



C&B
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RES 睿思

**Trimming Free Technology
Metal Alloy Current Sensor**

2023



Introduction

Purpose:

- To show a new technology-**Trimming Free Technology**-related to metal alloy current sensor

Objectives:

- When select a current sensor, what parameters engineers should care about most.

Content:

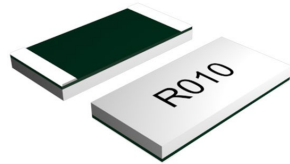
- 10 pages



Electron Beam Welded Alloy Resistor



Metal Foil Resistor



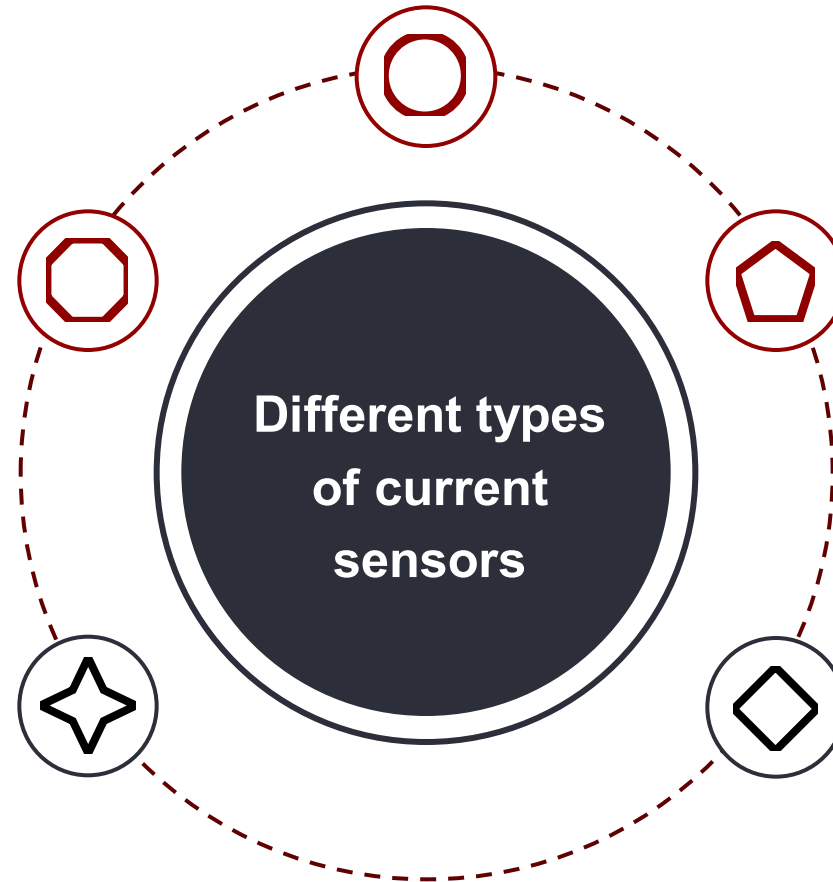
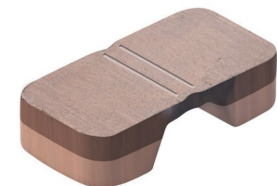
Molded Electron Beam Welded Alloy Resistor



Molded & Electroplating Alloy Resistor

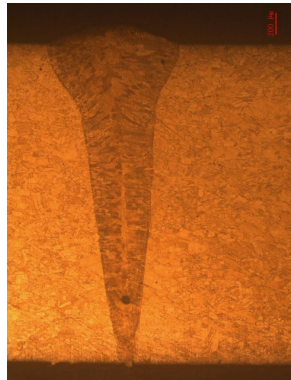


Composite Process Alloy Resistor





Here mainly talk about EB-Welding construction metal alloy current sensor because Trimming free technology is based on EB Welding construction current sensor. Electron beam weld the metal alloy and Cu electrode together by high energy as below Figure1.



The two figures show the different welding quality under microscope

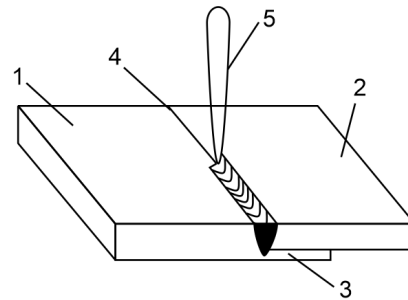


Figure 1

EB Welding Construction

Metal Alloy Current Sensor

Main Types of Alloy used in EB-Welding construction current sensor



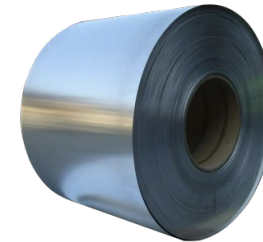
2. Fe-Cr-Al alloy

Fe-Cr-Al alloy features low TCR and economy. It is applied in the medium and high resistance range of current sensors. This alloy is magnetic only used in DC circuit.



1. Mn-Cu alloy

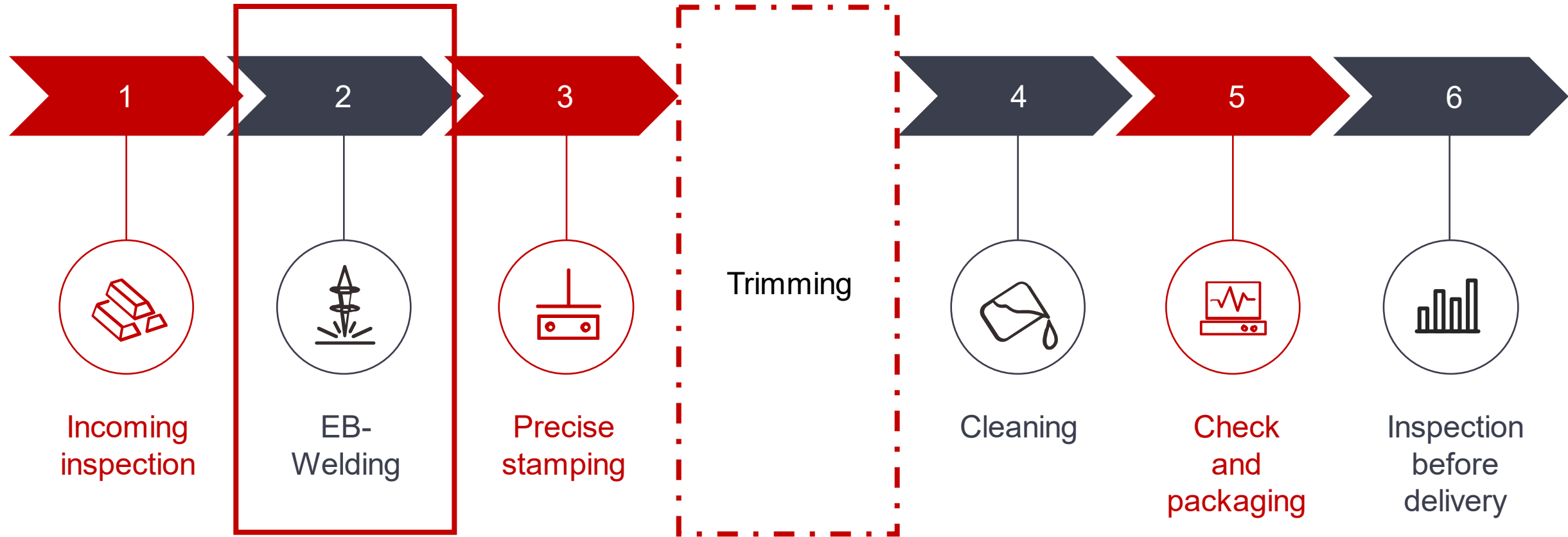
Mn-Cu alloy features low resistivity, generally applied in the low resistance range of current sensors. The TCR of alloy will increase at low temperature and high temperature environments, which is its limitation.



3. Ni-Cr alloy

Ni-Cr alloy has high resistivity, low TCR and can be adjusted by heat treatment. As a high-temperature alloy, it can withstand extremely high temperature without damage. Besides it has good long-term stability, widely applied in various resistor products, including precision resistor technology such as wirewound resistor and foil resistor.

EB-Welding process and **Trimming process** are bottleneck of manufacturing capacity of current sensor, RESI trimming free current sensor will skip trimming process. EB-Welding process is finished inside of house as well. Capacity is improved significantly.





**EB-WELDING process
is done by ourselves**

Advantages

- Depth to width ratio up to 20:1;
- Highly automated welding process, welding speed up to 20m/min;
- Excellent welding quality and narrow welding heat affected zone;
- Excellent repeatability and stability of welding parameters.





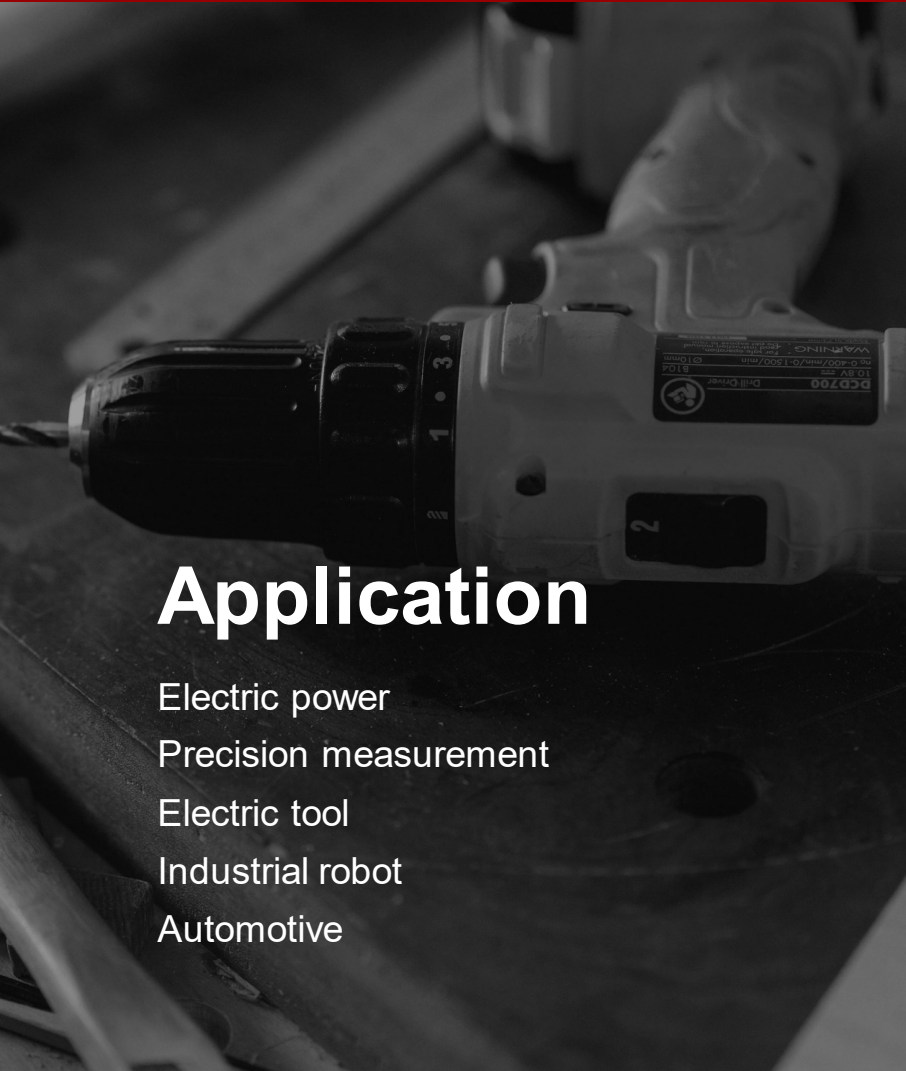
Disadvantages of Trimming

- For traditional manufacturing method, trimming process is necessary to reach $\pm 1\%$, much less $\pm 0.5\%$.
- Two types of trimming methods, mechanic and laser trimming. Mechanic trimming is wasteful and inefficient, laser trimming is costly.
- Loss of rated current
- Hot spot issue
- The consistency is not good due to trimming area is not exactly same for each resistor



RESI Product List

Present on [DigiKey](#)



Application

Electric power
Precision measurement
Electric tool
Industrial robot
Automotive

EBWM2512

0.5mΩ-1mΩ 2512 6W $\pm 0.5\%$ $\pm 200\text{ppm}$

EBWK2512

2mΩ~3mΩ 2512 4W~5W $\pm 0.5\%$ $\pm 100\text{ppm}$

PEWM3920

0.5mΩ~1mΩ 3920 8W~9W $\pm 0.5\%$ $\pm 100\text{ppm}$

PEWK3920

2mΩ~3mΩ 3920 5W~6W $\pm 0.5\%$ $\pm 50\text{ppm}$

SEWF2512

3mΩ 2512 4W $\pm 0.5\%$ $\pm 25\text{ppm}$

SEWF3920

1mΩ-3mΩ 3920 5W-8W $\pm 0.5\%$ $\pm 25\text{ppm}$



Important parameters while design

- **Load Life:** Value will be changed irreversibly when working under rated power in long term run, therefore load life stability is more important than initial value and TCR.
- **TCR:** TCR is not linear, and must be defined with temperature range at the same time, in some datasheet, there is no temperature range showed, then TCR parameter is meaningless.
- **Temp. Rise:** Temperature rise should be taken into account, because it will effect on stability of resistor, proper heat dissipation method should be applied.
- **EMF:** In DC applications, EMF effect should be paid more attention on.
- **Voltage PIN:** Voltage sensing point should be exactly matched with soldering pad pattern.



Summary

- Advantages of Trimming free technology current sensor: No hot spot issue, no loss of rated current, good consistency, short lead time, cost saving
- Alloy types: Fe-Cr-Al alloy, Mn-Cu alloy, Ni-Cr alloy
- Tightest tolerance: $\pm 0.5\%$
- Best TCR: $\pm 25\text{ppm}$
- AEC-Q200 Qualified and RoHS compliant
- Short lead time