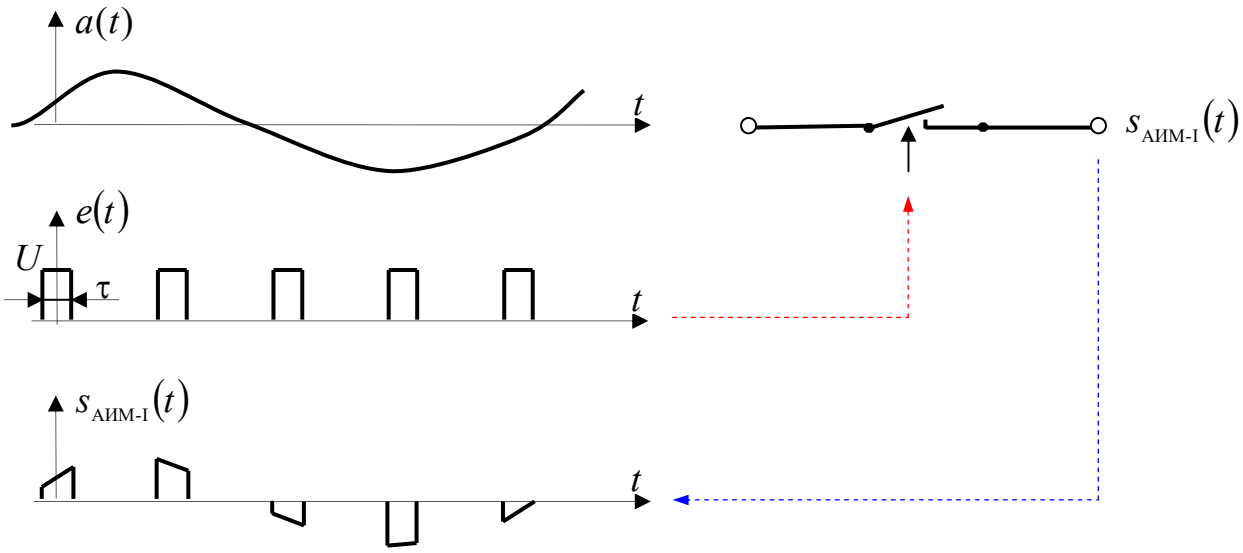
# Формирование канальных сигналов (АИМ-I, АИМ-II)

АИМ-I

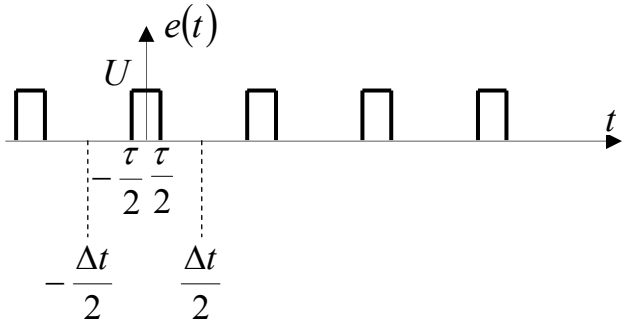



$$s(t)_{\text{АИМ-I}} = a(t)e(t) = a(t)\sum_{i=-\infty}^{\infty} e_0(t - i\Delta t)$$

$$e(t) = \sum_{n=-\infty}^{\infty} C_n \exp(jn\omega_{\text{Д}} t) \qquad C_n = \frac{1}{\Delta t}\int_{-\Delta t/2}^{\Delta t/2} e(t)\exp(-jn\omega_{\text{Д}} t)dt$$

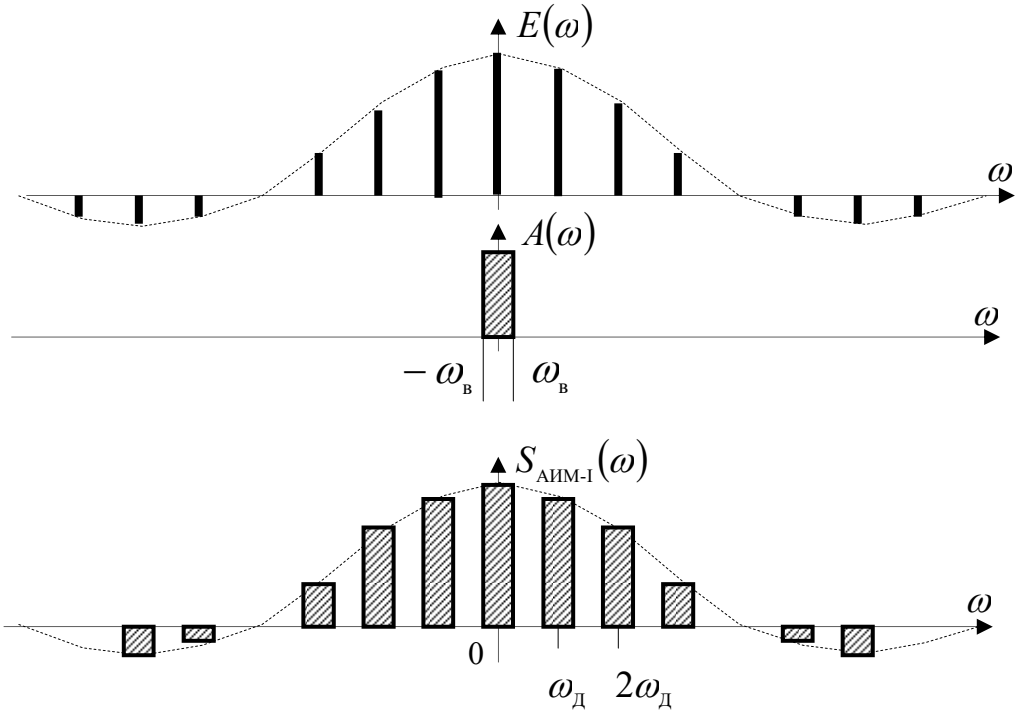
$$S(j\omega)_{\text{АИМ-I}} = \int_{-\infty}^{\infty} s(t)_{\text{АИМ-I}} \exp(-j\omega t)dt = \int_{-\infty}^{\infty} a(t)\sum_{n=-\infty}^{\infty} C_n \exp(jn\omega_{\text{Д}} t)\exp(-j\omega t)dt =$$

$$= \sum_{n=-\infty}^{\infty} C_n \int_{-\infty}^{\infty} a(t)\exp(-j(\omega - n\omega_{\text{Д}})t)dt = \sum_{n=-\infty}^{\infty} C_n A(j(\omega - n\omega_{\text{Д}}))$$




$$C_n = \frac{1}{\Delta t}\int_{-\tau/2}^{\tau/2} U\exp\left(-jn\omega_{Д}t\right)dt = \frac{U}{\Delta t}\frac{\exp\left(-jn\omega_{Д}t\right)}{-jn\omega_{Д}}\Bigg|_{-\tau/2}^{\tau/2} = U\frac{\tau}{\Delta t}\frac{\sin\left(n\omega_{Д}\,\tau/2\right)}{n\omega_{Д}\,\tau/2}$$

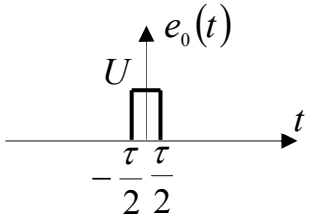
$$S(j\omega)_{\text{АИМ-I}} = U\frac{\tau}{\Delta t}\sum_{n=-\infty}^{\infty}\frac{\sin\left(n\omega_{Д}\,\tau/2\right)}{n\omega_{Д}\,\tau/2}A\left(j\left(\omega - n\omega_{Д}\right)\right)$$




$$\omega\tau/2 = \pi \Rightarrow \omega = \frac{2\pi}{\tau} > \frac{2\pi}{\Delta t} = \omega_{Д}$$

$$e(t)=\sum_{i=-\infty}^{\infty}e_0(t-i\Delta t)=\sum_{n=-\infty}^{\infty}C_n\cos(n\omega_{Д}t)$$

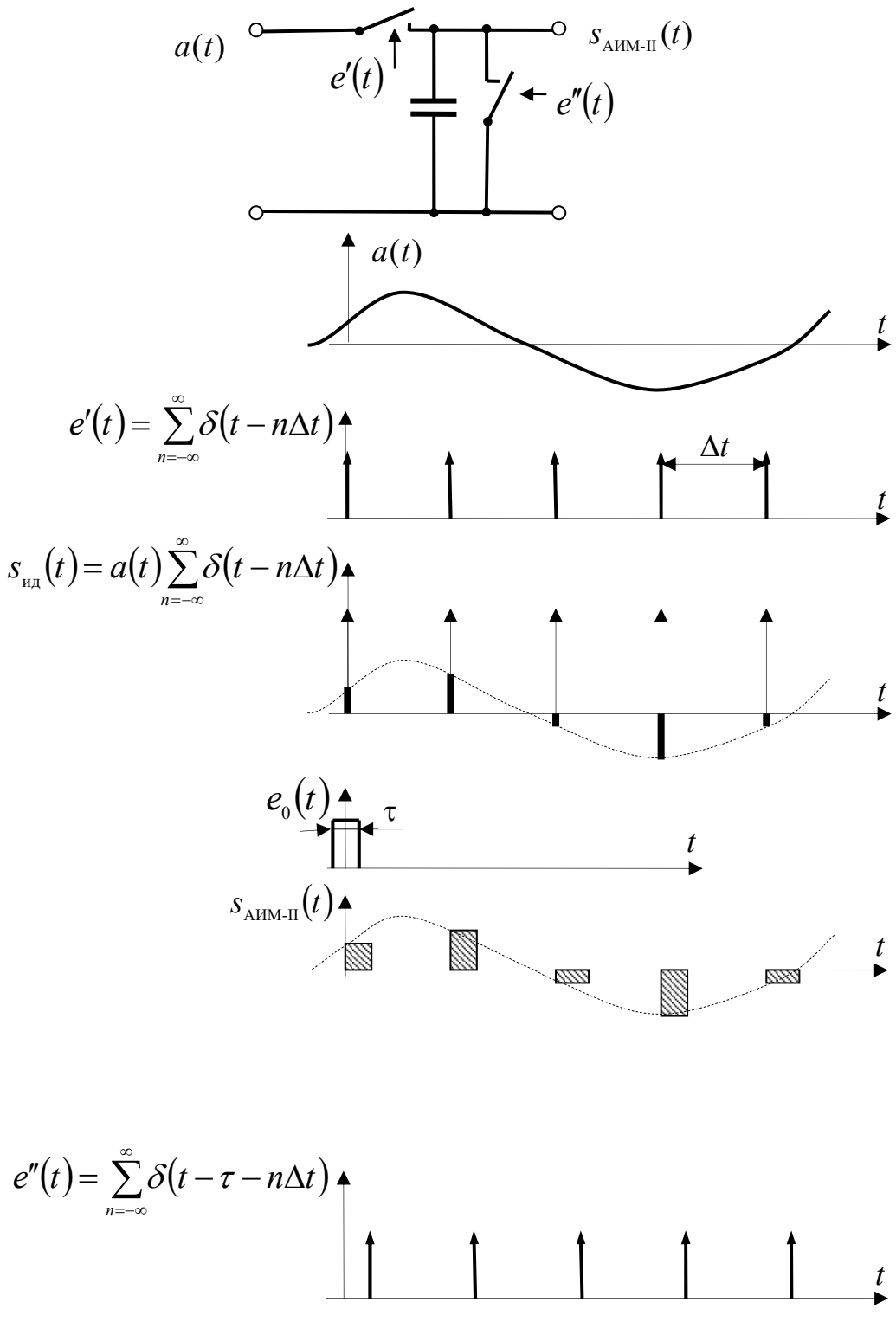
$$C_n=\frac{1}{\Delta t}\int_{-\Delta t/2}^{\Delta t/2}e(t)\cos(n\omega_{Д}t)dt=U\frac{\tau}{\Delta t}\frac{\sin(n\omega_{Д}\tau/2)}{n\omega_{Д}\tau/2}=\frac{1}{\Delta t}E_0(n\omega_{Д})$$




$$S(\omega)_{\text{АИМ-I}}=U\frac{\tau}{\Delta t}\sum_{n=-\infty}^{\infty}\frac{\sin(n\omega_{Д}\tau/2)}{n\omega_{Д}\tau/2}A(n\omega_{Д}\pm\omega)=$$

$$=U\frac{\tau}{\Delta t}A(\omega)+U\frac{\tau}{\Delta t}2\sum_{n=1}^{\infty}\frac{\sin(n\omega_{Д}\tau/2)}{n\omega_{Д}\tau/2}A(n\omega_{Д}\pm\omega)$$

АИМ-II




$$e''(t)=\sum_{n=-\infty}^{\infty}\delta(t-\tau-n\Delta t)$$

$t$

1. $$s_{\text{ид}}(t)=a(t)e'(t)=a(t)\sum_{n=-\infty}^{\infty}\delta(t-n\Delta t)$$

2. $$s_{\text{АИМ-II}}(t)=s_{\text{ид}}(t)*e_0(t)$$

$$e'(t)=\sum_{k=-\infty}^{\infty}\delta(t-k\Delta t)=\sum_{n=-\infty}^{\infty}C_n\exp(jn\omega_{Д}t)$$

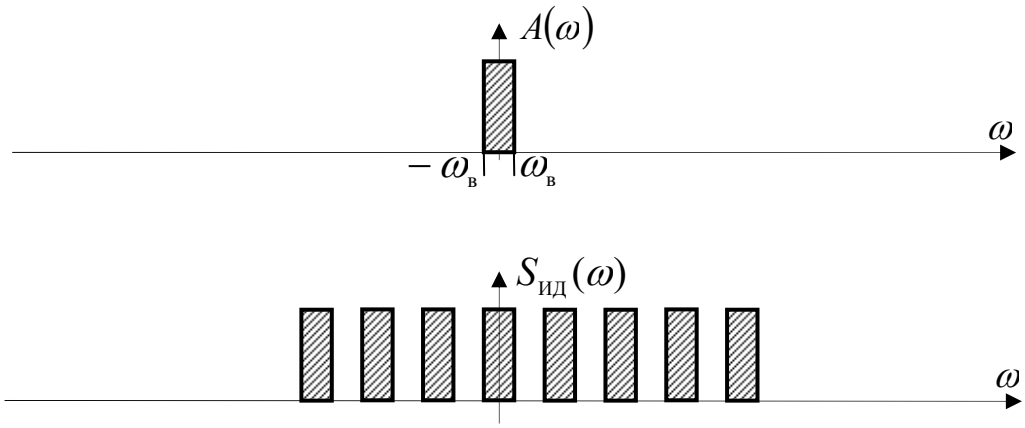
$$C_n=\frac{1}{\Delta t}\int_{-\Delta t/2}^{\Delta t/2}\sum_{k=-\infty}^{\infty}\delta(t-k\Delta t)\exp(-jn\omega_{Д}t)dt=\frac{1}{\Delta t}\int_{-\Delta t/2}^{\Delta t/2}\delta(t)\exp(-jn\omega_{Д}t)dt=\frac{1}{\Delta t}$$

$$e'(t)=\frac{1}{\Delta t}\sum_{n=-\infty}^{\infty}\exp(jn\omega_{Д}t)$$

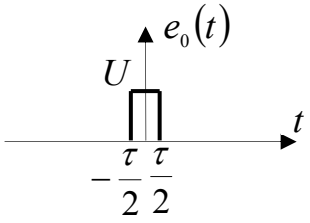
$$s_{ид}(t)=\frac{1}{\Delta t}a(t)\sum_{n=-\infty}^{\infty}\exp(jn\omega_{Д}t)$$

$$S(j\omega)_{ИД}=\int_{-\infty}^{\infty}s(t)_{ИД}\exp(-j\omega t)dt=\frac{1}{\Delta t}\int_{-\infty}^{\infty}a(t)\sum_{n=-\infty}^{\infty}\exp(jn\omega_{Д}t)\exp(-j\omega t)dt=$$

$$=\frac{1}{\Delta t}\sum_{n=-\infty}^{\infty}\int_{-\infty}^{\infty}a(t)\exp(-j(\omega-n\omega_{Д})t)dt=\frac{1}{\Delta t}\sum_{n=-\infty}^{\infty}A(j(\omega-n\omega_{Д}))$$

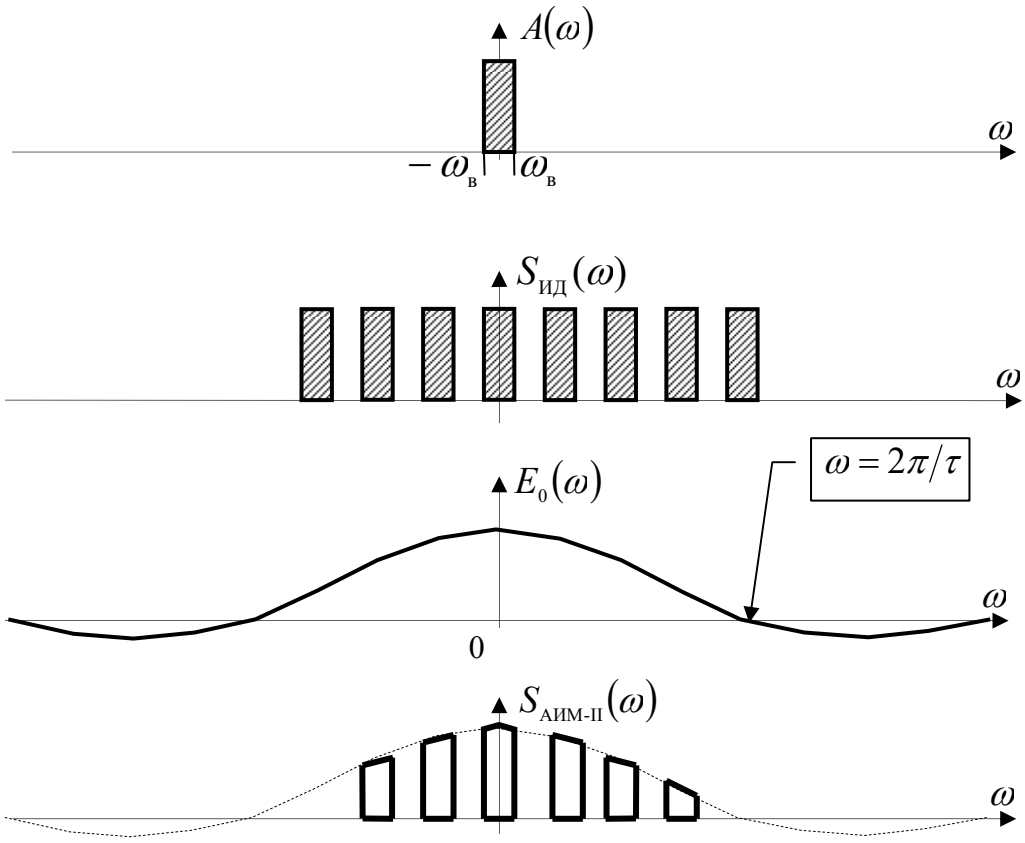


$$s_{\text{АИМ-II}}(t) = s_{\text{ид}}(t) * e_0(t) \Leftrightarrow S_{\text{АИМ-II}}(j\omega) = S_{\text{ид}}(j\omega) \cdot E_0(j\omega)$$

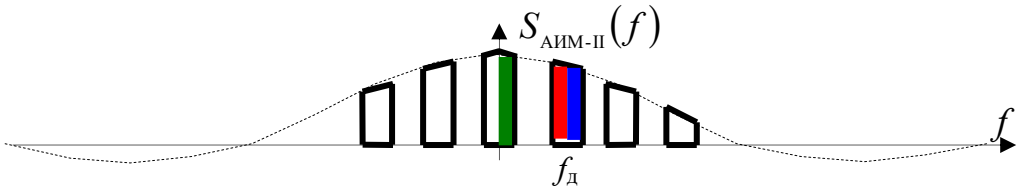


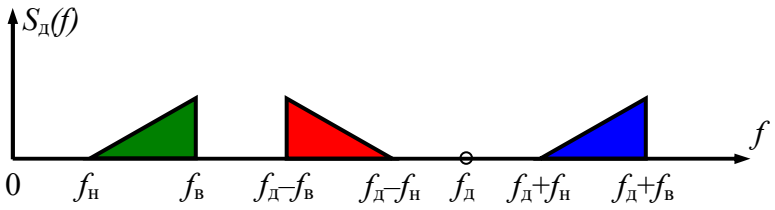

$$E_0(j\omega) = \int_{-\infty}^{\infty} e_0(t)\exp(-j\omega t)dt = \int_{-\tau/2}^{\tau/2} U\exp(-j\omega t)dt = U\tau\frac{\sin(n\omega_{\text{Д}}\tau/2)}{n\omega_{\text{Д}}\tau/2}$$

$$S_{\text{АИМ-II}}(j\omega) = S_{\text{ид}}(j\omega)\cdot E_0(j\omega) = U\frac{\tau}{\Delta t}\frac{\sin(n\omega_{\text{Д}}\tau/2)}{n\omega_{\text{Д}}\tau/2}\sum_{n=-\infty}^{\infty} A\left(j(\omega - n\omega_{\text{Д}})\right)$$




$$S(\omega)_{\text{АИМ-II}} = U\frac{\tau}{\Delta t}\frac{\sin(\omega\tau/2)}{\omega\tau/2}\left[A(\omega) + 2\sum_{n=1}^{\infty} A(n\omega_{\text{Д}} \pm \omega)\right]$$


$S_{\text{АИМ-II}}(f)$
$f$
$f_д$


$S_д(f)$
$f$
0
$f_н$
$f_в$
$f_д–f_в$
$f_д–f_н$
$f_д$
$f_д+f_н$
$f_д+f_в$