# IKALOGIC

## SP259 series datasheet and user manual

SP259 and SP259i 9 channels, 250 MSPS logic analyzer with industrial inputs option

www.ikalogic.com | support@ikalogic.com

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# Contents

# SP259 Series overview

SP259 series logic analyzers and protocol decoders offer in depth analysis of logic signals and protocols with 250MHz (4ns) timing resolution. 9-channel operation allows 8-bit parallel data to be captured along with a clock or strobe signal. SP259 series logic analyzers connect to a computer via a USB3 interface to configure the device and to visualize captured data.

**SP259 Series is composed of two devices, SP259 and SP259i. Both offer 9 logic inputs, but SP259i integrates industrial receivers for CAN, LIN, RS232 and RS485 buses.[1]**



Figure 1: SP259 Logic Analyzer



Figure 2: SP259i logic analyzer (industrial version)

# Embedded memory

SP259 series logic analyzers feature a 1Gb HyperRAM memory running at 4Gbps and is used to store compressed samples before streaming to host computer. This embedded memory ensures uninterrupted captures of high frequency signals for long period of time without needing any reliance on host computer performances.

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[1]Industrial receivers in the SP259i are multiplexed with one or more of the existing 9 logic channels

# Evolution from older SP209 series

SP259 are meant to replace and superceed older SP209 series of logic analyzers. SP259 devices have all the features found in older SP209 devices, and have the following enhancements:

| New SP259 Series | Older SP209 series |
|---|---|
| 250MHz maximum sampling frequency | 200MHz maximum sampling frequency |
| Adjustable sampling frequency | Sampling frequency fixed at 200MHz |
| USB3.0 interface | USB2.0 interface |
| Fine adjustment of Threholds for input frontend | Only 3 fixed thresholds |

# Typical applications

SP259 series logic analyzers are perfectly adapted for demanding applications, where it is needed to capture logic signals with maximum time resolution on all 9 channels for long periodes of time.

- Embedded systems debugging
- Research and education
- Serial protocols analysis, like I2C, SPI, UART or 1-Wire (non exhaustive list)
- Industrial bus analysis: RS232, RS485, CAN, LIN
- ADC and DAC system diagnostic

Figure 3: Example of logic signals captured and analyzed by SP259 logic analyzer

# Product highlights

- Schmitt trigger input stages with adjustable thresholds (fine tunable)
- 250 MHz maximum sampling rate, with all 9 channels used.
- External clock option (state mode), up to 62.5MHz
- Precise trigger-In and trigger-Out signals on dedicated SMA ports
- USB3 interface for fast data visualization on host computer

# Warning

Read **safety information** section carefully before using this instrument.

# SP259 system architecture

A functional SP259 measurement system consists of several main components that are presented in the image below.



Figure 4: SP259 system architecture

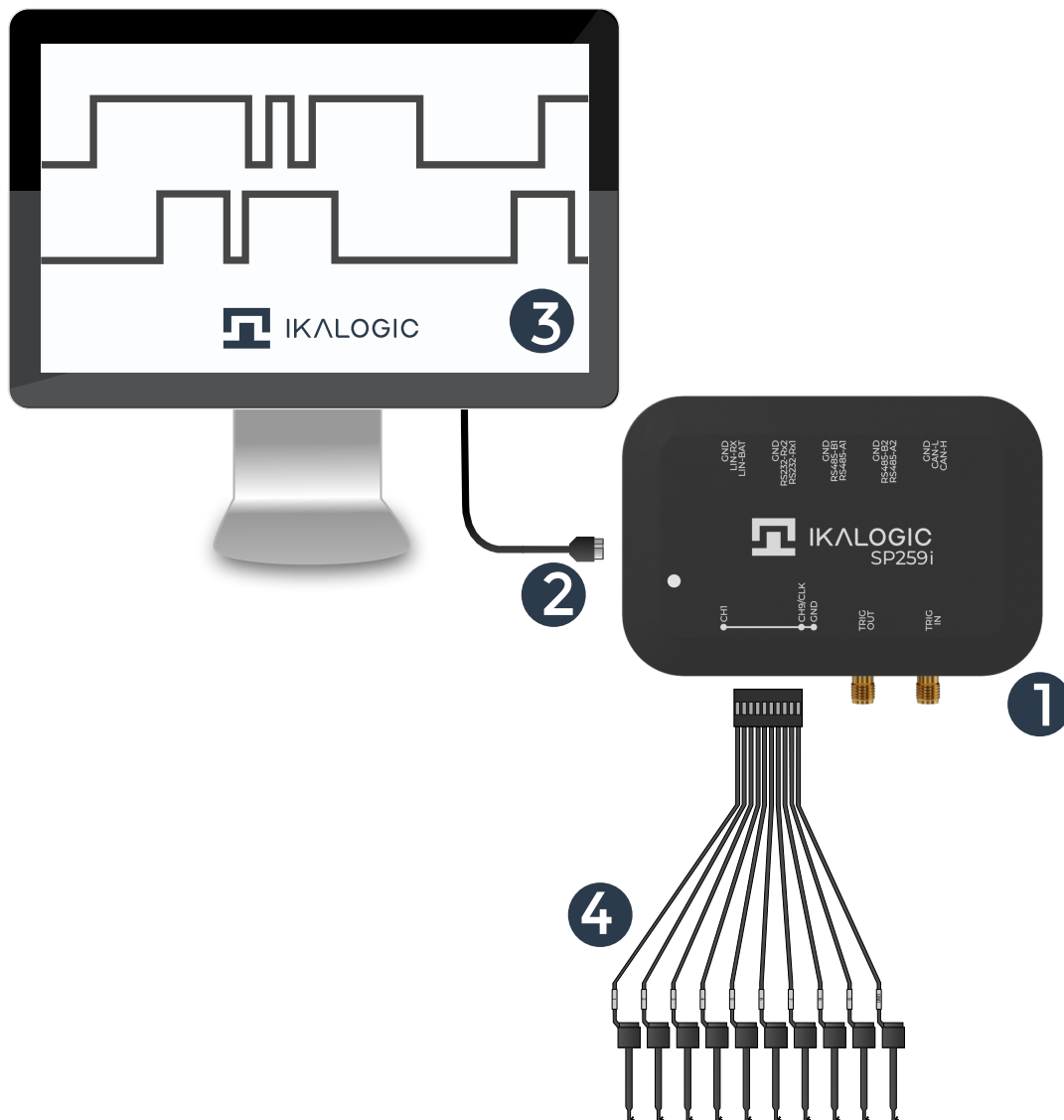The main labeled components are:

1. SP259 main host unit that contains the main memory buffer and the processing power to capture and compress signals before sending them over USB.
2. Type A to Micro USB3.0 Cable, 1 meter.

3.  Computer running ScanaStudio software (Windows / Mac / Linux) that controls the main host unit and display captured signals.
4.  10 points probe set (9 channels + Ground).

# Main characteristics

## Operating conditions

| | |
|---|---|
| Temperature | 10°C to 40°C |
| Relative humidity | < 80% non condensing |
| Altitude | < 2000m |

## Timing and measurements[2]

| | |
|---|---|
| Sampling rate (MAX.) | 250 MSPS |
| External clock Max rate (State mode) | 62.5 MHz |
| Logic Inputs digital bandwidth | 75 MHz |
| Embedded memory | 1 Gb |
| Trigger output | Yes, via SMA connector |
| External trigger input | Yes, via SMA connector |

## Logic inputs specifications

| | |
|---|---|
| Number of channels | 9 |
| Input impedance | 200 KΩ‖ 8 pF |
| Threshold circuits | 3 |
| Adjustable logic level (Fine tunable with 100mV steps) | 1.1 to 5V |
| Absolute max voltage on digital inputs (Continuous or Transient) | $\pm$ 25 V |

## Power requirements

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[2]HyperRAM sampling memory is used to buffer samples before streaming to host computer.

| Input power connector | Micro USB 3.0 female |
|---|---|
| Input current | 200 mA |
| Input voltage | $5\,\text{V} \pm 0.5\,\text{V}$ |

# SP259(i) Interfaces

SP259(i) logic analyzer ports and interfaces are shown in the diagram below:
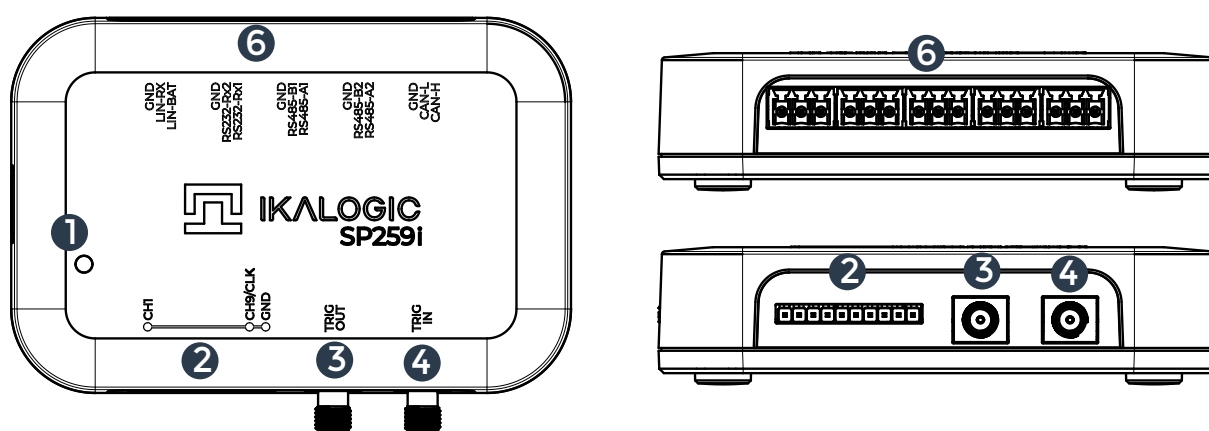


Figure 5: SP259i ports and interfaces

1. Status LED
2. 9-CH logic probes input
3. Trigger OUT SMA connector
4. Trigger IN SMA connector
5. USB 3.0 (micro-B) port.
6. Industrial port [3]

## Industrial ports (SP259i version only)

All industrial ports are 3.5mm plugable terminal blocks headers (Wurth Reference 691322110003 or equivalent). Compatible plugable terminal blocks are provided in the package (Wurth Reference 691361100003 or equivalent).

Read **Industrial ports** section for detailed information about industrial ports in SP259i devices.

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[3]Only on SP259i (industrial) version.

# Principle of operation

SP259 Series logic analyzers connects to a computer via a USB cable. A free software - called ScanaStudio - is used to configure the device and display captured signals. The software can also be used to further analyze the captured samples by decoding protocols like I2C, SPI or UART.

## Embedded memory vs streaming

USB based logic analyzers (ones that don't have a display and rely on a computer for that matter) usually operate according to one of two schemes:

- Using an **embedded memory** to store captured samples. Samples are later downloaded at a slower speed via the USB interface. This has the advantage of not being limited by USB transfer rate, but has the disadvantage of limited embedded memory.
- **Streaming** captured samples over the USB connection, at the maximum possible speed. While this offers the advantage of a virtually unlimited memory (only limited by host computer's memory), it has the disadvantage of limiting the sampling rate to USB's throughput.

SP259 combines the advantages of both streaming and embedded memory techniques. An embedded 1Gb HyperRAM memory stores captured and compressed samples at 250 MHz sampling rate on all channels, while a USB interface transfers the data simultaneously, effectively emptying the embedded memory and making more room for new samples. This results is a logic analyzer that can capture dozens of minutes of logic signals activity on 9 channels at 250 MSPS.

## Versatile trigger system

SP259 series offer a state of the art trigger system. It's composed of two FlexiTrig trigger engines, each FlexiTrig engine can be used in one of those modes:

- Edge trigger
- Pulse trigger (with minimum and maximum pulse width)
- Timed logic sequence
- Protocol based trigger (e.g. I2C bus address or serial UART character)
- External trigger source

Furthermore, the two trigger engines (called A and B hereafter) can be cascaded in one of the following modes:

- A then B (Wait until A triggers then arm B trigger engine)
- B then A
- A and B (Trigger engines A and B must trigger, but in any order)

- A or B (whoever triggers first)

Finally, an external trigger output is always active, in all modes and generates a trigger pulse whenever a trigger condition is met and a capture starts. Signal specifications for External trigger input and output are detailed in the following section.

# Flexitrig timing performances

Flexitrig offer the following timing performances:

- Edge or Logic level trigger: The signal used as trigger source must be sable for at least 16ns.
- Protocol based trigger or Timed logic sequences: The minimum time between two consecutive transitions should be more than 32ns.

## More about protocol based trigger

SP259 implements protocol based trigger using Flexitrig. It's important to understand the basics around the operation of this trigger engine in order to understand the limitations and specifications of that system.

Flexitrig allows trigger steps to be defined. Those trigger steps describe all the transitions that should occur, their order and their timing constraints in order to generate a valid trigger. Please note that in most situations, the user do not need to generate those trigger steps, as they are generated by ScanaStudio's scripts (like I2C protocol). Flexitrig have a step definition that is rich and sophisticated enough to describe various situation where some signals should be ignored (also called "masked" signals). The Flexitrig engine checks the captured signals against the first trigger step, if it matches the step definition, then the next step is loaded from memory and compared against the captured signals, and so forth. If Flexitrig reaches the last step (the number of steps depends on each and every different protocol and trigger sequence), then a trigger in generated. If one step fails, Flexitrig restarts the verification from the first step.

Flexitrig engine in the SP259 device can handle up to 128 steps. Each step carry its own timing information (if relevant), as well as making information to ignore some channels, again, according to each specific protocol.

Since the step definition need to be fetched from internal memory, and timing calculations need to be made (if relevant), some timing limitations apply in order to generate valid trigger.

For instance, the minimum time between two *unmasked* transitions is 32 ns. Unmasked channels, means channels that carry signals that are relevant for the Flexitrig engine. Data changes on other channels that are *masked,* which means they are totally ignored by the Flexitrig engine.
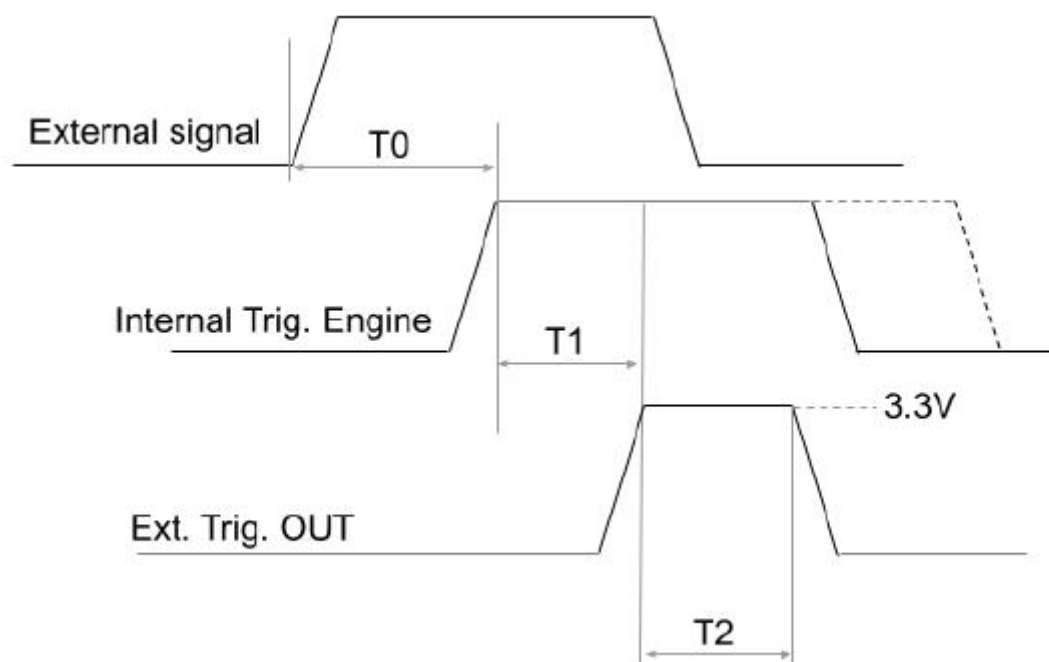
## External trigger OUT specifications



Figure 6: External trigger OUT timings

There is an internal data path delay of 20ns before external signals reach internal trigger engine (T0). When trigger event occurs, 10ms (T2) pulse is generated on the Trig Out port. This port has a 50 Ωseries impedance allowing easy interfacing to 50 Ωinput devices. This can be used to synchronise the capture with other equipment like an oscilloscope. Polarity of the trigger can be set in software. There is also a 10 ns delay (T1) between internal trigger detection and Trig Out assertion. Therefore, the total time for an external event to generate a Trigger OUT pulse is T0+T1 = 30ns.
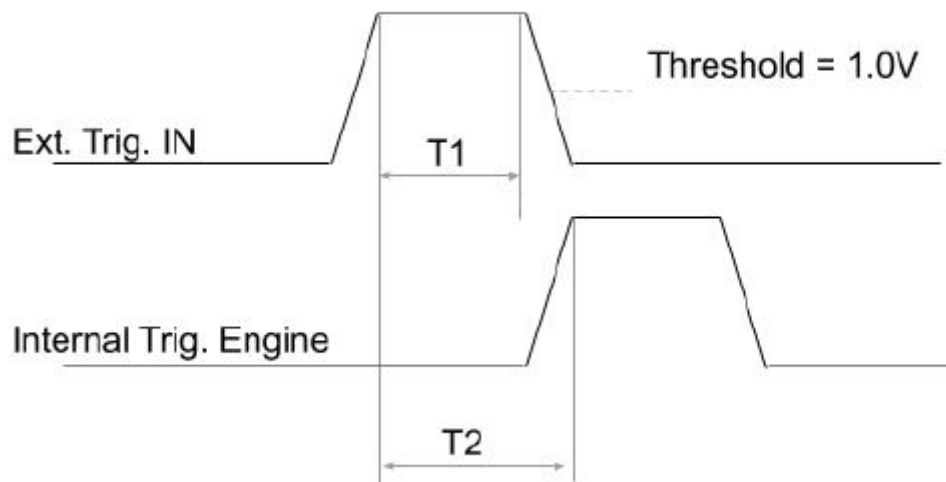
## External trigger IN specifications



Figure 7: External trigger IN timings

The Trig In port allows to start acquisition on an external event generated by another instrument. The minimum pulse width (T1) is 8ns. Polarity can be set in software. The input impedance is also software selectable (100k Ωor 50 Ω). The threshold level is 0.4V. T2, the time between external trigger in active edge and internal trigger engine assertion is 20ns.

# Industrial port (SP259i only)

SP259i offer the possibility to connect directly to industrial buses, as opposed to logic channels which can only be connected to single ended logic level such as LVCMOS or LVTTL. Each one of the industrial inputs integrates a dedicated receiver circuit, perfectly adapted to each standard. For more reliability in an industrial context, each bus receiver is exposed via screw terminals. Adequate wires (6-30 AWG) should be used to connect SP259i to the bus being probed[4]. Industrial receivers offer the advantage of visualizing exactly what a standard off-the-shelf transceiver would receive if connected to that bus. The list of the industrial inputs is detailed below:

- CAN bus receiver
- 2x RS485 bus receivers (can be combined to form a full duplex RS422 bus receiver)
- 2x RS232 receivers

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[4]Wires to connect SP259i to industrial buses are not provided.

- LIN bus receiver

Please refer to the marking on SP259i casing for exact pinout.

# RS485 receiver specifications

| | |
|---|---|
| Transceiver MPN | MaxLinear XR33180 |
| Maximum baudrate | 50 Mbps |
| Common Mode Operating range | -7 V to +12 V |
| Common Mode Input Impedance | 48 k Ω‖ 10 pF |
| Common Mode voltage (absolute maximum) | $\pm$ 15 V |
| Differential Threshold voltage | -125 mV |
| Differential Fixed hysteresis | 25 mV |
| Differential Input Impedance | 400 k Ωor 120 ΩSoftware selectable |

# RS232 receiver specifications

| | |
|---|---|
| Transceiver MPN | Maxim MAX3180 |
| Max. baudrate | 1.5 Mbps |
| Operating range | $\pm$ 15 V |
| Input Impedance | 5 kΩ‖ 50 pF |
| Absolute max voltage | $\pm$ 20 V |
| Threshold voltage | 1.5 V |
| Hysteresis | 300 mV |

# CAN receiver specifications

| | |
|---|---|
| Transceiver MPN | Microchip MCP2542 |
| CAN FD compatible | Yes (11898-2:2015) |
| Max. baudrate | 8 Mbps |
| Common Mode Operating range | $\pm$ 12 V |

| Common Mode Input Impedance | 6 to 50 kΩ‖ 20pF |
|---|---|
| Common Mode Absolute max voltage | ± 24 V |
| Differential Mode Operating range | -4 V to +9 V |
| Differential Threshold voltage | 700 mV |
| Differential Fixed hysteresis | 30 mV to 200 mV |
| Differential Input Impedance | 25 kΩ‖ 20 pF or 120 ΩSoftware selectable |

## LIN receiver specifications

| Transceiver MPN | Infineon TLE7257 |
|---|---|
| Main specification | ISO 17987-4 |
| Max. baudrate | 20 kbps |
| Operating range (BAT pin) | 6 V to 18 V |
| Operating range (RX pin) | 0 V to 18 V |
| RX pull up resistance (to BAT) | 40 kΩ |
| Absolute max voltage (BAT) | ± 24 V |
| Absolute max voltage (RX) | ± 24 V |
| Threshold voltage | 0.5 x VBAT |
| Hysteresis | 0.12 x VBAT |

**Please note that SP259i can still only capture 9 channels simultaneously. Industrial inputs are internally multiplexed with logic inputs.**

It is recommended to always connect the ground of the industrial bus being measured to the ground screw terminal (Refer to marking on SP259i casing for industrial connector pinout).

# What's in the box

SP259 series is shipped with the following items:

1. SP259(i) device

2.  Micro USB3.0 cable (micro-B to A)
3.  10 leads hook-style probes set (9 signals + 1 ground)
4.  SMA anti-dust covers
5.  5 Pluggable terminal blocks, Wurth reference 691361100003 or equivalent (for SP259i version only)

# Unpacking and first usage

We recommend the user to start by identifying all the different components that are provided. To turn ON the SP259 device, connect it to a free USB port of your computer using the provided USB cable[5]. The LED should glow according to the table in the "Status LEDs behavior" section. To switch off the device, simply disconnect the USB cable.

## Status LEDs behavior

Status led can be in one of 3 states:

| Status LED | Meaning |
|---|---|
| Orange | Device initializing |
| White Fix | Device powered up. |
| White blinking | Device powered up, and detecting activity on one of the logic channels. |

## Software Quick Start guide

Start by downloading the latest version of ScanaStudio software www.ikalogic.com and following instructions to install both software and provided drivers. It is recommended to restart your computer after the software and drivers have been installed.

Once the software is installed, run it, and create a new workspace by selecting "SP259" or "SP259i" as the device type.

**Note**: if at the point the device is not recognized by your computer, the ScanaStudio workspace is created as a demo workspace or the status LEDs stays orange even after creating a ScanaStudio workspace, please follow these steps:

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[5]Do not connect SP259 to anything else than a computer's USB port. Do not connect to a USB HUB, but connect directly to the root USB port. Never connect the SP259 to a USB charging adaptor.

- Ensure the USB port used is USB3 compatible and can deliver at least 250mA.
- Try switching to another machine if one is available.
- If all of the above fails, please contact Ikalogic support.

## Capturing your first signal

To capture your first logic signals, please follow these steps:

1. Connect the device via USB
2. Launch ScanaStudio and create an SP259(i) workspace.
3. Connect the probes to SP259(i) and to your signals source
4. Ensure the ground probe is connected
5. Check if the status LED is blinking: if it's the case, it means the some logic changes are already being detected on the probes.
6. Hit the start button in ScanaStudio and wait until signals are captured.

You can adjust the capture duration by adjusting the number of samples in the device configuration tab.

# Mechanical data

All SP259 series devices casing are manufactured from anodized aluminum, able to withstand heavy duty usage in various harsh environments. All markings are laser engraved, ensuring important pinout information is not lost over time.
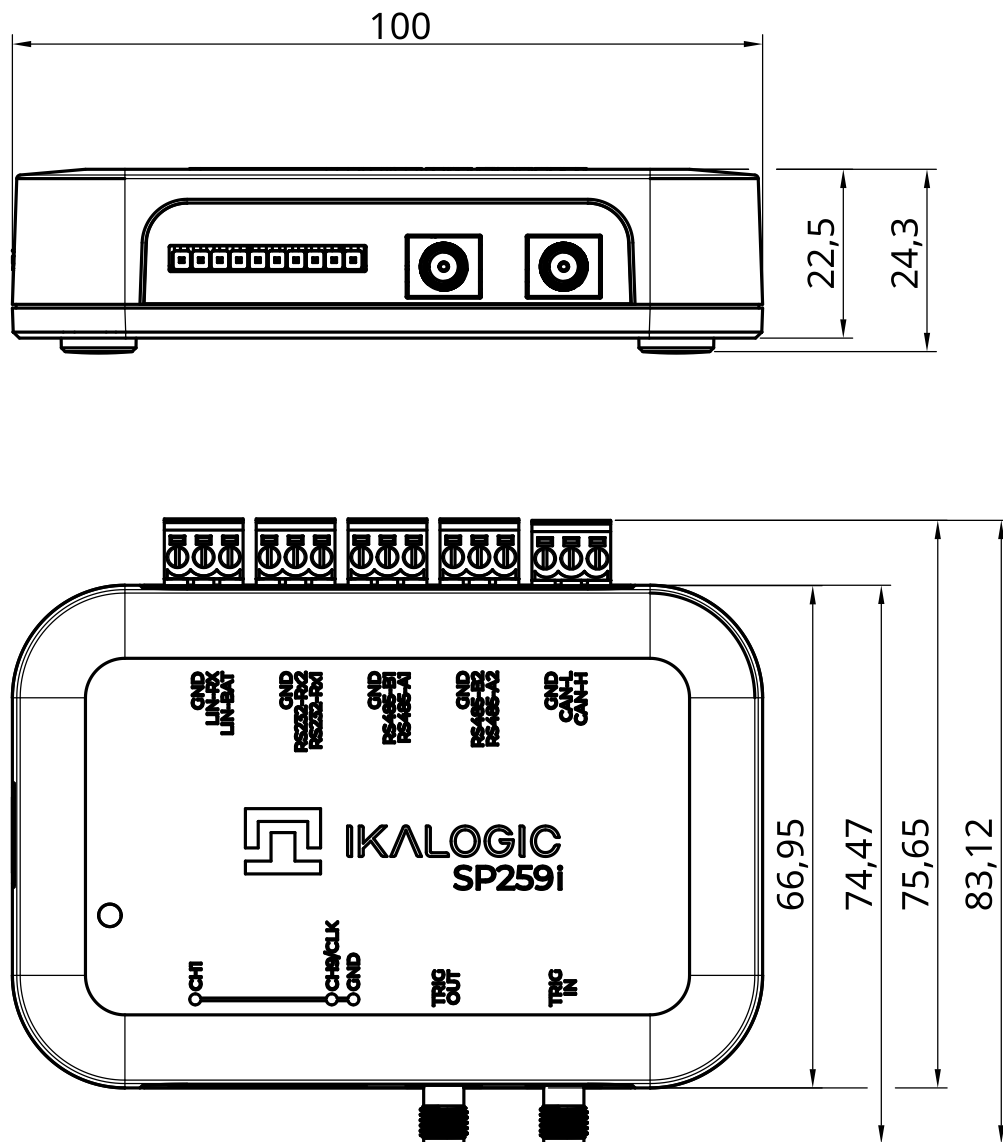
## Model SP259i

Weight: 95 gm



Figure 8: SP259i dimensions (mm)

**Note**: Dimensions are down with provided industrial terminal blocs, but they can be individualy detached and replaced by other compatible connectors.
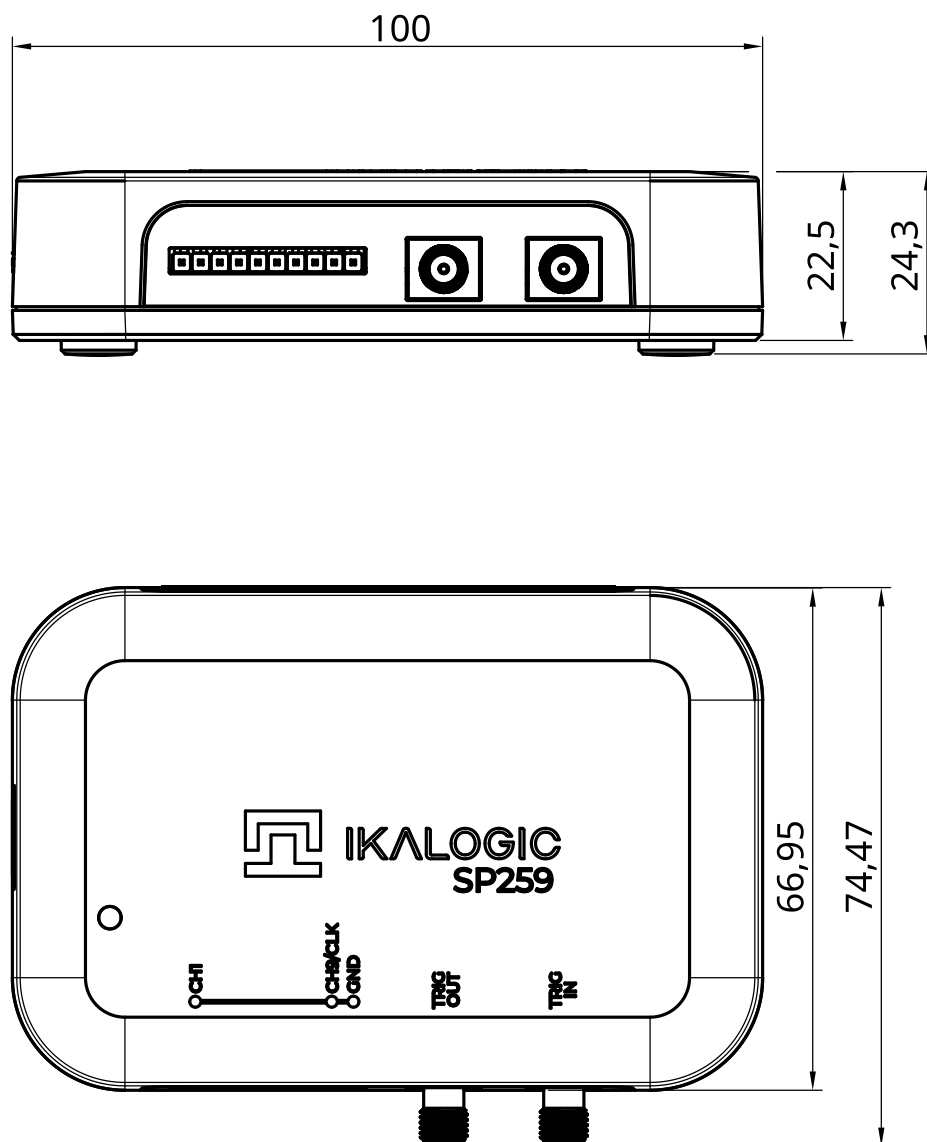
# Model SP259

Weight: 80 g



Figure 9: SP259 dimensions (mm)

# Probes

Probes cables are made of 24AWG flexible wires. All wires are black colored, but every wire has a white marking tube with the channel number (e.g. "1" or "GND").
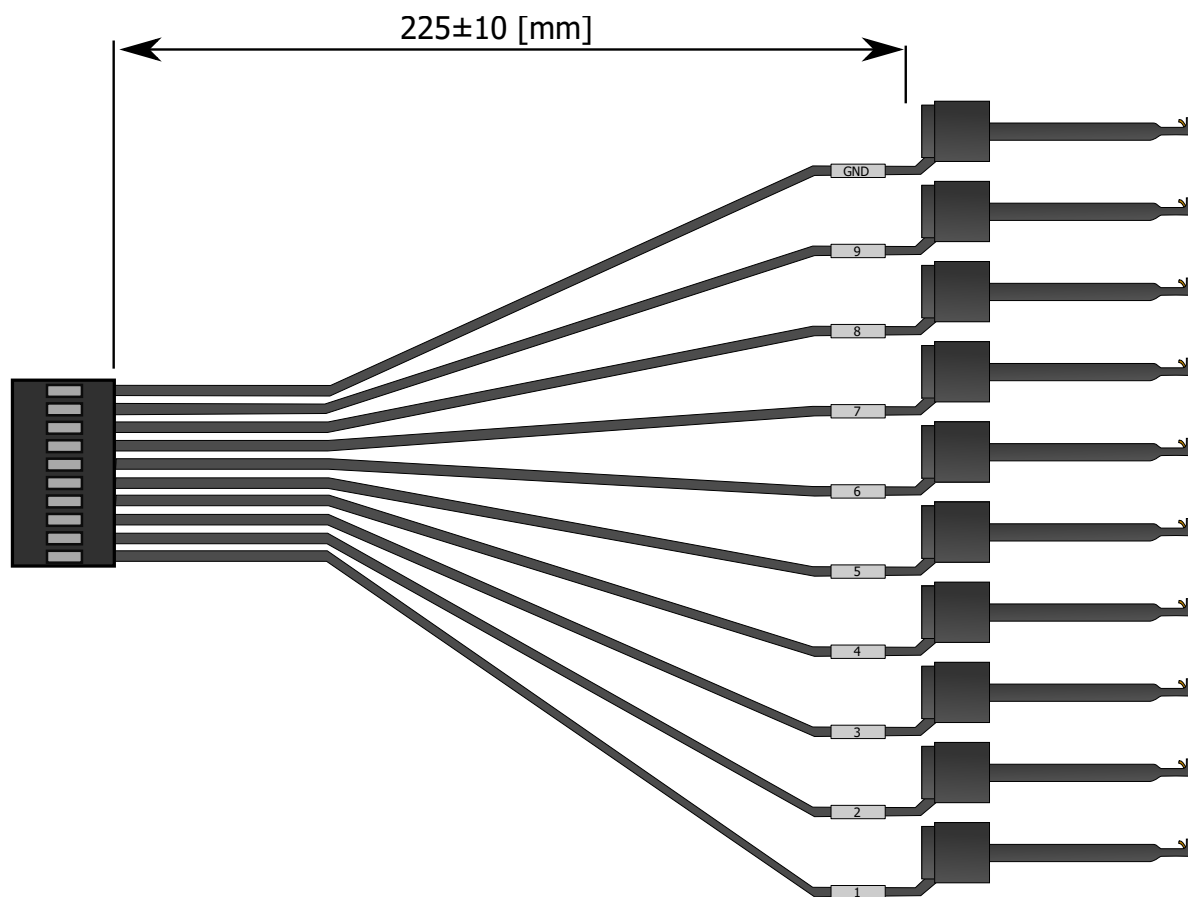


Figure 10: Probes dimensions (mm)

# Software technical requirements

Download ScanaStudio software on www.ikalogic.com so you can use your device on your favorite platform. SP259(i) and ScanaStudio were tested to supports the following platforms:

- Windows 7/8/10
- Mac OS 10.9 or later
- Ubuntu 14.04 or later

# Ordering information and customer support

For ordering information, please check for nearest distributor on www.ikalogic.com or contact us for any inquiry at contact@ikalogic.com.

# Accessories and maintenance

Accessories and maintenance services (probes replacement) are available on our website: www.ikalogic.com or by contacting customer support (support@ikalogic.com).

# Certifications and regulations

This device complies with the following applicable European Directives: Electromagnetic Compatibility (EMC) Directive 2004/108/EC, Low-Voltage Directive 2006/95/EC, IEC 61326-2.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

**CAN ICES-3 (B) / NMB-3 (B)**

RoHS Compliant 2011/65/EC. This device does not contain any of the substances in excess of the maximum concentration values ("MCVs") defined in the EU RoHS Directive.

**NOTE**: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur

in a particular installation. If this equipment does cause harmful interference to radio or television reception which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

# Safety information

This product complies with safety standards IEC NF/EN 61010-1: 2010, IEC NF/EN 61010-2-030 and UL 61010-1: 2015 To prevent possible electrical shock, fire, personal injury, or damage to the product, read all safety information before you use the product. The following international symbols are used on the product and in this manual.

## Symbols definitions

Figure 11: Risk of Danger. Important information. See Manual.

Figure 12: WEEE logo. This product complies with the WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste. Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as category 9 Do not dispose of this product as unsorted municipal waste.

Figure 13: CE Logo. Conforms to European Union directives.

## Important safety notes

**Warning, to avoid electrical shock or fire**:

- Carefully read all instructions.
- Use the product only as specified, otherwise the protection supplied by the product can be compromised.

- Do not use the product if it operates incorrectly.
- Before use, inspect device casing, probes, test leads and accessories for mechanical damage and replace if damaged.
- Never attempt to repair a defective device. Contact after-sale service.
- Do not use the product or its accessories in case of any damage.
- Remove all probes, test leads and accessories that are not in use.
- Never use the device for measuring mains circuits.
- Never use the device for measuring circuits which are not isolated from mains.
- Do not touch electrical wires with bare hands.
- Keep away from children's sight or from animals.
- Do not expose to water, heat or moisture.
- The device's ground connection through the USB cable is for measurement purposes only. The logic analyzer does not have a protective safety ground.
- Ensure there is no significant voltage between device ground and the point to which you intend to connect it.
- Do not apply more than the rated voltage (±25V), between the terminals or between each terminal and ground.
- Do not apply input voltages above the rating of the instrument (±25V).
- Measure a known voltage first to make sure that the product operates correctly.
- Do not work alone.
- Comply with local and national safety codes. Use personal protective equipment (approved rubber gloves, face protection, and flame resistant clothes) to prevent shock.
- Do not use the device in wet or damp conditions, or around explosive gas or vapor.
- Do not operate the product with covers removed or the case open. Hazardous voltage exposure is possible.
- Do not use in a system in which the failure of the product might result in personal injury.

# Limited warranty & limitation of liability

Each Ikalogic product is warranted to be free from defects in material and workmanship under normal use and service. The warranty period is three years for the test tool and two year for its accessories. This warranty extends only to the original buyer or end-user customer of an Ikalogic authorized reseller, and does not apply to fuses, disposable batteries or to any product which, in Ikalogic's opinion, has been misused, altered, neglected or damaged by accident or abnormal conditions of operation or handling.

THIS WARRANTY IS BUYER'S SOLE AND EXCLUSIVE REMEDY AND IS IN LIEU OF ALL OTHER WARRANTIES,

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# Document Revisions

| 06-Jan-2025 | Updated information about FlexiTrig. |
| 28-August-2023 | Initial release of this document. |

The information in this document is subject to change without notice.