SIEB & MEYER

SD2S Setup Instructions

HSBLOCK / FPAM Operation

Training documentation

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1 General Information

This document shall help you during initial operation of an SD2S with the drive function "HSBLOCK / FPAM ".

The drive function "HSBLOCK / FPAM " allows easy operation of synchronous high-frequency spindles via block commutation. The following drive functions are available:

- HSBLOCK: Hall sensors for speed and commutation measurement
- FPAM: Sensorless operation via measurement of phase voltage
  - only available for drives with controlled DC link and phase voltage measurement (device variants 0362142xy, 0362143xy, 0362144xy)

1.1 HSBLOCK with Hall Sensors

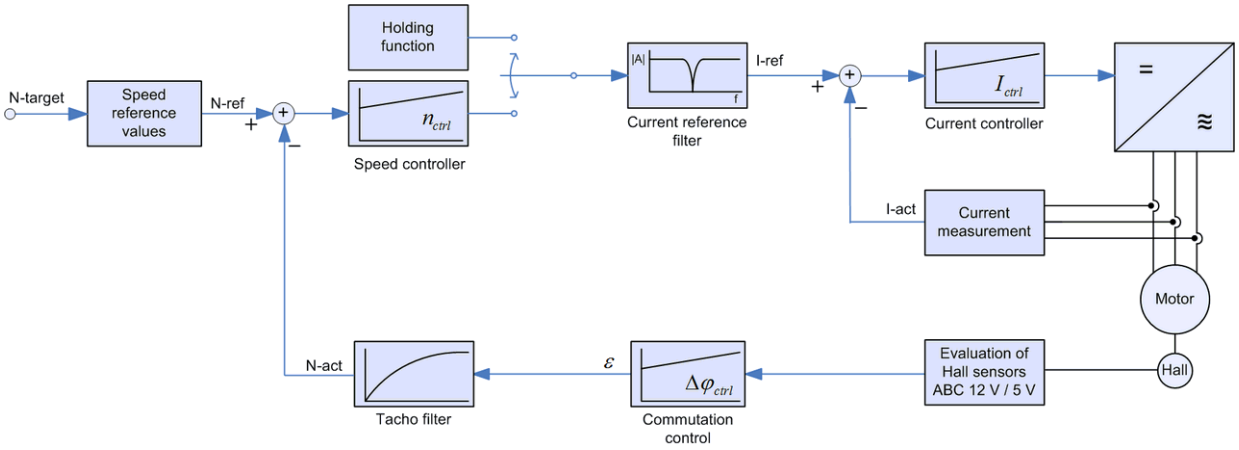


Fig. 1: Structure of the HSBLOCK control with Hall sensor evaluation

1.2 HSBLOCK with Phase Voltage Measurement / FPAM

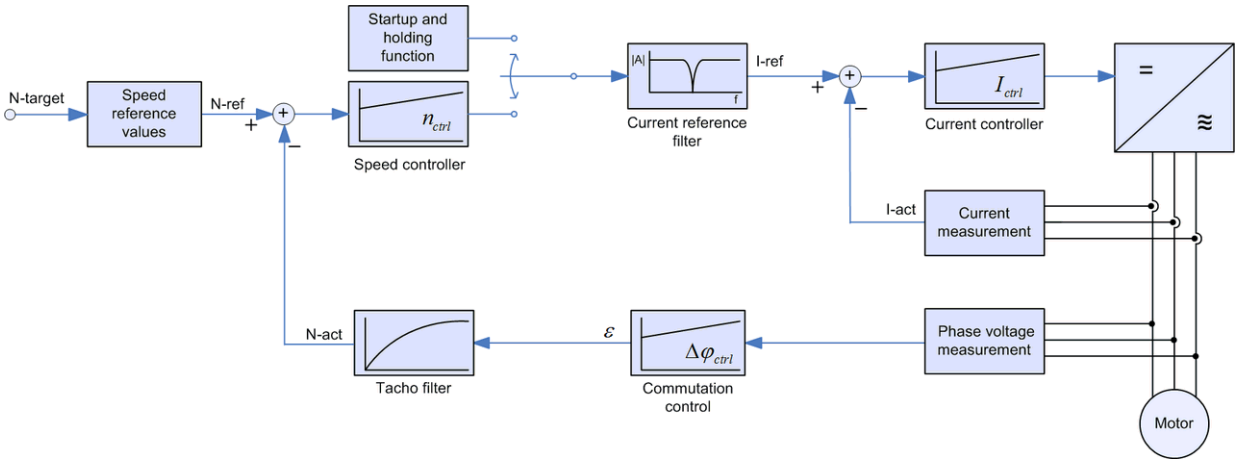


Fig. 2: Structure of the FPAM control

1

2 Device Connection and Software Startup

Read the hardware and software documentation of your device and pay attention to the safety instructions.

2.1 Install Software

➪ Install the latest version of the software *drivemaster2* on your PC.
This is located in the download directory of the SIEB & MEYER web page under www.sieb-meyer.de. (Please use the guest login.)
The drive function FPAM with phase voltage measurement is available in *drivemaster2* version 1.12 Build 040 and higher.

2.2 SD2S Connection and Switch-on

The following connectors must be wired at the least:
- power supply (single-phase/three-phase)
- motor phases (U, V, W, PE)
- OSSD (safety circuit)
  - connection without safety function:
    X10 (0362140xy - 0362143xy): bridge pin 1 and pin 3 to pin 6
    X43 (0362145xy - 0362148xy): bridge pin 1 and pin 3 to pin 5
- communication with PC (e.g. USB port)
- external ballast resistor, if applicable

We recommend also to connect the digital input D-IN2 with a quick stop function.

➪ Switch on the device now.
The device driver has been copied during the software installation. After switch-on the driver for the SD2S is selected automatically by the operating system.
With USB connection the driver installation may take some time. When the driver was installed correctly, the Windows Device Manager displays it as "LibUsb-Win32 SM2 TUSB3410".

2.3 Start Software

➪ Start the software *drivemaster2*.
➪ Select the option "Setup connection to the device" in the start screen and configure the type of communication.
➪ Click on the button "Search devices + connect" to apply your selection.
✓ The connected SD2S is found by the software and appears in the user interface as online device.

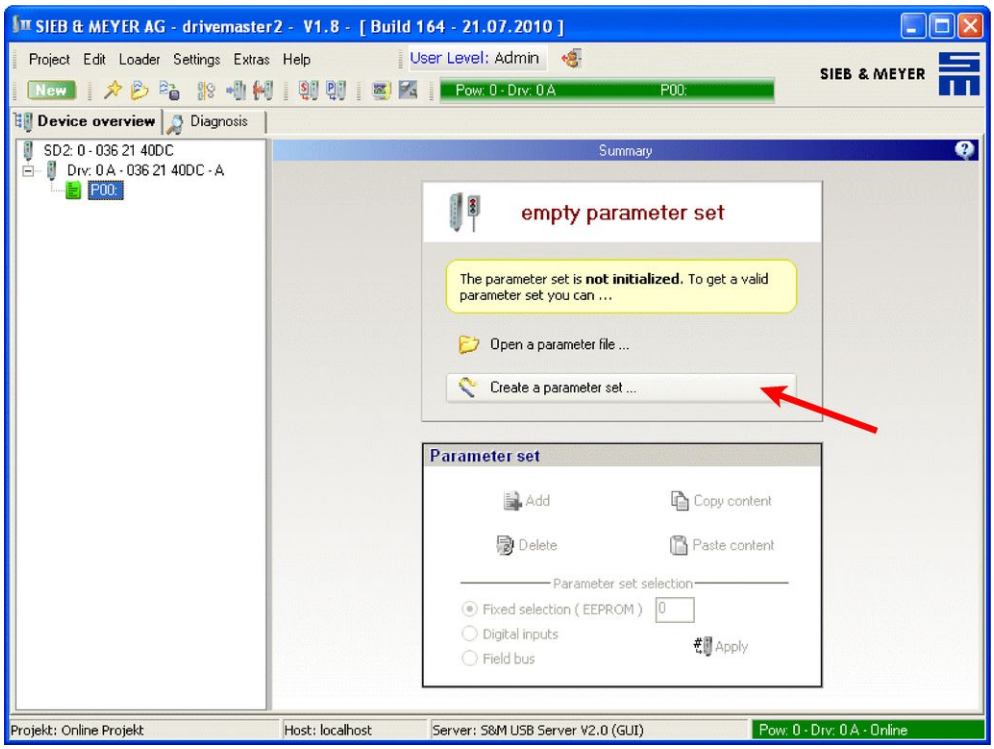
According to the delivery status of the device there are the following possibilities now:
1. The device was delivered with a complete parameter set (incl. controller adjustment).

a) The preset project is uploaded from the device. The device is ready for operation.

2. The device was delivered without parameter set.
   a) The parameter set must be created according to the data sheet of the motor manufacturer. The controller parameters must be set.
   b) An existing parameter set must be written into the device.

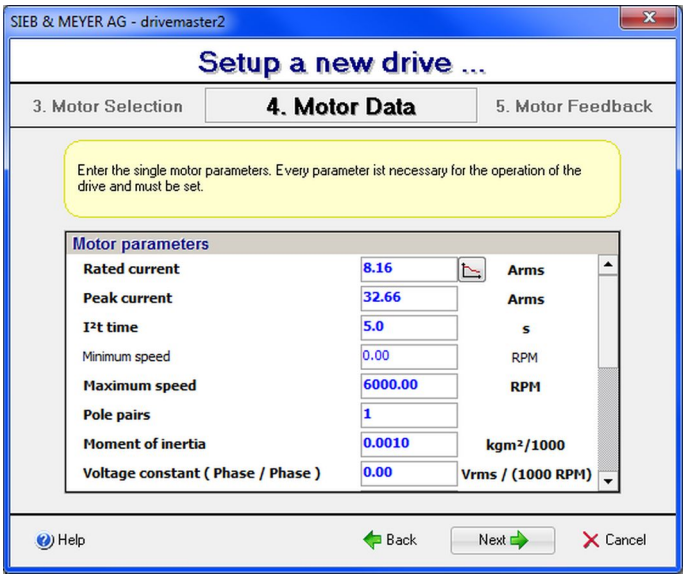
3 Create Parameter Set

If the device was delivered without parameter set, the following window is displayed after the device search.

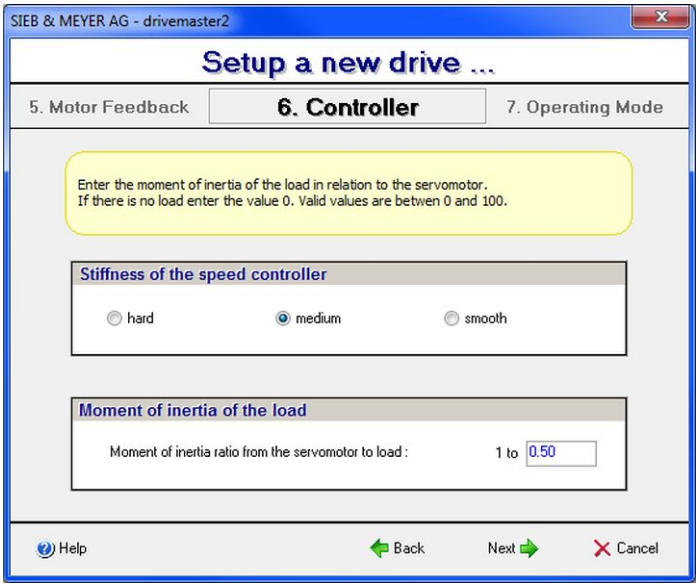


- Click on the button "Create a parameter set ...". A respective wizard will be opened. It takes you step-by-step through the parameter set creation.
- Step 1 – Drive Hardware: The basic drive is recognized automatically by the software.
- Step 2 – Basic Data: Select the drive function "HSBLOCK / FPAM ".
- Step 3 – Motor Selection: Select the option "Edit all motor data" and edit the field "Motor type".

- Step 4 – Motor Data: Enter the motor data from the data sheet provided by the motor manufacturer. The highlighted motor data (in bold) are necessary for parameterization and must be adapted to the connected motor.



- Step 5 – Motor Feedback: For operation with Hall sensors select motor measuring system "Hall ABC 12 V" or Hall ABC 5 V / RS422. For sensorless FPAM operation select "Phase Voltage Measurement".
- Step 6 – Controller: Select the control performance of the speed controller.



  - Stiffness of the speed controller
    hard: highest bandwidth, can tend to vibrating
    medium: medium bandwidth
    smooth: lowest bandwidth, can overshoot much
    Medium stiffness of the controller is suitable for the most applications.
  - Moment of inertia ratio of motor to load

    Example: $\text{Motor} = 0.1 \frac{\text{kg} \cdot \text{m}^2}{1000}$ $\text{Tool} = 0.05 \frac{\text{kg} \cdot \text{m}^2}{1000}$

    Moment of inertia ratio = 1 : **0.5**

    If you do not know the moment of inertia ratio of your application, set the moment of inertia ratio to '0'.
- Step 7 – Operating Mode: The operating mode is always "Velocity mode 1". Select the control channel according to the connection.

- After you have finished the parameterization with the wizard, select the menu "Loader → Write parameters to drive" or the button  . Then the parameters are loaded into the device.

If the system software of your device is not suitable for the parameterization, a respective message will pop up. In this case update the system software as described in the dialog window.

The latest version of the software *drivemaster2* always includes the latest system software.

4 Parameters of the Controller

After the parameter set has been created by means of the wizard the drive is properly set to operate the motor. However, depending on the specific application you must configure several additional setting in the controller parameters.

The following sections describe the controller settings for HSBLOCK / FPAM operation.

4.1 Motor Measurement System

The parameter wizard has already set the correct motor measuring system. On the page "Motor measurement system" you can adapt the commutation controller of the measuring system.

For HSBLOCK control with Hall sensors th following parameter page appears:

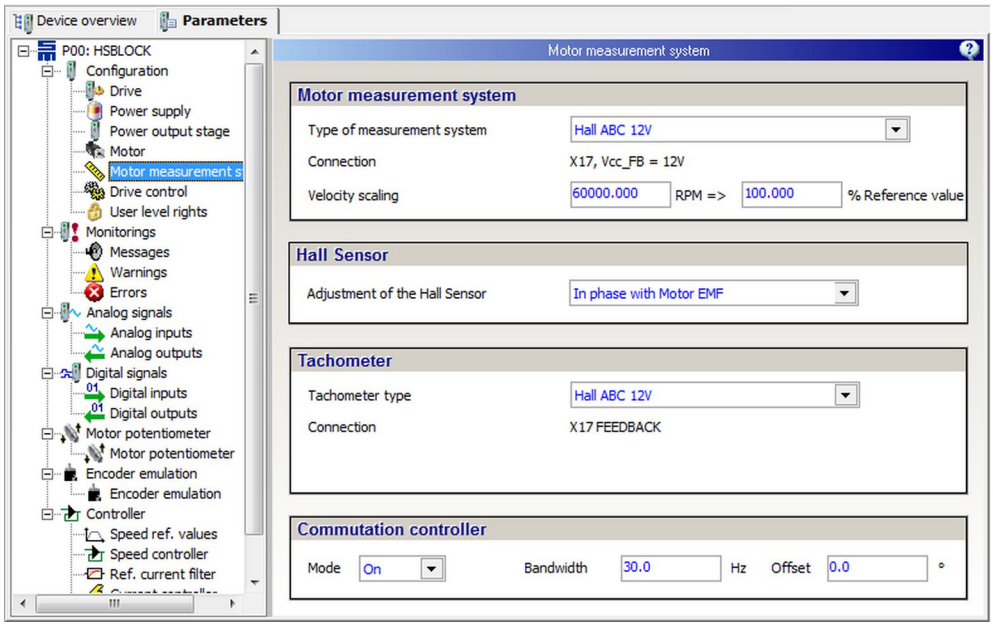


Fig. 3: Parameter page "Motor Measurement System" for HSBLOCK control with Hall sensors

Beside the commutation controller, you must set the orientation of the Hall sensors and the tachometer type. For this purpose refer to the following sections.

For HSBLOCK control with phase voltage measurement (FPAM) the following parameter page appears:

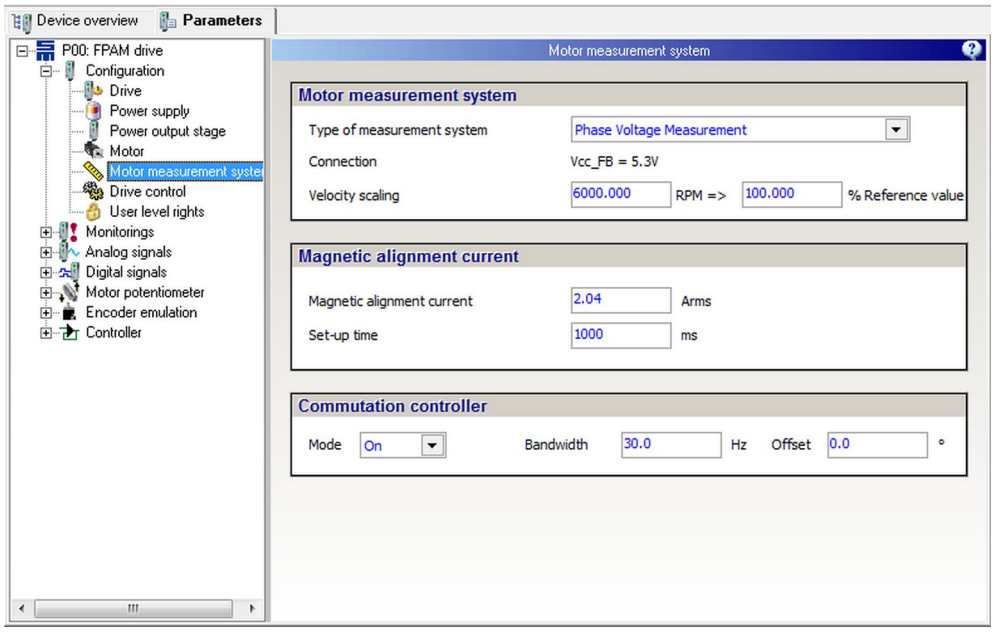


Fig. 4: Parameter page "Motor Measurement System" for FPAM control

Beside the commutation controller, you must set the magnetic alignment current and time. For this purpose refer to the following sections.

Hall Sensor

Via this parameter group the Hall sensors are analyzed. All three Hall sensors are in use.

Adjustment of the Hall sensor:

The parameter specifies the orientation of the Hall sensors. The parameter is set via a list box. If the Hall sensors are rotated by 180°, the Hall signals must be inverted.

Tachometer

In the parameter group "Tachometer" you can determine the speed measuring system for HSBLOCK operation: Either via Hall sensors or via TTL encoder.

Usually commutation and speed control are generated at the motor via Hall sensors. Commutation via Hall sensors is advantageous, because there is always an absolute commutation signal available. Thus additional synchronization of the motor measuring system with the rotor is not necessary (in contrast to using a TTL encoder for commutation and tachometer). However, speed measurement via Hall sensors is restricted in dynamics and accuracy at low speeds. This can be improved considerably by the use of a TTL encoder for speed measurement.

Hall ABC (12 V or 5 V/RS422)

The Hall sensors are activated to provide the commutation and the actual speed value. The parameter "Connection" indicates devices connector of the measuring system.

Incremental encoder TTL

The Hall sensors are activated only for the commutation. The speed is measured via TTL encoder. The parameter "Connection" indicates devices connector of the measuring system. Below that the "Signal periods per revolution" of the motor are set. If you activate the check box, the sensor signals are monitored.

Magnetic alignment current

This parameter group is used to configure the alignment. The phasing of the motor is also referred to as magnetic alignment.

Magnetic alignment current

The parameter indicates the current in *ampere*, which is admissible when the motor is phased in. The magnetic alignment current should not be higher than the rated current of the motor.

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Phasing of the motor

Some drive configurations do **not** allow phasing-in a motor. The reason is that in some cases the brakes must be released and torques are effective.

If the motor is not able to phase in, the commutation is incorrect and thus the control does not work.

Set-up time

The parameter indicates the phasing time in *milliseconds*.

Commutation Controller

Via this parameter group you can set the commutation controller.

Mode

Via the parameter "Mode" you can switch on/off the commutation controller. For FPAM operation (measuring system = "Phase Voltage Measurement") this parameter is always set to "On", i.e. the commutation controller is always active. For HSBLOCK operation with Hall sensors you should activate the commutation controller as well, since the synchronization is much more accurate then.

Bandwidth

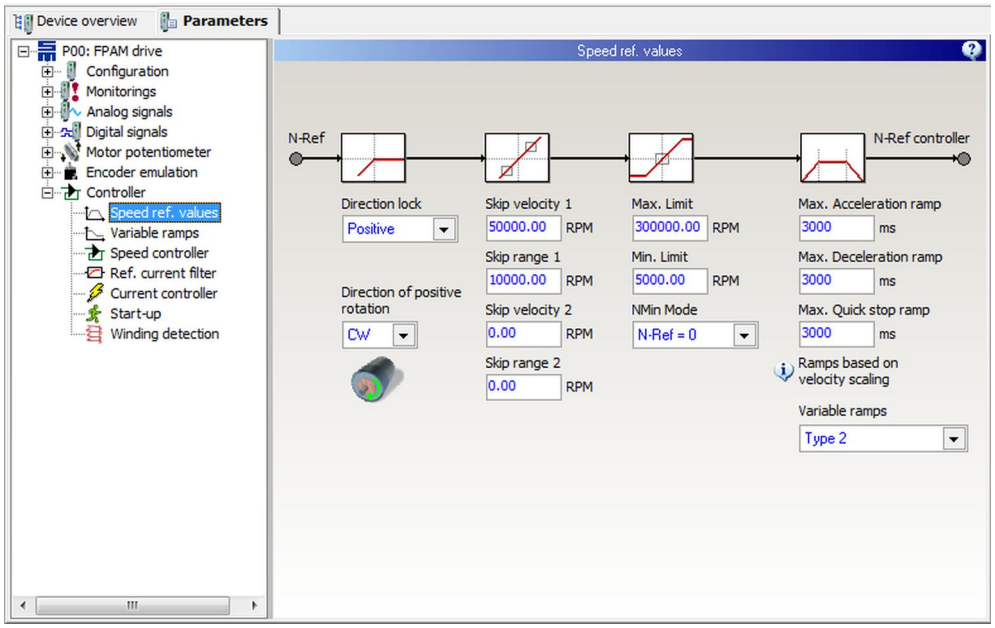
The parameter indicates the bandwidth of the controlled commutation correction in *hertz*. A typical bandwidth is 30 Hz.

Offset

The parameter indicates the manual offset of the commutation controller in *degrees*. For the measuring system "Phase Voltage Measurement" this parameter is always **0°**.

4.2 Speed Reference Values

On the page "Speed ref. values" you can parameterize the reference value generator.



Direction of rotation

The parameter defines the direction of motor rotation for positive reference values (viewed from the shaft end):

- clockwise rotation = CW
- counterclockwise rotation = CCW

The direction of rotation set in the software should match the actual rotation direction of the motor. If this is not the case, two motor phases must be exchanged.

Direction lock

If only one direction of the motor is permitted, you can lock the other direction via this parameter. The following settings are available:

- None: Both positive and negative speed values are passed to the motor.
- Positive: Positive speed values are not passed to the motor.
- Negative: Negative speed values are not passed to the motor.

Skip bandwidth

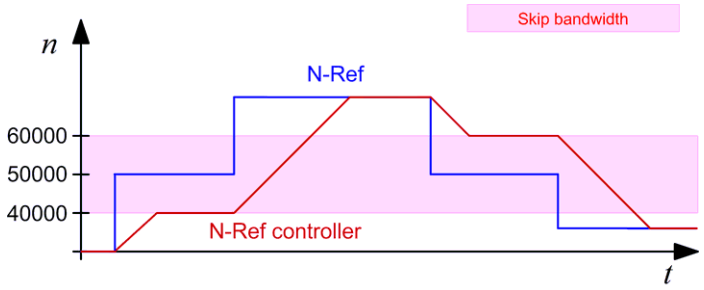
By means of a skip bandwidth you can prevent that definite speeds are driven for a long time. These speeds might be e.g. resonances of a machine.

Example

- Skip velocity: 50000 rpm
- Skip range: 10000 rpm
- max. admissible speed below skip speed = 40000 rpm

- min. admissible speed above skip speed = 60000 rpm

  Speed reference values within the skip bandwidth (40000 – 60000 rpm) are suppressed:



Max. limit

The parameter indicates the maximum possible reference speed in *revolutions per minute*.

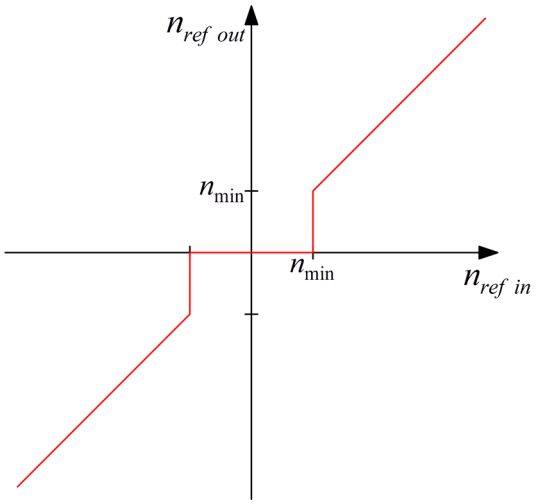
Min. limit

The parameter indicates the minimum possible reference speed in *revolutions per minute*.

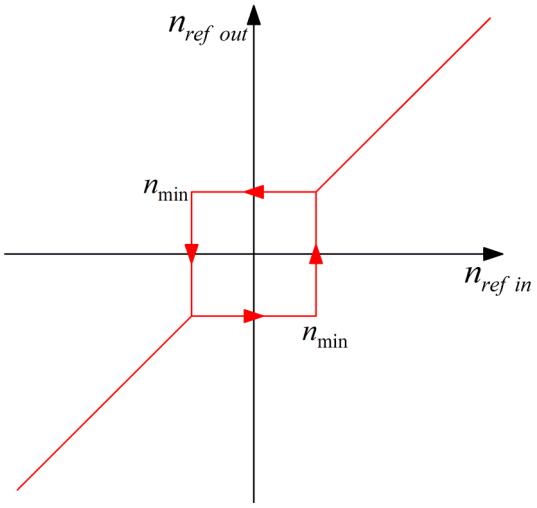
NMin mode

Via this parameter you can select the reference speed to be driven in case a target value below the minimum speed has been selected.

Mode "N-Ref = 0":



Mode "N-Ref = N-Min" (hysteresis):



It is not possible to reverse the direction of the motor rotation, when the target value is below the determined minimum speed.

Ramps

The ramps limit the acceleration via the reference speed value. They are indicated in *milliseconds*. The parameter displays the time required for reaching the speed scaling from standstill. A ramp of e.g. 30000 ms together with a speed scaling of 300000 rpm makes a maximum acceleration of 167 1/s² or $\frac{10000\ 1/min}{s}$.

- Acceleration ramp:
  The parameter indicates the time for the acceleration from 0 to the speed limit: (|v (t + Δt)| - |v (t)| > 0)
- Deceleration ramp:
  The parameter indicates the time for a break application to speed 0: (|v (t + Δt)| - |v (t)| < 0)
- Quick stop ramp:
  The parameter indicates the time for a quick stop to speed 0: (|v (t + Δt)| - |v (t)| < 0)

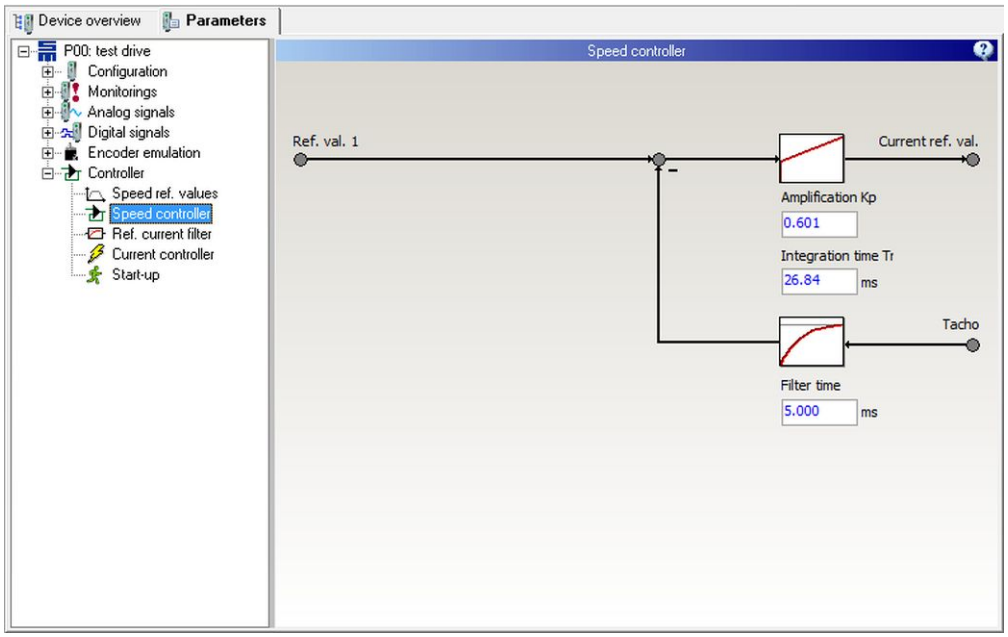
Variable ramps

By means of the function "Variable ramps" you can set a limit for the mean actual current. For this purpose the acceleration is reduced depending on the actual current. Typically, variable ramps are applied during the start-up of pumps or fans.

- Off:
  The function is not active – the ramps are fix as specified above.
- Type 1 (Current controlled ramp - relative to Imax):
  The acceleration is relative to the maximum current. For this purpose you must set the characteristic curve on the page "Variable Ramps".
- Type 2 (Current controlled ramp - absolute currents)
  The acceleration is relative to a fix current value. For this purpose you must set the characteristic curve on the page "Variable Ramps".

4.3 Speed Controller

On this page you can set the parameters of the speed controller.



Amplification Kp

The parameter specifies the proportional amplification of the speed controller in dependance on the speed scaling and the peak current of the power output stage.

The parameter wizard sets this value automatically during parameter set creation when the following values are correct:

- Moment of inertia of the motor
- Torque constant of the motor
- Stiffness of the speed controller (damping)
- Velocity scaling
- Drive peak current (is derived from the drive designation)

If you have configured additional reference current filters or a long tacho filter time, you must possibly reduce the amplification Kp.

The proportional amplification is in charge of the drive dynamics. The higher the value is set, the quicker the speed control circuit can react. If the amplification value is set too high, the speed control circuit starts vibrating.

Integration time Ti

The parameter sets the integral amplification of the speed controller (therefore it is often called integral time constant Ti). The integration time Ti is indicated in *milliseconds*.

The parameter wizard sets this value automatically during parameter set creation when the following values are correct:

- Stiffness of the speed controller (damping)

If you have configured additional reference current filters or a long tacho filter time, you must possibly increase the integral time Ti.

The integral time makes sure that the control deviation is zero in steady-state condition with constant reference value. The smaller the integration time is selected, the more

accurate the speed control operates. If the value is set too small, the speed control circuit starts vibrating.

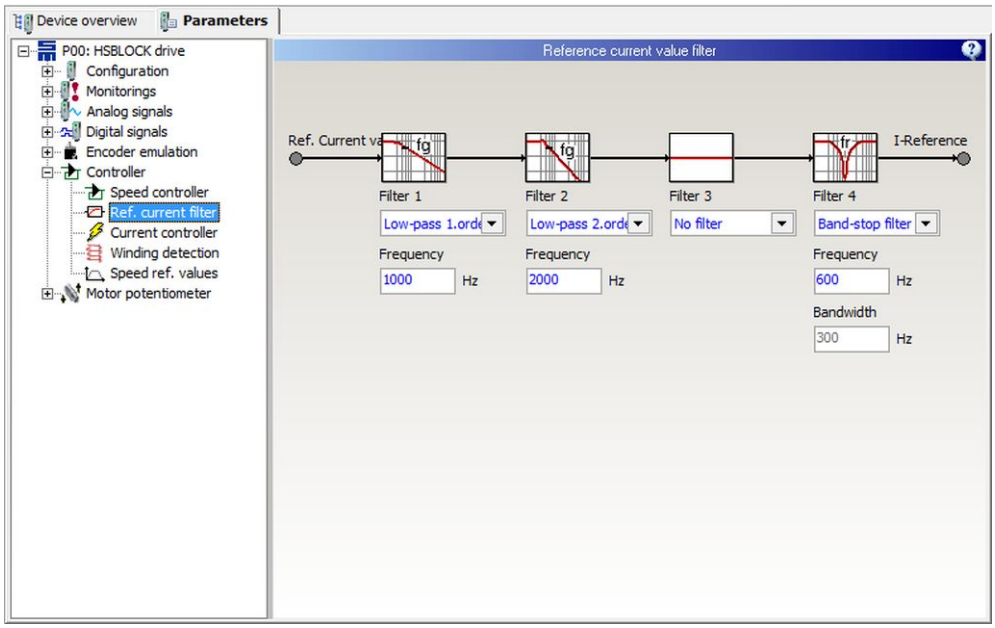
Filter time (tacho filter)

The parameter indicates the filter time for the actual speed (tachometer) in *milliseconds*. If the actual speed is noisy, you can smooth it by means of the filter.

A typical filter time value is 1 ms. You can increase the time constant, if a more smooth actual speed is needed.

4.4 Reference Current Filters

You can set up to 4 reference current filters.



Filter 1–4

The parameter specifies the type of the filter. It is set by means of a list box. The options "No filter", "Low-pass 1. order", "Low-pass 2. order" and "Band-stop filter" are available.

Low-pass 1./2. order

If the EMF of the motor is very low, the measurement of the actual speed value is not accurate. The signal of the actual speed value is noisy. This noise takes direct effect on the reference current value. In this case you can use a low-pass to steady the reference value for the current controller. Thus, the losses of motor and drive and consequently the heating are reduced.

You can use a low-pass 1. order or a low-pass 2. order with Butterworth characteristic. Set the desired filter and enter the 3 dB cut-off frequency of the filter. The unit is *hertz*.

Please consider that a low-pass in the reference current value reduces the dynamics of the current control. For this reason you must possibly adapt the control parameter of the speed controller (reduce the amplification and increase the integration time).

Band-stop filter

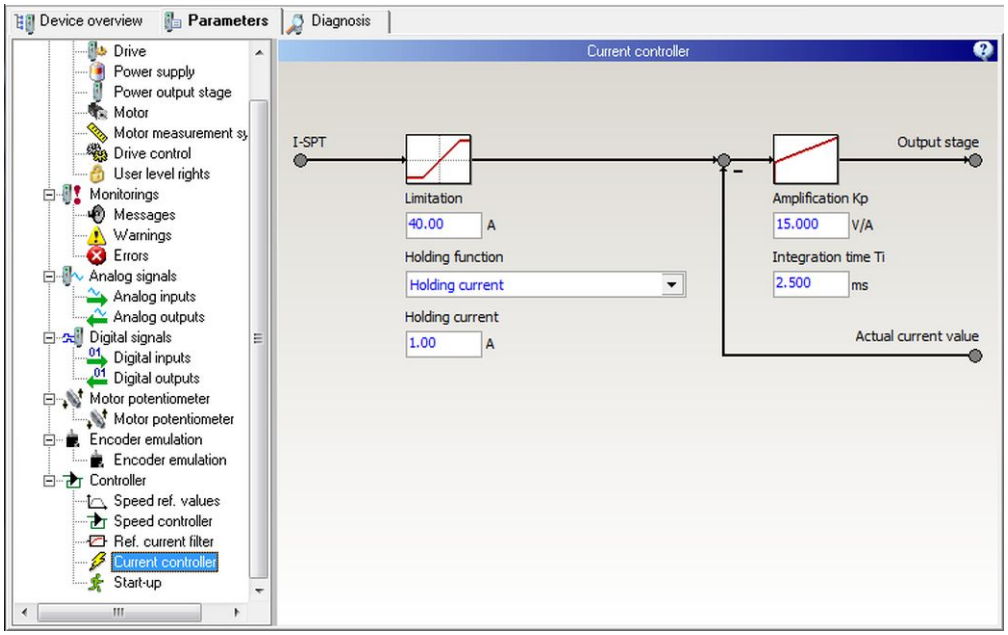
A band-stop filter is used to suppress resonance frequencies caused by the mechanical construction of the driven machine.

Enter the center frequency of the band-stop filter. The bandwidth is set automatically. The unit is *hertz*.

Please consider that a band-stop filter in the reference current value can reduce the dynamics of the current control. For this reason you must possibly adapt the control parameter of the speed controller (reduce the amplification and increase the integration time).

4.5 Current controller

Via the parameter page "Current controller" you can set the current limitation, the holding current and the control parameters.



Limitation

The parameter indicates the limitation in the current controller for the reference value of the current. The reference current and its limitation are indicated as peak value in *ampere*. The maximum value of the "Limitation" are the peak currents of the motor and the power output stage.

Holding Function

The parameter indicates whether a holding current is used. The holding current is active when the controller is switched on and no reference value is set. The holding current shall keep the motor in position at standstill.

The desired current is defined in the parameter "Holding current" in *amperes*.

Amplification Kp

The parameter indicates the proportional amplification of the current controller in *volts per ampere*. The reaction time of the current control circuit is reduced if a high propor-

tional amplification is selected. If the amplification value is set too high the current control circuit starts vibrating.

The proportional amplification of the current controller can be estimated by means of the following formula:

$$K_p\,[V/A] = \frac{3}{8} \cdot f_S\,[kHz] \cdot (\,L_{int}\,[mH] + L_{pp}\,[mH]\,)$$

- $L_{int}\,[mH]$ = internal inductance of the drive (e.g. 0362143EC: L_{int} = 1.5 mH)
- $L_{pp}\,[mH]$ = stator inductance of the motor (phase/phase)
- $f_S\,[kHz]$ = switching frequency of the output stage (f_S = 8, 16 or 32 kHz)

Integration time Ti

The parameter sets the integral amplification of the current controller (therefore it is often called integral time constant Ti). The integration time Ti is indicated in *milliseconds*. The smaller the integration time is selected, the quicker the current control circuit will react. If the value is set too small the current control circuit starts vibrating.

The integral time of the current controller can be estimated by means of the following formula:

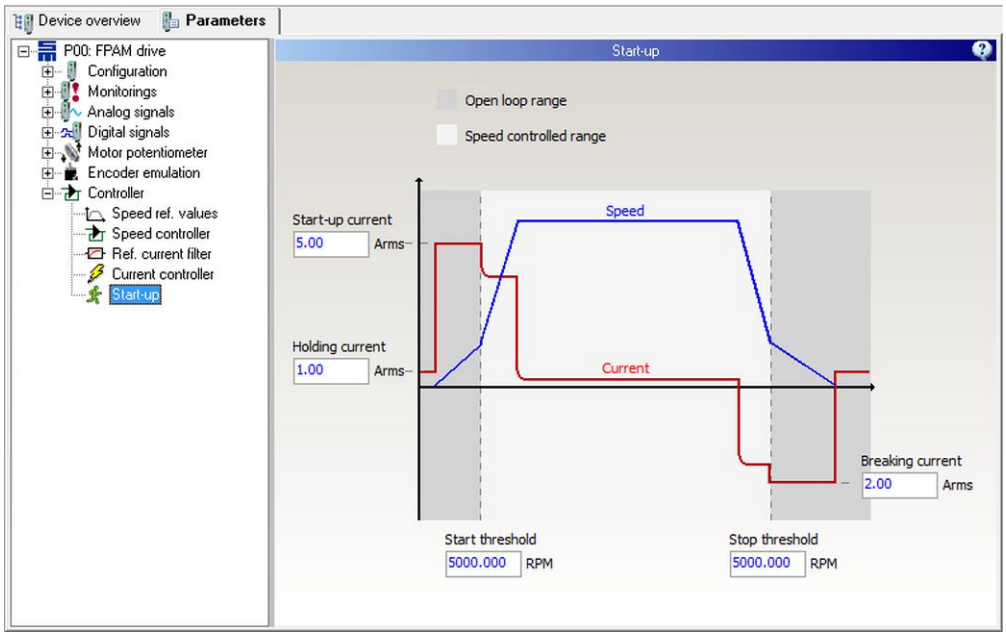
$$T_i\ [ms] = \frac{L_{int}\,[mH] + L_{pp}\,[mH]}{R_{pp}\,[\Omega]}$$

- $L_{int}\,[mH]$ = internal inductance of the drive (e.g. 0362143EC: L_{int} = 1.5 mH)
- $L_{pp}\,[mH]$ = stator inductance of the motor (phase/phase)
- $R_{pp}\,[\Omega]$ = stator resistance of the motor (phase/phase)

4.6 Start-up (FPAM Only)

The rotor position is determined by means of the phase voltage. At standstill and at very low speeds it is not possible to measure the phase voltage. For this reason the motor must be accelerated to a minimum speed via open-loop control at first. Then it can be commutated by the phase voltage measuring system. The same applies for the braking process. The motor is decelerated speed-controlled as long as the phase voltage is sufficient to control the rotor position. In consequence there are two motor driving ranges, "Open loop range" and "Speed-controlled range".

The page "Start-up" provides parameters to set the behavior of the drive in the open loop range.



Startup current

The parameter indicates a constant current in *amperes* that is impressed on startup. The starting current must be greater than the acceleration current of the drive (at least 120 %).

Start threshold

The parameter indicates the minimum speed required for the closed-loop control in *revolutions per minute*. As soon as the reference speed value (N-ref controller) reaches this value, the drive switches to the speed controlled range. From this point the actual speed is determined by the phase voltage measuring system and the commutation is derived from the rotor position

The reference speed values must not be below the start threshold, since the motor can not be driven optimally in this range.

In order to avoid reference values this low, switch to the page "Speed ref. values" and set the parameter "Min. limit" to a value equal to or greater than the start threshold. Thus, the motor can not be operated continuously in the range of open loop control.

Holding current

The parameter "Holding current" equals the set holding current on the page "Current controller". The value is displayed a second time here to make parameterizing easier.

Stop threshold

When the speed reference value (N-ref controller) drops below this value, braking the motor is continued by open-loop control.

Braking current

The parameter indicates the braking current in *amperes*. This current is impressed during open-loop controlled braking.

When operating highly inductive motors the commutation can shift due to high braking torques. In this case the braking rate is reduced automatically, i.e. the deceleration time might be longer.

5 Connection of Hall Sensors

➪ For HSBLOCK operation with Hall sensors you must connect the Hall sensors (A, B, C) according to the data sheet.

5.1 Measuring the Hall Sensors

If the pin assignment of the Hall sensors is not available, you must measure the sensor signals. For this purpose you need an oscilloscope with two channels. With channel 1 measure between two motor phases. With channel 2 measure the corresponding sensor. The phases U, V, W must not be connected to the device during measurement.

Timing diagram of the three Hall signals to the corresponding counter e.m.f of the motor

The motor rotates in the preferred direction.

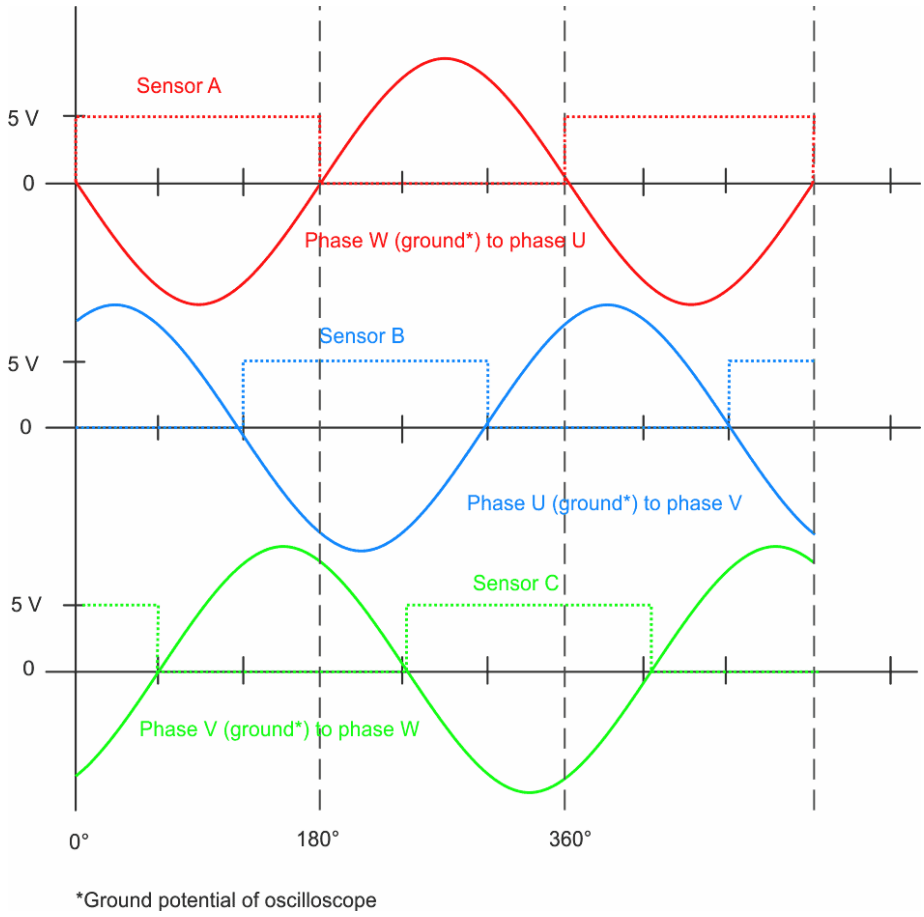


Fig. 5: Time diagram Hall A, B C to the counter e.m.f of the motor

Determining the correct position of a Hall signal to the counter e.m.f of the motor

The diagram below shows the required position of a Hall signal to the counter e.m.f of the motor. The proportion of sensor signal to counter e.m.f must be identical for all three Hall sensors under the following conditions:

- The shaft of the motor is rotated manually in the preferred direction (generally, the direction of rotation depends on the application).

- The Hall sensor signal must be generated simultaneously to the zero point of the counter e.m.f measured between two phases or the signal must lead within a range of approx. 0..15°. The Hall signal often leads when high-speed motors are used.
- The measured counter e.m.f must have the following position to the Hall signals:
  - phase W (ground) to phase U = sensor signal A
  - phase U (ground) to phase V = sensor signal B
  - phase V (ground) to phase W = sensor signal C

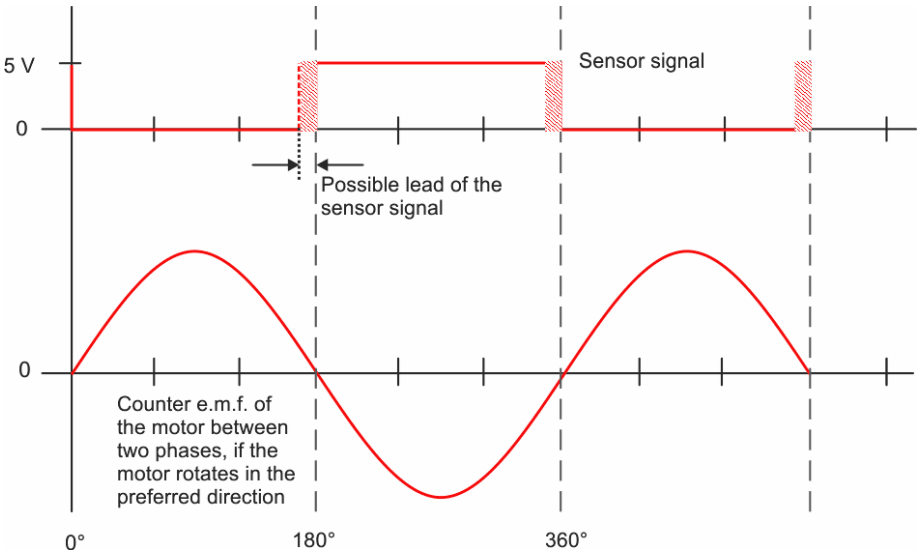
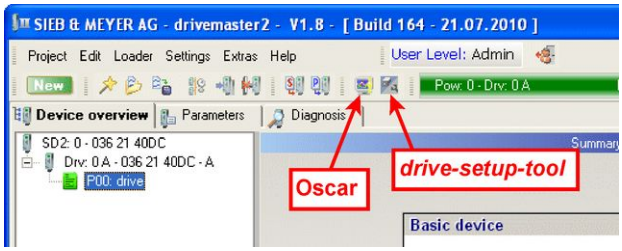


Fig. 6: Position of a Hall signal to the counter e.m.f of the motor

6 Example for Initial Operation of the Motor

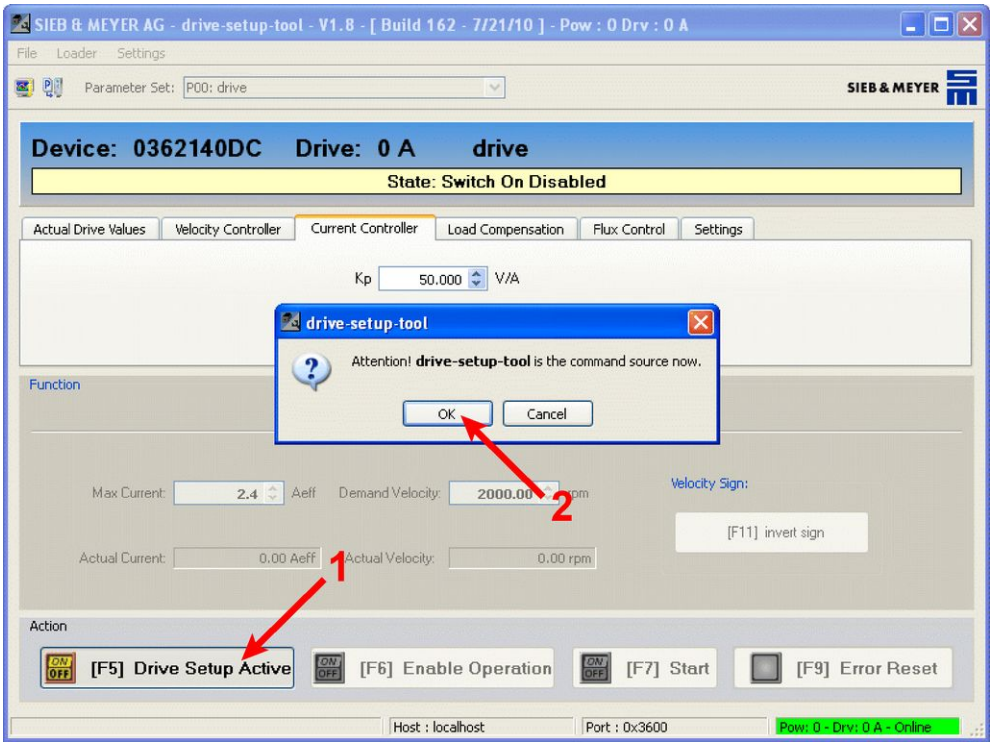
The following sections describe step-by-step how to adjust the controller for initial operation of the motor. For this purpose at first you must set the basic parameters of the SD2S by means of the parameter wizard (see chapter 3 "Create Parameter Set", p. 9).

For controller adjustment the tools *drive-setup-tool* and *Oscar* are available. Both can be started via the user interface.



Activate drive setup

➪ In order to control the drive via the *drive-setup-tool* , click the button "Drive Setup Active" and confirm the following inquiry with "OK".



6.1 Check Ramps

The ramp times are to find in *drivemaster2* via "Parameters → Controller → Speed ref. values". The values were set by the software according to the speed scaling of the measuring system.

- Check that the ramp times are suitable for your individual application. If this is not the case, change the parameters as required and write the new values into the drive using the button .

6.2 Check Direction of Rotation

The actual direction of motor rotation must match the parameterization on the page "Speed ref. values" in *drivemaster2*. If this is not the case, two motor phases must be exchanged.

Check the direction of rotation using *drive-setup-tool*:

- Make the following settings in the field "Function":
  - Function = Velocity - absolute values
  - Max. current = motor rated current
  - Demand velocity = 15 % of rated motor speed
- In order to start the test click first on the button "Enable Operation " and then activate the button "Start".
- Check that the direction of rotation of the motor matches the parameterization.

If the error E44 "Commutation lost" is displayed during the test, the motor parameters "Torque constant" and "Moment of inertia" are not correct or the bandwidth of the commutation controller is set too great.

- Quit the test by clicking the buttons "Start" and "Enable Operation".
- If the direction of rotation of the motor does not match the parameterization, you must exchange two motor phases.

For HSBLOCK operation with Hall sensors you must also exchange the sensor signals. The following combinations are possible:

- Exchange phases **U** and **V** → exchange sensors **A** and **C**.
- Exchange phases **V** and **W** → exchange sensors **A** and **B**.
- Exchange phases **U** and **W** → exchange sensors **B** and **C**.

6.3 Optimize Startup and Braking Current (FPAM Only)

The starting current must always be higher than the acceleration current. In order to set the starting current optimally, you must at first determine the acceleration current using the *Oscar*.

Settings in the *Oscar*

- Start the *Oscar*. Select the menu "File → Load settings" and open the file "SVC_Profile.OCf". Thus, the trigger parameters in the *Oscar* are set for the test.
- Click the button "Single Shot". Now the record ist started once on controller start-up.

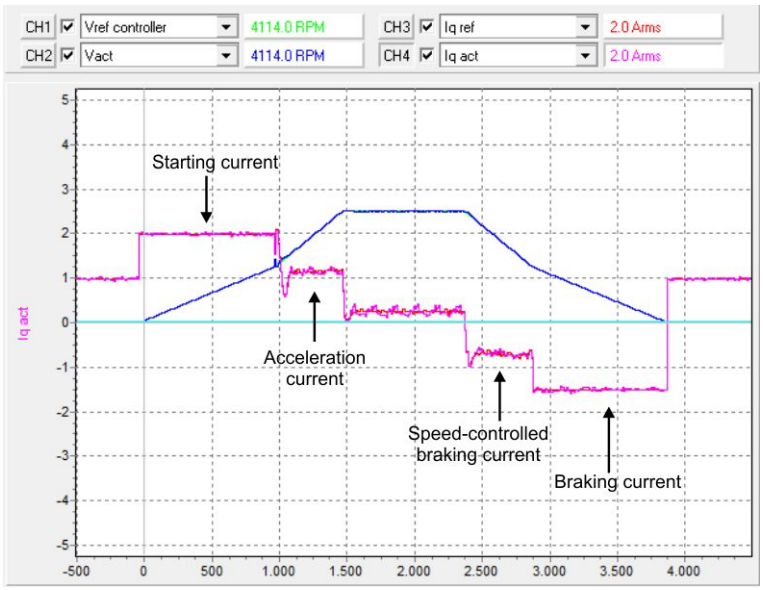
Settings in the *drive-setup-tool*

- Make the following settings in the field "Function":

- Function = Velocity - absolute values
- Max. current = motor peak current
- Demand velocity = 25 % of motor rated speed

Recording

- In order to start the test click first on the button "Enable Operation" and then activate the button "Start" in *drive-setup-tool*.
- Quit the test, when the set speed is reached. (Click a second time on the button "Start" and as soon as speed zero is reached click "Enable Operation".)
- Look at the actual current curve generated in the *Oscar* and read out the acceleration current. For this purpose click on channel "CH4" to display the actual current scaling.



- Open the page "Parameters → Controller → Start-up" in the software *drivemaster2*. Set each of the parameters "Startup current" and "Braking current" to at least 120 % of the acceleration current.
- Load the parameters to the drive via the button .

6.4 Optimize Start Threshold (FPAM Only)

The start threshold speed should be at motor voltage of 5 – 10 % of the maximum output voltage of the connected SD2S:

- max. output voltage = 230 V_{rms} → voltage threshold = 15 V_{rms}
- max. output voltage = 400 V_{rms} → voltage threshold = 30 V_{rms}

You need the following configuration to determine the start threshold:

Settings in the *Oscar*

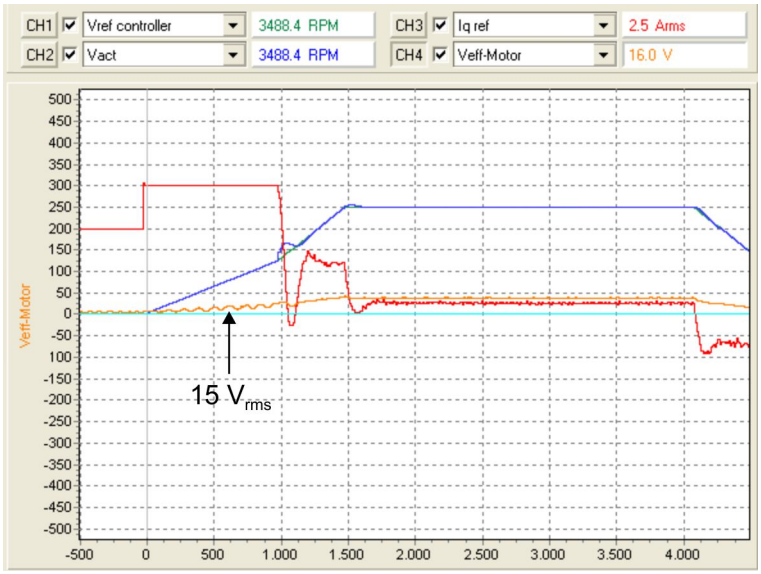
- Start the *Oscar*. Select the menu "File → Load settings" and open the file "SVC_StartThreshold.OCf". Thus, the trigger parameters in the *Oscar* are set for the test.
- Click the button "Single Shot". Now the record ist started once on controller start-up.

Settings in the *drive-setup-tool*

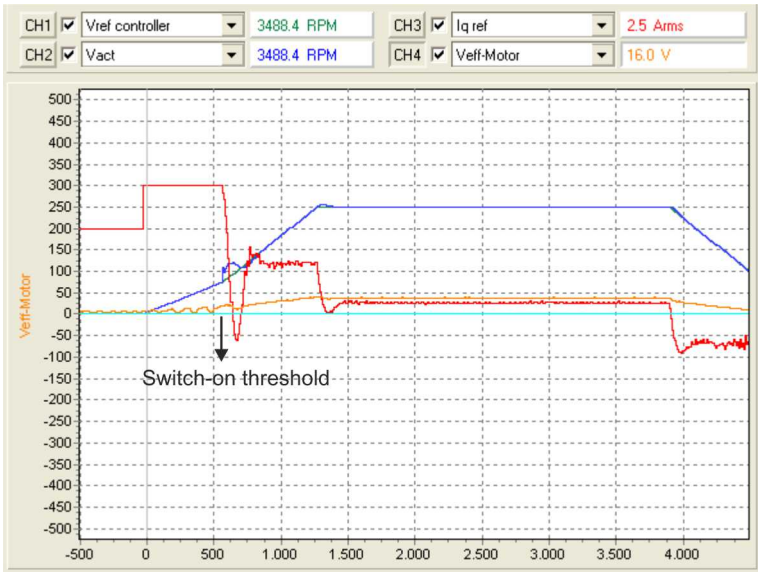
- Make the following settings in the field "Function":
  - Function = Velocity - absolute values
  - Max. current = motor peak current
  - Demand velocity = 25 % of motor rated speed

Recording

- In order to start the test click first on the button "Enable Operation" and then activate the button "Start" in *drive-setup-tool*.
- Quit the test, when the set speed is reached. (Click a second time on the button "Start" and as soon as speed zero is reached click "Enable Operation".)
- Look at the actual speed curve generated in the *Oscar* and read out the start threshold. For this purpose click on channel "CH4" to display the voltage scaling. Move the mouse pointer to the point, at which the voltage curve has reached 15 or 30 V_{rms}. The corresponding speed value is displayed in the Curves section at "CH2".



- Open the page "Parameters → Controller → Start-up" in the software *drivemaster2*. Enter the read-out value in the parameter "Start threshold".
  The parameterized minimum speed must not be smaller than the start threshold. Otherwise the motor could be operated in the open-loop range for longer time periods (see "Parameters → Speed ref. values → Min. Limit").
- Load the parameters to the drive via the button  .
- Record a second curve in the *Oscar* to check the start threshold.



6.5 Optimize Stop Threshold (FPAM Only)

If the motor loses commutation during braking, you must reduce the stop threshold in the software *drivemaster2* (see "Parameters → Controller → Start-up").

The stop threshold must not be smaller than the start threshold.

6.6 Optimize Tacho Filter

The actual speed value should not show more than 0.2 % noise in relation to the maximum speed. If the actual speed is too noisy, you can extend the filter time of the tacho filter.

Use the curve generated in the *Oscar* in section 6.4 "Optimize Start Threshold (FPAM Only)", p. 29 to check the actual speed value:

- Click on channel "CH2" to display the speed scaling.
- Zoom into the curve Vact and check whether the actual speed is more noisy than 2 % of the maximum motor speed. If this is the case, open the page "Parameters → Controller → Speed controller" in the software *drivemaster2* and increase the parameter "Filter time" step-by-step.
  Values between 1 and 5 ms are typical for the filter time.
- Load the new parameters after each change into the drive via the button and record a new *Oscar* curve to check the actual speed until the noise is sufficiently reduced.

6.7 Optimize Speed Controller

The parameters of the speed controller are set automatically by the parameter wizard. But you can optimize the parameterization, if required. For this purpose you need the following configuration:

Settings in the *Oscar*

- Start the *Oscar*. Select the menu "File → Load settings" and open the file "SVC_SpeedController.OCf". Thus the trigger parameters in the *Oscar* are set for the test.
- Click on the button "Normal mode" to activate the trigger. Thus a record is started on each operating start via the *drive-setup-tool*.

Settings in the *drive-setup-tool*

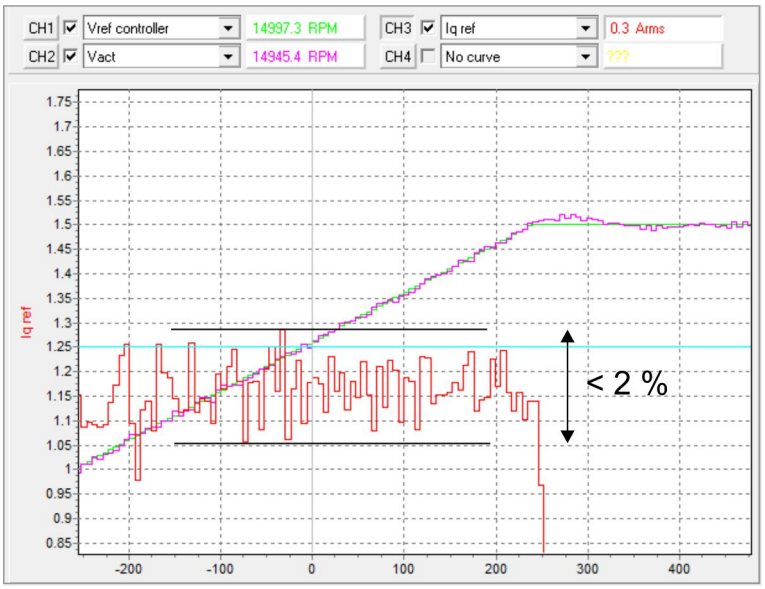
- Make the following settings in the field "Function":
  - Function = Velocity - reversing function
  - Max. current = motor peak current
  - V1 = 15 % of the maximum motor speed
  - V2 = 30 % of the maximum motor speed
  - tp = 0 ms
  - t1 = 50 % of the parameterized ramp time
  - t2 = 50 % of the parameterized ramp time
- Select the tab "Velocity controller" and make the following settings:
  - Amplification = 20 % of the currently set value
  - Readjustment time Tn = 200 ms

Recording

➪ In order to start the test click first on the button "Enable Operation" and then activate the button "Start" in *drive-setup-tool*.

Reference current noise

➪ Click on channel "CH3" to display the scaling of the reference current. Zoom into the reference current curve generated by *Oscar* and check that the noise is at least 2 % of the motor rated current.

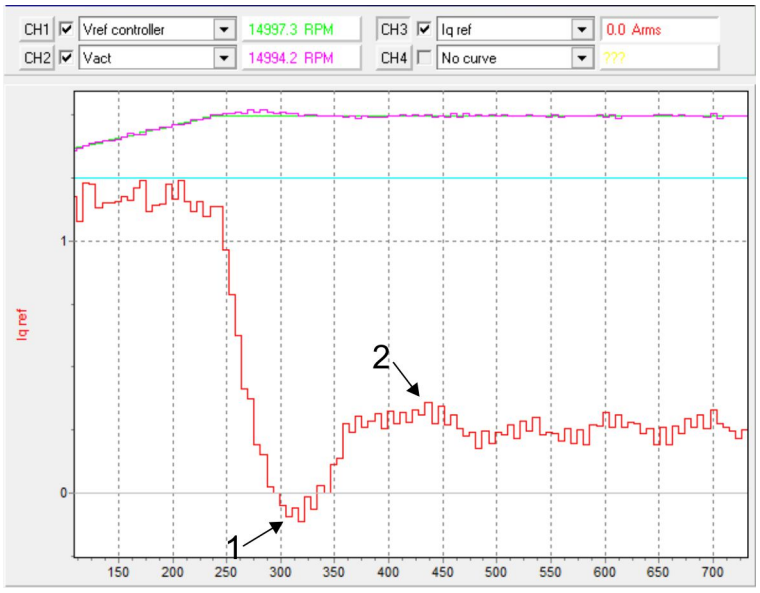


– If the noise is smaller than 2 % of the motor rated current, increase the amplification Kp by 50 % in the *drive-setup-tool*. Repeat this step, if necessary.

A parameter changed in *drive-setup-tool* will immediately become effective in operation after confirming with ENTER.

Second overshoot of reference current

➪ Check whether a second overshoot of the reference current is visible in the curve as shown in the following figure.



– If a second overshoot is not visible, reduce the readjustment time Tn by 30 % in *drive-setup-tool*. If necessary, repeat this step until a second overshoot is visible.

– As soon as a second overshoot is visible, increase the readjustment time Tn by 50 % in *drive-setup-tool*.

➪ Load the parameters into the controller via the button  in *drive-setup-tool*.

➪ Quit the initial operation by means of *drive-setup-tool*. (Click "Start → Enable Operation (at speed zero) → Drive Setup Active".)

6

7 Troubleshooting

The following problems may occur during initial operation:

Code	Description	Possible cause	Remedy
–	Direction of rotation of spindle/motor is wrong	Wiring of motor phases is faulty.	Correct the wiring of motor phases (U, V, W) according to the data sheet.
		Software: Bit for direction of rotation is set wrong.	Change the direction of rotation (CW/CCW) in *drivemaster2* (parameter page "Speed ref. values").
		Software: Digital input "Speed direction" is set.	Correct the digital input "Speed direction".
		Analog reference speed value is wrong.	Correct the analog reference speed value.
		Software: The analog reference speed value is inverted.	Analog reference speed value: Correct the parameter "Inverter" (Parameter page "Analog inputs")
E31	Speed error too great	Software: Settings of error E31 are wrong.	Adapt parameter "E31 - Shutdown threshold" (parameter page "Errors")
		Wiring of motor phases is faulty.	Correct the wiring of motor phases (U, V, W) according to the data sheet.
E34	Power supply load monitoring -> mains voltage too low	On switch-on SAFETY is on.	Make sure that SAFETY is off before switch-on of the device.
E41	Motor phase missing	At least one motor phase is not connected.	Check motor connections and motor cable.
E44−1	EMF monitoring triggered error.	Software: Voltage constant set too great.	Reduce voltage constant (parameter page "Motor").
		Error during alignment (motor breakdown)	Check settings of alignment in *drivemaster2* (parameter page "Motor measurement system").
		Software: Startup current too low (motor breakdown)	Increase startup current (parameter page "Start-up")
		Software: Tacho filter not correct (motor breakdown)	Change filter time (parameter page "Speed controller")
		Software: Bandwidth of commutation control not correct (motor breakdown)	Change bandwidth (Parameter page "Motor measurement system")
E44−5	Speed too low	Too much load	Reduce load.
E44−6	Error during alignment	Motor is not at standstill.	Wait for total motor stop.
		Software: Setting of alignment are not correct.	Extend alignment time (parameter page "Motor measurement system")
E45	Short circuit in power output stage	Power output stage defective	Activate power output stage without motor cable. 1. Error E41 appears: Power output stage is OK → motor cable or motor is defective. 2. Error E45 remains: Power output stage is defective → please send the device to SIEB & MEYER for repair works.
		Software: Motor parameters are not correct.	Correct the motor parameters "stator resistance" and "stator inductance" (parameter page "Motor").
–	Motor vibrates	Speed controller is not adjusted.	Set Kp and Tn of speed controller (see section 6.7 "Optimize Speed Controller", p. 31).

Code	Description	Possible cause	Remedy
–	Digital inputs/outputs are not working.	No voltage supply for the inputs/ outputs.	Connect X15, pin 9 to 24 V.
–	Analog outputs are not working.	Analog outputs are overloaded.	Make sure that the analog outputs are loaded with max. 1 mA.