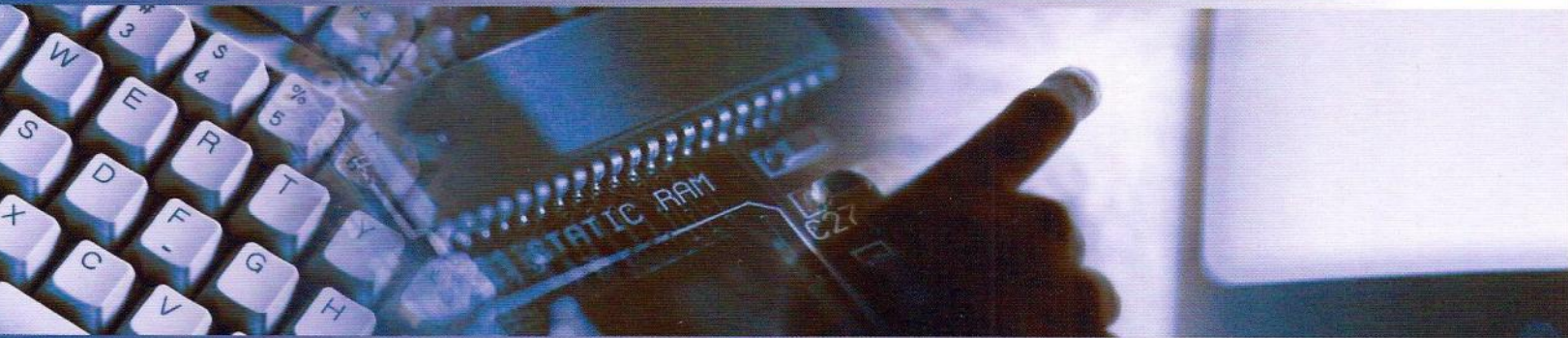


# Hall Effect Measurement System



## HMS-3000

Very Competitive Price, Compact Desktop Design, Easy-To-Use

The Ecopia HMS-3000 Hall Effect Measurement Systems are complete systems for measuring the resistivity, carrier concentration, and mobility of semiconductors.



# Hall Effect Measurement System

## HMS - 3000

### ■ Main Body



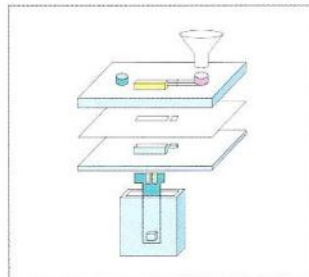
- Precise constant current source : 1nA ~20mA
- Confirm van der pauw law by this system.
- LED for checking Ohmic contact failure.
- Visualizing I-V, I-R curve.

### ■ Magnet Set



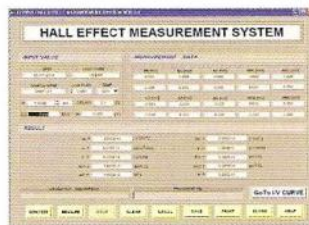
- Selectable magnetic set classified by Magnetic Flux Density.(1.0T, 0.51T, 0.37T, 0.31T)
- By ensuring magnet road, minimized outflow of Magnetic Flux Density.

### ■ Low temp test



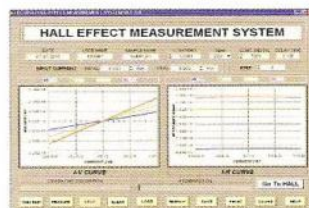
- 77K condition using liquid nitrogen offers simple structure cryostat.
- Sample protection by flowing liquid nitrogen through funnel.
- Measurable dark/light condition : built-in special material to intercept light.
- Maintain 15min at 77K by special insulating material.

### ■ HMS-3000 Software



- Results : bulk/sheet concentration, mobility, resistivity, magnetoresistance, hall coefficient (RH, RH1, RH2), conductivity, V/H ratio of resistance.

### ■ I-V, I-R Curve



- As applying input current, user can get I-V, I-R curve ranging from initial to final value.



## SPECIFICATION

SIZE (W×D×H) : MAIN BODY	320×300×105 mm (Constant Current Source/Meter System)
WEIGHT :	7.7kg(without package)
MEASURABLE SAMPLE SIZE :	6mm×6mm, 20 mm×20 mm
MEASUREMENT TEMPERATURE :	300K, 77K(Liquid Nitrogen)–Keep temp for 15min.
MEASUREMENT MATERIALS :	All semiconductors including Si, ZnO, SiGe, SiC, GaAs, InGaAs, InP, GaN (N Type & P Type can be measured).
PERMANENT MAGNETIC SIZE	50mm Diameter
MAGNETIC FLUX DENSITY :	0.31, 0.37T, 0.51T, 1.0T
INPUT CURRENT RANGE	1nA-20mA, Compliance: 13V
MOBILITY(cm <sup>2</sup> /Volt-sec)	1~10 <sup>7</sup> (including low temperature)
DENSITY(cm <sup>3</sup> ) :	10 <sup>7</sup> ~10 <sup>21</sup>
VOLTAGE MEASUREMENTS:	Input impedance: 2 x 10 <sup>7</sup> Input voltage range: +/- 12V
RESISTIVITY RANGE:	10 <sup>-4</sup> ~10 <sup>7</sup> Ohms-cm

Van der Pauw

# Ecopia HMS-3000 Hall Measurement System



The Ecopia HMS-3000 Hall Measurement System is a complete system for measuring the resistivity, carrier concentration, P/N type, and mobility of various materials including semiconductors (N Type & P Type) such as Si, Ge, SiGe, SiC, GaAs, InGaAs, InP, GaN, ZnO, TCOs, metals, oxides, etc., at both 300K and 77K. The user must supply the PC, however, all other materials needed to begin making measurements are included. The HMS-3000 includes software with I-V curve capability to check the ohmic contact of the sample "contacts".

**Characteristics** - Compact Desktop Model - Permanent magnets and an integrated meter / current source / circuit switching system are used instead of bulky electromagnets and separate constant current source and DVM, providing a very compact and easy-to-use desktop system.

**Simplicity and Accuracy** - 5 Stage current ranges reduce the error allowance to a minimum.

**Simple Operation - Speedy Data Results** - Data is input by a simple operation providing bulk/sheet carrier concentration, mobility, Hall coefficient, bulk resistivity, conductivity, magnetoresistance, and alpha (Vertical/Horizontal ratio of resistance).

Web Page: <http://www.fourpointprobes.com/ecopia.html>

Complete Brochure: [http://www.fourpointprobes.com/hms3000\\_brochure.pdf](http://www.fourpointprobes.com/hms3000_brochure.pdf)

Optional 300C Hot Stage System: <http://www.fourpointprobes.com/ht55t.pdf>

Sample Mounting Boards: <http://www.fourpointprobes.com/springclip.pdf>

**Specifications:**

**Size (W x D x H):** 320 x 300 x 105 mm (Constant Current Supply / Meter System)

**Weight:** 7.7kg (without package)

**Maximum sample size:** Small board – 6 mm x 6mm, Large Board - 20 mm x 20 mm.

**Measurement Temperature:** 300K, 77K (Liquid Nitrogen) Cool-down time: 10 sec.

**Measurement Materials:** All semiconductors including Si, SiGe, SiC, GaAs, InGaAs, InP, GaN (N Type & P Type can be measured). Data input of depth enables comprehensive measurement of the whole material.

**Resistivity Range:**  $10^{-4}$  to  $10^7$  (Ohms-cm)

**Magnet :** Permanent magnet (diameter: 30 mm)

**Magnet Flux Density:** 0.55T nominal +/-1% of marked value Stability: 2% over 1 years Uniformity: +/- 1% over 20mm diameter from center Pole Gap: 26 mm

**Alternative field strengths available as options: 0.27, 0.31, 0.37T, 1.0T**

**Current source:** Range: 1nA-20mA Compliance: 12V

**Mobility:** ( $\text{cm}^2/\text{Volt}\cdot\text{sec}$ )  $1 \sim 10^7$  (including low temperature)

**Density ( $\text{cm}^{-3}$ ):**  $10^7 \sim 10^{21}$

**Voltage measurements:** Input impedance:  $2 \times 10^7$  Input voltage range: +/-12V

**Sample input:** Sample boards—3 types, i.e., Small board, Large board, Device board

**Contact switching:** Mechanical relays



Sample kit with 0.55 Tesla magnet supplied standard with the system.

**Product Specifications**

① Common Specifications.

1) General Factors

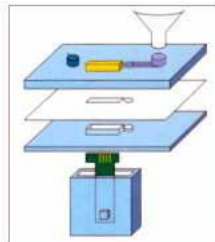
Input Current	Resistivity ( $\Omega \cdot \text{cm}$ )	Concentration ( $1/\text{cm}^3$ )	Mobility ( $\text{cm}^2/\text{Volt} \cdot \text{sec}$ )	Magnetic Flux Density(T)	Temperature (K)	Sample Measurement Board
1nA - 20mA	$10^{-4} \sim 10^7$	$10^7 \sim 10^{21}$	$1 \sim 10^7$	0.27	77 300	PCB Sample Board 6mmx6mm 20mmx20mm Spring Clip Board
				0.31		
				0.37		
				0.55 1		



PCB Sample Holder (6mmx6mm, 20mmx20mm)



Magnetic flux density input system 0.55T, 1.0T

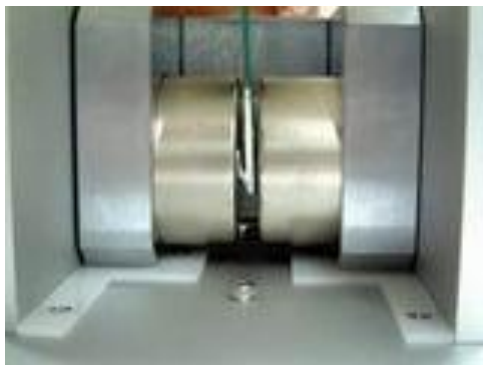


Low temperature measurement system (77K, 300K)

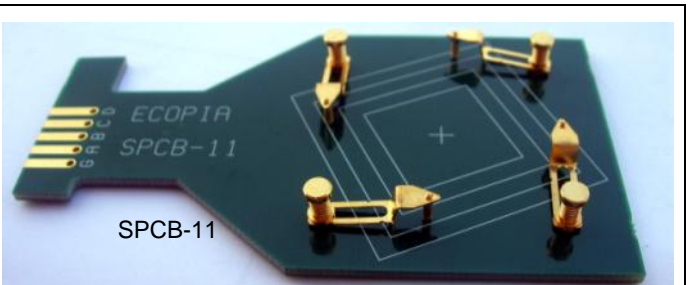


SPCB-1

The Spring Clip Board is for use with the 0.55 Tesla magnet kit (not the 1.0T) and it has spring loaded clips and tips to make contact without using bonding wires. The SPCB-1 is included with the system, however, it can be swapped for one of the other SPCB boards if preferred. (When using the Spring Clip Board, usually contacts must still be applied to the sample corners to insure good probe contact).



Optional 1.0 Tesla sample holder kit available for use in measuring low mobility samples. For use at 300K only. To use with Spring Clip Type board, please specify model SPCB-0



SPCB-11

The SPCB-11 is one of the optional boards that can be supplied in place of the SPCB-1 or purchased in addition, for mounting larger samples.



## MP55T

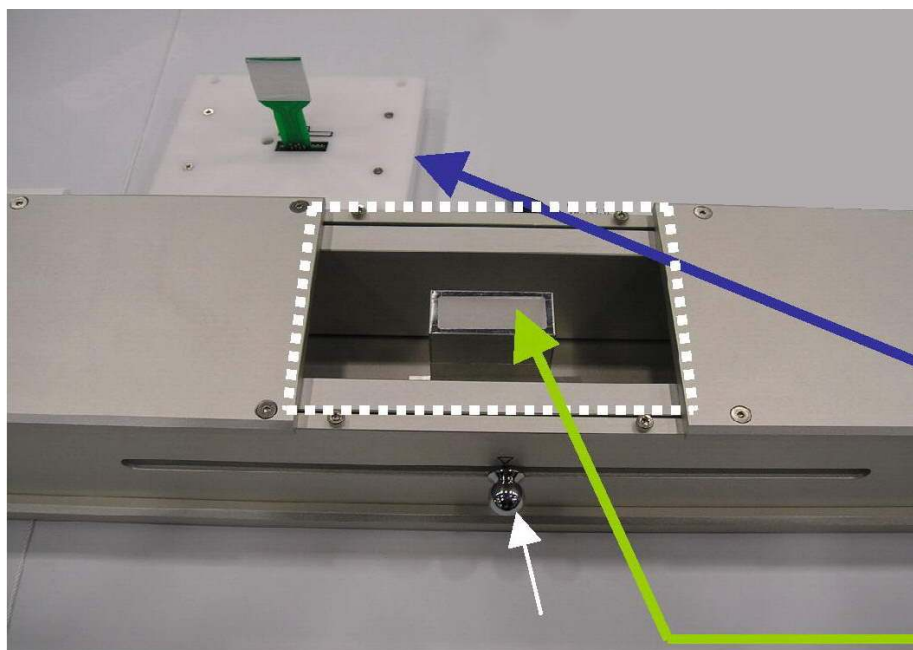
**Easy-Slide Magnet / Sample Kit for use with the Ecopia HMS-3000 Hall Measurement System**



The optional **MP55T Easy-Slide Sample Kit** reduces the effort required to change the position of the magnetic field when using the HMS-3000. Instead of the standard sample kit which includes one 0.55 Tesla magnet set which must be inserted and moved during the test, the MP55T includes TWO of the 0.55 Tesla magnets which are mounted on a ball bearing slide mechanism integrated with the LN2 reservoir and sample lid. The three magnet positions, i.e., “no magnet”, “north-south polarity”, or “south-north polarity” can be easily achieved by sliding the knob in the front of the MP55T to one of the three positions. This eliminates lifting, installing, removing, and reinserting the magnet into the sample kit by hand during the test procedure. The MP55T is available as an original configuration or it can be purchased as an upgrade.

Net weight ~14 Kg., Crated weight ~18 Kg.

# MP55T Easy-Slide Magnet / Sample Kit

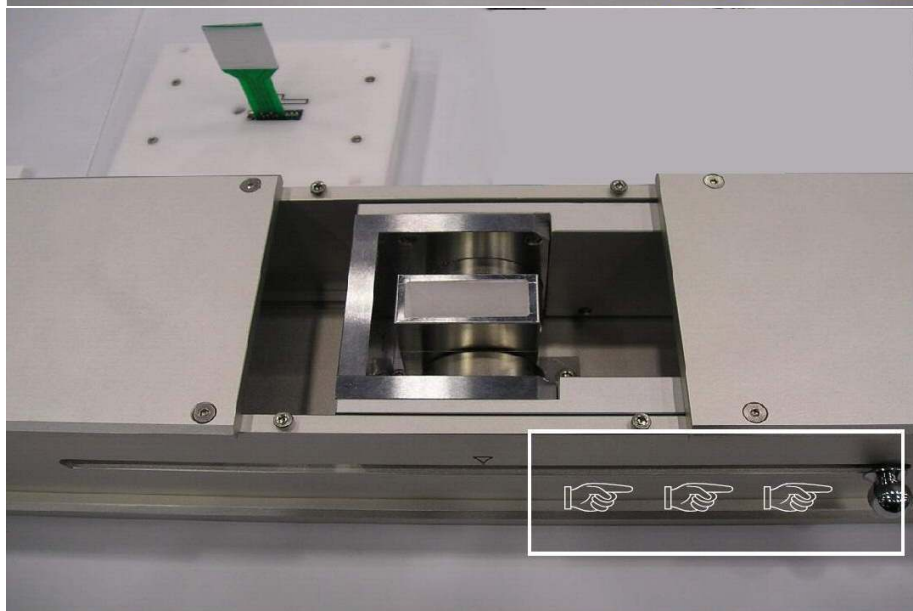


This image shows the sample mounted on a board and installed in the sample lid, but not yet installed into the MP55T sample kit. The blue arrow is pointing to the board mounted sample in the lid.

The yellow-green arrow is pointing to the LN2 reservoir.

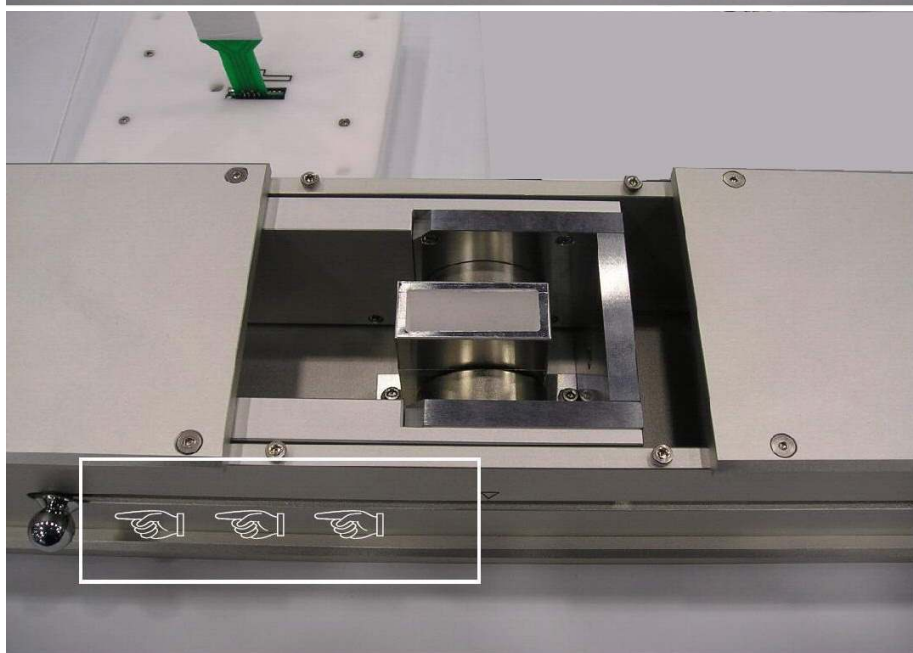
The knob (white arrow) has been positioned in the center so that the magnets are positioned away from the reservoir where the sample will be mounted upside down into the LN2 reservoir. This is the starting position for the test, in which the magnet is not yet introduced to the sample.

The sample normally would be installed, however, to show the magnet position, it has been left out.



Here the knob (see hands pointing) has been moved to the far right position, placing the magnet field in the north  $\rightarrow$  south orientation.

The sample normally would be installed, however, to show the magnet position, it has been left out.

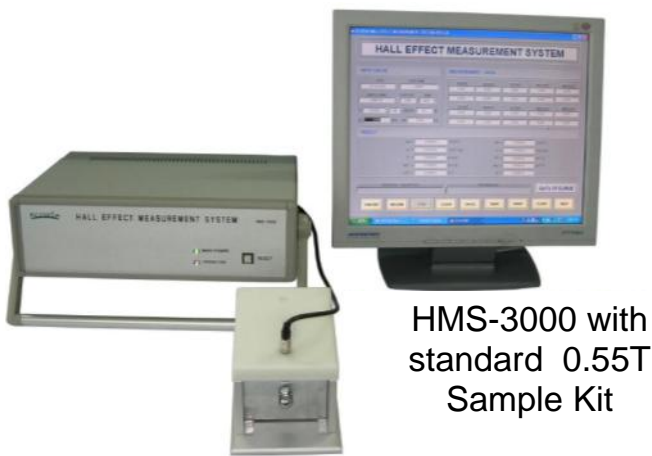


Here the knob (see hands pointing) has been moved to the far left position, placing the magnet field in the south  $\rightarrow$  north orientation.

The sample normally would be installed, however, to show the magnet position, it has been left out.



# 300°C Heated Stage / 0.55T Sample Kit for the Ecopia HMS-3000 Hall Measurement System



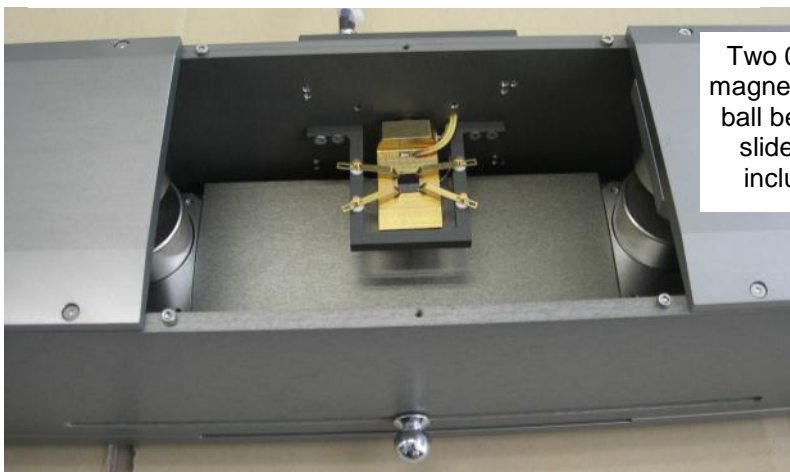
HMS-3000 with standard 0.55T Sample Kit

Ecopia offers a heated stage sample kit option for the HMS-3000, complete with two 0.55T magnets on a ball bearing slide. The heated stage includes a 0.1°C resolution temperature controller that can heat samples from ambient to 300° centigrade. The heating ramp rate is from ambient to 300°C in 30 minutes. Cooling time from 300°C back to ambient temperature, also in 30 minutes. The kit includes two 0.55T magnets on a ball bearing stage which essentially provides the same benefits as the [MP55T Easy-Slide Sample Kit](#), but with the addition of heating capability.

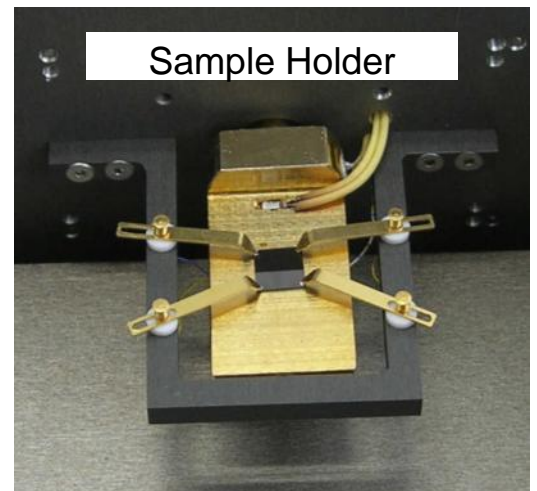
The software included with the HMS-3000 does not have the ability to control the temperature as does the [Ecopia HMS-5000 Hall Effect Measurement System](#) does, nor does the addition of the heated stage provide the plotting of temperature vs. resistivity, temperature vs. mobility, temperature vs. carrier concentration, etc., as the HMS-5000 does. However, the HMS-3000 software does include a field in which the user can specify the temperature at which a particular measurement was made. The temperature is set manually and controlled via the digital controller. The heated stage option is compatible with existing HMS-3000 systems or as an option on new systems.



300°C Heated Stage Option for the HMS-3000



Two 0.55T magnets on a ball bearing slide are included



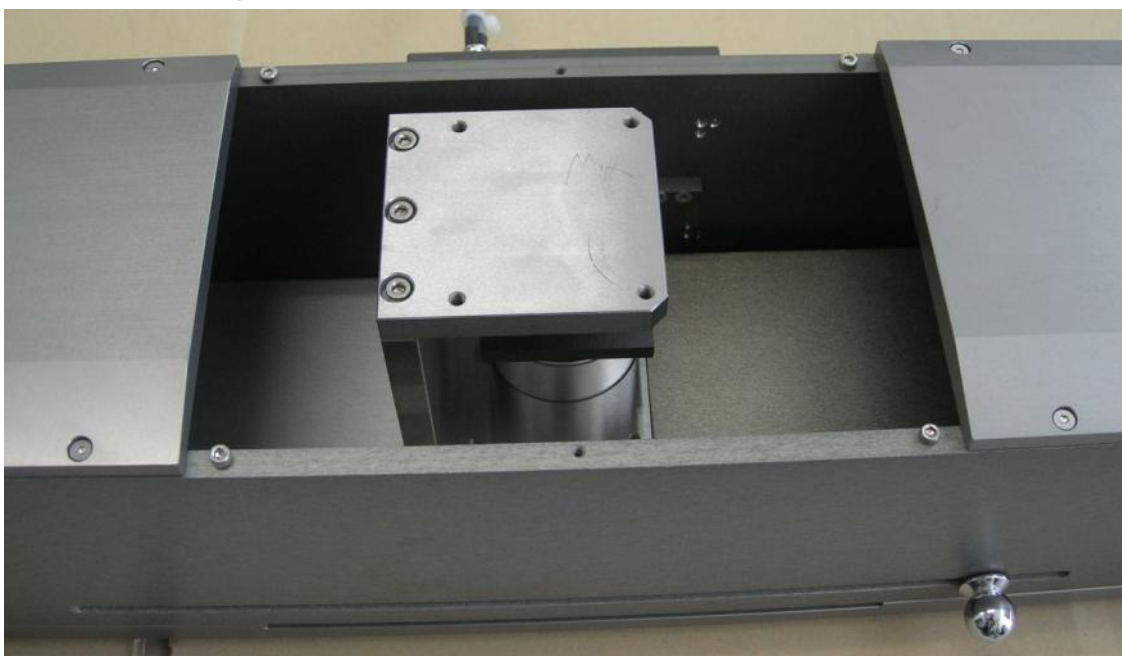
Continued On Page Two



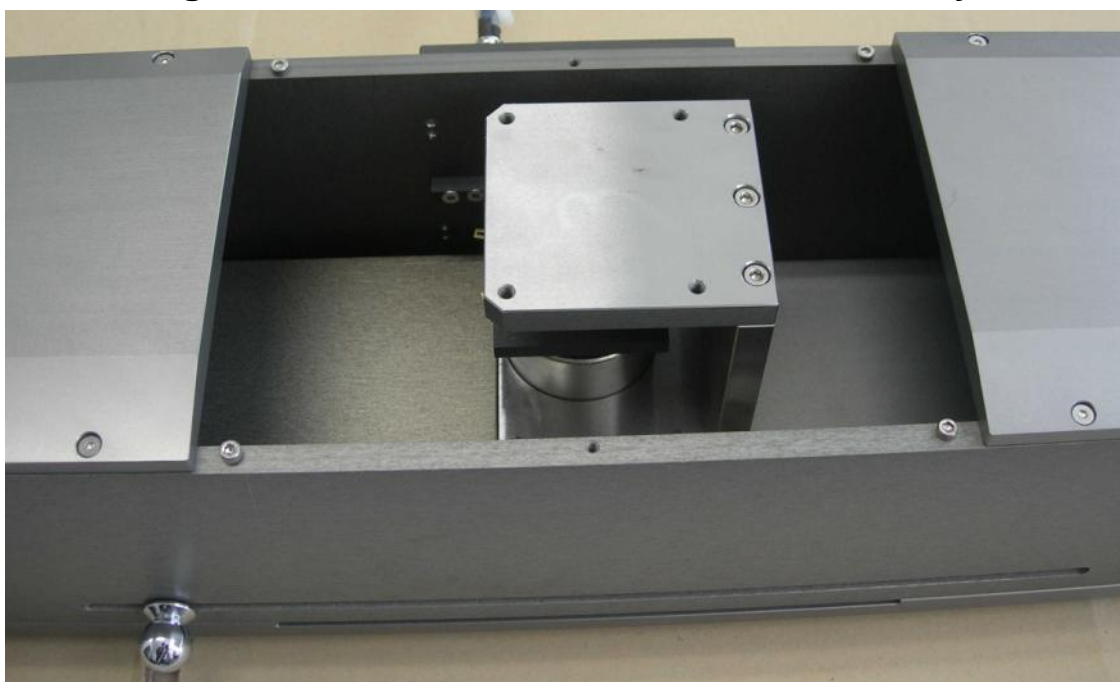
**Ambient to 300°C Sample Kit which includes two 0.55T magnets. Shown with top cover on.**



**Magnet Introduced from North to South Polarity**



**Magnet Introduced from South to North Polarity**





# Sample Mounting Boards

for use with the HMS-3000 Hall Effect Measurement System

Ecopia offers various styles of sample mounting boards for use with the HMS-3000 Hall Effect Measurement System.



## The Manual Wire Bond Sample Mounting Boards

The HMS-3000 includes 5 of each of the two types of standard mounting boards as shown to the left which require manual installation of small wires. The smaller board is used for mounting samples that are square in shape and up to 6mm on a side. The larger board is used to mount samples up to 20mm on a side. You can read about the process involved in mounting a sample onto one of the standard mounting boards by reading the following online PDF file: [http://www.fourpointprobes.com/sample\\_mounting.pdf](http://www.fourpointprobes.com/sample_mounting.pdf)

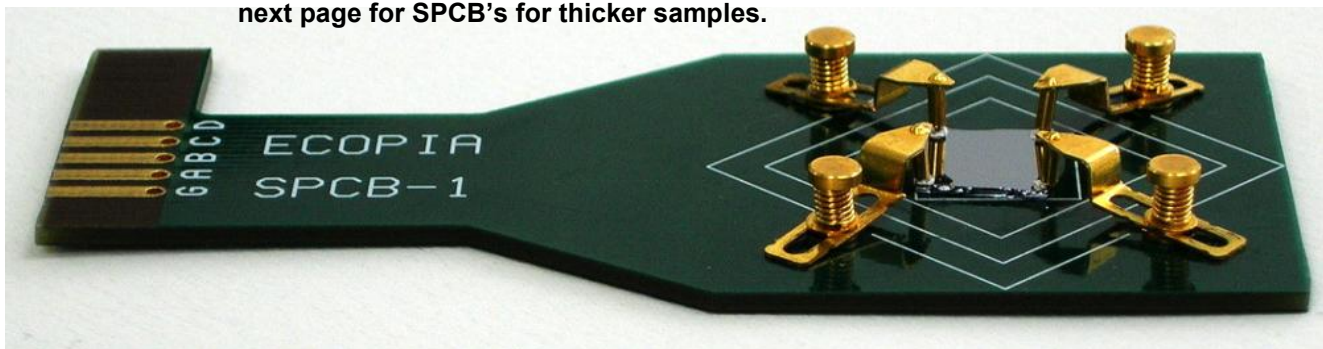
The HMS-3000 includes a small amount of the indium-tin compound and the thin wire that is used to mount samples onto these re-useable boards.

## The Spring Clip Board Sample Mounting Boards

The SPCB-1 Spring Clip Sample Mounting Board makes sample mounting much quicker and easier. One of the SPCB-1 sample mounting boards is included with the HMS-3000, or it can be exchanged instead for any of the other choices of spring clip boards as shown on the following pages. The benefits of the SPCB-1 include:

- The SPCB-1 can mount square shaped samples up to 2mm thick and up to 20mm on a side.
- Hand-bonding the small contact wires is eliminated
- The gold plated spring loaded pins make good ohmic contact to the sample, although contacts on the sample are normally still required.
- The SPCB-0 is designed for use with the 1.0 Tesla magnet kit at room temperature.
- Compatible with measurements at LN<sub>2</sub> temperature or 300K using the 0.55T magnet kit.

SPCB-1 for sample up to 2mm thick. See next page for SPCB's for thicker samples.



*Continued*

Ecopia offers the following additional models of the SPCB Spring Clip boards. The samples should be square in shape. Construction is of gold plated non-magnetic phosphor-bronze alloy. Contacts applied to the corners of the sample are normally required for good ohmic contact. A complete listing of the available board types is shown on the next page.

**SPCB-2** Spring Clip Sample Mounting Board for samples from **2mm up to 4.5mm thick** with square shape from **5mm to 20mm on a side**:

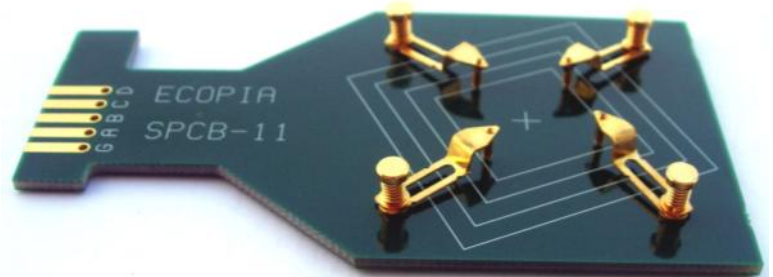


**SPCB-3** Spring Clip Sample Mounting Board for samples from **3mm up to 5.5mm thick** with square shape and from **5mm up to 20mm on a side**:

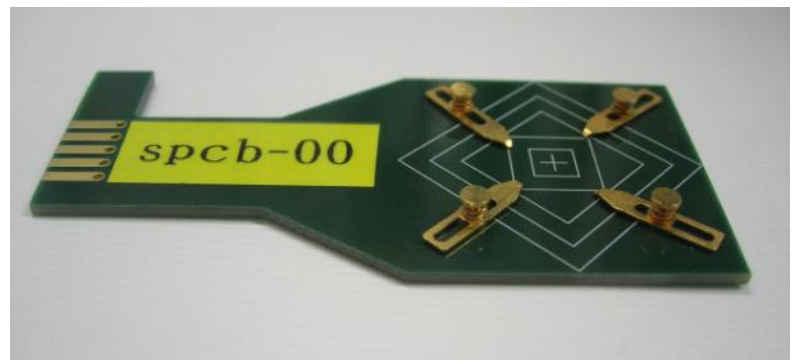


The **SPCB-11, -12, & -13** Spring Clip Sample Mounting Board are for samples from **15mm to 30mm on a side**.

NOTE: Due to the magnetic flux density area of the HMS-3000, Ecopia sample boards with up to 30mm square sample capacity are only for use with samples that are up to 20mm square, or for use with non-Hall effect measurement applications. These have been made available due to customer requests to mount larger samples, but for non-Hall Effect Applications.



The **SPCB-00** Spring Clip Sample Mounting Board for use with the 1.0 Tesla magnet, and samples **up to 1.5mm thick** with square shape up to **20mm on a side**:



Instructions for mounting a sample onto the SPCB boards can be found here:

[http://www.four-point-probes.com/springclip\\_mounting.pdf](http://www.four-point-probes.com/springclip_mounting.pdf)

See next page for a description of the available SPCB Spring Clip Sample Mounting Boards

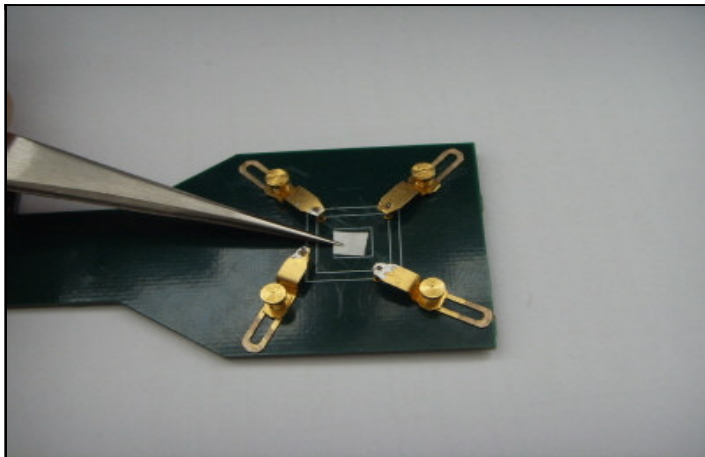
## Spring Clip Sample Mounting Board Types and Sample Capacities

Model	Sample X-Y Size Range	Sample Thickness Range
SPCB-00	5mm x 5mm to 20mm x 20mm	<= 1.5mm thick samples
SPCB-01	5mm x 5mm to 20mm x 20mm	<= 2.0mm thick samples
SPCB-02	5mm x 5mm to 20mm x 20mm	2 to 4.5mm thick samples
SPCB-03	5mm x 5mm to 20mm x 20mm	3 to 5.5mm thick samples
SPCB-11	15mm x 15mm to 30mm x 30mm	<= 2mm thick samples
SPCB-12	15mm x 15mm to 30mm x 30mm	2 to 4.5mm thick samples
SPCB-13	15mm x 15mm to 30mm x 30mm	3 to 5.5mm thick samples

**Notes:**

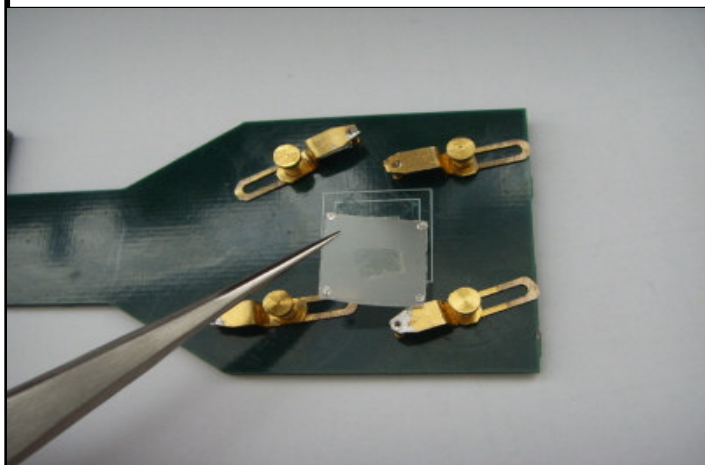
1. The SPCB-00 is for use with the 1.0 Tesla Magnet
2. Models for samples up to 30mm square are for use with samples up to 20mm square when using the HMS-3000 due to the 20mm square size of the uniform magnetic flux density that the HMS-3000 provides. These larger capacity sample boards have been provided by Ecopia due to customer requests for use with either non-Hall Effect applications, resistivity only testing, or for samples that are larger than 20mm square for which a less accurate measurement is acceptable, taking into account that the area of uniform magnetic flux density is 20mm square.

## NEW CLIP TYPE SAMPLE BOARD (1)



Above all, put the “double sticky tape” on the center of PCB board, with using tweezers.

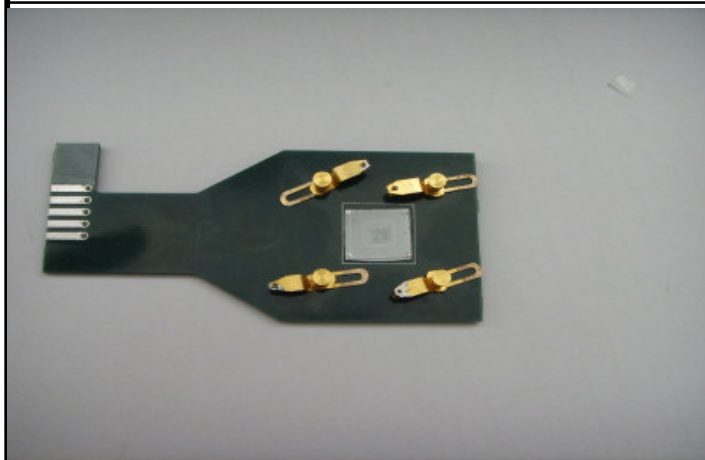
It will help the PCB hold sample.



And, then put the sample onto the center of PCB board.

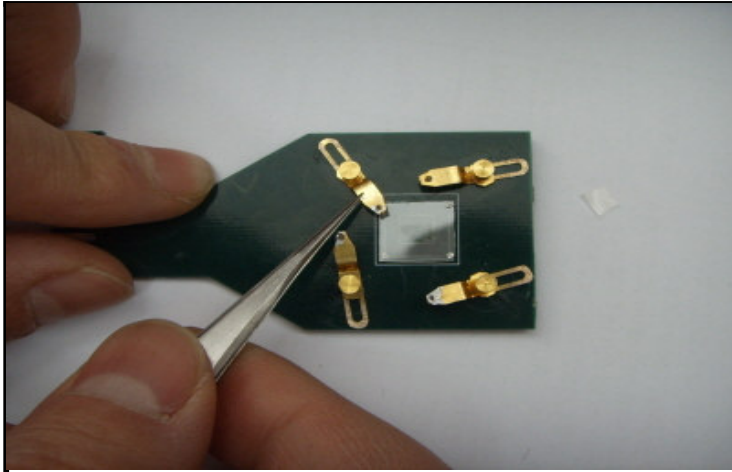
At this time, soldering on four point edge must be done in advance.

However, for some sample, it is possible to measure without soldering.



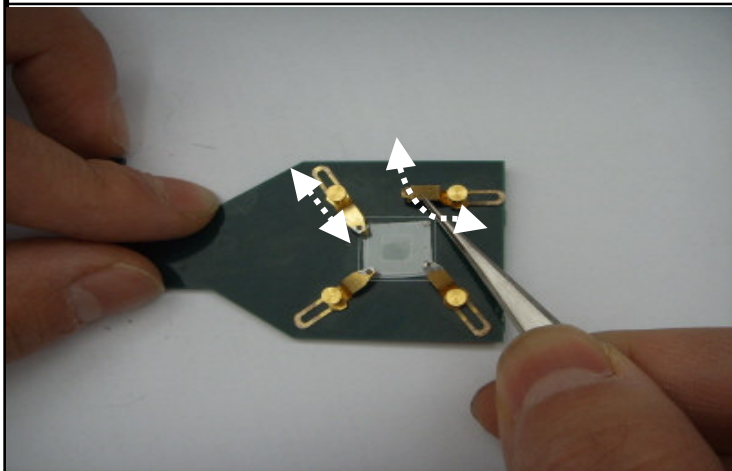
Sample was correctly on board on the center of PCB board as shown.

## NEW CLIP TYPE SAMPLE BOARD (2)



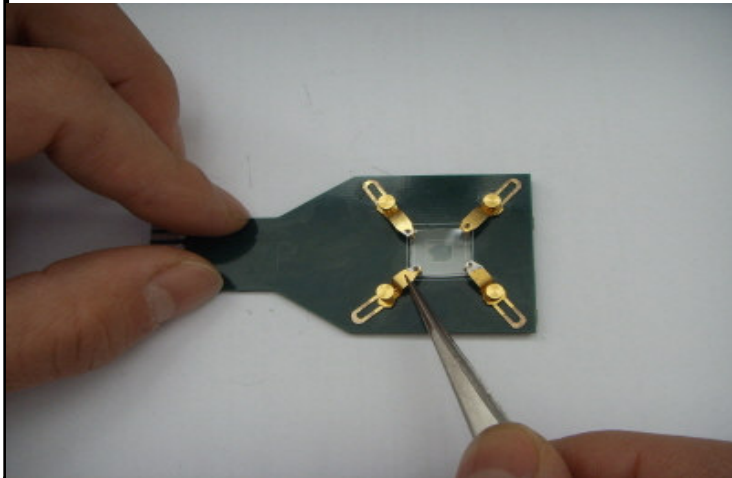
Lift clip and move onto the soldered point.

And, at this time, pogo pin will soften the impact on sample.



As explained above, pls go ahead 4 point edge at all.

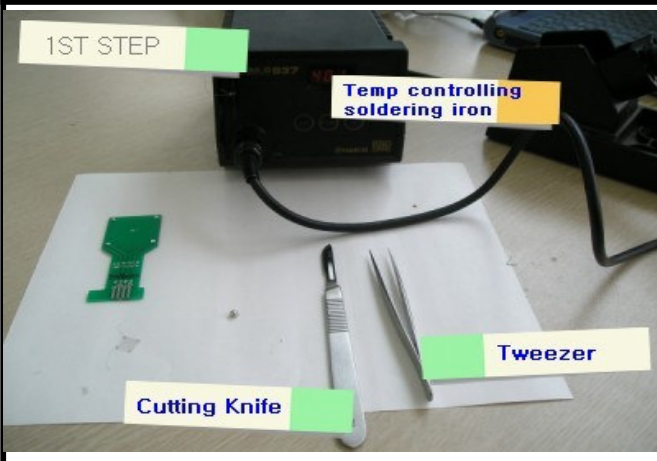

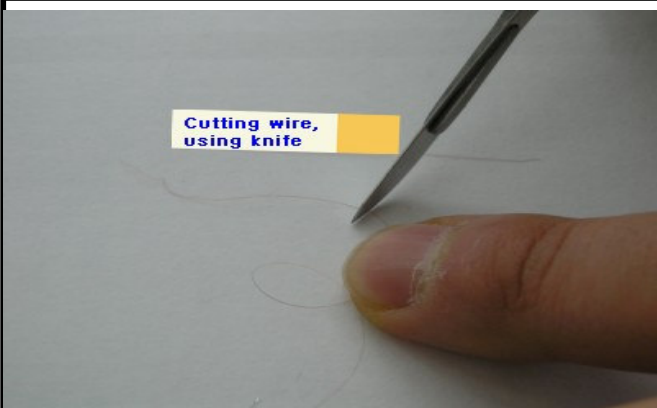
At this time, clip is freely moved up& down, left& right, forward & backward.





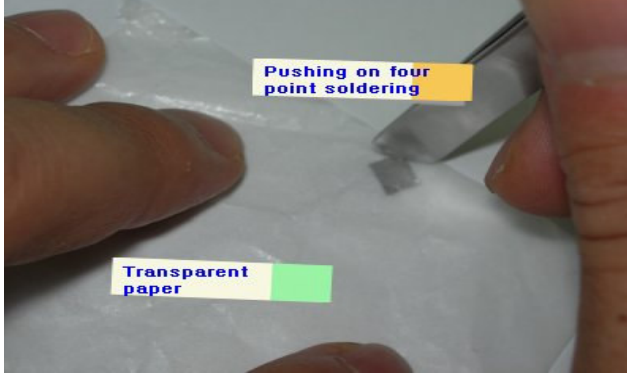
It was finished as shown.

It is all ready to measure.

## MOUNTING SAMPLE ON BOARD (1)

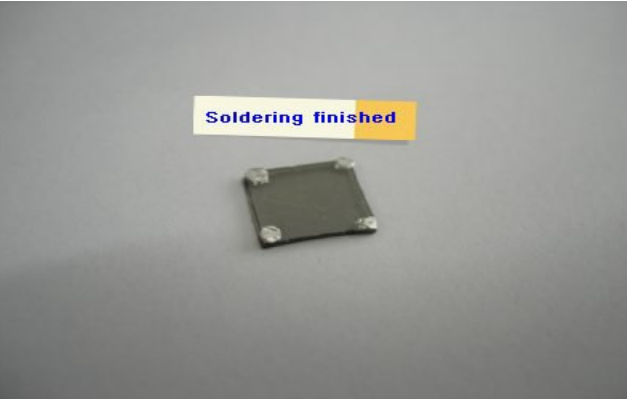
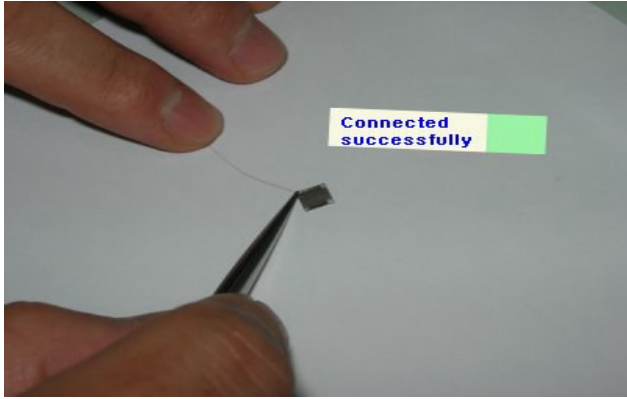
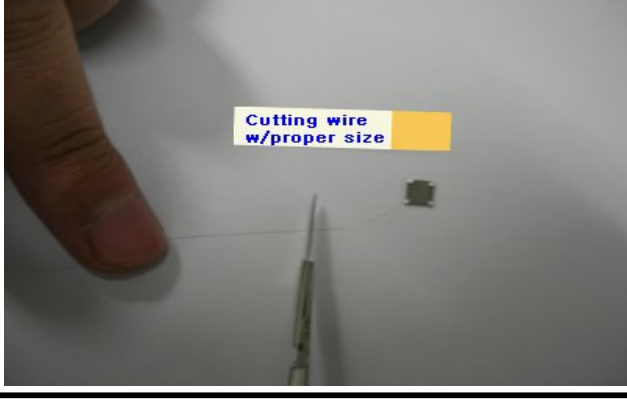
 <p>1ST STEP</p> <p>Temp controlling soldering iron</p> <p>Cutting Knife</p> <p>Tweezer</p> <p>A photograph showing the tools for the first step: a temperature-controlled soldering iron, a cutting knife, and tweezers, along with a small green sample board on a white surface.</p>	<p>User has to prepare for left cutting knife, tweezer, temperature control soldering iron, Sample board and InSn compound.</p>
 <p>Temp controlling soldering iron</p> <p>A close-up photograph of a hand holding a temperature-controlled soldering iron. The digital display on the iron shows the number 400.</p>	<p>When soldering, pls set up soldering iron on 350 ~ 400°C. It is best temp to solder. Too high and too low temperature is not so good to solder.</p>
 <p>Cutting wire, using knife</p> <p>A close-up photograph showing a hand using a sharp knife to cut a thin wire on a white surface.</p>	<p>Cutting copper wire or gold wire with proper size to connect, using sharp knife.</p>

## MOUNTING SAMPLE ON BOARD (2)

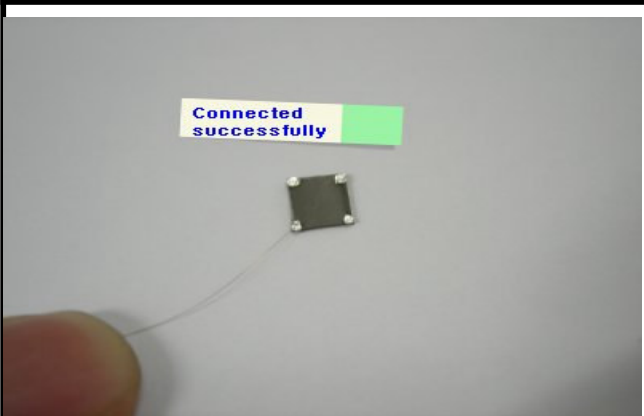

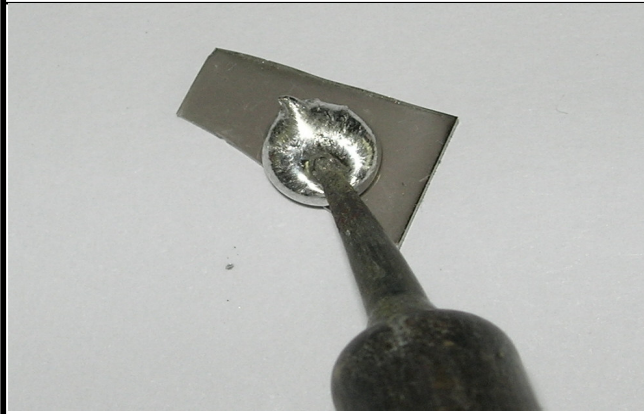
 <p>Cutting InSn compound minutely</p>	<p>Cutting InSn compound minutely.</p> <p>InSn can be usually used for electrical conductivity material. However, for some other samples, silver paste, carbon paste are recommended to improve ohmic contact.</p>
 <p>Soldering in four points, using iron.</p>	<p>Soldering in four points , using soldering iron. It has to be done in four points edge. And, if it was not annealed sample, annealing about 1min might be helpful.</p>
 <p>Pushing on four point soldering</p> <p>Transparent paper</p>	<p>After soldering in four points edge, four points should be flat , using transparent paper and tweezers. It might help to connect wire to soldering. Just push slightly above , seeing through transparent paper.</p>



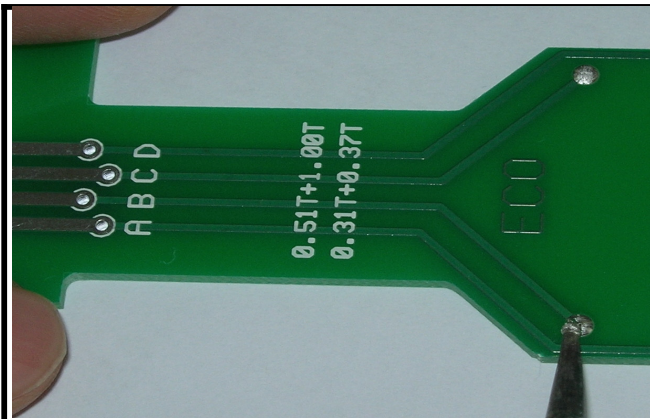
## MOUNTING SAMPLE ON BOARD (3)

 <p><b>Soldering finished</b></p>	<p>Four points soldering was finished as left pictures.</p>
 <p><b>Connected successfully</b></p>	<p>Put the wire on soldering edge and then push it slightly ,using tweezers.</p>
 <p><b>Cutting wire w/proper size</b></p>	<p>Cutting copper wire or gold wire with proper size to connect , using sharp knife.</p>

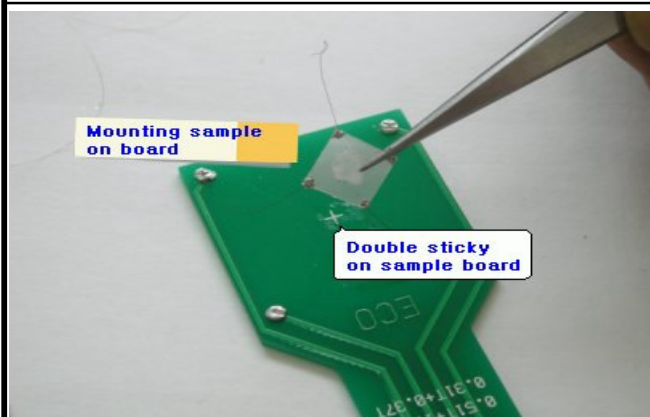
## MOUNTING SAMPLE ON BOARD (4)

 <p>Connected successfully</p>	<p>Connected successfully. Pull the wire slightly to check if it is really connected.</p>
 <p>Connecting finished on four points.</p>	<p>Connect wire to soldering 4point each. It was successfully connected as left.</p>
	<p>Put the InSn compound on the sample not used. And, put the soldering iron onto InSn. It is melted as shown left.</p>

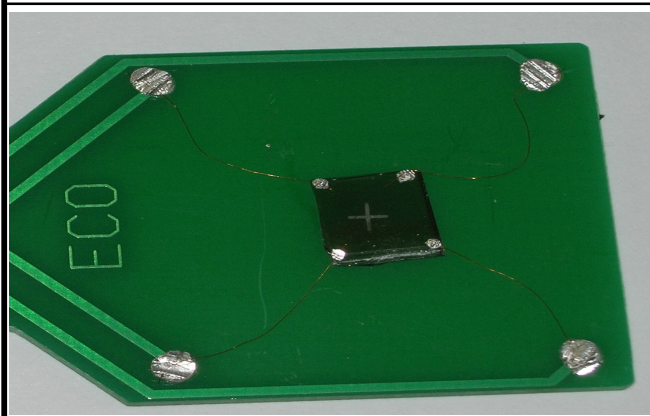
## MOUNTING SAMPLE ON BOARD (5)



Put the soldering iron that has melted InSn compound onto four point as shown left. It 's o.k to be proceeded in the first step in advance.



Put the connected sample on the center of the PCB board. There is double sticky tape on the center of the sample. And, then connect wire on the soldering of 4point of PCB.



It was finished to connect wire to soldering on 4points and mounting sample on PCB board.