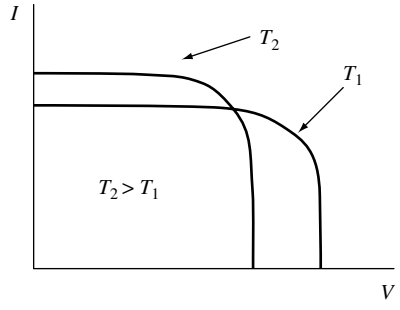

Figure 10.6 Effect of increasing temperature on solar cell $I-V$ photoresponse

Table 10.4 Theoretical normalized efficiency temperature coefficients [33]

Cell type	Temperature [°C]	η (28°C)	$(1/\eta)(d\eta/dT)$ [$\times 10^{-3}$/°C]
Si (calc.)	27	0.247	−3.27
Ge (calc.)	27	0.106	−9.53
GaAs (calc.)	27	0.277	−2.4

Table 10.5 Measured temperature coefficients for various types of solar cells used in space [26]

Cell type	Temp [°C]	η (28°C)	$(1/\eta)(d\eta/dT)$ [$\times 10^{-3}$/°C]
Si	28–60	0.148	−4.60
Ge	20–80	0.090	−10.1
GaAs/Ge	20–120	0.174	−1.60
2-j GaAs/Ge	35–100	0.194	−2.85
InP	0–150	0.195	−1.59
a-Si	0–40	0.066	−1.11 (nonlinear)
$CuInSe_2$	−40–80	0.087	−6.52

band gap cells such as InGaAs, the response is only linear with temperature for small temperature differences. Another frequently used definition for the temperature coefficient is the normalized temperature coefficient. In the case of the efficiency it is defined as

$$\beta = \frac{1}{\eta}\frac{d\eta}{dT} \tag{10.1}$$

or the fractional change in efficiency with temperature. Theoretical values for the normalized efficiency temperature coefficients for Si, Ge, and GaAs are given in Table 10.4. Representative temperature coefficients for the various types of cells used in space are given in Table 10.5. In general, the temperature coefficient decreases in magnitude with the increasing band gap but is always negative except in the case of a-Si, which can have a positive coefficient.