We start with the given equation:

$$\text{ck}(k, t_0, T) = \frac{2T^2 \sin\left(\frac{\pi k t_0}{2T}\right)}{k\pi(4T^2 - k^2 t_0^2)}$$

Step 1: Factor the denominator.

We factor the denominator as follows:

$$\text{ck}(k, t_0, T) = \frac{2T^2 \sin\left(\frac{\pi k t_0}{2T}\right)}{k\pi\left(2T - \frac{k t_0}{2}\right)\left(2T + \frac{k t_0}{2}\right)}$$

Step 2: Use the definition of sinc.

The sinc function is defined as:

$$\text{sinc}(x) = \frac{\sin(\pi x)}{\pi x}$$

Using this definition, we express the sine term in the numerator in terms of a sinc function:

$$\sin\left(\frac{\pi k t_0}{2T}\right) = \frac{k t_0}{2T} \cdot \pi \cdot \text{sinc}\left(\frac{k t_0}{2T}\right)$$

Step 3: Substituting into the equation.

Now, substitute the sinc form into the original equation:

$$\text{ck}(k, t_0, T) = \frac{2T^2 \cdot \frac{k t_0}{2T} \cdot \pi \cdot \text{sinc}\left(\frac{k t_0}{2T}\right)}{k\pi(4T^2 - k^2 t_0^2)}$$

Step 4: Simplify the equation.

First, cancel out the common factors of π and k:

$$\text{ck}(k, t_0, T) = \frac{2T^2 \cdot \frac{t_0}{2T} \cdot \text{sinc}\left(\frac{k t_0}{2T}\right)}{4T^2 - k^2 t_0^2}$$

Now, simplify the terms:

$$\text{ck}(k, t_0, T) = \frac{t_0}{4T} \cdot \frac{2T^2 \cdot \text{sinc}\left(\frac{k t_0}{2T}\right)}{4T^2 - k^2 t_0^2}$$

Step 5: Expand the final expression.

Now we split the term inside the bracket:

$$\text{ck}(k, t_0, T) = \frac{t_0}{4T} \cdot \text{sinc}\left(\frac{k t_0}{2T}\right)\left(1 - \frac{k^2 t_0^2}{4T^2}\right)$$

Step 6: Final expression:

$$\text{ck}(k, t_0, T) = \frac{t_0}{4T} \cdot \text{sinc}\left(\frac{k t_0}{2T}\right) - \frac{t_0}{4T} \cdot \frac{k^2 t_0^2 \cdot \text{sinc}\left(\frac{k t_0}{2T}\right)}{4T^2}$$