Question text	Answer Text
What changed in SMA's power electronics capability to now allow faster transients in current and more degrees of freedom as compared to the past products?	It is kind of an overly general question, but most all of what was presented in this webinar is having to do with new control methods, i.e. software based developments, not new power electronics.
What is special about "synchronous" grid forming? Does such a thing as asynchronous grid forming exist?	Yes, you could say a microgrid is "asynchronous" I suppose. It is a term SMA uses to describe the application of grid forming controls in parallel to existing synchronous generation.
Why can't rate of change based response (inertia) be provided by non-GFM?	You can achieve an inertia-like response even with grid-following, but it would be much slower and therefore less effective. Grid forming inertia behavior is an instantaneous response.
Why wouldn't it be possible to provide inertia using Grid Following by calculating the RoCoF using the PLL and changing the active power reference?	See above - it is possible but does not provide the same contribution to stability of the network because of the inherent response time lag. The definitions being adopted by Industry require an instantaneous, or near instantaneous, response which is only possible through a voltage phasor based control.
What is considered "short period of time" and what is reasonable overcurrent requirement for GFM applicaiton?	We see 100ms to 5 sec across different projects and regions
How does the performance Grid Forming inverter compare to a synchronous generator in terms of droop and inertia?	We would suggest it is a better response, since those characteristics in a synchronous generator are a fixed value corrresponding to the rotating mass. In an inverter-based generator, these are variables that can be tuned for optimum behaviors in each discrete project.
For inertia, could you please tell if plant controller is able to read measurements at POI and distribute setpoints to multiple	The methodology is proprietary, but it is able to provide a stable and accurate, aggregate provision of the grid services at the POI.
Does the "advanced" plant design reserve storage capacity for advanced control?	Correct. This is simply SMA terminology - we consider "basic" grid forming to be the behavior you get when you cannot be sure what the status of power and energy is within the battery at any moment in time. An "advanced" grid forming plant design reserves power and energy (i.e. on top opf the base case of the plant) so the plant can guarantee specific inertia or SCL response at all times.
Are GFM + sequence and EMT models available to your battery project developers that can be passed on to Transmission Planners for interconnection studies?	Yes, they are available by request through your SMA Sales Manager
When the grid frequency hits the nadir and tries to recover, an inertia mode GFM inverter will reduce power output. Will this hamper frequency recovery?	In theory, but with SMA's controls, the droop response can be overlaid, and each can be tuned individually to obtain an optimal response.

Are the advanced batteries (2023+) commercially available today?	The behavior is a characteristic of the inverter, not the battery. The only requirement for the battery is available SoC at the time of need of the response, unless power and energy headrooms are designed into the project to ensure the power and energy is always available from the battery.
Re layering droop+inertia (matching SM+governor), what applications are driving this? For microgrid, can you get same dynamics by tuning droop parameters only?	I would frame it as the market conditions causing the need. Droop and Inertia are different responses, each having a unique impact on grid stabilization for any given scenario. The grid is trending towards weaker conditions as we decommission traditional synronous generation plants and increase the amount of grid-tied inverter based generation. So, we need to replace the characteristics of the synchronous generation (i.e. inertia and SCL), and the exact "recipe" in any given project location is specific to that project. It is therefore advantageous to have both droop and inertia behavior that can be individually enabled and tuned to the projects' needs.
Is the supply chain able to provide GFM inverters for a big share of all the batteries in the US starting in a year or so? Should GFM requirements be slowed?	As the capabilities are primarily implemented in software, yes, the supply chain should not pose any bottleneck.
What, if any, requirements are needed from the battery itself to meet the demands of a grid forming inverter?	See question 12 above. In addition, it is recommended to secure the approval of the battery manufacturer, as we have heard (just a rumor maybe) that some may have concerns of micro-cycling the battery.
While in grid forming mode, can the inverter be programmed to output a negative sequence current magnitude and angle?	Yes, it is capable of negative sequence currents.
Have you tested how your GFM controls work with other manufacturer's GFM controls? Do they have any adverse interactions?	We do not have anything we can share, but we arediscussing such tests with the Fraunhofer institute, and am aware that Elevate Energy is also conducting such interoperability testing.
To achieve higher short circuit level, what additional component or control are needed in inverter's configuration?	No additional components are needed. Some controls tuning is involved, but primarily higher short circuit levels are achievable through project sizing, and due to the exceptional thermal management performance of SMA's inverters.
Could some of these features be extended to PV inverters for dealing with voltage strength issues?	It is technically possible, but this application has the challenges of managing the interaction of the grid forming controls with the Maximum power point tracking, as well as needing to implement some form of higher power/energy buffer. The DC link capacitors present in grid following inverters are insufficient for proper grid following responses.
Will VSM type GFM brings back traditional inter-area or intra-area electrical-mechanical oscillation problem?	There is potential for oscillatory behavior, but grid forming inverters (at least from SMA< but likely all OEMs) also have string and tuneable damping behaviors to mitigate oscillatory behavior.

In the example with 2 pu overcurrent, how long can the overcurrent last?	100ms, with other profiles also available
Can we operate VSM without droop in GFM inverters?	Within SMA's controls, yes, they can be operated and tuned indivudally, or can be overlaid.
How does the SMA Grid -following technology interact with non-SMA grid following inverters- any typical tuning or further studies are needed?	EMT studies are always recommended, even required, to identify any such interactions.
How does "Boost" allow greater over current? Is it simply over sizing hardware such as heat sinks?	It is a product of SMA's design reserves, the effectiveness of our thermal management system, and rigorous type testing.
What is the time duration you use to calculate inertia?	It is programmable, starting from time zero (instantaneous response) to some period of seconds. From a market design perspective we talk about it as the timeframe before other ancillary services (FFR, PFR, etc) are able to act and contribute to containment.
What are the assumptions made that result in added Revenue as indicated on slide 22.	It is assumed that the plant owner can monetize the higher short circuit and inertia levels through a market mechanism. This is generally not the case yet in the US, but is possible in other markets such as the UK. It is SMA's opinion that the US should open up our markets for a technology agnostic procurement of stability services (i.e. inertia and SCL). This approach allows BESS assets to be very competitive, in fact often much lower in cost, for providing the same quantified amounts of SCL and Inertia as compared against traditional grid stability assets like Syncons.