Deliverable Report

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Executive Summary

For task 2.7, “Design and prototype of new junction box design with all electronics integrated”, we have to design the enclosure that fit onto the baseplate with the contacts of the Solned SP2-SL905. The electronics of Femtogrid must be fitting onto the baseplate of the Solned junction box part.
We have designed an enclosure where the electronics that are standard inside of the junction box, must be integrated / combined with the electronics of the optimizer from Femtogrid.

Solned need for this fulfilment of the task the information and support of Femtogrid, because we do not have any knowledge about the Femtogrid optimizers and all specific details they use and need. So, for this information we contacted Femtogrid to share the details of the existing power optimizer. At that time, Femtogrid, in the person of Rob Schaacke did mention that due to the movement of the office of Femtogrid, no large files and drawings are available. Solned received only a drawing of the cooling plate of the power optimizer, no further specific information was available.

After Rob Schaacke left Femtogrid, the technical part of the project is taken over by Harry Stokman and Michiel Arnoldy. After making an appointment at the office of DC Current/Femtogrid, Harry Stokman was not available for the appointment, and the appointment was taken over by one of his colleges Jorrit Zuiker. Finally, in July 2017 we received all needed information and only from that moment on we could start with the design of the all integrated electronic design of the junction box.

Together with Femtogrid, Dico Kruining, the R&D manager at DC Current/Femtogrid and the rest of the consortium we decide to keep one part of the Femtogrid power optimizer as it is, because all the important technical features like heat management and pressure compensation are designed in this part of the Femtogrid enclosure.
Femtogrid is not willing to redesign the complete PCB with the standard junction box functions for this task, therefore Solned decide to make an extra PCB board that will be connected to the PCB board of Femtogrid. In order to accomplish this Solned has designed a support for this extra PCB, that is mounted in the enclosure of Femtogrid.

We did receive the drawing of the enclosure of Femtogrid, so this was a good starting point for design of the opposite part that will be connected to the junction box base plate. We defined all critical dimensions of the Femtogrid enclosure and measured how we could fit the extra PCB board inside of this enclosure without making it much higher than the original and that it can fit on the bottom part of the Solned junction box.
After looking to all the possibilities, we have found the place in the box where it can fit. We started to design the support for the PCB and at the end of the design we have designed it in a way that it can fit onto the original screws that are already in the PCB board of the Femtogrid enclosure.

After the design of the PCB support and defining the exact location, we started to design the opposite part of the Femtogrid enclosure, that will fit on the Solned SP2-SL905 base plate with the contacts that are connected to the solar module. De defined all sizes and measured the requested height of the details to make it IP65 again, same as the original Femtogrid enclosure. For this the new enclosure must have the exact dimensions at the sealing of the Femtogrid part with the new part, but also at the Solned SP2-SL905 bottom plate with the new designed enclosure.
At the end, we have defined all sizes and designed the new part that meet all the requirements.

Now we have designed all the parts needed for the prototype of the junction box with all electronics integrated. We have made for all these parts drawings to make the first samples out of 3D printing. We printed all the materials this special 3D printing material that have flame retardant characteristics, to meet the requirements of the original Femtogrid enclosure.

Printing of the 3D parts take a very long time due to all the details in the parts, that are critical and therefore need a precise printing at these points. After the printing is finished, the parts are very rough due to all the lines of the 3D printing build up. Also, the strength of some parts is not what we expected.

We have discussed this with some experts and came to the conclusion that the only solution to have a clean, strong, flame retardant material that also behaves like the original used material of Femtogrid, is to make the samples out of a Silicone Vacuum Mould. We have produced parts by this method; the result was excellent; smooth parts, all needed details like sealing body are in place. We have built the first samples with this vacuum moulded material, all parts fit exactly together as we have designed them. All seals for the IP65 protection fit perfectly, the PCB support can be mounted at the original screws inside of the Femtogrid enclosure and does not have any conflicts with the components on the PCB of Femtogrid. Also, the PCB with the junction box function fit perfectly at the support and can make connection to the contacts on the base plate of the Solned junction box.

We finished the design and prototype of the new junction box with all electronics integrated end of April 2018. It is now ready for testing at the solar modules, but the consortium has to define where these units will be mounted. For the testing of the complete Solned junction box and the Femtogrid electronics, we need the help from Femtogrid. They have to update the software of the power optimizer to prepare it for functioning properly in combination with the Fronius inverters used in the demonstrations, because Femtogrid are the only who have access to the operating system of their optimizers. But in this stage of the project we do not get any reaction of Femtogrid to our requests and question. We share our experience with the complete consortium during the GA12 meeting in addition to other complaints related to partner Femtogrid. The SUMMIT consortium partners decide to proceed with the defaulting procedure regarding Femtogrid. Until now Solned does not have any possibilities to test the complete prototype with the integrated power optimizer electronics from Femtogrid.

This deliverable report shows that Solned has executed all tasks and has achieved the design and prototype of the new junction box with all electronics integrated. We achieved the maximum possible given the circumstances caused by insufficient participation and commitment by Femtogrid. With more effort from Femtogrid's side, we could have managed to include more units of the new integrated design in demonstration projects. Unfortunately, it turned out this was not achievable.

The findings, after real-time measurements of the smart junction box including the Femtogrid electronics, are the following:

The Solned junction box and the Femtogrid power electronics fuctions really well and a relatively higher electrical yield has been obtained, about 10 % more utilizing the Femtogrid inverter, however more tests will have to be executed to confirm this result.

The internal temperature of the Power optimizers in the smart junction box is lower than the boxed version.
That means that the lifetime of the smart junction box is expected to be longer than the boxed version.
This test should be repeated when the enclosure is made of the production material (with injection mould) of the enclosure. Other positive advantages are:

a- Enclosure has more air volume and radiating surface and less dissipating electronics.
b- Position of the smart junction box is positive (is on the side of the PV module only half surrounded by heat radiating cells from the back side)
c- Air flow is always present. Even can be improved reversing the PV module so the PO (power optimizer) is closer to the roof and profits from the chimney effect ("cold" outside air is sucked in at the bottom and passes the PO)
d- Easy to click on, saves assembly time.

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http://cordis.europa.eu/fp7/cooperation/home_en.html

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