P48 Telescope / Dome Performance

Current (Vertex), ZTF Req, ZTF goal specs

Vertex current values:

RA:

Accel : 0.435 deg/s²

Decel : 0.2175 deg/s²

Velocity : 1.7 deg/s

DEC:

Accel : 0.30 deg/s²

Decel : 0.15 deg/s²

Velocity : 1.3 deg/s

ZTF required values:

RA: 15s for 7.25 deg move

Accel : 0.27 deg/s²

Decel : 0.20 deg/s²

Velocity : 1.18 deg/s

DEC: 10s for 7.3 deg move

Accel : 0.41 deg/s²

Decel : 0.41 deg/s²

Velocity : 1.5 deg/s

ZTF goal values:

RA:

Accel : 0.50 deg/s²

Decel : 0.50 deg/s²

Velocity : 3.0 deg/s

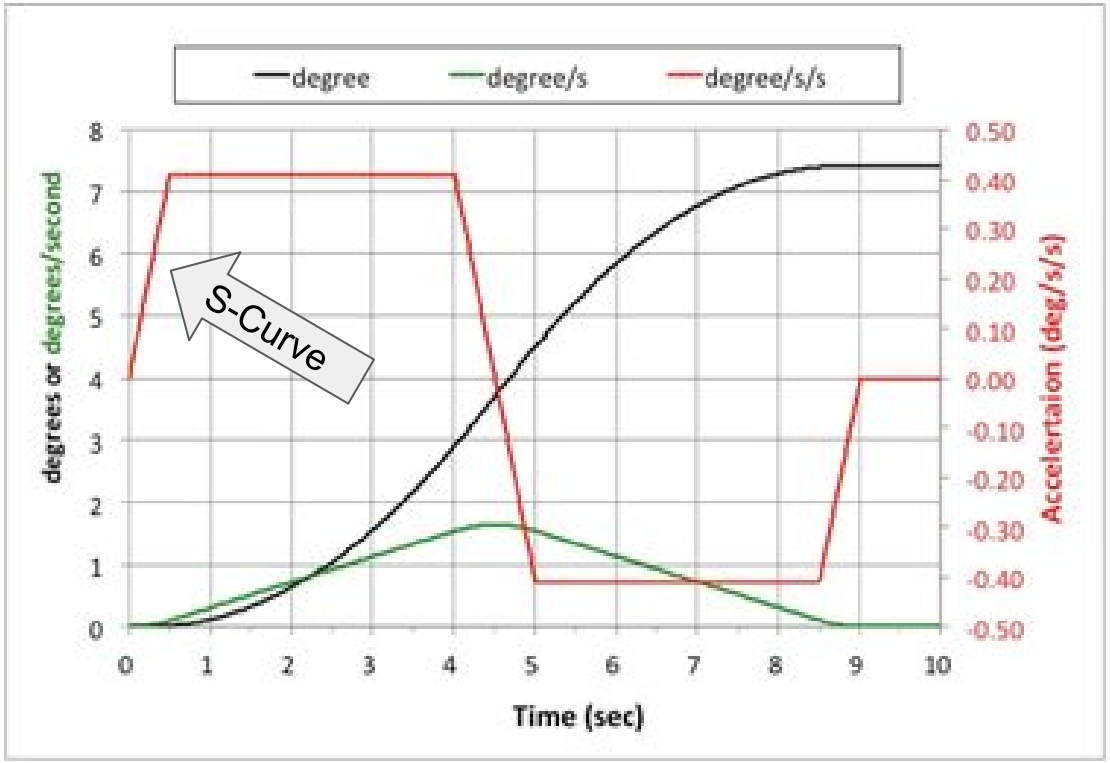
DEC:

Accel : 0.50 deg/s²

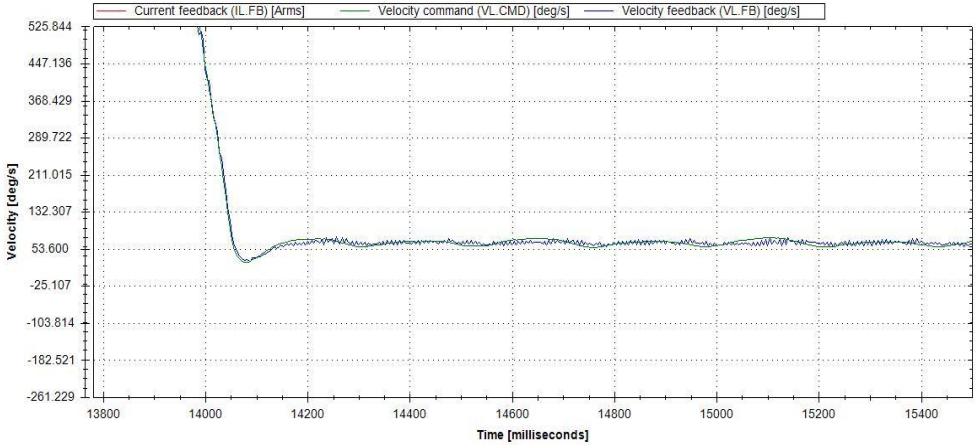
Decel : 0.50 deg/s²

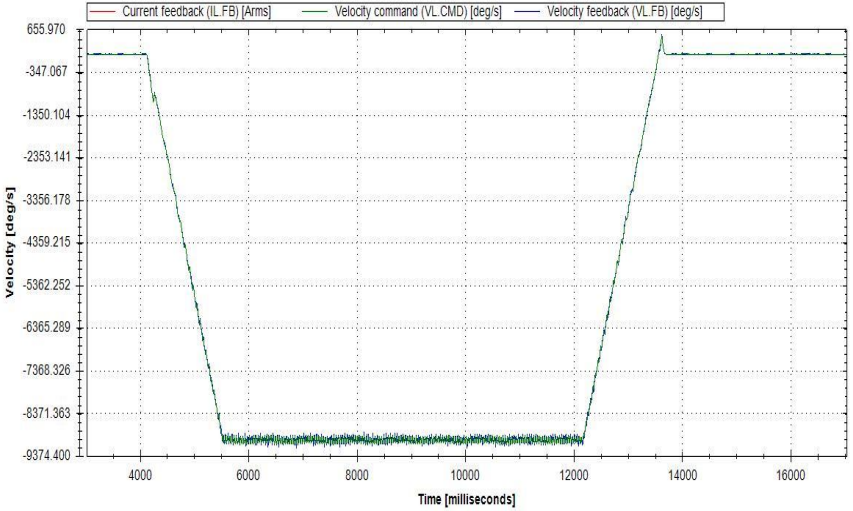
Velocity : 3.0 deg/s

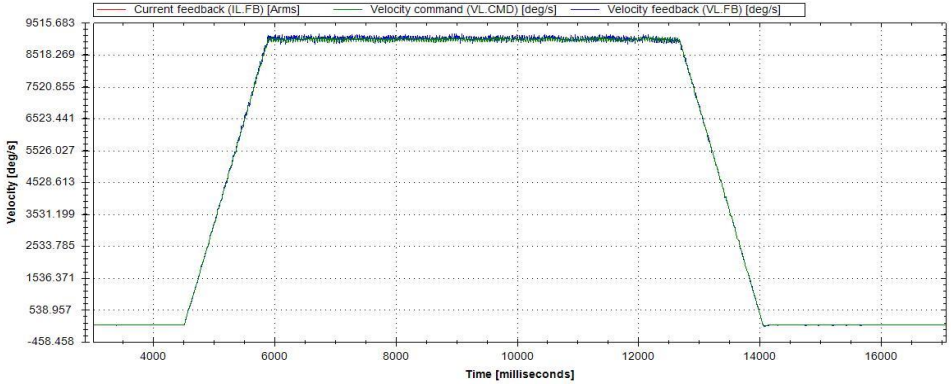
Typical telescope motion

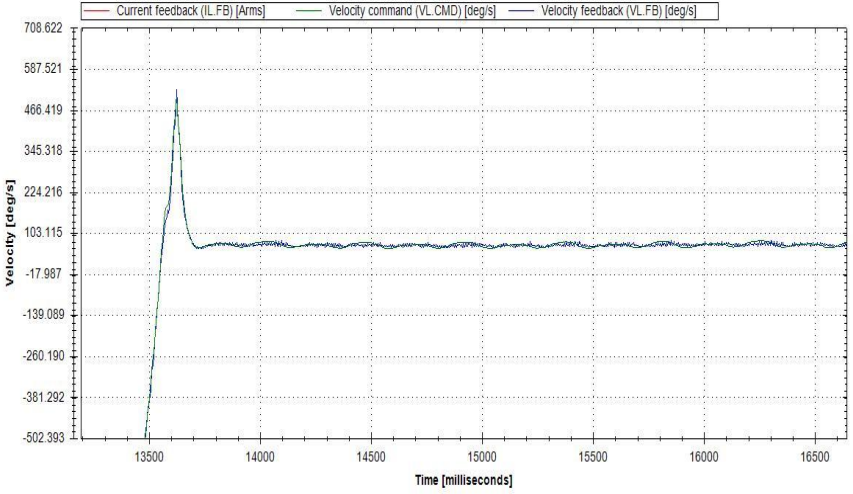


Servo Control Motion Profile



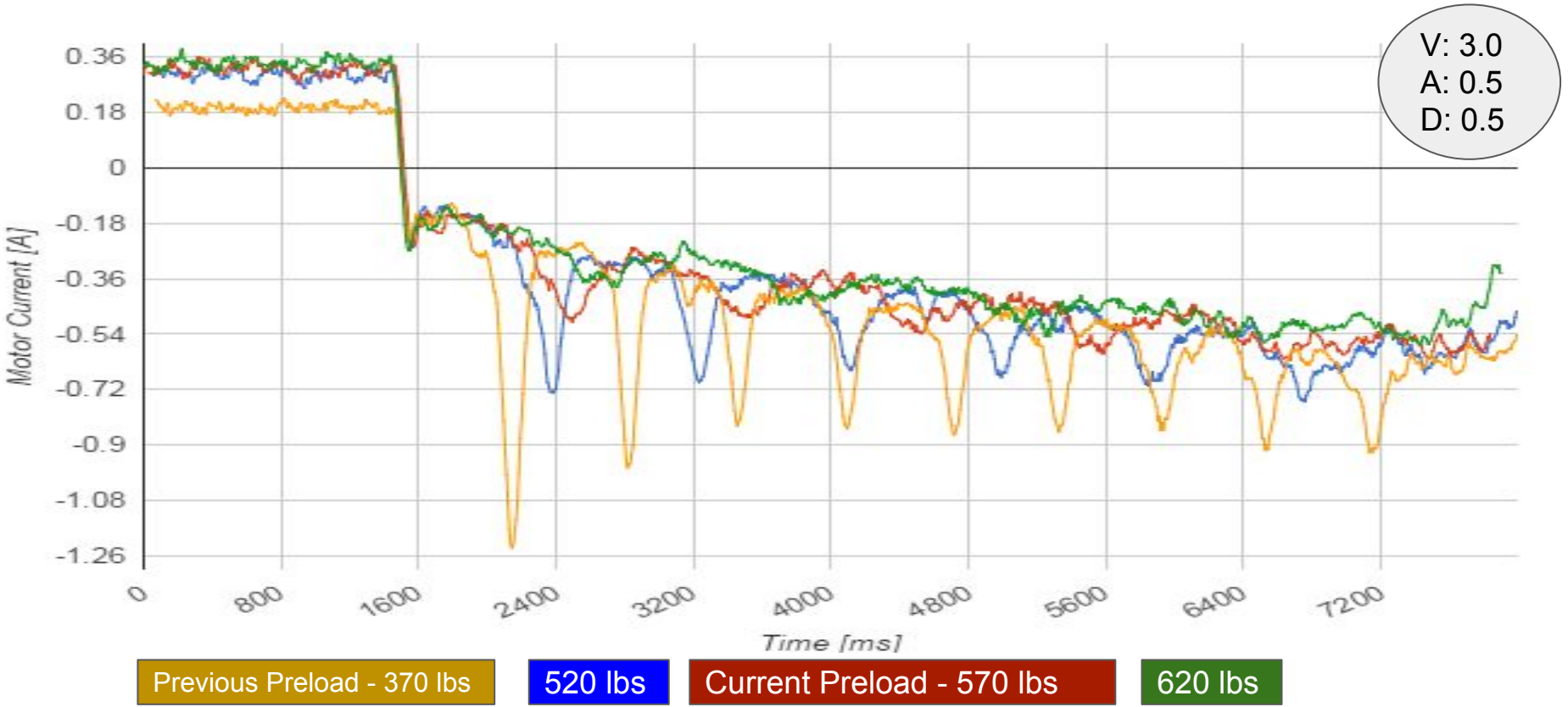






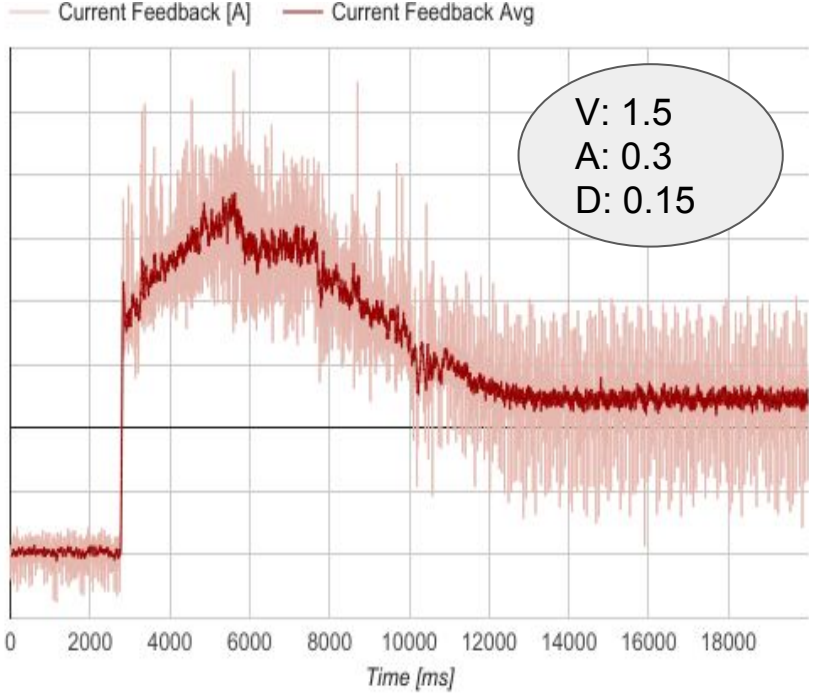
RA & DEC Drives

RA motor current - Varying preloads @ ZTF goal parameters

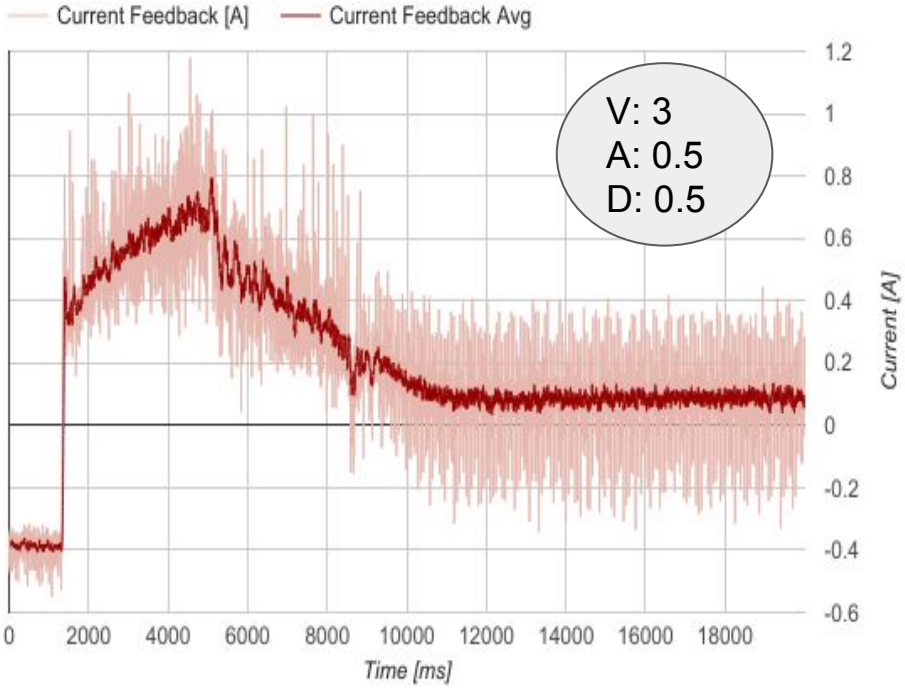


Dec Motor Current @ various parameters

Near Vertex Nominal Parameters



At Proposed Dec Parameters

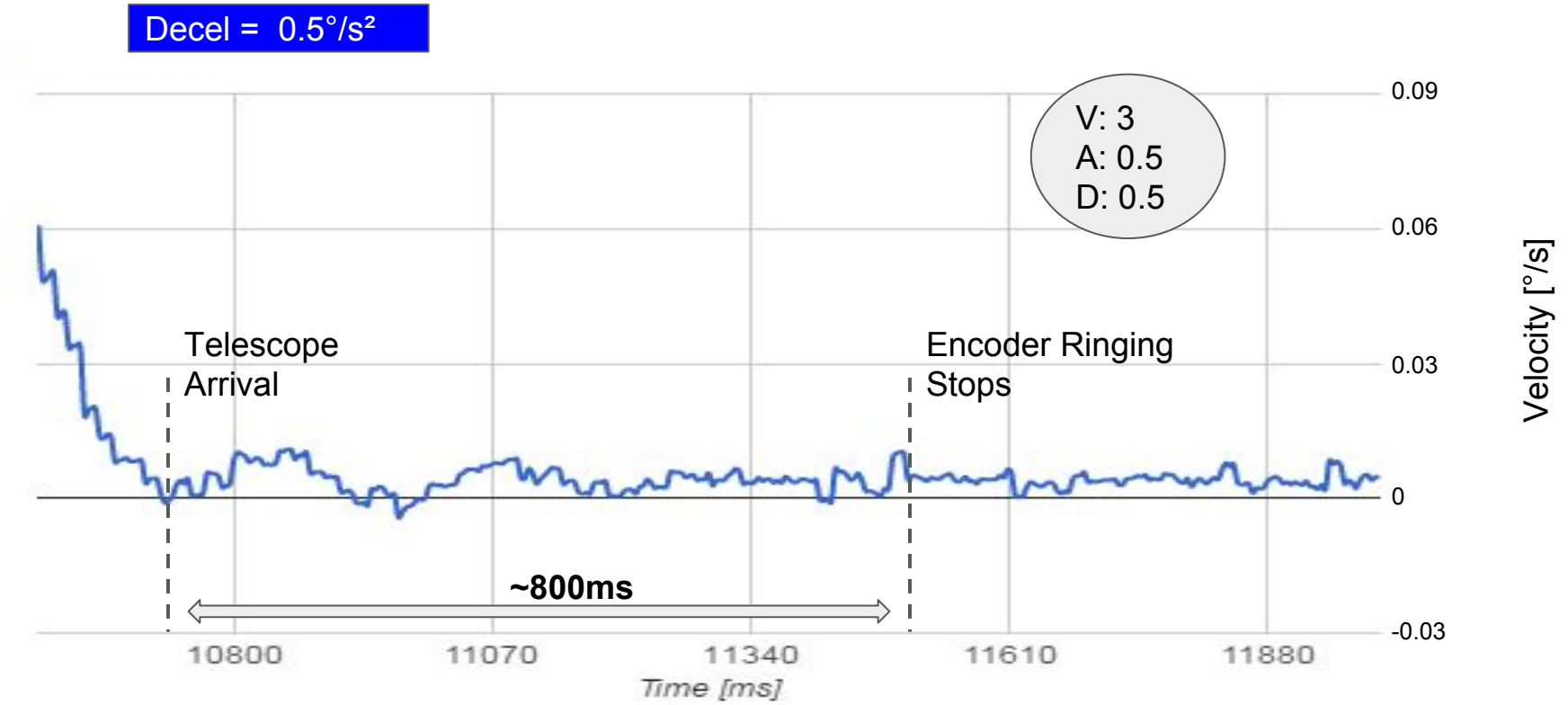


Telescope Settling

Proposed settling time target when amplitude of oscillation
< 0.5 arcsec RMS

Dec Encoder Settling time

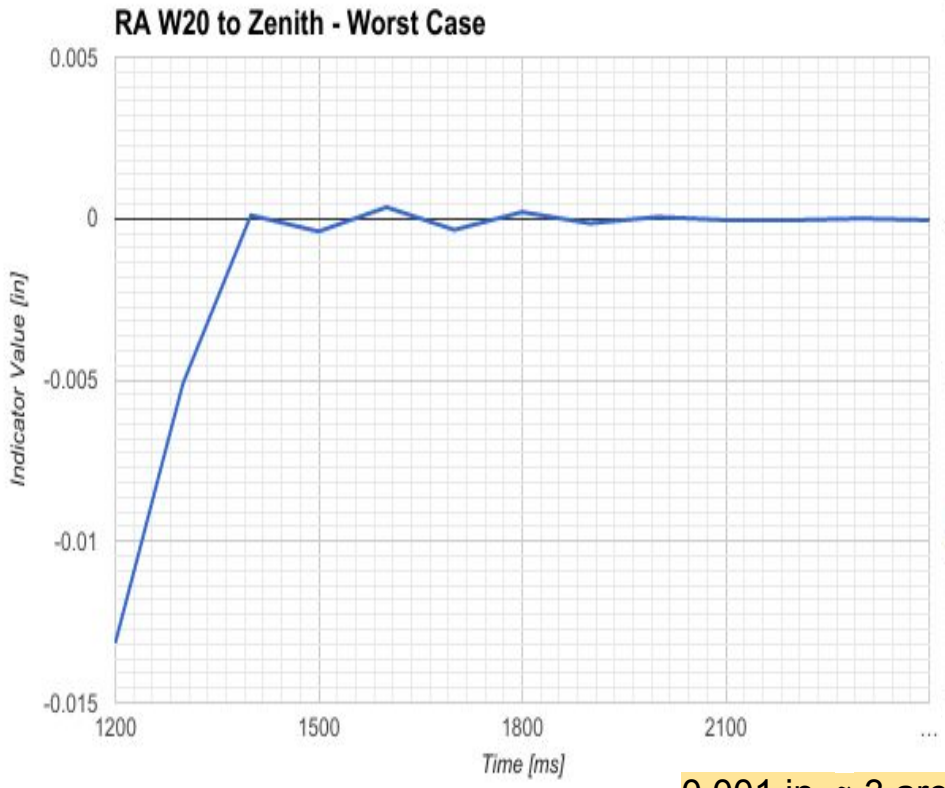
Zoomed on last few seconds of position move

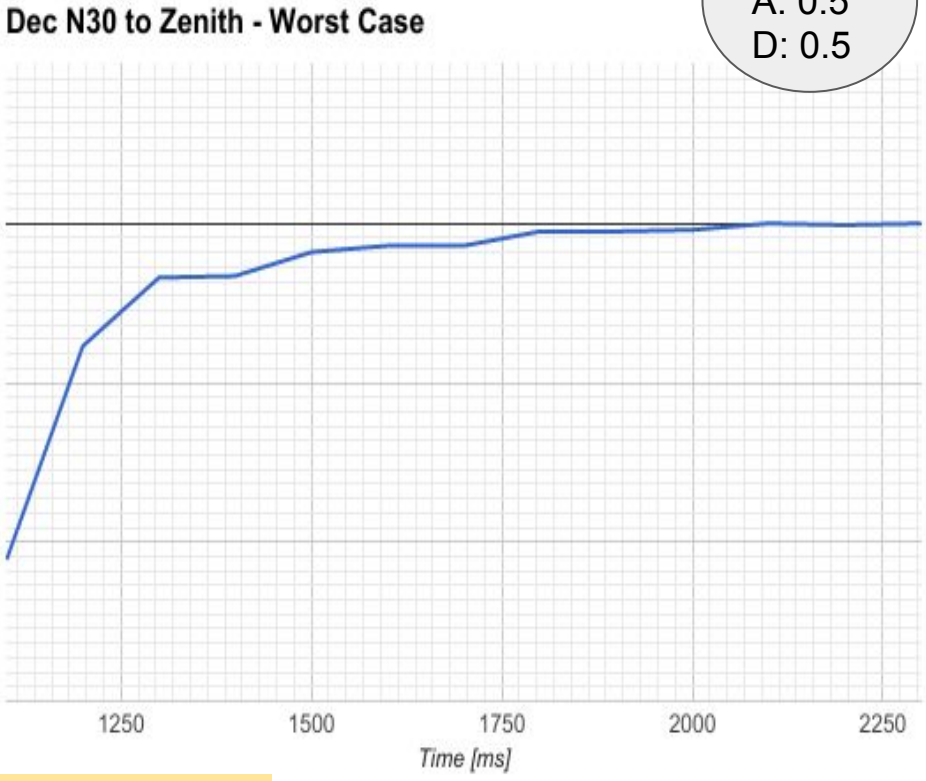


Dec & RA Indicator Data

Direct measurement of telescope structure with indicator showing last few seconds of position move.

V: 3.0
A: 0.5
D: 0.5





0.001 in ≈ 3 arcsec axis rotation

Telescope Proposed Operating Parameters

Proposed Specs - Telescope Performance

Vertex current values:

RA:
Accel : 0.435 °/s²
Decel : 0.2175 °/s²
Velocity : 1.7 °/s

DEC:
Accel : 0.30 °/s²
Decel : 0.15 °/s²
Velocity : 1.3 °/s

ZTF required values:

RA:
Accel : 0.27 °/s²
Decel : 0.20 °/s²
Velocity : 1.18 °/s

DEC:
Accel : 0.41 °/s²
Decel : 0.41 °/s²
Velocity : 1.5 °/s

ZTF proposed values:

RA:
Accel : 0.4 °/s²
Decel : 0.4 °/s²
Velocity : 3.0 °/s

DEC:
Accel : 0.50 °/s²
Decel : 0.50 °/s²
Velocity : 3.0 °/s

ZTF goal values:

RA:
Accel : 0.50 °/s²
Decel : 0.50 °/s²
Velocity : 3.0 °/s

DEC:
Accel : 0.50 °/s²
Decel : 0.50 °/s²
Velocity : 3.0 °/s

Limits of performance

RA Axis:

- “Bounce” behavior observed causes torque spikes that have been reduced by additional preload;
  - Even though, torque limiter trip torque is higher than expected for the defined acceleration;
- More tests, adjustment and motion control tuning is needed to determine if drive torque can be reduced;
  - RA drive performance target will exceed ZTF requirements, but peak acceleration may be limited below goal of 0.5°/s/s.

DEC Axis:

- Dynamic behavior looks good.
- Motion profile tuning should allow meeting ZTF goal parameters;

Dome Performance

Vertex vs Delta Tau Dome Control

VERTEX

- Dome slaves to telescope azimuth, lags when telescope slews
- Run/stop control: start when |error| > 2º, stop when |error| < 1º
- Typically two overshoots from full speed
- Dome acceleration 0.18º/s² , max speed 3.0º/s, deceleration 0.64º/s²

DELTA TAU

- When GO to new position is requested, destination telescope az/el are computed; dome is slewed there by shortest route and waits for telescope
- When telescope arrives, dome slaves to telescope
- Proportional speed control, servo'ed to avoid overshoot
- If dome arrives after telescope, availability is reported as soon as dome aperture clears telescope beam

Telescope Elevation (deg)	Dome Error at Begin Occult (deg)	Dome Azimuth Change for 8° Telescope Dec Moves (deg)	Time till Dome Clears Beam @ 0.5°/s² Accel, 3° /s Max Speed (sec)
10	3.5	6.7	3.6
20	3.6	7.1	3.7
30	4.0	7.7	3.8
40	4.5	8.8	4.1
50	5.4	10.7	4.6
60	6.9	13.9	5.3
70	10.1	20.3	6.4
80	20.0	36.4	8.5
85	39.8	55.8	8.3

Proposed Specs - Dome Rotation Performance

Vertex **current** values:

Accel : 0.18 °/s²

Decel : 0.2175 °/s²
Velocity : 3.0 °/s

ZTF proposed values*:

Accel : 0.5 °/s²

Decel : 0.5 °/s²

Velocity : 3.0 °/s

Limitations

- Wear and tear
- Safety
- Dome drive traction
- Radial load limits of drive components
- Further testing will determine if increases in acceleration beyond proposed performance is possible

*Performance driven by telescope cadence in tiling mode

Windscreen Performance

Windscreen Performance

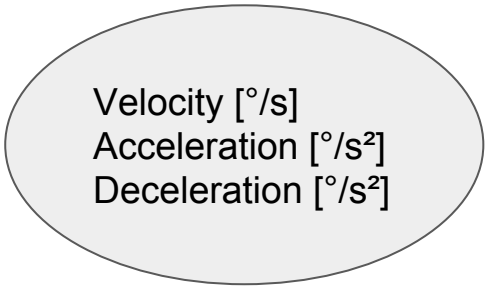
	Position [°]	Time [s]	Velocity [°/s]
Move to Top	85	36	2.02
Move to Bottom	12.2	35	2.08

More Plots

Tests Description

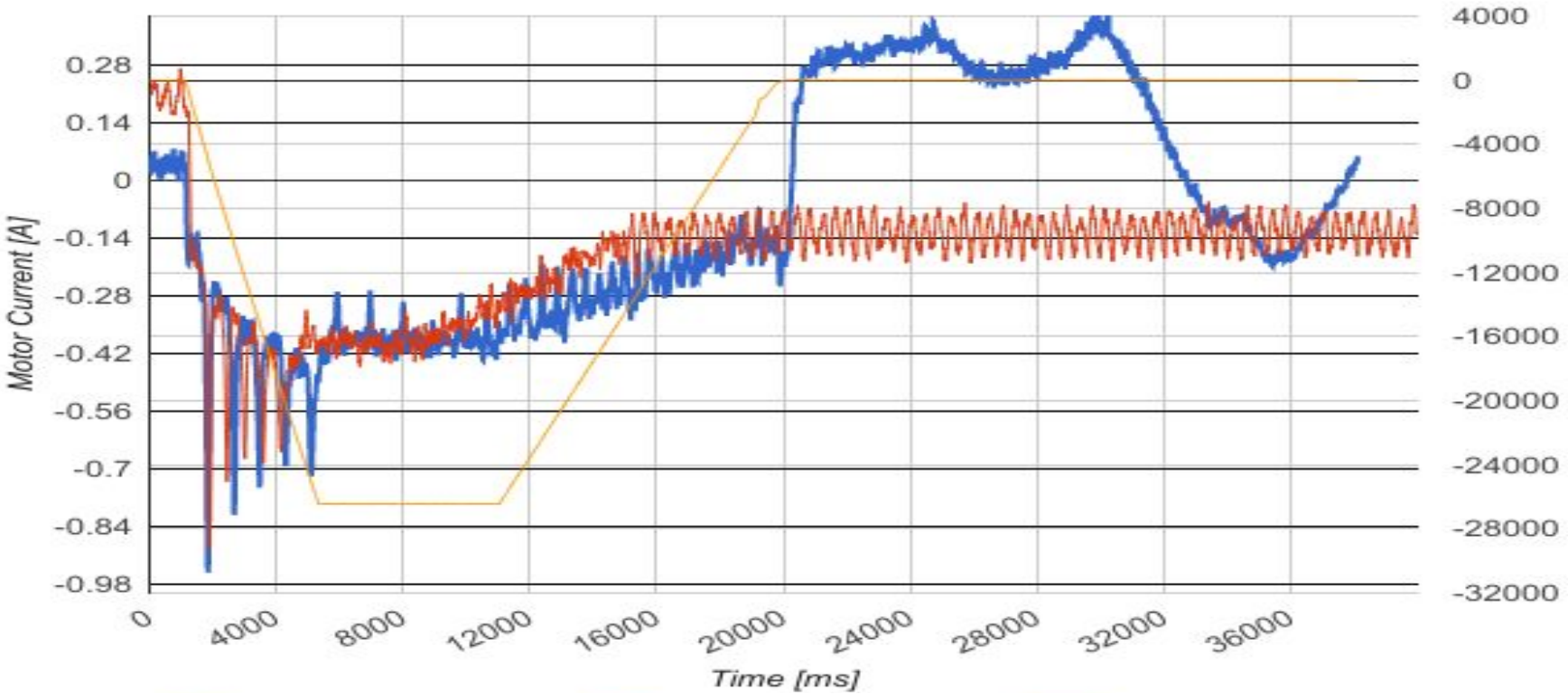
All tests were done by moving the telescope via Vertex control or through direct control of Kollmorgen motor drive amplifiers (KM). All Vertex controlled moves were done at its PTF parameters (accel, velocity, decel). KM moves were used to test all other parameter settings.

The following ellipse will be found on most of the graphs to illustrate parameters tested.



Comparison Vertex vs Kollmorgen RA Move

V: 1.7
A: 0.435
D: 0.218



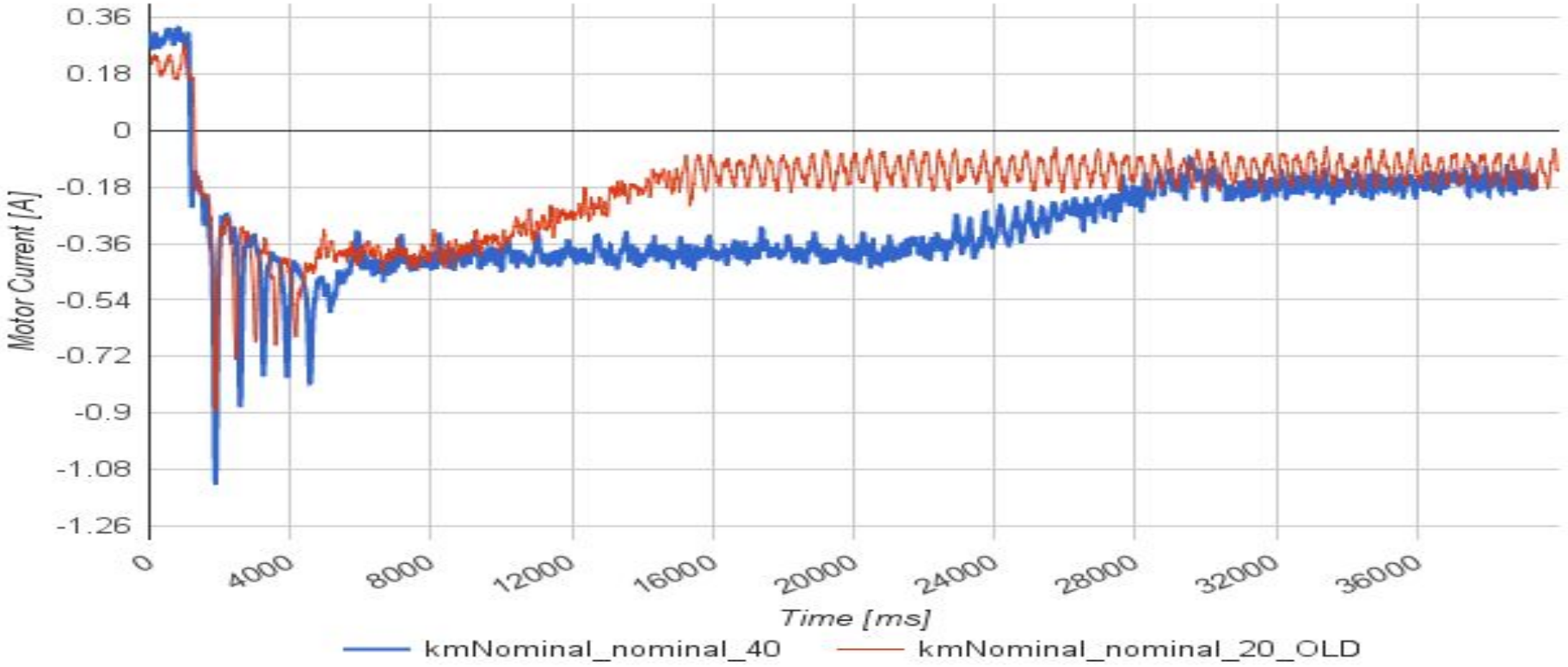
Vertex @ PTF Params

KM @ PTF Params

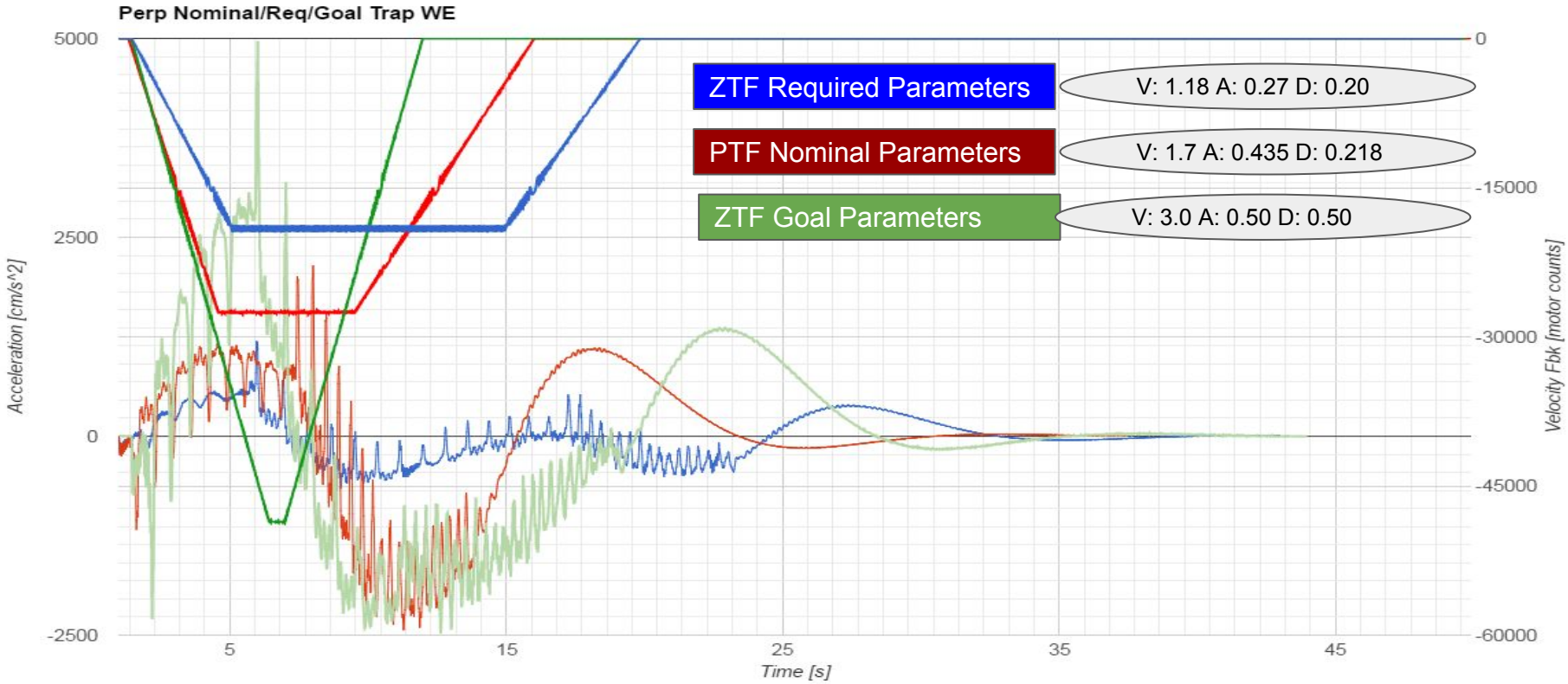
Velocity Feedback

KM RA Long Move (40°) vs Short Move (20°)

V: 1.7
A: 0.435
D: 0.218

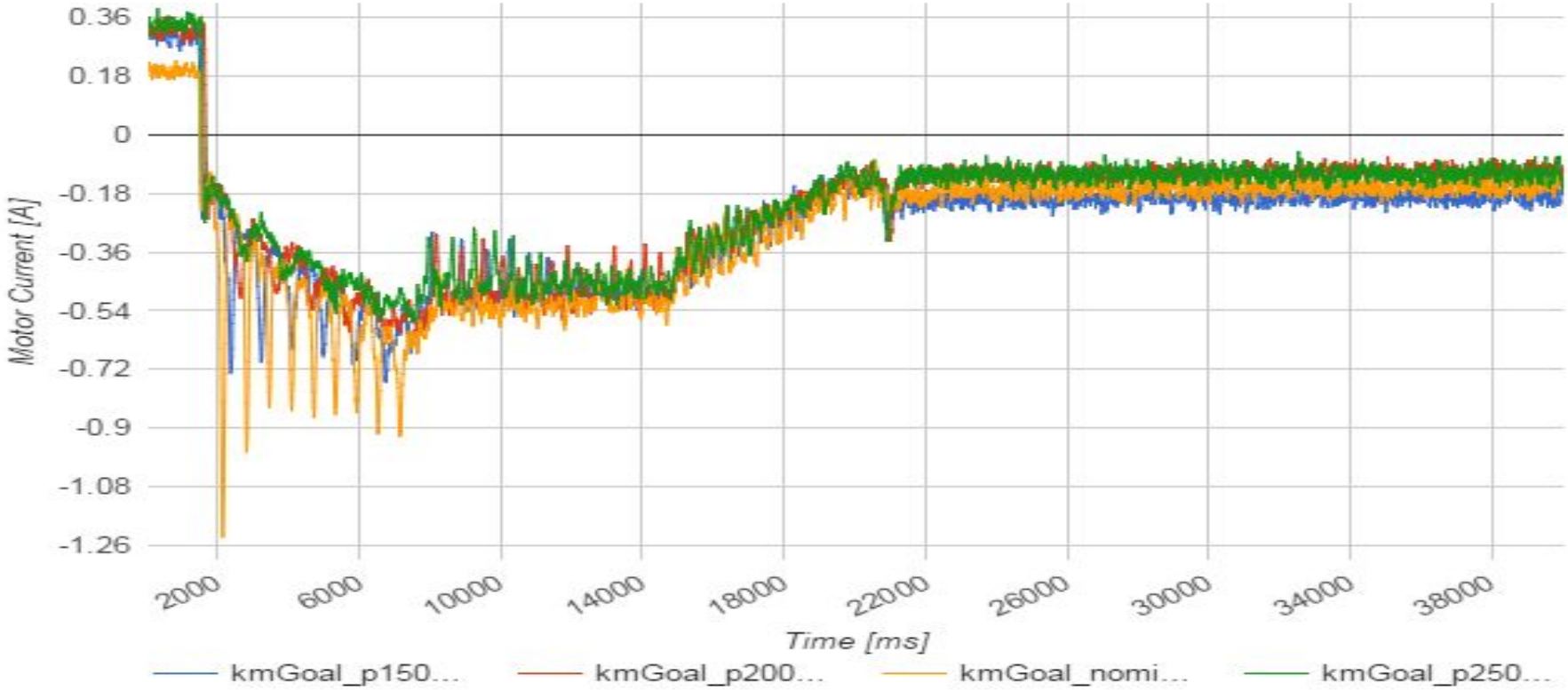


KM RA Various Parameters with Accelerometer Data

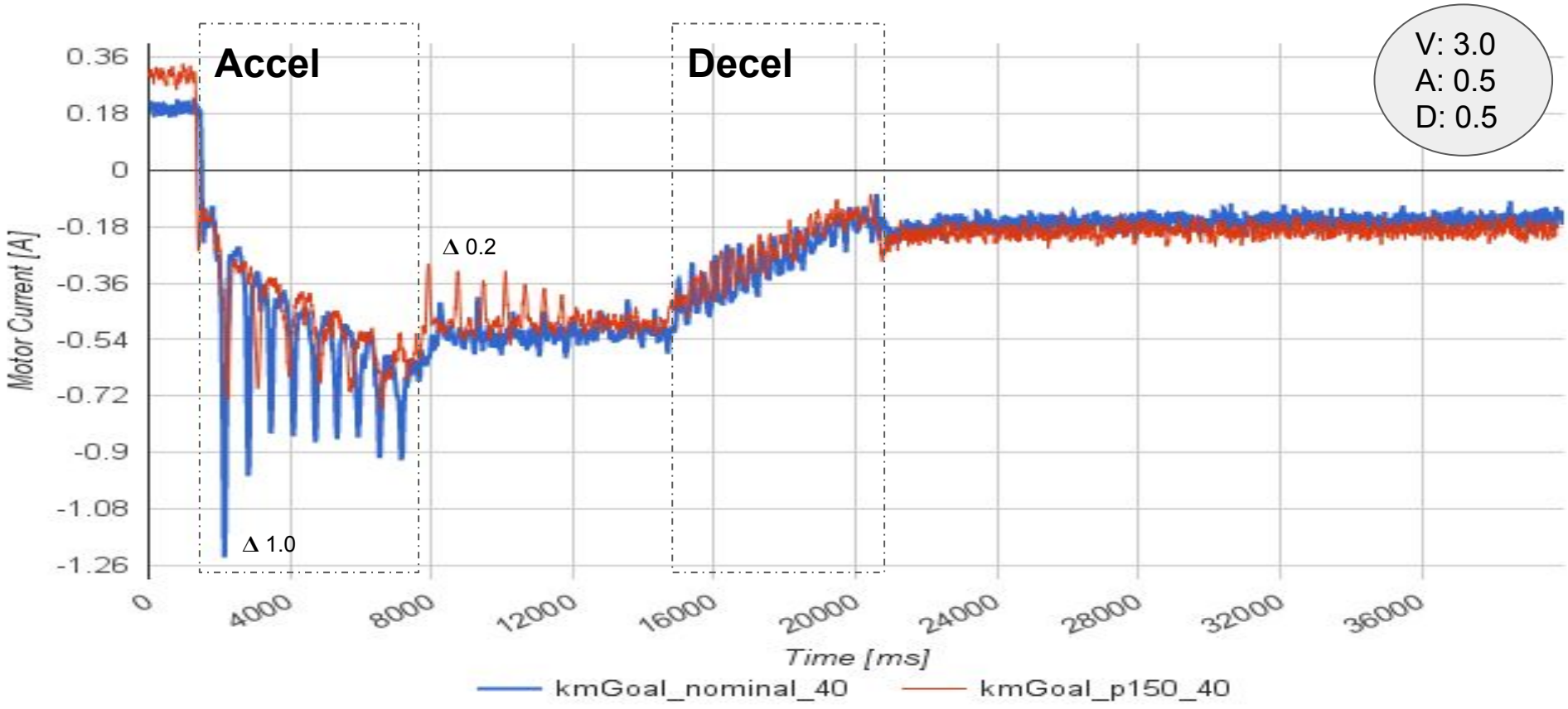


KM RA - Varying preload at goal parameters

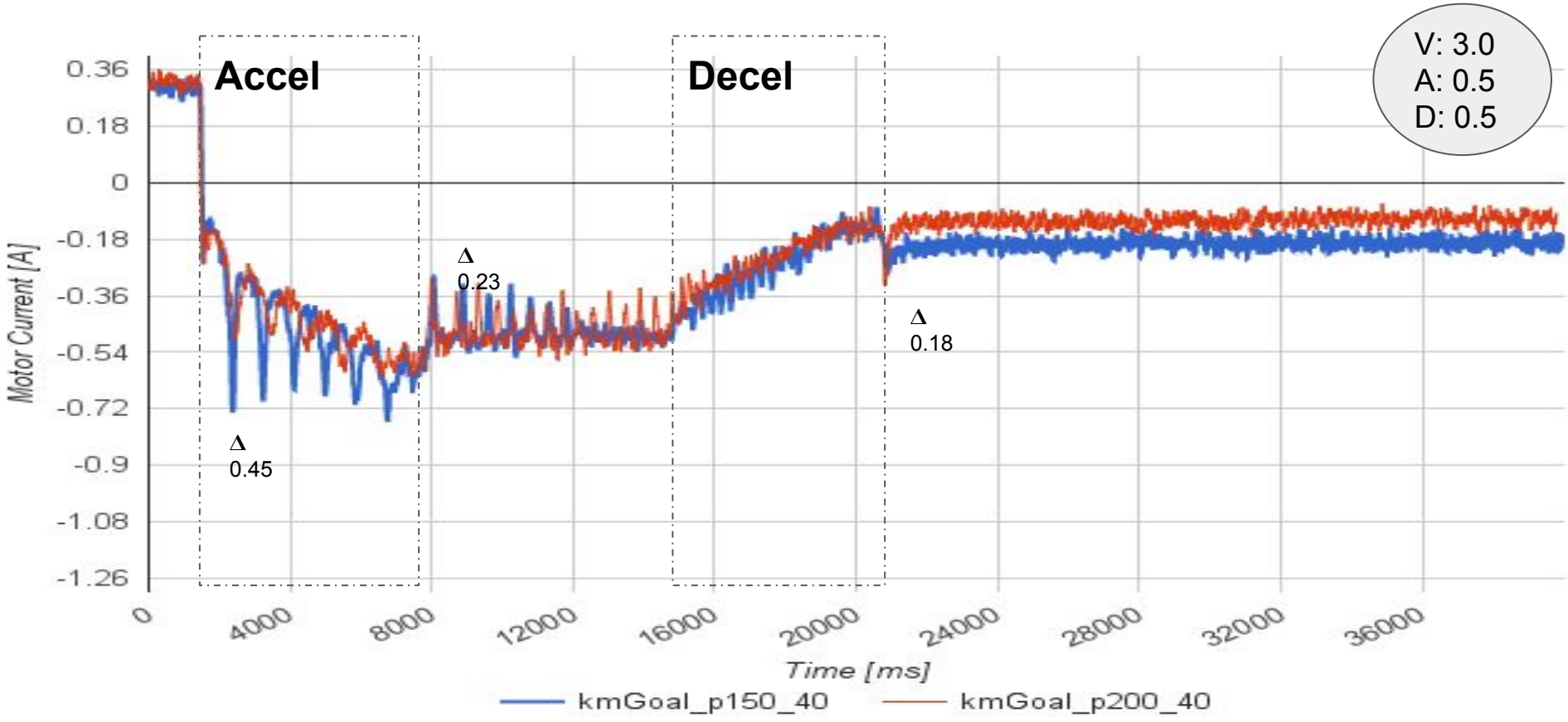
V: 3.0
A: 0.5
D: 0.5



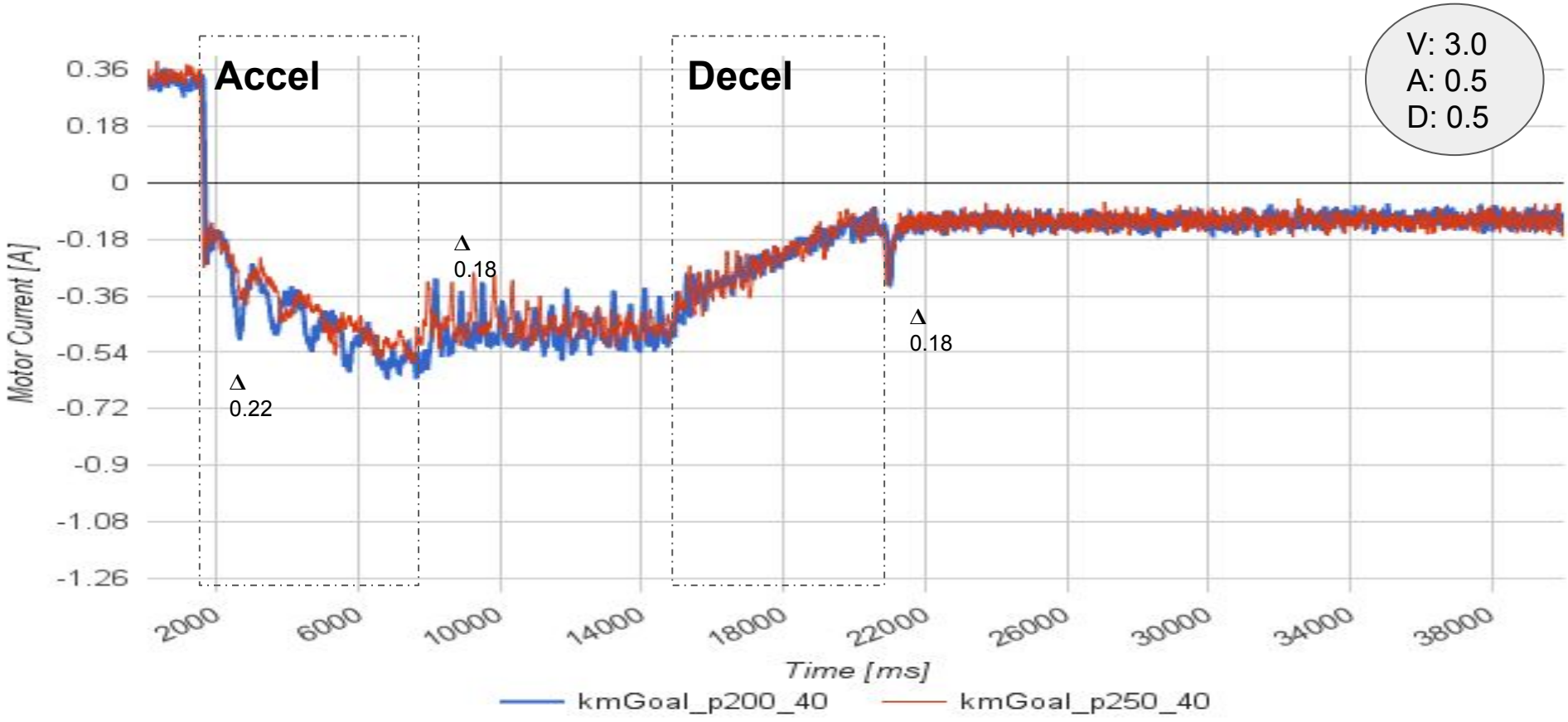
KM RA - Goal profile, Nominal & +150 lbs preload



KM RA 40°- Goal profile, +150 vs +200 lbs preload

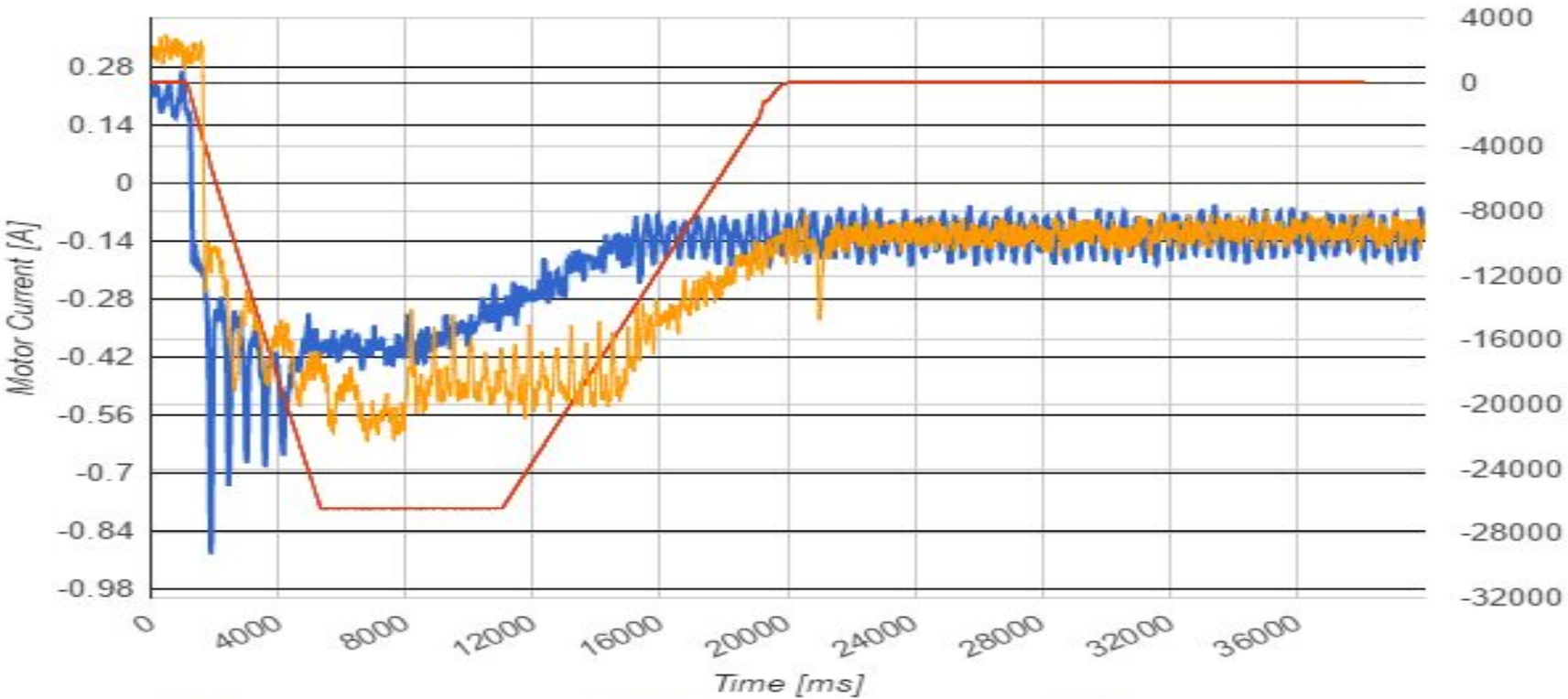


KM RA 40°- Goal profile, +200 vs +250 lbs preload



KM RA Motor Current Data - Preload Change

V: 1.7
A: 0.435
D: 0.218



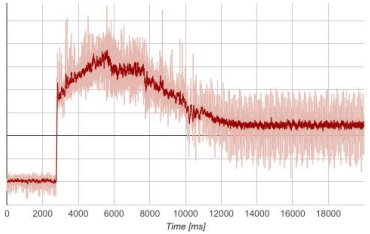
Previous Preload - 370 lbs

Velocity Feedback

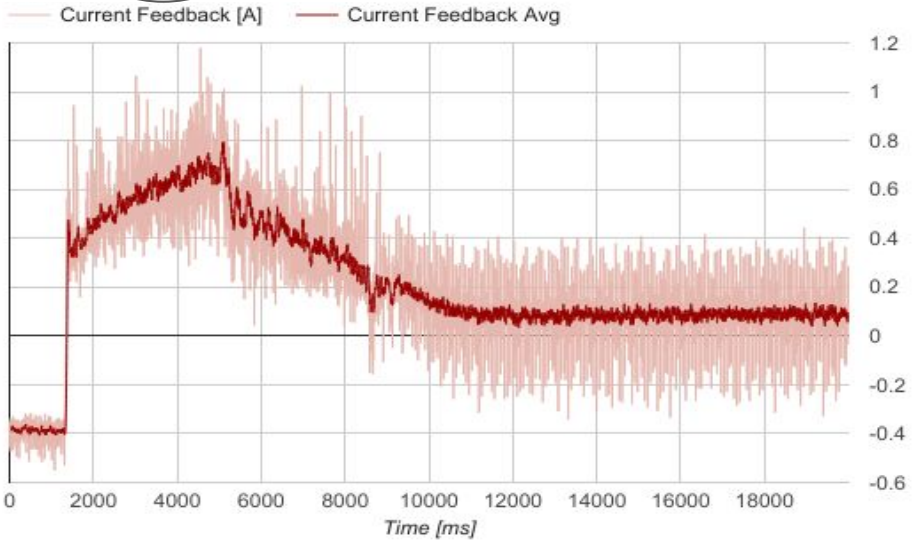
Current Preload - 570 lbs

KM Dec Motor Current @ various parameters

V: 1.5
A: 0.3
D: 0.15



V: 3
A: 0.5
D: 0.5



V: 3
A: 0.6
D: 0.6