Solar cell modelling with PC1D

Overview

- What is PC1D?

- How does PC1D work?

- PC1D in UNIK 4450
  - Solar cell models

What is PC1D?

- PC1D is a computer program for modelling charge transport in semiconductor devices
  - Solves the fully coupled nonlinear equations
  - Quasi-one-dimensional charge transport

- PC1D is often used for modelling photovoltaic devices

- Runs on Windows

- PC1D was developed by Paul A. Basore in 1985

Where is PC1D?

The University of New South Wales, Sydney, Australia

UNSW Home   SPREE Home   Other Links   Products and Services   PC1D

Other Links - Products and Services

PC1D

PC1D is a computer program written for IBM-compatible personal computers which solves the fully coupled nonlinear equations for the quasi-one-dimensional transport of electrons and holes in crystalline semiconductor devices, with emphasis on photovoltaic devices.

PC1D requires at least an 80386 CPU and an 80387 math coprocessor (note that most 80486 and Pentium processors have the math coprocessor built-in). Only one file is necessary to run the program, PC1D.EXE. The additional file PC1D.HLP provides on-screen help, and several additional files are provided which contain material parameters for selected semiconductors, standardized solar spectra, and example problems. All of the files can be simply copied into the directory of choice; no setup program is required. To store files of different type in different directories, see the instructions for the Options menu.

Please note that MS Vista does not support the 32-bit Help file format used in PC1D. MS may be able to provide a program to allow the PC1D Help files to be read by Vista users.

Order PC1D

The source code for PC1D has been made freely available, thanks to the generous support of Dr. Donald Clugston, through Source Forge. Please access the files through:
http://pc1d.svn.sourceforge.net/viewvc/pc1d/trunk/pc1d.

Discussion and exchange of future changes and improvements to the source code will be mediated through:http://sourceforge.net/projects/pc1d.

The latest verified and trusted version of PC1D, as of February 2008, is available for free download here.

- Download PC1D version 5.9

UNSW no longer offers technical support for PC1D.

In case you are unable to download from the link above, UNSW continues to provide PC1D version 5.9 via this web site, for which handling fees will be charged.

- Order Form for Domestic Orders
- Order Form for International Orders

Conference Papers on PC1D

More information on PC1D can be found in the following conference papers by Paul A. Basore and Donald A. Clugston:

- PC1D Version 4 for Windows: From Analysis to Design, *25th IEEE Photovoltaic Specialists Conference, Washington, May 1996, pp.377- 381.*
- PC1D Version 5: 32-bit Solar Cell Modeling on Personal Computers, *26th IEEE Photovoltaic Specialists Conference, Anaheim, Sep-Oct 1997, pp.207- 210.*
- PC-1D version 2: enhanced numerical solar cell modelling Rover, *D.T.; Basore, P.A.; Thorson, G.M. IEEE 1985, p. 703*
- PC-1D version 2: enhanced numerical solar cell modelling Basore, *P.A.; Rover, D.T.; Smith, A.W. IEEE*

http://www.engineering.unsw.edu.au/energy-engineering/pc1d-software-for-modelling-a-solar-cell

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Simulating solar cells with PC1D

- Simulation of solar cells in PC1D is a 3-step process

  1. Simulation parameters
     - Device configuration
     - Excitation
     - Material data

  2. Run simulation

  3. Analyze results
     - Simple analysis can be performed using PC1D
     - Further analysis is performed in other programs using exported data

IFe

Using PC1D

- PC1D is easy to learn and use

- Commands are either chosen from drag-down menus, given by clicking icons or by double-clicking parameters or device regions

- PC1D offers 3 display modes ("Views")
  - Parameter View
    - To modify parameters and the device schematic diagram
  - Four-Graph View
    - To keep track of program advancement
  - Interactive Graph View
    - To analyse and copy data into other Windows programs

Changing simulation parameters

- Use the Display menu and Excitation menu

    OR

- Double-click on the parameters name in the Parameter View

    OR

- Double-click on the device schematic to change device parameters

Running a simulation

- Use the Compute menu and select Run

OR

- Press the Run button in the toolbar

Analyzing simulation data

- Examine graphs in the Interactive Graph View

OR

- Copy values from a graph can to the clipboard and export to another program, e.g. a spreadsheet

ADDITIONALLY

- V_{oc}, I_{sc} and P_{max} are displayed in the parameter view under the heading *** RESULTS ***

Setting up the first device

- DEVICE parameters
  - Reflectance
  - Texturing
  - Surface charge
  - Base and emitter contacts must be enabled
    - For two-terminal devices (solar cells)
      - Use B and E only
      - C can be used for more complex devices
  - Parasitic resistances can be added

Setting up the first device

- REGION 1 parameters
  - Thickness
  - Material parameters
  - Emitter doping

Setting up the first device

- EXCITATION
  - I-V curve plotting (non-intuitive!)
    - Excitation mode: transient
    - Number of points on graph = timesteps
    - Base circuit: sweep from … to … (transient)
  - Several light sources possible
    - Lasers
    - Sun (AM1.5…)
    - Black bodies

- RESULTS
  - Main cell parameters are given here