

TopCon SAS - The Modular Solar Array Simulation System

1 Abstract

Based on the unique features of TopCon DC power supplies, even the strongly non-linear behaviour of Silicon standard or thin film Solar Arrays can be simulated. Thus, development and testing of solar equipment – namely solar inverters – are highly simplified, as TopCon AAP-feature allows for modelling, editing and storing of hundreds of voltage-to-current curves onboard of the system.

The power level ranges from 10 kW up to hundreds of kilowatts and voltages reach up to 1000 VDC. Preparing for the future ? Reach for TopCon SAS !

2 The TopCon Hardware

The basic TopCon unit contains all necessary elements for simulating a solar array. Inside the firmware, a very versatile function generator and **Application Area Programming** feature is available, which allows for loading, storing, editing and scaling of arbitrary curves, which – in the case of solar array simulation – mirrors exactly the interdependency of voltage and current of an envisaged array. Modulation of solar illumination can be done either by loading subsequent curves or by simply scaling the existing curve in both directions of the diagram. In order to avoid hard transitions from one to the sequent curve type, a “soft-blend” feature is provided. The transition time can be selected independently from all other parameters.

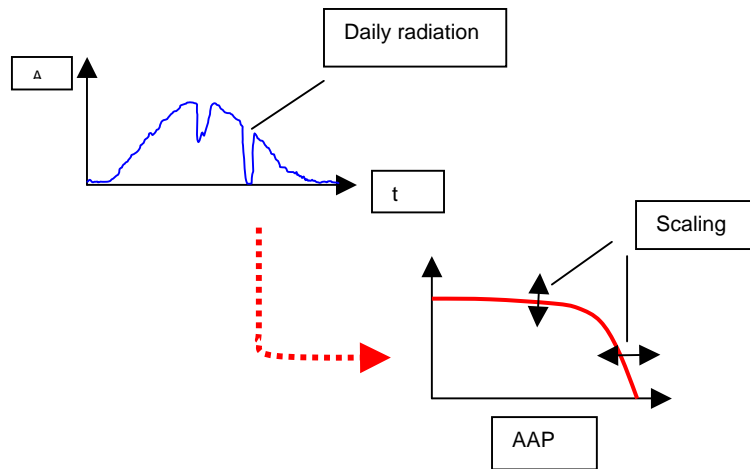


Picture 1:
TopCon 16 kW unit

Picture 1 shows a single 16 kW unit, other units are available as 10 kW, 20 kW and 32 kW DC units. Each power class disposes of a finely graduated series of voltages in the range of 52 VDC up to 1000 VDC.

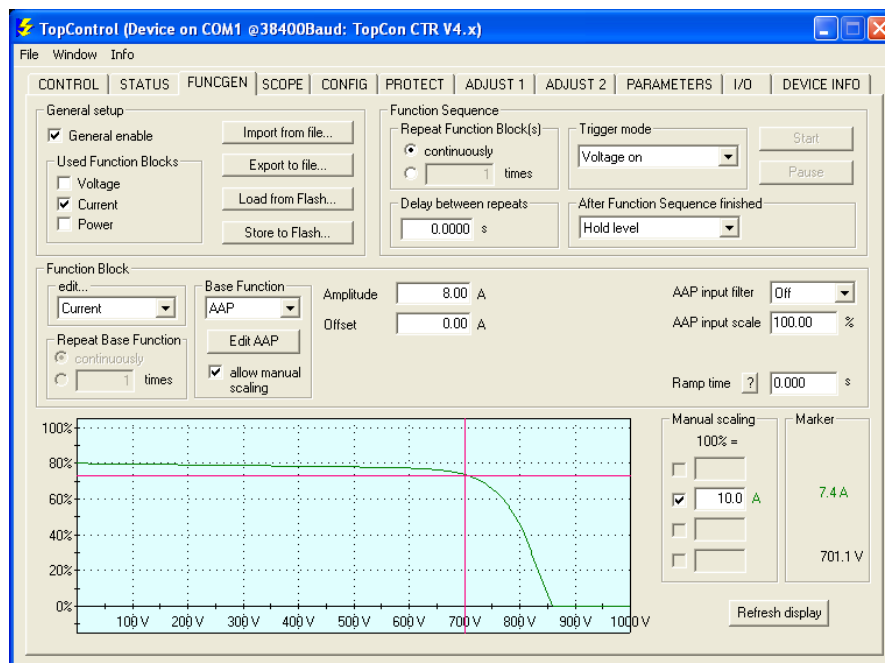
TopCon units allow for a number of extremely fast acting protecting possibilities, which monitor all process-relevant quantities and activate warning messages or even set a fast stop in the case of surpassing a given limit.

3 The Basic SAS Principle



Picture 2:
SAS principle schematic

Core of the system is formed by a fast interpolation and computing algorithm, which senses the system voltage and allocates the appropriate current reference given by the AAP stored curve. This value is input to the TopCon controller section, which sets the system current to the given value. As depicted in picture 2, an additional input “Daily radiation” can be activated, ensuring radiation modulation of the system and therefore allowing for running very specialized cycles of solar radiance. This will of course open up flexible future extensions of test figures.



Picture 3: Screenshot of AAP in TopControl software

Beside of time-domain functions, AAP opens up a way to work with arbitrary functions. In this example, a worked-out two-pole characteristic of a mid-sized solar array is programmed. All parameters inclusive scaling and soft blending are accessible in online mode.

4 Enhancing the Dynamic System Response

In most cases, the overall system response of standard units will match the time constants of an appropriate solar array. To simulate very fast thick film cells on smaller arrays, a faster system response can be of interest, depending also on the type of MPP tracking principle. In such cases REGATRON provides an optional fast system TopCon TC_LIN.



The basic difference to standard units is the additional post-controller unit TC_LIN, which enhances the dynamic range by a factor of 15. TopCon Master unit and Post-controller unit communicate by the proprietary CAN BUS. While TopCon provides for pre-regulated power, TC_LIN ensures very fast curve interpolation and current control by a fully programmable digital controller structure.

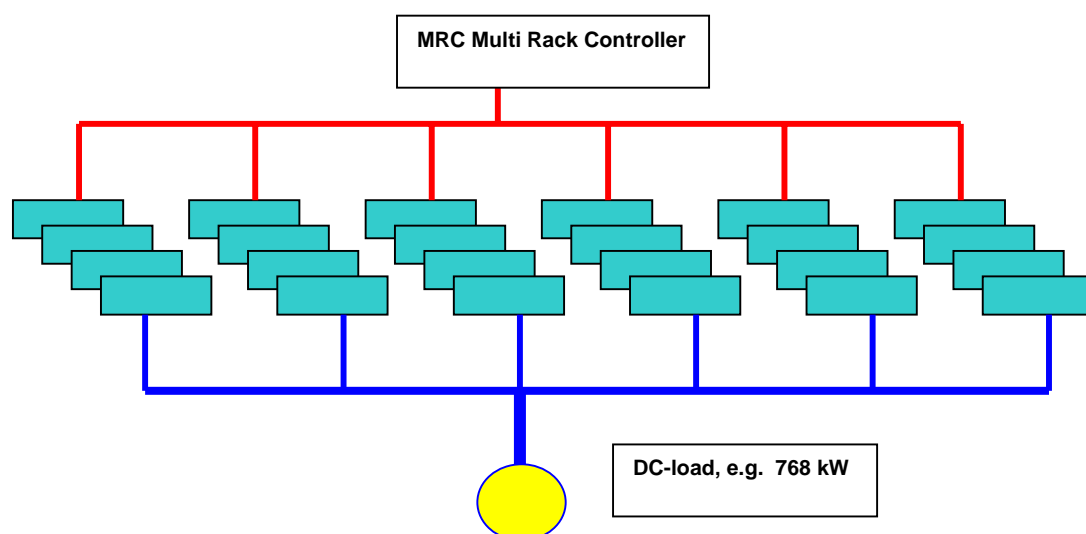
Picture 4: TopCon (below) and TC_LIN units form a 1000V/32 kW stack

5 Increasing Total System Power

There is an ongoing trend for bigger solar arrays, providing more and more solar power for commercial grids. By their modular system architecture, TopCon units can work in either parallel, serial, matrix and multi-load configuration.

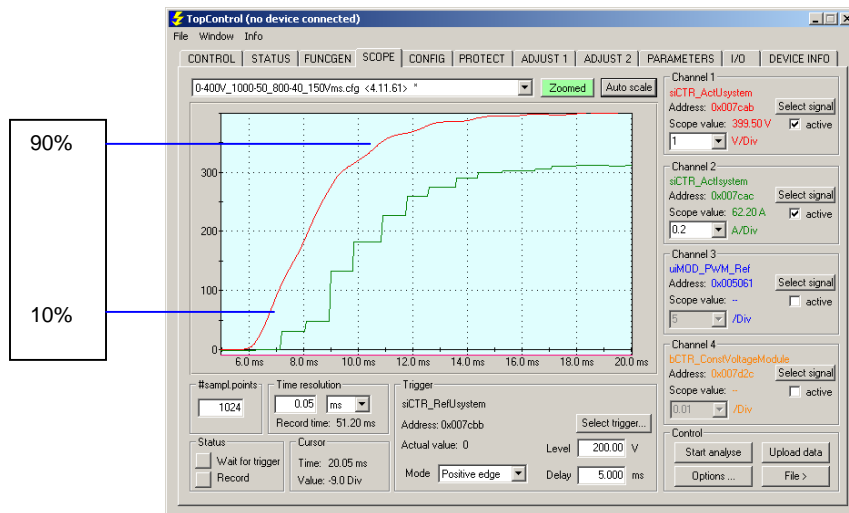
A TopCon master controls up to 7 slaves to form a 8-unit stack with 256 kW DC power.

If even more power is needed, a newly developed **Multiple Rack Controller TopCon MRC** is able to handle multiple stacks.



Picture 5: System Control

Control of big-sized solar array simulations can be done by the same principles as explained above. The MRC is based on the same system architecture like a single TopCon unit and allows therefore the use of both TFE function generator as of AAP arbitrary function feature. Even TopControl service and operation software works the same way as in single unit mode. Of course, other digital and analogue interfaces can be used to control the system.



Picture 6:
Step response of a
128 kW rack, taken by
TopControl SCOPE
Response time 4.5 msec
10%-90%

See picture 7 below for a system of 3 racks 128 kW/1000VDC each, and the separate MRC multirack-controller in the classical TopCon design.



Picture 7: Final adjustments on a 3 x 128 kW system

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Regatron Power Supplies

DC Power Supplies TopCon Quadro Series
Overview Standard Types, valid from 04.10.05

| Output voltage range (VDC) | Output power range (kW) | Output current range (A) | Dimensions (mm) width x height x depth | Weight (kg) | Type |
|----------------------------|-------------------------|--------------------------|---|-------------|--------------------|
| 0 – 52 | 0 – 10 | 0 – 250 | 19" x 6 U x 495 | 42 | TC.P.10.52.400.S |
| 0 – 52 | 0 – 16 | 0 – 400 | 19" x 6 U x 495 | 44 | TC.P.16.52.400.S |
| 0 – 52 | 0 – 20 | 0 – 500 | 19" x 9 U x 590 | 64 | TC.P.20.52.400.S |
| 0 – 52 | 0 – 32 | 0 – 700 | 19" x 9 U x 590 | 68 | TC.P.32.52.400.S |
| 0 – 65 | 0 – 10 | 0 – 193 | 19" x 6 U x 495 | 42 | TC.P.10.65.400.S |
| 0 – 65 | 0 – 16 | 0 – 308 | 19" x 6 U x 495 | 44 | TC.P.16.65.400.S |
| 0 – 65 | 0 – 20 | 0 – 385 | 19" x 9 U x 590 | 64 | TC.P.20.65.400.S |
| 0 – 65 | 0 – 32 | 0 – 600 | 19" x 9 U x 590 | 68 | TC.P.32.65.400.S |
| 0 – 100 | 0 – 10 | 0 – 125 | 19" x 6 U x 495 | 42 | TC.P.10.100.400.S |
| 0 – 100 | 0 – 16 | 0 – 200 | 19" x 6 U x 495 | 44 | TC.P.16.100.400.S |
| 0 – 100 | 0 – 20 | 0 – 250 | 19" x 9 U x 590 | 64 | TC.P.20.100.400.S |
| 0 – 100 | 0 – 32 | 0 – 400 | 19" x 9 U x 590 | 68 | TC.P.32.100.400.S |
| 0 – 130 | 0 – 10 | 0 – 96 | 19" x 6 U x 495 | 42 | TC.P.10.130.400.S |
| 0 – 130 | 0 – 16 | 0 – 153 | 19" x 6 U x 495 | 44 | TC.P.16.130.400.S |
| 0 – 130 | 0 – 20 | 0 – 192 | 19" x 9 U x 590 | 64 | TC.P.20.130.400.S |
| 0 – 130 | 0 – 32 | 0 – 308 | 19" x 9 U x 590 | 68 | TC.P.32.130.400.S |
| 0 – 200 | 0 – 10 | 0 – 63 | 19" x 6 U x 495 | 42 | TC.P.10.200.400.S |
| 0 – 200 | 0 – 16 | 0 – 100 | 19" x 6 U x 495 | 44 | TC.P.16.200.400.S |
| 0 – 200 | 0 – 20 | 0 – 125 | 19" x 9 U x 590 | 64 | TC.P.20.200.400.S |
| 0 – 200 | 0 – 32 | 0 – 200 | 19" x 9 U x 590 | 68 | TC.P.32.200.400.S |
| 0 – 400 | 0 – 10 | 0 – 31 | 19" x 6 U x 495 | 42 | TC.P.10.400.400.S |
| 0 – 400 | 0 – 16 | 0 – 50 | 19" x 6 U x 495 | 44 | TC.P.16.400.400.S |
| 0 – 400 | 0 – 20 | 0 – 63 | 19" x 9 U x 590 | 64 | TC.P.20.400.400.S |
| 0 – 400 | 0 – 32 | 0 – 100 | 19" x 9 U x 590 | 68 | TC.P.32.400.400.S |
| 0 – 500 | 0 – 10 | 0 – 25 | 19" x 6 U x 495 | 42 | TC.P.10.500.400.S |
| 0 – 500 | 0 – 16 | 0 – 40 | 19" x 6 U x 495 | 44 | TC.P.16.500.400.S |
| 0 – 500 | 0 – 20 | 0 – 50 | 19" x 9 U x 590 | 64 | TC.P.20.500.400.S |
| 0 – 500 | 0 – 32 | 0 – 80 | 19" x 9 U x 590 | 68 | TC.P.32.500.400.S |
| 0 – 600 | 0 – 10 | 0 – 20 | 19" x 6 U x 495 | 42 | TC.P.10.600.400.S |
| 0 – 600 | 0 – 16 | 0 – 32 | 19" x 6 U x 495 | 44 | TC.P.16.600.400.S |
| 0 – 600 | 0 – 20 | 0 – 40 | 19" x 9 U x 590 | 64 | TC.P.20.600.400.S |
| 0 – 600 | 0 – 32 | 0 – 66 | 19" x 9 U x 590 | 68 | TC.P.32.600.400.S |
| 0 – 800 | 0 – 10 | 0 – 16 | 19" x 6 U x 495 | 42 | TC.P.10.800.400.S |
| 0 – 800 | 0 – 16 | 0 – 25 | 19" x 6 U x 495 | 44 | TC.P.16.800.400.S |
| 0 – 800 | 0 – 20 | 0 – 32 | 19" x 9 U x 590 | 64 | TC.P.20.800.400.S |
| 0 – 800 | 0 – 32 | 0 – 50 | 19" x 9 U x 590 | 68 | TC.P.32.800.400.S |
| 0 – 1000 | 0 – 10 | 0 – 13 | 19" x 6 U x 495 | 42 | TC.P.10.1000.400.S |
| 0 – 1000 | 0 – 16 | 0 – 20 | 19" x 6 U x 495 | 44 | TC.P.16.1000.400.S |
| 0 – 1000 | 0 – 20 | 0 – 25 | 19" x 9 U x 590 | 64 | TC.P.20.1000.400.S |
| 0 – 1000 | 0 – 32 | 0 – 40 | 19" x 9 U x 590 | 68 | TC.P.32.1000.400.S |

- AC line input: 3 x 360-440 VAC, line frequency: 48-62 Hz
- Refer to type-specific technical datasheet for more detailed specifications.
- Contact factory for availability of models with output voltage ranges not listed here.

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