```
> restart;
```

PV generator model

In this MAPLE worksheet, the Jacobian matrix is applied to the PV generator model to calculate the first ten iterations of the open-circuit voltage $U_{OC}(\vartheta_C, \Phi_G)$ in (V) and the reverse saturation current $I_S(\vartheta_C)$. The calculations were performed for different values of the PV cell temperature ϑ_C and the irradiance E_G. However, in this printout $\vartheta_C = 25°\mathrm{C}$ and $E_G = 200\ \mathrm{Wm}^{-1}$.

Header

Used mathematical packages:

```
> with(LinearAlgebra):
> with(VectorCalculus, Jacobian):
```

Parameters

Specifications of the PV generator:

```
> param := [ I__SC_STC = 9.79, U__OC_STC = 24.27, m = 1, N_C = 36,
  E__STC = 1000, E__G = 200, k = 1.380649 * 10^(-23), e =
  1.602176634 * 10^(-19), vartheta__C = 25, vartheta__STC = 25,
  TC__I_SC = 0.05, TC__U_OC = -0.29 ];
```

$$param := [I_{SC\_STC} = 9.79,\ U_{OC\_STC} = 24.27,\ m = 1,\ N\_C = 36,\ E_{STC} = 1000,\ E_G = 200,\ k = 1.380649000\ 10^{-23},\ e = 1.602176634\ 10^{-19},\ \vartheta_C = 25,\ \vartheta_{STC} = 25,\ TC_{I\_SC} = 0.05,\ TC_{U\_OC} = -0.29] \tag{2.1}$$

Main calculation

First the necessary quantities for the model of the PV generator and the starting values for the Jacobian matrix are calulated. Based on these the Jacobian matrix is determined and transformed, so that it can be used with the Newton-Raphson Method. Finally, the iterations are presented.

Necessary quantities

Thermal voltage:

```
> U__T := k * (vartheta__C + 273.15) / e;
```

$$U_T := \frac{k\,(\vartheta_C + 273.15)}{e} \tag{3.1.1}$$

Photocurrent:

```
> I__Ph := I__SC_STC * E__G/E__STC * (1 + TC__I_SC/100 *
  (vartheta__C - vartheta__STC));
```

$$I_{Ph} := \frac{I_{SC\_STC}\,E_G\left(1 + \frac{TC_{I\_SC}\,(\vartheta_C - \vartheta_{STC})}{100}\right)}{E_{STC}} \tag{3.1.2}$$

Photocurrent with constant solar irradiance $(E_G = E_{STC})$:

```
> I__Ph_const_irr := eval(I__Ph, E__G = E__STC);
```