TECHNICAL NOTE

Maxwell Technologies®
BOOSTCAP® K2 Cell Family
Welding Guidelines

Maxwell Technologies® K2 series of products designated with K05 in the model number are designed to be connected using metal buss bars welded to the cell terminals. This document provides general guidelines to assist customers in getting started to develop a laser welding process for these products. It is not a replacement for and should not replace engineering expertise in welding of aluminum materials.

General Information and Safety

- The negative terminal material is 1100-F aluminum; the positive terminal material is 1070-F aluminum. These alloys are >99% aluminum and have low magnesium content (<0.03%) for high quality welds.
- Continuous overheating of the cell may cause deterioration of cell performance or may cause the safety vent to open, resulting in catastrophic failure.
- Excessive heat during welding may cause the outer plastic sleeve to shrink or crack.
- The process and parameters described in this document were developed on specific equipment. The parameters will apply to that equipment and it is very likely that alternative pieces of equipment will require adjustment and fine tuning of those parameters to achieve an optimized result.
- Welding in general requires extensive safety considerations that are beyond the scope of this technical note. Please consult with the laser welding equipment provider and assure the safe use of laser welding equipment.

DO NOT BREAK THROUGH CELL WALL THICKNESS.

This can result in catastrophic failure or reduced cell life. Cell wall thickness is minimum 1.9mm vertical and sidewall thickness is minimum 1.0mm

Laser Welding Guidelines

A laser welding process should be designed to provide good, reliable electrical connection with a minimum contact resistance. Further, the weld should be able to withstand the environmental requirements of the application in which the cells/module will be installed. The following lists some key items to consider:

MATERIALS AND WELD CHARACTERISTICS

- A butt weld is described in this document (Figure 1). An overlap weld may be used but is more difficult to view and ensure the weld quality without penetrating the cell wall.
- Buss bars should be designed as shown in Figure 2. This results in a maximum 0.15mm gap (approximately equivalent to 6 mils), between the buss bar and the cell terminal. This is the total diametrical gap between the buss bar and the terminal post.
- Material purity of the buss bar is critical to obtaining a good weld. In addition to material purity, the material composition should be regularly monitored in order to maintain a

consistent weld.

- Filler material in the weld gap should not normally be necessary.
- The weld depth should be minimum 0.7mm around at least 80% of the terminal post (see Figure 1). However, these characteristics should be checked against the application requirement. In particular, weld stresses from torque that may be place on the cell during installation or operation and shock and vibration requirements should be considered.

EQUIPMENT

- A 1kW Yb fiber laser or equivalent has been successfully used with a 200-300 μm spot size to achieve results shown in Figure 1.
- An inert gas such as nitrogen or argon is recommended as shield gas to reduce oxide formation in the weld.
- While a pulse laser is acceptable, a continuous wave laser is recommended.
- Good system maintenance of the laser optics should be implemented to ensure laser spot alignment and focus. It is recommended to protect the optics from back splatter through the use of a cleanable shield.

PROCESS

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- The laser spot should be centered over the gap between the buss bar and the cell terminal. The alignment of the laser to the gap can be achieved through a mechanical fixture or through a vision system. If a vision system is used, it is recommended to reference the sharp edge of the buss bar.
- Laser power should be used as a process control parameter. Power measurement should be taken downstream of the laser optics.
- Laser setup parameters should be adjusted to obtain 0.7mm weld depth (Figure 1)
- The diagram in Figure 1 is for general guidance only. The weld characteristics should be checked against the application requirement.

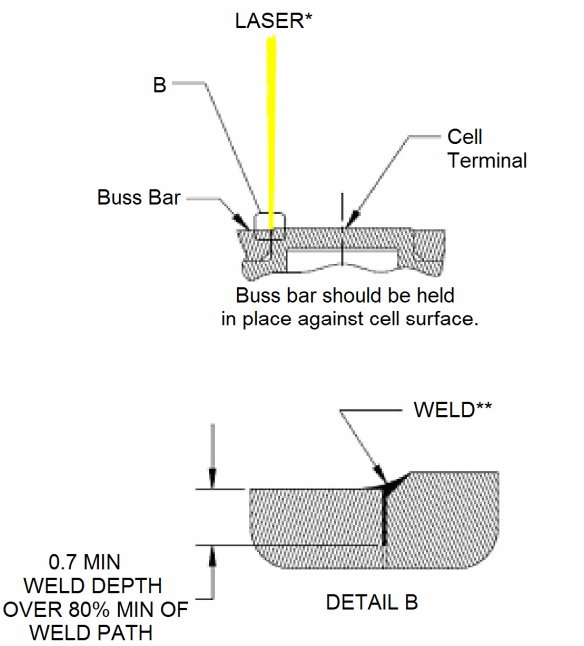

Figure 1. Laser welding process diagram. *Laser beam shown is for concept purposes. **Picture is intended to show resulting weld, not a filler material.

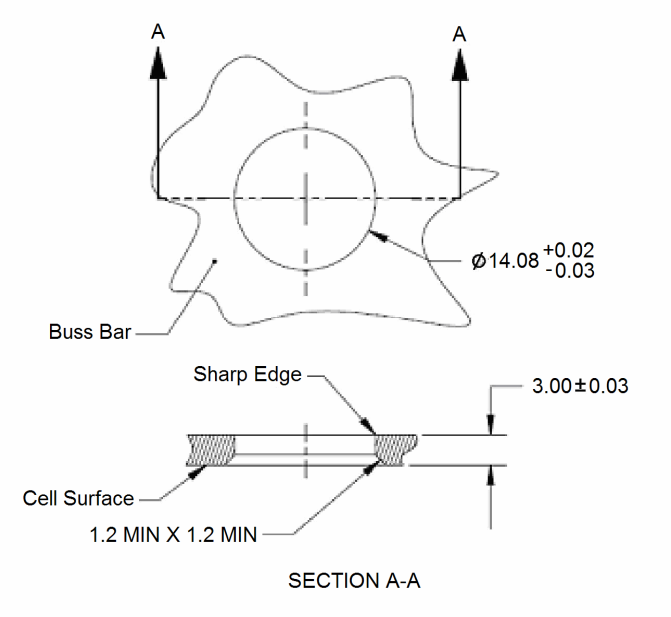

Figure 2. Recommended buss bar dimensions (mm)

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