a circle, because the reactance equals the 10 kΩ).

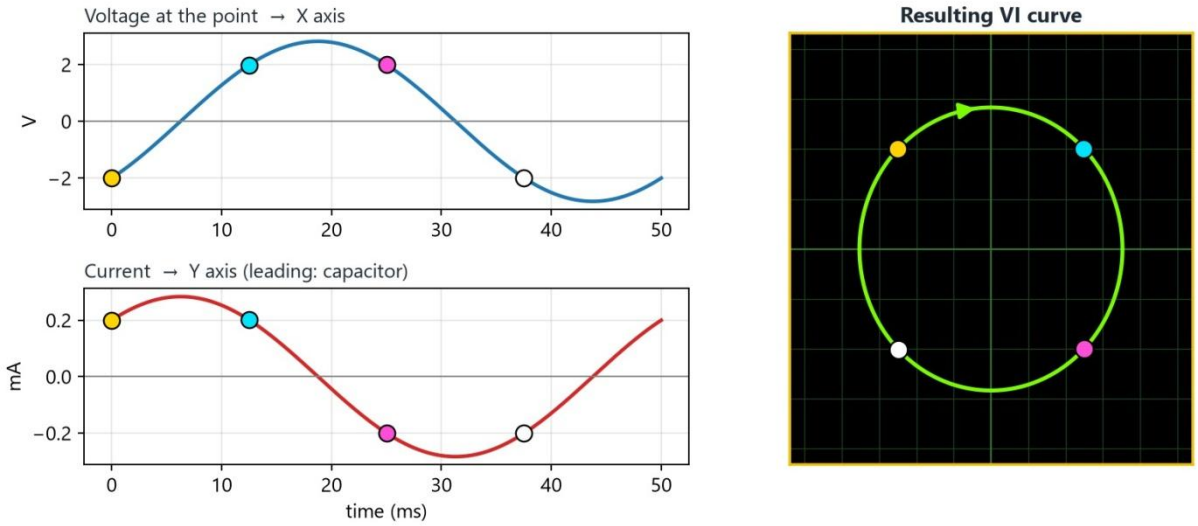


Figure 3 – The voltage (X axis) and the current (Y axis) over time form the VI curve

2.4 Resistance: the slope of the line

In a resistor, voltage and current are proportional and **in phase** (Ohm’s Law, V = R × I), so the curve is a **straight line**. The slope indicates the value: the **lower** the resistance, the more **vertical** (closer to a short); the **higher**, the more **horizontal** (closer to an open). With the internal 10 kΩ impedance, a 10 kΩ resistor sits at about 45°. Very low resistors look like a short and very high ones look open.

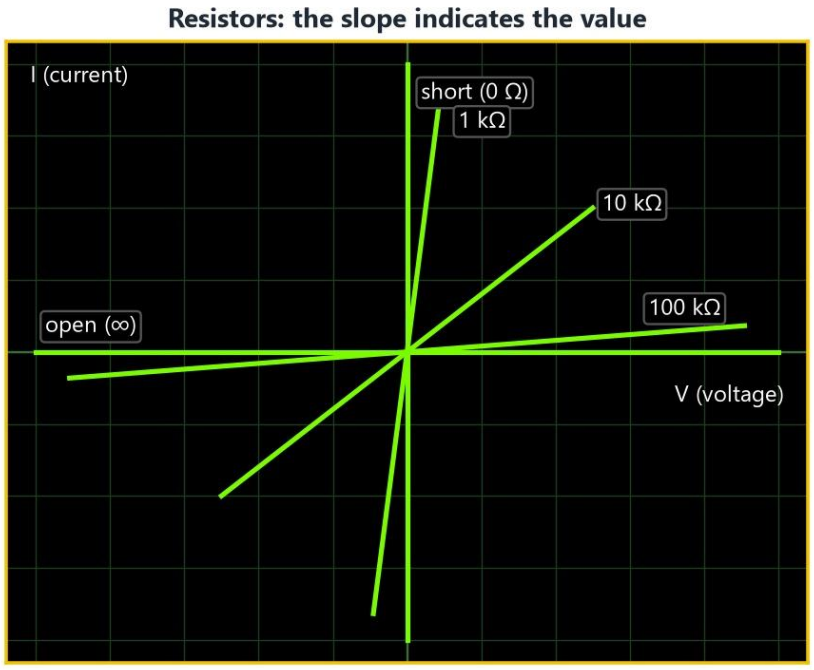


Figure 4 – Family of resistors: from short (vertical) to open (horizontal)

2.5 Reactance: capacitors, inductors and frequency

Capacitors and inductors **store energy**, so current and voltage are **out of phase** – the line opens into an **ellipse**. The "resistance" they offer is the **reactance**, which depends on frequency:

> **NOTE**
> Capacitor: **Xc = 1 / (2 × π × f × C)** – decreases as the frequency increases.
> Inductor: **XL = 2 × π × f × L** – increases as the frequency increases.

That is why **the same capacitor changes its drawing depending on the power profile**: at 4 Hz its reactance is high and it hardly interferes; at higher frequencies the reactance drops, the ellipse becomes vertical and the capacitor starts to "look like a short", dominating the curve of the point:

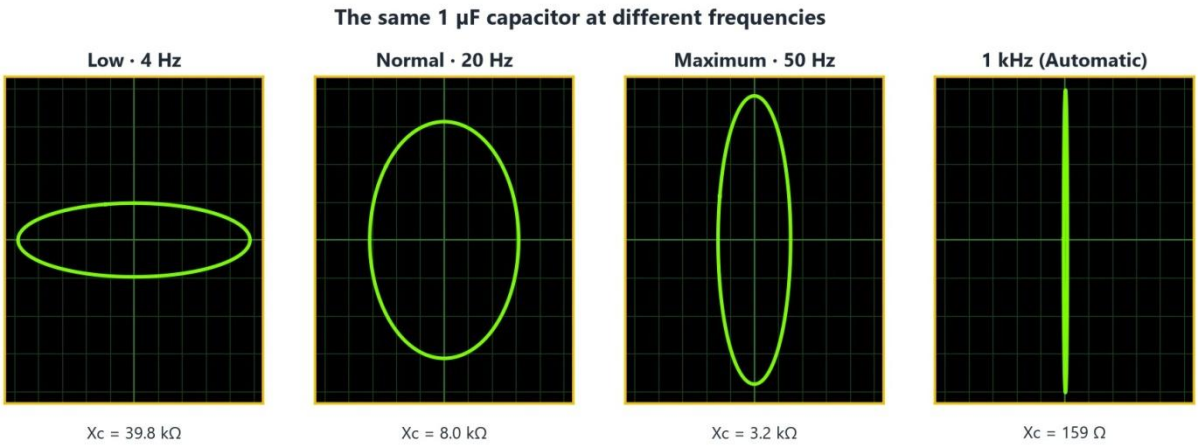


Figure 5 – A 1 µF capacitor seen at different frequencies

Capacitor	Low (4 Hz)	Normal (20 Hz)	Maximum (50 Hz)	1 kHz
100 nF	398 kΩ	80 kΩ	32 kΩ	1.6 kΩ
1 µF	39.8 kΩ	8.0 kΩ	3.2 kΩ	159 Ω

Capacitor	Low (4 Hz)	Normal (20 Hz)	Maximum (50 Hz)	1 kHz
10 µF	4.0 kΩ	796 Ω	318 Ω	16 Ω
100 µF	398 Ω	80 Ω	32 Ω	1,6 Ω

Rule of thumb: when the reactance becomes **much lower than 10 kΩ**, the capacitor dominates the point and hides the other components. That is why boards with large capacitors call for **Low Power** (chapter 8).

The direction of the spiral

Because the RastreCurve excitation is **pulsed** (section 2.7), the curve of a reactive component starts at the center and does not close perfectly: it forms a **spiral**. The direction of rotation identifies the component: **capacitor clockwise** (the current leads the voltage) and **inductor counterclockwise** (the current lags). The width of the spiral depends on the value of the component.

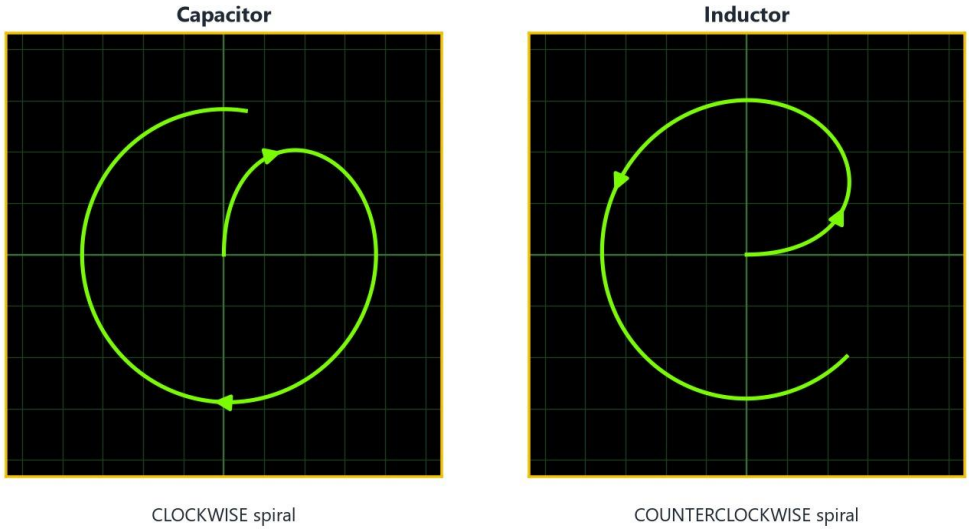


Figure 6 – Direction of rotation of the spiral: capacitor (clockwise) and inductor (counterclockwise)

2.6 Semiconductors: diodes, transistors and ICs

A **PN junction** (diode, base-emitter or base-collector of a transistor) practically does not conduct when reverse biased and starts conducting strongly above about **0.6 to 0.7 V** (silicon) when forward biased. The result is a curve with a **"knee"**: horizontal on one side (open) and vertical on the other (conducting). A **Zener** diode shows a second knee at the Zener voltage. **Integrated circuit pins** usually combine internal protection diodes with resistances, producing characteristic mixed shapes.

In the sheet below we have gathered the most common signatures – it is worth keeping it at hand on the bench:

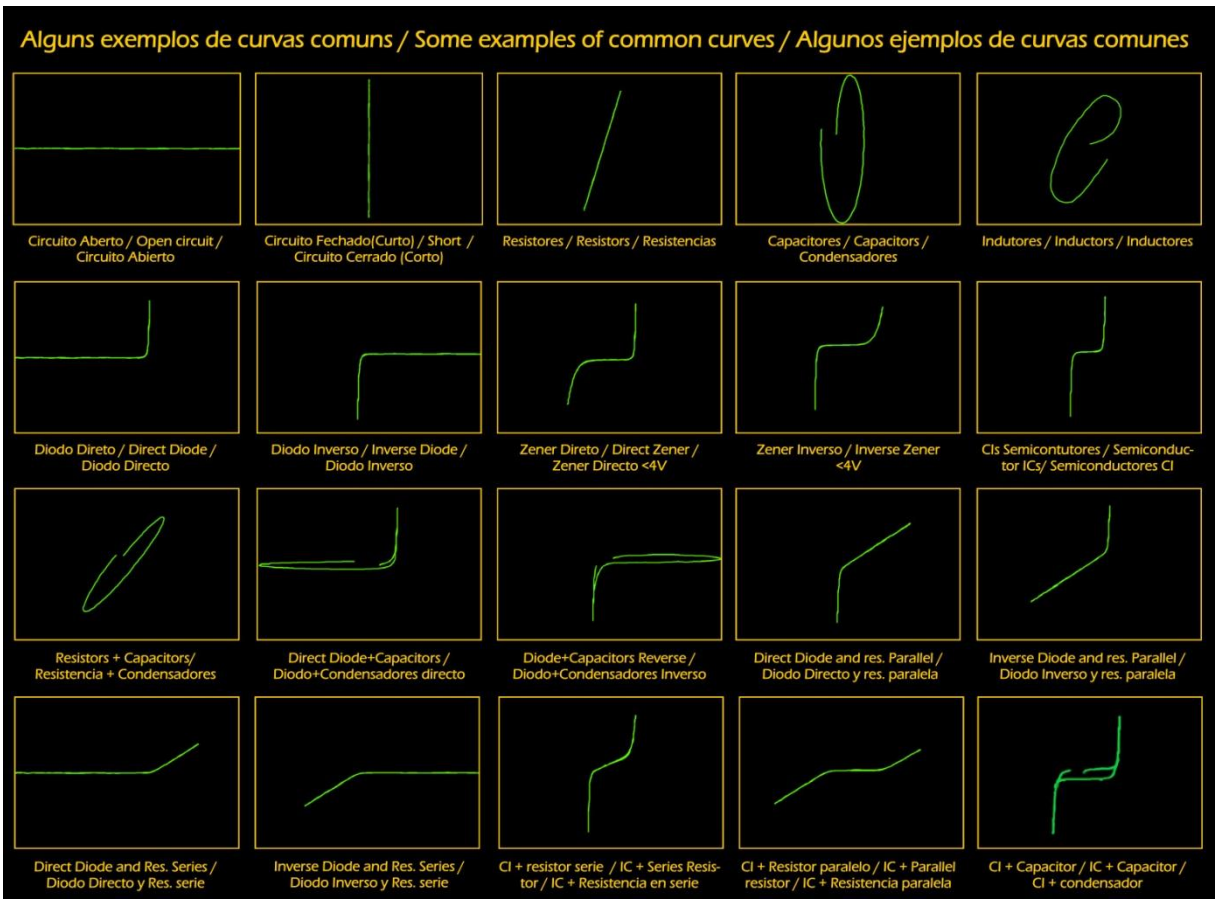


Figure 7 – Examples of common curves (RastreCurve reference sheet)

2.7 Pulsed excitation × continuous excitation

There are two excitation philosophies in signature analyzers:

- **Continuous** (used by instruments such as ABI and Huntron): the signal is applied non-stop; the circuit reaches steady state and the equipment captures an already stabilized cycle (about 100 samples per cycle). Capacitors and inductors appear as **closed ellipses**.
- **Pulsed** (RastreCurve): the signal is applied in **1.5 ms** pulses and each capture starts at the **beginning of the sine wave**. The acquisition includes the **transient response** – charging and discharging of capacitors, reaction of inductors. Capacitors and inductors appear as **spirals** whose direction identifies the component.



Figure 8 – Continuous signal (left) × pulsed signal, one cycle with a pause (right)

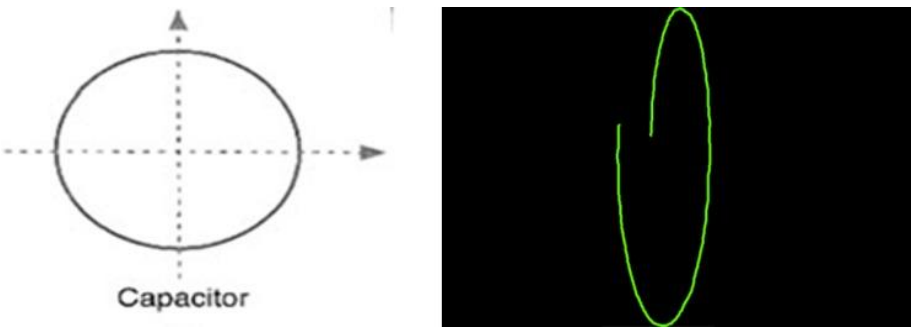


Figure 9 – Capacitor: ellipse with continuous excitation (left) and spiral with the RastreCurve pulsed excitation (right)

Characteristic	Continuous	Pulsed (RastreCurve)
Type of excitation	Continuous	Pulsed / restarted at each capture
Use of the transient	No (discarded)	Yes – it is a source of information
Typical shape of C and L	Ellipse	Spiral (direction indicates C or L)
Main information	Steady-state impedance	Transient response + impedance
Energy applied to the circuit	Continuous	Only for 1.5 ms – safe for CMOS, microcontrollers and sensors

The two methods are complementary. The pulsed method better reveals the **dynamic and reactive** behavior of components – useful for capacitors, inductors and dynamic faults – and applies less energy to the circuit.

2.8 The curve belongs to the net, not to the component

With the components soldered in place, the instrument measures **everything connected to the point**. The curve is the sum of the behaviors: a diode alone shows the typical knee; with a resistor in parallel, the "open" part tilts; with a capacitor in parallel, a spiral appears that may hide the diode.

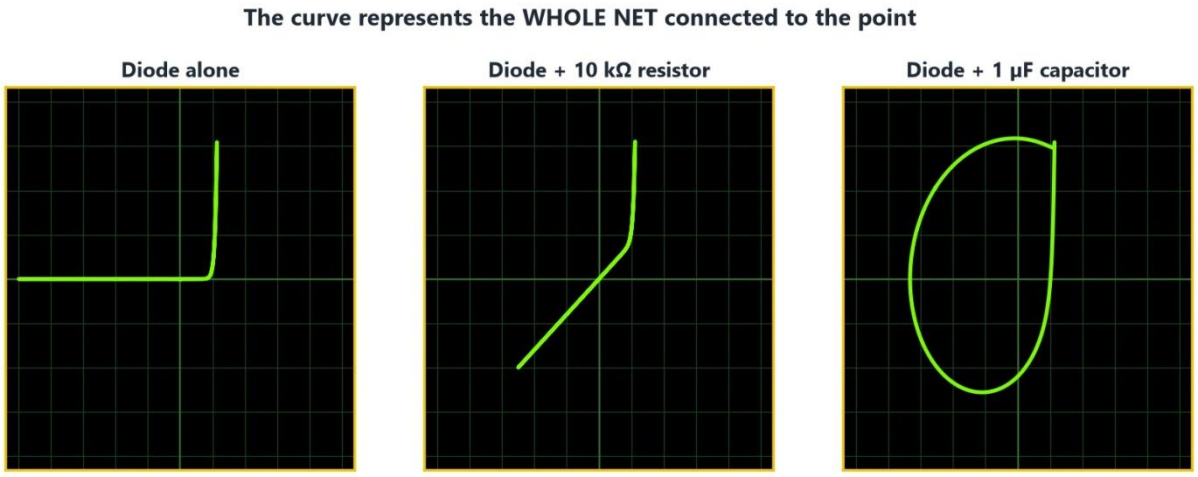


Figure 10 – The same diode with different components connected in parallel

- That is why the **same component in different circuits** has different curves – always compare the **same point** on identical boards.
- A shorted capacitor makes **all points on the same line** show a short. To find the culprit, **isolate sections** (remove a series diode or the suspect IC) and measure again.

2.9 Why there are power profiles

Each profile changes the **frequency** and the **amplitude** of the signal. The frequency controls how much capacitors and inductors interfere (section 2.5); the amplitude controls how much of the semiconductor junctions is "explored" (8 Vpp bias the junctions well beyond the knee; 4 Vpp protect low-voltage circuits). See how a diode with a 4.7 µF capacitor in parallel appears in each profile – only at Low Power is the diode still recognizable:

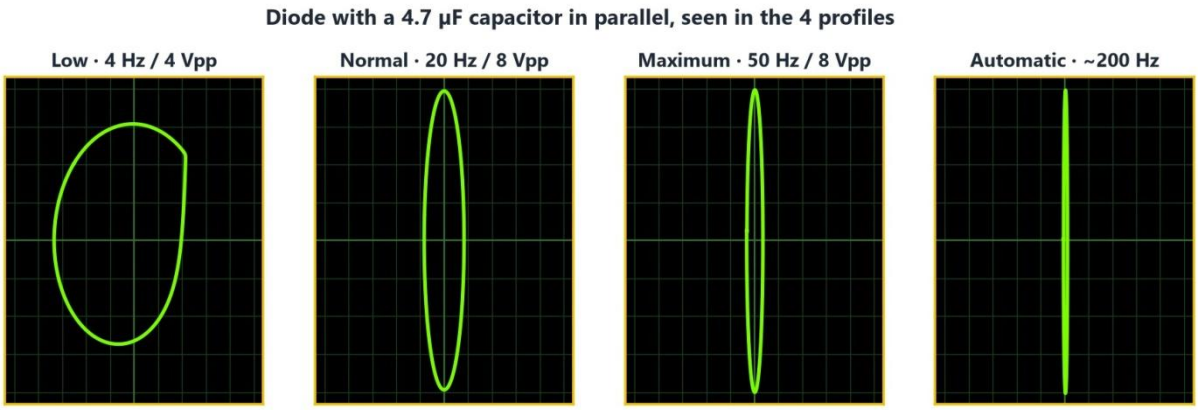


Figure 11 – The same point seen in the 4 power profiles

Detailed selection rules are in **chapter 8**.

2.10 How the software compares and calculates the difference

In a comparison, the reference curve (memory or good board) and the measured curve are drawn together. The software compares the more than 900 samples of the two curves and calculates a **percentage difference index** from the area between them. If the value exceeds the **tolerance** (2% to 20%, default 5%), the result turns red with a thumbs-down.

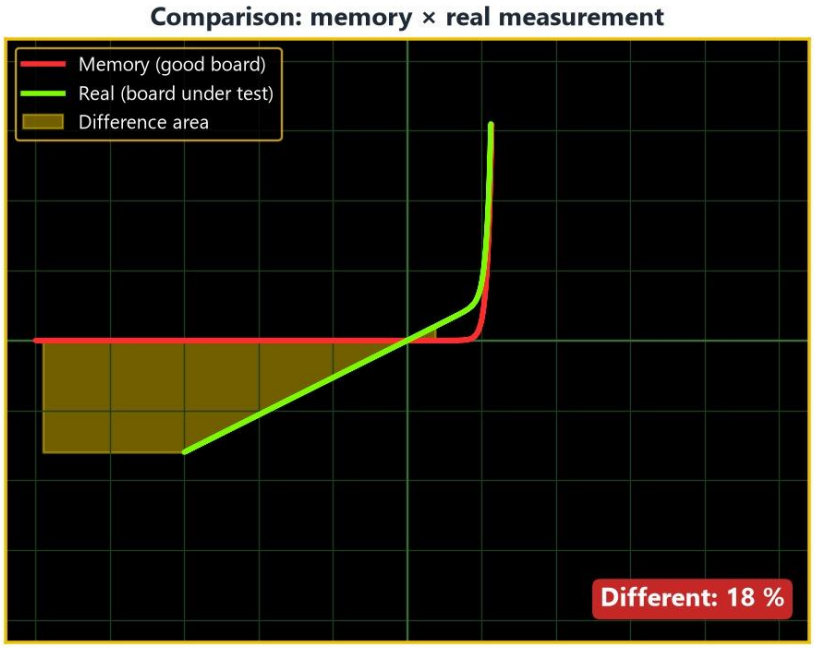


Figure 12 – Memory curve (red), real curve (green) and the difference area

> **TIP**
>
> **The shape of the curve is the most important information**; the number is supporting information. Small error values do not necessarily indicate a fault, and small differences **in the central part** of the curve deserve attention. Differences only in the left part (reverse bias) are usually tolerable.

Real example: a small difference that was the fault

A power supply with a **TNY** IC did not work. In the comparison, only the **BYPASS** pin showed a small difference (about 2%). This pin has the 100 nF bypass capacitor, which sets the IC current limit; on the

faulty board it measured **less than 20 nF**, and the IC shut down. After replacing the capacitor, the power supply worked again.

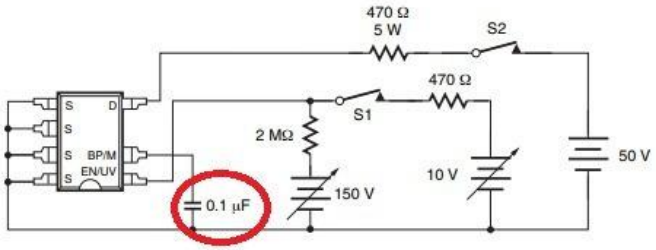


Figure 13 – TNY circuit: the 0.1 µF bypass capacitor (circled)



Figure 14 – Comparison of the BYPASS pin: a small but real difference

2.11 Earth, GND and chassis ground

The three terms are often used as synonyms, but they have nuances:

- **Earth** (PE): physical connection to the ground, used for safety and to reduce interference.
- **Chassis / signal ground**: the local reference of the circuit (the board ground plane, the negative).
- **GND**: generic term for "common reference". On the RastreCurve, the **GND** terminal (green) is the reference point of the instrument, which you connect to the negative, to the board ground or, if you wish, to a physical earth.

A physical earth connection is not required to use the RastreCurve, but it can help in very noisy environments. What matters is that **the equipment GND is on the same reference as the measured point** – and, if the board has separate grounds, to bridge them or measure in stages (chapter 9).

2.12 Limitations of the method

- The test is performed **with the board powered off**; it does not replace functional verification with the circuit powered.
- Components **in parallel** add up their curves – sometimes you need to isolate sections to find the culprit.
- Programmable components (microcontrollers, FPGAs, DSPs) and ICs with a **charge pump** may show variable or unstable curves.
- Internal logic faults (corrupted memory, firmware) do not show up in the curve; if nothing is found, carefully examine memories, processors and ICs that run hot.
- Components from **different manufacturers** may have slightly different curves; be suspicious when the difference repeats on several pins.

3. Safety and precautions

WARNING

All tests must be performed with the board or module **completely disconnected** from the mains and **without batteries**.

Discharge all capacitors before starting – especially power-supply filter electrolytics, which can hold tens or hundreds of volts. Confirm the discharge with a multimeter.

Never connect the RastreCurve to a powered circuit. The software itself shows this warning blinking on the main screen.

- Use an antistatic wrist strap, gloves or mat when handling sensitive boards and components.
- Do not touch the board or the probe tips with your fingers during measurement – this adds noise and changes the curve.
- Avoid non-original notebook power supplies on the computer used with the equipment: they can inject noise and mains voltage that disturb the acquisition.
- Do not inject external signals into the board during the test.
- Isolate and ground the chassis of the equipment under test whenever possible.
- If you bridge (“jumper”) separate grounds to make testing easier, **remove all jumpers** before powering the board again.
- The RastreCurve Lite is manufactured in compliance with the RoHS directive.

4. Getting to know the equipment

4.1 Package contents

- 1 RastreCurve Lite acquisition module;
- 1 pair of needle-type test probes (red and black);
- 2 green ground (GND) leads with clips;
- 1 USB cable;
- DVD with software, drivers, manuals and videos, with the **serial number** printed on the envelope.

> **TIP**
> Keep the DVD envelope: the serial number is required to register the software, download updated versions and sign up for the Unified Curve System.

4.2 Front panel and connections

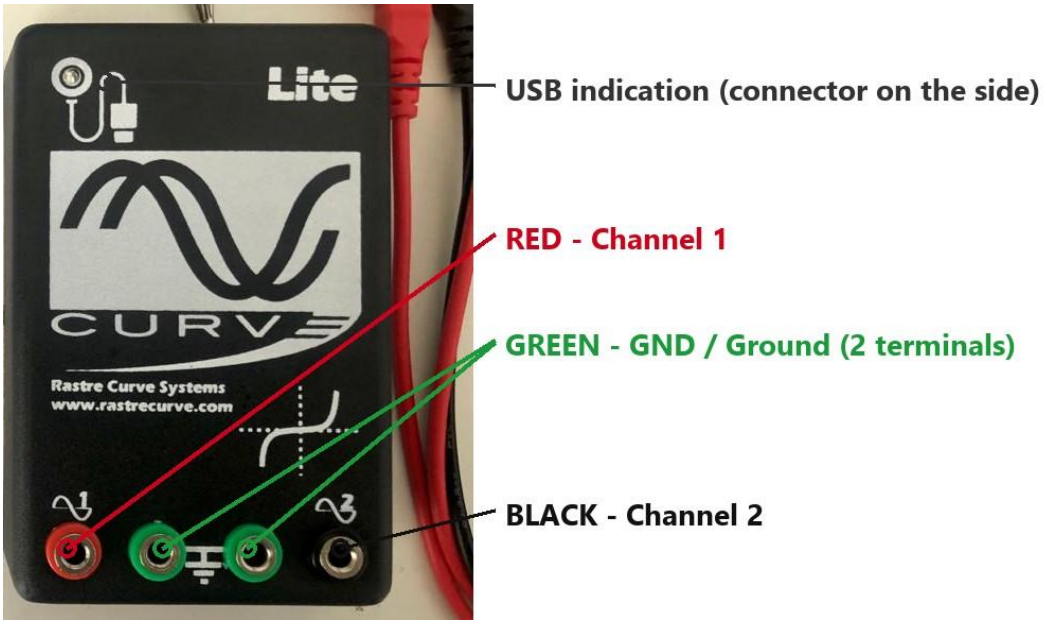


Figure 15 – Front panel of the RastreCurve Lite

Terminal	Color	Function
Channel 1	Red	Main test probe. It is the only channel used when creating projects, in the memory test and in the impedance test.
GND (2 terminals)	Green	Measurement reference (ground) – one terminal for each channel. Connect it to the board ground point.
Channel 2	Black	Second test probe: second board in the 2-channel comparison, or second technician/second terminal in the tests with independent channels.
USB	—	Connector on the side of the module. Communication with the PC and power supply of the equipment (there is no external power supply).

> **NOTE**
> The Lite **does not have** the yellow pulse terminal of the 2Plus. Therefore the pulse and saturation tests are not available on this model.

5. Technical specifications

Characteristic	Value
Channels	2 – Channel 1 and Channel 2, for testing, comparison and storing
Output impedance (series)	10 kΩ, fixed in all profiles
Maximum test current	10 mA
Signal application time	1.5 ms per measurement (pulsed excitation)
Power profiles	4 for testing and comparison; new projects are stored at Normal Power only
Frequency range	4 Hz to 1 kHz
Samples per curve	More than 900 (V, I) pairs per cycle
Power supply	Via the USB 2.0 port only
Weight	About 450 g with accessories
Operating system	Windows (XP SP3 to Windows 10/11, 32 or 64 bits); comparison mode also on Linux, macOS and Android via USB/OTG
Comparison tolerance	Adjustable from 2% to 20% (default 5%)

Power profile parameters

Profile	Frequency	Peak voltage	Peak-to-peak voltage
Low Power	4 Hz	2 Vp	4 Vpp
Normal Power (default)	20 Hz	4 Vp	8 Vpp
Automatic Power	20 Hz to 1 kHz (variable)	4 Vp	8 Vpp
Maximum Power	50 Hz	4 Vp	8 Vpp

NOTE

The profiles are the same as on the 2Plus and can be chosen during testing and comparison. When you **create** a project on the Lite, storing is done **at Normal Power only**. When you **open** a project created on the 2Plus, the Lite runs it at **all the power levels** in which it was stored. Profile selection is detailed in chapter 8.

6. Software installation

6.1 Where to get the installer

The software can be installed from the DVD supplied with the equipment, but we recommend downloading the latest version from **rastrecurve.com** (software download area) using the serial number printed on the DVD envelope. The download is also available in the **Portals** menu of the Unified Curve System.

The DVD contains the folders **Driver**, **Manual**, **Software acesso Remoto** (remote access software, so support can access your computer if necessary), **Suporte**, **Vídeo** and the installer **Setup_RastreCurve_Lite**.

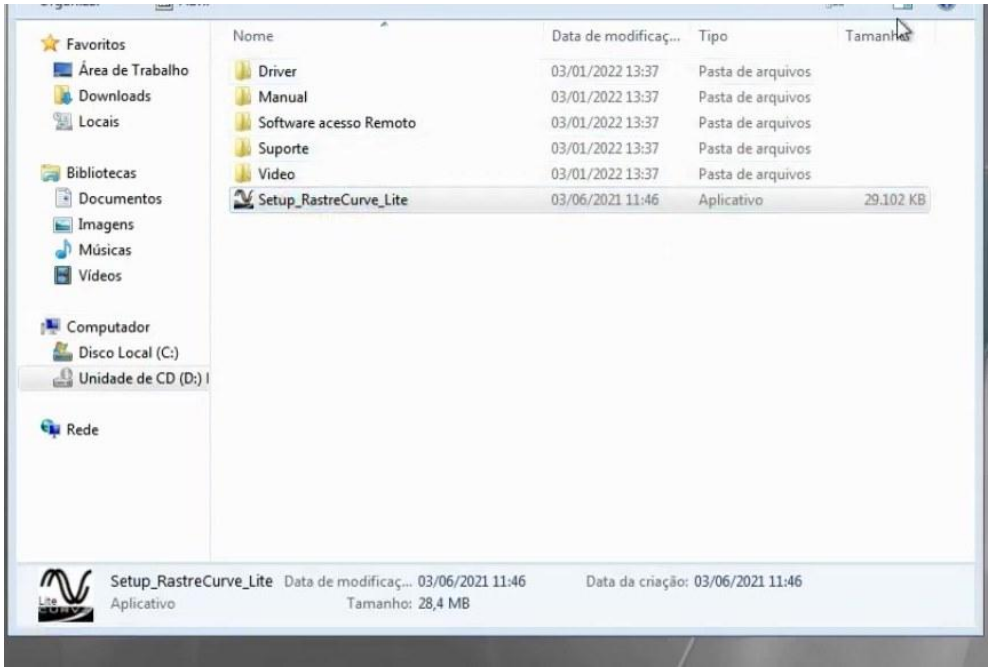


Figure 16 – Contents of the Lite installation DVD

6.2 Step by step

1. Run **Setup_RastreCurve_Lite**. If it does not open with a double-click, right-click it and choose **Run as administrator**.
2. Choose the language, accept the agreement and keep the suggested destination folder and Start menu folder (**Next**).
3. Check **Create a desktop icon** and click **Install**.
4. The equipment driver is installed automatically (a command window opens and closes); wait.
5. The **NI LabVIEW Run-Time Engine** installer then opens, required by the software. Click **Next** keeping the default directory, accept the terms and continue to the end.
6. On the “Completing the RastreCurve Lite Setup Wizard” screen, choose to restart the computer now or later and click **Finish**.

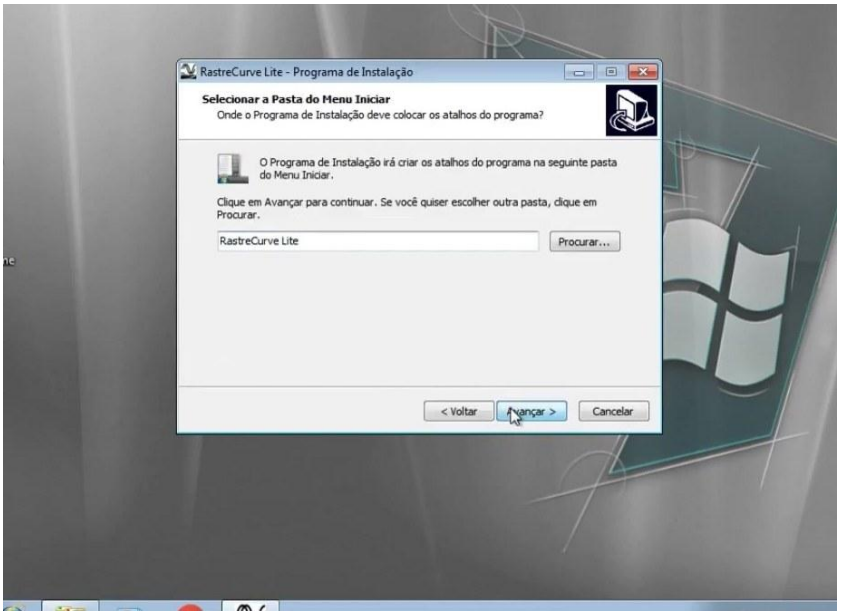


Figure 17 – Selecting the Start menu folder

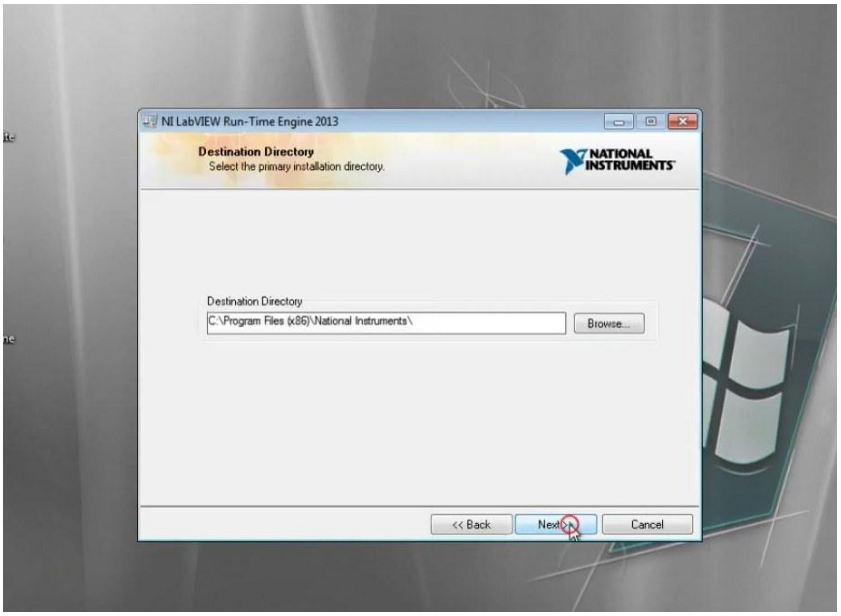


Figure 18 – Installing the NI LabVIEW Run-Time Engine



Figure 19 – End of the installation

6.3 First use and registration

When opening the program for the first time, choose the **language** and fill in the registration screen with **your name** and the equipment **serial number** (4 fields, starting with LITE). Click **OK**; the software shows "Releasing…" and opens the main menu.



Figure 20 – Choosing the language

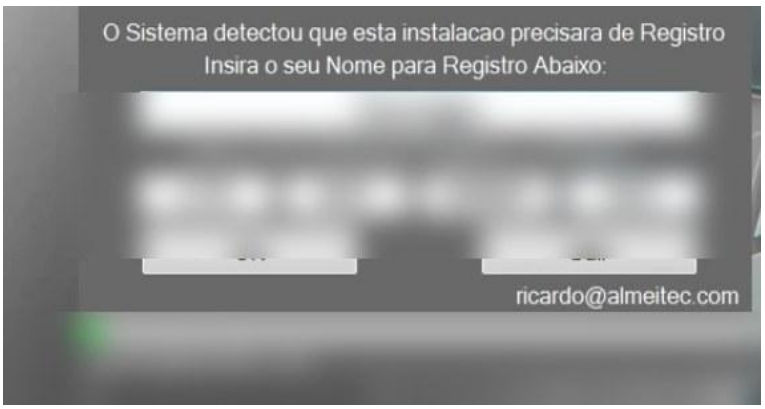


Figure 21 – Registration screen (name and serial number hidden)

6.4 Connecting the equipment

Connect the RastreCurve Lite to a USB port before opening the software, or with it open: the software searches for the device automatically. On the test screens, the **Connected** indicator turns green when the equipment is recognized.

6.5 If Windows rejects the driver

1. Open the **Driver** folder on the DVD, right-click **myDrivers.cer** and choose **Install Certificate**.
2. Select **Current User** and click **Next**.
3. Choose **Place all certificates in the following store**, select **Trusted Root Certification Authorities** and click **OK**.
4. Click **Next** and **Finish**; then reinstall the driver.

> **TIP**
> If the problem persists, use the program in the **Software acesso Remoto** folder and contact support (chapter 17).

7. Software main screen



Figure 22 – Main menu of the RastreCurve Lite (v1.92)

7.1 Function buttons

Button	What it does
Compare with 2 Channels	Compares two physical boards in real time: good board on one channel, faulty board on the other (chapter 9).
Compare with 2 Channels FULL	The same comparison in **full screen**, with power selection during the test (v1.91).
Compare with Memory	Compares the measured point with a captured curve (Channel 1 [Z] / Channel 2 [X]); each channel can be used independently.
Impedance Test	Distinguishes low-impedance sections from real short circuits (chapter 12).
New Project / Curve	Creates a new project (virtual board) with a photo and stored curves (chapter 10).
Curve Cloud	Downloads community projects (chapter 14).
Unified Curve System	**New in v1.92.** 2Plus and Lite curve portal, with community, rewards and gift shop (chapter 14).
Close System	Closes the program.

7.2 Curve area and settings

- **Curves in the System**: lists the saved projects. Click a project to open **Test Memory Curve**, **Edit Curve**, **Rename Curve**, **Delete Curve** and **Back to Menu**. The **Search** field filters the list.
- **Open 2Plus Curves from Another Path**: opens projects stored in another folder.
- **Import RC2PL Curve**: imports a downloaded or received project file.
- **Saved Curves Path**: default folder (c:\RastreCurve\Curvas_2Plus), with **Open Folder** and **Change Folder**.
- **Language**: changes the interface language.
- **Test Tolerance**: from 2% to 20% (default 5%). Above it the result appears in red with a thumbs-down; within it, in green with a thumbs-up.



Figure 23 – Selected project and its options

TIP

The tolerance is a reference, not the final rule. If all points of a board are around 1% and only one net shows 2%, that net deserves attention. **The shape of the curve is the most important information**; the number is supporting information.

8. Power profiles: which one to use?

> **NOTE**
> On the **Lite**, the 4 profiles can be chosen during **testing and comparison**. When you **create a project**, storing is done **at Normal Power only** (on the 2Plus it is possible to store at the 4 power levels). When you **open a project created on the 2Plus**, the Lite runs it at **all the power levels** in which it was stored.

Each profile changes the **frequency** and the **amplitude** of the test signal. The 10 kΩ impedance is always the same; what changes is how the signal interacts with the components, especially with capacitors. The profile can be changed at any time during testing and storing – but **always compare in the same profile in which the reference was stored**.

Profile	Use when…	Avoid when…
Low (4 Hz / 4 Vpp)	There are large capacitors (≥ 47 µF) at the point; power supplies and filters; transformers and inductors; most curves appear vertical (capacitor dominating); low-voltage circuits (≤ 3.3 V), sensors, displays, BGAs; ICs with a charge pump (after removing the external capacitors).	Power semiconductors (4 Vpp barely biases the junction); telling apart high-value resistors.
Normal (20 Hz / 8 Vpp) – default	Starting point for any board; digital logic (TTL, CMOS, microcontrollers, memories); signal diodes, resistors, optocouplers; good × bad board comparison; ECUs, motor drivers, medical boards.	Capacitors above 100 µF at the point; power transistors and amplifiers.
Automatic (20 Hz–1 kHz / 8 Vpp)	Completely unknown board with few capacitors; initial exploration; when adaptive current limiting is desired.	Boards with active oscillators (unstable curves); when the board type is already known (Normal is more repeatable).
Maximum (50 Hz / 8 Vpp)	NPN/PNP transistors, MOSFETs, IGBTs, SCRs, TRIACs; power amplifiers (TDA, LM, STK); rectifier diodes and Zeners > 2 V; shunt resistors; detection of leakage and junction degradation.	Capacitor ≥ 47 µF in parallel; very sensitive components (photodiodes, MEMS); low-voltage circuits where 8 Vpp may force conduction.

8.1 The capacitor rule

The instrument does not measure the isolated component: it measures **everything connected to the point**. A large capacitor in parallel diverts the test current and starts to “dominate” the curve. The larger the capacitance, the **lower** the power (frequency) should be:

Capacitor at the point	Recommendation
Below 10 µF	Normally does not interfere at Normal (20 Hz) or Maximum (50 Hz).
10 µF to 200 µF	May interfere at 20–50 Hz: use Low Power (4 Hz) or Automatic.
Above 200 µF	Always use Low Power; consider removing the capacitor before the test.
Above 2,000 µF	Removal strongly recommended in any profile.
100 nF decoupling	Rarely interfere – can be ignored.

8.2 Quick guide

Situation	Profile
First inspection of any board	Normal
Large filter capacitors (≥ 47 µF) at the point	Low
Signal or power transistors, MOSFET, SCR, TRIAC	Normal or Maximum
Audio / power amplifiers	Maximum
Almost all curves vertical	Low
Unknown board, without large capacitors	Automatic → then adjust
Digital logic (microcontrollers, CMOS, TTL)	Normal
IC with charge pump (MAX232, ICL7660…)	Low + remove external capacitors if they interfere
Transformers and inductors at the point	Low
Saturation test / leakage detection	Maximum
Shunt / sense resistors (very low value)	Maximum

TIP

In the 2-channel comparison, **change the profile** and watch how the difference behaves (section 8.3) to separate faults: a difference that **grows with frequency** indicates an altered capacitor or a frequency-dependent fault; a difference that is **the same in all profiles** indicates a resistive fault; a difference **only at low frequency** suggests a DC bias problem.

8.3 Comparing the same point in different profiles

In **Compare with 2 Channels** mode, with both boards connected, switch between Low (F9), Normal (F10), Maximum (F11) and Auto (F12) and watch the difference. If it **grows with frequency**, suspect an altered capacitor or a frequency-dependent fault; if it is **the same in all profiles**, the fault is resistive; if it appears **only at low frequency**, it may be a DC bias problem.

9. First tests: comparing with 2 channels

9.1 The reference point (GND)

Every measurement is taken between the channel probe and the **reference ground** (green lead). Before measuring, identify a GND point on the board:

- On boards with a **single ground net** (desktop and notebook motherboards, for example), any ground point works for the whole board: screws in plated holes, USB/audio/RJ-45/VGA connector shells, grounded heatsinks.
- Use the multimeter on the continuity range: with one probe on a known ground, go over the board – every point that “beeps” belongs to the same ground net.
- On boards with **separate grounds** (switching power supplies: primary × secondary, printer power supplies), move the green lead according to the section being tested **or** temporarily bridge the grounds with alligator clips/wires, forming a single net. Note this in the project description and **remove the jumpers** when finished.

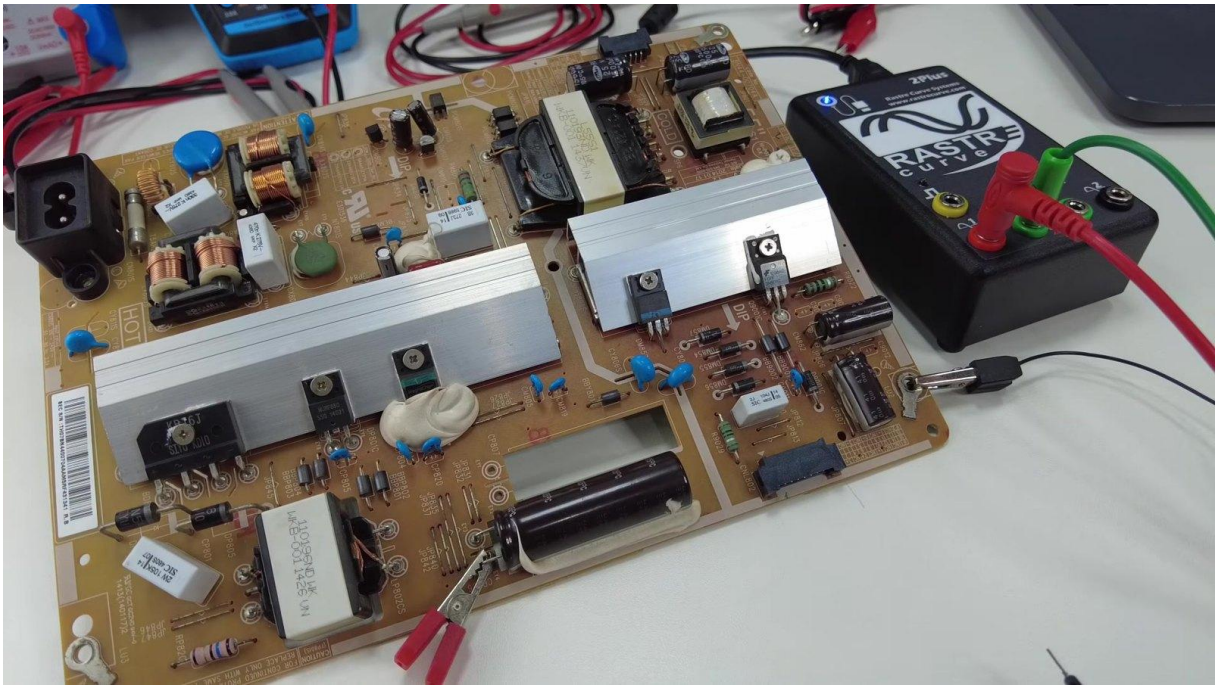


Figure 24 – Primary and secondary grounds bridged with alligator clips to test the whole board

9.2 The analysis is done “by net”

The curve of a point represents **all the components connected to it**. If a capacitor on the line is shorted, all points on that line may show a short. So, when you find a difference, investigate the components of the net; if possible, **isolate sections** (removing, for example, a series diode or the main IC) and repeat the measurement to find out where the fault is. The same component, soldered in different circuits, also produces different curves.

9.3 Comparing two physical boards

Use two **identical** boards (same brand, model and version): one good and one faulty. Ideal for workshops that always work on the same boards.

1. In the main menu click **Compare with 2 Channels**.

2. Connect the two pairs of probes respecting the colors: green leads on the green terminals, red on Channel 1, black on Channel 2.
3. Clip each green lead to the GND of one board (the same point on both).
4. Touch the Channel 1 probe on a point of the good board and the Channel 2 probe on **exactly the same point** of the faulty board. It does not matter which board is on which channel, as long as each board uses one channel.
5. Watch the curves (by default Channel 1 in green and Channel 2 in red) and the percentage deviation: green with thumbs-up = within tolerance; red with thumbs-down = difference.
6. Follow the fault line component by component, pin by pin. To speed things up, first compare groups of components (for example, starting from the power connector) and then focus on the group that differed.

On the comparison screen you can also **save** the measured curve, change the **colors** of each channel and return to the menu with **OK / Exit [ESC]**.

> **TIP**
>
> Test the whole board before replacing components and start with the most serious faults: **shorts and open circuits**. Then investigate the subtle differences – especially in the **central part** of the curve, which usually indicates a real fault. Differences only in the left part (reverse bias) can be tolerated, since manufacturers do not guarantee that characteristic.



Figure 25 – Compare with 2 Channels on the Lite: generated signals and curves of both channels

9.4 2 Channels FULL (full screen)

Since version **1.91**, **Compare with 2 Channels FULL** shows only the curves, in full screen, and allows changing the **power** during the comparison (Low F9, Normal F10, Maximum F11, Auto F12). The **Ok / Exit** button returns to the previous screen.

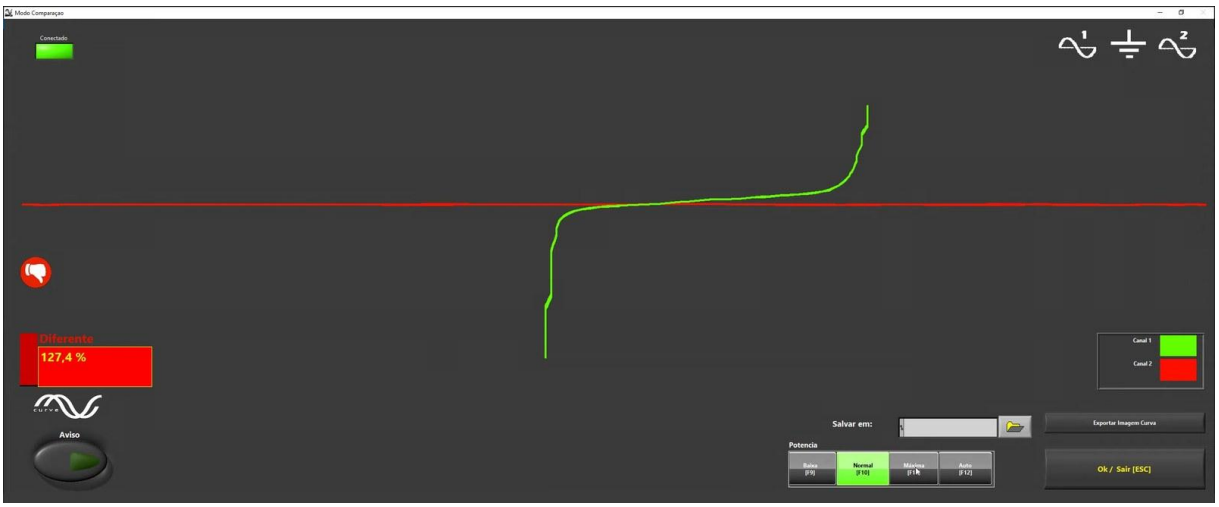


Figure 26 – Compare with 2 Channels FULL

9.5 Compare with Memory (independent channels)

In **Compare with Memory**, each channel has its own reference: touch the channel to the point of a good board and click **Capture Channel 1 [Z key]** (or **Capture Channel 2 [X key]**); then measure the same point on the faulty board and compare it with the captured memory. Since the channels are independent, **two technicians** can work at the same time with the same equipment, each on one channel.

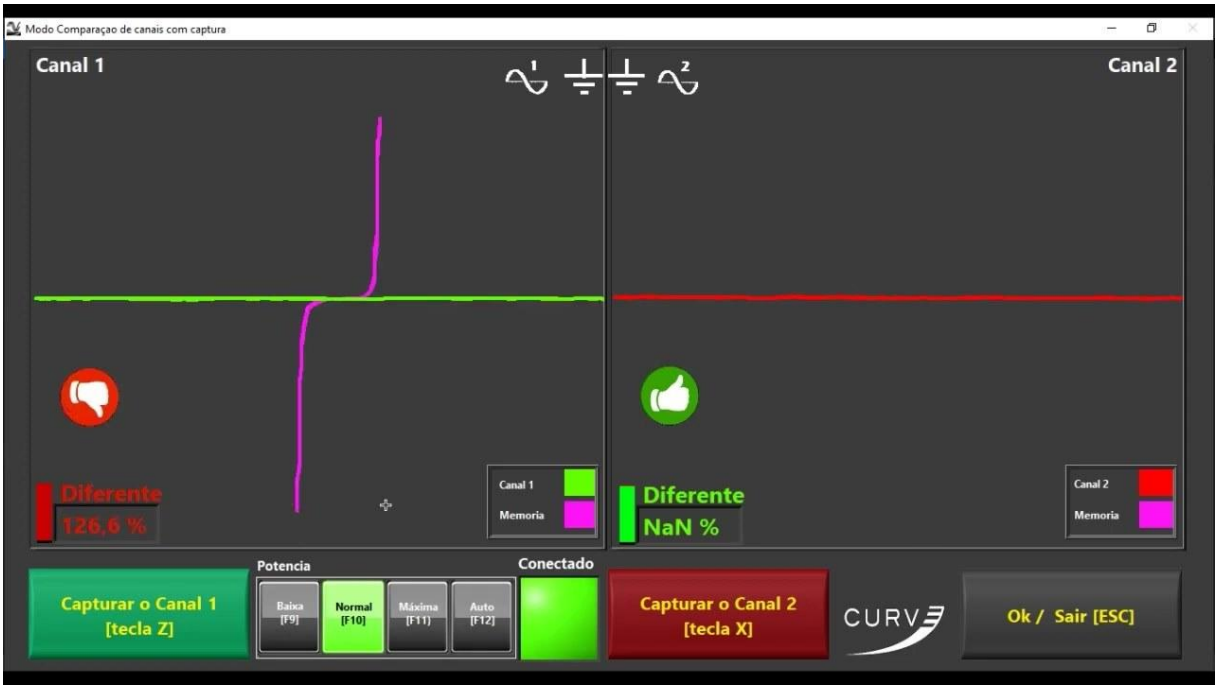


Figure 27 – Compare with Memory: Channel 1 and Channel 2 with independent memories

10. Creating a project (virtual board)

The project is the RastreCurve “gold mine”: you store the curves of a **good** board once, with the photo and position of each component, and then diagnose any identical faulty board without needing the good board on the bench. Over time, the workshop builds its own **curve database**.

> **NOTE**
> **Only Channel 1** is used when creating projects (red probe + green GND lead). On the Lite, created projects are stored **at Normal Power only** and record the **VI curve (normal mode)**; impedance and the special tests of the 2Plus are not stored.

10.1 Prepare the photos

Photograph the good board **from straight above**, with good lighting and sharp focus. If there are components on both sides, take one photo of each side. Save the photos on the computer before starting.

10.2 Create the project

1. In the main menu click **New Project / Curve**.
2. In **Curve Name**, type an easy-to-identify name (manufacturer, model and version of the board).
3. In **Project details**, record everything that may help in the future: equipment, model, bridged grounds, notes.
4. Click **Create Curve** and select the photo of the board.

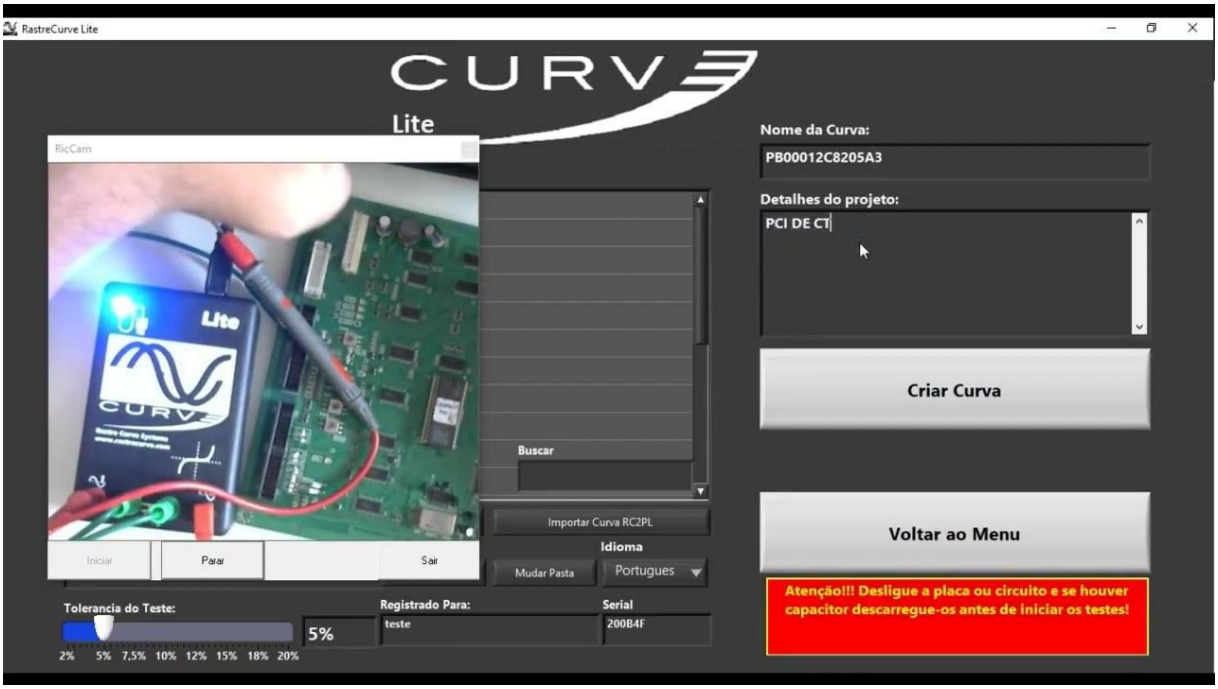


Figure 28 – New project: name and details

10.3 Adjust the image

In the editing window, crop the borders and use **Rotate Image**: choose the mode (rotate or **mirror**), adjust the angle with the **Tilt** bar (-180° to 180°) and click **Finish Rotating**; **Back to Original** undoes it. To include the back of the board, a datasheet or a pinout, add another image below or to the right.

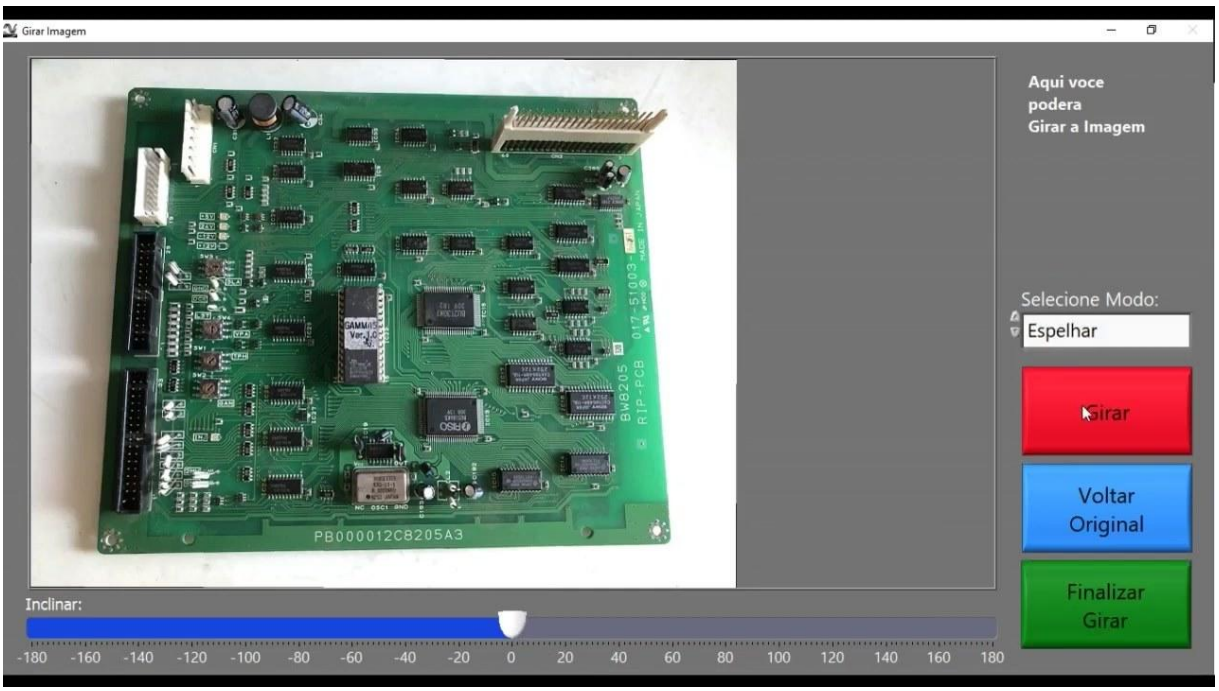


Figure 29 – Rotate Image: mode, tilt and finishing

10.4 The Edit Project window

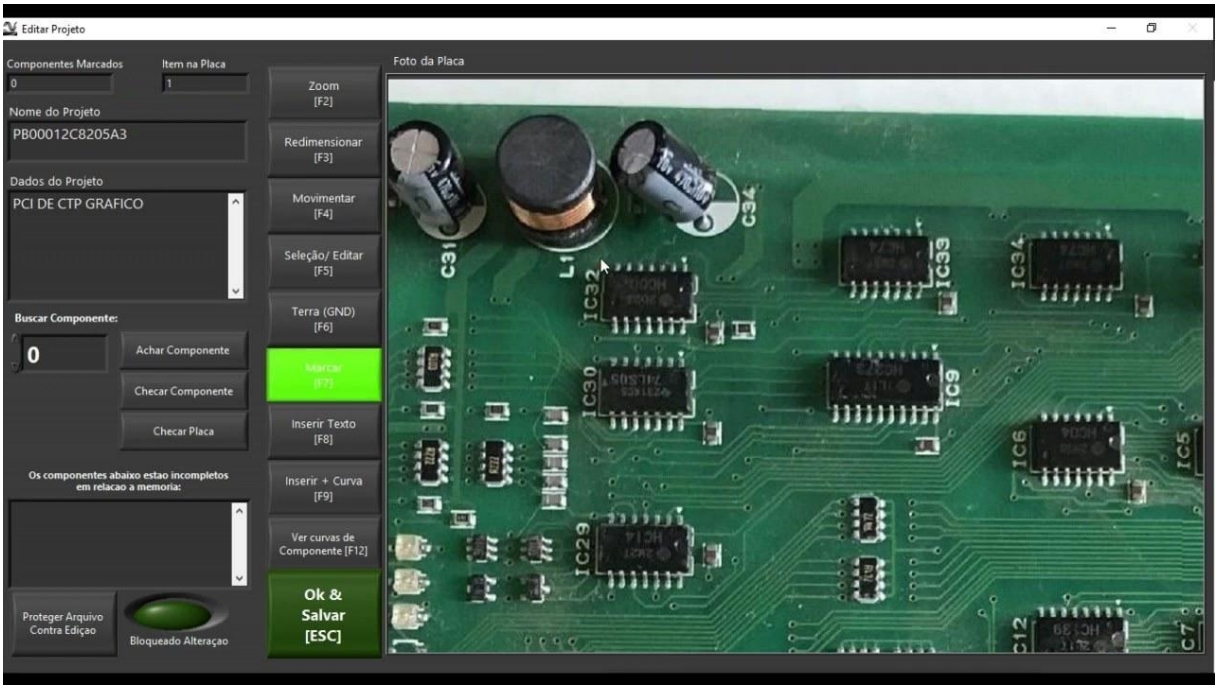


Figure 30 – Edit Project window of the Lite

Button / key	Function
Zoom [F2] / Resize [F3] / Move [F4]	Zooms in, returns to the original size and drags the image.
Select / Edit [F5]	Selects an already marked component to edit it or store curves.
Ground (GND) [F6]	Marks on the photo the ground point used in the measurement.
Mark [F7]	Marks a component on the photo (click and drag a rectangle).
Insert Text [F8]	Inserts notes on the photo, with text color, background color and font size.
Insert + Curve [F9]	Click a marked component to store the curves.

Button / key	Function
View Component curves [F12]	Shows the curves already stored.
Find / Check Component	Finds a registered component and checks the board.
Attach Files	Links datasheets and other files to a component or to the project.
Protect File Against Editing	Locks changes (it is not a password; it can be undone).
Ok & Save [ESC]	Saves the project and returns.

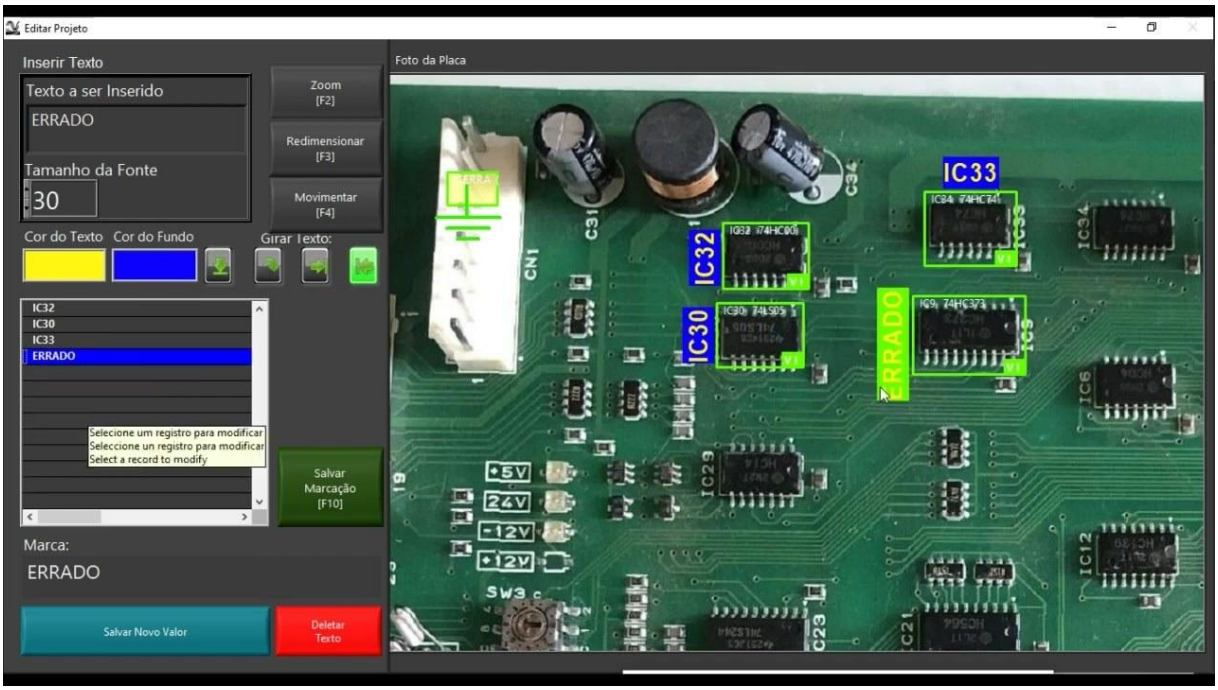


Figure 31 – Insert Text: notes about the components on the photo

10.5 Mark the ground and the components

1. Clip the green lead to a GND close to the area to be stored. Click **Ground (GND) [F6]**, draw a rectangle over the same point on the photo and click exactly on the point.
2. Use **Zoom** to see the component clearly, click **Mark [F7]** and draw a rectangle around it. You can mark several components at once.
3. Click **Insert + Curve [F9]** and the marked component. Fill in **Component Code** (e.g. 74HC00), **Component Id on the Board** (silkscreen: IC32, R12…), **Notes** and **Number of Pins**.
4. Click **Capture Curves Normal Mode**.

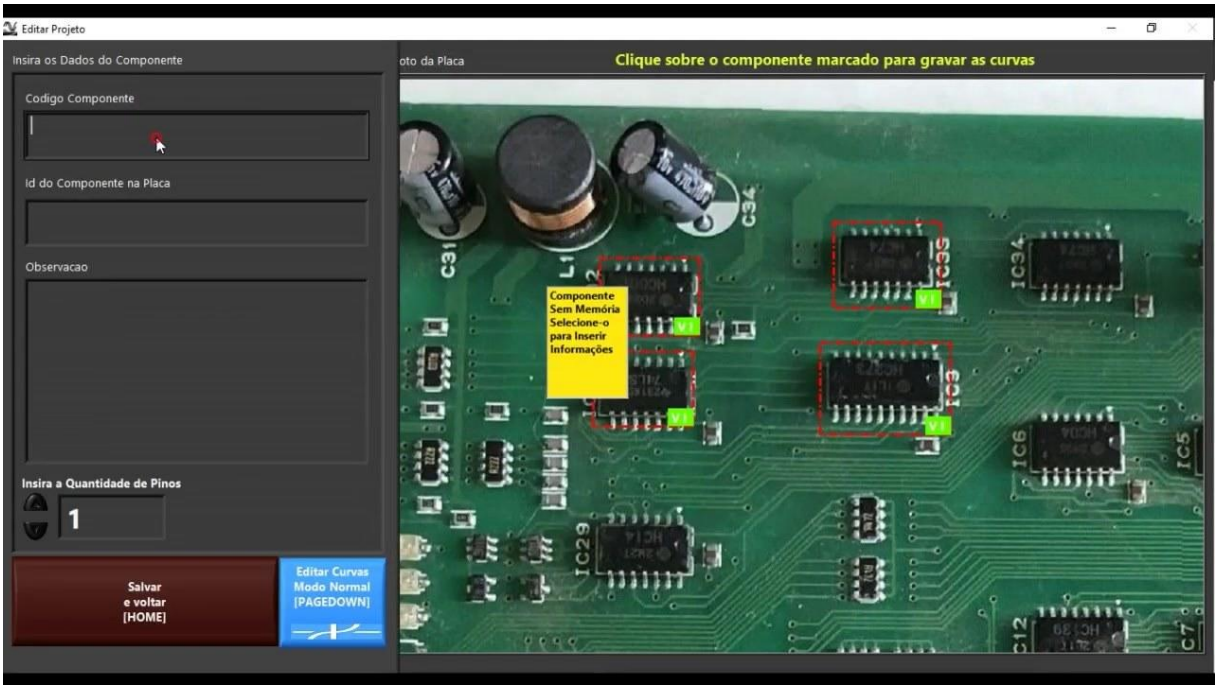


Figure 32 – Component data

10.6 Mark the position of the pins

Indicate on the enlarged photo where each pin is ("Click now on point N"). On ICs, pin 1 is next to the "dot" or the notch and counting continues counterclockwise; if in doubt, check the datasheet. Since version **1.91** marking can be done in **full screen**, with the buttons **Restart Re-marking**, **Restore Markings**, **Go Back**, **Edit Pin** and **Add New Image**. To correct a single pin, select its number in **Edit Pin** and click the right place.

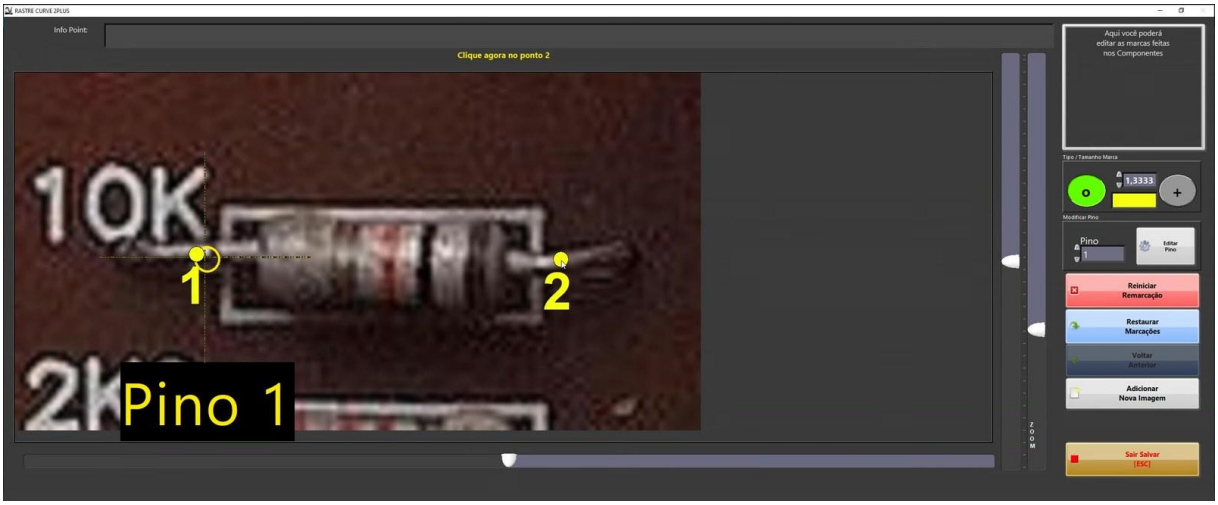


Figure 33 – Full-screen pin marking (v1.91)

10.7 Store the curves pin by pin

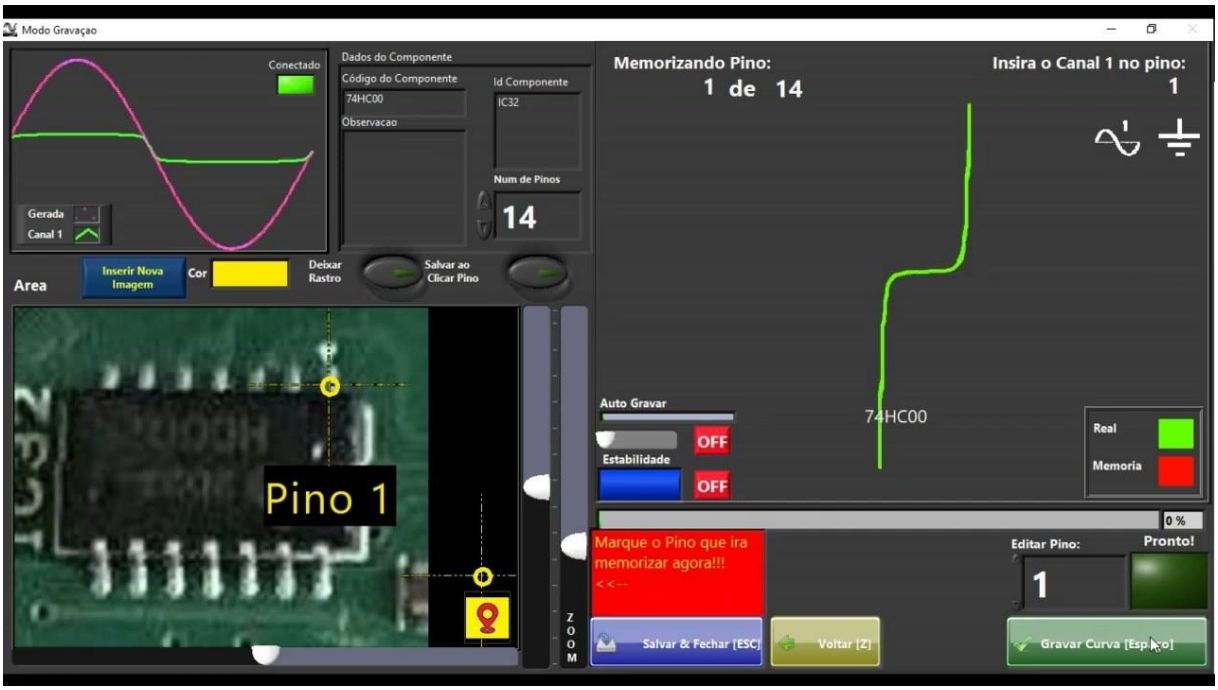


Figure 34 – Recording Mode – storing pin 1 of 14

The screen shows the generated signal, the component data, the enlarged photo with the pin mark, "**Storing Pin X of N**" and "**Insert Channel 1 on pin**". At the bottom are **Auto Record**, **Stability**, **Save & Close [ESC]**, **Back [Z]** and **Record Curve [Space]**.

1. Touch the red probe (Channel 1) to the indicated pin. The curve appears on the right.
2. With **Stability** on, the software only stores after the curve stabilizes – points with capacitors on the line take a few seconds (the time is adjustable).
3. Press **Space** (or **Record Curve**). With **Auto Record** on, recording is automatic as soon as the curve stabilizes and the software jumps to the next pin.
4. Repeat up to the last pin and click **Save & Close [ESC]**. The component is marked in **green**.

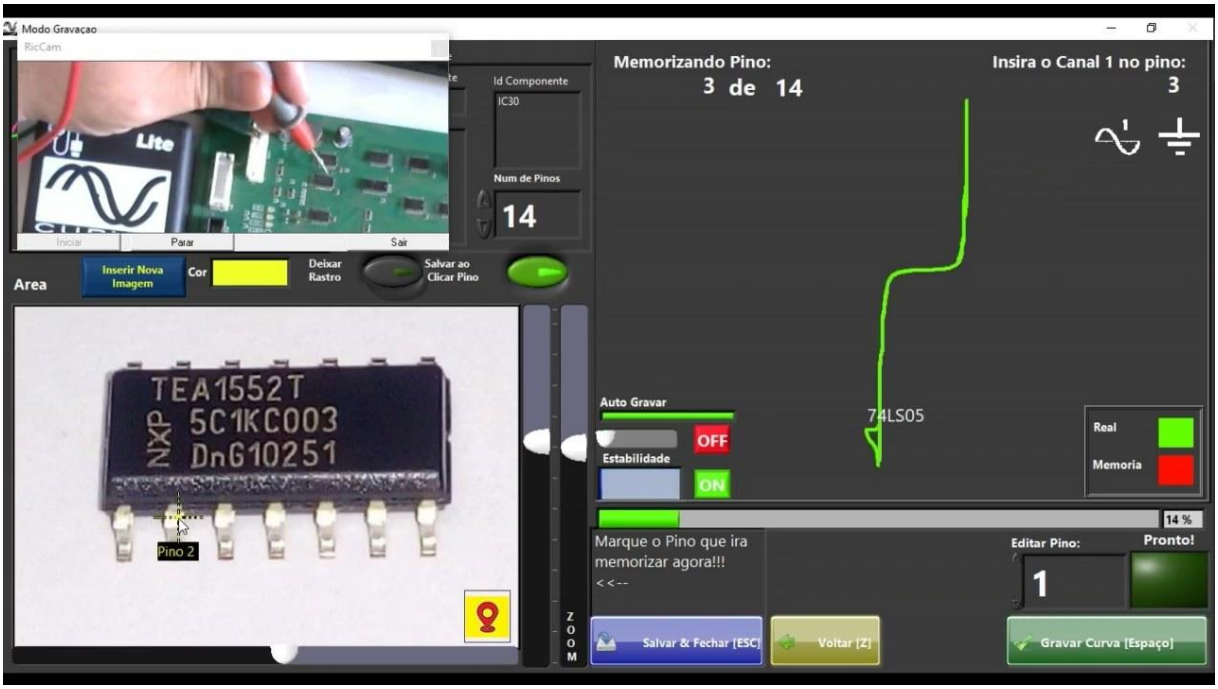


Figure 35 – Recording with Stability on

TIP

Store the components in the order that is most practical visually; within each component, store the pins **in order**, from 1 to the last.

You can change the **marking color** and **Insert New Image** for the component (for example, a high-resolution photo of the IC).

11. Testing a board with the memory

With the project of the good board ready, the faulty board is tested on **Channel 1**, comparing each pin with the stored curve.

1. In the main menu, click the project in the **Curves in the System** list.
2. Click **Test Memory Curve**. The **Board Test Mode** opens.

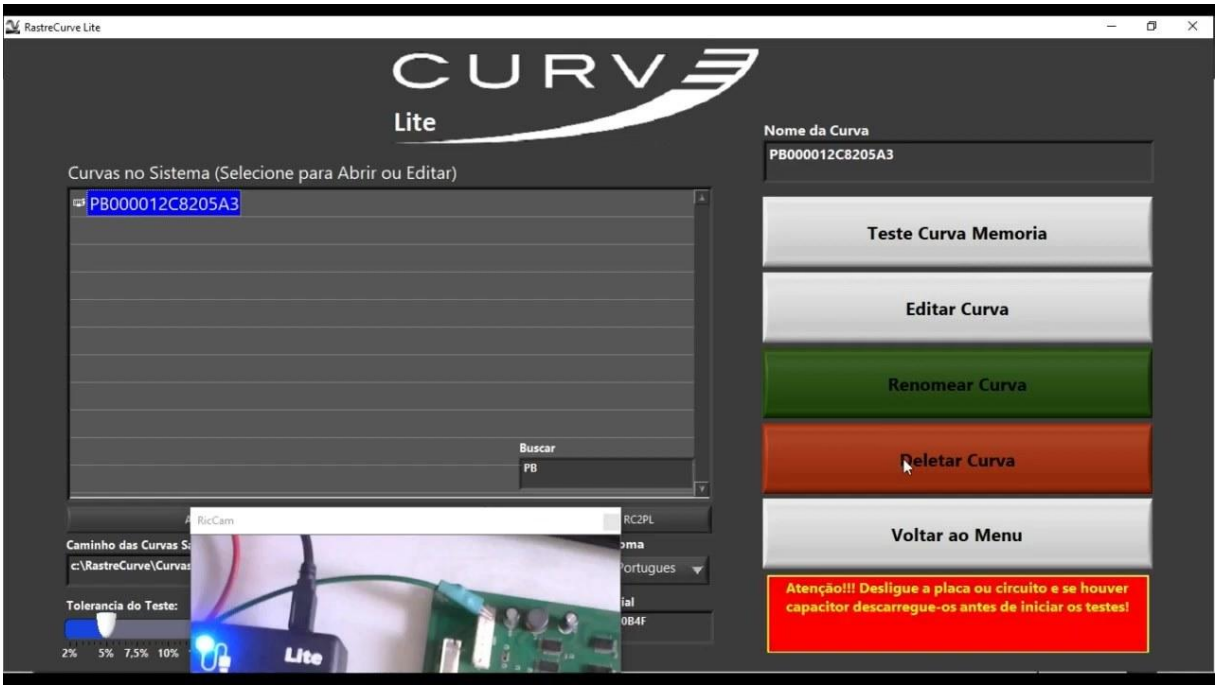


Figure 36 – Selected project: Test Memory Curve, Edit, Rename and Delete

11.1 Board Test Mode

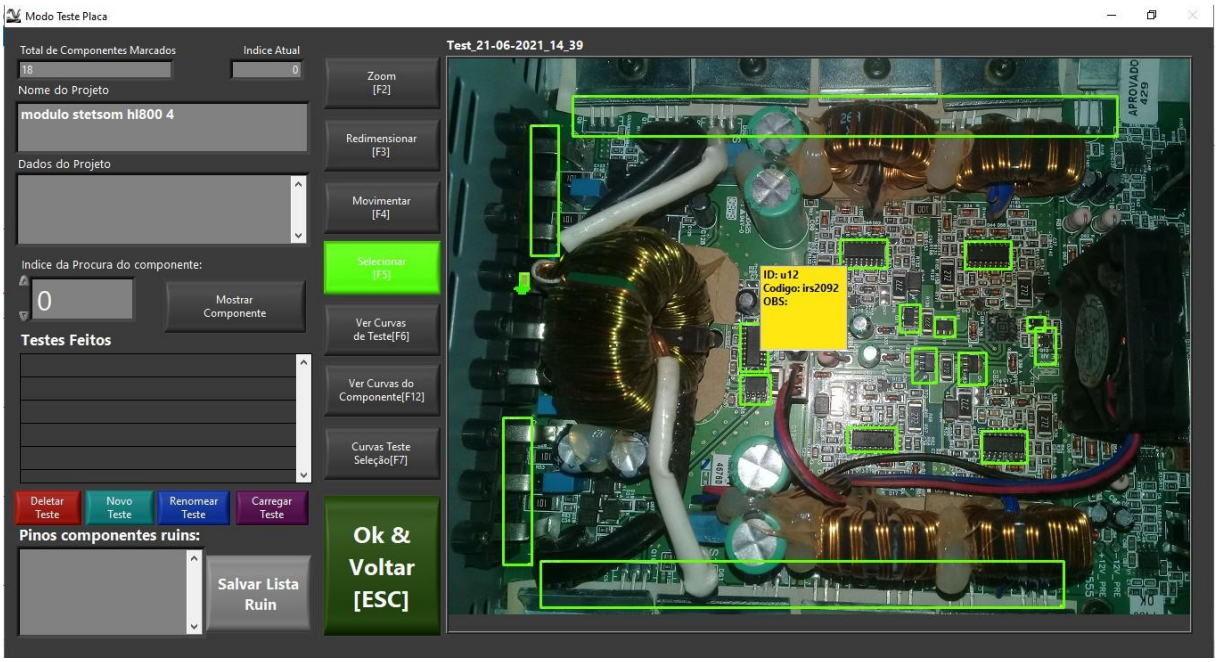


Figure 37 – Board Test Mode: tested components marked on the photo

The window shows the photo, the name and data of the project, the buttons **Zoom [F2]**, **Resize [F3]**, **Move [F4]**, **Select [F5]**, **View Test Curves**, the component search index and the **Tests Done** list (each test receives

date and time and can be deleted, renamed, loaded or started from scratch). The **Bad component pins** are listed and can be saved (**Save Bad List**). Attached files (datasheets) open with a double-click.



Figure 38 – Files linked to the component (datasheet)

11.2 Test Mode (pin by pin)

Click **Select [F5]** and the component and choose **Open and test**. The stored curve (**Memory**, red) appears for the indicated pin; touch the Channel 1 probe to the same pin and the **Real** curve (green) appears overlaid with the percentage difference.

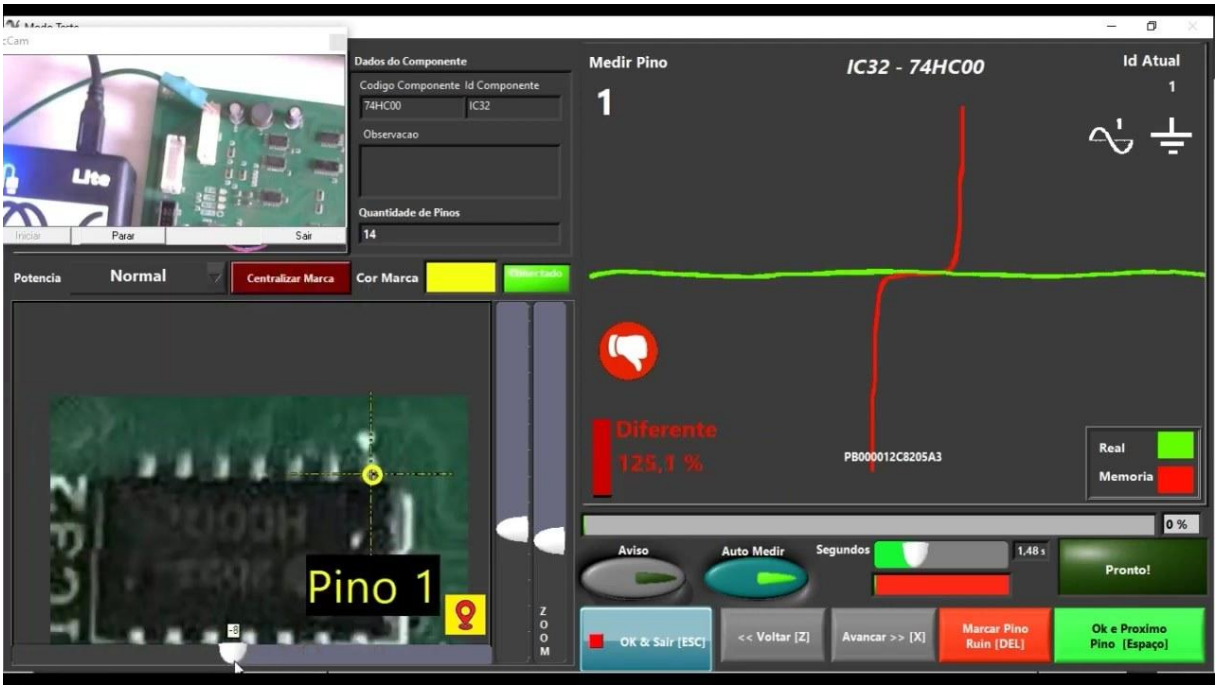


Figure 39 – Pin with a curve different from the memory: 125.1% and thumbs-down

> **NOTE**
>
> Projects created on the Lite are tested at **Normal Power**, in which they were stored. Projects created on the **2Plus** can be tested at **all the power levels** in which the 2Plus stored them – select the power indicated for each curve.

Button / key	Function
Ok and Next Pin [Space]	Accepts the pin as good and moves to the next one.
Mark Bad Pin [DEL]	Records the pin as faulty.
<< Back [Z] / Forward >> [X]	Navigates between pins.
OK & Exit [ESC]	Ends the test of the component.
Auto Measure / Seconds	Moves on automatically after the set time with a stable curve.
Alert	Turns the pass/fail beep on/off.
Center Mark / Mark Color	Re-centers the mark on the photo and changes its color.

You can also see **all the curves** of the component at once and test by clicking each pin (**View Test Curves**), with **Compare Full Screen**.

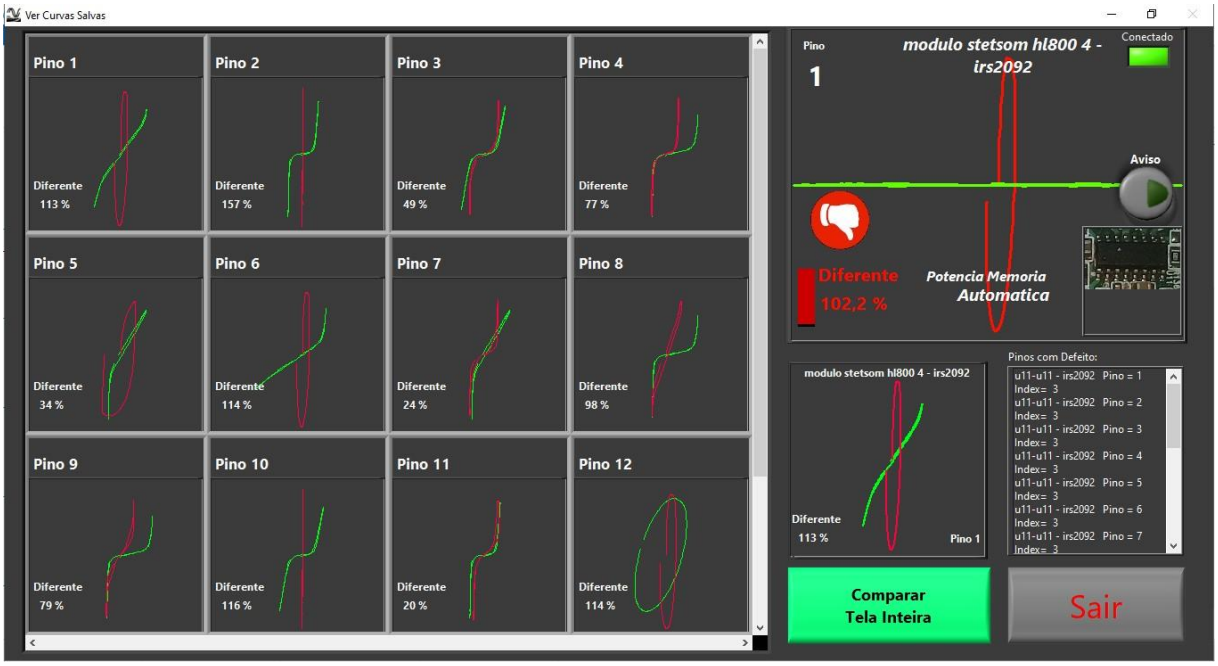


Figure 40 – All the curves of the component with the percentage of each pin

When finished, the component turns **green** on the photo if all pins are good, or **red** if any pin was marked as bad.

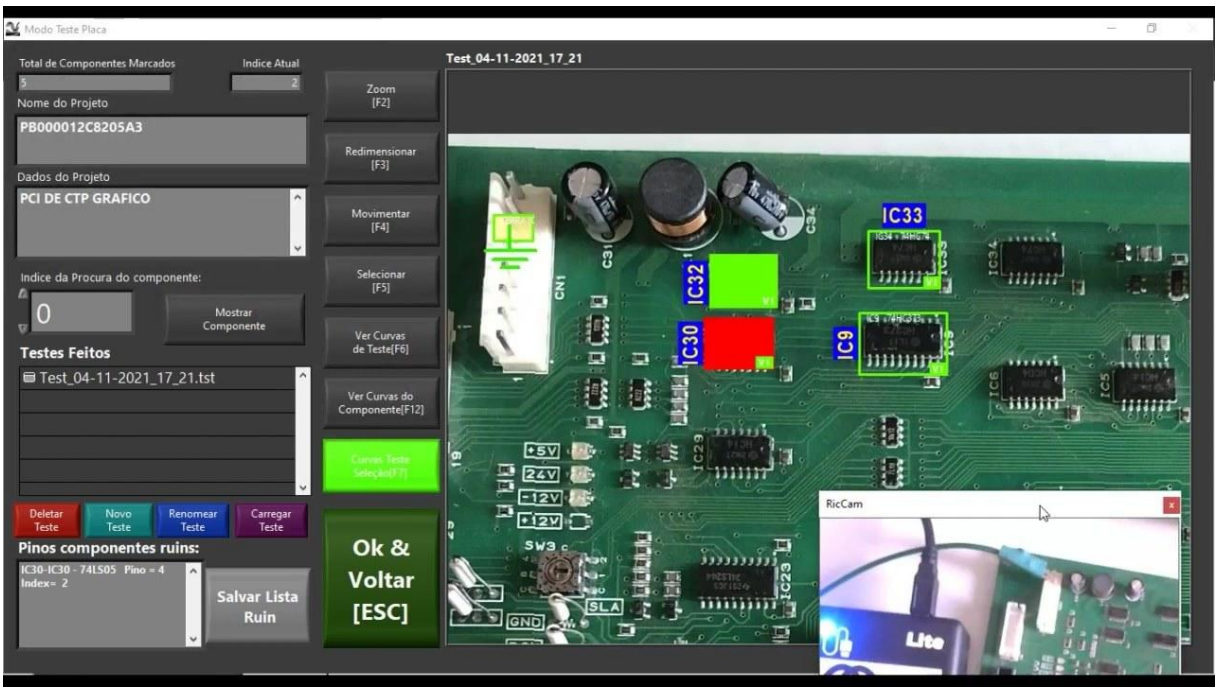


Figure 41 – Passed (green) and failed (red) components

WARNING

A bad pin indicates a fault **in the component or in something connected to that pin**. To confirm, desolder the suspect component and repeat the measurement on the points of the line: if the difference disappears, the fault was in the removed component; if it remains, it is in another component of the same net.

12. Impedance Test

> **NOTE**
> On the **Lite**, the Impedance Test is used through the **Impedance Test** button on the main menu. It **cannot be stored** or used inside projects (virtual boards) – that possibility is exclusive to the 2Plus.

The multimeter often “beeps” or shows a very low resistance (0.1 Ω, 0.2 Ω…) on nets that **are not shorted** – they just have low impedance, such as power rails, capacitor banks and filter coils. The impedance test applies a sine-wave signal, processes about 9,000 samples and expresses the impedance of the point **as a percentage relative to a calibrated short**, making it possible to distinguish low impedance from a real short. The equipment distinguishes sections from approximately 10 Ω.

> **NOTE**
> The impedance test is not a “short locator” by heat or voltage; it indicates **how close to a short** each point is, so you can compare points and follow the net.

12.1 Calibrate the short-circuit point

1. Open **Impedance Test** from the main menu. Only Channel 1 is used (red probe and green lead).
2. Click **Calibrate the Short-Circuit Point [HOME]**.
3. Touch the Channel 1 probe to the GND lead (tip to tip) and click **HOLD OFF**. Wait for it to finish.
4. The short reference (pink/lilac line, “Memory”) is stored as **0.00%**.

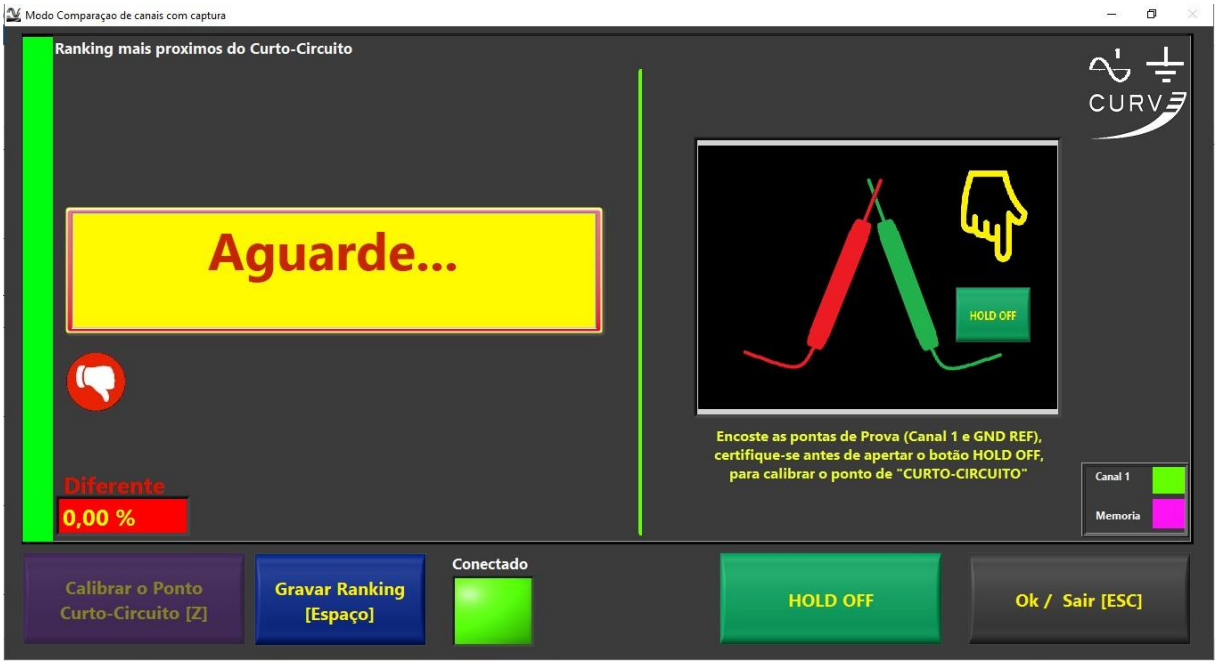


Figure 42 – Impedance Test on the Lite: calibration of the short-circuit point (HOLD OFF)

12.2 Measuring

Clip the green lead to the GND closest to the net and touch the Channel 1 probe on the desired points. The **Real Difference** value shows the percentage relative to the short: **the lower the percentage, the lower the impedance**.

TIP

Real example (PlayStation 4 board, 24-pin PWM IC): several pins show a **vertical line** – in the common VI test this could be mistaken for a short. In the impedance test, however, they read **0.15%**, **0.21%** and **0.23%**: they are **low-impedance** lines, not shorts. Only the pin really connected to GND reads **0.00%**.

Result	Interpretation
0,00%	True short circuit (or the point is GND itself).
0.20% to 5%	Significant low impedance: partially shorted component, main power rail or large capacitors. Analyze the context.
5% to 50%	Low to moderate impedance: active components, decoupling, signal traces. Usually normal.
Above 50%	Moderate to high impedance: normal for most points.

TIP

0% is different from 0.20%. Only consider it a short when the value is zero – and check in the datasheet that the pin is not the component's own GND.

What matters most is the **discrepancy**: if similar points are between 40% and 80% and one of them shows 0.5%, that is the one to investigate.

Use **Record Ranking [Space]** to save, with a clear name (silkscreen, component), the points **closest to a short**; they appear in "Ranking closest to short circuit". There is no need to record points reading 100%.

Divide the board into sections (power, processing, outputs), find the section with the lowest impedance and keep subdividing until you isolate the component.

13. Interpreting the curves

13.1 Characteristic curves

Even without a reference board, the shape of the curve already says a lot about the point:

Curve shape	Indicates	Remarks
Horizontal line	Open circuit (no current)	Broken trace, loose pin, open component. Very high-value resistors also look like this.
Vertical line	Short circuit / point connected to GND	Confirm with Low Power. Very low resistors and very large capacitors also tend to be vertical.
Tilted line	Resistor	The slope depends on the value (10 kΩ ≈ 45°).
Clockwise spiral / ellipse	Capacitor (or RC)	Width proportional to capacitance and frequency.
Counterclockwise spiral / ellipse	Inductor / transformer	At 4 Hz, large inductors look almost like a short.
Asymmetric exponential (knee ~0.6 V)	Diode / PN junction	B-E and B-C junctions of transistors, IC protection diodes.
Exponential + reverse step	Zener diode	The step indicates the Zener voltage.
Mixed shape (diode + resistor)	IC pin	Typical shape of TTL/CMOS IC pins.
Tilted ellipse	Resistor + capacitor	Combination of the two curves.

13.2 Example: optocoupler with 2 channels

In **Compare with 2 Channels**: Channel 1 on pin 1 (LED anode), one GND on pin 2 (cathode), the other GND on pin 3 (emitter) and Channel 2 on pin 4 (collector). Channel 1 shows the LED curve and, at the same time, Channel 2 shows the phototransistor tilting (conducting). Without the signal on the LED, Channel 2 stays flat (no conduction).

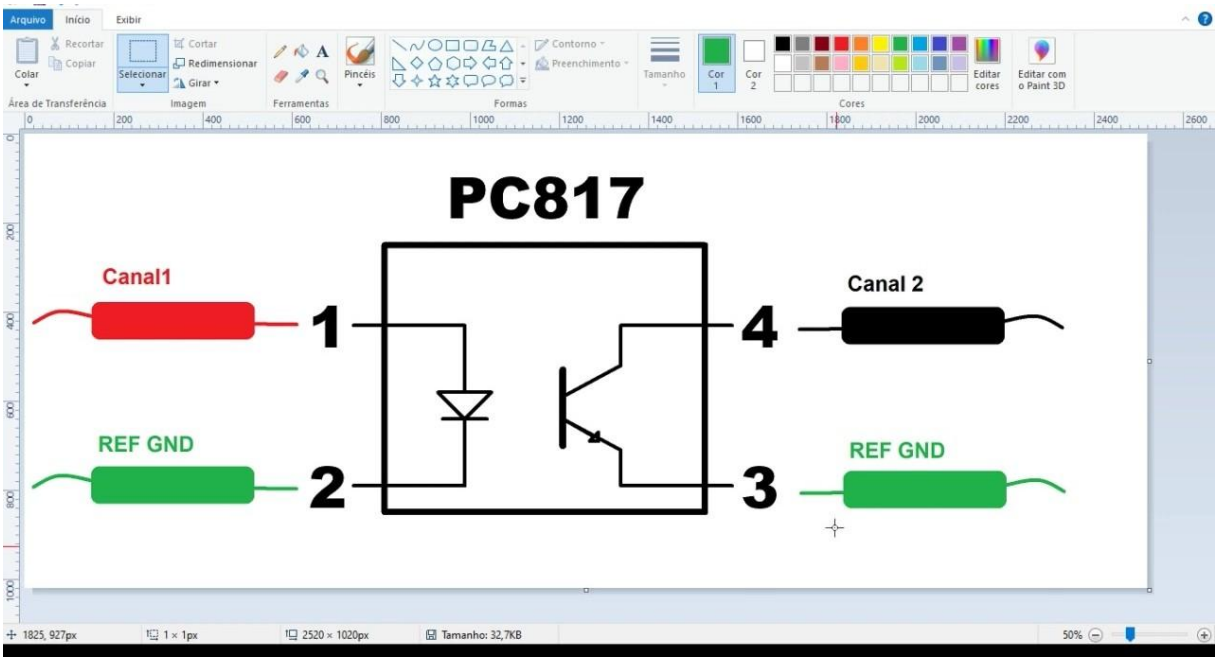


Figure 43 – PC817 connection in Compare with 2 Channels

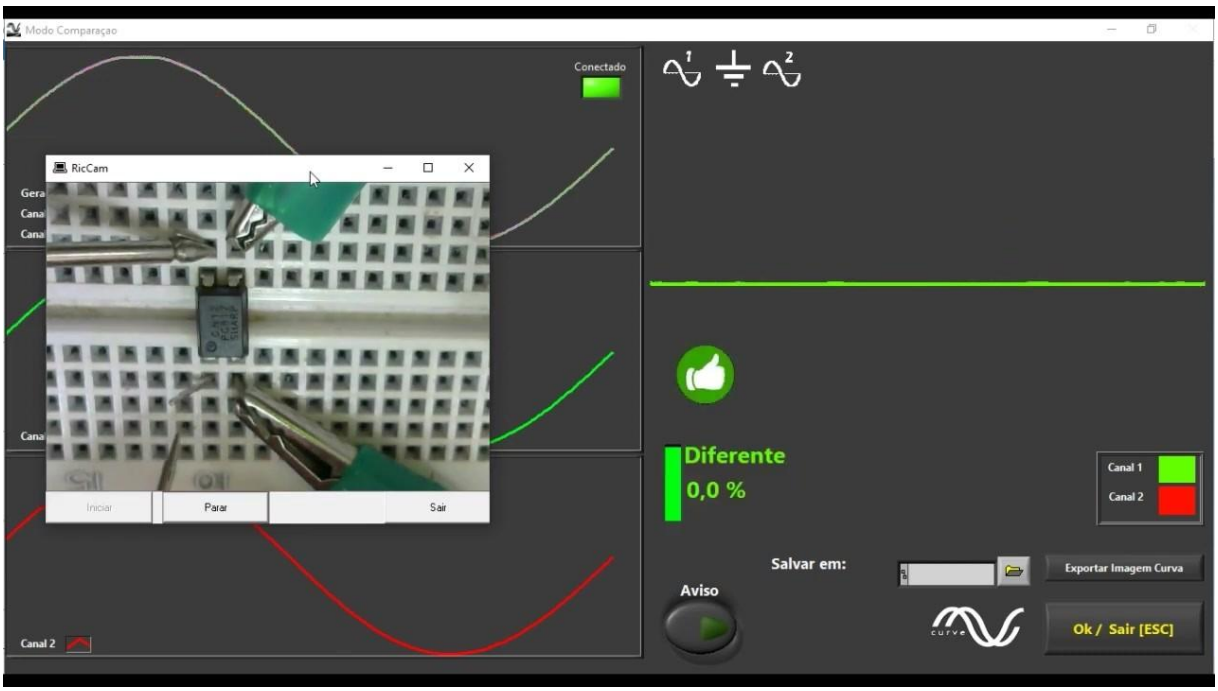


Figure 44 – Channel 2 conducting when the LED is biased by Channel 1

This test with 2 independent channels also works to check the **conduction of transistors, MOSFETs, FETs and TRIACs**: one channel drives the control terminal and the other observes the power terminal.

13.3 Example: automotive speed sensor

In a workshop, a new speed sensor (Channel 1, green) was compared with the used sensor (Channel 2, red), measuring the **same pin** on both. The curve of the used sensor was completely different (more than 130% difference), confirming the fault **before** fitting the new part in the vehicle.

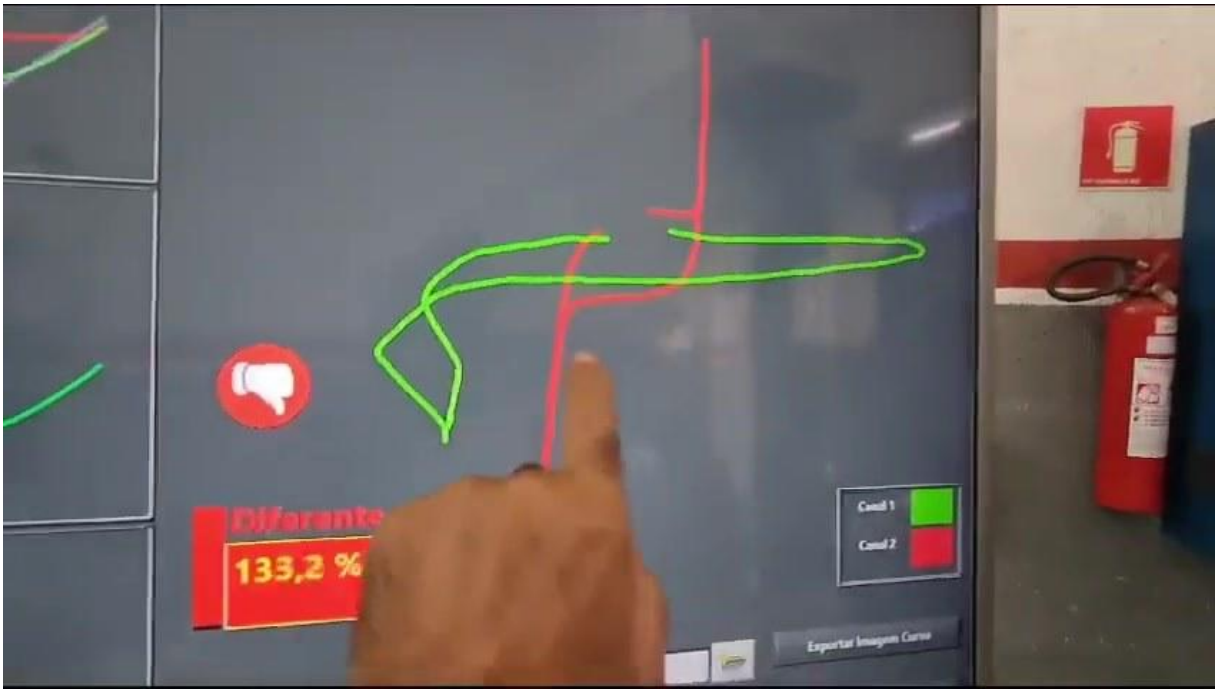


Figure 45 – Speed sensor: curve of the good sensor (green) × faulty sensor (red)

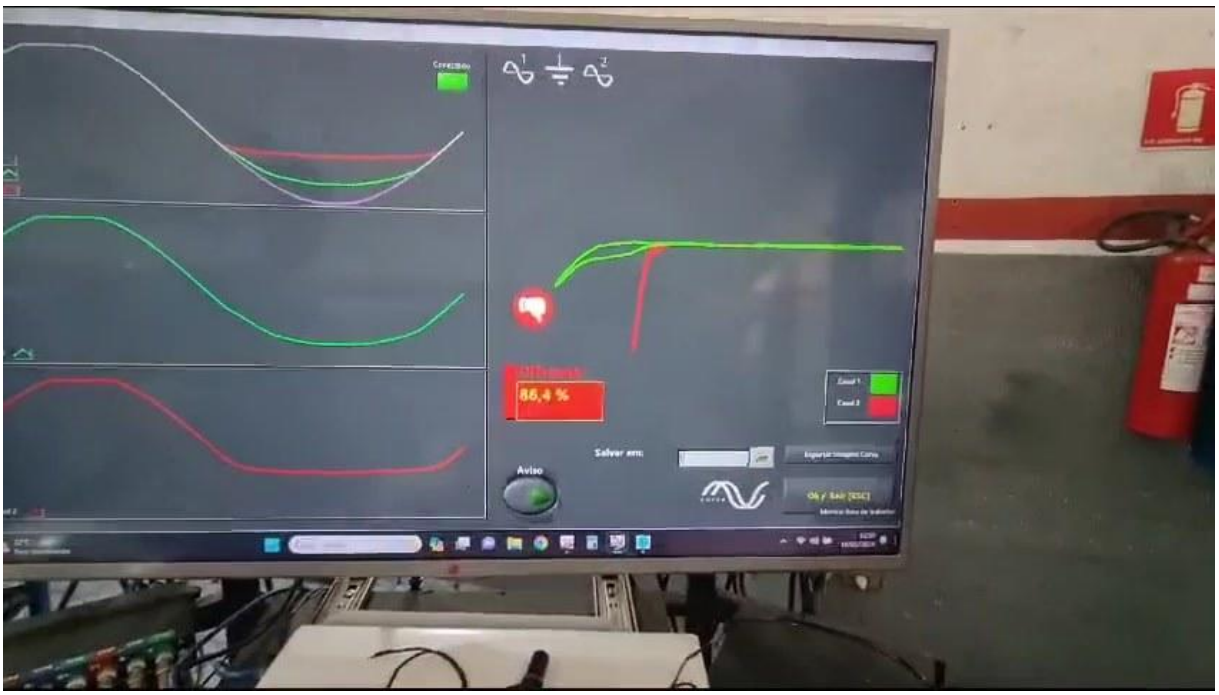


Figure 46 – Comparison on another terminal of the sensor

14. Curve Cloud and Unified Curve System

14.1 Curve Cloud (in the software)

The **Curve Cloud** gathers more than 1,100 free projects created by the community (automotive, air conditioning, agricultural, fitness equipment, amplifiers, industry…). You do not need to have every good board to build your database.

1. In the menu click **Curve Cloud** and select your equipment version; the software checks the connection and loads the list.
2. Use **Search** to filter and click a curve to see the information on the server.
3. Click **Download to your PC**. The project will then appear in **Curves in the System**.

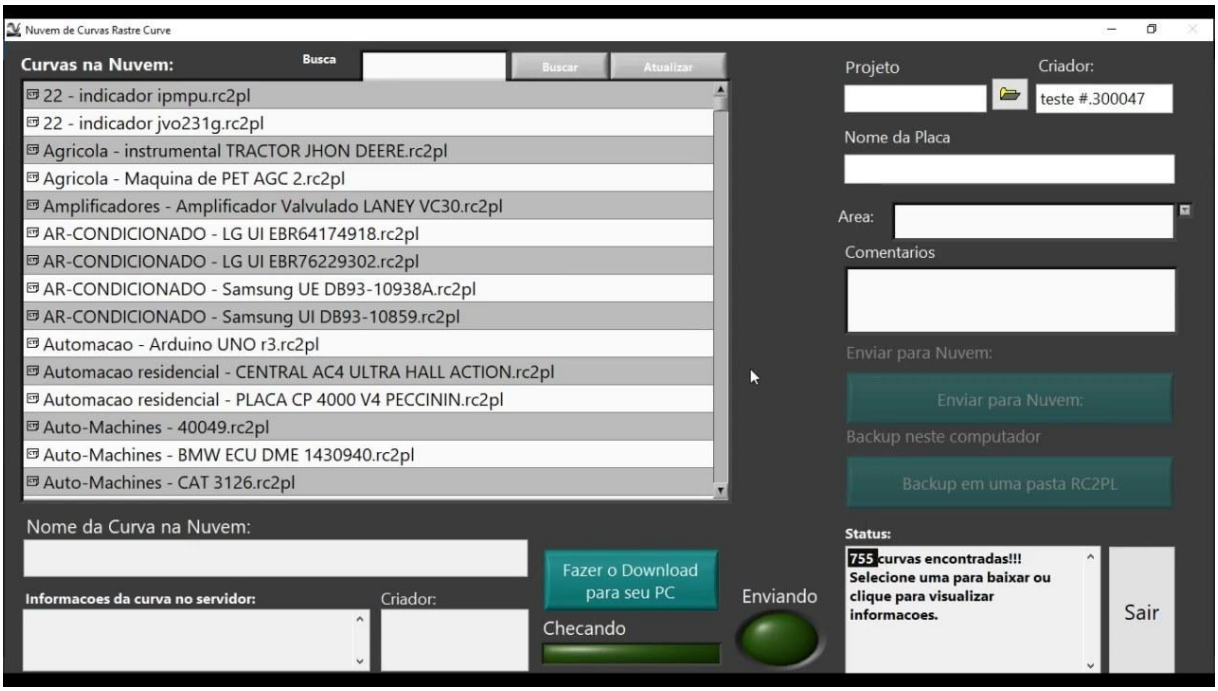


Figure 47 – Curve Cloud in the Lite software

To **contribute**, select your project, fill in **Board Name**, **Area** and **Comments** and click **Send to Cloud**. The **Backup to an RC2PL folder** button creates a local copy; in the menu, **Backup/Share RC2PL** exports the project and **Import RC2PL Curve** imports received files. Curves protected with a password and serial number can be opened on the Lite (curve password protection is a 2Plus feature).

On the **rastrecurve.com** website there is also the curve database, the discussion forum by area, the software download and explanatory videos. There are also WhatsApp user communities by specialty.

14.2 Unified Curve System (v1.92)

The **Unified Curve System** is the new RastreCurve community portal. It gathers in one place the curves of the **2Plus and Lite** (and also those of the Mini, 10 Vpp and 20 Vpp models, in tabs), as well as videos, rewards, ranking and gift shop. Access it with the blue **Unified Curve System** button on the main menu.

Registration and login

1. On the first access click **Register**: enter a **user name**, the **equipment serial number** and a **password**, and click **Validate Registration**.

2. On subsequent accesses, go to Login with your user name and password. Check remember user/password so you do not have to type them again.

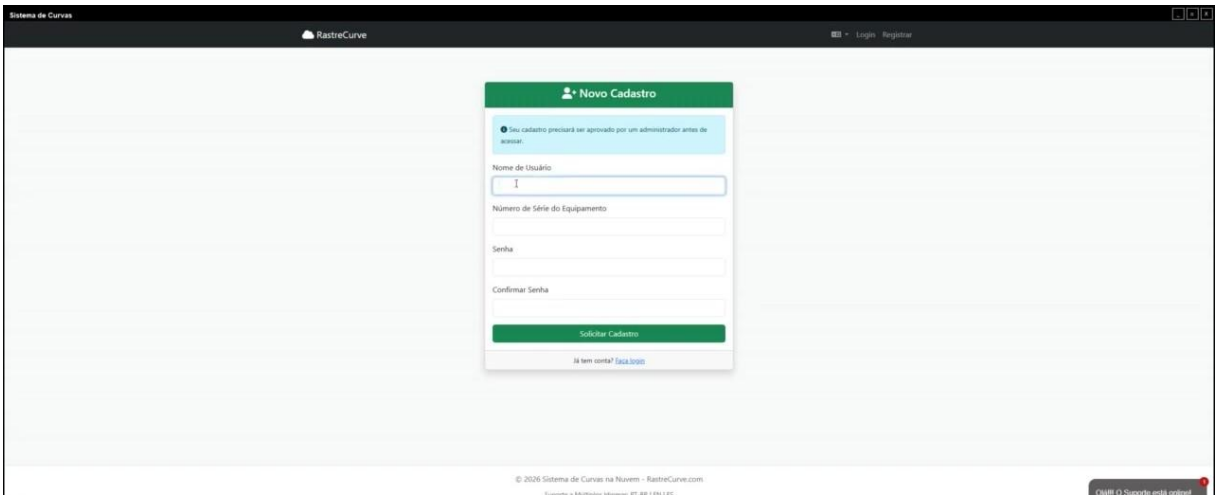


Figure 48 – Registration in the Unified Curve System

Dashboard

The home page shows the **Latest Curves**, the **Featured Rewards**, the **Latest Videos Posted**, the **Quick Chat** with whoever is online and the new members of the **Community**. The top menu gives access to **Home, Curves, Videos, Rewards, Ranking, Gift Shop and Portals**; on the right are the **notifications**, the **language** (Portuguese, English and Spanish) and your **profile**.

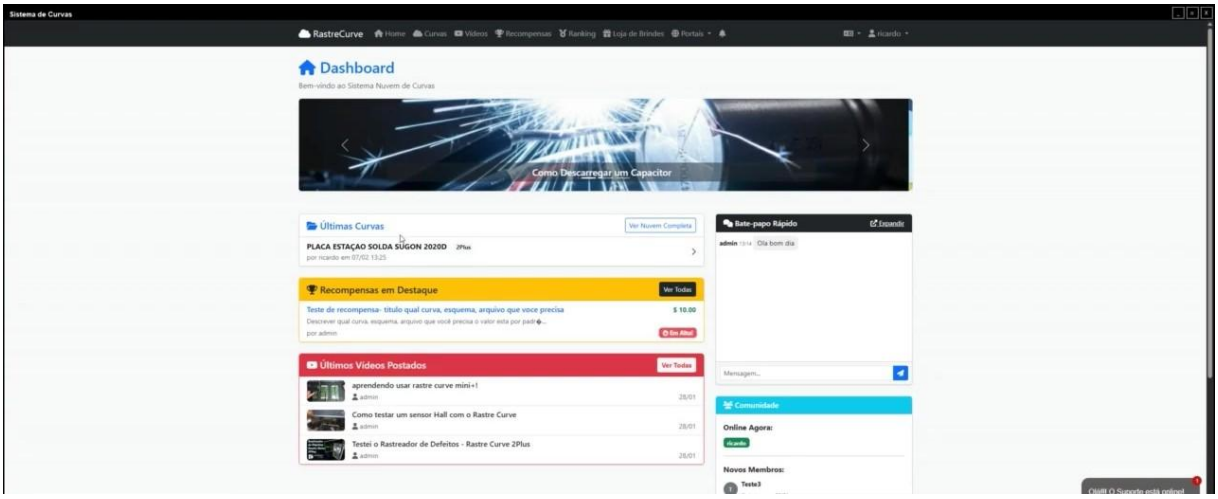


Figure 49 – Unified Curve System dashboard

Curves: search, view and download

- Browse the **2Plus/Lite**, **MINI**, **10vpp** and **20vpp** tabs or search by **name, description, user** or **category** (automotive, industrial, computing…).
- **Peek** opens the preview; right-click the photo and use **Enlarge image** to see details of the board.
- **Download**: if the Lite software is installed, the file is **unzipped automatically** and sent to your curve database; otherwise, save it and import it later (**Import RC2PL Curve**).

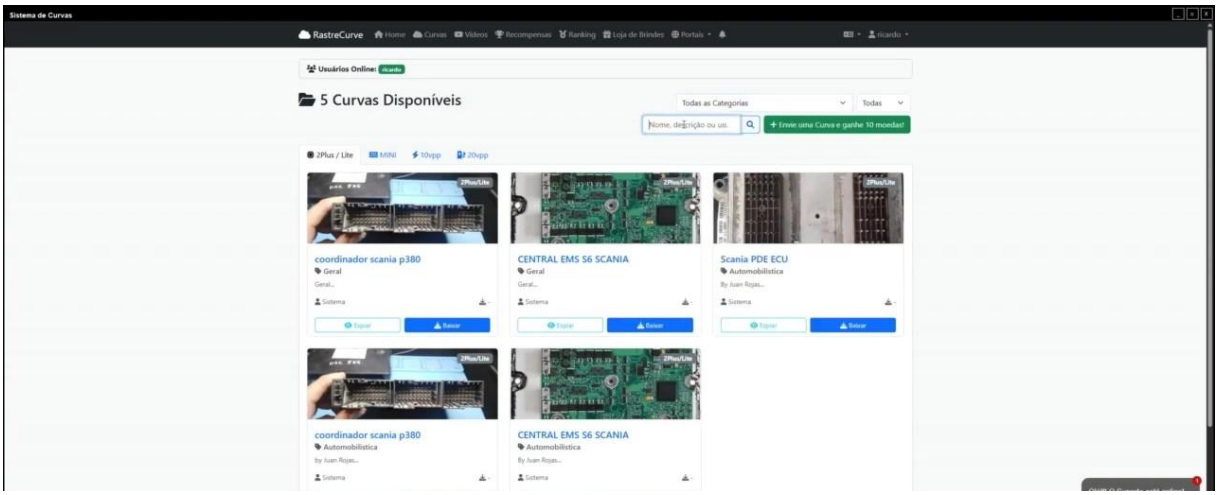


Figure 50 – Curves available on the portal

On the page of each curve there is the **Version History** (the author can publish corrections and you can download any version), the **Questions about the File** field to talk to the author and the **Ratings and Comments** (1 to 5 stars).

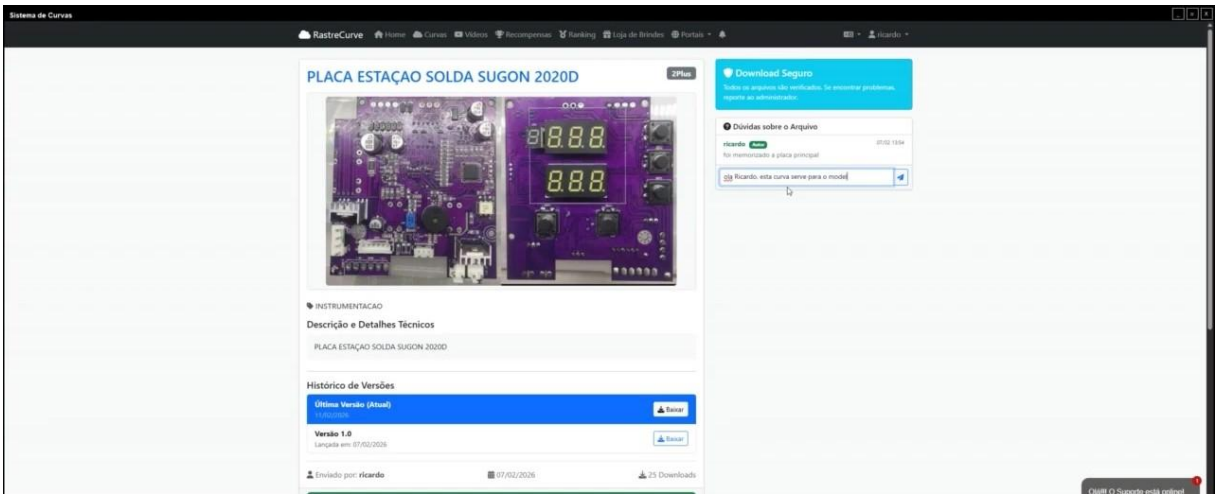


Figure 51 – Curve page: versions, download and questions to the author

Uploading a curve

Click **Upload a Curve and earn 10 coins!** and fill in **Curve Name**, **Category**, **Equipment Model**, **Notes and Details**, the **photo** (preview) and the **curve file**. Check **Is this a curve FOR SALE (Ad)?** if you want to sell it: enter the price, WhatsApp, e-mail and a **password**, which you release only to whoever pays. Without the sale option, the curve is free for everyone.

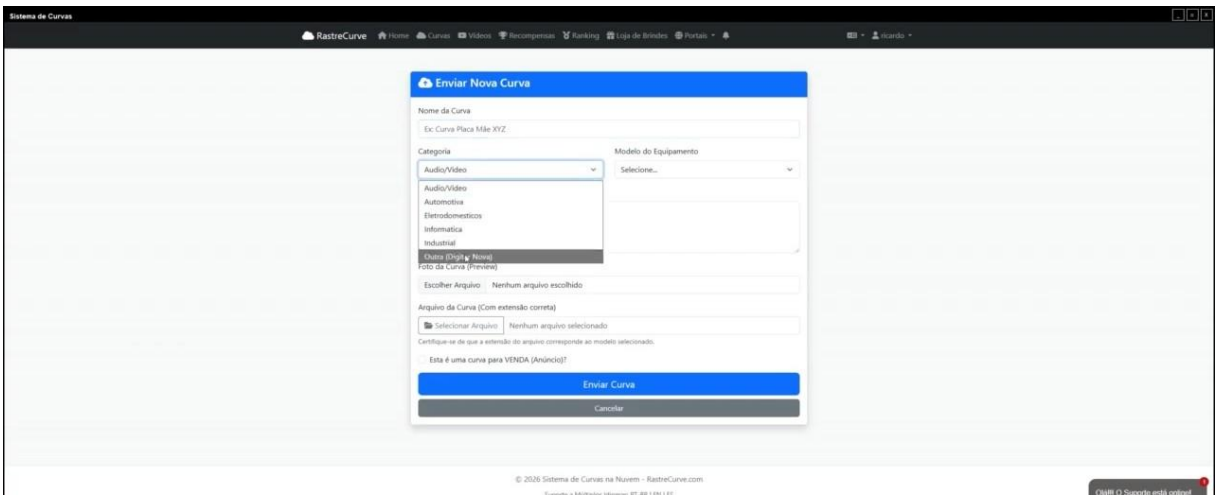


Figure 52 – Upload New Curve form

Coins, ranking and gift shop

Coins are **virtual points** of the system – **they are not money**. They accumulate as you use the portal and publish content. Each **curve** or **video** posted is worth **10 coins**, and the author also earns coins from **positive ratings**. Coins count toward the **Ranking** and can be exchanged in the **Gift Shop** (at the time of the video: key ring 50, needle test probe 120, mug 160 and T-shirt 200 coins). When redeeming, enter your name, tax ID and address; progress and tracking appear in **Track My Redemptions**. The coin **statement** is in your profile.

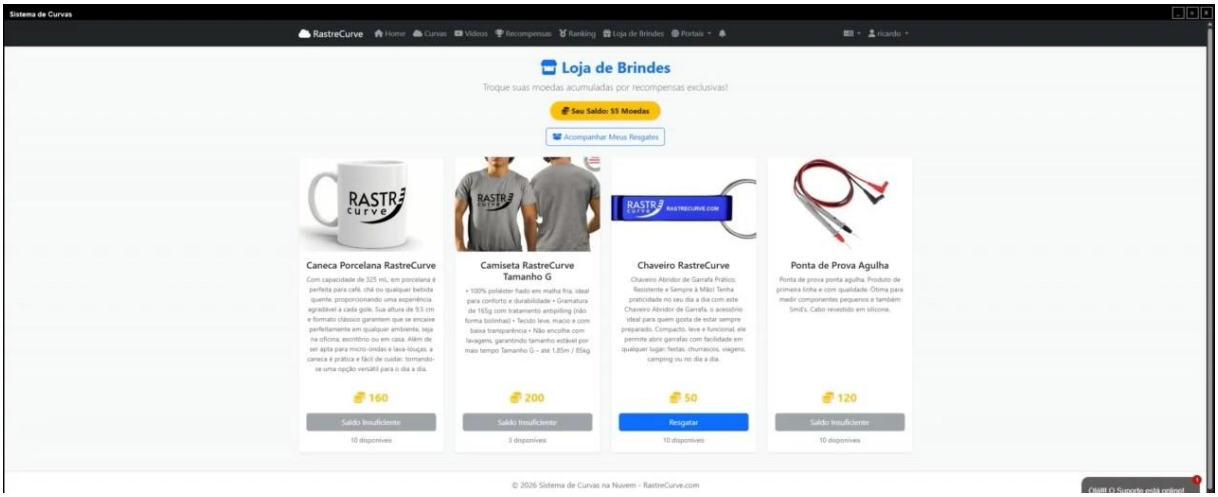


Figure 53 – Gift Shop

Rewards

Need a curve (or schematic, file) that nobody has published? Create a **reward** (unlike coins, here the amount offered is actually paid between users): click **Create a reward**, describe what you need, set the **share value** and, if you wish, attach a reference photo. Other interested users can **join** with the same share, increasing the total amount.

- Whoever **fulfills** the reward uploads the file, which is **held in escrow on the server**, and controls its release: they release the download to those who paid and block those who did not.
- Payment is arranged **directly between the users** (for example, by bank transfer); RastreCurve **charges no commission** and is not responsible for transactions made outside the system. In case of a problem, there is a feedback channel with the administrator.

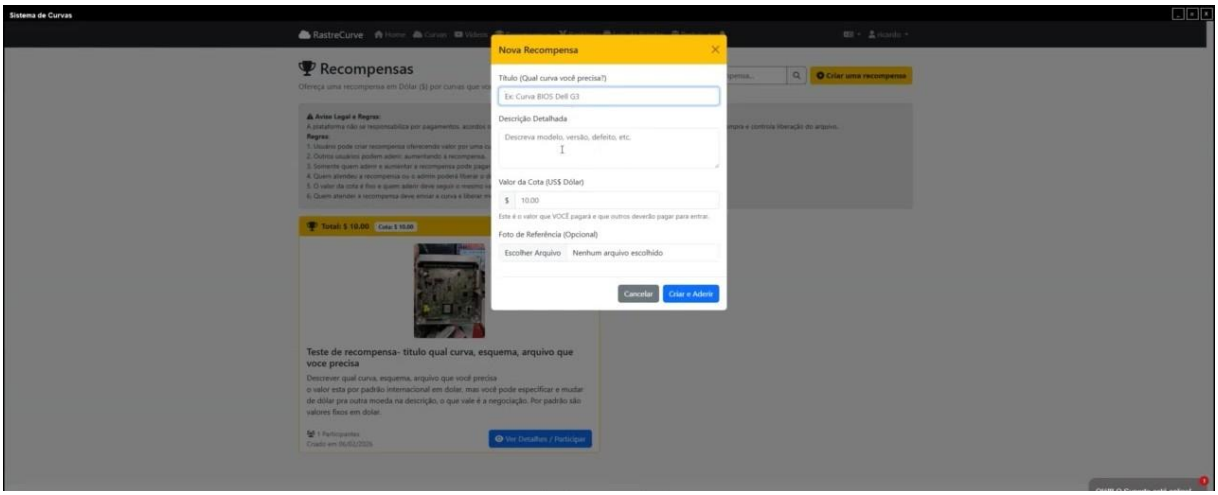


Figure 54 – Creating a new reward

Portals

The **Portals** menu gathers support, forum, feed, help center, training course, repair tips, YouTube channels, the RastreCurve book and the software download.

14.3 2Plus projects and RC2PL import

Since version **1.92**, the Lite opens **2Plus** projects that have **several parts** in the same project (for example: cover with the code, connector, side A and side B of the board). When you open one of these projects, the "Select on the side which linked project you want" window shows the parts; choose one and click **Open Project**.

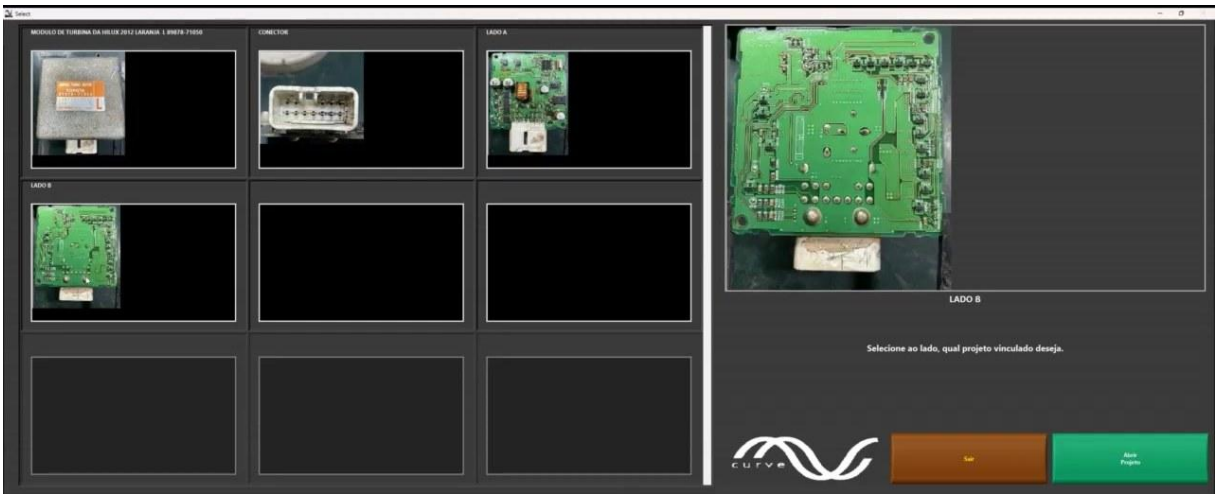


Figure 55 – 2Plus project with several parts opened on the Lite

If a downloaded curve does not appear automatically in **Curves in the System**, use **Import RC2PL Curve** on the main menu and point to the downloaded file: the software unzips it and adds the project to your database.

15. Tips and troubleshooting

Symptom	Probable cause	Solution
Curve oscillates / does not repeat	Active oscillator on the board (crystal, multivibrator); hand on the board	Disable the oscillators; place a 10 kΩ resistor between VCC and GND (or between the channel and GND); change the GND reference (for example, to the positive); do not touch the board.
Almost all curves vertical	Large capacitors at many points	Use Low Power (4 Hz). If necessary, remove the large capacitors.
Irregular curve on IC with charge pump (MAX232, ICL7660)	Internal charge pump voltage conflicts with the signal	Low Power + remove the external charge pump capacitors, or place a resistor between the channel and GND.
Identical ICs with different curves	Different manufacturers (typical on reset, set, preset, clear)	Normal on 1–2 pins; suspect a fault if it occurs on several pins.
No fault found, board does not work	Internal fault in memory, processor or IC that runs hot	Test these ICs carefully (Maximum Power); test them off the board if possible.
Small difference only in the center of the graph	Altered internal parameter (e.g. out-of-value bypass capacitor)	High attention – it may be the real fault. Mark the pin as bad and investigate the net.
Board with more than one ground	Separate GND nets	Bridge the grounds during the test or store in stages, noting it in the description.
“Device not found”	USB cable, port or driver	Change the port/cable; reinstall the driver (section 6.5); check the Connected indicator.
Inconsistent results	Poor contact, oxidized probe tips, temperature	Clean the probe tips with isopropyl alcohol; wait for thermal stabilization; check the leads.

TIP

Real example: a power supply with the TNY IC did not work. The only difference was on the BYPASS pin: the 100 nF ceramic capacitor was measuring less than 20 nF, causing the IC to shut down. **A small difference can be the fault.**

16. Quick key reference

Screen	Keys
Compare with 2 Channels / FULL	F9 Low • F10 Normal • F11 Maximum • F12 Auto • ESC Ok / Exit
Compare with Memory	Z Capture Channel 1 • X Capture Channel 2 • F9–F12 power • ESC Ok / Exit
Edit Project	F2 Zoom • F3 Resize • F4 Move • F5 Select/Edit • F6 Ground (GND) • F7 Mark • F8 Insert Text • F9 Insert + Curve • F12 View curves • ESC Ok & Save
Recording Mode	Space Record Curve • Z Back • ESC Save & Close
Test Mode	Space Ok and Next Pin • DEL Mark Bad Pin • Z Back • X Forward • ESC OK & Exit
Board Test Mode	F2 Zoom • F3 Resize • F4 Move • F5 Select • ESC Ok & Back
Impedance Test	Z Calibrate short-circuit point • Space Record Ranking • ESC Ok / Exit

17. Warranty and support

RastreCurve products have a **3-month** warranty against manufacturing defects, counted from the invoice date, in accordance with the consumer protection legislation that applies to the sale. Even after the warranty period, RastreCurve does not charge labor for repairs – only shipping and components at cost price. Returns are accepted only by prior agreement and within **7 days** of receipt.

Access to technical support, software updates and the Curve Cloud is free of charge.

Channel	Contact
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Help center	https://rastrecurve.tawk.help
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Support / WhatsApp	+55 17 99118-0770 • ricardo@rastrecurve.com
YouTube	youtube.com/@Rastrecurve
Company	RastreCurve Indústria de Equipamentos Eletrônicos Ltda – CNPJ (Brazilian company ID) 48.044.677/0001-58 – Rua Silvio Caldas, 2049, Nato Vetorasso – ZIP 15042-103 – São José do Rio Preto, SP – Brazil



Thank you for being part of this family!!!