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Simpl Global Technology

Simpl Global's innovation is centered on the following three patent pending technological breakthroughs:

1. **Simpl Power Electronics Topology**
2. **Simpl Communications and Controls**
3. **Simpl Mechanical and Electrical Integration**

In the following paragraphs we offer a high-level description of these technologies and why they are important to you are our customers and partners.

1. Simpl Power Electronics Topology

Maximum Power Point Tracking (MPPT) is the well-known technique for extracting maximum energy from solar panels as the intensity of the Sun's radiation and ambient temperature varies. The MPPT system continuously perturbs the operating current draw from the system and observes to see if the resulting voltage increases of decreases in a manner that would increase the resulting output power.

The energy output of a single solar panel, (in case of microinverters or DC optimizers) or a string of solar panels (in case of string or centralized inverters) when connected to the appropriate inverter(s), is optimized using the MPPT algorithm operating inside the inverter.

More and more solar systems would have to operate in conjunction with energy storage systems to maximize the economic value of the solar energy. Therefore, it is imperative to build highly optimal solar plus storage systems that deliver maximum amount of energy directly into the building and to an energy storage system simultaneously.

Prior art provides these capabilities, but the schema used in these systems is dramatically inefficient as the system relies on matching the battery voltage to the voltage of the solar panel at the MPP point. The voltages of both the solar panel and the battery stack are highly variable.

Novel System Topology

Instead of connecting the battery to the solar panel directly as performed by prior art, the solar panel is connected directly to the inverter and the patent pending (62/734, 172) battery system is designed to extract current from the combination at the connection voltage set by the inverter.

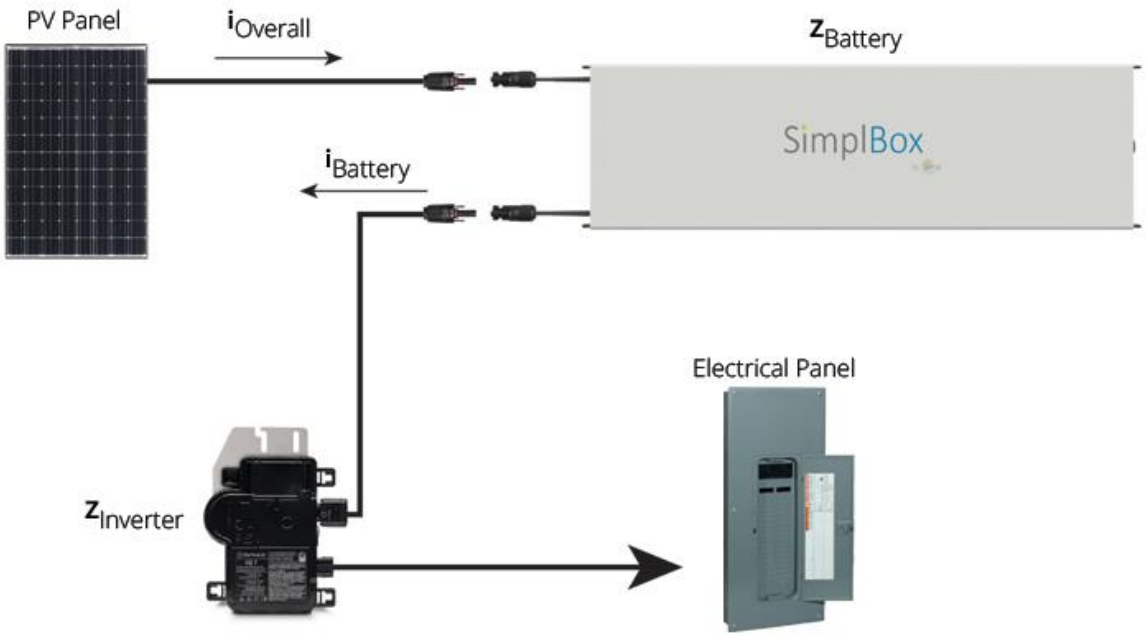
The microinverter, as an off-the-shelf, commercially-available device, optimizes the current draw in such a way that its power input is optimized.

Using the above topology, whether in string or single panel configurations, would establish the highest energy output over different conditions. However, to maximize the economic value of these systems, it is important to be able to drive the portion of the energy that is directed to the batteries versus delivered to the grid via the inverter system.

When the value of energy or demand are low, batteries are charged and when the value of energy or demand are high batteries must be discharged in a manner that maximizes the economic value.

Simpl Impedance-Matched Coupling (SIMC)

The total impedance presented to the solar panel is driven by the maximum power point for the solar panel. But the ratio of the impedance presented by the inverter to the impedance presented by the battery system drives the proportionality of the energy distribution. We refer to this technique as Impedance-Matched Coupling.



No Mechanical or solid-state relays

Energy storage Systems often use relays to connect and disconnect the sources of energy, such as a solar panel or a discharging battery stack, to the energy sinks, such as inverting systems and battery stacks while being charged. Relays, be it mechanical or solid-state, are notoriously prone to field failures.

SIMC topology does not use any relays. This is a direct consequence of the Impedance-Balancing system which uses impedances (rather than relays) to stop energy flows or control the proportionality of the energy flow from each source to each sink of energy.

2. Simpl Communications and Controls

Novel Method of Implementing a Fault-tolerant, Self-healing Control System

A traditional Control Systems uses a feedback controller to monitor and regulate its operation. The feedback controller runs a Proportional, Integral and Differential (PID) loop which allows it to read sensors located within the system and manipulates actuators to achieve a desired behavior. In controls systems with multiple sensors and actuators, dedicated hardware is used to collect data from all sensors, run the Control PID algorithms and change actuator setpoints. On occasions where the feedback controller is unable to perform its required tasks (lost communication, device failure, out of memory. etc..), the system will be not be able to operate at its full capacity.

Simpl Global's Floating Control System "FCS" does not use a dedicated hardware feedback controller. Instead, the feedback controller is a set of algorithms and datasets (System Ledgers) which are continuously distributed to all nodes in the system. This gives any node in the system the ability to immediately become the feedback controller.

Upon system initialization, a single node is elected to act as the feedback controller. In the event the feedback controller is no longer suitable to run the control algorithms all other nodes will elect a new node to operate as the feedback controller.

There are several advantages with a Floating Control System in comparison to a traditional Control System:

1. There is no single point of failure within the system. Due to the real time distribution of the System Ledger any node can immediately take responsibility of being the feedback controller.
2. The Floating Control System provides unparalleled data backup due to the distribution of the System Ledger to all nodes.
3. The Floating Control System allows for complete device autonomy if necessary. When a single node loses communication with the rest of the system, it will be able to elect itself as the Feedback Controller and create a subsystem until it is able to regain communication with the system.

3. Simpl Mechanical and Electrical Integration

Thermally Insulative Packaging

Traditional and prior-art systems use thermally-conductive, metallic materials to control keep electronic systems cool. While this makes a lot of sense in ordinary circumstances, it does not for MicroStorage systems. MicroStorage systems are installed underneath a solar panel where under normal circumstances, due to the intense solar radiation, the ambient temperature near the device is higher than ambient by 5 to 15 degrees centigrade. It is therefore more efficient to use thermally non-conductive, non-metallic materials to house the batteries.

Extruded, vacuum-formed or otherwise formed plastics provide the necessary thermal insulation to thermally isolate the batteries inside the system. A thin layer of trapped air on the interior side of this packaging further insulates the batteries from the ambient heat.

No External Initialization Required

A combination of novel techniques is used to simplify manufacturing, installation, commissioning and updating the system by eliminating the Power-on Reset Button.

The system is the first of its kind in energy storage systems where through a combination of logic, learning and self-healing techniques, the system is not required to ever be turned on, turned off, commissioned or restarted.