

The background image shows a large outdoor facility with numerous rows of grey, rectangular SMA inverter units. Each unit is mounted on a concrete pad and has a corrugated metal roof. The units are arranged in a grid-like pattern across a gravel-covered area. In the background, there are several high-voltage electrical transmission towers with power lines stretching across a hazy, green landscape under a clear sky. A semi-transparent white box is overlaid on the center of the image, containing the title text.

Central Inverter Var Capability for Power Electronic Inverters & Power Plants

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Var support at night (PV) 0 MW

Constant power factor or VAr set-point

Configure inverter with fixed Var output.

Controlled power factor or VAr via communication

Send pF or Var setpoint commands to inverter via Modbus/TCP.

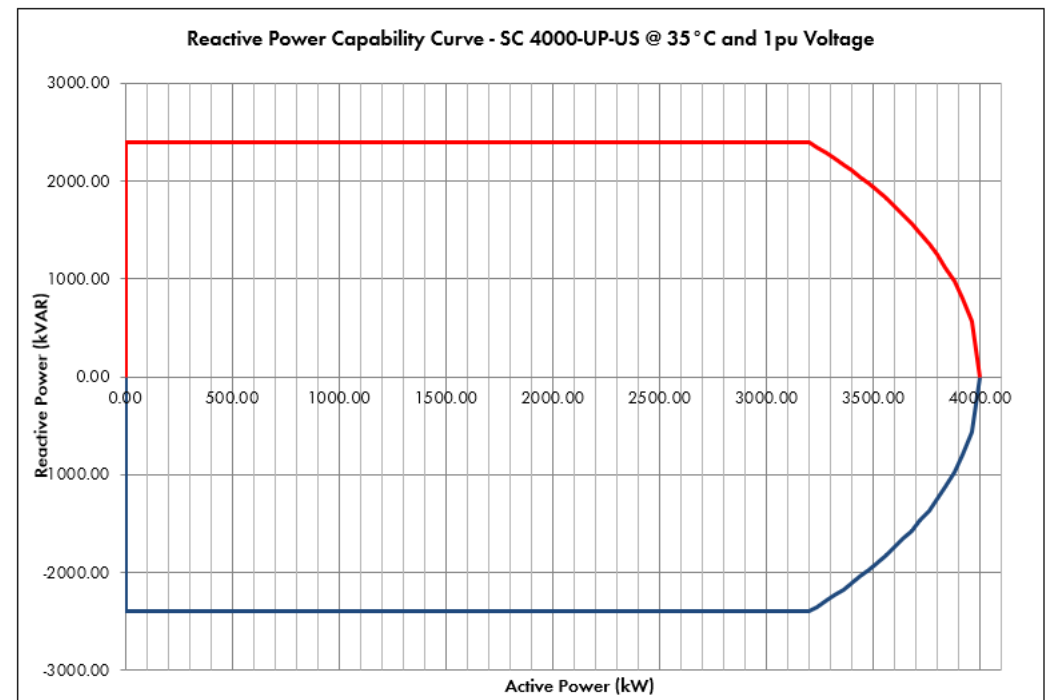
Autonomous VAr control depending on voltage

VoltVAr control based on curve.

Autonomous power factor control depending on real power output

VAr as a function of Watts.

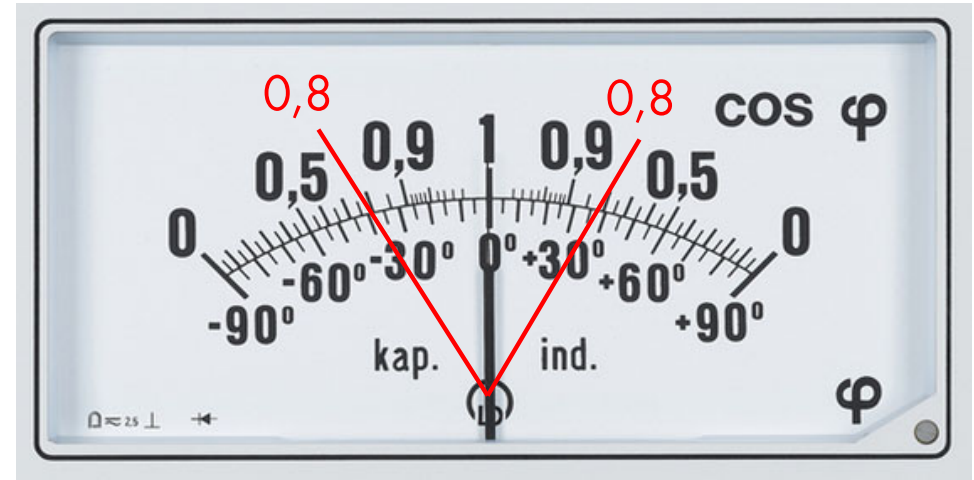
Capability Curve
at inverter Terminals - 0.8 lag/lead



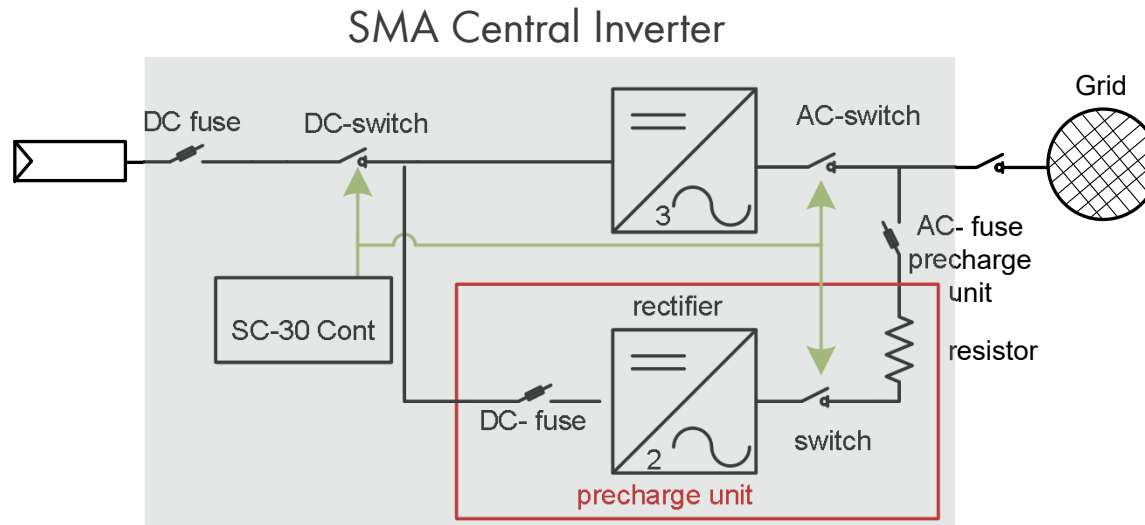
Q (kVAr) @ Night



- Reactive Power at night (optional)
- Reactive power up to 60% of nominal power
- Hardware modification required on older inverters
- Can be retrofitted on existing units
- No impact on Warranty
- Inverter switched to Q@Night when AC power generated falls below 10 kW



HARDWARE CHANGES TO ENABLE "Q AT NIGHT" OPERATION



- The pre-charge unit enables "Q at Night" operation as there is no available PV voltage.
- Pre-charge unit energizes the DC link via AC grid power.

REACTIVE POWER AT NIGHT (Q@NIGHT)

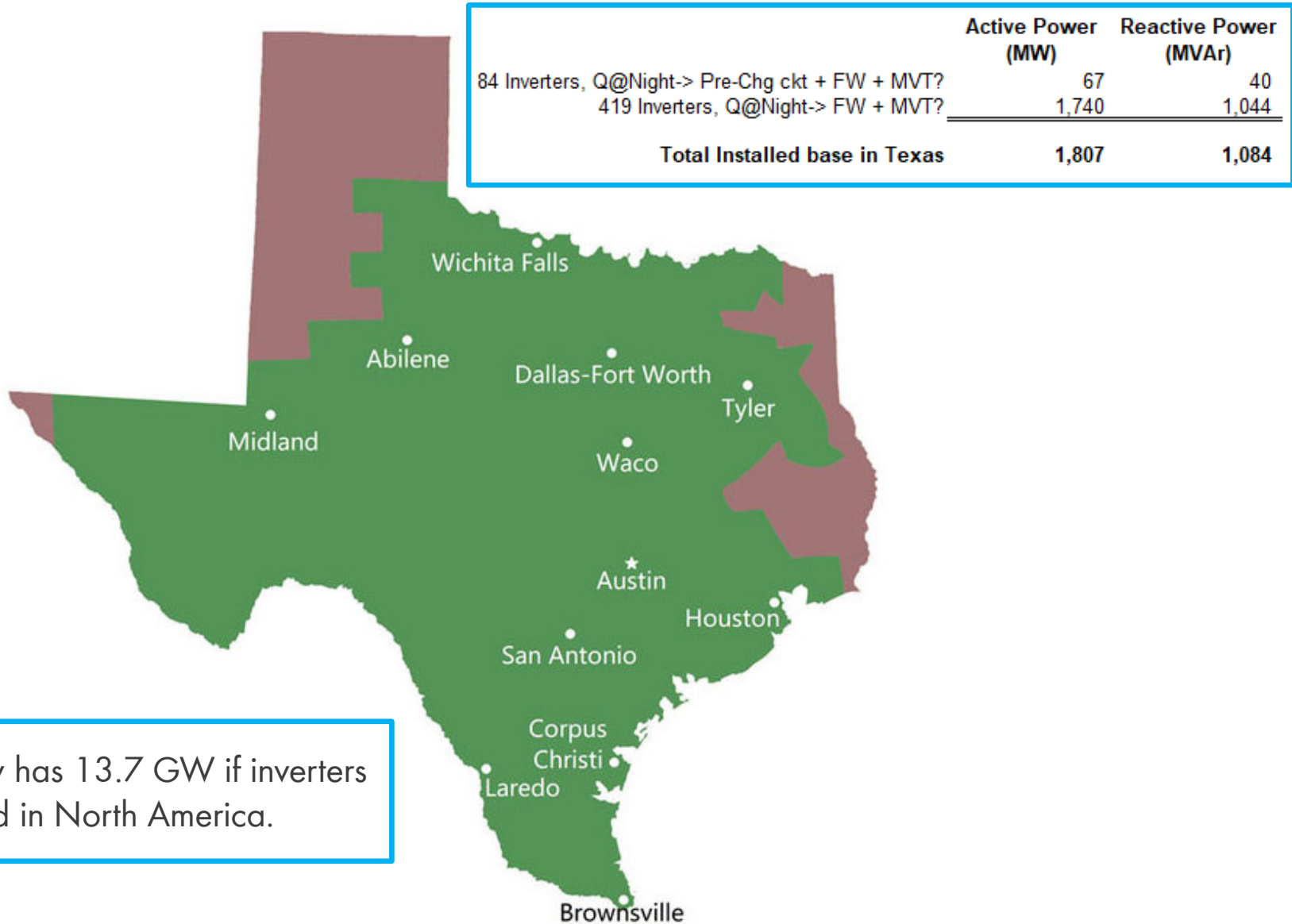


Q@Night facts:

1. Can be retrofitted on SMA CP-US and newer models of PV inverter
2. Does not affect inverter warranty.
3. Retrofit/upgrade does come at a financial cost.
4. SMA Service performs the retrofit/upgrade.
5. Probably the largest hurdle is a survey of your MVTs. MVTs must be rated for 24/7 duty to implement Q@Night.



SMA CENTRAL INVERTERS IN TEXAS



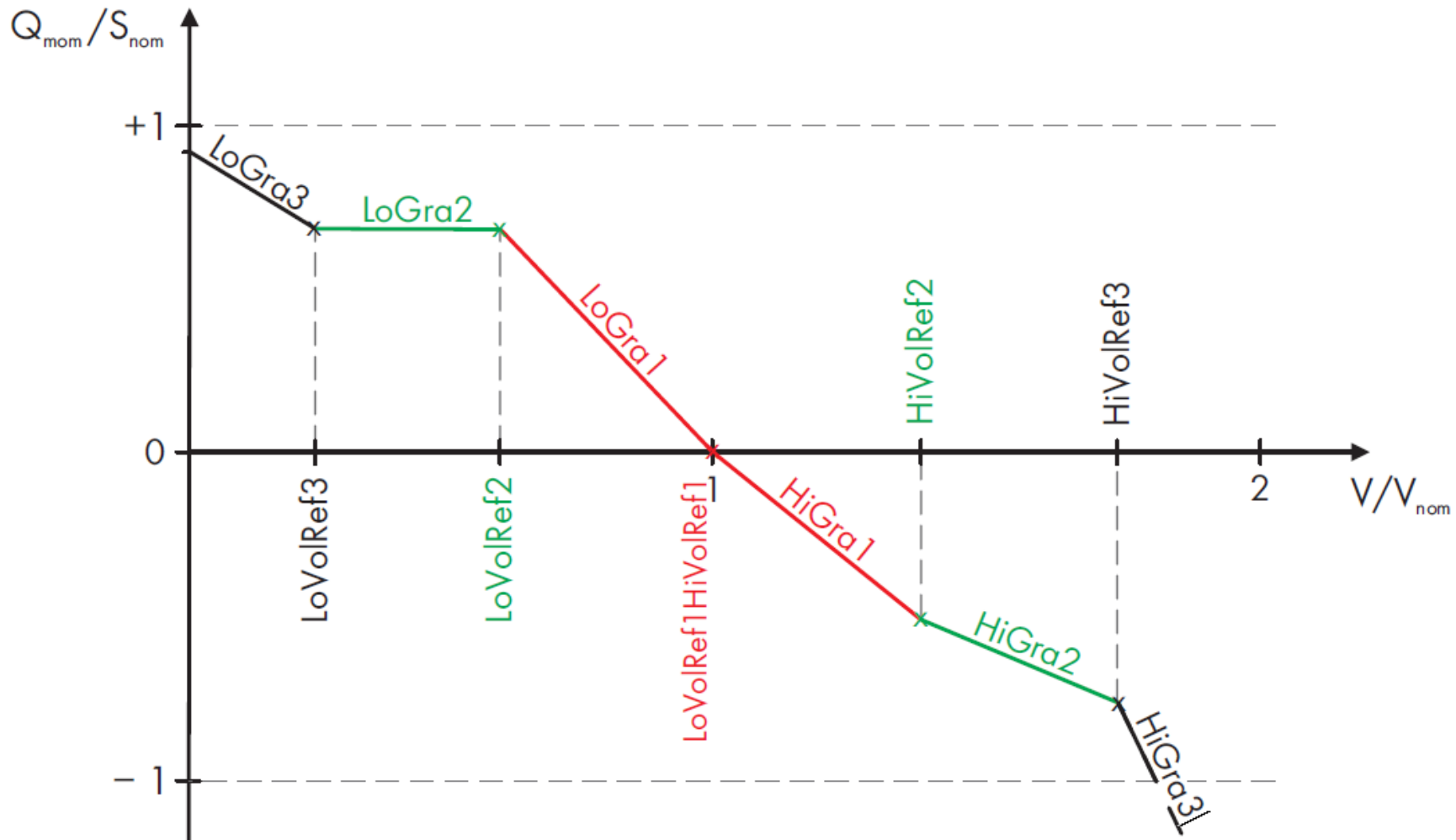
SMA currently has 13.7 GW if inverters installed in North America.

INVERTER VOLT-VAR CONTROL



- Voltage Control (VoltVAr) uses reactive power to stabilize the voltage at the terminals of the inverter
 - A characteristic is used which is working like a Proportional Controller
 - VoltVar uses **positive sequence only**
- VoltVAr keeps the voltage in a limited range and if it is configured the right way, it will increase the stability of the grid.
- The inverters are not “fighting” each other because of impedances between them (transformer, cable).
- No communication between the inverters is required.
- To control the voltage at the POI, use a PPC in combination with inverter voltage control. The PPC could send reactive power setpoints to the inverters (slow) while the inverters supply/absorb Vars to maintain voltage (fast...<20 ms)
- FRT-Full: German Grid Code (BDEW) requires a fast reaction with reactive current during a voltage sag (voltage < 0.9pu).
This is a separate feature which tries to **increase the positive sequence and to decrease the negative sequence.**

CHARACTERISTIC (VARCTLVOL)

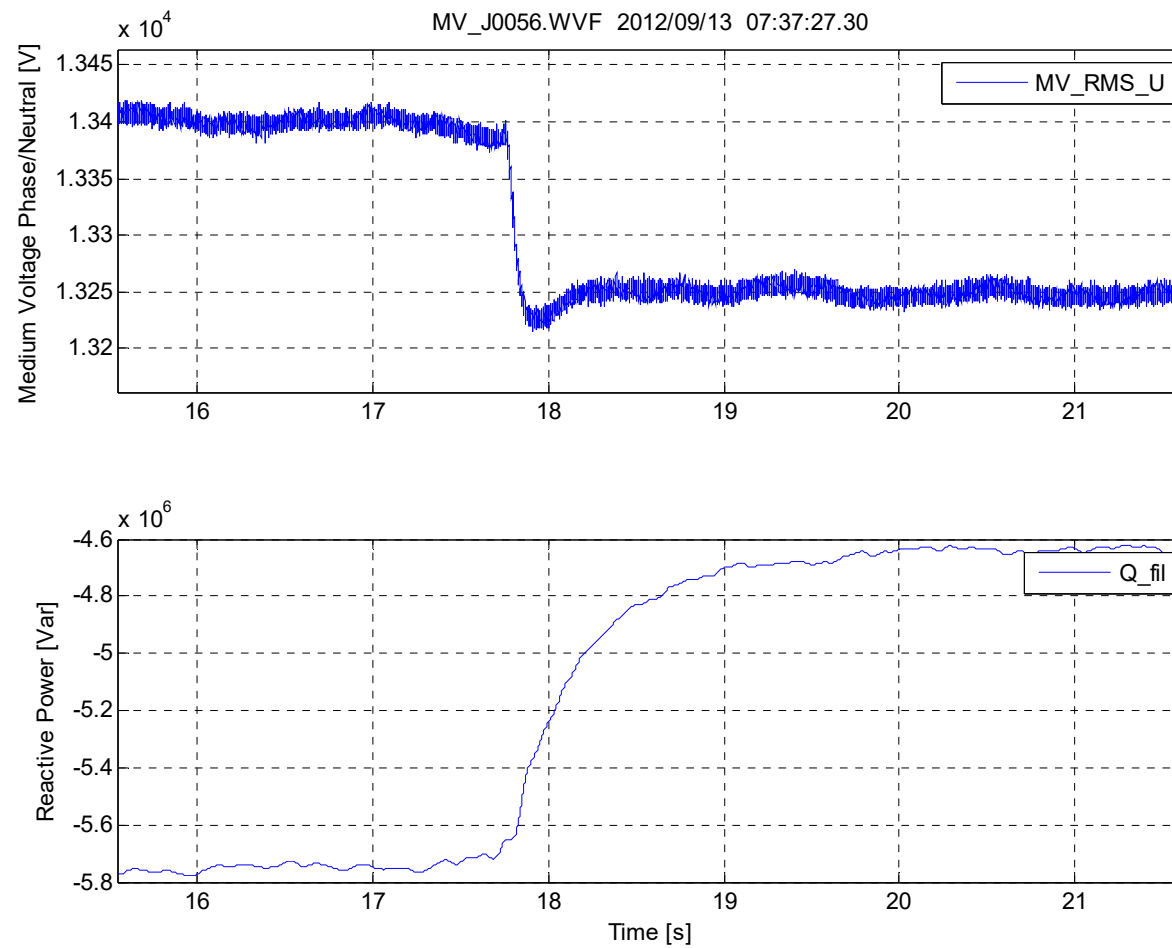


- UPSys inverters are able to receive Modbus set points for changing the voltage reference value (LoVolRef1 HiVolRef1).

VOLTAGE CONTROL – EXAMPLE 1



- Requirement: 90% reactive power after 1.5 seconds

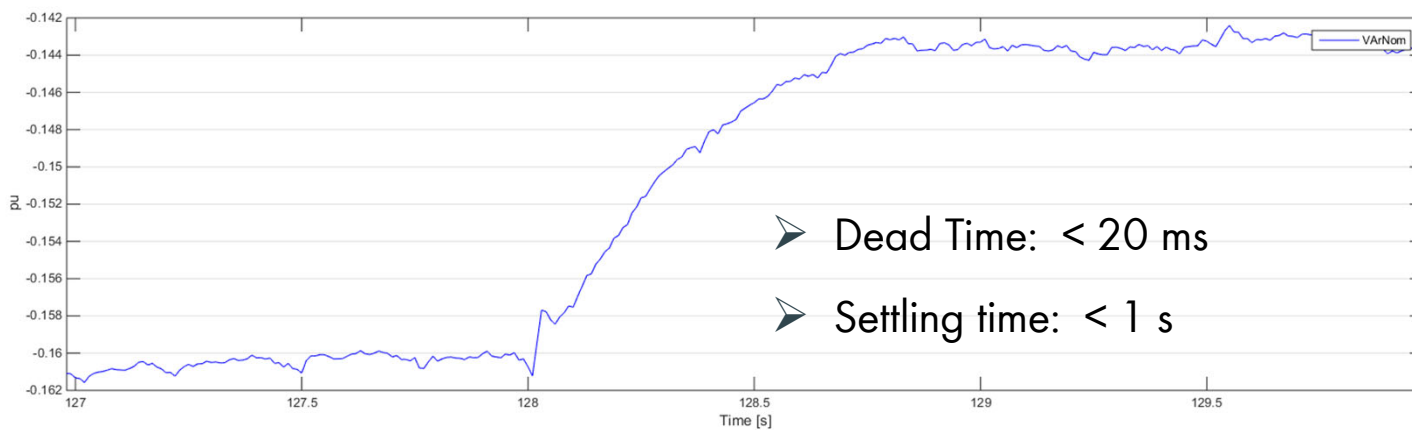
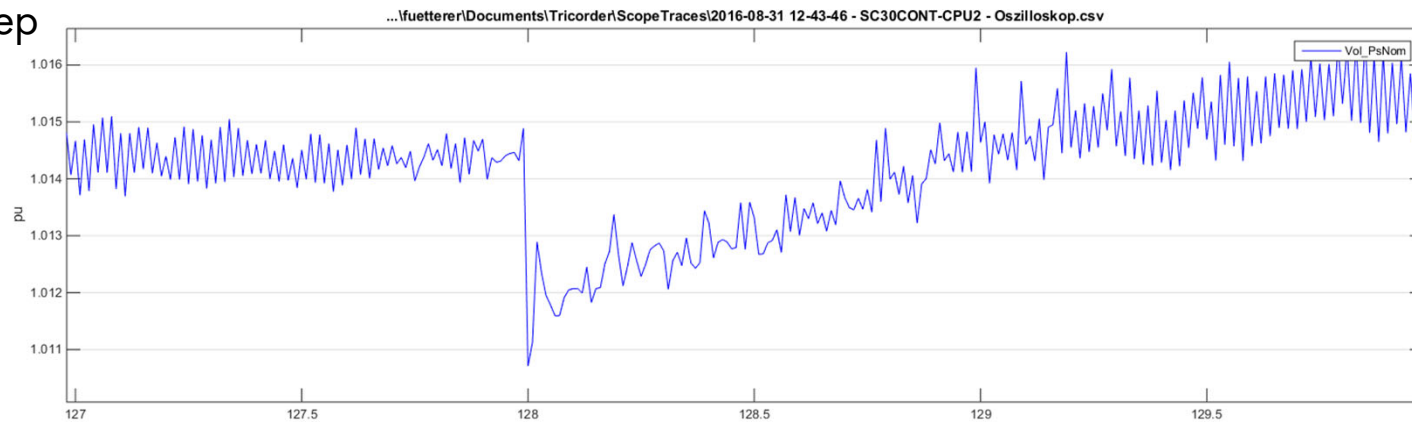


VOLTAGE CONTROL – EXAMPLE 2



➤ Inverter measurement SC2200, Gradient 10

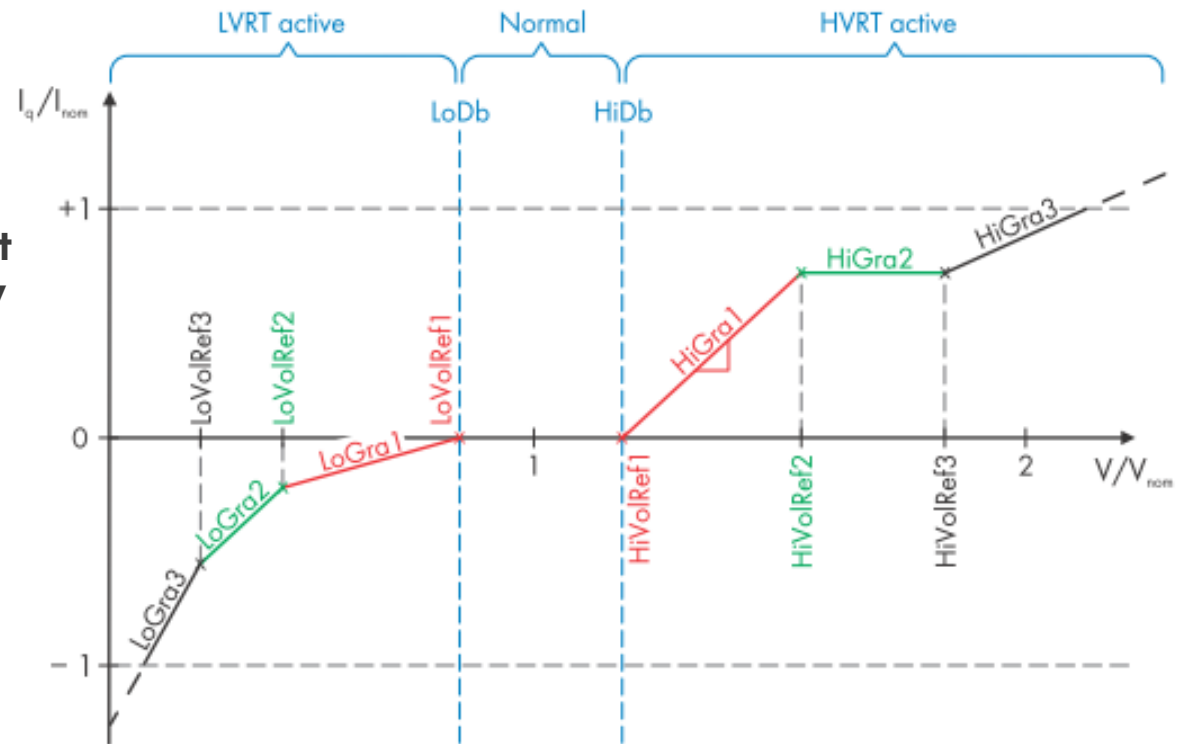
➤ AC voltage step



➤ Dead Time: < 20 ms

➤ Settling time: < 1 s

- **Full Dynamic Grid Support**
- Utility grid support during brief voltage dip by injecting reactive current **(Pos & Neg sequence)**.
- Three ranges each with different gradients can be defined for UV and OV.
- **Limited Dynamic Grid Support**
- Inverter interrupts grid feed-in during grid instability for a configurable time without disconnecting from the utility grid.
- The duration of the interruption is configurable via parameter `Fr.WaitTm`



ADVANCED ENGINEERING SERVICES

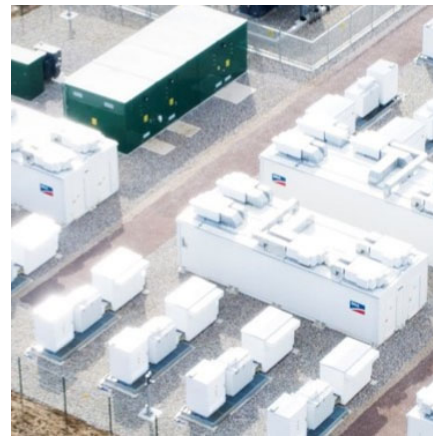


Offered to reduce the complexity of the challenging requirements



GRID STUDIES (ES-GS-01)

Grid codes and interconnection requirements are becoming very demanding worldwide, making compliance a real challenge. Complex power system studies are required from utilities for the integration of renewables to ensure a safe and reliable operation.



BATTERY STORAGE DESIGN (ES-BS-01)

Battery Storage can be used for energy shifting applications and grid support functions including frequency, voltage and reactive power control. This requires an assessment on the battery system sizing depending on the application.



SPECIALIZED ENGINEERING SUPPORT (ES-SUP-01) and SPECIALIZED ENGINEERING STUDIES/TESTING (ES-SUP-02)

Extend your team of experts for your critical projects. SMA leverages our expertise and technical knowledge for fast problem-solving during system studies or project execution to ensure a smoother process and risk mitigation.



GRID FORMING TECHNOLOGY PERFORMANCE (ES-PER-01)

There is an increasing need for stability solutions across the energy markets with a high renewable share. SMA can support studies including additional grid forming equipment which is ideal for voltage and frequency stabilization in combination with power & energy applications.



THANK
YOU

ENERGY
THAT
CHANGES



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