Frequencies and Circumference Calculations

Given:

- TPU Diameter = 15" => 0.381m => radius r = 0.1905m
- Circumference of circle = $2\pi r \ \ \therefore =$ **1.196947m**
- Speed of light $c = 2.99792458 \times 10^8 \, m/s$
- **Linear Velocity** $v = 2\pi rf$
- Frequencies: 35 kHz, **35.705 kHz**, 245 kHz, **249.935 kHz** (7^{th} harmonic)
- Wavelength $\lambda = \frac{v}{f}$

Calculations:

- Velocity @ 35 kHz = $0.0004189314 \times 10^8 \, m/s$
- Velocity @ 35.705 kHz = $0.0004273699 \times 10^8 \, m/s$
- Velocity @ 245 kHz = $0.0029325201 \times 10^8 \, m/s$
- Velocity @ 249.935 kHz = $0.0029915895 \times 10^8 \, m/s$

Given radius, required frequency for Linear Velocity $v = c$ is: $f = \frac{c}{2\pi r}$

- Frequency required (15" TPU) for Linear Velocity $v = c$ is 250.46427 MHz
- So at 249.935 kHz, Linear Velocity is = 1/1002 the speed of light

Then the exact frequencies required to perfectly match with 1/1000th of c are:

- 35.7806 kHz (fundamental)
- 71.5612 kHz (2^{nd} harmonic)
- 107.3418 kHz (3^{rd} harmonic)
- 143.1224 kHz (4^{th} harmonic)
- 178.9030 kHz (5^{th} harmonic)
- 214.6836 kHz (6^{th} harmonic)
- 250.4642 kHz (7^{th} harmonic)

Note that the *velocity of propagation* (VOP) or (Velocity Factor) through the wire/cable will be slower than c and therefore lower frequencies required. This may account for SM's use of 35.705 rather than 35.7806 (difference of 75.6 Hz).