By convention, waveforms are considered as starting \((t = 0)\) at their peak values, ie:

\[
V(t) = \cos(\omega t) \\
A(t) = \cos(\omega t + \theta)
\]

where \(\theta\) is the relative phase angle

So for harmonic analysis, using the complex notation:

\[
h_n = a_n + j b_n
\]

the in-phase and quadrature values of the \(n^{th}\) harmonic of a periodic waveform, \(v(\phi)\), are given by:

\[
an = \sqrt{2/\pi} \int_{-\pi/2}^{\pi/2} v(\phi) \cos(n\phi) \, d\phi
\]

\[
b_n = \sqrt{2/\pi} \int_{-\pi/2}^{\pi/2} v(\phi) \sin(n\phi) \, d\phi
\]

For a square wave:

\[
v(\phi) = -A \quad \text{for} \quad -\pi < \phi < -\pi/2 \\
= +A \quad \text{for} \quad -\pi/2 < \phi < \pi/2 \\
= -A \quad \text{for} \quad \pi/2 < \phi < \pi
\]

Then

\[
an = A \sqrt{2} /2\pi n \left( -[\sin(n\pi/2)] + [\sin(n\pi)] - [\sin(n\pi/2)] \right)
\]

\[
= A \sqrt{2} /2\pi n \left( -\sin(-n\pi/2) + \sin(n\pi/2) - \sin(-n\pi/2) + \sin(n\pi/2) \right)
\]

\[
= A 2\sqrt{2} /\pi n \sin(n\pi/2)
\]

and

\[
b_n = A \sqrt{2} /2\pi n \left( -[\cos(n\pi/2)] + [\cos(n\pi)] - [\cos(n\pi/2)] \right)
\]

\[
= A \sqrt{2} /2\pi n \left( -\cos(-n\pi) + \cos(n\pi) \right)
\]

\[
= 0
\]

So it can be seen that for

\[
n = 1, 5, 9 \ldots \quad a_n = A 2\sqrt{2}/\pi n \quad \text{(relative magnitude } 1/n, \text{ phase } 0^\circ)\]

and for \(n = 3, 7, 11 \ldots \quad a_n = -A 2\sqrt{2}/\pi n \quad \text{(relative magnitude } 1/n, \text{ phase } 180^\circ)\)

and for even \(n \quad a_n = 0\)

and in all cases \(b_n = 0\)