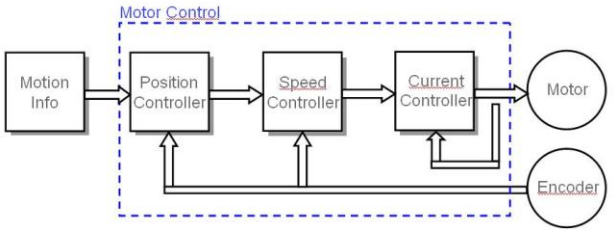
Tuning / Parameter Setting

Auto Tuning

Why Auto Tuning?



?

All 3 control loops have to be adjusted for a proper operation of the servo system.

The adjustment depends mainly on:
a. Motor and Drive-combination
b. Design of the mechanical system
c. Mechanical load in comparison with the inertia of the motor requested dynamic (inertia mismatch)

The settings can be done manually from experts, an Autotuning guarantees a proper setting of all relevant control loop parameters without expert knowledge

Auto Tuning is core function for Simplicity and Customer Satisfaction

Tuning / Parameter Setting

Auto Tuning

Target of Auto Tuning:

- **Automated procedure** for setting the control parameter
  KPp, KFPp, KPn, TNn, TAUnref, TAUiref
- **Automated procedure** for setting additional filters
  Posicast (overshoot damping) and Notch (mechanical resonances)
- Support mechanical system with friction and constant load
  (Z-axis)
- Under all conditions, this parameter setting has to ensure a
  stable system behaviour

Tuning / Parameter Setting

Auto Tuning

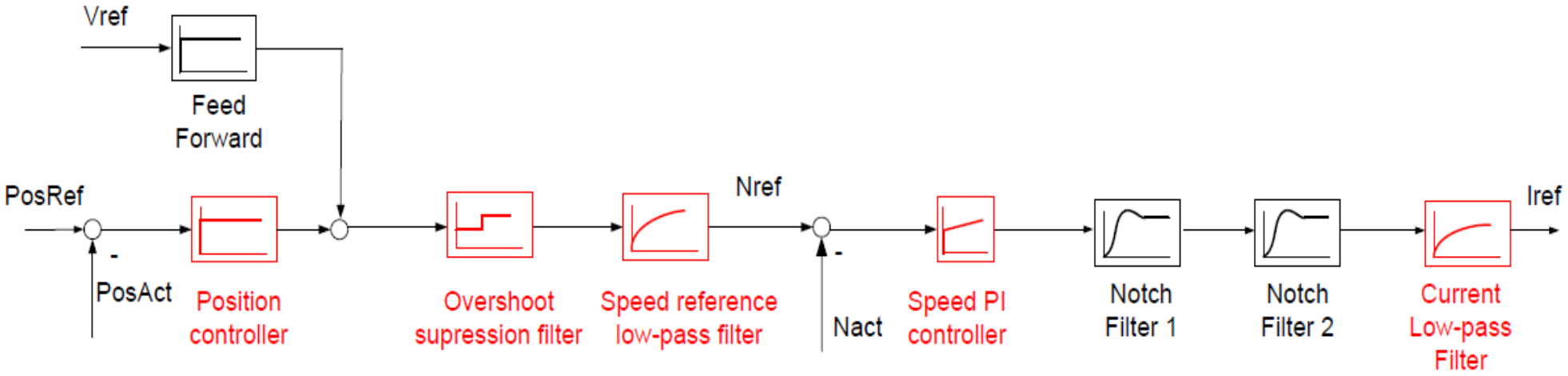
Procedure of Auto Tuning:

- Determine mechanical resonance frequency and setting of the integrated filter for vibration suppression
- Determine friction and constant load by means of constant movements
- Determine inertia by means of acceleration
-
- Calculate optimal speed and position loop parameter (no current loop)
- Test parameter for stability
- Increase parameter values, evaluation of the result

Tuning / Parameter Setting

Auto Tuning

Controllers structure in view of Autotuning Lexium32



Tuning / Parameter Setting

Auto Tuning

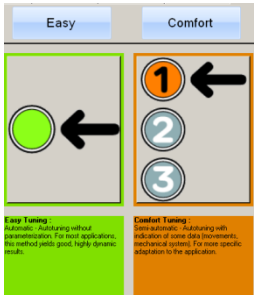
Autotuning can be executed with:

Internal HMI

Easy Tuning

External HMI

Easy/Comfort Tuning



Commissioning tool

Easy/Comfort Tuning

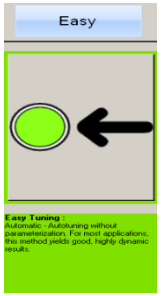
Tuning / Parameter Setting

Auto Tuning / Easy

Easy Tuning

Internal HMI

External HMI



Commissioning tool

Easy tuning with just one button

Can be performed from the internal HMI,external key pad and commissioning tool.
Fitting for main applications in uncritical conditions (e.g.pick and place)
No knowledge about drives and servo technology necessary. A very basic knowledge on mechanics necessary

Set up one parameter:Direction to protect the mechanic

Global gain can be used.

Tuning / Parameter Setting

Auto Tuning / Comfort

Comfort Tuning

External HMI

Commissioning tool

Comfort tuning with mechanical settings

Performed with the external HMI or commissioning tool

Control loop parameters depend on settings for the mechanical system

Two more parameters can be adjusted: mechanical coupling and the movement speed.
Best in class results can be achieved
Global gain can be used

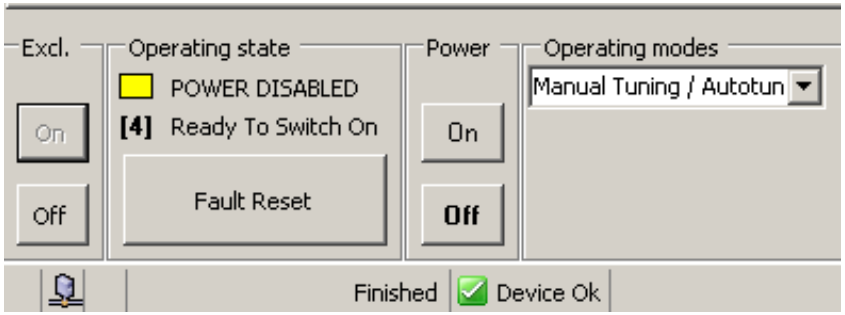
Results are very hard to beat even for real experts!

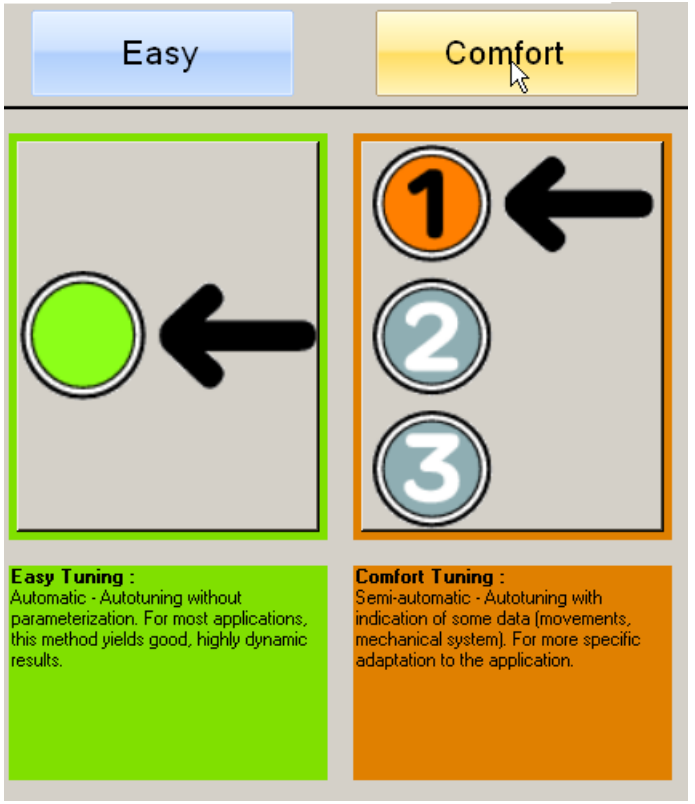
Tuning / Parameter Setting

Auto Tuning/ Comfort

Set Exclusive access „on“.

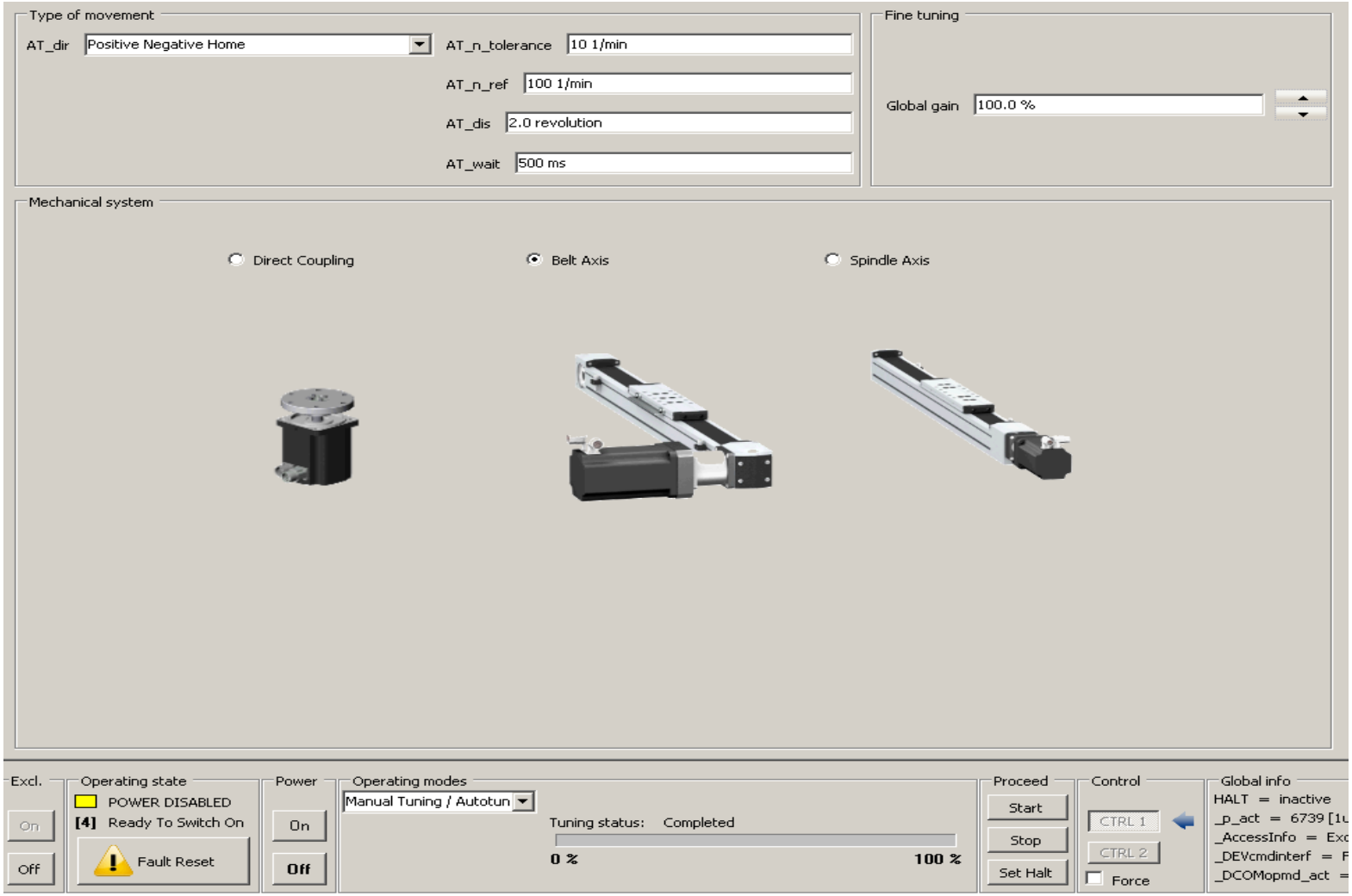
Switch to the operating mode Manual/Autotuning and start the Comfort Tuning





Tuning / Parameter Setting

Auto Tuning / Comfort



Tuning / Parameter Setting

Auto Tuning / Comfort

Parameter	Info	Setting	description
AT_state	x		Autotuning status (auto_tune_err/end/process)
AT_dis		x	Movement range autotuning
AT_dir		x	Direction of rotation autotuning (e.g. pos-neg-home)
AT_n_ref		x	Speed jump for motor starting
AT_gain		x	Adapting controller parameters (tighter/looser)
AT_n_tol		X	Revolution tolerance by parameter definition
AT_mechanics		X	System coupling type (e.g. direct coupling, medium, soft)

Tuning / Parameter Setting

Auto Tuning /Comfort

“AT_dis” Movement range auto tuning

Range in which the automatic optimisation processes of the controller parameters are run. The range is input relative to the current position.

Caution with “movement in only one direction “parameter AT_dir”, it corresponds to the actual movement of a multiple of this specified range. It is used for every optimisation step of the Auto Tuning.

Tuning / Parameter Setting

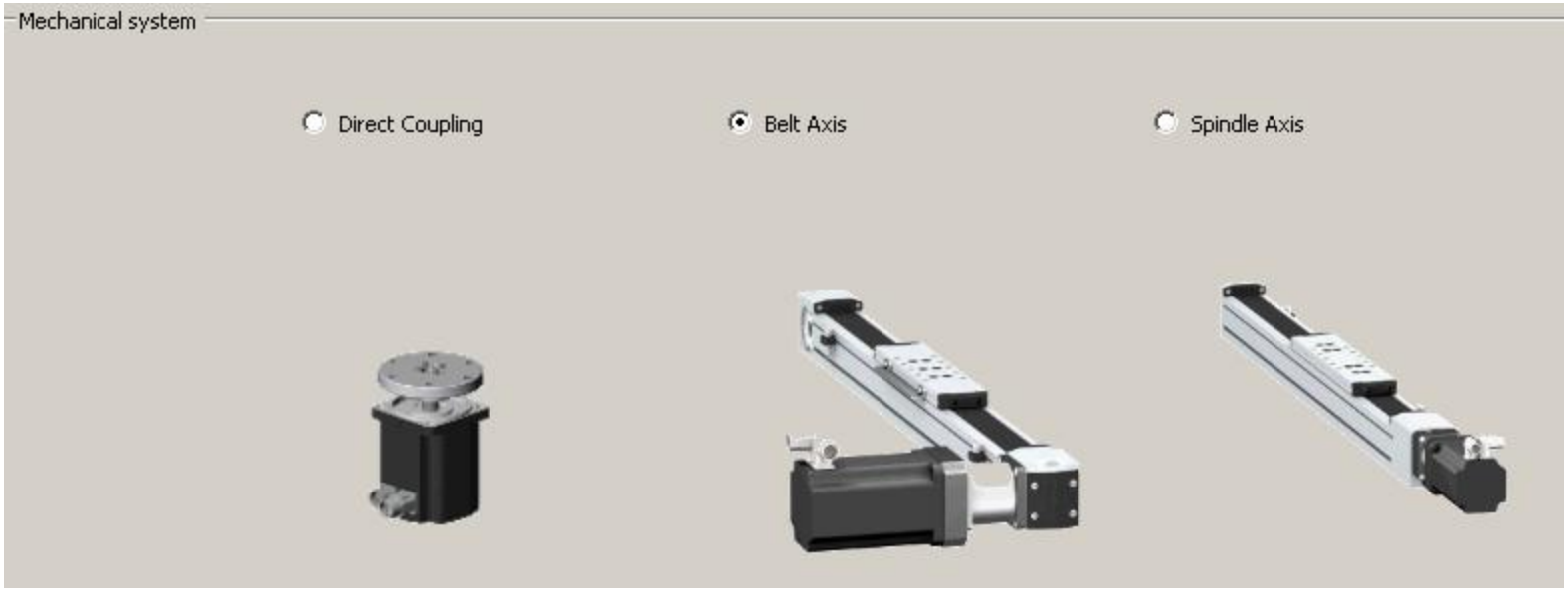
Auto Tuning /Comfort

Option	**AT_dir**	Information
1	+/-	**Pos-neg-home:** First positive direction, then negative direction with return to initial position
2	-/+	**Neg-pos-home:** First negative direction, then positive direction with return to initial position
3	+ with return to initial position	**Pos-home:** Only positive direction with return to initial position
4	+ without return to initial position	**Rotary_axis_Pos:** Only positive direction without return to initial position
5	- with return to initial position	**Neg-home:** Only negative direction with return to initial position
6	- without return to initial position	**Rotary_axis_Neg**: Only negative direction without return to initial position

Tuning / Parameter Setting

Auto Tuning /Comfort

AT_Mechanics :System coupling type:

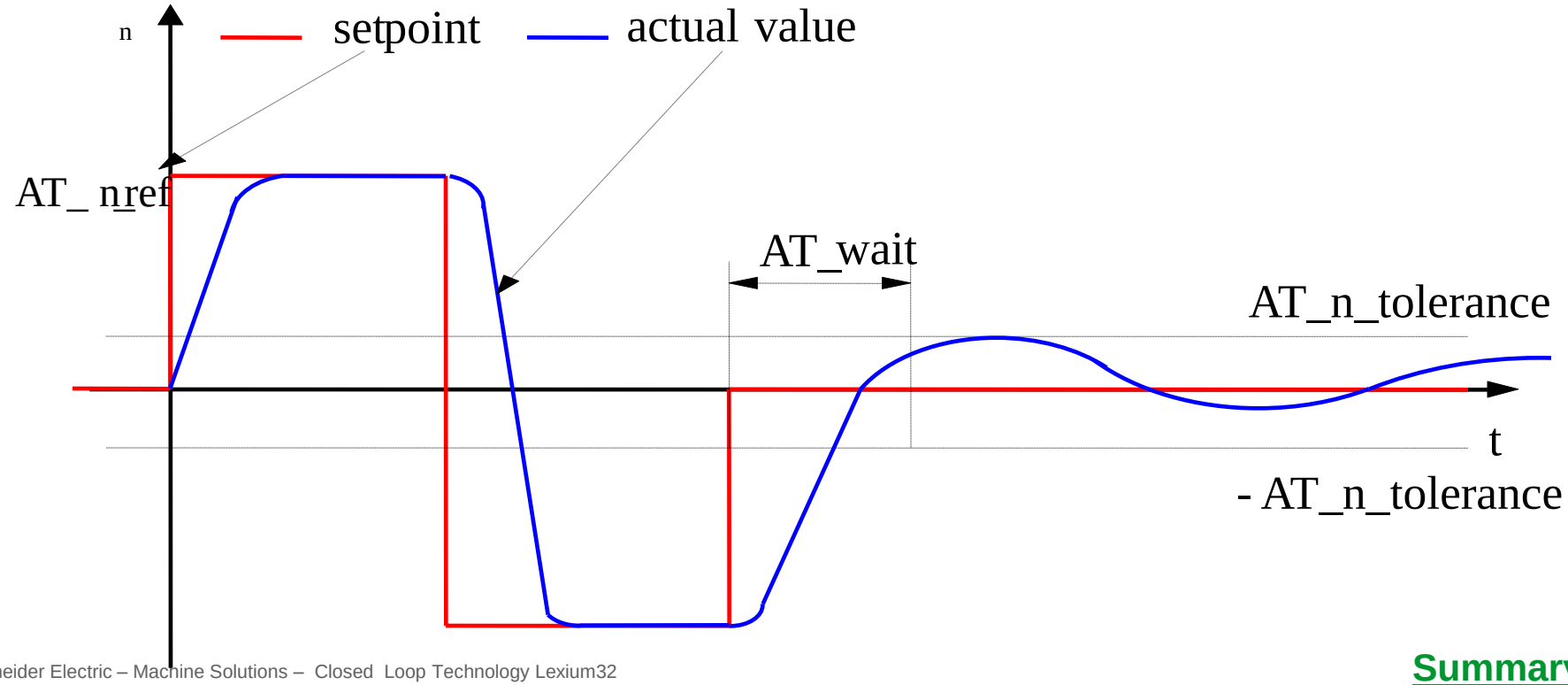


Tuning / Parameter Setting

Auto Tuning / Comfort

“AT_n_ref”, “AT_n_tolerance”:

To find the optimal controller settings, auto tuning starts a speed jump **(AT_n_ref)** and check the actual speed **(n_act)** performance. Afterwards the actual speed has to be in the rotation window **(AT_n_tolerance).**



Tuning / Parameter Setting

Auto Tuning/Comfort

Ctrl_Globgain: increase or reduce the stiffness

After the auto tuning is finished, it is possible to optimize the controller parameter with the parameter **Ctrl_Globgain**. In the same way as auto tuning, the parameter **Ctrl1_KPn, Ctrl1_TNn, Ctrl1_TAU_nref and Ctrl1_KPp** are synchronous changed.

The value 100 represents the theoretical optimum.

Value larger than 100 mean that the regulation is tighter and smaller values mean that the regulation is looser.

Tuning / Parameter Setting

Auto Tuning

Demonstration Autotuning

Linear axis PAS42

BSH1002

No gear, direct coupling

- JMotor= 2,3 Kgcm2
- Jextern (Load 3,75Kg): 38,1 Kgcm2
- Inertia mismatch =16,6 !