

# GDtool 2.0 position mode tuning tutorial

Document version 1.00

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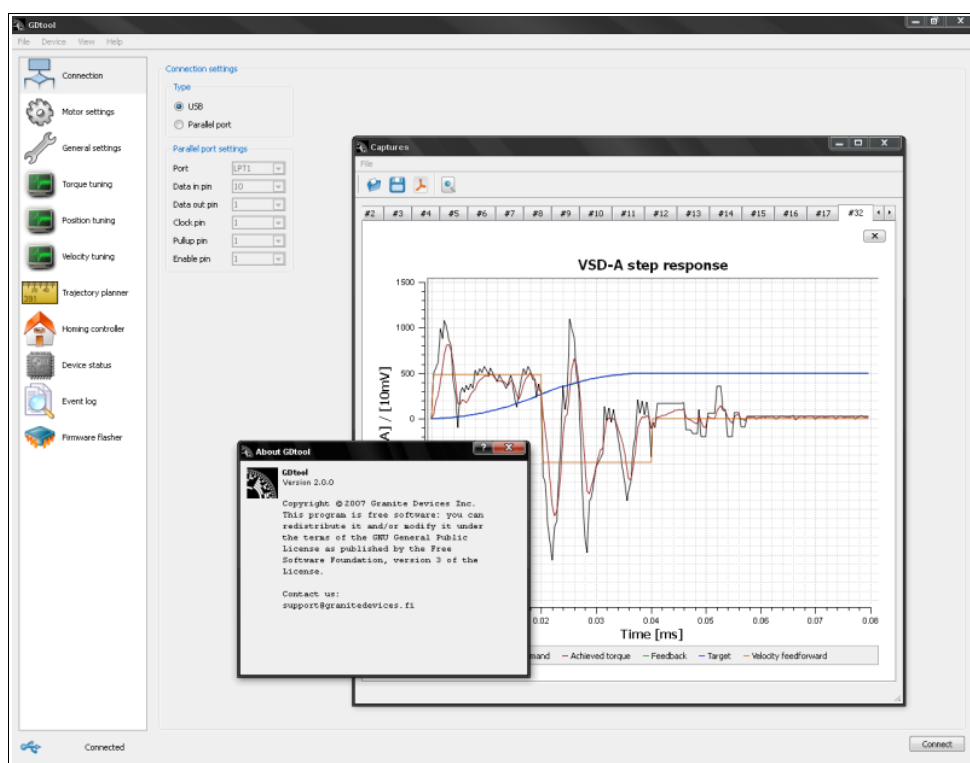
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## Introduction

This tutorial introduces to you how to tune position mode settings with GDtool v2.0 tuning software.

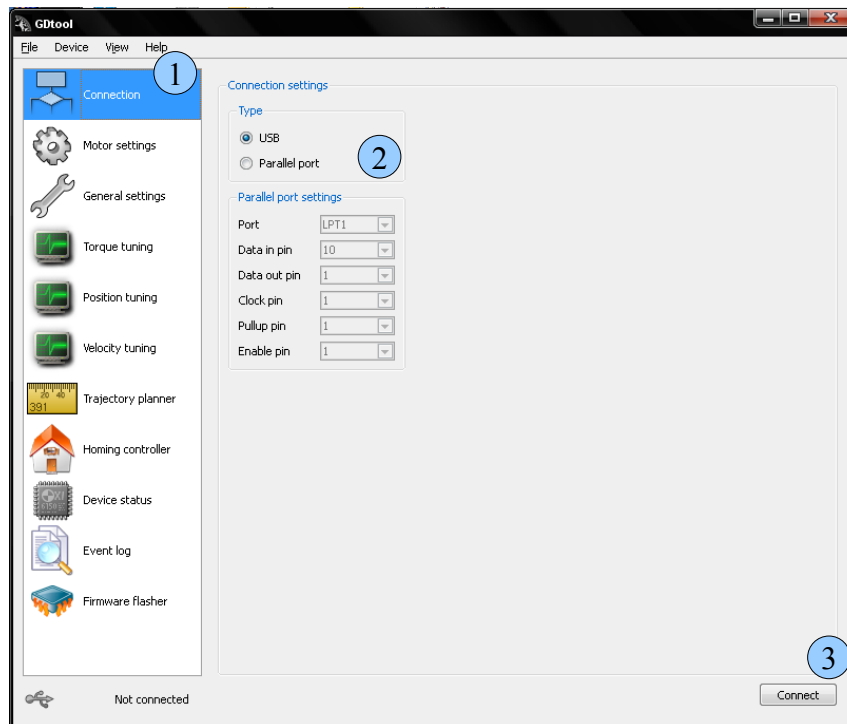
Requirements:

- A Granite Devices servo drive
- USB data cable or parallel cable with breakout board
- GDtool version 2.0.0 software installed
- Microsoft Windows NT4/2000/XP or Vista

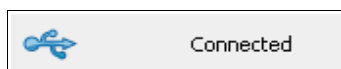


## Connecting to drive

1. Choose connection page
2. Select connection type to USB or parallel. If using parallel port, set pins to match you cable.
3. Press Connect button
4. If you get a dialog about old firmware version, jump to chapter **Upgrading firmware**
5. To load saved configuration from drive, choose **Device->Import settings**



Connection status should change to Connected state

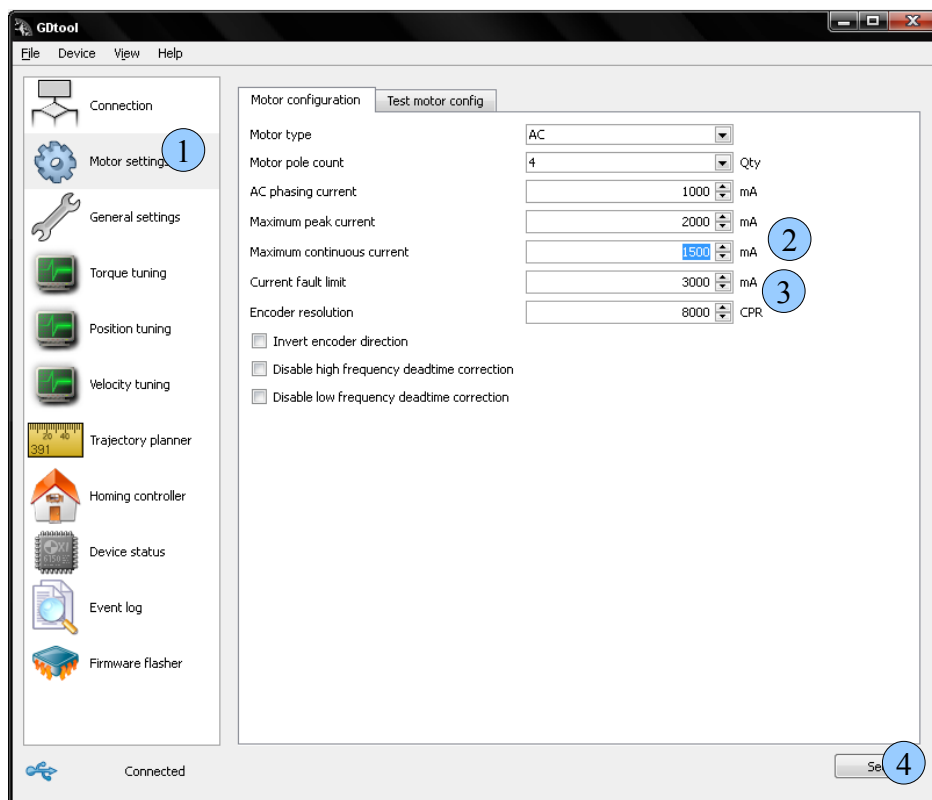


## Configuring motor settings

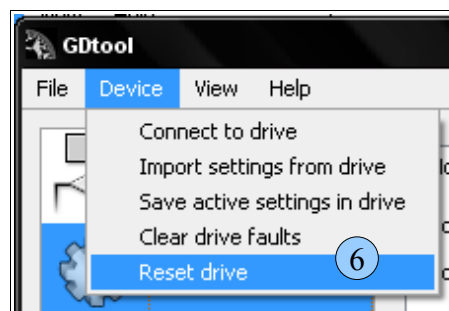
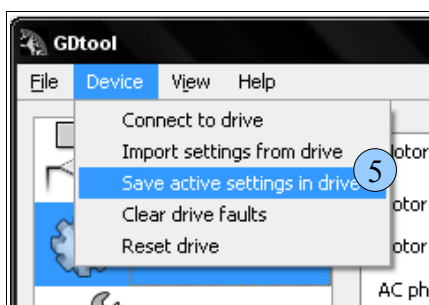
1. Choose motor settings page
2. Set proper values, check you motor specification from motor data sheet or contact motor supplier if unsure. Read **Advanced motor settings section** if unsure about purpose of parameters or read a **tool tip** by holding mouse over option for a while
3. After peak/cont current levels are set, set **Current fault limit** to 1000 to 2000 mA higher than peak current

**Note:** there is 50% change that encoder counting direction doesn't match to motor polarity at the first wiring. So if you are getting weird behavior or total instability, try setting **Invert encoder direction** check box. It is **absolutely necessary** to set encoder direction correctly to get proper servo operation.

4. Press Set values button



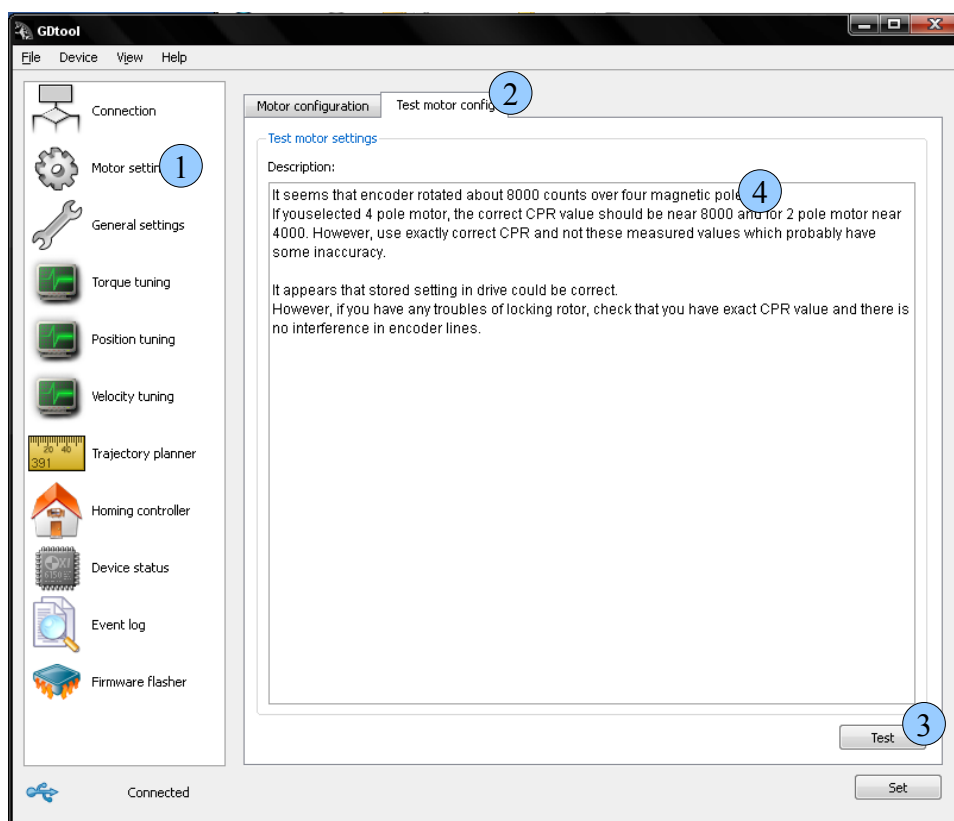
5. Save active settings to drive
6. Reset drive to activate new motor settings
7. Connect or power up HV power supply now



## Testing motor settings (AC and BLDC only)

**Note:** if you are using other than AC/BLDC motor, you please **skip** this chapter

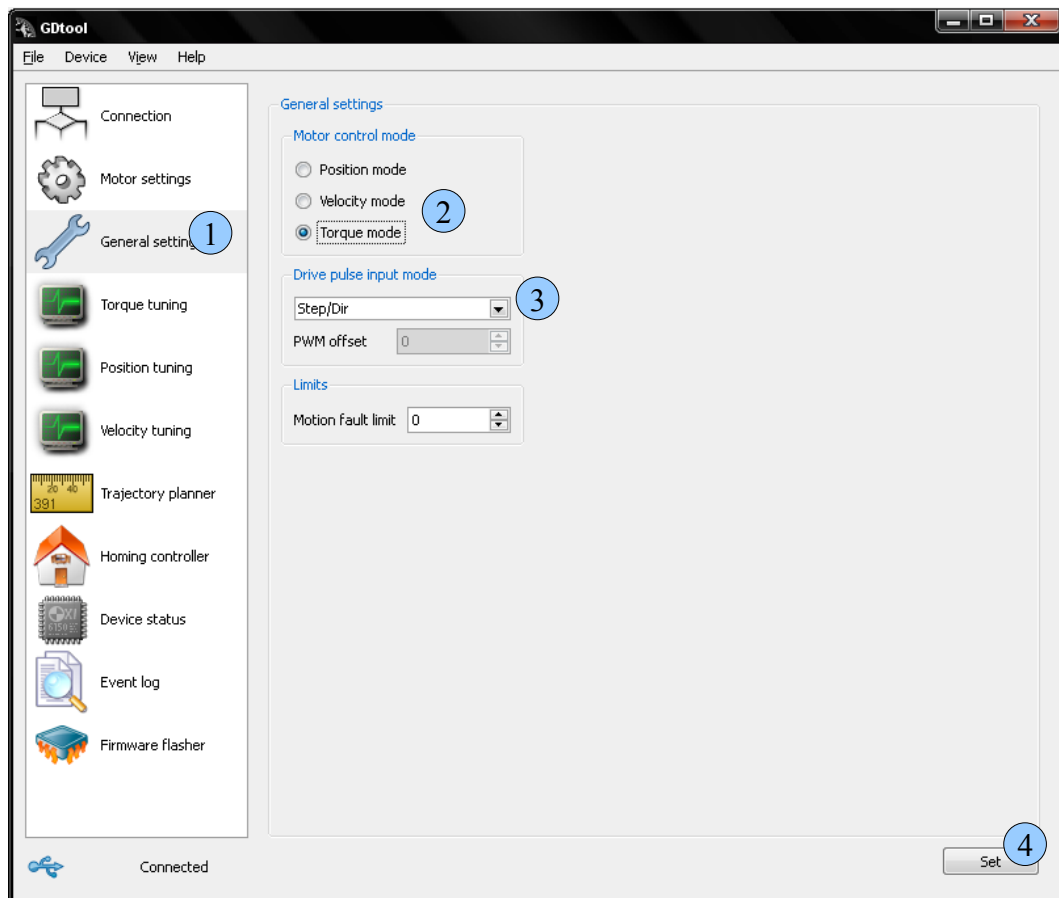
1. Choose motor settings page
2. Choose test motor config tab
3. Press test
4. Check that results matches to you configuration or check configuration and wiring if problems are found



## Configuring torque control mode

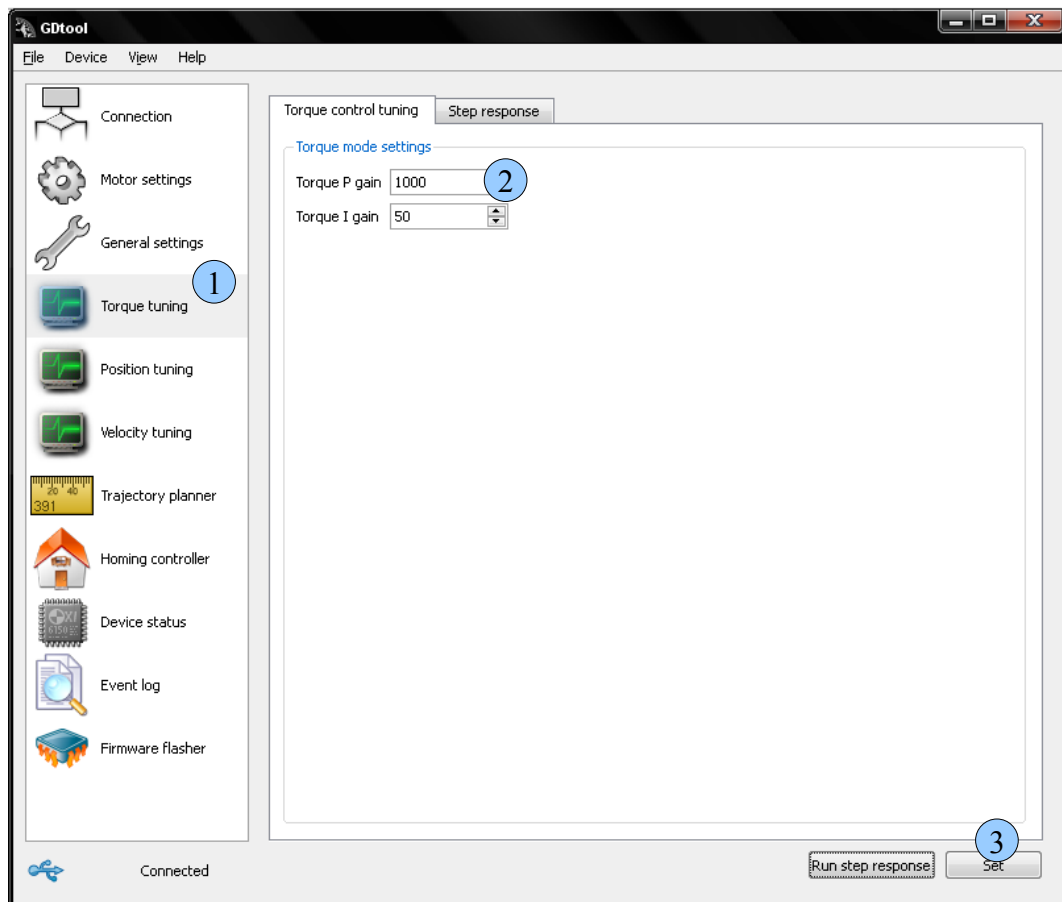
Torque mode **must** be tuned before proceeding to position mode tuning since all other modes utilize torque control in cascade with other modes

1. Choose General settings page
2. Select torque mode
3. You can set your preferred pulse input mode now, or after configuration
4. Press Set values button

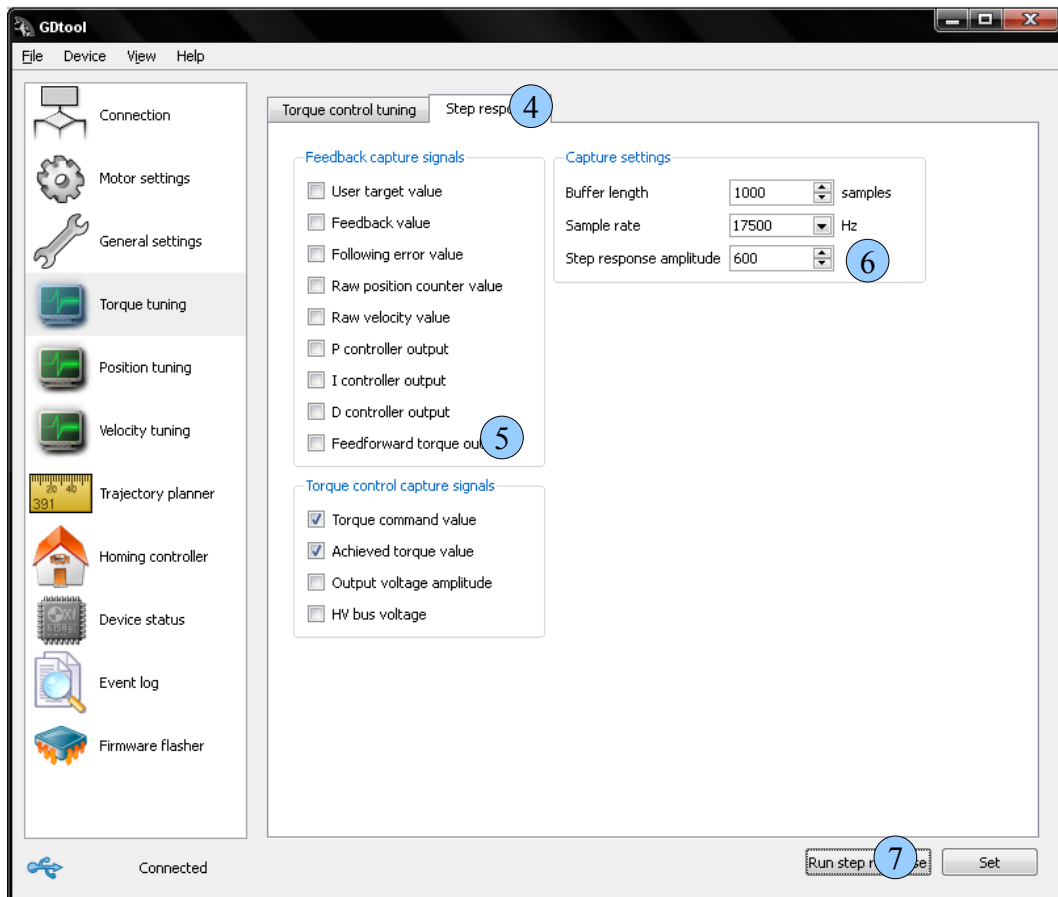


## Tuning torque mode

1. Choose torque tuning page
2. Adjust P and I gains (**note:** it's recommended use default gains for the first run)
3. Press Set values button

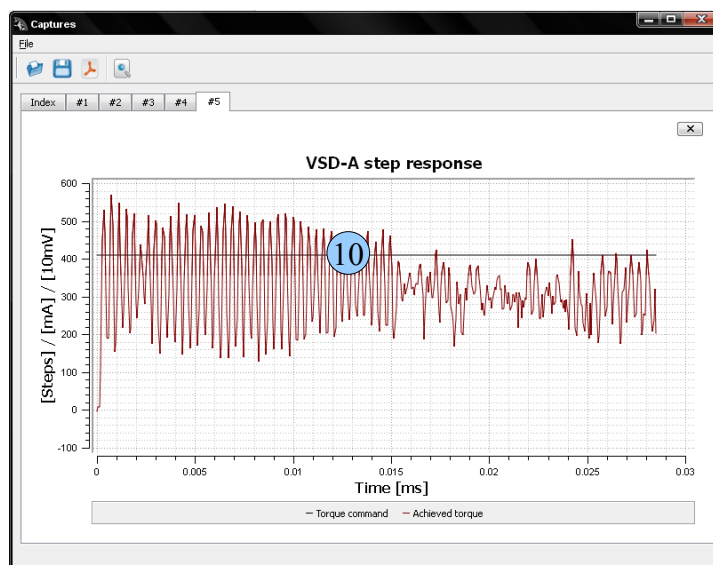
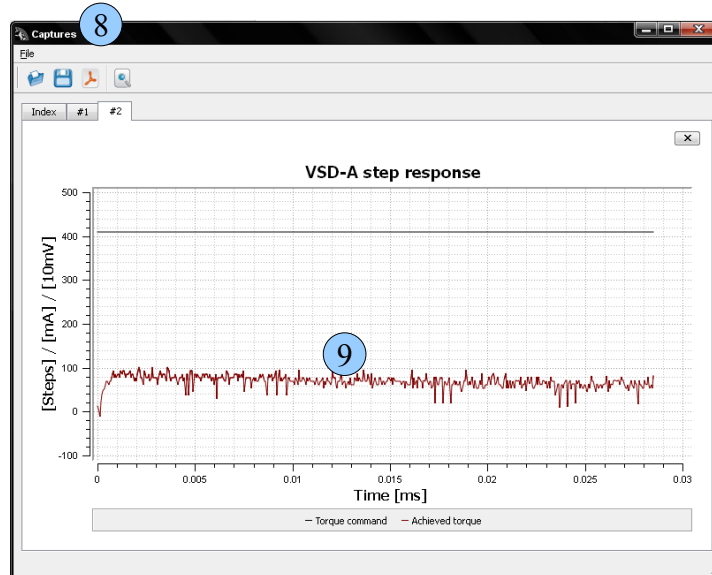


4. Click Step response tab
5. Choose capture signals you wish to plot or use defaults
6. Set step response amplitude value about from 50% to 100% of motor continuous current value (> 500 mA)
7. Press **Run step response** button

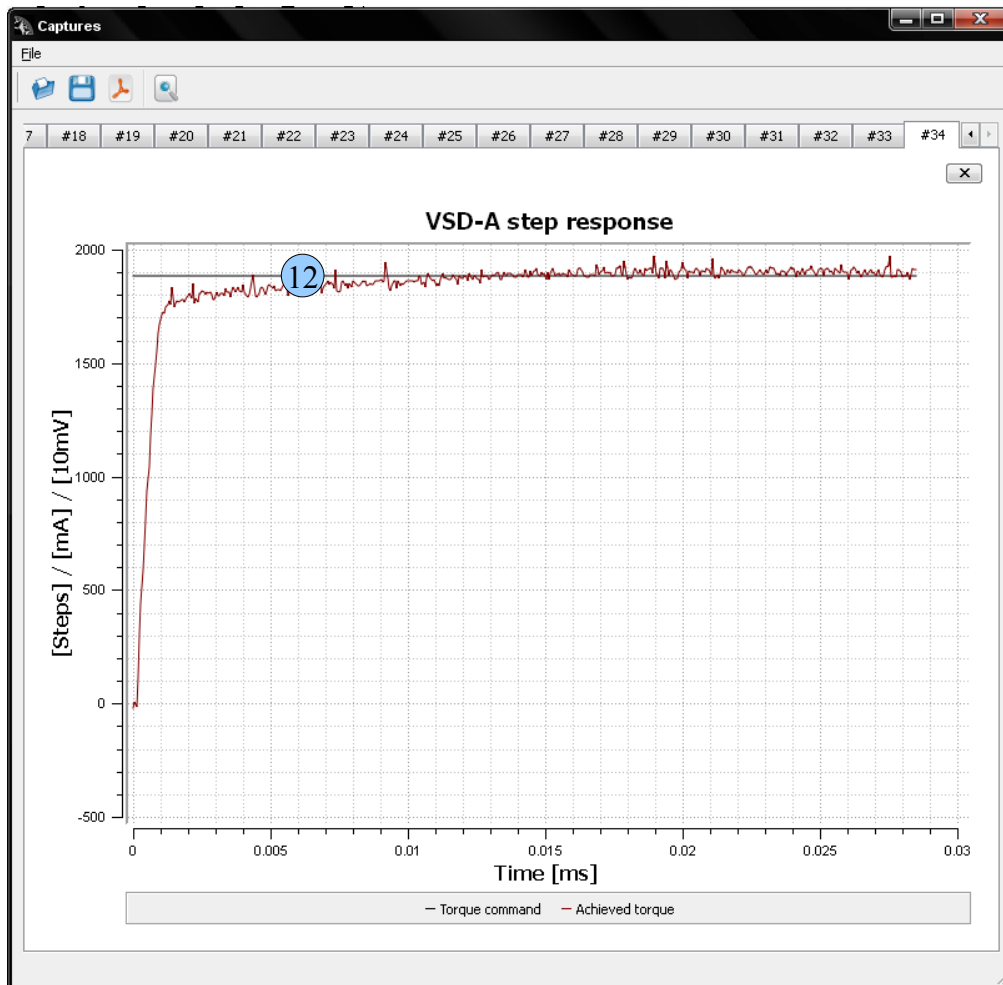




- 8. Captures window should appear after a short while
- 9. Example image 1. Too low gain values. (current not reaching target)
- 10. Example image 2. Too high gain values (oscillation)

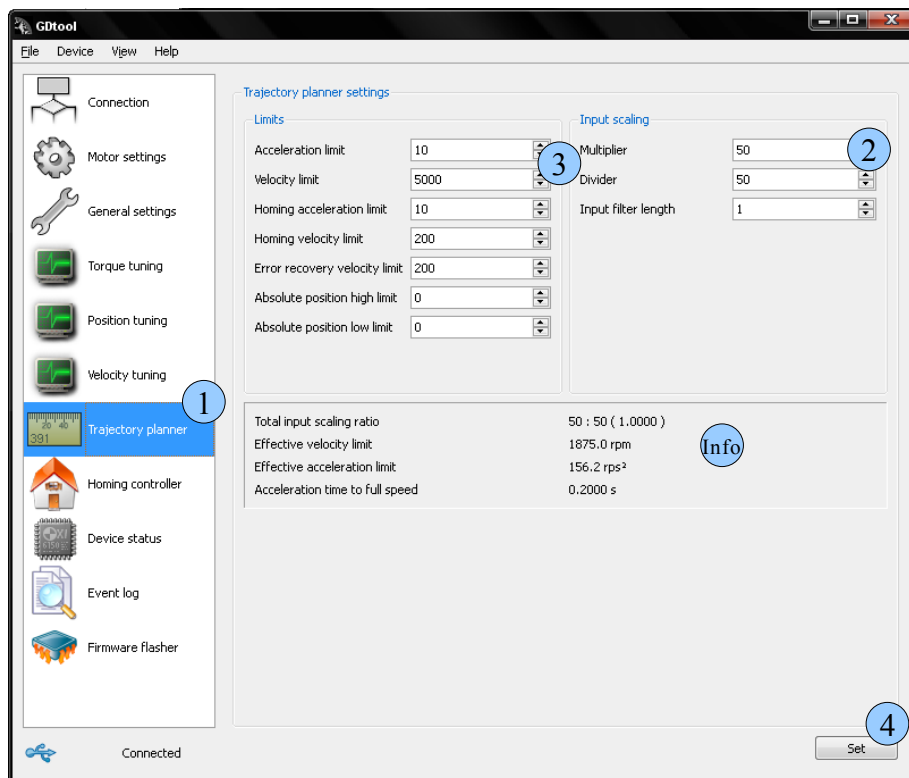


11. Check signals you have plotted and **adjust PI gains** (jump back to section 2). First increase P-gain to get good (non peaking) response and I-gain after that. **Remember** to press Set values button after each time you change values
12. Change PI-gain values and test response until you get good output (see picture below)



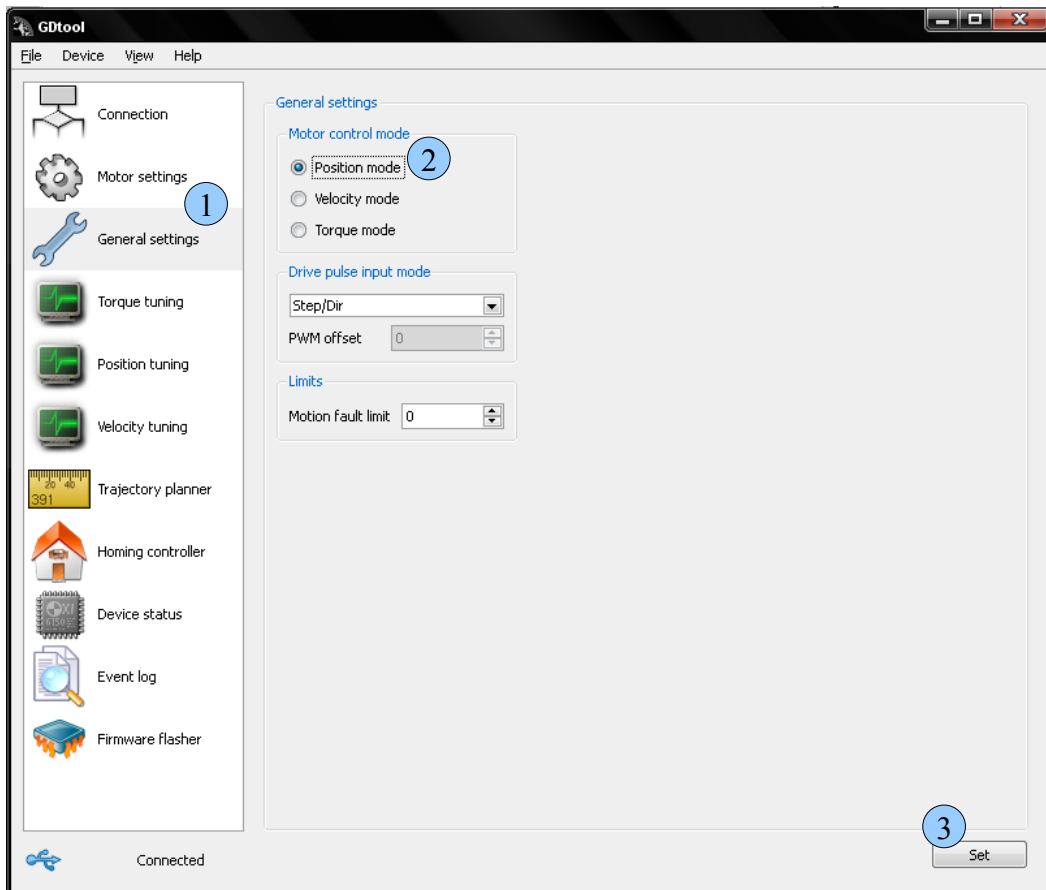
## Configuring trajectory planner settings

1. Choose trajectory planner page
2. Set **input scaling ratio** by adjusting **Multiplier**, **Divider** and **Input filter length**. Total input scaling ratio (in the *info* box) displays the real multiplier from drive input to output. **Note:** It is recommended to use **Divider** of at least **50**.
3. Set **acceleration** and **velocity limit** values depending your need to limit the motor shaft speed (see *info* box for values in real world units).
4. Press **Set values** button

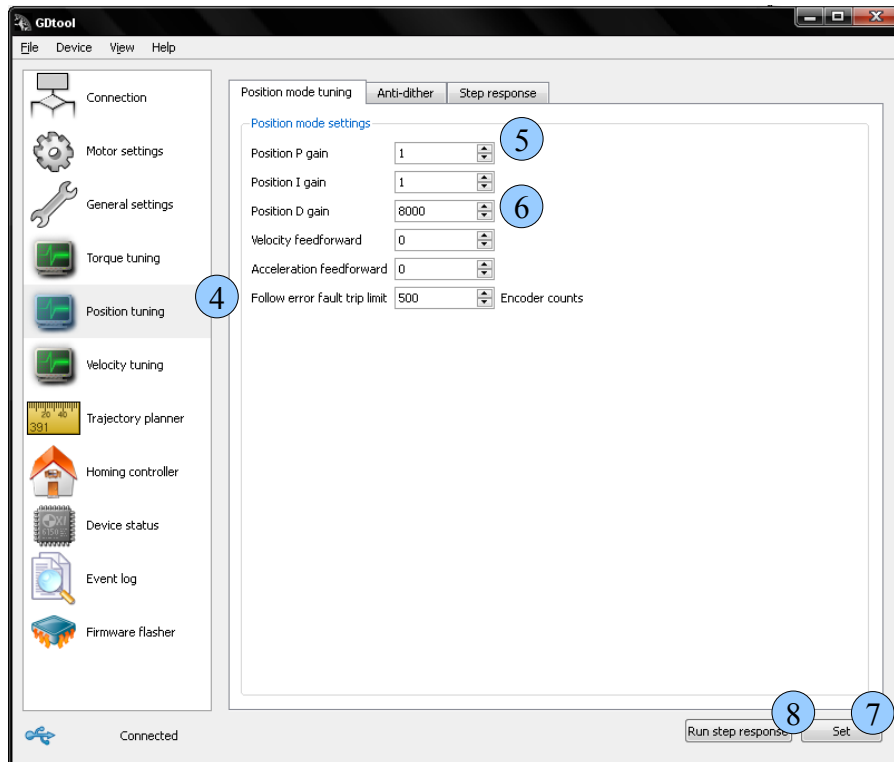


## ***Tuning position control mode***

1. Select General settings page
2. Select **position mode**
3. Press **Set values** button



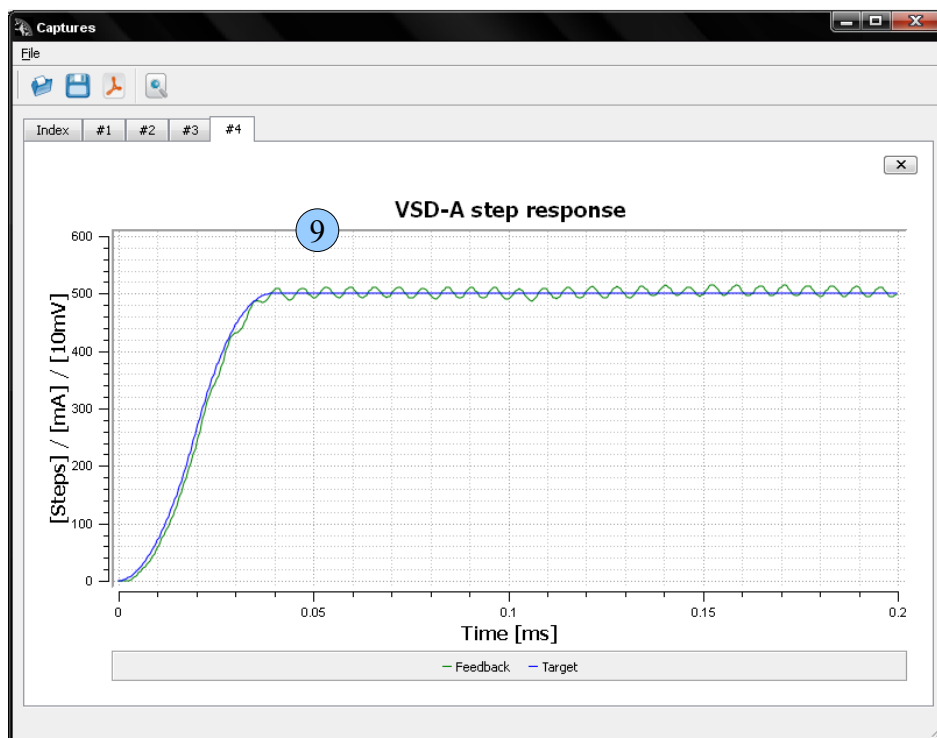
4. Choose position tuning page
5. Start by setting **P to 100** and **I to 1** or other very **low** value
6. Start with quite high **D gain** value (>500)
7. Press **Set values** button
8. Press **Run step response** button



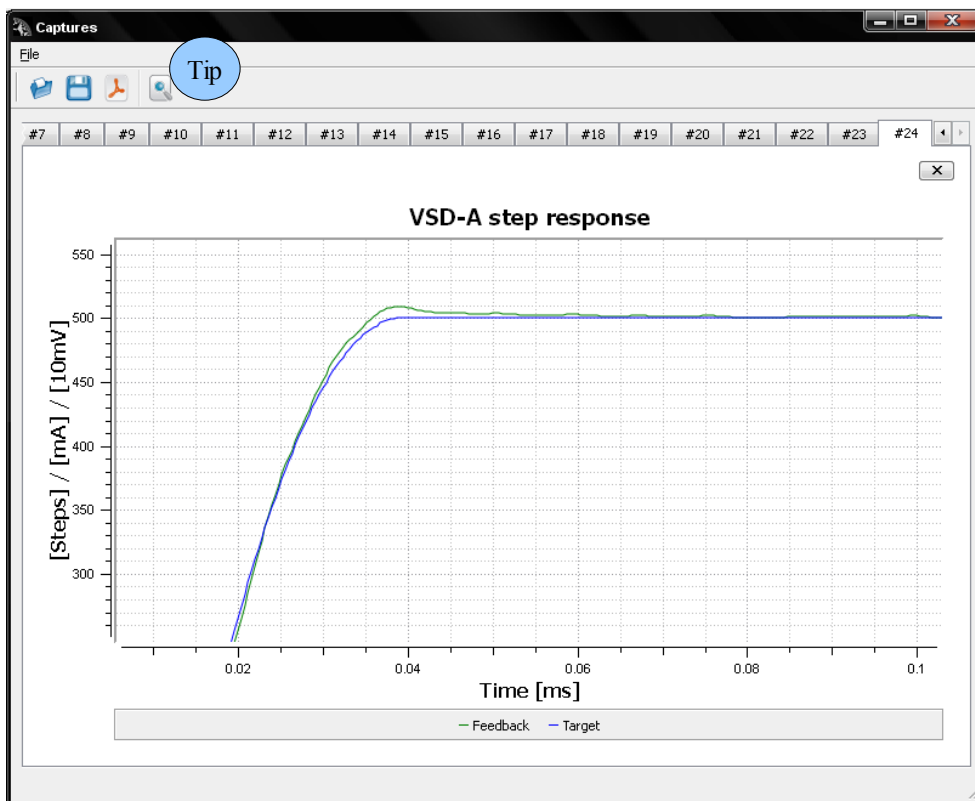
9. **Increase D gain** until you start getting little bit unstable response. **Too high D** causes high frequency oscillation that may be easily heard (see picture). **Remember** to press Set values button after each time you change values
10. **Decrease D** gain until you start getting smooth response again.
11. Start **increasing P gain** and stop when oscillation or overshoot starts appearing.
12. **Reduce P** to get nice response.
13. Start **adjusting I** just like you did with D and P

By result of this procedure, you should have nicely behaving and stiff servo operation. If you are getting noisy motor dithering (position hunting) or other undesirable effects, you may reduce all values in PID to get smoother operation.

After configuration is complete, **save active settings** to drive using **Device** menu.



Tip: you may use **Zoom** tool to check more accurately some parts of response plot

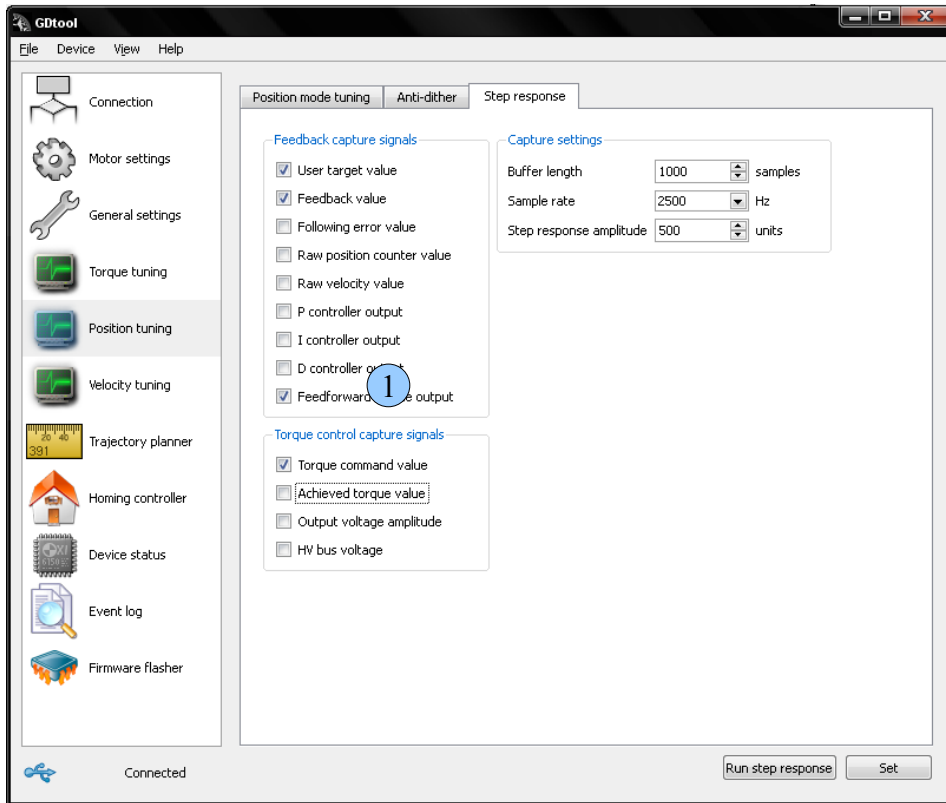


## Advanced position tuning: feedforwards

By using **feedforward** (FF) controls, you can further improve servo performance and reduce following error. It is recommended to return in this chapter after you have everything running nicely and tested to work as expected.

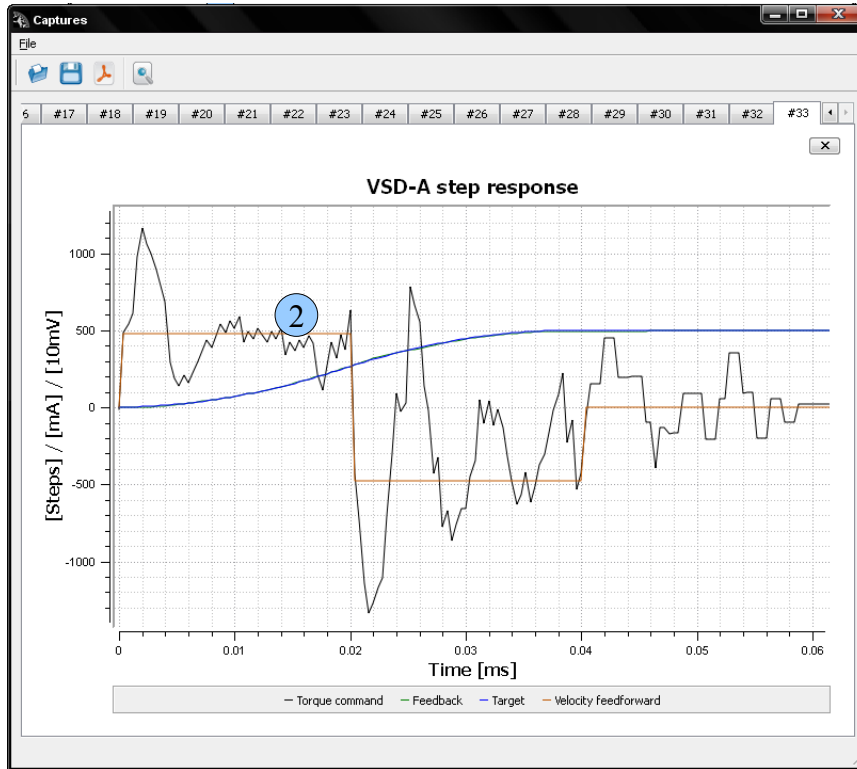
Feedforwards are used to compensate system mass or inertia (acceleration FF) and friction (velocity FF) before they start forming any following error that PID compensates.

1. Enable **Feedforward torque** output and **Torque command** scope signals from step response page





2. **Adjust acceleration feedforward gain** (in Position mode tuning page) until you get a plot where torque command (black) is roughly at same level with feedforward output (orange). In the example picture, orange line is crossing the torque output value which represents a correctly configured acceleration FF.

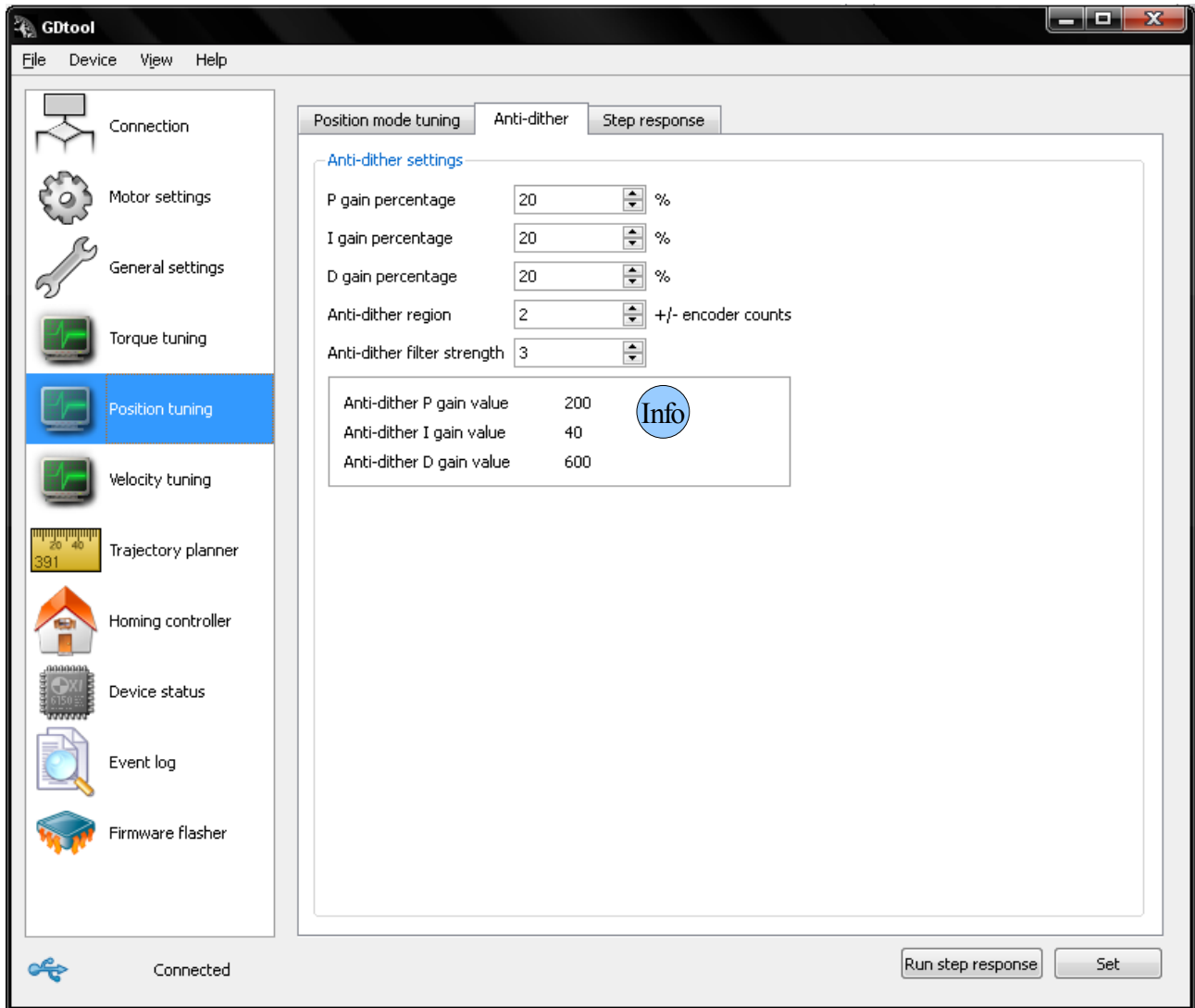


In most cases, acceleration FF has the most significant effect on FF performance. In systems, where significant amount of friction is present, then adjusting also **velocity FF** is recommended. For velocity FF, follow the previous rules (try to adjust it so that FF and torque plots match as well as possible).

After configuration is complete, **save active settings** to drive using the **Device** menu.

## Advanced position tuning: anti-dither

Anti-dither settings allow you set different PID-loop parameters when the encoder value reaches target region. Anti-dither PID gains can be tuned as percent values of position loop PID value. Anti-dither region sets the region where anti-dither gains are active. Anti-dither filter strength sets the D-gain low-pass filter strength. Anti-dither PID-loop effective values are shown in info box.



## ***Advanced motor settings***

Here are available motor setting options explained in same order they exists on motor configuration page

### **Motor type**

Choose motor type. 3 phase brushless motor (AC) or direct current (DC) motor.

### **Motor pole count (AC only)**

This is the number of magnetic poles in AC servo rotor.

### **AC phasing current (AC only)**

This is the current that is driven to AC servo windings at power-up to align rotor. This has no effect in DC servo mode.

### **Max peak current**

Maximum peak current output value [mA]. This is DC or peak of sine wave value.

### **Max continuous current**

Maximum continuous current value [mA]. This is DC or peak of sine wave value.

### **Current fault limit**

Sets drive fault current limit. If limit is exceeded drive goes to fault state. Should be 1000 to 2000 mA grater than peak current.

### **Encoder resolution (counts per revolution)**

Sets encoder resolution value to match your motors encoder. This is number of encoder counts in with 4X decoding, so CPR equals 4 times the encoder line or pulse count.

### **Invert encoder direction**

Inverts encoder counting direction. Use encoder inversion if you are getting follow errors without any stability

### **Disable high frequency deadtime correction**

This disables power stage deadtime distortion compensation at high output frequencies.

May reduce motor heating with some motors. If unsure, leave this unchecked.

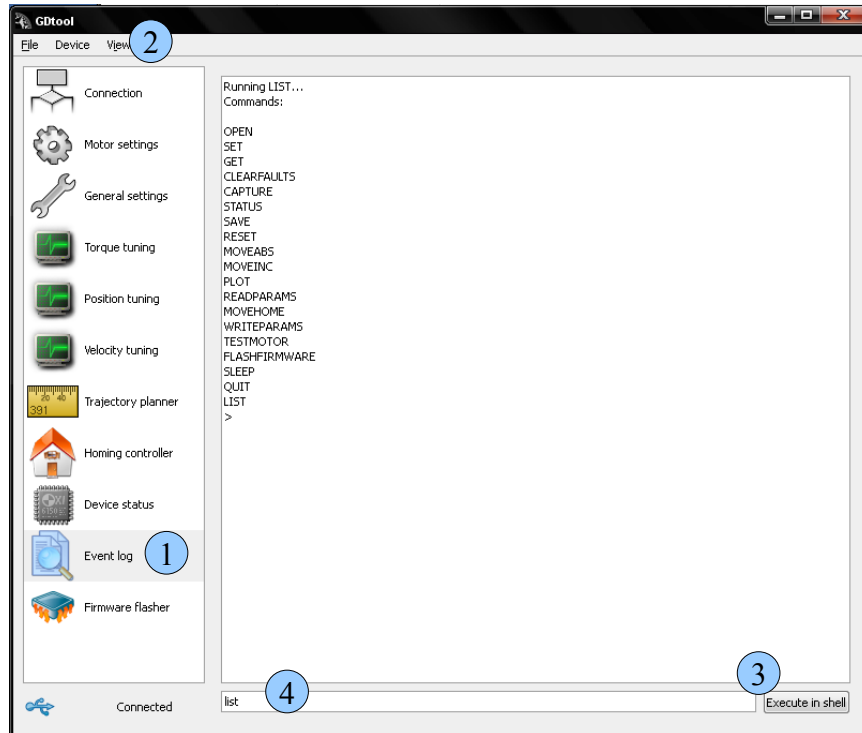
### **Disable low frequency deadtime correction**

This disables power stage deadtime distortion compensation at low output frequencies.

**Note:** checking this may reduce motor position mode stiffness. If unsure, leave this unchecked.

## Testing position mode by using GDtool 2.0 shell

1. Choose event log page
2. Clear log window by using menu View->Log->Clear
3. Execute **list** command by pressing **Execute in shell** button. All available commands should be listed into log window.

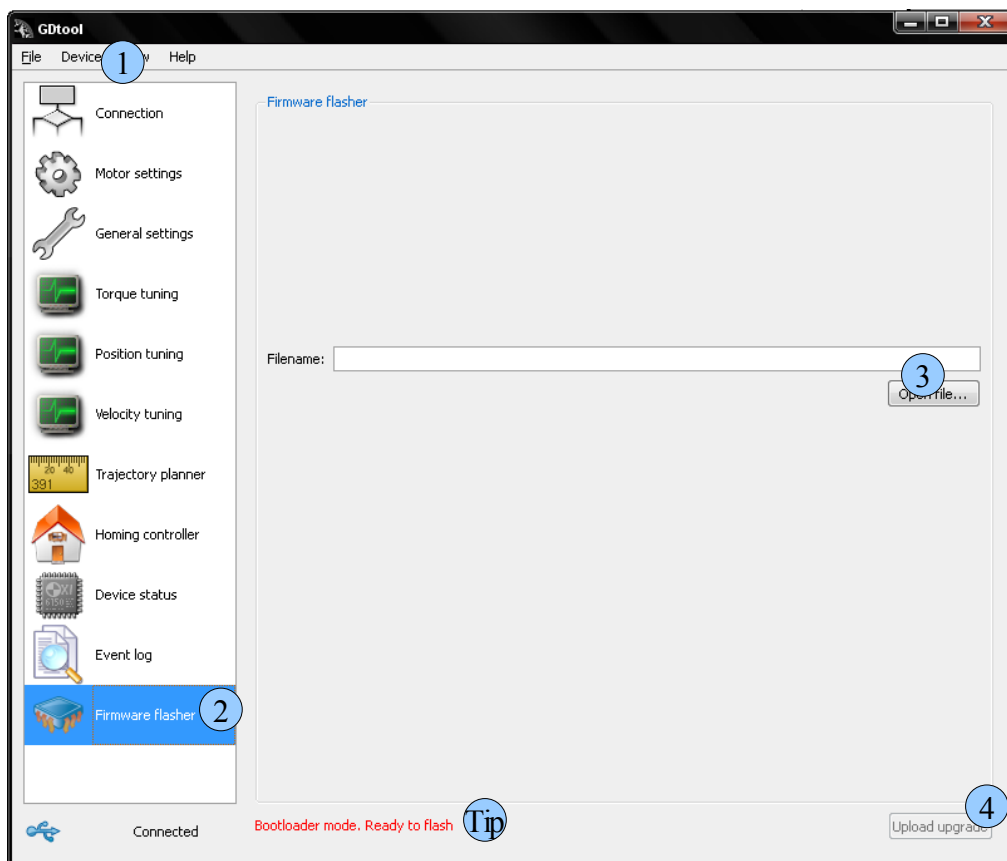


4. Remove list command and type **moveabs 1000** and press Execute in shell button. Motor shaft should turn 1000 encoder counts after button click. If you want to make incremental movement type **moveinc yy** to move incrementally yy encoder counts. Negative values changes the movement direction.
5. You should **not** need to use other commands available in log window

## Upgrading firmware

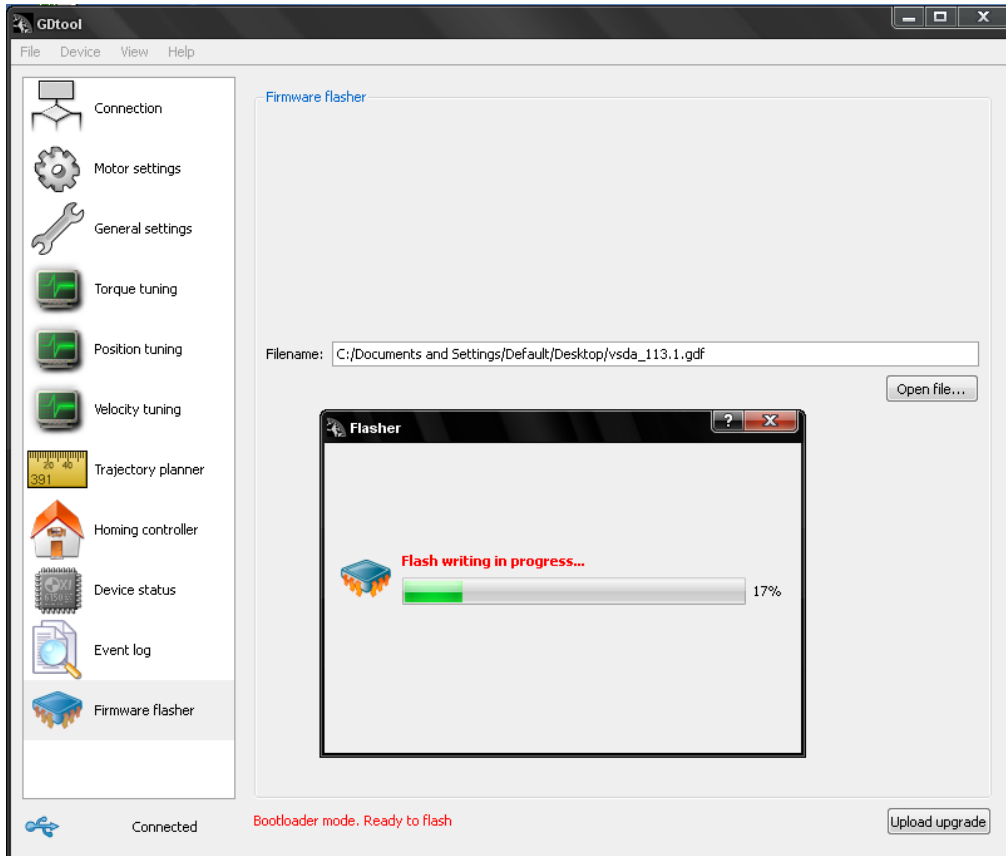
Start drive with CLR jumper set (Described in VSD-A data sheet)

1. Connect to drive (Described in chapter *Connecting to drive*).
2. Select Firmware flasher page
3. Select firmware file. Latest firmware can be found from homepage ([www.granitedevices.fi](http://www.granitedevices.fi))
4. Press upload upgrade button to start firmware upgrade



Tip: Information on bottom page informs that drive is in bootloader mode

Wait until flashing is finished. Do **NOT** remove power from drive while upgrading or the won't be operating normally.



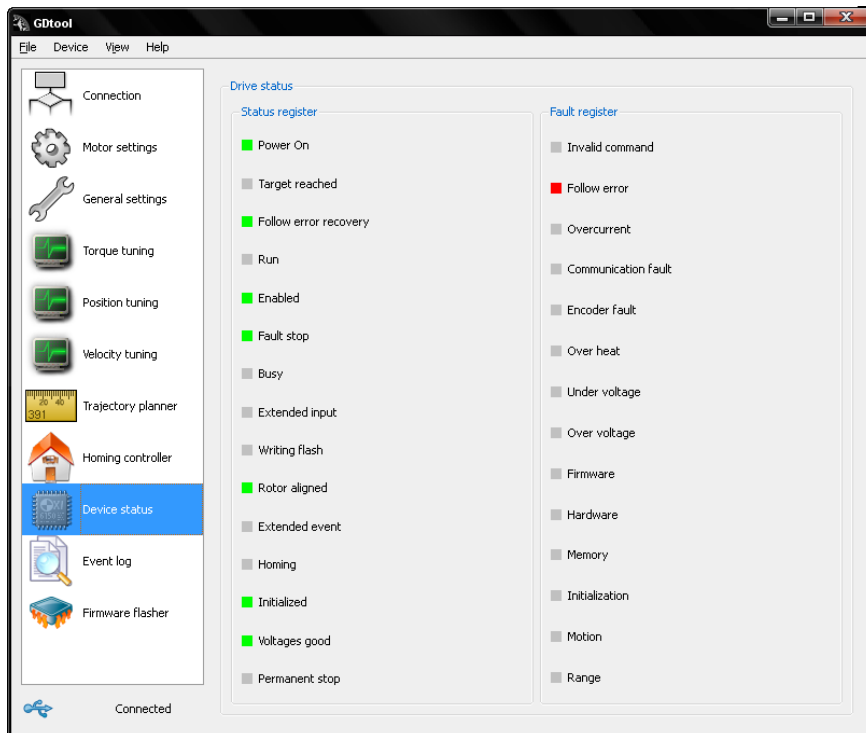
After flashing finished press close button, switch power off and remove jumper.  
Note that after flashing all drive parameters are reset to firmware defaults. You can save and load settings using file menu.



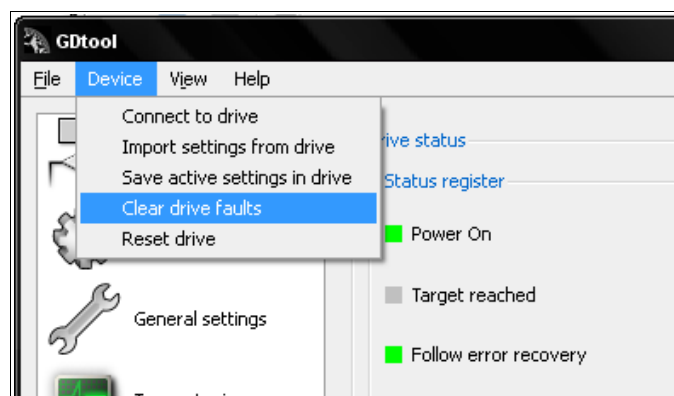
## Troubleshooting

When drive red led start to blink you can check the error reason from device status page.

In this case it is follow error which occurs when encoder value differs too much from target value. **Follow error** limit value needs to be increased or **PID gains** adjusted in **Position tuning page**. This is also typical if **encoder inversion** is incorrectly set in **Motor settings** page.



To recover from error state to normal state use **Clear drive faults** or Reset drive from **device** menu



Questions, troubles? Please, feel free to contact [support@granitedevices.fi](mailto:support@granitedevices.fi)