Jetter
AKTIENGESELLSCHAFT

Quickstart

Strategies for Commissioning and Optimization JetMove 600

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Contents — Drawing — Page

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I General

This document provides you with strategies for the commissioning of the digital servo amplifier JetMove 600 and the optimization of its control loops.

These strategies cannot be universally valid. You may have to develop your own strategy, depending the specification of your machine.

However, the sequences that are presented here will help you to understand the basic methodology.

II Parameterization

II.1 Requirements

The manufacturer of the machine must create a hazard analysis for the machine, and is responsible for the machine with regard to functional, mechanical and personnel safety. This applies particularly to the initiation of movements with the aid of commissioning-software functions.
The commissioning of the servo drive with the aid of commissioning-software functions is only permitted in combination with an interlock device according to EN292-1, that operates directly on the drive circuitry.

- **The servo amplifier is installed, and all the necessary electrical connections have been made. See Installations Manual, Chapter II.**
- **The 24V auxiliary supply and the 400V/480V main power supply are switched off.**
- **A personal computer, with the commissioning software installed, is connected.**
- **An interlock device according to EN292-1 is connected.**
- **The controls provide an LOW signal for the ENABLE input of the servo amplifier (Terminal X3/15), i.e. the servo amplifier is disabled.**

II.2 Switch on auxiliary supply

Switch on the 24V auxiliary supply for the servo amplifier.

LED display : **X.XX** (firmware version)
BTB/RTO contact : open

After about 5 seconds :

LED display : **YY.** (amount of current, blinking point for CPU o.k.)
BTB/RTO contact : closed

Switch on personal computer

Start commissioning software

Click on the interface (COM1: or COM2:) that is used for communication with the servo amplifier.

The parameter are transmitted to the PC.

Click on the check box “SW-disable” at bottom right.

NO ENABLE now stands in the AXIS status field.

II.3 Basic parameterization

The servo amplifier remains disabled and the main power supply is switched off.

Set up basic parameters (address, ballast details, line/mains supply voltage etc.):
- Click on the **SETTINGS** button above the picture of the motor
- Alter the fields, if necessary
- Click on **APPLY** and then on **OK**

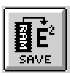
Select motor :
- Click on the **MOTOR** button below the picture of the motor
- Open the motor selection table, by clicking on the arrow in the field **NUMBER-NAME**
- Click on the motor that is connected
- Click on **APPLY**
- Answer the query about the brake
- Answer the query “Save to EEPROM/Reset” with **NO** (the data are in the RAM and will be permanently saved later)

Select feedback (resolver, encoder) :
- Click on the **FEEDBACK** button
- The values that are displayed correspond to the default data that you have loaded for the motor.
- Alter the fields, if necessary
- Click on **APPLY** and then on **OK**

Set up the encoder emulation (ROD, SSI) :
- Click on the **ENCODER CONNECTOR** button
- Select the desired encoder emulation
- Set up the corresponding parameters in the right half of the window
- Click on **APPLY** and then on **OK**

Configure the analog inputs/outputs :
- Clicken on the **I/O ANALOG** button
- Select the desired **SW-FUNCTION**
- Set the scaling relative to 10V for the SW input that is used.
- Set up the required output signals for **MONITOR1** and **MONITOR2**
- Click on **APPLY** and then on **OK**

Configure the digital inputs/outputs :
- Click on the **I/O DIGITAL**button
- Assign the required functions to the digital inputs (left half of window) and enter the auxiliary variable X if it is necessary.
- Assign the required functions to the digital outputs (right half of window) and enter the auxiliary variable X if it is necessary.
- Click on **APPLY** and then on **OK**

Save parameters :
- Click on the 

button
- Answer the query **RESET AMPLIFIER** with **YES**

Click on the check box “SW-disable” at bottom right.
NO ENABLE now stands in the status field for AXIS

If you want to use the position control of the servo amplifier, then you must enter the specific parameters for your drive:

Axis type :
- Click on the **POSITION** button
- Click on the **POSITION DATA** button
- Select the **axis type** (linear or rotary)

Resolution :
- Enter the denominator and numerator for the resolution. Here you adjust the path traversed by the load in positioning units (length unit for linear axes, or °mech. for rotary axes) to match the number of turns of the motor. Only integer entries are permitted.

Example 1: Ratio = $3.\overline{333}$ mm / turn
=> resolution = 10000/3 µm/turn (all other path entries in µm)
or
=> resolution = 10/3 mm/turn (all other path entries in mm)
Example 2: Ratio = 180 °mech./turn
=> resolution = 180/1 °mech./turn (all other path entries in °mech)

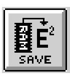
vmax :
- Enter the maximum traversing speed for the load that results from the resolution at the rated speed of the motor. The dimensional unit is derived from the resolution (°mech./sec or length units/sec).

Example 1: resolution = 10000/3 µm/turn, n_{nom} = 3000 turns/min
=> vmax = resolution * n_{nom} = 10000/3 * 3000 µm/min = 10 000 000 µm/min
or
=> vmax = resolution * n_{nom} = 10/3 * 3000 mm/min = 10 000 mm/min
Example 2: resolution = 180 °mech/turn, n_{nom} = 3000 turns/min
=> vmax = resolution * n_{nom} = 180 * 3000 °mech/min = 9000 °mech/s

t_acc/dec_min :
- Enter the time in ms that the drive requires, with the **mechanically permissible** maximum acceleration, to accelerate from zero speed to vmax.

InPosition :
- Enter the window for InPosition. This value is used for the InPosition message. The dimensional unit is derived from the resolution (°mech. or length unit).
  Typical value : e.g. approx. resolution * 1/100 turn
- Clicken on **APPLY** and then on **OK**
- Answer the query “Save to EEPROM/Reset” with **NO** (the data are in the RAM and will be permanently stored later)

max. following error :
- You now see the screen page **POSITION**
- Enter the window for the following error. This value is used for the message FOLLOWING ERROR. The dimensional unit is derived from the resolution (°mech. or length unit).
  Typical value : e.g. approx. resolution * 1/10 turn

Save parameters :
- Click on the 

button
- Answer the query **RESET AMPLIFIER** with **YES**

III Optimization

III.1 Requirements

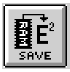
The basic parameterization described in Chapter II is finished.

III.2 Preparation

OPMODE :
Set the OPMODE “1,analog speed”

Setp. function :
Set the analog I/O-function to “0,Xsetp=SW1”

Save the parameters :

- Click on the  button
- Answer the query **RESET AMPLIFIER** with **YES**

SW/SETP.1 :
Short-circuit the setpoint input 1 or apply 0V to it

OSCILLOSCOPE :
Channel1 : n_act Channel2 : I_act

Reversing mode :
Go to the screen page **OSCILLOSCOPE/SERVICE/PARAMETER** and set the parameters for reversing mode to values that are safe for your machine, also when the positioning control loop is switched off (approx. 10% of the final limit speed).

During operation of the service function “Reversing mode” the analog setpoint input is switched off and the internal positioning control is disabled.
Make sure that the individual motion of the selected axis is possible without any hazard.
For safety, only operate the ENABLE signal of the amplifier with an interlock switch, and check the EMERGENCY STOP function for this axis.

III.3 Checking the current controller

If a suitable amplifier-motor combination is used, the current controller will already have a stable setting for almost all applications.

Ipeak :
- Reduce Ipeak to the Irated value for the motor (protection of the motor)

Switch on the **mains/line power.**

Provide the **analog setpoint :**
- Setpoint1 = 0V

Enable the amplifier :
- High signal at Enable input X3/15. In the AXIS status field: **NO SW-EN**
- Click on the SW-Enable check box. **ENABLE** now stands in the AXIS status field.

The motor now stands under speed control, with n=0 rpm. If the current controller is not stable in operation (motor oscillates with a frequency clearly above 100Hz), please contact our applications department.

III.4 Optimizing the speed controller

SETP. -OFFSET:
Leave the amplifier enabled. If the axis is drifting, alter the parameter SW-Offset until it stands still (or use the function AUTO-OFFSET).

SETP. RAMP +/-:
The setpoint ramps are used to smooth the setpoint input (filter effect).
Set the mechanical time constant for the complete system, i.e the rise time for the speed from 0 to n_{cmd}.
As long as the ramps that are set are shorter than the mechanical response time for the complete system, the response speed will not be affected.

LIMIT SPEED:
Set the desired final limit speed.

KP/Tn :
Increase KP until the motor starts to oscillate (audible, and visible on the oscilloscope) and then reduce KP again until the oscillations have **definitely** stopped and stability is assured.
Use the motor-specific default value for Tn .

Start reversing mode :
Start the reversing mode (F8, v1/v2 approx. +/-10% of n_{nom} for the motor).
Observe the speed response on the oscilloscope. If the settings are correct, there must be a **stable step response** in both directions.

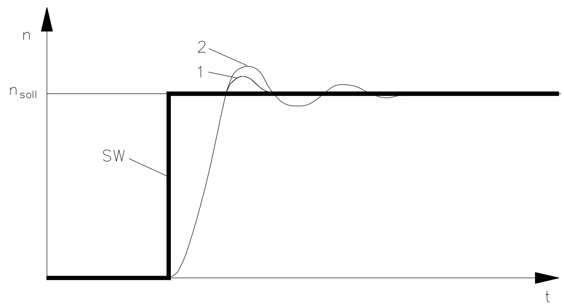


Diagram : Step response

n	= speed
n_{soll}	= set speed
SW	= setpoint
t	= time
1	= optimum
2	= KP too high

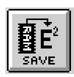
KP :
You can produce a fine tuning of the speed response by cautiously increasing KP.
Aim: the smallest overshoot, but still retaining good damping.
A larger total moment of inertia make it possible to use a larger value for KP.

PID-T2 :
You can dampen out disturbances, such as a small amount of play in the gearing, by increasing PID-T2 to about 1/3 the value of Tn.

FEEDBACK :
You can further improve the smooth runnning by using FEEDBACK, especially for small drives with a low torque.

End reversing mode :
Finish the reversing mode operation (F9).

Set up the correct, motor-specific value for Ipeak (current controller) again. Start up reversing mode again, and observe the step response. If there is any tendency to oscillation, reduce KP slightly.

Save the present parameter set in the EEPROM. Click on the  button.

III.5 Optimizing the position controller

Preparation

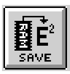
OPMODE :
Select **OPMODE 8**

Position the load in a middle position :
The aim is, to use the CONSTANT SPEED function to move the load to approximately the **middle** of the motion path.
- Click on the **POSITION** button
- Click on the **SETUP MODE** button
- Check that the parameter **v** (CONSTANT SPEED) is set to 1/10 of the preset speed limit vmax. Alter the value if necessary, and click on **APPLY**.
- Start the function **CONSTANT SPEED** by using the function key **F4**.
  Now use **F4** to move the load to approximately the middle of the motion path.
  WARNING :
  If the drive moves in the wrong direction, release the F4 function key and alter the sign of the parameter **v**. Click on **APPLY** and use F4 to move the load to approximately the middle of the motion path.

Set reference point :
- Set the homing type to activate **"0, set reference point"**.
  Start the homing run. The momentary position is set as the reference point.
- Stop the homing run
- Click on the check box "SW-disable" in the amplifier window

Define test motion blocks :
- Click on the **POSITION** button
- Click on the **POSITION DATA** button
- Click on the selection list for the motion tasks, and select task 1.
  Enter the values from the table below, then select task 2 and enter the corresponding values.

	Task 1	**Task 2**
units	SI	SI
type	REL setpoint	REL setpoint
s_cmd	+10% of total path	-10% of total path
v_cmd_source	digital	digital
v_cmd	10% of vmax	10% of vmax
t_acc_tot	10 * t_acc/dec_min	10 * t_acc/dec_min
t_dec_tot	10 * t_acc/dec_min	10 * t_acc/dec_min
ramp	trapeze	trapeze
next motion task	with	with
next number	2	1
acc./dec.	to target position	to target position
start condition	immediately	immediately
APPLY/OK	click	click

Save parameters :
- Click on the  button
- Answer the query **RESET AMPLIFIER** with **YES**

III.5.1 Optimization

The starting of motion tasks with the aid of commissioning-software functions is only permitted in combination with an interlock device according to EN292-1, that operates directly on the drive circuitry.

Start motion task :

- Click on the **POSITION** button
- Click on the **POSITION DATA** button
- Click on **START**, motion task 1 is started and, because of the definition of the motion task sequence, the drive moves in position-controlled reversing operation.

Optimize parameters

PID-T2, FEEDBACK :
The speed controller is not used in OPMODES4, 5 and 8. The position controller includes an integral speed controller, that takes on the preset parameters for PID-T2 and FEEDBACK from the screen page “Speed controller”.

KP, Tn :
If KP is set too low, the position controller tends to oscillate. Use the value for the **optimized** speed controller for KP. Tn should be 2...3 times as large as the Tn value for the optimized speed controller.

KV :
The acceleration behaviour of the motor should be well damped (no tendency to oscillation) with a minimum following error. If KV is larger, the tendency to oscillation increases. If it is smaller the following error increases and the drive becomes too soft. Vary KV until the desired response is achieved.

FF :
The integral component of the control loop is in the position controller, not the speed controller, so no following error results at constant speed (pure proportional control). The following error that arises during acceleration is affected by the FF parameter. This error is smaller if the FF parameter is increased. If increasing FF does not produce any improvement, then you can increase KP a little, to make the speed control loop somewhat stiffer.

If the drive does not run satisfactorily under position control, first look for external causes such as :

- **mechanical play in the transmission chain (limits the KP)**
- **jamming or slip-stick effects**
- **self-resonant frequency of the mechanical system is too low**
- **poor damping, drive is too weakly dimensioned**

before trying to optimize the control loop again.