HIOKI

# Technical Note

## Resistance Measurement of Busbar Welds Vol.3

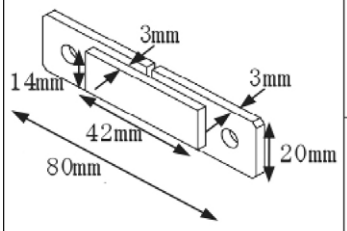
RM3545, RM3548
RM3543

*With the increase in battery capacity in recent years, currents flowing across busbars connecting batteries now exceed 100 amps. In particular, high resistance values at busbar welds cause degradation of batteries due to the generation of Joule heat ($RI^2$), potentially leading to serious accidents. As a result, management of weld resistance is becoming an even more important component of quality control programs than in the past. This Technical Note outlines some precautions that are necessary when measuring the resistance of busbars manufactured using different welding methods and when measuring weld resistance.*

### 1. Measurement of weld resistance

Two aluminum A5052 plates manufactured using different welding methods were used to simulate a number of busbars, and four such busbars were prepared with varying weld lengths for each welding method. Then, the Hioki Resistance Meter RM3548 with Model 9772 pin-type leads were used to measure the weld resistance. The RM3548 was set to the 3 mΩ range with the OVC function enabled. Table 1 and Figure 1 describe the measurement targets and probing positions.

*Table 1. Measurement Targets*

| Measurement target | Welding method | Weld length (mm) |
|---|---|---|
|  Material: Aluminum A5052 | Fillet weld | 5 |
| | | 10 |
| | | 15 |
| | | 20 |
| | Laser weld | 5 |
| | | 10 |
| | | 15 |
| | | 20 |

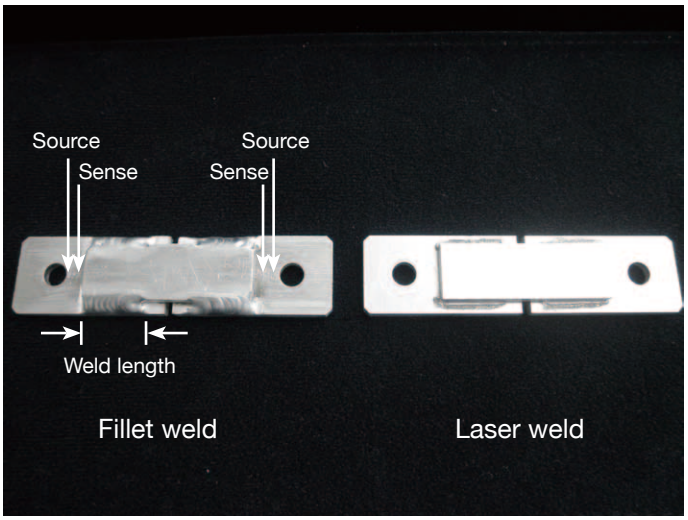



*Figure 1. Measurement Target Appearance and Probing Locations*

Figure 2 illustrates how probing was performed during measurement, while Figure 3 illustrates the measurement results, including both measured values and the RM3548's accuracy range.

The resistance value decreased as the weld became longer. In addition, busbars with fillet welds were characterized by lower resistance values than those with laser welds.

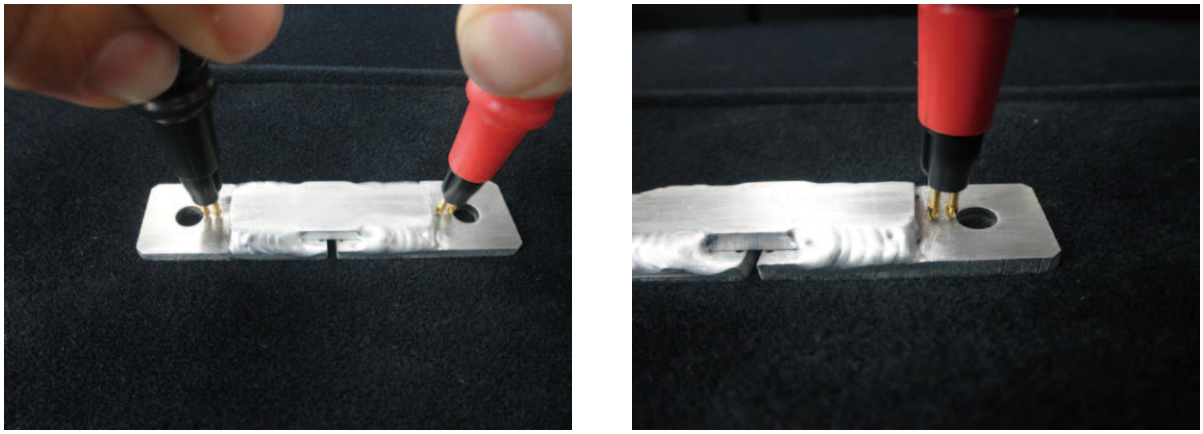


*Figure 2. Probing of the Busbars*

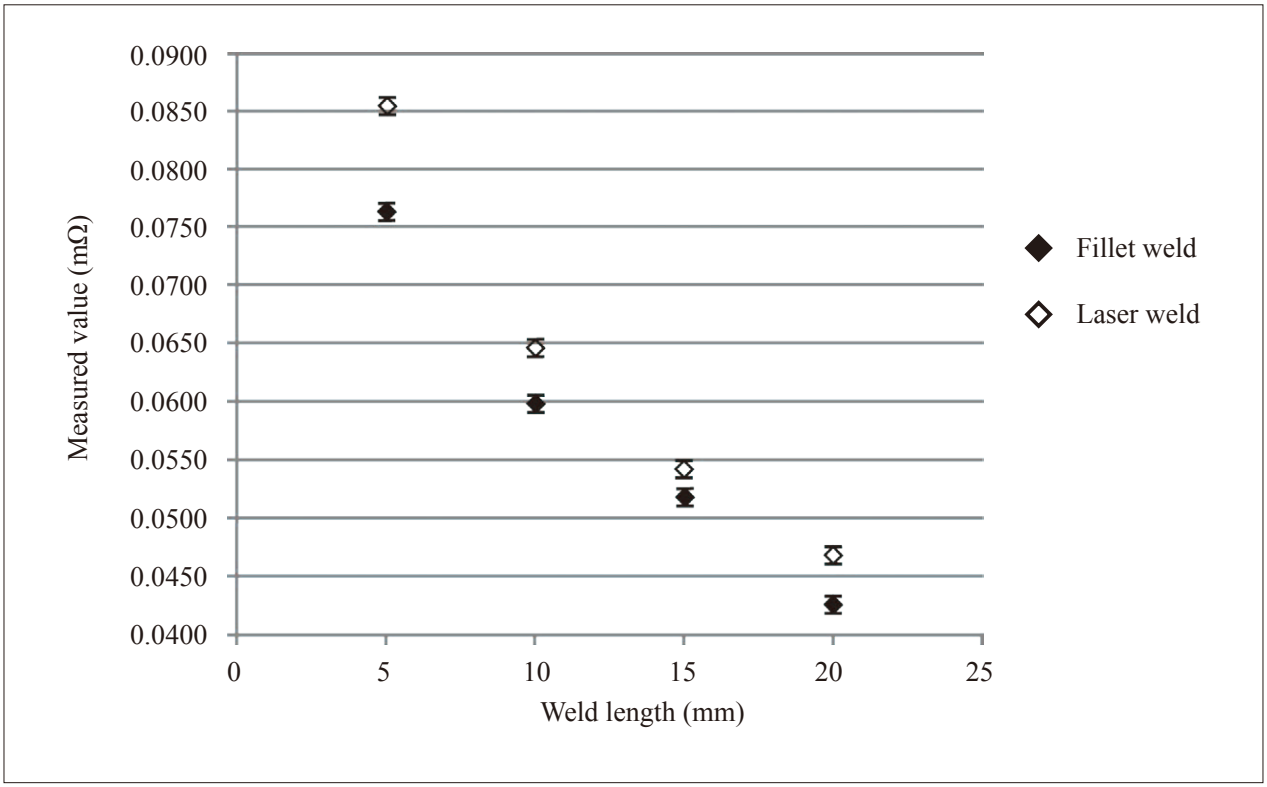



*Figure 3. Measurement Results*

## 2. Precautions when measuring weld resistance

### *-1. Probe positions*

Appropriate probing of the measurement target is the most important factor in obtaining stable and consistent measured values. For more information about the effects of probing on measured values, see the Technical Note entitled “Wide or Thick Resistor Measurement” (user_guide_RMs1-E1-49M), which is available on the Hioki website.

### *-2. Effects of thermo-electromotive force*

When measuring low resistance values such as those that characterize busbars, the extremely low detection voltage makes it impossible to ignore the effects of thermo-electromotive force. The offset voltage compensation (OVC) function can be used to achieve stable and consistent measurement.

*For more information, see the “Introduction to Resistance Measurement” (TN_Resist_vol1_E1-49E) available from the Hioki website as well as the instruction manual for the instrument being used.

### *-3. Effects of ambient temperature*

Since the measurement target exhibits temperature dependence, changes in the ambient temperature will cause resistance values to vary. For example, it is known that a difference of 1°C can cause a variation of approximately 0.4% in aluminum wire. The instrument’s temperature correction function can be used to calculate the resistance value at a reference temperature, making it possible to make measurements that are not affected by the ambient temperature.

*For more information, see the “Introduction to Resistance Measurement” (TN_Resist_vol1_E1-49E) available from the Hioki website as well as the instruction manual for the instrument being used.

## *3. Conclusion*

Weld resistance values vary not only with weld length, but also the welding method. Since the resulting differences in measured values are slight, it is important to use proper probing practices as well as instrument functionality that is designed to reduce measurement errors.

*Technical Notes explore measurement topics from a more in-depth perspective than conventional user guides. They are intended to be used in combination with product instruction manuals, user guides, and other documentation.*