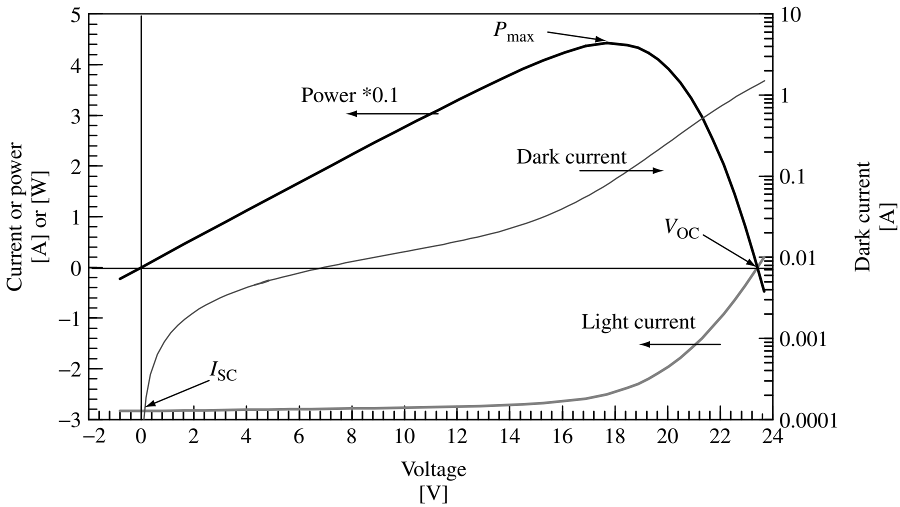

Figure 16.8 Typical light and dark current versus voltage curve of a commercial 50-W PV module

of commercial equipment includes the 20 $I-V$ points in the power quadrant closest to zero current. Another approach that works for all types of cells and modules is to include in the linear regression fit all points that satisfy the constraint that the absolute value of the voltage be less than 10% of the voltage at zero current and the additional constraint that the absolute value of the current be less than 20% of the current at zero voltage.

The value of I_{SC} is usually determined by linear interpolation of the two points closest to zero voltage. Performing a linear curve fit using more than two points can reduce the uncertainty in I_{SC}; however, care must be taken not to include points resulting from bypass diodes in parallel with a module or fitting in nonlinear regions. One manufacturer includes the 20 $I-V$ points in the power quadrant closest to zero voltage. Another approach that works for a wide variety of cells and modules is to include all $I-V$ points in the linear fit that satisfy the constraint that the current is within 4% of the current at zero voltage and the additional constraint that the absolute value of the voltage be less than 20% of the voltage at zero current. These constraints make no assumptions about the spacing between points (fit to a fixed number of $I-V$ points) or the shape of the curve (avoiding including nonlinear regions) while including as many $I-V$ points in the linear regression as possible.

The maximum power (P_{max}) is often taken to be the largest measured power. A more accurate method is to perform a fourth-order or higher polynomial curve fit to the measured power versus voltage data points within 80% of P_{max} [119]. To prevent erroneous results on low FF devices, the power versus voltage data selected for curve fitting must be restricted to voltages greater than 80% of the voltage at the measured maximum power (V_{max}). This algorithm can be improved by selecting the order of polynomial that gives the best fit to the data up to a fifth order. An approach recommended by American Society of Testing and Materials (ASTM) is to perform a fourth-order polynomial fit to the data where the measured current is greater $0.75I_{max}$ and less than $1.15I_{max}$ and