7 Functions

7.1 Basic functions

7.1.1 Time slots

The microprocessor system processes the function blocks sequentially. Each function block requires a certain calculating time and must be re-processed within a specified time. The microprocessor system therefore makes different times available to each individual function block. These times are designated as time slots.

A time slot is the period of time within which all output values of a function block are newly calculated.

NOTE

The following texts refer to function diagram 702 "Setting and monitoring the sampling times and sampling sequence".

The terms "Time slot" and "Sampling time" have a synonymous meaning in the documentation and are interchangeable.

7.1.1.1 Time slots T2 to T20

T2 represents the shortest possible time slot within which a function block can be processed. The sampling time T0 is set in parameter P357.

T2 = T0 = P357

The sampling time T0 forms the basis for all further time slots.

The time slots T3 to T10 and time slot T20 are available in addition to time slot T2. The time slots T3 to T10 are derived from the time slot T0.

Time slot T20 is used as an archive for function blocks which are not needed. Function blocks stored in time slot T20 are not processed.

Overview of the time slots

Time slot *)	Dependency on T0	Duration in ms
T2	T0	1.2
T3	2 x T0	2.4
T4	4 x T0	4.8
T5	8 x T0	9.6
T6	16 x T0	19.2
T7	32 x T0	38.4
T8	64 x T0	76.8
T9	128 x T0	153.6
T10	256 x T0	307.2
T20	none	archive

*) Value for P2950, P2951, P2952, P2953

7.1.1.2 Processing sequence

The time slots are processed in the sequence of their priority, whereby time slot T2 has the highest priority and time slot T10 the lowest priority. Each higher-priority time slot can interrupt a lower-priority time slot.

The sequence control of the converters and inverters starts every time slot automatically. If a higher-priority time slot is started, although another time slot is being processed, the time slot having the lower priority will be stopped and the time slot having the higher priority will then be processed before the interrupted time slot can be further processed.

Lower-priority time slots are lined up in a queue and are not processed until all higher-priority time slots are finished.

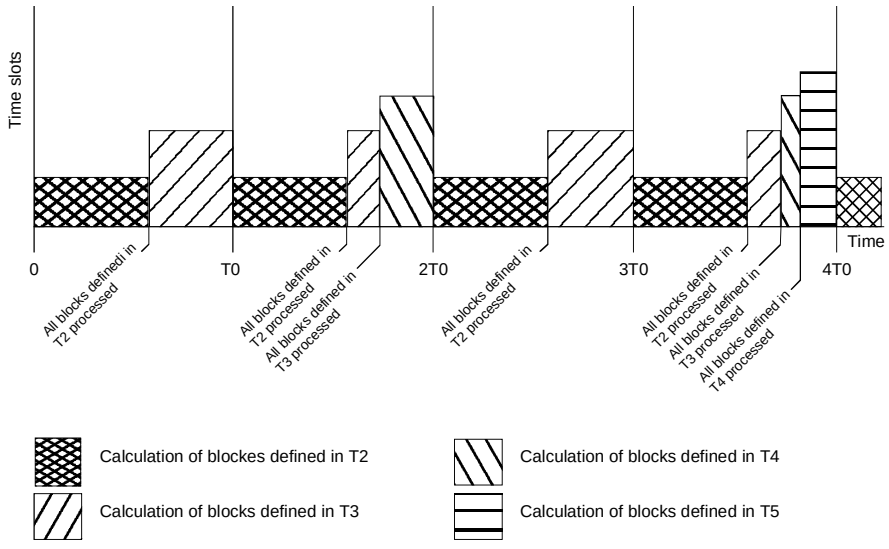


Fig. 7-1 Processing sequence of the time slots

7.1.1.3 Assignment of function blocks to time slots

To enable function blocks to carry out processing, a time slot (sampling time) must be assigned to each function block. Assignment is carried out by parameterizing in a table.

Time slot table

The time slot table consists of parameters U950 to U953. These parameters are indexed and have 100 indices each. Each index is assigned to precisely one function block. This means that the time slot in which the relevant function block is to be processed can be entered in the respective index.

The following applies regarding the assignment of the function block number to the parameter number with index:

Parameter number	Parameter index	Assigned function block
U950	001 ... 098 099	1 ... 98 99
U951	001 ... 098 099	101 ... 198 199
U952	001 ... 098 099	201 ... 298 299
U953	001 ... 098 099	301 ... 398 399

The following assignment applies regarding the parameterization of time slots in parameters U950 to U953:

Time slot	Parameter value
T2	2
T3	3
T4	4
T5	5
T6	6
T7	7
T8	8
T9	9
T10	10
T20	20

Examples:

1. Function block 350 should be processed in time slot T4:
   U953.50 = 4
2. Function block 390 should be processed in time slot T9:
   U953.90 = 9
3. Function block 374 should not be processed:
   U953.74 = 20

NOTE

When the units are delivered, time slots are already assigned to the function blocks. You should adjust these to suit your requirements once you have determined the interconnection of the function blocks.

7.1.2 Processing sequence of the function blocks

7.1.2.1 Time monitoring

Depending on the number and frequency of the blocks to be processed, the microprocessor system of the units has a varying degree of utilization. In order to avoid any dangerous overloading, the operating system has a time monitoring facility which

- monitors the system for its overall workload,
- monitors the various time slots to ensure they are being completely processed within the allocated time,
- generates a fault message if the calculating time for T2, T3, T4, T5 is not adequate and
- generates an alarm message if the calculating time for T2 to T7 is not adequate.

7.1.2.2 Influencing the time response

The time response affects two different areas:

- Calculation workload
- Control response

Calculation workload

You can influence the calculation workload as follows:

- By changing the sampling time P357. With a short sampling time, less calculating time is available per time slot. With a long sampling time, more calculating time is available per time slot.
- By assigning function blocks to different time slots.

If you assign too many function blocks to one time slot, it is no longer possible to process all function blocks within the specified time. The time monitoring facility generates an alarm message and de-energizes the unit if the alarm occurs repeatedly.

Control response

- You can influence the control response as follows
- By changing the sampling time P357. With a short sampling time, the reaction time is reduced. With a long sampling time, the reaction time is extended.
- By assigning function blocks to other time slots.
- By changing the processing sequence.
- By changing time-relevant parameters.

If you assign a function block to a slow time slot (e.g. T10), the result of this function block is only seldom re-calculated, i.e. the long processing time acts on the control circuit as a delay element. If you change the processing sequence of two consecutive function blocks by having an output block calculated before the associated input block, you will have integrated a delay element of the duration of one time slot into the control circuit.

Rules

You should observe the following rules regarding the assignment of function blocks to the time slot table and the processing table:

- Function blocks which can be combined to form a function group (with a mutual task) should be processed in the same time slot.
- Function blocks should be processed in the fastest necessary time slot, not in the fastest possible time slot.
- The sequence in which the function blocks are entered in the processing table should correspond to the signal flow.

7.2 Converter functions

7.2.1 Automatic restart (WEA)

Description

The automatic restart function (WEA) can be used for automatic fault acknowledgement and for automatic restart of the unit after a power failure has occurred (F006 "DC link overvoltage" and F008 "DC link undervoltage") as well as to permanently activate the "Flying restart" function, without the need for the operating personnel to intervene.

Please refer to the "Faults and Alarms" chapter regarding the fault messages F006 "DC link overvoltage" and F008 "DC link undervoltage".

Parameters for setting the automatic restart function (WEA)

P373.M WEA
Value range: 0 to 13

P373 = 0 WEA is inhibited.

P373 = 1 Only reset after power has been restored after power failure.

The fault message F008 "DC link undervoltage" (power failure) is acknowledged if this did not occur for an OFF or JOG command or for motor data identification MOTID.

The automatic restart function does **not** automatically switch on the converter.

P373 = 2 Restarting the drive after restoration of power.

The fault message F008 "DC link undervoltage" (power failure) is acknowledged if this did not occur for an OFF or JOG command or for motor data identification MOTID.

Once fault reset has occurred, the unit has to wait in the "Switch-on inhibit" status (008) for the wait time (P374) to elapse before the WEA function automatically restarts the unit.

If the flying restart function has been activated via the control word bit 23, the wait time (P374) is ignored.

The unit is only restarted if the ON command (control word bit 0) is still present once the power has been restored.
Therefore, the automatic restart function is not possible with a parameterized ON command (control word bit 0) via PMU or OP1!

P373 = 3 The drive is always powered up with automatic flying restart

As in the case of P373 = 2, however, the flying restart function is always activated irrespective of the control word bit 23.

The wait time (P374) is ignored.

Flying restart is activated every time the unit is switched on, even if no power failure has occurred beforehand!
A description of the additionally necessary settings for the flying restart function is contained in the "Flying restart" section.

P373 = 4 to 10 reserved

P373 = 11,12,13 Function as for P373 = 1, 2, 3, but the fault F006 "DC link overvoltage" is reset.

P374.M WEA wait time
Value range 0 s to 650 s

Wait time between recovery of power and restart of the converter when the automatic restart function is activated.

The wait time is not effective if P373 = 3, 13 or if control word bit 23 is set.

Alarm A065 (Auto restart active)

The alarm is set after a power failure when automatic restart is active, and is reset after switch-on of the unit and completion of precharging.

When the unit is restarted by the automatic restart function, the precharging time is not monitored, with the result that fault F002 "DC link precharging" cannot occur.

The unit can also be manually shut down during this switch-on phase by an OFF command (see Chapter "Faults and Alarms").

Special cases

- If the unit has an external aux. power supply, a fault is acknowledged and the unit is restarted dependent on parameter P373 even though there is still a power failure!
  The alarm A065 "Auto restart active" is continuously present until power has been restored!
- If other faults have occurred at the same time as fault message F008 "DC link undervoltage" (power failure), these are also acknowledged dependent on parameter P373!
- If the "Kinetic buffering" function is also activated, when the power fails, this is first executed before fault trip F008 occurs and before automatic restart intervenes.

WARNING

During power failures and activated automatic restart function (P373 = 2, 3, 12, 13), the unit can automatically restart when power is restored and after expiry of the wait time P374 (does not apply if the flying restart function is activated).

For this reason, the drive could be at a standstill for a long period of time and could be accidentally mistaken for being switched off.

If the drive area is approached when the drive is in this status, death or severe bodily injury or material damage could occur.

NOTICE

If the flying restart function is not activated and P373 = 2, overload trip F011 could occur or the motor could be suddenly braked when the unit is restarted and the motor is still rotating!
Thus, the wait time P374 must be selected high enough to ensure that the motor comes to a standstill before the switch-on command!

7.2.2 Kinetic buffering (KIB) (function diagram 600)

Description

The kinetic buffering function allows brief power failures to be buffered by utilizing the kinetic energy (i.e. inertia) of the connected load.

In this case, the frequency is controlled (closed-loop) so that the system losses are covered by a regenerative motor operation.

Function diagram 600 shows how kinetic buffering operates.

As the losses remain during the power failure, the converter output frequency has to be lower. The thus reduced speed must be taken into account.

When the supply returns, power is fed in from the supply and the converter output frequency returns to the selected reference frequency via a ramp-function generator function.

As long as the KIP function is switched in, the message **"KIB active"** is set by **status word bit 15**.

Parameters for setting the KIB function

P517.M KIB FLR
Value range 0 to 3

0	Kinetic buffering is not released.
1	Kinetic buffering is released.
2, 3	Flexible response is released.

P518.M KIB initiation points
Value range 65 % to 115 %

This parameter enables the KIB switch-in threshold to be set between 65 % and 115 %.
The switch-out threshold lies 5 % above the switch-in threshold (see chapter "Function diagrams").

For frequency / speed / torque control (P100 = 3, 4, 5), the drive is tripped with fault message F008 "DC link undervoltage" if:

- 61 % Vd rated is fallen short of
- or 10 % of the rated motor frequency (P107) is fallen short of
- or only for frequency control (P100 = 3): the control mode changes into the "current model" range
  (B0253 from 1 "EMF model" to 0 "Current model")

NOTE

For kinetic buffering, values for P518 > 90 % only make sense if an Active Front End (AFE) is used as the rectifier/regenerative unit.

P519.M Dynamic response of the KIB controllers
Value range 0 % to 200 %

This parameter enables the response of the PID controller to be influenced.

The factory setting is 25 %. At 0 % the KIB function is switched off.

The controller output can be visualized via connector K0270 or K0271.

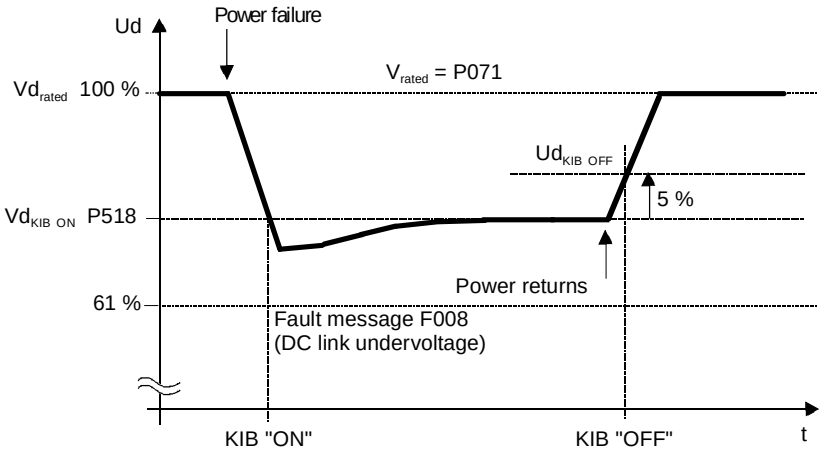


Fig. 7-2 Switch-in/switch-out threshold

$$Vd_{KIB\,ON} = P518 \times Vd_{rated}$$

Presetting: P518 = 76 %

$$Vd_{KIB\,OFF} = (P518 + 5\,\%) \times Vd_{rated}$$

Presetting: at P518 = 76 % ⇒ 81 %

$$Vd_{rated} = 1.315 \times P071$$

Parameters P520, P521 and P522 may only be adjusted by the service personnel.

7.2.3 Flexible response (FLR) (function diagram 605)

Description

With this function, the unit can continue to be operated during supply dips up to a minimum DC link voltage of 50 % of the rated value. The maximum converter output is decreased according to the current supply voltage during a voltage dip. If the "Flexible response" function is enabled, the modulation depth is limited to the range of asynchronous space vector modulation (reduction of the max. output voltage).

Function diagram 605 shows how the flexible response function operates.

NOTE

The maximum modulation depth can be taken from parameter r345. The maximum output voltage at the current operating point can be read off at parameter r346.

The message **"FLR active"** is set via the status word bit 15 as long as the FLR function is active.

Preconditions

A line commutating reactor of 4 % must be provided.

The power supply of the electronics must be ensured by an external 24 V supply at connector -X9 (see description of unit).

Thus, if an external main contactor is present, care must be taken to ensure that it does not drop out during a voltage dip.

When the power returns, it is not permissible that the voltage increases 50 % to 100 % of its rated value in less than 5 ms.

A maximum of 10 dips per hour are permitted to occur, with a minimum of 10 seconds time between them.

WARNING

Non-observance of the above can result in malfunctions or in destruction of the unit.

During a supply voltage dip, the available output of an induction motor is reduced

- approximately linear for operation with vector control,
- over-proportionally for operation with one of the V/f operating modes (P100 = 0, 1, 2)

Parameters for setting the flexible response function

P517.M KIB/FLR
Value range 0 to 3

0: Flexible response is disabled.

1: Kinetic buffering is released.

2: Flexible response is released with v/f = const.

3: Flexible response is released with f = const. (only for v/f characteristic mode P100 = 0, 1, 2).

P518.M FLR switch-in points
Value range 65 % to 115 %

This parameter enables the FLR switch-in threshold to be set between 65 % and 115 %.
The switch-out threshold is 5 % above the respective switch-in threshold (see chapter "Function diagrams").

NOTE

For flexible response, values for P518 > 90 % are not practical as otherwise the function may not be able to be switched out. If an Active Front End (AFE) is used as a rectifier/regenerative unit, the FLR function is automatically contained in the AFE.

P519.M Dynamic response of FLR
Value range 0 % to 200 %

This parameter enables the response of the PID controller to be changed.

The FLR controller is only released for v/f open/closed-loop control modes (P100 = 0, 1, 2) and P517 = 2.

The controller ensures that the v/f ratio remains constant. During a voltage dip, the output frequency of the converter and thus the speed of the motor can be reduced.

The factory setting is 25 %.

The controller output can be visualized via connector K0270 or K0271.

P523 FLR Vdmin
Value range 50 % to 76 %

This parameter enables the voltage threshold for fault message F008 (DC link undervoltage) to be reduced from 76 % (factory setting) down to 50 % (see chapter "Function diagrams").

P602 Excitation time
Value range 0.01 s to 10.00 s

If field weakening is achieved during a voltage dip, the output voltage is ramped-up which corresponds to twice the excitation time in the V/f control modes (P100 = 0, 1, 2) when the power returns. The excitation time is calculated during automatic parameterization (P115 = 1) and motor data identification (P115 = 2, 3).

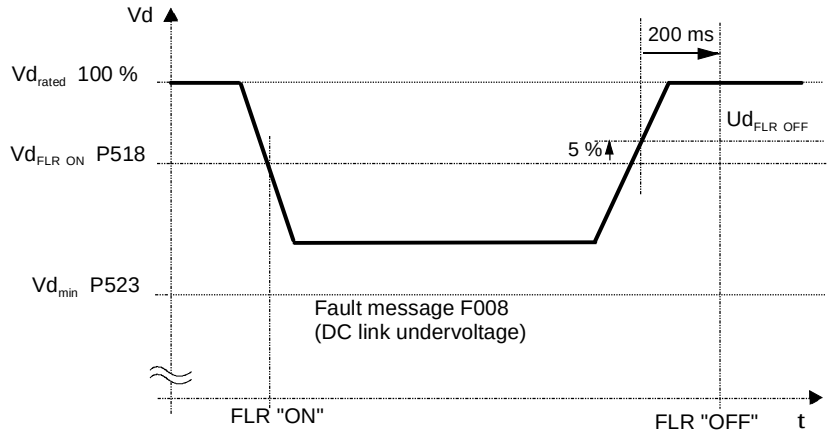


Fig. 7-3 Flexible response

$$Vd_{FLR\ ON} = P518 \times Vd_{rated}$$

Presetting: P518 = 76 %

$$Vd_{FLR\ OFF} = (P518 + 5\,\%) \times Vd_{rated}$$

Presetting: at P518 = 76 % $\Rightarrow$ 81 %

$$Vd_{FLR\ min} = P523 \times Vd_{rated}$$

$$Vd_{rated} = 1.315 \times P071$$

ParametersP520, P521 and P522 may only be adjusted by the service personnel.

7.2.4 Vdmax closed-loop control (function diagram 610)

Description

The Vdmax closed-loop control function allows briefly occurring regenerative loading to be handled without the unit shutting down with fault message F006 "DC link overvoltage". In this case, the frequency is controlled (closed-loop) so that the motor does not excessively enter over-synchronous operation.

For a steady-state load, the converter output frequency must increase. If a regenerative load exists for too long, the unit is shut down with F006 when the maximum frequency is reached (452, P453).

If regenerative loading occurs when the machine is decelerating too quickly (P464), this is automatically reduced so that the converter is operated at the voltage limit.

Function diagram 610 shows how the Vdmax closed-loop control function operates.

The Vdmax closed-loop control is also optimally suited for regenerative operation, which can occur when the speed stabilizes at the end of ramp-up.

Parameters for setting the Vdmax closed-loop control

P515.M Vdmax controller
Value range 0 and 1

0: The Vdmax controller is inhibited.
1: The Vdmax controller is released.

P516.M Dynamic response of the Vdmax controller
Value range 0 % to 200 %

This parameter enables the response of the PID controller to be influenced.

At 0 %, the Vdmax controller is shut down.

The factory setting is 25 %.

The controller output can be visualized via connector K0270 or K0271.

Alarm A041 "Vdmax controller inhibit"

The line voltage is too high or the converter supply voltage (P071) is incorrectly parameterized. The Vdmax controller is inhibited despite the parameter enable (P515 = 1), as otherwise the motor would immediately accelerate in operation to the maximum frequency.

The switch-in threshold for disabling the Vdmax controller is calculated as follows:

$$V_{d\,Max\,ON} = 119\% \times \sqrt{2} \times V_{supply,rated} = 168\%\ V_{supply,rated}$$

$V_{supply,\,rated} = P071$ for AC/AC converters and

$$V_{supply,\,rated} = \frac{P071}{1{,}315} \text{ for DC/AC converters}$$

Parameters P520, P521 and P522 may only be adjusted by the service personnel.

7.2.5 DC current braking (DC brake) (function diagram 615)

Description

The DC current braking function allows the drive to be brought to a standstill in the shortest possible time. To realize this, a DC current is impressed in the motor windings, which, for an induction motor, results in a very high braking torque.

NOTICE

The "DC current braking" function is only practical for induction motors!

With the DC current braking function, the kinetic energy of the motor is converted into heat **in the motor.** The drive could overheat if it remains in this status for an excessive period of time!

Function diagram 615 shows how the DC current braking function operates.

Parameters for setting the DC current brake function

P603.M De-excitation time of the motor
Value range 0.01 s to 10.00 s

This parameter enables the minimum delay time between pulse inhibit and pulse enable to be set. This is to ensure that the motor is de-magnetized to at least 90% upon pulse enable.

The parameter is preset during automatic parameterization and motor data identification.

P395.M DC brake on/off
Value range 0 to 1

0: DC brake is not activated.

1: With the OFF3 command (quick stop), DC current braking is carried out.

P396 DC braking current

This parameter enables the setpoint current which is impressed for DC braking to be set. A maximum of 4 times the rated motor current can be entered.

P397.M DC braking duration
Value range 0.1 s to 99.9 s

This parameter enables the duration of DC current braking to be set.

P398.M Frequency at which DC braking commences
Value range 0.1 Hz to 600.0 Hz

With an OFF3 command, DC current braking is commenced at this frequency.

Sequence

- The DC brake is activated using the OFF3 command.
- The converter ramps along the parameterized OFF3 ramp (P466.1) down to the start of DC braking frequency (P398). Thus, the kinetic energy of the motor can be reduced without potentially endangering the drive. However, if the OFF3 deceleration time (P466.1) is selected too low, there is a potential danger that the drive could be faulted by a DC link overvoltage (F006).
- The inverter pulses are inhibited for the duration of the de-excitation time (P603).
- The required braking current (P396) is then impressed for the set braking duration (P397)
- The converter changes to the SWITCH-ON INHIBIT (008) or READY TO SWITCH ON (009) state.

7.2.6 Flying restart (function diagram 620)

Description

This function offers the possibility of connecting the converter to a motor which is still rotating. If the motor were to be switched on without the flying restart function, an overcurrent condition would occur, as the flux in the motor first has to be built up and the open/closed-loop control has to be set to the speed of the motor.

NOTE

It is not possible to implement a flying restart function for multi-motor drives as the motors have different run-down characteristics.

The following is executed, depending on whether a tachometer is enabled.

7.2.6.1 Flying restart without tachometer (with search) (P130 = 0)

NOTE

The "Flying restart without tachometer" (search) function is only practical for induction motors!

For "Flying restart without tachometer", the "standstill test" generates a braking torque which can cause drives with low moments of inertia to be decelerated!

Description

- A standstill test (DC current is briefly impressed) is executed after the de-excitation time (P603) has expired after the supply returns with active WEA (see section "Automatic restart function") or since the last shutdown time with "OFF2" command (inverter inhibit). The standstill test can be shut down with P527.1 = 0 %.
- If it is identified that the motor is at standstill, excitation and acceleration are started as for a standard start.

- If a motor standstill has not been identified, searching is started with the maximum frequency, clockwise rotating phase sequence (P452); if only COUNTER-CLOCKWISE phase sequence is selected (see section "Control word"), searching starts with the maximum frequency, clockwise rotating phase sequence (P453).
- The search frequency is linearly reduced down to 0 Hz, more specifically, by the parameterizable search speed **P526** (in Hz, referred to the time interval of 1 second). In this case, the parameterizable search current **P525** is impressed.
  At P100 = 3 (frequency control), the implemented search current is limited to two times the rated magnetizing current (r119).
  - **P100 = 1** or **2** (V/f characteristic):
    The converter reference output voltage necessary for the search current is compared with the voltage of the V/f characteristic corresponding to the search frequency.
    If the motor frequency is found using this evaluation function, the search frequency is kept constant and the output voltage is changed to the voltage of the V/f characteristic with the excitation time constant (dependent on the excitation time P602)
  - **P100 = 3** (Frequency control):
    The converter reference output voltage necessary for the search current is compared with the search frequency corresponding to the EMF setpoint.
    If the motor frequency is found using this evaluation function, the search frequency is kept constant and the flux setpoint is changed to the rated flux with the excitation time constant (dependent on the excitation time (P602).
- Then the ramp-function generator is set to the search frequency.
  If the ramp-function generator cannot be set as the supplementary setpoint is too high, the converter is shut down with **fault F018** "Ramp-function generator could not be set during flying restart".
  Otherwise, the FLYING RESTART status (013) is exited and the motor is operated at the actual reference frequency (via the ramp-function generator).
- If the motor is not found, a standstill test at 0 Hz search frequency is re-executed and a search started in the other direction of rotation, with the rotating field enabled. If this search is also unsuccessful, switch-in is with 0 Hz.

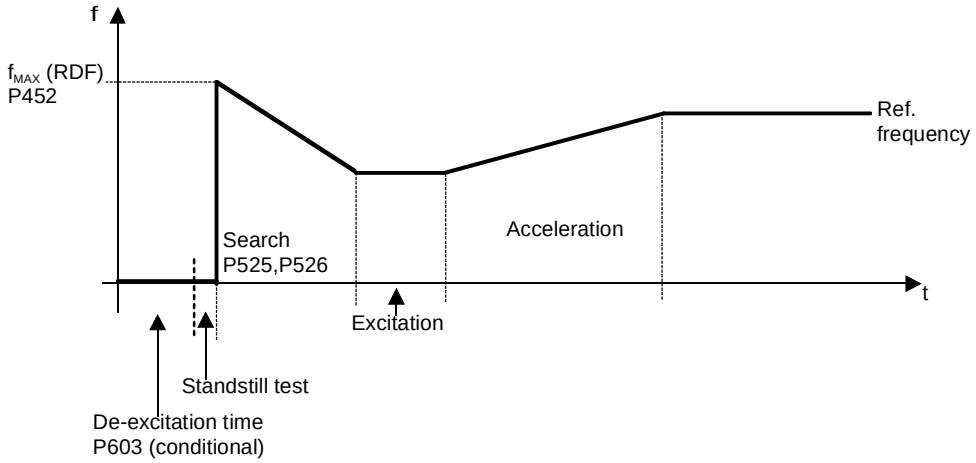


Fig. 7-4 Flying restart

7.2.6.2 Flying restart with tachometer (P130 <> 0)

Description

- After the de-excitation time (P603) has expired, afte the supply returns with activated WEA (see section "Automatic restart function) or since the last switch-off instant with "OFF2" command (Inverter inhibit), then:
  - For V/f control. the converter output voltage is increased linearly from 0 to the V/f characteristic value (determined from the measured smooth speed actual value within the excitation time (P602).
  - For vector control, the necessary magnetizing current is built up within the excitation time (P602).
- After the excitation time P602 has expired, the ramp-function generator is set to the smoothed speed actual value.
  If it is not possible to set the ramp-function generator, because the supplementary setpoint is too high, the converter is shut down with **fault F018** "Ramp-function generator could not be set during flying restart".
- Otherwise, the status FLYING RESTART (013) is exited and the motor is operated at the current reference frequency (via the ramp-function generator).
- For torque control (P100 = 5) or slave drive (see P587), the motor is operated at the current torque setpoint.

7.2.6.3 Parameters for setting the flying restart function

P583.B Flying restart enable
Value range 0 to 1

0: Flying restart is not enabled.
1: Flying restart is enabled with every ON command.

Exception: P373 = 3 or 13
The functions **Automatic restart and flying restart** (without taking into account the control word command "Flying restart enable" (bit 23)) are always activated.

Only for flying restart without tachometer (with search) (P130 = 0):

P525.M Flying restart search current
For V/f characteristic max. 4 times the rated motor current
For frequency control max. 2 times the magnetizing current (r119)
is implemented.

Setpoint of the impressed current when searching for the motor
Presetting via automatic parameterization.

P526.M Flying restart search speed
Value range 0.1 Hz to 100.0 Hz

Ramp gradient with which the frequency is changed when searching (in Hz, referred to 1 second).

The message **"Flying restart active"** is set via **status word bit 16** as long as the flying restart function is active.

WARNING

With the "Flying restart without tachometer" function (P373 = 3 with WEA or control word bit 23), the drive may suddenly accelerate as a result of the search current in spite of the fact that the drive is at a standstill and a 0 Hz setpoint!

Death, severe bodily injury or material damage can occur if the drive area is entered.

Standstill identification

Standstill identification can be optimized with P527 (r524) (only for service personnel). The standstill test can be deactivated with P527.1 = 0 % when the "flying restart without tachometer" function is active.

7.2.7 Temperature adaptation (function diagram 430)

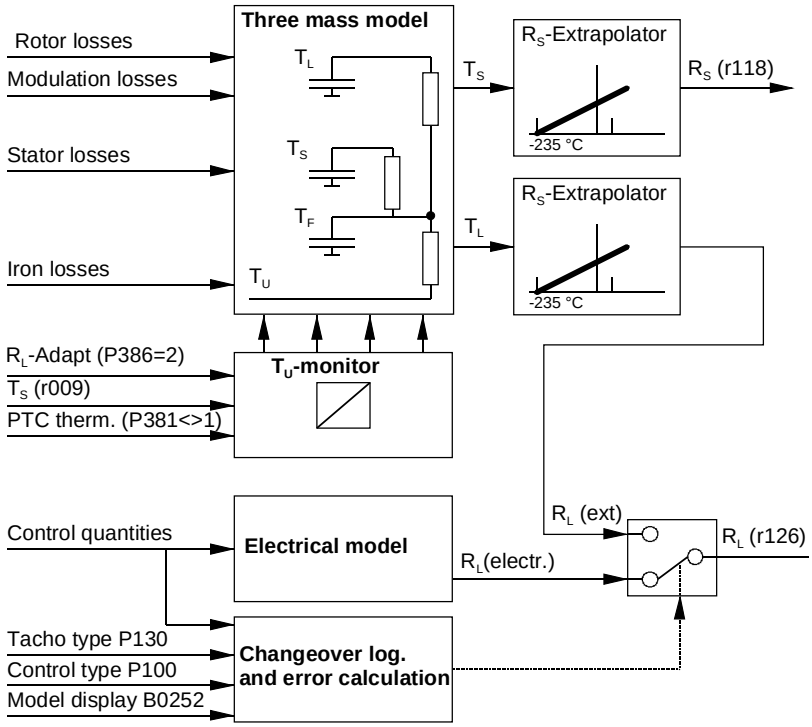


Fig. 7-5 Structure of temperature adaptation

Description

Temperature adaptation is used in order to reduce the torque error for n/f/T closed-loop control or speed errors for frequency control, which result from the temperature dependency of the stator and rotor resistances.

The resistances are calculated using a complex thermal three-mass model and, depending on the operating status, with an electrical motor model.

Temperature adaptation can be activated for the three closed-loop vector control types (P100 = 3, 4, 5).

The electrical model only operates for closed-loop speed/torque control (P100 = 4, 5) and if there is a pulse tachometer (P130 = 11, 12, 15, 16). In this case, the following error correction P217 should be activated.

Parameters for setting temperature adaptation

Basic settings

P386 RotResistTmpAdap
Value range 0 to 2

Temperature adaptation of the rotor and stator resistances.

0: Adaptation not active

1: Adaptation without measuring the stator temperature

2: Adaptation with KTY84 sensor available (connected to customer terminal X103 of the CU)

For the temperature measurement (**P386** = 2), the measurement quantity is displayed in **r009 (K0245).** A temperature sensor should be used if high demands are placed on the torque accuracy.

The motor temperature can also be read in via the connection in **P385** from an external measurement point (1 °C = 80 hex).

P387 (motor series) can be adjusted after adaptation is activated (**P386** > 0). If the motor is included in the listed motor series, this should be selected. It is then automatically determined whether the motor has an internal fan and which temperature rise of the motor series it corresponds to. Parameters **P388, P389, P390, P391** and **P392** are then suppressed.

P387	Motor series		Internal fan (P389)	Temperature rise (P390)	Temperature rise of rotor (P391)
1	1LA5 / 1LA7	⇒ determination	no	100 %	100 %
2	1LA6	⇒ determination	no	100 %	100 %
3	1LA8	⇒ determination	yes	100 %	100 %
4	1LA1	⇒ determination	yes	100 %	100 %
5	1PH6	⇒ determination	no	130 %	100 %
6	1PH7 (=1PA6)	⇒ determination	no	130 %	100 %
7	1PH4	⇒ determination	no	105 %	105 %
0	Unlisted motor	no determination	---	----	----

An unlisted motor is considered to be a motor from another manufacturer (**P387** = 0). Parameters **P388, P389, P390, P391** and **P392** have to be manually entered in this case (see special settings).

P388.M Motor weight
Value range 5 kg to 9999 kg

Total weight of the motor

The motor weight is estimated during automatic parameterization and before motor identification from the motor output and the pole pair number. It can be taken from the motor catalog for a more accurate calculation (if necessary, correct after automatic parameterization or MotId).

If **P387** is reset for a known motor series, the motor weight **P388** is kept for the calculation.

P392.M Pv (iron)
Value range 0.05 % to 10.00 %

Iron losses

The iron losses are calculated during automatic parameterization and before motor identification and refer to the apparent motor output.

The ambient temperature at the time of motor identification **(P115 = 2, 3)** has to be entered in **P379.**

P382.M Motor cooling
Value range 0 to 1

0: Naturally ventilated

1: Force ventilated (internally automatically assumed, if **P387** = 5, 6, 7)

After the temperature adaptation has been activated (**P386** = 1 or 2) and parameters **P387** to **P392** and **P379** and **P382** have been assigned, a motor identification (**P115** = 2, 3) must be carried out in order to determine the current rotor and stator resistance.

For a more accurate adaptation of the stator resistance - especially in the case of long feeder cables - before motor identification, the feeder cable resistance **P117** = Rcable has to be entered, referred to the rated motor impedance.

$$P117 = R_{cable}\ [\Omega] \times \frac{1.72 \times P102\,[A]}{P101[V]}$$

When temperature adaptation is active (**P386** > 0), the parameters **P127** "Temperature evaluation of rotor resistance" and **P121** "Stator and feeder cable resistance" are blocked for manual access. The adaptation itself sets them. The result is displayed in **r126** and **r118**.

r126 Rotor resistance

r118 Stator resistance (incl. feeder cable resistance **P117**)

At a power failure, the current adaptation values are lost. When the supply returns, the values determined during the last motor identification (**P115** = 1 or 2) for **P127** and **P121** are transferred.

If the adaptation values are to be kept even when there is a power failure, the electronic boards must be fed from a separate power supply.

When exiting adaptation with temperature measurement, the values are not stored because **P127** and **P121** always refer to the ambient temperature **P379**.

It is advisable, and even necessary in the case of adaptation with a temperature sensor, to carry out motor identification with the motor in a cold condition, so that when the converter is powered up after a longer down time the correct presetting is automatically effected. If there is a temperature sensor, the temperature model is then correctly preset even after a power failure.

Special settings

For sinusoidal operation of a motor (online operation or with an output filter **P068** = 1) at the rated operating point (rated load, rated voltage, rated current, rated frequency), increased temperatures are obtained in the rotor and in the stator windings. The difference between these temperatures and the ambient temperature is known as the temperature rise and is indicated in K (Kelvin).

The average temperature rises for the adaptation are set to **100 K** for the rotor and to **80 K** for the stator. For converter operation (pulse frequency 2.5 kHz, no output filter) an average temperature rise for the rotor of **110 K** is assumed.

If parameter **P390** "Temperature rise factor" is to be changed for a motor from a known series (e.g. 1LA5), then **P387 = 0** "Unlisted motor" must be entered so that parameters **P389, P390 a**nd **P391** are accessible. Parameter **P389** "Internal fan" has to be assigned in accordance with the table under "Basic settings".

If the actual temperature rises of the used motor deviate significantly from the average temperature rises, the temperature rise can be corrected with P390 (100 % = average temperature rise).

The factor for correcting the temperature rise can be calculated using the following equation:

$$\text{P390} = \frac{\text{Temp rise of stator}}{80\,\text{K}} \times 100\%$$

In this calculation, the temperature rise of the rotor is automatically corrected with the same error.

$$\text{Rotor temp.rise (converter oper.)} = 110\,\text{K} \times \frac{\text{P390}}{100\%} \times \frac{\text{P391}}{100\%}$$

$$\text{Rotor temp.rise (sinusoidal oper.)} = 100\,\text{K} \times \frac{\text{P390}}{100\%} \times \frac{\text{P391}}{100\%}$$

With P391, it is possible to set the temperature rise in the rotor independent of the temperature rise factor of the stator.

7.2.8 Functions for automatic motor parameterization and identification

Description The functions for automatic motor parameterization and identification are used to determine the motor parameters beyond what is stated on the rating plate.
Open-loop control is performed using parameter P115.
To obtain good closed-loop control behavior of the drive, it is necessary to perform motor identification.

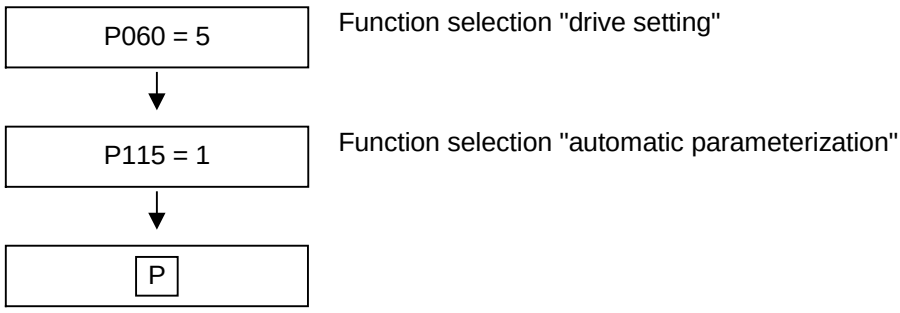
7.2.8.1 Automatic parameterization (P115 = 1)

Function Automatic parameterization is used to preset closed/open-loop control parameters depending on the drive setting (converter and motor data) and open/closed-loop control (P100).

Condition "Automatic parameterization" can only be selected from the state "DRIVE SETTING" (005) or READY TO SWITCH ON (009).

Consequence Only the parameters of the **currently** selected motor data set MDS are assigned default values! If "automatic parameterization" is selected from READY TO SWITCH ON (009), the reference variables (P350, P351, P352, P353, P354) are **not** assigned rated motor default values.

Flowchart (operation via PMU):



The operating display appears while the following parameters are reassigned:

P116	Startup time
P117	R(cable)
P120	Magnetizing reactance
P121	R(stator + cable)
P122	Total leakage reactance
P127	R(rotor) Ktmp
P128	Imax (maximum current value)
P161	i(op., minimum)
P215	Delta n(act.,perm.)
P216	Smoothing n/f feedforward control
P217	Carried-forward error comp.
P223	Smoothing n/f (act.)
P235	n/f controller Kp1
P236	n/f controller Kp2
P240	n/f controller Tn
P258	Pwmax(mot)
P259	Pwmax(gen)
P273	Smoothing Isq(soll)
P274	Isq(set) deg.
P278	M(static)
P279	M(dynamic)
P283	Current controller Kp
P284	Current controller Tn
P287	Smoothing Ud(act)
P293	Field weakening frequency
P295	Efficiency optimization
P303	Smoothing Psi(soll)
P306	EMF(max) controller Ti
P313	f(swit.EMF model)
P315	EMF controller Kp
P316	EMF controller Tn
P319	Current rise
P322	Acceleration current
P325	Voltage rise
P326	Final rise frequency
P334	IxR compensation Kp
P335	Smoothing Isq
P336	Slip compensation Kp
P337	Resonance attenuation Kp
P339	Pulse system enable
P344	Control margin
P347	Valve voltage compensation
P348	Dead time compensation
P388	Motor weight
P392	Pv(iron)
P396	DC braking current
P471	n/f controller feedforward contr. Kp
P525	Restart detection current
P536	n/f controller dynamics(set)
P602	Excitation time
P603	De-excitation time

If the parameter P103 (motor no-load current) has the value 0.0 %, the rated magnetization current is calculated and can then be read via r119. Otherwise the value is retained.

7.2.8.2 Motor identification at zero speed (P115 = 2)

Function

Motor identification at zero speed performs "automatic parameterization", then activates the ground fault test, the test pulse measurement, the leakage measurement, and performs DC measurement to improve the closed-loop control action.
Certain closed-loop control parameters are reassigned as a result.

Condition

"Motor identification at zero speed" can be selected from the state READY TO SWITCH ON (009).

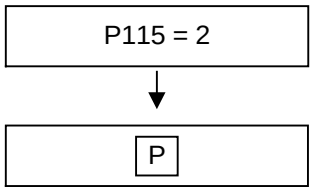
Consequence

- Only the parameters of the **currently** selected motor data set (MDS) are preset!
- "Motor identification at zero speed" can be canceled at any time with an OFF command. The fault message F114 "Measurement canceled" is then triggered.
- To display the current measurement section of the "motor identification at zero speed", you can use the monitoring parameter r377 "Measurement section".
- If a fault occurs during measurement, then the test is canceled with a fault message.
  The fault message (r947) is stored in the fault memory together with the fault value (r949). The fault value describes the cause of the fault in greater detail. The fault messages, fault values, and alarms are described in Chapter "Faults and Alarms".

NOTE

"Motor identification at zero speed" is not possible during operation of the converter with synchronous machines or with converters with a sine filter (option)!

Flowchart (operation via PMU):



Function selection "motor identification at zero speed"

The operating display appears again.

The alarm A078 "Zero-speed measurement following" is output, and the converter must be switched on within 20 s. Otherwise fault shutdown F114 "Measurement canceled" is triggered.

Switching on the converter

The alarm A078 "Zero-speed measurement following" is reset.

WARNING

Inverter pulses are enabled during motor identification at standstill, and the rotor can move into alignment!

The operating display appears while the following steps are executed automatically:

- Call-up of the "automatic parameterization"
- Ground-fault test:

  If the converter is operated in a grounded network, a ground fault of the connected motor (incl. leads) is detected if the ground current > 5 % $\hat{I}_{nom\ (converter)}$.

  Conductive defective valves in the inverter are also detected.

  The test consists of 7 steps. In the 1st step, no valve is fired, in the further steps, one and only one valve is fired in each case.

  In each step, the actual values of the output currents of phases U and W , the UCE feedback signals of the 3 phases, the overcurrent comparator, and the overvoltage comparator are monitored.

  The monitoring parameter r376 (ground-fault test result) from which the measurement result causing the fault can be read is available.

  Comment:
  The ground fault test can also be called up separately using parameter P375 (ground fault test) or deselected for the MOTID.
- Test pulses:
  Used to check the inverter and the connection with the motor. The result of the test can be queried in monitoring parameter r539 (test pulses result).
- Leakage measurement:
  By injecting suitable voltage pulses, the referenced total leakage x(sigma) of the connected motor is measured.
- DC measurement and resulting parameter change:
  In DC measurement, a direct current is injected successively in the direction of each output phase.
  No more than the magnitude of the peak value of the rated motor current is injected (maximum rated converter current). The pulse frequency of the converter is changed several times during the measurement.
  At the beginning of the zero-speed measurement, all parameters are calculated by "automatic parameterization".

Measured / calculated parameter values of zero-speed measurement:

P103	Motor no-load current
P120	Magnetizing reactance
P121	R (stator + cable)
P122	Total leakage reactance
P127	R(rotor) Ktmp
P283	Current controller Kp
P284	Current controller Tn
P315	EMF controller Kp
P316	EMF controller Tn
P347	Valve voltage compensation
P349	Dead time compensation time
P631	CU AnaIn offset (if analog tacho connected)

The measured values and the values calculated from them are only entered in the parameters after DC measurement has been completed without error. If measurement is canceled due to an off command or a fault, the parameter values that were calculated in automatic parameterization at the beginning of measurement are retained.

7.2.8.3 Complete motor identification (P115 = 3)

Function

Complete motor identification is used to improve the closed-loop control action in vector closed-loop control modes (P100 = 3, 4, or 5) and contains the functions:

- "Motor identification at zero speed" (contains "automatic parameterization")
- "No-load measurement " (contains "tacho test")
- "n/f controller optimization"

Condition

"Complete motor identification" can be selected from the state READY TO SWITCH ON (009).

Consequence

- Only the parameters of the **currently** selected motor data set (MDS) or function data set (FDS) are preset!
- "Complete motor identification" can be canceled at any time with an OFF command. The fault message F114 "Measurement canceled" is then triggered.
- To display the current measurement section of the "complete motor identification" you can use the monitoring parameter r377 "Measurement section".
  If a fault occurs during measurement, then the test is canceled with a fault message. The fault message (r947) is stored in the fault memory together with the fault value (r949). The fault value describes the cause of the fault in greater detail. The fault messages, fault values, and alarms are described in Chapter "Faults and Alarms".
- If P100 = 5 (m control) the duration of measurement is automatically switched over to mode n control.
- If P100 = 3 or 4 (f/n control and follower drive (cf. P587), measurement is canceled (F096).
- If the converter does not permit regenerative feedback (AFE, I/RF unit, or brake resistor), parameter P515 = 1 (Udmax controller on) should be set.
  If the converter still cancels measurement with the fault F006 (overvoltage in the DC link), the regenerative power should be limited to approx. –3 % to –0.1 % in parameter P259.

NOTE

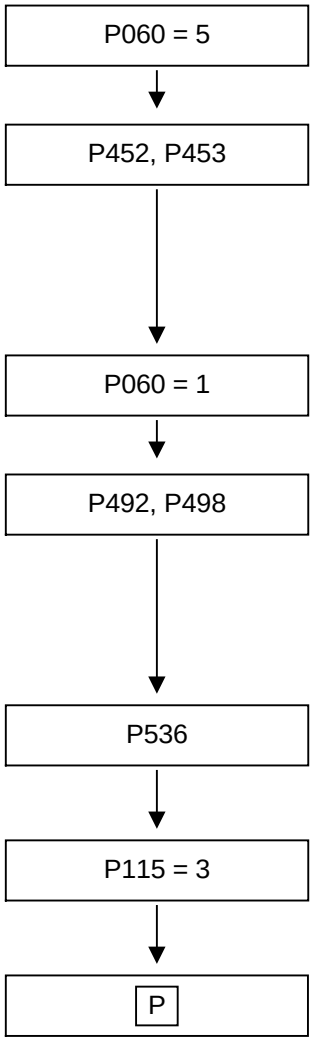
"Motor identification at zero speed" is not possible during operation of the converter with synchronous machines or with converters with a sine filter (option)!

WARNING

During motor identification inverter pulses are released and the drive rotates!

For reasons of safety, identification should first be carried out without coupling of the load.

Flowchart (operation via PMU):



Drive settings

Maximum frequencies
The speed of the drive during measurement is limited to the parameter values for the maximum frequencies P452 (RDF) and P453 (LDF) in the current motor data set. The maximum frequencies must be set before measurement starts in such a way that any working machine coupled to the motor is not damaged.

Parameter menu

Maximum torque
The torque during measurement is limited to the parameter values for the torque limits P492 (M_{lim1}) and P498 (M_{lim2}) in the current motor data set. The torque limits must be set before measurement starts in such a way that any working machine coupled to the motor is not damaged.

Dynamic response factor
Set the required dynamic response of the speed controller (in %): 10% being the minimum and 200% being the maximum
Note: Possible transmission backlash, etc.

Function selection **"Complete motor identification"**

The operating display appears (008/009):

The alarm A078 "Zero-speed measurement following" is output, and the converter must be switched on within 20 s. Otherwise fault shutdown F114 "Measurement canceled" occurs.

Switching on the converter

The alarm A078 "Zero-speed measurement following" is reset.

WARNING

The inverter is released, the motor carries current, and the rotor can align itself!

The operating display appears while the function "motor identification at zero speed" is executed automatically.

After completion of the subfunction, the operating display READY TO SWITCH ON (009) alternates with the alarm A080 "Rotating measurement following". The converter must be switched on within 20 s, otherwise the fault shutdown F114 "Measurement canceled" is triggered.

NOTE

If the converter is controlled via the terminal block or communication and pending ON command, the operating display READY TO SWITCH ON (008) appears after the subfunction has been completed. The ON command must be canceled so that measurement can be resumed.

NOTE

Even on cancellation at this point, the parameter changes of the preceding "Motor identification at zero speed" are stored.

Procedure:

Switching on the converter

Alarm A080 "Rotating measurement following" is reset.

WARNING

The inverter is released, the motor carries current, and the rotor rotates!

The operating display appears while the following steps are executed automatically:

- Call-up of the "No load measurement" including the tacho test at P100 = 4 or 5.
- Call-up of the "n/f controller optimization".

After completion of the selected function, the operating display READY TO SWITCH ON (009) or SWITCH-ON INHIBIT (008) appears.

7.2.8.4 No-load measurement (P115 = 4)

Function

No-load measurement is used to improve the closed-loop control action in vector closed-loop control modes (P100 = 3, 4, or 5) and is a subfunction of the "complete motor identification". The measurement is used to set the no-load current (P103, r119) and the magnetizing reactance of the motor.

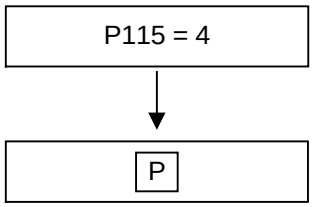
Condition

"No-load measurement" can be selected from the state READY TO SWITCH ON (009).

Consequence

- If speed or torque control (P100 = 4 or 5) is selected, a tacho test is also performed and if an analog tacho is used, analog tacho matching (P138) is set.
- The maximum speed of the drive during measurement is limited to the parameter values for the maximum frequencies P452 (RDF) and P453 (LDF).
- Only the parameters of the **currently** selected motor data set (MDS) are preset!
- "No-load measurement" can be canceled at any time with an OFF command. The fault message F114 "Measurement canceled" is then triggered.
- If a fault occurs during measurement, see Chapter "Faults and Alarms" for a detailed description of the fault message and the fault value!

Flowchart (for operation via PMU):



Function selection **"No-load measurement"**

The operating display appears (008/009):

The alarm A080 "Rotating measurement following" is output, and the converter must be switched on within 20 s. Otherwise fault shutdown F114 "Measurement canceled" is triggered.

Switching on the converter

The alarm A080 "Rotating measurement following" is reset.

WARNING

The inverter is released, the motor carries current, and the rotor rotates!

The operating display appears while the following steps are executed automatically:

- "Ground fault test": (only if selected via P375)
  see function "ground fault test" under "motor identification at zero speed"
- "Tacho test":
  Only if speed or torque control (P100 = 4 or 5) is selected, a tacho test is performed in addition. If an analog tacho is used, analog tacho matching (P138) is set.
- "No-load measurement":
  In steady-state closed-loop control operation, the following parameters are set as a result of measurement:
  P103 Motor no-load current in %
  P120 Magnetizing reactance

After completion of the selected function, the operating display READY TO SWITCH ON (009) or SWITCH-ON INHIBIT (008) appears.

7.2.8.5 n/f controller optimization (P115 = 5)

Function

n/f controller optimization is used to improve the closed-loop control action in vector closed-loop control modes (P100 = 3, 4, or 5) and is a subfunction of the "complete motor identification".

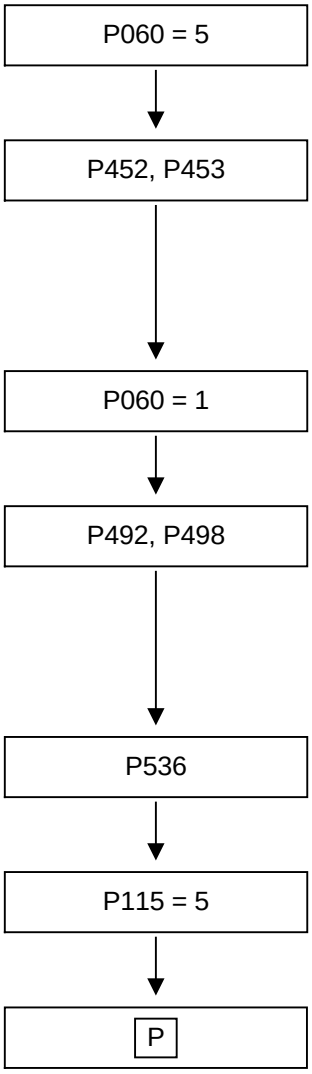
Condition

"n/f controller optimization" can be selected from the state READY TO SWITCH ON (009).

Consequence

- The function determines the mechanical moment of inertia of the drive and sets several parameters of the closed-loop control that depend on it.
  If speed or torque control (P100 = 4 or 5) is selected, a tacho test is also performed in addition.
- If P100 = 5 (m control) the duration of measurement is automatically switched over to mode n control.
- If P100 = 3 or 4 (f/n control and follower drive (cf. P587), measurement is canceled (F096).
- If the converter does not permit regenerative feedback (I/RF unit or brake resistor), parameter P515 = 1 (Udmax controller on) should be set.
  If the converter still cancels measurement with the fault F006 (overvoltage in the DC link), the regenerative power should be limited to approx. –3 % to –0.1 % in parameter P259.
- Only the parameters of the **currently** selected motor data set (MDS) or function data set (FDS) are preset!
- "n/f controller optimization can be canceled at any time with an OFF command. The fault message F114 "Measurement canceled" is then triggered.
- If a fault occurs during measurement, see Chapter "Faults and alarms " for a detailed description of the fault message and the fault value!
- "n/f controller optimization" automatically activates the "n controller feedforward control" (P471).

Flowchart (operation via PMU):



Drive settings

Maximum frequencies
The speed of the drive during measurement is limited to the parameter values for the maximum frequencies P452 (RDF) and P453 (LDF) in the current motor data set. The maximum frequencies must be set before measurement starts in such a way that any working machine coupled to the motor is not damaged.

Parameter menu

Maximum torque
The torque during measurement is limited to the parameter values for the torque limits P492 (M_{lim1}) and P498 (M_{lim2}) in the current motor data set. The torque limits must be set before measurement starts in such a way that any working machine coupled to the motor is not damaged.

Dynamic response factor
Set the required dynamic response of the speed controller (in %): 10% being the minimum and 200% being the maximum
Note: Possible transmission backlash, etc.

Function selection **"n/f controller optimization"**

The operating display appears:

The alarm A080 "Rotating measurement following" is output, and the converter must be switched on within 20 s. Otherwise fault shutdown F114 "Measurement canceled" is triggered.

Switching on the converter

The alarm A080 "Rotating measurement following" is reset.

WARNING

The inverter is released, the motor carries current, and the rotor rotates!

The operating display appears while the following steps are executed automatically:

- "Tacho test":
  Only if speed or torque control (P100 = 4 or 5) is selected, a tacho test is performed in addition.
- "Controller optimization":
  By evaluation of the torque and speed curve after automatically performed speed setpoint changes, the inertia of the drive is determined and the speed controller is set.

  Measurement is performed several times in succession.

  Parameters set:

  P116 Start-up time (ramp-up time at rated torque from zero speed to rated speed)

  P223 Smoothing n/f(act)

  P235 n/f controller Kp1

  P236 n/f controller Kp2

  P240 n/f controller Tn

  P471 n/f controller feedforward control Kp

  P537 n/f controller dynamics(act)

  P538 n/f controller vibration oscillation frequency
- Only if the units are specified in seconds (P463/P465 = 0) for the ramp-up and ramp-down times (P462/P464):

  If it is ascertained during measurement that the set ramp-up and ramp-down times cannot be achieved with the preset torque limits, are they set to the minimum possible times:

  P462 Ramp-up time

  P464 Ramp-down time

  P467 Protection semiconductor Kp (only for frequency control: P100 = 3)

After completion of the selected function, the operating display READY TO SWITCH ON (009) or SWITCH-ON INHIBIT (008) appears, and the dynamic response of the speed controller which was achieved is indicated in parameter P537 (n/f controller dynamics(act)).
The dynamic response achieved might deviate from the setpoint set previously (P536) (because of a very large moment of inertia or an unsettled speed actual value signal).

7.2.8.6 Self test (P115 = 6)

Function It is the same function as "motor identification at zero speed", **but no parameter values are changed**.

Condition The "self test" can be selected from the state READY TO SWITCH ON (009).

Consequence The "self test" is therefore suitable for testing the converter and the connected motor.

NOTICE

- The "self test " is not possible on converters with a sine filter (option)!
- For procedure and notes see: "Motor identification at zero speed".

WARNING

Inverter pulses are enabled, and the rotor can move into alignment!

7.2.8.7 Tacho test (P115 = 7)

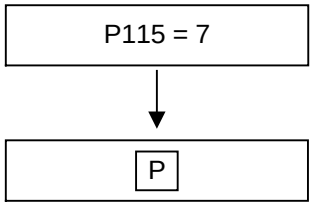
Function The tacho test is used to check the tacho (analog tacho and pulse encoder) in vector control modes with a tacho (P100 = 4 or 5).

Condition The "tacho test" can be selected from the state READY TO SWITCH ON (009).

Consequence The "tacho test can be canceled at any time with an OFF command. The fault message F114 "Measurement canceled" is then triggered.

If a fault occurs during measurement, see Chapter "Faults and Alarms" for a detailed description of the fault message and the fault value!

Flowchart



Function selection **"Tacho test"**

The operating display appears:

The alarm A080 "Rotating measurement following" is output, and the converter must be switched on within 20 s. Otherwise fault shutdown F114 "Measurement canceled" is triggered.

Switching on the converter

The alarm A080 "Rotating measurement following" is reset.

WARNING

The inverter is released, the motor carries current, and the rotor rotates!

The operating display appears while the following tacho errors are checked for:

- For pulse encoders:
  - No tacho signal
  - Wrong polarity of the tacho signal
  - Wrong standardization of the tacho signal (P151 pulse enc. bar number)
  - One track of the pulse encoder missing
- For analog tachos:
  - No tacho signal
  - Wrong polarity of the tacho signal
  - Wrong matching of the tacho signal (P138 ana.tacho mat.) or potentiometer when using the ATI (option)

The result of the test can be queried in monitoring parameter r540 (tacho test result).

After successful completion of the selected function, the operating display READY TO SWITCH ON (009) or SWITCH-ON INHIBIT (008) appears.

7.3 Special functions

7.3.1 Loading firmware

The firmware supplied in the units is stored non-volatilely in electrically erasable memory chips, so-called flash EPROMs. If required, the firmware can be erased and overwritten with new firmware.

It is necessary to import new firmware if

- an extended function scope is available in a new firmware version and this needs to be used, or if
- user-specific firmware needs to be loaded into the units.

The firmware can be loaded using a laptop or PC and the data is transferred into the units via the serial interface SCom or SCom1. A special cable is necessary for importing the firmware.

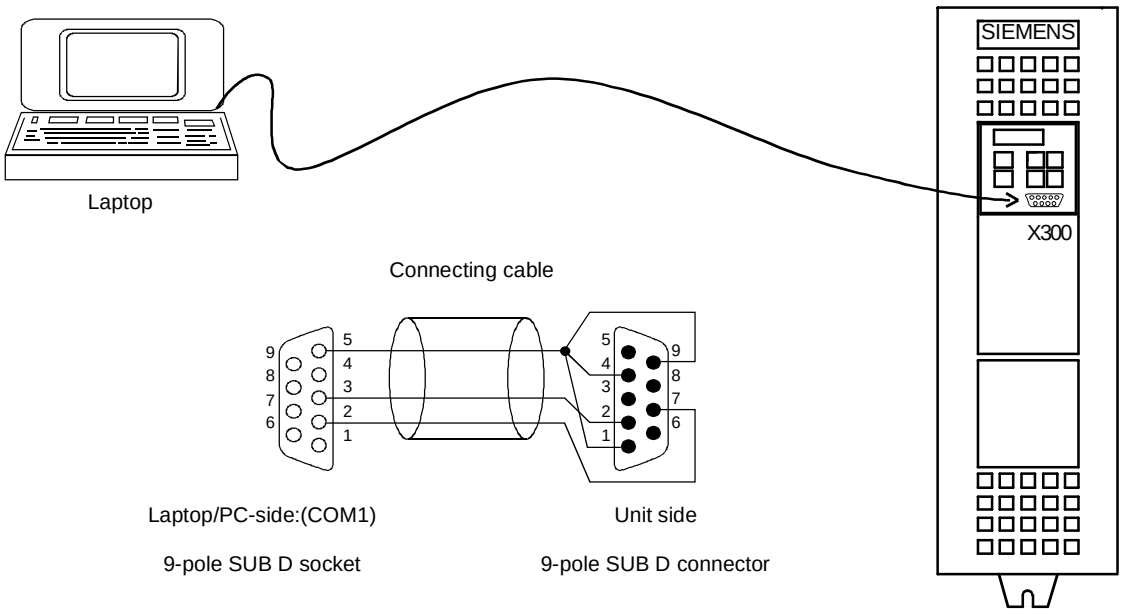
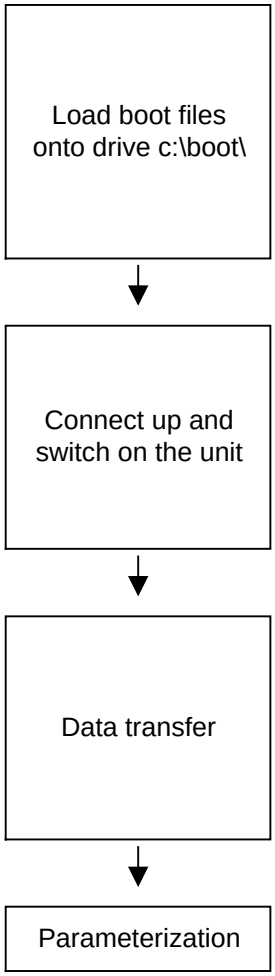


Fig. 7-6 Loading firmware by means of laptop or PC

Loading the firmware from a laptop/PC comprises the following work steps. All other programs that use the same PC port (COM1 or COM2), e.g. SIMOVIS, must first be closed.
In case problems occur under Windows NT with the loading program bsl.exe, the program WinBSL.exe is also provided on the SIMOVIS 5.4 CD.
Before loading the software, you should save your parameter settings (Upread with OP1S or SIMOVIS)! Make a note of the converter order number in P070 for definition of the power section later on.



Create a subdirectory called "boot" on your hard disk, change to this directory, load the compressed file containing the software (Vc_vxxx.exe; xxx = software version and ID) and double-click the file to inflate it. The firmware itself is in inflated files Vc_vxxx.b86 and Vcs_vxxx.b86. The files bsl.exe, bslvch.cfg, bslvcs.cfg, bslvc.bat, bslvch.bin and bslvcs.bin are required for loading the software.

First connect your laptop or PC (COM1 or COM2) to socket X300 using the specified cable (order No.: 9AK1012-1AA00) . Then power up the mains supply or the external 24 V power supply. If all connections are correct, the unit goes straight into boot mode and the PMU on the front section of the unit does not start (display: E).

Start data transfer on your laptop/PC by entering c:\boot\bslvc.bat com1 (or com2), depending which port you are using. The display of the data transferred so far indicates that data transfer is in progress. When data transfer has been completed, the unit initializes itself and goes into status °000 "Power section definition" or into the last active status. The PMU is active again in this status.

After removing the cable, you can commence parameterization.

If loading is aborted with the following error message although you have observed the correct procedure and made the connections to the correct ports,

Get Acknowledge-Byte: 0xD5
Error: Acknowledge-Byte 0xB5 expected!

You must call the batch file with the extension 0xD5 (bslvc 0xD5) or use a newer version of the program bsl.exe (Version 0.06 or higher) (supplied with Version 3.2 onwards).

WARNING

When loading a VC firmware < SW 3.30 onto a VC Compact PLUS unit, the output of FF13 "Incorrect firmware version" is not supported.

7.4 Functions for lifts and hoisting gear

7.4.1 Activating the function

The functions for elevators and hoisting gear are activated by setting U800 = 1
(=> the factory setting P366 = 10 for elevators and hoisting gear has the same effect).

Therefore the function diagrams are changed as follows:

Invalid (page)	Valid instead (page)
290	324
316	326
317	327
318	328
319	329
480	481

Please refer to the operating instruction for elevator and hoisting gear applications for detailed information concerning elevator commissioning.

7.4.2 Deviating technical data

Units intended for elevator applications with $U_{rat} \leq 480$ V (AC) or $U_{rat} \leq 650$ V (DC) have a current derating relative to the rated currents of units intended for the basic mode of operation. The following derating curve applies to the permissible rated current as a function of the set pulse frequency:

Units of 5.5 kW ≤ Pn ≤ 55 kW (400 V AC)

- Curve ① for supply voltages
  $U_{supply} < 440$ V (AC) or $U_{supply} < 590$ V (DC)
- Curve ② for supply voltages
  $U_{supply} > 440$ V (AC) or $U_{supply} > 590$ V (DC)

Units of 4 kW ≤ Pn ≤ 22 kW (230 V AC)

- Curve ① for all permissible supply voltages

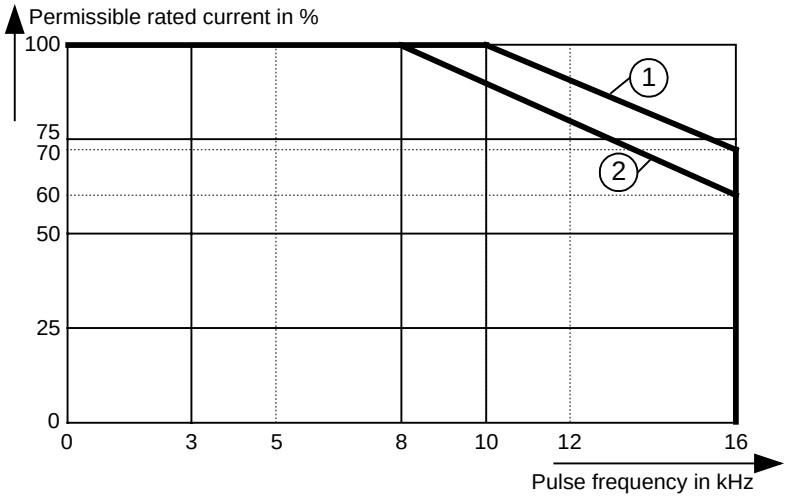


Fig. 7-7 Derating curve

Units with P_n 75 kW and 90 kW (400 V AC)

- Curve ① for supply voltages
  U_{supply} < 440 V (AC) or U_{supply} < 590 V (DC)
- Curve ② for supply voltages
  U_{supply} > 440 V (AC) or U_{supply} > 590 V (DC)

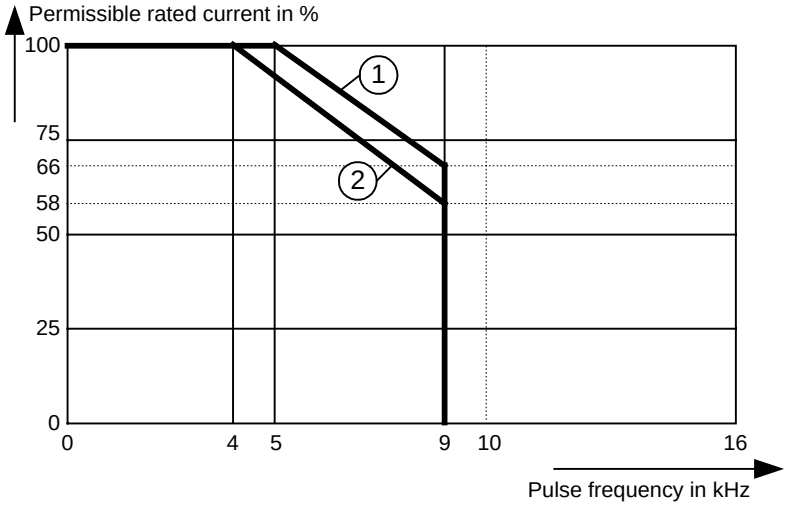
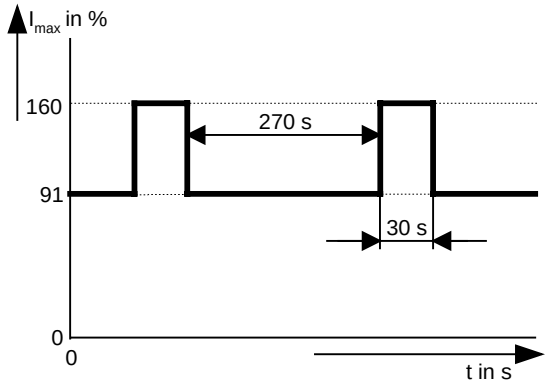
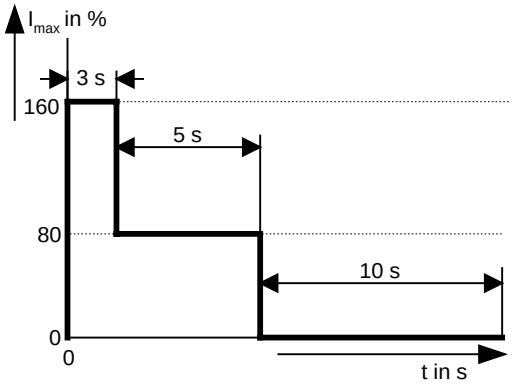


Fig. 7-8 Derating curve

In comparison with the standard derating curve, 100% rated current (or even 160 % for short-time overload) is permissible for higher frequencies (8 / 10 kHz for 4 kW ... 55 kW units, or 4 / 5 kHz for 75 kW and 90 kW units). In such cases, however, the mean loading of the converter must not exceed 60 % and the overload current (160 %) must be held for only
3 seconds (=> load cycle change). If these rules are broken, the pulse frequency will be reduced automatically and the standard load cycle will apply.



Standard load cycle



Load cycle "Elevator application"
for 10 kHz / 5 kHz pulse frequency

7.4.3 Approach delay and short run

Approach delay U845

Changeover to the approach setpoint (FSW5) is carried out with a delay defined by the time specified in the parameter.

The delay time can serve to minimize the approaching time without having to displace limit switches. A precondition for activation is that the ramp-function generator is not ramping up and that the speed of the drive is above that of the approach setpoint.

Short run U846

The approach setpoint is delayed by the time indicated in the parameter in order to achieve longer acceleration in the case of short starting distances (ramp-function generator still ramping up).

In order to minimize the travelling time with approaching speed because the ramp-function generator does not fall below the given fixed setpoint in this case and the approach setpoint is thus reached earlier.

A pre-condition for activation is that the ramp-function generator is ramping up when a change is made to the approach setpoint.

7.4.4 Starting pulse (for hoisting gear)

The starting pulse is for "biasing" the speed controller.

Purpose: To prevent "sagging" of the load when the brake is released and to ensure the load is assumed by the motor.

Precondition: The brake must receive the release command and the motor must previously have been at zero current.

The following can be set:

Level of the starting pulse (as a % of the rated speed of the equipment):	U842
Decay time of the starting pulse (in ms):	U843
Smoothing of the starting pulse (in ms):	U841

7.4.5 Emergency operation

After a power-system failure, the converter is able to recognize powering up of the power system with batteries to a lower DC link voltage as emergency operation. For this purpose, a voltage window in which the battery voltage is located must be parameterized. A motor data set to be selected during emergency operation as well can also be specified in order to enable travelling with another type of control, for example, with lower voltage. With the pre-settings, operation in normal and emergency mode is possible with motor data set 1.

In emergency mode, an emergency-operation speed is selected instead of fixed setpoints 2 to 8.

During operation with battery voltage, the converter must be separated from the mains supply because it can be destroyed when supply is restored. The changeover to batteries and back to mains supply should be carried out by a higher-level control system.

Purpose	**Parameter No.**	**Description**	**Pre-assigned value**
Set voltage window for emergency operation	U837	Index 1: Min. emergency-op. voltage Index 2: Max. emergency-op. voltage	Index 1: 380 V Index 2: 380 V
Specify speed for emergency operation	U839	Desired speed during emergency operation for all selections of travelling setpoints	0.2 m/s
Specify motor data set during emergency operation	U838	Number of the motor data set which is selected during emergency operation	1
Motor data set during normal operation	P578 P579	Selection of 4 possible motor data sets: 0 0: MDS1 0 1: MDS2 1 0: MDS3 1 1: MDS4	P578: 0 P579: 0

7.4.6 Setpoint specification by means of fixed setpoints

Fixed setpoint selection has been changed relative to the basic operating mode.

The following selection procedures can be set by means of U822:

- Selection 1 from n — U822 = 0
- BCD coded selection — U822 = 1
- BCD coded selection with external trigger — U822 = 1, U821 = Trigger input

The value of the fixed setpoints must be indicated in **m/s** below the relevant parameter number.

Setpoints are selected according to the following method:

1 from n

Fixed setpoint	P580.1	P581.1	P417.1	P418.1	U818	U819	U820
FSW1 U810	0	0	0	0	0	0	0
FSW2 U811	1	0	0	0	0	0	0
FSW3 U812	0	1	0	0	0	0	0
FSW4 U813	0	0	1	0	0	0	0
FSW5 U814	0	0	0	1	0	0	0
FSW6 U815	0	0	0	0	1	0	0
FSW7 U816	0	0	0	0	0	1	0
FSW8 U817	0	0	0	0	0	0	1

BCD and BCD with trigger

Fixed setpoint	P580.1	P581.1	P417.1
FSW1 U810	0	0	0
FSW2 U811	1	0	0
FSW3 U812	0	1	0
FSW4 U813	1	1	0
FSW5 U814	0	0	1
FSW6 U815	1	0	1
FSW7 U816	0	1	1
FSW8 U817	1	1	1

For correct calculation of the motor speed from the fixed setpoints, the gear ratio (U802), pulley diameter (U803) and cabin suspension (U804) must be given!

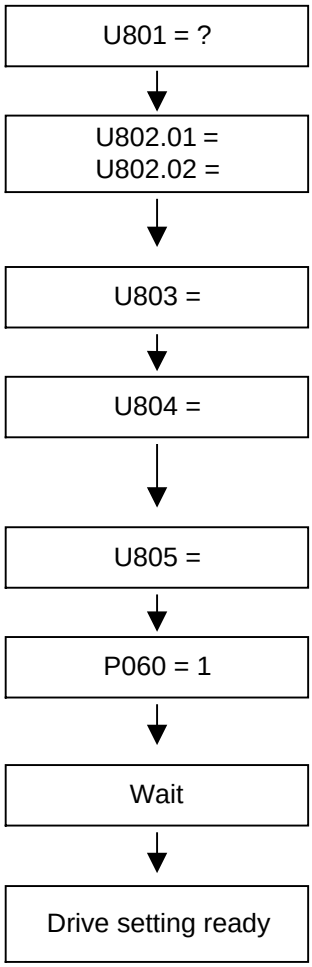
7.4.7 Changed reference variables

The lifts and hoisting gear mode permits entry of fixed setpoints in m/s (U810 ... U817) as well as ramp-function generator parameters as accelerations in m/s^2 (U827, U828) and jerks in m/s^3 (U829, U830).

The corresponding entries in % or in seconds are deactivated.

The reference speed/reference frequency (P352, P353) are also deactivated and replaced by the rated system speed (U801).

For corrected calculation of the motor speed, the drive setting also has to be defined by the following parameters:



Rated system speed in m/s
Scaling for setpoints/actual values from/for automatic control and analog inputs/outputs

Gear ratio
Index 01 gear input (motor side)
Index 02 gear output
e.g.: I = 30:1; Index 01 = 30; Index 02 = 1

Diameter of pulley in mm

Suspension of the cabin / load
1= 1:1 Rope direct to the cabin
2= 2:1 One guide roller
4= 4:1 Two guide rollers

Max. permissible motor speed rpm
Caution: Limited permissible rated system speed values!

Return to the **Parameter Menu**
Note: All user parameters can be read!

Wait until the converter signals status °008 or °009. If there is a fault signal, see the "Fault and Warning Signals" chapter in the SIMOVERT MASTERDRIVES VC operating instruction.

The converter status, although not yet optimized, is now such that the drive can turn.

7.4.8 List of parameters changed as a result of factory setting

P0366 = 10 (factory setting for LIFT operation)

	Parameter	Designator of the parameter at the OP1S	(Factory setting for LIFT operation) P366 = 10	
		(Q. = Source)	BICO1 (i001)	BICO2 (i002)
Display	P048	PMU OperDisp	n848	
	P049.3	OP OperDisp	n848	
	P049.4	OP OperDisp	n808	
Closed-loop control	P128.1	Imax	160 % x P072	
	P128.2	Imax	160 % x P072	
	P128.3	Imax	160 % x P072	
	P128.4	Imax	160 % x P072	
Gating unit	P339.1	PulsSysEn	3	
	P339.2	PulsSysEn	3	
	P339.3	PulsSysEn	3	
	P339.4	PulsSysEn	3	
Setpoint channel	P443	SrcMainSetp	KK0040	KK0040
	P492.1	TLim 1 FixSetp	200.0 %	
	P492.2	TLim 1 FixSetp	200.0 %	
	P492.3	TLim 1 FixSetp	200.0 %	
	P492.4	TLim 1 FixSetp	200.0 %	
	P498.1	TLim 2 FixSetp	-200.0 %	
	P498.2	TLim 2 FixSetp	-200.0 %	
	P498.3	TLim 2 FixSetp	-200.0 %	
	P498.4	TLim 2 FixSetp	-200.0 %	

Control word

Parameter	Designator of the parameter at the OP1S	(Factory setting for LIFT operation) P366 = 10	
	(Src = Source)	BICO1 (i001)	BICO2 (i002)
P554	Src ON/OFF1	B5123	B0005
P555	Src 1OFF2	B0001	B0001
P561	Src InvRelease	B0000	B0000
P564	Src Setp Release	B0277	B0277
P571	Src FWD Speed	B0016	B0001
P572	Src REV Speed	B0001	B0001
P573	Src MOP UPr	B0008	B0000
P574	Src MOP Down	B0009	B0000
P581	Src FixSetp Bit1	B0020	B0000
P417	Src FixSetp Bit2	B0022	B0022
P418	Src FixSetp Bit3	B0018	B0018
P590	Src BICO DSet	B0000	

Brake actuation and signals

P601	Src DigOutMCon	B0275	B0275
P605	BrakeCtrl	1	
P609.1	Src BrakeClose	B0105	
P609.2	Src BrakeClose	B0099	
P609.3	Src BrakeClose	B0330	
P609.4	Src BrakeClose	B0000	
P610	Src BrakeThresh1	K0242	
P611	BrakeThresh1	1.0 %	
P614	Src PBrakeClos	B0857	
P615	Src BrakeThresh2	K0148	
P800.1	OFF Value	0.4 %	
P800.2	OFF Value	0.4 %	
P800.3	OFF Value	0.4 %	
P800.4	OFF Value	0.4 %	
P801.1	OFF Time	0.50 s	
P801.2	OFF Time	0.50 s	
P801.3	OFF Time	0.50 s	
P801.4	OFF Time	0.50 s	
U824	Vib Setp PulsFree	0.01 %	
U953.48	Sampling Times4	4	

AND element for inverter release

U221	Src AND1	B0278	B5125
U950.78	Sampling time	4	

Digital inputs/outputs

Parameter	Designator of the parameter at the OP1S	(Factory setting for LIFT operation) P366 = 10	
	(Src = Source)	BICO1 (i001)	BICO2 (i002)
P651	Src DigOut1	B0000	B0000
P652	Src DigOut2	B0000	B0000
P674.1	EB2 Src RelayOut	B0107	
P674.2	EB2 Src RelayOut	B0104	
P674.3	EB2 Src RelayOut	B0851	
U953.13	Sampling Times 4	4	
U953.14	Sampling Times 4	4	

Lift operation

P352	Ref Frequency	38.19 Hz
P353	Ref Speed	1145 rpm
P468	Rgen Round Type	1
U800	Application	1
U822	Sel FixSetp	0

Table 7-1 Factory setting depending on P366