



October 27, 2008

VSD-E servo drive tuning tutorial

Tuning of torque controller

1. Select Torque mode from **General settings** page
2. Set **Torque low pass filter** to 3300 Hz from **Torque control tuning** page
3. Press **Set** and click **Run step response**
4. Inspect the result graph
 - If you are getting response that resembles Figure 1, increase **Torque P gain** and return to step 3.
 - If you are getting response that resembles Figure 2, decrease **Torque P gain** and return to step 3.
 - If you get response that resembles Figure 3, (fast rise and no overshooting or oscillating edges) you have optimal **Torque P gain** and should proceed forward.
5. Start increasing **Torque I gain**, click **Set** and **Run step response**
6. Repeat step 5. several times until you get minimum difference to target graph. Typical optimal results are shown in Figure 4.
7. Set **Torque low pass filter** back to 330 Hz, which is a good starting value for position or velocity tuning

Note: in plots, Torque achieved signal should never exceed Torque target by more than 5% (a.k.a. overshooting). Torque controller overshooting is typical reason for over current faults, which happens if measured current momentarily goes above **Current fault limit** (in **Motor settings** page).

Errata note: Following images has time axis scale as second, but it should be ms.

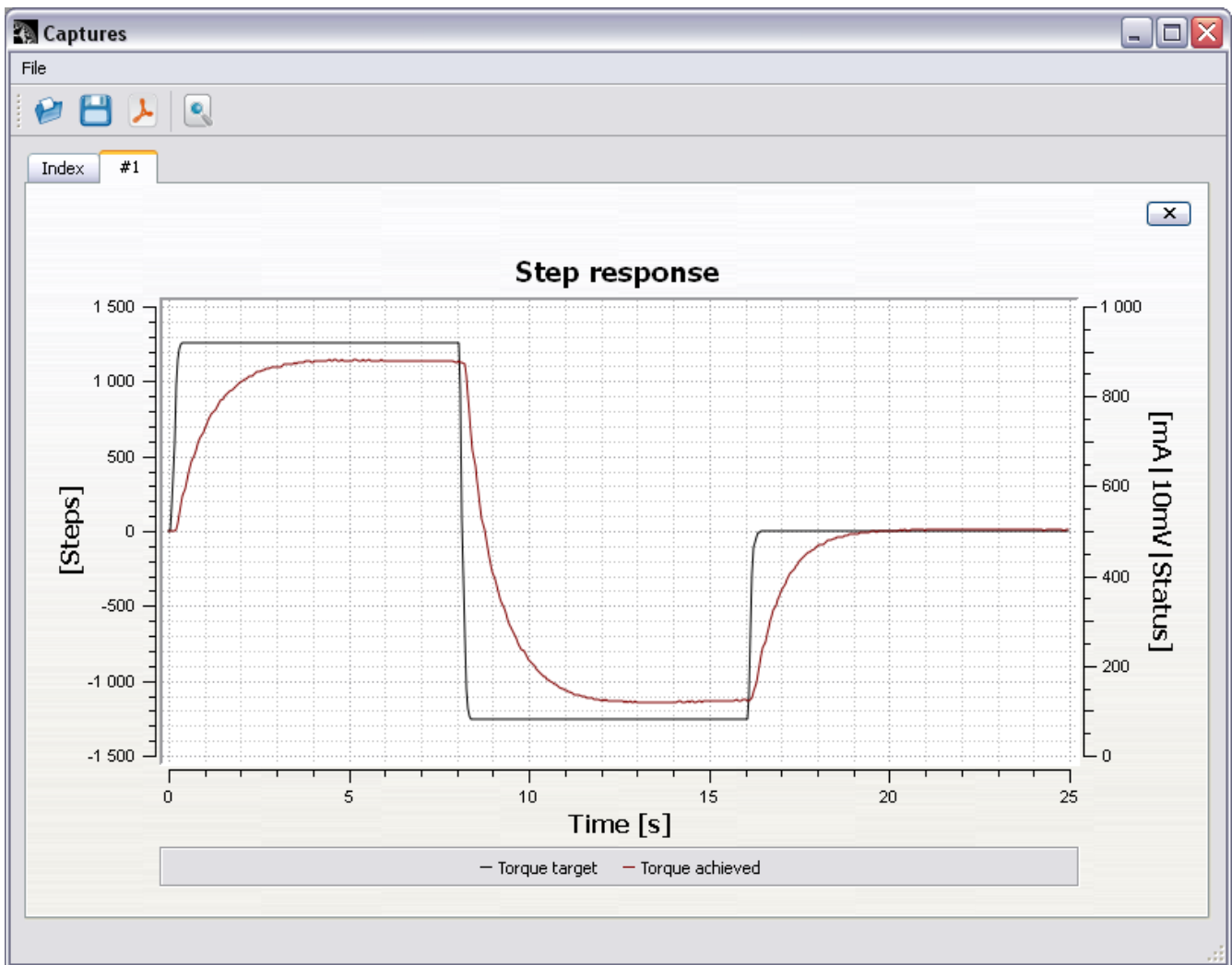


Figure 1: Too low torque gain values

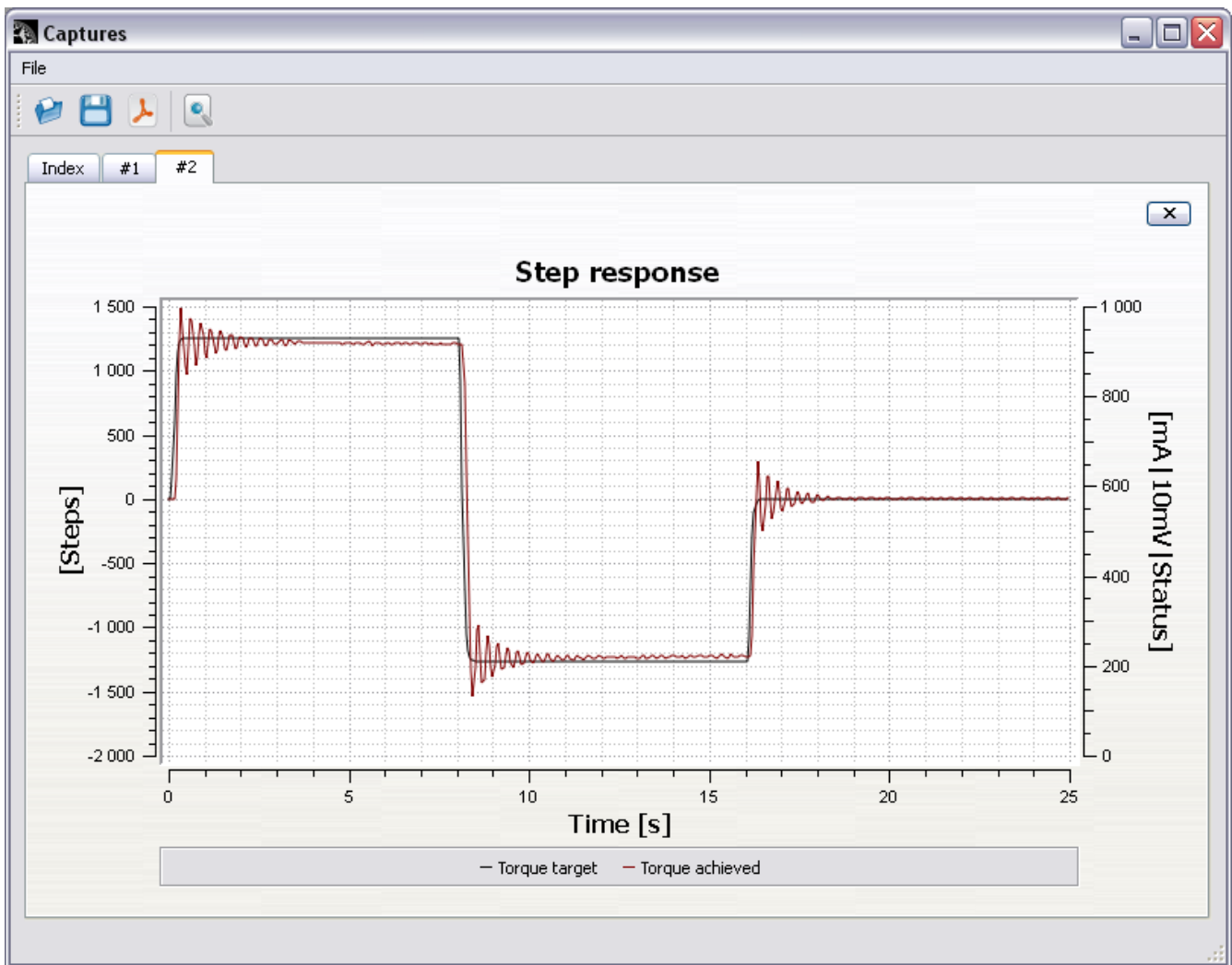


Figure 2: Too high torque P-gain value

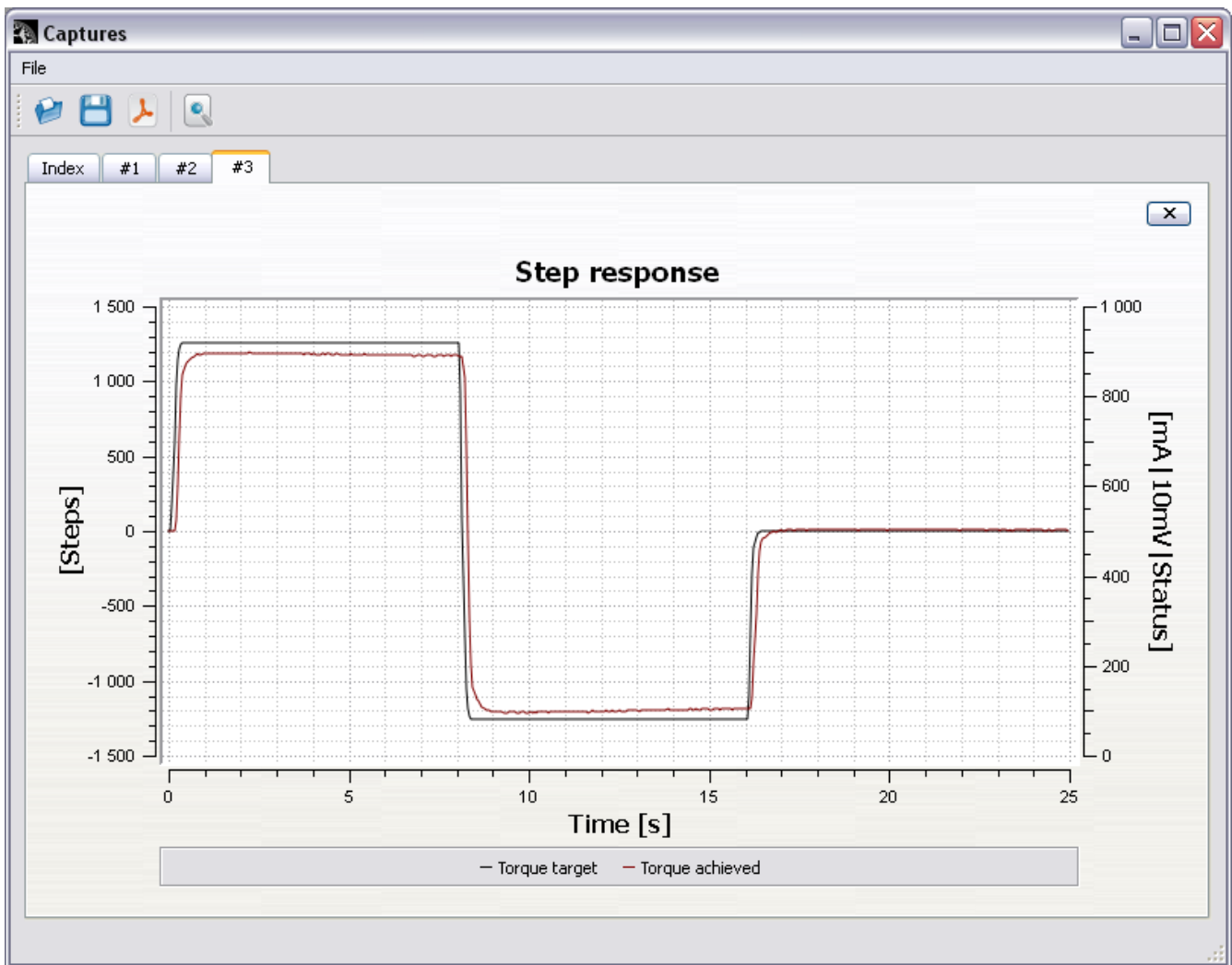


Figure 3: Correct torque P-gain value

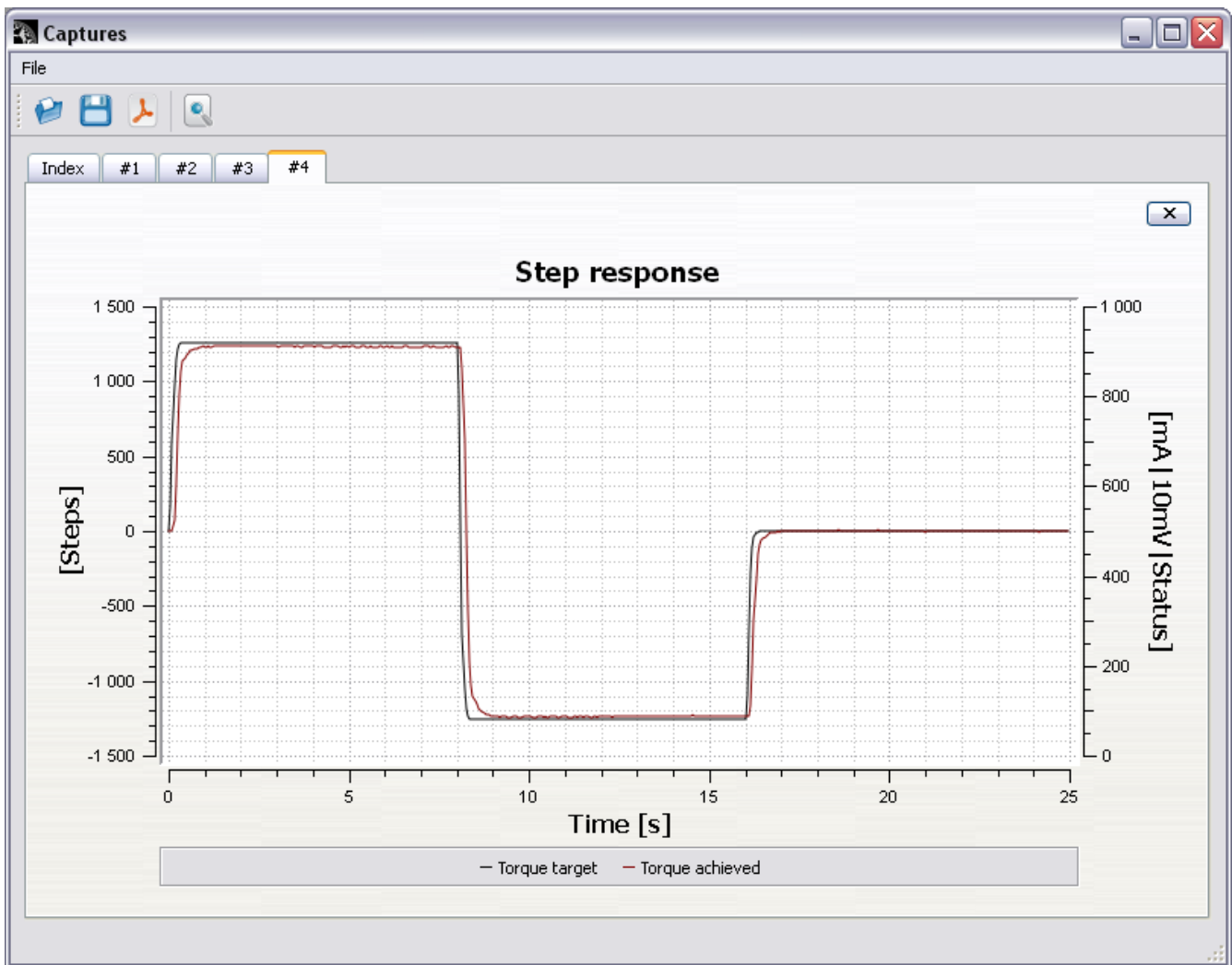


Figure 4: Optimal torque PI-gain values

Tuning of position controller

This chapter describes how to tune positioning motor operation in PIV controller mode. This method attempts tuning for high stiffness & fast response. Gains may be reduced from final values if higher following error is allowed.

1. Select **Position mode** from **General settings** page
2. Review and if necessary, adjust **acceleration** & **velocity** limits from **Trajectory planner** page to match your machine capabilities. Too high or low acceleration or velocity limits will make tuning difficult.
3. First we need to tune velocity PI gains. Select **Velocity target value** and **Velocity achieved value** signals (and de-select all others) from **Step response** tab from **Position tuning**
4. Click **Set** and **Run step response**
5. Inspect the result graph
 - If you are getting result that resembles Figure 5, (significant lag between target and achieved) increase **Velocity P** gain value, Return to step 4.
 - If you are getting result that resembles Figure 6, (oscillation or too much noise from motor) decrease **Velocity P** gain value. Return to step 4.
 - If you are getting result that resembles Figure 7, (small lag and tolerable noise from motor), you may proceed forward. If you wish to achieve highest possible control stiffness, you can try increasing **Velocity P** gain value further and try choosing another **Torque low pass filter** frequency and returning to step 4.
6. **Velocity P** gain adjustment is now done, we proceed adjusting **Velocity I** gain. First, click **Set** and **Run step response**.
7. Inspect the result graph
 - If you are getting reduced difference between target and achieved, like in Figure 8, continue increasing **Velocity I** gain and return to step 6 or leave it as is and proceed forward.
 - When you no longer get reduction in difference or start getting noisy operation or even worsening difference, like in Figure 9, decrease **Velocity I** gain and return to step 6.
8. **Velocity PI** gain adjustment is now done, we proceed adjusting **Position P** gain. Select **Position target value** and **Position achieved value** signals (and de-select all others) from **Step response** tab from **Position tuning**
9. Click **Set** and **Run step response**.
10. Inspect the result graph
 - If you are getting significant position following error, like in Figure 10, increase **Position P** gain and return to step 9.
 - If you are getting oscillation or overshooting or noisy control, like in Figure 11, decrease **Position P** gain and return to step 9.
 - If you are getting satisfactory results with small overshooting, like in Figure 12, you have successfully configured PIV controller!

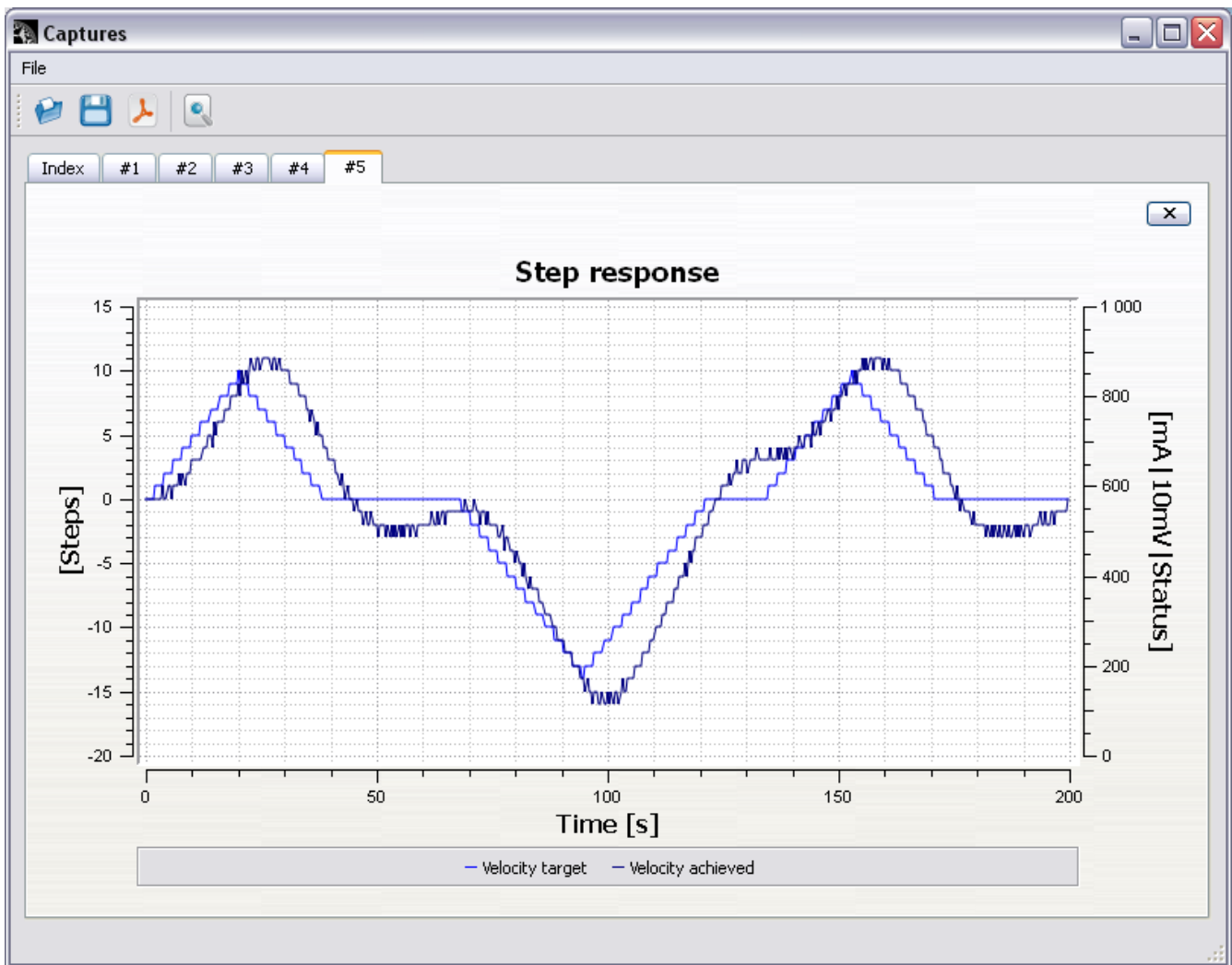


Figure 5: Too low velocity P-gain value

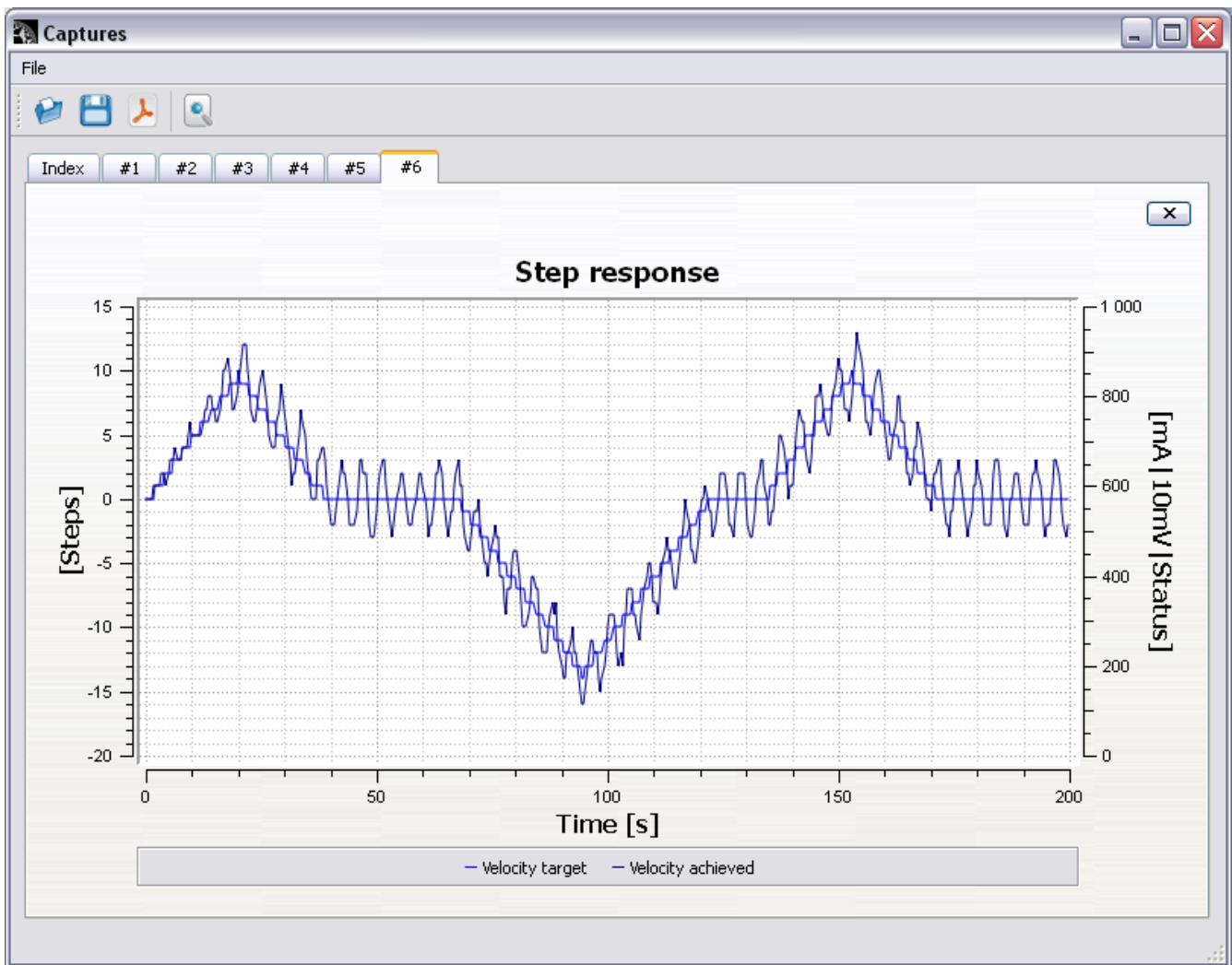


Figure 6: Too high velocity P-gain value

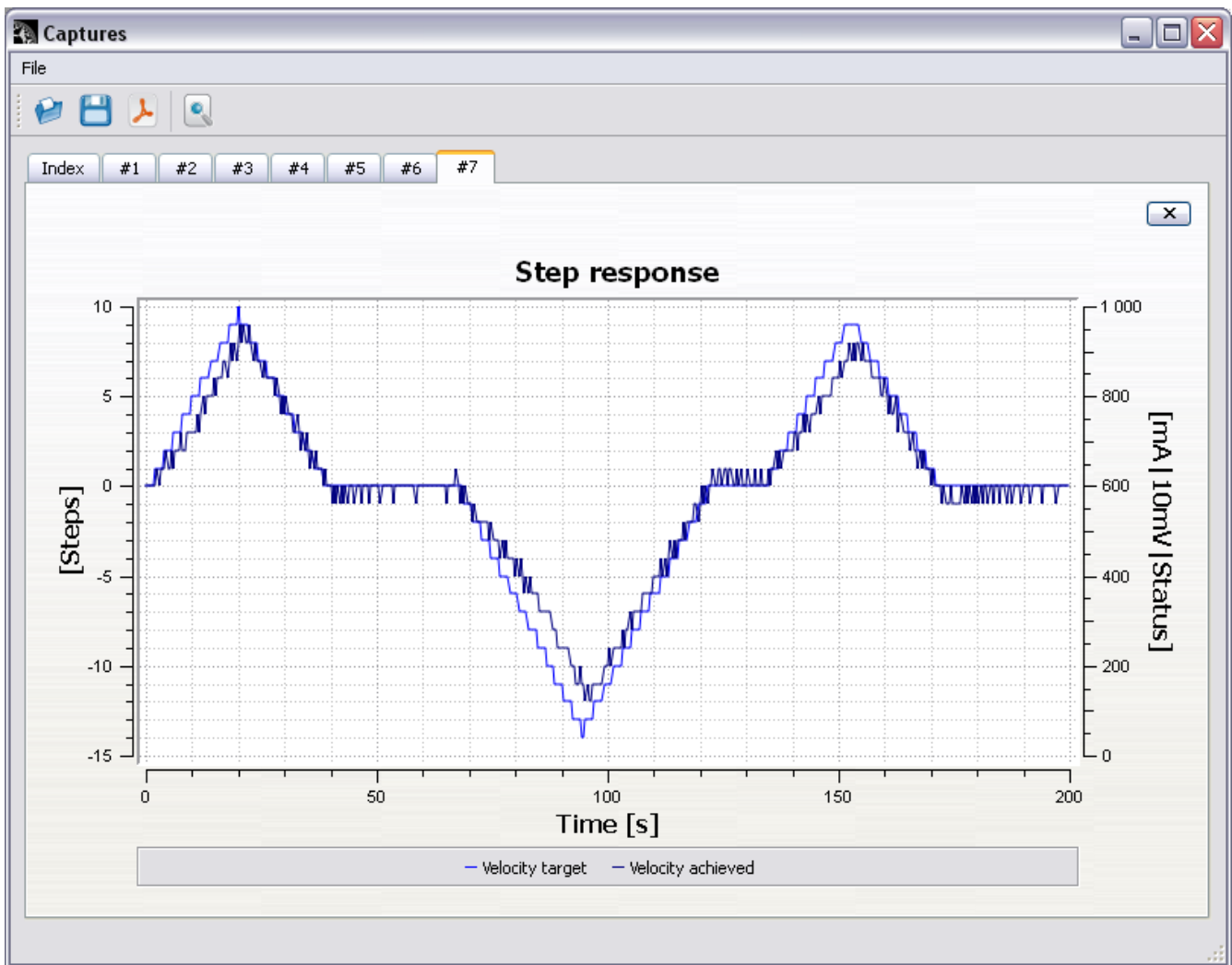


Figure 7: Correct velocity P-gain value

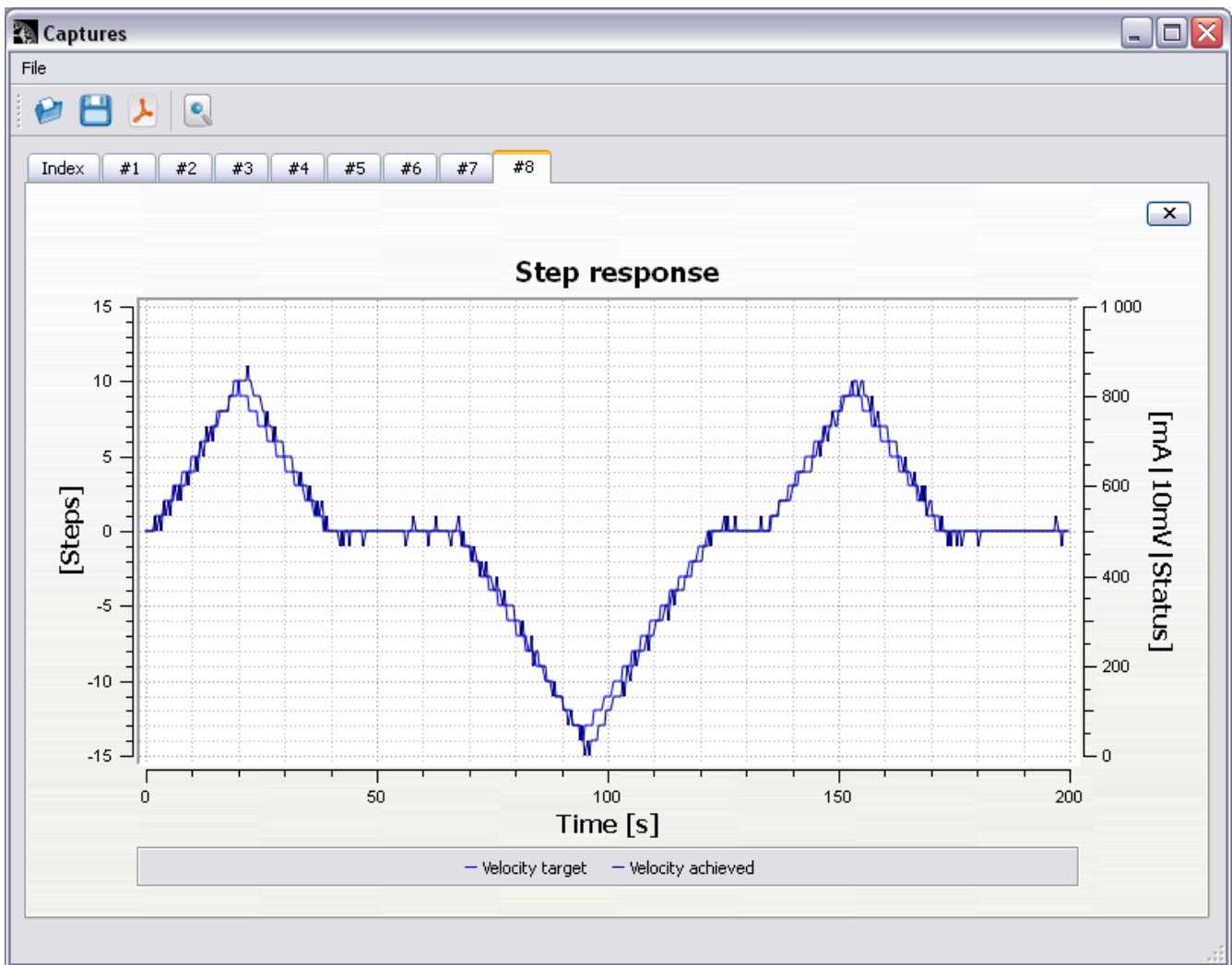


Figure 8: Too low velocity I-gain value

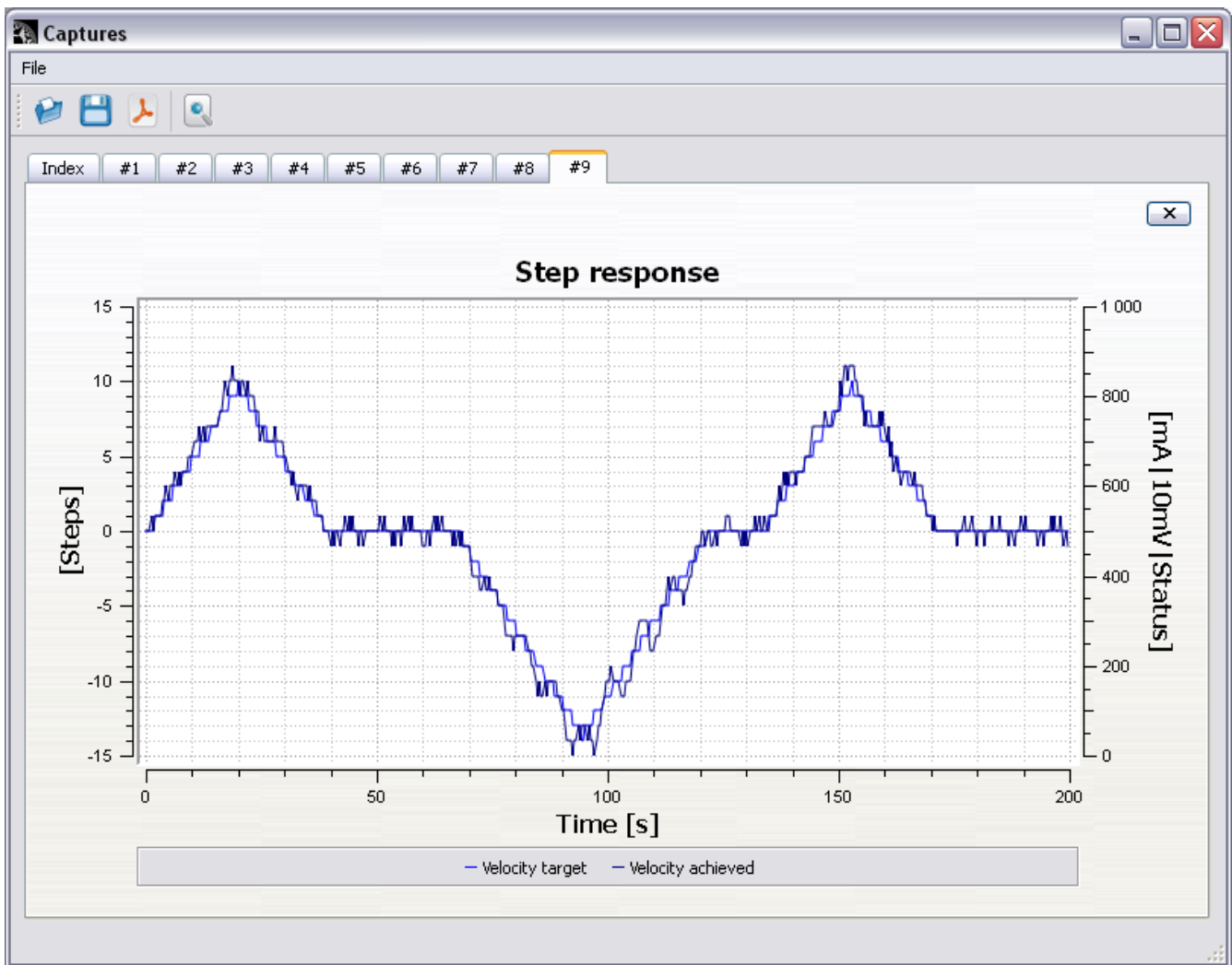


Figure 9: Too high velocity I-gain value

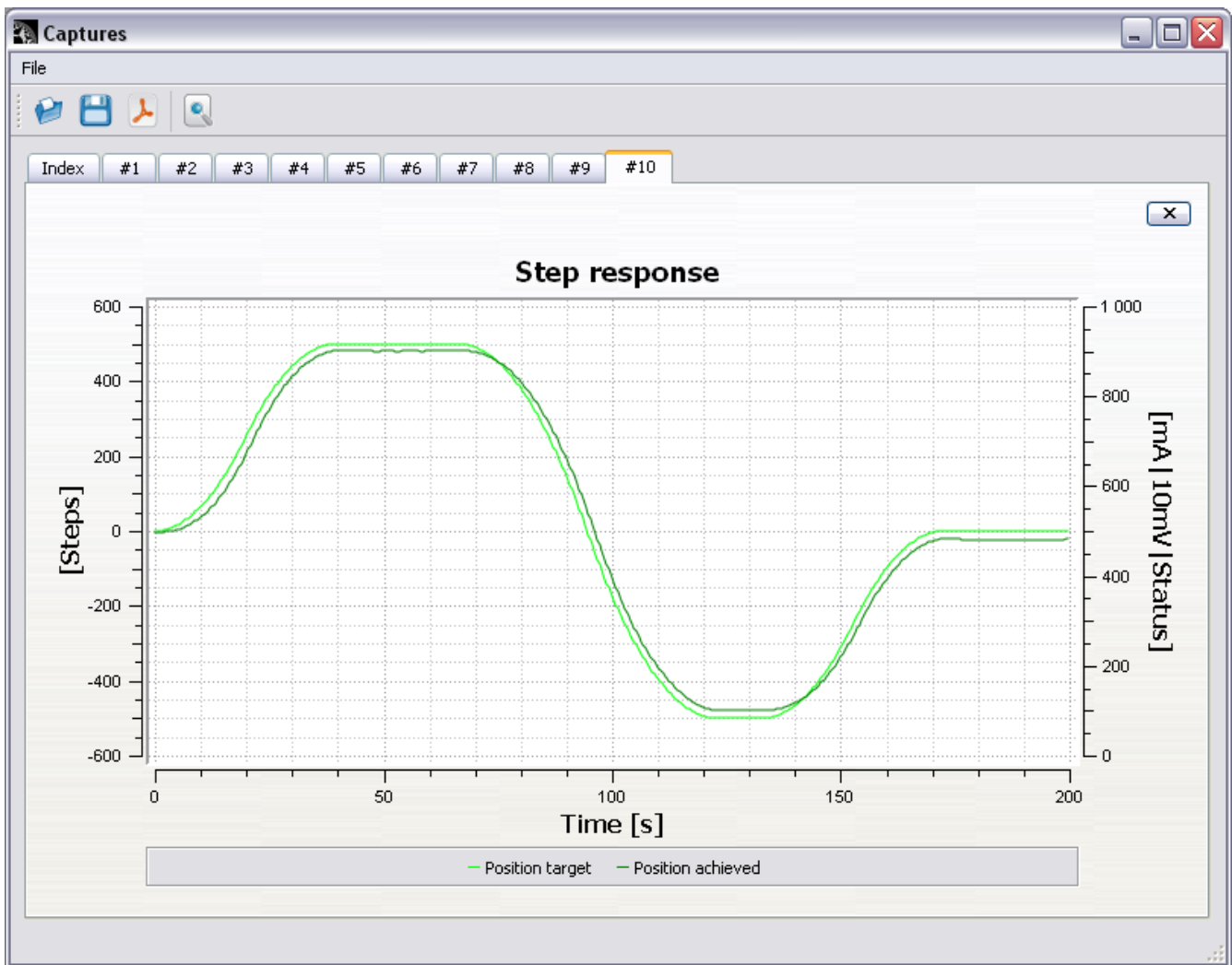


Figure 10: Too low position P-gain

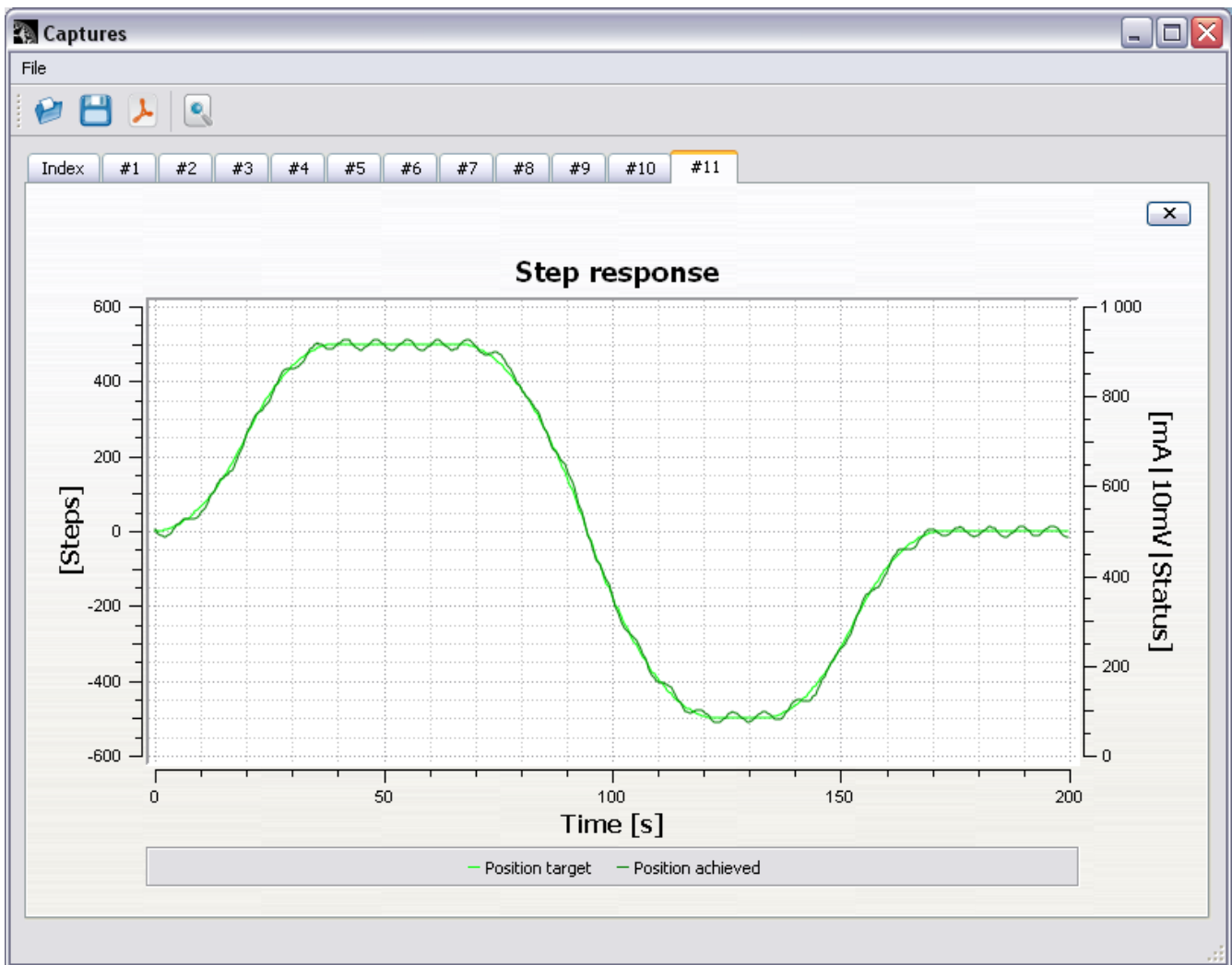


Figure 11: Too high position P-gain

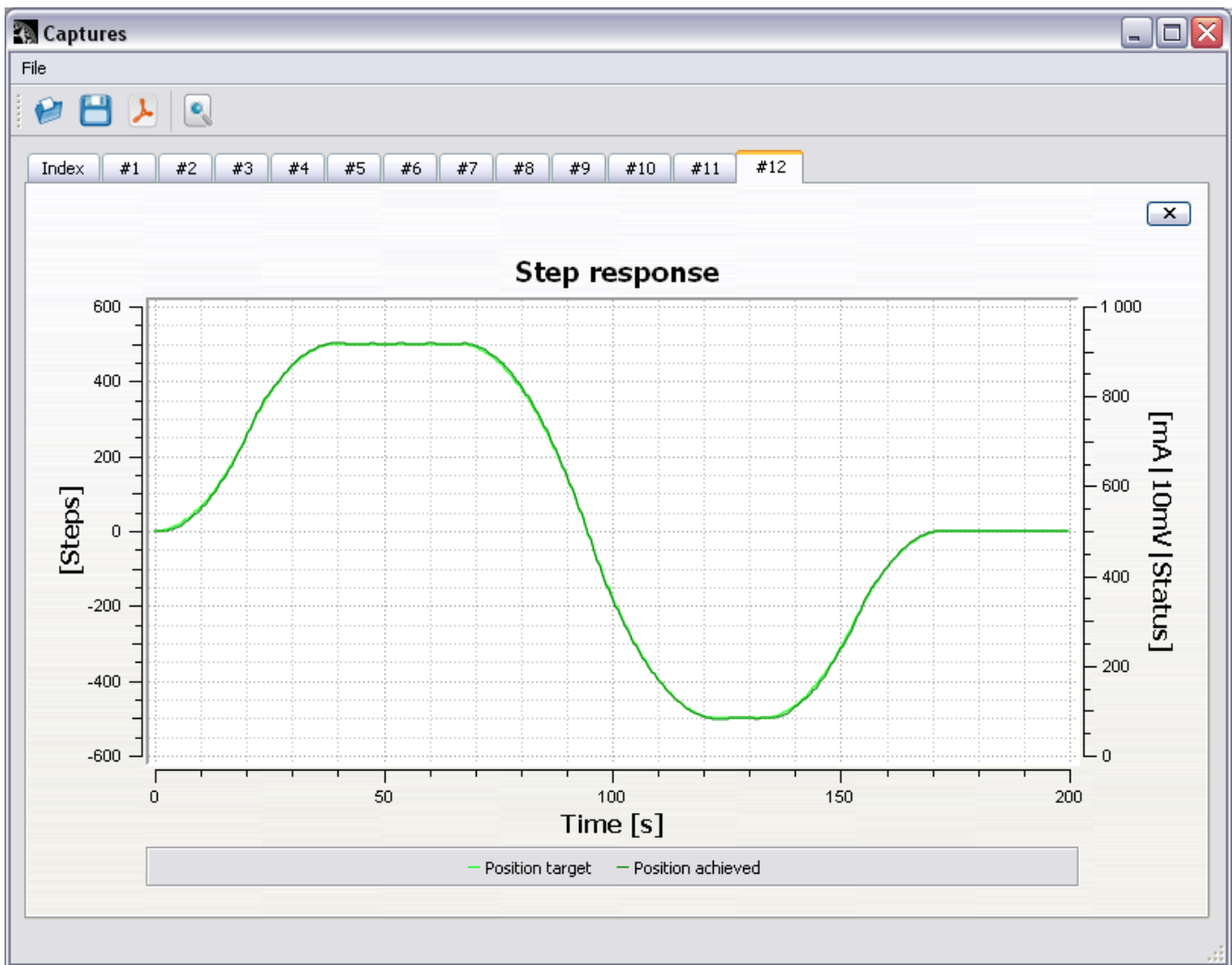


Figure 12: Correct position PIV-controller values