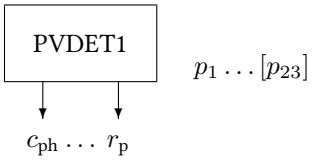
Block PVDET1

The PVDET1 block determines the one-diode-model parameters for c-Si modules from data sheet values and writes a .bp file.





Name	PVDET1
Function	se0025
Inputs	0
Outputs	6
Parameters	18 . . . [23]
Strings	6
Group	C

Inputs

None

Outputs

1 Coefficient of short-circuit current density c_{ph} / V^{-1}
2 Temperature coefficient of short-circuit current c_t / $V^{-1}\,K^{-1}$
3 Coefficient of saturation current density (Shockley diode) c_s / $A\,m^{-2}\,K^{-3}$
4 Diode ideality factor α
5 Series resistance parameter r_s / $\Omega\,m^2$
6 Parallel resistance parameter r_p / $\Omega\,m^2$

Parameters

1 Cells in series per module
2 Cells in parallel per module
3 Single cell area / m^2
4 Module area / m^2
5 Maximum power point voltage at STC V_m / V
6 Maximum power point current at STC I_m / A
7 Open-circuit voltage at STC V_{oc} / V

8 Temperature coefficient of open circuit voltage α_v / $\mathrm{V\,K^{-1}}$
9 Short-circuit current at STC I_{sc} / A
10 Temperature coefficient of short circuit current α_i / $\mathrm{A\,K^{-1}}$
11 Module tolerance plus / %
12 Module tolerance minus / % (≤ 0)
13 Characteristic module length / m
14 Module mass / kg
15 Absorption coefficient
16 Emission coefficient
17 Specific module heat capacity / $\mathrm{J\,kg^{-1}\,K^{-1}}$
18 NOCT temperature / °C
19 Overwrite mode
  0 Generate error (default)
  1 Overwrite
20..23 Ignored. They were used for the custom module info file, which isn't supported anymore.

Strings

1 INSEL module ID (pv000000 defaults to the smallest free number ≥ 900000 in folder SP(2).)
2 Path to .bp file
3 Module name
4 Manufacturer
5 Cell type (e. g., cristalline)
6 Ignored, see BP(20..23)

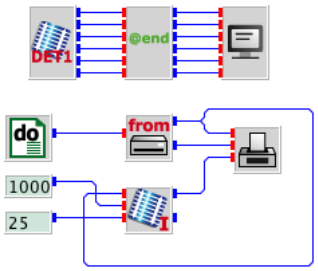
Description

The parameters of the one- or two-diode model can be calculated uniquely from the data usually provided on the data sheets of PV module manufacturers by a rather simple set of equations. The PVDET1 block uses these equations to determine the one-diode model parameters.

pvdet1.vseit A measured I-V curve of a typical crystalline solar cell is used to demonstrate the performance of the PVDET1 block. The data sheet of the cell would be

Nominal power P_n / W	2.3876
Nominal current I_m / A	4.8487
Nominal voltage V_m / V	0.49243
Short-circuit current I_{sc} / A	5.3125
Open-circuit voltage V_{oc} / V	0.60845
Current temperature coefficient α_I / mA K^{-1}	1.97222
Voltage temperature coefficient α_V / mV K^{-1}	−1.97222
NOCT / °C	47 ± 2
Area of a single cell A_c / m^2	0.015625
Number of cells in series N_s	1
Number of cells parallel N_p	1
Module area / m^2	0.015625
Weight / kg	0

The parameters as specified in the table above are used by the PVDET1 block.



An ATEND block is used to ensure that the SCREEN block shows the resulting values of the six block parameters only once.

```
0.27302E+00 0.22463E-03 0.59158E+04 0.10037E+01 0.12164E-03 0.37555E-01
```

Running this INSEL model results in a file written to the directory specified in Path to .bp file. It is necessary to have write access to this directory. The file name will be as specified in the INSEL module ID parameter plus extension `.bp`, so that the example writes the file `pvdet1.bp` to the current directory.

If several new `.bp` files are created, it is recommended to use `pv900000.bp`, `pv900001.bp`, `pv900002.bp` etc and to keep track that the numbers are unique.

pvdet1.bp

```
                % Filename       pvdet1.bp
                % Module         pvdet1
                % Manufacturer   Manufacturer
                % Cell type      crystalline

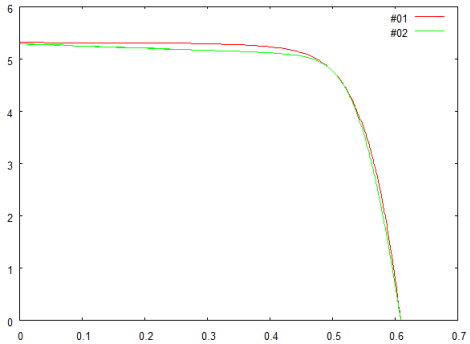
                % Mode must be set externally
  1             % Number of cells in series N_s per module
  1             % Number of cells in parallel N_p per module
  1             % Number of modules in series M_s
  1             % Number of modules in parallel M_p
  0.0156        % Cell area A_c (m^2)
  0.016         % Module area A_m (m^2)

                % Electrical parameters
  1.12          % Band gap (eV)
  0.273023E+00 % Short-circuit current parameter C_0 (V^-1)
  0.224639E-03 % Isc temperature coefficient  C_1 (V^-1 K-^1)
  0.591586E+04 % Shockley saturation parameter C_01 (A m-2 K^-3)
  0.000000E+00 % Recombination saturation parameter C_02 (A m-2 K^-5/2)
  0.121641E-03 % Series resistance r_s (Ohm m^2)
  0.375550E-01 % Parallel resistance r_p (Ohm m^2)
  0.100373E+01 % Shockley diode ideality factor alpha
      2.000000 % Recombination diode quality beta
  0.000000E+00 % Bishop parameter-1
  0.000000E+00 % Bishop parameter-2
  0.000000E+00 % Bishop parameter-3
  0.0           % Module tolerance plus
  0.0           % Module tolerance minus

                % Thermal parameters
  1.000         % Characteristic module length l_m (m)
  1.000         % Module mass m_m (kg)
  0.70          % Default absorption coefficient a
  0.85          % Default emission factor epsilon
900.0           % Default specific heat of a module C_mod (J kg^-1 K^-1)
 47.0           % Nominal operating cell temperature NOCT (degrees C)
 25.0           % Intial value of cell temperature (degrees C)

                % Numerical parameters (optional)
  1E-5          % Error tolerance of voltage of single cell (V)
 100            % Maximal number of iterations to solve I/V-equation
```

The `.bp` file can directly be used in a `.insel` model. The following graph shows a comparison between the measured curve and the curve based on the obtained parameter set.



Since the open-circuit voltage, short-circuit current and maximum power point data are part of the analytical determination of the one-diode-model parameters, these points are met exactly by the method.

The generated `.bp` file can be included in the parameters of the PVI and PVV blocks, e. g., `i 'pv900000.bp'`, or its values can be entered in VSEit with Provide parameters. The parameters for the custom module info file are ignored: VSEit's PV browser lists the modules of the INSEL PV module database `data/pv/pv_modules.fb.bin`.

See also Blocks PVI, PVV, PVDET2.