# TeensyStep Calculations

## Basic Formulas

$$s\left(v, v_0, a, s_s\right) := \frac{v^2 - {v_0}^2}{2\ a} + s_s$$

define:

$$\nu\left(v\right) := v^2 \qquad s\left(\nu, \nu_0, a, s_s\right) := \frac{\nu - \nu_0}{2\ a} + s_s$$

$$\nu\left(s, \nu_0, a, s_s\right) := 2\ a \cdot \left(s - s_s\right) + \nu_0$$

quadratic speed

$$s_{sec}\left(\nu_s, \nu_e, a, \Delta s\right) := \frac{1}{2}\left(\frac{\nu_e - \nu_s}{2\ a} + \Delta s\right)$$

Intersection of acceleration and deceleration curves. Must be within s_s and s_e to generate a valid movement

$$s_{acc}\left(\nu_s, \nu_t, a\right) := \frac{\nu_t - \nu_s}{2\ a}$$

$$s_{dec}\left(\nu_s, \nu_e, \nu_t, a, \Delta s\right) := 2 \cdot s_{sec}\left(\nu_s, \nu_e, a, \Delta s\right) - s_{acc}\left(\nu_s, \nu_t, a\right)$$

## Example

$a := 50000 \qquad s_s := 0 \qquad s_e := 20000 \qquad \Delta s := s_e - s_s = 2 \cdot 10^4$

$v_s := 500 \qquad v_t := 15000 \qquad v_e := 10000$

$s_{acc} := s_{acc}\left({v_s}^2, {v_t}^2, a\right) = 2248 \qquad s_{dec} := s_{dec}\left({v_s}^2, {v_e}^2, {v_t}^2, a, \Delta s\right) = 18750$

$s_{sec} := s_{sec}\left({v_s}^2, {v_e}^2, a, \Delta s\right) = 10499$

$\nu_{acc}\left(s\right) := \nu\left(s, {v_s}^2, a, 0\right) \qquad \nu_{dec}\left(s\right) := \nu\left(-s, {v_e}^2, a, -\Delta s\right) \qquad \nu_t := {v_t}^2$

The following graph shows the squared motor speed depending on the position s and the transition points from acceleration to constant to deceleration.

$s := 0 \mathinner{..} \Delta s$