

**LOCAL/REMOTE CONTROL APPLICATION**  
(par. 0.1 = 3)

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## 2.1 General

By utilizing the Local/Remote Control Application, the use of two different control and frequency reference sources is programmable. The active control source is selected with digital input DIB6.

The Local/Remote Control Application can be activated from the Group 0 by setting the value

of parameter 0. 1 to 3.

Basic connections of inputs and outputs are shown in the figure 2.2-1. The control signal logic is shown in the figure 2.3-1. Programming of I/O terminals is explained in chapter 2.5, Special parameters.

## 2.2 Control I/O

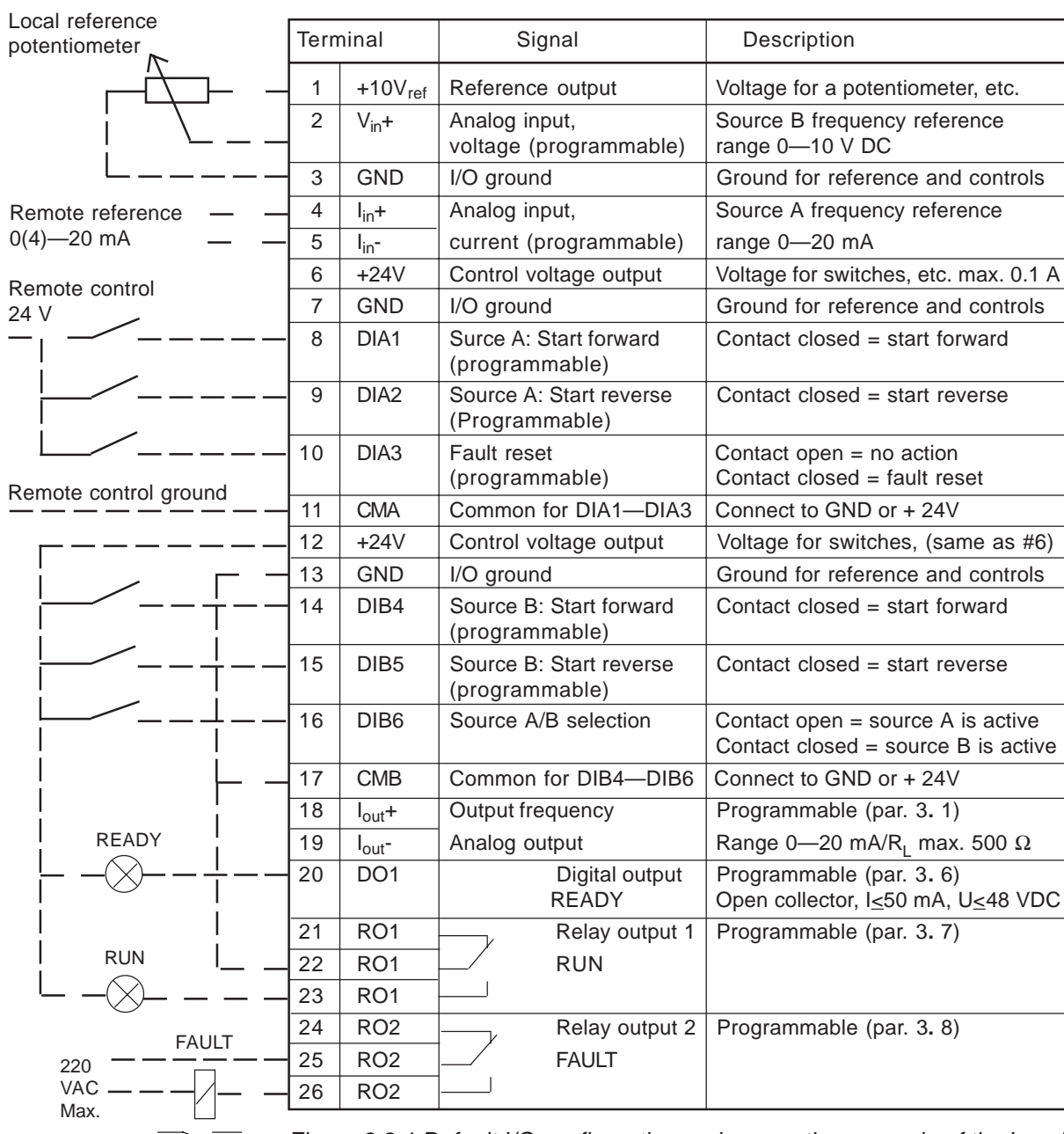


Figure 2.2-1 Default I/O configuration and connection example of the Local/Remote Control Application.

## 2.3 Control signal logic

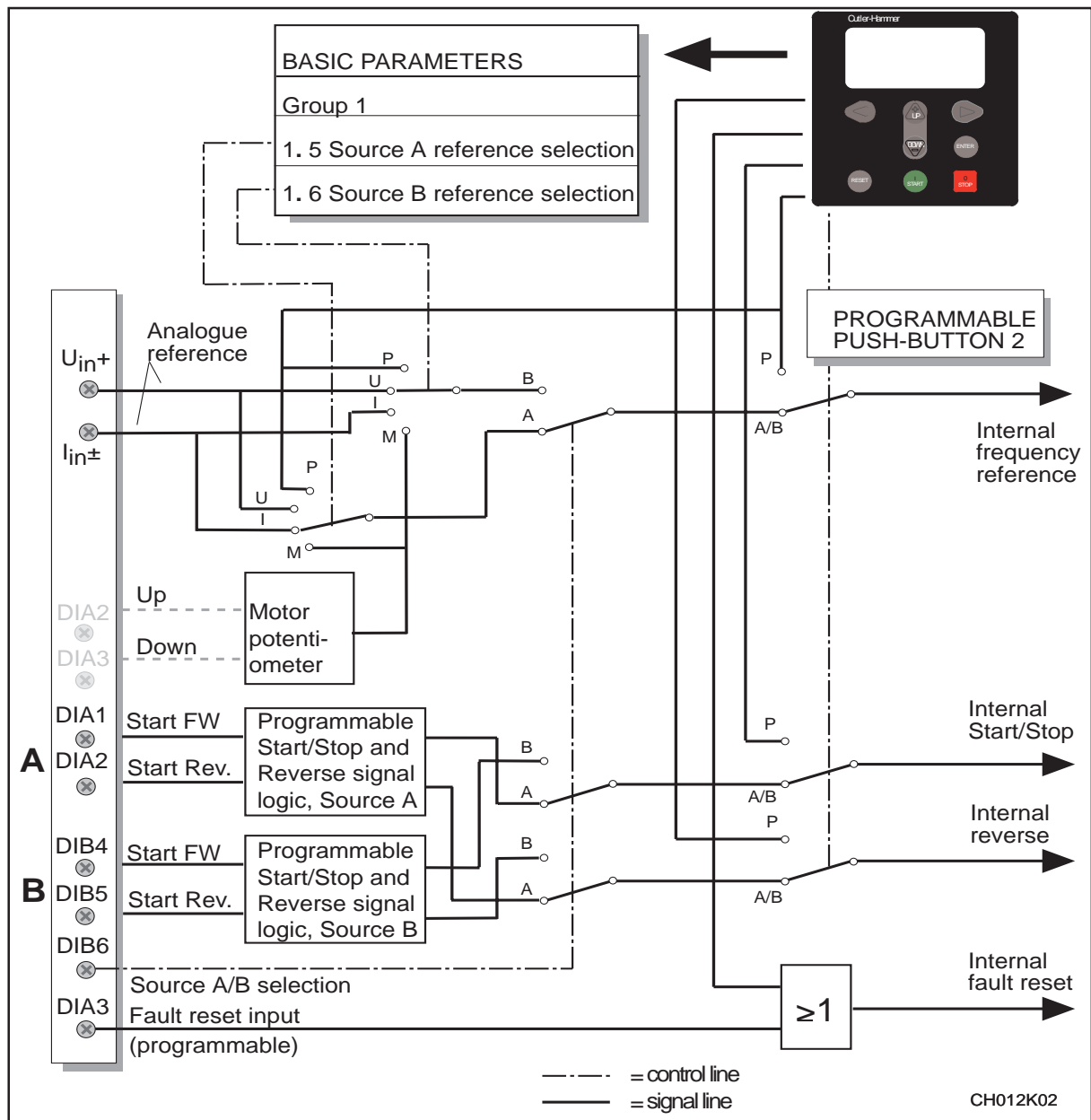


Figure 2.3-1 Control signal logic of the Local/Remote Control Application.  
Switch positions shown are based on the factory settings.

## 2.4 Basic parameters, Group 1

## 2.4.1 Parameter table











Code	Parameter	Range	Step	Default	Custom	Description	Page
1.1	Minimum frequency	0— $f_{\max}$	1 Hz	0 Hz			2-5
1.2	Maximum frequency	$f_{\min}$ -120/500 Hz	1 Hz	60 Hz		*)	2-5
1.3	Acceleration time 1	0.1—3000.0 s	0.1 s	3.0 s		Time from $f_{\min}$ (1. 1) to $f_{\max}$ (1. 2)	2-5
1.4	Deceleration time 1	0.1—3000.0 s	0.1 s	3.0 s		Time from $f_{\max}$ (1. 2) to $f_{\min}$ (1. 1)	2-5
1.5	Source A: reference signal 	0—4	1	1		0 = Anal. voltage input (term. 2) 1 = Anal. current input (term. 4) 2 = Set reference from the panel 3 = Signal from internal motor pot. 4 = Signal from internal motor pot. reset if SV9000 is stopped	2-5
1.6	Source B: reference signal 	0—4	1	0		0 = Anal. voltage input (term. 2) 1 = Anal. current input (term. 4) 2 = Set reference from the panel 3 = Signal from internal motor pot. 4 = Signal from internal motor pot. reset if SV9000 unit is stopped	2-5
1.7	Current limit	0.1—2.5 $\times I_{\text{NCX}}$	0.1	1.5 $\times I_{\text{NCX}}$		Output current limit[A] of the unit	2-5
1.8	V/Hzf ratio selection 	0—2	1	0		0 = Linear 1 = Squared 2 = Programmable V/Hz ratio	2-5
1.9	V/Hz optimization 	0—1	1	0		0 = None 1 = Automatic torque boost	2-7
1.10	Nominal voltage of the motor 	180—690 V	1 V	230 V 380 V 480 V 575 V		Voltage code 2 Voltage code 4 Voltage code 5 Voltage code 6	2-7
1.11	Nominal frequency of the motor 	30—500 Hz	1 Hz	60 Hz		$f_n$ from the nameplate of the motor	2-7
1.12	Nominal speed of the motor 	1—20000 rpm	1 rpm	1720 rpm **)		$n_n$ from the nameplate of the motor	2-7
1.13	Nominal current of the motor 	2.5 $\times I_{\text{NCX}}$	0.1 A	$I_{\text{NCX}}$		$I_n$ from the nameplate of the motor	2-7
1.14	Supply voltage 	208—240		230 V		Voltage code 2	2-7
		380—440		400 V		Voltage code 4	
		380—500		500 V		Voltage code 5	
		525—690		690 V		Voltage code 6	
1.15	Parameter conceal	0—1	1	0		Visibility of the parameters: 0 = All parameter groups visible 1 = Only group 1 is visible	2-7
1.16	Parameter value lock	0—1	1	0		Disables parameter changes: 0 = Changes enabled 1 = Changes disabled	2-7

Table 2.4-1 Group 1 basic parameters.

\*) If 1. 2 > motor synchr. speed, check suitability for motor and drive system. Selecting 120 Hz/500 Hz range, see page 2-5.

**Note!**  = Parameter value can be changed only when the drive is stopped.

\*\*)Default value for a four pole motor and a nominal size SV9000.

## 2.4.2 Description of Group 1 parameters

### 1. 1, 1. 2 Minimum / maximum frequency

Defines the frequency limits of the drive.

The default maximum value for parameters 1. 1 and 1. 2 is 120 Hz. By setting the value of parameter 1. 2 to 120 Hz when the drive is stopped (RUN indicator not lit) parameters 1. 1 and 1. 2 are changed to 500 Hz. At the same time the resolution of the panel reference is changed from 0.01 Hz to 0.1 Hz.

Changing the max. value from 500 Hz to 120 Hz is done by setting parameter 1. 2 to 119 Hz while the drive is stopped.

### 1. 3, 1. 4 Acceleration time1, deceleration time 1:

These limits correspond to the time required for the output frequency to accelerate from the set minimum frequency (par. 1. 1) to the set maximum frequency (par. 1. 2). Acceleration/deceleration times can be reduced with a free analog input signal, see parameters 2. 18 and 2. 19.

### 1. 5 Source A reference signal

- 0** Analog voltage reference from terminals 2—3, e.g. a potentiometer
- 1** Analog current reference from terminals 4—5, e.g. a transducer.
- 2** Panel reference is the reference set from the Reference Page (REF), see chapter 7.5 in the User's Manual.
- 3** Reference value is changed with digital input signals DIA2 and DIA3.
  - switch in DIA2 closed = frequency reference increases
  - switch in DIA3 closed = frequency reference decreases
 The speed range for the reference change can be set with the parameter 2. 3.
- 4** Same as setting 3 but the reference value is set to the minimum frequency (par. 2. 14 or par. 1. 1 if par 2. 15 = 0) each time the drive is stopped. When value of the parameter 1. 5 is set to 3 or 4, value of the parameter 2. 1 is automatically set to 4 and value of the parameter 2. 2 is automatically set to 10.

### 1. 6 Source B reference signal

See the values of the parameter 1. 5.

### 1. 7 Current limit

This parameter determines the maximum motor current that the SV9000 will provide short term. Current limit can be set lower with a free analog input signal. See parameters 2. 18 and 2. 19.

### 1. 8 V/Hz ratio selection

- Linear:
- 0** The voltage of the motor changes linearly with the frequency in the constant flux area from 0 Hz to the field weakening point (par. 6. 3) where a constant voltage (nominal value) is supplied to the motor. See figure 2.4-1.

A linear V/Hz ratio should be used in constant torque applications.

**This default setting should be used if there is no special requirement for another setting.**

Squared: The voltage of the motor changes following a squared curve form with the frequency in the area from 0 Hz to the field weakening point (par. 6. 3) where the nominal maximum voltage is supplied to the motor. See figure 2.4-1.

1

The motor runs undermagnetized below the field weakening point and produces less torque and electromechanical noise. A squared V/Hz ratio can be used in applications where the torque demand of the load is proportional to the square of the speed, e.g. in centrifugal fans and pumps.

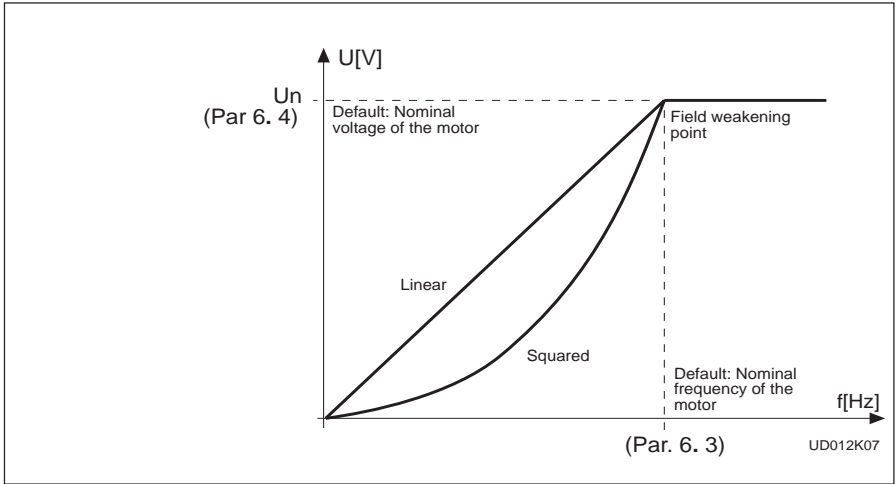


Figure 2.4-1 Linear and squared V/Hz curves.

Programm. The V/Hz curve can be programmed with three different points.  
V/Hz curve The parameters for programming are explained in chapter 2.5.2  
2 Programmable V/Hz curve can be used if the standard settings do not satisfy the needs of the application. See figure 2.4-2.

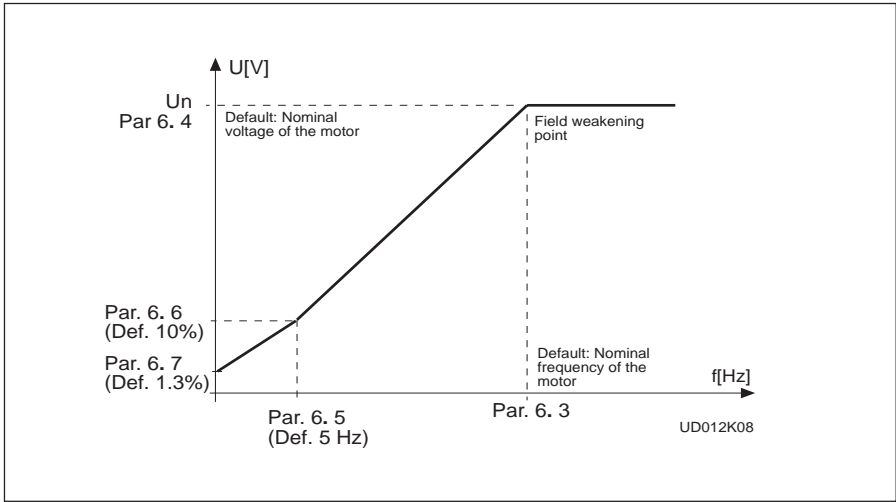


Figure 2.4-2 Programmable V/Hz curve.

**1.9 V/Hz optimization**

Automatic torque boost      The voltage to the motor changes automatically which allows the motor to produce torque enough to start and run at low frequencies. The voltage increase depends on the motor type and horsepower.

Automatic torque boost can be used in applications where starting torque due to starting friction is high, e.g. in conveyors.

**NOTE!**

*In high torque - low speed applications - it is likely the motor will overheat.*

*If the motor has to run for a prolonged time under these conditions, special attention must be paid to cooling of the motor. Use external cooling for the motor if the temperature rise is too high.*

**1.10 Nominal voltage of the motor**

Find this value  $U_n$  from the nameplate of the motor.

This parameter sets the Voltage at the field weakening point, parameter 6. 4, to 100%  $\times U_{n\text{motor}}$ .

**1.11 Nominal frequency of the motor**

Find this value  $f_n$  from the nameplate of the motor.

This parameter sets the field weakening point, parameter 6. 3, to the same value.

**1.12 Nominal speed of the motor**

Find this value  $n_n$  from the nameplate of the motor.

**1.13 Nominal current of the motor**

Find the value  $I_n$  from the nameplate of the motor.

The internal motor protection function uses this value as a reference value.

**1.14 Supply voltage**

Set parameter value according to the nominal voltage of the supply.

Values are pre-defined for voltage codes 2, 4, 5, and 6. See table 2.4-1.

**1.15 Parameter conceal**

Defines which parameter groups are available:

0 = all groups are visible

1 = only group 1 is visible

**1.16 Parameter value lock**

Defines access for changing the parameter values:





0 = parameter value changes enabled


1 = parameter value changes disabled

If you have to adjust more of the functions of the Local/Remote Control Application, see chapter 2.5 to set up parameters of Groups 2—8.

## 2.5 Special parameters, Groups 2—8

### 2.5.1 Parameter tables, Group 2, Input signal parameters

Code	Parameter	Range	Step	Default	Custom	Description	Page
2. 1	Source A Start/Stop logic selection 	0—4	1	0		DIA1	2-15
						DIA2 0 = Start forward 1 = Start/Stop 2 = Start/Stop 3 = Start pulse 4 = Start forward	
2. 2	DIA3 function (terminal 10) 	0—10	1	7		0 = Not used 1 = Ext. fault, closing contact 2 = External fault, opening contact 3 = Run enable 4 = Acc./dec. time selection 5 = Reverse (if par. 2. 1 = 3) 6 = Jogging speed 7 = Fault reset 8 = Acc/dec. operation prohibit 9 = DC-braking command 10 = Motor potentiometer DOWN	2-16
2. 3	V <sub>in</sub> signal range	0—1	1	0		0 = 0—10 V 1 = Custom setting range	2-17
2. 4	V <sub>in</sub> custom setting min.	0.00—100.00%	0.01%	0.00%			2-17
2. 5	V <sub>in</sub> custom setting max.	0.00—100.00%	0.01%	100.00%			2-17
2. 6	V <sub>in</sub> signal inversion	0—1	1	0		0 = Not inverted 1 = Inverted	2-18
2. 7	V <sub>in</sub> signal filter time	0.00—10.00s	0.01s	0.10s		0 = No filtering	2-18
2. 8	I <sub>in</sub> signal range	0—2	1	0		0 = 0—20 mA 1 = 4—20 mA 2 = Custom setting range	2-19
2. 9	I <sub>in</sub> custom setting minim.	0.00—100.00%	0.01%	0.00%			2-19
2. 10	I <sub>in</sub> custom setting maxim.	0.00—100.00%	0.01%	100.00%			2-19
2. 11	I <sub>in</sub> signal inversion	0—1	1	0		0 = Not inverted 1 = Inverted	2-19
2. 12	I <sub>in</sub> signal filter time	0.01—10.00s	0.01s	0.10s		0 = No filtering	2-19
2. 13	Source B Start/Stop logic selection 	0—3	1	0		DIB4	2-20
						DIB5 0 = Start forward 1 = Start/Stop 2 = Start/Stop 3 = Start pulse	
2. 14	Source A reference scaling minimum value	0—par. 2. 15	1 Hz	0 Hz		Selects the frequency that corres. to the min. reference signal	2-20
2. 15	Source A reference scaling maximum value	0—f <sub>max</sub> (1. 2)	1 Hz	0 Hz		Selects the frequency that corresp. to the max. reference signal 0 = Scaling off >0 = Scaled maximum value	2-20
2. 16	Source B reference scaling minimum value	0—par. 2. 17	1 Hz	0 Hz		Selects the frequency that corresp. to the min. reference signal	2-20
2. 17	Source B reference scaling maximum value 	0—f <sub>max</sub> (1. 2)	1 Hz	0 Hz		Selects the frequency that corresp. to the max. reference signal 0 = Scaling off >0 = Scaled maximum value	2-20



**Note!**  = Parameter value can be changed only when the drive is stopped.


(Continues)






Code	Parameter	Range	Step	Default	Custom	Description	Page
2. 18	Free analog input, signal selection	0—2	1	0		0 = Not used 1 = $V_{in}$ (analog voltage input) 2 = $I_{in}$ (analog current input)	2-20
2. 19	Free analog input, function	0—4	1	0		0 = No function 1 = Reduces current limit (par. 1. 7) 2 = Reduces DC-braking current 3 = Reduces acc. and decel. times 4 = Reduces torque supervis. limit	2-20
2. 20	Motor potentiometer ramp time	0.1—2000.0 Hz/s	0.1 Hz/s	10.0 Hz/s			2-22

### Group 3, Output and supervision parameters


Code	Parameter	Range	Step	Default	Custom	Description	Page
3. 1	Analog output function 	0—7	1	1		0 = Not used      Scale 100% 1 = O/P frequency (0— $f_{max}$ ) 2 = Motor speed (0—max. speed) 3 = O/P current (0— $2.0 \times I_{nFC}$ ) 4 = Motor torque (0— $2 \times T_{nMot}$ ) 5 = Motor power (0— $2 \times P_{nMot}$ ) 6 = Motor voltage (0— $100\% \times U_{nMot}$ ) 7 = DC-link volt. (0—1000 V)	2-22
3. 2	Analog output filter time	0.00—10.00 s	0.01 s	100 s			2-22
3. 3	Analog output inversion	0—1	1	0		0 = Not inverted 1 = Inverted	2-22
3. 4	Analog output minimum	0—1	1	0		0 = 0 mA 1 = 4 mA	2-22
3. 5	Analog output scale	10—1000%	1%	100%			2-22
3. 6	Digital output function 	0—21	1	1		0 = Not used 1 = Ready 2 = Run 3 = Fault 4 = Fault inverted 5 = SV9000 overheat warning 6 = External fault or warning 7 = Reference fault or warning 8 = Warning 9 = Reversed 10 = Jogging speed selected 11 = At speed 12 = Motor regulator activated 13 = Output frequency limit superv. 1 14 = Output frequency limit superv. 2 15 = Torque limit supervision 16 = Reference limit supervision 17 = External brake control 18 = Control from I/O terminals 19 = Drive temperature limit supervision 20 = Unrequested rotation direction 21 = External brake control inverted	2-23

**Note!**  = Parameter value can be changed only when the drive is stopped. (Continues)

Code	Parameter	Range	Step	Default	Custom	Description	Page
3.7	Relay output 1 function 	0—21	1	2		As parameter 3.6	2-23
3.8	Relay output 2 function 	0—21	1	3		As parameter 3.6	2-23
3.9	Output freq. limit 1 supervision function	0—2	1	0		0 = No 1 = Low limit 2 = High limit	2-24
3.10	Output freq. limit 1 supervision value	0.0— $f_{\max}$ (par. 1.2)	0.1 Hz	0.0 Hz			2-24
3.11	Output freq. limit 2 supervision function	0—2	1	0		0 = No 1 = Low limit 2 = High limit	2-24
3.12	Output freq. limit 2 supervision value	0.0— $f_{\max}$ (par. 1.2)	0.1 Hz	0.0 Hz			2-24
3.13	Torque limit supervision function	0—2	1	0		0 = No 1 = Low limit 2 = High limit	2-24
3.14	Torque limit supervision value	0.0—200.0% x $T_{\text{NCX}}$	0.1%	100.0%			2-24
3.15	Active reference limit supervision	0—2	1	0		0 = No 1 = Low limit 2 = High limit	2-24
3.16	Active reference limit supervision value	0.0— $f_{\max}$ (par. 1.2)	0.1 Hz	0.0 Hz			2-24
3.17	External brake OFF delay	0.0—100.0 s	0.1 s	0.5 s			2-25
3.18	External brake ON delay	0.0—100.0 s	0.1 s	1.5 s			2-25
3.19	Drive temperature limit supervision function	0—2	1	0		0 = No supervision 1 = Low limit 2 = High limit	2-25
3.20	Drive temperature limit	-10—+75°C	1	+40°C			2-25
3.21	I/O-expander board (opt.) analog output function	0—7	1	3		See parameter 3.1	2-22
3.22	I/O-expander board (opt.) analog output filter time	0.00—10.00 s	0.01 s	1.00 s		See parameter 3.2	2-22
3.23	I/O-expander board (opt.) analog output inversion	0—1	1	0		See parameter 3.3	2-22
3.24	I/O-expander board (opt.) analog output minimum	0—1	1	0		See parameter 3.4	2-22
3.25	I/O-expander board (opt.) analog output scale	10—1000%	1	100%		See parameter 3.5	2-22

**Note!**  = Parameter value can be changed only when the drive is stopped.

## Group 4, Drive control parameters







Code	Parameter	Range	Step	Default	Custom	Description	Page
4. 1	Acc./Dec. ramp 1 shape	0.0—10.0 s	0.1 s	0.0 s		0 = Linear >0 = S-curve acc./dec. time	2-26
4. 2	Acc./Dec. ramp 2 shape	0.0—10.0 s	0.1 s	0.0 s		0 = Linear >0 = S-curve acc./dec. time	2-26
4. 3	Acceleration time 2	0.1—3000.0 s	0.1 s	10.0 s			2-26
4. 4	Deceleration time 2	0.1—3000.0 s	0.1 s	10.0 s			2-26
4. 5	Brake chopper 	0—2	1	0		0 = Brake chopper not in use 1 = Brake chopper in use 2 = External brake chopper	2-26
4. 6	Start function	0—1	1	0		0 = Ramp 1 = Flying start	2-26
4. 7	Stop function	0—1	1	0		0 = Coasting 1 = Ramp	2-27
4. 8	DC-braking current	0.15—1.5* $I_{nCX}$ (A)	0.1	0.5 x $I_{nCX}$			2-27
4. 9	DC-braking time at Stop	0.00—250.00 s	0.01 s	0.00 s		0 = DC-brake is off at Stop	2-27
4. 10	Turn on frequency of DC-brake during ramp Stop	0.1—10.0 Hz	0.1 Hz	1.5 Hz			2-28
4. 11	DC-brake time at Start	0.00—25.00 s	0.01 s	0.00 s		0 = DC-brake is off at Start	2-28
4. 12	Jogging speed reference	$f_{min}$ — $f_{max}$	0.1 Hz	10.0 Hz			2-29


## Group 5, Prohibit frequency parameters

Code	Parameter	Range	Step	Default	Custom	Description	Page
5. 1	Prohibit frequency range 1 low limit	$f_{min}$ — par. 5. 2	0.1 Hz	0.0 Hz			2-29
5. 2	Prohibit frequency range 1 high limit	$f_{min}$ — $f_{max}$ (1. 1) (1. 2)	0.1 Hz	0.0 Hz		0 = Prohibit range 1 is off	2-29
5. 3	Prohibit frequency range 2 low limit	$f_{min}$ — par. 5. 4	0.1 Hz	0.0 Hz			2-29
5. 4	Prohibit frequency range 2 high limit	$f_{min}$ — $f_{max}$ (1. 1) (1. 2)	0.1 Hz	0.0 Hz		0 = Prohibit range 2 is off	2-29
5. 5	Prohibit frequency range 3 low limit	$f_{min}$ — par. 5. 6	0.1 Hz	0.0 Hz			2-29
5. 6	Prohibit frequency range 3 high limit	$f_{min}$ — $f_{max}$ (1. 1) (1. 2)	0.1 Hz	0.0 Hz		0 = Prohibit range 3 is off	2-29

**Note!**  = Parameter value can be changed only when the drive is stopped.

## Group 6, Motor control parameters

Code	Parameter	Range	Step	Default	Custom	Description	Page
6. 1	Motor control mode 	0—1	1	0		0 = Frequency control 1 = Speed control	2-29
6. 2	Switching frequency	1.0—16.0 kHz	0.1 kHz	10/3.6 kHz		Dependant on Hp rating	2-29
6. 3	Field weakening point 	30—500 Hz	1 Hz	Param. 1. 11			2-29
6. 4	Voltage at field weakening point 	15—200% $\times U_{nmot}$	1%	100%			2-29
6. 5	V/Hz-curve mid point frequency 	0.0— $f_{max}$	0.1 Hz	0.0 Hz			2-30
6. 6	V/Hz-curve mid point voltage 	0.00—100.00 % $\times U_{nmot}$	0.01%	0.00%			2-30
6. 7	Output voltage at zero frequency 	0.00—100.00 % $\times U_{nmot}$	0.01%	0.00%			2-30
6. 8	Overvoltage controller	0—1	1	1		0 = Controller is not operating 1 = Controller is operating	2-30
6. 9	Undervoltage controller	0—1	1	1		0 = Controller is not operating 1 = Controller is operating	2-30

**Note!**  = Parameter value can be changed only when the drive is stopped.

## Group 7, Protections

Code	Parameter	Range	Step	Default	Custom	Description	Page
7.1	Response to reference fault	0—3	1	0		0 = No action 1 = Warning 2 = Fault, stop according to par. 4.7 3 = Fault, always coasting stop	2-30
7.2	Response to external fault	0—3	1	0		0 = No action 1 = Warning 2 = Fault, stop according to par. 4.7 3 = Fault, always coasting stop	2-31
7.3	Phase supervision of the motor	0—2	2	2		0 = No action 2 = Fault	2-31
7.4	Ground fault protection	0—2	2	2		0 = No action 2 = Fault	2-31
7.5	Motor thermal protection	0—2	1	2		0 = No action 1 = Warning 2 = Fault	2-32
7.6	Motor thermal protection break point current	50.0—150.0% $\times I_{nMOTOR}$	1.0%	100.0%			2-32
7.7	Motor thermal protection zero frequency current	5.0—150.0% $\times I_{nMOTOR}$	1.0%	45.0%			2-32
7.8	Motor thermal protection time constant	0.5—300.0 minutes	0.5 min.	17.0 min.		Default value is set according to motor nominal current	2-33
7.9	Motor thermal protection break point frequency	10—500 Hz	1 Hz	35 Hz			2-33
7.10	Stall protection	0—2	1	1		0 = No action 1 = Warning 2 = Fault	2-34
7.11	Stall current limit	5.0—200.0% $\times I_{nMOTOR}$	1.0%	130.0%		2-34	
7.12	Stall time	2.0—120.0 s	1.0 s	15.0 s			2-34
7.13	Maximum stall frequency	1— $f_{max}$	1 Hz	25 Hz			2-34
7.14	Underload protection	0—2	1	0		0 = No action 1 = Warning 2 = Fault	2-35
7.15	Underload prot., field weakening area load	10.0—150.0% $\times T_{nMOTOR}$	1.0%	50.0%			2-35
7.16	Underload protection, zero frequency load	5.0—150.0% $\times T_{nMOTOR}$	1.0%	10.0%			2-35
7.17	Underload time	2.0—600.0 s	1.0 s	20.0s			2-36

**Group 8, Autorestart parameters**

Code	Parameter	Range	Step	Default	Custom	Description	Page
8.1	Automatic restart: number of tries	0—10	1	0		0 = Not in use	2-36
8.2	Automatic restart: multi attempt maximum trial time	1—6000 s	1 s	30 s			2-36
8.3	Automatic restart: start function	0—1	1	0		0 = Ramp 1 = Flying start	2-37
8.4	Automatic restart of undervoltage	0—1	1	0		0 = No 1 = Yes	2-37
8.5	Automatic restart of overvoltage	0—1	1	0		0 = No 1 = Yes	2-37
8.6	Automatic restart of overcurrent	0—1	1	0		0 = No 1 = Yes	2-37
8.7	Automatic restart of reference fault	0—1	1	0		0 = No 1 = Yes	2-37
8.8	Automatic restart after over/undertemperature fault	0—1	1	0		0 = No 1 = Yes	2-37

Table 2.5-1 Special parameters, Groups 2—8.

## 2.5.2 Description of Groups 2—8 parameters

### 2.1 Start/Stop logic selection

- 0: DIA1: closed contact = start forward  
 DIA2: closed contact = start reverse,  
 See figure 2.5-1.

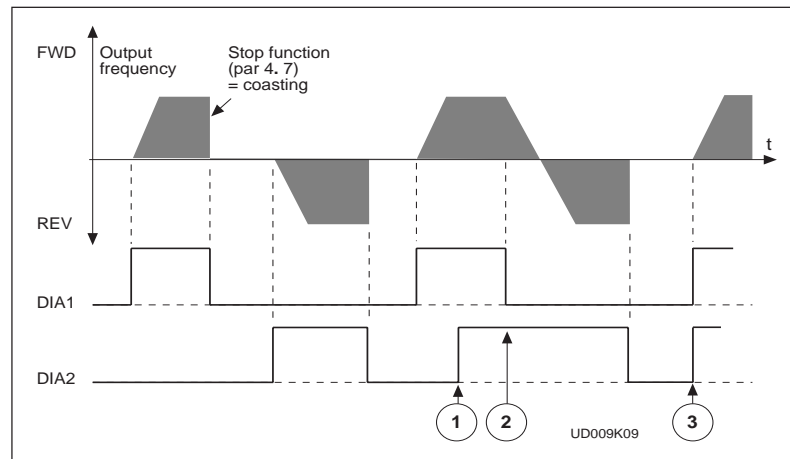


Figure 2.5-1 Start forward/Start reverse.

- ① The first selected direction has the highest priority
- ② When DIA1 contact opens, the direction of rotation starts to change
- ③ If Start forward (DIA1) and Start reverse (DIA2) signals are active simultaneously, the Start forward signal (DIA1) has priority.

- 1: DIA1: closed contact = start      open contact = stop  
 DIA2: closed contact = reverse    open contact = forward  
 See figure 2.5-2.

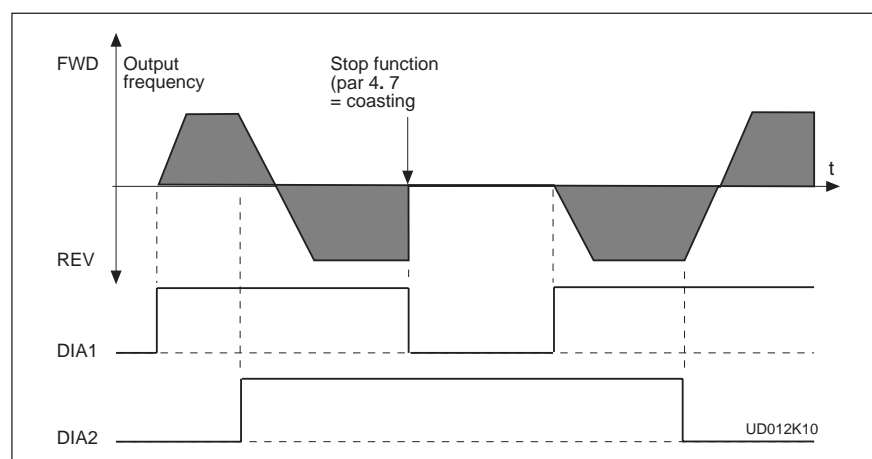


Figure 2.5-2 Start, Stop, reverse.

- 2: DIA1: closed contact = start                      open contact = stop  
       DIA2: closed contact = start enabled        open contact = start disabled
- 3: 3-wire connection (pulse control):  
       DIA1: closed contact = start pulse  
       DIA2: closed contact = stop pulse  
       (DIA3 can be programmed for reverse command)  
       See figure 2.5-3.
- 4: DIA1: closed contact = start forward  
       DIA2: closed contact = reference increases (motor potentiometer  
       reference, par. 2. 1 is automatically set to 4 if  
       par. 1. 5 is set to 3 or 4).

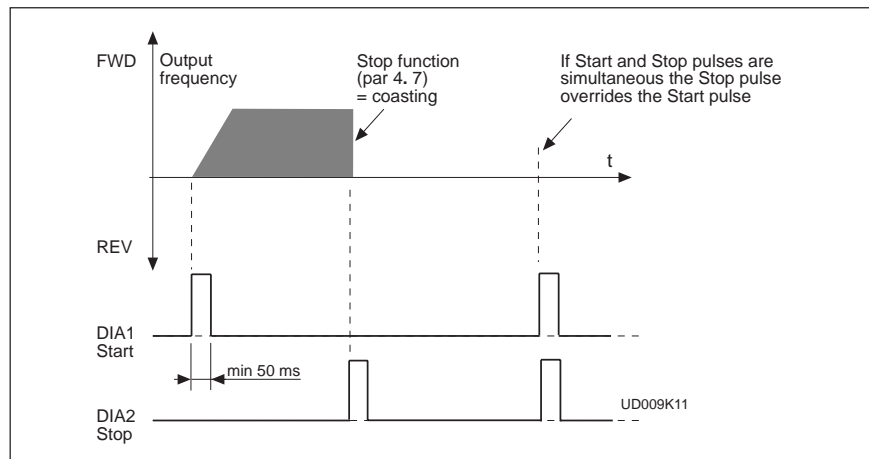


Figure 2.5-3 Start pulse /Stop pulse.

## 2. 2 DIA3 function

- 1: External fault, closing contact = Fault is shown and motor is stopped when the contact is closed
- 2: External fault, opening contact = Fault is shown and motor is stopped when the input is open
- 3: Run enable      contact open      = Start of the motor disabled  
                          contact closed      = Start of the motor enabled
- 4: Acc. / Dec time select.      contact open      = Acceleration/Deceleration time 1 selected  
    contact closed      = Acceleration/Deceleration time 2 selected
- 5: Reverse              contact open      = Forward || Can be used for reversing if  
    contact closed      = Reverse || parameter 2. 1 has value 3
- 6: Jogging freq.      contact closed      = Jogging frequency selected for freq. refer.
- 7: Fault reset              contact closed      = Resets all faults
- 8: Acc./Dec. operation prohibited  
    contact closed      = Stops acceleration and deceleration until the contact is opened
- 9: DC-braking command  
    contact closed      = In the stop mode, the DC-braking operates until the contact is opened, see figure 2.5-4.  
    Dc-brake current is set with parameter 4. 8.
- 10: Motor pot. meter down  
    contact closed      = Reference decreases until the contact is opened



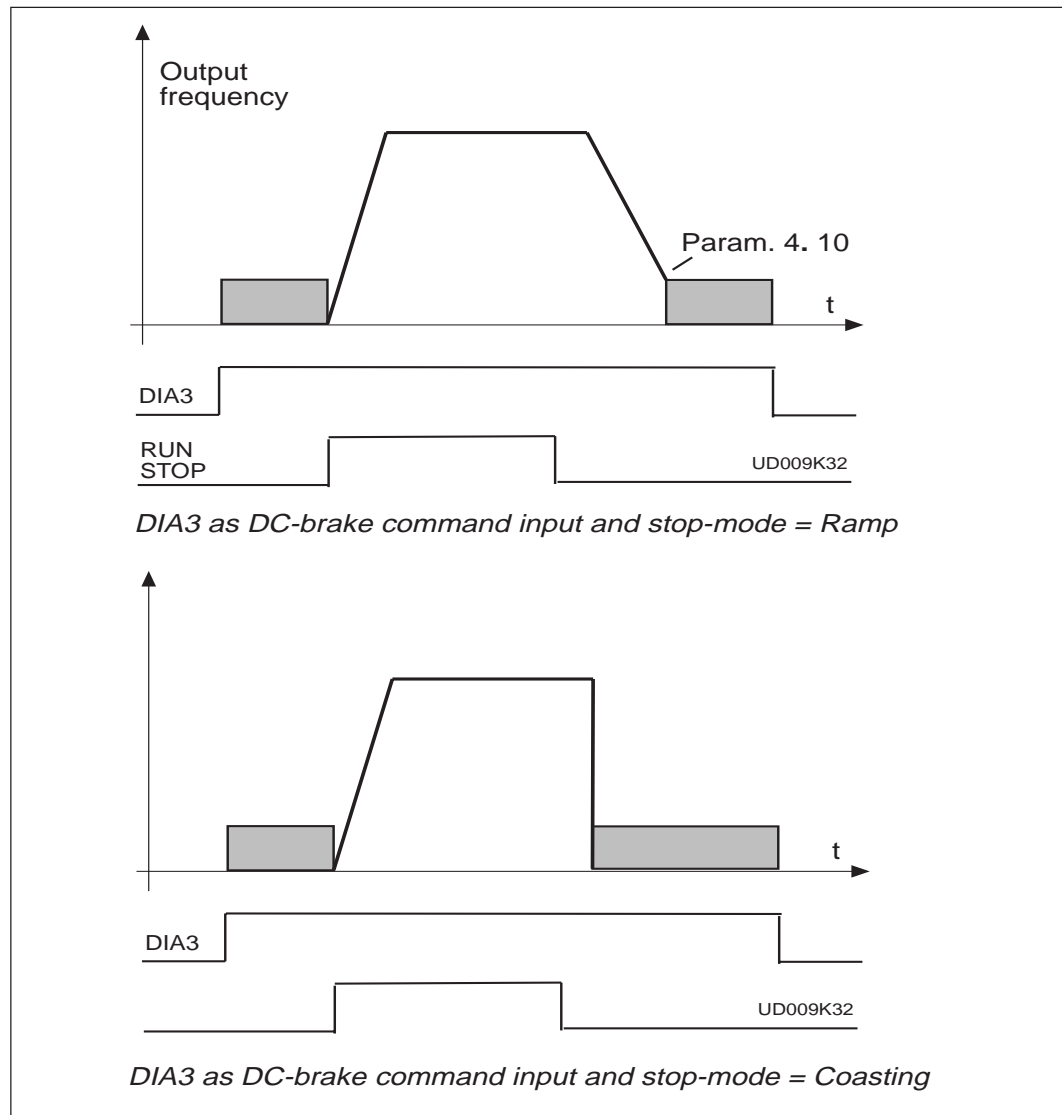


Figure 2.5-4 DIA3 as DC-brake command input: a) Stop-mode = Ramp, b) Stop-mode = Coasting.

### 2.3 $V_{in}$ signal range

0 = Signal range 0—10 V

1 = Custom setting range from custom minimum (par. 2. 4) to custom maximum (par. 2. 5)

### 2.4 $V_{in}$ custom setting minimum/maximum

2.5 With these parameters you can set  $V_{in}$  for any input signal span within 0—10 V.

Minimum setting: Set the  $V_{in}$  signal to its minimum level, select parameter 2. 4, press the Enter button

Maximum setting: Set the  $V_{in}$  signal to its maximum level, select parameter 2. 5, press the Enter button

**Note!** The parameter values can only be set with this procedure (not with arrow up/arrow down buttons).

## 2.6 $V_{in}$ signal inversion

$V_{in}$  is source B frequency reference, par. 1.6 = 1 (default)

Parameter 2.6 = 0, no inversion of analog  $V_{in}$  signal.

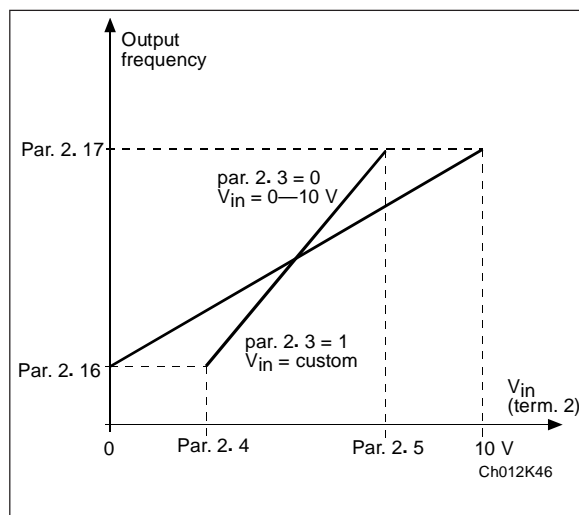


Figure 2.5-5  $V_{in}$  no signal inversion.

Parameter 2.6 = 1, inversion of analog  $V_{in}$  signal

max.  $V_{in}$  signal = minimum set speed

min.  $V_{in}$  signal = maximum set speed

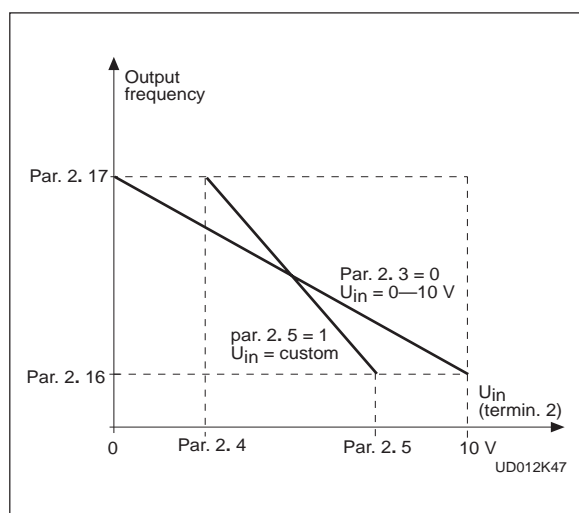


Figure 2.5-6  $V_{in}$  signal inversion.

## 2.7 $V_{in}$ signal filter time

Filters out disturbances from the incoming analog  $V_{in}$  signal.

A long filtering time makes regulation response slower.

See figure 2.5-7.

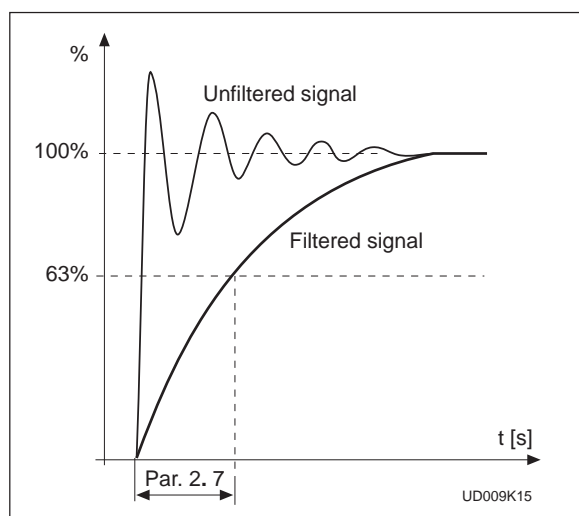


Figure 2.5-7  $V_{in}$  signal filtering.

## 2.8 Analog input $I_{in}$ signal range

0 = 0—20 mA

1 = 4—20 mA

2 = Custom signal span

See figure 2.5-8.

## 2.9 Analog input $I_{in}$ custom setting minimum/maximum

With these parameters you can scale the input current to correspond to a minimum and maximum frequency range. See figure 2.5-8.

Minimum setting:

Set the  $I_{in}$  signal to its minimum level, select parameter 2. 9, press the Enter button

Maximum setting:

Set the  $I_{in}$  signal to its maximum level, select parameter 2. 10, press the Enter button

**Note!** The parameter values can only be set with this procedure (not with arrow up/arrow down-buttons).

## 2.11 Analog input $I_{in}$ inversion

$I_{in}$  is source A frequency reference, par. 1. 5 = 0 (default)

Parameter 2. 11 = 0, no inversion of  $I_{in}$  input

Parameter 2. 11 = 1, inversion of  $I_{in}$  input. See figure 2.5-9.

max.  $I_{in}$  signal = minimum set speed  
min.  $I_{in}$  signal = maximum set speed

## 2.12 Analog input $I_{in}$ filter time

Filters out disturbances from the incoming analog  $I_{in}$  signal. A long filtering time makes regulation response slower.

See figure 2.5-10.

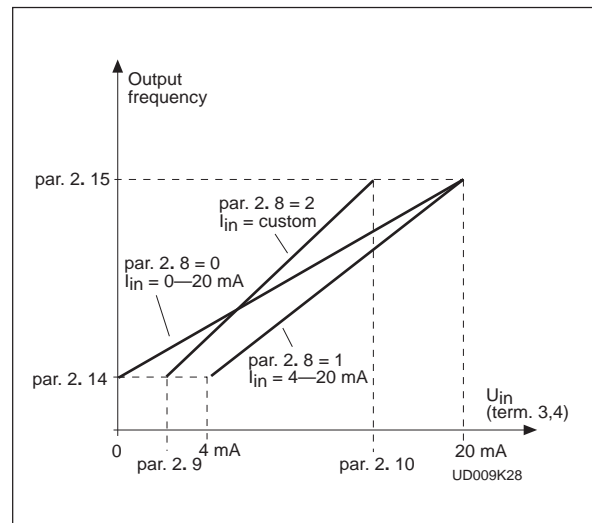


Figure 2.5-8 Analog input  $I_{in}$  scaling.

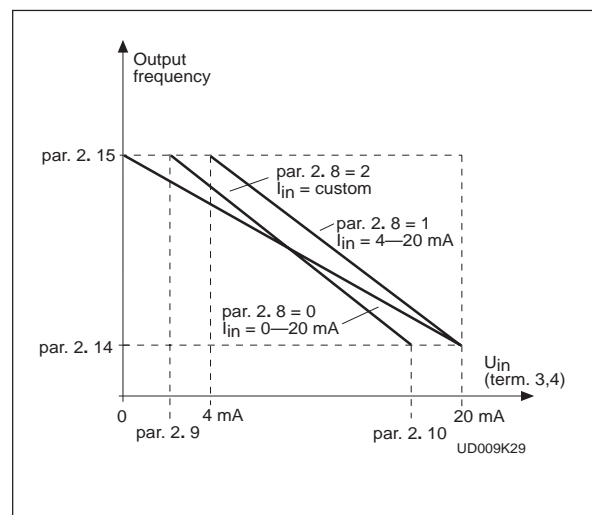


Figure 2.5-9  $I_{in}$  signal inversion.

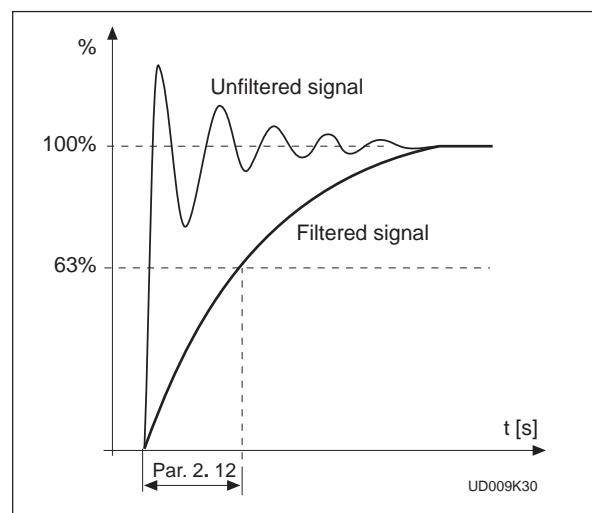


Figure 2.5-10 Analog input  $I_{in}$  filter time.

**2. 13 Source B Start/Stop logic selection**

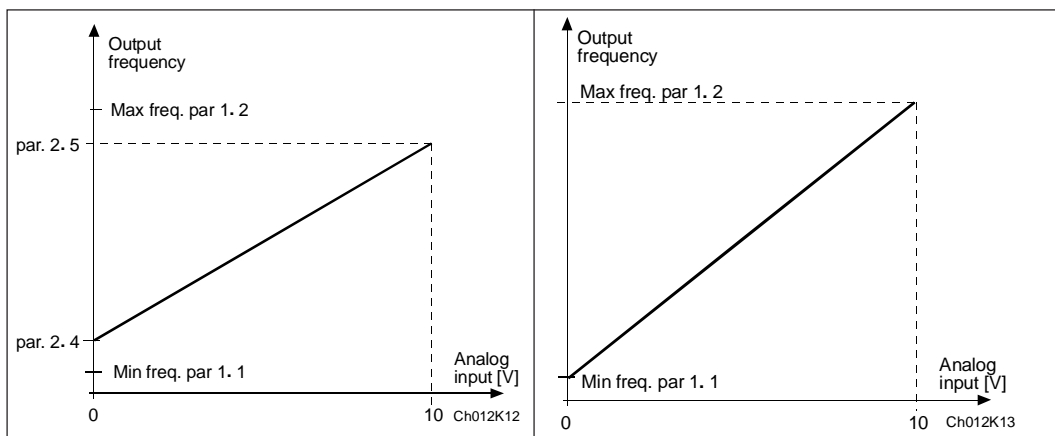
See parameter 2. 1, settings 0—3.

**2. 14, Source A reference scaling, minimum value/maximum value**

Setting limits:  $0 < \text{par. 2. 14} < \text{par. 2. 15} < \text{par. 1. 2}$ .

If  $\text{par. 2. 15} = 0$  scaling is set off. See figures 2.5-11 and 2.5-12.

(In figures voltage input  $V_{in}$  with signal range 0—10 V selected for source A reference)

**2. 16, Source B reference scaling, minimum value/maximum value**

See parameters 2. 14 and 2. 15.

**2. 18 Free analog input signal**

Selection of input signal of a free analog input (an input not used for reference signal):

0 = Not in use

1 = Voltage signal  $V_{in}$

2 = Current signal  $I_{in}$

**2. 19 Free analog input signal function**

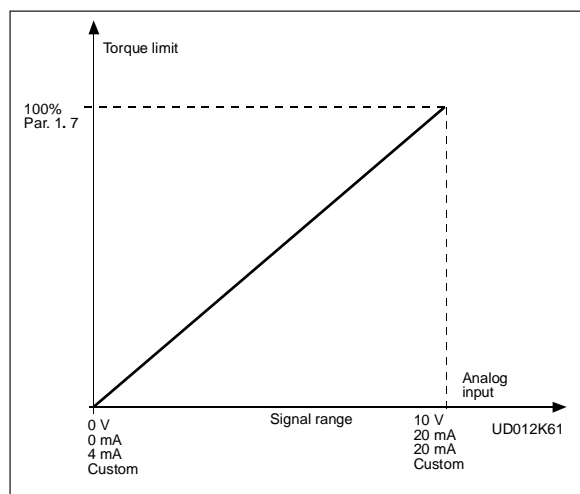
Use this parameter to select a function for a free analog input signal:

0 = Function is not used

1 = Reducing motor current limit (par. 1. 7)

This signal will adjust the maximum motor current between 0 and ,par. 1. 7 set max. limit. See figure 2.5-13.

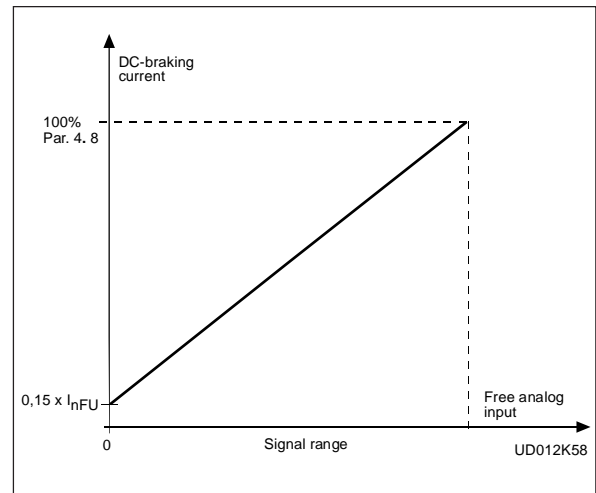
Figure 2.5-13 Scaling of max. motor current.



## 2 Reducing DC brake current.

DC braking current can be reduced with the free analog input signal between current  $0.15 \times I_{nFC}$  and the current set by parameter 4. 8. See figure 2.5-14.

*Figure 2.5-14 Reducing DC brake current.*

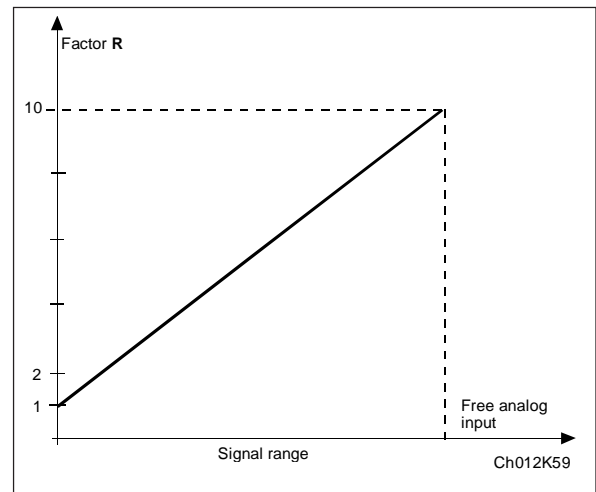


## 3 Reducing acceleration and deceleration times.

Acceleration and deceleration times can be reduced with the free analog input signal according to the following formulas:

Reduced time = set acc./deceler. time (par. 1. 3, 1. 4; 4. 3, 4. 4) divided by the factor R from figure 2.5-15.

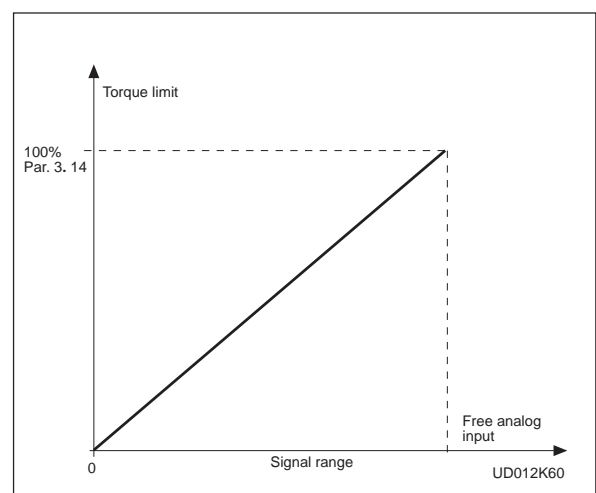
*Figure 2.5-15 Reducing acceleration and deceleration times.*



## 4 Reducing torque supervision limit.

Torque supervision limit can be reduced with a free analog input signal between 0 and the set supervision limit (par. 3. 14). See figure 2.5-16.

*Figure 2.5-16 Reducing torque supervision limit.*



## 2.20 Motor potentiometer ramp time

Defines how fast the electronic motor potentiometer value changes.

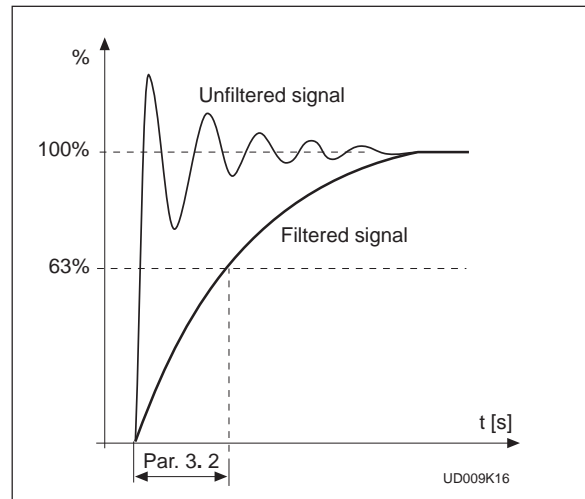
## 3.1 Analog output Content

See table on page 2-9.

## 3.2 Analog output filter time

Filters the analog output signal.  
See figure 2.5-17.

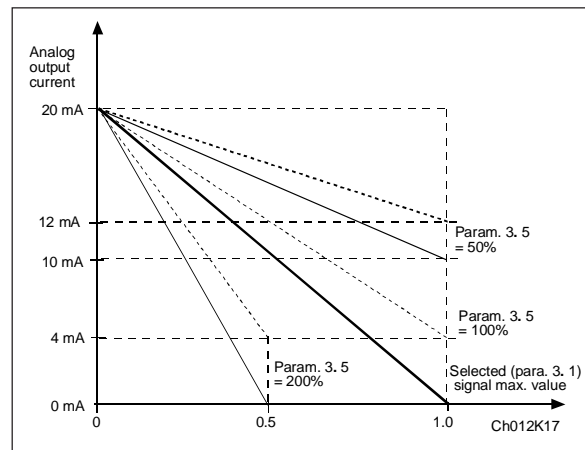
Figure 2.5-17 Analog output filtering.



## 3.3 Analog output invert

Inverts analog output signal:  
max. output signal = minimum set value  
min. output signal = maximum set value

Figure 2.5-18 Analogue output invert.



## 3.4 Analog output minimum

Defines the signal minimum to be either 0 mA or 4 mA.  
See figure 2.5-19.

## 3.5 Analog output scale

Scaling factor for analog output.  
See figure 2.5-19.

Signal	Max. value of the signal
Output frequency	Max. frequency (p. 1. 2)
Motor speed	Max. speed ( $n_n \times f_{\max} / f_n$ )
Output current	$2 \times I_{nFC}$
Motor torque	$2 \times T_{nMot}$
Motor power	$2 \times P_{nMot}$
Motor voltage	$100\% \times U_{nMot}$
DC-link volt.	1000 V

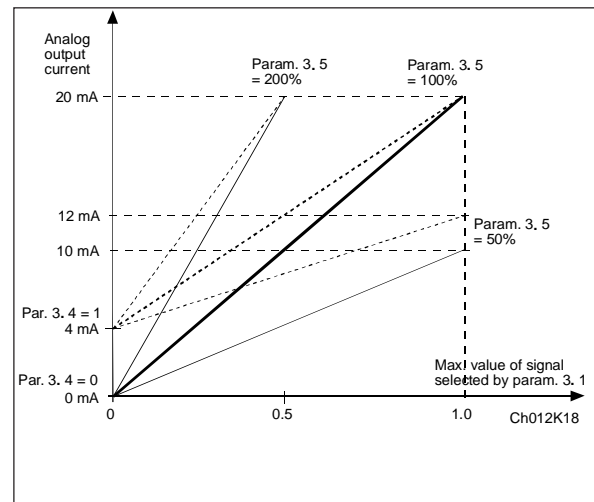


Figure 2.5-19 Analog output scale.

3. 6 Digital output function  
 3. 7 Relay output 1 function  
 3. 8 Relay output 2 function

Setting value	Signal content
0 = Not used	Out of operation <u>Digital output DO1 sinks current and programmable relay (RO1, RO2) is activated when:</u>
1 = Ready	The drive is ready to operate
2 = Run	The drive operates (motor is running)
3 = Fault	A fault trip has occurred
4 = Fault inverted	A fault trip <u>has not</u> occurred
5 = SV9000 overheat warning	The heat-sink temperature exceeds +70°C
6 = External fault or warning	Fault or warning depending on parameter 7. 2
7 = Reference fault or warning	Fault or warning depending on parameter 7. 1 - if analog reference is 4—20 mA and signal is <4mA
8 = Warning	Always if a warning exists
9 = Reversed	The reverse command has been selected
10 = Jogging speed	Jogging speed has been selected with digital input
11 = At speed	The output frequency has reached the set reference
12 = Motor regulator activated	Overvoltage or overcurrent regulator was activated
13 = Output frequency supervision 1	The output frequency goes outside of the set supervision Low limit/ High limit (par. 3. 9 and 3. 10)
14 = Output frequency supervision 2	The output frequency goes outside of the set supervision Low limit/ High limit (par. 3. 11 and 3. 12)
15 = Torque limit supervision	The motor torque goes outside of the set supervision Low limit/ High limit (par. 3. 13 and 3. 14)
16 = Active reference limit supervision	Active reference goes outside of the set supervision Low limit/ High limit (par. 3. 15 and 3. 16)
17 = External brake control	External brake ON/OFF control with programmable delay (par 3. 17 and 3. 18)
18 = Control from I/O terminals	External control mode selected with prog. pushbutton #2
19 = Drive temperature limit supervision	Temperature on drive is outside the set supervision limits (par. 3. 19 and 3. 20)
20 = Unrequested rotation direction	Rotation direction of the motor shaft is different from the requested one
21 = External brake control inverted	External brake ON/OFF control (par. 3.17 and 3.18), output active when brake control is OFF

Table 2.5-2 Output signals via DO1 and output relays RO1 and RO2.

**3. 9 Output frequency limit 1, supervision function****3. 11 Output frequency limit 2, supervision function**

0 = No supervision

1 = Low limit supervision

2 = High limit supervision

If the output frequency goes under/over the set limit (3. 10, 3. 12) this function generates a warning message via the digital output DO1 or via a relay output RO1 or RO2 depending on the settings of the parameters 3. 6—3. 8.

**3. 10 Output frequency limit 1, supervision value****3. 12 Output frequency limit 2, supervision value**

The frequency value to be supervised by the parameter 3. 9 (3. 11).

See figure 2.5-20.

**3. 13 Torque limit , supervision function**

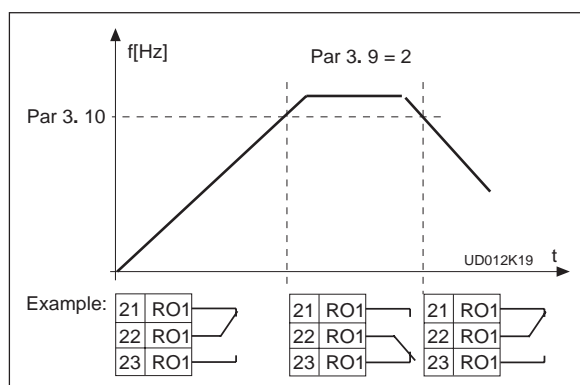
0 = No supervision

1 = Low limit supervision

2 = High limit supervision

If the calculated torque value goes under/over the set limit (3.14) this function generates a warning message via the digital output DO1 or via a relay output RO1 or RO2 depending on the settings of the parameters 3. 6—3. 8.

Figure 2.5-20 Output frequency supervision.

**3. 14 Torque limit , supervision value**

The calculated torque value to be supervised by the parameter 3. 13.

Torque supervision value can be reduced below the setpoint with a free analog input signal, see parameters 2. 18 and 2. 19.

**3. 15 Reference limit , supervision function**

0 = No supervision

1 = Low limit supervision

2 = High limit supervision

If the reference value goes under/over the set limit (3. 16) this function generates a warning message via the digital output DO1 or via a relay output RO1 or RO2 depending on the settings of the parameters 3. 6—3. 8. The supervised reference is the current active reference. It can be source A or B reference depending on DIB6 input or panel reference if panel is the active control source.

**3. 16 Reference limit , supervision value**

The frequency value to be supervised by the parameter 3. 15.



### 3. 17 External brake-off delay

### 3. 18 External brake-on delay

The function of the external brake can be delayed from the start and stop control signals with these parameters. See figure 2.5-21.

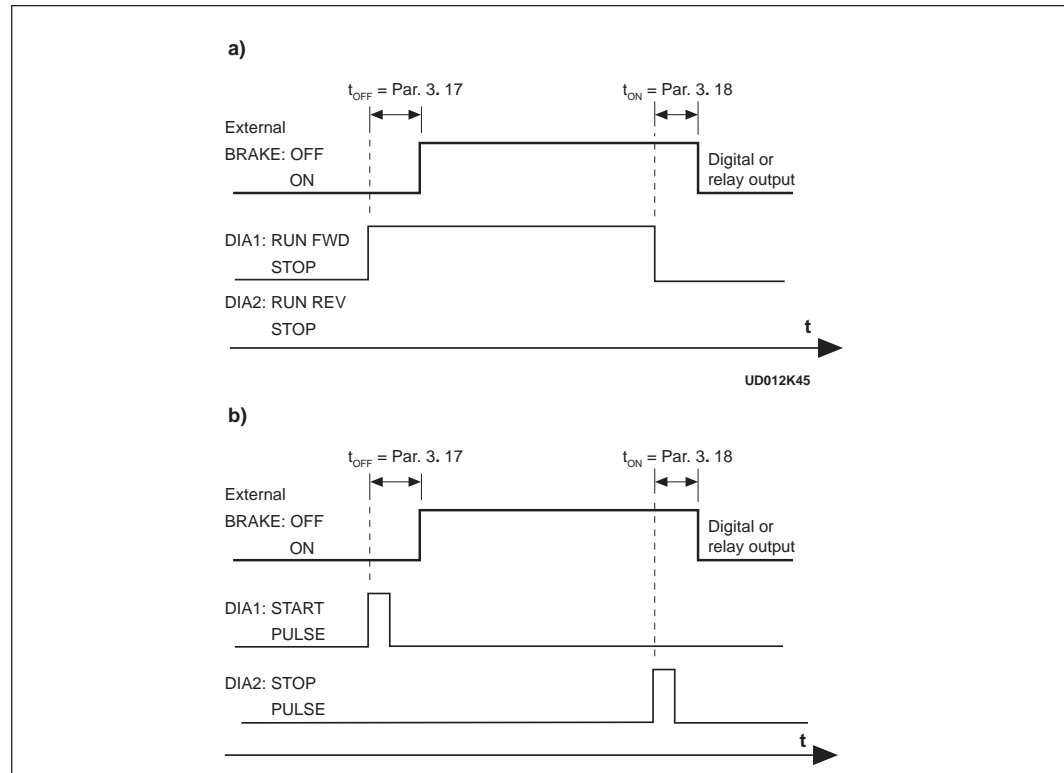


Figure 2.5-21 Ext. brake control: a) Start/Stop logic selection par 2. 1 = 0, 1 or 2  
b) Start/Stop logic selection par 2. 1 = 3.

The brake control signal can be programmed via the digital output DO1 or via one of the relay outputs RO1 and RO2, see parameters 3. 6—3. 8.

### 3. 19 Drive temperature limit supervision

- 0 = No supervision
- 1 = Low limit supervision
- 2 = High limit supervision

If temperature of the unit goes under/over the set limit (par. 3. 20) this function generates a warning message via the digital output DO1 and via a relay output RO1 or RO2 depending on the settings of the parameters 3. 6—3. 8.

### 3. 20 Drive temperature supervision limit value

The set temperature value to be supervised with the parameter 3. 19.

**4. 1 Acc/Dec ramp 1 shape****4. 2 Acc/Dec ramp 2 shape**

The acceleration and deceleration ramp shape can be programmed with these parameters.

Setting value 0 gives linear ramp shape which causes acceleration and deceleration to act immediately to the changes in the reference signal with the time constant set by the parameter 1. 3 and 1. 4 (4. 3 and 4. 4).

Setting value 0.1—10 seconds for 4. 1 (4. 2) causes an S-shape ramp. Parameter 1. 3 and 1. 4 (4. 3 and 4. 4) determine the time constant of acceleration/deceleration in the middle of the curve. See figure 2.5-22.

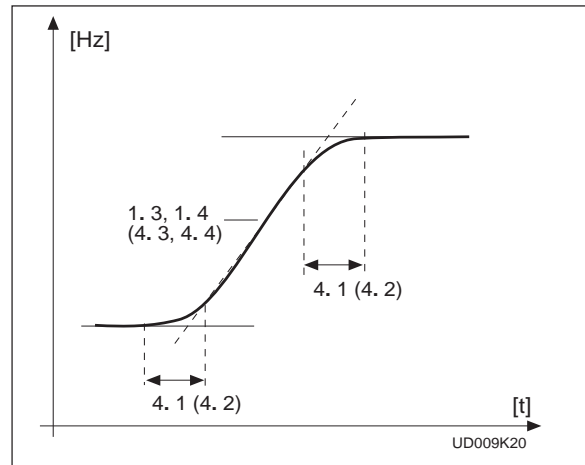


Figure 2.5-22 S-shaped acceleration/deceleration.

**4. 3 Acceleration time 2****4. 4 Deceleration time 2**

These values correspond to the time required for the output frequency to accelerate from the set minimum frequency (par. 1. 1) to the set maximum frequency (par. 1. 2). With this parameter it is possible to set two different acceleration/deceleration times for one application. The active set can be selected with the programmable signal DIA3. See parameter 2. 2. Acceleration/deceleration times can be reduced with a free analog input signal. See parameters 2. 18 and 2. 19.

**4. 5 Brake chopper**

0 = No brake chopper

1 = Brake chopper and brake resistor installed

2 = External brake chopper

When the drive is decelerating the motor, the energy stored in the inertia of the motor and the load is fed into the external brake resistor. This enables the drive to decelerate the load with the torque equal to that of acceleration, if the brake resistor is selected correctly. See separate Brake resistor installation manual.

**4. 6 Start function**

Ramp:

- 0** The drive starts from 0 Hz and accelerates to the set reference frequency within the set acceleration time. (Load inertia or starting friction may cause prolonged acceleration times).

Flying start:

- 1** The drive is able to start into running motor by applying a small torque to motor and searching for frequency corresponding to the speed the motor is running. Searching starts from the maximum frequency towards the actual frequency until the correct value is detected. The output frequency will then accelerate/ decelerate to the set reference value at a rate determined by the acceleration/ deceleration ramp parameters.

Use this mode if the motor may be coasting when the start command is given. With the flying start it is possible to ride through short utility voltage interruptions.

#### 4.7 Stop function

Coasting:

- 0** The motor coasts to an uncontrolled stop with the SV9000 off, after the Stop command.

Ramp:

- 1** After the Stop command, the speed of the motor is decelerated based on the deceleration ramp time parameter.  
If the regenerated energy is high, it may be necessary to use an external braking resistor for faster deceleration.

#### 4.8 DC braking current

Defines the current injected into the motor during DC braking.

The DC braking current can be reduced from the setpoint with a external free analog input signal, see parameters 2. 18 and 2. 19.

#### 4.9 DC braking time at stop

Defines if braking is ON or OFF and the braking duration time of the DC-brake when the motor is stopping. The function of the DC-brake depends on the stop function, parameter 4. 7. See figure 2.5-23.

- 0** DC-brake is not used
- >0** DC-brake is in use and its function depends of the stop function, (parameter 4. 7), The time is set by the value of parameter 4. 9:

Stop-function = 0 (coasting):

After the stop command, the motor will coast to a stop with the SV9000 off.

With DC-injection, the motor can be electrically stopped in the shortest possible time, without using an optional external braking resistor.

The braking time is scaled according to the frequency when the DC-braking starts. If the frequency is  $\geq$  nominal frequency of the motor (par. 1.11), the set value of parameter 4.9 determines the braking time. When the frequency is  $\leq 10\%$  of the nominal, the braking time is 10% of the set value of parameter 4.9. See figure 1.5-13.

Stop-function = 1 (ramp):

After the Stop command, the speed of the motor is reduced based on the deceleration ramp parameter, if no regeneration occurs due to load inertia, to a speed defined with parameter 4. 10 where the DC-braking starts.

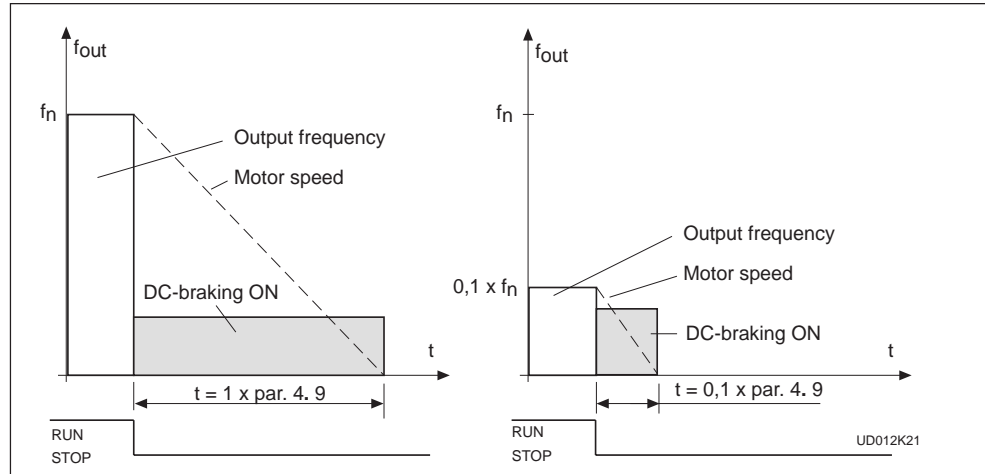


Figure 2.5-23 DC-braking time when par. 4. 7 = 0.

The braking time is defined with parameter 4. 9. If high inertia exists it is recommended to use an external braking resistor for faster deceleration. See figure 2.5-24.

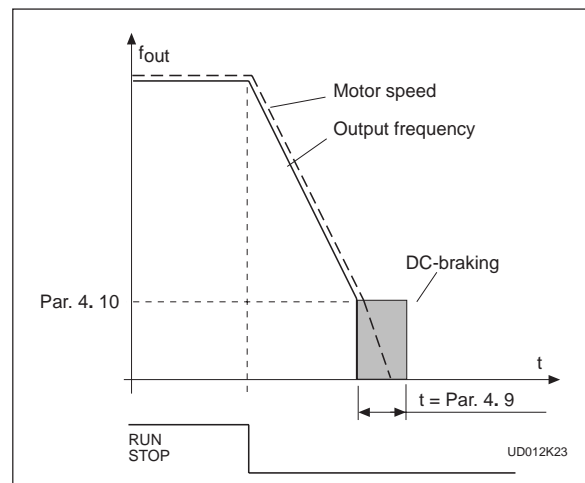


Figure 2.5-24 DC-braking time when par. 4. 7 = 1.

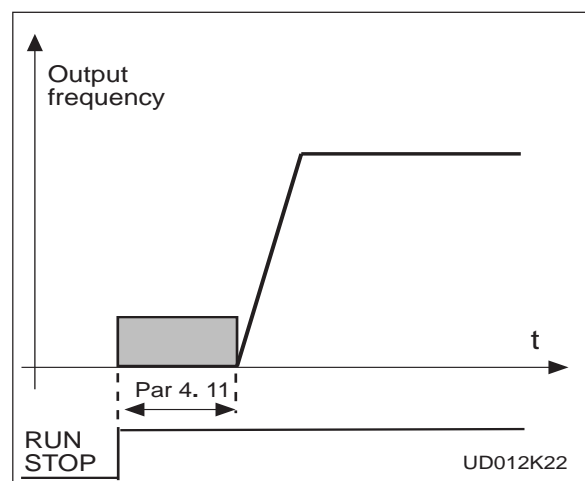
#### 4. 10 Execute frequency of DC-brake during ramp Stop

See figure 2.5-24.

#### 4. 11 DC-brake time at start

- 0 DC-brake is not used
- >0 The DC-brake is activated when the start command is given. This parameter defines the time before the brake is released. After the brake is released the output frequency increases according to the set start function parameter 4. 6 and the acceleration parameters (1. 3, 4. 1 or 4. 2, 4. 3). See figure 2.5-25.

Figure 2.5-25 DC-braking time at start.



#### 4. 12 Jog speed reference

This parameter value defines the jog speed if the DIA3 digital input is programmed for Jog and is selected. See parameter 2. 2.

#### 5. 1 Prohibit frequency area Low 5. 2 limit/High limit

5. 3

5. 4

5. 5

5. 6

In some systems it may be necessary to avoid certain frequencies because of mechanical resonance problems.

With these parameters it is possible to set limits for three "skip frequency" regions between 0 Hz and 500 Hz. The accuracy of the setting is 0.1 Hz. See figure 2.5-6.

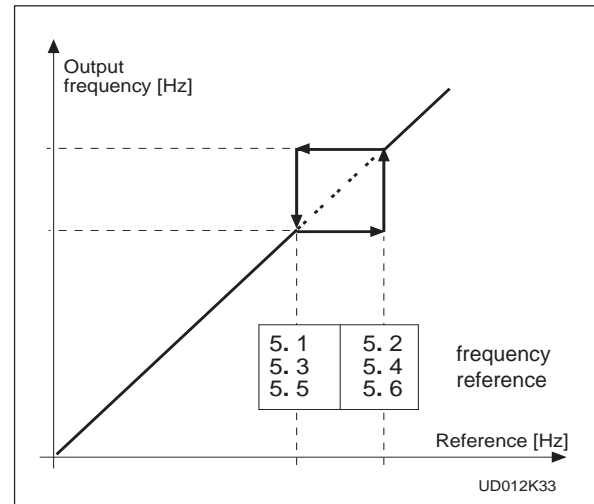


Figure 2.5-26 Example of prohibit frequency area setting.

#### 6. 1 Motor control mode

0 = Frequency control:

The I/O terminal and panel references are frequency references and the drive controls the output frequency (output freq. resolution 0.01 Hz)

1 = Speed control:

The I/O terminal and panel references are speed references and the drive controls the motor speed (regulation accuracy  $\pm 0.5\%$ ).

#### 6. 2 Switching frequency

Motor noise can be minimized using a high switching frequency. Increasing the switching frequency reduces the capacity of the SV9000.

Before changing the frequency from the factory default 10 kHz ( $3.6 \text{ kHz} \geq 40 \text{ Hp}$ ), check the drive derating from the curves shown in figures 5.2-2 and 5.2-3 in chapter 5.2 of the User's manual.

#### 6. 3 Field weakening point

#### 6. 4 Voltage at the field weakening point

The field weakening point is the the output frequency where the output voltage reaches the set maximum value(parm. 6.4). Above that frequency the output voltage remains at the set maximum value. Below that frequency output voltage depends on the setting of the V/Hz curve parameters 1. 8, 1. 9, 6. 5, 6. 6 and 6. 7. See figure 2.5-27.

When the parameters 1. 10 and 1. 11, nominal voltage and nominal frequency of the motor are set, parameters 6. 3 and 6. 4 are also set automatically to the corresponding values. If you need different values for the field weakening point and the maximum output voltage, change these parameters after setting parameters 1. 10 and 1. 11.

### 6.5 V/Hz curve, middle point frequency

If the programmable V/Hz curve has been selected with parameter 1. 8, this parameter defines the middle frequency point of the curve. See figure 2.5-27.

### 6.6 V/Hz curve, middle point voltage

If the programmable V/Hz curve has been selected with parameter 1. 8, this parameter defines the middle point voltage (% of motor nominal voltage) of the curve. See figure 2.5-27.

### 6.7 Output voltage at zero frequency

If the programmable V/Hz curve has been selected with parameter 1. 8, this parameter defines the zero frequency voltage (% of motor nominal voltage) of the curve. See figure 2.5-27.

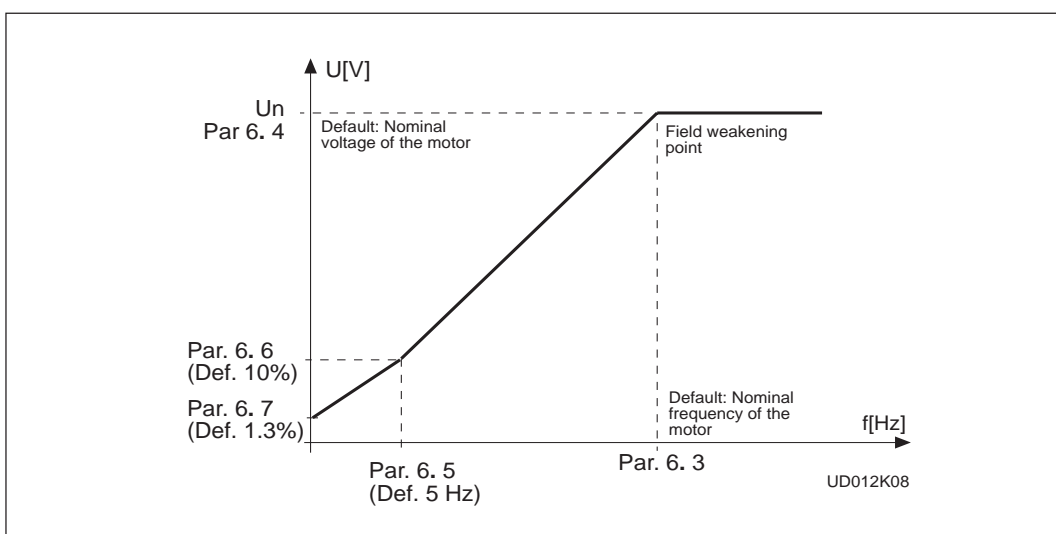


Figure 2.5-27 Programmable V/Hz curve.

### 6.8 Overvoltage controller

### 6.9 Undervoltage controller

These parameters allow the over/undervoltage controllers to be switched out of operation. This may be useful, for example, if the utility supply voltage varies more than -15%—+10% and the application will not tolerate this over-/undervoltage. The regulator controls output frequency according to the supply fluctuations.

Over/undervoltage trips may occur when controllers are switched out of operation.

### 7.1 Response to the reference fault

0 = No response

1 = Warning

2 = Fault, stop mode after fault according to parameter 4.7

3 = Fault, always coasting stop mode after fault detection

A warning or a fault action and message is generated if the 4—20 mA reference signal is used and the signal falls below 4 mA.

The information can also be programmed via digital output DO1 and via relay outputs RO1 and RO2.

**7.2 Response to external fault**

- 0 = No response
- 1 = Warning
- 2 = Fault, stop mode after fault according to parameter 4.7
- 3 = Fault, always coasting stop mode after fault detection

A warning or a fault action and message is generated from the external fault signal on digital input DIA3.

The information can also be programmed into digital output DO1 and into relay outputs RO1 and RO2.

**7.3 Phase supervision of the motor**

- 0 = No action
- 2 = Fault

Phase supervision of the motor ensures that the motor phases have approximately equal current.

**7.4 Ground fault protection**

- 0 = No action
- 2 = Fault message

Ground fault protection ensures that the sum of the motor phase currents is zero. The standard overcurrent protection is always present and protects the frequency converter from ground faults with high current levels.

**Parameters 7.5—7.9 Motor thermal protection****General**

Motor thermal protection protects the motor from overheating. The SV9000 drive is capable of supplying higher than nominal current to the motor. If the load requires this high current there is a risk that motor will be thermally overloaded. This is true especially at low frequencies. With low frequencies the cooling effect of the motor fan is reduced and the capacity of the motor is reduced. If the motor is equipped with a separately powered external fan, the load derating at low speed is small.

Motor thermal protection is based on a calculated model and it uses the output current of the drive to determine the load on the motor. When the motor is powered from the drive, the calculated model uses the heatsink temperature to determine the initial thermal stage for the motor. The calculated model assumes that the ambient temperature of the motor is 40°C.

Motor thermal protection can be adjusted by setting several parameters. The thermal current  $I_T$  specifies the load current above which the motor is overloaded. This current level is a function of the output frequency. The curve for  $I_T$  is set with parameters 7.6, 7.7 and 7.9. Refer to the figure 2.5-28. The default values of these parameters are set from the motor nameplate data.

With the output current at  $I_T$  the thermal stage will reach the nominal value (100%). The thermal stage changes by the square of the current. With output current at 75% from  $I_T$  the thermal stage will reach 56% value and with output current at 120% from  $I_T$  the thermal stage would reach 144% value. The function will trip the drive (refer par. 7.5) if the thermal stage will reach a value of 105%. The response time of the thermal stage is determined with the time constant parameter 7.8. The larger the motor, the longer it takes to reach the final temperature.

The thermal stage of the motor can be monitored through the display. Refer to the table for monitoring items. (User's Manual, table 7.3-1).

**CAUTION!**

*The calculated model does not protect the motor if the airflow to the motor is reduced by blocked air intake grill, dirt or dust.*

## 7.5 Motor thermal protection

Operation:

- 0 = Not in use
- 1 = Warning
- 2 = Trip function

Tripping and warning will give a display indication with the same message code. If tripping is selected the drive will stop and activate the fault stage.

Deactivating the protection by setting this parameter to 0, will reset the thermal stage of the motor to 0%.

## 7.6 Motor thermal protection, break point current

This current can be set between 50.0—150.0%  $\times I_{nMotor}$ .

This parameter sets the value for thermal current at frequencies above the break point on the thermal current curve. Refer to the figure 2.5-28.

The value is set as a percentage of the motor nameplate nominal current, parameter 1. 13, not the drive's nominal output current.

The motor's nominal current is the current which the motor can withstand in direct online use without being overheated.

If parameter 1. 13 is adjusted, this parameter is automatically restored to the default value.

Setting this parameter (or parameter 1. 13) does not affect the maximum output current of the drive. Parameter 1. 7 alone determines the maximum output current of the drive.

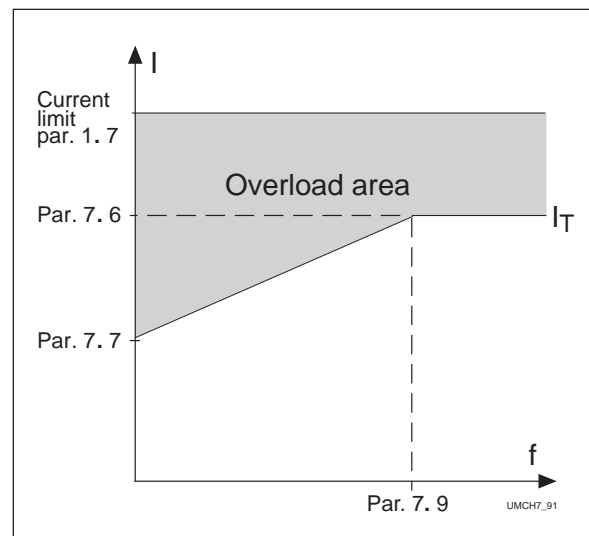


Figure 2.5-28 Motor thermal current  $I_T$  curve.

## 7.7 Motor thermal protection, zero frequency current

This current can be set between 10.0—150.0%  $\times I_{nMotor}$ .

This parameter sets the value for thermal current at zero frequency. Refer to the figure 2.5-28.

The default value is set assuming that there is no external fan cooling the motor. If an external fan is used this parameter can be set to 90% (or higher).



The value is set as a percentage of the motor's nominal nameplate current, parameter 1. 13, not the drive's nominal output current. The motor's nominal current is the current which the motor can stand in direct on-line use without being overheated.

If you change parameter 1. 13, this parameter

is automatically restored to the default value.

Setting this parameter (or parameter 1. 13) does not affect to the maximum output current of the drive. Parameter 1. 7 alone determines the maximum output current of the drive.

## 7.8 Motor thermal protection, time constant

This time can be set between 0.5—300 minutes.

This is the thermal time constant of the motor. The larger the motor the greater the time constant. The time constant is defined as the time that it takes the calculated thermal stage to reach 63% of its final value.

The motor thermal time is specific to a motor design and it varies between different motor manufacturers.

The default value for the time constant is calculated based on the motor nameplate data from parameters 1. 12 and 1. 13. If either of these parameters is reset, then this parameter is set to default value.

parameter could be set based on  $t_6$ -time. As a rule of thumb, the motor thermal time constant in minutes equals to  $2 \times t_6$  ( $t_6$  in seconds is the time a motor can safely operate at six times the rated current). If the drive is stopped the time constant is internally increased to three times the set parameter value. Cooling in the stop stage is based on convection with an increased time constant

If the motor's  $t_6$ -time is known (given by the motor manufacturer) the time constant

## 7.9 Motor thermal protection, break point frequency

This frequency can be set between 10—500 Hz.

This is the frequency break point of the thermal current curve. With frequencies above this point the thermal capacity of the motor is assumed to be constant. Refer to the figure 2.5-28.

The default value is based on the motor's nameplate data, parameter 1. 11. It is 35 Hz for a 50 Hz motor and 42 Hz for a 60 Hz motor. More generally it is 70% of the frequency at the field weakening point (parameter 6. 3). Changing either parameter 1. 11 or 6. 3, will restore this parameter to its default value.

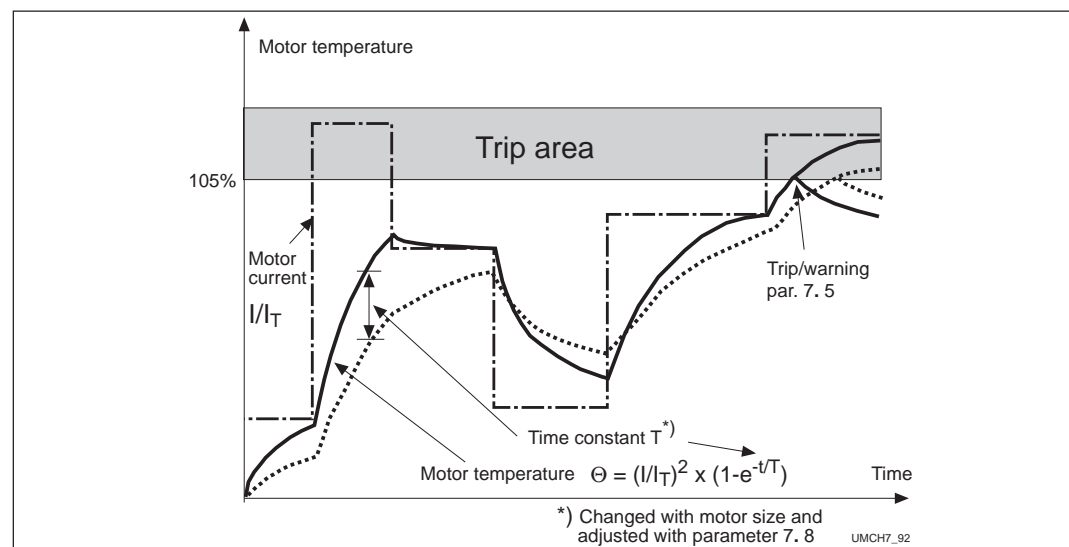


Figure 2.5-29 Calculating motor temperature.

## Parameters 7. 10— 7. 13, Stall protection

### General

Motor stall protection protects the motor from short time overload situations like a stalled shaft. The reaction time of stall protection can be set shorter than with motor thermal protection. The stall state is defined with two parameters, 7.11., Stall Current and 7.13., Stall Frequency. If the current is higher than the set limit and output frequency is lower than the set limit the stall state is true. There is actually no real indication of the shaft rotation. Stall protection is a type of overcurrent protection.

2

#### 7. 10 Stall protection

Operation:

- 0 = Not in use
- 1 = Warning
- 2 = Trip function

Tripping and warning will give a display indication with the same message code. If tripping is set on, the drive will stop and activate the fault stage. Setting this parameter to 0 will deactivate the protection and will reset the stall time counter to zero.

#### 7. 11 Stall current limit

The current can be set between 0.0—200%  $\times I_{nMotor}$ .

In the stall stage the current has to be above this limit. Refer to figure 2.5-30. The value is set as a percentage of the motor name-plate nominal current, parameter 1. 13. If parameter 1. 13 is adjusted, this parameter is automatically restored to its default value.

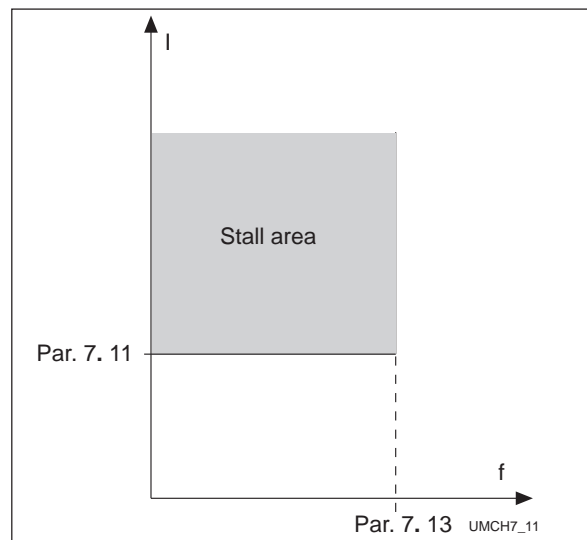


Figure 2.5-30 Setting the stall characteristics.

#### 7. 12 Stall time

The time can be set between 2.0—120 s.

This is the maximum allowed time for a stall stage. There is an internal up/down counter to count the stall time. Refer to the figure 2.5-31. If the stall time counter value goes above this limit, this protection will cause a trip (refer to the parameter 7. 10).

#### 7. 13 Maximum stall frequency

This frequency can be set between 1— $f_{max}$  (param. 1. 2). In the stall state the output frequency has to be smaller than this limit. Refer to the figure 2.5-30.

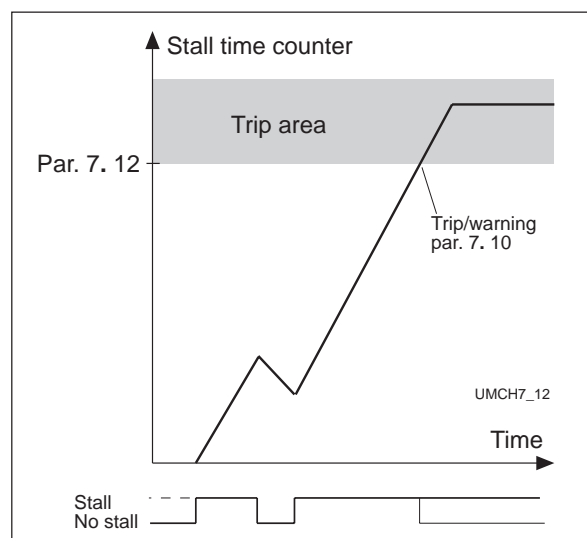


Figure 2.5-31 Counting the stall time.

## Parameters 7. 14— 7. 17, Underload protection

### General

The purpose of motor underload protection is to ensure there is load on the motor while the drive is running. If the motor load is reduced, there might be a problem in the process, e.g. broken belt or dry pump.

Motor underload protection can be adjusted by setting the underload curve with parameters 7. 15 and 7. 16. The underload curve is a squared curve set between zero frequency and the field weakening point. The protection is not active below 5Hz (the underload counter value is stopped). Refer to the figure 2.5-32.

The torque values for setting the underload curve are set with percentage values which refer to the nominal torque of the motor. The motor's nameplate data, parameter 1. 13, the motor's nominal current and the drive's nominal current  $I_{CT}$  are used to create the scaling ratio for the internal torque value. If other than a standard motor is used with the drive, the accuracy of the torque calculation is decreased.

2

### 7. 14 Underload protection

Operation:

- 0 = Not in use
- 1 = Warning message
- 2 = Fault message

Tripping and warning will give a display indication with the same message code. If tripping is set active the drive will stop and activate the fault stage.

Deactivating the protection, by setting this parameter to 0, will reset the underload time counter to zero.

### 7. 15 Underload protection, field weakening area load

The torque limit can be set between 20.0—150 %  $\times T_{nMotor}$ .

This parameter is the value for the minimum allowed torque when the output frequency is above the field weakening point.

Refer to the figure 2.5-32.

If parameter 1. 13 is adjusted, this parameter is automatically restored to its default value.

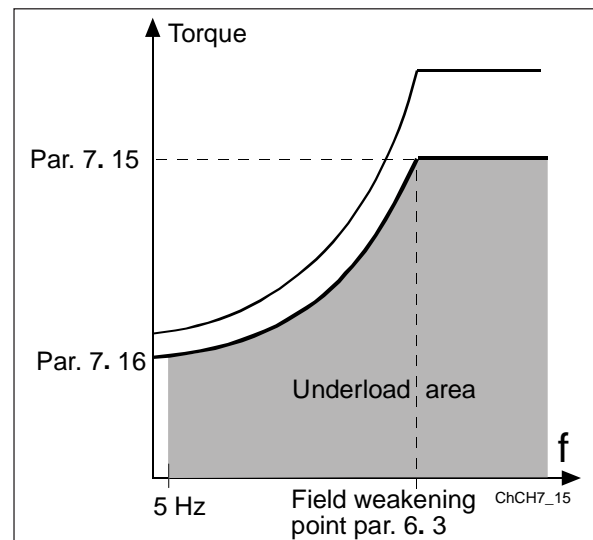


Figure 2.5-32 Setting of minimum load.

### 7. 16 Underload protection, zero frequency load

The torque limit can be set between 10.0—150 %  $\times T_{nMotor}$ .

This parameter is the value for the minimum allowed torque with zero frequency. Refer to the figure 2.5-32. If parameter 1. 13 is adjusted, this parameter is automatically restored to its default value.

## 7.17 Underload time

This time can be set between 2.0—600.0 s.

This is the maximum allowed time for an underload state. There is an internal up/down counter to accumulate the underload time. Refer to the figure 2.5-33.

If the underload counter value goes above this limit, the underload protection will cause a trip (refer to the parameter 7.14). If the drive is stopped the underload counter is reset to zero.

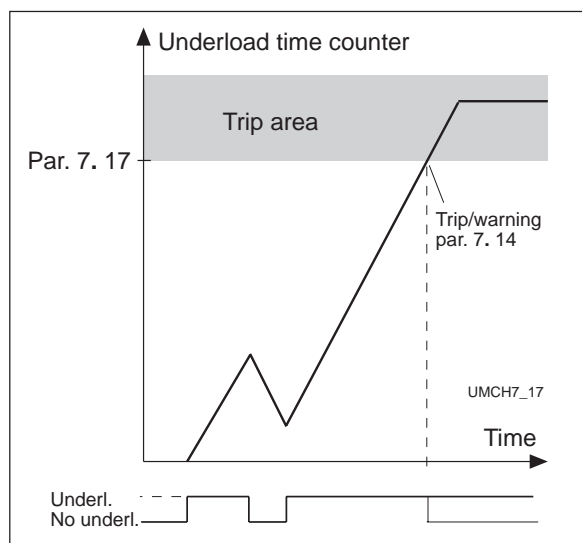


Figure 2.5-33 Counting the underload time.

## 8.1 Automatic restart: number of tries

## 8.2 Automatic restart: trial time

The Automatic restart function restarts the drive after the faults selected with parameters 8.4—8.8. The Start type for Automatic restart is selected with parameter 8.3. See figure 2.5-34.

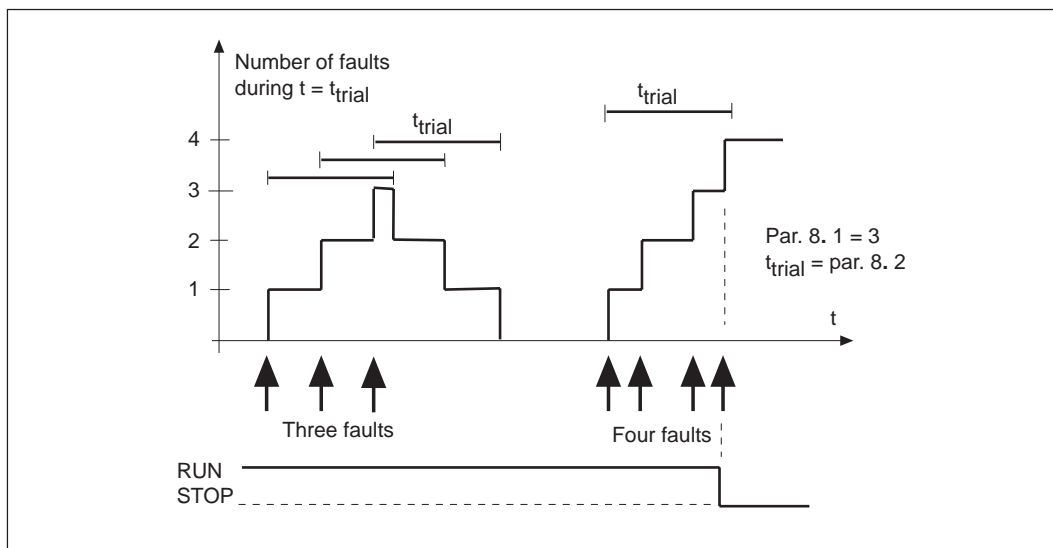


Figure 2.5-34 Automatic restart.

Parameter 8.1 determines how many automatic restarts can be made during the trial time set by the parameter 8.2.

The count time starts from the first autorestart. If the number of restarts does not exceed the value of parameter 8.1 during the trial time, the count is cleared after the trial time has elapsed. The next fault starts the counting again.

**8.3 Automatic restart, start function**

The parameter defines the start mode:

0 = Start with ramp

1 = Flying start, see parameter 4. 6.

**8.4 Automatic restart after undervoltage**

0 = No automatic restart after undervoltage fault

1 = Automatic restart after undervoltage fault condition returns to the normal condition (DC-link voltage returns to the normal level)

**8.5 Automatic restart after overvoltage**

0 = No automatic restart after overvoltage fault

1 = Automatic restart after overvoltage fault condition returns to the normal condition (DC-link voltage returns to the normal level)

**8.6 Automatic restart after overcurrent**

0 = No automatic restart after overcurrent fault

1 = Automatic restart after overcurrent faults

**8.7 Automatic restart after reference fault**

0 = No automatic restart after reference fault

1 = Automatic restart after analog current reference signal (4—20 mA) returns to the normal level ( $\geq 4$  mA)

**8.8 Automatic restart after over-/undertemperature fault**

0 = No automatic restart after temperature fault

1 = Automatic restart after heatsink temperature has returned to its normal level between -10°C—+75°C.

Remarks:

# 2