An example of THD computation and result. P. T. Krein, September 1998.

A distortion example: What is the THD of the integral-cycle control waveform in Fig. 2.44?.

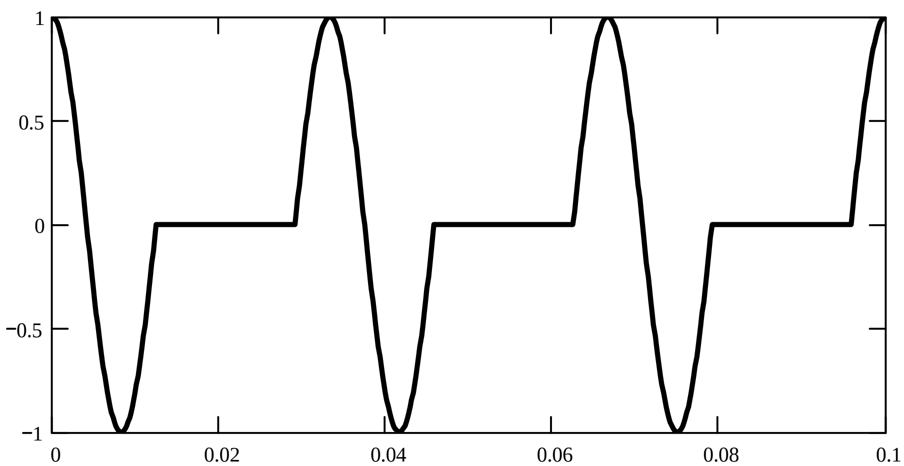
First, construct the waveform.

The input voltage source: $V_0 := 1 \cdot V$ $\quad \omega_{in} := 2 \cdot \pi \cdot 60 \cdot \frac{rad}{s}$ $\quad v_{in}(t) := V_0 \cdot \cos(\omega_{in} \cdot t)$

Now, construct a 30 Hz switching function. The switching function is shifted 1/240 s.

$\omega_{switch} := 2 \cdot \pi \cdot 30 \cdot \frac{rad}{s}$ $\quad q(t) := \text{if}\left[\cos\left[\omega_{switch} \cdot \left(t - \frac{1}{240} \cdot s\right)\right] > 0, 1, 0\right]$

The output voltage: $v_{out}(t) := q(t) \cdot v_{in}(t)$ Now, set up a plot. $i := 0..600$ $\quad t_i := \frac{0.1}{600} \cdot i \cdot s$



The frequency of this waveform is 30 Hz (the difference 60 Hz - 30 Hz).

Now, what is the THD? $T := \frac{1}{30} \cdot s$ Fundamental: $\omega f := \frac{2 \cdot \pi}{T}$

$RMS := \sqrt{\frac{1}{T} \cdot \int_0^T v_{out}(t)^2 \, dt}$ $\quad RMS = 0.5 \cdot V$ $\quad a1 := \frac{2}{T} \cdot \int_0^T v_{out}(t) \cdot \cos(\omega f \cdot t) \, dt$ $\quad a1 = 0.3001 \cdot V$

$b1 := \frac{2}{T} \cdot \int_0^T v_{out}(t) \cdot \sin(\omega f \cdot t) \, dt$ $\quad b1 = -0.3001 \cdot V$ $\quad c1 := \sqrt{a1^2 + b1^2}$ $\quad c1 = 0.4244 \cdot V$

$c1rms := \frac{c1}{\sqrt{2}}$ $\quad c1rms = 0.3001 \cdot V$ From (3.3), we have $THD := \sqrt{\frac{RMS^2 - c1rms^2}{c1rms^2}}$

$THD = 1.3326$ <-- 133.3%