SAP8000D

Differential Probe

User Manual

EN01A

Contents

1 Introduction

This user manual contains important safety information related to the SAP8000D Differential Active Probe, as well as a basic tutorial on the probe's operational use.

2 Safety Instructions

This section contains essential information and warnings that must be adhered to while operating the probe under the respective safety conditions. In addition to the safety precautions outlined in this section, you must also follow recognized safety procedures.

1. Connect the probe to the oscilloscope before probing the signal.
2. Intended for indoor use only.
3. Keep the product's surface clean and dry.
4. Do not operate in damp environments.
5. Do not operate in potentially explosive atmospheres.
6. Maintenance procedures should only be performed by qualified technicians.
7. Ensure proper connection of signal wires, keeping the signal ground at the same potential as the ground voltage. Do not connect the ground wire to high voltage sources. During testing, avoid touching exposed contacts and components.
8. If you suspect a product malfunction, refrain from further operation. In the event of suspected damage to the product, seek examination by qualified service personnel.

2.1 Symbols

The following symbol may appear on the product's exterior or within this manual, signifying a need for special attention to safety.

This symbol is used in areas that require caution. Refer to accompanying information or documents to prevent personal injury or damage to the equipment.

2.2 Operating Environment

This product is intended for indoor operation only. Before using this product, please ensure that the operating environment remains within the following parameter ranges.

Temperature: 5°C to 40°C.

Humidity: Maximum relative humidity of 80% at 30°C, linearly decreasing to 50% at 40°C.

Altitude: Up to 10,000 feet (3,048 meters).

Note: Consider direct sunlight, electric heaters, and other heat sources when evaluating temperature. It is recommended to operate this product in a well-ventilated environment. Elevated

probe housing temperatures may occur in enclosed or unventilated spaces, which constitutes a normal operational characteristic.

⚠ WARNING	Do not operate this product in explosive, dusty, or humid atmospheres.

⚠ CAUTION	Do not exceed the specified maximum input voltage. For details, please refer to the technical data.

2.3 Calibration

The recommended calibration interval is one year and should be performed by personnel with the appropriate qualifications.

2.4 Cleaning

Only use a soft, damp cloth to clean the probe's surface. Do not use chemicals or corrosive substances. Under no circumstances should moisture be allowed to infiltrate the probe. To avoid damaging the probe, disconnect it from the oscilloscope before cleaning.

	The probe case is not sealed and should never be immersed in any fluid.

2.5 Abnormalities

Use this probe only for the purpose specified by the manufacturer.
The probe may be damaged if it exhibits visible damage or experiences significant transport pressure.
Bending the probe cable may affect the high-frequency performance of the probe.
If you suspect probe damage, disconnect it from the oscilloscope immediately.
To use the probe correctly, carefully read all instructions and labels.

⚠ WARNING	Using the probe in a manner not specified by the manufacturer may damage the probe. This probe and related accessories should not be directly connected to the human body or used for patient monitoring.

3 First Steps

3.1 Delivery Checklist

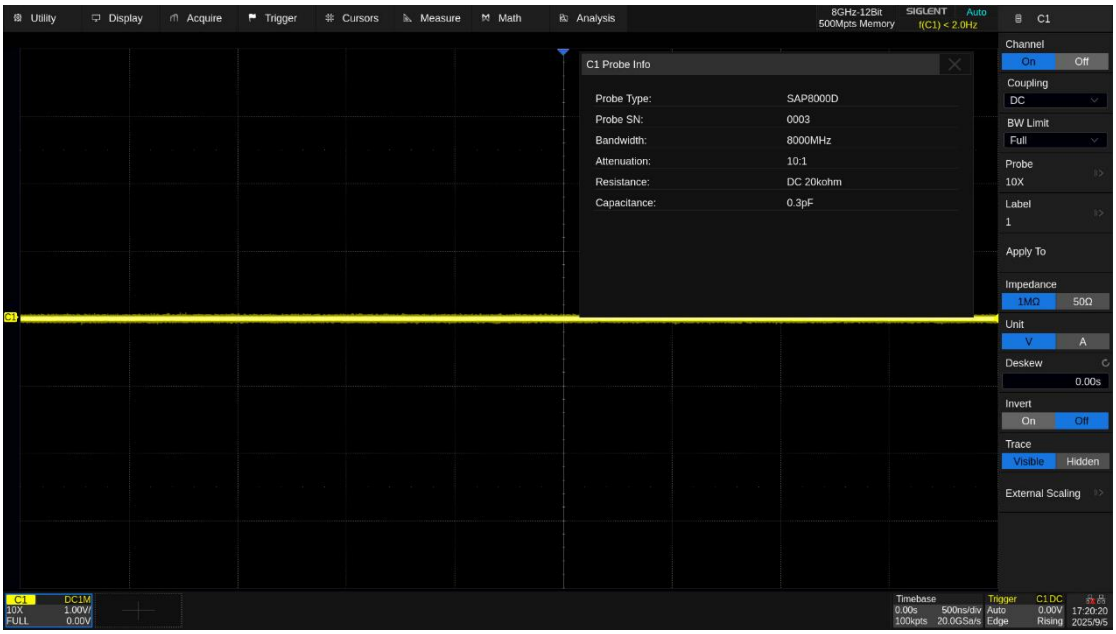
First, check that all items listed on the packing list have been delivered. If you note any omissions or damage, please contact your nearest SIGLENT customer service center or distributor as soon as possible. If you fail to contact us immediately in case of omission or damage, we will not be responsible for replacement.

3.2 Functional Check

To perform a function check, you will need an oscilloscope with SAPBus interface support. Follow these steps to check the probe's function:

1. Power on the oscilloscope and allow it to warm up for 20 minutes.
2. Connect the active probe to Channel 1 of the oscilloscope.
3. Open the parameter panel for Channel 1 and inspect the probe information, including the probe model, serial number, bandwidth, impedance, capacitance, and attenuation ratio.
4. Set the vertical scale for Channel 1 to 1 V/div.
5. Set the offset voltage for Channel 1 to 0 V.
6. Measure the average voltage for Channel 1. The reading should be within ± (1.5% * full-scale reading + 10 mV). If the reading is outside this range, the check does not pass.

7. Change the vertical scale for Channel 1 to 500 mV/div, 200 mV/div, 100 mV/div, 50 mV/div, 20 mV/div, and 10 mV/div, respectively. Repeat step 6 for each scale to check the average voltage readings at each scale level.



3.3 Quality Assurance

The probe is covered by a 1-year warranty from the date of shipment, provided it is used and operated under normal conditions. SIGLENT can repair or choose to replace any product returned to an authorized service center during the warranty period. We must first examine the product to make sure that the defect is caused by the process or material, not by abuse, negligence, accident, abnormal conditions, or operation.

SIGLENT shall not be responsible for any defect, damage, or failure caused by any of the following:

1. Repairs or installation conducted by individuals not authorized by SIGLENT.
2. Connection of incompatible devices and improper connections.
3. Any damage or failure resulting from the use of products provided by non-SIGLENT suppliers.

3.4 Maintenance Agreement

We offer various services through maintenance agreements. We offer extended warranties, and you can create a maintenance cost budget after the one-year warranty period. We offer installation, training, enhancements, on-site repairs, and other services through dedicated supplementary support agreements. For more information, please contact the SIGLENT customer service center or your national distributor.

4 Probe Technical Specifications

SAP8000D is a high-bandwidth differential active probe known for its features such as high bandwidth, low noise, making it suitable for measuring high-speed signals. Its low input capacitance characteristics ensure minimal load introduced to the measurement system.

The SAP8000D active probe utilizes the SAPBus interface and is compatible with oscilloscopes that support the SAPBus interface, such as the SDS7000A series oscilloscopes. The SAP series active probes do not require external power sources as the oscilloscope provides power and communication interface to the active probe through the SAPBus interface. When connected to the oscilloscope, the SAP series active probes allow you to read probe information from the oscilloscope's interface.

Here are the performance characteristics:

- Probe Bandwidth: DC to 8 GHz
- Single-ended input resistance: 10 kΩ
- Differential input resistance: 20 kΩ
- Probe gain: ÷ 10
- Differential input capacitance: 300 fF
- ± 2.5 V input dynamic range
- ± 12 V offset voltage setting range
- SAPBus interface

4.1 Model and Specifications

The specifications of the probe need to meet the following conditions:

1. The probe is within its valid calibration period.
2. The environmental temperature is within 25°C ± 5°C.
3. The probe is correctly connected to the oscilloscope.
4. The probe and oscilloscope are in a thermally stable environment, and both the probe and oscilloscope have been preheated for at least 20 minutes.

Probe Model and Specification Parameters:

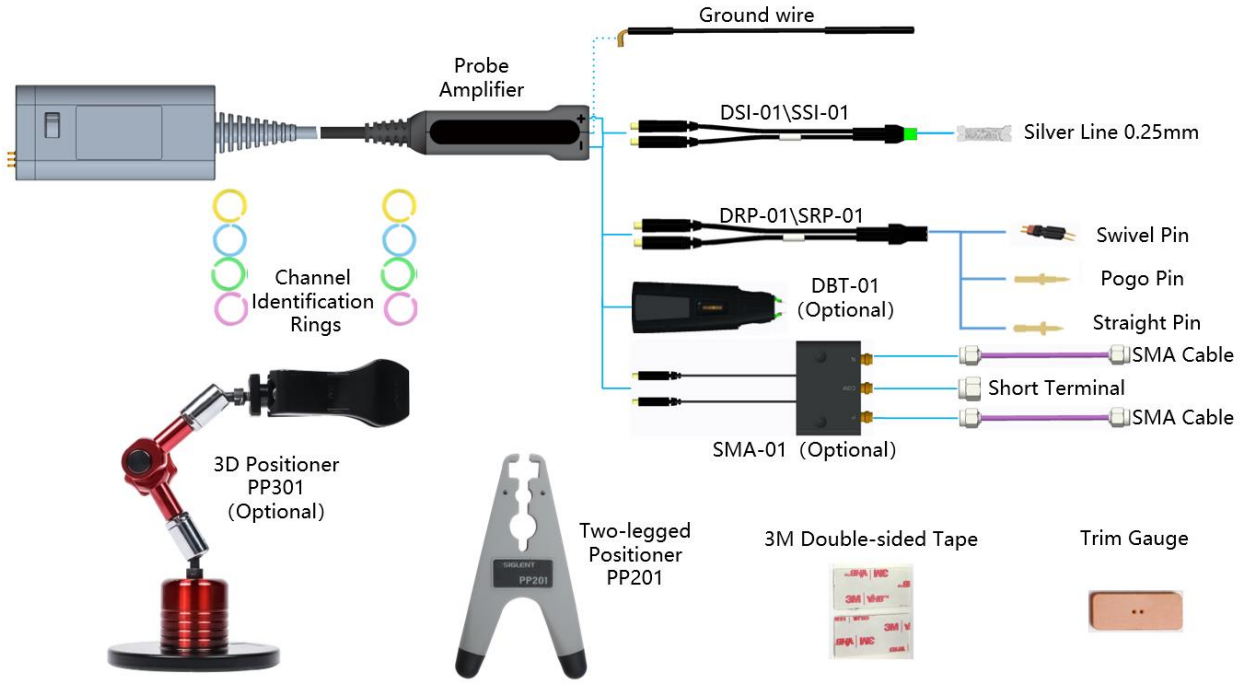
Parameters	SAP8000D
Bandwidth (Probe only)	8 GHz
Bandwidth (with Oscilloscope)	8 GHz（SDS7804A H12）
Differential input capacitance	300fF
Differential input resistance	20 kΩ
Single-ended input resistance	10 kΩ
Offset range	± 12 V
Attenuation ratio (DC)	÷ 10
Offset accuracy	< 3%
DC gain accuracy	< 3%
Input dynamic range	± 2.5 V
common-mode voltage range	DC：6.25 V AC：1.25 V
Probe noise (typical)	3.5 mV RMS
Damage voltage	20 V
Cable length	130 cm

4.2 Accessories

The accessories included with SAP8000D are as follows:

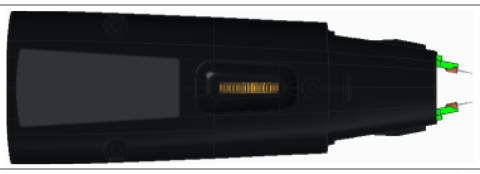
Standard Accessories	Part Number	Quantity	Unit
Solder-in Differential Head DSI-01	1.99.20.10.356	1	pcs
Solder-in Single-ended Head SSI-01	1.99.20.10.357	1	pcs
Socketed Differential Head DRP-01	1.99.20.10.358	1	pcs
Socketed Single-ended Head SRP-01	1.99.20.10.359	1	pcs
thickness gauge	2.78.50.20.090	1	pcs
10cm Ground Wire	2.52.42.11.043	2	pcs
Straight Pin	2.74.70.12.003	5	pcs
Pogo Pin	2.74.70.12.011	5	pcs
Swivel Pin	2.74.70.12.028	2	pcs
Silver Wire	2.52.42.11.037	1	Meter

Colored Rings (4 colors)	2.75.23.10.005	2	set
Two-legged Positioner PP201	2.78.50.20.027	1	pcs
3M Double-sided Tape	2.78.25.10.047	10	pcs



Probe Accessories Illustration

Optional accessories	Part Number	Quantity	Unit
3D Positioner PP301	0.01.80.10.136	1	pcs
Two-legged Positioner PP201	0.01.80.10.126	1	pcs
SAP-SMA01	0.01.80.10.191	1	pcs
SAP-DBT01	0.01.80.10.192	1	pcs
SAP5-TEP	0.01.80.10.181	1	pcs
SAP-DSI01	0.01.80.10.195	1	pcs
SAP-SSI01	0.01.80.10.196	1	pcs
SAP-DRP01	0.01.80.10.194	1	pcs
SAP-SRP01	0.01.80.10.193	1	pcs

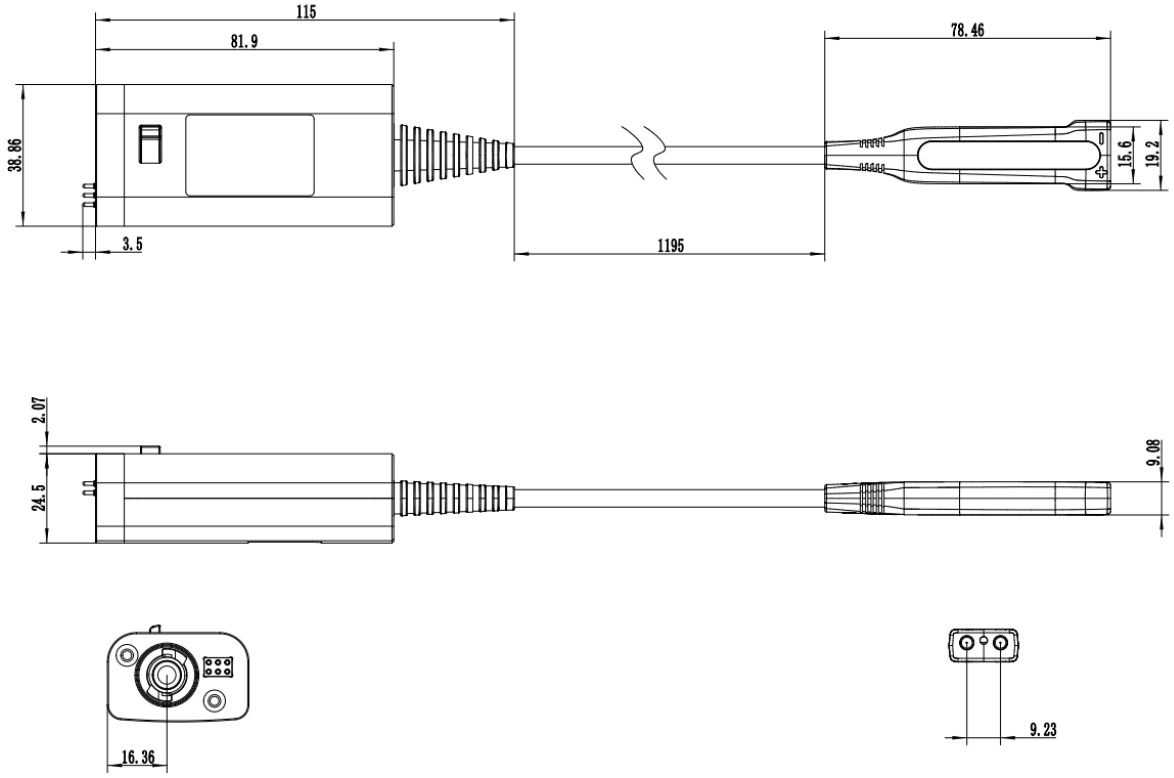
Image	Introduction
	**Straight Pin:** Universal ejector, small size, with sharp needle, for use with DRP-01\SRP-01.
	**Pogo Pin:** The elastic ejector pin provides more reliable contact during detection and is used with DRP-01\SRP-01.
	**Swivel Pin:** The probe can be rotated to adapt to various test spacings. Used with DRP-01\SRP-01.
	**Silver Wire:** 0.25mm diameter, connects DUT and probe pin.
	**Thickness gauge:** Used for cutting silver wires. The length of the silver wires cut using the thickness gauge enables the probe's high-frequency response to be closer to the optimal state.
	**Solder-in Head DSI-01\SSI-01:** SMP interface, connected to the probe amplifier, the pin can be Solder-inwith silver wire.
	**Socketed Head DRP-01\SRP-01:** SMP interface, connected to the probe amplifier. The distance between the two holes is 2.54 mm.
	**Adjustable Pin Head DBT-01:** SMP interface, connected to the probe amplifier. The distance of two pins can be adjusted by the roller.
	**SMA Head SMA-50:** SMP interface, connected to the probe amplifier. The other end is SMA female.
	**SMA Cable:** 6cm long, connects the SMA-50 header and the SMA female connector of the circuit under test.
	**SMA Short Terminal**.
	**10cm Ground Wire:** One end is a pin and the other end is a socket for grounding.
	**Colored Rings:** When mulpinle probes are used, it is used to distinguish the oscilloscope channels to which the probes are connected.
	**3M Double-sided Tape:** Used to fix solder-in heads.

	**Two-legged Positioner PP201:** Used to fix the probe.
	**3D Positioner PP301:** Used to fix the probe.

Introduction to optional accessories	
SAP-SMA01:	The SMA head SMA-01 comes with the matching accessories. It includes the SMA-01 head, 2 SMA cables, and 2 SMA short terminals.
SAP-DBT01	Adjustable spacing head DBT-01 comes with matching accessories. It includes the DBT-01 head, 4pcs steel pins, 10pcs pogo pins, and 1pcs plastic forceps.
SAP5-TEP:	Accessory kit of DBT-01, for purchasing additional accessories when standard accessories are damaged. Includes 4 steel pins, 10 elastic pins, and 1 plastic tweezers.
SAP-DRP01:	Accessory kit, for purchasing additional accessories when standard accessories are damaged. Includes 1 socketed head DRP-01, 2 swivel pins, 5 straight pins, 5 pogo pins.
SAP-SRP01:	Accessory kit, for purchasing additional accessories when standard accessories are damaged. Includes 1 socketed head SRP-01, 2 swivel pins, 5 straight pins, 5 pogo pins.
SAP-DSI01:	Accessory kit, for purchasing additional accessories when standard accessories are damaged. Includes 1 solder-in head DSI-01, 1 meter of silver wire.
SAP-SSI01:	Accessory kit, for purchasing additional accessories when standard accessories are damaged. Includes 1 solder-in head SSI-01, 1 meter of silver wire.

4.3 Probe Dimensions

Unit: mm



5 Probe Operation

The SAP8000D active probe is a precision test and measurement instrument. Avoid excessive pulling on the cable during use, and when not in use, store the probe in the provided probe pack.

Electrostatic Sensitive: The probe is sensitive to ESD. When using the probe, adhere to ESD protection procedures.

5.1 Connecting the Probe to an Oscilloscope

The SAP8000D is compatible with oscilloscopes that support the SAPBus interface, such as the SDS6000 Pro, and SDS7000A series oscilloscopes.

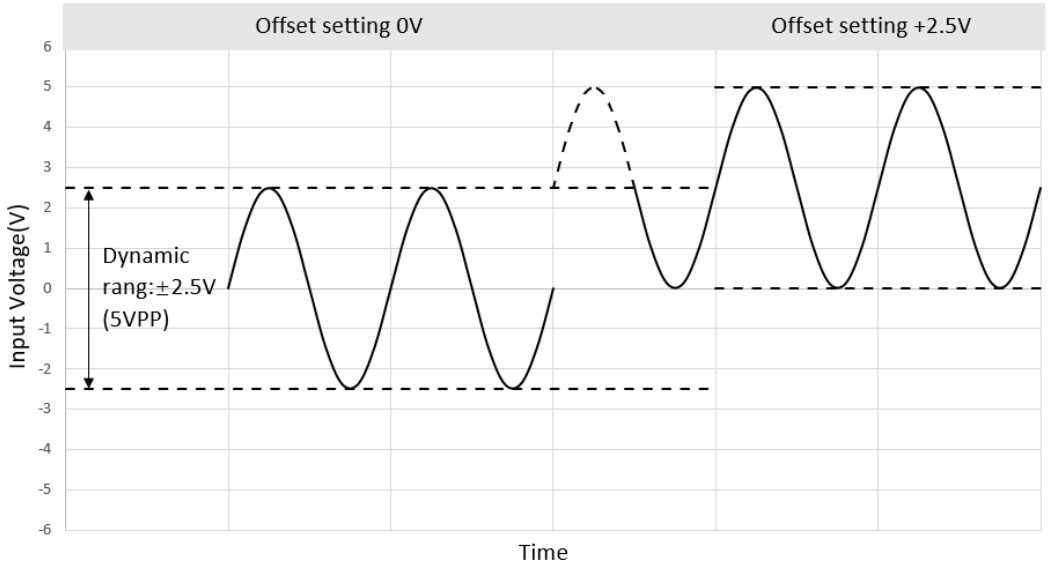
When the probe is connected to the oscilloscope, the oscilloscope can automatically identify the probe model and adjust display scales and measurements accordingly. Basic information about the probe, such as the model and serial number, can be viewed on the oscilloscope's user interface. After connecting the probe, the maximum vertical scale on the oscilloscope is 1 V/div, and the DC offset can be set in the range of ± 12 V.

5.2 Probe Input

5.2.1 Offset Compensation

Differential mode offset compensation

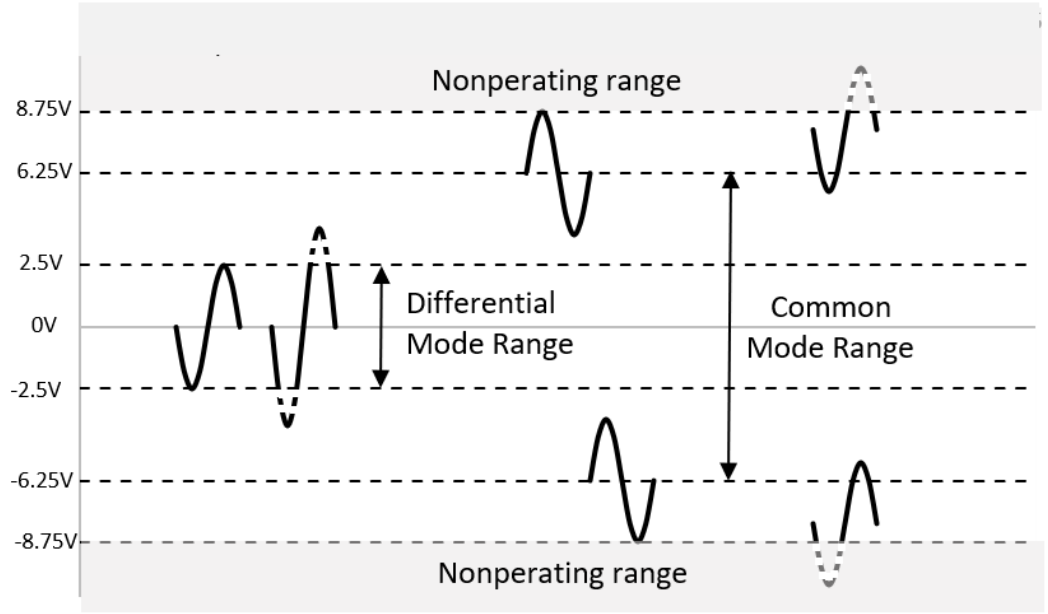
The vertical displacement function can compensate for the DC voltage applied between the positive and negative input terminals. This function is particularly useful when using a differential probe to measure small AC single-ended signals with large DC offsets (e.g., with the negative input terminal grounded). Since SAP8000D measures differential voltage, setting differential mode offset compensation can directly display the voltage offset of the measured waveform on the oscilloscope screen.



Schematic diagram of the input voltage range for single-ended measurement (with one input terminal grounded)

Common-mode offset compensation

Common-mode offset compensation can compensate for the common-mode DC voltage applied to the two input terminals (with the ground socket as the reference). This is particularly useful for measuring differential signals with high common-mode voltage, such as when the two input terminals use the voltage at the ends of a measurement shunt resistor. The SAP8000D only measures differential signals. Common-mode signals are suppressed by the probe, so common-mode offset compensation cannot be directly displayed on the oscilloscope screen.



Schematic diagram showing the requirements for common-mode voltage and differential-mode voltage when used for differential measurement

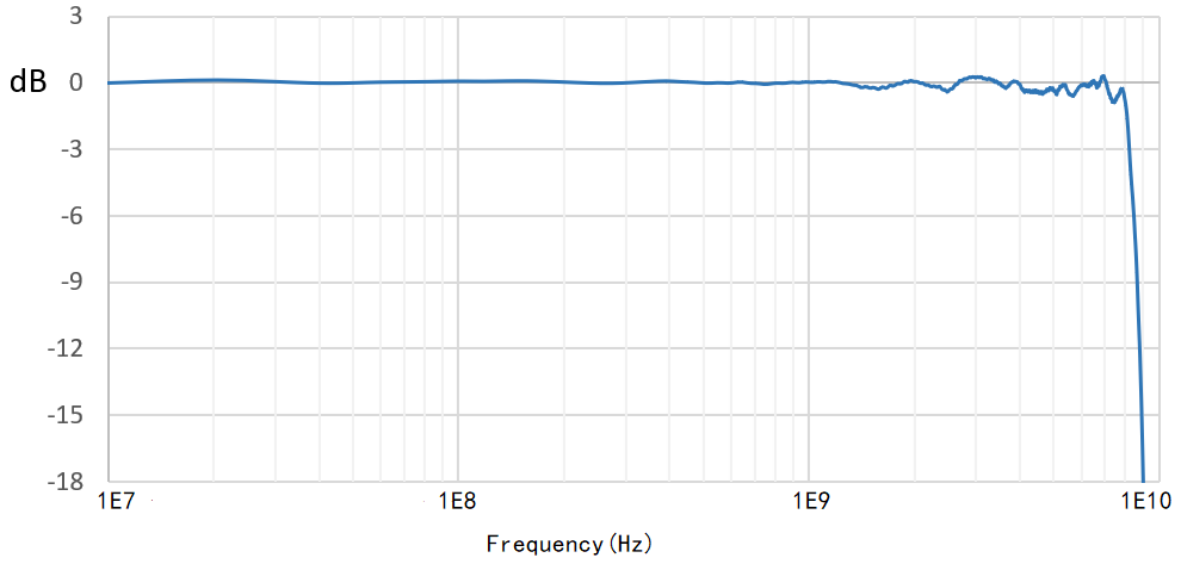
5.3 Probe Head Selection

Different probe heads are suitable for different usage scenarios, and users can choose as needed.

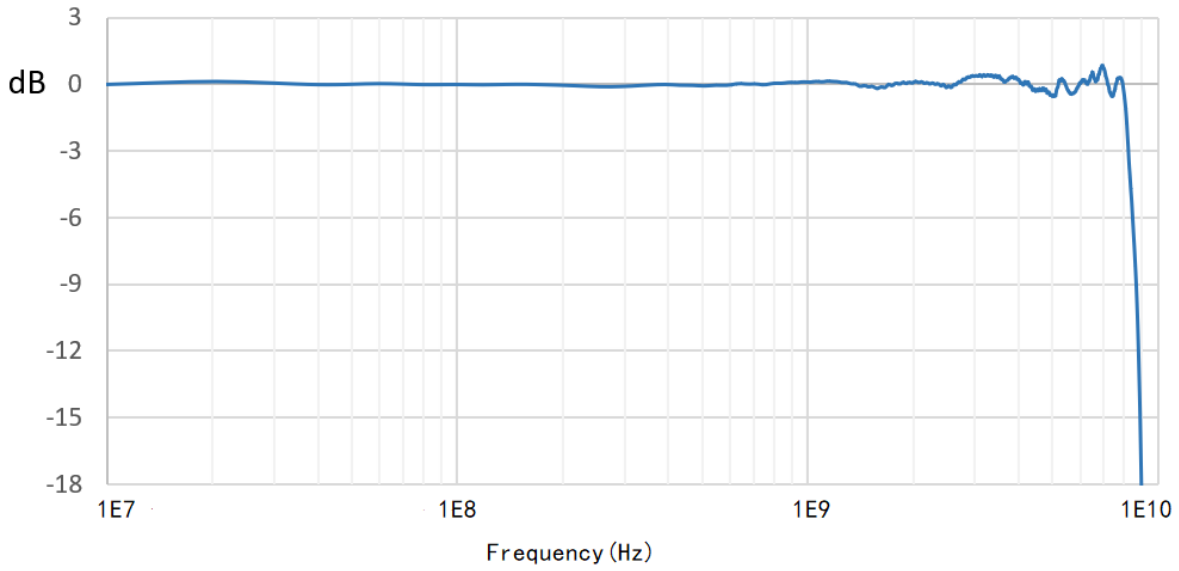
5.3.1 DSI-01/SSI-01 Solder-in Heads

DSI-01 features a low input capacitance of 300pF. The pin of this head can be soldered to the DUT, freeing both hands and providing a reliable connection. We offer silver wires with a minimum diameter of 0.25mm, which can capture signals at very small and narrow measurement points, using a measurement bandwidth of 8GHz on SAP8000D. The SSI-01 is a single-ended measurement head, with the white model sleeve being the positive input terminal and the other end being the negative input terminal. It measures single-ended signals, with the positive input terminal of SSI-01 connected to the signal under test and the negative input terminal connected to the reference ground.

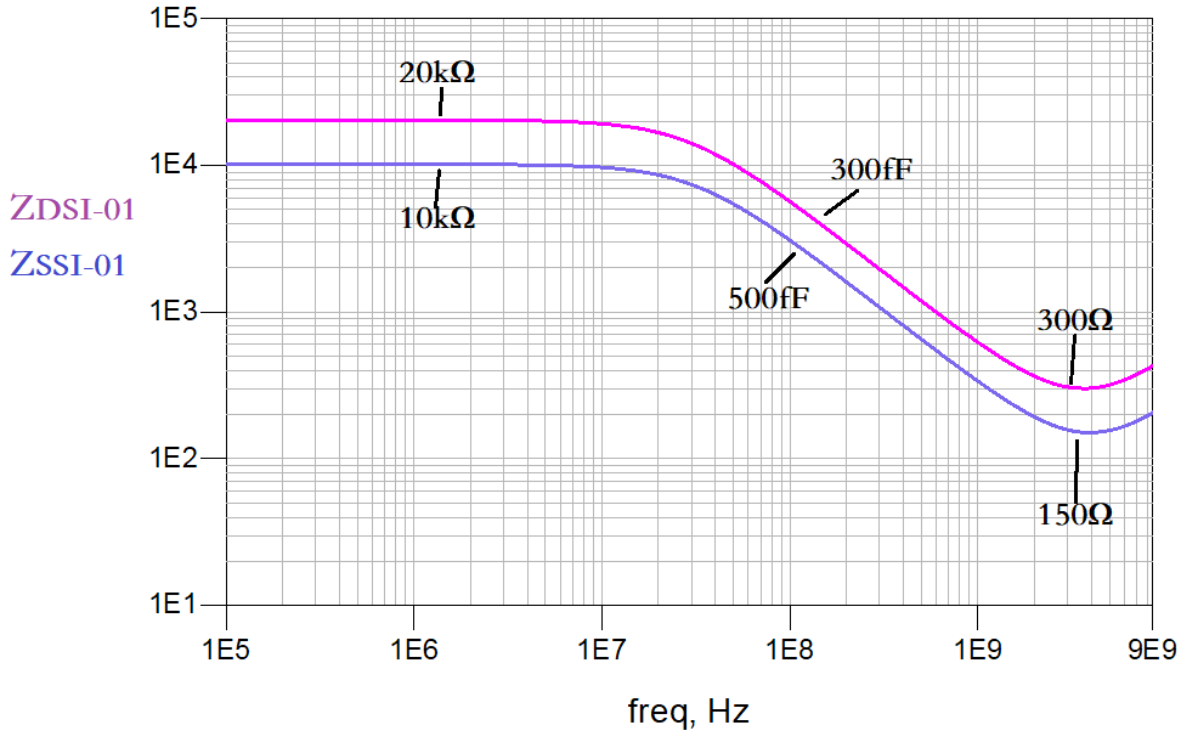
Head Models	Bandwidth (GHz))	Input Capacitance (fF)	Purpose
DSI-01	8	300	Measure Differential Signals
SSI-01	8	500	Measure Single-Ended Signals



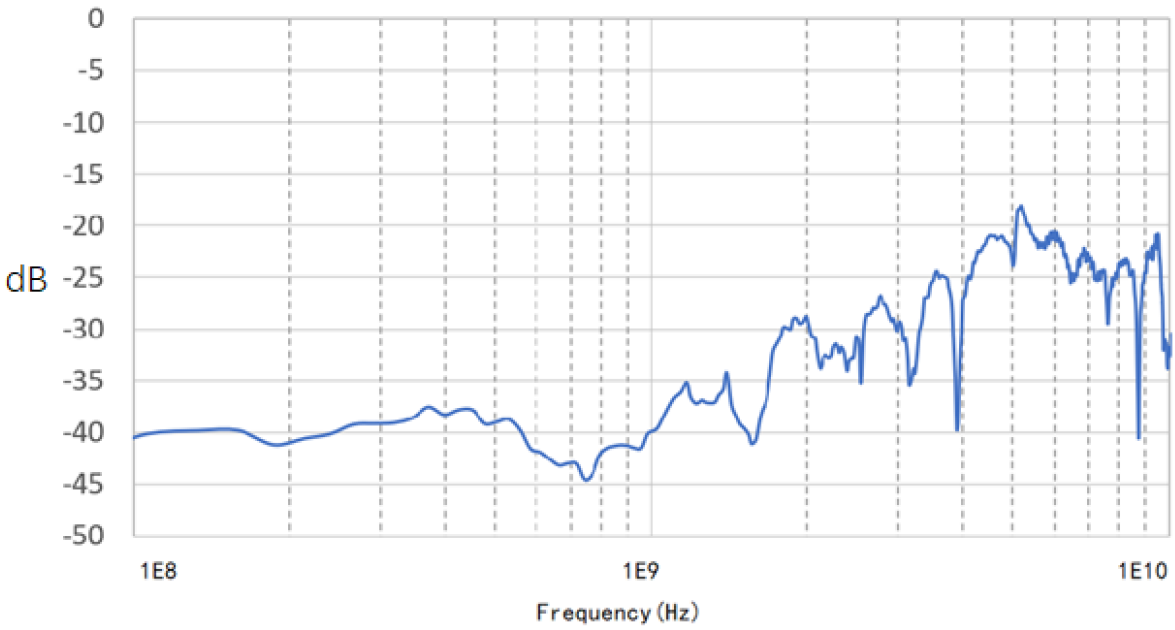
DSI-01 frequency response curve （Connect SDS7804A H12）



SSI-01 frequency response curve（Connect SDS7804A H12）



The input impedance curves of DSI-01 and SSI-01



DSI-01 Common Mode Suppression Ratio

If you need to replace the silver wire on the probe pin, please refer to "5.4.1 Soldering Method for Silver Wire on the Head Tip"

When soldering leads onto the DUT, use a sufficient amount of flux. Reliable soldering can be achieved with a moderate amount of solder after using flux.

Use a fixed stand or tape to secure the probe and DUT, reducing the stress on the soldering points.

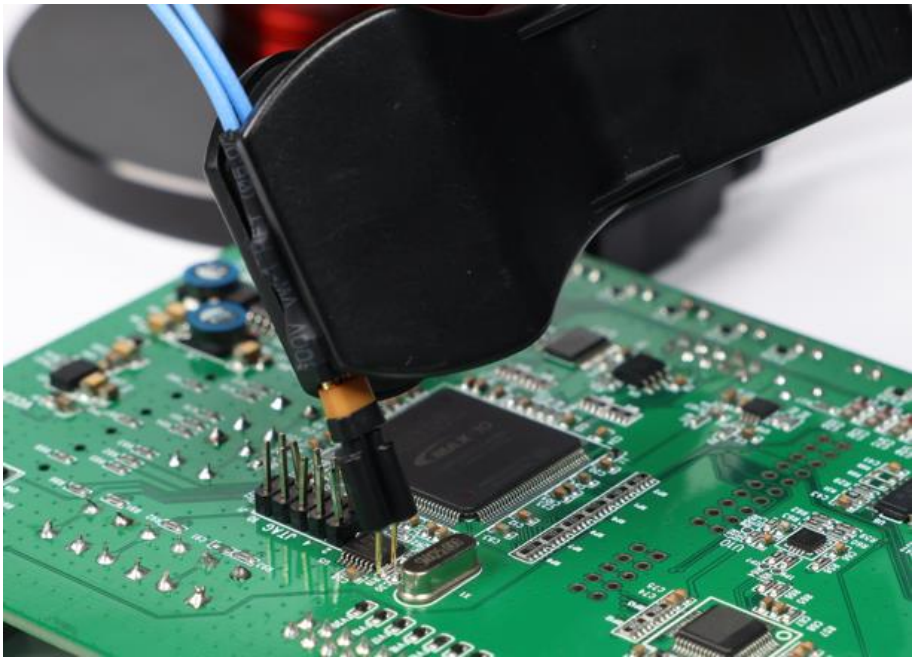
When using SSI-01 to measure a single-ended signal, the input terminal corresponding to the white model sleeve is the positive pole. If it is connected in the wrong way, the measurement accuracy of the high-frequency signal will be affected.

5.3.2 DRP-01/SRP-01 Socketed Head

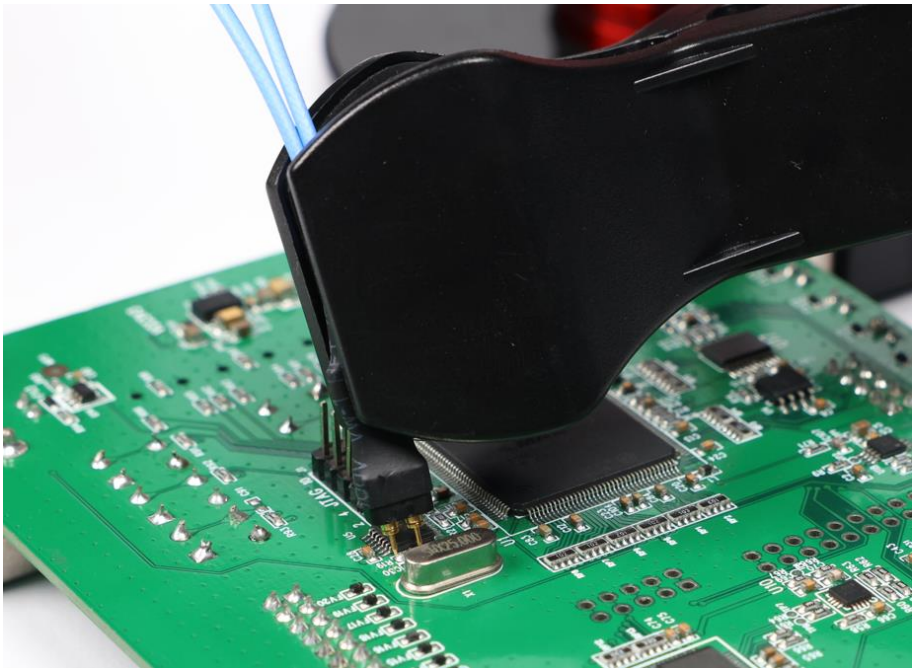
The straight plug is suitable for connecting with 2.54 mm pitch pin headers, and is used for USB testing, Ethernet testing, etc. These probe heads is plug-and-play, and the standard probe can also be used for point testing, greatly improving test efficiency. And SRP-01 is a single-ended measurement head. The white model tube has the positive input terminal at one end and the negative input terminal at the other end. When measuring a single-ended signal, connect the positive input terminal of the SRP-01 to the signal being measured and connect the negative input terminal to the reference ground.

Head Models	Bandwidth (GHz))	Input Capacitance (fF)	Purpose
DRP-01	8	800	Measure Differential Signals
SRP-01	8	1000	Measure Single-Ended Signals

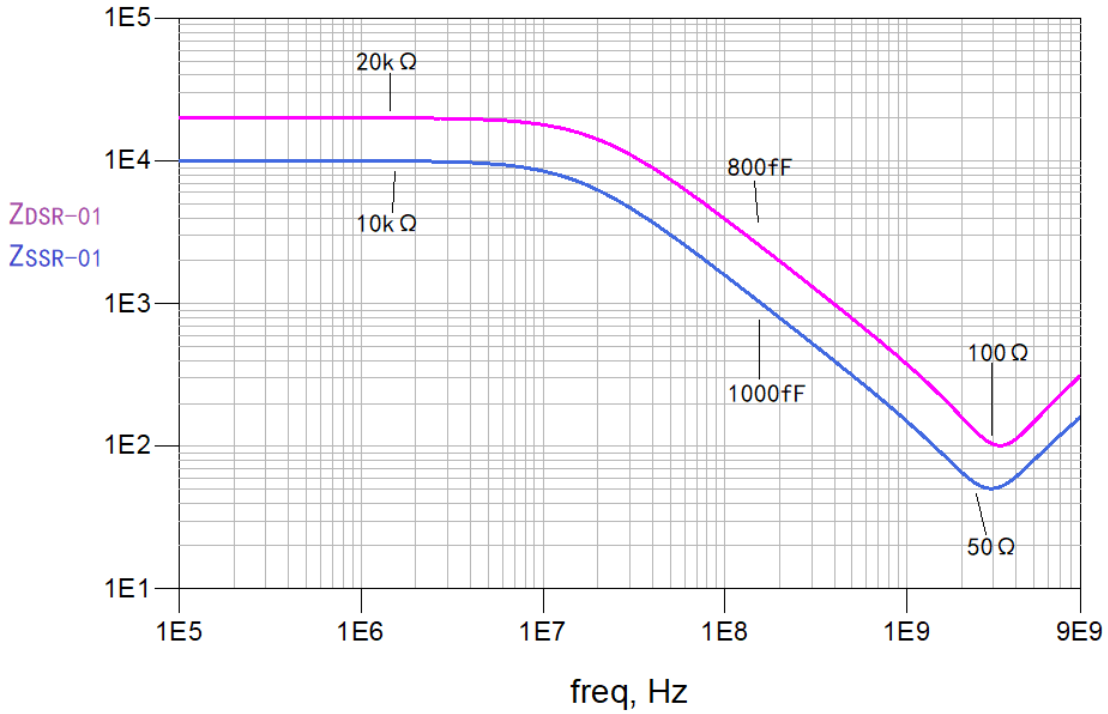
Directly connected to the pin header



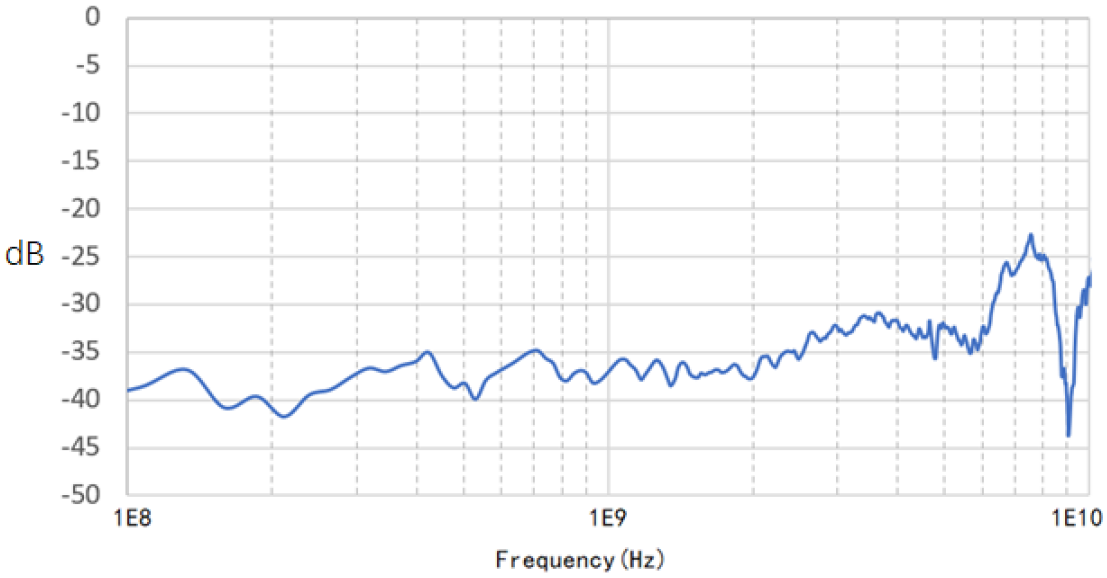
Use with Swivel Pin



Use with Straight Pin



The input impedance curves of DRP-01 and SRP-01

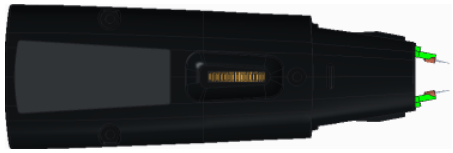


DRP-01 Common mode rejection ratio

When using SRP-01 to measure single-ended signals, the input terminal corresponding to the white model sleeve is the positive terminal. If connected reversely, the measurement accuracy of high-frequency signals will be affected.

5.3.3 DBT-01 Adjustable Pin Head

The spacing between the input terminals of the DBT-01 adjustable pin head can be adjusted by scroll wheel, which can quickly measure differential signals with different spacings.



5.3.4 SMA-01 SMA Head

The SMA-01 SMA head can be connected to the circuit under test with an SMA interface. The connection method is stable and reliable.

5.4 Solder-in Probe Head Usage

Before using a Solder-in probe head, please carefully read the following usage instructions to avoid damaging the probe and the circuit board under test.

5.4.1 Soldering Method for Silver Wire on the Head Tip

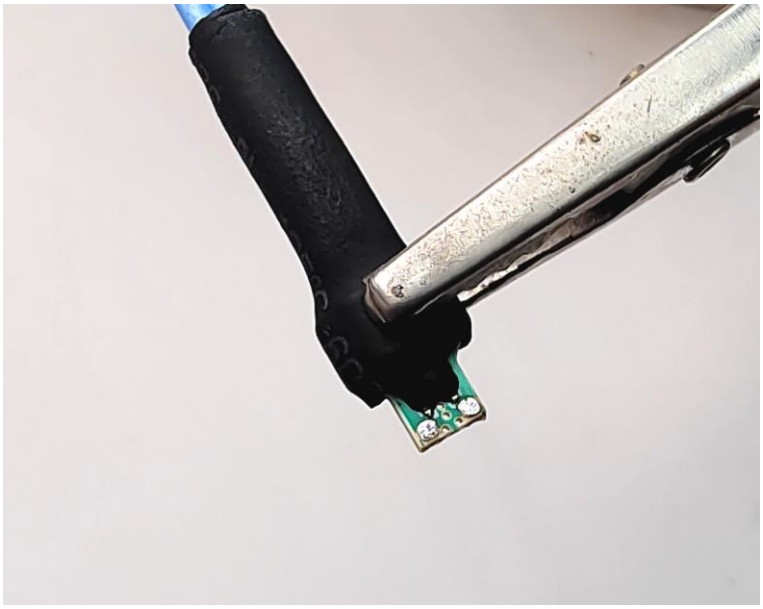
If the silver wire is damaged and needs to be replaced, please use the following method.

Soldering Preparation

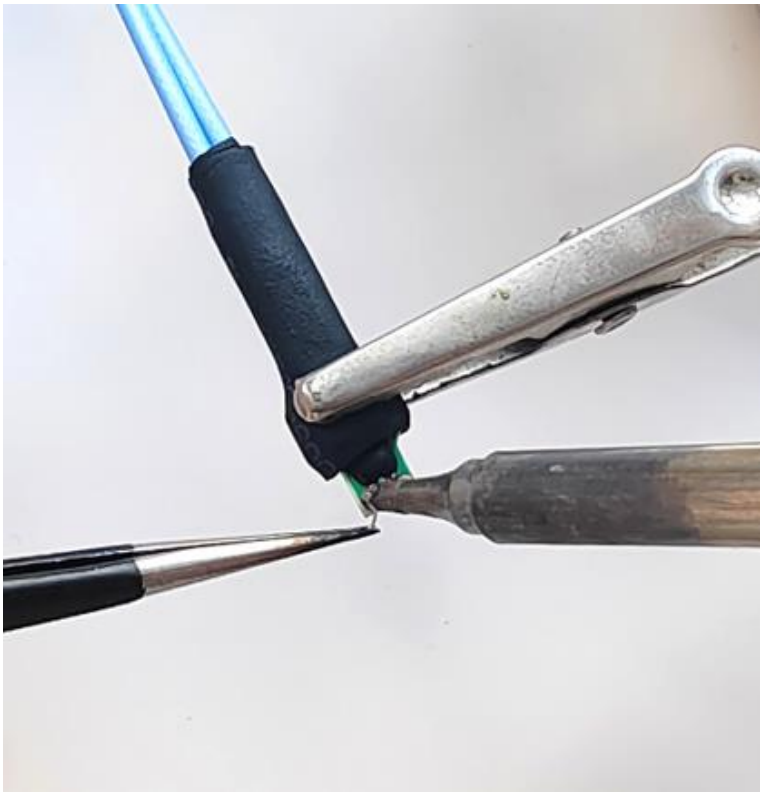
Materials or Tools:
Vise or equivalent fixture for securing the tip.
Adjustable-temperature fine-pin soldering iron.
Solder wire.
Fine stainless steel tweezers.
Flux.
thickness gauge.
Wire cutters.

Soldering Steps

1. Use a vise or fixture to secure the tip for soldering. If the fixture has sharp edges, wrap it with tape to protect the head.



2. If you need to remove the existing or damaged leads, grip the leads with tweezers and gently pull them upward. Ensure the soldering iron contacts the solder point for a sufficient amount of time to detach the leads from the tip.

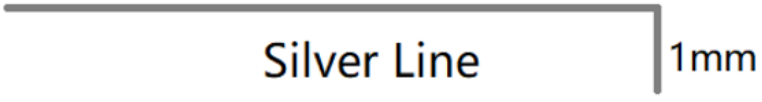


	To avoid overheating and damaging the circuit board, do not allow the soldering iron to contact the solder point for longer than necessary. The solder joints are very small and have low thermal mass, so they will melt quickly.

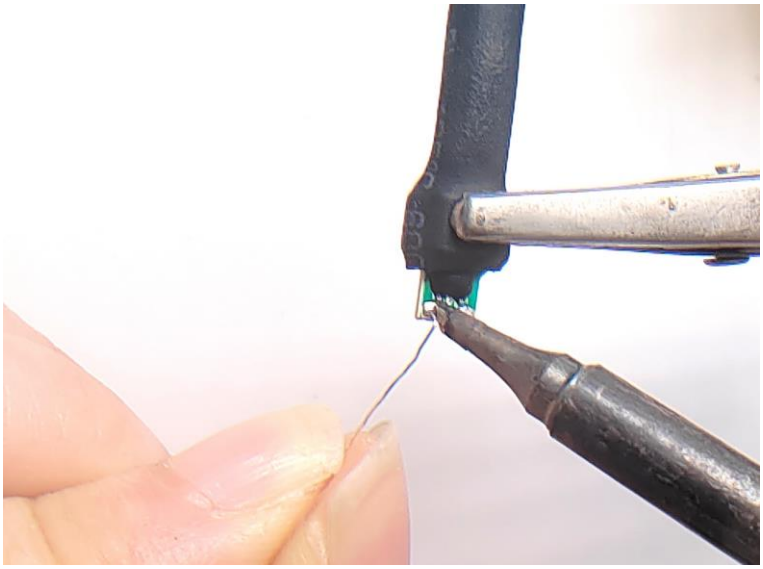
3. Fill the mounting hole with solder, preparing it for the new leads.

4. To reduce the soldering temperature, it is recommended to apply flux to the soldering area.

5. Prepare the silver wire for connection to the head's PCB. Trim the silver wire leads as shown in the diagram. The wires soldered to the head's PCB should have a 90° bend, with a bend length of about 1mm, to enter the through-hole in the probe pin's PCB. The processed silver wire should look as shown in the diagram.

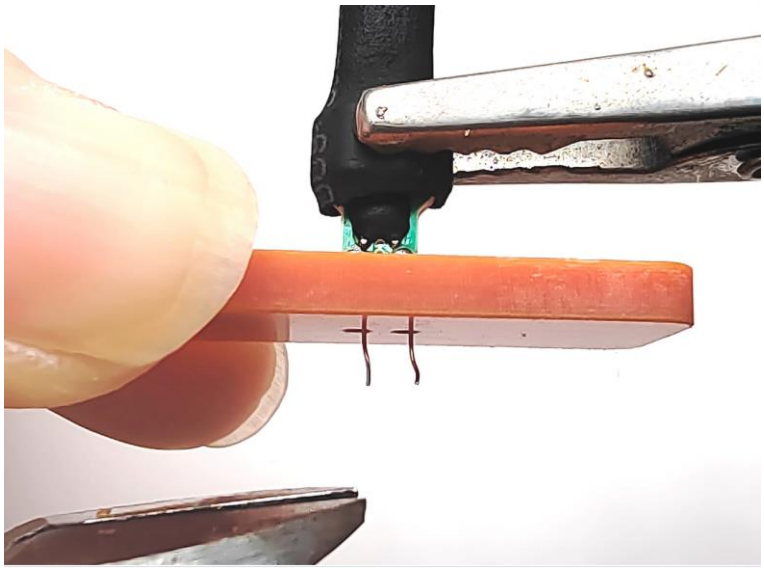


6. Hold the lead of the silver wire with tweezers in one hand, and in the other hand, hold the soldering iron to place the end of the silver wire (the 90° bend) over the filled solder hole. Touch the soldering iron to the side of the hole. As the solder in the hole melts, the lead of the silver wire will drop into the hole. Once the lead drops into the hole, immediately remove the soldering iron.



Silver Wire Soldering

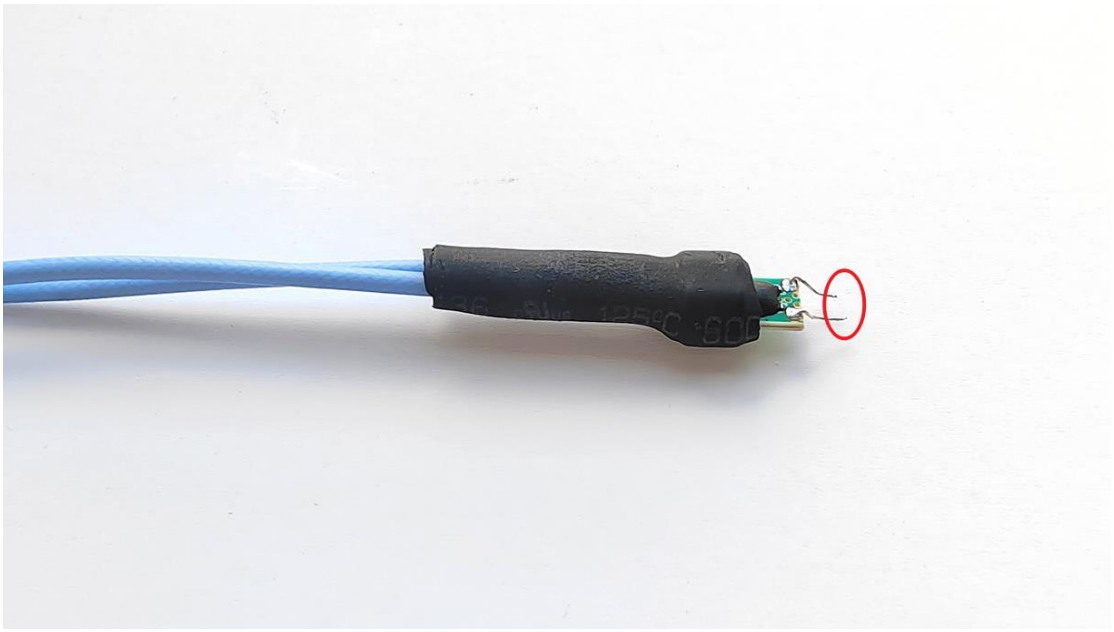
7. After welding, trim the silver wire using flush cutters and a thickness gauge.



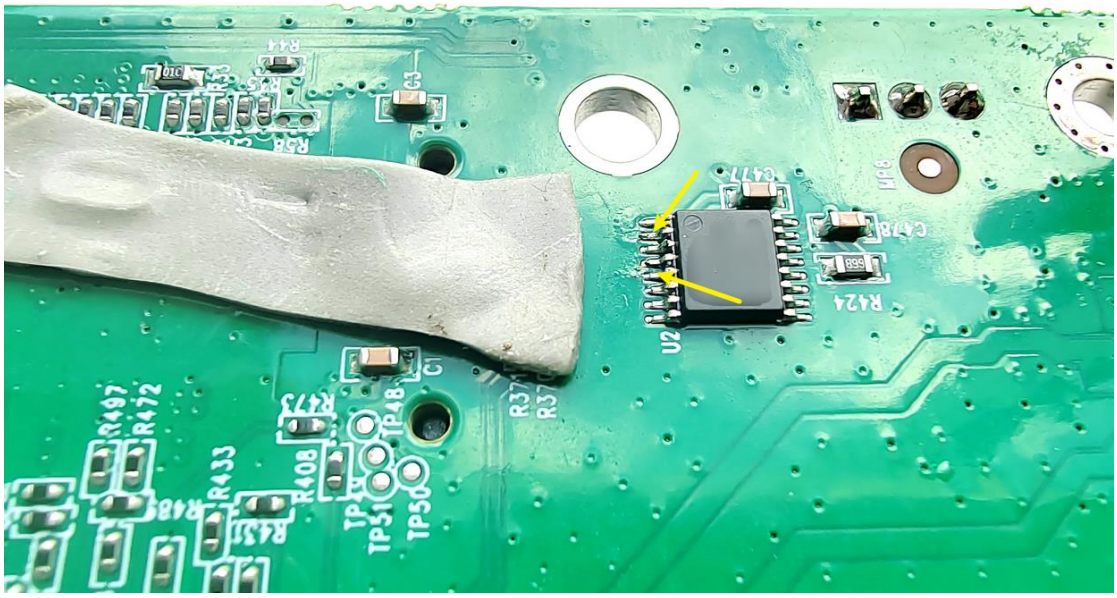
Silver Wire Cutting

5.4.2 Connecting SAP8000D probe and circuit board with Solder-in head

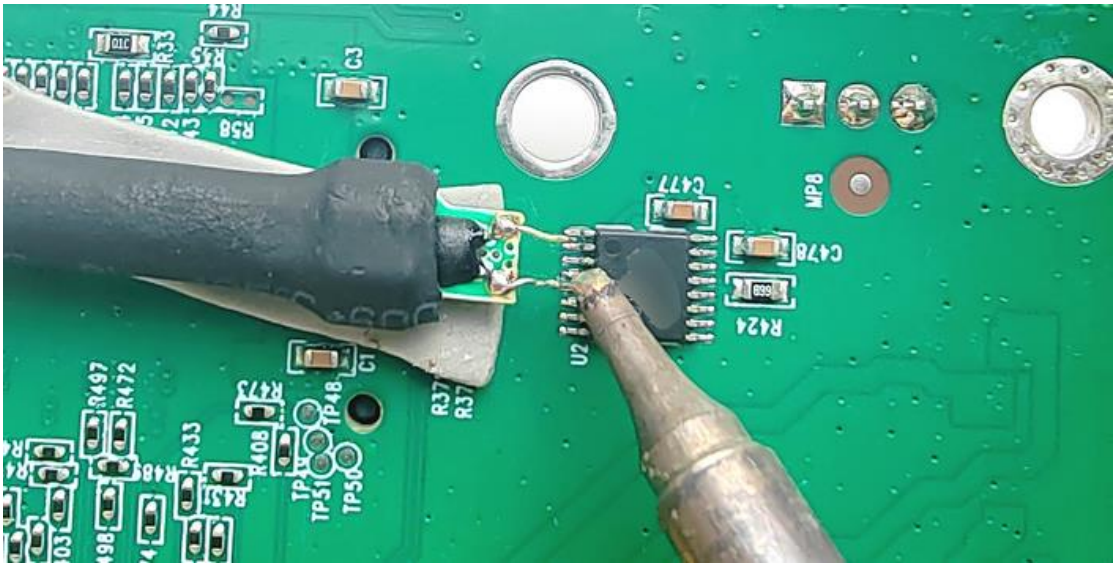
1. Solder the silver wire onto the Solder-in head, as described in 5.4.1. Before soldering to the test point, apply solder to the area circled in red.



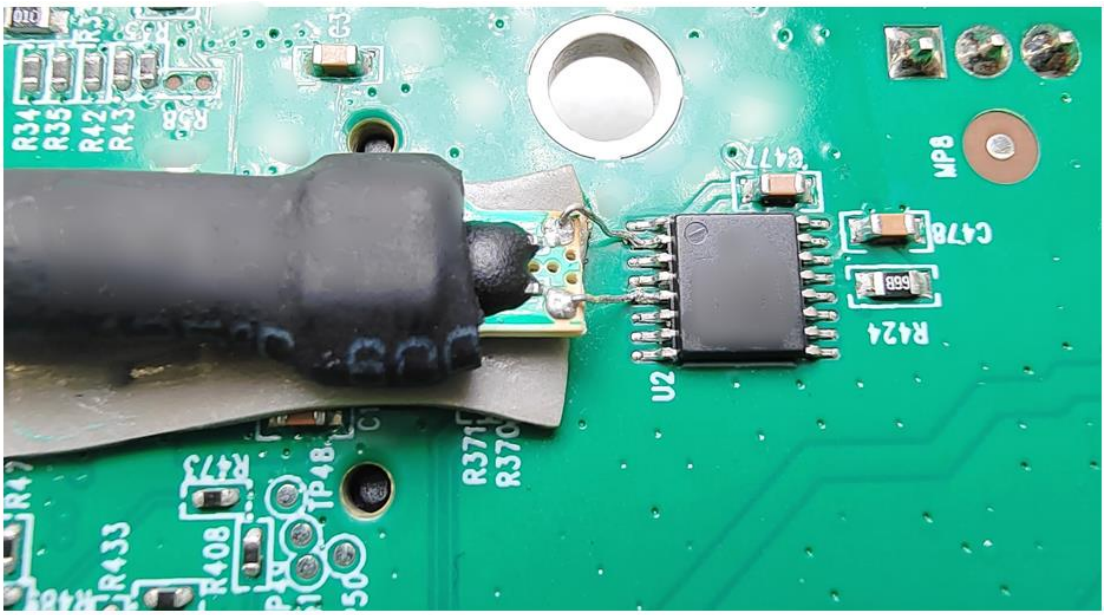
2. Apply flux to the test points on the circuit board, then add solder. If the test points are through-holes, it is recommended to use low-temperature solder. Select the method of securing the probe head and apply double-sided tape to the circuit board to prevent stress damage to the solder joints.



3. Solder the pin of the head to the test points on the circuit board.

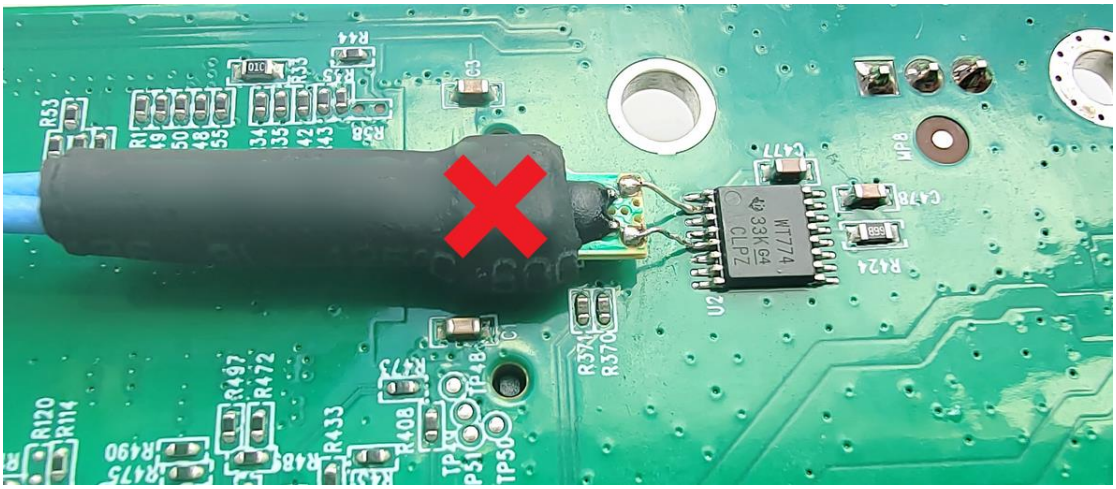


4. Clean the flux on the solder joints with board cleaner.



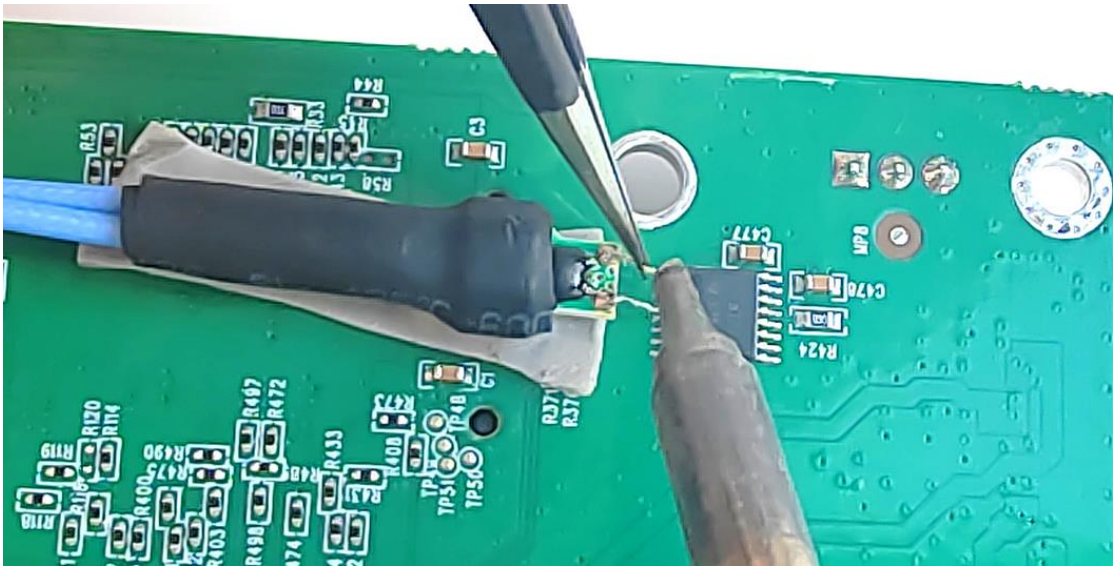
To avoid overheating and damaging the circuit board, use the lowest possible temperature for the soldering iron, and do not allow the soldering iron to contact the solder points for longer than necessary.

The PCB on the probe pin cannot directly touch the circuit board under test, as it will result in inaccurate measurements.



5.4.3 Remove the Solder-in head from the circuit board

1. First, remove the solder joints.

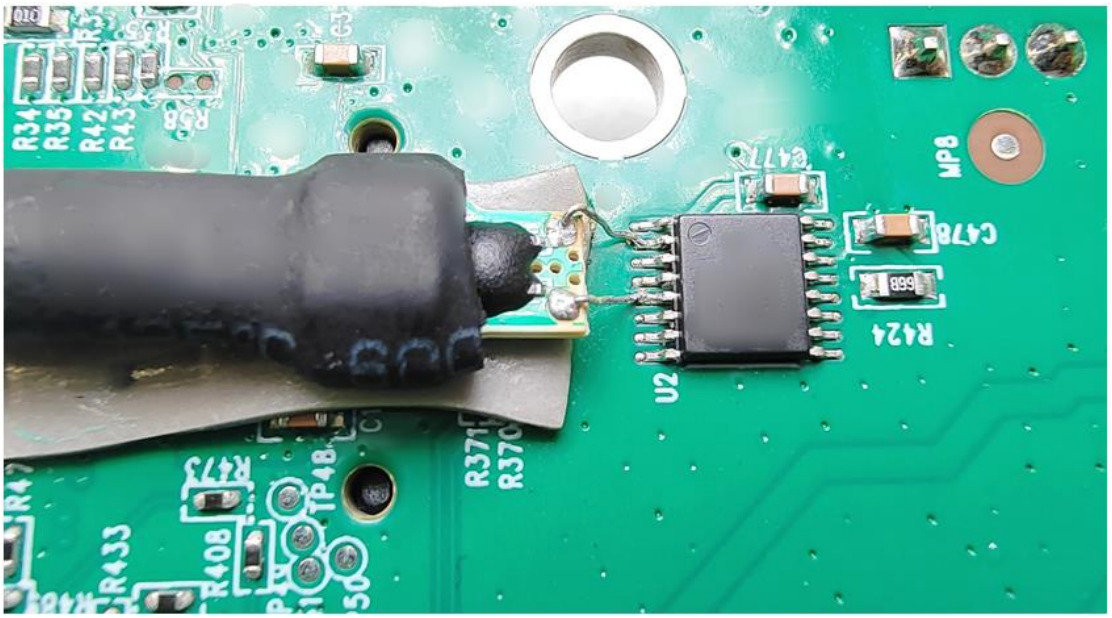


2. Then, carefully remove the probe head.

It's essential to remove the solder joints before unfastening the head to avoid damaging the probe head or the circuit board under test.

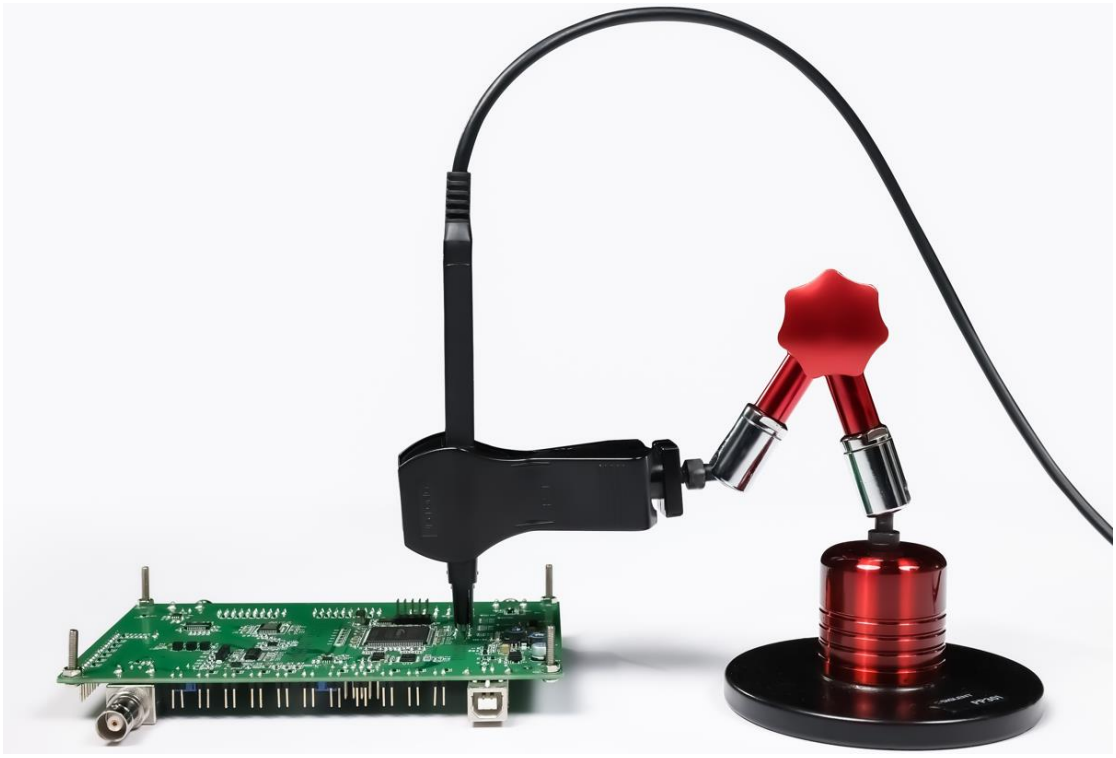
5.5 Probe Head Stabilization

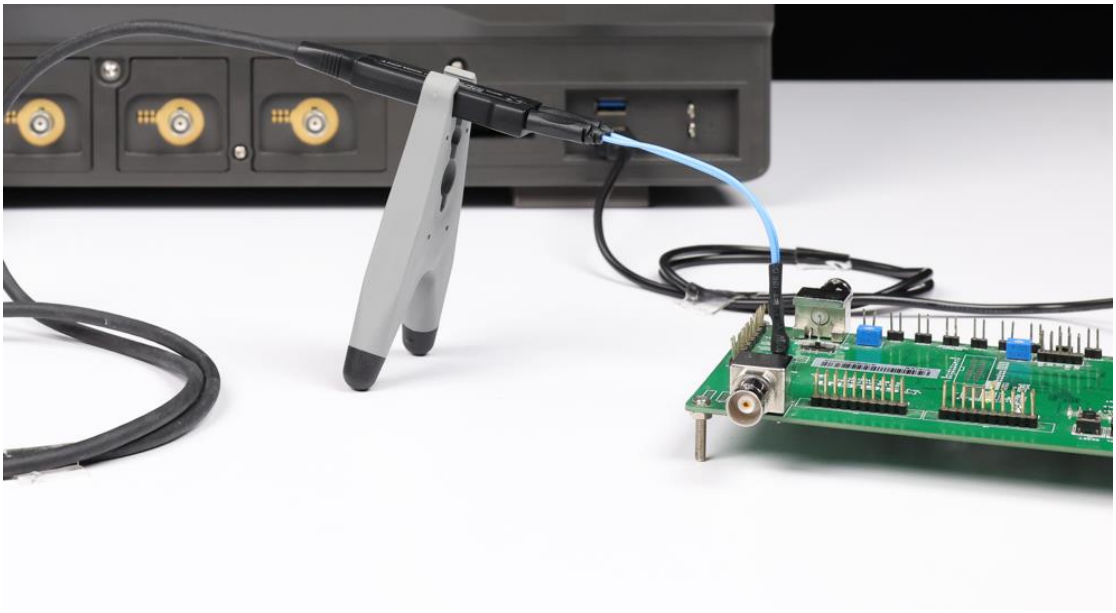
During the use of the probe, securely fixing the probe head will extend its lifespan and prevent damage to the test points due to stress. You can use 3M double-sided tape to secure the probe head.

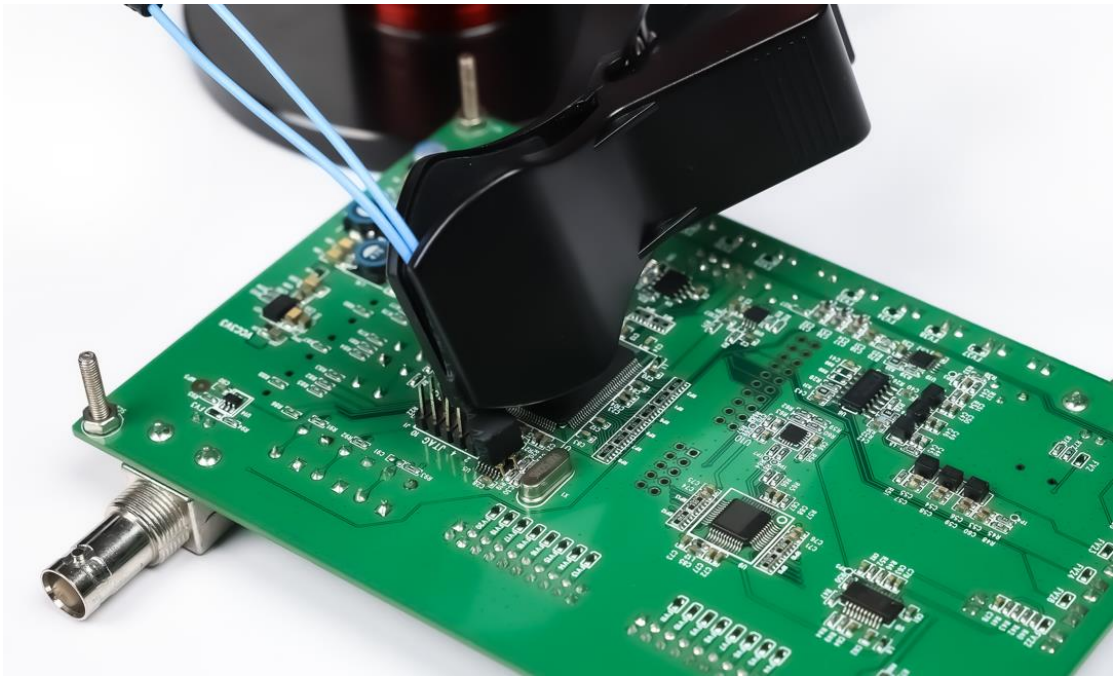


When using double-sided tape or adhesive tape to fix the probe head, it may inevitably leave marks on the circuit board.

Use the probe positioner to fix the browser probe, freeing the user's hands.







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