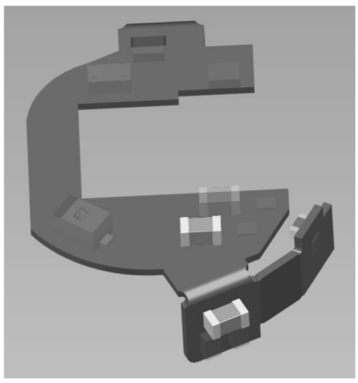
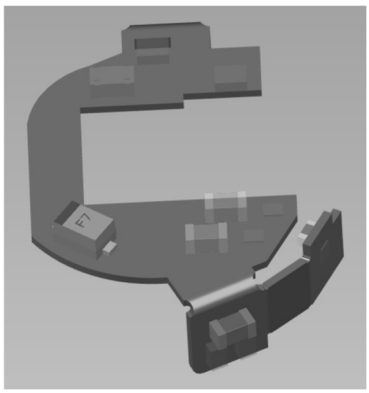
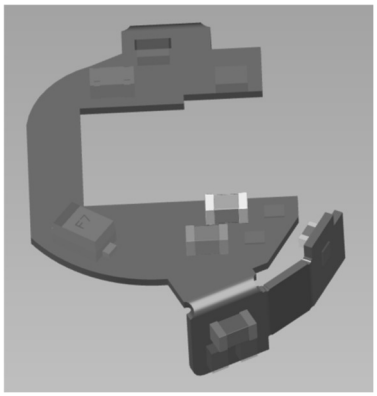
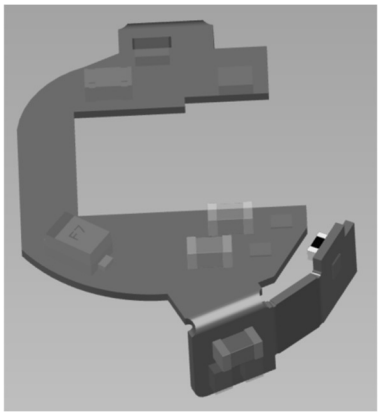
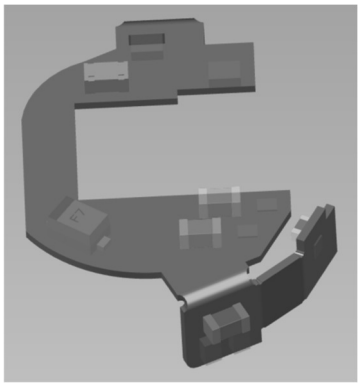
happening with a high current flow through and for restoring to normal condition after the short circuit resolves after a certain period. The resettable fuse is preferably placed in series to the output of the battery positive terminal. All the pads in the flexible PCB are used as the external connection terminal from another to the battery coil module. Except for the pad connector, the whole enhanced design battery coil module surface is preferably coated with an insulation layer, such as Parylene coating, to prevent a short circuit happening to the battery positive surface and negative surface. Table 1 below summarizes the feature for all the electronic components in the enhanced design battery coil module and shows a drawing to illustrate the location of the respective component.

| PCB component | Feature | Drawing indicating location of the component |
|---|---|---|
| Two Resonance capacitor(Cr1 and Cr2) | • To tune the inductive receiver coil to a resonance frequency<br>• Parallel to the receiver coil<br>• Larger value capacitor defined as Cr1 is placed closer to the receiver coil end<br>• 1% capacitance tolerance |  |
| Diode | • To transform a bipolar energy to an unipolar energy that allow positive energy to flow through and restrict negative energy flowing<br>• Power rating must be at least 2 times larger than the maximum received power to avoid it damage in the event of excessive received power<br>• Anode connect to the resonance capacitor and receiver coil |  |

| PCB component | Feature | Drawing indicating location of the component |
|---|---|---|
| | • Cathod connect to the smoothing capacitor and output | |
| Smoothing capacitor(Cs) | • Smoothen out the fluctuated unipolar energy to a smooth DC energy with much smaller ripple<br>• The capacitance is in hundred nF range<br>• Place in parallel to the output |  |
| Thermistor(Rth) | • To sense the battery temperature while charging<br>• Located close to the ferrite sheet and receiver coil and facing the battery |  |
| Resettable fuse | • To prevent a sudden short circuit with high current flow.<br>• It can restore back to normal condition after short circuit resolve at certain period of time<br>• Placed in series to the battery positive terminal and along the<br>• positive trace |  |

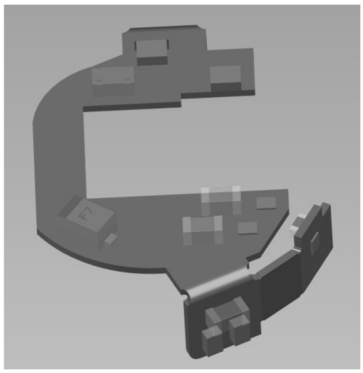
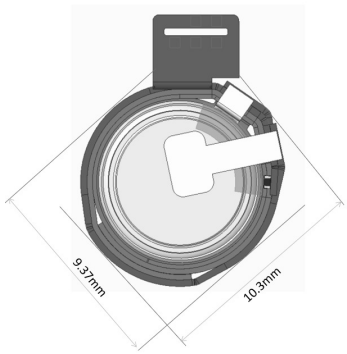
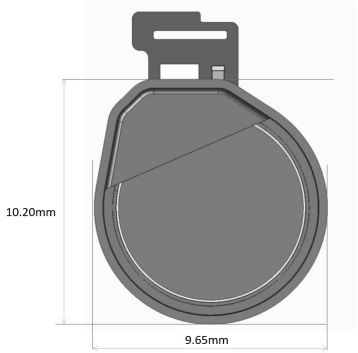
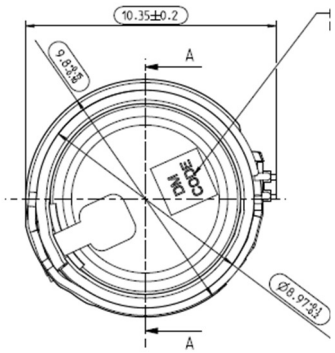
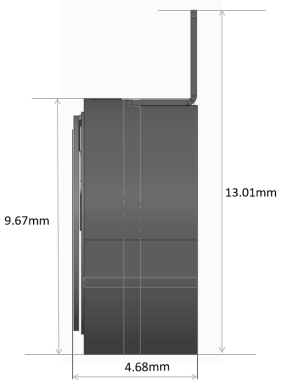
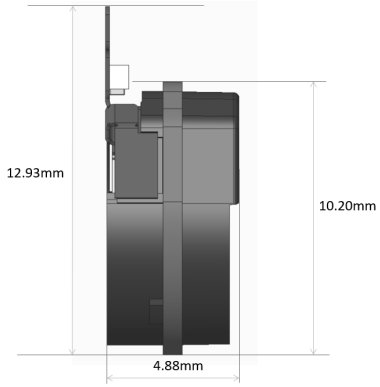
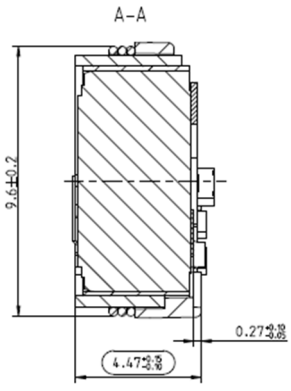
| PCB component | Feature | Drawing indicating location of the component |
|---|---|---|
| Connector pad | • To have external connection terminal from other device to the battery coil module |  |

Table 1: Summary of the feature for all the electronic components in the enhanced design battery coil module and the component located drawing in the flexible PCB

A particular key aspect of the inventive enhanced design battery coil module presented here is that it achieves 1) enhanced quality factor, 2) lower charging temperature, 3) tolerance control for inductance, 4) tolerance control for resonance frequency, 5) reusable protection component, 6) dimension reduction. The idea of the enhanced design battery coil module is based on the advantages of the battery coil module design as described further above. The hard molded ferrite copper coil battery coil module has the feature of high inductance and high-quality factor due to the adoption of copper coil. The soft ferrite PCB coil battery coil module has the feature of a more stable inductance value due to the utilization of a flexible ferrite sheet. Therefore, both advantage features from the previous design are adopted in the inventive enhanced design battery coil module presented here. In the following will, each component is explained in detail for the enhancement of this inventive design battery coil module and compared to the battery coil module previously described and as further detailed in yet unpublished DE 10 2020 205 157 A1.

Compared to the magnetized material battery tab that was introduced in DE 10 2020 205 157 A1, the utilization of non-magnetized battery tabs reduces the overall resistance of the battery coil module significantly. The reduction of battery coil module resistance results in enhancing the quality factor of the battery coil module.

A mechanical simulation drawing is carried out to compare the dimension of the enhanced battery coil module presented here and the previous design battery coil module. The dimension of soft ferrite flexible PCB coil module and hard ferrite molded copper coil module are shown in DE 10 2020 205 157 A1. Table 4 below shows the comparison table of the enhanced design battery coil module versus the previous design battery coil module. For the front dimension, all kinds of battery coil module designs have an almost similar diameter and almost the same length from edge to edge. However, the enhanced battery coil module presented in the present application has a shorter side edge to edge and slightly smaller thickness when looking from the side dimension. This dimensions measurement verifies that the enhanced design battery coil module presented here is smaller than the previous design battery coil module.

| | Soft ferrite flexible PCB coil module | Hard ferrite molded copper coil module | Invented enhance battery coil module |
|---|---|---|---|
| Front Dimension |  |  |  |
| Maximum diameter length | 10.30mm | 10.20mm | 10.35mm |
| Side Dimension |  |  |  |