

# SV9000 AF DRIVES SVReady™ User Manual

## Standard Control Application



**SV9000**



**Cutler-Hammer**

**EATON**

## A General

This manual provides you with the information needed to apply these applications.

Each application is described in its own chapter. Section B tells how to select the application.

## B Application selection

If the Basic Application is in use, first open the application package lock (parameter 1.15 = 0) Group 0 appears. By changing the value of parameter 0.1 a different application can be selected. See table B-1.

To change from one application to another, simply change the value of parameter 0.1 to that of the application desired: see table B-1.

Number	Parameter	Range	Description
0. 1	Application	1 —7	1 = Basic Application 2 = Standard Application 3 = Local / Remote Control Application 4 = Multi-step Speed Application 5 = PI-control Application 6 = Multi-purpose Control Application 7 = Pump and Fan Control Application

Table B-1 Application selection parameters.

Besides the parameter group 1, the applications also have parameter groups 2 — 8 available (see figure B-1).

Parameters of the groups sequentially follow each other and changing from the last parameter of one group to the first parameter of the next group or vice versa is done simply by pushing the arrow up/arrow down buttons.

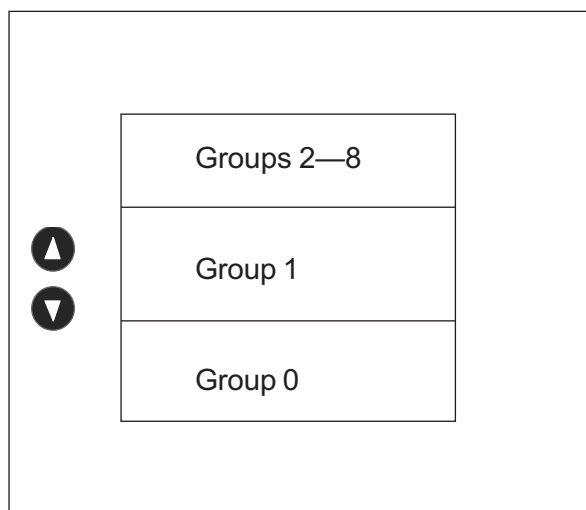


Figure B-1 Parameter Groups.

## C Restoring default values of application parameters

Default values of the parameters of the applications 1 to 7 can be restored by selecting the same application again with parameter 0.1 or by setting the value of parameter 0.2 to 1. See User's manual chapter 12.

If parameter group 0 is not visible, make it visible as follows:

1. If parameter lock is set on, open the lock, parameter 1. 16, by setting the value of the parameter to 0.
2. If parameter conceal is set on, open the conceal parameter 1. 15, by setting the value of the parameter to 0.  
Group 0 becomes visible.

## D Language selection

The language of the text shown on the operator's panel can be chosen with parameter 0. 3. See SV9000 User's Manual, chapter 11.



STANDARD CONTROL APPLICATION

(par. 0.1 = 2)

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## 1

## 1 STANDARD APPLICATION

## 1.1 General

The Standard application has the same I/O signals and same Control logic as the Basic application. Digital input DIA3 and all outputs are programmable.

The Standard Application can be selected by

setting the value of parameter 0. 1 to 2. Basic connections of inputs and outputs are shown in the figure 1.2-1. The control signal logic is shown in the figure 1.3-1. Programming of I/O terminals is explained in chapter 1.5.

**\* NOTE!** Remember to connect the CMA and CMB inputs.

## 1.2 Control I/O

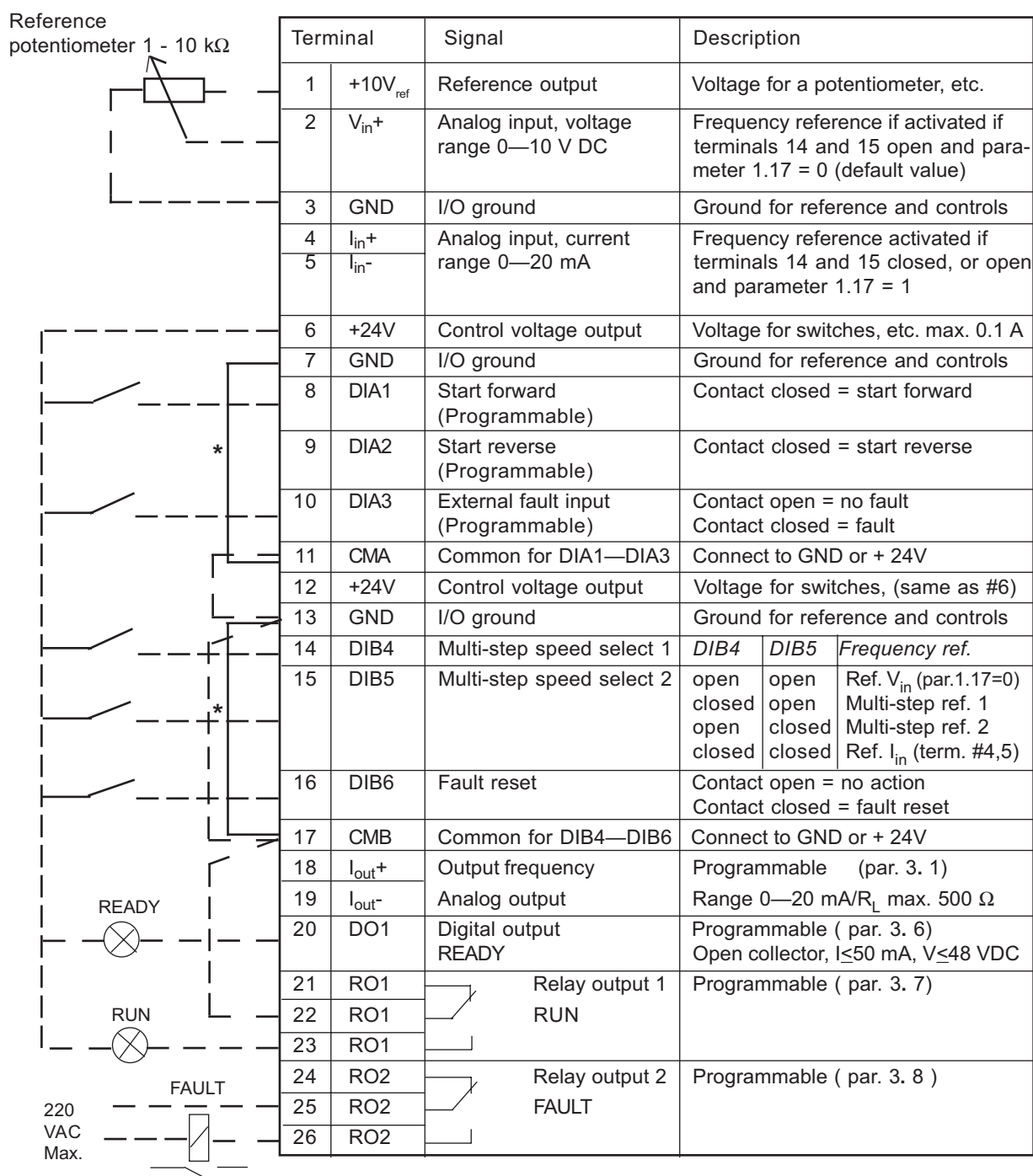


Figure 1.2-1 Default I/O configuration and connection example of the Standard Application.



## 1.3 Control signal logic

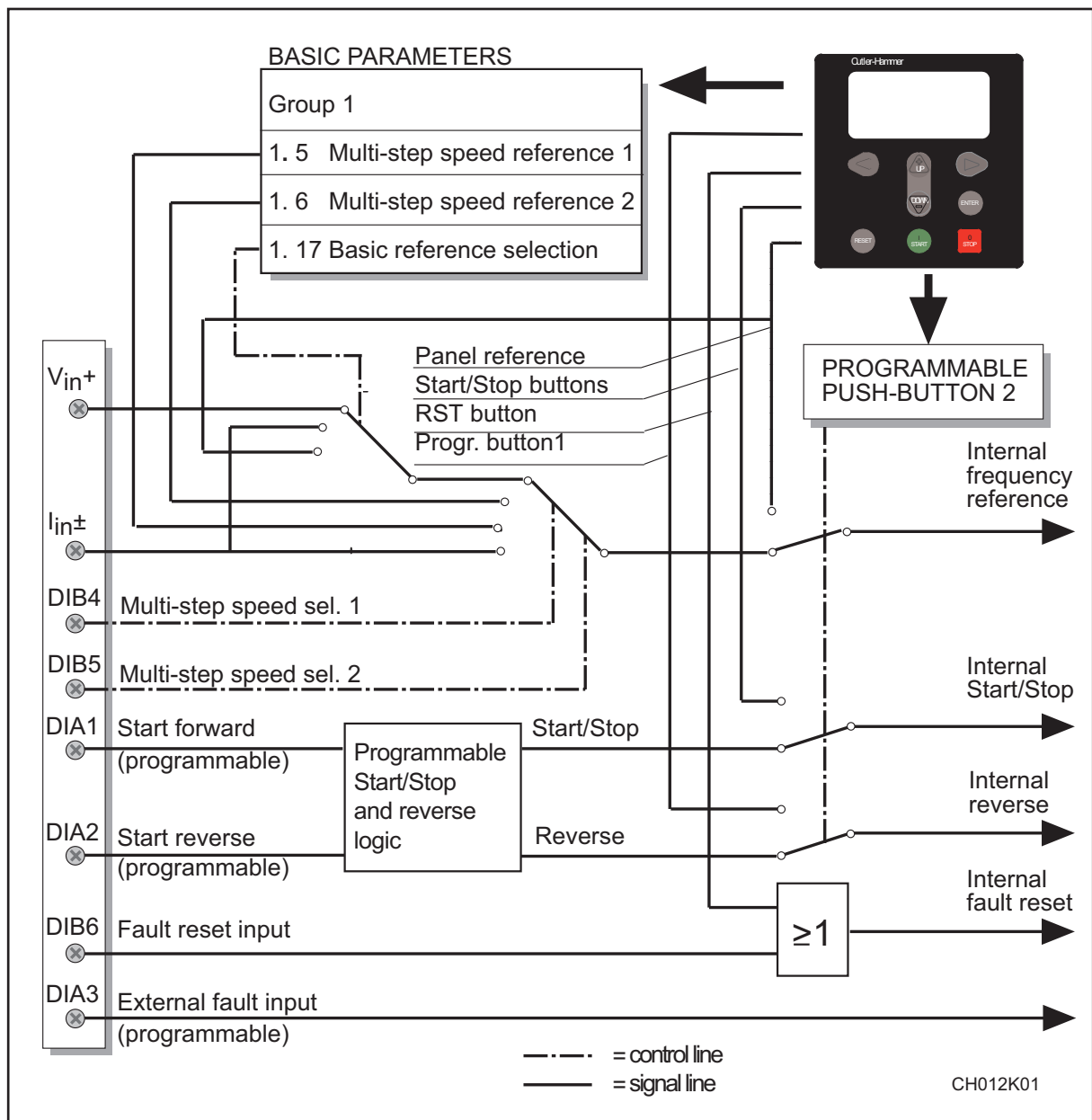


Figure 1.3-1 Control signal logic of the Standard Application.


## 1

## 1.4 PARAMETERS, GROUP 1

## 1.4.1 Parameter table

Code	Parameter	Range	Step	Default	Custom	Description	Page
1. 1	Minimum frequency	0— $f_{\max}$	1 Hz	0 Hz			1-5
1. 2	Maximum frequency	$f_{\min}$ -120/500 Hz	1 Hz	60 Hz		*	1-5
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)	1-5
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)	1-5
1. 5	Multi-step speed reference 1	$f_{\min}$ — $f_{\max}$	0.1 Hz	10.0 Hz			1-5
1. 6	Multi-step speed reference 2	$f_{\min}$ — $f_{\max}$	0.1 Hz	60.0 Hz			1-5
1. 7	Current limit	0.1—2.5 × $I_{nSV9}$	0.1 A	1.5 × $I_{nSV9}$		Output current limit [A] of the unit	1-5
1. 8	V/Hz ratio selection	0—2	1	0		0 = Linear 1 = Squared 2 = Programmable V/Hz ratio	1-5
1. 9	V/Hz optimization	0—1	1	0		0 = None 1 = Automatic torque boost	1-6
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	1-7
1. 11	Nominal frequency of the motor	30—500 Hz	1 Hz	60 Hz		$f_n$ from the nameplate of the motor	1-7
1. 12	Nominal speed of the motor	1—20000 rpm	1 rpm	1720 rpm **		$n_n$ from the nameplate of the motor	1-7
1. 13	Nominal current of the motor	2.5 × $I_{nSV9}$	0.1 A	$I_{nSV9}$		$I_n$ from the nameplate of the motor	1-7
1. 14	Supply voltage	208—240		230 V		Voltage code 2	1-7
		380—440		380 V		Voltage code 4	
		380—500		480 V		Voltage code 5	
		525—690		575 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	1-7
1. 16	Parameter value lock	0—1	1	0		Disables parameter changes: 0 = changes enabled 1 = changes disabled	1-7
1. 17	Basic frequency reference selection	0—2	1	0		0 = analog input $V_n$ 1 = analog input $I_n$ 2 = reference from the panel	1-7

Table 1.4-1 Group 1 basic parameters.

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

\* If 1. 2 > motor synchr. speed, check suitability for motor and drive system.

Selecting 120 Hz/500 Hz range see page 1-5.

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



## 1.4.2 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 the 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 display panel 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).

### 1. 5, 1. 6 Multi-step speed reference 1, Multi-step speed reference 2:

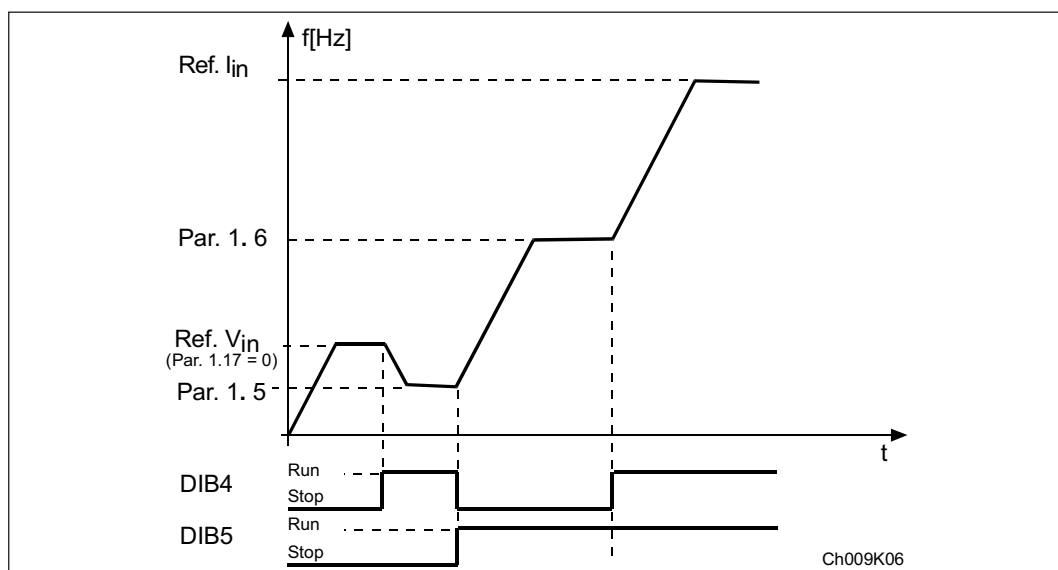


Figure 1.4-1 Example of Multi-step speed references.

Parameter values are automatically limited between minimum and maximum frequency ( par 1. 1, 1. 2).

### 1. 7 Current limit

This parameter determines the maximum motor current that the SV9000 will provide short term.

### 1. 8 V/Hz ratio selection

Linear: 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 1.4-2.

0

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 voltage is also supplied to the motor. See figure 1.4-2.

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.

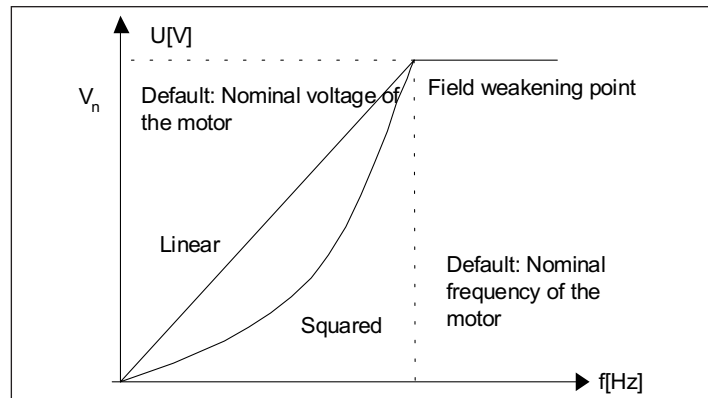
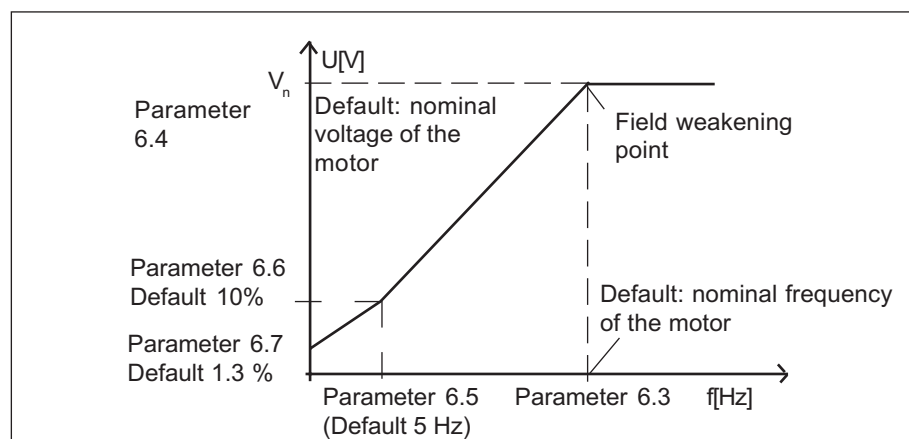


Figure 1.4-2 Linear and squared V/Hz curves.

Programm. The V/Hz curve can be programmed with three different points.  
V/Hz curve The parameters for programming are explained in chapter 1.5.2.  
A programmable V/Hz curve can be used if the standard settings



2 do not satisfy the needs of the application. See figure 1.4-3.

Figure 1.4-3 Programmable V/Hz curve.

## 1.9 V/Hz optimization

**Automatic torque** The voltage to the motor changes automatically which allows the motor to produce enough torque to start and run at low frequencies. The boost 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 that the motor will overheat.*

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

**1. 10 Nominal voltage of the motor**

Find this value from the nameplate of the motor.

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

**Note!** If the nominal motor voltage is lower than the supply voltage, check that the insulation level of the motor is adequate.

**1. 11 Nominal frequency of the motor**

Find the nominal frequency  $f_n$  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 predefined for voltage codes 2, 4, 5, and 6. See table 1.4-1.

**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**

Permits access for changing the parameter values:

0 = parameter value changes enabled

1 = parameter value changes disabled

**1. 17 Basic frequency reference selection**

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.





## 1


## 1.5 SPECIAL PARAMETERS, GROUPS 2—8


## 1.5.1 Parameter tables

## Group 2, Input signal parameters

Code	Parameter	Range	Step	Default	Custom	Description	Page
2.1	Start/Stop logic selection 	0—3	1	0		DIA1	DIA2
						0 = Start forward 1 = Start/Stop 2 = Start/Stop 3 = Start pulse	Start reverse Reverse Run enable Stop pulse
2.2	DIA3 function (terminal 10) 	0—5	1	1		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)	1-13
2.3	Reference offset for current input	0—1	1	0		0 = 0—20 mA 1 = 4—20 mA	1-13
2.4	Reference scaling, minimum value	0—par. 2.5	1 Hz	0 Hz		Selects the frequency that corresponds to the minimum reference signal	1-13
2.5	Reference scaling, maximum value	0— $f_{max}$	1 Hz	0 Hz		Selects the frequency that corresponds to the maximum reference signal 0 = Scaling off >0 = Maximum frequency value	1-13
2.6	Reference invert	0—1	1	0		0 = No inversion 1 = Reference inverted	1-14
2.7	Reference filter time	0.00—10.00s	0.01s	0.10s		0 = No filtering	1-14




## 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— $2.0 \times I_{nSV9}$ ) 4 = Motor torque (0— $2 \times T_{nMot}$ ) 5 = Motor power (0— $2 \times P_{nMot}$ ) 6 = Motor voltage (0— $100\% \times V_{nMot}$ ) 7 = DC-link volt. (0—1000 V)	1-15
3.2	Analog output filter time	0.00—10.00 s	0.01s	1.00 s		0 = no filtering	1-15
3.3	Analog output inversion	0—1	1	0		0 = Not inverted 1 = Inverted	1-15
3.4	Analog output minimum	0—1	1	0		0 = 0 mA 1 = 4 mA	1-15
3.5	Analog output scale	10—1000%	1%	100%			1-15


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




**Group 3, Output and supervision parameters**

Code	Parameter	Range	Step	Default	Custom	Description	Page
3. 6	Digital output function 	0—14	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 = Multi-step speed selected 11 = At speed 12 = Motor regulator activated 13 = Output frequency limit superv. 14 = Control from I/O-terminal	1-16
3. 7	Relay output 1 function 	0—14	1	2		As parameter 3. 6	1-16
3. 8	Relay output 2 function 	0—14	1	3		As parameter 3. 6	1-16
3. 9	Output freq. limit supervision function	0—2	1	0		0 = No 1 = Low limit 2 = High limit	1-16
3. 10	Output freq. limit supervision value	0.0— $f_{\max}$ (par. 1. 2)	0.1 Hz	0.0 Hz			1-16
3. 11	I/O-expander option board analog output function	0—7	1	3		As parameter 3. 1	1-15
3. 12	I/O-expander option board analog output scale	10—1000%	1%	100%		As parameter 3. 5	1-15

**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	1-17
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	1-17
4. 3	Acceleration time 2	0.1—3000.0 s	0.1 s	10.0 s			1-17
4. 4	Deceleration time 2	0.1—3000.0 s	0.1 s	10.0 s			1-17
4. 5	Brake chopper 	0—2	1	0		0 = Brake chopper not in use 1 = Brake chopper in use 2 = External brake chopper	1-17
4. 6	Start function	0—1	1	0		0 = Ramp 1 = Flying start	1-17
4. 7	Stop function	0—1	1	0		0 = Coasting 1 = Ramp	1-18
4. 8	DC-braking current	0.15—1.5 x $I_{nSV9}$ (A)	0.1 A	0.5 x $I_{nSV9}$			1-18
4. 9	DC-braking time at Stop	0.00—250.00 s	0.01 s	0.00 s		0 = DC-brake is off	1-18

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










## 1

**Group 5, Prohibit frequency parameters**

Code	Parameter	Range	Step	Default	Custom	Description	Page
5.1	Prohibit frequency range low limit	$f_{\min}$ — $f_{\max}$ par. 5.2	0.1 Hz	0.0 Hz			1-19
5.2	Prohibit frequency range high limit	$f_{\min}$ — $f_{\max}$ (1.1) (1.2)	0.1 Hz	0.0 Hz		0 = no prohibit frequency range (max limit = par. 1.2)	1-19

**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	1-20
6.2	Switching frequency	1.0—16.0 kHz	0.1	10/3.6 kHz		Dependant on Hp rating	1-20
6.3	Field weakening point 	30—500 Hz	1 Hz	Param. 1.11			1-20
6.4	Voltage at field weakening point 	15—200% $\times V_{\text{nmot}}$	1%	100%			1-20
6.5	V/Hz curve mid point frequency 	0.0— $f_{\max}$	0.1 Hz	0.0 Hz			1-20
6.6	V/Hz curve mid point voltage 	0.00—100.00% $\times V_{\text{nmot}}$	0.01%	0.00%			1-20
6.7	Output voltage at zero frequency 	0.00—100.0% $\times V_{\text{nmot}}$	0.01%	0.00%			1-20
6.8	Overvoltage controller	0—1	1	1		0 = Controller is off 1 = Controller is on	1-20
6.9	Undervoltage controller	0—1	1	1		0 = Controller is off 1 = Controller is on	1-20

**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 par. 4.7 3 = Fault, always coasting stop	1-21
7.2	Response to external fault	0—3	1	2		0 = No action 1 = Warning 2 = Fault, stop according par. 4.7 3 = Fault, always coasting stop	1-21
7.3	Phase supervision of the motor	0—2	2	2		0 = No action 2 = Fault	1-21
7.4	Ground fault protection	0—2	2	2		0 = No action 2 = Fault	1-21
7.5	Motor thermal protection	0—2	1	2		0 = No action 1 = Warning 2 = Fault	1-22
7.6	Stall protection	0—2	1	1		0 = No action 1 = Warning 2 = Fault	1-22



Group 8, Autorestart parameters

Code	Parameter	Range	Step	Default	Custom	Description	Page
8. 1	Automatic restart: number of tries	0—10	1	0		0 = no action	1-23
8. 2	Automatic restart: multi- attempt max. trial time	1—6000 s	1 s	30 s			1-23
8. 3	Automatic restart: start function	0—1	1	0		0 = Ramp 1 = Flying start	1-24

Table 1.5-1 Special parameters, Groups 2—8.



## 1

## 1.5.2 Description of Group 2—8 parameters

## 2.1 Start/Stop logic selection

- 0 DIA1: closed contact = start forward  
DIA2: closed contact = start reverse,  
See figure 1.5-1.

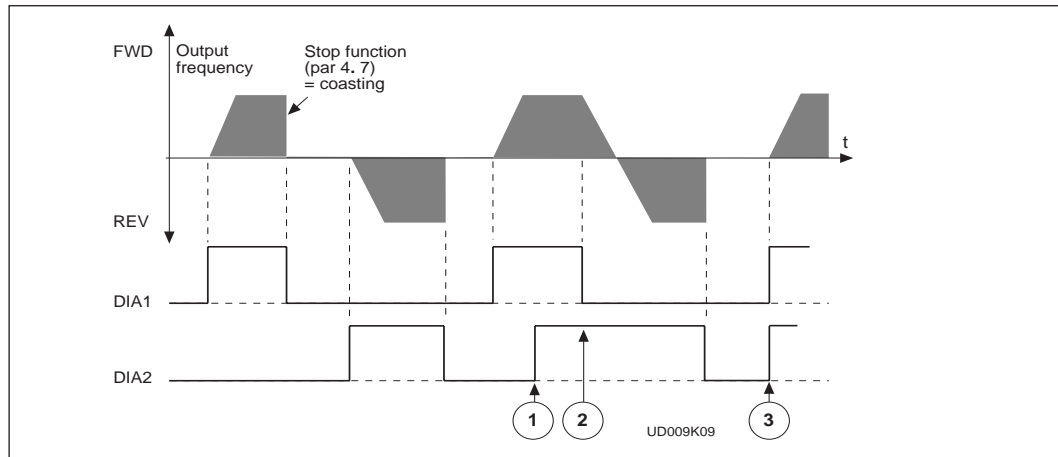


Figure 1.5-1 Start forward/Start reverse.

- 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 1.5-2.

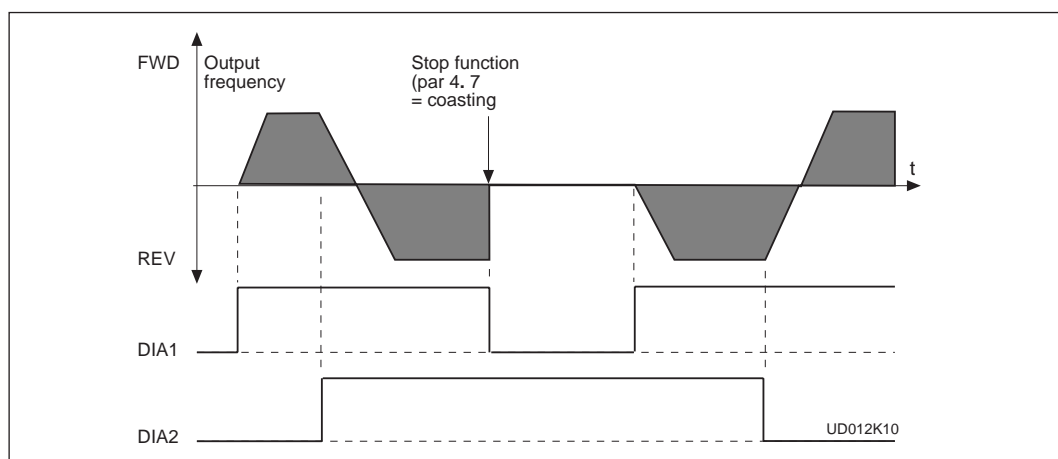


Figure 1.5-2 Start, Stop, reverse.



- 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 1.5-3.

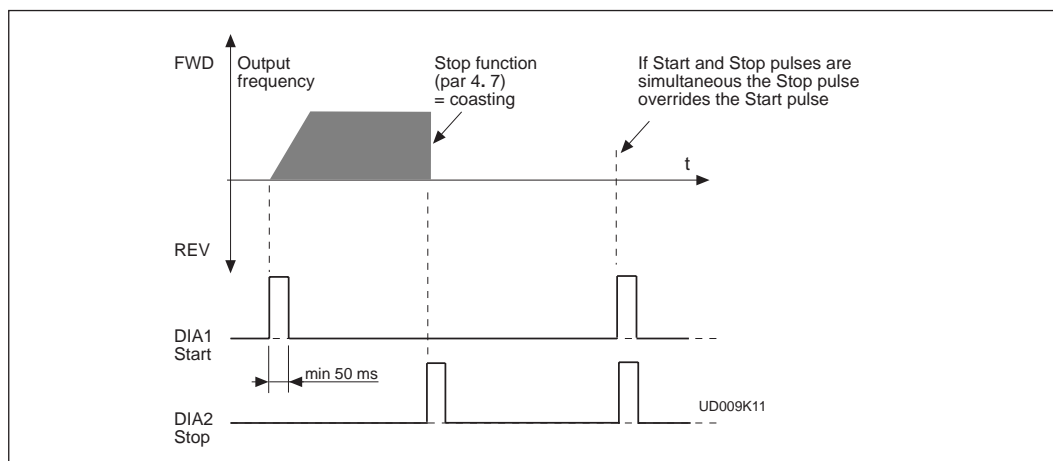


Figure 1.5-3 Start pulse/Stop pulse.

## 2. 2 DIA3 function

- 1: External fault, closing contact = Fault is shown and drive responds according to parameter 7.2.
- 2: External fault, opening contact = Fault is shown and drive responds according to parameter 7.2.
- 3: Run enable      contact open      = Start of the motor disabled  
                          contact closed    = Start of the motor enabled
- 4: Acc. / Dec      contact open      = Acceleration/Deceleration time 1 selected  
    time select.    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

## 2.3 Reference offset for current input

- 0: No offset
- 1: Offset 4 mA, provides supervision of zero level signal. The response to reference fault can be programmed with the parameter 7. 1.



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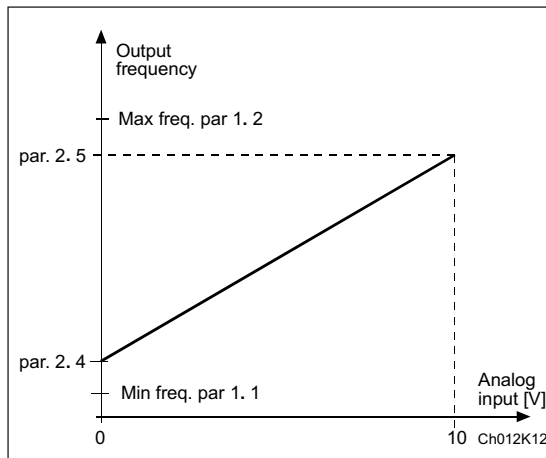


Figure 1.5-4 Reference scaling.

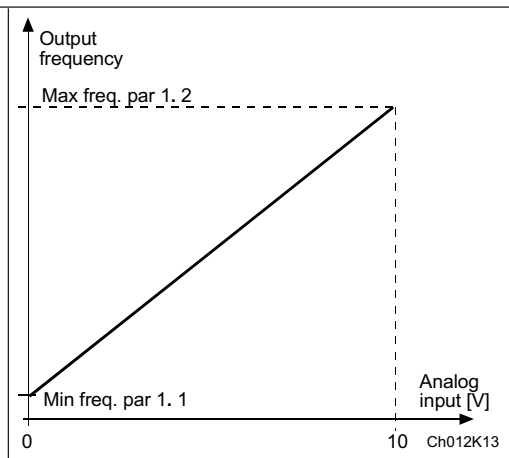


Figure 1.5-5 Reference scaling, parameter 2. 5 = 0.

## 2.4, 2.5 Reference scaling, minimum value/maximum value

Setting value limits:  $0 \leq \text{par. 2. 4} \leq \text{par. 2. 5} \leq \text{par. 1. 2}$ .  
If parameter 2. 5 = 0 scaling is set off. See figures 1.5-4 and 1.5-5.

## 2.6 Reference invert

Inverts reference signal:

max. ref. signal = min.set freq.  
min. ref. signal = max. set freq.  
See figure 1.5-6.

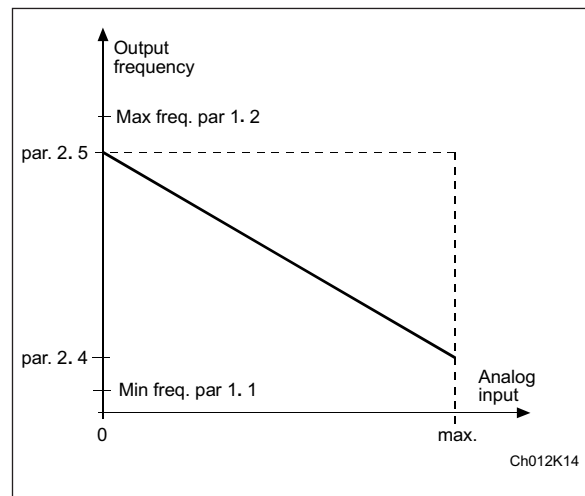


Figure 1.5-6 Reference invert.

## 2.7 Reference filter time

Filters out disturbances from the incoming reference signal. A long filtering time makes regulation response slower. See figure 1.5-7.

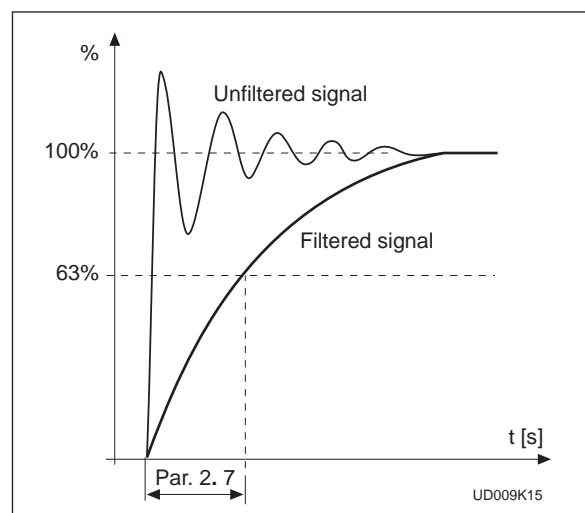


Figure 1.5-7 Reference filtering.





**3.1 Analog output function**

See table "Group 3, output and supervision parameters" on the page 1-8.

**3.2 Analog output filter time**

Filters the analog output signal.  
See figure 1.5-8.

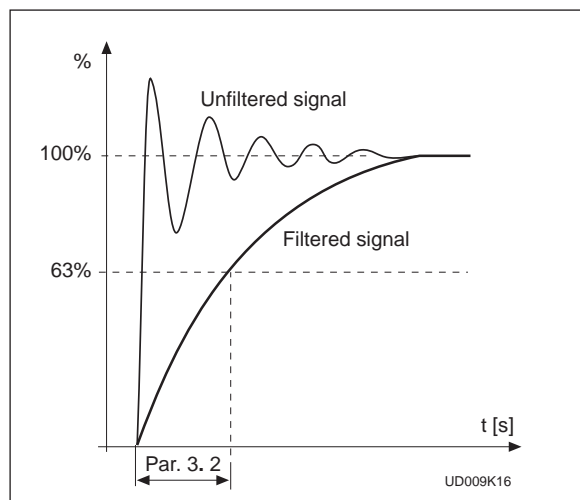


Figure 1.5-8 Analog output filtering.

**3.3 Analog output invert**

Inverts analog output signal:  
max. output signal = minimum set value  
min. output signal = maximum set value  
See figure 1.5-9

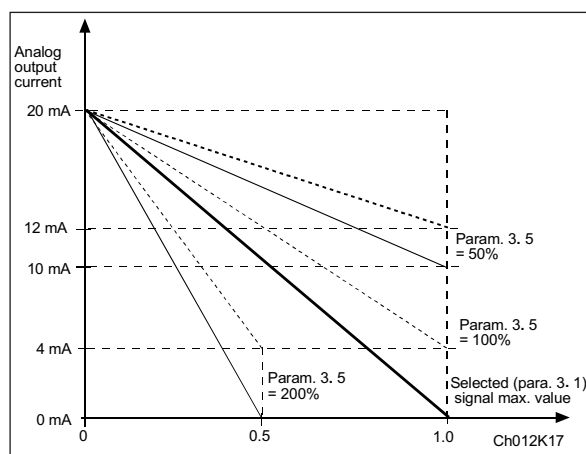


Figure 1.5-9 Analog output invert.

**3.4 Analog output minimum**

Defines the signal minimum to be either 0 mA or 4 mA. See figure 1.5-10.

**3.5 Analog output scale**

Scaling factor for analog output.  
See figure 1.5-10.

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	$2 \times I_{nSV9}$
Motor torque	$2 \times T_{nMot}$
Motor power	$2 \times P_{nMot}$
Motor voltage	$100\% \times V_{nMot}$
DC-link volt.	1000 V

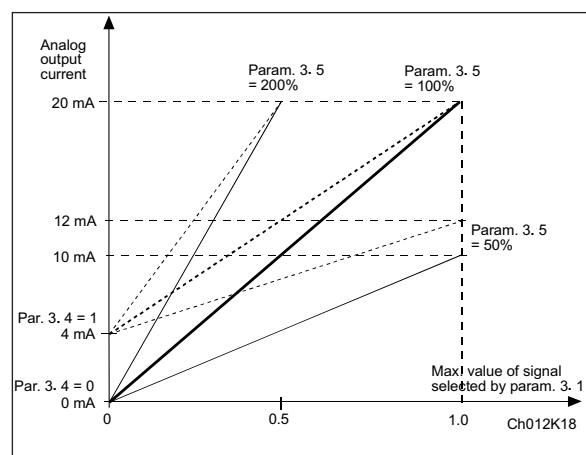


Figure 1.5-10 Analog output scale.



- 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
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 = Multi-step speed selected	A multi-step speed has been selected
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	The output frequency goes outside of the set supervision low limit/ high limit (par. 3. 9 and 3. 10)
14 = Control from I/O terminals	Ext. control mode selected with progr. push-button #2

Table 1.5-2 Output signals via DO1 and output relays RO1 and RO2.

### 3.9 Output frequency limit 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) 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.

### 3.10 Output frequency limit supervision value

The frequency value to be supervised by the parameter 3. 9.  
 See figure 1.5-11.

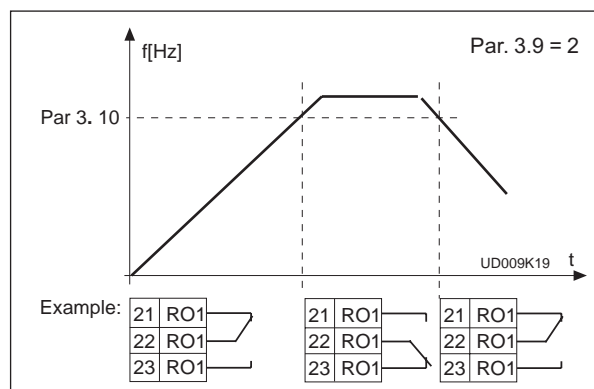


Figure 1.5-11 Output frequency supervision.



**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 the value = 0 gives you a linear ramp shape. The output frequency immediately follows the input with a ramp time set by parameters 1. 3, 1. 4 (4. 3, 4. 4 for Acc/Dec. time 2).

Setting 0.1—10 seconds for 4. 1 (4. 2) causes an S-shaped ramp. The speed changes are smooth. Parameter 1. 3/ 1. 4 (4. 3/ 4. 4) determines the ramp time of the acceleration/deceleration in the middle of the curve. See figure 1.5-12.

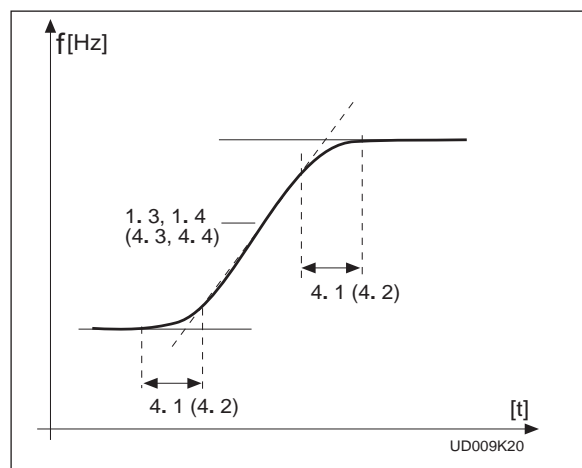


Figure 1.5-12 S-shaped acceleration/deceleration.

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

These values correspond to the time required for the output frequency to change 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.

**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. If the brake resistor is selected correctly the drive is able to decelerate the load with a torque equal to that of acceleration. See the 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 extend the acceleration times).



Flying start:

- 1 The drive starts into a running motor by first finding the speed the motor is running at. Searching starts from the maximum frequency down until the actual frequency reached. The output frequency then accelerates/decelerates 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 is issued.

Ramp:

- 1 After the Stop command is issued, 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.

#### 4.9 DC braking time at stop

Determines whether DC braking is ON or OFF. It also determines 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 1.5-13.

- 0 DC-brake is not used
- >0 DC-brake is in use depending on the setup of the stop function (param. 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 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.



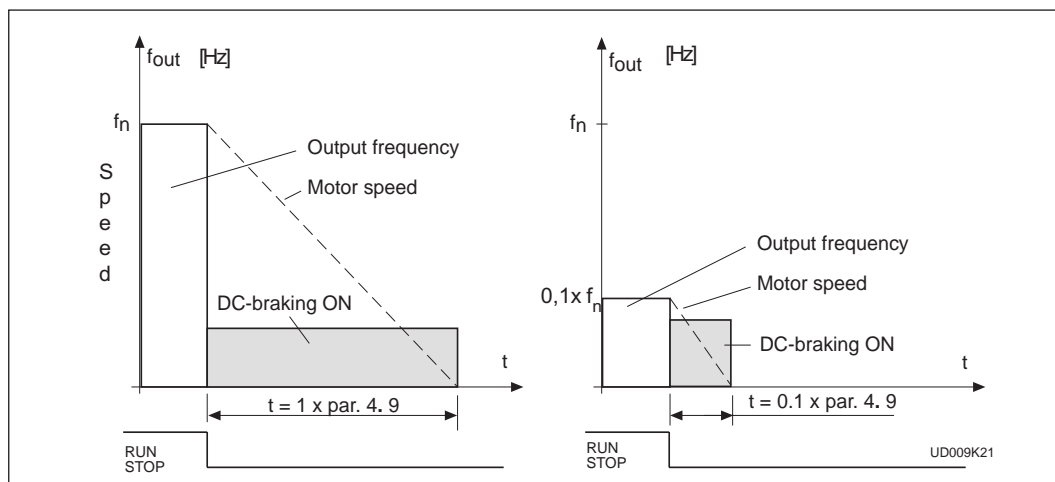


Figure 1.5-13 DC-braking time when stop = coasting.

#### Stop-function = 1 (ramp):

After a Stop command, the speed of the motor is reduced based on the deceleration ramp parameter. If no regeneration occurs due to load inertia DC-braking starts at 0.5 Hz.

The braking time is defined by par. 4. 9. If the load has a high inertia, use an external braking resistor for faster deceleration.

See figure 1.5-14.

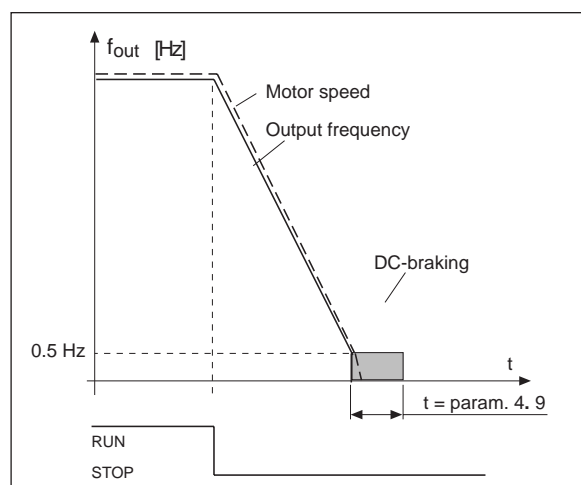


Figure 1.5-14 DC-braking time when stop function = ramp.

#### 5.1 Prohibit frequency area

#### 5.2 Low limit/High limit

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 one "skip frequency" region between 0 Hz and 120 Hz/500 Hz. Accuracy of the setting is 0.1 Hz.

See figure 1.5-15.

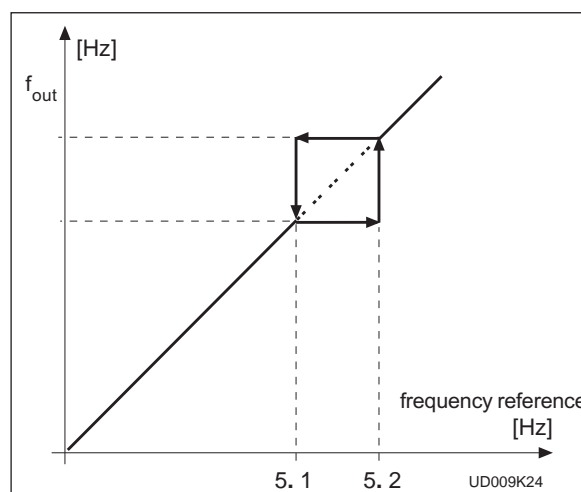


Figure 1.5-15 Example of prohibit frequency area setting.



**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 (control accuracy  $\pm 0.5\%$ ) (sensorless vector)

**6.2 Switching frequency**

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

Before changing the frequency from the factory default 10 kHz (3.6 kHz  $\geq$  40 Hp) check the drive derating in 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 output frequency where the output voltage reaches the set maximum value (parameter 6.4). Above that frequency the output voltage remains constant at the set maximum value. Below that frequency the 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 1.5-16.

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 same 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 1.5-16.

**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 voltage point of the curve. See figure 1.5-16.

**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 the curve. See figure 1.5-16.

**6.8 Overvoltage controller****6.9 Undervoltage controller**

These parameters allow the over/undervoltage controllers to be switched ON or OFF. This may be useful in cases where the utility supply voltage varies more than -15%—+10% and the application requires a constant speed. If the controllers are ON, they will change the motor speed in over/undervoltage cases. Overvoltage = faster, undervoltage = slower.

Over/undervoltage trips may occur when the controllers are not used.



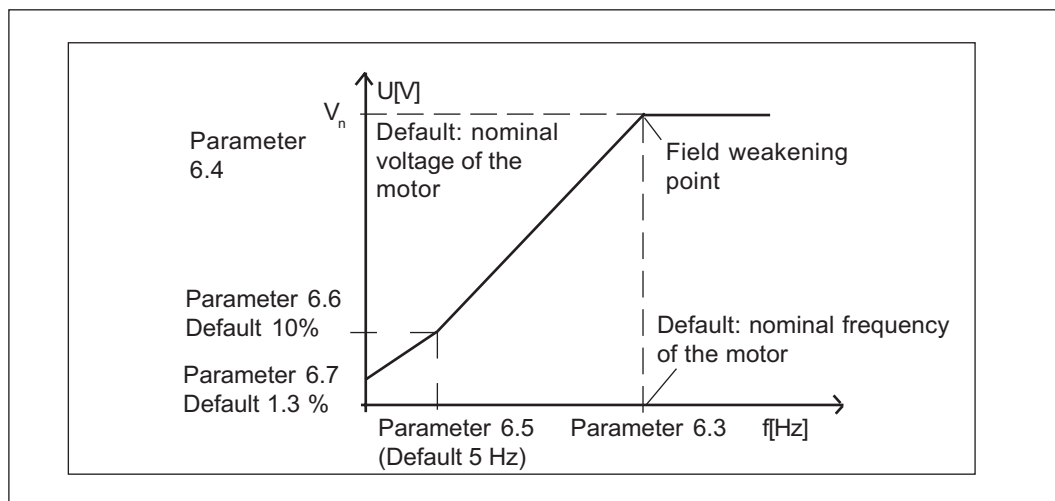


Figure 1.5-16 Programmable V/Hz curve.

### 7.1 Response to reference faults

- 0 = No response
- 1 = Warning
- 2 = Fault, stop mode after fault detection 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 detection 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 in the 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

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



## 1

## 7.5 Motor thermal protection

Operation:

0 = Not in use

1 = Warning

2 = Trip

The motor thermal protection protects the motor from overheating. In the Standard application the thermal protection has fixed settings. In other applications it is possible to set the thermal protection parameters. A trip or a warning will give an indication on the display. If trip is selected, the drive will stop the motor and generate a fault.

Deactivating the protection by setting the parameter to 0 will reset the internal thermal model to 0% heating.

The SV9000 is capable of providing 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. 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.

The thermal current  $I_T$  specifies the load current above which the motor is overloaded. See figure 1.5-17. If the motor current is over the curve the motor temperature is increasing.

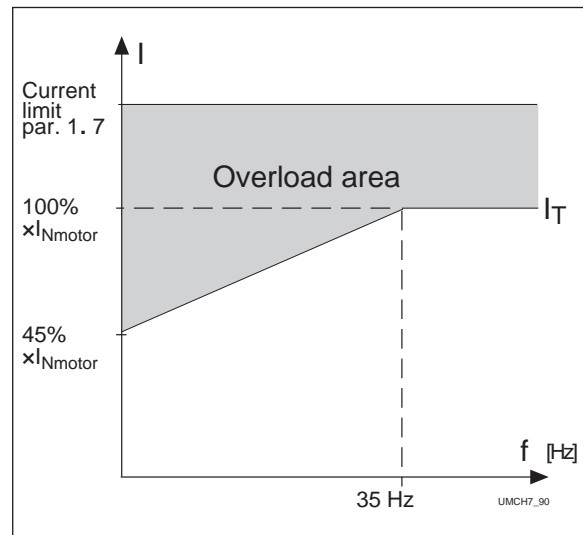


Figure 1.5-17 Motor thermal current  $I_T$  curve.



**CAUTION!** *The calculated model does not protect the motor if the cooling of the motor is reduced either by blocking the airflow or due to dust or dirt.*

## 7.6 Stall protection

Operation:

0 = Not in use

1 = Warning

2 = Trip function

The Motor Stall protection provides a warning or a fault based on a short time overload of the motor e.g. stalled shaft. The stall protection is faster than the motor thermal protection. The stall state is defined with Stall Current and Stall Frequency. In the Standard application they both have fixed values. See figure 1.5-18. If the current is higher than the set limit and output frequency is lower than the set limit the stall state is true. If the stall lasts longer than 15 s a stall warning is given on the display panel. In the other applications it is possible to set the parameters of the Stall protection function. Tripping and warning will give a display indication. If tripping is set on, the drive will stop and generate a fault.





Deactivating the stall protection by setting the parameter to 0 will reset the stall time counter to zero.

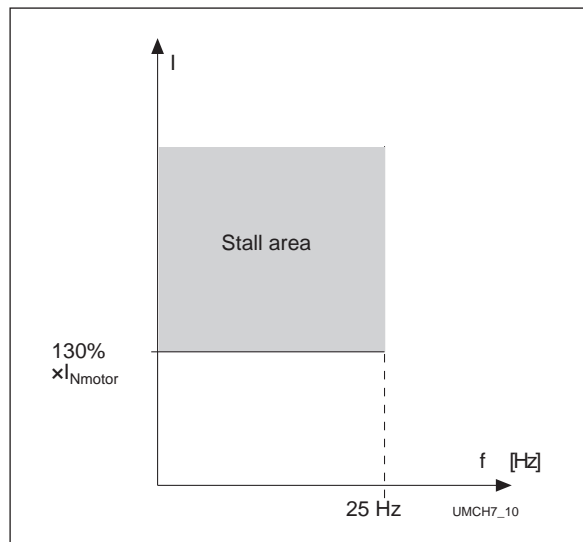


Figure 1.5-18 Stall state.

### 8.1 Automatic restart: number of tries

### 8.2 Automatic restart: trial time

The Automatic restart function will restart the drive after the following faults:

- overcurrent
- overvoltage
- undervoltage
- over/under temperature of the drive
- reference fault

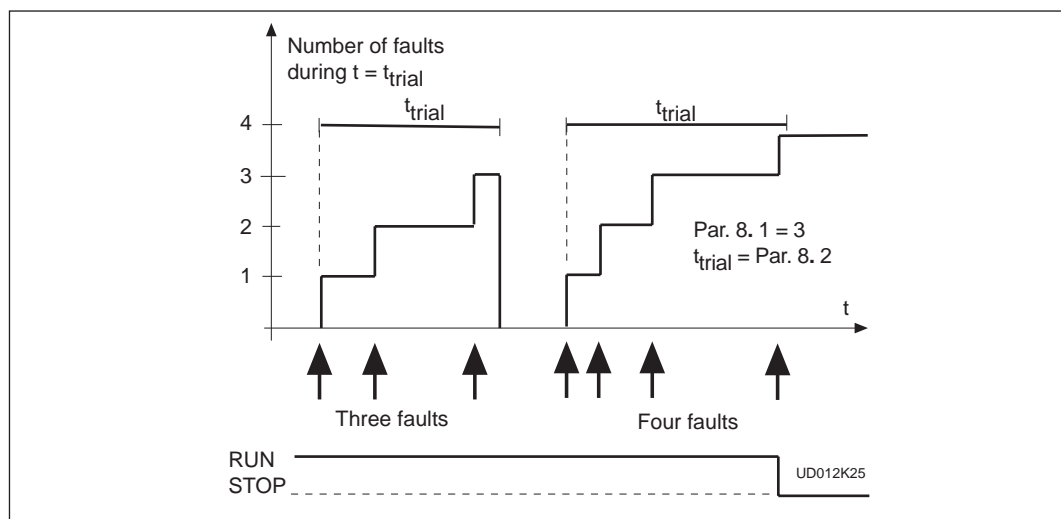


Figure 1.5-19 Automatic restart.

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 the parameter 8.1 during the trial time, the count is cleared after the trial time has elapsed. The next fault starts the counting again.



## 1

### 8.3 Automatic restart, start function

The parameter defines the start mode:

0 = Start with ramp

1 = Flying start, see parameter 4. 6.

Notes:



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TD.08H.10.T.E

## **Cutler-Hammer**

Milwaukee, Wisconsin U.S.A.

Publication No. TD.08H.10.T.E  
March 1999  
Printed in U.S.A.

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