# Band-pass signal definition

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The signal power in band-pass representation can be defined in multiple ways. Let us first define the initial signal $S(t)$ and assuming this has a real amplitude $A(t)$:

$$S(t) = A(t)\cos(\omega t + \theta(t)) = \frac{A(t)}{2}\left(e^{i(\omega t+\theta(t))} + e^{-i(\omega t+\theta(t))}\right). \tag{1}$$

We can now define the band-pass representation signal as:

$$s(t) = a(t)\cos(\theta(t)) \tag{2}$$

For simplicity, and with no loss of generality, let us assume that $a(t) = a$ and $A(t) = A$, that is, both are time constant. Let us also assume that $\theta(t) = 0$. Using the definition for instant power we get the relation between $a$ and $A$.

$$P = \lim_{T\to 0}\frac{1}{T}\int_0^T dt\ S(t) = \frac{A^2}{2} = \left(\frac{A}{\sqrt{2}}\right)^2 \Rightarrow a(t) = \frac{A(t)}{\sqrt{2}} \tag{3}$$