TopCon – TechNote SAS

Keyword / title	***How to simulate solar cell arrays***
Date	*12-05-2009*
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1. Abstract

Development and testing of solar inverters call for power systems able to simulate solar cell arrays. The well-known current vs. voltage slope as also the influence of size and type of cells, illumination and temperature have to be reproduced as close as possible to the original. In order to run automated test sequences, sequential loading of different slopes should be applicable with the possibility to blend softly from one to the next slope.
It is the aim of this paper to introduce to the techniques of simulation of solar cell arrays using the wide spectrum of REGATRON TopCon SAS power systems.

2. TopCon AAP - the basic approach

*The famous Application Area programming feature **AAP** enables each TopCon standard unit to follow exactly a given voltage-to current slope. Up to 1000 slopes may be stored in the on-board flash memory enabling the user to run well defined series of illumination conditions. Control of the slopes may be established either by TopControl PC software or by external software by the aid of REGATRON .DLL API interface.*

Picture 1: TopCon 10/16 kW unit

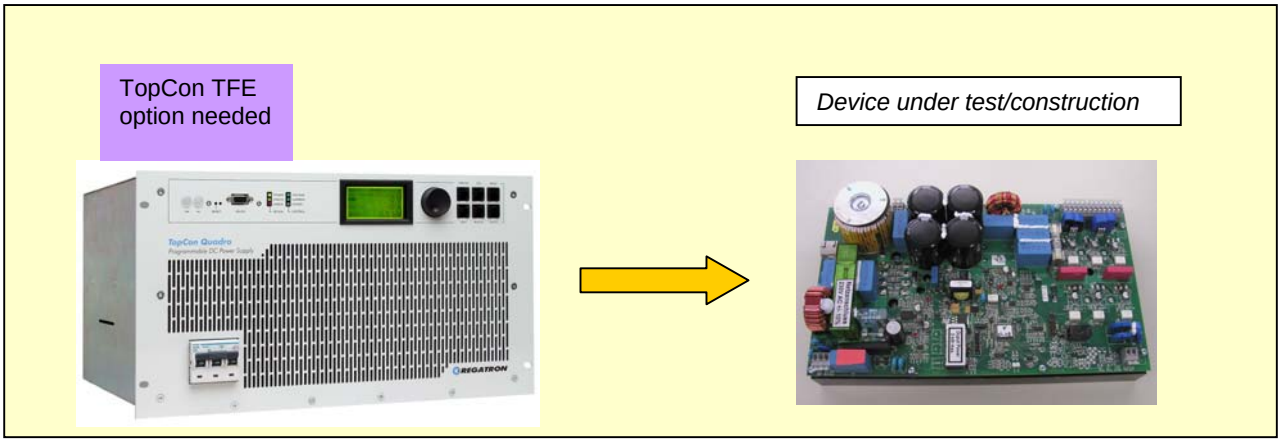
In AAP mode, the full range of TopCon features is still available: Current and voltage limits, overvoltage and overcurrent protection, programmable limit switching, open controller parameters, the 4-channel SCOPE function, updateable firmware.

For further TopCon details see:

- *TopCon_Standard_types*
- *TopControl_Operating_Manual*
- *TopCon_AAP_short_description*

3. Completing a TopCon SAS system

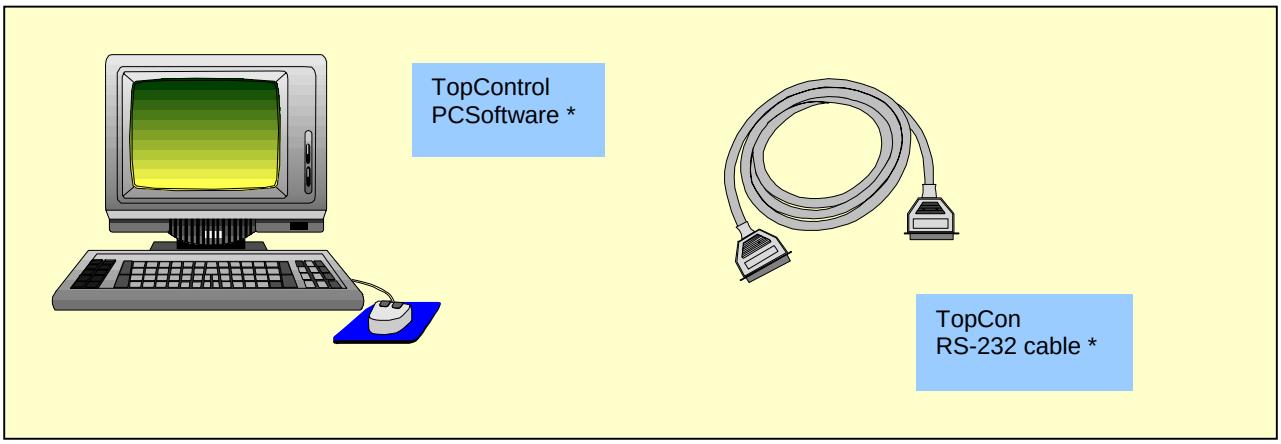
A hardware overview



Picture 2: Setting up TopCon power supply and the device under test

Step 1:

- *Select the proper TopCon unit according to your application, see TopCon family datasheet*
- *Order TFE/AAP option*
- *Connect unit to mains and to your application*



Picture 3: Setting up TopControl software ***** *scope of delivery*

Step 2:

- *Load supplied software TopControl to your PC/Laptop (1 free RS-232 port or USB needed)*
- *Connect supplied cable from TopCon-RS-232 to the computer RS-232 port or use USB cable*
- *Run software and log-in to TopCon unit*
- *Perform all further actions (editing, storing, loading, SCOPE, scaling, blending etc. via TopControl*

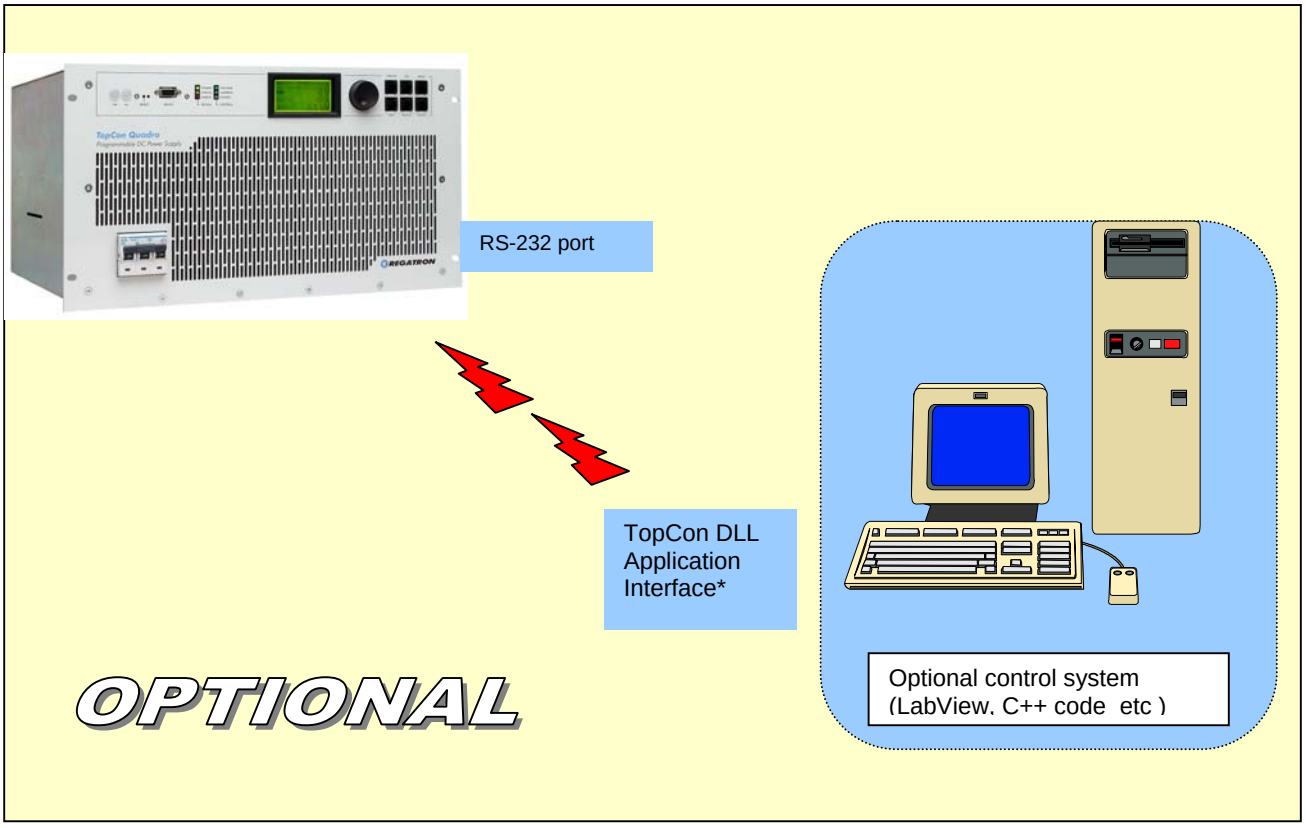
Note: *TopControl PC software allows for manual sequencing of slopes. Full automatic sequencing is under construction and will be available in due course. For automated sequencing refer to chapter 4.*

For further topics on TopControl/AAP/SAS see :

- *PV simulation with TopCon*
- *TopCon Applications Solar Array Simulation*
- *TopControl_Example_Userdefined_Characteristic*

4. Optional system control via TopCon DLL - interface

System overview



Picture 4: Setup of an external control system ***** *scope of delivery*

By using TopCon .DLL application programming interface, a superposed control and visualisation system
(e.g. LabView, own C++ code etc.) will be able to run completely automated test and stress cycles and allow for visualisation and storage of obtained data. By this, evaluation of effective MPP efficiency and other hardware related data can be done in a simple way.

For further details on DLL interface see:

- *API für DLL Version 2.90 (V2.0)*
- *Store AAP characteristic by means of TopCon DLL*
- *DLL functions to run function sequences*
- *DLL-Funktionen für AAP-Kennlinien (German, describing all available functions)*

5. APPENDIX 1 How AAP works

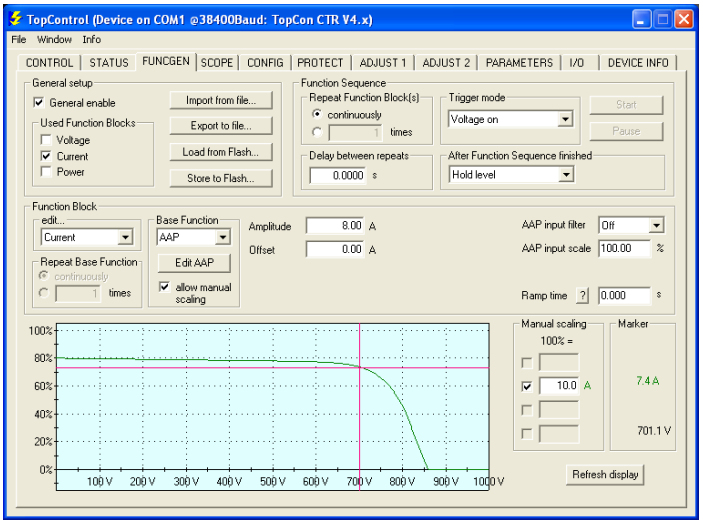
AAP reads permanently the DC voltage on the DC Bus and in turn generates the respective current into the device under test (DUT). By this, the behaviour of a solar cell array can be reproduced and edited.

Simulation of predetermined radiance patterns, as for example the simulation of day course of illumination, can be done in two different ways:

a) by scaling up and down of a given current vs. voltage slope

b) by sequential loading of an appropriate set of parametric slopes

In both cases, transition from a given slope to the following can be done as a steep step or as a continuous ramp with programmable ramp time.



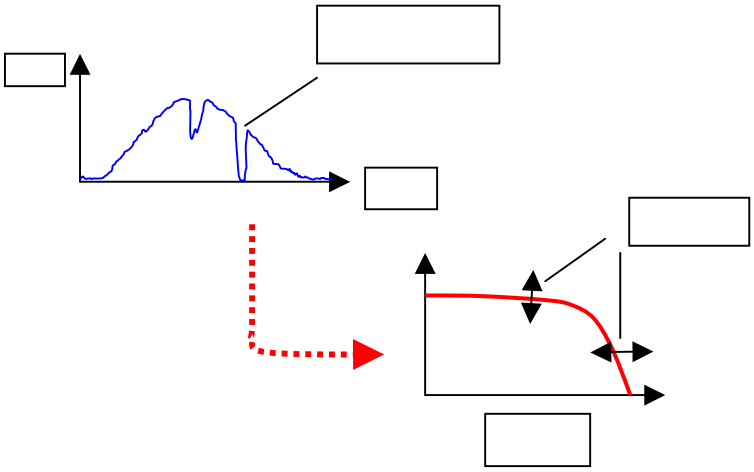
Picture 4:
Edit window of AAP-functions within TopControl software

Picture 5: AAP EDIT window

Example 1: Sequence by scaling

The illumination values of a day course are expressed as scale factors, affecting in turn the curve parameters.

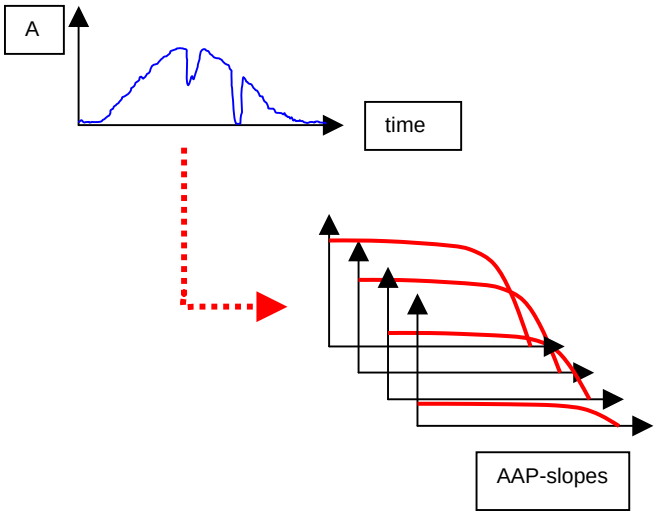
The scale factors may be entered either by hand or in an automated way by a superposed control program, as stated in chapter 4.



Example 2: Sequencing by calling subsequent slopes

As an alternative to method "scaling" TopCon AAP offers a second way to simulate day courses:
An appropriate number of predeterminated slopes are stored and sequentially loaded into AAP work area. Again, changes from one to the subsequent slope can be done as step or as a programmable ramp.

Note that steep step changes are subject to test the inverter tracking capabilities. Therefore TopCon AAP is well prepared to future standardised test procedures: The blend-over ramp time can be set finely graduated in order to exactly analyze the DUT's trackers.



Picture 6: Curve parameterisation by scaling