MECHANICAL BRAKE CONTROL APPLICATION MANUAL

Software Part Number 695181.Vxx

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AVTRON INDUSTRIAL AUTOMATION, INC.
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SECTION I

MECHANICAL BRAKE CONTROL APPLICATION

1-1 Introduction

Select the Mechanical Brake Control Application in menu **M6**.

The Mechanical Brake Control Application is typically used in applications where brake control is needed.

The hardware can be any Avtron ACCel500™ frequency converter. In closed loop motor control mode an encoder option board is required (Avtron P/N 397047).

All outputs are freely programmable. Digital input functions are freely programmable to any digital input. Start forward and reverse signals are fixed to input DIN1 and DIN2 (see next page).

Additional functions:

- Programmable Start/Stop and Reverse signal logic
- Reference scaling
- One frequency limit supervision
- Second ramps and S-shape ramp programming
- Programmable start and stop functions
- DC-brake at stop
- One prohibit frequency area
- Programmable U/f curve and switching frequency
- Autorestart
- Motor thermal and stall protection: Programmable action; off, warning, fault
- Mechanical brake control related parameters
- 8 digital speed references selected by 3 digital inputs

IMPORTANT:

Configuration information in this manual is provided to assist users in designing their own operational/functional schemes. It is deemed to be correct, however, if any errors or omissions exist, Avtron and/or Avtron representatives will not be liable to provide “warranty” on-site support. If one is designing his own configuration, or using one of the examples, it is highly recommended to test the operation prior to putting the drive into production.

SECTION II

PROGRAMMING PRINCIPLE OF THE DIGITAL INPUT SIGNALS

The programming principle of the input signals in the Mechanical brake control Application as well as in the Multipurpose Control Application (and partly in the other applications) is different compared to the conventional method used in other Avtron ACCel500 applications.

In the conventional programming method, Function to Terminal Programming Method (FTT), you have a fixed input that you define a certain function for. The applications mentioned above, however, use the Terminal to Function Programming method (TTF) in which the programming process is carried out the other way round: Functions appear as parameters that the operator defines a certain input for (see Figure 2-1).

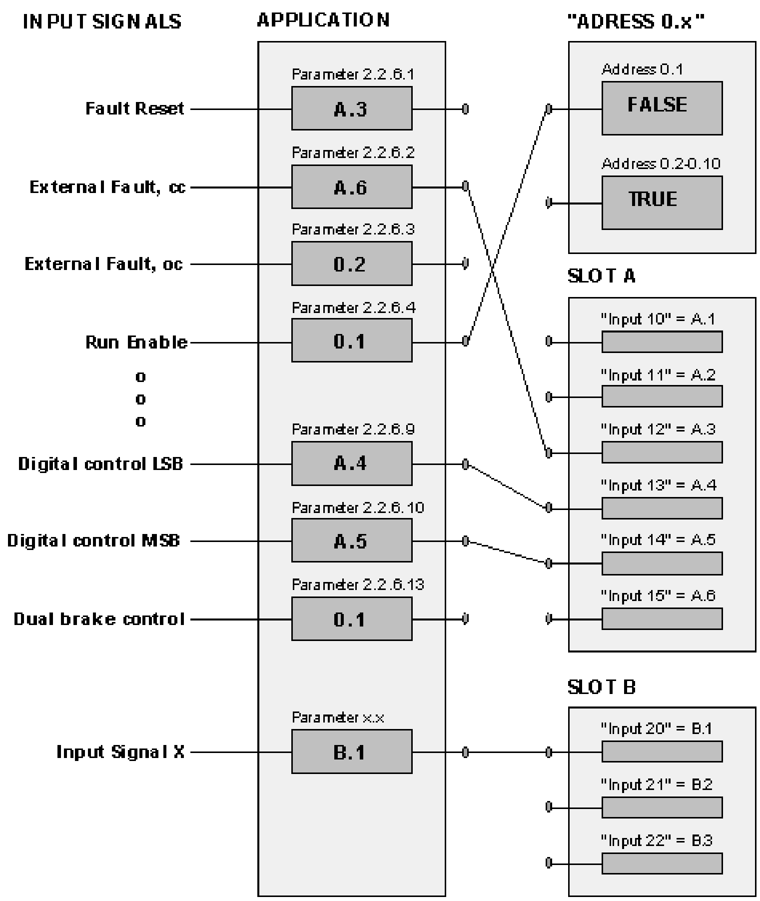


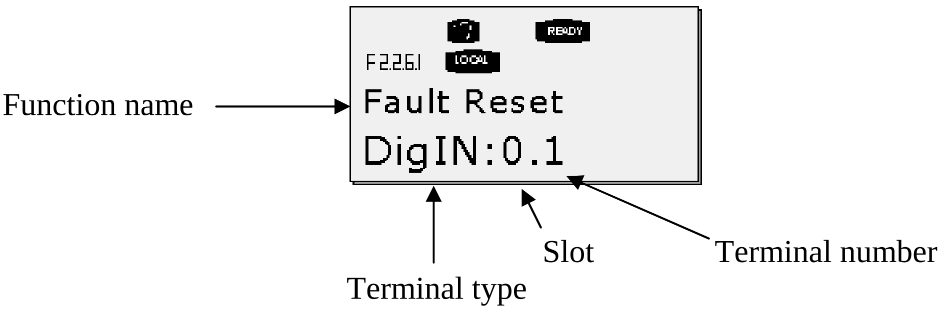
Figure 2-1. Basic Principle of the Terminal to Function Programming Method (TTF)

NOTE

A constant value can be given to an input signal. Value 0.1 is a constant FALSE and values from 0.2 through 0.10 are constant TRUE (see Figure 2-1).

2-1 Defining an Input for a Certain Function On Keypad

Connecting a certain function (input signal) to a certain digital input is done by giving the parameter an appropriate value. The value is formed of the *Board slot* on the ACCel500 control board (see ACCel500 User's Manual, Chapter 4) and the *respective signal number*, see below.

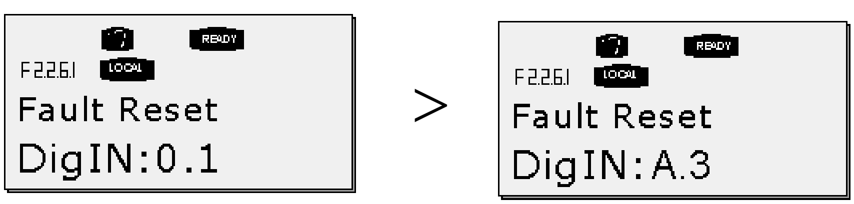


Example: You want to connect the digital input function *Fault Reset* (parameter 2.2.6.1) to a digital input A.3 on the basic I/O board located in Slot A.

First find the parameter 2.2.6.1 on the keypad. Press the Menu button right once to enter the edit mode. On the value line, you will see the terminal type on the left (DigIN) and on the right, digital input where function is connected.

When the value is blinking, hold down the Browser button up or down to find the desired board slot and signal number. The program will scroll the board slots starting from **0** and proceeding from **A** to **E** and the I/O numbers from **1** to **10**.

Once you have set the desired value, press the Enter button once to confirm the change.



2-2 Defining a Certain Function with ADDAPT ACC Programming Tool

If you use the ADDAPT ACC programming tool for assigning parameter values, you will have to establish the connection between the function and input/output in the same way as with the control panel. Just pick the address code from the drop-down menu in the Value column (see Figure 2-2).

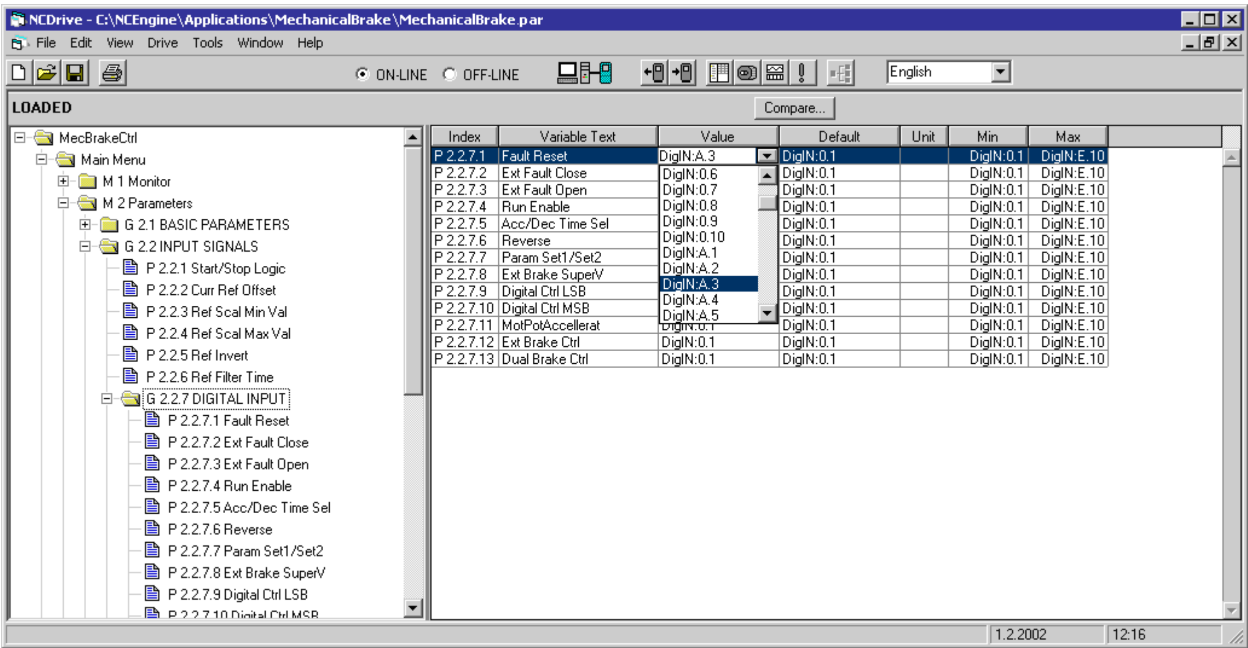


Figure 2-2. Screenshot of ADDAPT ACC Programming Tool; Entering the Address Code

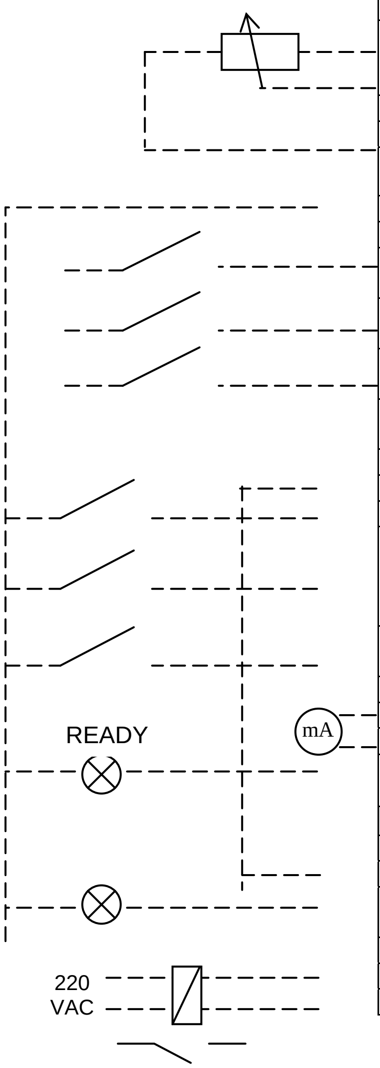
NOTE

Two inputs signals can be connected to same digital input. Use this feature very cautiously.

SECTION III

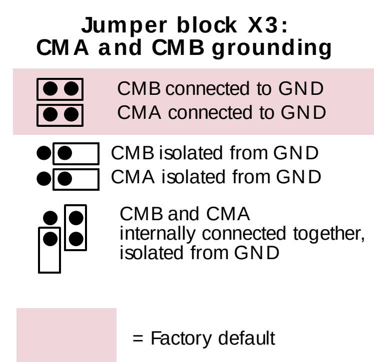
CONTROL I/O

TABLE 3-1. DEFAULT I/O CONFIGURATION



Terminal		Signal	Description
ACCel500 Slot A			
1	$+10V_{ref}$	Reference output	Voltage for potentiometer, etc.
2	AI1+	Analog input, voltage range 0—10V DC	Voltage input frequency reference
3	AI1-	I/O Ground	Ground for reference and controls
4	AI2+	Analog input, current range 0—20mA	Current input frequency reference
5	AI2-		
6	+24V	Control voltage output	Voltage for switches, etc. max 0.1 A
7	GND	I/O ground	Ground for reference and controls
8	DIN1	Start forward (programmable)	Contact closed = start forward
9	DIN2	Start reverse (programmable)	Contact closed = start reverse
10	DIN3	External fault input (programmable)	Contact open = no fault Contact closed = fault
11	CMA	Common for DIN 1—DIN 3	Connect to GND or +24V
12	+24V	Control voltage output	Voltage for switches (see #6)
13	GND	I/O ground	Ground for reference and controls
14	DIN4	Programmable	.
15	DIN5	Programmable	
16	DIN6	Fault reset (programmable)	Contact open = no action Contact closed = fault reset
17	CMB	Common for DIN4—DIN6	Connect to GND or +24V
18	AO1+	Output frequency Analog output	Programmable Range 0—20 mA/R_L, max. 500Ω
19	AO1-		
20	DO1	Digital output READY	Programmable Open collector, I≤50mA, U≤48 VDC
ACCel500 Slot B			
21	RO1	Relay output 1 Brake open signal	Programmable
22	RO1		
23	RO1		
24	RO2	Relay output 2 FAULT	Programmable
25	RO2		
26	RO2		

Note: See jumper selections below. More information in the product's User's Manual.



SECTION IV

PARAMETER LISTS

On the next pages you will find the lists of parameters within the respective parameter groups. The parameter descriptions are given in Section V.

Column explanations:

Code = Location indication on the keypad; Shows the operator the present parameter number
Parameter = Name of parameter
Min = Minimum value of parameter
Max = Maximum value of parameter
Unit = Unit of parameter value; Given if available
Default = Value preset by factory
Cust = Customer's own setting
ID = ID number of the parameter (used with PC tools)
[grey] = In parameter row: Use TTF method to program these parameters.
[cyan] = On parameter code: Parameter value can only be changed after the frequency converter has been stopped.

4-1 Monitoring values (Control keypad: menu M1)

The monitoring values are the actual values of parameters and signals as well as statuses and measurements. Monitoring values cannot be edited. See Avtron ACCel500 User's Manual, Chapter 5 for more information.

TABLE 4-1. MONITORING VALUES

Code	Parameter	Unit	ID	Description
V1.1	Output frequency	Hz	1	Output frequency to motor
V1.2	Frequency reference	Hz	25	Frequency reference to motor control
V1.3	Motor speed	rpm	2	Motor speed in rpm
V1.4	Motor current	A	3	
V1.5	Motor torque	%	4	In % of the nominal motor torque
V1.6	Motor power	%	5	Motor shaft power
V1.7	Motor voltage	V	6	
V1.8	DC link voltage	V	7	
V1.9	Unit temperature	°C	8	Heatsink temperature
V1.10	Voltage input	V	13	AI1
V1.11	Current input	mA	14	AI2
V1.12	DIN1, DIN2, DIN3		15	Digital input statuses
V1.13	DIN4, DIN5, DIN6		16	Digital input statuses
V1.14	DO1, RO1, RO2		17	Digital and relay output statuses
V1.15	Analog I_{out}	mA	26	AO1
V1.16	Encoder speed	rpm	1501	Encoder speed in rpm
V1.17	Calculated sync speed	rpm	1502	Calculated synchronous speed
V1.18	Torque	%	1125	Unfiltered motor torque
V1.19	Current	A	1113	Unfiltered motor current
V1.20	DC Voltage	V	44	Unfiltered DC Voltage
V1.21	Status Word		43	Drive status word
V1.22	Encoder 1 Freq	Hz	1124	Shaft Frequency
G1.23	Multimonitor			Multimonitor page

4-2 Basic parameters (Control keypad: Menu M2 → G2.1)

TABLE 4-2. BASIC PARAMETERS G2.1

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.1.1	Min frequency	0.00	Par. 2.1.2	Hz	0.00		101	
P2.1.2	Max frequency	Par. 2.1.1	320.00	Hz	50.00		102	**NOTE**: If f_{max} > than the motor synchronous speed, check suitability for motor and drive system
P2.1.3	Accel Time 1	0.1	3000.0	s	3.0		103	
P2.1.4	Decel Time 1	0.1	3000.0	s	3.0		104	
P2.1.5	Current limit	0.1 x I_L	2.5 x I_L	A	1.5 x I_L		107	**NOTE**: This applies for frequency converters up to FR7. For greater sizes, consult the factory.
P2.1.6	Motor Nom Voltg	180	690	V	230V 400V 690V		110	
P2.1.7	Motor Nom Freq	30.00	320.00	Hz	50.00		111	Check the rating plate of the motor
P2.1.8	Motor Nom Speed	300	20,000	rpm	1440		112	The default applies for a 4-pole motor and a nominal size frequency converter.
P2.1.9	Motor Nom Currnt	1 x I_L	2.5 x I_L	A	I_L		113	Check the rating plate of the motor
P2.1.10	Motor cosφ	0.30	1.00		0.85		120	Check the rating plate of the motor
P2.1.11	I/O Reference	0	3		4		117	**0** = AI1 **1** = AI2 **2** = Keypad **3** = Fieldbus **4** = Digital **5** = Joystick (Voltage input) **6** = Motor potentiometer
P2.1.12	Keypad Ctrl Ref	0	3		2		121	**0** = AI1 **1** = AI2 **2** = Keypad **3** = Fieldbus
P2.1.13	Fieldbus Ctr Ref	0	3		3		122	**0** = AI1 **1** = AI2 **2** = Keypad **3** = Fieldbus
P2.1.14	Digital Ref 00	0.00	Par. 2.1.2	Hz	5.00		1506	Digital reference preset by operator **NOTE:** *Not used in this software application.*
P2.1.15	Digital Ref 01	0.00	Par. 2.1.2	Hz	10.00		1507	
P2.1.16	Digital Ref 10	0.00	Par. 2.1.2	Hz	25.00		1508	
P2.1.17	Digital Ref 11	0.00	Par. 2.1.2	Hz	50.00		1509	

4-3 Input signals (Control keypad: Menu M2 → G2.2)

TABLE 4-3. INPUT SIGNALS, G2.2

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.1	Curr Ref Offset	0	1		1		302	**0** = No offset **1** = 4—20 mA
P2.2.2	Ref Scal Min Val	0.00	par. 2.2.5	Hz	0.00		303	Selects the frequency that corresponds to the min. reference signal 0.00 = No scaling
P2.2.3	Ref Scal Max Val	0.00	320.00	Hz	0.00		304	Selects the frequency that corresponds to the max. reference signal 0,00 = No scaling
P2.2.4	Ref Invert	0	1		0		305	**0** = Not inverted **1** = Inverted
P2.2.5	Ref Filter Time	0.00	10.00	s	0.10		306	**0** = No filtering
P2.2.6.x	**Digital Inputs**							
P2.2.6.1	Fault Reset	0	E.10		DigIN:0.1		1510	
P2.2.6.2	Ext Fault Close	0	E.10		DigIN:A.3		1511	
P2.2.6.3	Ext Fault Open	0	E.10		DigIN:0.1		1512	
P2.2.6.4	Run Enable	0	E.10		DigIN:0.1		1513	
P2.2.6.5	Acc/Dec Time Sel	0	E.10		DigIN:0.1		1514	
P2.2.6.6	Reverse	0	E.10		DigIN:0.1		1515	
P2.2.6.7	Param Set Set1/Set2	0	E.10		DigIN:0.1		1516	
P2.2.6.8	Ext Brake SuperV	0	E.10		DigIN:0.1		1517	
P2.2.6.9	Digital Ctrl LSB	0	E.10		DigIN:0.1		1518	
P2.2.6.10	Digital Ctrl MSB	0	E.10		DigIN:0.1		1519	
P2.2.6.11	MotPotAccellerat	0	E.10		DigIN:0.1		1520	
P2.2.6.12	Ext Brake Ctrl	0	E.10		DigIN:0.1		1521	
P2.2.6.13	Dual Brake Ctrl	0	E.10		DigIN:0.1		1522	
P2.2.7.x	**Non-Linearization**							
P2.2.7.1	NonLin X_1 Cord	0.00	100,00	%	40.00		1526	
P2.2.7.2	NonLin Y_1 Cord	0.00	100.00	%	40.00		1527	
P2.2.7.3	NonLin X_2 Cord	0.00	100.00	%	80.00		1528	
P2.2.7.4	NonLin Y_2 Cord	0.00	100.00	%	80.00		1529	

* = Rising edge required to start

4-4 Output signals (Control keypad: Menu M2 → G2.3)

TABLE 4-4. OUTPUT SIGNALS, G2.3

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.3.1	Iout Content	0	8		1		307	**0** = Not used **1** = Output freq. (0—f_{max}) **2** = Freq. reference (0—f_{max}) **3** = Motor speed (0—Motor nominal speed) **4** = Output current (0-I_{nMotor}) **5** = Motor torque (0—T_{nMotor}) **6** = Motor power (0—P_{nMotor}) **7** = Motor voltage (0-U_{nMotor}) **8** = DC-link volt (0—1000V)
P2.3.2	Iout Filter Time	0.00	10.00	s	1.00		308	
P2.3.3	Iout Invert	0	1		0		309	**0** = Not inverted **1** = Inverted
P2.3.4	Iout Minimum	0	1		0		310	**0** = 0 mA **1** = 4 mA
P2.3.5	Iout Scale	10	1000	%	100		311	
P2.3.6	DO1 Content	0	18		1		312	**0** = None/WD Timer **1** = Ready **2** = Run **3** = Fault **4** = Fault inverted **5** = FC overheat warning **6** = Ext. fault or warning **7** = Ref. fault or warning **8** = Warning **9** = Reversed **10** = Preset speed **11** = At speed **12** = Mot. regulator active **13** = OP freq. limit superv. **14** = Control place: IO **15** = Therm Fault/Warning **16** = FB DigIN 1 **17** = Open external Brake **18** = Open Enable
P2.3.7	RO1 Content	0	18		17		313	As parameter 2.3.6
P2.3.8	RO2 Content	0	18		3		314	As parameter 2.3.6
P2.3.9	Freq Supv Lim 1	0	2		0		315	**0** = No limit **1** = Low limit supervision **2** = High limit supervision
P2.3.10	Freq Supv Val 1	0,00	320.00	Hz	0.00		316	
P2.3.11	Iout 2 Signal	0			0.1		471	TTF programming method used.
P2.3.12	Iout 2 Content	0	8		4		472	As parameter 2.3.1
P2.3.13	Iout 2 Filter T	0.00	10.00	s	1.00		473	
P2.3.14	Iout 2 Invert	0	1		0		474	**0** = Not inverted **1** = Inverted
P2.3.15	Iout 2 Minimum	0	1		0		475	**0** = 0 mA **1** = 4 mA
P2.3.16	Iout 2 Scale	10	1000	%	1000		476	

4-5 Drive control parameters (Control keypad: Menu M2 → G2.4)

TABLE 4-5. DRIVE CONTROL PARAMETERS, G2.4

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.4.1	Ramp 1 Shape	0.0	10.0	s	0.0		500	**0** = Linear **>0** = S-curve ramp time
P2.4.2	Ramp 2 Shape	0.0	10.0	s	0.0		501	**0** = Linear **>0** = S-curve ramp time
P2.4.3	Accel Time 2	0.1	3000.0	s	10.0		502	
P2.4.4	Decel Time 2	0.1	3000.0	s	10.0		503	
P2.4.5	Brake Chopper	0	4		1		504	**0** = Disabled **1** = Used when running **2** = External brake chopper **3** = Used when stopped/running **4** = Used when running, no test
P2.4.6	Start Function	0	1		0		505	**0** = Ramp **1** = Flying start
P2.4.7	Stop Function	0	3		1		506	**0** = Coasting **1** = Ramp **2** = Ramp+Run enable coast **3** = Coast+Run enable ramp
P2.4.8	Flux Brake	0	1		0		520	**0** = Off **1** = On
P2.4.9	FluxBrakeCurrent	0.0	Varies	A	0.0		519	
P2.4.10	RampChangeFreq	0.0	Par. 2.1.2	Hz	0.00		1530	Acc/dec. ramps 2 are used below this frequency
P2.4.11.x	**Prohibit freq**							
P2.4.11.1	Range 1 Low Lim	0.00	par. 2.5.2	Hz	0.00		509	
P2.4.11.2	Range 1 High Lim	0.00	320.00	Hz	0.0		510	
P2.4.11.3	PH Acc/Dec Ramp	0.1	10.0	x	1.0		518	
P2.4.12	Fwd Slw Dwn Spd	0	60	Hz	10.00			Active when P2.4.20 is LOW.
P2.4.13	Fwd Low Spd	0	120	Hz	15.00			First step fixed FWD speed reference.
P2.4.14	Fwd High Spd	0	120	Hz	60.00			Second step fixed speed reference (if P2.4.25 is LOW).
P2.4.15	Fwd Ext Spd	0	320	Hz	120.00			Second step fixed speed reference (if P2.4.25 is HI)
P2.4.16	Rev Slw Dwn Spd	0	60	Hz	10.00			Active when P2.4.21 is LOW.
P2.4.17	Rev Low Spd	0	120	Hz	15.00			First step fixed REV speed reference.
P2.4.18	Rev High Spd	0	120	Hz	60.00			Second step fixed speed reference (if P2.4.25 is LOW).
P2.4.19	Rev Ext Spd	0	320	Hz	120.00			Second step fixed speed reference (if P2.4.25 is HI).
P2.4.20	Fwd Slw Dwn Inp	0	E.10		DigIN:0.2			**0** = In Slowspeed zone. **1** = Normal Speed zone.
P2.4.21	Rev Slw Dwn Inp	0	E.10		DigIN:0.2			**0** = In Slowspeed zone. **1** = Normal Speed zone.
P2.4.22	Fast Spd Inp	0	E.10		DigIN:0.1			**0** = Use First Step Speed reference. **1** = Use Second Step Speed reference.
P2.4.24	Ext Spd Cur Lim	0	200	%	80.00			Current limit in extended speed range.

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.4.25	Ext Spd Inp	0	E.10		DigIN:0.1			**0** = Use P2.4.14 and P2.4.18 second step speed. **1** = Use P2.4.15 and P2.4.19 second step speed.
P2.4.26	Ld Float Bit ID	0	E.10		DigIN:0.1			**0** = Load Float disabled. **1** = Load Float enabled.
P2.4.27	Load Float TC	0	100	s	10.00			Load Float time.
P2.4.28	Load Float Spd	0	60	Hz	5.00			Load Float Speed ref.
P2.4.29	LF Trq Prv Spd	0	600	Hz	5.00			
P2.4.30	REV End Inp ID	0	E.10		DigIN:0.2			Reverse Direction Travel Limit **0** = Stop **1** = OK
P2.4.31	FWD End Inp ID	0	E.10		DigIN:0.2			Forward Direction Travel Limit **0** = Stop **1** = OK
P2.4.32	Brake Close Time	0	100	s	0.10			
P2.4.33	En Brake Slip F	0	1		1			**0** = Disable **1** = Enable
P2.4.34	Brake Slip Freq	0	10	Hz	4.00			
P2.4.35	Over Wt Delay	0	100	s	2.00			
P2.4.36	En Over Wt Fault	0	1		1			**0** = Disable **1** = Enable
P2.4.37	Over Wt Flt Stpt	0	300	%	100.00			
P2.4.38	Brk Slip DOUT ID	0	E.10		DigOUT:0.1			Brake slip Detection warning output
P2.4.39	Over Wt Out ID	0	E.10		DigOUT:0.1			Overweight Detection warning output
P2.4.40	End Stop Mode	0	2		1			**0** = Normal Stop **1** = Fast Stop **2** = Coast Stop

4-6 Brake control parameters (Control keypad: Menu M2 → G2.5)

TABLE 4-6. BRAKE CONTROL PARAMETERS, G2.5

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.5.1.x	**OPEN LOOP PARAMETERS**							
P2.5.1.1	CurrentLimit FWD	0.0	P2.1.9	A	0.0		1531	
P2.5.1.2	CurrentLimit REV	0.0	P2.1.9	A	0.0		1532	
P2.5.1.3	TorqueLimit FWD	0.0	100.0	%	0.0		1533	
P2.5.1.4	TorqueLimit REV	0.0	100.0	%	0.0		1534	
P2.5.1.5	Freq limit FWD	0.00	P2.1.7	Hz	1.00		1535	
P2.5.1.6	Freq limit REV	0.00	P2.1.7	Hz	1.00		1536	
P2.5.1.7	MecBreakClosDFWD	0.00	10.00	s	0.50		1537	
P2.5.1.8	MecBreakClosDREV	0.00	10.00	s	0.50		1538	
P2.5.1.9	FreqLimClos FWD	0.00	P2.1.7	Hz	1.00		1539	
P2.5.1.10	FreqLimClos REV	0.00	P2.1.7	Hz	1.00		1540	
P2.5.1.11	MecBrakeClosDFWD	0.00	10.00	s	0.00		1541	
P2.5.1.12	MecBrakeClosDREV	0.00	10.00	s	0.00		1542	
P2.5.1.13	MaxFreqBrakeClos	0.00	P2.1.2	Hz	4.00		1543	
P2.5.1.14	MecBrakReactTime	0.00	10.00	s	0.50		1544	
P2.5.1.15	DC-Brake Current	0.15 x I_n	1.5 x I_n	A	Varies		507	
P2.5.1.16	Start DC-BrakeTM	0.00	600.00	s	0.00		516	**0** = DC brake is off at start
P2.5.1.17	Stop DC-BrakeTM	0.00	600.00	s	0.00		508	**0** = DC brake is off at stop
P2.5.1.18	Stop DC-BrakeFr	0.10	10.00	Hz	0.00		515	
P2.5.1.19	DirectChangeMode	0	1		0		1545	**0** = No action **1** = Brake closed **2** = Stop state
P2.5.2.x	**CLOSED LOOP PARAMETERS**							
P2.5.2.1	CurrentLimit	0.0	P2.1.9	A	0.0		1551	
P2.5.2.2	TorqueLimit	0.0	100.0	%	0.0		1553	
P2.5.2.3	FreqLimit	0.00	P2.1.7	Hz	1.00		1555	
P2.5.2.4	MecBrakeOpenDela	0.00	10.00	s	0.50		1557	
P2.5.2.5	FreqLimClose	0.00	P2.1.7	Hz	1.00		1559	
P2.5.2.6	MecBrakeClosDela	0.00	10.00	s	0.00		1661	
P2.5.2.7	MaxFreqBrakeClos	0.00	P2.1.2	Hz	0.10		1563	
P2.5.2.8	MecBrakReactTime	0.00	10.00	s	0.50		1544	
P2.5.2.9	0 Hz TimeAtStart	0.000	32.000	s	0.100		615	
P2.5.2.10	0 Hz TimeAtStop	0.000	32.000	s	0.100		616	
P2.5.2.11	SmoothStartTime	0.00	10.00	s	0.00		1564	
P2.5.2.12	SmoothStartFreq	0.00	P2.1.2	s	0.00		1565	
P2.5.2.13	DirectChangeMode	0	1		0		1545	**0** = No action **1** = Brake closed **2** = Stop state
P2.5.2.14	Start Magn Curr	0.00	I_L	A	0.00		627	Start magnetizing current
P2.5.2.15	Start Magn Time	0	32000	ms	0		628	Start magnetizing time

4-7 Motor control parameters (Control keypad: Menu M2 → G2.6)

TABLE 4-7. MOTOR CONTROL PARAMETERS, G2.6

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.6.1	Motor Ctrl Mode	0	1		0		600	**0** = OL, Frequency control **1** = OL, Speed control **2** = OL, Torque control **3** = CL, Speed control **4** = CL, Torque control **5** = Advanced OL Freq **6** = Advanced OL Speedl
P2.6.2	U/f Optimization	0	1		0		109	**0** = Not used **1** = Automatic torque boost
P2.6.3	U/f Ratio Select	0	3		0		108	**0** = Linear **1** = Squared **2** = Programmable **3** = Linear with flux optim.
P2.6.4	Field WeakngPnt	30.00	320.00	Hz	50.00		602	
P2.6.5	Voltage at FWP	10.00	200.00	%	100.00		603	n% x U_{nmot} Parameter max. value = par. 2.6.7
P2.6.6	U/f Mid Freq	0.00	par. P2.6.4	Hz	50.00		604	
P2.6.7	U/f Mid Voltg	0.00	100.00	%	100.00		605	N% x U_{nmot}
P2.6.8	Zero Freq Voltg	0.00	40.00	%	0.00		606	N% x U_{nmot}
P2.6.9	Switching Freq	1.0	16.0	kHz	Varies		601	Depends on kW
P2.6.10	Overvolt Contr	0	1		1		607	**0** = Not used **1** = Used
P2.6.11	Undervolt Contr	0	1		1		608	**0** = Not used **1** = Used
P2.6.12	SlipCompensation	0	1		0		156 7	**0** = Calculated **1** = Encoder speed
P2.6.13	OL Speed Reg P	0	32767		3000		637	
P2.6.14	OL Speed Reg I	0	32767		300		638	
P2.6.15	LoadDrooping	0.00	100.00	%	0		620	
P2.6.16	Identification	0	5		0		631	**0** = No action **1** = Identification w/o run **2** = Identification with run
P2.6.17.x	**CLOSED LOOP PARAMETERS**							
P2.6.17.1	MagnCurrent	0,0	1000.0	A			612	
P2.6.17.2	Speed Control Kp	0	1000		30		613	Gain for the speed controller
P2.6.17.3	Speed Control Ti	0.0	500.0	Ms	30.0		614	Time constant for the speed controller
P2.6.17.4	CurrentControlKp	0.00	100.00	%	40.00		617	
P2.6.17.5	Encoder1FiltTime	0	1000	ms	0		618	
P2.6.17.6	Slip Adjust	0	500	%	100		619	
P2.6.17.7	StartupTorqueSel	0	1		0		621	**0** = Not Used **1** = TorqMemory
P2.6.17.8	StopStateFlux	0.0	150.0	%	100.0		140 1	Stop state magnetizing Current
P2.6.17.9	Flux Off Delay	-1	32000	s	0		140 2	Max time for stop state magnetization
P2.6.18.x	**ADVANCED OPEN LOOP PARAMETERS**							
P2.6.18.1	0 Speed Current	0.0	250.0	%	120.0		625	
P2.6.18.2	Minimum Current	0.0	100.0	%	80.0		622	
P2.6.18.3	FluxReference	0.0	100.0	%	80.0		623	
P2.6.18.4	Frequency Limit	0.0	100.0	%	20.0		635	
P2.6.18.5	M5 StrayFluxCurr	0,0	100.0	%	40.0		624	

4-8 Protections (Control keypad: Menu M2 → G2.7)

TABLE 4-8. PROTECTIONS, G2.7

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.7.1	4mA Input Fault	0	5		0		700	**0** = No response **1** = Warning **2** = Warning+Old Freq. **3** = Wrng+PresetFreq 2.7.2 **4** = Fault,stop acc. to 2.4.7 **5** = Fault,stop by coasting
P2.7.2	4mA Fault Freq.	0.00	Par. 2.1.2	Hz	0.00		728	
P2.7.3	External Fault	0	3		2		701	**0** = No response **1** = Warning **2** = Fault,stop acc. to 2.4.7 **3** = Fault,stop by coasting
P2.7.4	Input Phase Supv	0	3		2		730	
P2.7.5	UVolt Fault Resp	1	3		2		727	
P2.7.6	OutputPh. Superv	0	3		2		702	
P2.7.7	Earth Fault	0	3		2		703	
P2.7.8	Motor Therm Prot	0	3		2		704	
P2.7.9	MotAmbTemp Factor	–100.0	100.0	%	0.0		705	
P2.7.10	MTP f0 Current	0.0	150.0	%	40.0		706	
P2.7.11	MTP Motor T	1	200	min	10		707	
P2.7.12	Motor Duty Cycle	0	100	%	100		708	
P2.7.13	Stall protection	0	3		0		709	**0** = No response **1** = Warning **2** = Fault,stop acc. to 2.4.7 **3** = Fault,stop by coasting
P2.7.14	Stall Current	0.1	6000.0	A	10.0		710	
P2.7.15	Stall Time Lim	1.00	120.00	s	15.00		711	
P2.7.16	Stall Freq Limit	1,0	Par. 2.1.2	Hz	25.0		712	
P2.7.17	Underload Protec	0	3		0		713	**0** = No response **1** = Warning **2** = Fault,stop acc. to 2.4.7 **3** = Fault,stop by coasting
P2.7.18	UP fnom Torque	10	150	%	50		714	
P2.7.19	UP f0 Torque	5.0	150.0	%	10.0		715	
P2.7.20	UP Time Limit	2	600	s	20		716	
P2.7.21	ThermistorF.Resp	0	3		0		732	**0** = No response **1** = Warning **2** = Fault,stop acc. to 2.4.7 **3** = Fault,stop by coasting
P2.7.22	FBComm.Fault Resp	0	3		0		733	See P2.7.21
P2.7.23	SlotComFaultResp	0	3		0		734	See P2.7.21
P2.7.24	BrakeSuperVFault	0	3		0		1570	
P2.7.25	BrakeSuperV Time	0.00	10.00	s	3.00		1571	
P2.7.26	BrakeLogicSFault	0	3		0		1572	
P2.7.27	BrakeLogicSVTime	0.00	10.00	s	5.00		1573	
P2.7.28	UnderCurrent Fa	0	3		0		1574	
P2.7.29	UnderCurrentSup	0.0	P2.1.15	A	0.0		1575	
P2.7.30	Shaftspeed SV	0	3		0		1576	
P2.7.31	ShaftspeedSHyst	0.00	10,00	Hz	5.00		1577	
P2.7.32	ShaftspeedSTime	0.00	2,00	s	0.50		1578	

4-9 Autorestart parameters (Control keypad: Menu M2 → G2.8)

TABLE 4-9. AUTORESTART PARAMETERS, G2.8

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.8.1	Wait Time	0.10	10.00	s	0.50		717	
P2.8.2	Trial Time	0.00	60.00	s	30.00		718	
P2.8.3	Start Function	0	2		0		719	**0** = Ramp **1** = Flying start **2** = According to par. 2.4.6
P2.8.4	Undervolt. Tries	0	10		0		720	
P2.8.5	Overvolt Tries	0	10		0		721	
P2.8.6	Overcurr. Tries	0	3		0		722	
P2.8.7	4mA Fault Tries	0	10		0		723	
P2.8.8	MotTempF Tries	0	10		0		726	
P2.8.9	Ext.Fault Tries	0	10		0		725	

4-10 Identified parameters (Control keypad: Menu M2 → G2.9)

Parameters are updated when the automatic motor identification is done. The identification is activated by parameter P2.6.16 and start order within 20 seconds. It is also possible to change these parameters manually but then a very good knowledge in motor tuning is required.

TABLE 4-10. IDENTIFIED PARAMETERS

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.9.1	Flux 10 %	0	250.0	%	10.0		1355	Flux linearization point 10%
P2.9.2	Flux 20 %	0	250.0	%	20.0		1356	Flux linearization point 20%
P2.9.3	Flux 30 %	0	250.0	%	30.0		1357	Flux linearization point 30%
P2.9.4	Flux 40 %	0	250.0	%	40.0		1358	Flux linearization point 40%
P2.9.5	Flux 50 %	0	250.0	%	50.0		1359	Flux linearization point 50%
P2.9.6	Flux 60 %	0	250.0	%	60.0		1360	Flux linearization point 60%
P2.9.7	Flux 70 %	0	250.0	%	70.0		1361	Flux linearization point 70%
P2.9.8	Flux 80 %	0	250.0	%	80.0		1362	Flux linearization point 80%
P2.9.9	Flux 90 %	0	250.0	%	90.0		1363	Flux linearization point 90%
P2.9.10	Flux 100 %	0	250.0	%	100.0		1364	Flux linearization point 100%
P2.9.11	Flux 110 %	0	250.0	%	110.0		1365	Flux linearization point 110%
P2.9.12	Flux 120 %	0	250.0	%	120.0		1366	Flux linearization point 120%
P2.9.13	Flux 130 %	0	250.0	%	130.0		1367	Flux linearization point 130%
P2.9.14	Flux 140 %	0	250.0	%	140.0		1368	Flux linearization point 140%
P2.9.15	Flux 150 %	0	250.0	%	150.0		1369	Flux linearization point 150%
P2.9.16	MakeFluxTime	0	60000		Varies		660	Time to magnetize the motor
P2.9.17	MakeFluxVoltage	0	30000		Varies		661	Magnetizing voltage
P2.9.18	RsVoltageDrop	0	65535		Varies		662	Measured voltage drop at stator resistance between two phases with nominal current of the motor
P2.9.19	MFVhwDtComp	0	30000		Varies		663	Magnetizing voltage with hardware dead time compensation
P2.9.20	IRaddZeroPointV	0	100.00	%	Varies		664	IrAddVoltage for Zero frequency, used with torque boost.
P2.9.21	IrAddGeneScale	0	200	%	Varies		665	Scaling factor for generator side IR-compensation.
P2.9.22	IrAddMotorScale	0	200	%	Varies		667	Scaling factor for motor side IR-compensation.
P2.9.23	IU Offset	-32000	32000		0		668	Offsets value for phase U current measurement.
P2.9.24	IV Offset	-32000	32000		0		669	Offsets value for phase V current measurement.
P2.9.25	IW Offset	-32000	32000		0		670	Offsets value for phase W current measurement.

4-11 Keypad control (Control keypad: Menu M3)

The parameters for the selection of control place and direction on the keypad are listed below. See the Keypad control menu in the Avtron ACCel500 User's Manual.

TABLE 4-11. KEYPAD CONTROL PARAMETERS, M3

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P3.1	Control Place	1	3		1		125	**0** = I/O terminal **1** = Keypad **2** = Fieldbus
R3.2	Keypad Reference	Par. 2.1.1	Par. 2.1.2	Hz				
P3.3	Keypad Direction	0	1		0		123	**0** = Forward **1** = Reverse
R3.4	StopButtonActive	0	1		1		114	**0** =Limited function of Stop button **1** =Stop button always enabled

4-12 System menu (Control keypad: M5)

For parameters and functions related to the general use of the frequency converter, such as application and language selection, customised parameter sets or information about the hardware and software, see Chapter 5 in the Avtron ACCel500 User's Manual.

4-13 Expander boards (Control keypad: Menu M6)

The **M6** menu shows the expander and option boards attached to the control board and board-related information. For more information, see Chapter 5 in the Avtron ACCel500 User's Manual.

SECTION V

DESCRIPTION OF PARAMETERS

5-1 Basic Parameters

2.1.1 Minimum frequency

2.1.2 Maximum frequency

Defines the frequency limits of the frequency converter. The maximum value for parameters 2.1.1 and 2.1.2 is 320 Hz. The software will automatically check the values of parameters 2.1.14, 2.1.15, 2.1.16, 2.1.17, 2.3.10 and 2.7.2

2.1.3 Acceleration time 1
2.1.4 Deceleration time 1

These limits correspond to the time required for the output frequency to accelerate from the zero frequency to the set maximum frequency (par. 2.1.2).

2.1.5 Current limit

This parameter determines the maximum motor current from the frequency converter. To avoid motor overload, set this parameter according to the rated current of the motor. The current limit is 1.5 times the rated current (I_L) by default.

2.1.6 Nominal voltage of the motor

Find this value U_n on the rating plate of the motor. This parameter sets the voltage at the field weakening point (parameter 2.6.5) to 100% x U_{nmotor}.

2.1.7 Nominal frequency of the motor

Find this value f_n on the rating plate of the motor. This parameter sets the field weakening point (parameter 2.6.4) to the same value.

2.1.8 Nominal speed of the motor

Find this value n_n on the rating plate of the motor.

2.1.9 Nominal current of the motor

Find this value I_n on the rating plate of the motor.

2.1.10 Motor cos phi

Find this value “cos phi” on the rating plate of the motor.

2.1.11 I/O frequency reference selection

Defines which frequency reference source is selected when controlled from the I/O control place. Default value is 0.

0 = Analog voltage reference from terminals 2–3, e.g., potentiometer
1 = Analog current reference from terminals 4–5, e.g., transducer
2 = Keypad reference from the Reference Page (Group M3)
3 = Reference from the fieldbus
4 = Digital reference, frequency is set according to parameters P2.1.14 to P2.1.17
5 = Joystick control, U_{in} reference from terminals 2–3
6 = Internal motorized potentiometer

Digital input P2.2.6.11 can be used as internal motorized potentiometer. Drive is started and the digital input increases speed. The current speed is held as long as start command is active. Deceleration is made by stop command.

2.1.12 Keypad frequency reference selection

Defines which frequency reference source is selected when controlled from the keypad. Default value is 2.

0 = Analog voltage reference from terminals 2–3, e.g. potentiometer
1 = Analog current reference from terminals 4–5, e.g. transducer
2 = Keypad reference from the Reference Page (Group M3)
3 = Reference from the Fieldbus

2.1.13 Fieldbus frequency reference selection

Defines which frequency reference source is selected when controlled from the fieldbus. Default value is 3.

0 = Analog voltage reference from terminals 2–3, e.g. potentiometer
1 = Analog current reference from terminals 4–5, e.g. transducer
2 = Keypad reference from the Reference Page (Group M3)
3 = Reference from the Fieldbus

2.1.14-2.1.17 Digital reference 00-11 (NOT USED)

5-2 INPUT SIGNALS

Start/Stop Logic

Though not configurable, it should be noted that the ACCel500's first two digital inputs are reserved specifically for enabling the drive to run in dedicated directions, as described below.

DigIN:A.1 (digital input 1): closed contact = start forward
DigIN:A.2 (digital input 2): closed contact = start reverse

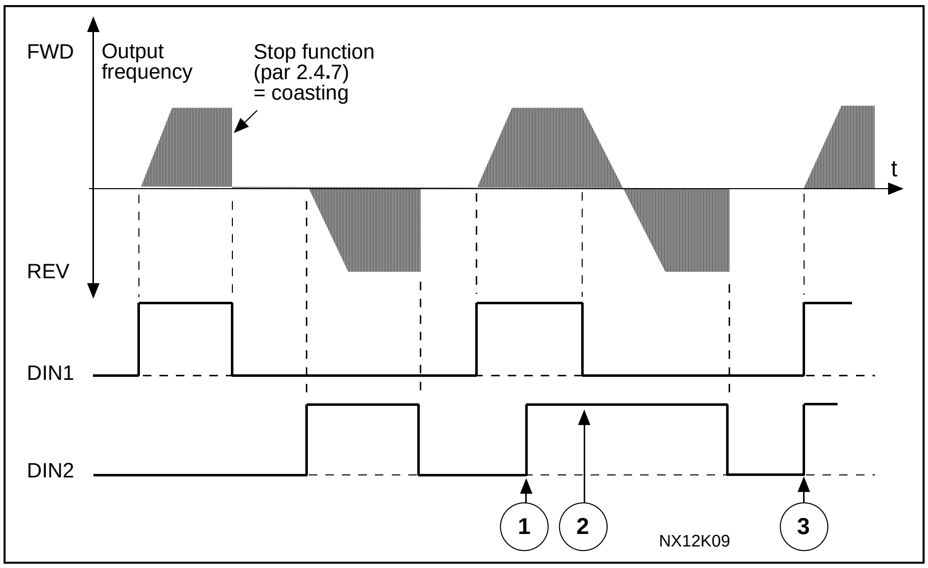


Figure 5-1. Start forward/Start reverse

① The first selected direction has the highest priority.

② When the DIN1 contact opens the direction of rotation starts the change.

③ If Start forward (DIN1) and Start reverse (DIN2) signals are active simultaneously the Start forward signal (DIN1) has priority.

1 DIN1: closed contact = start open contact = stop
DIN2: closed contact = reverse open contact = forward

See Figure 5-2.

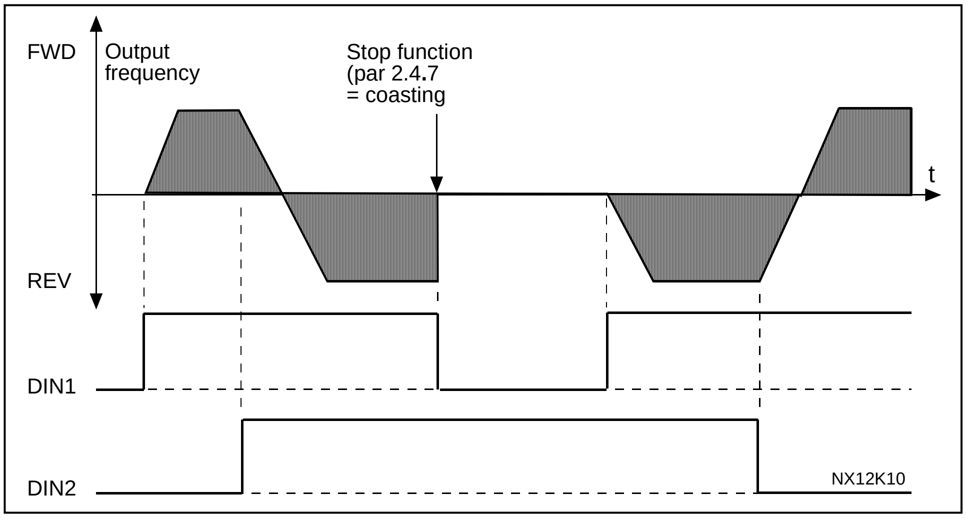


Figure 5-2. Start, Stop, Reverse

2 DIN1: closed contact = start open contact = stop
DIN2: closed contact = start enabled open contact = start disabled and drive stopped if running

3 3-wire connection (pulse control):

DIN1: closed contact = start pulse
DIN2: open contact = stop pulse
(DIN3 can be programmed for reverse command)

See Figure 5-3.

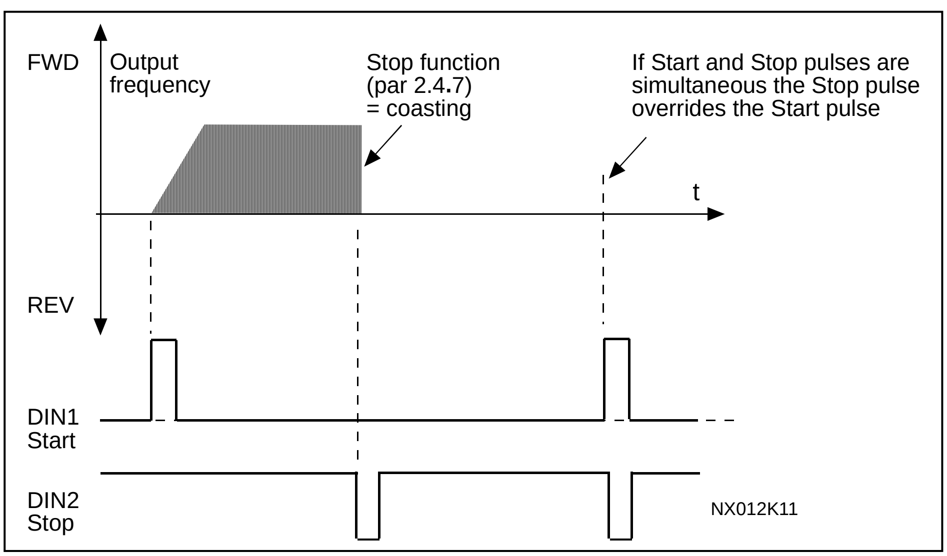


Figure 5-3. Start pulse/ Stop pulse

The selections **4** to **6** shall be used to exclude the possibility of an unintentional start when, for example, power is connected, re-connected after a power failure, after a fault reset, after the drive is stopped by Run Enable (Run Enable = False) or when the control place is changed. The Start/Stop contact must be opened before the motor can be started.

4 DIN1: closed contact = start forward **(Rising edge required to start)**
DIN2: closed contact = start reverse **(Rising edge required to start)**

5 DIN1: closed contact = start **(Rising edge required to start)**
open contact = stop
DIN2: closed contact = reverse
open contact = forward

6 DIN1: closed contact = start **(Rising edge required to start)**
open contact = stop
DIN2: closed contact = start enabled
open contact = start disabled and drive stopped if running

2.2.1 Reference offset for current input

0 No offset
1 Offset 4 mA ("living zero"), provides supervision of zero level signal. The response to reference fault can be programmed with parameter 2.7.1.

2.2.2 - 2.2.3 Reference scaling, minimum value/maximum value

Setting value limits: 0 ≤ par. 2.2.2 ≤ par. 2.2.3 ≤ par. 2.1.2. If parameter 2.2.5 = 0 scaling is set off. The minimum and maximum frequencies are used for scaling.

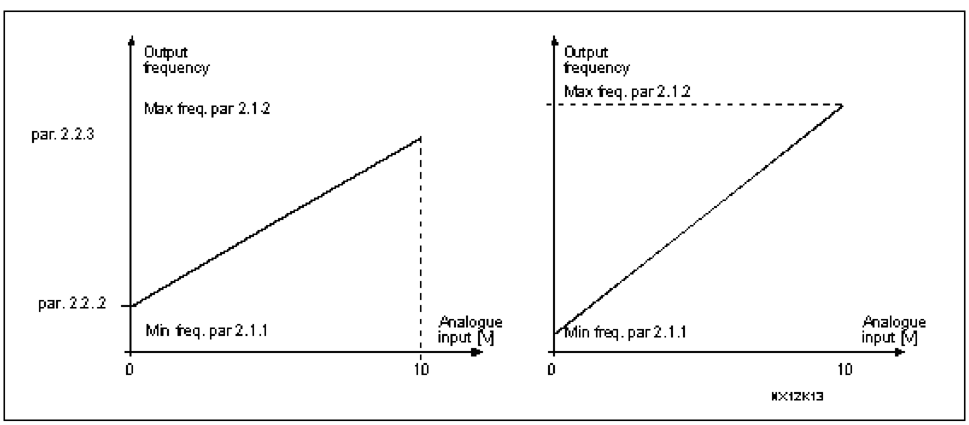


*Figure 5-4. **Left**: Reference scaling; **Right**: No scaling used (par. 2.2.5 = 0)*

2.2.4 Reference inversion

Inverts reference signal:
Max. ref. signal = Min. set freq.
Min. ref. signal = Max. set freq.

0 No inversion
1 Reference inverted

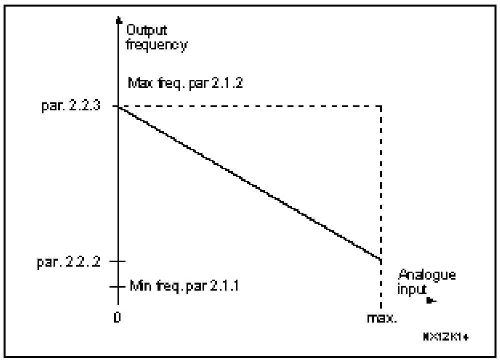


Figure 5-5. Reference inversion

2.2.5 Reference filter time

Filters out disturbances from the incoming analog U_{in} signal. Long filtering time makes regulation response slower.

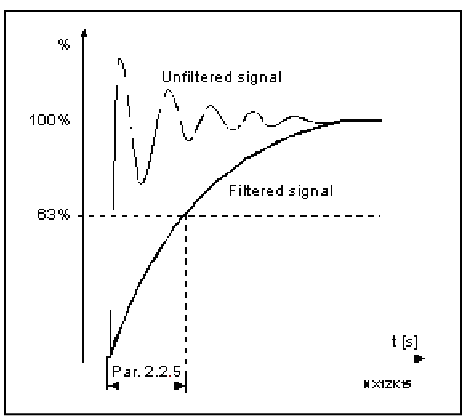


Figure 5-6. Reference filtering

2.2.6.x DIGITAL INPUTS

All digital Inputs (not DigIN:0.1 and DigIN:0.2) shall be programmed using the Terminal To Function method (TTF). See instructions in Section II. In other words, all functions (parameters) that you wish to use shall be connected to a certain input on a certain option board.

2.2.6.1 Fault reset

Contact closed: All faults are reset

2.2.6.2 External Fault closing contact

Contact closed: Fault is displayed and motor stopped.

2.2.6.3 External Fault opening contact

Contact open: Fault is displayed and motor stopped.

2.2.6.4 Run Enable

Treat this parameter as a "Ready to Run" permissive. Regardless of direction, this parameter must have a high bit in order to spin motor.

Contact open: Start of motor disabled
Contact closed: Start of motor enabled

2.2.6.5 Acc/Dec time selection

Set Acceleration/Deceleration times 2 with parameters P2.4.3 and P2.4.4

Contact open: Acceleration/Deceleration time 1 selected
Contact closed: Acceleration/Deceleration time 2 selected

2.2.6.6 Reverse

Even though DigIN:A.2 is a dedicated reverse motor direction input, set this parameter equal to the reverse direction input as well.

Contact open: Direction forward
Contact closed: Direction reverse

2.2.6.7 Parameter set 1 / set 2

With this parameter you can select between Parameter Set 1 and Set 2.

Digital input = FALSE:
- The active set is saved to set 2
- Set 1 is loaded as the active set

Digital input = TRUE:
- The active set is saved to set 1
- Set 2 is loaded as the active set

Note: The parameter values can be changed in the active set only.

2.2.6.8 External brake supervision

External supervision of the mechanical brake. The Boolean value is forced to TRUE if function is not connected to a digital input.

Contact open: Mechanical brake closed
Contact closed: Mechanical brake opened

2.2.6.9 Speed select 1 (NOT USED)

2.2.6.10 Speed select 2 (NOT USED)

2.2.6.11 Motorized potentiometer acceleration

Acc/dec ramp times 2 can be used below frequency set by parameter P2.4.10. Frequencies above the limit set by P2.4.10 uses acc/dec ramp times 1.

Contact open: Maintain current speed
Contact closed: Acceleration

2.2.6.12 External brake control

Digital input can be used as an external opening condition in the brake opening logic. The Boolean value is forced to TRUE if function is not connected to a digital input.

Contact open: FALSE
Contact closed: TRUE

2.2.6.13 Dual brake control

If running the machine with two ACCel500 drives, this function is to gain synchronized brake and ramp control. The Open enable signal from the other drive is connected to the Dual brake control digital output and the other drive is connected the other way round. An example of the Dual brake control connections can be seen in Figure 5-7.

Contact open: The brake doesn’t open
Contact closed: Open enable

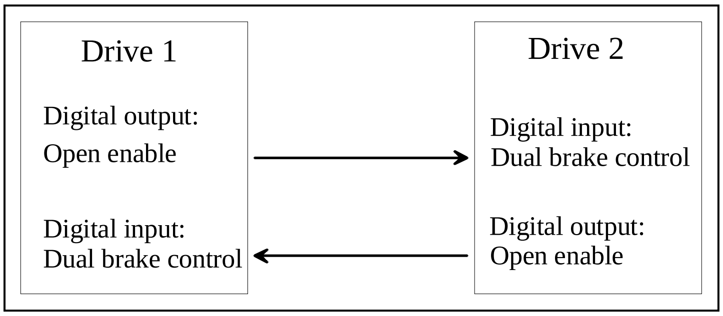


Figure 5-7. Dual brake control connections

2.2.7.x Non-linearization

Non-linear response of the analog inputs

2.2.7.1 NonLinearization coordinate X_1
2.2.7.2 NonLinearziation coordinate Y_1
2.2.7.3 NonLinearization coordinate X_2
2.2.7.4 NonLinearization coordinate Y_2

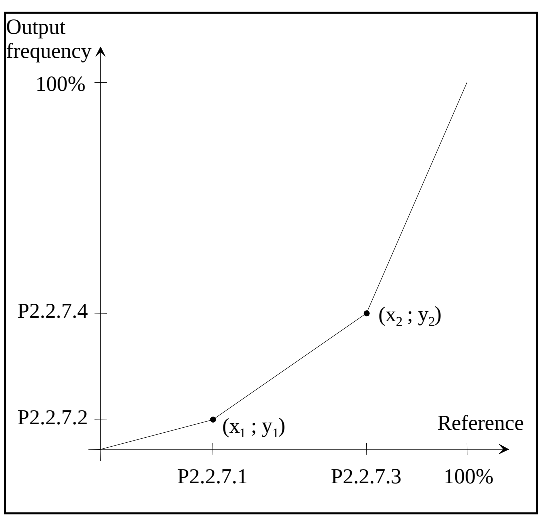


Figure 5-8. Non-Linearization of the analog inputs

5-3 OUTPUT SIGNALS

2.3.1 Analog output function

This parameter selects the desired function for the analog output signal.
See Table 4-4 for the parameter values.

2.3.2 Analog output filter time

Defines the filtering time of the analog output signal.

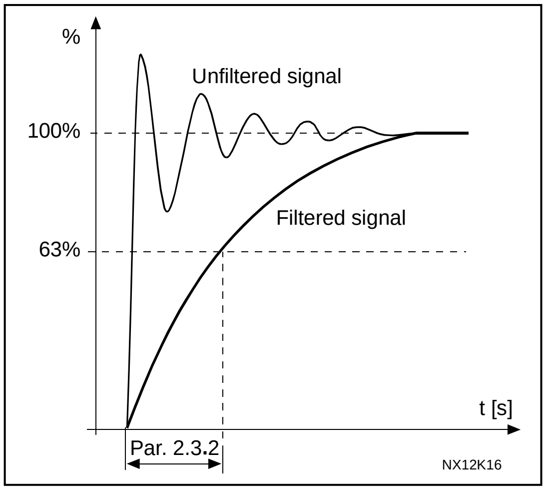


Figure 5-9. Analog output filtering

2.3.3 Analog output invert

Inverts the analog output signal.

Maximum output signal = Minimum set value
Minimum output signal = Maximum set value

See parameter 2.3.5 below.

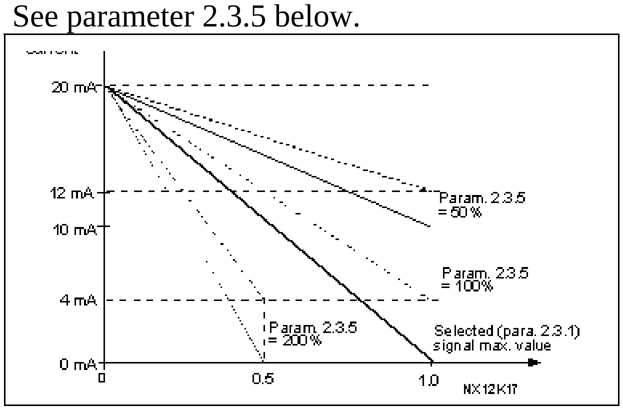


Figure 5-10. Analog output invert

2.3.4 Analog output minimum

Defines the signal minimum to either 0 mA or 4 mA (living zero). Note the difference in analog output scaling in parameter 2.3.5 (Figure 5-11).

0 Set minimum value to 0 mA
1 Set minimum value to 4 mA

2.3.5 Analog output scale

Scaling factor for Analog output.

TABLE 5-1. ANALOG OUTPUT SCALING

Signal	Max. value of the signal
Output frequency	Max frequency (par. 2.1.2)
Freq. Reference	Max frequency (par. 2.1.2)
Motor speed	Motor nom. speed $1xn_{mMotor}$
Output current	Motor nom. current $1xI_{nMotor}$
Motor torque	Motor nom. torque $1xT_{nMotor}$
Motor power	Motor nom. power $1xP_{nMotor}$
Motor voltage	100% x U_{nmotor}
DC-link voltage	1000 V

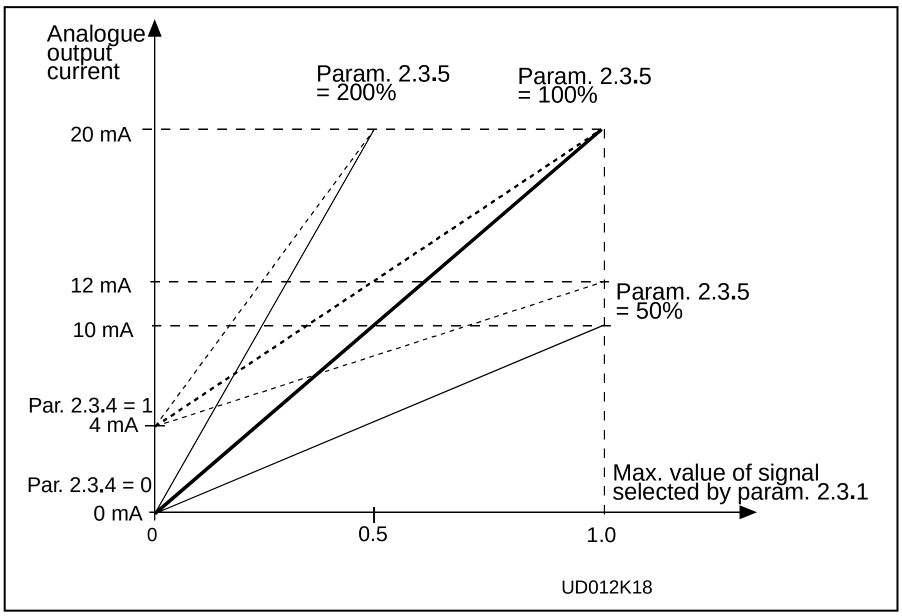


Figure 5-11. Analog output scaling

2.3.6 Digital output function

Programmable. Set to “0/None/WDTim” for output of software watchdog toggle bit.

2.3.7 Relay output 1 function

Typically used for brake control output.

2.3.8 Relay output 2 function

TABLE 5-2. OUTPUT SIGNALS VIA DO1 AND OUTPUT RELAYS RO1 AND RO2

Setting value	**Signal content**
0 = Not used	Out of operation
	Digital output DO1 sinks the current and programmable relay (RO1, RO2) is activated when:
1 = Ready	The frequency converter is ready to operate
2 = Run	The frequency converter operates (motor is running)
3 = Fault	A fault trip has occurred
4 = Fault inverted	A fault trip not occurred
5 = Overheat warning	The heat-sink temperature exceeds +70°C
6 = External fault or warning	Fault or warning depending on par. 2.7.3
7 = Reference fault or warning	Fault or warning depending on par. 2.7.1 - 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 = Preset speed	The preset 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	The output frequency goes outside the set supervision low limit/high limit (see parameters 2.3.9 and 2.3.10 below)
14 = Control from I/O terminals	I/O control mode selected (in menu M3)
15 = Therm. Fault/Warn	
16 = FB DigIN 1	
17 = Brake open	Brake open signal to the mechanical brake
18 = Open enable	Open enable signal (Dual brake control)

2.3.9 Output frequency limit supervision function

If the output frequency goes under/over the set limit (P 2.3.10) this function generates a warning message via the digital output DO1 and via the relay output RO1 or RO2 depending on the settings of parameters 2.3.6 to 2.3.8.

0 No supervision
1 Low limit supervision
2 High limit supervision

2.3.10 Output frequency limit supervision value

Selects the frequency value supervised by parameter 2.3.9.

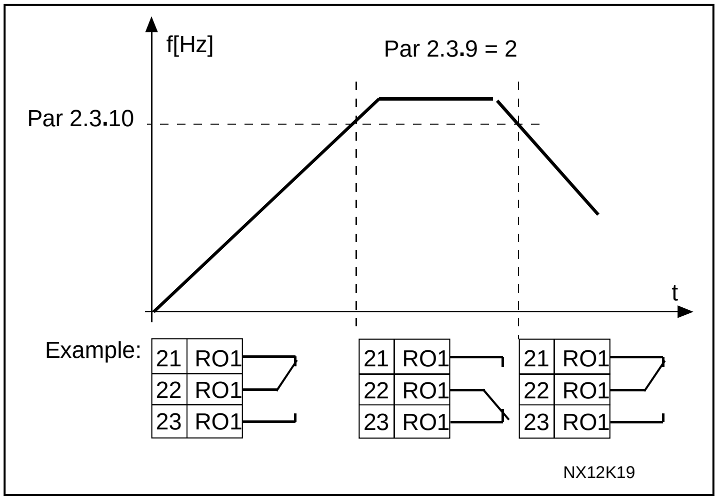


Figure 5-12. Output frequency supervision

2.3.11 Analog output 2 signal selection

Connect the AO2 signal to the analog output of your choice with this parameter. For more information, see Pump and Fan Control Application Manual, Chapter 2.

2.3.12 Analog output 2 function
2.3.13 Analog output 2 filter time
2.3.14 Analog output 2 inversion
2.3.15 Analog output 2 minimum
2.3.16 Analog output 2 scaling

For more information on these five parameters, see the corresponding parameters for the analog output 1 (parameters 2.3.1 to 2.3.5).

5-4 DRIVE CONTROL

2.4.1 Acceleration/Deceleration ramp 1 shape
2.4.2 Acceleration/Deceleration ramp 2 shape

The start and end of acceleration and deceleration ramps can be smoothed with these parameters. Setting value 0 gives a linear ramp shape which causes acceleration and deceleration to act immediately to the changes in the reference signal.

Setting value 0.1 to 10 seconds for this parameter produces an S-shaped acceleration/deceleration. The acceleration time is determined with parameters 2.1.3/2.1.4 (2.4.3/2.4.4).

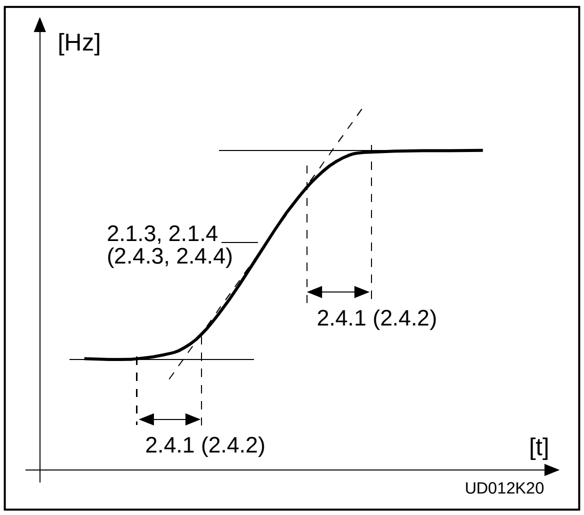


Figure 5-13. Acceleration/Deceleration (S-shaped)

2.4.3 Acceleration time 2
2.4.4 Deceleration time 2

These values correspond to the time required for the output frequency to accelerate from the zero frequency to the set maximum frequency (par. 2.1.2). These parameters give the possibility to set two different acceleration/deceleration time sets for one application. The active set can be selected with the programmable signal DIN3 (par. 2.2.6.5).

2.4.5 Brake chopper

When the frequency converter is decelerating the motor, the inertia of the motor and the load are fed into an external brake resistor. This enables the frequency converter to decelerate the load with a torque equal to that of acceleration (provided that the correct brake resistor has been selected).

0 = No brake chopper used
1 = Brake chopper in use when running
2 = External brake chopper
3 = Used when stopped/running
4 = Brake chopper in use when running, no test

2.4.6 Start function

Ramp:

0 The frequency converter 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 frequency converter is able to start into a running motor by applying a small torque to motor and searching for the frequency corresponding to the speed the motor is running at. Searching starts from the maximum frequency towards the actual frequency until the correct value is detected. Thereafter, the output frequency will be increased/decreased to the set reference value according to the set acceleration/deceleration parameters.

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

2.4.7 Stop function

Coasting:

0 The motor coasts to a halt without any control from the frequency converter, after the Stop command.

Ramp:

1 After the Stop command, the speed of the motor is decelerated according to the set deceleration parameters. If the regenerated energy is high it may be necessary to use an external braking resistor for faster deceleration.

Normal stop: Ramp/ Run Enable stop: coasting

2 After the Stop command, the speed of the motor is decelerated according to the set deceleration parameters. However, when Run Enable is selected (e.g. DIN3), the motor coasts to a halt without any control from the frequency converter.

Normal stop: Coasting/ Run Enable stop: ramping

3 The motor coasts to a halt without any control from the frequency converter. However, when Run Enable signal is selected (e.g. DIN3), the speed of the motor is decelerated according to the set deceleration parameters. If the regenerated energy is high it may be necessary to use an external braking resistor for faster deceleration.

2.4.8 Flux brake

The flux braking can be set ON or OFF.

0 = Flux braking OFF
1 = Flux braking ON

2.4.9 Flux braking current

Defines the flux braking current value.

2.4.10 Ramp change frequency, Motorized potentiometer.

Acceleration and deceleration times 2 (P2.4.3 and P2.4.4) are used below this frequency when motorized potentiometer is selected.

2.4.11.x PROHIBIT FREQUENCIES

2.4.11.1 Prohibit frequency area; Low limit
2.4.11.2 Prohibit frequency area; 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 the "skip frequency" region. See Figure 5-14.

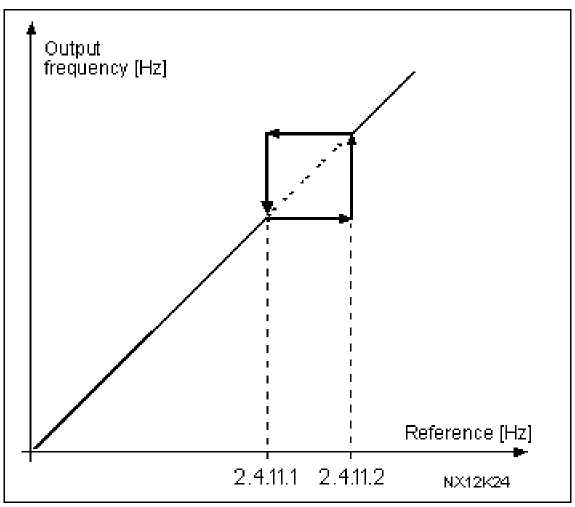


Figure 5-14. Prohibit frequency area setting.

2.4.11.3 Acc/dec ramp speed scaling ratio between prohibit frequency limits

Defines the acceleration/deceleration time when the output frequency is between the selected prohibit frequency range limits (parameters 2.5.1 and 2.5.2). The ramping speed (selected acceleration/ deceleration time 1 or 2) is multiplied with this factor. For example, value 0.1 makes the acceleration time 10 times shorter than outside the prohibit frequency range limits.

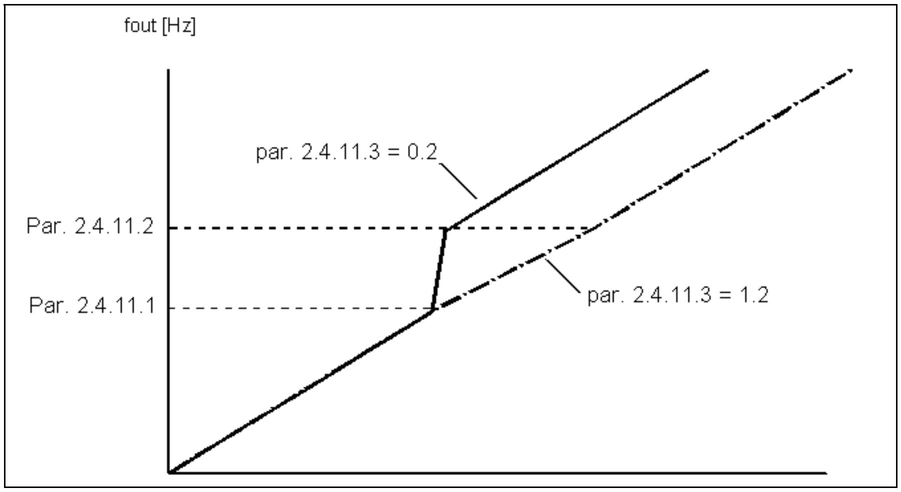


Figure 5-15. Ramp speed scaling between prohibit frequencies

2.4.12 Forward Slowdown Speed Setpoint

Defines max forward speed of motor when slow down limit bit (P2.4.20:Fwd Slw Dwn Inp) is LOW.

2.4.13 Forward Low Speed Setpoint

Defines forward speed of motor when fast speed input (P2.4.22:Fast Spd Inp) is LOW and DigIN:A.1 is HI.

2.4.14 Forward High Speed Setpoint

Defines forward speed reference of motor under the below condition.

DigIN:A.1 = HI
DigIN:A.2 = LOW
P2.4.22:Fast Spd Inp = HI
P2.4.25:Ext Spd Inp = LOW

2.4.15 Forward Extended Speed Setpoint

Defines forward speed reference of motor into extended speed range under the below condition.

DigIN:A.1 = HI
DigIN:A.2 = LOW
P2.4.22:Fast Spd Inp = HI
P2.4.25:Ext Spd Inp = HI

2.4.16 Reverse Slowdown Speed Setpoint

Defines max reverse speed of motor when slow down limit bit (P2.4.20:Fwd Slw Dwn Inp) is LOW.

2.4.17 Reverse Low Speed Setpoint

Defines reverse speed of motor when fast speed input (P2.4.22:Fast Spd Inp) is LOW energized and DigIN:A.2 is HI.

2.4.18 Reverse High Speed Setpoint

Defines reverse speed reference of motor under the below condition.

DigIN:A.1 = LOW
DigIN:A.2 = HI
2.4.22:Fast Spd Inp = HI
P2.4.25:Ext Spd Inp = HI

2.4.19 Reverse Extended Speed Setpoint

Defines reverse speed reference of motor into extended speed range under the below condition.

DigIN:A.1 = LOW
DigIN:A.2 = HI
P2.4.22:Fast Spd Inp = HI
P2.4.25:Ext Spd Inp = HI

2.4.20 Forward Slowdown Input

Drive to operate at max FWD speed setpoint configured in P2.4.12 when this input LOW.

2.4.21 Reverse Slowdown Input

Drive to operate at max REV speed setpoint configured in P2.4.16 when this input is LOW.

2.4.22 Fast Speed Input

When bit is HI and either DigIN:A.1 or DigIN:A.2 are HI the drive will run at speed setpoints configured in either P2.4.14 for forward direction or P2.4.18 for reverse direction.

2.4.24 Extended Speed Current Limit

Maximum value drive will produce current to as motor runs in extended speed range.

2.4.25 Extended Speed Input

When bit is HI allows drive to operate in motor’s extended speed range. High bit will also allow drive run motor to speed setpoint configured in either P2.4.15 for forward direction or P2.4.19 for reverse direction.

2.4.26 Load Float Bit ID

HI bit will enable Load Float function. When enabled the drive will maintain motor speed set at parameter 2.4.28:Load Float Spd after the drive looses its run command and ramps down to load float speed. Drive will hold speed until either run is re-energized or Load Float Timer expires (P2.4.27).

2.4.27 Load Float Time Constant

Period of time the drive will have the motor maintain speed set at parameter 2.4.28:Load Float Spd. Period of time is in seconds.

2.4.28 Load Float Speed

Speed of motor maintained when run when parameter 2.4.26:LD Float Bit ID is enabled, the drive's speed ramps down, and the run command is removed.

2.4.29 LF Trq Prv Spd

Not used/future addition.

2.4.30 Reverse End Stop Input ID

Disables drive run in reverse direction when LOW. Normally used for end of travel stop limits input.

2.4.31 Forward End Stop Input ID

Disables drive run in the forward direction when LOW. Normally used for end of travel stop limits input.

2.4.32 Brake Close Timer

After the run command is removed, the drive ramps the motor to zero, and the brakes are commanded to close, this timer makes the brake slip logic wait in order to allow the brakes to close before the logic starts monitoring the brake. Time is in seconds.

2.4.33 Enable Brake Slip Fault

HI bit (1 = Yes) enables the open brake detection logic. After the drive has ramped the motor to zero, the run command is low, and the Brake Close Timer has expired, the open brake logic will compare V1.16:Encoder Speed to P2.4.34:Brake Slip Freq. If V1.16 exceeds P2.4.34, the logic will determine that the brake is open when it shouldn't. A detected open brake will cause the parameter programmed to P2.4.38:Brk Slip DOUT ID to toggle.

2.4.34 Brake Slip Frequency

Speed setpoint that V1.16:Encoder Speed has to cross for the open brake logic to detect an open brake.

2.4.35 Overweight Delay

A timer that forces the excess load logic to wait before monitoring. This timer should be set to have the excess load logic allow the drive and motor to reach steady state speed before determining there's an excessive load on the motor.

2.4.36 Enable Overweight Fault

HI bit (1 = Yes) will enable the excessive load protection logic. If this logic detects an excessive load after the Overweight Delay has expired, the drive will fault and set the parameter programmed to P2.4.39:Over Wt Out ID to HI bit.

2.4.37 Overweight Fault Setpoint

Percent current setpoint for the excess load protection. If V1.4:Motor Current exceeds this setpoint value and the Overweight Delay time has expired, the excessive load protection logic will detect an excess load on the motor.

2.4.38 Brake Slip Digital Output Identification

When the drive's open brake logic detects an open brake, this parameter will set the mapped digital parameter to HI bit. Generally used to drive operator warning horn.

2.4.39 Overweight Digital Output Identification

When the drive's excessive load logic detects an excessive load, this parameter will set the mapped digital parameter to HI bit. Generally used to drive operator warning horn. Overweight condition is removed upon operating drive in opposite direction.

2.4.40 End Stop Mode

If either P2.4.30:REV End Inp ID or P2.4.31:FWD End Inp ID toggle low, the drive will ramp the motor to a stop at the rate selected to this parameter. The drive will not enable the load float function prior to the actual stop under this condition.

Selectable Parameter	**Description of Function**
0 = Normal Stop	Drive ramps the motor to a stop under normal stop/deceleration rates (P2.1.4:Decel Time 1).
1 = Fast Stop	Drive ramps the motor to a stop under an alternate stop/deceleration rate (P2.4.4:Decel Time 2).
2 = Coast Stop	Drive stops running the motor at the current speed. Motor then coasts to a stop, dependent on its remaining inertia or how soon the brakes set.

5-5 BRAKE CONTROL

Mechanical brake control parameters are affecting the mechanical brake control, the smooth start and stop function and the safety functions.

Mechanical brake can be set to release on current, on torque, on frequency or on external input. The closing can be performed by frequency, by external input or by run request signal. In case of fault the closing is done immediately without delay.

Mechanical brake control is different in open loop and in closed loop control mode. Parameters are divided in two different groups. Parameters in closed loop group are not affected in open loop mode and vice versa. Open loop brake control parameters are direction sensitive, different parameters for forward and reverse. There are also some common parameters. Typical start and stop sequences can be seen in Figure 5-16 and Figure 5-17. The mechanical brake control logic can be seen in Figure 5-18.

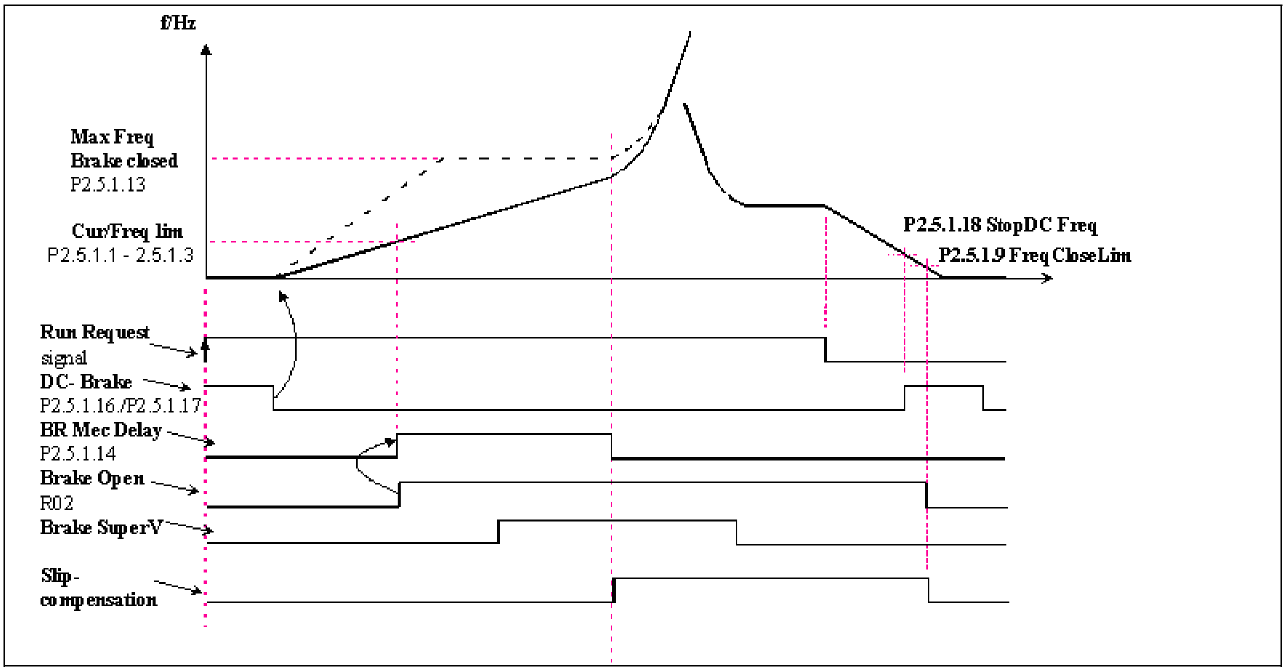


Figure 5-16. Mechanical Brake Control in Open Loop

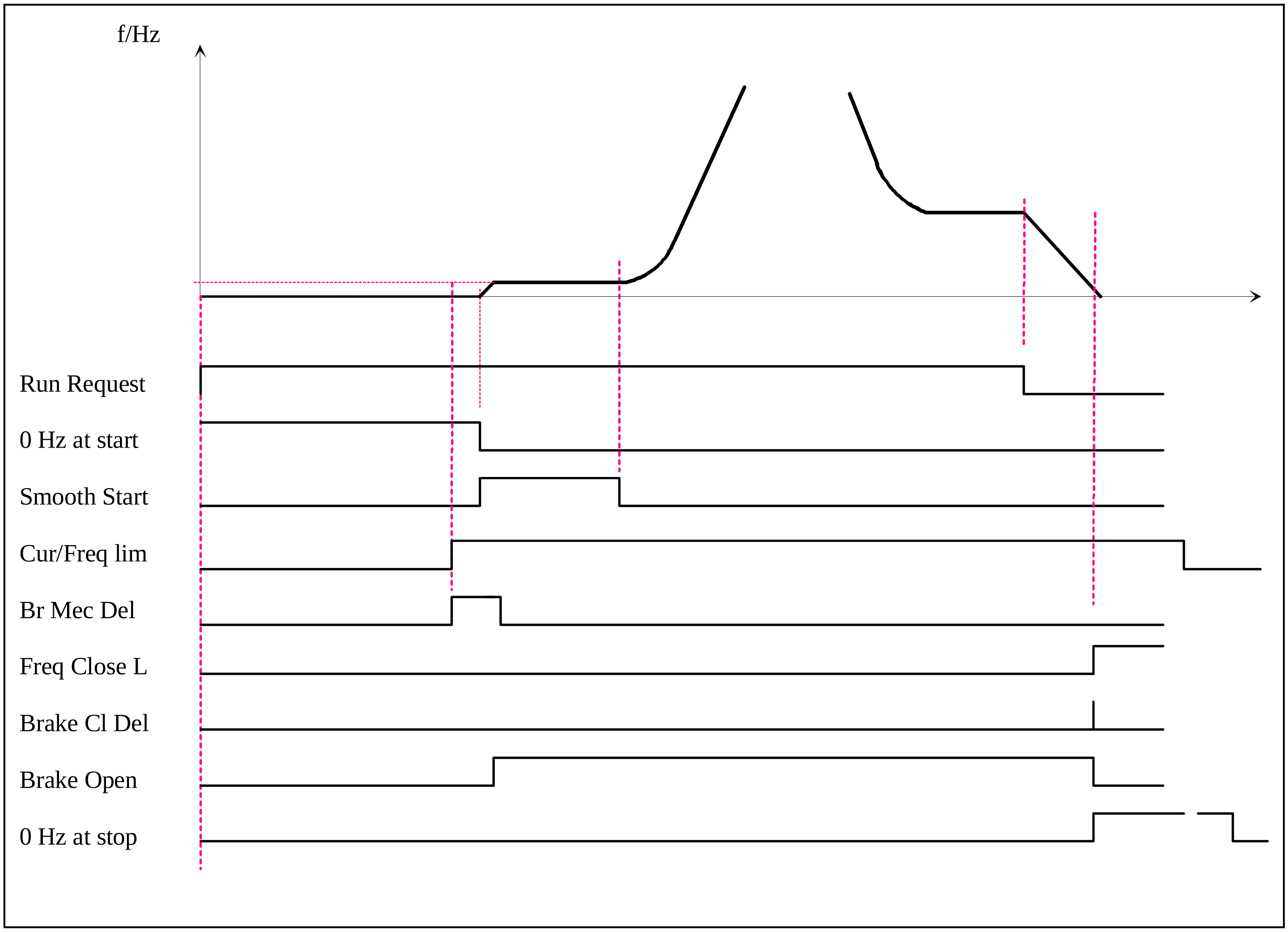


Figure 5-17. Mechanical brake in closed loop.

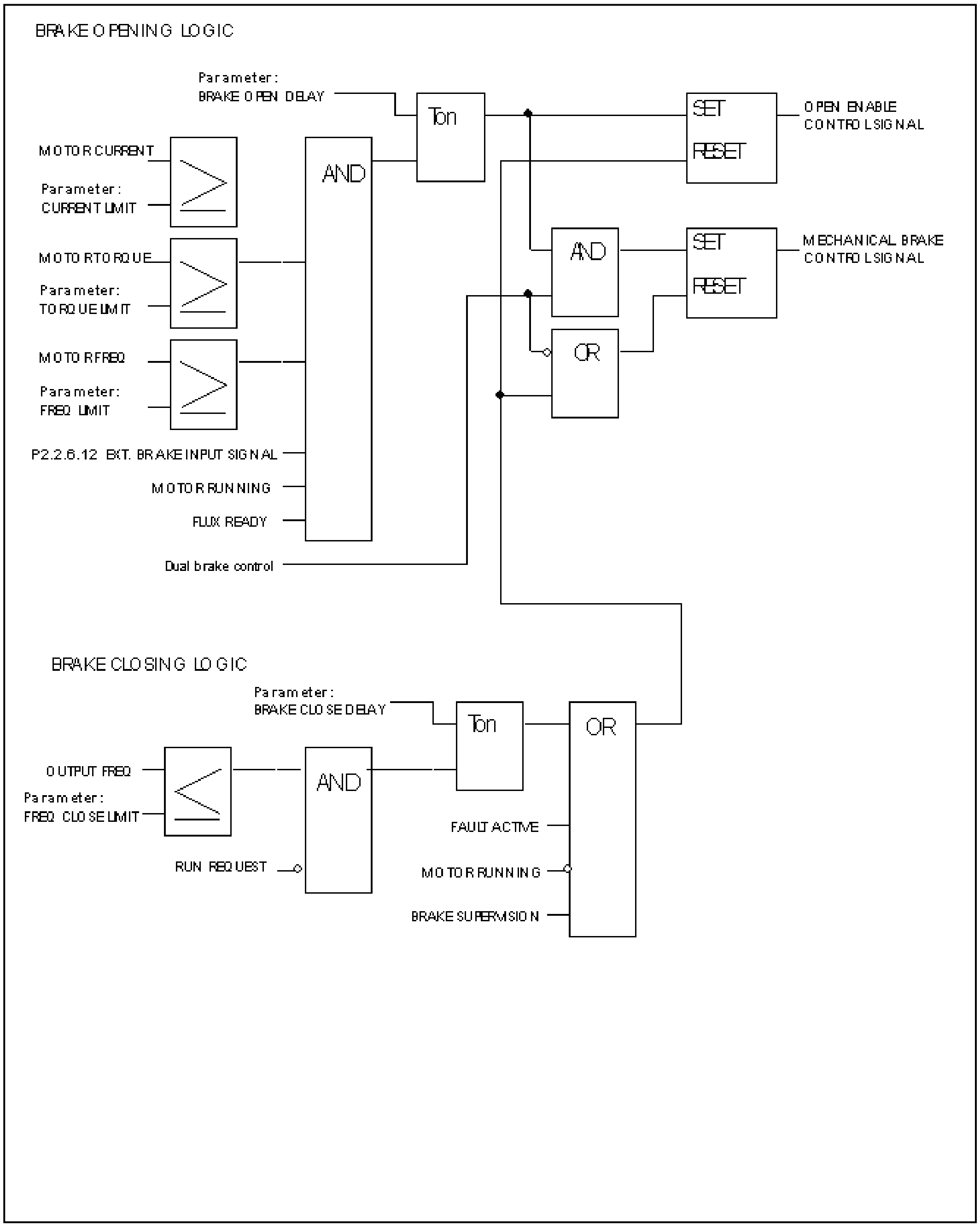


Figure 5-18. Mechanical Brake Control Logic

2.5.1.x OPEN LOOP BRAKE CONTROL PARAMETERS

2.5.1.1 Current limit forward
2.5.1.2 Current limit reverse

These parameters define the motor current limit that has to be exceeded before releasing the mechanical brake. If set to zero this condition is excluded.

2.5.1.3 Torque limit forward
2.5.1.4 Torque limit reverse

These parameters define the motor torque limit that has to be exceeded before releasing the mechanical brake. If set to zero this condition is excluded. 100% corresponds to calculated nominal torque of the motor.

2.5.1.5 Frequency limit forward
2.5.1.6 Frequency limit reverse

These parameters define the frequency limit that has to be exceeded before releasing the mechanical brake. If set to zero this condition is excluded.

2.5.1.7 Opening delay forward
2.5.1.8 Opening delay reverse

Time delay before releasing the brake after the opening conditions are fulfilled.

2.5.1.9 Closing frequency forward
2.5.1.10 Closing frequency reverse

Output frequency limit that is closing the brake. The run request signal needs to be inactive to allow the signal to affect.

2.5.1.11 Closing delay forward
2.5.1.12 Closing delay reverse

Time delay before closing the brake after the closing conditions are fulfilled

2.5.1.13 Max frequency when the brake is closed

Output frequency cannot exceed this value when the brake is closed

2.5.1.14 Mechanical brake reaction time

After the brake is released is the speed reference in hold for a defined time. This hold time should be set corresponding to the mechanical brake reaction time.

2.5.1.15 DC-braking current

Defines the current injected into the motor during DC-braking.

2.5.1.16 DC-braking time at start

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 by parameter 2.4.6.

2.5.1.17 DC-braking time at stop

Determines if braking is ON or OFF and the braking time of the DC-brake when the motor is stopping. The function of the DC-brake depends on the stop function, parameter 2.4.7.

0 DC-brake is not used
>0 DC-brake is in use and its function depends on the Stop function, (param. 2.4.7). The DC-braking time is determined with this parameter

<u>Par. 2.4.7 = 0; Stop function = Coasting:</u>

After the stop command, the motor coasts to a stop without control of the frequency converter.

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 ≥ the nominal frequency of the motor, the set value of parameter 2.5.1.17 determines the braking time. When the frequency is ≤10% of the nominal, the braking time is 10% of the set value of parameter 2.5.1.17.

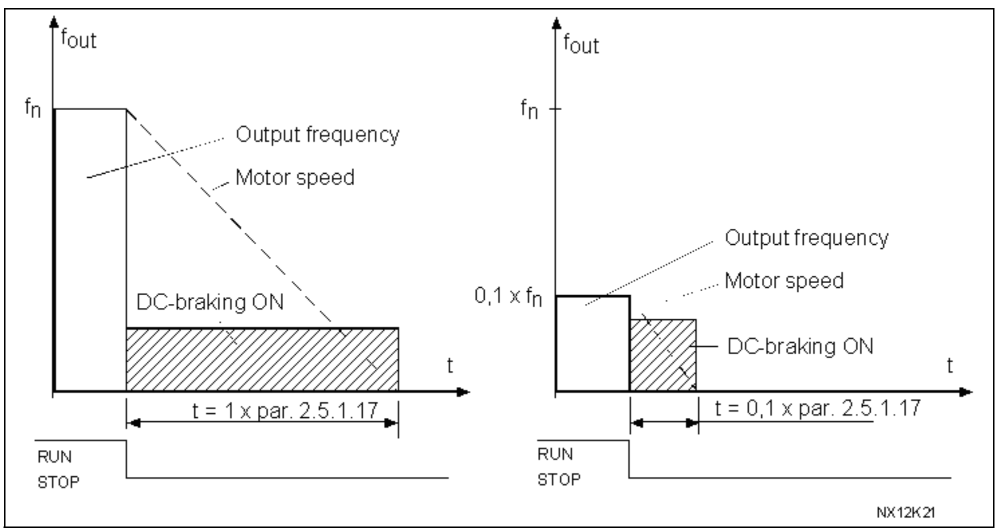


Figure 5-19. DC-braking time when Stop mode = Coasting.

Par. 2.4.7 = 1; Stop function = Ramp:

After the Stop command, the speed of the motor is reduced according to the set deceleration parameters, as fast as possible, to the speed defined with parameter 2.5.1.18, where the DC-braking starts.

The braking time is defined with parameter 2.5.1.17. If high inertia exists, it is recommended to use an external braking resistor for faster deceleration. See Figure 5-20.

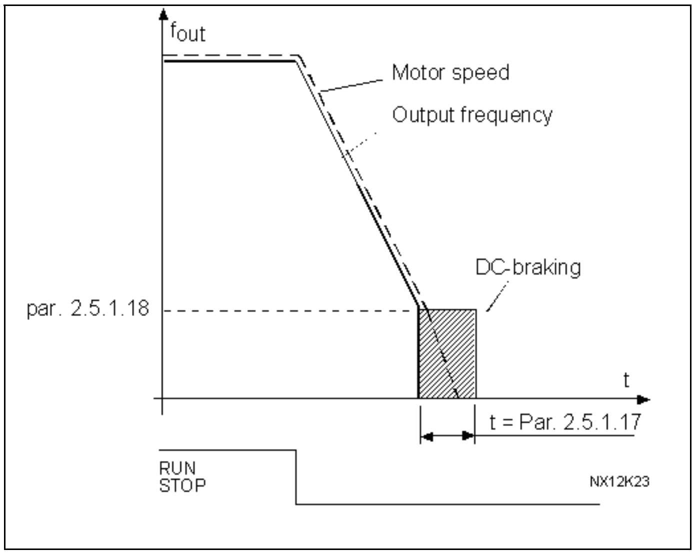


Figure 5-20. DC Braking Time when Stop Mode = Ramp

2.5.1.18 DC-braking frequency at stop

The output frequency at which the DC-braking is applied. See Figure 5-20.

2.5.1.19 Direction change mode

If direction change situation have to be handled with the mechanical brake is the function set with this parameter.

0 Inactive. The change of direction does not close the mechanical brake
1 Brake closed. The brake is closed when the frequency falls below the limits defined by parameters P2.5.1.9 and P2.5.1.10.
2 Stop state. The drive is stopped, the brake is closed and then started in the other direction.

2.5.2.x CLOSED LOOP BRAKE CONTROL PARAMETERS

2.5.2.1 Current limit

This parameters defines the motor current limit that has to be exceeded before releasing the mechanical brake. If set to zero this condition is excluded.

2.5.2.2 Torque limit

This parameters defines the motor torque limit that has to be exceeded before releasing the mechanical brake. If set to zero this condition is excluded. 100% corresponds to calculated nominal torque of the motor.

2.5.2.3 Frequency limit

This parameters defines the frequency limit that has to be exceeded before releasing the mechanical brake. If set to zero this condition is excluded.

2.5.2.4 Opening delay

Time delay before releasing the brake after the opening conditions are fulfilled.

2.5.2.5 Closing frequency

Output frequency limit that is closing the brake. The run request signal needs to be inactive to allow the signal to affect.

2.5.2.6 Closing delay

Time delay before closing the brake after the closing conditions are fulfilled

2.5.2.7 Max frequency when the brake is closed

Output frequency cannot exceed this value when the brake is closed

2.5.2.8 Mechanical brake reaction time

After the brake is released is the speed reference in hold for a defined time. This hold time should be set corresponding to the mechanical brake reaction time.

2.5.2.9 0 Hz time at start
2.5.2.10 0 Hz time at stop

Zero hertz time during start and stop. Motor can be magnetised and torque can be generated during that time. In closed loop mode this time should be used. Smooth start time (par 2.5.2.11) will start straight after zero hertz time. The mechanical brake should be set to release when this change takes place.

2.5.2.11 Smooth start time

The smooth start time function is used in closed loop mode. It cannot be used in open loop. After the start command has been given the drive is rotating the motor shaft with a very low frequency (par 2.5.2.12) to overcome the static friction.

Smooth start time will start straight after zero hertz time (par 2.3.2.9). The mechanical brake should be set to release when this change takes place. Setting same value for frequency limit (par 2.5.2.3) and smooth start frequency (par 2.3.2.12) will do this.

When smooth start time elapsed frequency will be released.

2.5.2.12 Smooth start frequency

Smooth start frequency is a reference frequency that is used with the smooth start time operation. Value should be set very small.

2.5.2.13 Direction change mode

If direction change situation have to be handled with the mechanical brake is the function set with this parameter.

0 Inactive - The change of direction does not close the mechanical brake.
1 Brake closed - The brake is closed when the frequency falls below the limits defined by parameters P2.5.1.9 and P2.5.1.10.
2 Stop state - The drive is stopped, the brake is closed and then started in the other direction.

2.5.2.14 Start magnetizing current

With this parameter and P2.5.1.15, it is possible to have a higher magnetizing current at start to magnetize the motor faster. This will speed up the start in closed loop.

2.5.2.15 Start magnetizing time

Specify the time for start magnetizing current specified by P2.5.1.14.

5-6. MOTOR CONTROL

2.6.1 Motor control mode

0 Frequency control: The I/O terminal and keypad references are frequency references and the frequency converter controls the output frequency (output frequency resolution = 0.01 Hz)

1 Speed control: The I/O terminal and keypad references are speed references and the frequency converter controls the motor speed (accuracy ± 0,5%).

2 Torque control: **Not supported**

3 Closed loop speed control: Closed loop speed control

4 Closed loop torque control: **Not supported**

5 Advanced open loop frequency control

6 Advanced open loop speed control

2.6.2 U/f optimization

Automatic torque boost

The voltage to the motor changes automatically which makes the motor produce sufficient torque to start and run at low frequencies. The voltage increase depends on the motor type and power. 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 a prolonged time under these conditions, special attention must be paid to cooling the motor. Use external cooling for the motor if the temperature tends to rise too high.

2.6.3 U/f 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 where the nominal voltage is supplied to the motor. Linear U/f ratio should be used in constant torque applications. **This default setting should be used if there is no special need for another setting.**

Squared:
1
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 where the nominal voltage is also supplied to the motor. The motor runs under magnetized below the field weakening point and produces less torque and electromechanical noise. Squared U/f ratio can be used in applications where torque demand of the load is proportional to the square of the speed, e.g. in centrifugal fans and pumps.

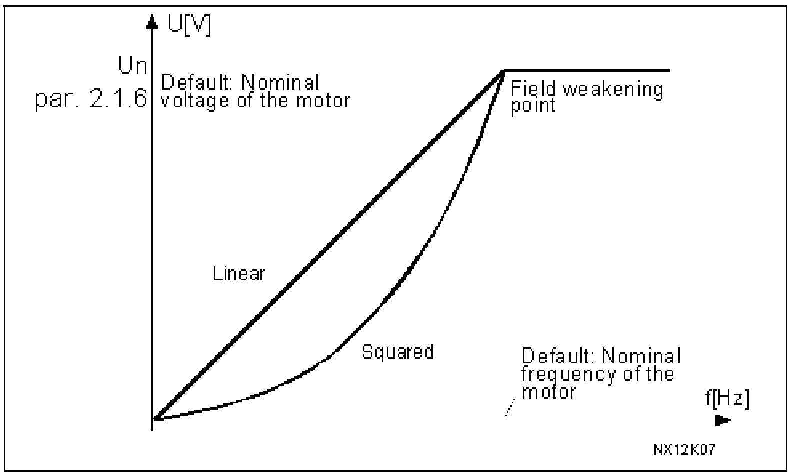


Figure 5-21. Linear and Squared Change of Motor Voltage

Programmable U/f curve:
2
The U/f curve can be programmed with three different points. Programmable U/f curve can be used if the other settings do not satisfy the needs of the application. See Figure 5-22.

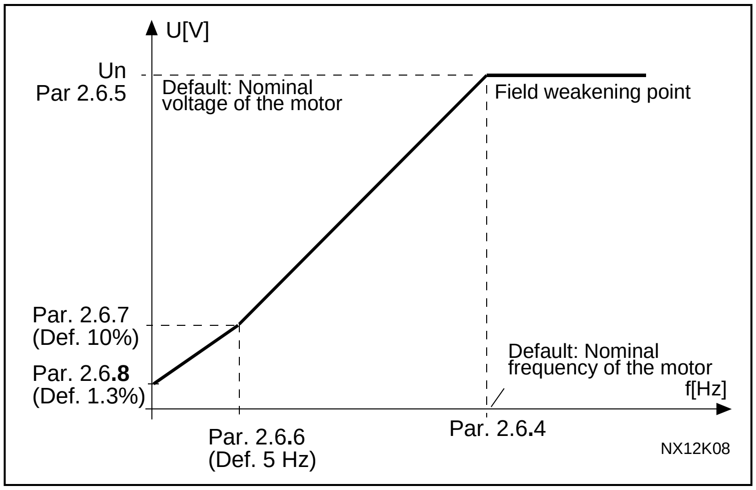


Figure 5-22. Programmable U/f curve

3 Linear with flux optimization: The frequency converter starts to search for the minimum motor current in order to save energy, lower the disturbance level and the noise. This function can be used in applications with constant motor load, such as fans, pumps etc.

2.6.4 Field weakening point

The field weakening point is the output frequency at which the output voltage reaches the set (par. 2.6.5) maximum value.

2.6.5 Voltage at field weakening point

Above the frequency at the field weakening point, the output voltage remains at the set maximum value. Below the frequency at the field weakening point, the output voltage depends on the setting of the U/f curve parameters. See parameters 2.6.2, 2.6.3, 2.6.6 and 2.6.7.

When the parameters 2.1.6 and 2.1.7 (nominal voltage and nominal frequency of the motor) are set, the parameters 2.6.4 and 2.6.5 are automatically given the corresponding values. If you need different values for the field weakening point and the maximum output voltage, change these parameters **after** setting the parameters 2.1.6 and 2.1.7.

2.6.6 U/f curve, middle point frequency

If the programmable U/f curve has been selected with the parameter 2.6.3 this parameter defines the middle point frequency of the curve. See Figure 5-22.

2.6.7 U/f curve, middle point voltage

If the programmable U/f curve has been selected with the parameter 2.6.3 this parameter defines the middle point voltage of the curve. See Figure 5-22.

2.6.8 Output voltage at zero frequency

If the programmable U/f curve has been selected with the parameter 2.6.3 this parameter defines the zero frequency voltage of the curve. See Figure 5-22.

2.6.9 Switching frequency

Motor noise can be minimised using a high switching frequency. Increasing the switching frequency reduces the capacity of the frequency converter unit.
The range of this parameter depends on the size of the frequency converter:

Up to ACCH0061: 1 to16 kHz
>ACCH0072: 1 to 10 kHz

2.6.10 Overvoltage controller
2.6.11 Undervoltage controller

These parameters allow the under-/overvoltage controllers to be switched out of operation. This may be useful, for example, if the mains supply voltage varies more than –15% to +10% and the application will not tolerate this over-/undervoltage. In this case, the regulator controls the output frequency taking the supply fluctuations into account.

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

0 Controller switched off
1 Controller switched on

2.6.12 Slip compensation

Real speed can be used as slip compensation in motor control mode 6, (Advance open loop speed control). Avtron P/N 397047 encoder option board has to be installed.

0 Calculated speed
1 Real speed (encoder)

2.6.13 Open loop speed regulator P-gain

Sets the Proportional-gain for the open loop speed controller

2.6.14 Open loop speed regulator I-gain

Sets the Integration-gain for the open loop speed controller

2.6.15 Load drooping

The drooping function enables speed drop as a function of load. The amount of allowed speed drop is proportional to the load or speed controller output (lq reference). This parameter sets that amount corresponding to 100% load of the motor.

2.6.16 Identification

Identification Run is a part of tuning the motor and the drive specific parameters. It is a tool for commissioning and service of the drive with the aim to find as good parameter values as possible for most drives. The automatic motor identification calculates or measures the motor parameters that are needed for optimum motor and speed control. Identification is made in open loop independent of selected motor control mode.

0 = No action

1 = Identification without motor run

The drive is run without speed to identify the motor parameters. The motor is supplied with current and voltage but with zero frequency. Parameters for U/f curve, stator resistance, and parameters for auto torque boost are identified. The magnetizing current for closed loop is estimated.

2 = Identification with motor run

The drive is run with speed to identify the motor parameters.
Same parameters as in identification without motor run are identified and additionally the magnetizing current and a 15 point flux linearization point curve is identified.

Note: The mechanical brake has to be opened manually due to safety reasons.
It is recommended to do this identification with no load on the motor.

The basic motor name plate data has to be set correctly before performing the identification run:

Nominal voltage of the motor (par. 2.1.6)
Nominal frequency of the motor (par. 2.1.7)
Nominal speed of the motor (par. 2.1.8)
Nominal current of the motor (par. 2.1.9)
Motor cos phi (par. 2.1.10)

For closed loop with encoder also the parameter for pulses / revolutions (in Menu M7) has to be set.

The automatic identification is activated by setting this parameter to the appropriate value followed by a start command in the requested direction. The start command to the drive has to be given within 20 s. If no start command is given within 20 s, the identification run is cancelled and the parameter will be reset to its default setting. The identification run can be stopped any time with normal stop command and the parameter is reset to its default setting. In case identification run detects fault or other problems, the identification run is completed if possible. After the identification is finished, the application checks the status of the identification and generates fault/ warning if any.

During Identification Run, the brake control is disabled.

2.6.17.x CLOSED LOOP PARAMETERS

2.6.17.1 Magnetizing current

Set here the rated magnetizing current for the motor. This parameter is used for adjusting the motor in no-load conditions.

2.6.17.2 Speed control Kp

Sets the gain for the speed controller in % per Hz.

2.6.17.3 Speed control Ti

Sets the integral time constant for the speed controller

2.6.17.4 Current control Kp

Sets the gain for the current controller. This controller is active only in closed loop and advanced open loop modes. The controller generates the voltage vector reference to the modulator.

2.6.17.5 Encoder filter time

Sets the filter time constant for speed measurement.

2.6.17.6 Slip adjust

The motor name plate speed is used to calculate the nominal slip. This value should be used to adjust motor voltage when loaded. Reducing the slip adjust value increases the motor voltage when the motor is loaded.

2.6.17.7 Startup torque selection

Startup torque is used to reduce erratic motion after start. Torque Memory is used in crane applications.
0 = Not Used
1 = TorqMemory

2.6.17.8 Stop state flux

Stop state magnetization current in percent of nominal magnetizing current. Useful when there is a need to keep the motor magnetized during short stops to be able to get a faster restart. The stop state magnetization time is specified by P2.6.17.9

2.6.17.9 Flux off delay

Maximum time for the stop state magnetization specified by P2.6.17.8

2.6.18.x ADVANCED OPEN LOOP PARAMETERS

If the value of par. 2.6.1 = 5, the advanced open loop mode is selected. Value 6 is advanced open loop with slip compensation. These modes are designed e.g. for lift and hoisting applications to give smoother operation with less tuning required. The operation is based on current control mode at low frequencies. Above a certain frequency limit, the operation is under standard V/Hz control. At low frequencies the motor current is adjusted between minimum current and zero speed current according to the load in order to maintain the flux. In the frequency corner, the U/f-boost parameter is used to optimise motor current and torque.

2.6.18.1 Zero speed current

At very low frequencies this parameter defines the constant current reference to the motor.

2.6.18.2 Minimum current

Minimum current to the motor in the current control frequency region. Larger value gives more torque, but increases losses.

2.6.18.3 Flux reference

Reference for flux below frequency limit. Larger value gives more torque, but increases losses.

2.6.18.4 Frequency limit

Corner frequency for transition to standard V/Hz control in % of motor nominal frequency.

2.6.18.5 Stray Flux Current

Stray flux at nominal load in % of motor nominal current.

5-7 PROTECTIONS

2.7.1 Response to the reference fault

A warning or a fault action and message is generated if the 4 to 20 mA reference signal is used and the signal falls below 3.5 mA for 5 seconds or below 0.5 mA for 0.5 seconds. The information can also be programmed into digital output DO1 or relay outputs RO1 and RO2.

0 = No response
1 = Warning
2 = Warning, the frequency from 10 seconds back is set as reference
3 = Warning, the Preset Frequency (Par. 2.7.2) is set as reference
4 = Fault, stop mode after fault according to parameter 2.4.7
5 = Fault, stop mode after fault always by coasting

2.7.2 4 mA Fault: preset frequency reference

If the value of parameter 2.7.1 is set to 3 and the 4 mA fault occurs then the frequency reference to the motor is the value of this parameter.

2.7.3 Response to external fault

A warning or a fault action and message is generated from the external fault signal in the programmable digital inputs DIN3. The information can also be programmed into digital output DO1 and into relay outputs RO1 and RO2.

0 = No response
1 = Warning
2 = Fault, stop mode after fault according to parameter 2.4.7
3 = Fault, stop mode after fault always by coasting

2.7.4 Input phase supervision

The input phase supervision ensures that the input phases of the frequency converter have an approximately equal current.

0 = No response
1 = Warning
2 = Fault, stop mode after fault according to parameter 2.4.7
3 = Fault, stop mode after fault always by coasting

2.7.5 Response to undervoltage fault

For the undervoltage limits see Avtron ACCel500 User's Manual, Table 4-7.

1 = Warning
2 = Fault, stop mode after fault according to parameter 2.4.7
3 = Fault, stop mode after fault always by coasting

2.7.6 Output phase supervision

Output phase supervision of the motor ensures that the motor phases have an approximately equal current.

0 = No response
1 = Warning
2 = Fault, stop mode after fault according to parameter 2.4.7
3 = Fault, stop mode after fault always by coasting

2.7.7 Earth fault protection

Earth fault protection ensures that the sum of the motor phase currents is zero. The overcurrent protection is always working and protects the frequency converter from earth faults with high currents.

0 = No response
1 = Warning
2 = Fault, stop mode after fault according to parameter 2.4.7
3 = Fault, stop mode after fault always by coasting

Parameters 2.7.8—2.7.12, Motor Thermal Protection:

General

The motor thermal protection is to protect the motor from overheating. The ACCel500 drive is capable of supplying higher than nominal current to the motor. If the load requires this high current there is a risk that the motor will be thermally overloaded. This is the case especially at low frequencies. At low frequencies the cooling effect of the motor is reduced as well as its capacity. If the motor is equipped with an external fan the load reduction at low speeds is small.

The 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 motor thermal protection can be adjusted with parameters. The thermal current I_T specifies the load current above which the motor is overloaded. This current limit is a function of the output frequency.

The thermal stage of the motor can be monitored on the control keypad display. See the product's User's Manual.

****

CAUTION

The calculated model does not protect the motor if the airflow to the motor is reduced by blocked air intake grill.

****

2.7.8 Motor thermal protection

If tripping is selected the drive will stop and activate the fault stage.
Deactivating the protection, i.e. setting parameter to 0, will reset the thermal stage of the motor to 0%.

0 = No response
1 = Warning
2 = Fault, stop mode after fault according to parameter 2.4.7
3 = Fault, stop mode after fault always by coasting

2.7.9 Motor thermal protection: Motor ambient temperature factor

The factor can be set between -100.0%—100.0%.

2.7.10 Motor thermal protection: Zero frequency current

The current can be set between 0 to 150.0% x InMotor. This parameter sets the value for thermal current at zero frequency. See Figure 5-23.

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 even higher).

Note: The value is set as a percentage of the motor name plate data, parameter 2.1.9 (Nominal current of motor), not the drive's nominal output current. The motor's nominal current is the current that the motor can withstand in direct on-line use without being overheated.

If you change the parameter Nominal current of motor, this parameter is automatically restored to the default value.
Setting this parameter does not affect the maximum output current of the drive which is determined by parameter 2.1.5 alone.

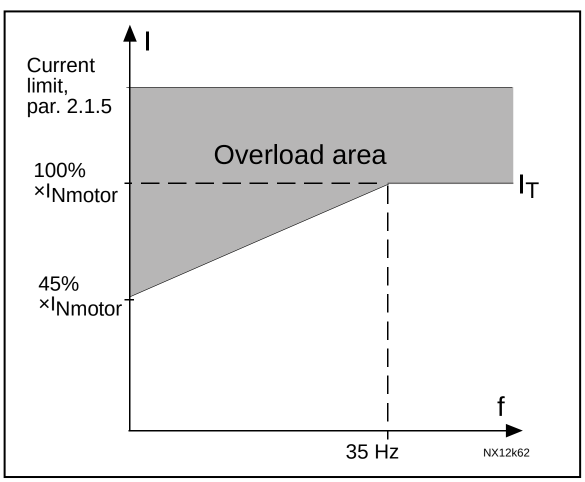


Figure 5-23. Motor thermal current I_T curve

2.7.11 Motor thermal protection: Time constant

This time can be set between 1 and 200 minutes.

This is the thermal time constant of the motor. The larger the motor, the larger the time constant. The time constant is the time within which the calculated thermal stage has reached 63% of its final value.

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

If the motor's t6–time (t6 is the time in seconds the motor can safely operate at six times the rated current) is known (given by the motor manufacturer) the time constant parameter can be set basing on it. As a rule of thumb, the motor thermal time constant in minutes equals to 2xt6. If the drive is in stop stage the time constant is internally increased to three times the set parameter value. The cooling in the stop stage is based on convection and the time constant is increased. See also Figure 5-24.

2.7.12 Motor thermal protection: Motor duty cycle

Defines how much of the nominal motor load is applied. The value can be set to 0% to 100%.

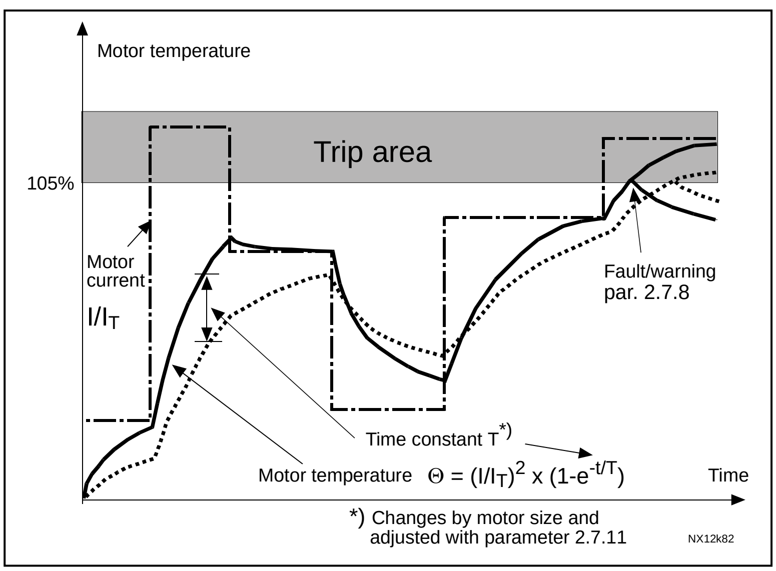


Figure 5-24. Motor temperature calculation

Parameters 2.7.13—2.7.16, Stall protection:

General

The motor stall protection protects the motor from short time overload situations such as one caused by a stalled shaft. The reaction time of the stall protection can be set shorter than that of motor thermal protection. The stall state is defined with two parameters, 2.7.14 (Stall current) and 2.7.16 (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.

2.7.13 Stall protection

0 = No response
1 = Warning
2 = Fault, stop mode after fault according to parameter 2.4.7
3 = Fault, stop mode after fault always by coasting

Setting the parameter to 0 will deactivate the protection and reset the stall time counter.

2.7.14 Stall current limit

The current can be set to 0.0 to 6000.0 A. For a stall stage to occur, the current must have exceeded this limit. See Figure 5-25.

This value is set in percentage of the motor's name plate data (parameter 2.1.9). If the parameter 2.1.9 Nominal current of motor is changed, this parameter is automatically restored to the default value.

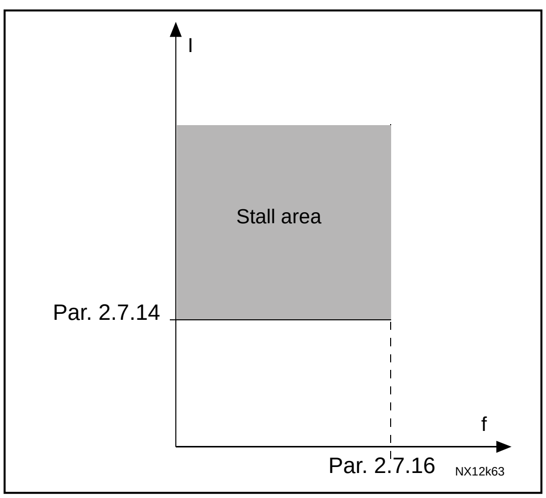


Figure 5-25. Stall characteristics settings

2.7.15 Stall time

This time can be set between 1.0 and 120.0 s.
This is the maximum time allowed for a stall stage. The stall time is counted by an internal up/down counter.

If the stall time counter value goes above this limit the protection will cause a trip (see parameter 2.7.13).

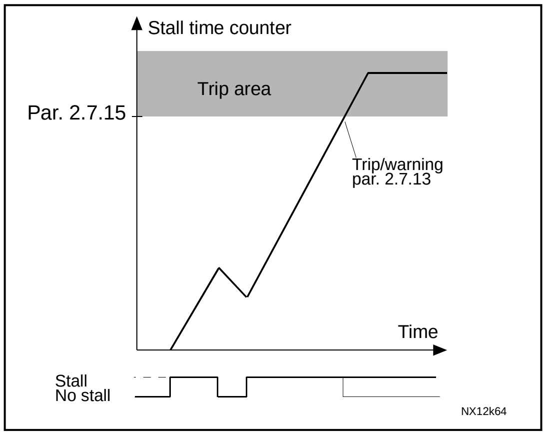


Figure 5-26. Stall time count

2.7.16 Maximum stall frequency

The frequency can be set between 1-f_{max} (par. 2.1.2). For a stall state to occur, the output frequency must have remained below this limit.

Parameters 2.7.17—2.7.20, Underload protection:

General

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

Motor underload protection can be adjusted by setting the underload curve with parameters 2.7.18 (Field weakening area load) and 2.7.19 (Zero frequency load), see below. The underload curve is a squared curve set between the zero frequency and the field weakening point. The protection is not active below 5Hz (the underload time counter is stopped).

The torque values for setting the underload curve are set in percentage which refers to the nominal torque of the motor. The motor's name plate data, parameter motor nominal current and the drive's nominal current I_{CT} are used to find the scaling ratio for the internal torque value. If other than nominal motor is used with the drive, the accuracy of the torque calculation decreases.

2.7.17 Underload protection

If tripping is set active the drive will stop and activate the fault stage.
Deactivating the protection by setting the parameter to 0 will reset the underload time counter to zero.

0 = No response
1 = Warning
2 = Fault, stop mode after fault according to parameter 2.4.7
3 = Fault, stop mode after fault always by coasting

2.7.18 Underload protection, field weakening area load

The torque limit can be set between 10.0—150.0 % x T_{nMotor}.

This parameter gives the value for the minimum torque allowed when the output frequency is above the field weakening point. See Figure 5-27.

If you change the parameter 2.1.9 (Motor nominal current) this parameter is automatically restored to the default value.

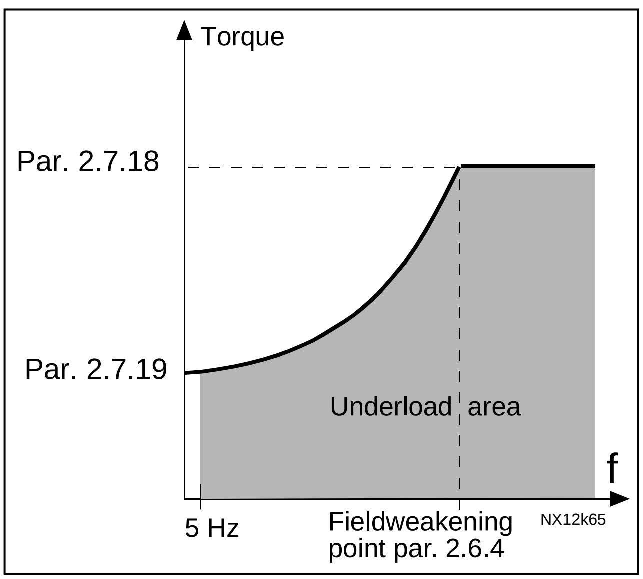


Figure 5-27. Setting of minimum load

2.7.19 Underload protection, zero frequency load

The torque limit can be set between 5.0—150.0 % x TnMotor. This parameter gives value for the minimum torque allowed with zero frequency. See Figure 5-27.

If you change the value of parameter 2.1.9 (Motor nominal current) this parameter is automatically restored to the default value.

2.7.20 Underload time

This time can be set between 2.0 and 600.0 s.

This is the maximum time allowed for an underload state to exist. An internal up/down counter counts the accumulated underload time. If the underload counter value goes above this limit the protection will cause a trip according to parameter 2.7.17). If the drive is stopped the underload counter is reset to zero. See Figure 5-28.

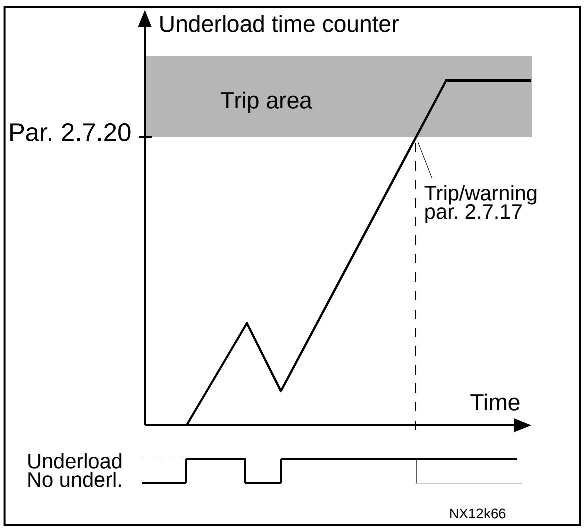


Figure 5-28. Underload time counter function

2.7.21 Response to thermistor fault

Setting the parameter to 0 will deactivate the protection and reset the stall time counter.

0 = No response
1 = Warning
2 = Fault, stop mode after fault according to parameter 2.4.7
3 = Fault, stop mode after fault always by coasting

2.7.22 Response to fieldbus fault

Set here the response mode for the fieldbus fault if a fieldbus board is used. For more information, see the respective Fieldbus Board Manual. See parameter 2.7.21 for selections.

2.7.23 Response to slot fault

Set here the response mode for a board slot fault due to missing or broken board. See parameter 2.7.21 for selections.

2.7.24 Response to Brake supervision fault

Set here the response mode for brake supervision fault due to missing external brake supervision signal (P2.2.6.8) after the brake is opened.

2.7.25 Brake supervision time

The time window within the external brake supervision signal (P2.2.6.8) needs to be activated.

2.7.26 Response to Brake logic fault

Set here the response mode for brake logic fault.

2.7.27 Brake logic supervision time

The time window within the brake open signal needs to be activated after run request command.

2.7.28 Response to under current fault

Set the response mode for under current fault.

2.7.29 Under current supervision value

If motor current goes below this value when the brake is open the drive will generate fault according to the response mode set by parameter (P2.7.28).

2.7.30 Response to shaft speed supervision fault

Set the response mode for shaft speed fault. Actual shaft speed according to encoder and calculated shaft speed from motor control are compared and, in a case the speed difference is more than the limit set by P2.7.31 for a defined time in P2.7.32, the set action is taken. See Figure 5-29. This fault is generated only when the mechanical brake is open. That is, if running against mechanical brake, this fault is not set.

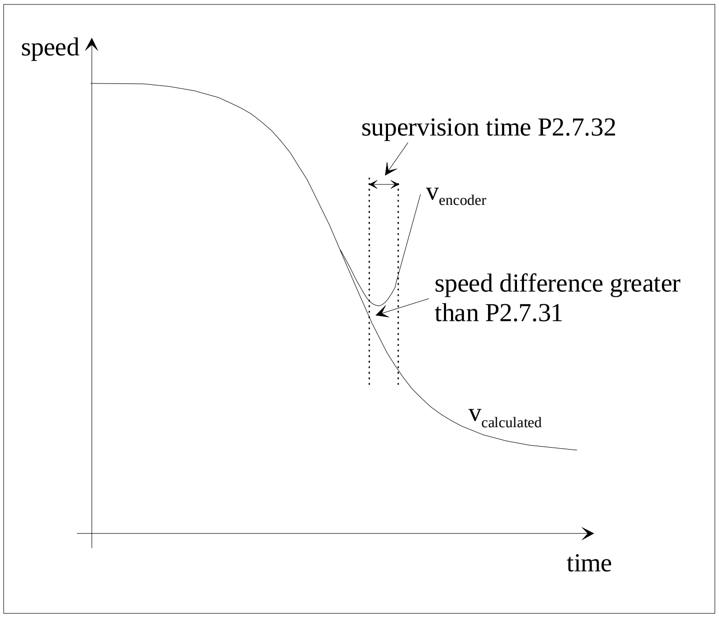


Figure 5-29. Shaft speed supervision

2.7.31 Shaft speed supervision hysteresis

The speed difference between encoder speed and the calculated speed that will cause a tripping according to the mode set by P2.7.30.

2.7.32 Shaft speed supervision time

Supervision time for the shaft speed fault.

5-8 AUTO RESTART PARAMETERS

2.8.1 Automatic restart: Wait time

Defines the time before the frequency converter tries to automatically restart the motor after the fault has disappeared.

2.8.2 Automatic restart: Trial time

The Automatic restart function restarts the frequency converter when the faults selected with parameters 2.8.4 to 2.8.9 have disappeared and the waiting time has elapsed.

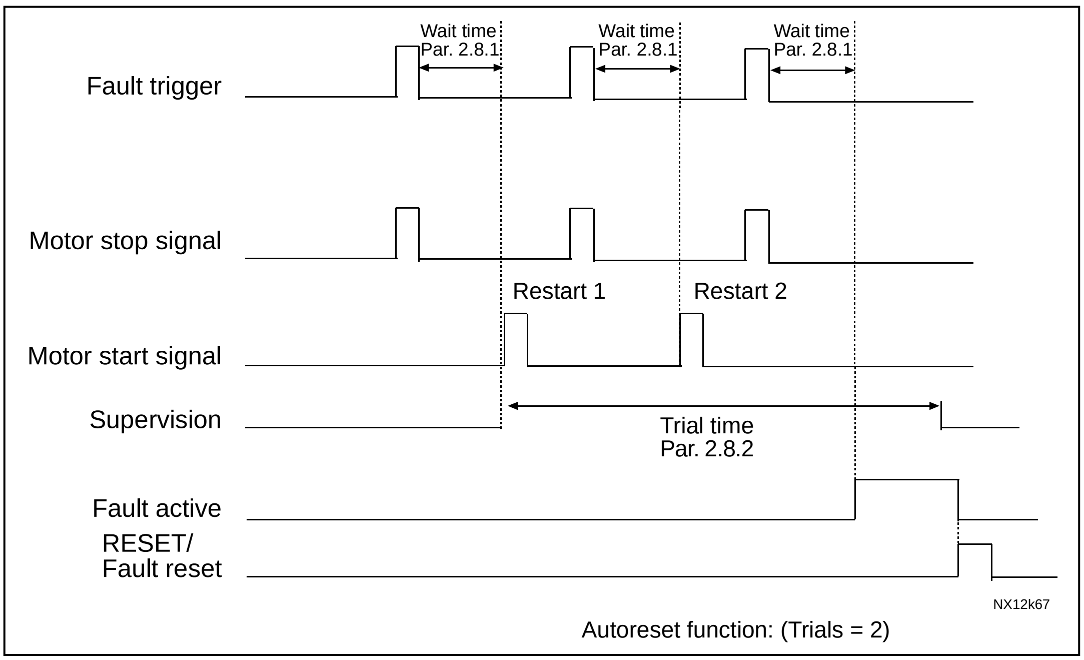


Figure 5-30. Example of Automatic restart with two restarts.

Parameters 2.8.4 to 2.8.9 determine the maximum number of automatic restarts during the trial time set by parameter 2.8.2. The time count starts from the first autorestart. If the number of faults occurring during the trial time exceeds the values of parameters 2.8.4 to 2.8.9, the fault state becomes active. Otherwise the fault is cleared after the trial time has elapsed and the next fault starts the trial time count again. If a single fault remains during the trial time, a fault state is true.

2.8.3 Automatic restart, start function

The Start function for Automatic restart is selected with this parameter. The parameter defines the start mode:

0 = Start with ramp
1 = Flying start
2 = Start according to par. 2.4.6

2.8.4 Automatic restart: Number of tries after undervoltage fault trip

This parameter determines how many automatic restarts can be made during the trial time set by parameter 2.8.2 after an undervoltage trip.

0 = No automatic restart after undervoltage fault trip
>**0** = Number of automatic restarts after undervoltage fault. The fault is reset and the drive is started automatically after the DC-link voltage has returned to the normal level.

2.8.5 Automatic restart: Number of tries after overvoltage trip

This parameter determines how many automatic restarts can be made during the trial time set by parameter 2.8.2 after an overvoltage trip.

0 = No automatic restart after overvoltage fault trip
>**0** = Number of automatic restarts after overvoltage fault. The fault is reset and the drive is started automatically after the DC-link voltage has returned to the normal level.

2.8.6 Automatic restart: Number of tries after overcurrent trip

(NOTE: IGBT temp Fault also included)
This parameter determines how many automatic restarts can be made during the trial time set by parameter 2.8.2.

0 = No automatic restart after overcurrent fault trip
>**0** = Number of automatic restarts after overcurrent trip, saturation trip and IGBT temperature faults.

2.8.7 Automatic restart: Number of tries after reference trip

This parameter determines how many automatic restarts can be made during the trial time set by parameter 2.8.2.

0 = No automatic restart after reference fault trip
>**0** = Number of automatic restarts after the Analog current signal (4…20 mA) has returned to the normal level (≥4 mA)

2.8.8 Automatic restart: Number of tries after motor temperature fault trip

This parameter determines how many automatic restarts can be made during the trial time set by parameter 2.8.2.

0 = No automatic restart after Motor temperature fault trip
>**0** = Number of automatic restarts after the motor temperature has returned to its normal level.

2.8.9 Automatic restart: Number of tries after external fault trip

This parameter determines how many automatic restarts can be made during the trial time set by parameter 2.8.2.

0 = No automatic restart after External fault trip
>**0** = Number of automatic restarts after External fault trip

5-9 IDENTIFIED PARAMETERS

P2.9.1 – P2.9.15 Flux linearization points

Flux 10 to 150%
Motor voltage corresponding to 10% to 150% of flux as a percentage of Nominal Flux voltage.

P2.9.16 Make flux time

Time to magnetize the motor. Use of DC Brake will overwrite this value

P2.9.17 Make flux voltage

Voltage used to magnetize motor during Make flux time

P2.9.18 Rs Voltage drop

Measured Voltage drop at stator resistance between two phases with nom current of motor.

P2.9.19 Make flux voltage, hardware

Magnetizing voltage with hardware dead time compensation.

P2.9.20 Ir: Add zero point voltage

IrAddVoltage for Zero frequency, used with torque boost.

P2.9.21 Ir: Add generator scale

Scaling factor for generator side IR-compensation.

P2.9.22 Ir: Add motoring scale

Scaling factor for motoring side IR-compensation.

P2.9.23 IU Offset
P2.9.24 IV Offset
P2.9.25 IW Offset

Offsets values for phase current measurements

5-10 KEYPAD CONTROL PARAMETERS

3.1 Control Place

The active control place can be changed with this parameter.

Pushing the Start button for 3 seconds selects the control keypad as the active control place and copies the Run status information (Run/Stop, direction and reference).

3.2 Keypad Reference

The frequency reference can be adjusted from the keypad with this parameter.

The output frequency can be copied as the keypad reference by pushing the Stop button for 3 seconds when you are on any of the pages of menu **M3**.

3.3 Keypad Direction

0 Forward: The rotation of the motor is forward, when the keypad is the active control place.

1 Reverse: The rotation of the motor is reversed, when the keypad is the active control place.

3.4 Stop button activated

If you wish to make the Stop button a "hotspot" which always stops the drive regardless of the selected control place, give this parameter the value **1**.

See also parameter 3.1.

SECTION VI

CONTROL SIGNAL LOGIC

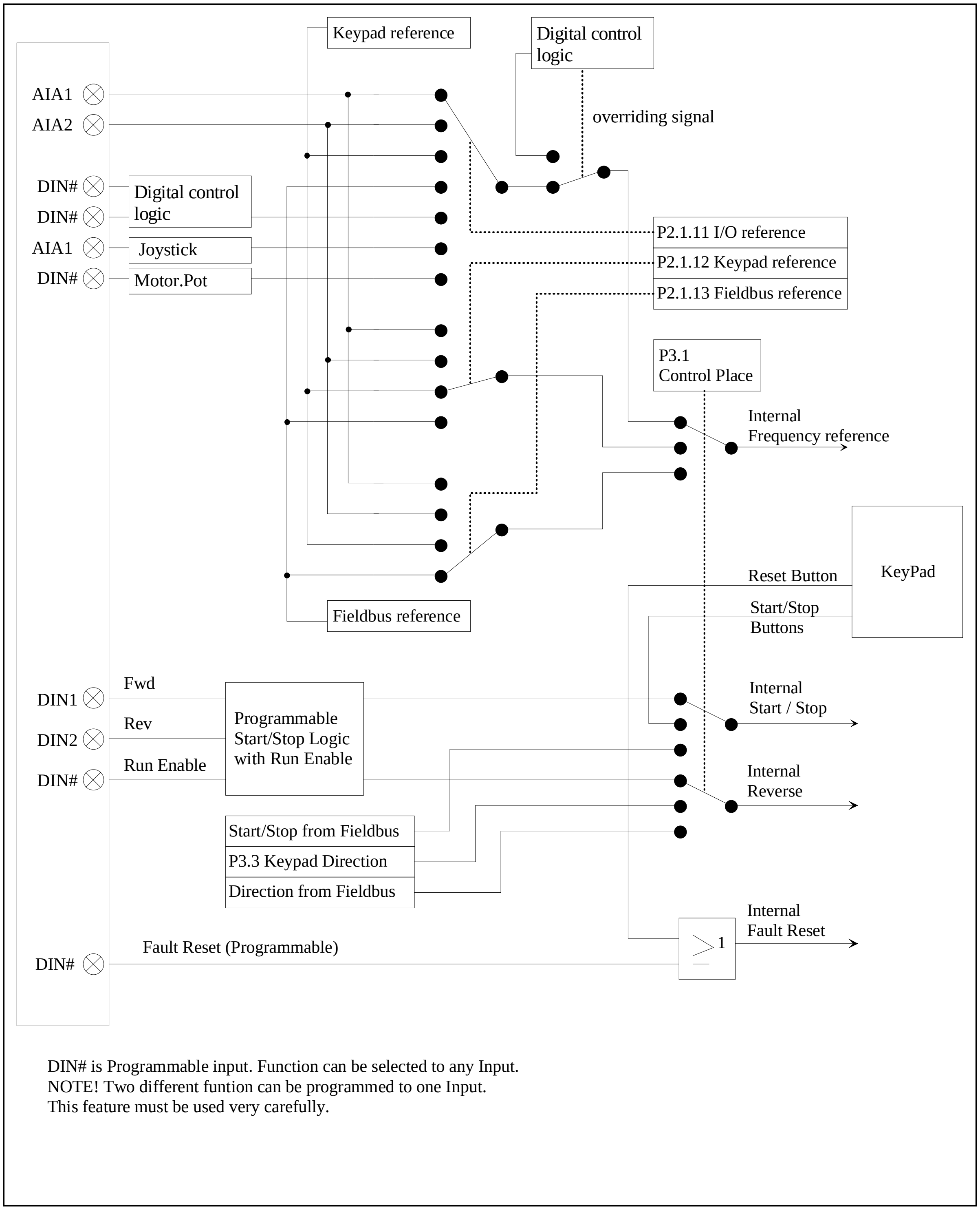


Figure 6-1. Control Signal Logic of the Mechanical Brake Control Application

SECTION VII

FAULT TRACING

When a fault is detected by the frequency converter control electronics, the drive is stopped and the symbol F together with the ordinal number of the fault, the fault code and a short fault description appear on the display. The fault can be reset with the Reset button on the control keypad or via the I/O terminal. The faults are stored in the Fault History menu, which can be browsed.

The fault codes and their possible causes are presented in Table 7-1.

TABLE 7-1. FAULT CODES

Fault code	Fault	Possible cause
1	Overcurrent	Frequency converter has detected too high a current (>4*In) in the motor cable: • sudden heavy load increase • short circuit in motor cables • unsuitable motor
2	Overvoltage	The DC-link voltage has exceeded the limits defined in Table 4-1. • too short a deceleration time • high overvoltage spikes in utility
3	Earth fault	Current measurement has detected that the sum of motor phase current is not zero. insulation failure in cables or motor
5	Charging switch	The charging switch is open, when the START command has been given. • faulty operation • component failure
6	Emergency stop	Stop signal has been given from the option board.
7	Saturation trip	Defective component
8	Unknown fault	The frequency converter troubleshooting system is unable to locate the fault.
9	Undervoltage	DC-link voltage is under the voltage limits defined in Table 4-2 of the Avtron ACCel500 User's Manual. Most probable causes: • too low a supply voltage • frequency converter internal fault
10	Input line supervision	Input line phase is missing.
11	Output phase supervision	Current measurement has detected that there is no current in one motor phase.
12	Brake chopper supervision	• no brake resistor installed • brake resistor is broken • brake chopper failure
13	Frequency converter undertemperature	Heatsink temperature is under –10°C
14	Frequency converter overtemperature	Heatsink temperature is over 90°C. Overtemperature warning is issued when the heatsink temperature exceeds 85°C.

Fault code	Fault	Possible cause
15	Motor stalled	Motor stall protection has tripped.
16	Motor overtemperature	Motor overheating has been detected by frequency converter motor temperature model. Motor is overloaded.
17	Motor underload	Motor underload protection has tripped.
22 **23**	EEPROM checksum fault	• parameter save fault • faulty operation • component failure
24	Changed data warning	Changes may have occurred in the different counter data due to mains interruption
25	Microprocessor watchdog fault	• faulty operation • component failure
29	Thermistor fault	Thermistor is broken.
37	Device change	Option board changed. Different power rating of drive.
38	Device added	Option board added. Drive of different power rating added.
39	Device removed	Option board removed. Drive removed.
40	Device unknown	Unknown option board or drive.
41	IGBT temperature	
50	Analog input I_{in} < 4mA (selected signal range 4 to 20 mA)	Current at the Analog input is < 4mA. • control cable is broken or loose • signal source has failed
51	External fault	Digital input fault.
52	Keypad communication fault	The connection between the control keypad and the frequency converter is broken.
53	Fieldbus communication fault	The connection from the fieldbus to the frequency converter is broken.
54	SPI communication fault	The connection between the component board and the control board is broken.
80	Brake supervision	External brake supervision signal has not been activated after the brake open signal is activated P2.7.24.
81	Brake logic supervision	Brake open signal has not been activated after defined time after run request P2.7.25
82	Under current	Motor current is less than set limit parameter P2.7.29
83	Shaft speed	Shaft speed from encoder differs from the calculated shaft speed P2.7.30.