DIY RF CURRENT PROBE

Carpov Pascual - Field Application Engineer

CONTENTS

MATERIALS NEEDED

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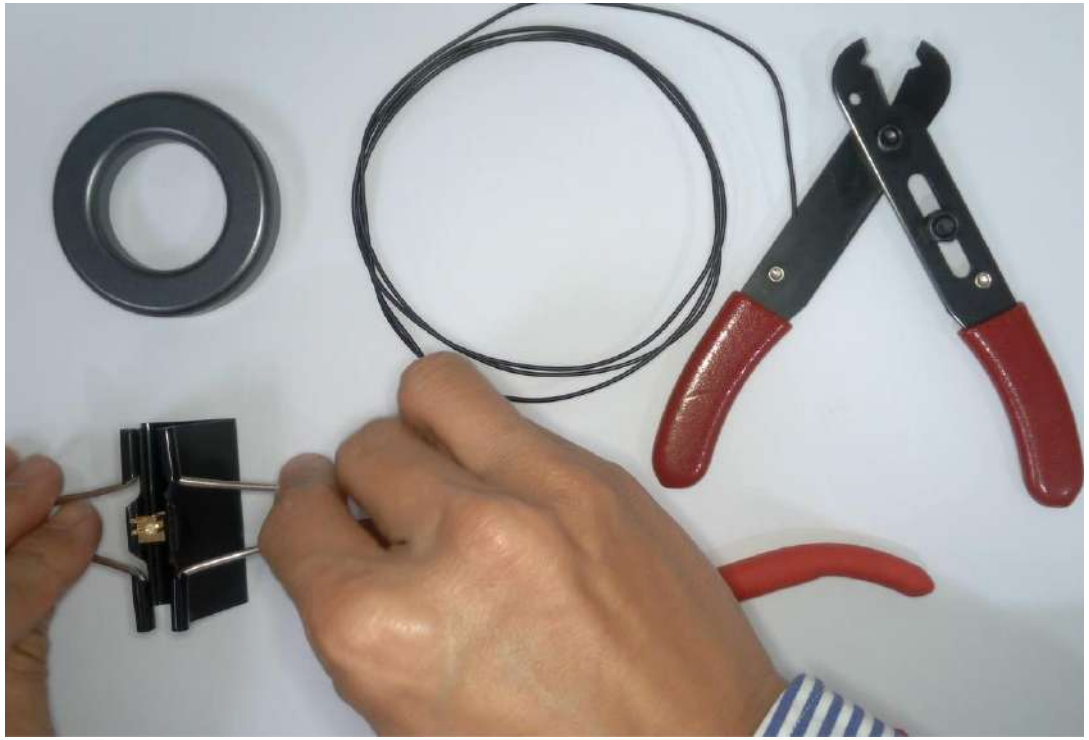
1. 60312002114503 - WR-SMA PCB THT Jack Straight - Male SMA Connector (X1)
2. 74270097 – WE-TOF Toroidal Ferrite (X1)
3. 33040 - WE-TS Shielding Textiles (4cm X 40cm) X 1 + (4cm X 2.5cm) X 8 – Fabric shielding
4. AWG 20/22 single core/solid PVC wire – 100cm (X1)
5. Electrical Insulation tape – 1 Roll (Any color)
6. Hot glue
7. Soldering kit
8. Wire cutter

TOOLS NEEDED – PART 1

PREPARATION
PART 1

PREPARATION

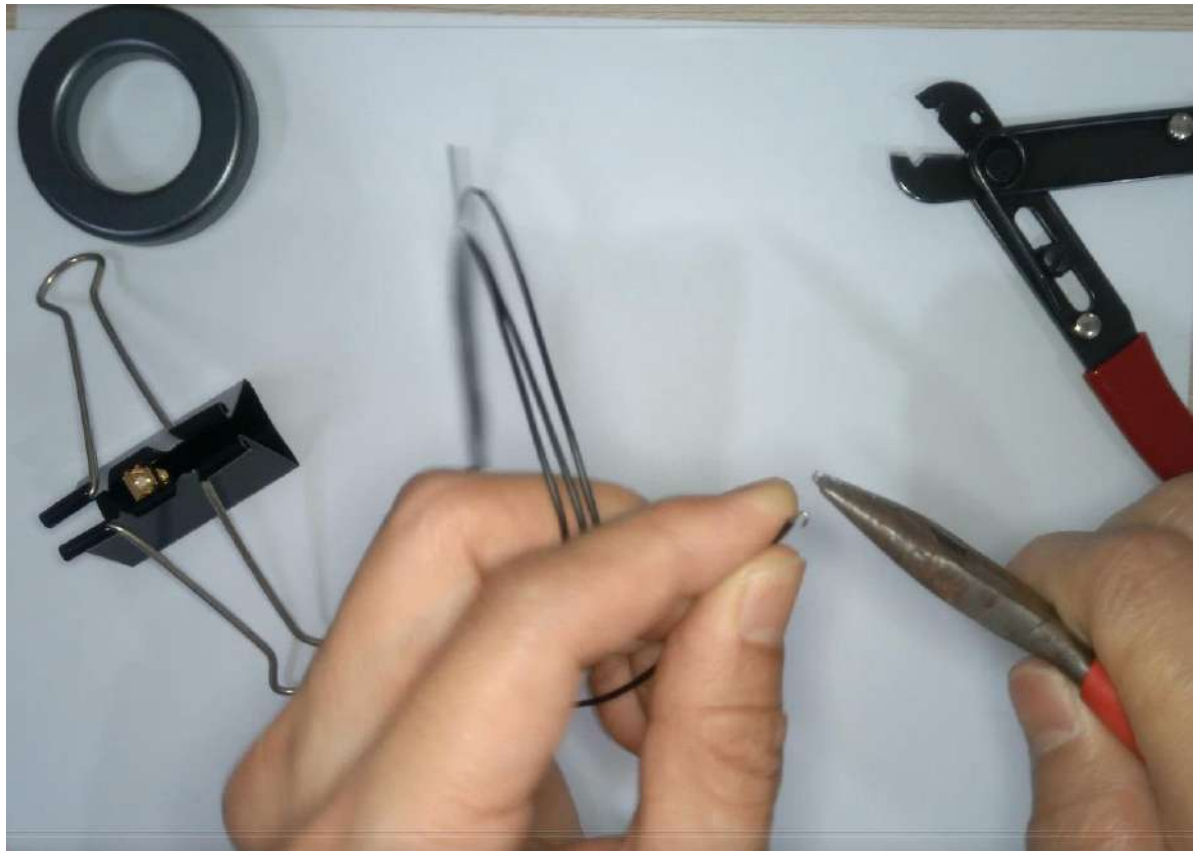
Clip the SMA connector on the Binder Clip



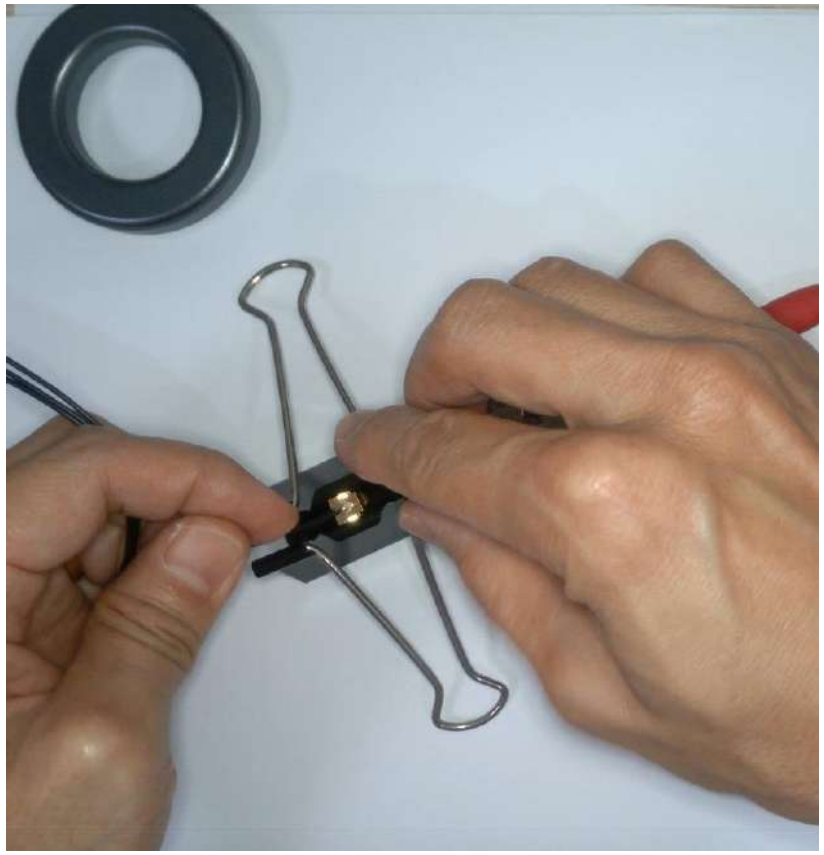
Prepare the wire by removing the insulation

PREPARATION

Prepare the wire by bending it to J-hook

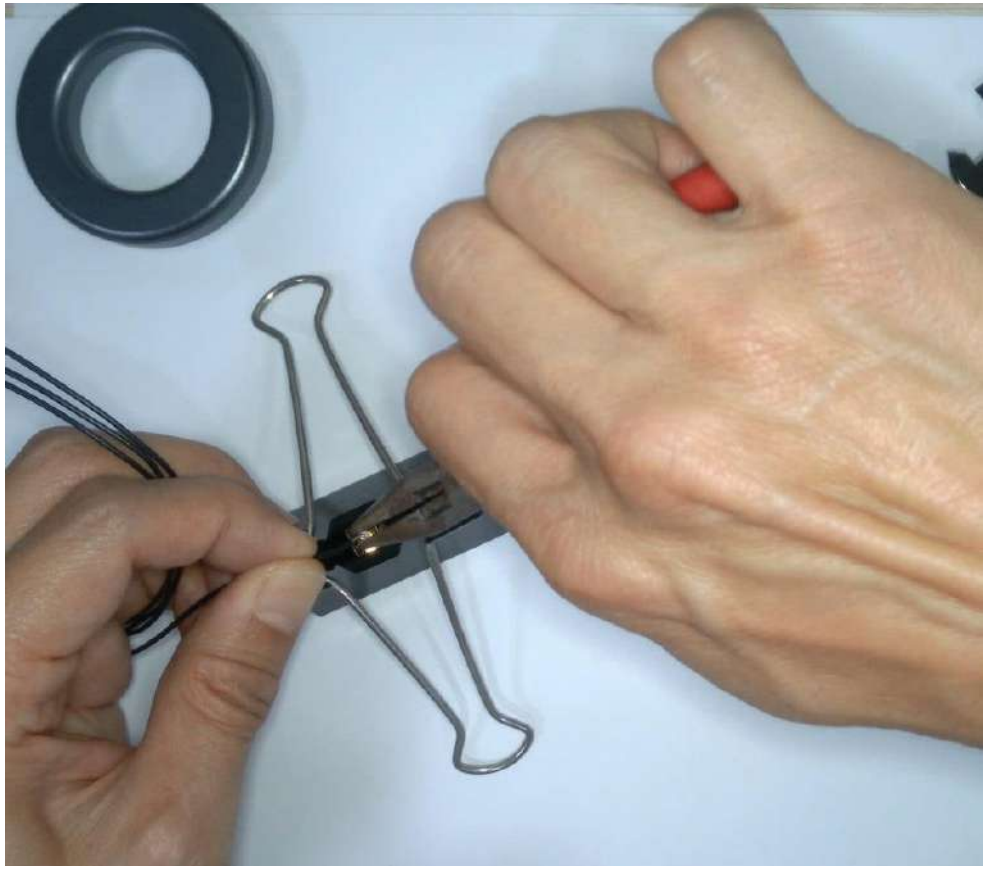


Attached the J-hook to SMA connector



PREPARATION

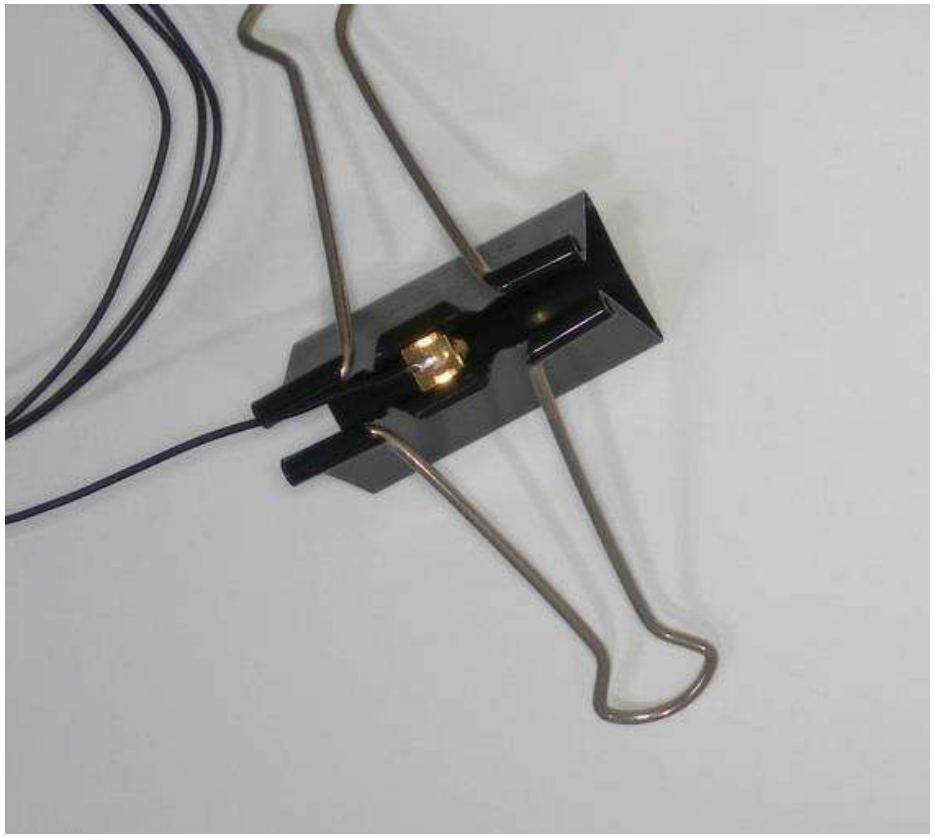
Press on the J-hook to secure it to SMA connector pin



Solder the SMA connector

PREPARATION

SMA connector solder securely

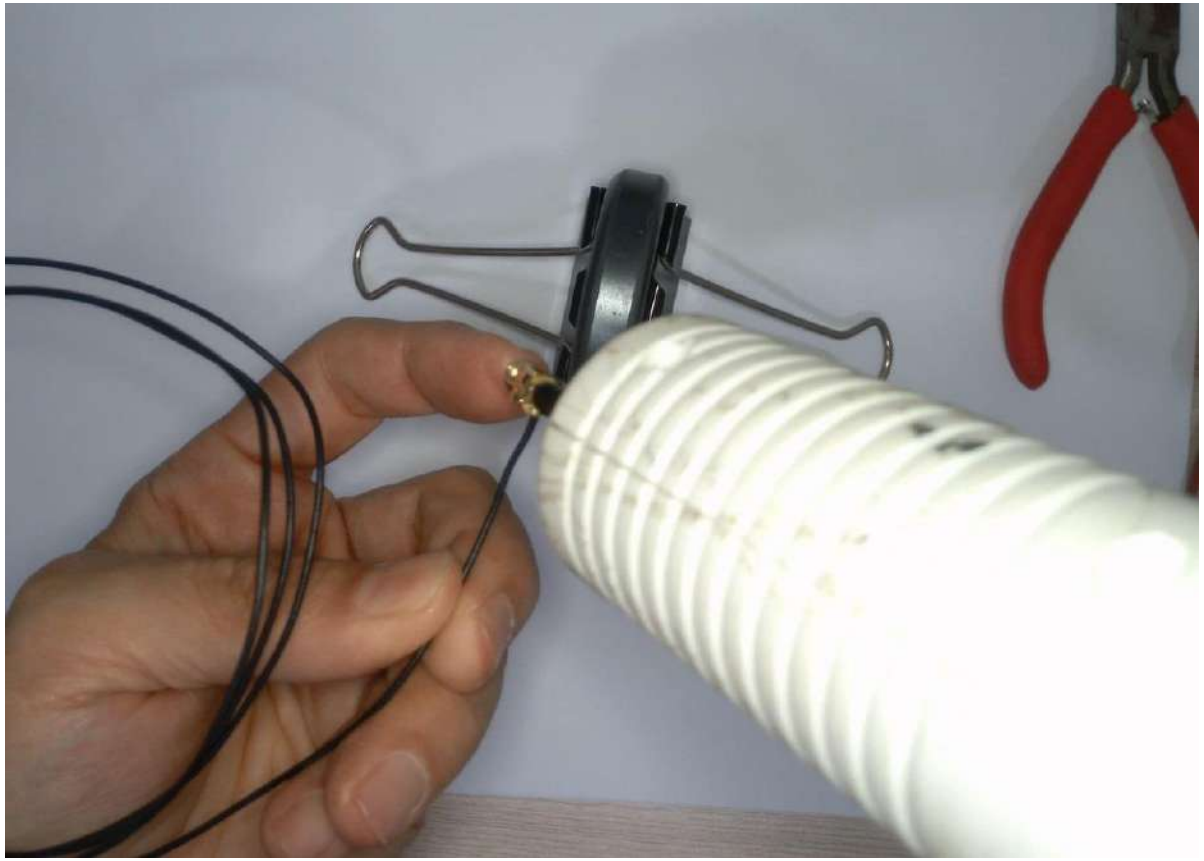


Inspect SMA connector pin solder quality

PREPARATION

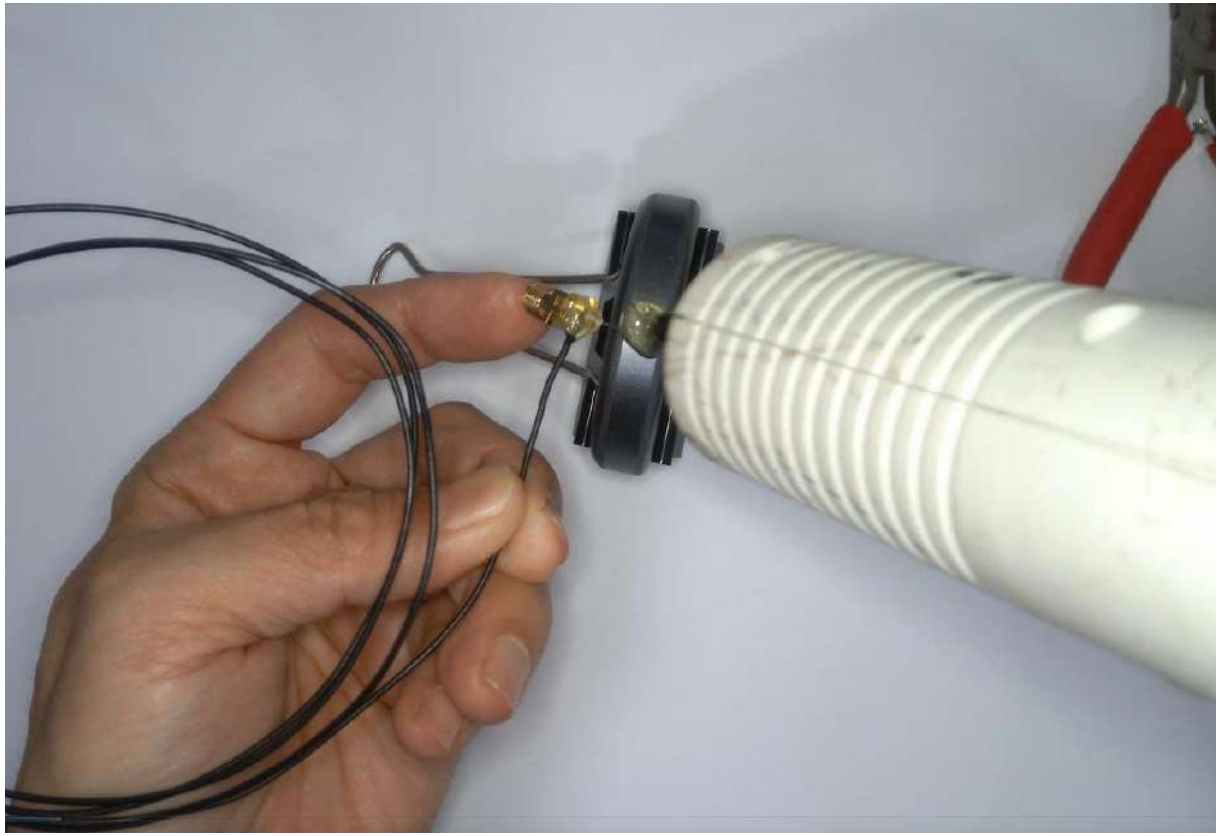
Clamp Ring Ferrite on binder clamp securely

Apply hot glue on SMA

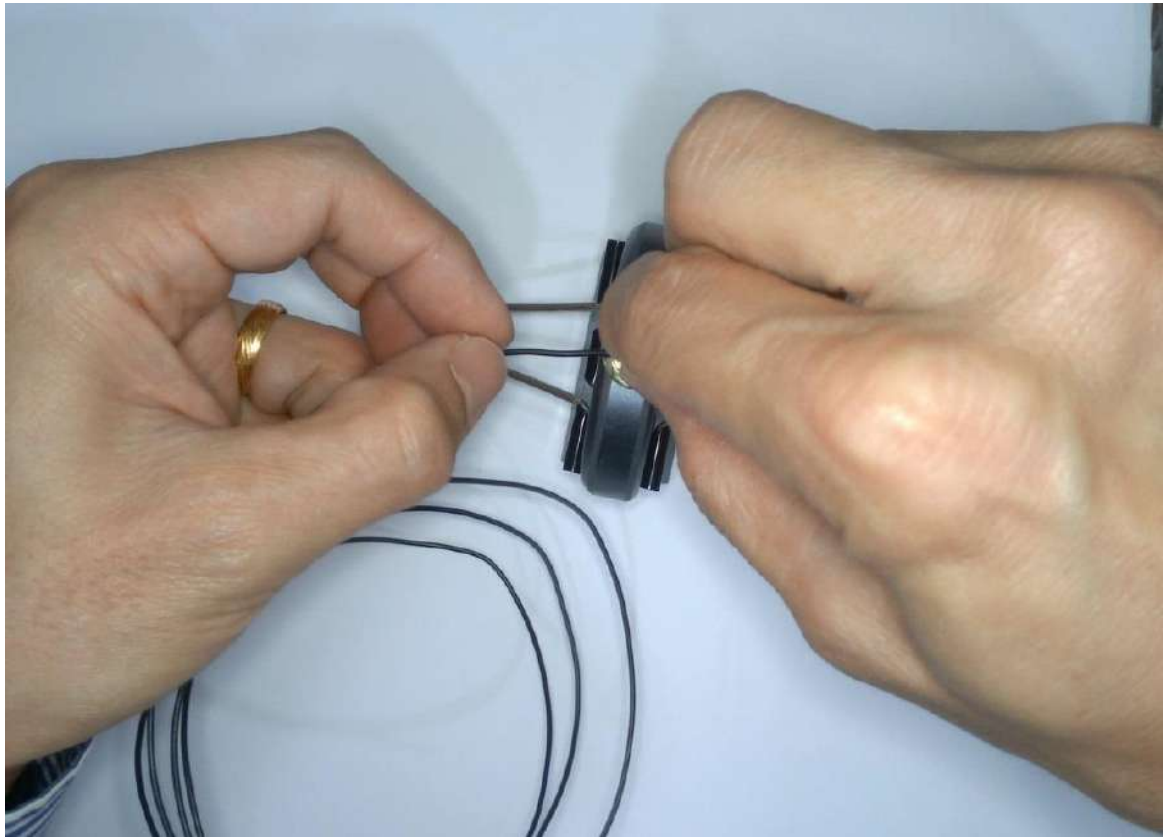


PREPARATION

Apply hot glue on ferrite surface

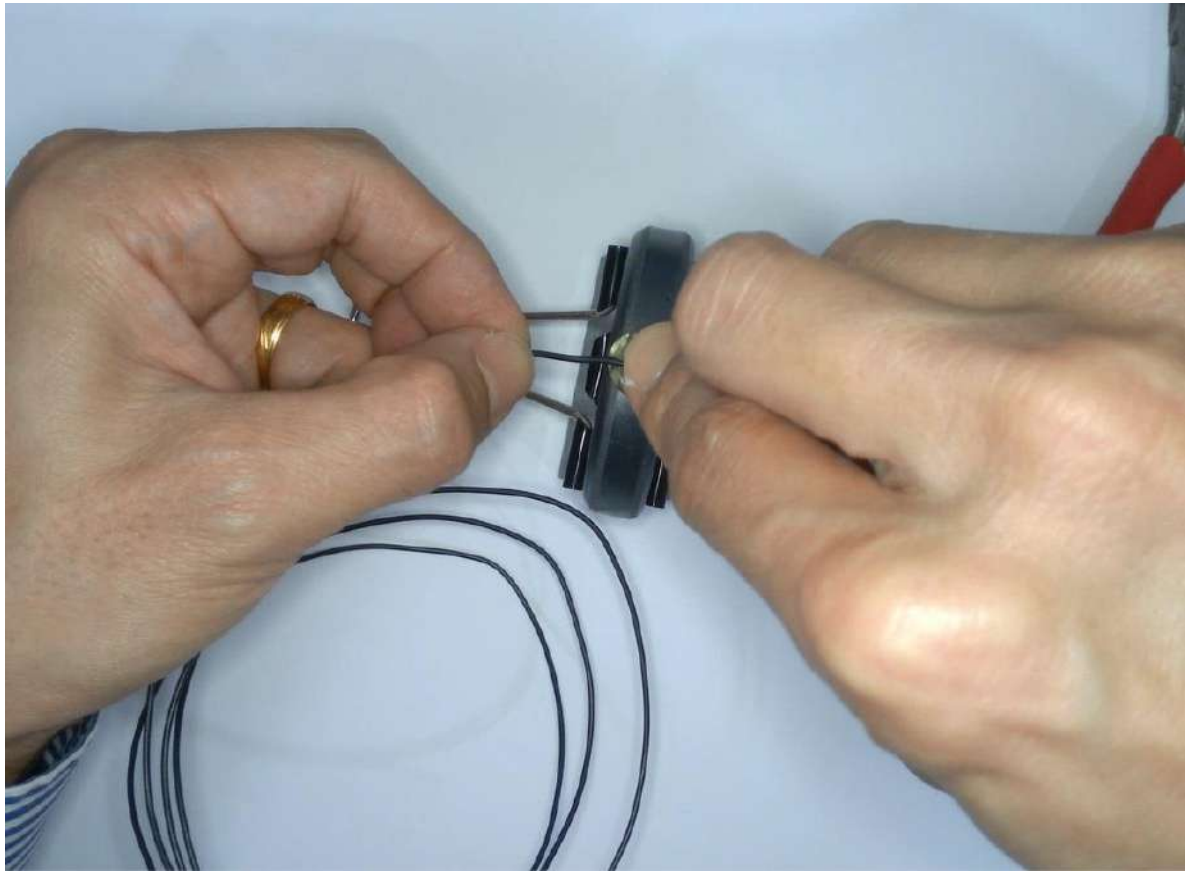


Attached the SMA connector to ferrite to glue them

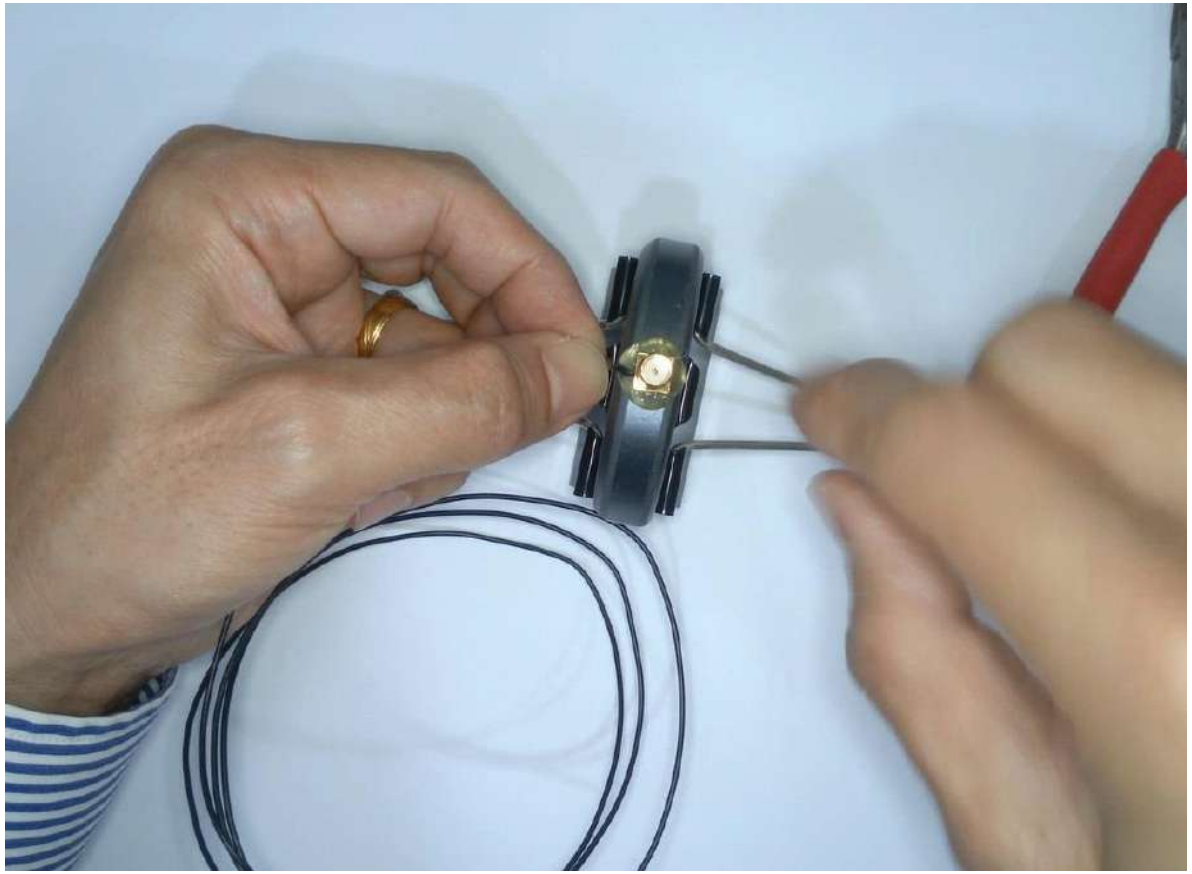


PREPARATION

Pressed down firmly to secure the part

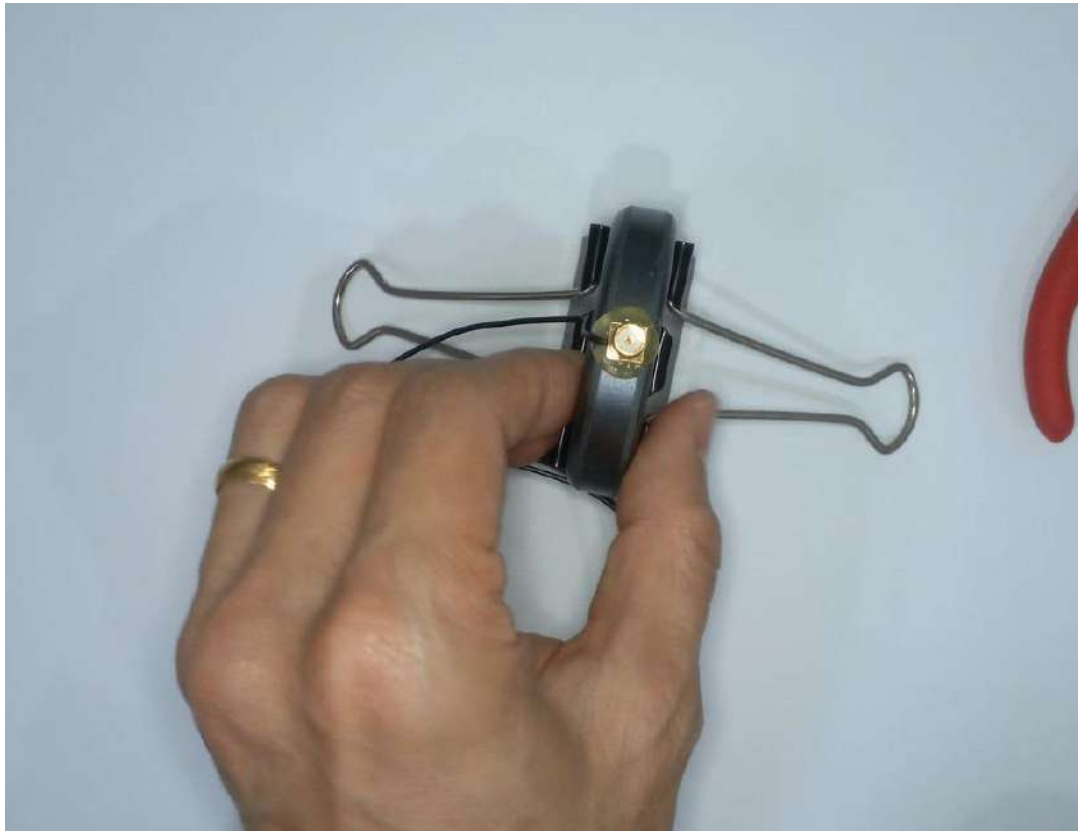


Wait until the hot glue cold down and set



PREPARATION

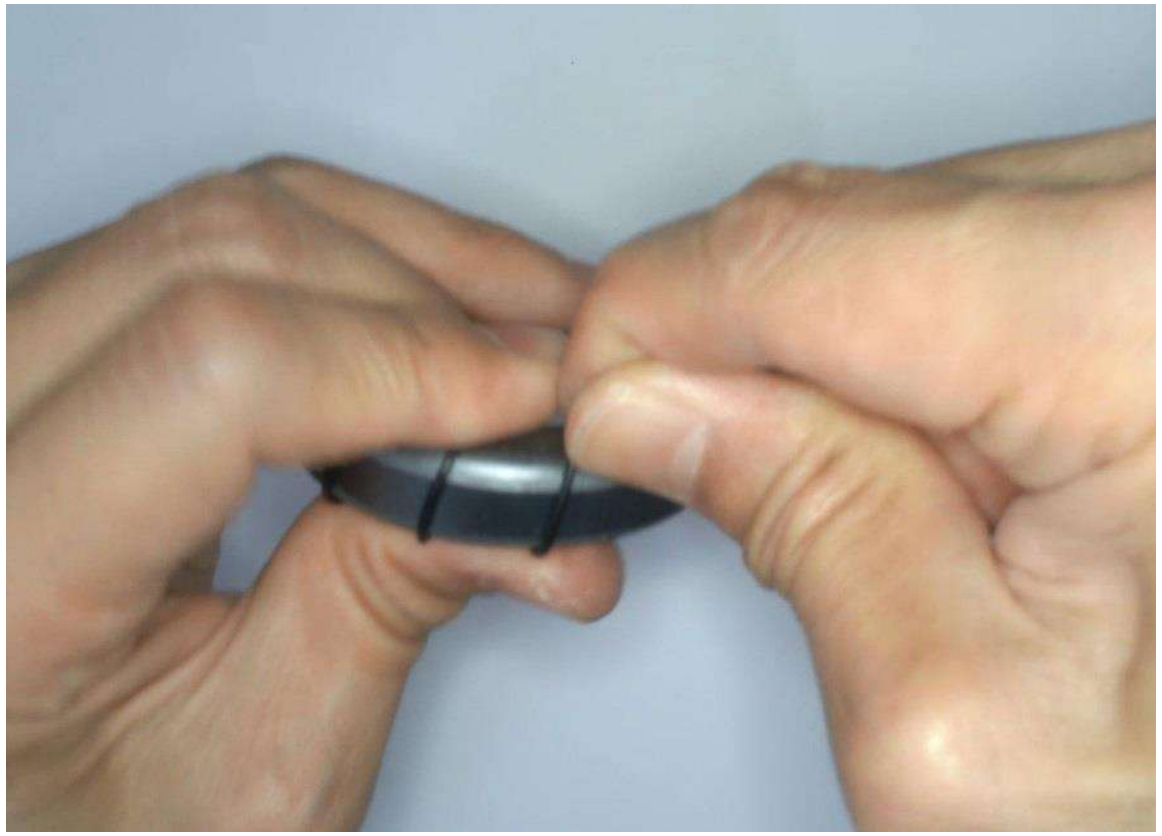
The gluing process is done



Carefully start winding the wire to the ferrite core

PREPARATION

Wind the wire in equal spacing of ~1.5cm

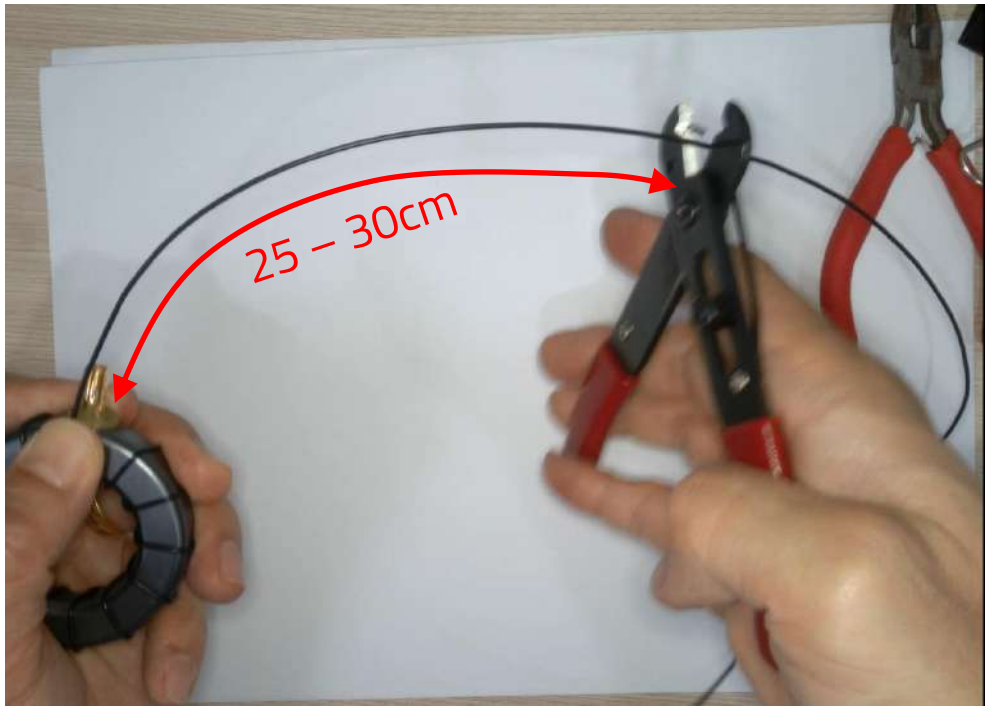


Wind the wire between 8 to 12 turns around the ferrite

PREPARATION

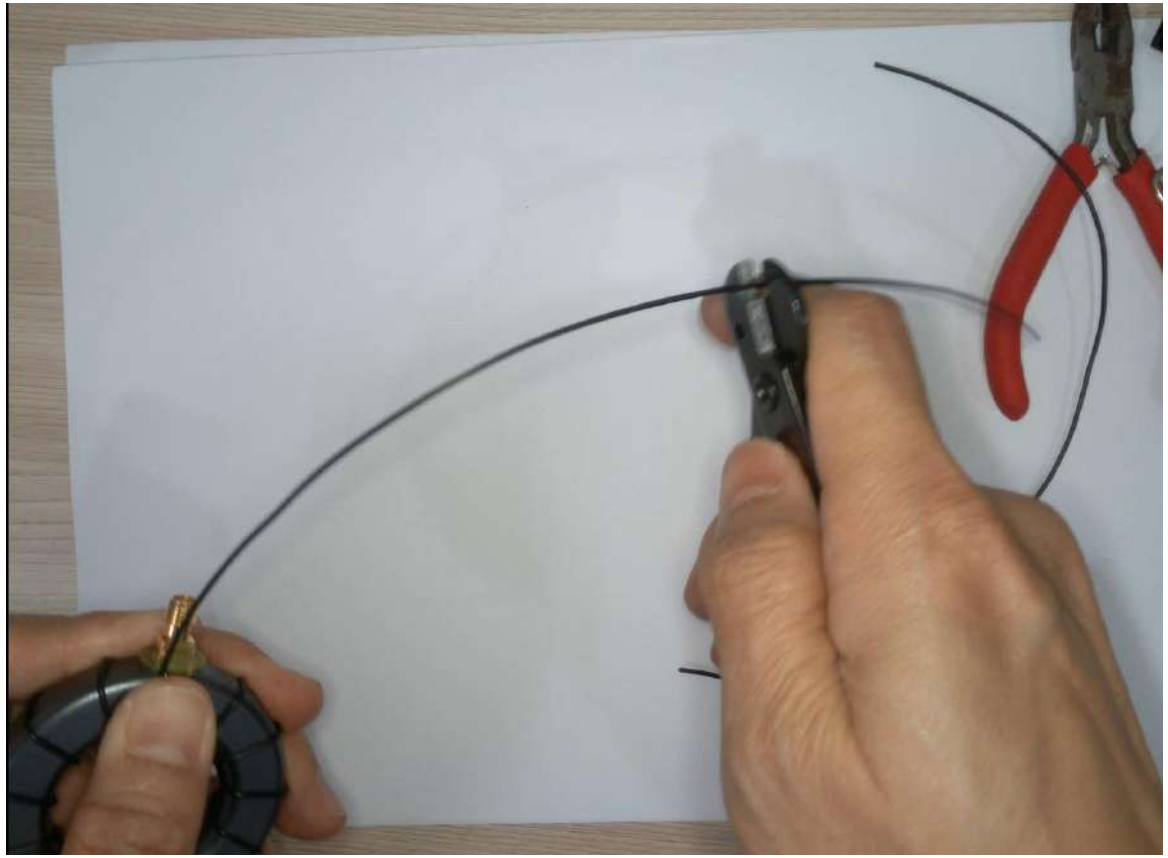
Towards the end. Gauge the wire length

Leave about 25 cm to 30cm of wire length

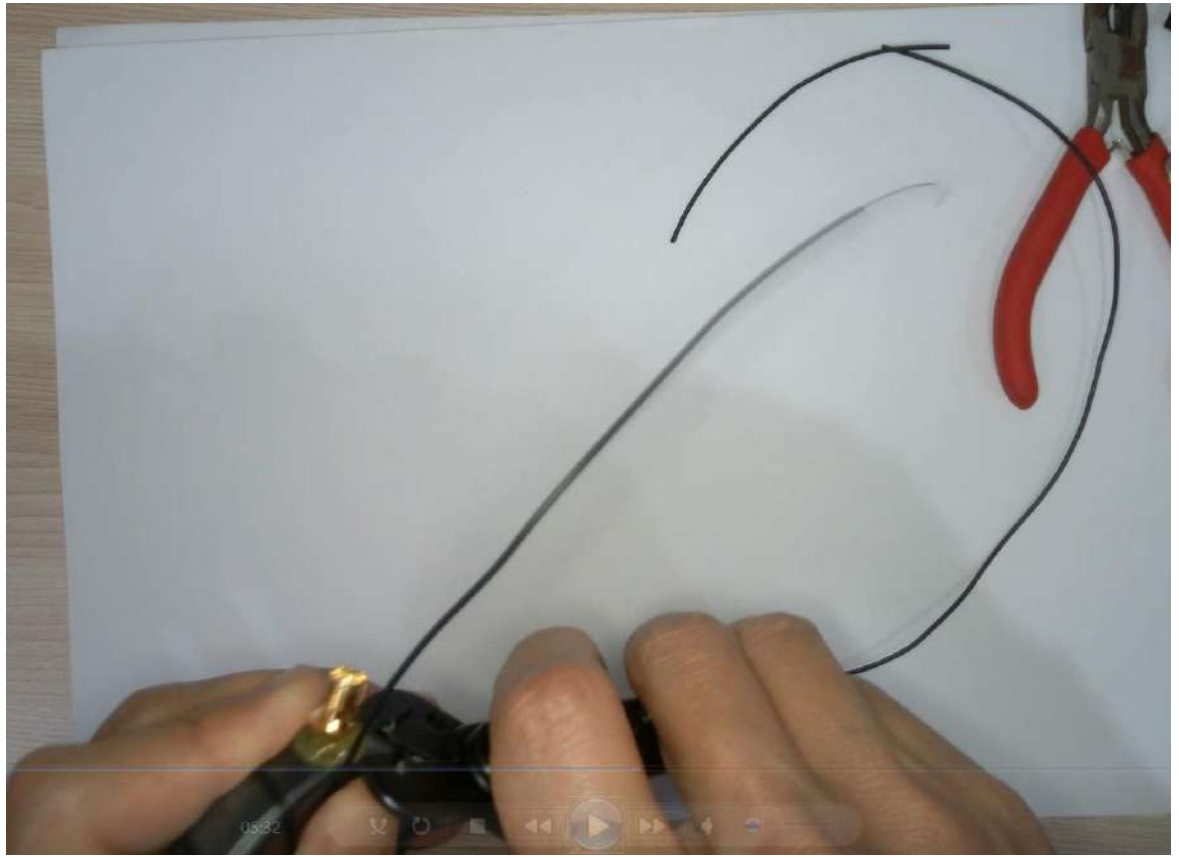


PREPARATION

Removed the insulation ½ the let over length



Trim of the remaining insulation to expose the copper wire



PREPARATION

Start wrapping the copper wire around SMA connector.

Wrap the copper wire few round around SMA connector to secure and reinforce the SMA connector with the core.

PREPARATION

Solder the copper wire to SMA connector carefully. Do not put too much solder on the SMA connector to **avoid covering the screw thread.**

Solder the side of the ferrite copper wire as shown in picture below as reinforcement to secure the SMA connector

PREPARATION

Inspect solder to ensure quality joint

Completed work for part 1

MATERIALS NEEDED

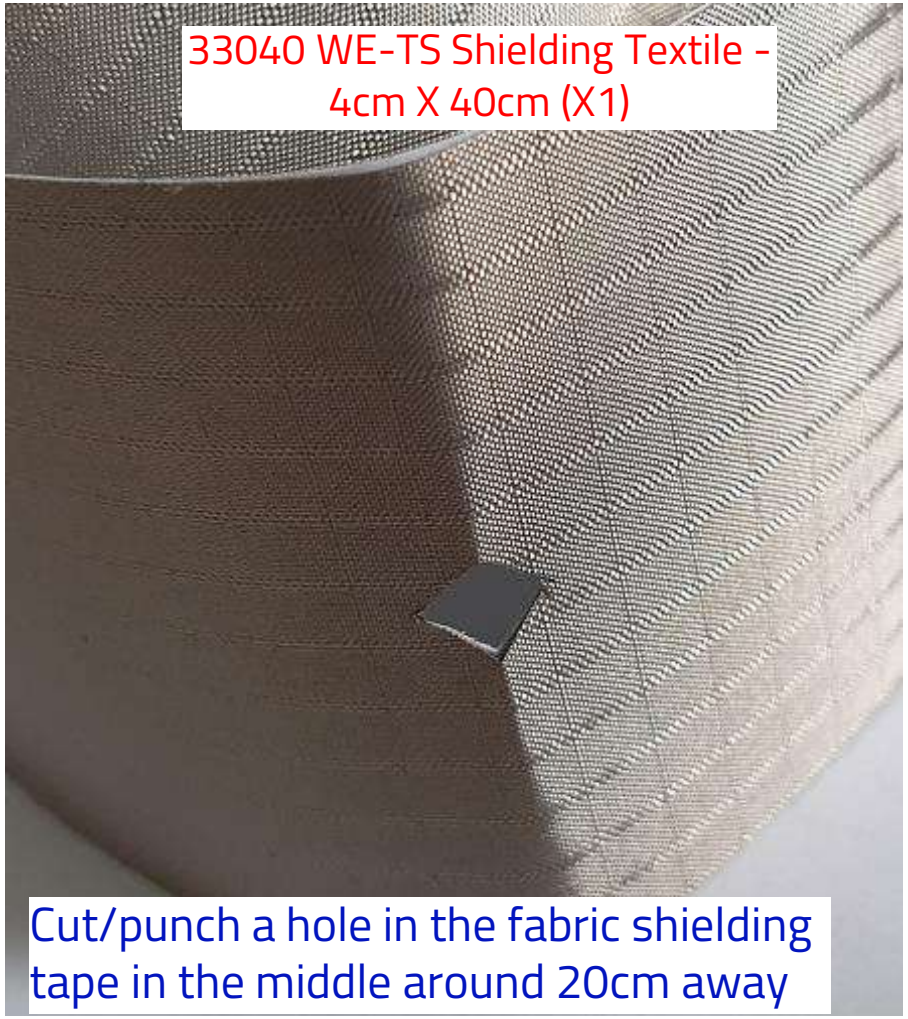
TOOLS NEEDED – PART 2

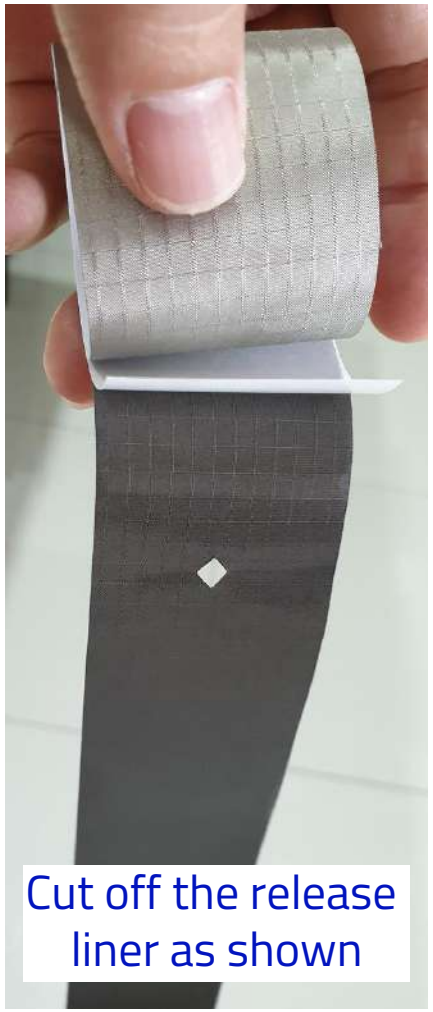
PREPARATION
PART 2

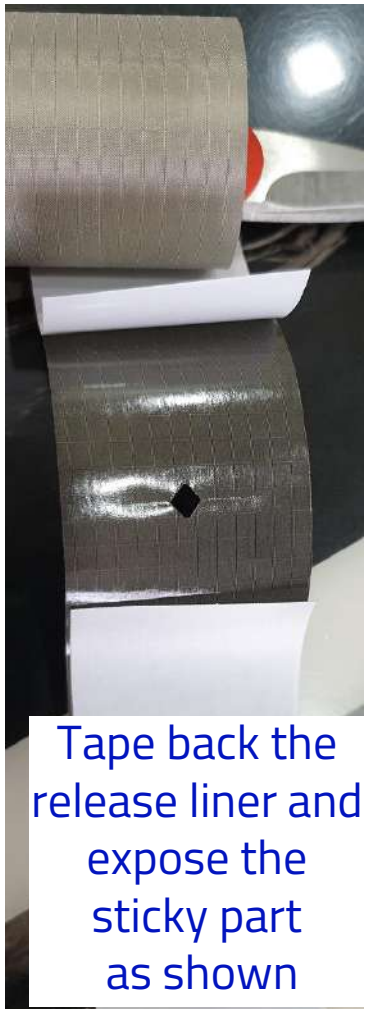
PREPARATION PART 2

Wrap one round of PVC tape to the Part 1 ferrite core

PREPARATION PART 2

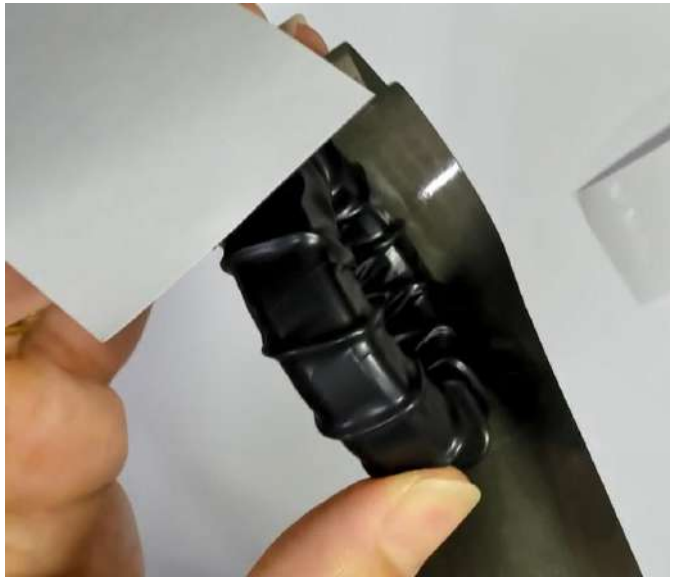




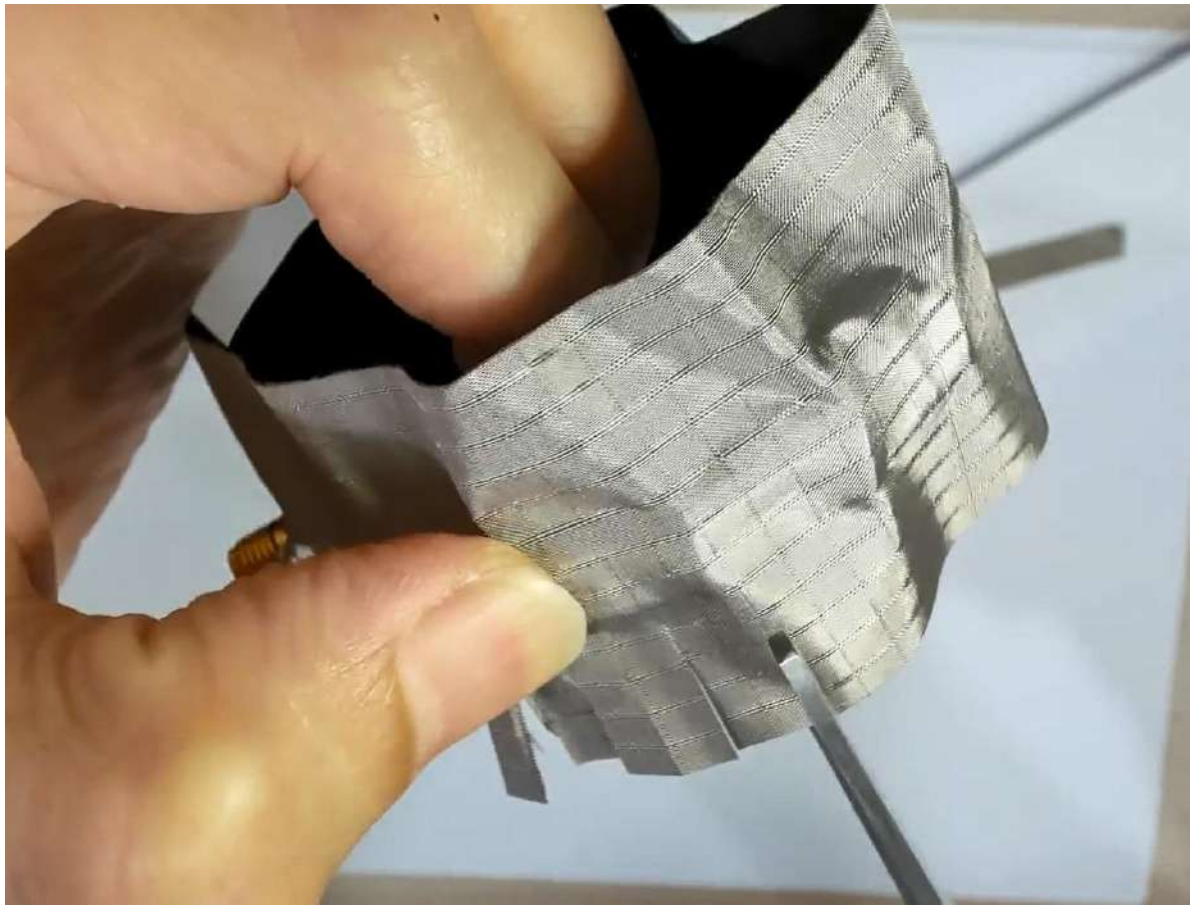


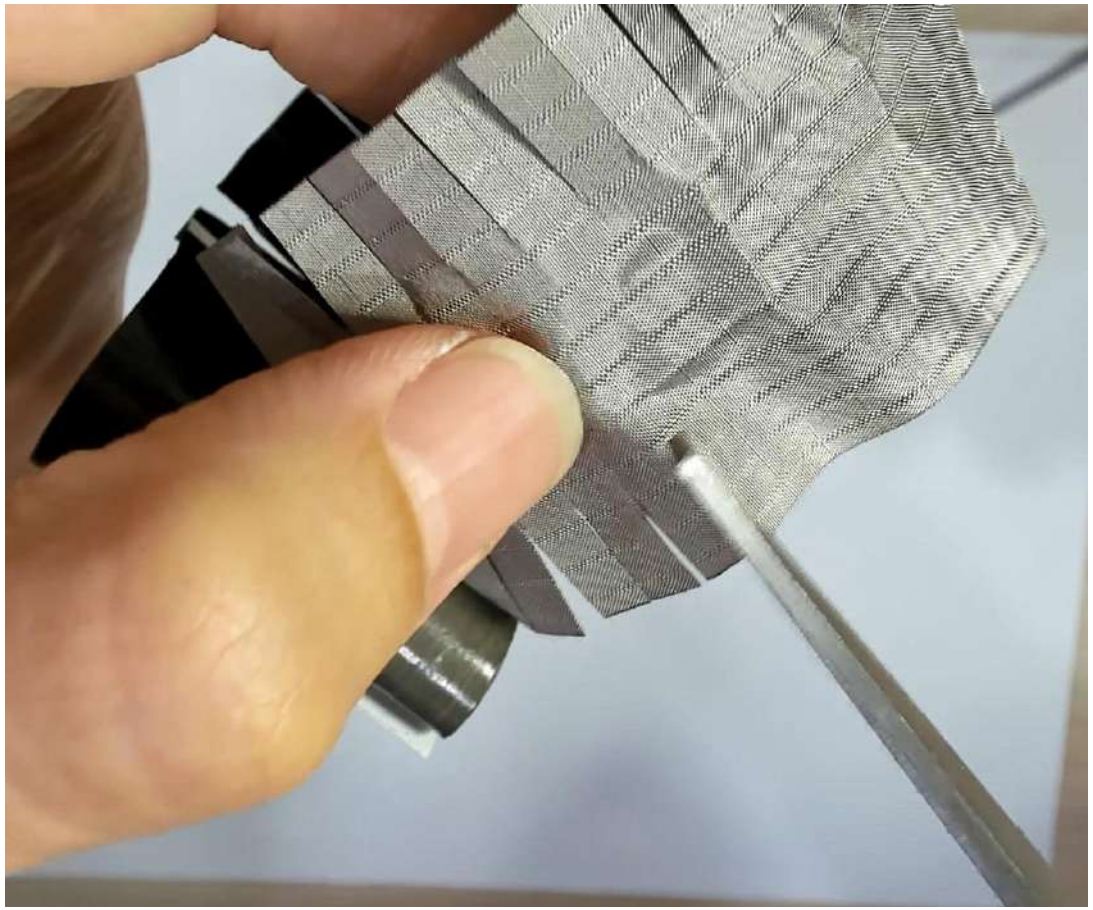
PREPARATION PART 2

Wrap the first half of fabric shielding around toroidal core



PREPARATION PART 2

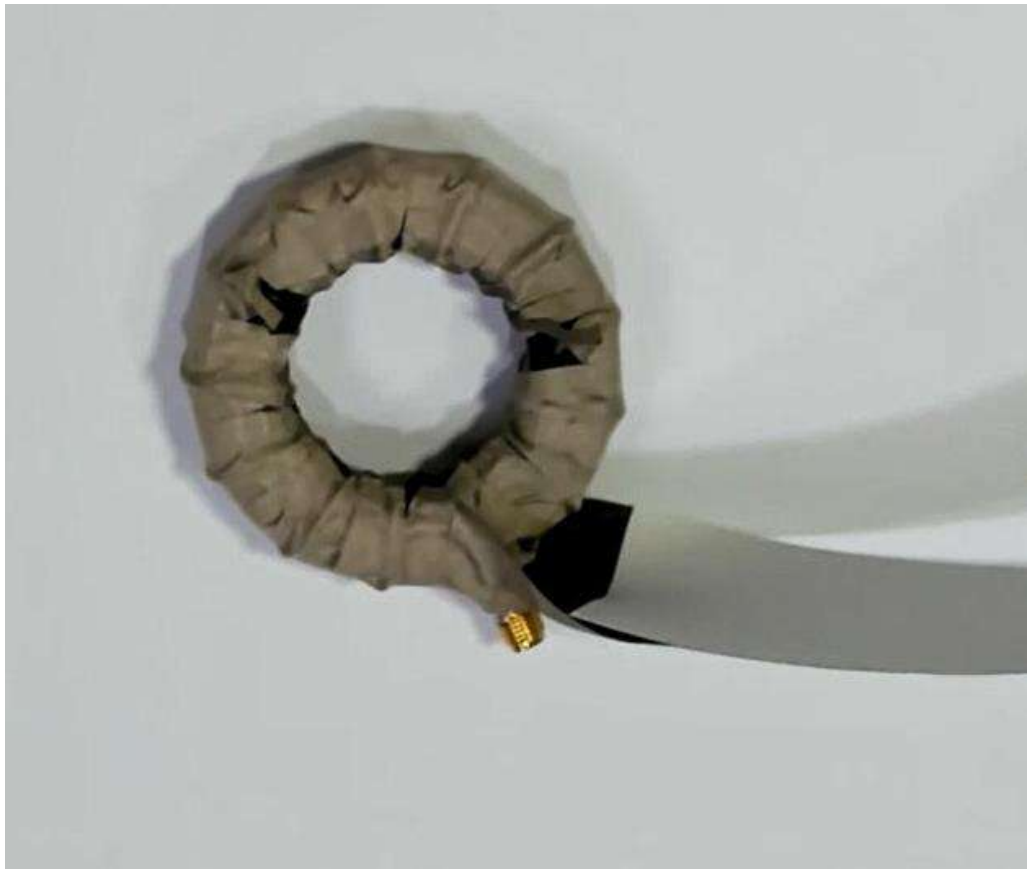




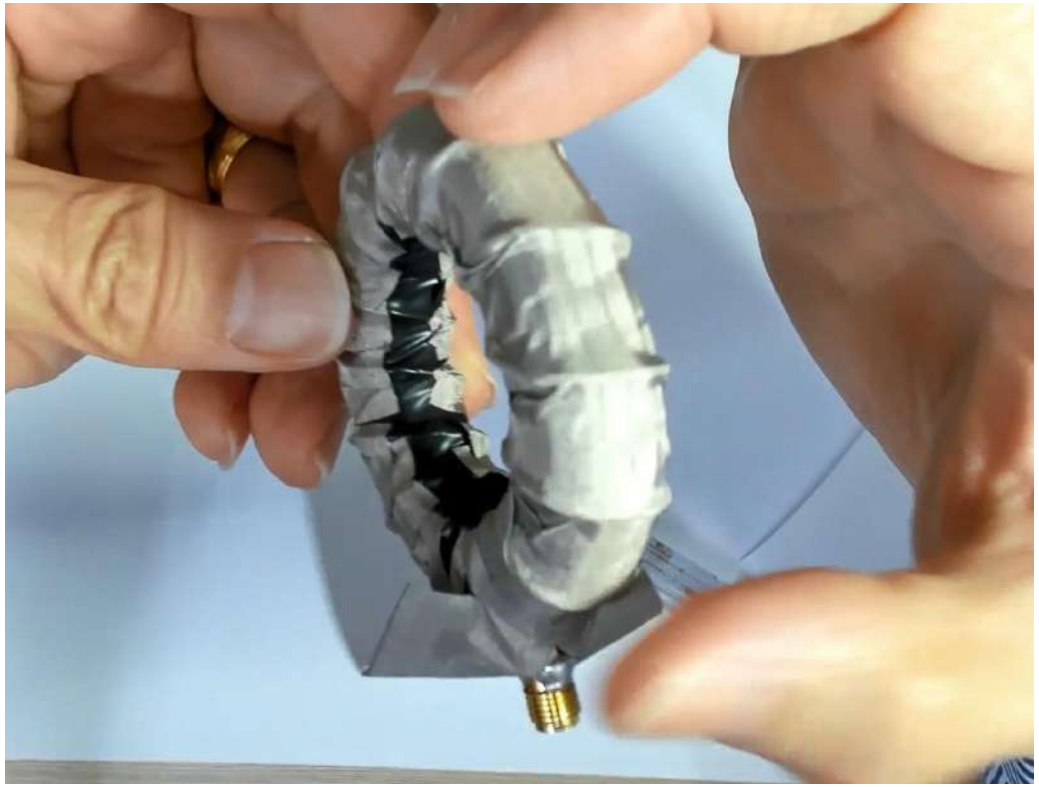
Cut the edges approximately 5mm apart and 10mm depth on both side

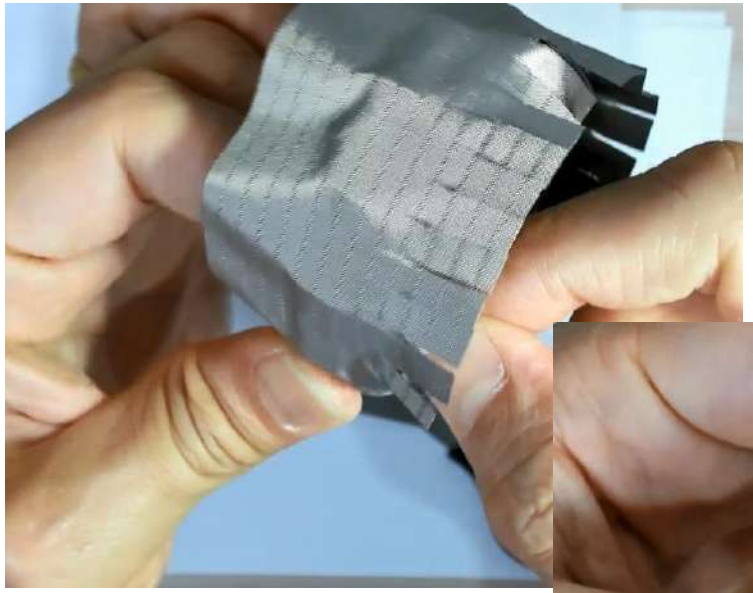
PREPARATION PART 2

Pull in and stick it to the inner part of toroidal core of first part of fabric shield



PREPARATION PART 2





Pull the fabric shielding as tight as possible to the inner core
There will be empty space in the middle of the core

PREPARATION PART 2

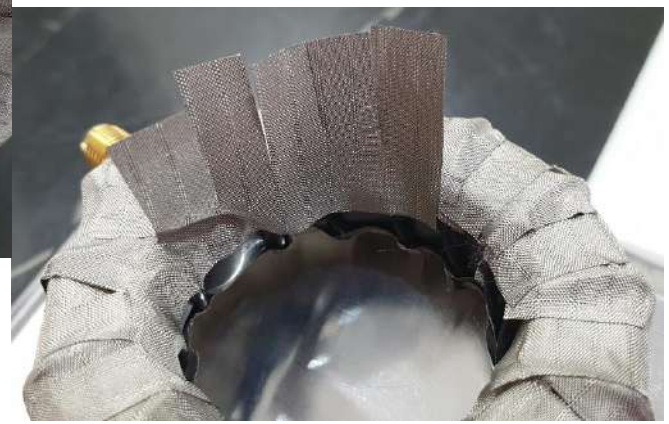
There will be empty space in the middle of the core

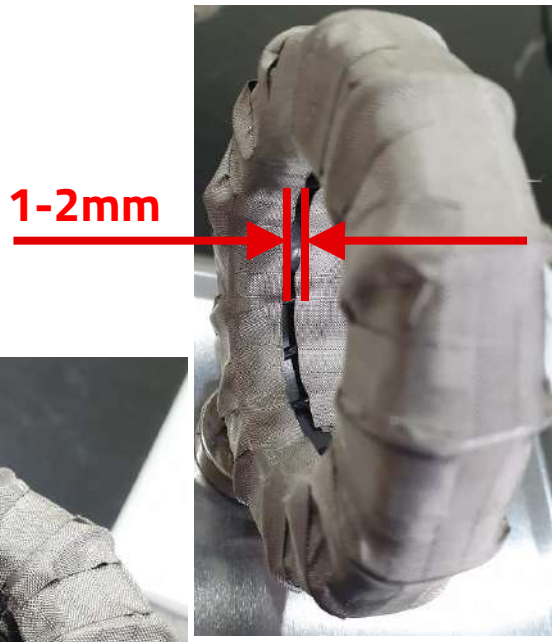
PREPARATION PART 2

The inner core of the toroidal ferrite will now have a big opening gap. This need to be reduced to 1~2mm gap

By using the small pieces of 4cm X 2.5cm fabric shielding …

PREPARATION PART 2





Paste the 4cm X 2.5cm fabric shielding around the inner core in such a way that it leaves a small even gap of (1~2mm) in the middle of the ferrite inner core

Repeat the steps until the entire inner gap are identical

The middle gap should be as even as possible to ensure measuring consistency

PREPARATION PART 2

Wrap another layer of PCV insulation tape tightly to the ferrite core to secure the shielding in place properly

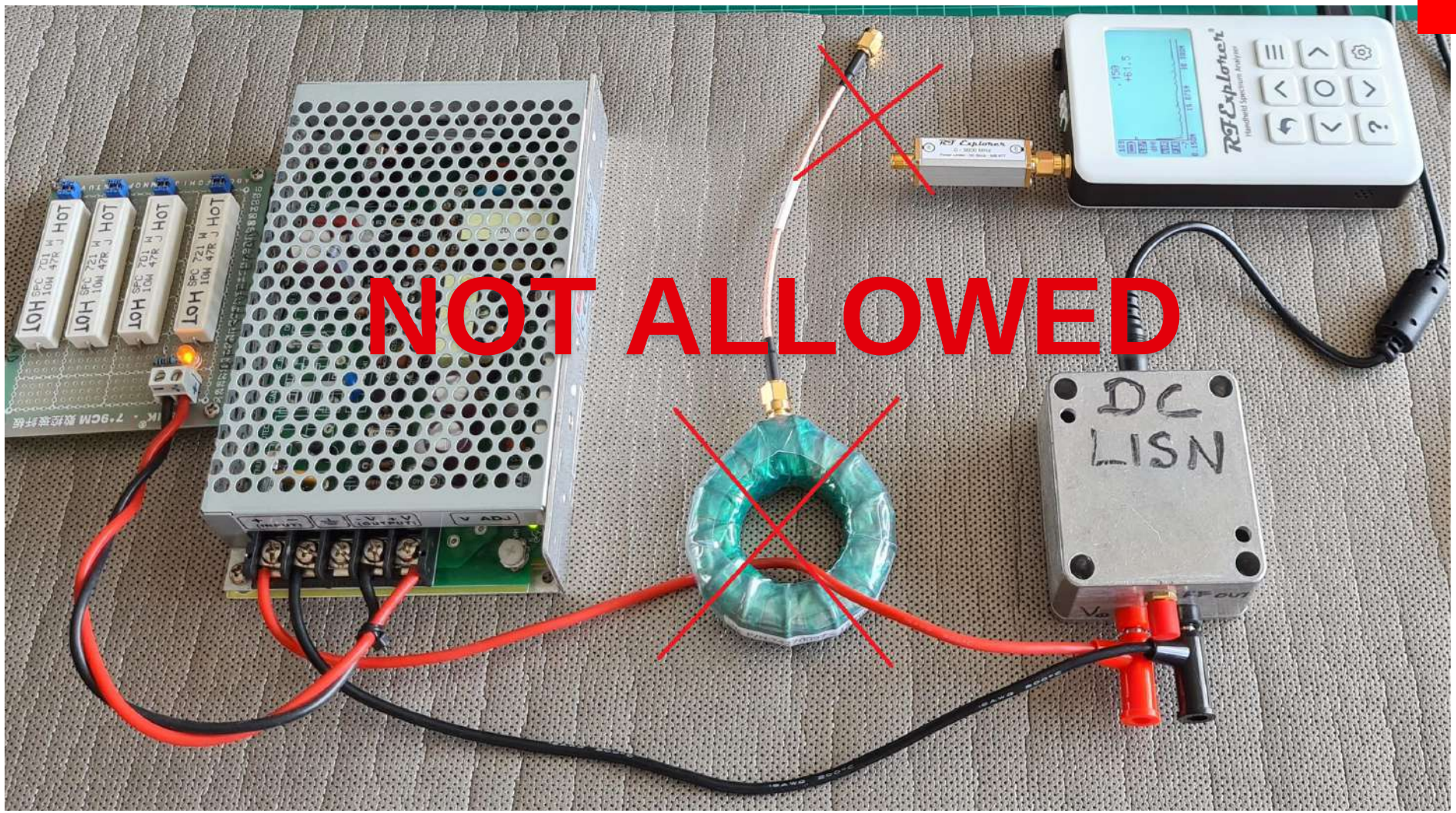
PREPARATION PART 2

Low cost RF current probe is done

TESTING

DO NOT CONNECT RF CURRENT PROBE AS SHOWN BELOW

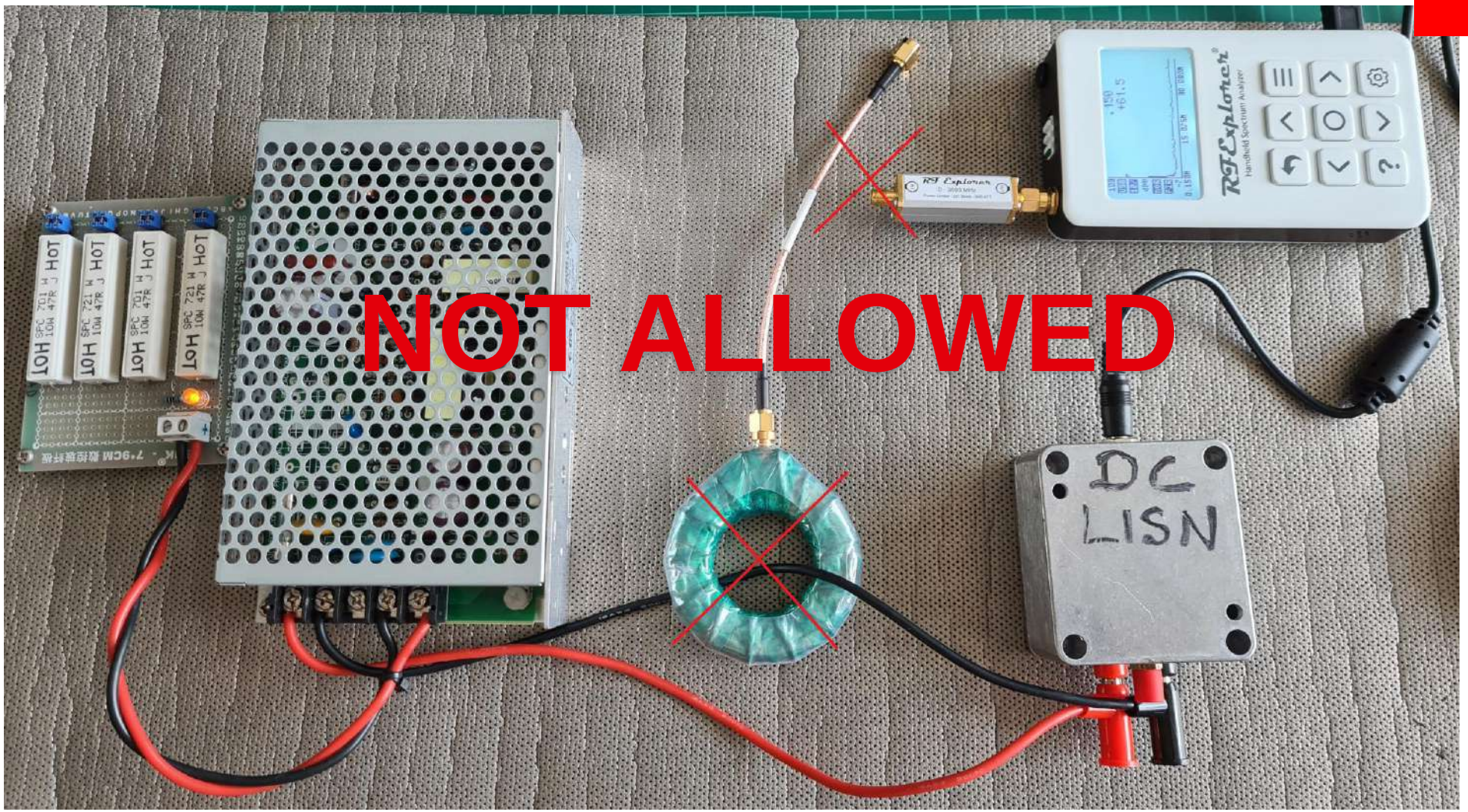
DON'T measure with ONE WIRE only



- Similarly, by monitoring just the positive wire of the load is measuring the actual load current. This will overload the spectrum analyzer sensitive receiver current detector which usually can only handle µA or nA RF current as well
- **This can damage the spectrum analyzer**

DO NOT CONNECT RF CURRENT PROBE AS SHOWN BELOW

DON'T measure with ONE WIRE only



- By monitoring just the negative wire of the load is measuring the actual load current. This will overload the spectrum analyzer sensitive receiver current detector which usually can only handle µA or nA RF current
- **This can damage the spectrum analyzer**

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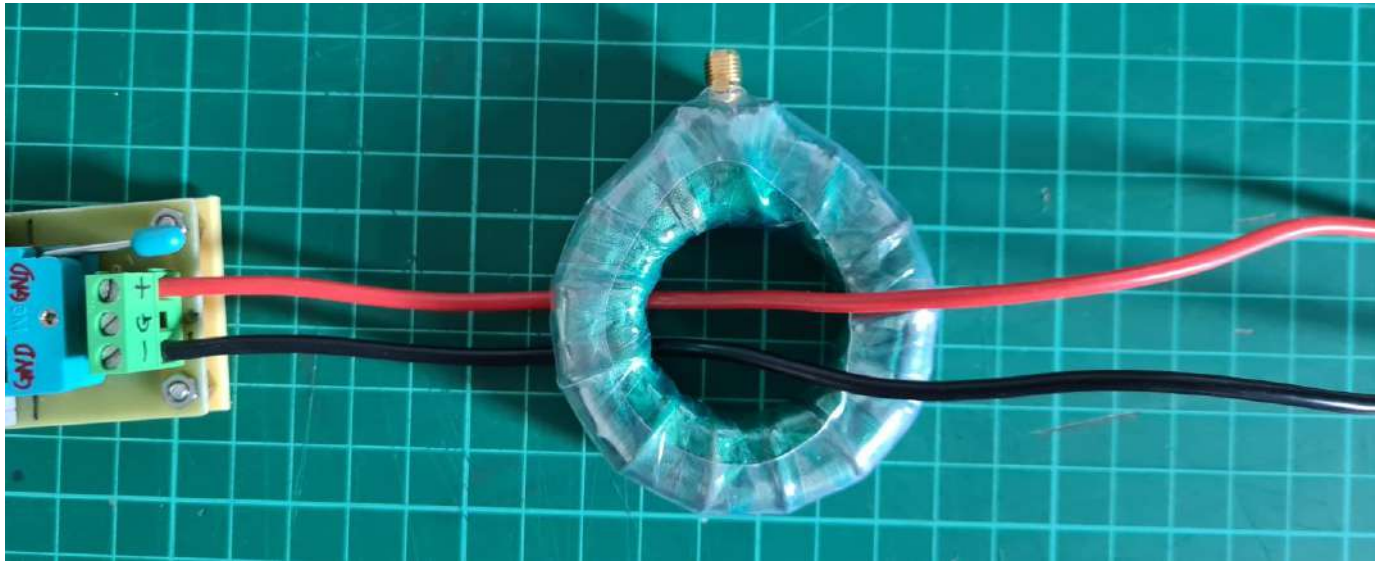
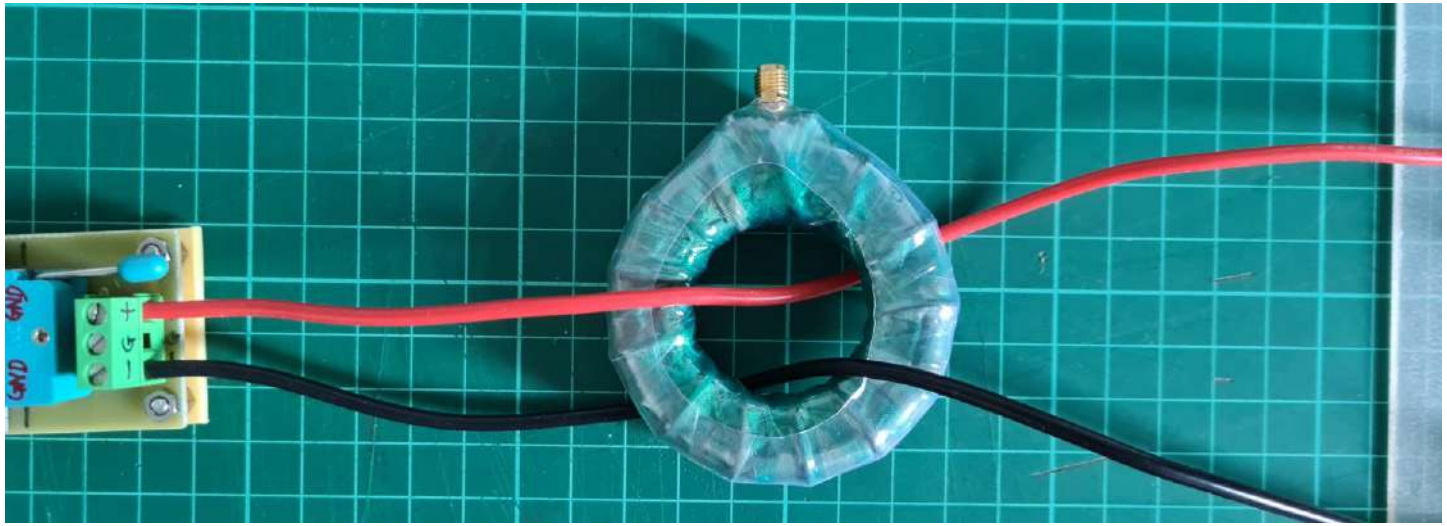
PROPER RF CURRENT PROBE CONNECTION

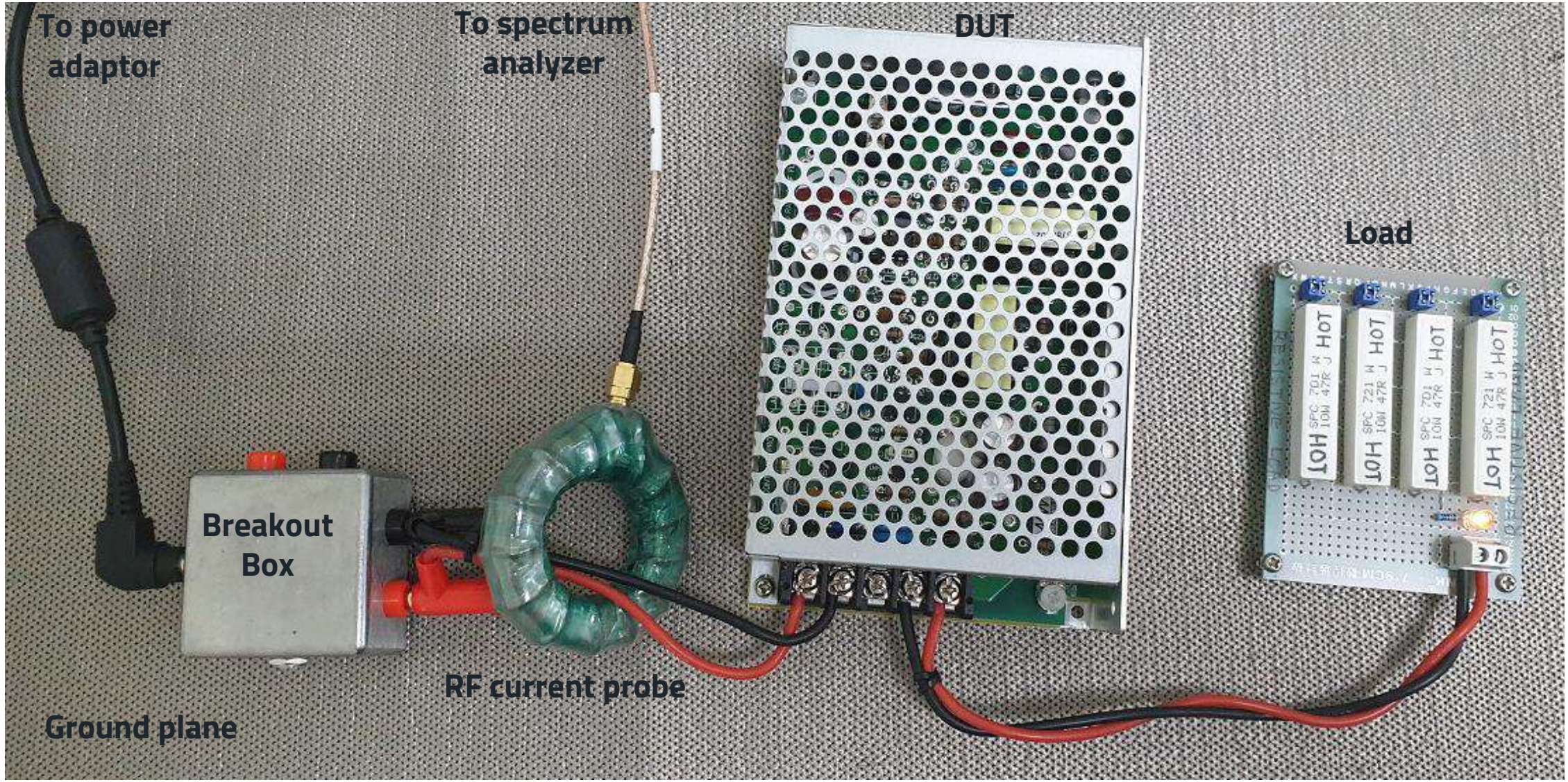


- Common mode noise measurement setup

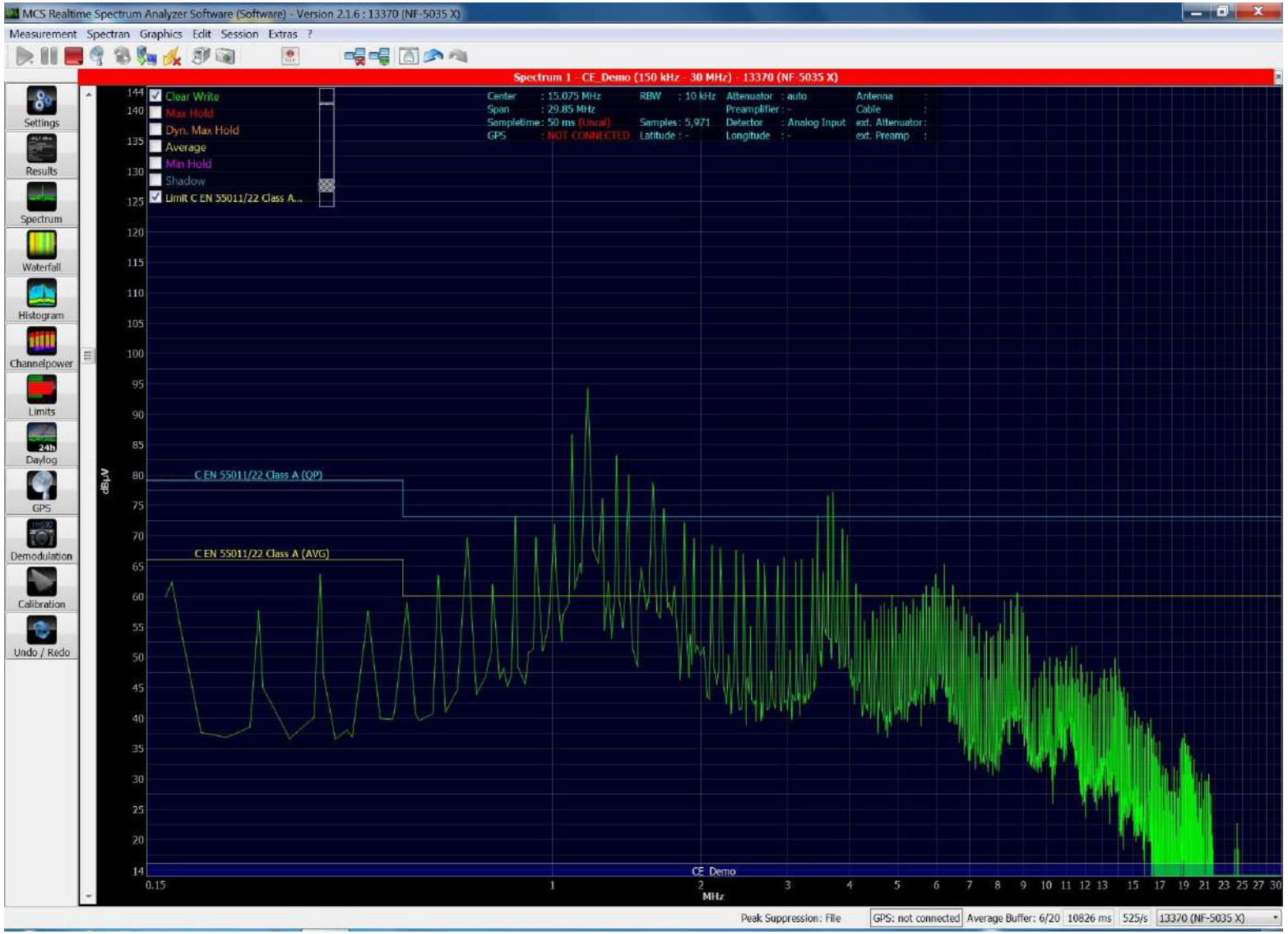


- Differential mode noise measurement setup

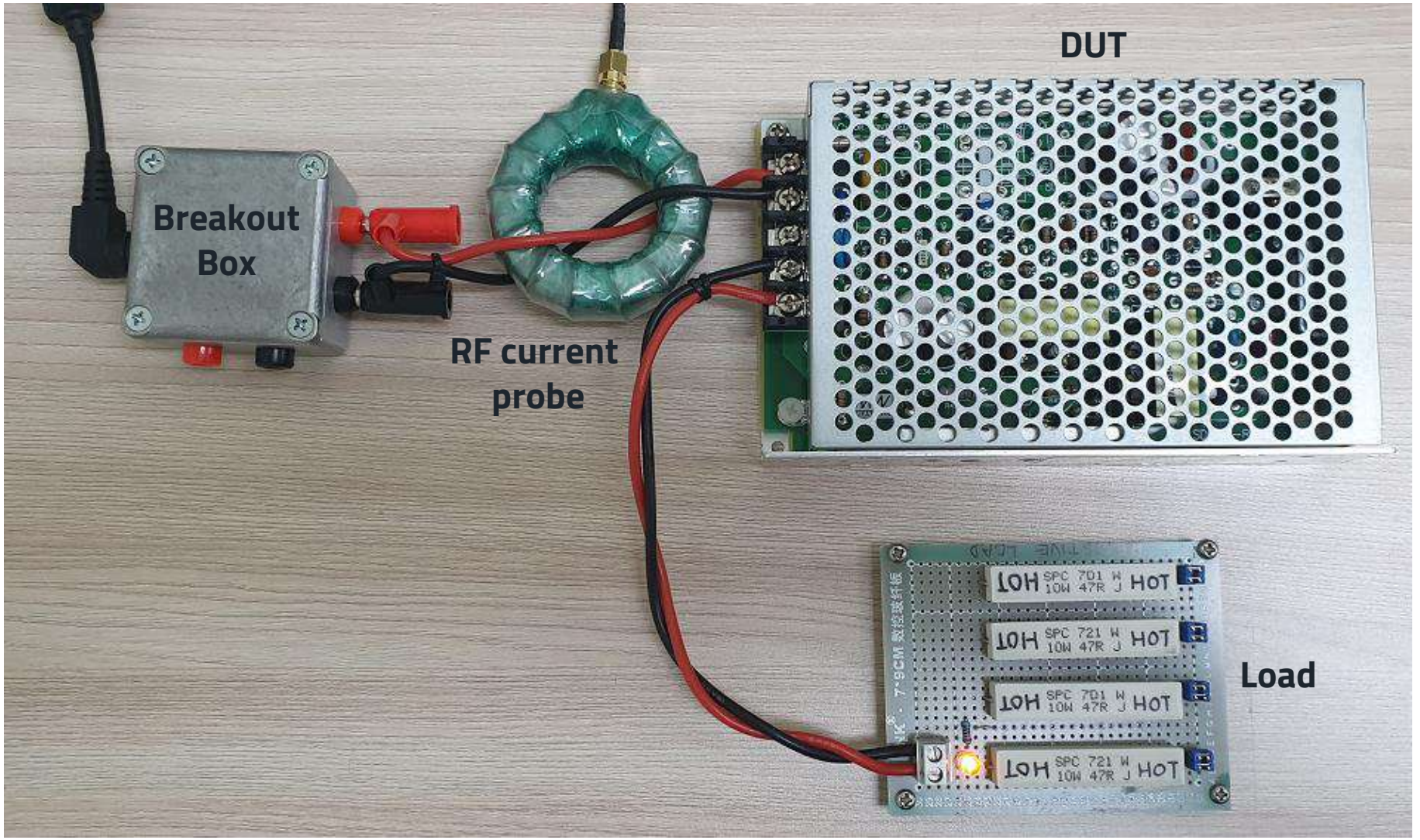
TESTING 1 – COMMON MODE NOISE



TESTING 1 – COMMON MODE NOISE



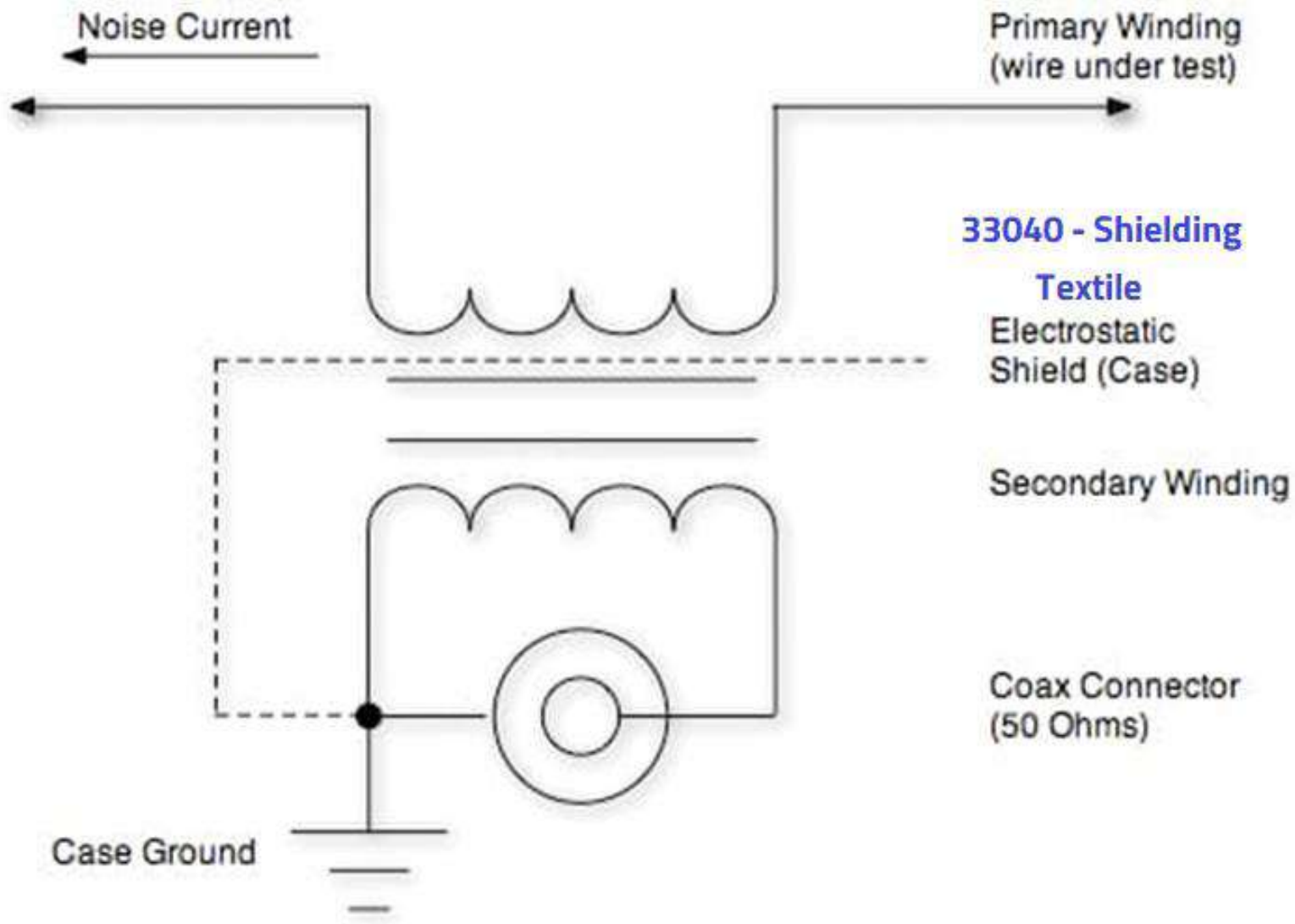
TESTING 1 – DIFFERENTIAL MODE NOISE



TESTING 1 – DIFFERENTIAL MODE NOISE

RF CURRENT PROBE THEORY

RF CURRENT PROBE THEORY



Courtesy of Kenneth Wyatt

RF CURRENT PROBE THEORY

1) The RF current probe is a type of radio frequency current transformer. When the probe is clamped over the wire in which current is to be measured, the wire forms the primary winding.

2) The clamp-on feature of this probe enables easy placement around any wire or cable. This is essentially a broadband high-frequency transformer. High-frequency currents can be measured in cables without physically disturbing the circuit.

3) Winding 8 to 12 turns (not too critical), and terminating with a SMA connector is all we need. Keeping the turns as far apart as will reduce inter-winding capacitance and yield better results at the higher frequencies.

RF CURRENT PROBE THEORY

3) Usable frequency range from 1MHz to 1000MHz.

4) Use this current probe on small DC power and Signal line only. Improper usage may lead to measurement equipment damage. Wurth Electronic can not be liable.

5) For AC line CMC/DMC noise measurement, additional knowledge and special skill are needed. Kindly manage at your own risk.

https://interferencetechnology.com/measuring-common-mode-versus-differential-mode-conducted-emissions/

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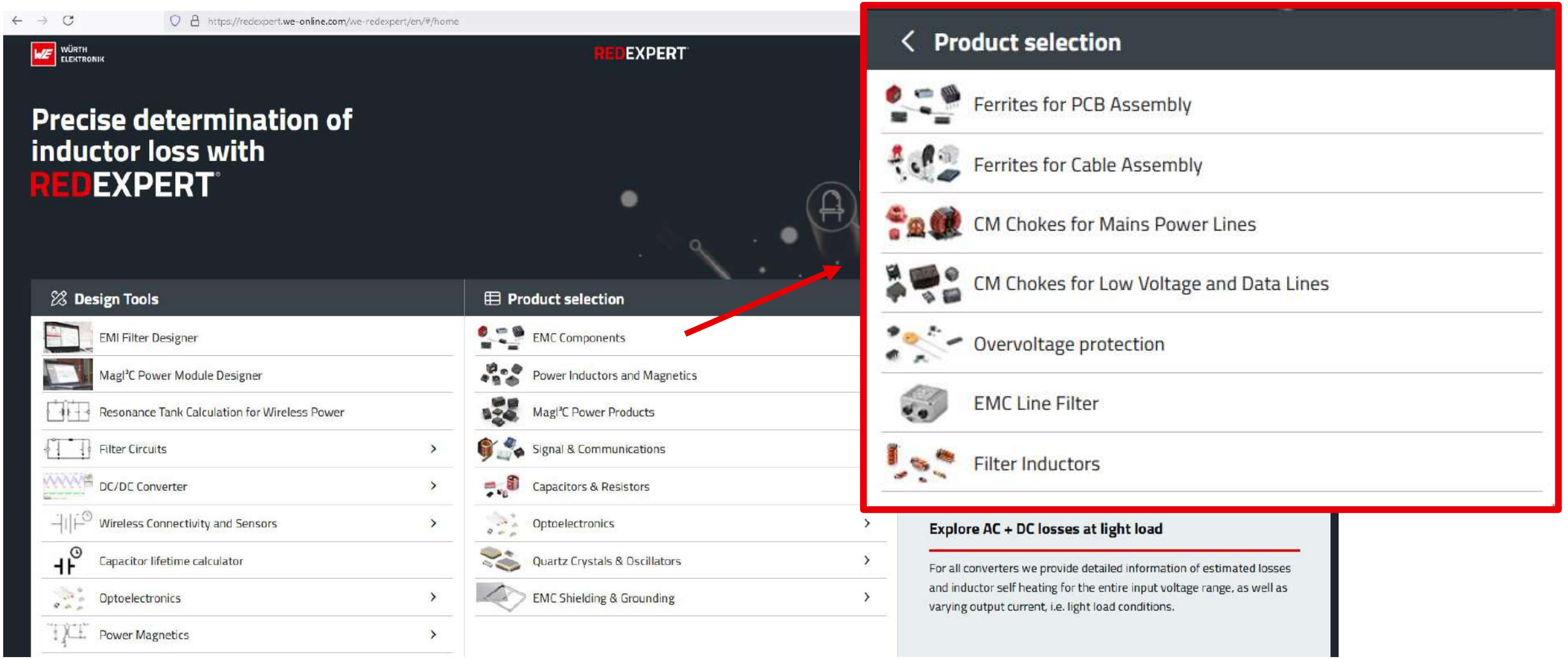
Simulation and Component Selection Tool



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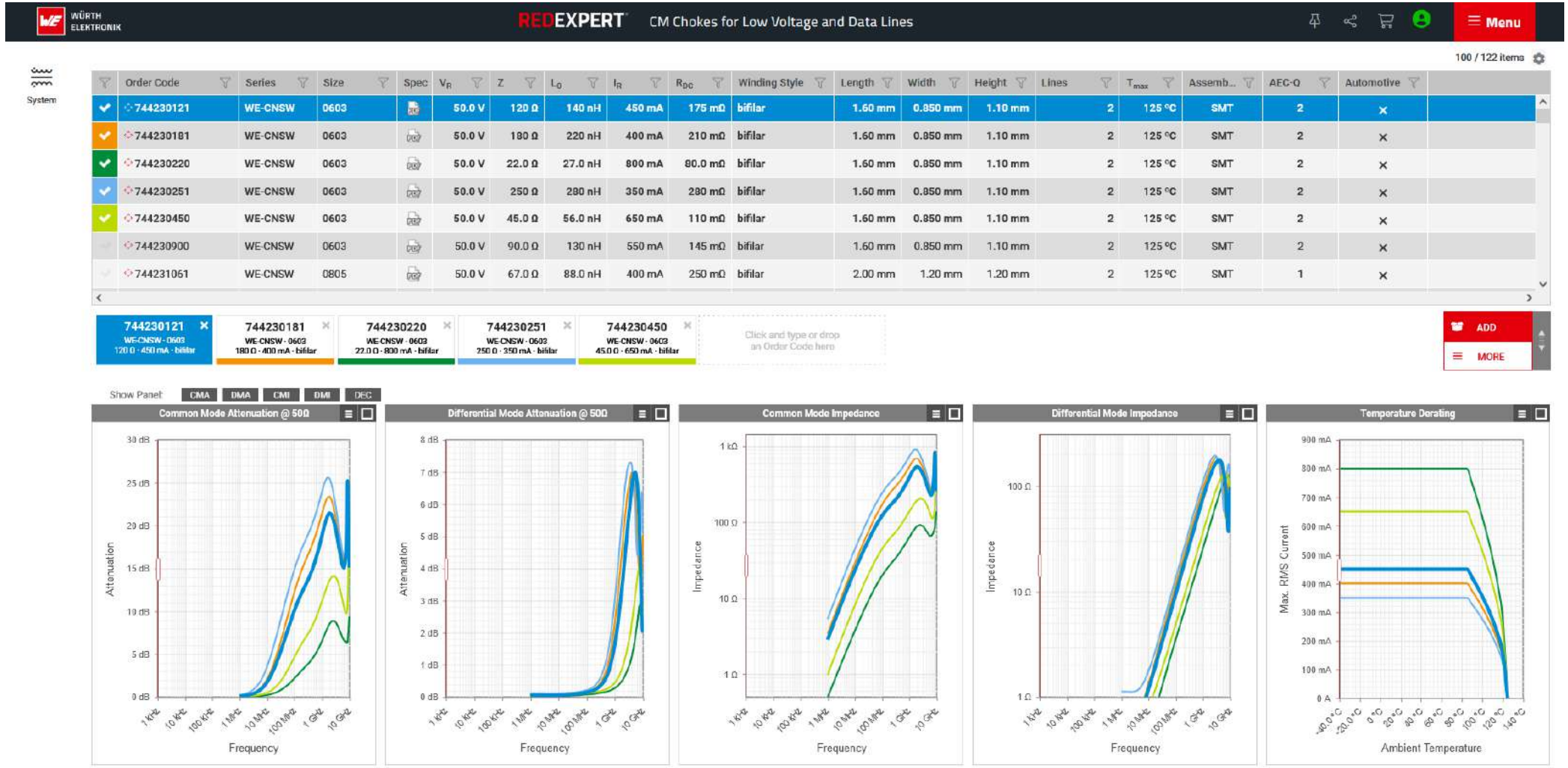
Simulation and Component Selection Tool



THANK YOU

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