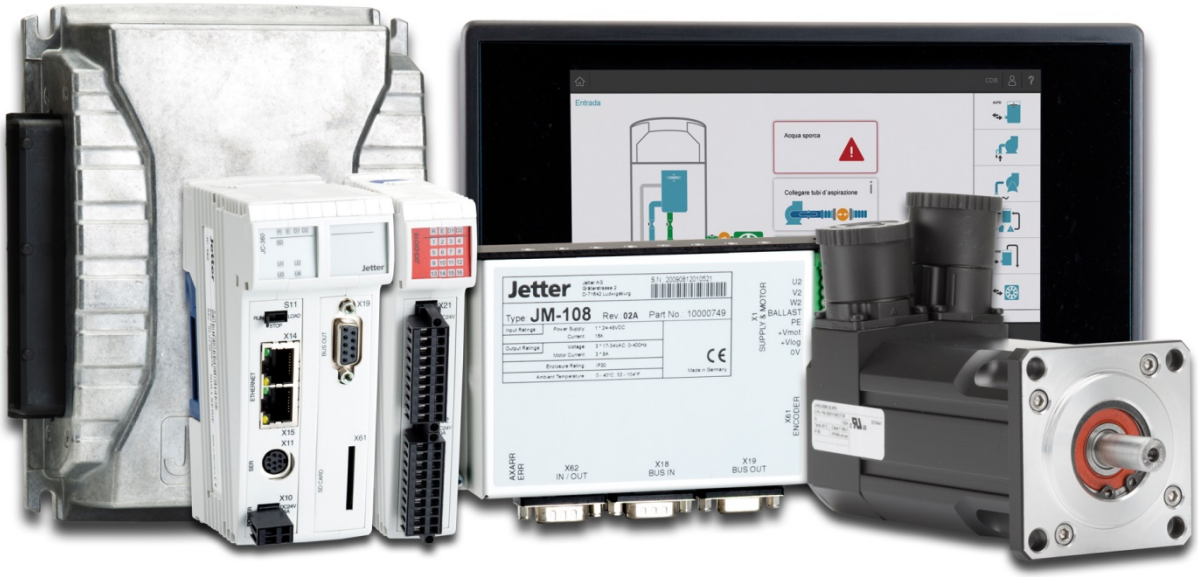
Jetter automation



Motion Control - Filters in a Technology Group

Application Note 053

608 853 44_01

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Table of Contents

1 Introduction

1.1 Prerequisites

- The following versions were used for the code and project examples as well as screen-shots:
  - JetSym 5,601
  - Motion API 1.0.0.16 along with JC365MC-OS 1.30.0.00
  - Motion API 2.0.0.4 along with JC440MC-OS 1.06.0.00
- Application Note 049: Motion Control - Technology Group
- Application Note 050: Motion Control - Electrical Gearbox
- Application Note 052: Motion Control - Cam Definition
- Application Note 056: Motion Control - Using the Cam Disc in a Technology Group

2 Filter function - Introduction

As the name "Filter" suggests, this function causes an input source to be filtered and output.
A typical application for the filter function is the coupling of a follower axis to the actual value of a master axis.

Example
An incremental encoder is connected to a sensor wheel to determine the movement of a workpiece. Even if the workpiece is supposedly at a standstill, the input value on the encoder acquisition is hunting a few increments around a mean value. This encoder is the master axis in the technology group. If the follower axis in the technology group is coupled to this master axis, the hunting of the incremental encoder is now transferred to the follower axis. This is often noticeable by a hissing or crackling in the motor of the follower axis. To avoid this, a filter can be activated which cushions these jumps in the actual value of the master axis.

2.1 Mode of operation

The MC kernel uses a polynomial filter. The internal polynomial coefficients of the filter are determined by the adjustable filter coefficient.

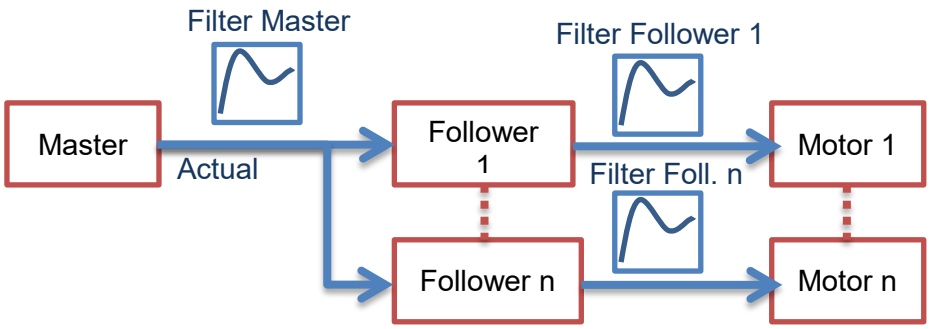
The filter coefficient ranges from 0 … 100%.

- 0 % - filter is inactive
- 100 % - filter has maximum effect

You can think of the filter as the aperture of a camera. At 0%, the aperture is fully open and the image reaches the sensor without any changes. At 100%, the aperture is completely closed and the image does no longer reach the sensor.
For the filter in the technology group, this means that at 100% filter coefficient, no position change will occur and thus the follower axis will stop.

2.1.1 Filter structure

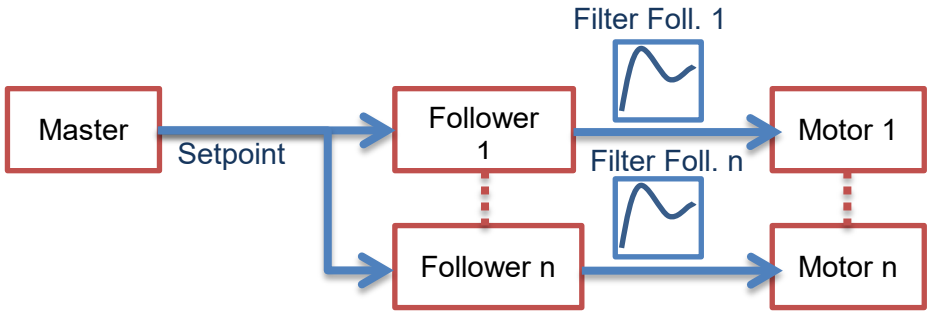
The following filter structure exists within a technology group:



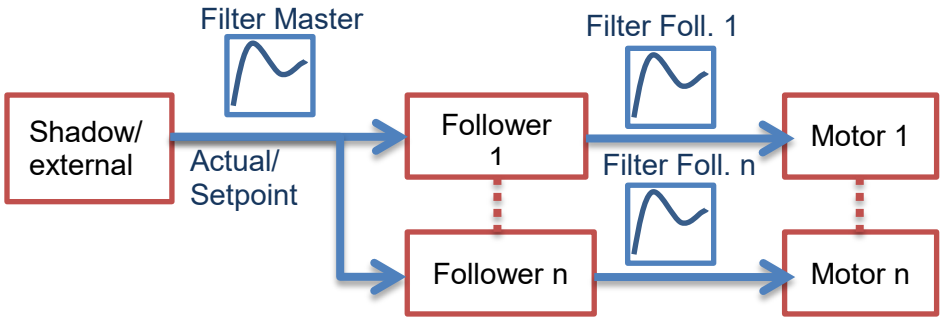
A global filter can be set between the master axis and the follower axes. In addition, a further filter can be activated for each individual follower axis.

2.1.2 Master axis filter

The filter of the master axis is only active for an actual value coupling.
If follower axes are coupled to the setpoint of the master axis, the filter has no effect.



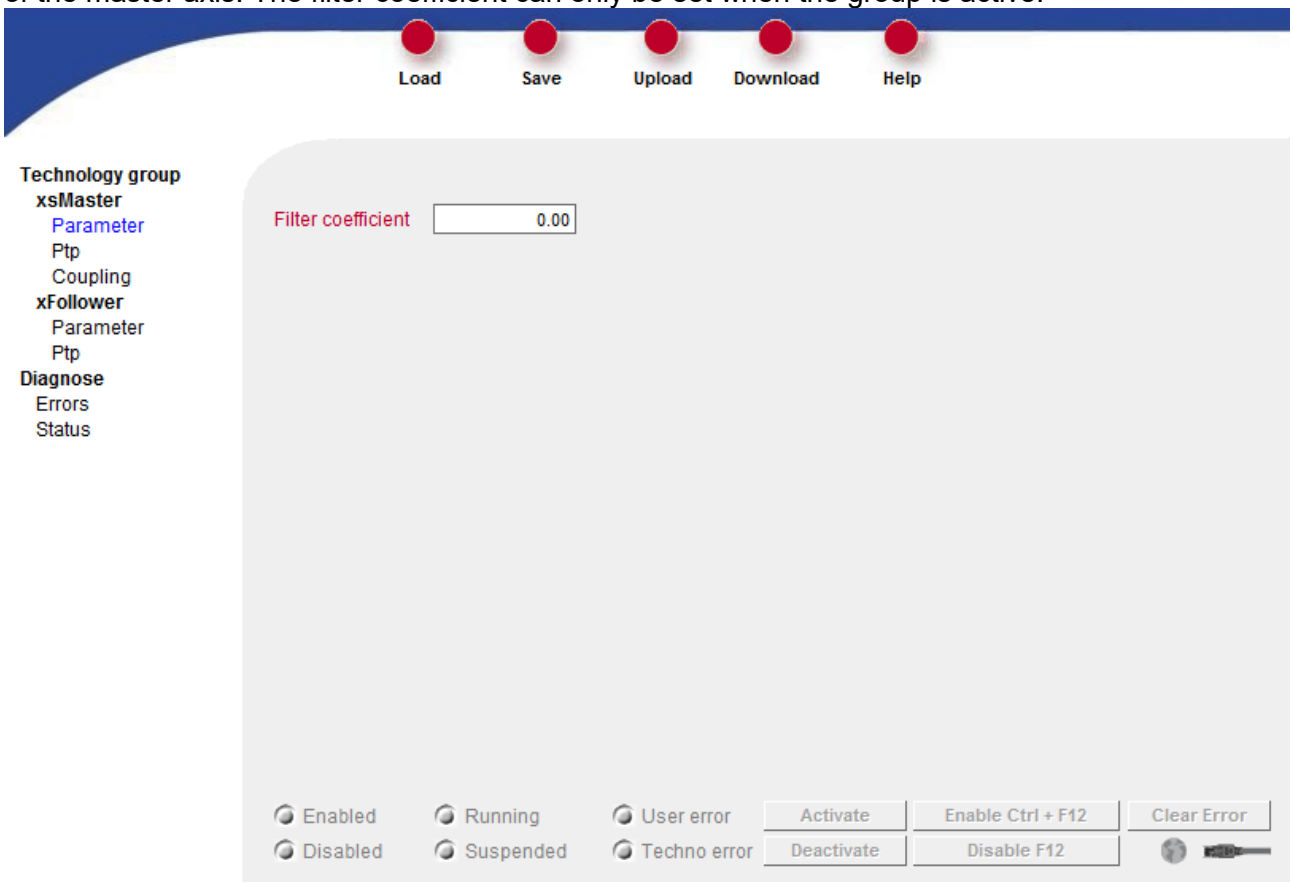
If the master axis is an external axis (encoder wheel etc.) or a shadow axis, the follower axes are automatically coupled via the actual value. In this configuration the filter is effective.



3 Setting the filter in Motion Setup

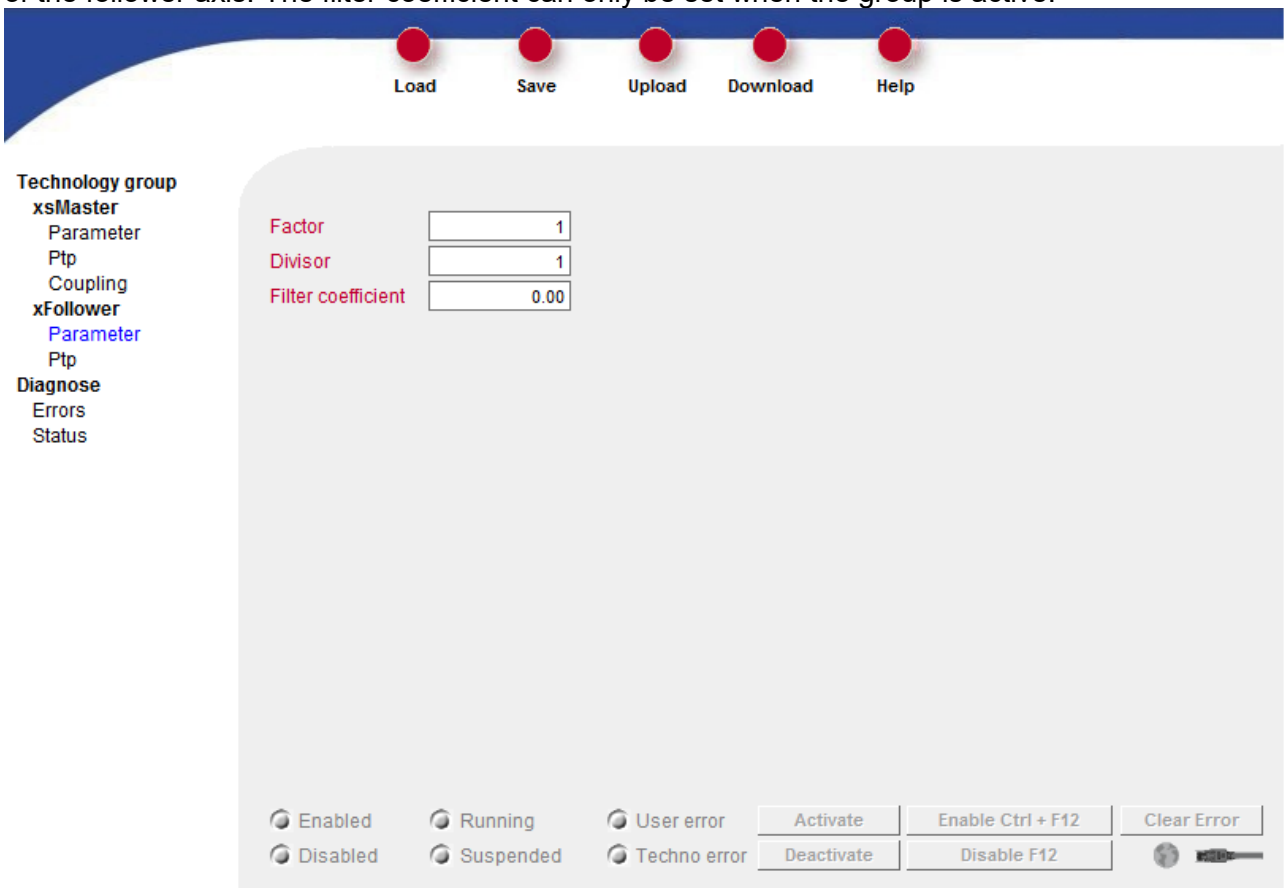
3.1 Master axis filter

In the Motion Setup of the relevant technology group, the filter can be set on the "Parameter" page of the master axis. The filter coefficient can only be set when the group is active.



3.2 Follower axis filter

In the Motion Setup of the relevant technology group, the filter can be set on the "Parameter" page of the follower axis. The filter coefficient can only be set when the group is active.



4 Setting the filter coefficient in the application

If the filter coefficient is to be set in the application program, the commands in MotionAPI are as follows:

- Master axis filter

```
if <Techno>.State.IsEnabled or <Techno>.State.IsRunning or <Techno>.State.IsDisabled then
    <Techno>.Coupling.Filter.SetCoefficient(xMaster, 50.0);
end_if;
```

- Follower axis filter

```
if <Techno>.State.IsEnabled or <Techno>.State.IsRunning or <Techno>.State.IsDisabled then
       <Techno>.Coupling.Filter.SetCoefficient(xFollower, 50.0);
end_if;
```

The entry is made in percent [%].

The filter can only be set in the active technology group when the operating state is "Enabled", "Running" or "Disabled".

4.1 Example

The associated "Filter" project uses a hardware configuration with a virtual axis "xMaster", a shadow axis "xsMaster" with "xMaster" as source, a simulated follower axis "xFollower" and a technology group "tecFilter" with "xsMaster" as master axis and "xFollower" as follower axis in the form of an e-gear axis.

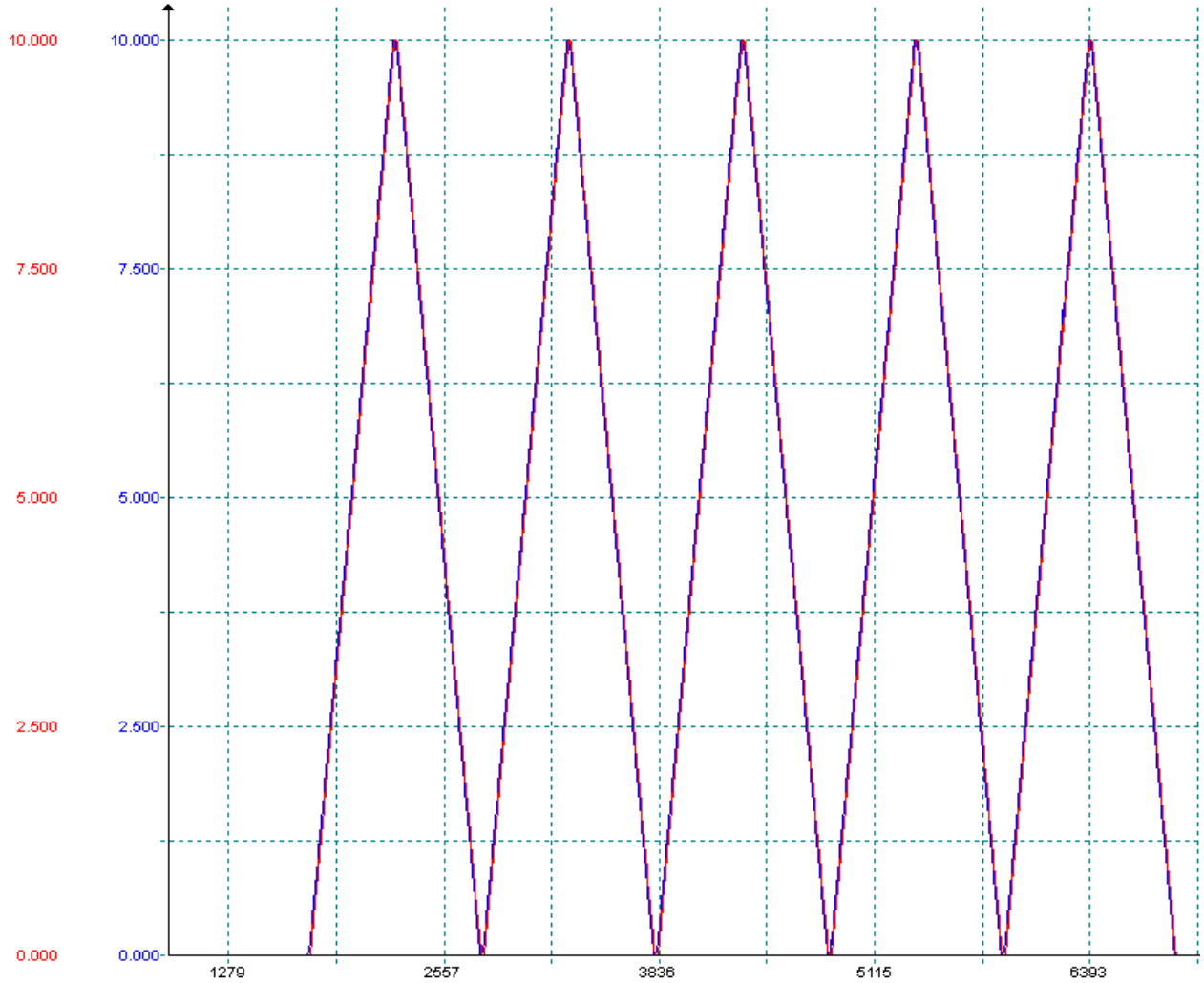
```
task main autorun
var
   nIndex:            int32;
   bRun:              bool;
   dFilterMaster:     double;
   dFilterFollower:   double;
end_var;
   resetTechnoAll();
   resetAxisAll();
   xMaster.Power.Enable();
   when xMaster.State.IsEnabled continue;
   tecFilter.Activate();
   when tecFilter.State.IsDisabled continue;

   tecFilter.Power.Enable();
   when tecFilter.State.IsEnabled continue;
   loop
      bRun := false;
      when bRun continue;
      tecFilter.Coupling.Filter.SetCoefficient(xsMaster, dFilterMaster);
      tecFilter.Coupling.Filter.SetCoefficient(xFollower, dFilterFollower);
      for nIndex := 0 to 4 by 1 do
```

```
        xMaster.MovePtp.Start(AxisPositioningModes.RelTarget, 10, 20, 10000, 10000);
        when xMaster.State.IsEnabled continue;
        xMaster.MovePtp.Start(AxisPositioningModes.RelTarget, -10, 20, 10000, 10000);
        when xMaster.State.IsEnabled continue;
      end_for;
   end_loop;
end_task;
```

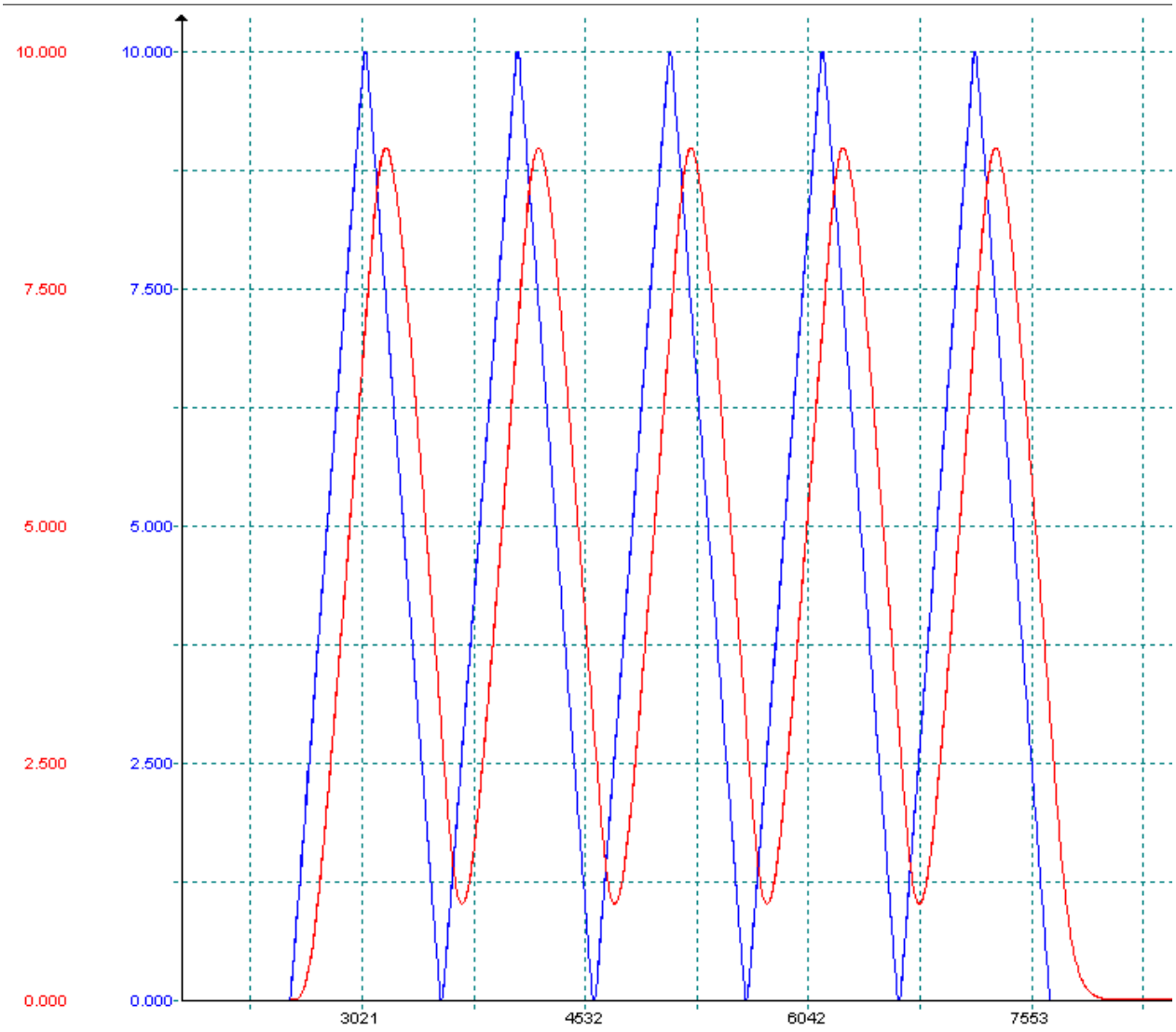
The virtual axis "xMaster" is positioned 5 times in reverse. Due to the configuration "xFollower" follows the movement of this axis.
At the beginning of this motion sequence, the filter for both the master and follower axis is set with "main.dFilterMaster" or "main.dFilterFollower".
The sequence is started with the help of "main.bRun".
Legend to oscillograph curves:
Blue: Set position of "xMaster
Red: Set position of "xFollower

4.1.1 Filter coefficient 0% for master and follower axis



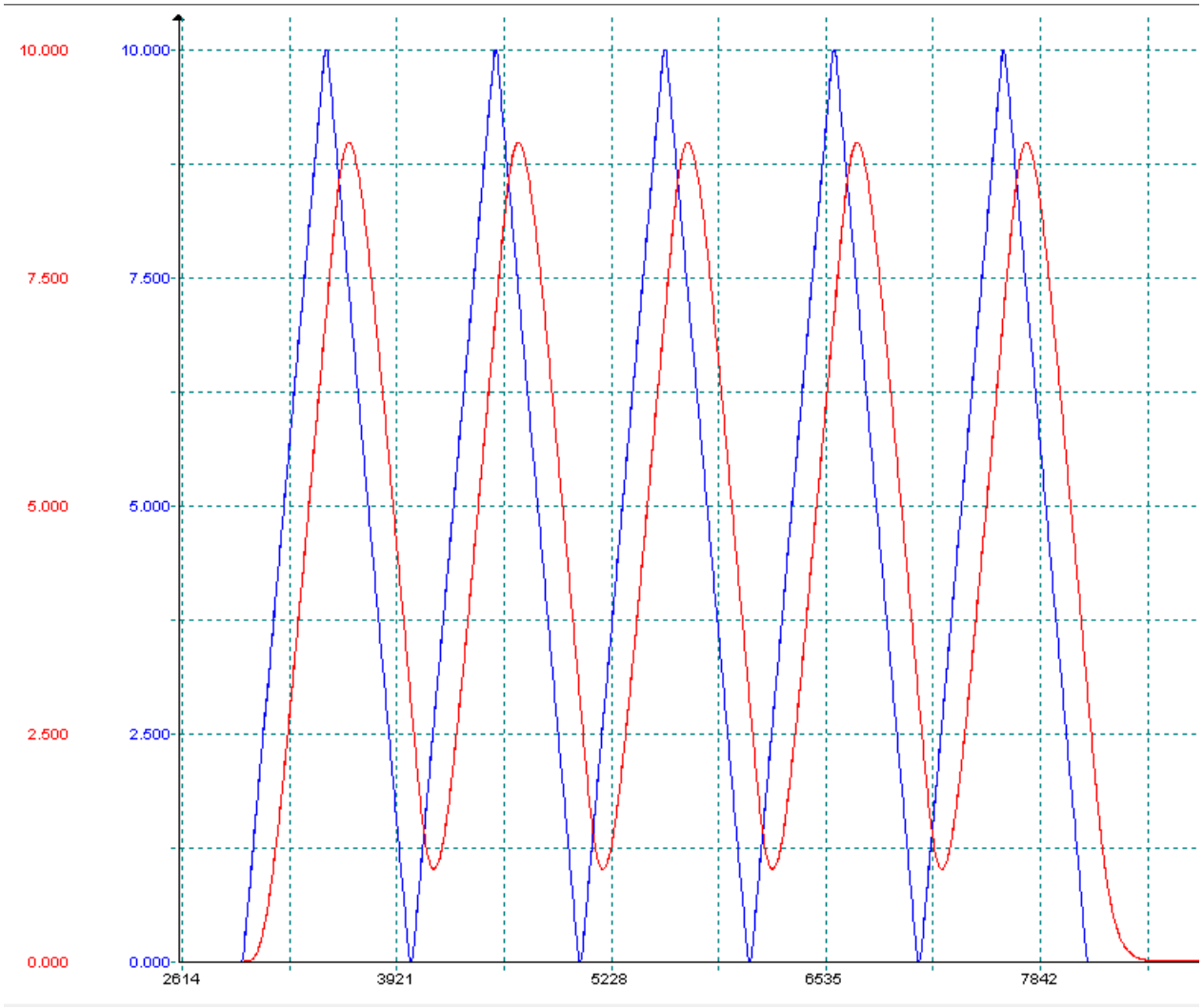
The follower axis follows exactly the movement of the master axis.

4.1.2 Filter coefficient 90% for master axis and 0% for follower axis



The movement of the follower axis is smoothed in relation to the master axis.

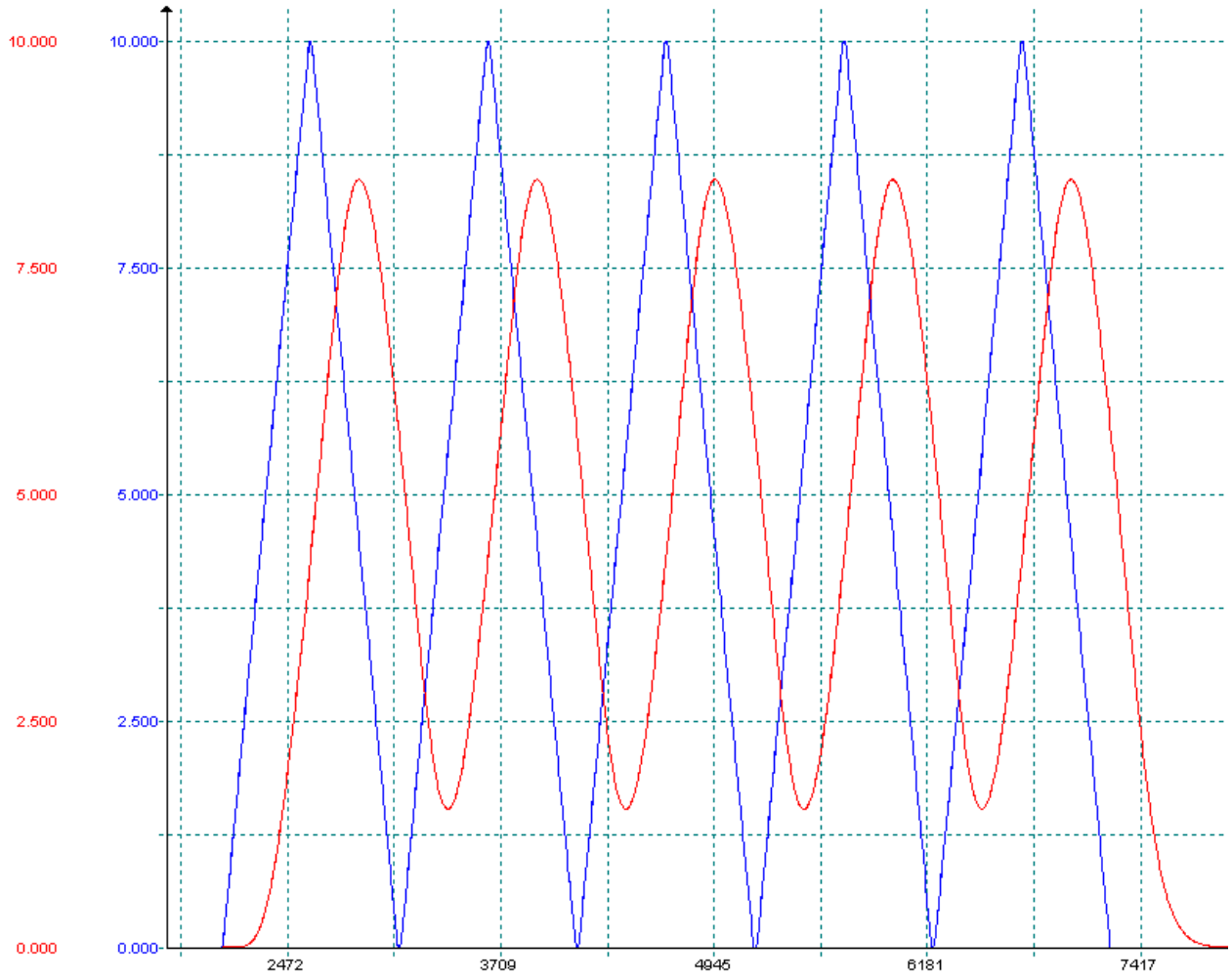
4.1.3 Filter coefficient 0% for master axis and 90% for follower axis



The movement of the follower axis is smoothed in relation to the master axis. Due to the electric gear with a transmission ratio of 1:1, this movement corresponds to the movement in the previous figure.

If the transmission ratio is not equal to 1:1 or if a cam coupling with any profile is set, the effects of the filters in the master and follower axis train are different.

4.1.4 Filter coefficient 90% for master axis and 90% for follower axis



The filters of the master and follower axis now add up, so that the smoothing effect in this example is twice as strong.

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