SIEB & MEYER

SD2S Setup Instructions

V/f Operation

Training documentation

P-TD-0000223.3
2013-08-27

Copyright

Trademarks

SIEB & MEYER worldwide

For questions regarding our products and technical problems please contact us.

SIEB & MEYER AG
Auf dem Schmaarkamp 21
21339 Lüneburg
Germany

Phone: +49 4131 203 0
Fax: +49 4131 203 2000
support@sieb-meyer.de
http://www.sieb-meyer.de

SIEB & MEYER Shenzhen Trading Co. Ltd.
Room 306, 3rd Floor, Building A1,
Dongjiaotou Industrial Area, Houhai Dadao,
Shekou, Nanshan District,
Shenzhen City, 518067
China

Phone: +86 755 2681 1417 / +86 755 2681 2487
Fax: +86 755 2681 2967
sm.china.support@gmail.com
http://www.sieb-meyer.cn

SIEB & MEYER Asia Co. Ltd.
4 Fl, No. 532, Sec. 1
Min-Sheng N. Road
Kwei-Shan Hsiang
333 Tao-Yuan Hsien
Taiwan

Phone: +886 3 311 5560
Fax: +886 3 322 1224
smasia@ms42.hinet.net
http://www.sieb-meyer.com

SIEB & MEYER USA
3975 Port Union Road
Fairfield, OH 45014
USA

Phone: +1 513 563 0860
Fax: +1 513 563 7576
info@sieb-meyerusa.com
http://www.sieb-meyer.com

1 Introduction

This brief instruction shall help you during initial operation of an SD2S as V/f converter.

The drive function "HSPAM / VF " allows easy operation of asynchronous motors without sensor. Depending on the device type output frequencies up to 2000 Hz or 10000 Hz can be reached.

- SD2, SD2S with fixed intermediate circuit voltage:
  max. output frequency = 2000 Hz
- SD2T, SD2S with controlled intermediate circuit voltage:
  max. output frequency = 10000 Hz

The V/f control is an open-loop system without position or speed measurement. Since there is no measuring system available, the respective reference speed value is displayed as actual motor speed.

Optionally you can connect a suitable motor measuring system to evaluate the actual motor speed and thus check the states "reference value reached" and "speed zero".

1.1 V/f Structure

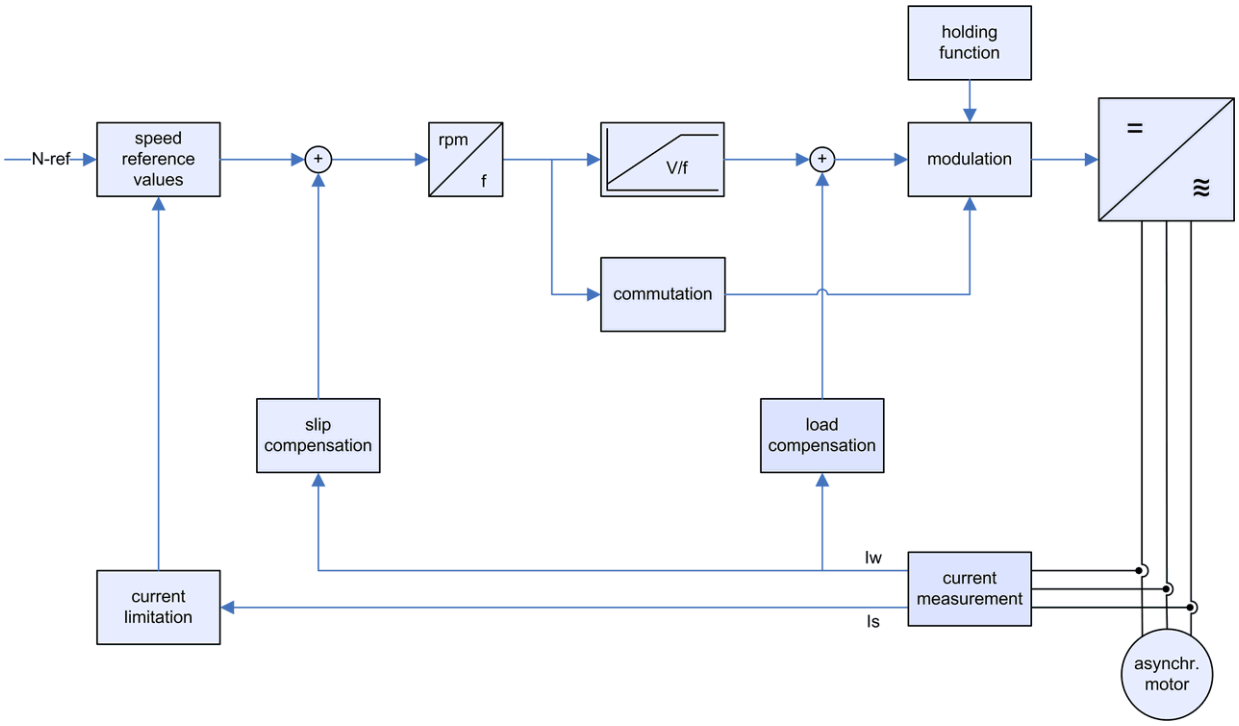


Fig. 1: Structure of the V/f control

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.)

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

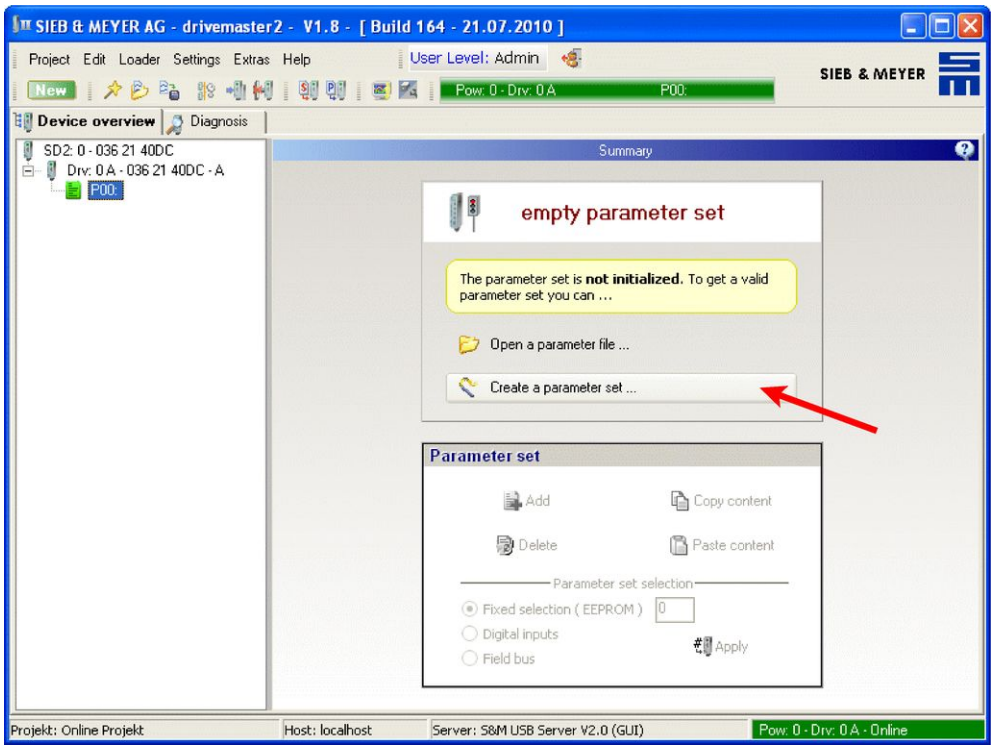
➪ Start the software *drivemaster2*.
➪ Select the option "Setup connection to the device" in the start screen and configure the type of communication.
➪ Click on the button "Search devices + connect" to apply your selection.
✓ The connected SD2S is found by the software and appears in the user interface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

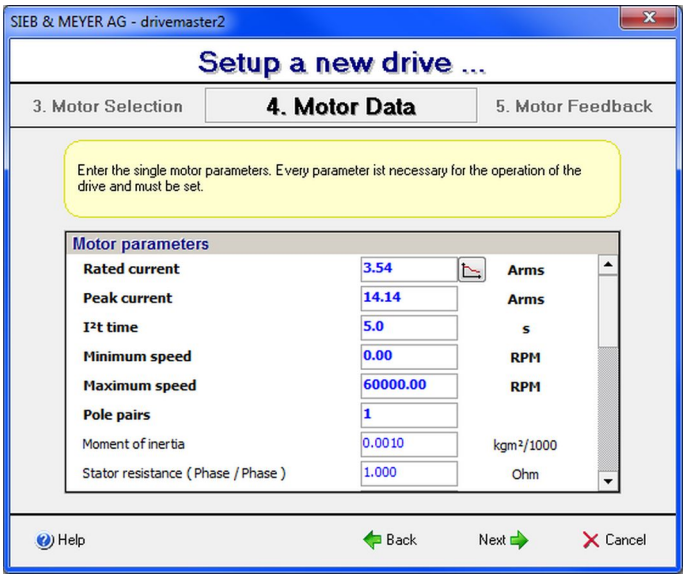
3 Create Parameter Set

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

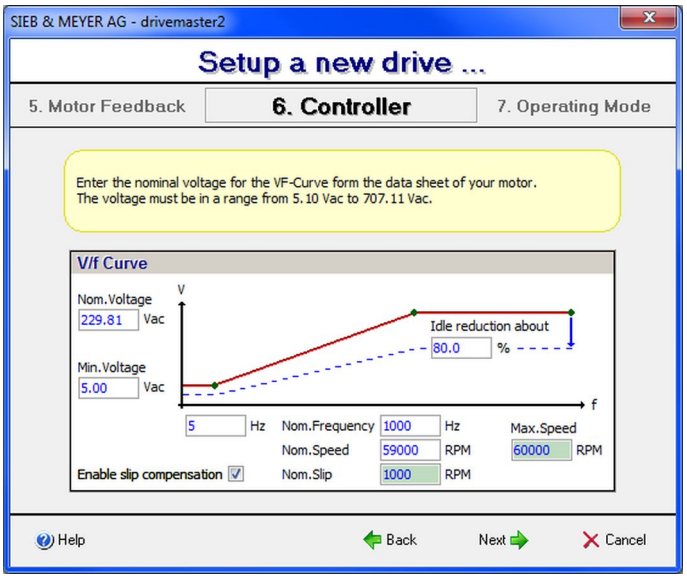


- Click on the button "Create a parameter set ...". A respective wizard will be opened. It takes you step-by-step through the parameter set creation.
- Step 1 – Drive Hardware: The basic drive is recognized automatically by the software.
- Step 2 – Basic Data: Select the drive function "HSPAM / VF ".
- 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. For the parameter set of the V/f control the highlighted motor data (in bold) are necessary and must be adapted to the connected motor.



- Step 5 – Motor Feedback: Select a motor measuring system (e.g. sensorless).
- Step 6 – Controller: Enter the parameters of the V/f characteristic curve.



  - Min. Voltage: At first you set the minimum voltage of the V/f curve. The voltage does not fall below this value even at very low speeds. Thus, sufficient magnetization is available at all times.
  - Nom. frequency / nom. speed: Then the nominal slip is defined at the nominal operating point of the motor. If desired you can use the nominal slip for the slip compensation.
  - Idle reduction in %: Finally you can set the voltage reduction during no-load operation. This value automatically sets the load compensation, which stops the voltage reduction as soon as the nominal load is reached again.
- 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.

3

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.

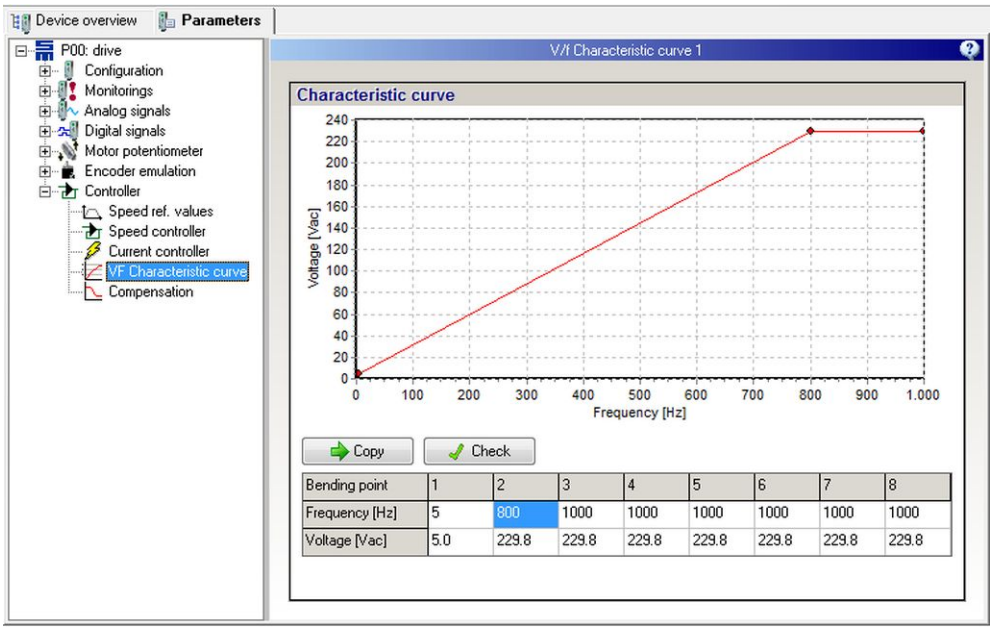
The following sections describe the controller settings for V/f operation.

4.1 V/f Characteristic Curve

For V/f control the motor voltage is set via a table proportionally to the rotating field frequency. The output voltage depends on the current reference speed value and is automatically set to the correct value. Thereby possible variations of the supply voltage are considered and compensated.

There are two methods for setting the parameters of the V/f characteristic curve:

1. Only the values for nominal voltage and nominal frequency are known. In this case the parameter wizard provides the suitable characteristic curve. There is no need to enter more data.
2. A complete V/f characteristic curve is available. In this case the V/f characteristic curve can be entered in the software *drivemaster2* via the corresponding parameter page.



Make sure that you enter the voltage values of the V/f characteristic curve as AC voltage.

4.2 Compensation

Via the parameter page "Compensation" you can set load and slip compensation.

4.2.1 Load Compensation

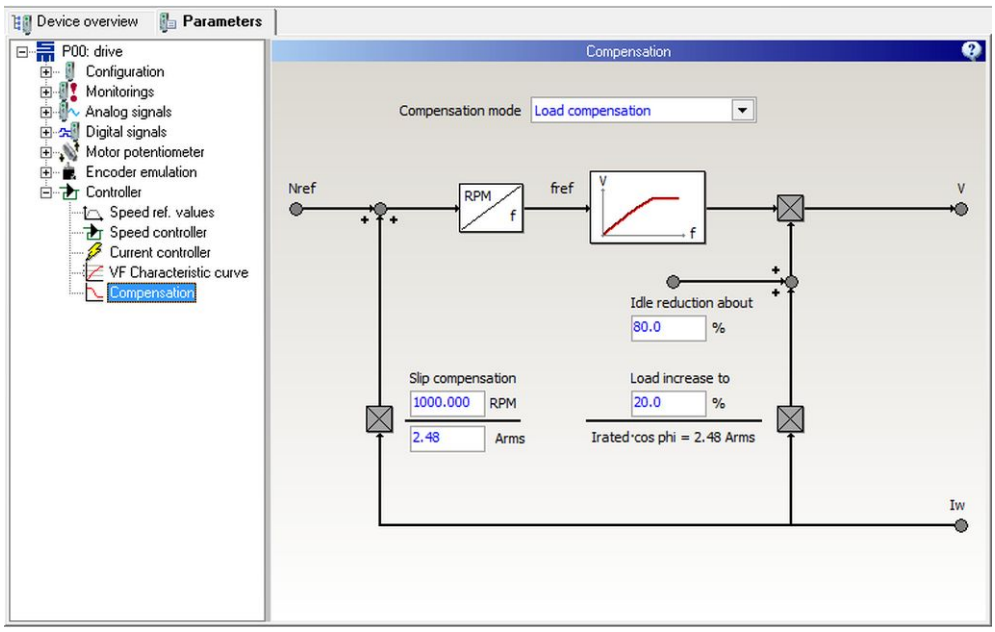
You can set the following modes for the compensation:
- FC2 load compensation: compatible to older devices and to the series FC2
  You should use this mode only to apply older parameter sets.
- Load compensation: standard load compensation

For V/f control you can switch between FC2 load compensation and standard compensation. The values are converted accordingly.

The standard load compensation provides the option "Idle reduction to". By means of this you can reduce the V/f characteristic curve to a certain percentage during no-load operation. Via the parameter "Load increase by" the V/f characteristic curve can be increased back to 100 % as soon as nominal load is reached again.

Examples

Reduction during no-load operation
- Idle reduction to: 80 %
- Load increase by: 20 %
- Characteristic curve during no-load operation = 80 %
- Characteristic curve at nominal operating point = 100 %



Reduction during no-load operation with overcompensation
- Idle reduction to: 80 %
- Load increase by: 40 %
- Characteristic curve during no-load operation = 80 %
- Characteristic curve at nominal operating point = 120 %

If you have set an overcompensation via the load increase, the output voltage is higher than the one set in the V/f characteristic curve.

4.2.2 Slip Compensation

The slip compensation is an open-loop control to compensate the slip of an asynchronous motor.

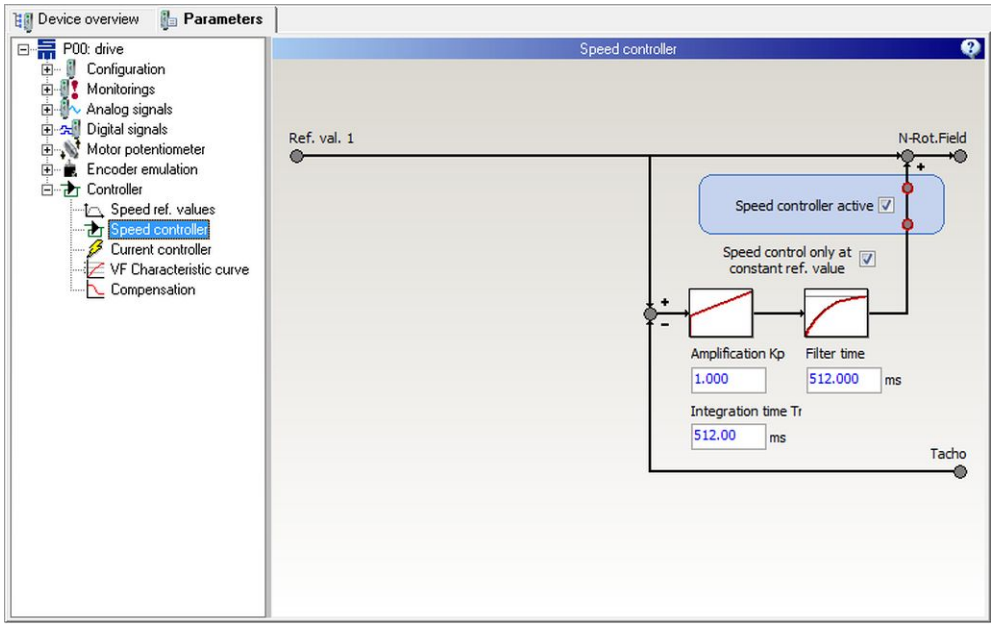
The correct settings are taken from the data entered in the parameter wizard (nominal slip, rated current and power factor cos phi).

As an alternative the slip can be determined by means of an external measuring device. For this purpose proceed as follows:

- Load the drive with nominal load.
- Record the active current of the drive and measure the real speed externally.
- Enter the two values in the corresponding input fields below the point "Slip compensation".

4.3 Speed Controller

The speed controller can be used only when a speed measuring system is available. At first this measuring system must be parameterized correctly on the page "Motor measurement system".



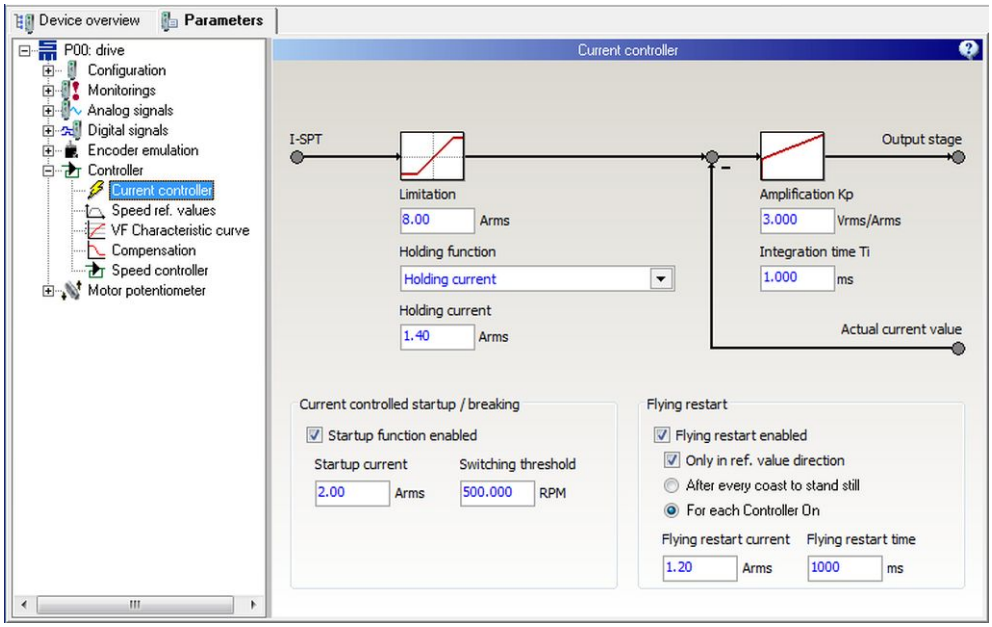
The speed controller is a bypass controller. Due to its structure it can only operate with an amplification (Kp) in the range of 0.0 to 1.0.

Since the available measuring systems have low dynamics, a very long integration times (Ti) must be set. This is in the range of 128 ms to 1000 ms.

Ideally filter time and integration time are the same.

4.4 Current controller

Via the parameter page "Current controller" the current limitation is set and a holding function is selected. In addition the current-controlled startup and braking and the flying restart are activated and configured here.

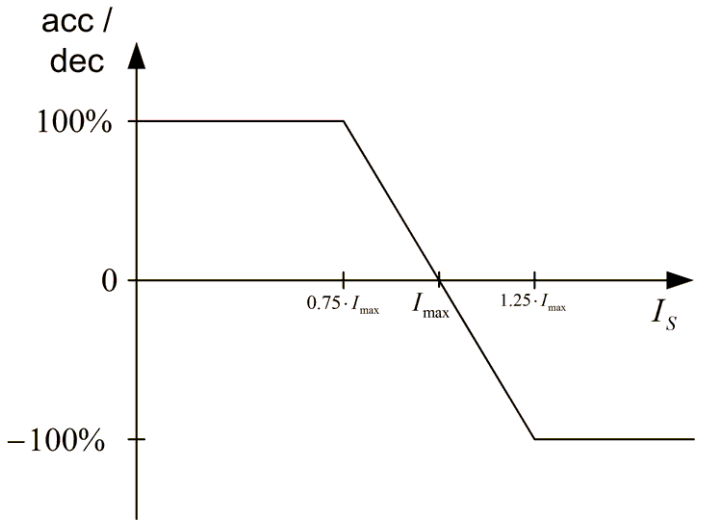


4.4.1 Current limitation

The V/f control works without current control (except for standstill). Thus conventional current limitation is not available. However, the apparent current is indirectly limited by the acceleration and deceleration ramps.

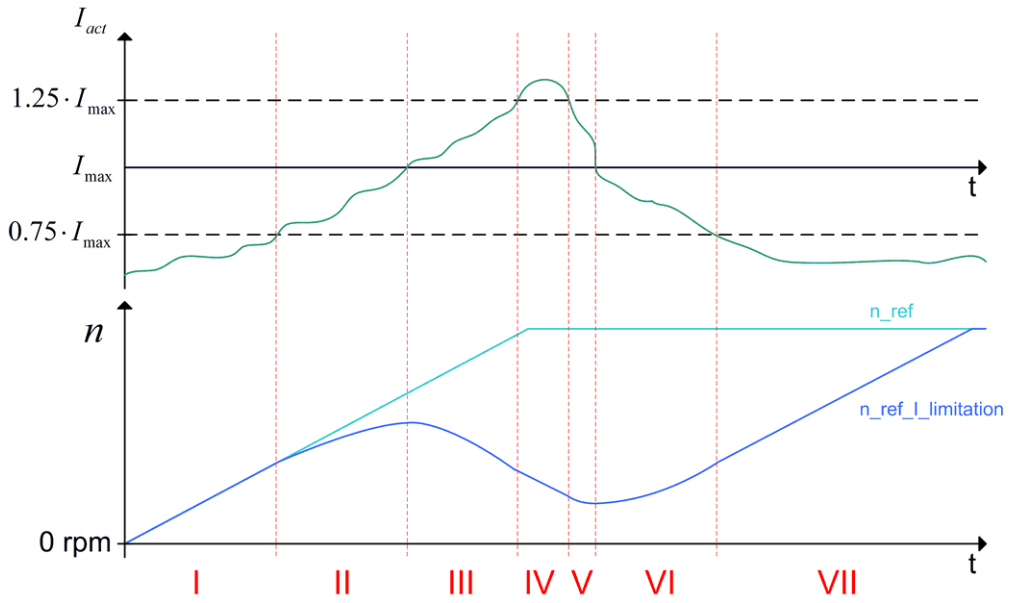
Indirect current limitation means that the actual acceleration is changed depending on the actual current. Thus the reference speed, the speed frequency, the voltage and also the current are limited indirectly.

The following characteristic curve shows the limitation of the acceleration:



The parameter "Limitation" indicates I_{max}. The value is taken from the data entered in the parameter wizard and can be changed, if necessary.

Example



I $I < 0.75 \cdot I_{max}$
Full acceleration is available.

II $0.75 \cdot I_{max} < I < I_{max}$
Acceleration is reduced.

III $I_{max} < I < 1.25 \cdot I_{max}$
The motor is decelerated rather than accelerated.

IV $I > 1.25 \cdot I_{max}$
Full deceleration ramp is active.

V $I_{max} < I < 1.25 \cdot I_{max}$
Reduced deceleration ramp is active.

VI $0.75 \cdot I_{max} < I < I_{max}$
The motor is accelerated again but with reduced acceleration ramp.

VII $I < 0.75 \cdot I_{max}$
Full acceleration is available again.

For deceleration the scheme is vice versa and the motor is accelerated:

Operating state	$I < 0.75 \cdot I_{max}$	$0.75 \cdot I_{max} < I < I_{max}$	$I_{max} < I < 1.25 \cdot I_{max}$	$I > 1.25 \cdot I_{max}$
Acceleration	Full acceleration	Reduced acceleration	Reduced deceleration	Full deceleration
Constant speed	Constant speed	Constant speed	Reduced deceleration	Full deceleration
Deceleration	Full deceleration	Reduced deceleration	Reduced acceleration	Full acceleration

4.4.2 Holding Function

In order to hold the position of the motor during standstill (0 Hz), you can choose one of the modes "Holding current" and "Holding voltage". Both modes can be selected with or without time limit.

Holding current

In the mode "Holding current" a PI current controller induces a voltage at the motor, which then generates the desired current.

The parameterization of the current controller is uncritical. You can always set the amplification Kp to 3 V/A and the integration time Ti to 10 ms.

Holding current with time limit

In the mode "Holding current" a PI current controller induces a voltage at the motor, which then generates the desired current.

The parameterization of the current controller is uncritical. You can always set the amplification Kp to 3 V/A and the integration time Ti to 10 ms.

After the reference value zero is reached the holding current is limited to a certain time. Its only purpose is to decelerate the motor securely to standstill.

Holding voltage

In the mode "Holding voltage" a current is generated by means of a fix voltage value. The holding current controller is not active in this mode, i.e. there is no current limitation (not even indirect).

The holding voltage can hold the position of the motor permanently.

NOTICE

Holding voltage too high

If you set the value for the holding voltage too high, the current flow in the motor will be too high and possibly causes device damage. One of the following error messages appears:

- E45 – Short circuit in power output stage
- E29 – Motor load too high (Motor I²t)
- E30 – Power output stage load too high (I²t)

If you are not sure of the holding voltage value suitable for your motor, use the function "Holding current".

Holding voltage with time limit

In the mode "Holding voltage with time limit" a current is generated by means of a fix voltage value. The holding current controller is not active in this mode, i.e. there is no current limitation (not even indirect).

After the reference value zero is reached the holding voltage is limited to a certain time. Its only purpose is to decelerate the motor securely to standstill.

NOTICE

Holding voltage too high

If you set the value for the holding voltage too high, the current flow in the motor will be too high and possibly causes device damage. One of the following error messages appears:

- E45 – Short circuit in power output stage
- E29 – Motor load too high (Motor I²t)
- E30 – Power output stage load too high (I²t)

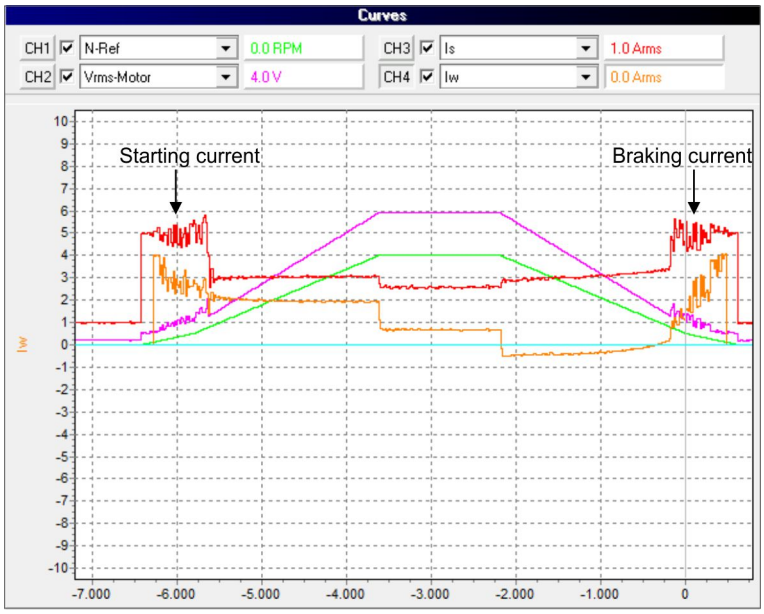
If you are not sure of the holding voltage value suitable for your motor, use the function "Holding current".

4.4.3 Current-controlled Startup / Braking

At lower speeds the voltage generated by means of V/f characteristic curve is often not sufficient to impress full magnetizing current. For this reason a fix starting current can be impressed for acceleration and deceleration in the low speed range.

The starting current should be set to a value between magnetizing current and rated current. In addition a speed threshold for switching to V/F characteristic curve must be entered.

Current-controlled starting and braking during V/f operation:



4.4.4 Flying Restart

If the controller is activated when the spindle is not at standstill but coasts down, the spindle is decelerated to speed zero first. In the worst case, the error E45 "Short circuit in power output stage" is triggered. In order to avoid this behavior, the spindle can be restarted at the actual position.

"Flying restart" means that the actual spindle speed is determined and the new target speed is reached from that point.

Typical values:

- Flying restart current = 50 % of the rated current
- Flying restart time = 1000 ms
  If a measuring system is configured, the actual speed is not determined but directly applied from the measuring system. Thus, no time is lost by searching for the actual speed value.

The function "flying restart" can only work properly, when the current controller is configured correctly.

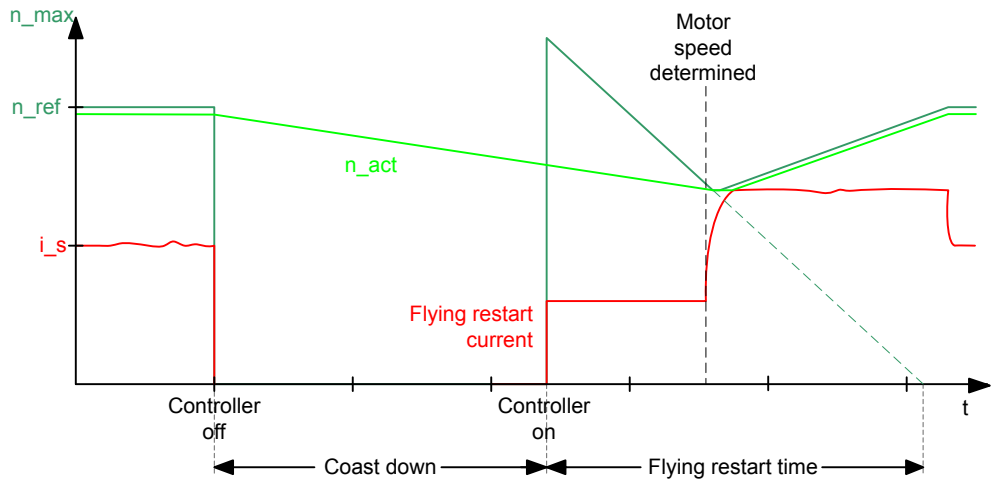
You can set the following configurations for the "flying restart":

Configuration	Description	t_{min}	t_{max}
☐ Only in ref. value direction ○ After every coast to standstill ◉ For each Controller On	Flying restart is executed each time after activating the output stage.	0	2 × $t_{flying\ restart}$
☐ Only in ref. value direction ◉ After every coast to standstill ○ For each Controller On	Flying restart is executed each time the spindle was stopped by coasting to standstill.	0	2 × $t_{flying\ restart}$
☑ Only in ref. value direction ○ After every coast to standstill ◉ For each Controller On	Flying restart is executed each time after activating the output stage. But the controller searches for the actual speed only in the direction of the actual reference value.	0	$t_{flying\ restart}$
☑ Only in ref. value direction ◉ After every coast to standstill ○ For each Controller On	Flying restart is executed each time the spindle was stopped by coasting to standstill. But the controller searches for the actual speed only in the direction of the actual reference value.	0	$t_{flying\ restart}$

The spindle only coasts to standstill on controller switch-off, when this reaction is configured on the parameter page "Drive control" in "Behaviors in case of … 'Controller off' command". Select the entry "Shutdown (The motor coasts to standstill)" in the list box.

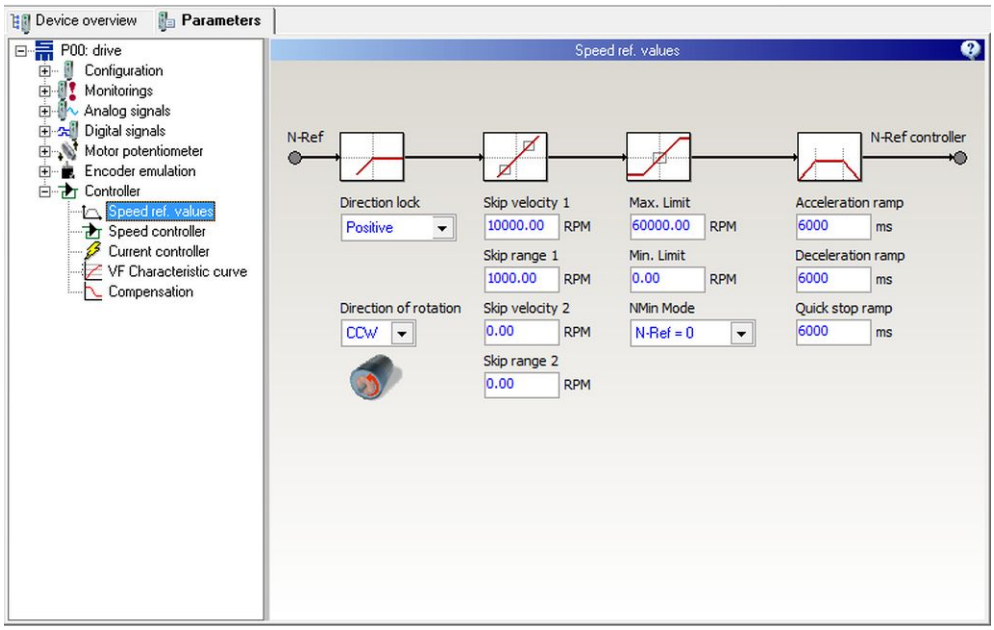
After controller switch-off please do not deactivate the motor relays until the message "M01 – Message power output stage ready" is reset.

Functional sequence of "flying restart":



4.5 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 rotation for rotary motors:
- 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

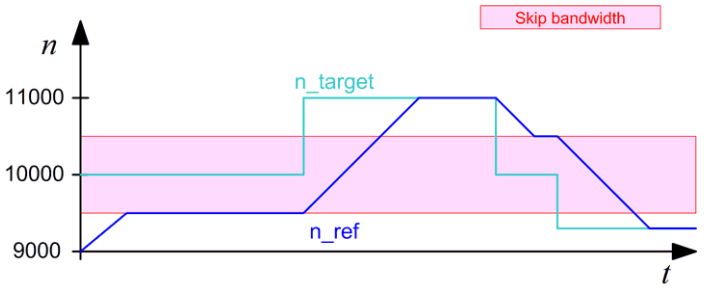
If only one direction of the motor is permitted, you can lock the other direction via this parameter. The following settings are available:
- None: Both positive and negative speed values are passed to the motor.
- Positive: Positive speed values are not passed to the motor.
- Negative: Negative speed 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 speed: 10000 rpm
- Skip range: 500 rpm
- max. admissible speed below skip speed = 9500 rpm
- min. admissible speed above skip speed = 10500 rpm

Speed reference values within the skip bandwidth (9500 – 10500 rpm) are suppressed:



Max. limit

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

Min. limit

The parameter indicates the minimum possible 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.

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. 6000 ms together with a speed scaling of 60000 rpm makes a maximum acceleration of 167 1/s² or $\frac{10000\ 1/\text{min}}{\text{s}}$.

- 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)

In the range of 0 to 6.25 % of the speed scaling the ramp times are doubled automatically, that means the acceleration or deceleration is cut by half.

5 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.
		Wiring of motor measuring system is faulty.	Correct the wiring of the motor measuring system according to the data sheet.
		Software: Bit for direction of rotation is set wrong.	Change parameter "Direction of rotation" (CW/CCW) in *drivemaster2* (parameter page "Speed controller").
		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 or slip too high (only for synchronous motors)	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.
		Wiring of motor measuring system is faulty.	Correct the wiring of the motor measuring system 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.
–	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.

5