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To whom it may concern

Operation of the Sunny Central (Storage) (UP-XT) inverters at low SCR

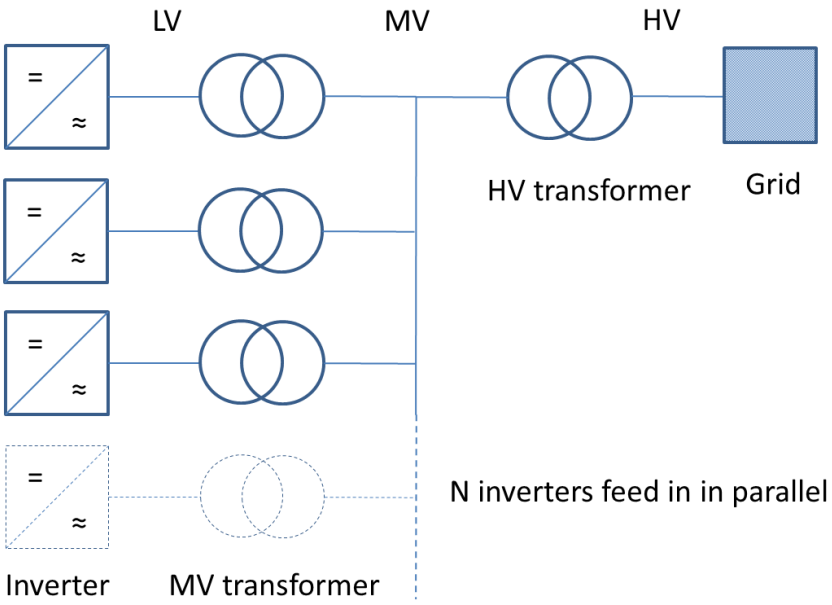
The SC(S) XXXX (UP-XT) inverters are designed to work properly also at weak grids. During lab testing and exemplary EMT simulation results, SMA has successfully demonstrated stable operation of the inverter in grid-following operation at a Short-circuit ration as low as 1.0 at the inverter LV terminal for PV (Sunny Central) and BESS (Sunny Central Storage).

However, with lower SCR there is an increasing risk of fundamental power system operation limits which must be considered carefully and accordingly a proper project specific parameter tuning is mandatory.

It is not appropriate to use phasor/rms (root-mean-square) models (e.g. PSS®E or PowerFactory) to simulate inverter behavior at low SCR's as this model does not reflect instabilities of the inverter, so that it behaves equal also at lower SCR's. In reality the inverter might behave differently. Therefore only instantaneous value (electro-magnetic transient) models can be used for that purpose. SMA provides an appropriate generic EMT model on request.

Calculation method for SCR at inverter terminals:
The effective impedance seen at the inverter terminals must be calculated. With this value the synchronous short-circuit power at the inverter terminals can be determined. The synchronous short-circuit power divided by the inverter nominal apparent power rating gives the SCR at the inverter terminals.

Note:
When calculating the effective impedance it must be considered that the effective impedance which is seen by *N* parallel inverter units has to be multiplied by *N* (see following figure).



In this simplified example the effective impedance of the HV transformer and the grid impedance have to be multiplied by *N*.

Yours sincerely

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