Altivar 78

Programming Manual

Variable Speed Drive



a brand of Schneider Electric

Telemecanique

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Programming Manual ATV78

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1. Telemecanique Basic Application

1.1 Introduction

The Basic Application is easy and flexible to use due to its versatile fieldbus features. It is the default setting on delivery from the factory. Otherwise select the Basic Application in menu **M6** on page *S6.2*. See Chapter 7.3.6.2 of the ATV78 User's Manual.

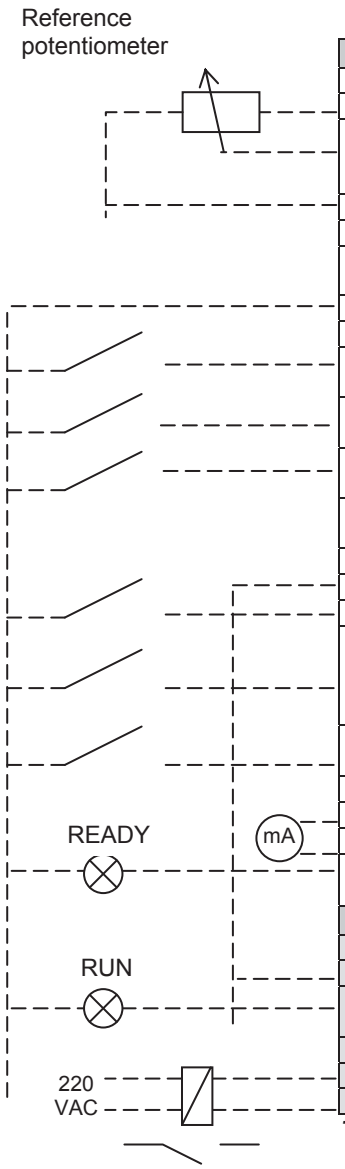
The parameters of the Basic Application are explained in Chapter 1.3 of this manual.

The function of the motor thermal protection in the Basic Application is explained in Chapter 1.4

Digital input DIN3 is programmable.

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1.2 Control I/O

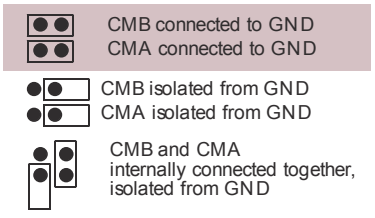


VW3A78201					
Terminal		Signal	Description		
1	$+10V_{ref}$	Reference output	Voltage for potentiometer, etc.		
2	AI1+	Analogue input, voltage range 0—10V DC	Voltage input frequency reference		
3	AI1-	I/O Ground	Ground for reference and controls		
4	AI2+	Analogue input, current range 0—20mA	Current input 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	Contact closed = start forward		
9	DIN2	Start reverse	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	Multi-step speed select 1	DIN4	DIN5	Frequency ref.
15	DIN5	Multi-step speed select 2	Open	Open	Ref.U_{in}
			Closed	Open	Multi-step ref.1
			Open	Closed	Multi-step ref.2
			Closed	Closed	RefMax
16	DIN6	Fault reset	Contact open = no action Contact closed = fault reset		
17	CMB	Common for DIN4—DIN6	Connect to GND or +24V		
18	AO1+	Output frequency Analogue 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		
VW3A78202					
21	RO1	Relay output 1 RUN			
22	RO1				
23	RO1				
24	RO2	Relay output 2 FAULT			
25	RO2				
26	RO2				

Table 1- 1. Basic application default I/O configuration.

Note: See jumper selections below. More information in ATV78 User's Manual, Chapter 6.2.2.2.

Jumper block X3: CMA and CMB grounding



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1.3 Basic Application – Parameter lists

On the next pages you will find the lists of parameters within the respective parameter groups.

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)

= parameter value can only be changed after the variable speed drive has been stopped.

1.3.1 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 ATV78 User's Manual, Chapter 7 for more information.

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 Motor nominal 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	Motor temperature	%	9	Calculated motor temperature
V1.11	Voltage input	V	13	AI1
V1.12	Current input	mA	14	AI2
V1.13	DIN1, DIN2, DIN3		15	Digital input statuses
V1.14	DIN4, DIN5, DIN6		16	Digital input statuses
V1.15	DO1, RO1, RO2		17	Digital and relay output statuses
V1.16	Analogue I_{out}	mA	26	AO1
M1.17	Multimonitoring items			Displays three selectable monitoring values

Table 1- 2. Monitoring values

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1.3.2 Basic parameters (Control keypad: Menu M2 → G2.1)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.1	Min frequency	0,00	Par. 2.2	Hz	0,00		101	
P2.2	Max frequency	Par. 2.1	320,00	Hz	50,00		102	**NOTE**: If f_{max} > than the motor synchronous speed, check suitability for motor and drive system
P2.3	Acceleration time 1	0,1	3000,0	s	3,0		103	
P2.4	Deceleration time 1	0,1	3000,0	s	3,0		104	
P2.5	Current limit	Varies	Varies	A	Varies		107	
P2.6	Nominal voltage of the motor	180	690	V	NX6: 690V		110	Check the rating plate of the motor
P2.7	Nominal frequency of the motor	30,00	320,00	Hz	50,00		111	Check the rating plate of the motor
P2.8	Nominal speed of the motor	300	20 000	rpm	1440		112	Check the rating plate of the motor The default applies for a 4-pole motor and a nominal size variable speed drive.
P2.9	Nominal current of the motor	Varies	Varies	A	Varies		113	Check the rating plate of the motor.
P2.10	Motor cosφ	0,30	1,00		0,85		120	Check the rating plate of the motor
P2.11	Start function	0	1		0		505	**0**=Ramp **1**=Flying start
P2.12	Stop function	0	3		0		506	**0**=Coasting **1**=Ramp **2**=Ramp+Run enable coast **3**=Coast+Run enable ramp
P2.13	U/f optimisation	0	1		0		109	**0**=Not used **1**=Automatic torque boost
P2.14	I/O reference	0	3		0		117	**0**=AI1 **1**=AI2 **2**=Keypad **3**=Fieldbus
P2.15	Current reference offset	0	1		1		302	**0**= No offset, 0—20mA **1**= Offset, 4mA—20 mA
P2.16	Analogue output function	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)

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P2.17	DIN3 function	0	7		1		301	**0**=Not used **1**=Ext. fault, closing cont. **2**=Ext. fault, opening cont. **3**=Run enable, cc **4**=Run enable, oc **5**=Force cp. to IO **6**=Force cp. to keypad **7**=Force cp. to fieldbus
P2.18	Preset speed 1	0,00	Par. 2.1.2	Hz	0,00		105	Speeds preset by operator
P2.19	Preset speed 2	0,00	Par. 2.1.2	Hz	50,00		106	Speeds preset by operator
P2.20	Automatic restart	0	1		0		731	**0**=Disabled **1**=Enabled

Table 1- 3. Basic parameters G2.1

1.3.3 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 ATV78 User's Manual.

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P3.1	Control place	1	3		1		125	Selected control place (from panel)
R3.2	Keypad reference	Par. 2.1	Par. 2.2	Hz				
P3.3	Direction (on keypad)	0	1		0		123	Reverse request activated from the panel
R3.4	Stop button	0	1		1		114	**0**=Limited function of Stop button **1**=Stop button always enabled

Table 1- 4. Keypad control parameters, M3

1.3.4 System menu (Control keypad: Menu M6)

For parameters and functions related to the general use of the variable speed drive, such as application and language selection, customised parameter sets or information about the hardware and software, see Chapter 7.3.6 in the ATV78 User's Manual.

1.3.5 Expander boards (Control keypad: Menu M7)

The **M7** menu shows the expander and option boards attached to the control board and board-related information. For more information, see Chapter 7.3.7 in the ATV78 User's Manual.

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1.4 Motor protection functions in the Basic Application

The Basic Application provides almost all the same protection functions as the other applications:

- External fault protection
- Input phase supervision
- Undervoltage protection
- Output phase supervision
- Earth fault protection
- Motor thermal protection
- Thermistor fault protection
- Fieldbus fault protection
- Slot fault protection

Unlike the other applications, the Basic Application does not provide any parameters for choosing the response function or limit values for the faults. The following chapter explains the motor thermal protection in more detail.

1.4.1 Motor thermal protection

The motor thermal protection is to protect the motor from overheating. The Telemecanique 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.

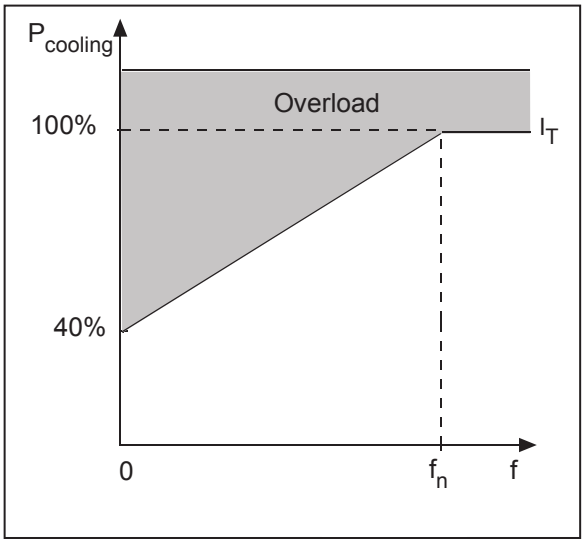


Figure 1- 1. Motor thermal current I_T curve

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.

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

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1.5 Control signal logic in Basic Application

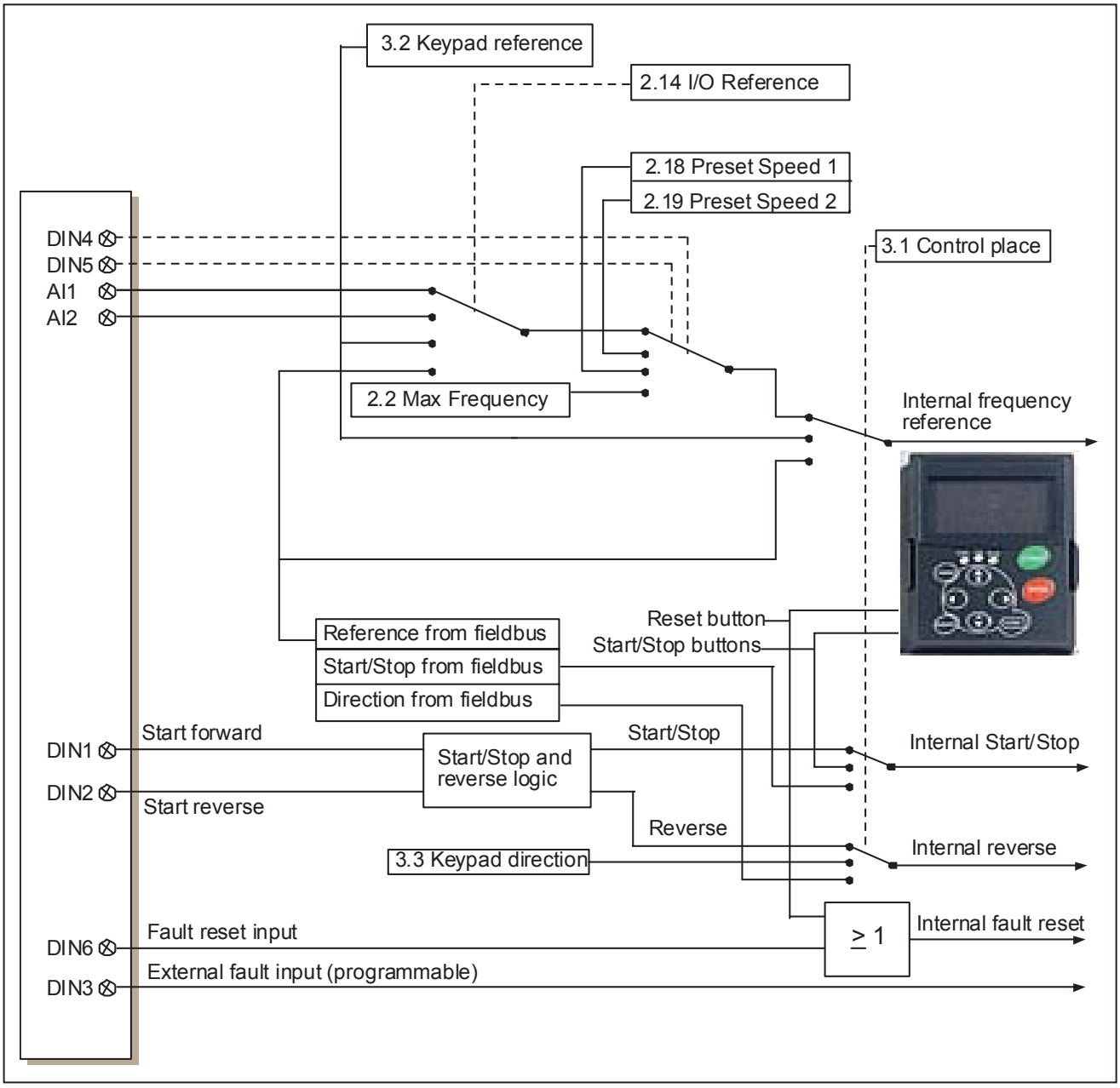


Figure 1- 2. Control signal logic of the Basic Application

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2. Standard Application

2.1 Introduction

Select the Standard Application in menu **M6** on page *S6.2*.

The Standard Application is typically used in pump and fan applications and conveyors for which the Basic Application is too limited but where no special features are needed.

- The Standard Application has the same I/O signals and the same control logic as the Basic Application.

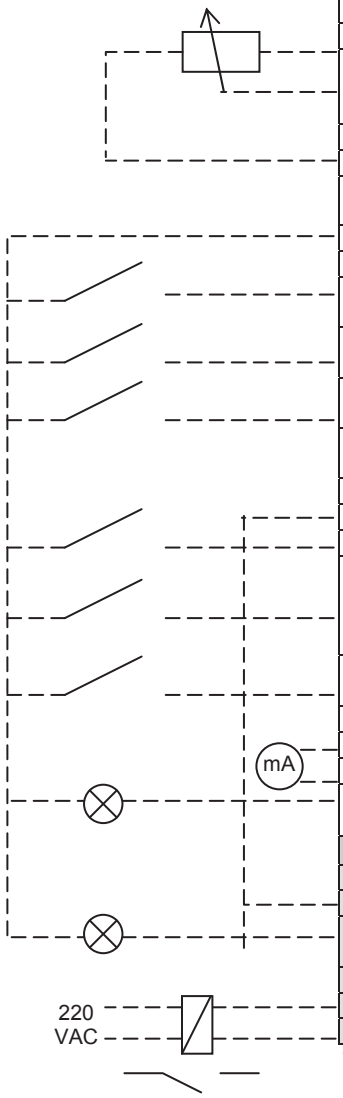
- Digital input DIN3 and all the outputs are freely programmable.

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 skip frequency area
- Programmable U/f curve and switching frequency
- Autorestart
- Motor thermal and stall protection: Programmable action; off, warning, fault

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2.2 Control I/O

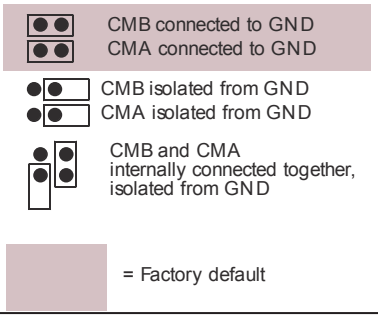


VW3A78201					
Terminal		Signal	Description		
1	$+10V_{ref}$	Reference output	Voltage for potentiometer, etc.		
2	AI1+	Analogue input, voltage range 0—10V DC	Voltage input frequency reference		
3	AI1-	I/O Ground	Ground for reference and controls		
4	AI2+	Analogue input, current range 0—20mA	Current input 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	Multi-step speed select 1	DIN4	DIN5	Frequency ref.
15	DIN5	Multi-step speed select 2	Open	Open	Ref.U_{in}
			Closed	Open	Multi-step ref.1
			Open	Closed	Multi-step ref.2
			Closed	Closed	Ref.I_{in}
16	DIN6	Fault reset	Contact open = no action Contact closed = fault reset		
17	CMB	Common for DIN4—DIN6	Connect to GND or +24V		
18	AO1+	Output frequency Analogue 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		
VW3A78202					
21	RO1	Relay output 1 RUN	Programmable		
22	RO1				
23	RO1				
24	RO2	Relay output 2 FAULT	Programmable		
25	RO2				
26	RO2				

Table 2- 1. Standard application default I/O configuration.

Note: See jumper selections below. More information in ATV78 User's Manual, Chapter 6.2.2.2.

Jumper block X3:
CMA and CMB grounding



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2.3 Control signal logic in Standard Application

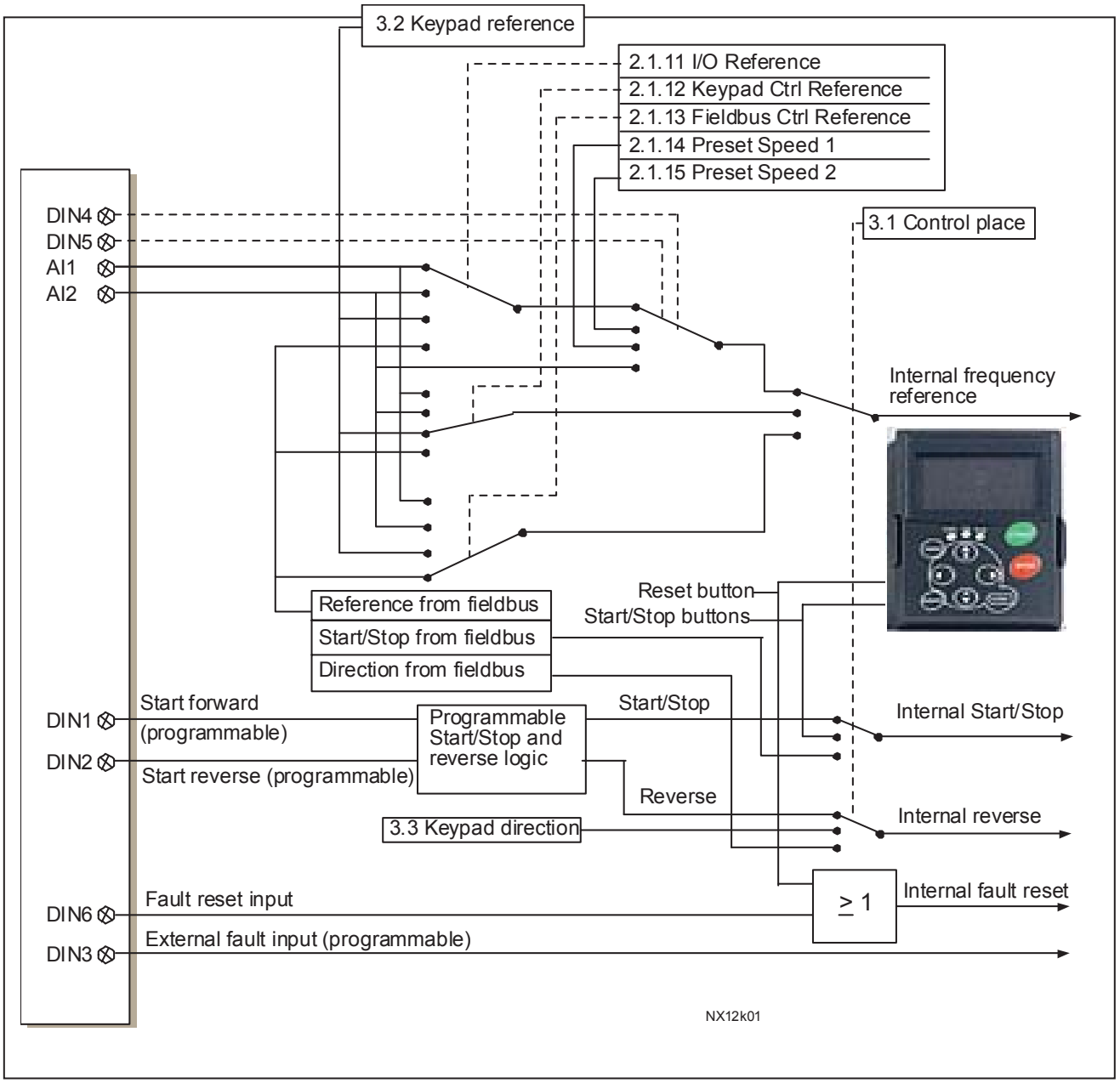


Figure 2- 1. Control signal logic of the Standard Application

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2.4 Standard Application – Parameter lists

On the next pages you will find the lists of parameters within the respective parameter groups.

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)
= In parameter row: Use TTF method to program these parameters.
= On parameter code: Parameter value can only be changed after the variable speed drive has been stopped.

2.4.1 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 ATV78 User's Manual, Chapter 7 for more information.

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	Motor temperature	%	9	Calculated motor temperature
V1.11	Analogue input 1	V	13	AI1
V1.12	Analogue input 2	mA	14	AI2
V1.13	DIN1, DIN2, DIN3		15	Digital input statuses
V1.14	DIN4, DIN5, DIN6		16	Digital input statuses
V1.15	DO1, RO1, RO2		17	Digital and relay output statuses
V1.16	Analogue I_{out}	mA	26	AO1
M1.17	Monitoring items			Displays three selectable monitoring values

Table 2- 2. Monitoring values

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2.4.2 Basic parameters (Control keypad: Menu M2 → 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	Acceleration time 1	0,1	3000,0	s	3,0		103	
P2.1.4	Deceleration time 1	0,1	3000,0	s	3,0		104	
P2.1.5	Current limit	Varies	Varies	A	Varies		107	
P2.1.6	Nominal voltage of the motor	180	690	V	NX6: 690V		110	
P2.1.7	Nominal frequency of the motor	30,00	320,00	Hz	50,00		111	Check the rating plate of the motor
P2.1.8	Nominal speed of the motor	300	20 000	rpm	1440		112	The default applies for a 4-pole motor and a nominal size variable speed drive.
P2.1.9	Nominal current of the motor	Varies	Varies	A	Varies		113	Check the rating plate of the motor.
2.1.10	Motor cosφ	0,30	1,00		0,85		120	Check the rating plate of the motor
2.1.11	I/O reference	0	3		0		117	**0**=AI1 **1**=AI2 **2**=Keypad **3**=Fieldbus
2.1.12	Keypad control reference	0	3		2		121	**0**=AI1 **1**=AI2 **2**=Keypad **3**=Fieldbus
2.1.13	Fieldbus control reference	0	3		3		122	**0**=AI1 **1**=AI2 **2**=Keypad **3**=Fieldbus
2.1.14	Preset speed 1	0,00	Par. 2.1.2	Hz	10,00		105	Speeds preset by operator
2.1.15	Preset speed 2	0,00	Par. 2.1.2	Hz	50,00		106	

Table 2- 3. Basic parameters G2.1

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2.4.3 Input signals (Control keypad: Menu M2 → G2.2)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.1	Start/Stop logic	0	6		0		300	0 Start fwd / Start/Stop 1 Start/Stop / Run enable 2 Start pulse / Stop pulse 3 Fwd* / Rvs* 4 Start*/Stop / Rvs/Fwd 5 Start*/Stop / Run enable 6
P2.2.2	DIN3 function	0	8		1		301	**0**=Not used **1**=Ext. fault, closing cont. **2**=Ext. fault, opening cont. **3**=Run enable **4**=Acc./Dec. time select. **5**=Force cp. to IO **6**=Force cp. to keypad **7**=Force cp. to fieldbus **8**=Rvs (if par. 2.2.1=3)
P2.2.3	Current reference offset	0	1		1		302	**0**=0—20mA **1**=4—20mA
P2.2.4	Reference scaling minimum value	0,00	par. 2.2.5	Hz	0,00		303	Selects the frequency that corresponds to the min. reference signal 0,00 = No scaling
P2.2.5	Reference scaling maximum value	0,00	320,00	Hz	0,00		304	Selects the frequency that corresponds to the max. reference signal 0,00 = No scaling
P2.2.6	Reference inversion	0	1		0		305	**0** = Not inverted **1** = Inverted
P2.2.7	Reference filter time	0,00	10,00	s	0,10		306	**0** = No filtering
P2.2.8	AI1 signal selection				A.1		377	TTF programming method used. See PFC application.
P2.2.9	AI2 signal selection				A.2		388	TTF programming method used. See PFC application.

Table 2- 4. Input signals, G2.2

* = Rising edge required to start

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

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.3.1	Analogue output 1 signal selection	0			A.1		464	TTF programming method used. See PFC application.
P2.3.2	Analogue output function	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**=Motor current (0—I_{nMot}) **5**=Motor torque (0—T_{nMot}) **6**=Motor power (0—P_{nMot}) **7**=Motor voltage (0--U_{nMot}) **8**=DC-link volt (0—1000V)
P2.3.3	Analogue output filter time	0,00	10,00	s	1,00		308	**0**=No filtering
P2.3.4	Analogue output inversion	0	1		0		309	**0** = Not inverted **1** = Inverted
P2.3.5	Analogue output minimum	0	1		0		310	**0** = 0 mA **1** = 4 mA
P2.3.6	Analogue output scale	10	1000	%	100		311	
P2.3.7	Digital output 1 function	0	16		1		312	**0**=Not used **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 1 **11**=At speed **12**=Mot. regulator active **13**=OP freq.limit 1 superv. **14**=Control place: IO **15**=Thermistor fault/warng **16**=Fieldbus input data
P2.3.8	Relay output 1 function	0	16		2		313	As parameter 2.3.7
P2.3.9	Relay output 2 function	0	16		3		314	As parameter 2.3.7
P2.3.10	Output frequency limit 1 supervision	0	2		0		315	**0**=No limit **1**=Low limit supervision **2**=High limit supervision
P2.3.11	Output frequency limit 1; Supervised value	0,00	320,00	Hz	0,00		316	
P2.3.12	Analogue output 2 signal selection	0			0.1		471	TTF programming method used. See PFC application.
P2.3.13	Analogue output 2 function	0	8		4		472	As parameter 2.3.2
P2.3.14	Analogue output 2 filter time	0,00	10,00	s	1,00		473	**0**=No filtering
P2.3.15	Analogue output 2 inversion	0	1		0		474	**0**=Not inverted **1**=Inverted
P2.3.16	Analogue output 2 minimum	0	1		0		475	**0**=0 mA **1**=4 mA
P2.3.17	Analogue output 2 scaling	10	1000	%	100		476	

Table 2- 5. Output signals, G2.3

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2.4.5 Drive control parameters (Control keypad: Menu M2 → 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	Acceleration time 2	0,1	3000,0	s	10,0		502	
P2.4.4	Deceleration time 2	0,1	3000,0	s	10,0		503	
P2.4.5	Brake chopper	0	4		0		504	**0**=Disabled **1**=Used when running **2**=External brake chopper **3**=Used when stopped/running **4**=Used when running (no testing)
P2.4.6	Start function	0	1		0		505	**0**=Ramp **1**=Flying start
P2.4.7	Stop function	0	3		0		506	**0**=Coasting **1**=Ramp **2**=Ramp+Run enable coast **3**=Coast+Run enable ramp
P2.4.8	DC braking current	0,15 x I_n	1,5 x I_n	A	Varies		507	
P2.4.9	DC braking time at stop	0,00	600,00	s	0,00		508	**0** = DC brake is off at stop
P2.4.10	Frequency to start DC braking during ramp stop	0,10	10,00	Hz	1,50		515	
P2.4.11	DC braking time at start	0,00	600,00	s	0,00		516	**0** = DC brake is off at start
P2.4.12	Flux brake	0	1		0		520	**0** = Off **1** = On
P2.4.13	Flux braking current	0,0	Varies	A	0,0		519	

Table 2- 6. Drive control parameters, G2.4

2.4.6 Skip frequency parameters (Control keypad: Menu M2 → G2.5)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.5.1	Skip frequency range 1 low limit	0,00	par. 2.5.2	Hz	0,00		509	
P2.5.2	Skip frequency range 1 high limit	0,00	320,00	Hz	0,0		510	
P2.5.3	Skip acc./dec. ramp	0,1	10,0		1,0		518	

Table 2- 7. Skip frequency parameters, G2.5

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2.4.7 Motor control parameters (Control keypad: Menu M2 → G2.6)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.6.1	Motor control mode	0	1/6		0		600	**ATV78:** **0**=Frequency control **1**=Speed control **Additionally for ATV78F:** **2**=Torque control **3**=Closed loop speed ctrl **4**=Closed loop torque ctrl **5**=Adv. open loop freq. control **6**=Advanced open loop speed control
P2.6.2	U/f optimisation	0	1		0		109	**0**=Not used **1**=Automatic torque boost
P2.6.3	U/f ratio selection	0	3		0		108	**0**=Linear **1**=Squared **2**=Programmable **3**=Linear with flux optim.
P2.6.4	Field weakening point	8,00	320,00	Hz	50,00		602	
P2.6.5	Voltage at field weakening point	10,00	200,00	%	100,00		603	n% x U_{nmot}
P2.6.6	U/f curve midpoint frequency	0,00	par. P2.6.4	Hz	50,00		604	
P2.6.7	U/f curve midpoint voltage	0,00	100,00	%	100,00		605	n% x U_{nmot} Parameter max. value = par. 2.6.5
P2.6.8	Output voltage at zero frequency	0,00	40,00	%	0,00		606	n% x U_{nmot}
P2.6.9	Switching frequency	1,0	Varies	kHz	Varies		601	
P2.6.10	Overvoltage controller	0	2		1		607	**0**=Not used **1**=Used (no ramping) **2**=Used (ramping)
P2.6.11	Undervoltage controller	0	1		1		608	**0**=Not used **1**=Used
Closed Loop parameter group 2.6.12 (ATV78F only)								
P2.6.12.1	Magnetizing current	0,00	100,00	A	0,00		612	
P2.6.12.2	Speed control P gain	0	1000		30		613	
P2.6.12.3	Speed control I time	0,0	500,0	ms	30,0		614	
P2.6.12.4	Load drooping	0,00	100,00	%	0,00		620	
P2.6.12.5	Acceleration compensation	0,00	300,00	s	0,00		626	
P2.6.12.6	Slip adjust	0	500	%	100		619	
P2.6.12.7	Magnetizing current at start	MotCurr Min	MotCurr Max	A	0,00		627	
P2.6.12.8	Magnetizing time at start	0,0	600,0	s	0,0		628	
P2.6.12.9	0-speed time at start	0	32000	ms	100		615	
P2.6.12.10	0-speed time at stop	0	32000	ms	100		616	
P2.6.12.11	Start-up torque	0	3		0		621	**0**=Not used **1**=Torque memory **2**=Torque reference **3**=Start-up torque fwd/rev
P2.6.12.12	Start-up torque FWD	–300,0	300,0	s	0,0		633	
P2.6.12.13	Start-up torque REV	–300,0	300,0	s	0,0		634	
P2.6.12.15	Encoder filter time	0	1000	ms	0		618	
P2.6.12.17	Current control P gain	0,00	100,00	%	40,00		617	

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Advanced Open Loop parameter group 2.6.13 (ATV78F only)								
P2.6.13.1	Zero speed current	0,0	250,0	%	120,0		625	
P2.6.13.2	Minimum current	0,0	100,0	%	80,0		622	
P2.6.13.3	Flux reference	0,0	100,0	%	80,0		623	
P2.6.13.4	Frequency limit	0,0	100,0	%	20,0		635	
P2.6.13.5	U/f boost	0	1		0		632	

Table 2- 8. Motor control parameters, G2.6

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2.4.8 Protections (Control keypad: Menu M2 → G2.7)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.7.1	Response to 4mA reference fault	0	5		0		700	**0**=No response **1**=Warning **2**=Warning+Previous Freq. **3**=Wrng+PresetFreq 2.7.2 **4**=Fault,stop acc. to 2.4.7 **5**=Fault,stop by coasting
P2.7.2	4 mA reference fault frequency	0,00	Par. 2.1.2	Hz	0,00		728	
P2.7.3	Response to 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 supervision	0	3		0		730	
P2.7.5	Response to undervoltage fault	1	3		3		727	
P2.7.6	Output phase supervision	0	3		2		702	
P2.7.7	Earth fault protection	0	3		2		703	
P2.7.8	Thermal protection of the motor	0	3		2		704	
P2.7.9	Motor ambient temperature factor	–100,0	100,0	%	0,0		705	
P2.7.10	Motor cooling factor at zero speed	0,0	150,0	%	40,0		706	
P2.7.11	Motor thermal time constant	1	200	min	45		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 limit	0,1	I_{nMotor} x 2	A	I_{nMotor} x1,3		710	
P2.7.15	Stall time limit	1,00	120,00	s	15,00		711	
P2.7.16	Stall frequency limit	1,0	Par. 2.1.2	Hz	25,0		712	
P2.7.17	Underload protection	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	Underload curve at nominal frequency	10	150	%	50		714	
P2.7.19	Underload curve at zero frequency	5,0	150,0	%	10,0		715	
P2.7.20	Underload protection time limit	2	600	s	20		716	
P2.7.21	Response to thermistor fault	0	3		2		732	**0**=No response **1**=Warning **2**=Fault,stop acc. to 2.4.7 **3**=Fault,stop by coasting
P2.7.22	Response to fieldbus fault	0	3		2		733	See P2.7.21
P2.7.23	Response to slot fault	0	3		2		734	See P2.7.21

Table 2- 9. Protections, G2.7

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2.4.9 Autorestart parameters (Control keypad: Menu M2 → 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	Number of tries after undervoltage trip	0	10		0		720	
P2.8.5	Number of tries after overvoltage trip	0	10		0		721	
P2.8.6	Number of tries after overcurrent trip	0	3		0		722	
P2.8.7	Number of tries after reference trip	0	10		0		723	
P2.8.8	Number of tries after motor temperature fault trip	0	10		0		726	
P2.8.9	Number of tries after external fault trip	0	10		0		725	
P2.8.10	Number of tries after underload fault trip	0	10		1		738	

Table 2- 10. Autorestart parameters, G2.8

2.4.10 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 ATV78 User's Manual.

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	Direction (on keypad)	0	1		0		123	**0** = Forward **1** = Reverse
R3.4	Stop button	0	1		1		114	**0**=Limited function of Stop button **1**=Stop button always enabled

Table 2- 11. Keypad control parameters, M3

2.4.11 System menu (Control keypad: M6)

For parameters and functions related to the general use of the variable speed drive, such as application and language selection, customised parameter sets or information about the hardware and software, see Chapter 7.3.6 in the ATV78 User's Manual.

2.4.12 Expander boards (Control keypad: Menu M7)

The **M7** menu shows the expander and option boards attached to the control board and board-related information. For more information, see Chapter 7.3.7 in the ATV78 User's Manual.

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3. Local/Remote Control Application

3.1 Introduction

Select the Local/Remote Control Application in menu **M6** on page *S6.2*.

Utilising the Local/Remote Control Application it is possible to have two different control places. For each control place the frequency reference can be selected from either the control keypad, I/O terminal or fieldbus. The active control place is selected with the digital input DIN6.

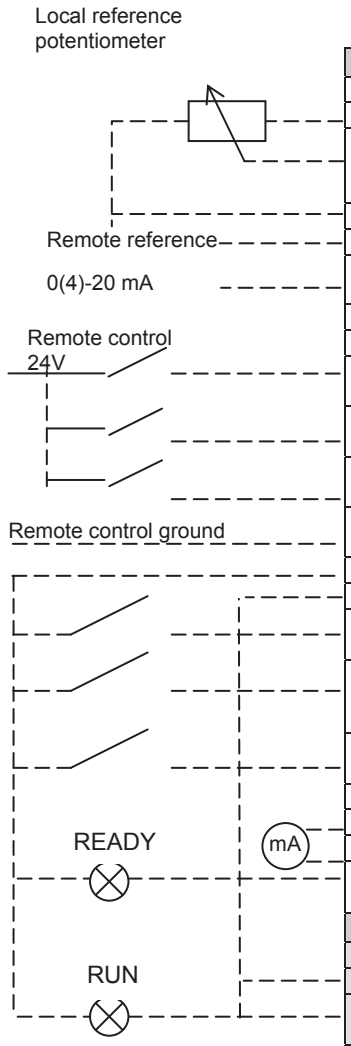
- All outputs are freely programmable.

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

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3.2 Control I/O

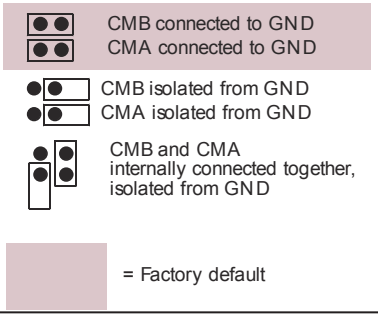


VW3A78201			
Terminal		Signal	Description
1	$+10V_{ref}$	Reference output	Voltage for potentiometer, etc.
2	AI1+	Analogue input, voltage range 0—10V DC	Place B frequency reference range 0-10 V DC
3	AI1-	I/O Ground	Ground for reference and controls
4	AI2+	Analogue input, current range 0—20mA	Place A frequency reference, range 0-20 mA
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	Place A start forward (programmable)	Contact closed = start forward
9	DIN2	Place A 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	Place B: Start forward (programmable)	Contact closed = start forward
15	DIN5	Place B: Start reverse (programmable)	Contact closed = start reverse
16	DIN6	Place A/B selection	Contact open = place A is active Contact closed = Place B is active
17	CMB	Common for DIN4—DIN6	Connect to GND or +24V
18	AO1+	Output frequency Analogue 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
VW3A78202			
21	RO1	Relay output 1 RUN	Programmable
22	RO1		
23	RO1		
24	RO2	Relay output 2 FAULT	Programmable
25	RO2		
26	RO2		

Table 3- 1. Local/Remote control application default I/O configuration.

Note: See jumper selections below. More information in ATV78 User's Manual, Chapter 6.2.2.2.

Jumper block X3: CMA and CMB grounding



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3.3 Control signal logic in Local/Remote Control Application

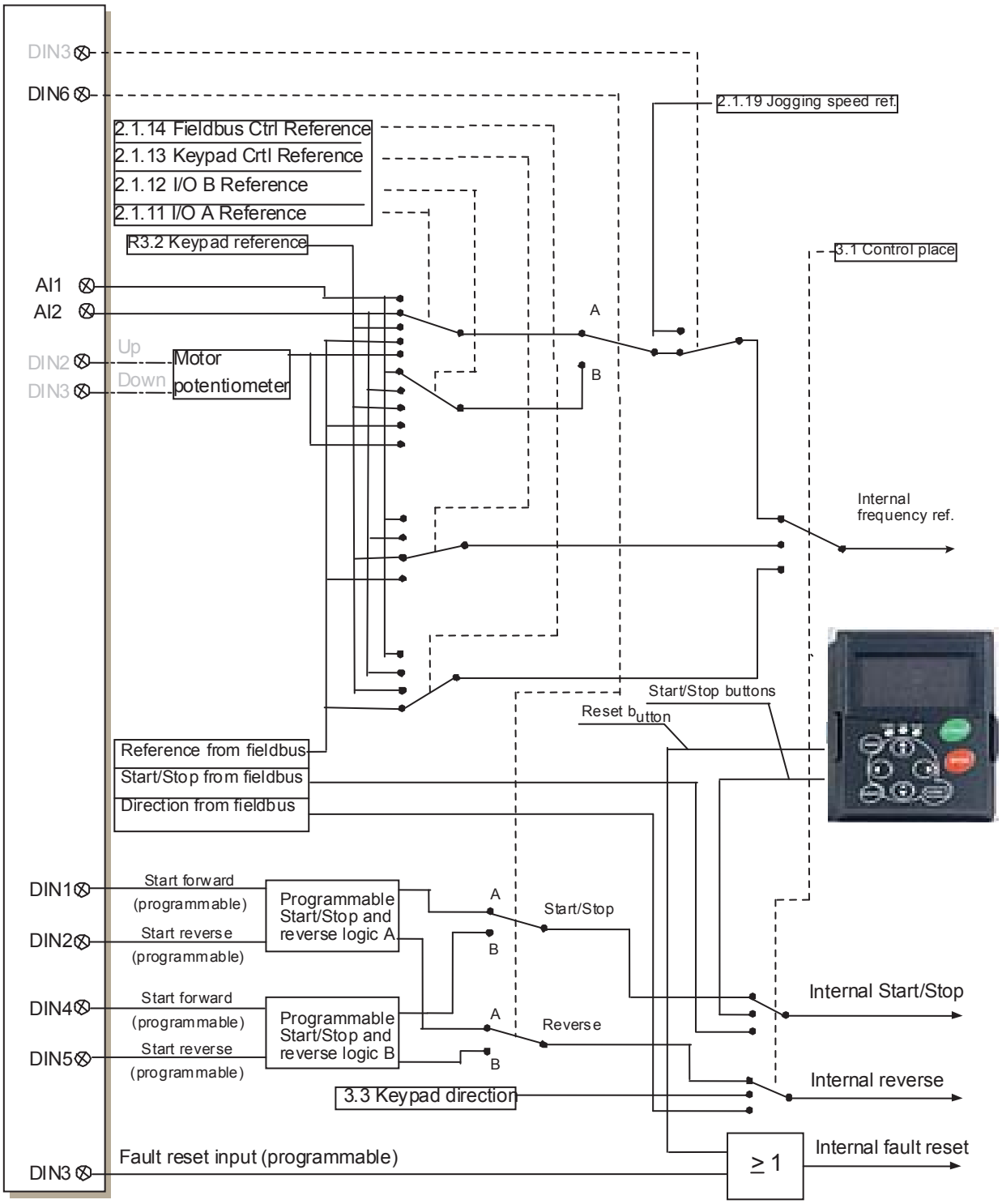


Figure 3- 1. Control signal logic of the Local/Remote Control Application

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3.4 Local/Remote control application – Parameter lists

On the next pages you will find the lists of parameters within the respective parameter groups.

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 settings
ID = ID number of the parameter (used with PC tools)
= In parameter row: Use TTF method to program these parameters.
= On parameter number: Parameter value can only be changed after the frequency converter has been stopped.

3.4.1 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 ATV78 User's Manual, Chapter 7 for more information.

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 motor nominal 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	Motor temperature	%	9	Calculated motor temperature
V1.11	Analogue input 1	V	13	AI1
V1.12	Analogue input 2	mA	14	AI2
V1.13	DIN1, DIN2, DIN3		15	Digital input statuses
V1.14	DIN4, DIN5, DIN6		16	Digital input statuses
V1.15	DO1, RO1, RO2		17	Digital and relay output statuses
V1.16	Analogue I_{out}	mA	26	AO1
M1.17	Multimonitoring items			Displays three selectable monitoring values

Table 3- 2. Monitoring values

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3.4.2 Basic parameters (Control keypad: Menu M2 → G2.1)

Code	Parameter	Min	Max		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	Acceleration time 1	0,1	3000,0	s	3,0		103	
P2.1.4	Deceleration time 1	0,1	3000,0	s	3,0		104	
P2.1.5	Current limit	Varies	Varies	A	Varies		107	
P2.1.6	Nominal voltage of the motor	180	690	V	690V		110	
P2.1.7	Nominal frequency of the motor	30,00	320,00	Hz	50,00		111	Check the rating plate of the motor
P2.1.8	Nominal speed of the motor	300	20 000	rpm	1440		112	The default applies for a 4-pole motor and a nominal size frequency converter.
P2.1.9	Nominal current of the motor	Varies	Varies	A	Varies		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 A reference	0	4		1		117	**0**=AI1 **1**=AI2 **2**=Keypad **3**=Fieldbus **4**=Motor potentiometer
P2.1.12	I/O B reference	0	4		0		131	**0**=AI1 **1**=AI2 **2**=Keypad **3**=Fieldbus **4**=Motor potentiometer
P2.1.13	Keypad control reference	0	3		2		121	**0**=AI1 **1**=AI2 **2**=Keypad **3**=Fieldbus
P2.1.14	Fieldbus control reference	0	3		3		122	**0**=AI1 **1**=AI2 **2**=Keypad **3**=Fieldbus
P2.1.15	Jogging speed reference	0,00	Par. 2.1.2	Hz	0,00		124	

Table 3- 3. Basic parameters G2.1

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3.4.3 Input signals (Control keypad: Menu M2 → G2.2)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.1	Place A Start/Stop logic selection	0	8		0		300	**DIN1** / **DIN2** **0** Start fwd / Start/Stop **1** Start/Stop / Reverse **2** Start pulse / Run enable **3** Start fwd / Stop pulse **4** Fwd* / Mot.pot.UP **5** Start*/Stop / Rvs* **6** Start*/Stop / Rvs/Fwd **7** Start fwd* / Run enable **8** Mot.pot.UP
P2.2.2	DIN3 function	0	13		1		301	**0**=Not used **1**=Ext. fault, closing cont. **2**=Ext. fault, opening cont. **3**=Run enable **4**=Acc./Dec. time select. **5**=Force cp. to IO **6**=Force cp. to keypad **7**=Force cp. to fieldbus **8**=Rvs (if par. 2.2.1=3) **9**=Jogging speed **10**=Fault reset **11**=Acc./Dec. operation prohibit **12**=DC Braking command **13**=Motor potentiometer DOWN
P2.2.3	AI1 signal selection	0			A.1		377	TTF programming method used. See PFC application.
P2.2.4	AI1 signal range	0	2		0		320	**0**=0 – 10 V** **1**=2 – 10 V** **2**=custom setting range
P2.2.5	AI1 custom setting minimum	0,00	100,00	%	0,00		321	Analogue input 1 scale minimum
P2.2.6	AI1 custom setting maximum	0,00	100,00	%	100,0		322	Analogue input 1 scale maximum
P2.2.7	AI1 signal inversion	0	1		0		323	Analogue input 1 reference inversion yes/no
P2.2.8	AI1 signal filter time	0,00	10,00	s	0,10		324	Analogue input 1 reference filter time, constant
P2.2.9	AI2 signal selection	0			A.2		388	TTF programming method used. See PFC application.
P2.2.10	AI2 signal range	0	2		1		325	**0**=0 – 20 mA** **1**=4 – 20 mA** **2**=custom setting range
P2.2.11	AI2 custom setting minimum	0,00	100,00	%	0,00		326	Analogue input 2 scale minimum
P2.2.12	AI2 custom setting maximum	0,00	100,00	%	100,00		327	Analogue input 2 scale maximum
P2.2.13	AI2 signal inversion	0	1		0		328	Analogue input 2 reference inversion yes/no
P2.2.14	AI2 signal filter time	0,00	10,00	s	0,10		329	Analogue input 2 reference filter time, constant

*Rising edge required to start
**Remember to place jumpers of block X2 accordingly. See ATV78 User's Manual, chapter 6.2.2.2

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P2.2.15	Place B Start/Stop logic selection	0	6		0		363	**0** Start fwd / Start rvs **1** Start/Stop / Rvs/Fwd **2** Start/Stop / Run enable **3** Start pulse / Stop pulse **4** Fwd* / Rvs* **5** Start*/Stop / Rvs/Fwd **6** Start*/Stop / Run enable (**DIN4** / **DIN5**)
P2.2.16	Place A Reference scaling minimum value	0,00	par. 2.2.17	Hz	0,00		303	Selects the frequency that corresponds to the min. reference signal
P2.2.17	Place A Reference scaling maximum value	0,00	320,00	Hz	0,00		304	Selects the frequency that corresponds to the max. reference signal 0,00 = No scaling >0 = scaled max. value
P2.2.18	Place B Reference scaling minimum value	0,00	par. 2.2.19	Hz	0,00		364	Selects the frequency that corresponds to the min. reference signal
P2.2.19	Place B Reference scaling maximum value	0,00	320,00	Hz	0,00		365	Selects the frequency that corresponds to the max. reference signal 0,00 = No scaling >0 = scaled max. value
P2.2.20	Free analogue input, signal selection	0	2		0		361	**0**=Not used **1**=U_{in} (analogue voltage input **2**=I_{in} (analogue current input)
P2.2.21	Free analogue input, function	0	4		0		362	**0**=No function **1**=Reduces current limit (par. 2.1.5) **2**=Reduces DC braking current **3**=Reduces accel. and decel. times **4**=Reduces torque supervision limit
P2.2.22	Motor potentiometer ramp time	0,1	2000,0	Hz/s	10,0		331	
P2.2.23	Motor potentiometer frequency reference memory reset	0	2		1		367	**0**=No reset **1**=Reset if stopped or powered down **2**=Reset if powered down
P2.2.24	Start pulse memory	0	1		0		498	**0**=Run state not copied **1**=Run state copied

Table 3- 4. Input signals, G2.2

* = Rising edge required to

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

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.3.1	AO1 signal selection	0			A.1		464	TTF programming method used. See PFC application.
P2.3.2	Analogue output function	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**=Motor 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)
P2.3.3	Analogue output filter time	0,00	10,00	s	1,00		308	**0**=No filtering
P2.3.4	Analogue output inversion	0	1		0		309	**0**=Not inverted **1**=Inverted
P2.3.5	Analogue output minimum	0	1		0		310	**0**=0 mA **1**=4 mA
P2.3.6	Analogue output scale	10	1000	%	100		311	
P2.3.7	Digital output 1 function	0	22		1		312	**0**=Not used **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**=Jogging spd selected **11**=At speed **12**=Mot. regulator active **13**=OP freq.limit superv. 1 **14**=OP freq.limit superv. 2 **15**=Torque limit superv. **16**=Ref. limit superv. **17**=Ext. brake control **18**=Control place: IO **19**=FC temp. limit superv. **20**=Unrequested rotation direction **21**=Ext. brake control inverted **22**=Thermistor fault/warn.
P2.3.8	Relay output 1 function	0	22		2		313	As parameter 2.3.7
P2.3.9	Relay output 2 function	0	22		3		314	As parameter 2.3.7
P2.3.10	Output frequency limit 1 supervision	0	2		0		315	**0**=No limit **1**=Low limit supervision **2**=High limit supervision

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P2.3.11	Output frequency limit 1; Supervision value	0,00	320,00	Hz	0,00		316	
P2.3.12	Output frequency limit 2 supervision	0	2		0		346	**0**=No limit **1**=Low limit supervision **2**=High limit supervision
P2.3.13	Output frequency limit 2; Supervision value	0,00	320,00	Hz	0,00		347	
P2.3.14	Torque limit supervision function	0	2		0		348	**0**=No **1**=Low limit **2**=High limit
P2.3.15	Torque limit supervision value	0,0	200,0	%	0,0		349	
P2.3.16	Reference limit supervision function	0	2		0		350	**0**=No **1**=Low limit **2**=High limit
P2.3.17	Reference limit supervision value	0,0	100,0	%	0,0		351	
P2.3.18	External brake Off-delay	0,0	100,0	s	0,5		352	
P2.3.19	External brake On-delay	0,0	100,0	s	1,5		353	
P2.3.20	Frequency converter temperature limit supervision	0	2		0		354	**0**=No **1**=Low limit **2**=High limit
P2.3.21	Frequency converter temperature limit value	-10	75	°C	0		355	
P2.3.22	Analogue output 2 signal selection	0			0.1		471	TTF programming method used. See PFC application.
P2.3.23	Analogue output 2 function	0	8		4		472	As parameter 2.3.2
P2.3.24	Analogue output 2 filter time	0,00	10,00	s	1,00		473	**0**=No filtering
P2.3.25	Analogue output 2 inversion	0	1		0		474	**0**=Not inverted **1**=Inverted
P2.3.26	Analogue output 2 minimum	0	1		0		475	**0**=0 mA **1**=4 mA
P2.3.27	Analogue output 2 scaling	10	1000	%	100		476	

Table 3- 5. Output signals, G2.3

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3.4.5 Drive control parameters (Control keypad: Menu M2 → 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	Acceleration time 2	0,1	3000,0	s	10,0		502	
P2.4.4	Deceleration time 2	0,1	3000,0	s	10,0		503	
P2.4.5	Brake chopper	0	4		0		504	**0**=Disabled **1**=Used when running **2**=External brake chopper **3**=Used when stopped/running **4**=Used when running (no testing)
P2.4.6	Start function	0	1		0		505	**0**=Ramp **1**=Flying start
P2.4.7	Stop function	0	3		0		506	**0**=Coasting **1**=Ramp **2**=Ramp+Run enable coast **3**=Coast+Run enable ramp
P2.4.8	DC braking current	0,15 x I_n	1,5 x I_n	A	Varies		507	
P2.4.9	DC braking time at stop	0,00	600,00	s	0,00		508	**0**=DC brake is off at stop
P2.4.10	Frequency to start DC braking during ramp stop	0,10	10,00	Hz	1,50		515	
P2.4.11	DC braking time at start	0,00	600,00	s	0,00		516	**0**=DC brake is off at start
P2.4.12	Flux brake	0	1		0		520	**0**=Off **1**=On
P2.4.13	Flux braking current	0,0	Varies	A	0,0		519	

Table 3- 6. Drive control parameters, G2.4

3.4.6 Prohibit frequency parameters (Control keypad: Menu M2 → G2.5)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.5.1	Prohibit frequency range 1 low limit	0,00	par. 2.5.2	Hz	0,00		509	
P2.5.2	Prohibit frequency range 1 high limit	0,00	320,00	Hz	0,0		510	**0**=Prohibit range 1 is off
P2.5.3	Prohibit frequency range 2 low limit	0,00	par. 2.5.2	Hz	0,00		511	
P2.5.4	Prohibit frequency range 2 high limit	0,00	320,00	Hz	0,0		512	**0**=Prohibit range 2 is off
P2.5.5	Prohibit frequency range 3 low limit	0,00	par. 2.5.2	Hz	0,00		513	
P2.5.6	Prohibit frequency range 3 high limit	0,00	320,00	Hz	0,0		514	**0**=Prohibit range 3 is off
P2.5.7	Prohibit acc./dec. ramp	0,1	10,0		1,0		518	

Table 3- 7. Prohibit frequency parameters, G2.5

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3.4.7 Motor control parameters (Control keypad: Menu M2 → G2.6)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.6.1	Motor control mode	0	1/6		0		600	**0**=Frequency control **1**=Speed control **Additionally for ATV78F:** **2**=Torque control **3**=Closed loop speed ctrl **4**=Closed loop torque ctrl **5**=Adv. open loop freq. control **6**=Advanced open loop speed control
P2.6.2	U/f optimisation	0	1		0		109	**0**=Not used **1**=Automatic torque boost
P2.6.3	U/f ratio selection	0	3		0		108	**0**=Linear **1**=Squared **2**=Programmable **3**=Linear with flux optim.
P2.6.4	Field weakening point	8,00	320,00	Hz	50,00		602	
P2.6.5	Voltage at field weakening point	10,00	200,00	%	100,00		603	n% x U_{nmot}
P2.6.6	U/f curve midpoint frequency	0,00	par. P2.6.4	Hz	50,00		604	
P2.6.7	U/f curve midpoint voltage	0,00	100,00	%	100,00		605	n% x U_{nmot} Parameter max. value = par. 2.6.5
P2.6.8	Output voltage at zero frequency	0,00	40,00	%	0,00		606	n% x U_{nmot}
P2.6.9	Switching frequency	1,0	Varies	kHz	Varies		601	
P2.6.10	Overvoltage controller	0	2		1		607	**0**=Not used **1**=Used (no ramping) **2**=Used (ramping)
P2.6.11	Undervoltage controller	0	1		1		608	**0**=Not used **1**=Used
Closed Loop parameter group 2.6.12 (ATV78F only)								
P2.6.12.1	Magnetizing current	0,00	100,00	A	0,00		612	
P2.6.12.2	Speed control P gain	0	1000		30		613	
P2.6.12.3	Speed control I time	0,0	500,0	ms	30,0		614	
P2.6.12.4	Load drooping	0,00	100,00	%	0,00		620	
P2.6.12.5	Acceleration compensation	0,00	300,00	s	0,00		626	
P2.6.12.6	Slip adjust	0	500	%	100		619	
P2.6.12.7	Magnetizing current at start	MotCurr Min	MotCurr Max	A	0,00		627	
P2.6.12.8	Magnetizing time at start	0,0	600,0	s	0,0		628	
P2.6.12.9	0-speed time at start	0	32000	ms	100		615	
P2.6.12.10	0-speed time at stop	0	32000	ms	100		616	
P2.6.12.11	Start-up torque	0	3		0		621	**0**=Not used **1**=Torque memory **2**=Torque reference **3**=Start-up torque fwd/rev
P2.6.12.12	Start-up torque FWD	–300,0	300,0	s	0,0		633	
P2.6.12.13	Start-up torque REV	–300,0	300,0	s	0,0		634	
P2.6.12.15	Encoder filter time	0	1000	ms	0		618	
P2.6.12.17	Current control P gain	0,00	100,00	%	40,00		617	

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Advanced Open Loop parameter group 2.6.13 (ATV78F only)								
P2.6.13.1	Zero speed current	0,0	250,0	%	120,0		625	
P2.6.13.2	Minimum current	0,0	100,0	%	80,0		622	
P2.6.13.3	Flux reference	0,0	100,0	%	80,0		623	
P2.6.13.4	Frequency limit	0,0	100,0	%	20,0		635	
P2.6.13.5	U/f boost	0	1		0		632	

Table 3- 8. Motor control parameters, G2.6

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3.4.8 Protections (Control keypad: Menu M2 → G2.7)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.7.1	Response to 4mA reference fault	0	5		0		700	**0**=No response **1**=Warning **2**=Warning+prev.freq. **3**=Wrng+PresetFreq 2.7.2 **4**=Fault,stop acc. to 2.4.7 **5**=Fault,stop by coasting
P2.7.2	4mA reference fault frequency	0,00	Par. 2.1.2	Hz	0,00		728	
P2.7.3	Response to 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 supervision	0	3		0		730	
P2.7.5	Response to undervoltage fault	1	3		3		727	
P2.7.6	Output phase supervision	0	3		2		702	
P2.7.7	Earth fault protection	0	3		2		703	
P2.7.8	Thermal protection of the motor	0	3		2		704	
P2.7.9	Motor ambient temperature factor	–100,0	100,0	%	0,0		705	
P2.7.10	Motor cooling factor at zero speed	0,0	150,0	%	40,0		706	
P2.7.11	Motor thermal time constant	1	200	min	45		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 limit	0,1	200% x P2.1.9	A	130% x P2.1.9		710	
P2.7.15	Stall time limit	1,00	120,00	s	15,00		711	
P2.7.16	Stall frequency limit	1,0	Par. 2.1.2	Hz	25,0		712	
P2.7.17	Underload protection	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	Underload curve at nominal frequency	10	150	%	50		714	
P2.7.19	Underload curve at zero frequency	5,0	150,0	%	10,0		715	
P2.7.20	Underload protection time limit	2	600	s	20		716	
P2.7.21	Response to thermistor fault	0	3		2		732	**0**=No response **1**=Warning **2**=Fault,stop acc. to 2.4.7 **3**=Fault,stop by coasting
P2.7.22	Response to fieldbus fault	0	3		2		733	See P2.7.21
P2.7.23	Response to slot fault	0	3		2		734	See P2.7.21

Table 3- 9. Protections, G2.7

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3.4.9 Autorestart parameters (Control keypad: Menu M2 → 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	Number of tries after undervoltage trip	0	10		0		720	
P2.8.5	Number of tries after overvoltage trip	0	10		0		721	
P2.8.6	Number of tries after overcurrent trip	0	3		0		722	
P2.8.7	Number of tries after reference trip	0	10		0		723	
P2.8.8	Number of tries after motor temperature fault trip	0	10		0		726	
P2.8.9	Number of tries after external fault trip	0	10		0		725	
P2.8.10	Number of tries after underload fault trip	0	10		1		738	

Table 3- 10. Autorestart parameters, G2.8

3.4.10 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 ATV78 User's Manual.

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	Direction (on keypad)	0	1		0		123	**0**=Forward **1**=Reverse
R3.4	Stop button	0	1		1		114	**0**=Limited function of Stop button **1**=Stop button always enabled

Table 3- 11. Keypad control parameters, M3

3.4.11 System menu (Control keypad: Menu M6)

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 7.3.6 in the ATV78 User's Manual.

3.4.12 Expander boards (Control keypad: Menu M7)

The **M7** menu shows the expander and option boards attached to the control board and board-related information. For more information, see Chapter 7.3.7 in the ATV78 User's Manual.

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4. Multi-step Speed Control Application

4.1 Introduction

Select the Multi-step Speed Control Application in menu **M6** on page *S6.2*.

The Multi-step Speed Control Application can be used in applications where fixed speeds are needed. Totally 15 + 2 different speeds can be programmed: one basic speed, 15 multi-step speeds and one jogging speed. The speed steps are selected with digital signals DIN3, DIN4, DIN5 and DIN6. If jogging speed is used, DIN3 can be programmed from fault reset to jogging speed select.
The basic speed reference can be either voltage or current signal via analogue input terminals (2/3 or 4/5). The other one of the analogue inputs can be programmed for other purposes.

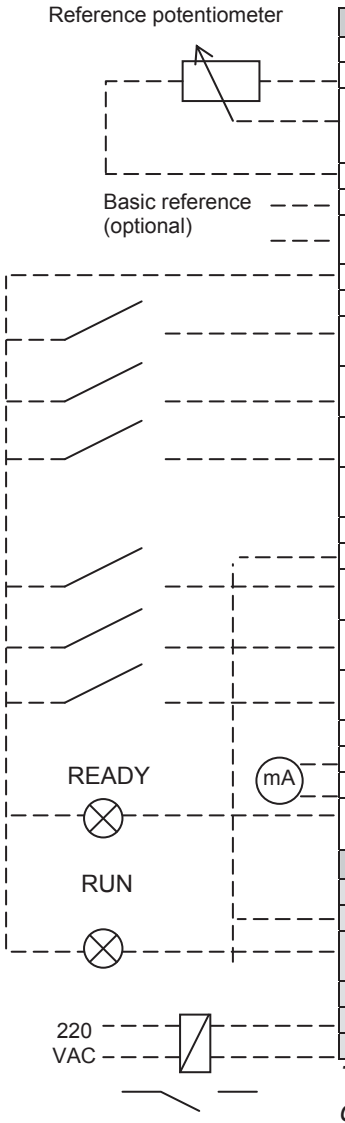
- All outputs are freely programmable.

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

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4.2 Control I/O

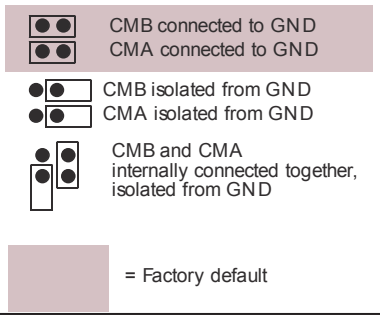


VW3A78201			
Terminal		Signal	Description
1	$+10V_{ref}$	Reference output	Voltage for potentiometer, etc.
2	AI1+	Analogue input, voltage range 0—10V DC	Basic reference (programmable), range 0-10 V DC
3	AI1-	I/O Ground	Ground for reference and controls
4	AI2+	Input for reference current	Basic reference (programmable), range 0-20 mA
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	Multi-step speed select 1	sel 1 sel 2 sel 3 sel 4 (with DIN3) 0 0 0 0 basic speed 1 0 0 0 speed 1 0 1 0 0 speed 2 - - - - - - 1 1 1 1 speed 15
15	DIN5	Multi-step speed select 2	
16	DIN6	Multi-step speed select 3	
17	CMB	Common for DIN4—DIN6	Connect to GND or +24V
18	AO1+	Output frequency Analogue 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
VW3A78202			
21	RO1	Relay output 1 RUN	Programmable
22	RO1		
23	RO1		
24	RO2	Relay output 2 FAULT	Programmable
25	RO2		
26	RO2		

Table 4-1. Multi-step speed control application default I/O configuration.

Note: See jumper selections below. More information in ATV78 User's Manual, Chapter 6.2.2.2.

Jumper block X3:
CMA and CMB grounding



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4.3 Control signal logic in Multi-step Speed Control Application

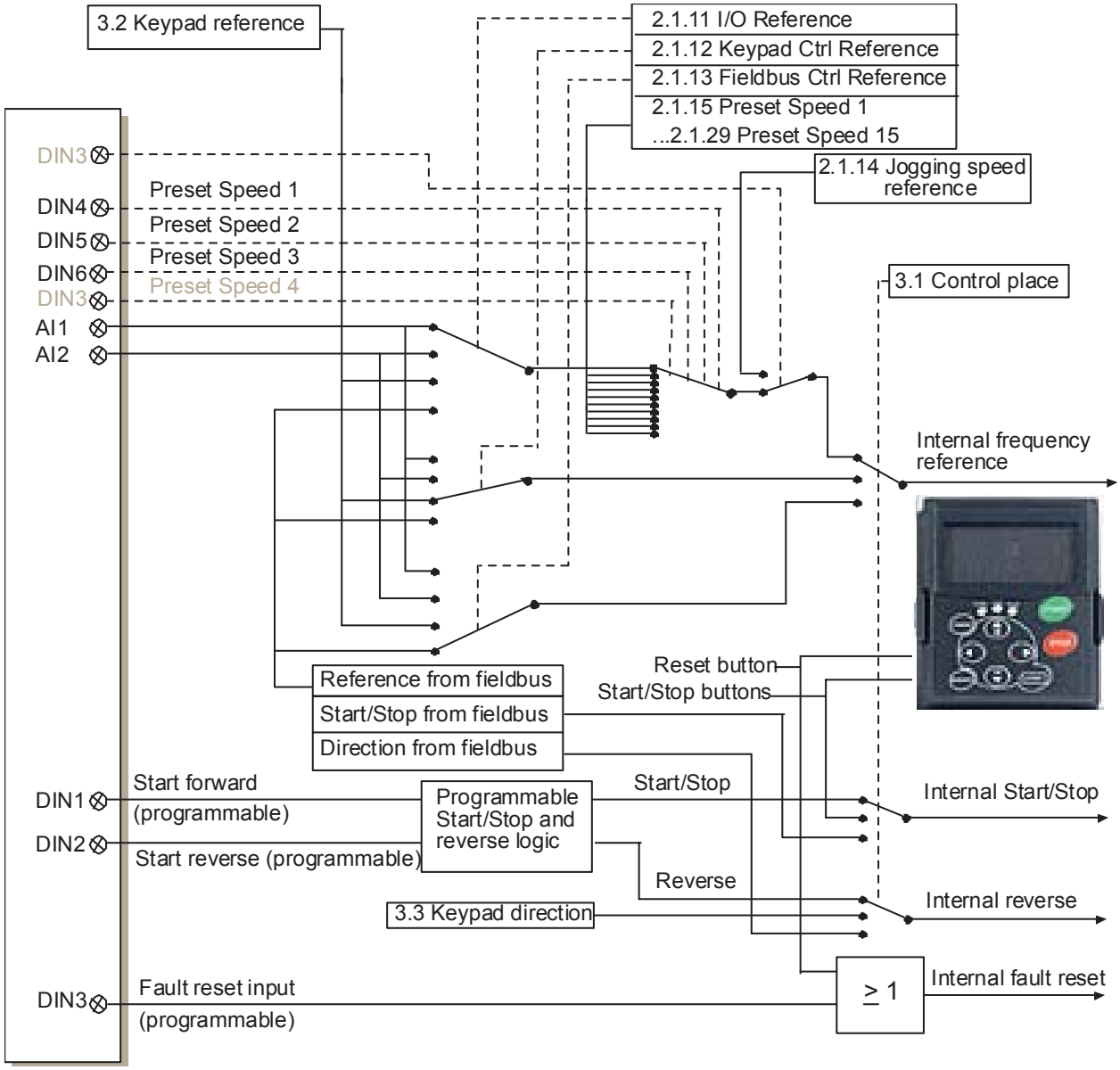


Figure 4- 1. Control signal logic of the Multi-step Speed Application

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4.4 Multi-step speed control application – Parameter lists

On the next pages you will find the lists of parameters within the respective parameter groups.

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)
= In parameter row: Use TTF method to program these parameters.
= On parameter code: Parameter value can only be changed after the variable speed drive has been stopped.

4.4.1 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 ATV78 User's Manual, Chapter 7 for more information.

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 motor nominal 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	Motor temperature	%	9	Calculated motor temperature
V1.11	Analogue input 1	V	13	AI1
V1.12	Analogue input 2	mA	14	AI2
V1.13	DIN1, DIN2, DIN3		15	Digital input statuses
V1.14	DIN4, DIN5, DIN6		16	Digital input statuses
V1.15	DO1, RO1, RO2		17	Digital and relay output statuses
V1.16	Analogue output	mA	26	AO1
M1.17	Multimonitoring items			Displays three selectable monitoring values

Table 4- 2. Monitoring values

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4.4.2 Basic parameters (Control keypad: Menu M2 → 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	Acceleration time 1	0,1	3000,0	s	3,0		103	
P2.1.4	Deceleration time 1	0,1	3000,0	s	3,0		104	
P2.1.5	Current limit	Varies	Varies	A	Varies		107	
P2.1.6	Nominal voltage of the motor	180	690	V	690V		110	
P2.1.7	Nominal frequency of the motor	30,00	320,00	Hz	50,00		111	Check the rating plate of the motor
P2.1.8	Nominal speed of the motor	300	20 000	rpm	1440		112	The default applies for a 4-pole motor and a nominal size variable speed drive.
P2.1.9	Nominal current of the motor	Varies	Varies	A	Varies		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		1		117	**0**=AI1 **1**=AI2 **2**=Keypad **3**=Fieldbus
P2.1.12	Keypad control reference	0	3		2		121	**0**=AI1 **1**=AI2 **2**=Keypad **3**=Fieldbus
P2.1.13	Fieldbus control reference	0	3		3		122	**0**=AI1 **1**=AI2 **2**=Keypad **3**=Fieldbus
P2.1.14	Jogging speed pref.	0,00	Par. 2.1.2	Hz	0,00		124	
P2.1.15	Preset speed 1	0,00	Par. 2.1.2	Hz	5,00		105	Multi-step speed 1
P2.1.16	Preset speed 2	0,00	Par. 2.1.2	Hz	10,00		106	Multi-step speed 2
P2.1.17	Preset speed 3	0,00	Par. 2.1.2	Hz	12,50		126	Multi-step speed 3
P2.1.18	Preset speed 4	0,00	Par. 2.1.2	Hz	15,00		127	Multi-step speed 4
P2.1.19	Preset speed 5	0,00	Par. 2.1.2	Hz	17,50		128	Multi-step speed 5
P2.1.20	Preset speed 6	0,00	Par. 2.1.2	Hz	20,00		129	Multi-step speed 6
P2.1.21	Preset speed 7	0,00	Par. 2.1.2	Hz	22,50		130	Multi-step speed 7
P2.1.22	Preset speed 8	0,00	Par. 2.1.2	Hz	25,00		612	Multi-step speed 8
P2.1.23	Preset speed 9	0,00	Par. 2.1.2	Hz	27,50		613	Multi-step speed 9
P2.1.24	Preset speed 10	0,00	Par. 2.1.2	Hz	30,00		614	Multi-step speed 10
P2.1.25	Preset speed 11	0,00	Par. 2.1.2	Hz	32,50		615	Multi-step speed 11
P2.1.26	Preset speed 12	0,00	Par. 2.1.2	Hz	35,00		616	Multi-step speed 12
P2.1.27	Preset speed 13	0,00	Par. 2.1.2	Hz	40,00		617	Multi-step speed 13
P2.1.28	Preset speed 14	0,00	Par. 2.1.2	Hz	45,00		618	Multi-step speed 14
P2.1.29	Preset speed 15	0,00	Par. 2.1.2	Hz	50,00		619	Multi-step speed 15

Table 4- 3. Basic parameters G2.1

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4.4.3 Input signals (Control keypad: Menu M2 → G2.2)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.1	Start/Stop logic	0	6		0		300	0 Start fwd / Start/Stop 1 Start/Stop / Rvs/Fwd 2 Start pulse / Run 3 Fwd* / enable 4 Start*/Stop / Stop pulse 5 Start*/Stop / Rvs* 6 Rvs/Fwd / Run enable
P2.2.2	DIN3 function	0	13		1		301	**0**=Not used **1**=Ext. fault, closing cont. **2**=Ext. fault, opening cont. **3**=Run enable **4**=Acc./Dec. time select. **5**=Force control. to IO **6**=Force control. to keypad **7**=Force control. to fieldbus **8**=Rvs (if par. 2.2.1=3) **9**=Jogging speed **10**=Fault reset **11**=Acc./Dec. operation prohibit **12**=DC Braking command **13**=Preset speed
P2.2.3	AI1 signal selection	0			A.1		377	TTF programming method used. See PFC application.
P2.2.4	AI1 signal range	0	2		0		320	Analogue input 1 offset*
P2.2.5	AI1 custom setting minimum	0,00	100,00	%	0,00		321	Analogue input 1 scale minimum
P2.2.6	AI1 custom setting maximum	0,00	100,00	%	100,0		322	Analogue input 1 scale maximum
P2.2.7	AI1 signal inversion	0	1		0		323	Analogue input 1 reference inversion yes/no
P2.2.8	AI1 signal filter time	0,00	10,00	s	0,10		324	Analogue input 1 reference filter time, constant
P2.2.9	AI2 signal selection	0			A.2		388	TTF programming method used. See PFC application.
P2.2.10	AI2 signal range	0	2		1		325	**0**=0 – 20 mA* **1**=4 – 20 mA* **2**=custom setting range
P2.2.11	AI2 custom setting minimum	0,00	100,00	%	0,00		326	Analogue input 2 scale minimum
P2.2.12	AI2 custom setting maximum	0,00	100,00	%	100,00		327	Analogue input 2 scale maximum
P2.2.13	AI2 signal inversion	0	1		0		328	Analogue input 2 reference inversion yes/no
P2.2.14	AI2 signal filter time	0,00	10,00	s	0,10		329	Analogue input 2 reference filter time, constant

*Remember to place jumpers of block X2 accordingly.
See ATV78 User's Manual, chapter 6.2.2.2

cc=closing contact
oc=opening contact

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P2.2.15	Reference scaling minimum value	0,00	par. 2.2.16	Hz	0,00		303	Selects the frequency that corresponds to the min. reference signal
P2.2.16	Reference scaling maximum value	0,00	320,00	Hz	0,00		304	Selects the frequency that corresponds to the max. reference signal 0,00 = No scaling >0 = scaled max. value
P2.2.17	Free analogue input, signal selection	0	2		0		361	**0**=Not used **1**=U_{in} (analogue voltage input **2**=I_{in} (analogue current input)
P2.2.18	Free analogue input, function	0	4		0		362	**0**=No function **1**=Reduces current limit (par. 2.1.5) **2**=Reduces DC braking current **3**=Reduces accel. and decel. times **4**=Reduces torque supervision limit

Table 4- 4. Input signals, G2.2

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

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.3.1	AO1 signal selection	0			A.1		464	TTF programming method used. See PFC application.
P2.3.2	Analogue output function	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**=Motor 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)
P2.3.3	Analogue output filter time	0,00	10,00	s	1,00		308	**0**=No filtering
P2.3.4	Analogue output inversion	0	1		0		309	**0**=Not inverted **1**=Inverted
P2.3.5	Analogue output minimum	0	1		0		310	**0**=0 mA **1**=4 mA
P2.3.6	Analogue output scale	10	1000	%	100		311	
P2.3.7	Digital output 1 function	0	22		1		312	**0**=Not used **1**=Ready **2**=Run **3**=Fault **4**=Fault inverted **5**=VSD* overheat warning **6**=Ext. Fault or warning **7**=Ref. fault or warning **8**=Warning **9**=Reversed **10**=Jogging spd selected **11**=At speed **12**=Mot. Regulator active **13**=OP freq.limit superv. 1 **14**=OP freq.limit superv. 2 **15**=Torque limit superv. **16**=Ref. limit superv. **17**=Ext. Brake control **18**= Control place: IO **19**=VSD* temp. limit superv. **20**=Unknown rotation direction **21**=Ext. brake control inverted **22**=Thermistor fault/warn.
P2.3.8	Relay output 1 function	0	22		2		313	As parameter 2.3.7
P2.3.9	Relay output 2 function	0	22		3		314	As parameter 2.3.7
P2.3.10	Output frequency limit 1 supervision	0	2		0		315	**0**=No limit **1**=Low limit supervision **2**=High limit supervision

* VSD : variable speed drive

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P2.3.11	Output frequency limit 1; Supervision value	0,00	320,00	Hz	0,00		316	
P2.3.12	Output frequency limit 2 supervision	0	2		0		346	**0**=No limit **1**=Low limit supervision **2**=High limit supervision
P2.3.13	Output frequency limit 2; Supervision value	0,00	320,00	Hz	0,00		347	
P2.3.14	Torque limit supervision function	0	2		0		348	**0**=No **1**=Low limit **2**=High limit
P2.3.15	Torque limit supervision value	0,0	200,0	%	100,0		349	
P2.3.16	Reference limit supervision function	0	2		0		350	**0**=No **1**=Low limit **2**=High limit
P2.3.17	Reference limit supervision value	0,0	100,0	%	0,0		351	
P2.3.18	External brake Off-delay	0,0	100,0	s	0,5		352	
P2.3.19	External brake On-delay	0,0	100,0	s	1,5		353	
P2.3.20	Variable speed drive temperature limit supervision	0	2		0		354	**0**=No **1**=Low limit **2**=High limit
P2.3.21	Variable speed drive temperature limit value	-10	75	°C	0		355	
P2.3.22	Analogue output 2 signal selection	0			0.1		471	TTF programming method used. See PFC application.
P2.3.23	Analogue output 2 function	0	8		4		472	As parameter 2.3.2
P2.3.24	Analogue output 2 filter time	0,00	10,00	s	1,00		473	**0**=No filtering
P2.3.25	Analogue output 2 inversion	0	1		0		474	**0**=Not inverted **1**=Inverted
P2.3.26	Analogue output 2 minimum	0	1		0		475	**0**=0 mA **1**=4 mA
P2.3.27	Analogue output 2 scaling	10	1000	%	100		476	

Table 4- 5. Output signals, G2.3

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4.4.5 Drive control parameters (Control keypad: Menu M2 → 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	Acceleration time 2	0,1	3000,0	s	10,0		502	
P2.4.4	Deceleration time 2	0,1	3000,0	s	10,0		503	
P2.4.5	Brake chopper	0	4		0		504	**0**=Disabled **1**=Used when running **2**=External brake chopper **3**=Used when stopped/running **4**=Used when running (no testing)
P2.4.6	Start function	0	1		0		505	**0**=Ramp **1**=Flying start
P2.4.7	Stop function	0	3		0		506	**0**=Coasting **1**=Ramp **2**=Ramp+Run enable coast **3**=Coast+Run enable ramp
P2.4.8	DC braking current	0,15 x I_n	1,5 x I_n	A	Varies		507	
P2.4.9	DC braking time at stop	0,00	600,00	s	0,00		508	**0**=DC brake is off at stop
P2.4.10	Frequency to start DC braking during ramp stop	0,10	10,00	Hz	1,50		515	
P2.4.11	DC braking time at start	0,00	600,00	s	0,00		516	**0**=DC brake is off at start
P2.4.12	Flux brake	0	1		0		520	**0**=Off **1**=On
P2.4.13	Flux braking current	0,0	Varies	A	0,0		519	

Table 4- 6. Drive control parameters, G2.4

4.4.6 Prohibit frequency parameters (Control keypad: Menu M2 → G2.5)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.5.1	Prohibit frequency range 1 low limit	0,00	par. 2.5.2	Hz	0,00		509	
P2.5.2	Prohibit frequency range 1 high limit	0,00	320,00	Hz	0,0		510	**0**=Prohibit range 1 is off
P2.5.3	Prohibit frequency range 2 low limit	0,00	par. 2.5.2	Hz	0,00		511	
P2.5.4	Prohibit frequency range 2 high limit	0,00	320,00	Hz	0,0		512	**0**=Prohibit range 2 is off
P2.5.5	Prohibit frequency range 3 low limit	0,00	par. 2.5.2	Hz	0,00		513	
P2.5.6	Prohibit frequency range 3 high limit	0,00	320,00	Hz	0,0		514	**0**=Prohibit range 3 is off
P2.5.7	Prohibit acc./dec. ramp	0,1	10,0		1,0		518	

Table 4- 7. Prohibit frequency parameters, G2.5

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4.4.7 Motor control parameters (Control keypad: Menu M2 → G2.6)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.6.1	Motor control mode	0	1/6		0		600	**ATV78:** **0**=Frequency control **1**=Speed control **Additionally for ATV78F:** **2**=Torque control **3**=Closed loop speed ctrl **4**=Closed loop torque ctrl **5**=Adv. open loop freq. control **6**=Advanced open loop speed control
P2.6.2	U/f optimisation	0	1		0		109	**0**=Not used **1**=Automatic torque boost
P2.6.3	U/f ratio selection	0	3		0		108	**0**=Linear **1**=Squared **2**=Programmable **3**=Linear with flux optim.
P2.6.4	Field weakening point	8,00	320,00	Hz	50,00		602	
P2.6.5	Voltage at field weakening point	10,00	200,00	%	100,00		603	n% x U_{nmot}
P2.6.6	U/f curve midpoint frequency	0,00	par. P2.6.4	Hz	50,00		604	
P2.6.7	U/f curve midpoint voltage	0,00	100,00	%	100,00		605	n% x U_{nmot} Parameter max. value = par. 2.6.5
P2.6.8	Output voltage at zero frequency	0,00	40,00	%	0,00		606	n% x U_{nmot}
P2.6.9	Switching frequency	1,0	Varies	kHz	Varies		601	
P2.6.10	Overvoltage controller	0	2		1		607	**0**=Not used **1**=Used (no ramping) **2**=Used (ramping)
P2.6.11	Undervoltage controller	0	1		1		608	**0**=Not used **1**=Used
Closed Loop parameter group 2.6.12 (ATV78F only)								
P2.6.12.1	Magnetizing current	0,00	100,00	A	0,00		612	
P2.6.12.2	Speed control P gain	0	1000		30		613	
P2.6.12.3	Speed control I time	0,0	500,0	ms	30,0		614	
P2.6.12.4	Load drooping	0,00	100,00	%	0,00		620	
P2.6.12.5	Acceleration compensation	0,00	300,00	s	0,00		626	
P2.6.12.6	Slip adjust	0	500	%	100		619	
P2.6.12.7	Magnetizing current at start	MotCurr Min	MotCurr Max	A	0,00		627	
P2.6.12.8	Magnetizing time at start	0,0	600,0	s	0,0		628	
P2.6.12.9	0-speed time at start	0	32000	ms	100		615	
P2.6.12.10	0-speed time at stop	0	32000	ms	100		616	
P2.6.12.11	Start-up torque	0	3		0		621	**0**=Not used **1**=Torque memory **2**=Torque reference **3**=Start-up torque fwd/rev
P2.6.12.12	Start-up torque FWD	–300,0	300,0	s	0,0		633	

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P2.6.12.13	Start-up torque REV	–300,0	300,0	s	0,0		634	
P2.6.12.15	Encoder filter time	0	1000	ms	0		618	
P2.6.12.17	Current control P gain	0,00	100,00	%	40,00		617	
Advanced Open Loop parameter group 2.6.13 (ATV78F only)								
P2.6.13.1	Zero speed current	0,0	250,0	%	120,0		625	
P2.6.13.2	Minimum current	0,0	100,0	%	80,0		622	
P2.6.13.3	Flux reference	0,0	100,0	%	80,0		623	
P2.6.13.4	Frequency limit	0,0	100,0	%	20,0		635	
P2.6.13.5	U/f boost	0	1		0		632	

Table 4- 8. Motor control parameters, G2.6

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4.4.8 Protections (Control keypad: Menu M2 → G2.7)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.7.1	Response to 4mA reference fault	0	5		0		700	**0**=No response **1**=Warning **2**=Warning+prev.freq. **3**=Wrng+PresetFreq 2.7.2 **4**=Fault,stop acc. to 2.4.7 **5**=Fault,stop by coasting
P2.7.2	4mA reference fault frequency	0,00	Par. 2.1.2	Hz	0,00		728	
P2.7.3	Response to 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 supervision	0	3		0		730	
P2.7.5	Response to undervoltage fault	1	3		3		727	
P2.7.6	Output phase supervision	0	3		2		702	
P2.7.7	Earth fault protection	0	3		2		703	
P2.7.8	Thermal protection of the motor	0	3		2		704	
P2.7.9	Motor ambient temperature factor	–100,0	100,0	%	0,0		705	
P2.7.10	Motor cooling factor at zero speed	0,0	150,0	%	40,0		706	
P2.7.11	Motor thermal time constant	1	200	min	45		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 limit	0,1	200% x P2.1.9	A	130% x P2.1.9		710	
P2.7.15	Stall time limit	1,00	120,00	s	15,00		711	
P2.7.16	Stall frequency limit	1,0	Par. 2.1.2	Hz	25,0		712	
P2.7.17	Underload protection	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	Underload curve at nominal frequency	10	150	%	50		714	
P2.7.19	Underload curve at zero frequency	5,0	150,0	%	10,0		715	
P2.7.20	Underload protection time limit	2	600	s	20		716	
P2.7.21	Response to thermistor fault	0	3		2		732	**0**=No response **1**=Warning **2**=Fault,stop acc. to 2.4.7 **3**=Fault,stop by coasting
P2.7.22	Response to fieldbus fault	0	3		2		733	See P2.7.21
P2.7.23	Response to slot fault	0	3		2		734	See P2.7.21

Table 4- 9. Protections, G2.7

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4.4.9 Autorestart parameters (Control keypad: Menu M2 → 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	Number of tries after undervoltage trip	0	10		0		720	
P2.8.5	Number of tries after overvoltage trip	0	10		0		721	
P2.8.6	Number of tries after overcurrent trip	0	3		0		722	
P2.8.7	Number of tries after reference trip	0	10		0		723	
P2.8.8	Number of tries after motor temperature fault trip	0	10		0		726	
P2.8.9	Number of tries after external fault trip	0	10		0		725	
P2.8.10	Number of tries after underload fault trip	0	10		1		738	

Table 4- 10. Autorestart parameters, G2.8

4.4.10 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 ATV78 User's Manual.

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	Direction (on keypad)	0	1		0		123	**0** = Forward **1** = Reverse
R3.4	Stop button	0	1		1		114	**0**=Limited function of Stop button **1**=Stop button always enabled

Table 4- 11. Keypad control parameters, M3

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4.4.11 System menu (Control keypad: M6)

For parameters and functions related to the general use of the variable speed drive, such as application and language selection, customised parameter sets or information about the hardware and software, see Chapter 7.3.6 in the ATV78 User's Manual.

4.4.12 Expander boards (Control keypad: Menu M7)

The **M7** menu shows the expander and option boards attached to the control board and board-related information. For more information, see Chapter 7.3.7 in the ATV78 User's Manual.

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5. PID Control Application

5.1 Introduction

Select the PID Control Application in menu **M6** on page *S6.2*.

In the PID Control Application, there are two I/O terminal control places; place A is the PID controller and source B is the direct frequency reference. The control place A or B is selected with digital input DIN6.

The PID controller reference can be selected from the analogue inputs, fieldbus, motorised potentiometer, enabling the PID Reference 2 or applying the control keypad reference. The PID controller actual value can be selected from the analogue inputs, fieldbus, the actual values of the motor or through the mathematical functions of these.

The direct frequency reference can be used for the control without the PID controller and selected from the analogue inputs, fieldbus, motor potentiometer or keypad.

The PID Application is typically used to control level measuring or pumps and fans. In these applications, the PID Application provides a smooth control and an integrated measuring and controlling package where no additional components are needed.

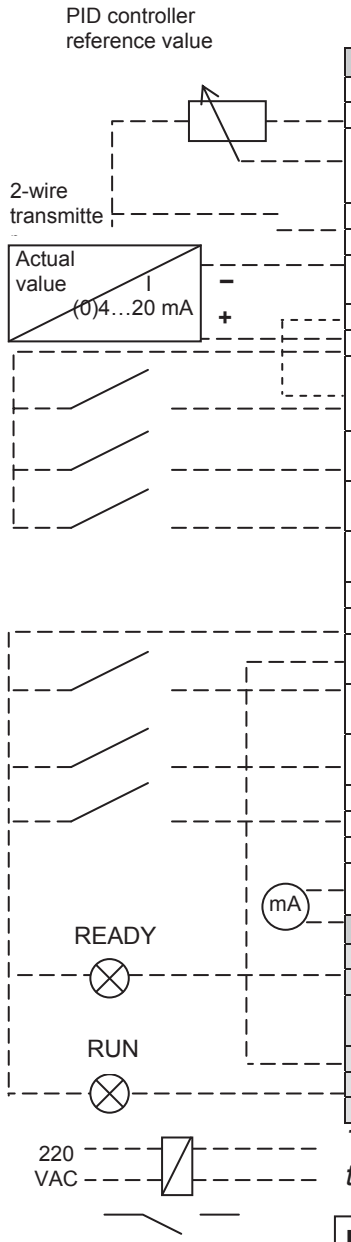
- Digital inputs DIN2, DIN3, DIN5 and all the outputs are freely programmable.

Additional functions:

- Analogue input signal range selection
- Two frequency limit supervisions
- Torque limit supervision
- Reference limit supervision
- Second ramps and S-shape ramp programming
- Programmable start and stop functions
- DC-brake at start and stop
- Three prohibit frequency areas
- Programmable U/f curve and switching frequency
- Autorestart
- Motor thermal and stall protection: fully programmable; off, warning, fault
- Motor underload protection
- Input and output phase supervision
- Sum point frequency addition to PID output
- The PID controller can additionally be used from control places I/O B, keypad and fieldbus
- Easy ChangeOver function
- Sleep function

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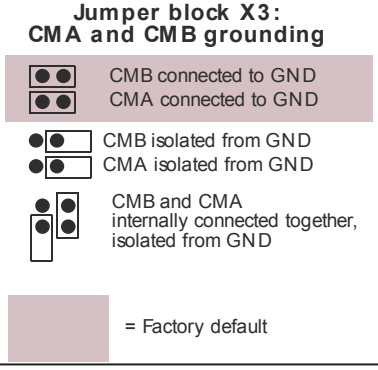
5.2 Control I/O



VW3A78201			
Terminal		Signal	Description
1	$+10V_{ref}$	Reference output	Voltage for potentiometer, etc.
2	AI1+	Analogue input, voltage range 0—10V DC	Voltage input frequency reference
3	AI1-	I/O Ground	Ground for reference and controls
4	AI2+	Analogue 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/Stop Control place A (PID controller)	Contact closed = start
9	DIN2	External fault input (programmable)	Contact closed = fault Contact open = no fault
10	DIN3	Fault reset (programmable)	Contact closed = fault reset
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	Start/Stop Control place B (Direct frequency reference)	Contact closed = Start
15	DIN5	Jogging speed selection (programmable)	Contact closed = Jogging speed active
16	DIN6	Control place A/B selection	Contact open = Control place A is active Contact closed = Control place B is active
17	CMB	Common for DIN4—DIN6	Connect to GND or +24V
18	AO1+	Output frequency Analogue output	Programmable (par. 2.3.2) Range 0—20 mA/R_L, max. 500Ω
19	AO1-		
20	DO1	Digital output READY	Programmable Open collector, I≤50mA, U≤48 VDC
VW3A78202			
21	RO1	Relay output 1 RUN	Programmable (par. 2.3.8)
22	RO1		
23	RO1		
24	RO2	Relay output 2 FAULT	Programmable (par. 2.3.9)
25	RO2		
26	RO2		

Table 5- 1. PID application default I/O configuration (with 2-wire transmitter).

Note: See jumper selections below. More information in ATV78 User's Manual, Chapter 6.2.2.2.



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5.3 Control signal logic in PID Control Application

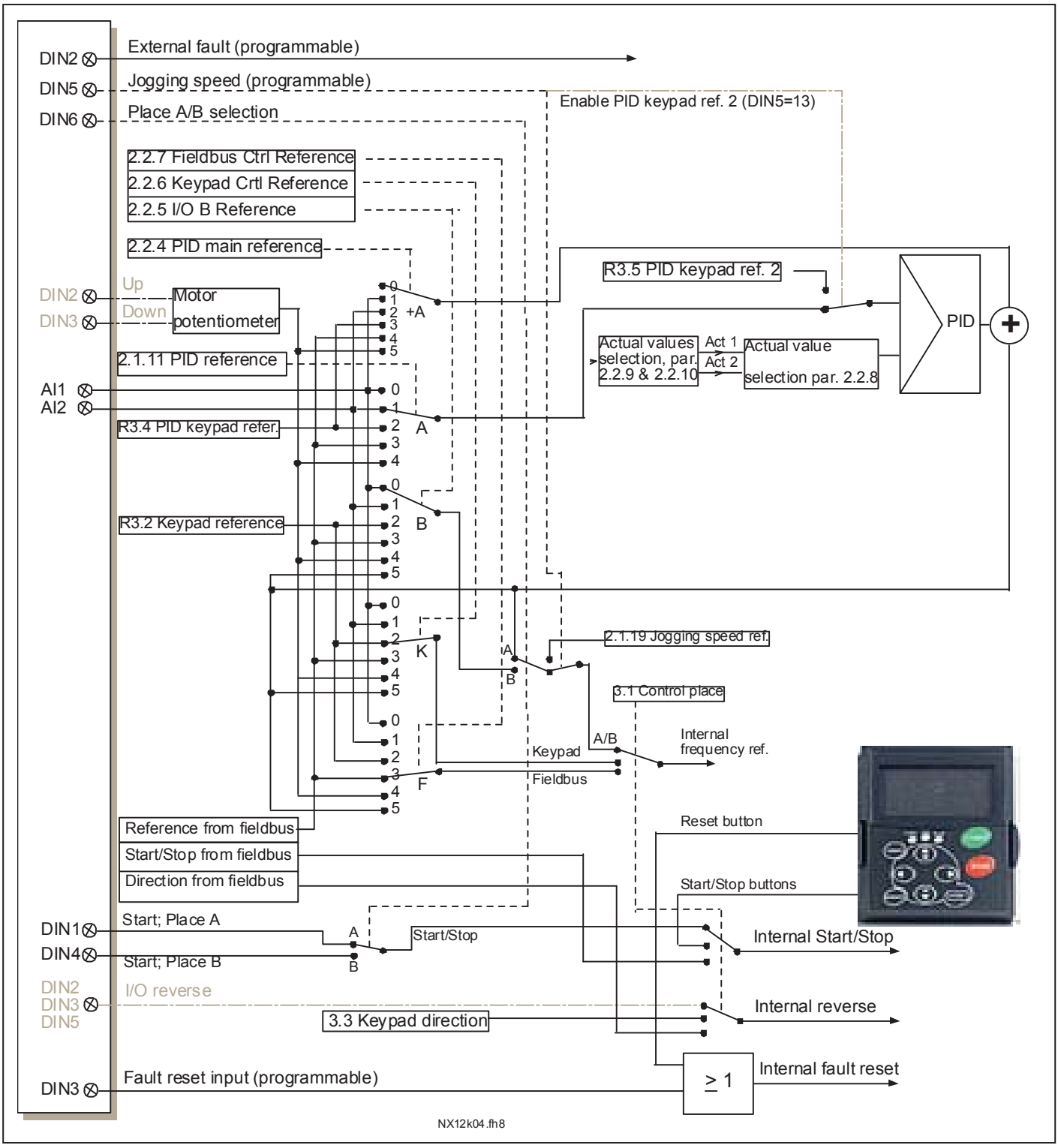


Figure 5- 1. Control signal logic of the PID Control Application

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5.4 PID Application – Parameter lists

On the next pages you will find the lists of parameters within the respective parameter groups.

Column explanations:

Code = Location indication on the keypad; Shows the operator the present param. 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)
= In parameter row: Use TTF method to program these parameters.
= On parameter code: Parameter value can only be changed after the FC has been stopped.

5.4.1 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 ATV78 User's Manual Chapter 7 for more information. Note that the monitoring values V1.19 to V1.22 are available with the PID control application only.

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 Motor nom. 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	Motor temperature	%	9	Calculated motor temperature
V1.11	Analogue input 1	V	13	AI1
V1.12	Analogue input 2	mA	14	AI2
V1.13	Analogue input 3		27	AI3
V1.14	Analogue input 4		28	AI4
V1.15	DIN1, DIN2, DIN3		15	Digital input statuses
V1.16	DIN4, DIN5, DIN6		16	Digital input statuses
V1.17	DO1, RO1, RO2		17	Digital and relay output statuses
V1.18	Analogue I_{out}	mA	26	AO1
V1.19	PID Reference	%	20	In % of the max. frequency
V1.20	PID Actual value	%	21	In % of the max. actual value
V1.21	PID Error value	%	22	In % of the max. error value
V1.22	PID Output	%	23	In % of the max. output value
M1.23	Monitoring items			Displays three selectable monitoring values

Table 5- 2. Monitoring values

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5.4.2 Basic parameters (Control keypad: Menu M2 → 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	Acceleration time 1	0,1	3000,0	s	1,0		103	**NOTE**: If PID-controller is used, Acceleration time 2 (par. 2.4.3) is automatically applied
P2.1.4	Deceleration time 1	0,1	3000,0	s	1,0		104	**NOTE**: If PID-controller is used, Deceleration time 2 (par. 2.4.4) is automatically applied
P2.1.5	Current limit	Varies	Varies	A	Varies		107	
P2.1.6	Nominal voltage of the motor	180	690	V	690V		110	
P2.1.7	Nominal frequency of the motor	30,00	320,00	Hz	50,00		111	Check the rating plate of the motor
P2.1.8	Nominal speed of the motor	300	20 000	rpm	1440		112	The default applies for a 4-pole motor and a nominal size variable speed drive.
P2.1.9	Nominal current of the motor	Varies	Varies	A	Varies		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	PID controller reference signal (Place A)	0	4		0		332	**0**=Anal.volt. input (#2—3) **1**=Anal.curr.input (#4—5) **2**=PID ref from Keypad control page, par. 3.4 **3**=PID ref from fieldbus (ProcessDataIN 1) **4**=Motor potentiometer
P2.1.12	PID controller gain	0,0	1000,0	%	100,0		118	
P2.1.13	PID controller I-time	0,00	320,00	s	1,00		119	
P2.1.14	PID controller D-time	0,00	100,00	s	0,00		132	
P2.1.15	Sleep frequency	Par. 2.1.1	Par. 2.1.2	Hz	10,00		1016	
P2.1.16	Sleep delay	0	3600	s	30		1017	
P2.1.17	Wake up level	0,00	100,00	%	25,00		1018	
P2.1.18	Wake up function	0	1		0		1019	**0**=Wake-up at fall below wake up level (2.1.17) **1**=Wake-up at exceeded wake up level (2.1.17)
P2.1.19	Jogging speed reference	0,00	Par. 2.1.1	Hz	10,00		124	

Table 5- 3. Basic parameters G2.1

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5.4.3 Input signals (Control keypad: Menu M2 → G2.2)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.1	DIN2 function	0	13		1		319	**0**=Not used **1**=External fault cc **2**=External fault oc **3**=Run enable **4**=Acc/Dec time selection **5**=CP: I/O terminal **6**=CP: Keypad **7**=CP: Fieldbus **8**=Forward/Reverse **9**=Jogging frequency (cc) **10**=Fault reset (cc) **11**=Acc/Dec prohibit (cc) **12**=DC braking command **13**=Motor pot. UP (cc)
P2.2.2	DIN3 function	0	13		10		301	See above except: **13**=Motor pot. DOWN (cc)
P2.2.3	DIN5 function	0	13		9		330	See above except: **13**=Enable PID reference 2
P2.2.4	PID sum point reference	0	7		0		376	**0**=Direct PID output value **1**=AI1+PID output **2**=AI2+PID output **3**=AI3+PID output **4**=AI4+PID output **5**=PID keypad+PID output **6**=Fieldbus+PID output (ProcessDataIN3) **7**=Mot.pot.+PID output
P2.2.5	I/O B reference selection	0	7		1		343	**0**=AI1 **1**=AI2 **2**=AI3 **3**=AI4 **4**=Keypad reference **5**=Fieldbus reference (FBSpeedReference) **6**=Motor potentiometer **7**=PID controller
P2.2.6	Keypad control reference selection	0	7		4		121	As in par. 2.2.5
P2.2.7	Fieldbus control reference selection	0	7		5		122	As in par. 2.2.5
P2.2.8	Actual value selection	0	7		0		333	**0**=Actual value 1 **1**=Actual 1 + Actual 2 **2**=Actual 1 – Actual 2 **3**=Actual 1 * Actual 2 **4**=Max(Actual 1, Actual 2) **5**=Min(Actual 1, Actual 2) **6**=Mean(Actual1, Actual2) **7**=Sqrt (Act1) + Sqrt (Act2)

CP=control place
cc=closing contact
oc=opening contact

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P2.2.9	Actual value 1 input	0	10		2		334	**0**=Not used **1**=AI1 signal (c-board) **2**=AI2 signal (c-board) **3**=AI3 **4**=AI4 **5**=Fieldbus (ProcessDataIN2) **6**=Motor torque **7**=Motor speed **8**=Motor current **9**=Motor power **10**=Encoder frequency
P2.2.10	Actual value 2 input	0	9		0		335	**0**=Not used **1**=AI1 signal (c-board) **2**=AI2 signal (c-board) **3**=AI3 **4**=AI4 **5**=Fieldbus (ProcessDataIN3) **6**=Motor torque **7**=Motor speed **8**=Motor current **9**=Motor power
P2.2.11	Actual value 1 minimum scale	–1000,0	1000,0	%	0,0		336	**0**=No minimum scaling
P2.2.12	Actual value 1 maximum scale	–1000,0	1000,0	%	100,0		337	**100**=No maximum scaling
P2.2.13	Actual value 2 minimum scale	–1000,0	1000,0	%	0,0		338	**0**=No minimum scaling
P2.2.14	Actual value 2 maximum scale	–1000,0	1000,0	%	100,0		339	**100**=No maximum scaling
P2.2.15	AI1 signal selection	0			A.1		377	TTF programming method used. See PFC application
P2.2.16	AI1 signal range	0	2		0		320	**0**=Signal range 0—10V* **1**=Signal range 2—10V* **2**=Custom range
P2.2.17	AI1 custom minimum setting	0,00	100,00	%	0,00		321	
P2.2.18	AI1 custom maximum setting	0,00	100,00	%	100,00		322	
P2.2.19	AI1 inversion	0	1		0		323	**0**=Not inverted **1**=Inverted
P2.2.20	AI1 filter time	0,00	10,00	s	0,10		324	**0**=No filtering
P2.2.21	AI2 signal selection	0			A.2		388	TTF programming method used. See PFC application
P2.2.22	AI2 signal range	0	2		1		325	**0**=0—20 mA* **1**=4—20 mA* **2**=Customised
P2.2.23	AI2 custom minimum setting	0,00	100,00	%	0,00		326	
P2.2.24	AI2 custom maximum setting	0,00	100,00	%	100,00		327	
P2.2.25	AI2 inversion	0	1		0		328	**0**=Not inverted **1**=Inverted
P2.2.26	AI2 filter time	0,00	10,00	s	0,10		329	**0**=No filtering

*Remember to place jumpers of block X2 accordingly.
See ATV78 User's Manual, chapter 6.2.2.2

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P2.2.27	Motor potentiometer ramp time	0,1	2000,0	Hz/s	10,0		331	
P2.2.28	Motor potentiometer frequency reference memory reset	0	2		1		367	**0**=No reset **1**=Reset if stopped or powered down **2**=Reset if powered down
P2.2.29	Motor potentiometer PID reference memory reset	0	2		0		370	**0**=No reset **1**=Reset if stopped or powered down **2**=Reset if powered down
P2.2.30	PID minimum limit	–1000,0	Par. 2.2.29	%	0,0		359	
P2.2.31	PID maximum limit	Par. 2.2.28	1000,0	%	100,0		360	
P2.2.32	Error value inversion	0	1		0		340	**0**=No inversion **1**=Inversion
P2.2.33	PID reference rising time	0,0	100,0	s	5,0		341	
P2.2.34	PID reference falling time	0,0	100,0	s	5,0		342	
P2.2.35	Reference scaling minimum value, place B	0,00	Par. 2.2.34	Hz	0,00		344	
P2.2.36	Reference scaling maximum value, place B	Par. 2.2.33	320,00	Hz	0,00		345	
P2.2.37	Easy changeover	0	1		0		366	**0**=Keep reference **1**=Copy actual reference
P2.2.38	AI3 signal selection	0			0.1		141	TTF programming method used. See PFC application
P2.2.39	AI3 signal range	0	1		1		143	**0**=Signal range 0—10V **1**=Signal range 2—10V
P2.2.40	AI3 inversion	0	1		0		151	**0**=Not inverted **1**=Inverted
P2.2.41	AI3 filter time	0,00	10,00	s	0,10		142	**0**=No filtering
P2.2.42	AI4 signal selection	0			0.1		152	TTF programming method used. See PFC application
P2.2.43	AI4 signal range	0	1		1		154	**0**=Signal range 0—10V **1**=Signal range 2—10V
P2.2.44	AI4 inversion	0	1		0		162	**0**=Not inverted **1**=Inverted
P2.2.45	AI4 filter time	0,00	10,00	s	0,10		153	**0**=No filtering

Table 5- 4. Input signals, G2.2

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

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.3.1	Analogue output 1 signal selection	0			A.1			TTF programming method used. See PFC application
P2.3.2	Analogue output function	0	13		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**=Motor 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) **9**=PID controller ref. value **10**=PID contr. act. value 1 **11**=PID contr. act. value 2 **12**=PID contr. error value **13**=PID controller output
P2.3.3	Analogue output filter time	0,00	10,00	s	1,00		308	**0**=No filtering
P2.3.4	Analogue output inversion	0	1		0		309	**0**=Not inverted **1**=Inverted
P2.3.5	Analogue output minimum	0	1		0		310	**0**=0 mA **1**=4 mA
P2.3.6	Analogue output scale	10	1000	%	100		311	
P2.3.7	Digital output 1 function	0	23		1		312	**0**=Not used **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**=Jogging speed **11**=At speed **12**=Mot. regulator active **13**=OP freq. limit superv.1 **14**=OP freq.limit superv.2 **15**=Torque limit superv. **16**=Ref. limit supervision **17**=External brake control **18**=Control place: IO **19**=FC temp. limit superv. **20**=Unrequested direction **21**=Ext. brake control inv. **22**=Thermistor fault/warn. **23**=FB data to DO/RO
P2.3.8	Relay output 1 function	0	23		2		313	As parameter 2.3.7
P2.3.9	Relay output 2 function	0	23		3		314	As parameter 2.3.7

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P2.3.10	Output frequency limit 1 supervision	0	2		0		315	**0**=No limit **1**=Low limit supervision **2**=High limit supervision
P2.3.11	Output frequency limit 1; Supervised value	0,00	Par. 2.1.2	Hz	0,00		316	
P2.3.12	Output frequency limit 2 supervision	0	2		0		346	**0**=No limit **1**=Low limit supervision **2**=High limit supervision
P2.3.13	Output frequency limit 2; Supervised value	0,00	Par. 2.1.2	Hz	0,00		347	
P2.3.14	Torque limit supervision	0	2		0		348	**0**=Not used **1**=Low limit supervision **2**=High limit supervision
P2.3.15	Torque limit supervision value	0,0	300,0	%	100,0		349	
P2.3.16	Reference limit supervision	0	2		0		350	**0**=Not used **1**=Low limit **2**=High limit
P2.3.17	Reference limit supervision value	0,00	Par. 2.1.2	Hz	0,00		351	
P2.3.18	External brake-off delay	0,0	100,0	s	0,5		352	
P2.3.19	External brake-on delay	0,0	100,0	s	1,5		353	
P2.3.20	FC temperature supervision	0	2		0		354	**0**=Not used **1**=Low limit **2**=High limit
P2.3.21	FC temperature supervised value	–10	75	°C	40		355	
P2.3.22	Analogue output 2 signal selection	0			0.1		471	TTF programming method used. See PFC application.
P2.3.23	Analogue output 2 function	0	13		4		472	As parameter 2.3.2
P2.3.24	Analogue output 2 filter time	0,00	10,00	s	1,00		473	**0**=No filtering
P2.3.25	Analogue output 2 inversion	0	1		0		474	**0**=Not inverted **1**=Inverted
P2.3.26	Analogue output 2 minimum	0	1		0		475	**0**=0 mA **1**=4 mA
P2.3.27	Analogue output 2 scaling	10	1000	%	100		476	

Table 5- 5. Output signals, G2.3

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5.4.5 Drive control parameters (Control keypad: Menu M2 → 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	Acceleration time 2	0,1	3000,0	s	0,1		502	
P2.4.4	Deceleration time 2	0,1	3000,0	s	0,1		503	
P2.4.5	Brake chopper	0	4		0		504	**0**=Disabled **1**=Used when running **2**=External brake chopper **3**=Used when stopped/running **4**=Used when running (no testing)
P2.4.6	Start function	0	1		0		505	**0**=Ramp **1**=Flying start
P2.4.7	Stop function	0	3		0		506	**0**=Coasting **1**=Ramp **2**=Ramp+Run enable coast **3**=Coast+Run enable ramp
P2.4.8	DC braking current	0,15 x I_n	1,5 x I_n	A	Varies		507	
P2.4.9	DC braking time at stop	0,00	600,00	s	0,00		508	**0**=DC brake is off at stop
P2.4.10	Frequency to start DC braking during ramp stop	0,10	10,00	Hz	1,50		515	
P2.4.11	DC braking time at start	0,00	600,00	s	0,00		516	**0**=DC brake is off at start
P2.4.12	Flux brake	0	1		0		520	**0**=Off **1**=On
P2.4.13	Flux braking current	0,0	Varies	A	0,0		519	

Table 5- 6. Drive control parameters, G2.4

5.4.6 Prohibit frequency parameters (Control keypad: Menu M2 → G2.5)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.5.1	Prohibit frequency range 1 low limit	0,0	Par. 2.5.2	Hz	0,0		509	**0**=Not used
P2.5.2	Prohibit frequency range 1 high limit	0,0	Par. 2.1.2	Hz	0,0		510	**0**=Not used
P2.5.3	Prohibit frequency range 2 low limit	0,0	Par. 2.5.4	Hz	0,0		511	**0**=Not used
P2.5.4	Prohibit frequency range 2 high limit	0,0	Par. 2.1.2	Hz	0,0		512	**0**=Not used
P2.5.5	Prohibit frequency range 3 low limit	0,0	Par. 2.5.6	Hz	0,0		513	**0**=Not used
P2.5.6	Prohibit frequency range 3 high limit	0,0	Par. 2.1.2	Hz	0,0		514	**0**=Not used
P2.5.7	Prohibit frequencies acc./dec. ramp scaling	0,1	10,0	Times	1,0		518	

Table 5- 7. Prohibit frequency parameters, G2.5

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5.4.7 Motor control parameters (Control keypad: Menu M2 → G2.6)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.6.1	Motor control mode	0	1/6		0		600	**ATV78:** **0**=Frequency control **1**=Speed control **Additionally for ATV78F:** **2**=Torque control **3**=Closed loop speed ctrl **4**=Closed loop torque ctrl **5**=Adv. open loop freq. control **6**=Advanced open loop speed control
P2.6.2	U/f optimisation	0	1		0		109	**0**=Not used **1**=Automatic torque boost
P2.6.3	U/f ratio selection	0	3		0		108	**0**=Linear **1**=Squared **2**=Programmable **3**=Linear with flux optim.
P2.6.4	Field weakening point	8,00	320,00	Hz	50,00		602	
P2.6.5	Voltage at field weakening point	10,00	200,00	%	100,00		603	n% x U_{nmot}
P2.6.6	U/f curve midpoint frequency	0,00	par. P2.6.4	Hz	50,00		604	
P2.6.7	U/f curve midpoint voltage	0,00	100,00	%	100,00		605	n% x U_{nmot} Parameter max. value = par. 2.6.5
P2.6.8	Output voltage at zero frequency	0,00	40,00	%	0,00		606	n% x U_{nmot}
P2.6.9	Switching frequency	1,0	Varies	kHz	Varies		601	
P2.6.10	Overvoltage controller	0	2		1		607	**0**=Not used **1**=Used (no ramping) **2**=Used (ramping)
P2.6.11	Undervoltage controller	0	1		1		608	**0**=Not used **1**=Used
Closed Loop parameter group 2.6.12 (ATV78F only)								
P2.6.12.1	Magnetizing current	0,00	100,00	A	0,00		612	
P2.6.12.2	Speed control P gain	0	1000		30		613	
P2.6.12.3	Speed control I time	0,0	500,0	ms	30,0		614	
P2.6.12.4	Load drooping	0,00	100,00	%	0,00		620	
P2.6.12.5	Acceleration compensation	0,00	300,00	s	0,00		626	
P2.6.12.6	Slip adjust	0	500	%	100		619	
P2.6.12.7	Magnetizing current at start	MotCurr Min	MotCurr Max	A	0,00		627	
P2.6.12.8	Magnetizing time at start	0,0	600,0	s	0,0		628	
P2.6.12.9	0-speed time at start	0	32000	ms	100		615	
P2.6.12.10	0-speed time at stop	0	32000	ms	100		616	
P2.6.12.11	Start-up torque	0	3		0		621	**0**=Not used **1**=Torque memory **2**=Torque reference **3**=Start-up torque fwd/rev
P2.6.12.12	Start-up torque FWD	–300,0	300,0	s	0,0		633	

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P2.6.12.13	Start-up torque REV	–300,0	300,0	s	0,0		634	
P2.6.12.15	Encoder filter time	0	1000	ms	0		618	
P2.6.12.17	Current control P gain	0,00	100,00	%	40,00		617	
Advanced Open Loop parameter group 2.6.13 (ATV78F only)								
P2.6.13.1	Zero speed current	0,0	250,0	%	120,0		625	
P2.6.13.2	Minimum current	0,0	100,0	%	80,0		622	
P2.6.13.3	Flux reference	0,0	100,0	%	80,0		623	
P2.6.13.4	Frequency limit	0,0	100,0	%	20,0		635	
P2.6.13.5	U/f boost	0	1		0		632	

Table 5- 8. Motor control parameters, G2.6

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5.4.8 Protections (Control keypad: Menu M2 → G2.7)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.7.1	Response to 4mA reference fault	0	5		4		700	**0**=No response **1**=Warning **2**=Warning+prev.freq. **3**=Wrng+PresetFreq 2.7.2 **4**=Fault,stop acc. to 2.4.7 **5**=Fault,stop by coasting
P2.7.2	4mA reference fault frequency	0,00	Par. 2.1.2	Hz	0,00		728	
P2.7.3	Response to 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 supervision	0	3		0		730	
P2.7.5	Response to undervoltage fault	1	3		3		727	
P2.7.6	Output phase supervision	0	3		2		702	
P2.7.7	Earth fault protection	0	3		2		703	
P2.7.8	Thermal protection of the motor	0	3		2		704	
P2.7.9	Motor ambient temperature factor	–100,0	100,0	%	0,0		705	
P2.7.10	Motor cooling factor at zero speed	0,0	150,0	%	40,0		706	
P2.7.11	Motor thermal time constant	1	200	min	45		707	
P2.7.12	Motor duty cycle	0	100	%	100		708	
P2.7.13	Stall protection	0	3		1		709	**0**=No response **1**=Warning **2**=Fault,stop acc. to 2.4.7 **3**=Fault,stop by coasting
P2.7.14	Stall current limit	0,1	I_{nMotor} x 2	A	I_{nMotor} x1,3		710	
P2.7.15	Stall time limit	1,00	120,00	s	15,00		711	
P2.7.16	Stall frequency limit	1,0	Par. 2.1.2	Hz	25,0		712	
P2.7.17	Underload protection	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	Underload curve at nominal frequency	10	150	%	50		714	
P2.7.19	Underload curve at zero frequency	5,0	150,0	%	10,0		715	
P2.7.20	Underload protection time limit	2	600	s	20		716	
P2.7.21	Response to thermistor fault	0	3		2		732	**0**=No response **1**=Warning **2**=Fault,stop acc. to 2.4.7 **3**=Fault,stop by coasting
P2.7.22	Response to fieldbus fault	0	3		2		733	See P2.7.21
P2.7.23	Response to slot fault	0	3		2		734	See P2.7.21

Table 5- 9. Protections, G2.7

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5.4.9 Autorestart parameters (Control keypad: Menu M2 → 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	Number of tries after undervoltage trip	0	10		0		720	
P2.8.5	Number of tries after overvoltage trip	0	10		0		721	
P2.8.6	Number of tries after overcurrent trip	0	3		0		722	
P2.8.7	Number of tries after reference trip	0	10		0		723	
P2.8.8	Number of tries after motor temperature fault trip	0	10		0		726	
P2.8.9	Number of tries after external fault trip	0	10		0		725	
P2.8.10	Number of tries after underload fault trip	0	10		1		738	

Table 5- 10. Autorestart parameters, G2.8

5.4.10 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 ATV78 User's Manual.

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	Direction (on keypad)	0	1		0		123	**0** = Forward **1** = Reverse
R3.4	PID reference	0,00	100,00	%	0,00			
R3.5	PID reference 2	0,00	100,00	%	0,00			
R3.6	Stop button	0	1		1		114	**0**=Limited function of Stop button **1**=Stop button always enabled

Table 5- 11. Keypad control parameters, M3

5.4.11 System menu (Control keypad: M6)

For parameters and functions related to the general use of the variable speed drive, such as application and language selection, customised parameter sets or information about the hardware and software, see Chapter 7.3.6 in the ATV78 User's Manual.

5.4.12 Expander boards (Control keypad: Menu M7)

The **M7** menu shows the expander and option boards attached to the control board and board-related information. For more information, see Chapter 7.3.7 in the ATV78 User's Manual.

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6. Multi-purpose Control Application

6.1 Introduction

Select the Multi-purpose Control Application in menu **M6** on page *S6.2.*

Multi-purpose control application provides a wide range of parameters for controlling motors. It can be used for various kinds of different processes, where wide flexibility of I/O signals is needed and PID-control is not necessary (if you need PID-control functions, use PID-control Application or Pump and Fan Control Application).
The frequency reference can be selected e.g. from the analoque inputs, joystick control, motor potentiometer and from a mathematical function of the analoque inputs. There are parameters also for Fieldbus communication. Multi-step speeds and jogging speed can also be selected if digital inputs are programmed for these functions.

The digital inputs and all the outputs are freely programmable and the application supports all I/O-boards

Additional functions:

- Analogue input signal range selection
- Two frequency limit supervisions
- Torque limit supervision
- Reference limit supervision
- Second ramps and S-shape ramp programming
- Programmable Start/Stop and Reverse logic
- DC-brake at start and stop
- Three prohibit frequency areas
- Programmable U/f curve and switching frequency
- Autorestart
- Motor thermal and stall protection: fully programmable; off, warning, fault
- Motor underload protection
- Input and output phase supervision
- Joystick hysteresis
- Sleep function

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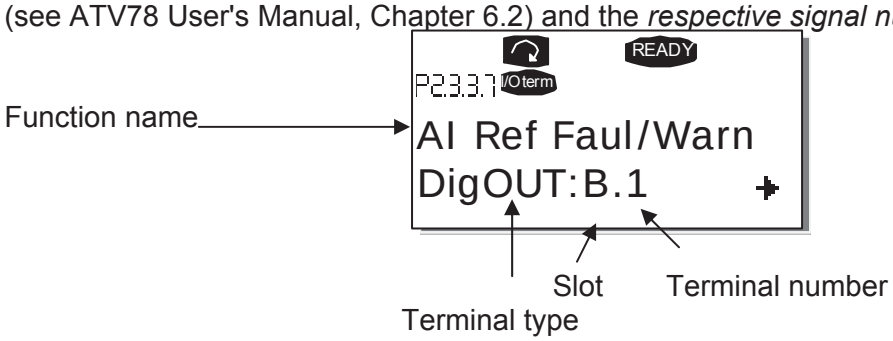
6.2 Programming principle of the Multi-purpose Control application

The programming principle of the input and output signals in the **Multipurpose Control Application** as well as in the **Pump and Fan Control Application** (and partly in the other applications) is different compared to the conventional method used in other ATV78 applications.

In the conventional programming method, *Function to Terminal Programming Method (FTT),* you have a fixed input or output 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 which the operator defines a certain input/output for. See *Warning* on page 70.

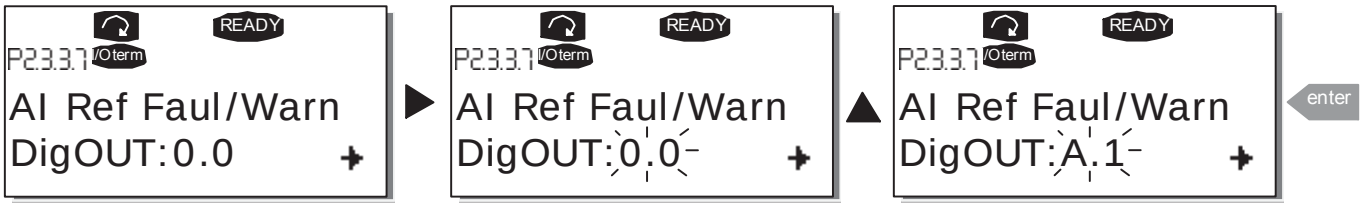
6.2.1 Defining an input/output for a certain function on keypad

Connecting a certain input or output with a certain function (parameter) is done by giving the parameter an appropriate value. The value is formed of the *Board slot* on the ATV78 control board (see ATV78 User's Manual, Chapter 6.2) and the *respective signal number*, see below.



Example: You want to connect the digital output function *Reference fault/warning* (parameter 2.3.3.7) to the digital output DO1 on the basic board VW3A78201 (see ATV78 User's Manual, Chapter 6.2).

First find the parameter 2.3.3.7 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, DigOUT, An.IN, An.OUT) and on the right, the present input/output the function is connected to (B.3, A.2 etc.), or if not connected, a value (0.#).
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 numbers referring to the I/O selection from **1** to **10**.
Once you have set the desired value, press the *Enter button* once to confirm the change.



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6.2.2 Defining a terminal for a certain function with PC software programming tool

If you use the PC software Programming Tool for parametrizing 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 the Figure below).

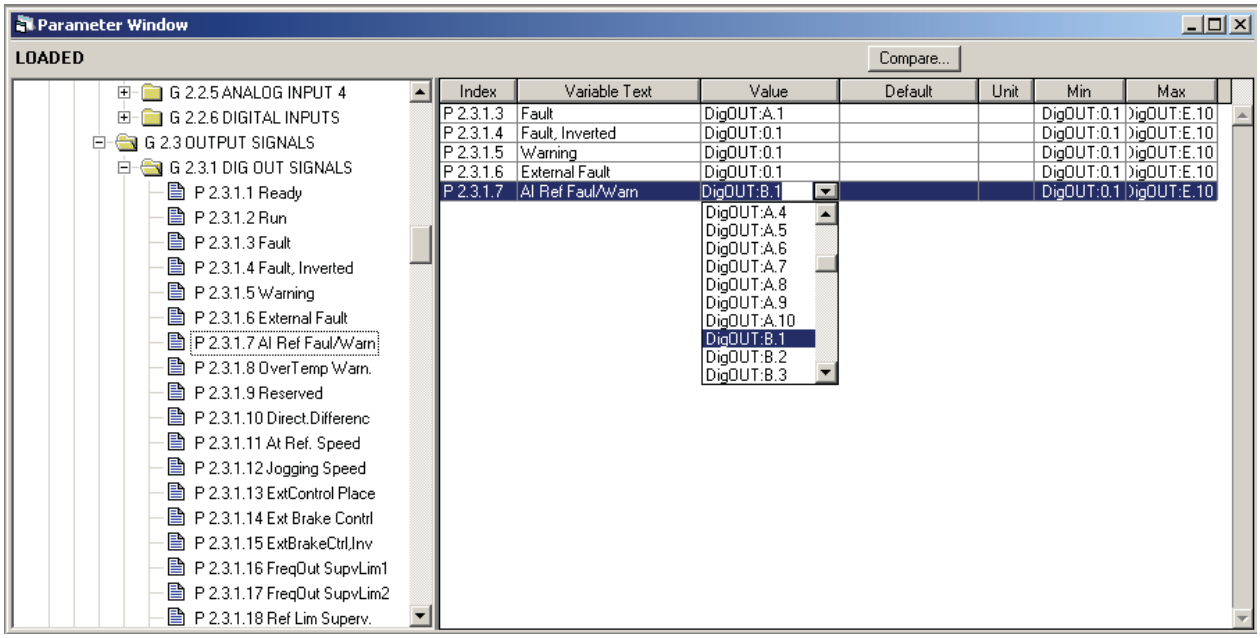


Figure 6- 1. Screenshot of PC software programming tool; Entering the address code

WARNING	**Be ABSOLUTELY sure not to connect two functions to one and same output in order to avoid function overruns and to ensure flawless operation.**

Note: The *inputs*, unlike the *outputs*, cannot be changed in RUN state.

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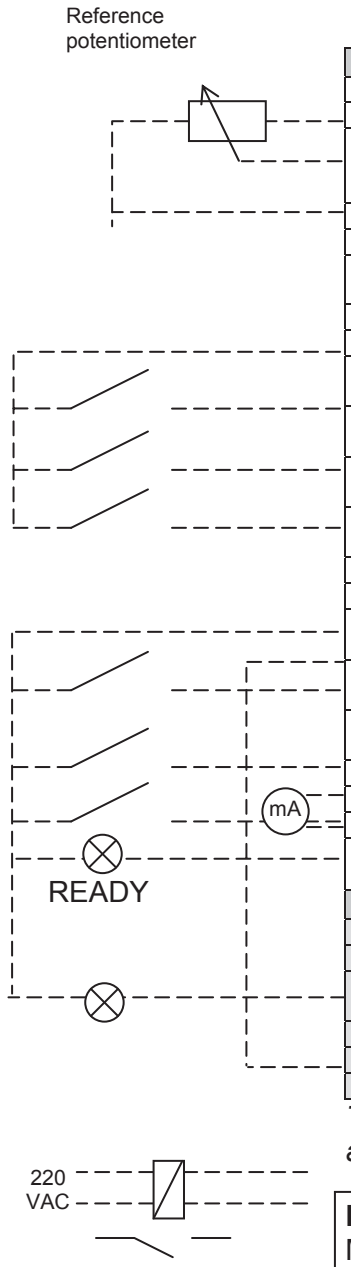
6.2.3 Defining unused inputs/outputs

All unused inputs and outputs must be given the board slot value **0** and the value **1** also for the terminal number. The value **0.0** is also the default value for most of the functions. However, if you want to use the **values of a digital input signal** for e.g. testing purposes only, you can set the board slot value to **0** and the terminal number to any number between 2…10 to place the input to a TRUE state. In other words, the value 1 corresponds to 'open contact' and values 2 to 10 to closed contact.

In case of analogue inputs, giving the value **1** for the terminal number corresponds to 0%, value **2** corresponds to 20% and any value between **3** and **10** corresponds to 100%.

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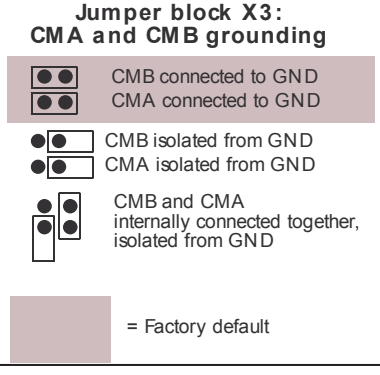
6.3 Control I/O



VW3A78201			
Terminal		Signal	Description
1	+10V$_{ref}$	Reference output	Voltage for potentiometer, etc.
2	AI1+	Analogue input, voltage range 0—10V DC	Voltage input frequency reference
3	AI1-	I/O Ground	Ground for reference and controls
4	AI2+	Analogue 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	Fault reset (programmable)	Contact closed = fault reset
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	Jogging speed selection (programmable)	Contact closed = Jogging speed active
15	DIN5	External fault (programmable)	Contact open = no fault Contact closed = fault
16	DIN6	Accel. /decel. time select (programmable)	Contact open = par. 2.1.3, 2.1.4 in use Contact closed = par. 2.4.3., 2.4.4 in use
17	CMB	Common for DIN4—DIN6	Connect to GND or +24V
18	AOA1+	Output frequency	Programmable
19	AOA1-	Analogue output	Range 0—20 mA/R_L, max. 500Ω
20	DOA1	Digital output READY	Programmable Open collector, I≤50mA, U≤48 VDC
VW3A78202			
21	RO1	Relay output 1 RUN	Programmable
22	RO1		
23	RO1		
24	RO2	Relay output 2 FAULT	Programmable
25	RO2		
26	RO2		

Table 6- 1. Multi-purpose control application default I/O configuration and connection example.

Note: See jumper selections below. More information in ATV78 User's Manual, Chapter 6.2.2.2.



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6.4 Control signal logic in Multi-purpose Control Application

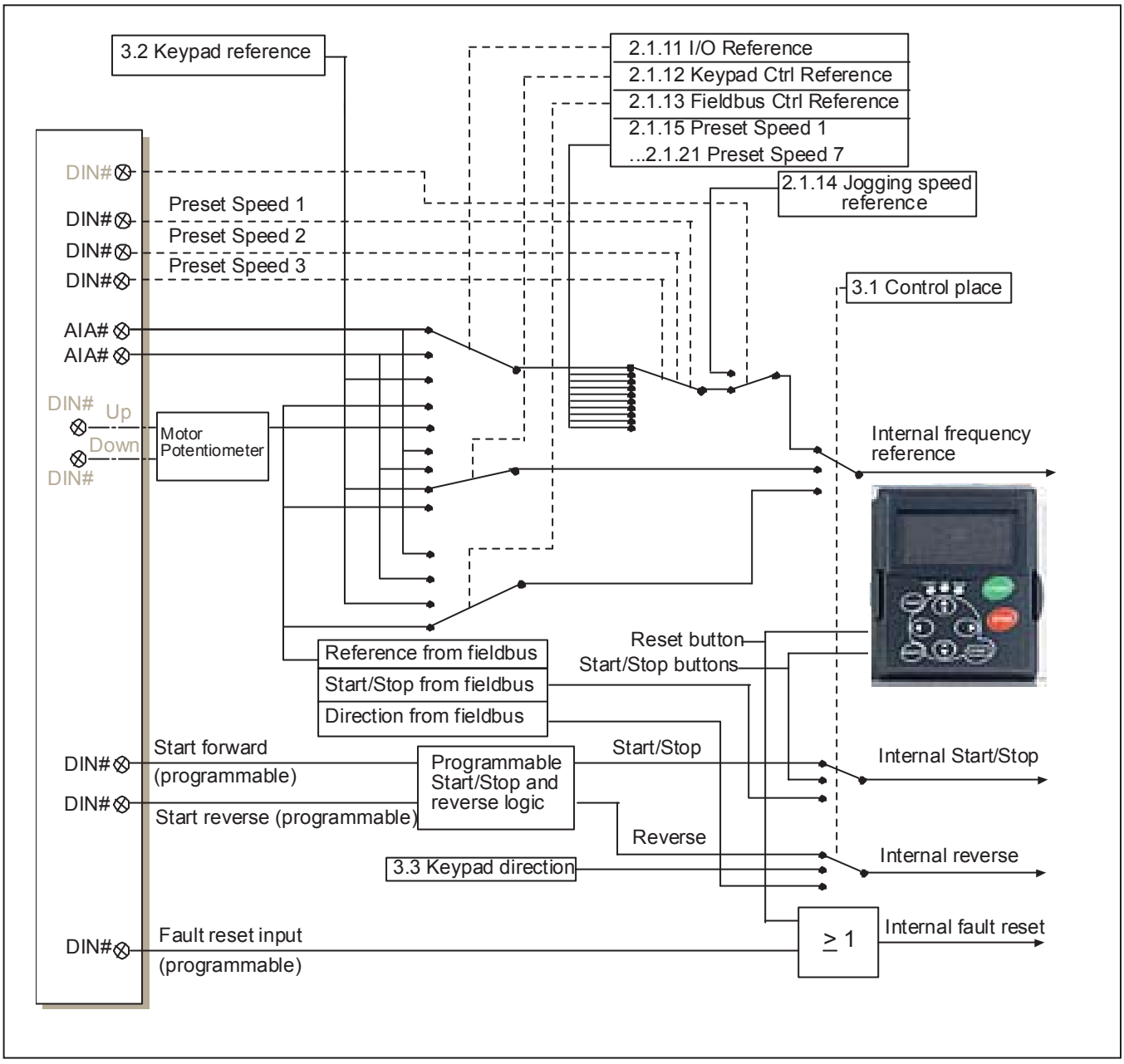


Figure 6- 2. Control signal logic of the Multi-purpose Control Application

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6.5 Multi-purpose Control Application – Parameter lists

On the next pages you will find the lists of parameters within the respective parameter groups.

Column explanations:

Code = Location indication on the keypad; Shows the operator the present param. 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)
=On parameter code: Parameter value can only be changed after the FC has been stopped.

= Apply the *Terminal to Function method (TTF)* to these parameters (see Chapter 2)

6.5.1 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 ATV78 User's Manual, Chapter 7 for more information.

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 Motor nominal 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	Motor temperature	%	9	Calculated motor temperature
V1.11	Analogue input 1	V/mA	13	AI1
V1.12	Analogue input 2	V/mA	14	AI2
V1.13	DIN1, DIN2, DIN3		15	Digital input statuses
V1.14	DIN4, DIN5, DIN6		16	Digital input statuses
V1.15	Analogue I_{out}	mA	26	AOA1
V1.16	Analogue input 3	V/mA	27	AI3
V1.17	Analogue input 4	V/mA	28	AI4
V1.18	Torque reference	%	18	
M1.19	Multimonitoring items			Displays three selectable monitoring values

Table 6- 2. Monitoring values

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6.5.2 Basic parameters (Control keypad: Menu M2 → 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	Acceleration time 1	0,1	3000,0	s	1,0		103	
P2.1.4	Deceleration time 1	0,1	3000,0	s	1,0		104	
P2.1.5	Current limit	Varies	Varies	A	Varies		107	
P2.1.6	Nominal voltage of the motor	180	690	V	690V		110	
P2.1.7	Nominal frequency of the motor	30,00	320,00	Hz	50,00		111	Check the rating plate of the motor
P2.1.8	Nominal speed of the motor	300	20 000	rpm	1440		112	The default applies for a 4-pole motor and a nominal size variable speed drive.
P2.1.9	Nominal current of the motor	Varies	Varies	A	Varies		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	14		0		117	**0**=AI1 **1**=AI2 **2**=AI1+AI2 **3**=AI1-AI2 **4**=AI2-AI1 **5**=AI1xAI2 **6**=AI1 Joystick **7**=AI2 Joystick **8**=Keypad **9**=Fieldbus **10**=Motor potentiometer **11**=AI1, AI2 minimum **12**=AI1, AI2 maximum **13**=Max frequency **14**=AI1/AI2 selection
P2.1.12	Keypad control reference	0	9		8		121	**0**=AI1 **1**=AI2 **2**=AI1+AI2 **3**=AI1-AI2 **4**=AI2-AI1 **5**=AI1xAI2 **6**=AI1 Joystick **7**=AI2 Joystick **8**=Keypad **9**=Fieldbus
P2.1.13	Fieldbus control reference	0	9		9		122	See par. 2.1.12
P2.1.14	Jogging speed reference	0,00	Par. 2.1.2	Hz	5,00		124	
P2.1.15	Preset speed 1	0,00	Par. 2.1.2	Hz	10,00		105	Multi-step speed 1
P2.1.16	Preset speed 2	0,00	Par. 2.1.2	Hz	15,00		106	Multi-step speed 2
P2.1.17	Preset speed 3	0,00	Par. 2.1.2	Hz	20,00		126	Multi-step speed 3
P2.1.18	Preset speed 4	0,00	Par. 2.1.2	Hz	25,00		127	Multi-step speed 4
P2.1.19	Preset speed 5	0,00	Par. 2.1.2	Hz	30,00		128	Multi-step speed 5
P2.1.20	Preset speed 6	0,00	Par. 2.1.2	Hz	40,00		129	Multi-step speed 6
P2.1.21	Preset speed 7	0,00	Par. 2.1.2	Hz	50,00		130	Multi-step speed 7

Table 6- 3. Basic parameters G2.1

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6.5.3 Input signals

6.5.3.1 Basic Settings (Control keypad: Menu M2 → G2.2.1)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.1.1	Start/Stop logic selection	0	7		0		300	Start signal **1** (Default: DIN1) / Start signal **2** (Default: DIN2) **0** Start forw. / Start rev. **1** Start/Stop / Reverse **2** Start/Stop / Run enable **3** Start pulse / Stop pulse **4** Start / Mot.pot.UP **5** Fwd pulse / Rev pulse **6** Start pulse / Rev pulse **7** Start pulse / Enabl pulse
P2.2.1.2	Motor potentiometer ramp time	0,1	2000,0	Hz/s	10,0		331	
P2.2.1.3	Motor potentiometer frequency reference memory reset	0	2		1		367	**0**=No reset **1**=Reset if stopped or powered down **2**=Reset if powered down
P2.2.1.4	Adjust input	0	5		0		493	**0**=Not used **1**=AI1 **2**=AI2 **3**=AI3 **4**=AI4 **5**=Fieldbus (FBProcessDataIN3
P2.2.1.5	Adjust minimum	0,0	100,0	%	0,0		494	
P2.2.1.6	Adjust maximum	0,0	100,0	%	0,0		495	

Table 6- 4. Input signals: basic settings, G2.2.1

6.5.3.2 Analogue input 1 (Control keypad: Menu M2 → G2.2.2)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.2.1	AI1 signal selection	0			A.1		377	
P2.2.2.2	AI1 filter time	0,00	10,00	s	0,10		324	**0**=No filtering
P2.2.2.3	AI1 signal range	0	3		0		320	**0**=0…100%* **1**=20…100%* **2**= -10V…+10V* **3**= Custom range
P2.2.2.4	AI1 custom minimum setting	-100,00	100,00	%	0,00		321	
P2.2.2.5	AI1 custom maximum setting	-100,00	100,00	%	100,00		322	
P2.2.2.6	AI1 reference scaling, minimum value	0,00	320,00	Hz	0,00		303	Selects the frequency that corresponds to the min. reference signal
P2.2.2.7	AI1 reference scaling, maximum value	0,00	320,00	Hz	0,00		304	Selects the frequency that corresponds to the max. reference signal
P2.2.2.8	AI1 joystick hysteresis	0,00	20,00	%	0,00		384	
P2.2.2.9	AI1 sleep limit	0,00	100,00	%	0,00		385	
P2.2.2.10	AI1 sleep delay	0,00	320,00	s	0,00		386	

Table 6- 5. Analogue input 1 parameters, G2.2.2

*Remember to place jumpers of block X2 accordingly. See ATV78 User's Manual, chapter 6.2.2.2

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6.5.3.3 Analogue input 2 (Control keypad: Menu M2 → G2.2.3)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.3.1	AI2 signal selection	0			A.2		388	
P2.2.3.2	AI2 filter time	0,00	10,00	s	0,10		329	**0**=No filtering
P2.2.3.3	AI2 signal range	0	3		1		325	**0**=0…100%* **1**=20…100%* **2**= -10V…+10V* **3**= Custom range
P2.2.3.4	AI2 custom minimum setting	-100,00	100,00	%	0,00		326	
P2.2.3.5	AI2 custom maximum setting	-100,00	100,00	%	100,00		327	
P2.2.3.6	AI2 reference scaling, minimum value	0,00	320,00	Hz	0,00		393	Selects the frequency that corresponds to the min. reference signal
P2.2.3.7	AI2 reference scaling, maximum value	0,00	320,00	Hz	0,00		394	Selects the frequency that corresponds to the max. reference signal
P2.2.3.8	AI2 joystick hysteresis	0,00	20,00	%	0,00		395	
P2.2.3.9	AI2 sleep limit	0,00	100,00	%	0,00		396	
P2.2.3.10	AI2 sleep delay	0,00	320,00	s	0,00		397	

Table 6- 6. Analogue input 2 parameters, G2.2.3

6.5.3.4 Analogue input 3 (Control keypad: Menu M2 → G2.2.4)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.4.1	AI3 signal selection	0			0.1		141	
P2.2.4.2	AI3 filter time	0,00	10,00	s	0,10		142	**0**=No filtering
P2.2.4.3	AI3 signal range	0	3		0		143	**0**=0…100% **1**=20…100% **2**= -10V…+10V **3**= Custom range
P2.2.4.4	AI3 custom minimum setting	-100,00	100,00	%	0,00		144	
P2.2.4.5	AI3 custom maximum setting	-100,00	100,00	%	100,00		145	
P2.2.4.6	AI3 signal inversion	0	1		0		151	**0**=Not inverted **1**=Inverted

Table 6- 7. Analogue input 3 parameters, G2.2.4

*Remember to place jumpers of block X2 accordingly. See ATV78 User's Manual, chapter 6.2.2.2

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6.5.3.5 Analogue input 4 (Control keypad: Menu M2 → G2.2.5)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.5.1	AI4 signal selection	0			0.1		152	
P2.2.5.2	AI4 filter time	0,00	10,00	s	0,10		153	**0**=No filtering
P2.2.5.3	AI4 signal range	0	3		1		154	**0**=0…100% **1**=20…100% **2**= -10V…+10V **3**= Custom range
P2.2.5.4	AI4 custom minimum setting	-100,00	100,00	%	0,00		155	
P2.2.5.5	AI4 custom maximum setting	-100,00	100,00	%	100,00		156	
P2.2.5.6	AI4 signal inversion	0	1		0		162	**0**=Not inverted **1**=Inverted

Table 6- 8. Analogue input 4 parameters, G2.2.5

6.5.3.6 Free analogue input, signal selection (Keypad: Menu M2 → G2.2.6)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.6.1	Scaling of current limit	0	5		0		399	**0**=Not used **1**=AI1 **2**=AI2 **3**=AI3 **4**=AI4 **5**=Fieldbus (FBProcessDataIN2)
P2.2.6.2	Scaling of DC-braking current	0	5		0		400	See par. 2.2.6.1
P2.2.6.3	Reducing of acc./dec. times	0	5		0		401	See par. 2.2.6.1
P2.2.6.4	Reducing of torque supervision limit	0	5		0		402	See par. 2.2.6.1
P2.2.6.5	Torque limit	0	5		0		485	See par. 2.2.6.1

Table 6- 9. Free analogue input signal selection, G2.2.6

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6.5.3.7 Digital inputs (Control keypad: Menu M2 → G2.2.4)

Code	Parameter	Min	Default	Cust	ID	Note
P2.2.7.1	Start signal 1	0	A.1		403	
P2.2.7.2	Start signal 2	0	A.2		404	
P2.2.7.3	Run enable	0	0.2		407	Motor start enabled (cc)
P2.2.7.4	Reverse	0	0.1		412	Direction forward (oc) Direction reverse (cc)
P2.2.7.5	Preset speed 1	0	0.1		419	
P2.2.7.6	Preset speed 2	0	0.1		420	
P2.2.7.7	Preset speed 3	0	0.1		421	
P2.2.7.8	Motor potentiometer reference DOWN	0	0.1		417	Mot.pot. reference decreases (cc)
P2.2.7.9	Motor potentiometer reference UP	0	0.1		418	Mot.pot. reference increases (cc)
P2.2.7.10	Fault reset	0	A.3		414	All faults reset (cc)
P2.2.7.11	External fault (close)	0	A.5		405	Ext. fault displayed (cc)
P2.2.7.12	External fault (open)	0	0.2		406	Ext. fault displayed (oc)
P2.2.7.13	Acc/Dec time selection	0	A.6		408	Acc/Dec time 1 (oc) Acc/Dec time 2 (cc)
P2.2.7.14	Acc/Dec prohibit	0	0.1		415	Acc/Dec prohibited (cc)
P2.2.7.15	DC braking	0	0.1		416	DC braking active (cc)
P2.2.7.16	Jogging speed	0	A.4		413	Jogging speed selected for frequency reference (cc)
P2.2.7.17	AI1/AI2 selection	0	0.1		422	
P2.2.7.18	Control from I/O terminal	0	0.1		409	Force control place to I/O terminal (cc)
P2.2.7.19	Control from keypad	0	0.1		410	Force control place to keypad (cc)
P2.2.7.20	Control from fieldbus	0	0.1		411	Force control place to fieldbus (cc)
P2.2.7.21	Parameter set 1/set 2 selection	0	0.1		496	Closed cont.=Set 2 is used Open cont.=Set 1 is used
P2.2.7.22	Motor control mode 1/2	0	0.1		164	Closed cont.=Mode 2 is used Open cont.=Mode 1 is used See par 2.6.1, 2.6.12

Table 6- 10. Digital input signals, G2.2.4

cc = closing contact
oc = opening contact

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6.5.4 Output signals

6.5.4.1 Delayed digital output 1 (Keypad: Menu M2 → G2.3.1)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.3.1.1	Digital output 1 signal selection	0			0.1		486	
P2.3.1.2	Digital output 1 function	0	26		1		312	**0**=Not used **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**=Reverse **10**=Jogging spd selected **11**=At speed **12**=Mot. regulator active **13**=Freq. limit 1 superv. **14**=Freq. limit 2 superv. **15**=Torque limit superv. **16**=Ref. limit supervision **17**=External brake control **18**=I/O control place act. **19**=FC temp. limit superv. **20**=Reference inverted **21**=Ext. brake control inverted **22**=Therm. fault or warn. **23**=On/Off control **24**=FB data to DO/RO **25**=FB data to DO/RO **26**=FB data to DO/RO
P2.3.1.3	Digital output 1 on delay	0,00	320,00	s	0,00		487	0,00 = delay not in use
P2.3.1.4	Digital output 1 off delay	0,00	320,00	s	0.00		488	0,00 = delay not in use

Table 6- 11. Delayed digital output 1 parameters, G2.3.1

6.5.4.2 Delayed digital output 2 (Keypad: Menu M2 → G2.3.2)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.3.2.1	Digital output 2 signal selection	0			0.1		489	
P2.3.2.2	Digital output 2 function	0	26		0		490	See par. 2.3.1.2
P2.3.2.3	Digital output 2 on delay	0,00	320,00	s	0,00		491	0,00 = delay not in use
P2.3.2.4	Digital output 2 off delay	0,00	320,00	s	0,00		492	0,00 = delay not in use

Table 6- 12. Delayed digital output 2 parameters, G2.3.2

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6.5.4.3 Digital output signals (Control keypad: Menu M2 → G2.3.3)

Code	Parameter	Min	Default	Cust	ID	Note
P2.3.3.1	Ready	0	A.1		432	
P2.3.3.2	Run	0	B.1		433	
P2.3.3.3	Fault	0	B.2		434	
P2.3.3.4	Inverted fault	0	0.1		435	
P2.3.3.5	Warning	0	0.1		436	
P2.3.3.6	External fault	0	0.1		437	
P2.3.3.7	Reference fault/warning	0	0.1		438	
P2.3.3.8	Overtemperature warning	0	0.1		439	
P2.3.3.9	Reverse	0	0.1		440	
P2.3.3.10	Unrequested direction	0	0.1		441	
P2.3.3.11	At speed	0	0.1		442	
P2.3.3.12	Jogging speed	0	0.1		443	
P2.3.3.13	External control place	0	0.1		444	
P2.3.3.14	External brake control	0	0.1		445	
P2.3.3.15	External brake control, inverted	0	0.1		446	
P2.3.3.16	Output frequency limit 1 supervision	0	0.1		447	
P2.3.3.17	Output frequency limit 2 supervision	0	0.1		448	
P2.3.3.18	Reference limit supervision	0	0.1		449	
P2.3.3.19	Temperature limit supervision	0	0.1		450	
P2.3.3.20	Torque limit supervision	0	0.1		451	
P2.3.3.21	Motor thermal protection	0	0.1		452	
P2.3.3.22	Analogue input supervision limit	0	0.1		463	
P2.3.3.23	Motor regulator activation	0	0.1		454	
P2.3.3.24	Fieldbus data to DO/RO	0	0.1		455	
P2.3.3.25	Fieldbus data to DO/RO	0	0.1		456	
P2.3.3.26	Fieldbus data to DO/RO	0	0.1		457	

Table 6- 13. Digital output signals, G2.3.3

	**Be ABSOLUTELY sure not to connect two functions to one and same <u>output</u> in order to avoid function overruns and to ensure flawless operation.**

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6.5.4.4 Limit settings (Control keypad: Menu M2 → G2.3.4)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.3.4.1	Output frequency limit 1 supervision	0	3		0		315	**0**=No limit **1**=Low limit supervision **2**=High limit supervision **3**=Brake-on control
P2.3.4.2	Output frequency limit 1; Supervised value	0,00	Par. 2.1.2	Hz	0,00		316	
P2.3.4.3	Output frequency limit 2 supervision	0	4		0		346	**0**=No limit **1**=Low limit supervision **2**=High limit supervision **3**=Brake-off control **4**=Brake on/off-control
P2.3.4.4	Output frequency limit 2; Supervised value	0,00	Par. 2.1.2	Hz	0,00		347	
P2.3.4.5	Torque limit supervision	0	3		0		348	**0**=Not used **1**=Low limit supervision **2**=High limit supervision **3**=Brake-off control
P2.3.4.6	Torque limit supervision value	-1000,0	1000,0	%	100,0		349	
P2.3.4.7	Reference limit supervision	0	2		0		350	**0**=Not used **1**=Low limit **2**=High limit
P2.3.4.8	Reference limit supervision value	0,00	Par. 2.1.2	Hz	0,00		351	
P2.3.4.9	External brake-off delay	0,0	100,0	s	0,5		352	
P2.3.4.10	External brake-on delay	0,0	100,0	s	1,5		353	
P2.3.4.11	FC temperature supervision	0	2		0		354	**0**=Not used **1**=Low limit **2**=High limit
P2.3.4.12	FC temperature supervised value	–10	75	°C	0		355	
P2.3.4.13	On/Off control signal	0	4		0		356	**0**=Not used **1**=AI1 **2**=AI2 **3**=AI3 **4**=AI4
P2.3.4.14	On/Off control low limit	0	Par. 2.3.4.15	%	10,00		357	
P2.3.4.15	On/Off control high limit	Par. 2.3.4.14	100,00	%	90,00		358	

Table 6- 14. Limit settings, G2.3.4

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6.5.4.5 Analogue output 1 (Control keypad: Menu M2 → G2.3.5)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.3.5.1	Analogue output 1 signal selection	0			A.1		464	
P2.3.5.2	Analogue output 1 function	0	13		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**=Motor 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) **9**=AI1 **10**=AI2 **11**=Output freq. (f_{min} - f_{max}) **12**=Motor torque (–2…+2xT_{Nmot}) **13**=Motor power (–2…+2xT_{Nmot})
P2.3.5.3	Analogue output 1 filter time	0,00	10,00	s	1,00		308	**0**=No filtering
P2.3.5.4	Analogue output 1 inversion	0	1		0		309	**0**=Not inverted **1**=Inverted
P2.3.5.5	Analogue output 1 minimum	0	1		0		310	**0**=0 mA **1**=4 mA
P2.3.5.6	Analogue output 1 scale	10	1000	%	100		311	
P2.3.5.7	Analogue output 1 offset	-100,00	100,00	%	0,00		375	

Table 6- 15. Analogue output 1 parameters, G2.3.5

6.5.4.6 Analogue output 2 (Control keypad: Menu M2 → G2.3.6)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.3.6.1	Analogue output 2 signal selection	0			0.1		471	
P2.3.6.2	Analogue output 2 function	0	13		4		472	See par. 2.3.5.2
P2.3.6.3	Analogue output 2 filter time	0,00	10,00	s	1,00		473	**0**=No filtering
P2.3.6.4	Analogue output 2 inversion	0	1		0		474	**0**=Not inverted **1**=Inverted
P2.3.6.5	Analogue output 2 minimum	0	1		0		475	**0**=0 mA **1**=4 mA
P2.3.6.6	Analogue output 2 scale	10	1000	%	100		476	
P2.3.6.7	Analogue output 2 offset	-100,00	100,00	%	0,00		477	

Table 6- 16. Analogue output 2 parameters, G2.3.6

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6.5.4.7 Analogue output 3 (Control keypad: Menu M2 → G2.3.7)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.3.7.1	Analogue output 3 signal selection	0			0.1		478	
P2.3.7.2	Analogue output 3 function	0	13		5		479	See par. 2.3.5.2
P2.3.7.3	Analogue output 3 filter time	0,00	10,00	s	1,00		480	**0**=No filtering
P2.3.7.4	Analogue output 3 inversion	0	1		0		481	**0**=Not inverted **1**=Inverted
P2.3.7.5	Analogue output 3 minimum	0	1		0		482	**0**=0 mA **1**=4 mA
P2.3.7.6	Analogue output 3 scale	10	1000	%	100		483	
P2.3.7.7	Analogue output 3 offset	-100,00	100,00	%	0,00		484	

Table 6- 17. Analogue output 3 parameters, G2.3.7

6.5.5 Drive control parameters (Control keypad: Menu M2 → 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	Acceleration time 2	0,1	3000,0	s	10,0		502	
P2.4.4	Deceleration time 2	0,1	3000,0	s	10,0		503	
P2.4.5	Brake chopper	0	4		0		504	**0**=Disabled **1**=Used when running **2**=External brake chopper **3**=Used when stopped/running **4**=Used when running (no testing)
P2.4.6	Start function	0	1		0		505	**0**=Ramp **1**=Flying start
P2.4.7	Stop function	0	3		0		506	**0**=Coasting **1**=Ramp **2**=Ramp+Run enable coast **3**=Coast+Run enable ramp
P2.4.8	DC braking current	0,15 x I_n	1,5 x I_n	A	Varies		507	
P2.4.9	DC braking time at stop	0,00	600,00	s	0,00		508	**0**=DC brake is off at stop
P2.4.10	Frequency to start DC braking during ramp stop	0,10	10,00	Hz	1,50		515	
P2.4.11	DC braking time at start	0,00	600,00	s	0,00		516	**0**=DC brake is off at start
P2.4.12	Flux brake	0	1		0		520	**0**=Off **1**=On
P2.4.13	Flux braking current	0,0	Varies	A	0,0		519	

Table 6- 18. Drive control parameters, G2.4

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6.5.6 Prohibit frequency parameters (Control keypad: Menu M2 → G2.5)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.5.1	Prohibit frequency range 1 low limit	0,00	Par. 2.5.2	Hz	0,00		509	**0**=Not used
P2.5.2	Prohibit frequency range 1 high limit	0,00	Par. 2.1.2	Hz	0,00		510	**0**=Not used
P2.5.3	Prohibit frequency range 2 low limit	0,00	Par. 2.5.4	Hz	0,00		511	**0**=Not used
P2.5.4	Prohibit frequency range 2 high limit	0,00	Par. 2.1.2	Hz	0,00		512	**0**=Not used
P2.5.5	Prohibit frequency range 3 low limit	0,00	Par. 2.5.6	Hz	0,00		513	**0**=Not used
P2.5.6	Prohibit frequency range 3 high limit	0,00	Par. 2.1.2	Hz	0,00		514	**0**=Not used
P2.5.7	Prohibit freq. acc./ dec. ramp scaling	0,1	10,0	Times	1,0		518	

Table 6- 19. Prohibit frequency parameters, G2.5

6.5.7 Motor control parameters (Control keypad: Menu M2 → G2.6)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.6.1	Motor control mode	0	2/6		0		600	**ATV78:** **0**=Frequency control **1**=Speed control **2**=Torque control **Additionally for ATV78F:** **3**=Closed loop speed ctrl **4**=Closed loop torque ctrl **5**=Adv. OL* freq. control **6**=Advanced open loop speed control
P2.6.2	U/f optimisation	0	1		0		109	**0**=Not used **1**=Automatic torque boost
P2.6.3	U/f ratio selection	0	3		0		108	**0**=Linear **1**=Squared **2**=Programmable **3**=Linear with flux optim.
P2.6.4	Field weakening point	8,00	320,00	Hz	50,00		602	
P2.6.5	Voltage at field weakening point	10,00	200,00	%	100,00		603	n% x U_{nmot}
P2.6.6	U/f curve midpoint frequency	0,00	par. P2.6.4	Hz	50,00		604	
P2.6.7	U/f curve midpoint voltage	0,00	100,00	%	100,00		605	n% x U_{nmot} Parameter max. value = par. 2.6.5
P2.6.8	Output voltage at zero frequency	0,00	40,00	%	0,00		606	n% x U_{nmot}
P2.6.9	Switching frequency	1,0	Varies	kHz	Varies		601	
P2.6.10	Overvoltage controller	0	2		1		607	**0**=Not used **1**=Used (no ramping) **2**=Used (ramping)
P2.6.11	Undervoltage controller	0	1		1		608	**0**=Not used **1**=Used
P2.6.12	Motor control mode 2	0	2/6		2		521	See par. 2.6.1
P2.6.13	Speed controller P gain (open loop)	0	32767		3000		637	
P2.6.14	Speed controller I gain (open loop)	0	32767		300		638	

* OL = Open Loop

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Closed Loop parameter group 2.6.15 (ATV78F only)								
P2.6.15.1	Magnetizing current	0,00	100,00	A	0,00		612	
P2.6.15.2	Speed control P gain	0	1000		30		613	
P2.6.15.3	Speed control I time	0,0	500,0	ms	30,0		614	
P2.6.15.4	Load drooping	0,00	100,00	%	0,00		620	
P2.6.15.5	Acceleration compensation	0,00	300,00	s	0,00		626	
P2.6.15.6	Slip adjust	0	500	%	100		619	
P2.6.15.7	Magnetizing current at start	MotCurr Min	MotCurr Max	A	0,00		627	
P2.6.15.8	Magnetizing time at start	0,0	600,0	s	0,0		628	
P2.6.15.9	0-speed time at start	0	32000	ms	100		615	
P2.6.15.10	0-speed time at stop	0	32000	ms	100		616	
P2.6.15.11	Start-up torque	0	3		0		621	**0**=Not used **1**=Torque memory **2**=Torque reference **3**=Start-up torque fwd/rev
P2.6.15.12	Start-up torque FWD	–300,0	300,0	s	0,0		633	
P2.6.15.13	Start-up torque REV	–300,0	300,0	s	0,0		634	
P2.6.15.15	Encoder filter time	0	1000	ms	0		618	
P2.6.15.17	Current control P gain	0,00	100,00	%	40,00		617	
Advanced Open Loop parameter group 2.6.16 (ATV78F only)								
P2.6.16.1	Zero speed current	0,0	250,0	%	120,0		625	
P2.6.16.2	Minimum current	0,0	100,0	%	80,0		622	
P2.6.16.3	Flux reference	0,0	100,0	%	80,0		623	
P2.6.16.4	Frequency limit	0,0	100,0	%	20,0		635	
P2.6.16.5	U/f boost	0	1		0		632	

Table 6- 20. Motor control parameters, G2.6

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6.5.8 Protections (Control keypad: Menu M2 → G2.7)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.7.1	Response to 4mA reference fault	0	5		0		700	**0**=No response **1**=Warning **2**=Warning+prev.freq. **3**=Wrng+PresetFreq 2.7.2 **4**=Fault,stop acc. to 2.4.7 **5**=Fault,stop by coasting
P2.7.2	4mA reference fault frequency	0,00	Par. 2.1.2	Hz	0,00		728	
P2.7.3	Response to 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 supervision	0	3		0		730	
P2.7.5	Response to undervoltage fault	1	3		3		727	
P2.7.6	Output phase supervision	0	3		2		702	
P2.7.7	Earth fault protection	0	3		2		703	
P2.7.8	Thermal protection of the motor	0	3		2		704	
P2.7.9	Motor ambient temperature factor	–100,0	100,0	%	0,0		705	
P2.7.10	Motor cooling factor at zero speed	0,0	150,0	%	40,0		706	
P2.7.11	Motor thermal time constant	1	200	min	45		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 limit	0,1	I_{nMotor} x 2	A	I_{nMotor} x1,3		710	
P2.7.15	Stall time limit	1,00	120,00	s	15,00		711	
P2.7.16	Stall frequency limit	1,0	Par. 2.1.2	Hz	25,0		712	
P2.7.17	Underload protection	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	Underload curve at nominal frequency	10,0	150,0	%	50,0		714	
P2.7.19	Underload curve at zero frequency	5,0	150,0	%	10,0		715	
P2.7.20	Underload protection time limit	2,00	600,00	s	20,00		716	
P2.7.21	Response to thermistor fault	0	3		2		732	**0**=No response **1**=Warning **2**=Fault,stop acc. to 2.4.7 **3**=Fault,stop by coasting
P2.7.22	Response to fieldbus fault	0	3		2		733	See P2.7.21
P2.7.23	Response to slot fault	0	3		2		734	See P2.7.21

Table 6- 21. Protections, G2.7

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6.5.9 Autorestart parameters (Control keypad: Menu M2 → 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	0,10		718	
P2.8.3	Start function	0	2		0		719	**0**=Ramp **1**=Catch on the fly **2**=According to par. 2.4.6
P2.8.4	Number of tries after undervoltage trip	0	10		0		720	
P2.8.5	Number of tries after overvoltage trip	0	10		0		721	
P2.8.6	Number of tries after overcurrent trip	0	3		0		722	
P2.8.7	Number of tries after reference trip	0	10		0		723	
P2.8.8	Number of tries after motor temperature fault trip	0	10		0		726	
P2.8.9	Number of tries after external fault trip	0	10		0		725	
P2.8.10	Number of tries after underload fault trip	0	10		1		738	

Table 6- 22. Autorestart parameters, G2.8

6.5.10 Fieldbus parameters (Control Keypad: Menu M2 →G2.9)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.9.1	Fieldbus min scale	0,00	320,00	Hz	0,00		850	
P2.9.2	Fieldbus max scale	0,00	320,00	Hz	0,00		851	
P2.9.3	Fieldbus data out 1 selection	0	10000		1		852	Choose monitoring data with parameter ID
P2.9.4	Fieldbus data out 2 selection	0	10000		2		853	Choose monitoring data with parameter ID
P2.9.5	Fieldbus data out 3 selection	0	10000		3		854	Choose monitoring data with parameter ID
P2.9.6	Fieldbus data out 4 selection	0	10000		4		855	Choose monitoring data with parameter ID
P2.9.7	Fieldbus data out 5 selection	0	10000		5		856	Choose monitoring data with parameter ID
P2.9.8	Fieldbus data out 6 selection	0	10000		6		857	Choose monitoring data with parameter ID
P2.9.9	Fieldbus data out 7 selection	0	10000		7		858	Choose monitoring data with parameter ID
P2.9.10	Fieldbus data out 8 selection	0	10000		37		859	Choose monitoring data with parameter ID

Table 6- 23. Fieldbus parameters

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6.5.11 Torque control parameters (Control Keypad: Menu M2 →G2.10)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.10.1	Torque limit	0,0	400,0	%	400,0		609	
P2.10.2	Torque limit control P-gain	0,0	32000		3000		610	
P2.10.3	Torque limit control I-gain	0,0	32000		200		611	
P2.10.4	Torque reference selection	0	8		0		641	**0**=Not used **1**=AI1 **2**=AI2 **3**=AI3 **4**=AI4 **5**=AI1 joystick **6**=AI2 joystick **7**=Torque reference from keypad, R3.5 **8**=Fieldbus
P2.10.5	Torque reference max.	–300,0	300,0	%	100		642	
P2.10.6	Torque reference min.	–300,0	300,0	%	0,0		643	
P2.10.7	Torque speed limit	0	2		1		644	**0**=Max. frequency **1**=Selected freq.reference **2**=Preset speed 7
P2.10.8	Minimum frequency for open loop torque control	0,00	par.2.1.1	Hz	3,00		636	
P2.10.9	Torque controller P gain	0	32000		150		639	
P2.10.10	Torque controller I gain	0	32000		10		640	

Table 6- 24. Torque control parameters, G2.10

6.5.12 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 ATV78 User's Manual.

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	Direction (on keypad)	0	1		0		123	**0** = Forward **1** = Reverse
P3.4	Stop button	0	1				114	**0**=Limited function of Stop button **1**=Stop button always enabled
R3.5	Torque reference	0,0	100,0	%	0,0			

Table 6- 25. Keypad control parameters, M3

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6.5.13 System menu (Control keypad: Menu M6)

For parameters and functions related to the general use of the variable speed drive, such as application and language selection, customized parameter sets or information about the hardware and software, see Chapter 7.3.6 in the ATV78 User's Manual.

6.5.14 Expander boards (Control keypad: Menu M7)

The **M7** menu shows the expander and option boards attached to the control board and board-related information. For more information, see Chapter 7.3.7 in the ATV78 User's Manual.

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7. Pump and Fan Control Application

7.1 Introduction

Select the Pump and Fan Control Application in menu **M6** on page *S6.2*.

The Pump and Fan Control Application can be used to control one variable speed drive and up to four auxiliary drives. The PID controller of the variable speed drive controls the speed of the variable speed drive and gives control signals to start and stop the auxiliary drives to control the total flow. In addition to the eight parameter groups provided as standard, a parameter group for multi-pump and fan control functions is available.

The application has two control places on the I/O terminal. Place A is the pump and fan control and place B is the direct frequency reference. The control place is selected with input DIN6.

As already its name tells, the Pump and Fan Control Application is used to control the operation of pumps and fans. It can be used, for example, to decrease the delivery pressure in booster stations if the measured input pressure falls below a limit specified by the user.

The application utilizes external contactors for switching between the motors connected to the variable speed drive. The autochange feature provides the capability of changing the starting order of the auxiliary drives. Autochange between 2 drives (main drive + 1 auxiliary drive) is set as default, see chapter 7.2.1.

- All inputs and outputs are freely programmable.

Additional functions:

- Analogue input signal range selection
- Two frequency limit supervisions
- Torque limit supervision
- Reference limit supervision
- Second ramps and S-shape ramp programming
- Programmable Start/Stop and Reverse logic
- DC-brake at start and stop
- Three prohibit frequency areas
- Programmable U/f curve and switching frequency
- Autorestart
- Motor thermal and stall protection: fully programmable; off, warning, fault
- Motor underload protection
- Input and output phase supervision
- Sleep function

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7.2 Short description of function and essential parameters

7.2.1 Automatic changing between drives (Autochange, P2.9.24)

The *Autochange function* allows the starting and stopping order of drives controlled by the pump and fan automatics to be changed at desired intervals. The drive controlled by variable speed drive can also be included in the automatic changing and locking sequence (par. 2.9.25). The Autochange function makes it possible to equalize the run times of the motors and to prevent e.g. pump stalls due to too long running breaks.

- Apply the Autochange function with parameter 2.9.24, *Autochange*.
- The autochange takes place when the time set with parameter 2.9.26, *Autochange interval,* has expired and the capacity used is below the level defined with parameter 2.9.28, *Autochange frequency limit*.
- The running drives are stopped and re-started according to the new order.
- External contactors controlled through the relay outputs of the variable speed drive connect the drives to the variable speed drive or to the mains. If the motor controlled by the variable speed drive is included in the autochange sequence, it is always controlled through the relay output activated first. The other relays activated later control the auxiliary drives (see Figure 7- 2 and Figure 7- 3).

Parameter 2.9.24, Autochange

0 Autochange not used
1 Autochange used

The automatic change of starting and stopping order is activated and applied to either the auxiliary drives only or the auxiliary drives **and** the drive controlled by the variable speed drive. depending on the setting of parameter 2.9.25, *Automatics selection*. By default, the Autochange is activated for 2 drives. See Figure 7- 2 and Figure 7- 6.

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Parameter 2.9.25, Autochange/Interlockings automatics selection

0 Automatics (autochange/interlockings) applied to auxiliary drives only

The drive controlled by the variable speed drive remains the same. Therefore, mains contactor is needed for one auxiliary drive only.

1 All drives included in the autochange/interlockings sequence

The drive controlled by the variable speed drive is included in the automatics and a contactor is needed for each drive to connect it to either the mains or the variable speed drive.

Parameter 2.9.26, Autochange interval

After the expiry of the time defined with this parameter, the autochange function takes place if the capacity used lies below the level defined with parameters 2.9.28 (*Autochange frequency limit*) and 2.9.27 (*Maximum number of auxiliary drives*). Should the capacity exceed the value of P2.9.28, the autochange will not take place before the capacity goes below this limit.

- The time count is activated only if the Start/Stop request is active at control place A.
- The time count is reset after the autochange has taken place or on removal of Start request at control place A

Parameters 2.9.27, Maximum number of auxiliary drives and

2.9.28, Autochange frequency limit

These parameters define the level below which the capacity used must remain so that the autochange can take place.

This level is defined as follows:

- If the number of running auxiliary drives is smaller than the value of parameter 2.9.27 the autochange function can take place.

- If the number of running auxiliary drives is equal to the value of parameter 2.9.27 and the frequency of the controlled drive is below the value of parameter 2.9.28 the autochange can take place.

- If the value of parameter 2.9.28 is 0.0 Hz, the autochange can take place only in rest position (Stop and Sleep) regardless of the value of parameter 2.9.27.

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7.2.2 Interlock selection (P2.9.23)

This parameter is used to activate the interlock inputs. The interlocking signals come from the motor switches. The signals (functions) are connected to digital inputs which are programmed as interlock inputs using the corresponding parameters. The pump and fan control automatics only control the motors with active interlock data.

- The interlock data can be used even when the Autochange function is not activated
- If the interlock of an auxiliary drive is inactivated and another unused auxiliary drive available, the latter will be put to use without stopping the variable speed drive.
- If the interlock of the controlled drive is inactivated, all motors will be stopped and re-started with the new set-up.
- If the interlock is re-activated in Run status, the automatics functions according to parameter 2.9.23, *Interlock selection*:

  0 Not used

  1 Update in stop

  Interlocks are used. The new drive will be placed last in the autochange line without stopping the system. However, if the autochange order now becomes, for example, [P1 → P3 → P4 → P2], it will be updated in the next Stop (autochange, sleep, stop, etc.)

  Example:

  [P1 → P3 → P4] → [P2 LOCKED] →[P1 → P3 → P4 → P2] → [SLEEP] → [P1 → P2 → P3 → P4]

  2 Stop & Update

  Interlockings are used. The automatics will stop all motors immediately and re-start with a new set-up

  Example:

  [P1 → P2 → P4] → [P3 LOCKED] → [STOP] → [P1 → P2 → P3 → P4]

  See Chapter 7.2.3, Examples.

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7.2.3 Examples

Pump and fan automatics with interlocks and no autochange

Situation: One controlled drive and three auxiliary drives.
Parameter settings: 2.9.1=3, 2.9.25=0
Interlock feedback signals used, autochange not used.
Parameter settings: 2.9.23=1, 2.9.24=0
The interlock feedback signals come from the digital inputs selected with parameters 2.2.6.18 to 2.2.6.21.
The Auxiliary drive 1 control (par. 2.3.1.27) is enabled through Interlock 1 (par. 2.2.6.18), the Auxiliary drive 2 control (par. 2.3.1.28) through Interlock 2 (par. 2.2.6.19) etc.

Phases:

1) The system and the motor controlled by the variable speed drive are started.

2) The Auxiliary drive 1 starts when the main drive reaches the starting frequency set (par. 2.9.2).

3) The main drive decreases speed down to Auxiliary drive 1 Stop frequency (par. 2.9.3) and starts to rise toward the Start frequency of Auxiliary drive 2, if needed.

4) The Auxiliary drive 2 starts when the main drive has reached the starting frequency set (par. 2.9.4).

5) The Interlock feedback is removed from Aux. drive 2. Because the Aux. drive 3 is unused, it will be started to replace the removed Aux. drive 2.

6) The main drive increases speed to maximum because no more auxiliary drives are available.

7) The removed Aux.drive 2 is reconnected and placed last in the auxiliary drive start order which now is 1-3-2. The main drive decreases speed to the set Stop frequency. The auxiliary drive start order will be updated either immediately or in the next Stop (autochange, sleep, stop, etc.) according to par. 2.9.23.

8) If still more power is needed, the main drive speed rises up to the maximum frequency placing 100% of the output power in the system's disposal.

When the need of power decreases, the auxiliary drives turn off in the opposite order (2-3-1; after the update 3-2-1).

Pump and fan automatics with interlocks and autochange

The above is also applicable if the autochange function is used. In addition to the changed and updated start order, also the change order of main drives depends on parameter 2.9.23.

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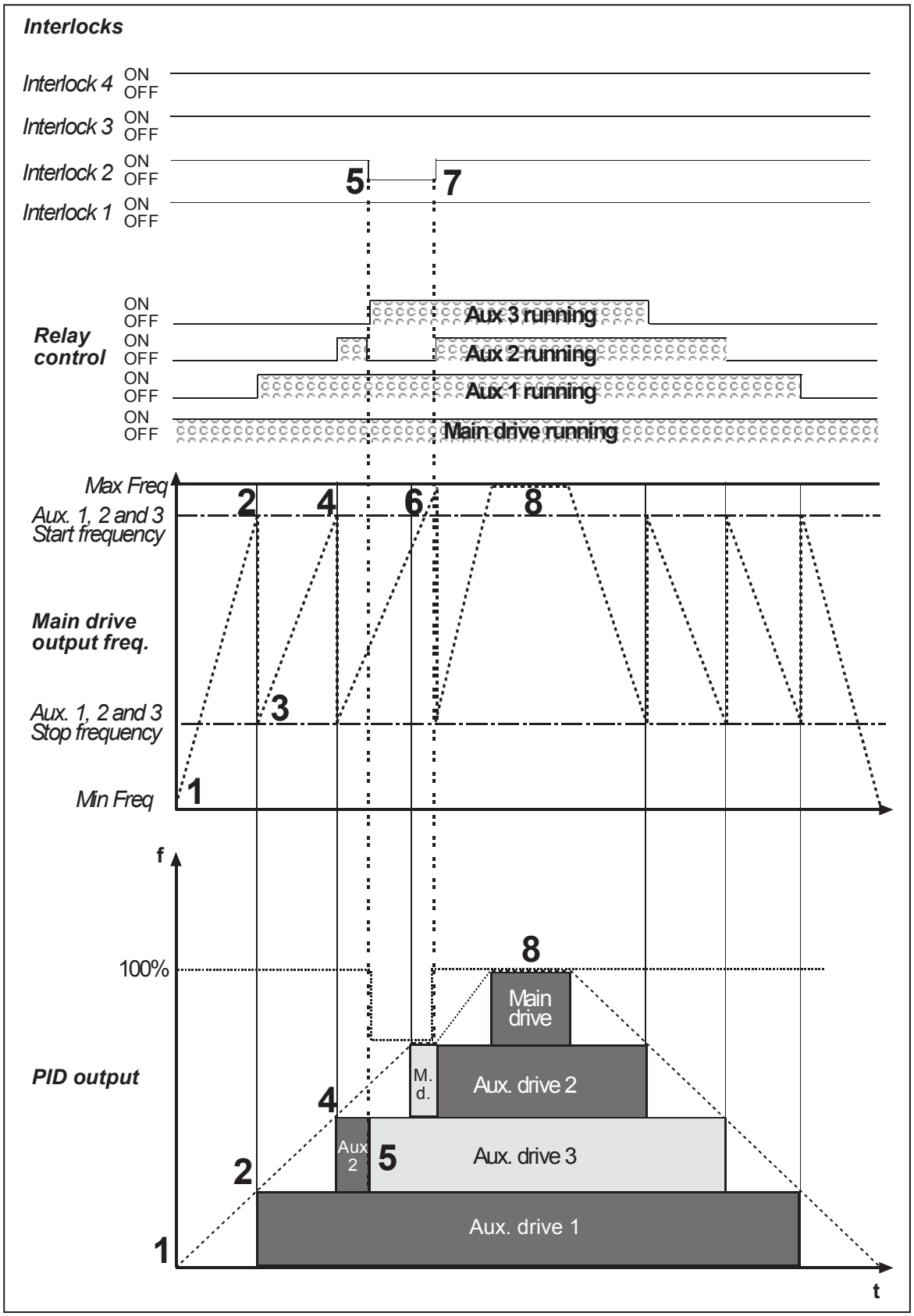


Figure 7- 1. Example of the function of the PFC application with three aux. drives.

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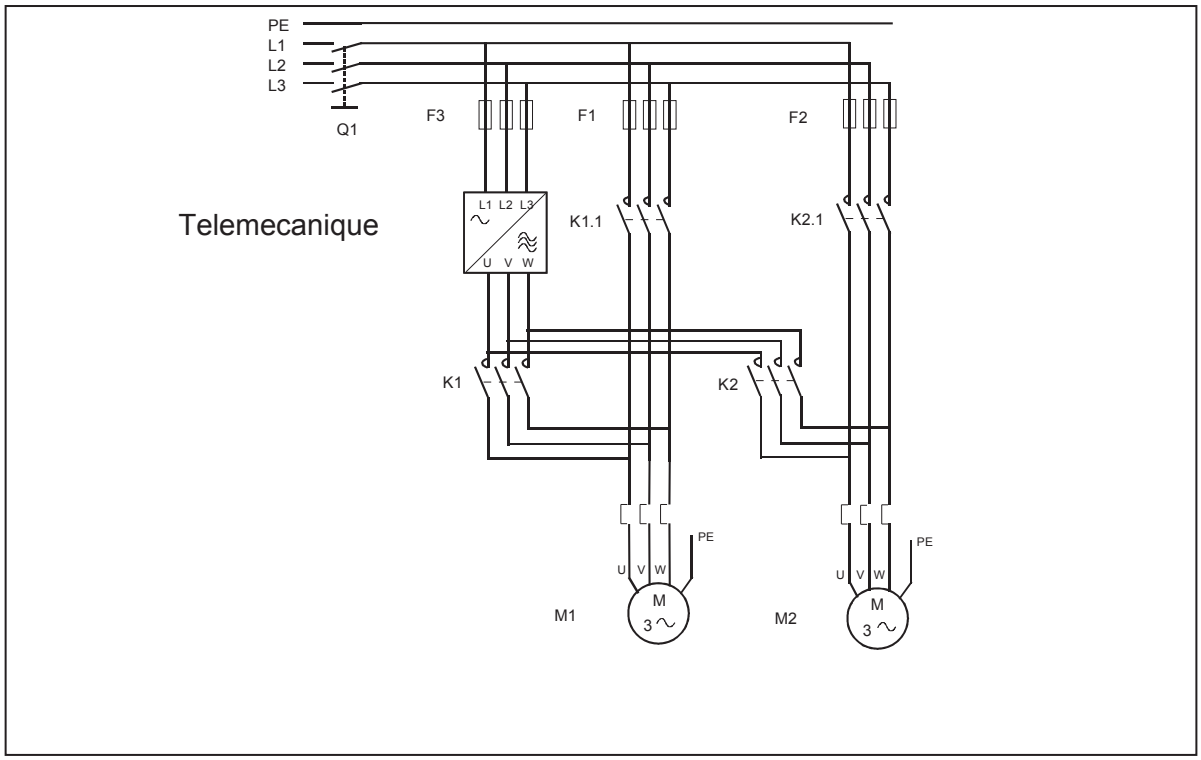


Figure 7- 2. Example of 2-pump autochange, main diagram

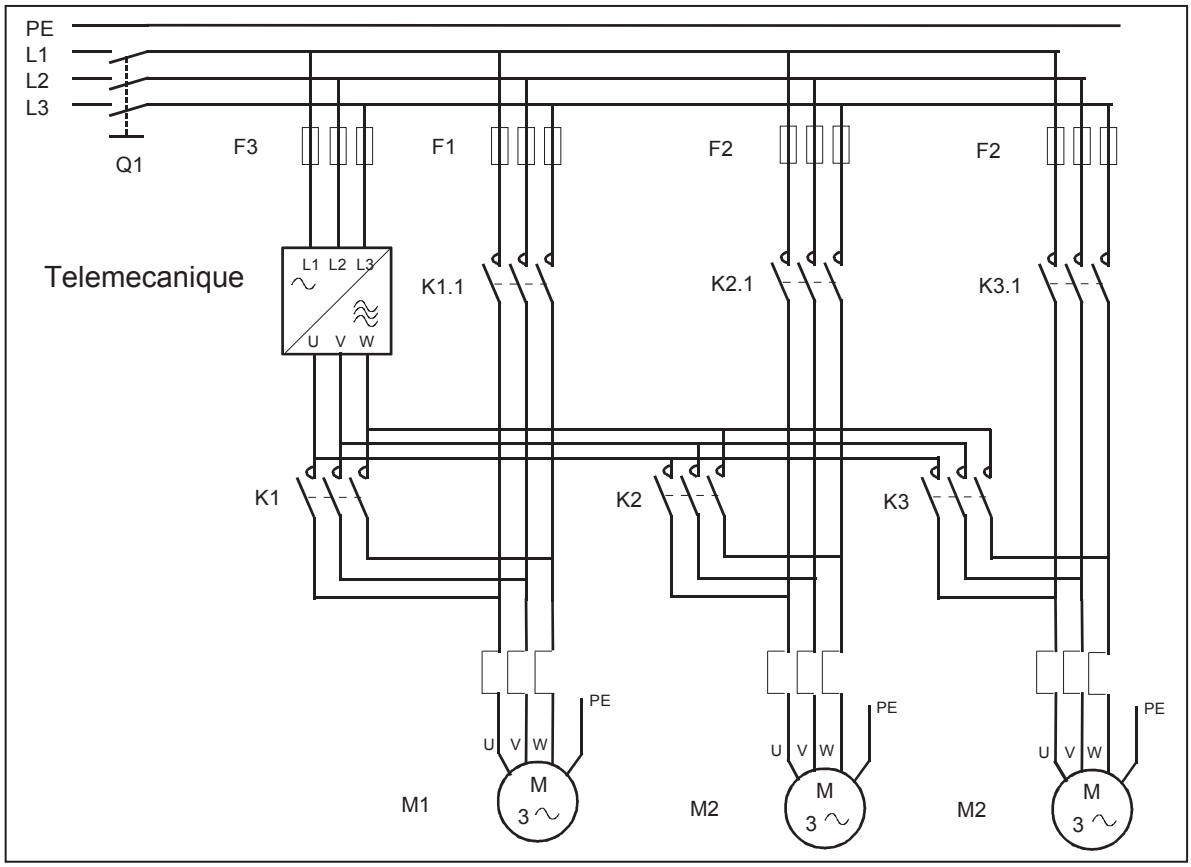


Figure 7- 3. Example of 3-pump autochange, main diagram

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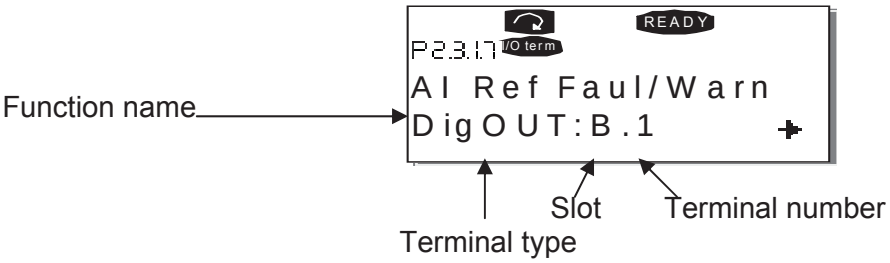
7.3 Programming principle of the Pump and fan control application

The programming principle of the input and output signals in the **Pump and Fan 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 ATV78 applications.

In the conventional programming method, *Function to Terminal Programming Method (FTT),* you have a fixed input or output 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 which the operator defines a certain input/output for. See *Warning* on page 99.

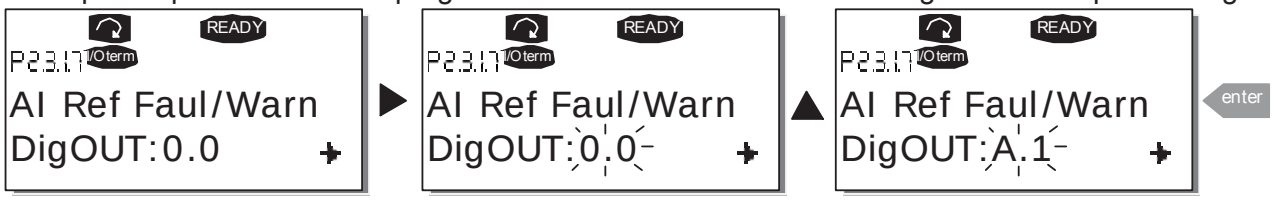
7.3.1 Defining an input/output for a certain function on keypad

Connecting a certain input or output to a certain function (parameter) is done by giving the parameter an appropriate value. The value is formed of the *Board slot* on the ATV78 control board (see ATV78 User's Manual, Chapter 6.2) and the *respective input/output number*, see below.



Example: You want to connect the digital output function *Reference fault/warning* (parameter 2.3.1.7) to the digital output DO1 on the basic board VW378201 (see ATV78 User's Manual, Chapter 6.2).

First find the parameter 2.3.1.7 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, DigOUT, An.IN, An.OUT) and on the right, the present input/output the function is connected to (B.3, A.2 etc.), or if not connected, a value (0.#).
When the value is blinking, hold down the *Browser button up* or *down* to find the desired board slot and input/output number. The program will scroll the board slots starting from **0** and proceeding from



A to **E** and the numbers referring to the I/O selection from **1** to **10**.
Once you have set the desired value, press the *Enter button* once to confirm the change.

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7.3.2 Defining a terminal for a certain function with PC software programming tool

If you use the PC software Programming Tool for parametrizing 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 7- 4).

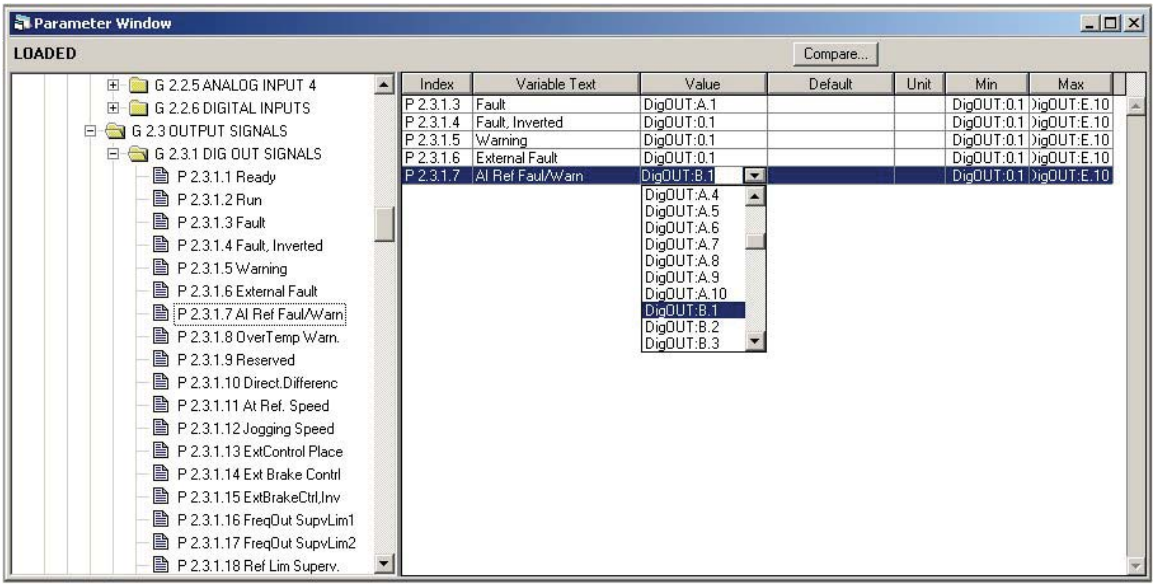


Figure 7- 4. Screenshot of PC software programming tool; Entering the address code

WARNING	**Be ABSOLUTELY sure not to connect two functions to one and same output in order to avoid function overruns and to ensure flawless operation.**

Note: The *inputs*, unlike the *outputs*, cannot be changed in RUN state.

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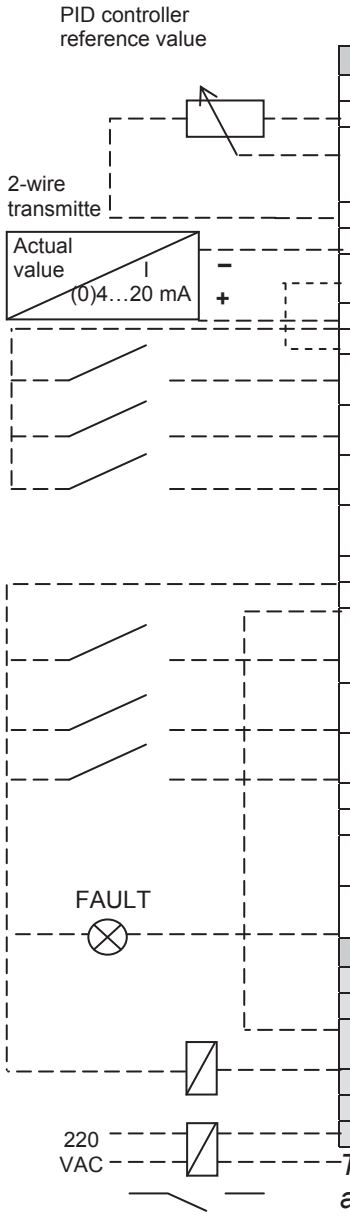
7.3.3 Defining unused inputs/outputs

All unused inputs and outputs must be given the board slot value **0** and the value **1** for the terminal number. The value **0.1** is also the default value for most of the functions. However, if you want to use the **values of a digital input signal** for e.g. testing purposes only, you can set the board slot value to **0** and the terminal number to any number between 2…10 to place the input to a TRUE state. In other words, the value 1 corresponds to 'open contact' and values 2 to 10 to closed contact.

In case of analogue inputs, giving the value **1** for the terminal number corresponds to 0%, value **2** corresponds to 20% and any value between **3** and **10** corresponds to 100%.

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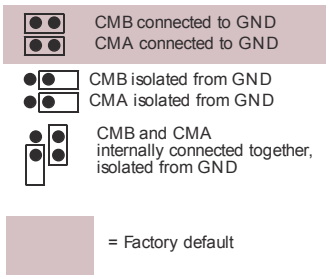
7.3.4 Control I/O



VW3A78201			
Terminal		Signal	Description
1	$+10V_{ref}$	Reference output	Voltage for potentiometer, etc.
2	AI1+	Analogue input, voltage range 0—10V DC	Voltage input frequency reference
3	AI1-	I/O Ground	Ground for reference and controls
4	AI2+	Analogue 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/Stop; Control place A (PID controller) (programm.)	Contact closed = start
9	DIN2	Interlock 1 (programmable)	Contact closed = Interlock used Contact open = Interlock not used
10	DIN3	Interlock 2 (programmable)	Contact closed = Interlock used Contact open = Interlock not used
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	Start/Stop Control place B (Direct frequency reference) (programmable)	Contact closed = Start
15	DIN5	Jogging speed selection (programmable)	Contact closed = Jogging speed active
16	DIN6	Control place A/B selection (programmable)	Contact open = Control place A is active Contact closed = Control place B is active
17	CMB	Common for DIN4—DIN6	Connect to GND or +24V
18	AO1+	Output frequency Analogue output	Programmable; See chapters 7.5.4.3, 7.5.4.4 and 7.5.4.5 Range 0—20 mA/R_L, max. 500Ω
19	AO1- (GND)		
20	DO1	Digital output FAULT	Programmable Open collector, I≤50mA, U≤48 VDC
VW3A78202			
21	RO1	Relay output 1 Aux/Autochange 1	Programmable; See chapter 7.5.4.1
22	RO1		
23	RO1		
24	RO2	Relay output 2 Aux/Autochange 2	Programmable; See chapter 7.5.4.1
25	RO2		
26	RO2		

Table 7- 1. Pump and fan control application default I/O configuration and connection example (with 2-wire transmitter).

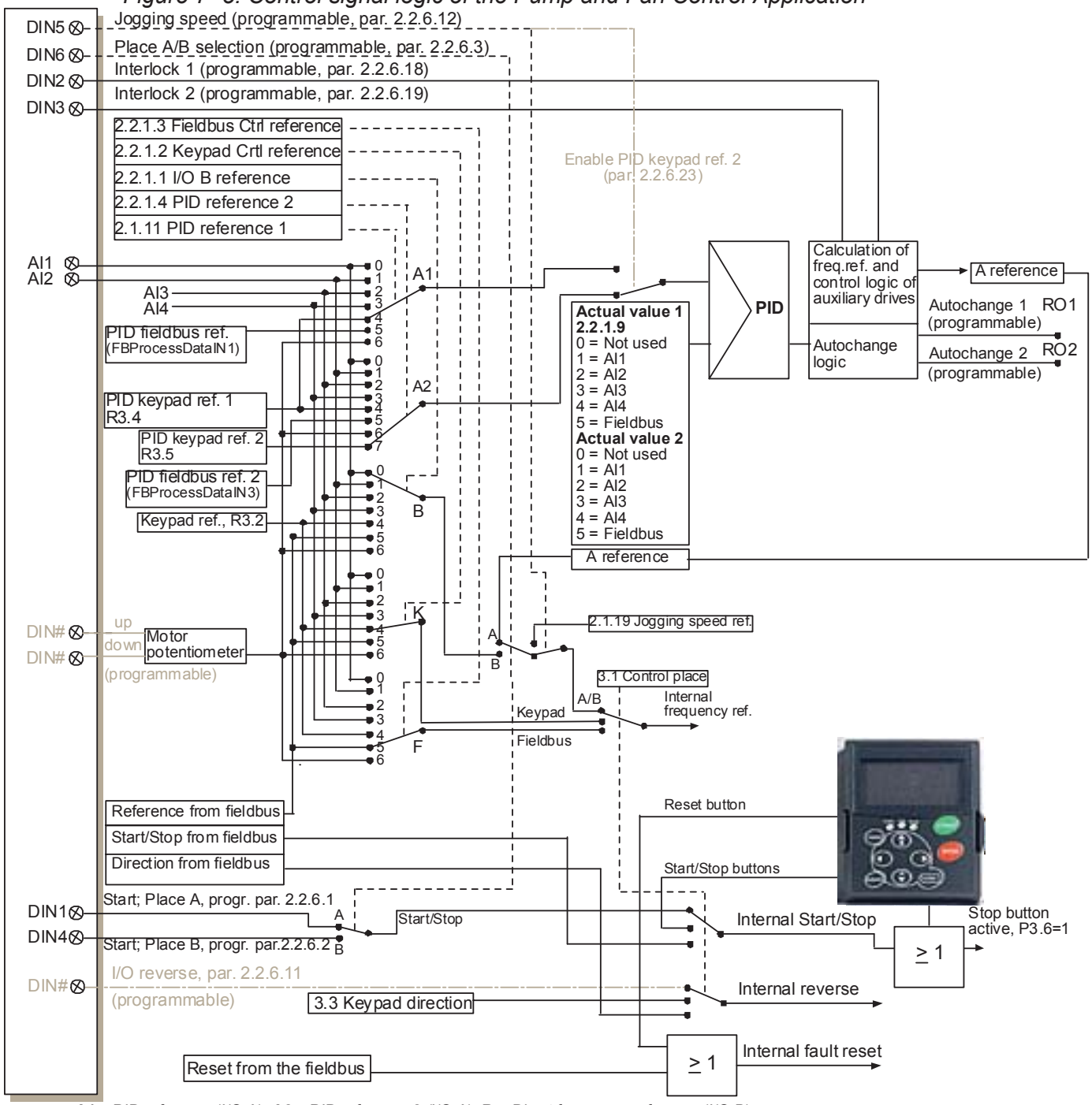
Note: See jumper selections below. More information in ATV78 User's Manual, Chapter 6.2.2.2.



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7.4 Control signal logic in Pump and Fan Control Application

Figure 7- 5. Control signal logic of the Pump and Fan Control Application



A1 = PID reference (I/O A); **A2** = PID reference 2 (I/O A); **B** = Direct frequency reference (I/O B);
K = Keypad reference; **F** = Fieldbus reference

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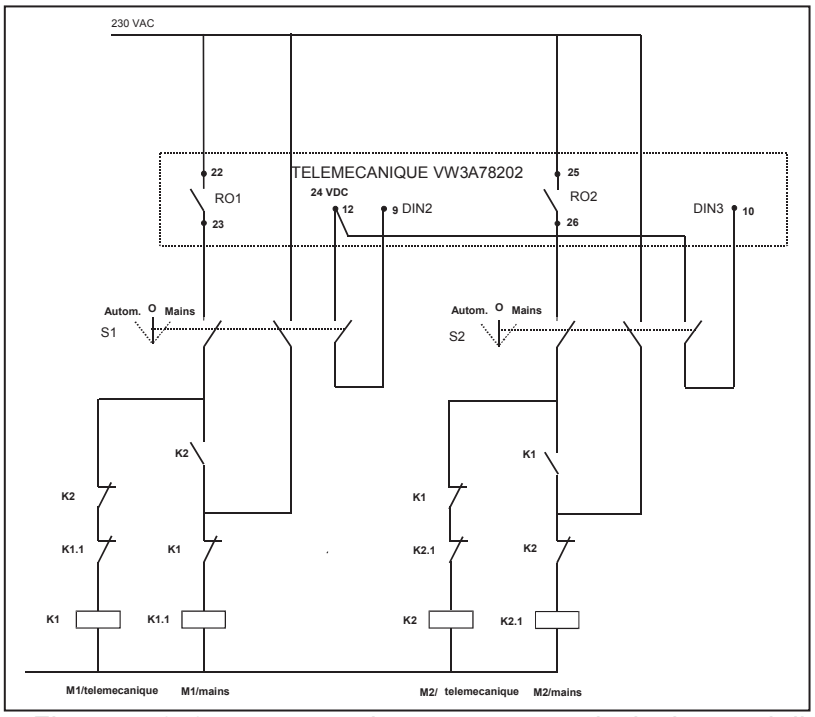


Figure 7- 6. 2-pump autochange system, principal control diagram

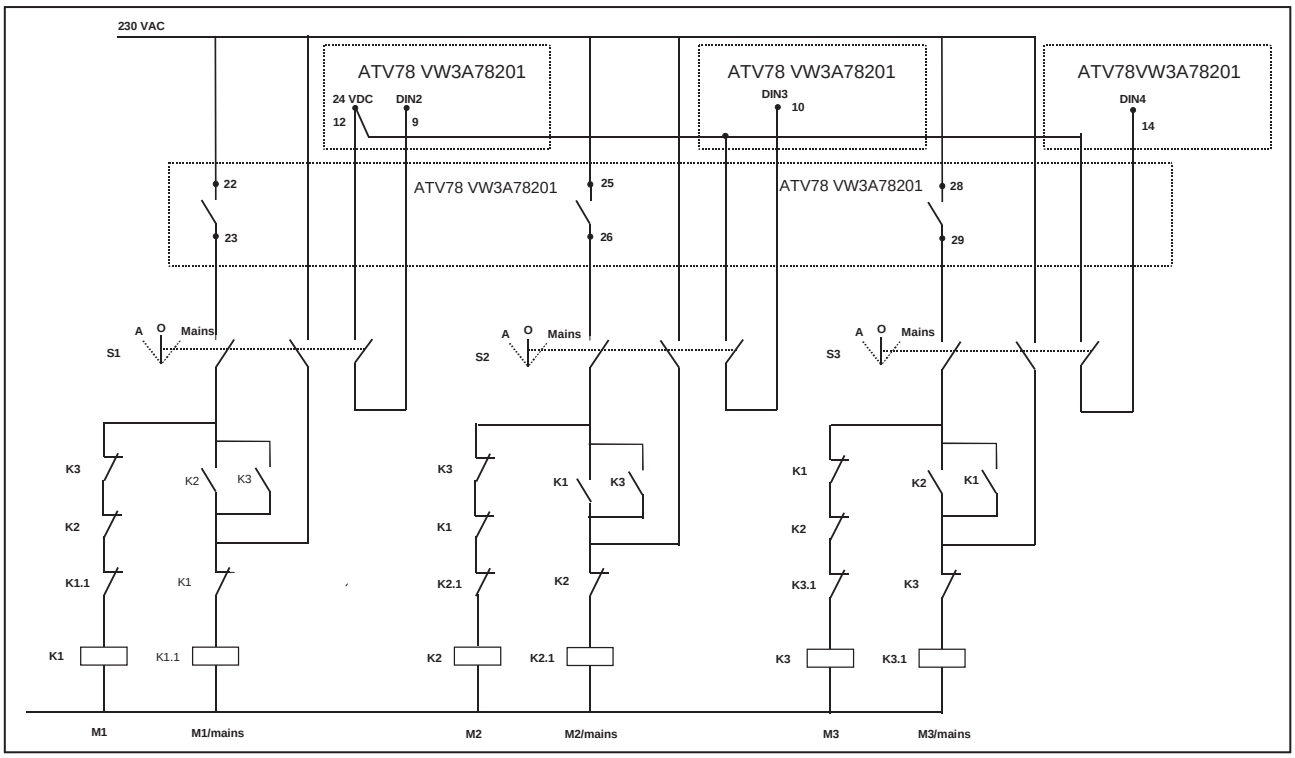


Figure 7- 7. 3-pump autochange system, principal control diagram

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7.5 Pump and Fan Control Application – Parameter lists

On the next pages you will find the lists of parameters within the respective parameter groups..

Column explanations:
Code = Location indication on the keypad; Shows the operator the present param. 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 settings
ID = ID number of the parameter (used with PC tools)
= On parameter code: Parameter value can only be changed after the FC has been stopped.

= Apply the *Terminal to Function method (TTF)* to these parameters (see Chapter 2)

7.5.1 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 ATV78 User's Manual, Chapter 7 for more information. Note that the monitoring values V1.18 to V1.23 are available in the PFC control application only.

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 Motor nominal 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	Motor temperature	%	9	Calculated motor temperature
V1.11	Analogue input 1	V/mA	13	AI1 input value
V1.12	Analogue input 2	V/mA	14	AI2 input value
V1.13	DIN1, DIN2, DIN3		15	Digital input statuses
V1.14	DIN4, DIN5, DIN6		16	Digital input statuses
V1.15	Analogue I_{out}	mA	26	AO1
V1.16	Analogue input 3	V/mA	27	AI3 input value
V1.17	Analogue input 4	V/mA	28	AI4 input value
V1.18	PID Reference	%	20	In % of the max. frequency
V1.19	PID Actual value	%	21	In % of the max actual value
V1.20	PID Error value	%	22	In % of the max error value
V1.21	PID Output	%	23	In % of the max output value
V1.22	Running auxiliary drives		30	Number of running auxiliary drives
V1.23	Special display for actual value		29	See parameters 2.9.29 to 2.9.31
M.1.24	Multimonitoring items			Displays 3 selectable monitor. values

Table 7- 2. Monitoring values

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7.5.2 Basic parameters (Control keypad: Menu M2 → 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	Acceleration time 1	0,1	3000,0	s	1,0		103	
P2.1.4	Deceleration time 1	0,1	3000,0	s	1,0		104	
P2.1.5	Current limit	Varies	Varies	A	Varies		107	
P2.1.6	Nominal voltage of the motor	180	690	V	690V		110	
P2.1.7	Nominal frequency of the motor	30,00	320,00	Hz	50,00		111	Check the rating plate of the motor
P2.1.8	Nominal speed of the motor	300	20 000	rpm	1440		112	The default applies for a 4-pole motor and a nominal size variable speed drive.
P2.1.9	Nominal current of the motor	Varies	Varies	A	Varies		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	PID controller reference signal (Place A)	0	6		4		332	**0**=AI1 (#2—3) **1**=AI2 (#4—5) **2**=AI3 **3**=AI4 **4**=PID ref from Keypad control page, par. 3.4 **5**=PID ref. from fieldbus (FBProcessDataIN1) **6**=Motor potentiometer
P2.1.12	PID controller gain	0,0	1000,0	%	100,0		118	
P2.1.13	PID controller I-time	0,00	320,00	s	1,00		119	
P2.1.14	PID controller D-time	0,00	10,00	s	0,00		132	
P2.1.15	Sleep frequency	0,00	Par. 2.1.2	Hz	10,00		1016	
P2.1.16	Sleep delay	0	3600	s	30		1017	
P2.1.17	Wake up level	0,00	100,00	%	25,00		1018	
P2.1.18	Wake up function	0	3		0		1019	**0**=Wake-up at fall below wake up level (2.1.17) **1**=Wake-up at exceeded wake up level (2.1.17) **2**=Wake-up at fall below wake up level (PID ref) **3**=Wake-up at exceeded wake up level (PID ref)
P2.1.19	Jogging speed reference	0,00	Par. 2.1.1	Hz	10,00		124	

Table 7- 3. Basic parameters G2.1

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7.5.3 Input signals

7.5.3.1 Basic Settings (Control keypad: Menu M2 → G2.2.1)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.1.1	I/O B reference selection	0	7		0		343	**0**=AI1 **1**=AI2 **2**=AI3 **3**=AI4 **4**=Keypad reference **5**=Fieldbus reference (FB SpeedReference) **6**=Motor potentiometer **7**=PID control
P2.2.1.2	Keypad control reference selection	0	7		4		121	As in par. 2.2.1.1
P2.2.1.3	Fieldbus control reference selection	0	7		5		122	As in par. 2.2.1.1
P2.2.1.4	PID Reference 2	0	7		7		371	**0**=AI1 **1**=AI2 **2**=AI3 **3**=AI4 **4**=PID reference 1 from keypad **5**=Fieldbus reference (FBProcessDataIN3) **6**=Motor potentiometer **7**=PID reference 2 from keypad
P2.2.1.5	PID error value inversion	0	1		0		340	**0**=No inversion **1**=Inversion
P2.2.1.6	PID reference rising time	0,0	100,0	s	5,0		341	Time for reference value to change from 0% to 100%
P2.2.1.7	PID reference falling time	0,0	100,0	s	5,0		342	Time for reference value to change from 100% to 0%
P2.2.1.8	PID actual value selection	0	7		0		333	**0**=Actual value 1 **1**=Actual 1 + Actual 2 **2**=Actual 1 – Actual 2 **3**=Actual 1 * Actual 2 **4**=Max(Actual 1, Actual 2) **5**=Min(Actual 1, Actual 2) **6**=Mean(Actual1, Actual2) **7**=Sqrt (Act1) + Sqrt (Act2)
P2.2.1.9	Actual value 1 input	0	5		2		334	**0**=Not used **1**=AI1 (control board) **2**=AI2 (control board) **3**=AI3 **4**=AI4 **5**=Fieldbus (FBProcessDataIN2)
P2.2.1.10	Actual value 2 input	0	5		0		335	**0**=Not used **1**=AI1 (control board) **2**=AI2 (control board) **3**=AI3 **4**=AI4 **5**=Fieldbus (FBProcessDataIN3)

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P2.2.1.11	Actual value 1 minimum scale	–1000,0	1000,0	%	0,0		336	**0**=No minimum scaling
P2.2.1.12	Actual value 1 maximum scale	–1000,0	1000,0	%	100,0		337	**100**=No maximum scaling
P2.2.1.13	Actual value 2 minimum scale	–1000,0	1000,0	%	0,0		338	**0**=No minimum scaling
P2.2.1.14	Actual value 2 maximum scale	–1000,0	1000,0	%	100,0		339	**100**=No maximum scaling
P2.2.1.15	Motor potentiometer ramp time	0,1	2000,0	Hz/s	10,0		331	
P2.2.1.16	Motor potentiometer frequency reference memory reset	0	2		1		367	**0**=No reset **1**=Reset if stopped or powered down **2**=Reset if powered down
P2.2.1.17	Motor potentiometer PID reference memory reset	0	2		0		370	**0**=No reset **1**=Reset if stopped or powered down **2**=Reset if powered down
P2.2.1.18	B reference scale, minimum	0,0	P2.2.1.19	Hz	0,0		344	**0**=Scaling off **>0**=Scaled min. value
P2.2.1.19	B reference scale, maximum	0,0	320,0	Hz	0,0		345	**0**=Scaling off **>0**=Scaled max. value

Table 7- 4. Input signals, Basic settings

7.5.3.2 Analogue input 1 (Control keypad: Menu M2 → G2.2.2)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.2.1	AI1 signal selection	0			A.1		377	
P2.2.2.2	AI1 filter time	0,00	10,00	s	0,10		324	**0**=No filtering
P2.2.2.3	AI1 signal range	0	2		0		320	**0**=Signal range 0—10V* **1**=Signal range 2—10V* **2**=Custom range
P2.2.2.4	AI1 custom minimum setting	-100,00	100,00	%	0,00		321	
P2.2.2.5	AI1 custom maximum setting	-100,00	100,00	%	100,00		322	
P2.2.2.6	AI1 signal inversion	0	1		0		323	**0**=Not inverted **1**=Inverted

Table 7- 5. Input signals, Analogue input 1

*Remember to place jumpers of block X2 accordingly. See ATV78 User's Manual, chapter 6.2.2.2

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7.5.3.3 Analogue input 2 (Control keypad: Menu M2 → G2.2.3)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.3.1	AI2 signal selection	0			A.2		388	
P2.2.3.2	AI2 filter time	0,00	10,00	s	0,10		329	**0**=No filtering
P2.2.3.3	AI2 signal range	0	2		1		325	**0**=0—20 mA* **1**=4—20 mA* **2**=Customised
P2.2.3.4	AI2 custom minimum setting	-100,00	100,00	%	0,00		326	
P2.2.3.5	AI2 custom maximum setting	-100,00	100,00	%	100,00		327	
P2.2.3.6	AI2 inversion	0	1		0		328	**0**=Not inverted **1**=Inverted

Table 7- 6. Input signals, Analogue input 2

7.5.3.4 Analogue input 3 (Control keypad: Menu M2 → G2.2.4)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.4.1	AI3 signal selection	0			0.1		141	
P2.2.4.2	AI3 filter time	0,00	10,00	s	0,10		142	**0**=No filtering
P2.2.4.3	AI3 signal range	0	2		1		143	**0**=0—20 mA **1**=4—20 mA **2**=Customised
P2.2.4.4	AI3 custom minimum setting	-100,00	100,00	%	0,00		144	
P2.2.4.5	AI3 custom maximum setting	-100,00	100,00	%	100,00		145	
P2.2.4.6	AI3 inversion	0	1		0		151	**0**=Not inverted **1**=Inverted

Table 7- 7. Input signals, Analogue input 3

7.5.3.5 Analogue input 4, (Control keypad: Menu M2 → G2.2.5)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.5.1	AI4 signal selection	0			0.1		152	
P2.2.5.2	AI4 filter time	0,00	10,00	s	0,10		153	**0**=No filtering
P2.2.5.3	AI4 signal range	0	2		1		154	**0**=0—20 mA **1**=4—20 mA **2**=Customised
P2.2.5.4	AI4 custom minimum setting	-100,00	100,00	%	0,00		155	
P2.2.5.5	AI4 custom maximum setting	-100,00	100,00	%	100,00		156	
P2.2.5.6	AI4 inversion	0	1		0		162	**0**=Not inverted **1**=Inverted

Table 7- 8. Input signals, Analogue input 4

*Remember to place jumpers of block X2 accordingly. See ATV78 User's Manual, chapter 6.2.2.2

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7.5.3.6 Digital inputs (Control keypad: Menu M2 → G2.2.4)

Code	Parameter	Min	Default	Cust	ID	Note
P2.2.6.1	Start A signal	0	A.1		423	
P2.2.6.2	Start B signal	0	A.4		424	
P2.2.6.3	Control place A/B selection	0	A.6		425	Control place A (oc) Control place B (cc)
P2.2.6.4	External fault (close)	0	0.1		405	Ext. fault displayed (cc)
P2.2.6.5	External fault (open)	0	0.2		406	Ext. fault displayed (oc)
P2.2.6.6	Run enable	0	0.2		407	Motor start enabled (cc)
P2.2.6.7	Acc/Dec time selection	0	0.1		408	Acc/Dec time 1 (oc) Acc/Dec time 2 (cc)
P2.2.6.8	Control from I/O terminal	0	0.1		409	Force control place to I/O terminal (cc)
P2.2.6.9	Control from keypad	0	0.1		410	Force control place to keypad (cc)
P2.2.6.10	Control from fieldbus	0	0.1		411	Force control place to fieldbus (cc)
P2.2.6.11	Reverse	0	0.1		412	Direction forward (oc) Direction reverse (cc)
P2.2.6.12	Jogging speed	0	A.5		413	Jogging speed selected for frequency reference (cc)
P2.2.6.13	Fault reset	0	0.1		414	All faults reset (cc)
P2.2.6.14	Acc/Dec prohibit	0	0.1		415	Acc/Dec prohibited (cc)
P2.2.6.15	DC braking	0	0.1		416	DC braking active (cc)
P2.2.6.16	Motor potentiometer reference DOWN	0	0.1		417	Mot.pot. reference decreases (cc)
P2.2.6.17	Motor potentiometer reference UP	0	0.1		418	Mot.pot. reference increases (cc)
P2.2.6.18	Autochange 1 Interlock	0	A.2		426	Activated if cc
P2.2.6.19	Autochange 2 Interlock	0	A.3		427	Activated if cc
P2.2.6.20	Autochange 3 Interlock	0	0.1		428	Activated if cc
P2.2.6.21	Autochange 4 Interlock	0	0.1		429	Activated if cc
P2.2.6.22	Autochange 5 Interlock	0	0.1		430	Activated if cc
P2.2.6.23	PID reference 2	0	0.1		431	Selected with 2.1.11 (oc) Selected with 2.2.1.4 (cc)

Table 7- 9. Input signals, Digital inputs

cc = closing contact
oc = opening contact

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7.5.4 Output signals

7.5.4.1 Digital output signals (Control keypad: Menu M2 → G2.3.1)

Code	Parameter	Min	Default	Cust	ID	Note
P2.3.1.1	Ready	0	0.1		432	
P2.3.1.2	Run	0	0.1		433	
P2.3.1.3	Fault	0	A.1		434	
P2.3.1.4	Inverted fault	0	0.1		435	
P2.3.1.5	Warning	0	0.1		436	
P2.3.1.6	External fault	0	0.1		437	
P2.3.1.7	Reference fault/warning	0	0.1		438	
P2.3.1.8	Overtemperature warning	0	0.1		439	
P2.3.1.9	Reverse	0	0.1		440	
P2.3.1.10	Unrequested direction	0	0.1		441	
P2.3.1.11	At speed	0	0.1		442	
P2.3.1.12	Jogging speed	0	0.1		443	
P2.3.1.13	External control place	0	0.1		444	
P2.3.1.14	External brake control	0	0.1		445	
P2.3.1.15	External brake control, inverted	0	0.1		446	
P2.3.1.16	Output frequency limit 1 supervision	0	0.1		447	
P2.3.1.17	Output frequency limit 2 supervision	0	0.1		448	
P2.3.1.18	Reference limit supervision	0	0.1		449	
P2.3.1.19	Temperature limit supervision	0	0.1		450	
P2.3.1.20	Torque limit supervision	0	0.1		451	
P2.3.1.21	Motor thermal protection	0	0.1		452	
P2.3.1.22	Analogue input supervision limit	0	0.1		463	
P2.3.1.23	Motor regulator activation	0	0.1		454	
P2.3.1.24	Fieldbus data to DO/RO	0	0.1		455	
P2.3.1.25	Fieldbus data to DO/RO	0	0.1		456	
P2.3.1.26	Fieldbus data to DO/RO	0	0.1		457	
P2.3.1.27	Autochange 1/Aux 1 control	0	B.1		458	
P2.3.1.28	Autochange 2/Aux 2 control	0	B.2		459	
P2.3.1.29	Autochange 3/Aux 3 control	0	0.1		460	
P2.3.1.30	Autochange 4/Aux 4 control	0	0.1		461	
P2.3.1.31	Autochange 5	0	0.1		462	

Table 7- 10. Output signals, Digital outputs

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7.5.4.2 Limit settings (Control keypad: Menu M2 → G2.3.2)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.3.2.1	Output frequency limit 1 supervision	0	2		0		315	**0**=No limit **1**=Low limit supervision **2**=High limit supervision
P2.3.2.2	Output freq. limit 1; Supervised value	0,00	Par. 2.1.2	Hz	0,00		316	
P2.3.2.3	Output frequency limit 2 supervision	0	2		0		346	**0**=No limit **1**=Low limit supervision **2**=High limit supervision
P2.3.2.4	Output freq. limit 2; Supervised value	0,00	Par. 2.1.2	Hz	0,00		347	
P2.3.2.5	Torque limit supervision	0	2		0		348	**0**=Not used **1**=Low limit supervision **2**=High limit supervision
P2.3.2.6	Torque limit supervision value	0,0	300,0	%	100,0		349	
P2.3.2.7	Reference limit supervision	0	2		0		350	**0**=Not used **1**=Low limit **2**=High limit
P2.3.2.8	Reference limit supervision value	0,0	100,0	%	0,0		351	
P2.3.2.9	External brake-off delay	0,0	100,0	s	0,5		352	
P2.3.2.10	External brake-on delay	0,0	100,0	s	1,5		353	
P2.3.2.11	FC temperature supervision	0	2		0		354	**0**=Not used **1**=Low limit **2**=High limit
P2.3.2.12	FC temperature supervised value	–10	75	°C	40		355	
P2.3.2.13	Supervised analogue input	0	3		0		372	**0**=AI1 **1**=AI2
P2.3.2.14	Analogue input limit supervision	0	2		0		373	**0**=No limit **1**=Low limit supervision **2**=High limit supervision
P2.3.2.15	Analogue input supervised value	0,00	100,00	%	0,00		374	

Table 7- 11. Output signals, Limit settings

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7.5.4.3 Analogue output 1 (Control keypad: Menu M2 → G2.3.3)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.3.3.1	Analogue output signal selection	0			A.1		464	
P2.3.3.2	Analogue output function	0	13		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**=Motor 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) **9**=PID controller ref. value **10**=PID contr. act.value 1 **11**=PID contr. act.value 2 **12**=PID contr. error value **13**=PID controller output
P2.3.3.3	Analogue output filter time	0,00	10,00	s	1,00		308	**0**=No filtering
P2.3.3.4	Analogue output inversion	0	1		0		309	**0**=Not inverted **1**=Inverted
P2.3.3.5	Analogue output minimum	0	1		0		310	**0**=0 mA **1**=4 mA
P2.3.3.6	Analogue output scale	10	1000	%	100		311	
P2.3.3.7	Analogue output offset	–100,00	100,00	%	0,00		375	

Table 7- 12. Output signals, Analogue output 1

7.5.4.4 Analogue output 2 (Control keypad: Menu M2 → G2.3.4)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.3.4.1	Analogue output 2 signal selection	0			0.1		471	
P2.3.4.2	Analogue output 2 function	0	13		0		472	See par. 2.3.3.2
P2.3.4.3	Analogue output 2 filter time	0,00	10,00	s	1,00		473	**0**=No filtering
P2.3.4.4	Analogue output 2 inversion	0	1		0		474	**0**=Not inverted **1**=Inverted
P2.3.4.5	Analogue output 2 minimum	0	1		0		475	**0**=0 mA **1**=4 mA
P2.3.4.6	Analogue output 2 scale	10	1000	%	100		476	
P2.3.4.7	Analogue output 2 offset	–100,00	100,00	%	0,00		477	

Table 7- 13. Output signals, Analogue output 2

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7.5.4.5 Analogue output 3 (Control keypad: Menu M2 → G2.3.5)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.3.5.1	Analogue output 3 signal selection	0			0.1		478	
P2.3.5.2	Analogue output 3 function	0	13		0		479	See par. 2.3.3.2
P2.3.5.3	Analogue output 3 filter time	0,00	10,00	s	1,00		480	**0**=No filtering
P2.3.5.4	Analogue output 3 inversion	0	1		0		481	**0**=Not inverted **1**=Inverted
P2.3.5.5	Analogue output 3 minimum	0	1		0		482	**0**=0 mA **1**=4 mA
P2.3.5.6	Analogue output 3 scale	10	1000	%	100		483	
P2.3.5.7	Analogue output 3 offset	–100,00	100,00	%	0,00		484	

Table 7- 14. Output signals, Analogue output 3

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7.5.5 Drive control parameters (Control keypad: Menu M2 → 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	Acceleration time 2	0,1	3000,0	s	10,0		502	
P2.4.4	Deceleration time 2	0,1	3000,0	s	10,0		503	
P2.4.5	Brake chopper	0	4		0		504	**0**=Disabled **1**=Used when running **2**=External brake chopper **3**=Used when stopped/running **4**=Used when running (no testing)
P2.4.6	Start function	0	1		0		505	**0**=Ramp **1**=Flying start
P2.4.7	Stop function	0	3		0		506	**0**=Coasting **1**=Ramp **2**=Ramp+Run enable coast **3**=Coast+Run enable ramp
P2.4.8	DC braking current	0,15 x I_n	1,5 x I_n	A	Varies		507	
P2.4.9	DC braking time at stop	0,00	600,00	s	0,00		508	**0**=DC brake is off at stop
P2.4.10	Frequency to start DC braking during ramp stop	0,10	10,00	Hz	1,50		515	
P2.4.11	DC braking time at start	0,00	600,00	s	0,00		516	**0**=DC brake is off at start
P2.4.12	Flux brake	0	1		0		520	**0**=Off **1**=On
P2.4.13	Flux braking current	0,1 x P2.1.9	Varies	A	0,0		519	

Table 7- 15. Drive control parameters, G2.4

7.5.6 Prohibit frequency parameters (Control keypad: Menu M2 → G2.5)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.5.1	Prohibit frequency range 1 low limit	0,0	Par. 2.5.2	Hz	0,0		509	**0**=Not used
P2.5.2	Prohibit frequency range 1 high limit	0,0	Par. 2.1.2	Hz	0,0		510	**0**=Not used
P2.5.3	Prohibit frequency range 2 low limit	0,0	Par. 2.5.4	Hz	0,0		511	**0**=Not used
P2.5.4	Prohibit frequency range 2 high limit	0,0	Par. 2.1.2	Hz	0,0		512	**0**=Not used
P2.5.5	Prohibit frequency range 3 low limit	0,0	Par. 2.5.6	Hz	0,0		513	**0**=Not used
P2.5.6	Prohibit frequency range 3 high limit	0,0	Par. 2.1.2	Hz	0,0		514	**0**=Not used
P2.5.7	Prohibit frequencies acc./dec. ramp scaling	0,1	10,0	Times	1,0		518	

Table 7- 16. Prohibit frequency parameters, G2.5

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7.5.7 Motor control parameters (Control keypad: Menu M2 → G2.6)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.6.1	Motor control mode	0	1		0		600	**ATV78:** **0**=Frequency control **1**=Speed control
P2.6.2	U/f optimisation	0	1		0		109	**0**=Not used **1**=Automatic torque boost
P2.6.3	U/f ratio selection	0	3		0		108	**0**=Linear **1**=Squared **2**=Programmable **3**=Linear with flux optim.
P2.6.4	Field weakening point	8,00	320,00	Hz	50,00		602	
P2.6.5	Voltage at field weakening point	10,00	200,00	%	100,00		603	n% x U_{nmot}
P2.6.6	U/f curve midpoint frequency	0,00	par. P2.6.4	Hz	50,00		604	
P2.6.7	U/f curve midpoint voltage	0,00	100,00	%	100,00		605	n% x U_{nmot} Parameter max. value = par. 2.6.5
P2.6.8	Output voltage at zero frequency	0,00	40,00	%	0,00		606	n% x U_{nmot}
P2.6.9	Switching frequency	1,0	Varies	kHz	Varies		601	
P2.6.10	Overvoltage controller	0	2		1		607	**0**=Not used **1**=Used (no ramping) **2**=Used (ramping)
P2.6.11	Undervoltage controller	0	1		1		608	**0**=Not used **1**=Used

Table 7- 17. Motor control parameters, G2.6

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7.5.8 Protections (Control keypad: Menu M2 → G2.7)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.7.1	Response to 4mA reference fault	0	5		4		700	**0**=No response **1**=Warning **2**=Warning+prev.freq. **3**=Wrng+PresetFreq 2.7.2 **4**=Fault,stop acc. to 2.4.7 **5**=Fault,stop by coasting
P2.7.2	4mA reference fault frequency	0,00	Par. 2.1.2	Hz	0,00		728	
P2.7.3	Response to 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 supervision	0	3		0		730	
P2.7.5	Response to undervoltage fault	1	3		3		727	
P2.7.6	Output phase supervision	0	3		2		702	
P2.7.7	Earth fault protection	0	3		2		703	
P2.7.8	Thermal protection of the motor	0	3		2		704	
P2.7.9	Motor ambient temperature factor	–100,0	100,0	%	0,0		705	
P2.7.10	Motor cooling factor at zero speed	0,0	150,0	%	40,0		706	
P2.7.11	Motor thermal time constant	1	200	min	45		707	
P2.7.12	Motor duty cycle	0	100	%	100		708	
P2.7.13	Stall protection	0	3		1		709	**0**=No response **1**=Warning **2**=Fault,stop acc. to 2.4.7 **3**=Fault,stop by coasting
P2.7.14	Stall current limit	0,1	I_{nMotor} x 2	A	I_{nMotor} x1,3		710	
P2.7.15	Stall time limit	1,00	120,00	s	15,00		711	
P2.7.16	Stall frequency limit	1,0	Par. 2.1.2	Hz	25,0		712	
P2.7.17	Underload protection	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, field weakening area load	10	150	%	50		714	
P2.7.19	Underload curve at zero frequency	5,0	150,0	%	10,0		715	
P2.7.20	Underload protection time limit	2	600	s	20		716	
P2.7.21	Response to thermistor fault	0	3		2		732	**0**=No response **1**=Warning **2**=Fault,stop acc. to 2.4.7 **3**=Fault,stop by coasting
P2.7.22	Response to fieldbus fault	0	3		2		733	See P2.7.21
P2.7.23	Response to slot fault	0	3		2		734	See P2.7.21

Table 7- 18. Protections, G2.7

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7.5.9 Autorestart parameters (Control keypad: Menu M2 → 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	Number of tries after undervoltage trip	0	10		1		720	
P2.8.5	Number of tries after overvoltage trip	0	10		1		721	
P2.8.6	Number of tries after overcurrent trip	0	3		1		722	
P2.8.7	Number of tries after reference trip	0	10		1		723	
P2.8.8	Number of tries after motor temperature fault trip	0	10		1		726	
P2.8.9	Number of tries after external fault trip	0	10		0		725	
P2.8.10	Number of tries after underload fault trip	0	10		1		738	

Table 7- 19. Autorestart parameters, G2.8

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7.5.10 Pump and fan control parameters (Control keypad: Menu M2 → G2.9)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.9.1	Number of auxiliary drives	0	4		1		1001	
P2.9.2	Start frequency, auxiliary drive 1	Par. 2.9.3	320,00	Hz	51,00		1002	
P2.9.3	Stop frequency, auxiliary drive 1	Par. 2.1.1	Par. 2.9.2	Hz	10,00		1003	
P2.9.4	Start frequency, auxiliary drive 2	Par. 2.9.5	320,00	Hz	51,00		1004	
P2.9.5	Stop frequency, auxiliary drive 2	Par. 2.1.1	Par. 2.9.4	Hz	10,00		1005	
P2.9.6	Start frequency, auxiliary drive 3	Par. 2.9.7	320,00	Hz	51,00		1006	
P2.9.7	Stop frequency, auxiliary drive 3	Par. 2.1.1	Par. 2.9.6	Hz	10,00		1007	
P2.9.8	Start frequency, auxiliary drive 4	Par. 2.9.9	320,00	Hz	51,00		1008	
P2.9.9	Stop frequency, auxiliary drive 4	Par. 2.1.1	Par. 2.9.8	Hz	10,00		1009	
P2.9.10	Start delay, auxiliary drives	0,0	300,0	s	4,0		1010	
P2.9.11	Stop delay, auxiliary drives	0,0	300,0	s	2,0		1011	
P2.9.12	Reference step, auxiliary drive 1	0,0	100,0	%	0,0		1012	
P2.9.13	Reference step, auxiliary drive 2	0,0	100,0	%	0,0		1013	
P2.9.14	Reference step, auxiliary drive 3	0,0	100,0	%	0,0		1014	
P2.9.15	Reference step, auxiliary drive 4	0,0	100,0	%	0,0		1015	
P2.9.16	PID controller bypass	0	1		0		1020	**1**=PID contr. bypassed
P2.9.17	Analogue input selection for input pressure measurement	0	5		0		1021	**0**=Not used **1**=AI1 **2**=AI2 **3**=AI3 **4**=AI4 **5**=Fieldbus signal (FBProcessDataIN3)
P2.9.18	Input pressure high limit	0,0	100,0	%	30,00		1022	
P2.9.19	Input pressure low limit	0,0	100,0	%	20,00		1023	
P2.9.20	Output pressure drop	0,0	100,0	%	30,00		1024	
P2.9.21	Frequency drop delay	0,0	300,0	s	0,0		1025	**0**=No delay **300**=No frequency drop nor increase
P2.9.22	Frequency increase delay	0,0	300,0	s	0,0		1026	**0**=No delay **300**=No frequency drop nor increase
P2.9.23	Interlock selection	0	2		1		1032	**0**=Interlocks not used **1**=Set new interlock last; update order after value of par. 2.9.26 or Stop state **2**=Stop and update order immediately

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P2.9.24	Autochange	0	1		1		1027	**0**=Not used **1**=Autochange used
P2.9.25	Autoch. and interl. automatics selection	0	1		1		1028	**0**=Auxiliary drives only **1**=All drives
P2.9.26	Autochange interval	0,0	3000,0	h	48,0		1029	**0,0**=TEST=40 s
P2.9.27	Autochange; Maximum number of auxiliary drives	0	4		1		1030	
P2.9.28	Autochange frequency limit	0,00	par. 2.1.2	Hz	25,00		1031	
P2.9.29	Actual value special display minimum	0	30000		0		1033	
P2.9.30	Actual value special display maximum	0	30000		100		1034	
P2.9.31	Actual value special display decimals	0	4		1		1035	

Table 7- 20. Pump and fan control parameters

7.5.11 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 ATV78 User's Manual.

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P3.1	Control place	1	3		1		125	**1**=I/O terminal **2**=Keypad **3**=Fieldbus
R3.2	Keypad reference	Par. 2.1.1	Par. 2.1.2	Hz				
P3.3	Direction (on keypad)	0	1		0		123	**0**=Forward **1**=Reverse
R3.4	PID reference 1	0,00	100,00	%	0,00			
R3.5	PID reference 2	0,00	100,00	%	0,00			
R3.6	Stop button	0	1		1		114	**0**=Limited function of Stop button **1**=Stop button always enabled

Table 7- 21. Keypad control parameters, M3

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7.5.12 System menu (Control keypad: M6)

For parameters and functions related to the general use of the variable speed drive, such as application and language selection, customised parameter sets or information about the hardware and software, see Chapter 7.3.6 in the ATV78 User's Manual.

7.5.13 Expander boards (Control keypad: Menu M7)

The **M7** menu shows the expander and option boards attached to the control board and board-related information. For more information, see Chapter 7.3.7 in the ATV78 User's Manual.

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8. Description of parameters

On the following pages you will find the parameter descriptions arranged according to the individual ID number of the parameter. A shaded parameter ID number (e.g. ***418 Motor potentiometer UP***) indicates that the *TTF programming method* shall be applied to this parameter.
Some parameter names are followed by a number code indicating the applications in which the parameter is included. If **no code** is shown the parameter is available in **all applications**. See below. The parameter numbers under which the parameter appears in different applications are also given.

1 *Basic Application*
2 *Standard Application*
3 *Local/Remote Control Application*
4 *Multi-Step Speed Control Application*
5 *PID Control Application*
6 *Multi-Purpose Control Application*
7 *Pump and Fan Control Application*

ID number of the parameter	Parameter description	Applications code
105	***Preset speed 1***	***1246***

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101 ***Minimum frequency*** *(2.1, 2.1.1)*
102 ***Maximum frequency*** *(2.2, 2.1.2)*

Defines the frequency limits of the variable speed drive.
The maximum value for these parameters is 320 Hz.
The software will automatically check the values of parameters ID105, ID106, ID315 and ID728.

103 ***Acceleration time 1*** *(2.3, 2.1.3)*
104 ***Deceleration time 1*** *(2.4, 2.1.4)*

These limits correspond to the time required for the output frequency to accelerate from the zero frequency to the set maximum frequency (par. ID102).

105 ***Preset speed 1*** ***1246*** *(2.18, 2.1.14, 2.1.15)*
106 ***Preset speed 2*** ***1246*** *(2.19, 2.1.15, 2.1.16)*

Parameter values are automatically limited between the minimum and maximum frequencies (par. ID101, ID102).
Note the use of TTF-programming method in the Multi-purpose Control Application. See parameters ID419, ID420 and ID421.

Speed	Multi-step speed sel. 1 (DIN4)	Multi-step speed sel. 2 (DIN5)
Basic speed	0	0
ID105	1	0
ID106	0	1

Table 8-1. Preset speed

107 ***Current limit*** *(2.5, 2.1.5)*

This parameter determines the maximum motor current from the variable speed drive. The parameter value range differs from size to size.

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108 U/f ration selection 234567 *(2.6.3)*

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 ration 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 undermagnetised 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.

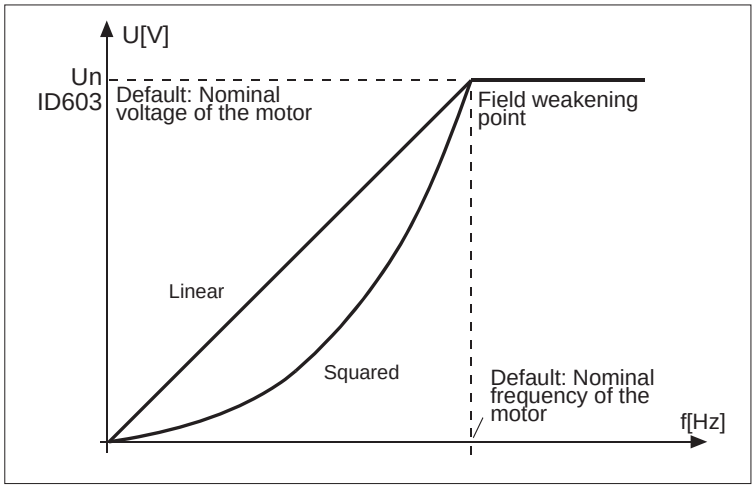


Figure 8-1. Linear and squared change of motor voltage

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.

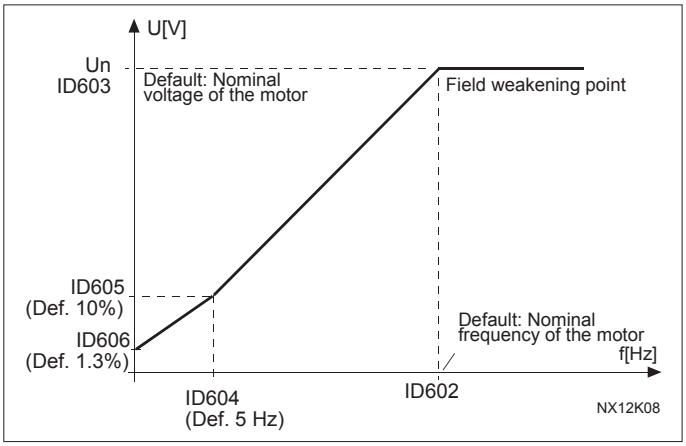


Figure 8-2. Programmable U/f curve

Linear with flux optimisation:

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3	The variable speed drive 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.

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109 ***U/f optimisation*** *(2.13, 2.6.2)*

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.

EXAMPLE:

What changes are required to start with load from 0 Hz?
First set the motor nominal values (Parameter group 2.1).

Option 1: Activate the Automatic torque boost.

Option 2: Programmable U/f curve
To get torque you need to set the zero point voltage and midpoint voltage/frequency (in parameter group 2.6) so that the motor takes enough current at low frequencies.
First set par. ID108 to *Programmable U/f curve* (value **2**). Increase zero point voltage (ID606) to get enough current at zero speed. Set then the midpoint voltage (ID605) to 1.4142*ID606 and midpoint frequency (ID604) to value ID606/100%*ID111.

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.

110 ***Nominal voltage of the motor*** *(2.6, 2.1.6)*

Find this value U_n on the rating plate of the motor. This parameter sets the voltage at the field weakening point (ID603) to 100% * U_{nMotor}.

111 ***Nominal frequency of the motor*** *(2.7, 2.1.7)*

Find this value f_n on the rating plate of the motor. This parameter sets the field weakening point (ID602) to the same value.

112 ***Nominal speed of the motor*** *(2.8, 2.1.8)*

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

113 ***Nominal current of the motor*** *(2.9, 2.1.9)*

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

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117 I/O frequency reference selection 12346 *(2.14, 2.1.11)*

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

Applic. Sel.	1 to 4	6
0	Analogue volt.ref. Terminals 2-3	Analogue volt. ref. Terminals 2-3
1	Analogue curr.ref. Terminals 4-5	Analogue curr.ref. Terminals 4-5
2	Keypad reference (Menu M3)	AI1+AI2
3	Fieldbus reference	AI1–AI2
4		AI2–AI1
5		AI1*AI2
6		AI1 joystick
7		AI2 joystick
8		Keypad reference (Menu M3)
9		Fieldbus reference
10		Potentiometer reference; controlled with DIN5 (TRUE=increase) and DIN6 (TRUE=decrease)
11		AI1 or AI2, whichever is lower
12		AI1 or AI2, whichever is greater
13		Max. frequency (recommended in torque control only)
14		AI1/AI2 selection

Table 8-2. Selections for parameter ID117

118 PID controller gain 57 *(2.1.12)*

This parameter defines the gain of the PID controller. If the value of the parameter is set to 100% a change of 10% in the error value causes the controller output to change by 10%. If the parameter value is set to **0** the PID controller operates as ID-controller.
See examples on page 128.

119 PID controller I-time 57 *(2.1.13)*

The parameter ID119 defines the integration time of the PID controller. If this parameter is set to 1,00 second a change of 10% in the error value causes the controller output to change by 10.00%/s. If the parameter value is set to 0.00 s the PID controller will operate as PD controller.
See examples on page 128.

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120 ***Motor cos phi*** *(2.10, 2.1.10)*

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

121 ***Keypad frequency reference selection*** ***234567*** *(2.1.12, 2.1.13, 2.2.6, 2.2.1.2)*

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

Applic. Sel.	2–4	5	6	7
0	Analogue volt.ref. Terminals 2–3	Analogue volt.ref. Terminals 2–3	Analogue volt.ref. Terminals 2–3	Analogue volt.ref. Terminals 2–3
1	Analogue curr.ref. Terminals 4–5	Analogue curr.ref. Terminals 4–5	Analogue curr.ref. Terminals 4–5	Analogue curr.ref. Terminals 4–5
2	Keypad reference (Menu M3)	AI3	AI1+AI2	AI3
3	Fieldbus reference*	AI4	AI1–AI2	AI4
4		Keypad reference (Menu M3)	AI2–AI1	Keypad reference (Menu M3)
5		Fieldbus reference*	AI1*AI2	Fieldbus reference*
6		Potentiometer ref.	AI1 joystick	Potentiometer ref.
7		PID controller ref.	AI2 joystick	PID controller ref.
8			Keypad reference (Menu M3)	
9			Fieldbus reference*	

Table 8-3. Selections for parameter ID121

*FBSpeedReference

122 ***Fieldbus frequency reference selection*** ***234567*** *(2.1.13, 2.1.14, 2.2.7, 2.2.1.3)*

Defines which frequency reference source is selected when controlled from the fieldbus.
For selections in different applications, see ID121.

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124 ***Jogging speed reference*** ***34567*** *(2.1.14, 2.1.15, 2.1.19)*

Defines the jogging speed selected with the DIN3 digital input which can be programmed for Jogging speed. See parameter ID301.

Parameter value is automatically limited between minimum and maximum frequency (ID's 101 and 102).

126 ***Preset speed 3*** ***46*** *(2.1.17)*
127 ***Preset speed 4*** ***46*** *(2.1.18)*
128 ***Preset speed 5*** ***46*** *(2.1.19)*
129 ***Preset speed 6*** ***46*** *(2.1.20)*
130 ***Preset speed 7*** ***46*** *(2.1.21)*

Parameter values define the Multi-step speeds selected with the DIN3, DIN4, DIN5 and DIN6 digital inputs. See also parameter ID's 105 and 106.

Parameter value is automatically limited between minimum and maximum frequency (ID's 101 and 102).

Speed	Multi-step speed sel. 1 (DIN4)	Multi-step speed sel. 2 (DIN5)	Multi-step speed sel. 3 (DIN6)	Multi-step speed sel. 4 (DIN3)
Basic speed	0	0	0	0
P2.1.17 (3)	1	1	0	0
P2.1.18 (4)	0	0	1	0
P2.1.19 (5)	1	0	1	0
P2.1.20 (6)	0	1	1	0
P2.1.21 (7)	1	1	1	0

Table 8-4. Preset speeds 3 to 7

131 ***I/O frequency reference selection, place B*** ***3*** *(2.1.12)*

See the values of the parameter ID117 above.

132 ***PID controller D-time*** ***57*** *(2.1.14)*

The parameter ID132 defines the derivation time of the PID controller. If this parameter is set to 1,00 second a change of 10% in the error value during 1.00 s causes the controller output to change by 10.00%. If the parameter value is set to 0.00 s the PID controller will operate as PI controller.
See examples below.

Example 1:
In order to reduce the error value to zero, with the given values, the variable speed drive output behaves as follows:

Given values:
Par. 2.1.12, P = 0%
Par. 2.1.13, I-time = 1.00 s
Par. 2.1.14, D-time = 0.00 s Min freq. = 0 Hz
Error value (setpoint – process value) = 10.00% Max freq. = 50 Hz

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In this example, the PID controller operates practically as I-controller only. According to the given value of parameter 2.1.13 (I-time), the PID output increases by 5 Hz (10% of the difference between the maximum and minimum frequency) every second until the error value is 0.

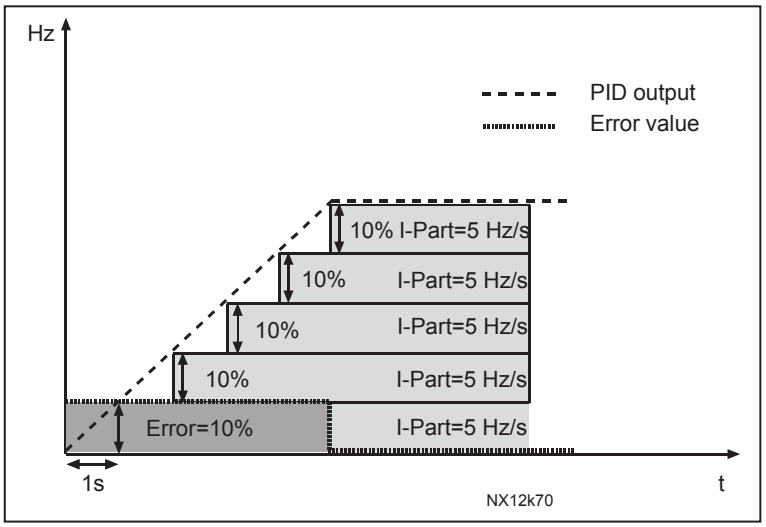


Figure 8-3. PID controller function as I-controller.

Example 2:
Given values:

Par. 2.1.12, P = 100%
Par. 2.1.13, I-time = 1.00 s
Par. 2.1.14, D-time = 1.00 s Min freq. = 0 Hz
Error value (setpoint – process value) = ±10% Max freq. = 50 Hz

As the power is switched on, the system detects the difference between the setpoint and the actual process value and starts to either raise or decrease (in case the error value is negative) the PID output according to the I-time. Once the difference between the setpoint and the process value has been reduced to 0 the output is reduced by the amount corresponding to the value of parameter 2.1.13. In case the error value is negative, the variable speed drive reacts reducing the output correspondingly.

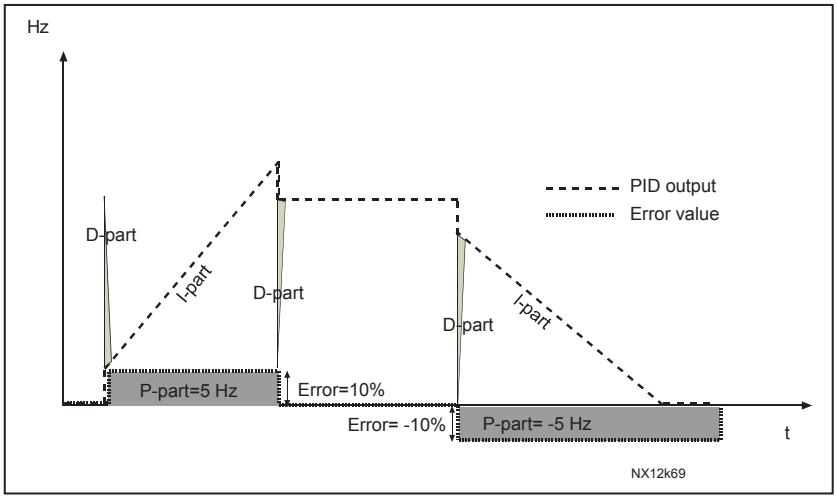


Figure 8-4. PID output curve with the values of Example 2.

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Example 3:
Given values:

Par. 2.1.12, P = 100%
Par. 2.1.13, I-time = 0.00 s
Par. 2.1.14, D-time = 1.00 s Min freq. = 0 Hz
Error value (setpoint – process value) = ±10%/s Max freq. = 50 Hz

As the error value increases, also the PID output increases according to the set values (D-time = 1.00s)

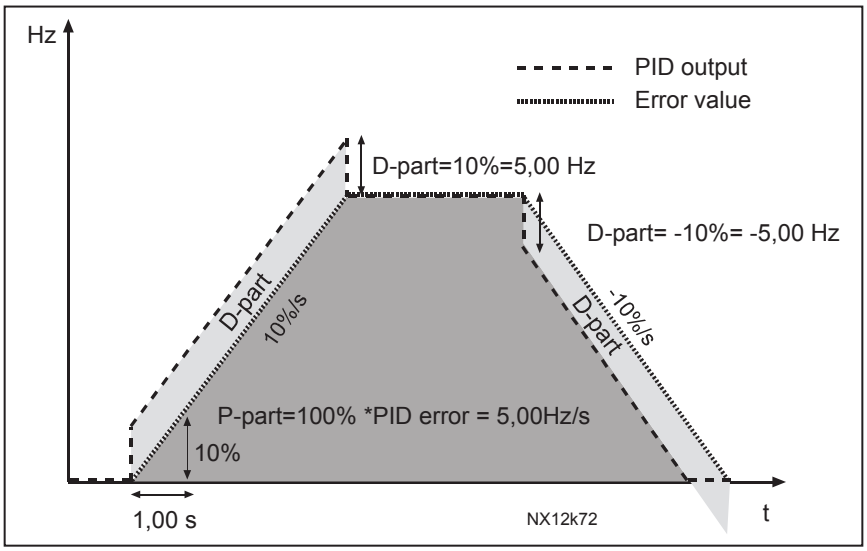


Figure 8-5. PID output with the values of Example 3.

133	***Preset speed 8***	***4***	*(2.1.22)*
134	***Preset speed 9***	***4***	*(2.1.23)*
135	***Preset speed 104***	*(2.1.24)*	
136	***Preset speed 114***	*(2.1.25)*	
137	***Preset speed 124***	*(2.1.26)*	
138	***Preset speed 134***	*(2.1.27)*	
139	***Preset speed 144***	*(2.1.28)*	
140	***Preset speed 154***	*(2.1.29)*	

Speed	Multi-step speed sel. 1 (DIN4)	Multi-step speed sel. 2 (DIN5)	Multi-step speed sel. 3 (DIN6)	Multi-step speed sel. 4 (DIN3)
P2.1.22 (8)	0	0	0	1
P2.1.23 (9)	1	0	0	1
P2.1.24 (10)	0	1	0	1
P2.1.25 (11)	1	1	0	1
P2.1.26 (12)	0	0	1	1
P2.1.27 (13)	1	0	1	1
P2.1.28 (14)	0	1	1	1
P2.1.29 (15)	1	1	1	1

Table 8-5. Multi-step speed selections with digital inputs DIN3, DIN4, DIN5 and DIN6

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141 ***AI3 signal selection*** ***567*** *(2.2.38, 2.2.4.1)*

Connect the AI3 signal to the analogue input of your choice with this parameter. For more information.

142 ***AI3 signal filter time*** ***567*** *(2.2.41, 2.2.4.2)*

When this parameter is given a value greater than 0 the function that filters out disturbances from the incoming analogue signal is activated.
Long filtering time makes the regulation response slower. See parameter ID324.

143 ***AI3 signal range*** ***567*** *(2.2.39, 2.2.4.3)*

With this parameter you can select the AI3 signal range.

Applic. Sel.	5	6	7
0	0…100%	0…100%	0…100%
1	20…100%	20…100%	20…100%
2		–10…+10V	Customised
3		Customised	

Table 8-6. Selections for parameter ID143

144 ***AI3 custom setting minimum 67*** *(2.2.4.4)*
145 ***AI3 custom setting maximum 67*** *(2.2.4.5)*

Set the custom minimum and maximum levels for the AI3 signal within 0…100%.

151 ***AI3 signal inversion*** ***567*** *(2.2.40, 2.2.4.6)*

0 = No inversion
1 = Signal inverted

152 ***AI4 signal selection*** ***567*** *(2.2.42, 2.2.5.1)*

See ID141.

153 ***AI4 filter time*** ***567*** *(2.2.45, 2.2.5.2)*

See ID142.

154 ***AI4 signal range*** ***567*** *(2.2.43, 2.2.5.3)*

See ID 143.

155 ***AI4 custom setting minimum 67*** *(2.2.5.4)*
156 ***AI4 custom setting maximum 67*** *(2.2.5.5)*

See ID's 144 and 145.

162 ***AI4 signal inversion*** ***567*** *(2.2.44, 2.2.5.6)*

See ID 151.

164 ***Motor control mode 1/2*** ***6*** *(2.2.7.22)*

Contact is open = Motor control mode 1 is selected
Contact is closed = Motor control mode 2 is selected

See parameter ID's 600 and 521.

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165 ***AI1 joystick offset*** ***6*** *(2.2.2.11)*

Define the frequency zero point as follows: With this parameter on display, place the potentiometer at the assumed zero point and press *Enter* on the keypad.
Note: This will not, however, change the reference scaling.
Press *Reset* button to change the parameter value back to 0,00%.

166 ***AI2 joystick offset*** ***6*** *(2.2.3.11)*

See par. ID165.

300 ***Start/Stop logic selection*** ***2346*** *(2.2.1, 2.2.1.1)*

0 DIN1: closed contact = start forward
DIN2: closed contact = start reverse

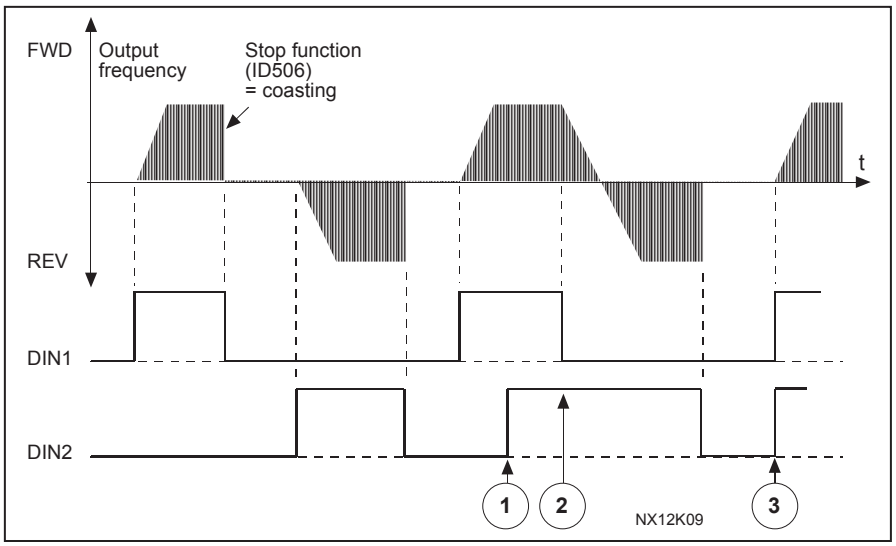


Figure 8-6. Start forward/Start reverse

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 below.

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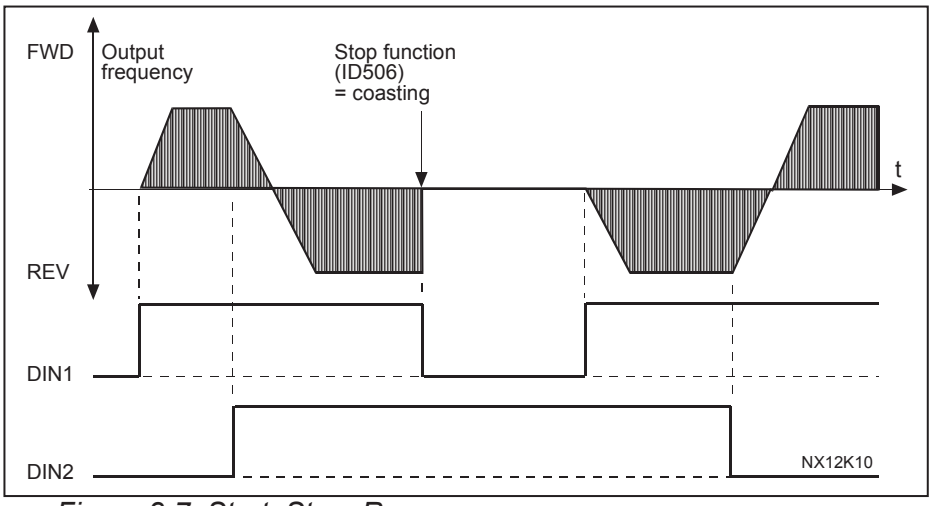


Figure 8-7. Start, Stop, Reverse

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)

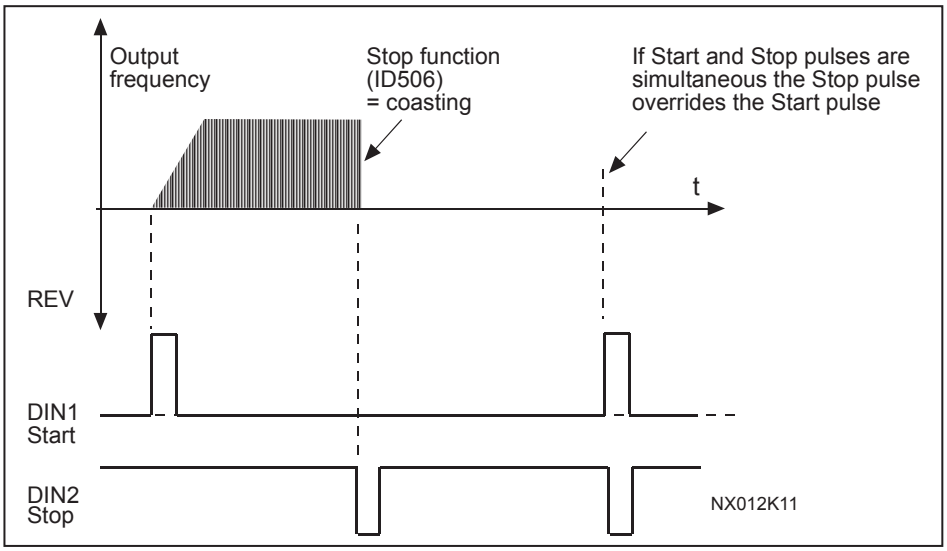


Figure 8-8. Start pulse/ Stop pulse.

The selections including the text **'Rising edge required to start'** 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.

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Applications 2 and 4:

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

Application 3 and 6:

4 DIN1: closed contact = start forward
DIN2: closed contact = reference increases (motor potentiometer reference; this parameter is automatically set to 4 if par. ID117 is set to 3 or 4).

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

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

7 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

Application 3:

8 DIN1: closed contact = start forward **(Rising edge required to start)**
DIN2: closed contact = reference increases (motor potentiometer reference; this parameter is automatically set to 4 if par. ID117 is set to 3 or 4).

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301 DIN3 function 12345 *(2.17, 2.2.2)*

0 Not used
1 External fault, closing contact = Fault is shown and motor is stopped when the input is active.
2 External fault, opening contact = Fault is shown and motor is stopped when the input is not active.
3 Run enable, contact open = Motor start disabled and the motor is stopped
contact closed = Motor start enabled

Application 1:
4 Run enable contact open = Motor start enabled
contact closed = Motor start disabled and the motor is stopped
Applications 2 to 5:
4 Acc./Dec time select. contact open = Acceleration/deceleration time 1 selected
contact closed = Acceleration/deceleration time 2 selected

5 Closing contact: Force control place to I/O terminal
6 Closing contact: Force control place to keypad
7 Closing contact: Force control place to fieldbus
When the control place is forced to change the values of Start/Stop, Direction and Reference valid in the respective control place are used (reference according to parameters ID117, ID121 and ID122).
Note: The value of parameter ID125 Keypad Control Place does not change.
When DIN3 opens the control place is selected according to parameter 3.1.

Applications 2 to 5:
8 Reverse contact open = Forward
contact closed = Reverse

Can be used for reversing if parameter ID300 has value 3.

Applications 3 to 5:
9 Jogging sp. contact closed = Jogging speed selected for frequency reference
10 Fault reset contact closed = Resets all faults
11 Acc./dec. operation prohibited
contact closed = Stops acceleration or deceleration until the contact is opened
12 DC-braking command
contact closed = In Stop mode, the DC-braking operates until the contact is opened, see Figure 8-9

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Applications 3 and 5:
Motor potentiometer down
contact closed= Reference decreases until the contact is opened

Application 4:
13 Preset speed

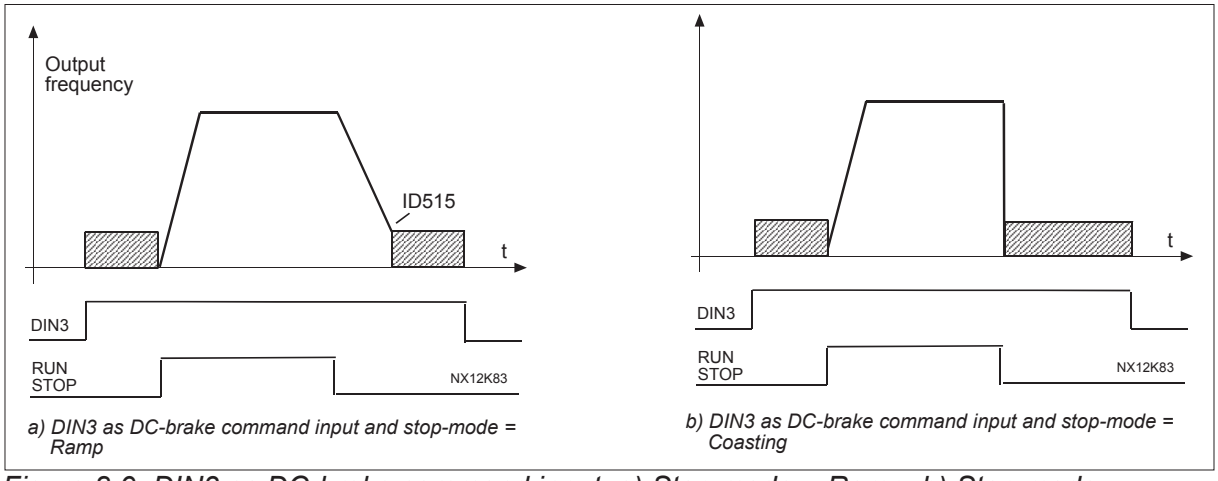


Figure 8-9. DIN3 as DC-brake command input: a) Stop mode = Ramp, b) Stop mode = coasting

302 ***Reference offset for current input*** ***12*** *(2.15, 2.2.3)*

0 No offset: 0—20mA
1 Offset 4 mA (“living zero”), provides supervision of zero level signal. In Standard Application, the response to reference fault can be programmed with parameter ID700.

303 ***Reference scaling, minimum value*** ***2346*** *(2.2.4, 2.2.16, 2.2.2.6)*
304 ***Reference scaling, maximum value*** ***2346*** *(2.2.5, 2.2.17, 2.2.2.7)*

Setting value limits: 0 ≤ par. ID303 ≤ par. ID304 ≤ par. ID102. If parameter ID303 = 0 scaling is set off. The minimum and maximum frequencies are used for scaling.

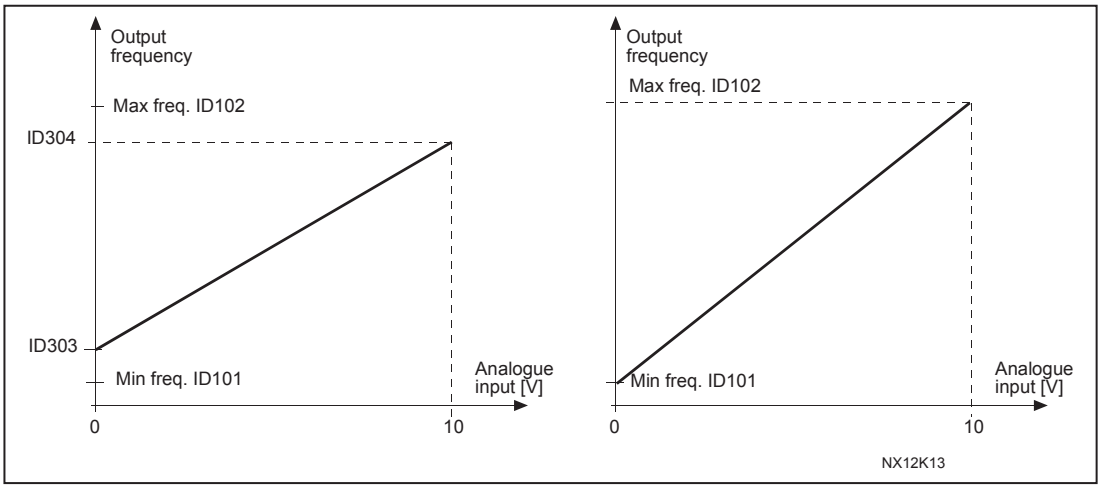


*Figure 8-10. **Left**: Reference scaling; **Right**: No scaling used (par. ID303 = 0).*

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305 ***Reference inversion*** ***2*** *(2.2.6)*

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

0 No inversion
1 Reference inverted

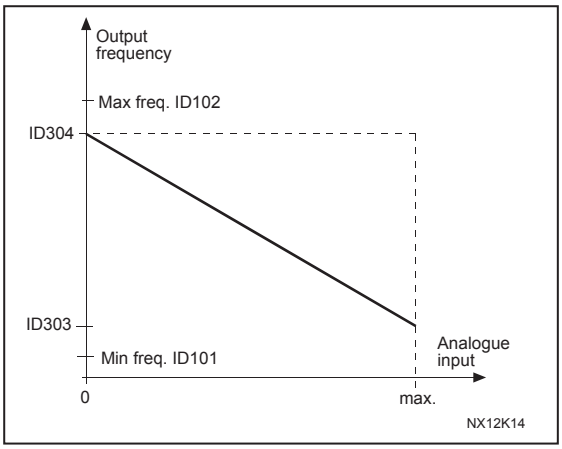


Figure 8-11. Reference invert.

306 ***Reference filter time*** ***2*** *(2.2.7)*

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

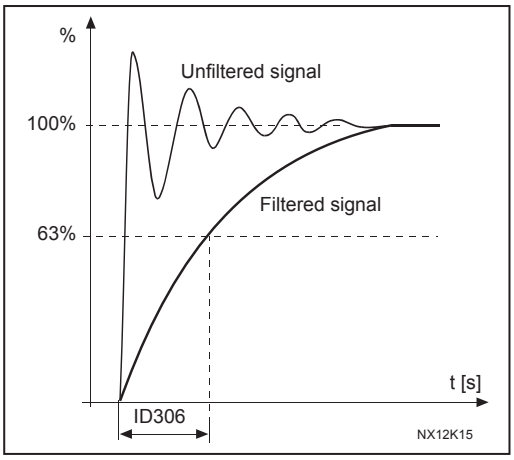


Figure 8-12. Reference filtering

307 ***Analogue output function*** *(2.16, 2.3.2, 2.3.5.2, 2.3.3.2)*

This parameter selects the desired function for the analogue output signal.

308 ***Analogue output filter time*** ***234567*** *(2.3.3, 2.3.5.3, 2.3.3.3)*

Defines the filtering time of the analogue output signal.
Setting this parameter value **0** will deactivate filtering.

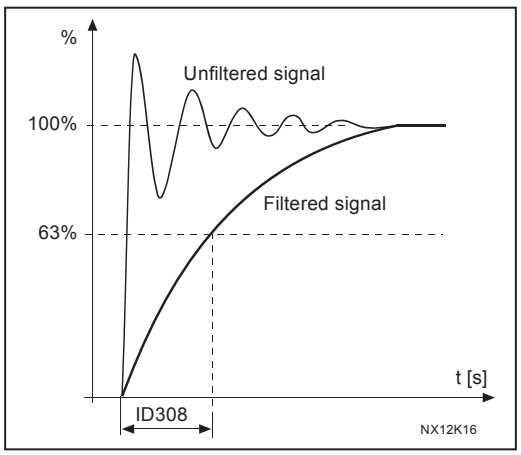


Figure 8-13. Analogue output filtering

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309 ***Analogue output inversion*** ***234567*** *(2.3.4, 2.3.5.4, 2.3.3.4)*

Inverts the analogue output signal:

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

See parameter ID311 below.

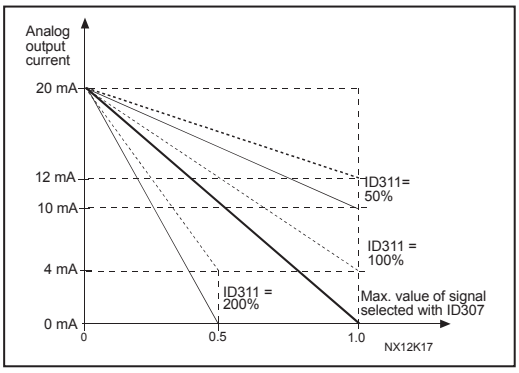


Figure 8-14. Analogue output invert

310 ***Analogue output minimum*** ***234567*** *(2.3.5, 2.3.5.5, 2.3.3.5)*

Defines the signal minimum to either 0 mA or 4 mA (living zero). Note the difference in analogue output scaling in parameter ID311 (Figure 8-15).

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

311 ***Analogue output scale 234567*** *(2.3.6, 2.3.5.6, 2.3.3.6)*

Scaling factor for analogue output.

Signal	Max. value of the signal
Output frequency	Max frequency (par.ID102)
Freq. Reference	Max frequency (par.ID102)
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
PI-ref. value	100% x ref. value max.
PI act. value 1	100% x actual value max.
PI act. value 2	100% x actual value max.
PI error value	100% x error value max.
PI output	100% x output max.

Table 8-7. Analogue output scaling scaling

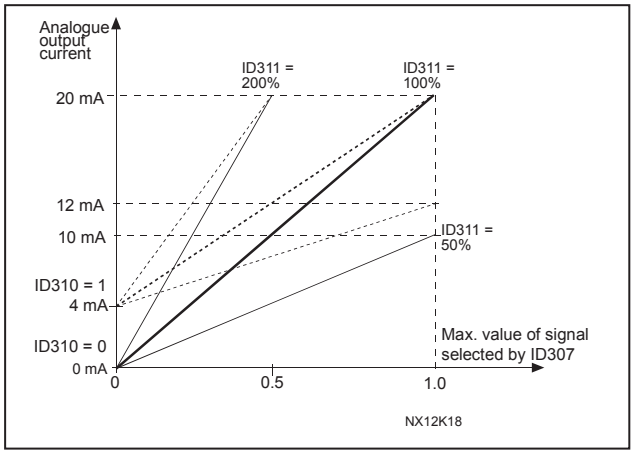


Figure 8-15. Analogue output

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312 ***Digital output function 23456*** *(2.3.7, 2.3.1.2)*
313 ***Relay output 1 function*** ***2345*** *(2.3.8, 2.3.1.3)*
314 ***Relay output 2 function*** ***2345*** *(2.3.9)*

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 variable speed drive is ready to operate
2 = Run	The variable speed drive operates (motor is running)
3 = Fault	A fault trip has occurred
4 = Fault inverted	A fault trip not occurred
5 = Telemecanique overheat warning	The heat-sink temperature exceeds +70°C
6 = External fault or warning	Fault or warning depending on par. ID701
7 = Reference fault or warning	Fault or warning depending on par. ID700 - if analogue 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 1 (Applications 2) 10 = Jogging speed (Applications 3456)	The preset speed has been selected with digital input The jogging speed has been selected with digital input
11 = At speed	The output frequency has reached the set reference
12 = Motor regulator activated	Overvoltage or overcurrent regulator was activated
13 = Output frequency limit supervision	The output frequency goes outside the set supervision low limit/high limit (see parameter ID's 315 and 316 below)
14 = Control from I/O terminals (Appl. 2) 14 = Output freq.limit 2 supervision (Applications 3456)	I/O control mode selected (in menu M3) The output frequency goes outside the set supervision low limit/high limit (see parameter ID's 346 and 347 below)
15 = Thermistor fault or warning (Appl.2) 15 = Torque limit supervision (Appl.3456)	The thermistor input of option board indicates overtemperature. Fault or warning depending on par ID732. The motor torque goes beyond the set supervision low limit/high limit (par. ID348 and ID349).
16 = Fieldbus input data (Application 2) 16 = Reference limit supervision	Fieldbus input data (FBFixedControlWord) to DO/RO. Active reference goes beyond the set supervision low limit/high limit (par. ID350 and ID351)

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17 = External brake control (Appl. 3456)	External brake ON/OFF control with programmable delay (par. ID352 and ID353)
18 = Control from I/O terminals (Appl. 3456)	External control mode (Menu **M3**; ID125)
19 = Variable speed drive temperature limit supervision (Appl. 3456)	Variable speed drive heatsink temperature goes beyond the set supervision limits (par. ID354 and ID355).
20 = Unrequested rotation direction (Appl. 345) 20 = Reference inverted (Appl. 6)	Rotation direction is different from the requested one.
21 = External brake control inverted (Appl. 3456)	External brake ON/OFF control (par. ID352 and ID353); Output active when brake control is OFF
22 = Thermistor fault or warning (Appl.3456)	The thermistor input of option board indicates overtemperature. Fault or warning depending on parameter ID732.
23 = Fieldbus input data (Application 5) 23 = On/Off control (Application 6)	Fieldbus input data (FBFixedControlWord) to DO/RO. Selects the analogue input to be monitored. See par. ID356, ID357, ID358 and ID463.
24 = Fieldbus input data 1 (Application 6)	Fieldbus data (FBFixedControlWord) to DO/RO
25 = Fieldbus input data 2 (Application 6)	Fieldbus data (FBFixedControlWord) to DO/RO
26 = Fieldbus input data 3 (Application 6)	Fieldbus data (FBFixedControlWord) to DO/RO

Table 8-8. Output signals via DO1 and output relays RO1 and RO2.

315 ***Output frequency limit supervision function*** ***234567*** *(2.3.10, 2.3.4.1, 2.3.2.1)*

0 No supervision
1 Low limit supervision
2 High limit supervision
3 Brake-on control (Application 6 only)

If the output frequency goes under/over the set limit (ID316) this function generates a warning message via the digital output DO1 or via the relay output RO1
or RO2 depending on the settings of parameters ID312…ID314.

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316 ***Output frequency limit supervision value 234567*** *(2.3.11, 2.3.4.2, 2.3.2.2)*

Selects the frequency value supervised by parameter ID315.

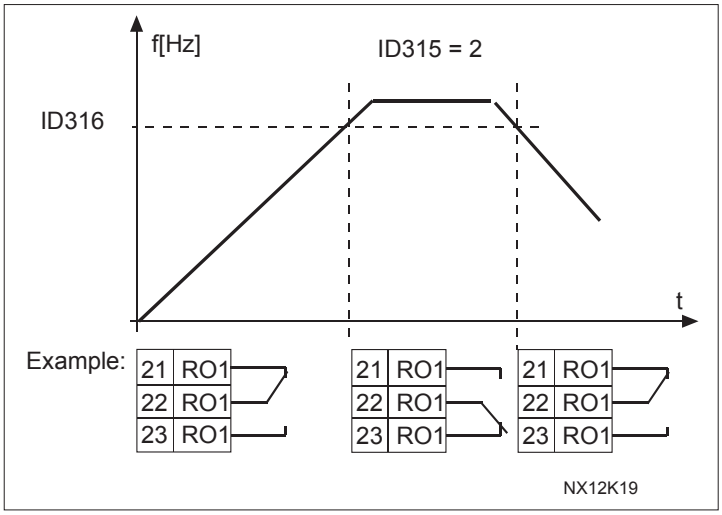


Figure 8-16. Output frequency supervision

319 ***DIN2 function 5*** *(2.2.1)*

This parameter has 14 selections. If digital input DIN2 need not be used, set the parameter value to **0**.

1 External fault
Contact closed: Fault is displayed and motor stopped when the input is active
2 External fault
Contact open: Fault is displayed and motor stopped when the input is not active
3 Run enable
Contact open: Start of motor disabled
Contact closed: Start of motor enabled
4 Acceleration or deceleration time selection
Contact open: Acceleration/Deceleration time 1 selected
Contact closed: Acceleration/Deceleration time 2 selected
5 Closing contact: Force control place to I/O terminal
6 Closing contact: Force control place to keypad
7 Closing contact: Force control place to fieldbus
When the control place is forced to change the values of Start/Stop, Direction and Reference valid in the respective control place are used (reference according to parameters ID343, ID121 and ID122).
Note: The value of ID125 (Keypad Control Place) does not change.
When DIN2 opens the control place is selected according to keypad control place selection.
8 Reverse
Contact open: Forward
Contact closed: Reverse

If several inputs are programmed to reverse, one active contact is enough to set the direction to

9 Jogging speed (see par. ID124)
Contact closed: Jogging speed selected for frequency reference
10 Fault reset
Contact closed: All faults reset

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11 Acceleration/Deceleration prohibited
Contact closed: No acceleration or deceleration possible until the contact is opened
12 DC braking command
Contact closed: In Stop mode, the DC braking operates until the contact is opened. See Figure 8-17.
13 Motor potentiometer UP
Contact closed: Reference increases until the contact is opened.

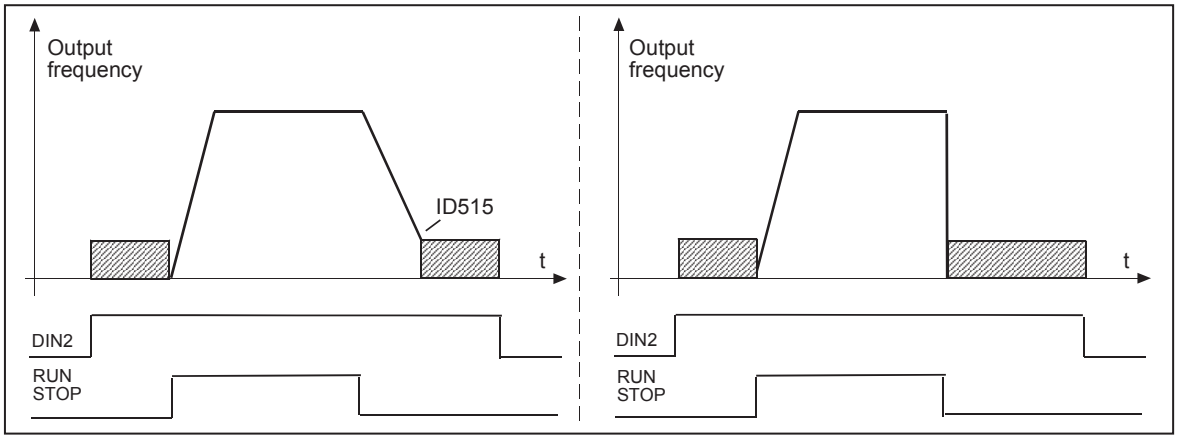


Figure 8-17. DC braking command (selection 12) selected for DIN2. Left: Stop mode = Ramp; Right: Stop mode = Coasting

320 ***AI1 signal range*** ***34567*** *(2.2.4, 2.2.16, 2.2.2.3)*

Applic. Sel.	3, 4,5	6	7
0	0…100%	0…100%	0…100%
1	20…100%	20…100%	20…100%
2	Customised	–10…+10V	Customised
3		Customised	

Table 8-9. Selections for parameter ID320

For selection 'Customised', see parameters ID321 and ID322.

321 ***AI1 custom setting minimum*** ***34567*** *(2.2.5, 2.2.17, 2.2.2.4)*
322 ***AI1 custom setting maximum*** ***34567*** *(2.2.6, 2.2.18, 2.2.2.5)*

These parameters set the analogue input signal for any input signal span within 0-100%.

323 ***AI1 signal inversion*** ***3457***
(2.2.7, 2.2.19, 2.2.2.6)

If this parameter = **0**, no inversion of analogue U_{in} signal takes place.

Note: In application 3, AI1 is place B frequency reference if parameter ID131= 0 (default).

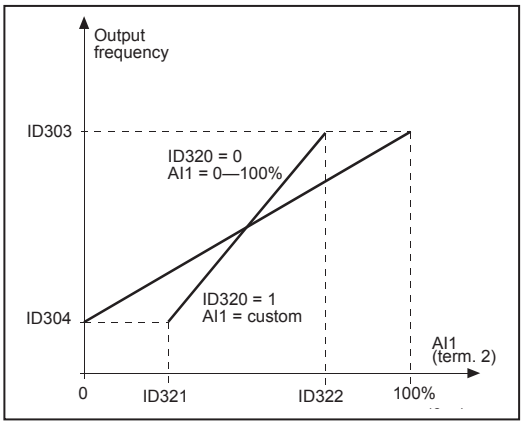


Figure 8-18. AI1 no signal inversion

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If this parameter = **1** inversion of analogue signal takes place.
max. AI1 signal = minimum set speed
min. AI1 signal = maximum set speed

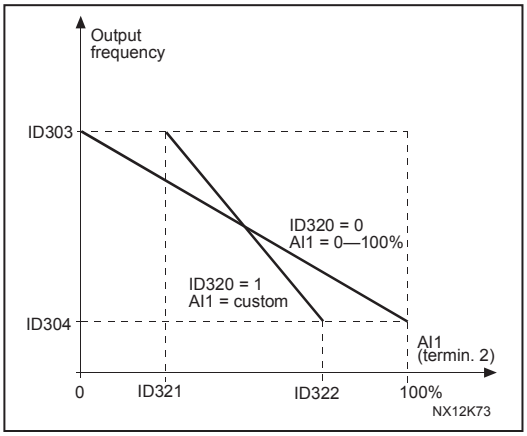


Figure 8-19. AI1 signal inversion

324 AI1 signal filter time ***34567*** *(2.2.8, 2.2.20, 2.2.2.2)*

When this parameter is given a value greater than 0 the function that filters out disturbances from the incoming analogue signal is activated.

Long filtering time makes the regulation response slower.

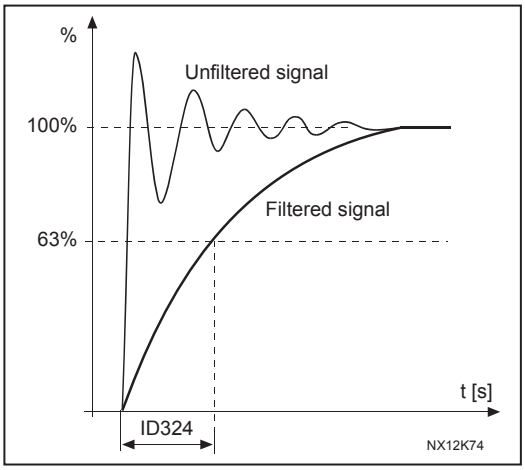


Figure 8-20. AI1 signal filtering

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325 ***Analogue input AI2 signal range*** ***34567*** *(2.2.10, 2.2.22, 2.2.3.3)*

Applic. Sel.	3, 4	5	6	7
0	0…20mA	0…20mA	0…100%	0…100%
1	4…20mA	4mA/20…100%	20…100%	20…100%
2	Customised	Customised	–10…+10V	Customised
3			Customised	

Table 8-10. Selections for parameter ID325

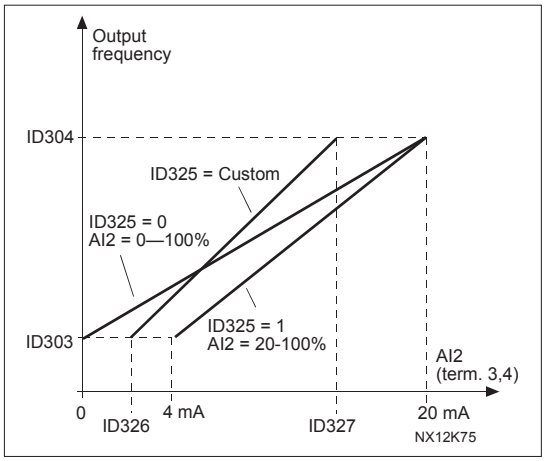


Figure 8-21. Analogue input AI2 scaling.

326 ***Analogue input AI2 custom setting min.*** ***34567*** *(2.2.11, 2.2.23, 2.2.3.4)*
327 ***Analogue input AI2 custom setting max.*** ***34567*** *(2.2.12, 2.2.24, 2.2.3.5)*

These parameters set AI2 for any input signal span within 0…100%.

328 ***Analogue input AI2 inversion*** ***3457*** *(2.2.13, 2.2.25, 2.2.3.6)*

See ID323.
Note: In application 3, AI2 is the place A frequency reference, if parameter ID117 = 1 (default)

329 ***Analogue input AI2 (I_{in}) filter time*** ***34567*** *(2.2.14, 2.2.26, 2.2.3.2)*

See ID324.

330 ***DIN5 function*** ***5*** *(2.2.3)*

The digital input DIN5 has 14 possible functions. If it need not be used, set the value of this parameter to **0**.
The selections are the same as in parameter ID319 except:

13 Enable PID reference 2
Contact open: PID controller reference selected with parameter ID332.
Contact closed: PID controller keypad reference 2 selected with parameter R3.5.

331 ***Motor potentiometer ramp time*** ***3567*** *(2.2.22, 2.2.27, 2.2.1.2, 2.2.1.15)*

Defines the speed of change of the motor potentiometer value.

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332 ***PID controller reference signal (Place A)*** ***57*** *(2.1.11)*

Defines which frequency reference place is selected for the PID controller.

Applic. Sel.	5	7
0	AI1; terminals 2-3	AI1; terminals 2-3
1	AI2; terminals 4-5	AI2; terminals 4-5
2	PID ref. from menu M3, par. R34	AI3
3	Fieldbus ref. (FBProcessDataIN1)	AI4
4	Motor potentiometer reference	PID ref. from menu M3, par. R34
5		Fieldbus ref. (FBProcessDataIN1)
6		Motor potentiometer reference

Table 8-11. Selections for parameter ID332

333 ***PID controller actual value selection 57*** *(2.2.8, 2.2.1.8)*

This parameter selects the PID controller actual value.
0 Actual value 1
1 Actual value 1 + Actual value 2
2 Actual value 1 – Actual value 2
3 Actual value 1 * Actual value 2
4 Greater one of Actual value 1 and Actual value 2
5 Smaller one of Actual value 1 and Actual value 2
6 Mean value of Actual value 1 and Actual value 2
7 Square root of Actual value 1 + Square root of Actual value 2

334 ***Actual value 1 selection*** ***57*** *(2.2.9, 2.2.1.9)*
335 ***Actual value 2 selection*** ***57*** *(2.2.10, 2.2.1.10)*

0 Not used
1 AI1 (control board)
2 AI2 (control board)
3 AI3
4 AI4
5 Fieldbus (*Actual value 1*: FBProcessDataIN2; *Actual value 2*: FBProcessDataIN3)
Application 5
6 Motor torque
7 Motor speed
8 Motor current
9 Motor power
10 Encoder frequency (for Actual value 1 only)

336 ***Actual value 1 minimum scale*** ***57*** *(2.2.11, 2.2.1.11)*

Sets the minimum scaling point for Actual value 1. See Figure 8-22.

337 ***Actual value 1 maximum scale*** ***57*** *(2.2.12, 2.2.1.12)*

Sets the maximum scaling point for Actual value 1. See Figure 8-22.

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338 ***Actual value 2 minimum scale*** ***57*** *(2.2.13, 2.2.1.13)*

Sets the minimum scaling point for Actual value 2. See Figure 8-22.

339 ***Actual value 2 maximum scale*** ***57*** *(2.2.14, 2.2.1.14)*

Sets the maximum scaling point for Actual value 2.

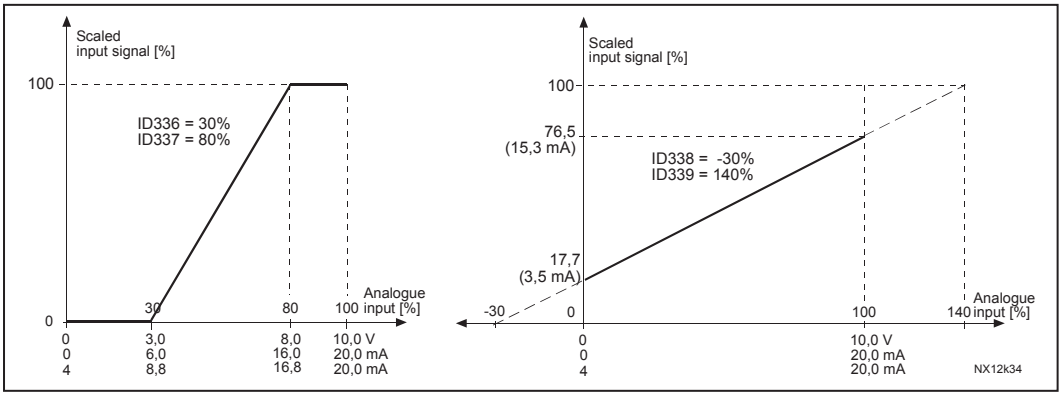


Figure 8-22. Examples of actual value signal scaling

340 ***PID error value inversion*** ***57*** *(2.2.32, 2.2.1.5)*

This parameter allows you to invert the error value of the PID controller (and thus the operation of the PID controller).

0 No inversion
1 Inverted

341 ***PID reference rise time*** ***57*** *(2.2.33, 2.2.1.6)*

Defines the time during which the PID controller reference rises from 0% to 100%.

342 ***PID reference fall time*** ***57*** *(2.2.34, 2.2.1.7)*

Defines the time during which the PID controller reference falls from 100% to 0%.

343 ***I/O B reference selection*** ***57*** *(2.2.5, 2.2.1.1)*

Defines the selected frequency reference place when the drive is controlled from the I/O terminal and reference place B is active (DIN6=closed).

0 AI1 reference (terminals 2 and 3, e.g. potentiometer)
1 AI2 reference (terminals 5 and 6, e.g. transducer)
2 AI3 reference
3 AI4 reference
4 Keypad reference (parameter R32)
5 Reference from Fieldbus (FBSpeedReference)
6 Motor potentiometer reference
7 PID controller reference
- select actual value (par. ID333 to ID339) and the PID control reference (par. ID332)

If value **6** is selected for this parameter in **Application 5**, the values of parameters ID319 and ID301 are automatically set to 13.
In **Application 7**, the functions *Motorpotentiometer DOWN* and *Motorpotentiometer UP* must be connected to digital inputs (parameters ID417 and ID418), if value **6** is selected for this parameter.

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344 ***Reference scaling minimum value, place B 57*** *(2.2.35, 2.2.1.18)*
345 ***Reference scaling maximum value, place B 57*** *(2.2.36, 2.2.1.19)*

You can choose a scaling range for the frequency reference from control place B between the Minimum and Maximum frequency.
If no scaling is desired set the parameter value to **0**.
In the figures below, input AI1 with signal range 0…100% is selected for Place B reference.

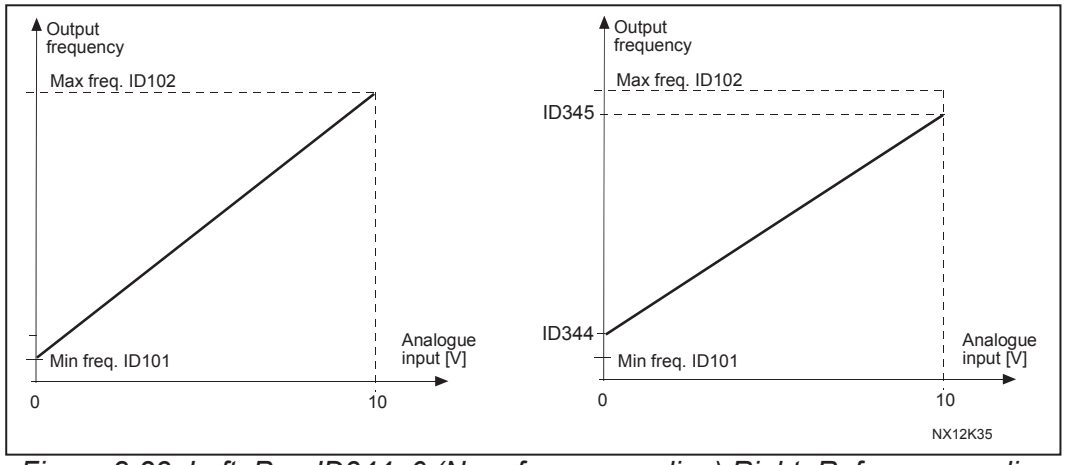


Figure 8-23. Left: Par. ID344=0 (No reference scaling) Right: Reference scaling

346 ***Output freq. limit 2 supervision function*** ***34567*** *(2.3.12, 2.3.4.3, 2.3.2.3)*

0 No supervision
1 Low limit supervision
2 High limit supervision
3 Brake-on control (Application 6 only)
4 Brake-on/off control (Application 6 only)

If the output frequency goes under/over the set limit (ID347) this function generates a warning message via the digital output DO1 and via the relay output RO1
or RO2 depending
1) on the settings of parameters ID312 to ID314 (applications 3,4,5) or
2) depending on to which output the supervision signals (par. ID447 and ID448) are connected (applications 6 and 7).

347 ***Output frequency limit 2 supervision value*** ***34567*** *(2.3.13, 2.3.4.4, 2.3.2.4)*

Selects the frequency value supervised by parameter ID346. See Figure 8-16.

348 ***Torque limit, supervision function*** ***34567*** *(2.3.14, 2.3.4.5, 2.3.2.5)*

0 = No supervision
1 = Low limit supervision
2 = High limit supervision
3 = Brake-off control (Application 6 only)

If the calculated torque value falls below or exceeds the set limit (ID349) this function generates a warning message via the digital output DO1 or via a relay output RO1 or RO2 depending
1) on the settings of parameters ID312 to ID314 (applications 3,4,5) or

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2) depending on to which output the supervision signal (par. ID451) is connected (applications 6 and 7).

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349 Torque limit, supervision value ***34567*** **(2.3.15, 2.3.4.6, 2.3.2.6)**

Set here the torque value to be supervised by parameter ID348.

Applications 3 and 4:
Torque supervision value can be reduced below the setpoint with external free analogue input signal, see parameters ID361 and ID362.

350 Reference limit, supervision function ***34567*** *(2.3.16, 2.3.4.7, 2.3.2.7)*

0 = No supervision
1 = Low limit supervision
2 = High limit supervision
If the reference value falls below or exceeds the set limit (ID351), this function generates a warning message via the digital output DO1 or via a relay output RO1 or RO2 depending
1) on the settings of parameters ID312 to ID314 (applications 3,4,5) or
2) depending on to which output the supervision signal (par. ID449) is connected (applications 6 and 7).

The supervised reference is the current active reference. It can be place A or B reference depending on DIN6 input, or panel reference if the panel is the active control place.

351 Reference limit, supervision value ***34567*** *(2.3.17, 2.3.4.8, 2.3.2.8)*

The frequency value to be supervised with the parameter ID350.

352 External brake-off delay ***34567*** *(2.3.18, 2.3.4.9, 2.3.2.9)*
353 External brake-on delay ***34567*** *(2.3.19, 2.3.4.10, 2.3.2.10)*

The function of the external brake can be timed to the start and stop control signals with these parameters. See **Erreur ! Source du renvoi introuvable.**.
The brake control signal can be programmed via the digital output DO1 or via one of the relay outputs RO1 and RO2, see parameters ID312 to ID314 (applications 3,4,5) or ID445 (applications 6 and 7).

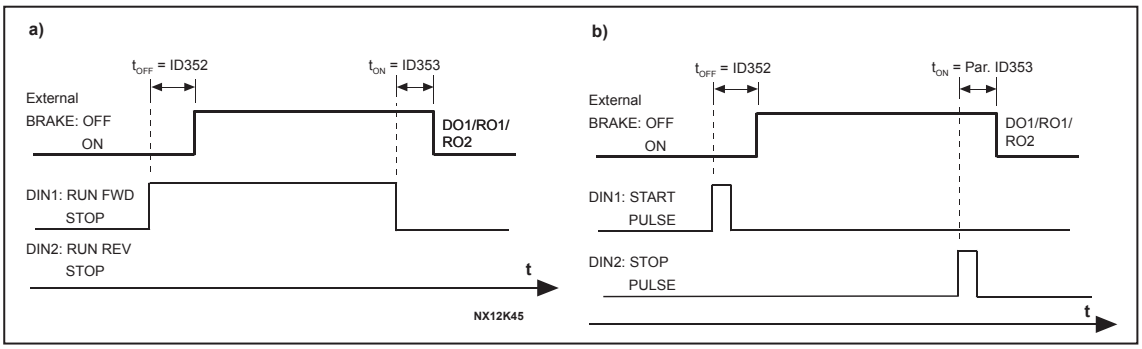


Figure 8-24. External brake control:
a) Start/Stop logic selection, ID300 = 0, 1 or 2
b) Start/Stop logic selection, ID300= 3

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354 ***Variable speed drive temperature limit supervision*** ***34567*** *(2.3.20, 2.3.4.11, 2.3.2.11)*

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

If the temperature of the variable speed drive unit falls below or exceeds the set limit (ID355), this function generates a warning message via the digital output DO1 or via a relay output RO1 or RO2 depending
1) on the settings of parameters ID312 to ID314 (applications 3,4,5) or
2) depending on to which output the supervision signal (par. ID450) is connected (applications 6 and 7).

355 ***Variable speed drive temperature limit value*** ***34567*** *(2.3.21, 2.3.4.12, 2.3.2.12)*

This temperature value is supervised by parameter ID354.

356 ***On/Off control signal*** ***6*** *(2.3.4.13)*

With this parameter you can select the analogue input to be monitored.

0 = Not used
1 = AI1
2 = AI2
3 = AI3
4 = AI4

357 ***On/Off control low limit*** ***6*** *(2.3.4.14)*
358 ***On/Off control high limit*** ***6*** *(2.3.4.15)*

These parameters set the low and high limits of the signal selected with par. ID356.

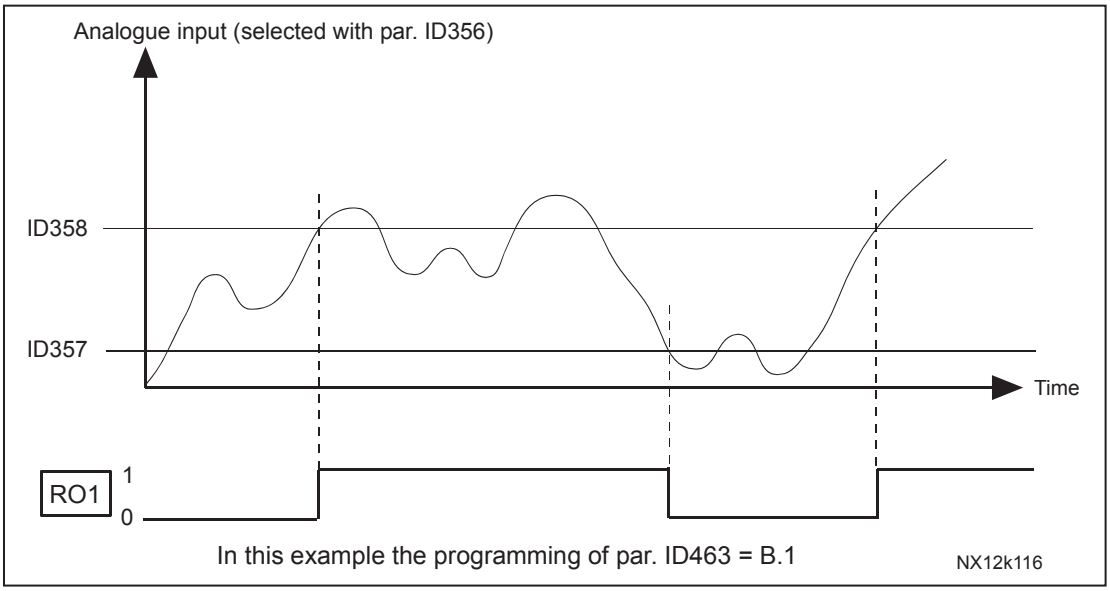


Figure 8-25. An example of On/Off-control

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359 ***PID controller minimum limit*** ***5*** *(2.2.30)*
360 ***PID controller maximum limit*** ***5*** *(2.2.31)*

With these parameters you can set the minimum and maximum limits for the PID controller output.
Limit setting: –1000.0% (of f_{max}) < par. ID359 < par. ID360 < 1000.0% (of f_{max}).
These limits are of importance for example when you define the gain, I-time and D-time for the PID controller.

361 ***Free analogue input, signal selection*** ***34*** *(2.2.20, 2.2.17)*

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

0 = Not in use
1 = Voltage signal U_{in}
2 = Current signal I_{in}

362 ***Free analogue input, function*** ***34*** *(2.2.21, 2.2.18)*

This parameter is used for selecting a function for a free analogue input signal:

0 = Function is not in use

1 = Reduces motor current limit (ID107)

This signal will adjust the maximum motor current between 0 and max. limit set with ID107.

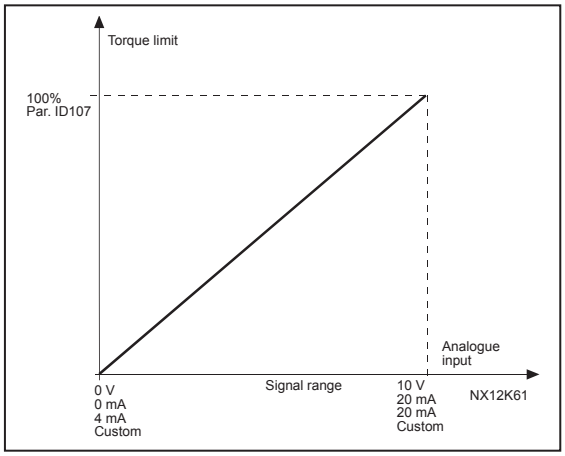


Figure 8-26. Scaling of max. motor current

2 = Reduces DC braking current.

DC braking current can be reduced with the free analogue input signal between current 0.4 x I_H and the current set with the parameter ID507.

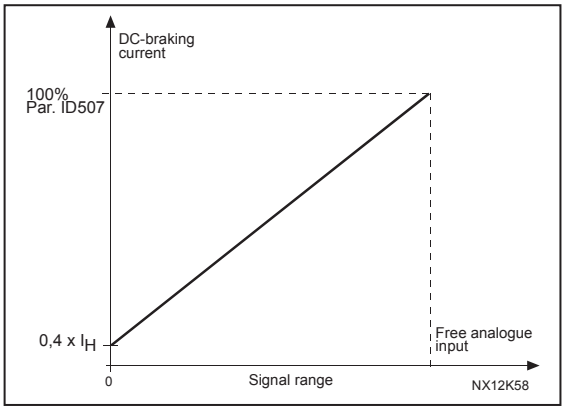


Figure 8-27. Reduction of DC braking current

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3 = Reduces acceleration and deceleration times.

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

Reduced time = set acc./deceler. time (par.ID103, ID104; ID502, ID503) divided by the factor R in Figure 8-28.

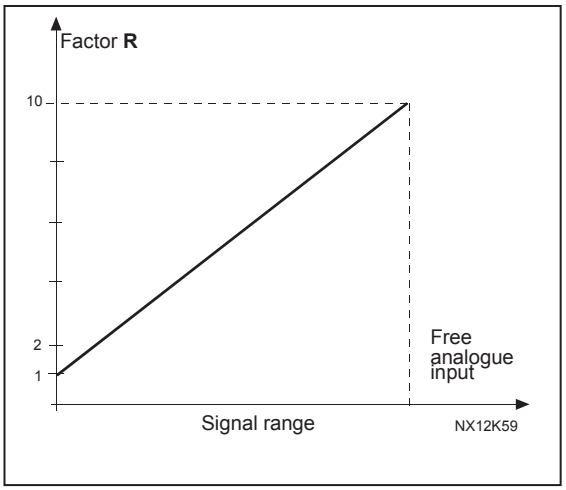


Figure 8-28. Reduction of acceleration and deceleration times

4 = Reduces torque supervision limit

Set supervision limit can be reduced with the free analogue input signal between 0 and set supervision limit (ID349).

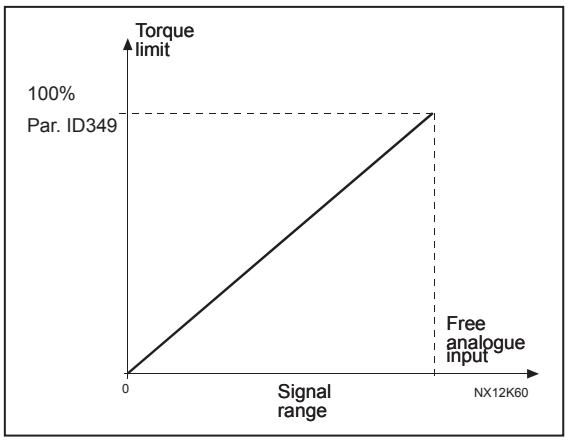


Figure 8-29. Reduction of torque supervision limit

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363 ***Start/Stop logic selection, place B*** ***3*** *(2.2.15)*

0 DIN4: closed contact = start forward
DIN5: closed contact = start reverse

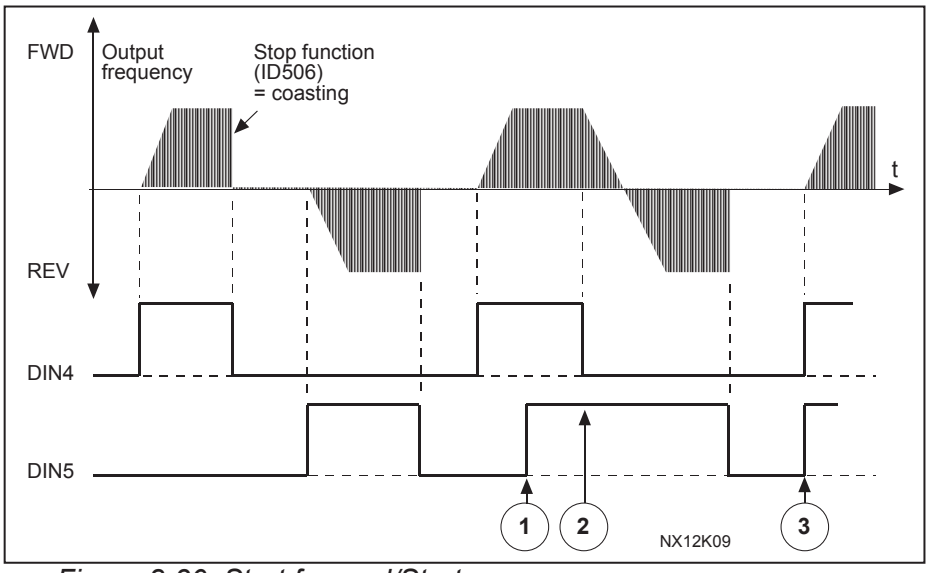


Figure 8-30. Start forward/Start reverse

① The first selected direction has the highest priority.

② When the DIN4 contact opens the direction of rotation starts the change.

③ If Start forward (DIN4) and Start reverse (DIN5) signals are active simultaneously the Start forward signal (DIN4) has priority.

1 DIN4: closed contact = start open contact = stop
DIN5: closed contact = reverse open contact = forward

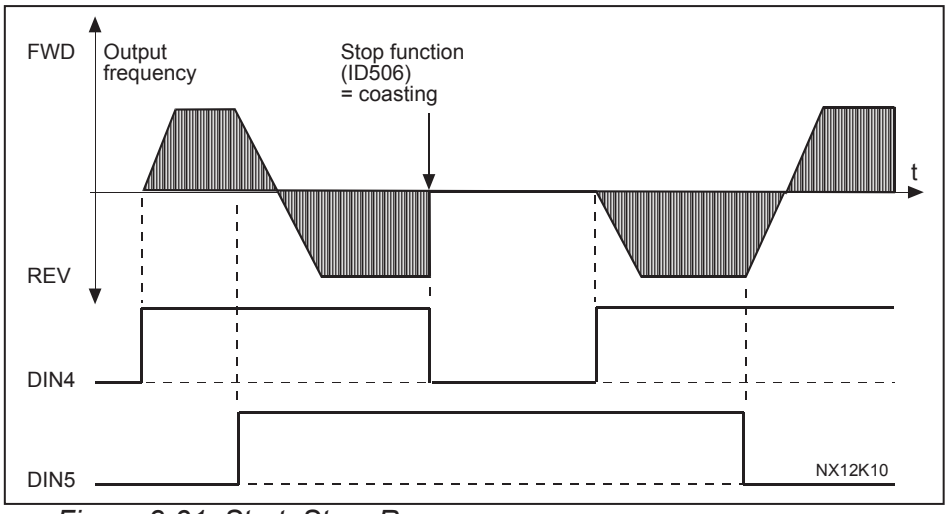


Figure 8-31. Start, Stop, Reverse

2 DIN4: closed contact = start open contact = stop
DIN5: closed contact = start enabled open contact = start disabled and drive stopped if running

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3 3-wire connection (pulse control):
DIN4: closed contact = start pulse
DIN5: open contact = stop pulse
(DIN3 can be programmed for reverse command)

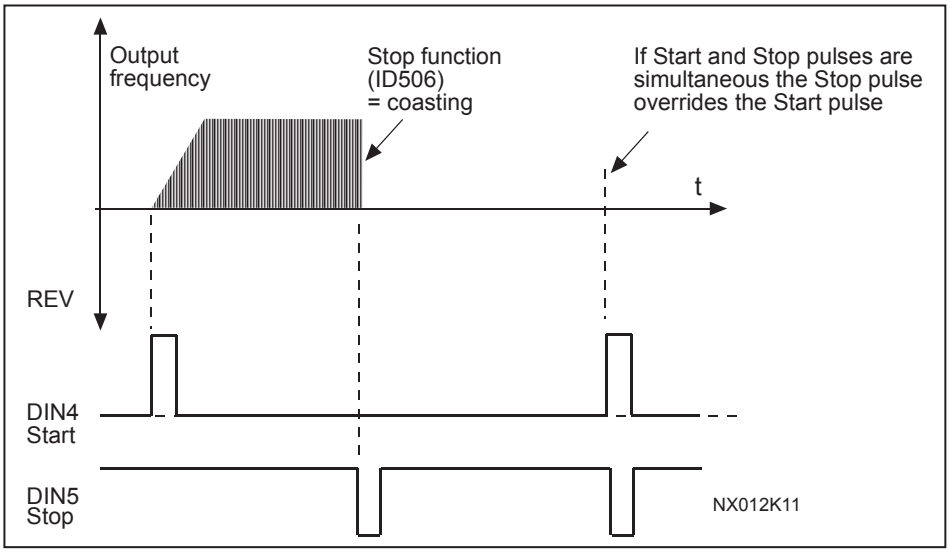


Figure 8-32. Start pulse/ Stop pulse.

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 DIN4: closed contact = start forward **(Rising edge required to start)**
DIN5: closed contact = start reverse **(Rising edge required to start)**

5 DIN4: closed contact = start (Rising edge required to start)
open contact = stop
DIN5: closed contact = reverse
open contact = forward

6 DIN4: closed contact = start (Rising edge required to start)
open contact = stop
DIN5: closed contact = start enabled
open contact = start disabled and drive stopped if running

364 ***Reference scaling, minimum value, place B*** ***3*** *(2.2.18)*
365 ***Reference scaling, maximum value, place B*** ***3*** *(2.2.19)*

See parameters ID303 and ID304 above.

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366 ***Easy changeover*** ***5*** *(2.2.37)*

0 Keep reference
1 Copy reference
If Copy reference has been selected it is possible to switch from direct control to PID control and back without scaling the reference and actual value.
For example: The process is driven with direct frequency reference (Control place I/O B, fieldbus or keypad) to some point and then the control place is switched to one where the PID controller is selected. The PID control starts to maintain that point. The PID controller error value is forced to zero when the control place is changed.
It is also possible to change the control source back to direct frequency control. In this case, the output frequency is copied as the frequency reference. If the destination place is Keypad the run status (Run/Stop, Direction and Reference) will be copied.
The changeover is smooth when the reference of the destination source comes from the Keypad or an internal motor potentiometer (par. ID332 [PID Ref.] = 2 or 4, ID343 [I/O B Ref] = 2 or 4, par. ID121 [Keypad Ref] = 2 or 4 and ID122 [Fieldbus Ref]= 2 or 4.

367 ***Motor potentiometer memory reset (Frequency reference)*** ***3567***
(2.2.23, 2.2.28, 2.2.1.3, 2.2.1.16)

0 No reset
1 Memory reset in stop and powerdown
2 Memory reset in powerdown

370 ***Motor potentiometer memory reset (PID reference)*** ***57*** *(2.2.29, 2.2.1.17)*

0 No reset
1 Memory reset in stop and powerdown
2 Memory reset in powerdown

371 ***PID reference 2 (Place A additional reference)*** ***7*** *(2.2.1.4)*

If the *PID reference 2 enable* input function (ID330)= TRUE, this parameter defines which reference place is selected as PID controller reference.
0 = AI1 reference (terminals 2 and 3, e.g. potentiometer)
1 = AI2 reference (terminals 5 and 6, e.g. transducer)
2 = AI3 reference
3 = AI4 reference
4 = PID reference 1 from keypad
5 = Reference from Fieldbus (FBProcessDataIN3)
6 = Motor potentiometer
7 = PID reference 2 from keypad
If value **6** is selected for this parameter, the functions *Motor potentiometer DOWN* and *Motor potentiometer UP* must be connected to digital inputs (parameters ID417 and ID418).

372 ***Supervised analogue input*** ***7*** *(2.3.2.13)*

0 = Analogue reference from AI1 (terminals 2 and 3, e.g. potentiometer)
1 = Analogue reference from AI2 (terminals 4 and 5, e.g. transducer)

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373 ***Analogue input limit supervision*** ***7*** *(2.3.2.14)*

If the value of the selected analogue input goes under/over the set limit (par. ID374) this function generates a warning message through the digital output or the relay outputs depending on to which output the supervision function (par. ID463) is connected.

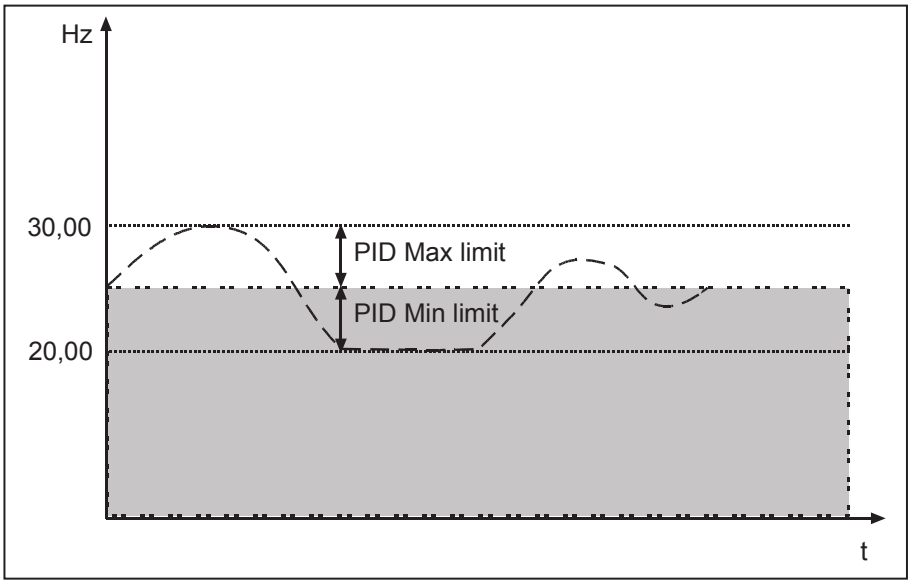
0 No supervision
1 Low limit supervision
2 High limit supervision

374 ***Analogue input supervised value*** ***7*** *(2.3.2.15)*

The value of the selected analogue input to be supervised by parameter ID373.

375 ***Analogue output offset*** ***67*** *(2.3.5.7, 2.3.3.7)*

Add –100.0 to 100.0% to the analogue output.



376 ***PID sum point reference (Place A direct reference)*** ***5*** *(2.2.4)*

Defines which reference source is added to PID controller output if PID controller is used.

0 No additional reference (Direct PID output value)
1 PID output + AI1 reference from terminals 2 and 3 (e.g. potentiometer)
2 PID output + AI2 reference from terminals 4 and 5 (e.g. transducer)
3 PID output + PID keypad reference
4 PID output + Fieldbus reference (FBSpeedReference)
5 PID output + Motor potentiometer reference
6 Fieldbus + PID output (ProcessDataIN3)
7 Motor potentiometer + PID output

If value **5** is selected for this parameter, the values of parameters ID319 and ID301 are automatically set to 13. See Figure 8-33.

Figure 8-33. PID sum point reference

Note: The maximum and minimum limits illustrated in the picture limit only the PID output, no other outputs.

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377 ***AI1 signal selection*** ***234567*** *(2.2.8, 2.2.3, 2.2.15, 2.2.2.1)*

Connect the AI1 signal to the analogue input of your choice with this parameter. For more information about the TTF programming method.

384 ***AI1 joystick hysteresis 6*** *(2.2.2.8)*

This parameter defines the joystick hysteresis between 0 and 20 %.
When the joystick or potentiometer control is turned from reverse to forward, the output frequency falls linearly to the selected minimum frequency (joystick/potentiometer in middle position) and stays there until the joystick/potentiometer is turned towards the forward command. It depends on the amount of joystick hysteresis defined with this parameter, how much the joystick/potentiometer must be turned to start the increase of the frequency towards the selected maximum frequency.
If the value of this parameter is 0, the frequency starts to increase linearly immediately when the joystick/potentiometer is turned towards the forward command from the middle position. When the control is changed from forward to reverse, the frequency follows the same pattern the other way round.

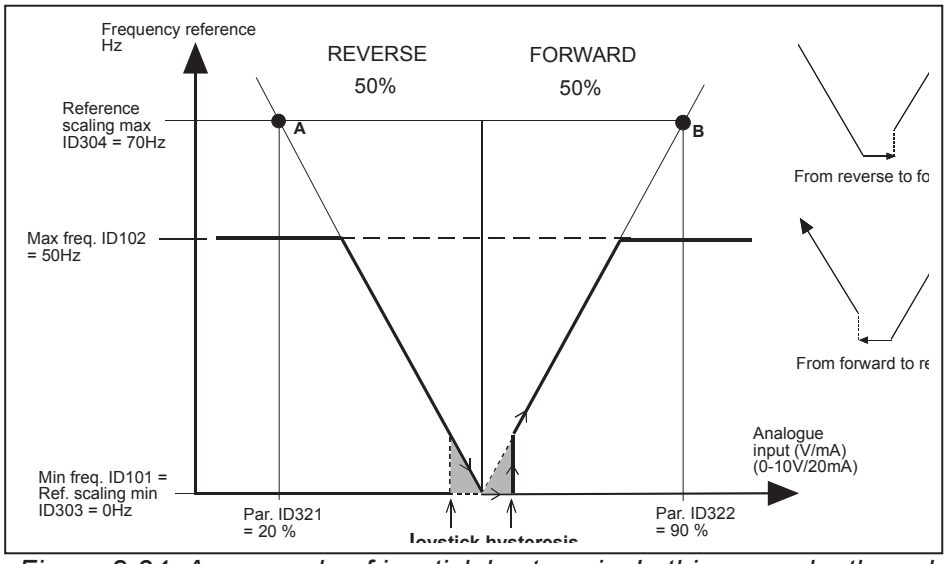
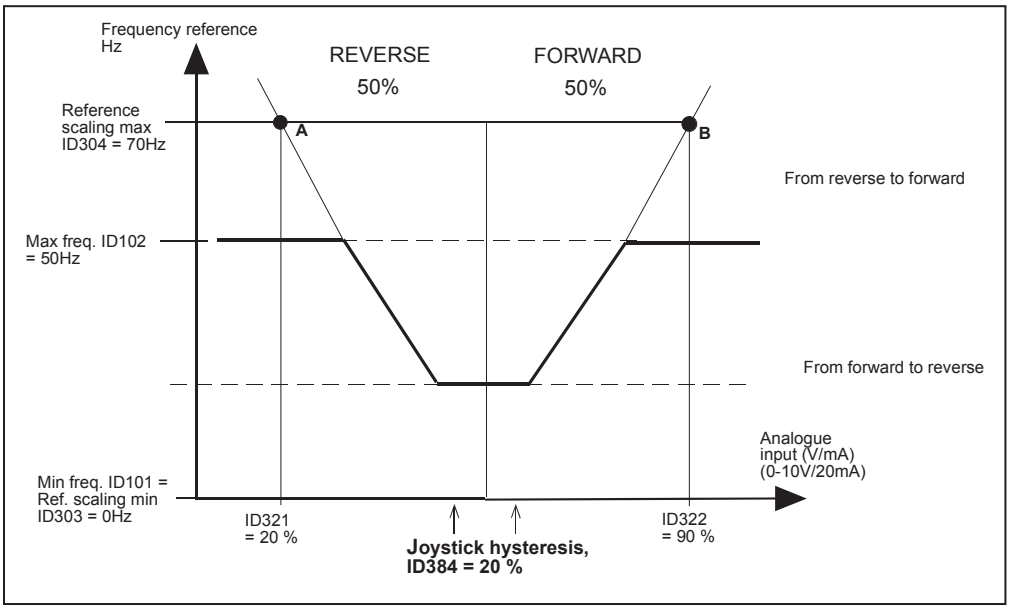


Figure 8-34. An example of joystick hysteresis. In this example, the value of par. ID385 (Sleep limit) = 0

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385 ***AI1 sleep limit*** **6** *(2.2.2.9)*

The variable speed drive is stopped automatically if the AI signal level falls below the S*leep limit* defined with this parameter.

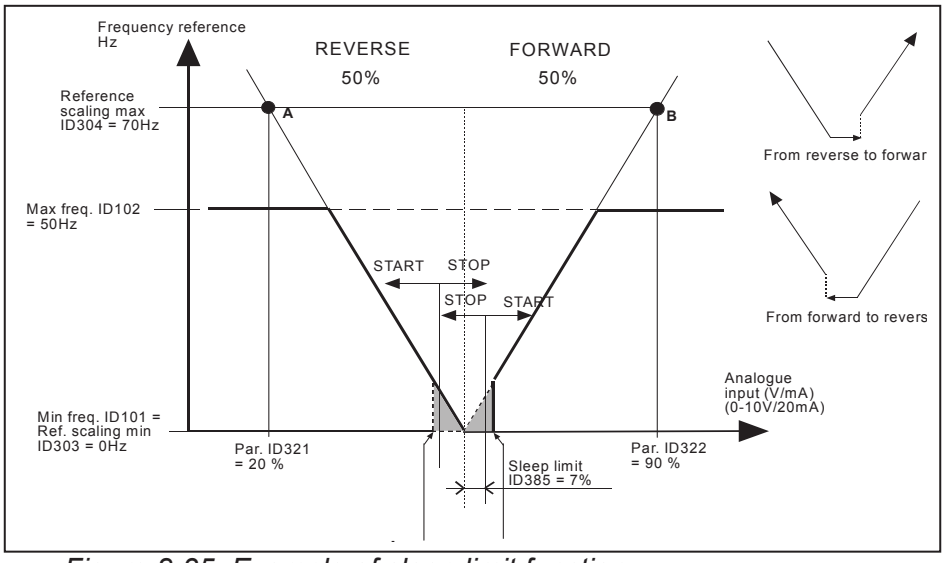


Figure 8-35. Example of sleep limit function

Figure 8-36. Joystick hysteresis with minimum frequency at 35Hz

386 ***AI1 sleep delay*** **6** *(2.2.2.10)*

This parameter defines the time the analogue input signal has to stay under the sleep limit determined with parameter ID385 in order to stop the variable speed drive.

388 ***AI2 signal selection*** **234567** *(2.2.9, 2.2.21, 2.2.3.1)*

Connect the AI2 signal to the analogue input of your choice with this parameter. For more information about the TTF programming.

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393	***AI2 reference scaling, minimum value***	***6***	*(2.2.3.6)*
394	***AI2 reference scaling, maximum value***	***6***	*(2.2.3.7)*

See ID's 303 and 304.

395	***AI2 joystick hysteresis***	***6***	*(2.2.3.8)*

See ID384.

396	***AI2 sleep limit***	***6***	*(2.2.3.9)*

See ID385.

397	***AI2 sleep delay***	***6***	*(2.2.3.10)*

See ID386.

399	***Scaling of current limit***	***6***	*(2.2.6.1)*

0 = Not used
1 = AI1
2 = AI2
3 = AI3
4 = AI4
5 = Fieldbus (FBProcessDataIN2)

This signal will adjust the maximum motor current between 0 and max. limit set with parameter ID107.

400	***Scaling of DC-braking current***	***6***	*(2.2.6.2)*

See par. ID399 for the selections.

DC-braking current can be reduced with the free analogue input signal between current 0.4 x I_H and the current set with parameter ID507.

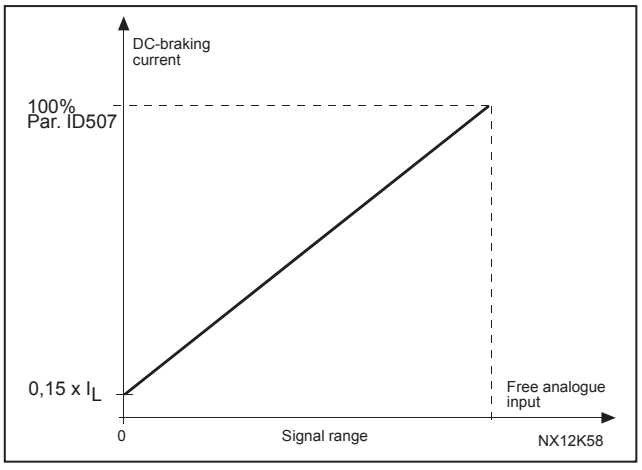


Figure 8-37. Scaling of DC-braking current

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401 ***Reducing of acceleration and deceleration times*** **6** *(2.2.6.3)*

See par. ID399.

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

Reduced time = set acc./deceler. time (par. ID103, 104; ID502, ID503) divided by the factor R from Figure 8-38.

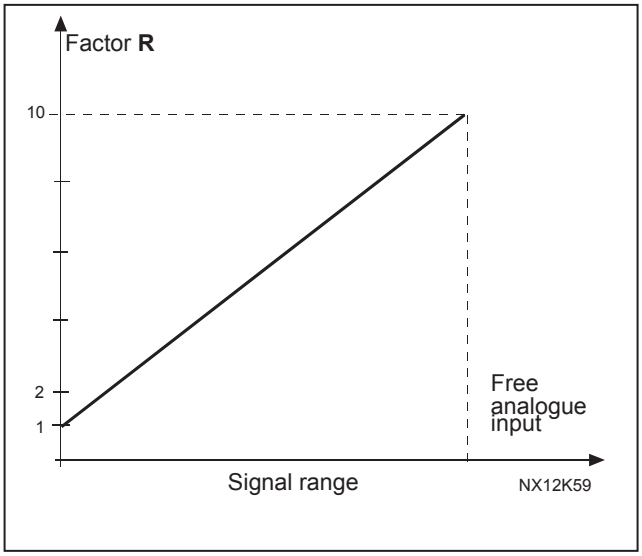


Figure 8-38. Reducing of acceleration and deceleration times

402 ***Reducing of torque supervision limit*** **6** *(2.2.6.4)*

See ID399.

The set torque supervision limit can be reduced with the free analogue input signal between 0 and the set supervision limit, ID349.

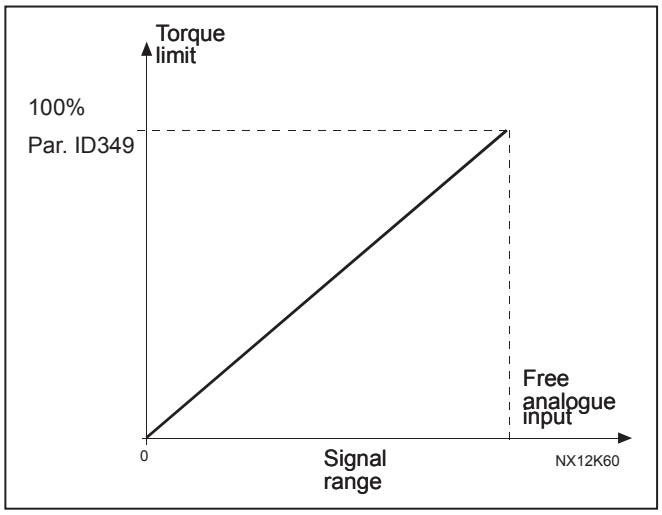


Figure 8-39. Reducing torque supervision limit

403 ***Start signal 1*** **6** *(2.2.7.1)*

Signal selection 1 for the start/stop logic.
Default programming A.1.

404 ***Start signal 2*** **6** *(2.2.7.2)*

Signal selection 2 for the start/stop logic.
Default programming A.2.

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405 ***External fault (close)*** ***67*** *(2.2.7.11, 2.2.6.4)*

Contact closed: Fault is displayed and motor stopped.

406 ***External fault (open)*** ***67*** *(2.2.7.12, 2.2.6.5)*

Contact open: Fault is displayed and motor stopped.

407 ***Run enable*** ***67*** *(2.2.7.3, 2.2.6.6)*

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

408 ***Acceleration/Deceleration time selection*** ***67*** *(2.2.7.13, 2.2.6.7)*

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

Set Acceleration/Deceleration times with parameters ID103 and ID104.

409 ***Control from I/O terminal*** ***67*** *(2.2.7.18, 2.2.6.8)*

Contact closed: Force control place to I/O terminal

410 ***Control from keypad*** ***67*** *(2.2.7.19, 2.2.6.9)*

Contact closed: Force control place to keypad

411 ***Control from fieldbus*** ***67*** *(2.2.7.20, 2.2.6.10)*

Contact closed: Force control place to fieldbus

NOTE: When the control place is forced to change the values of Start/Stop, Direction and Reference valid in the respective control place are used.
The value of parameter ID125 (Keypad Control Place) does not change.
When the input opens the control place is selected according to keypad control parameter ID125.

412 ***Reverse*** ***67*** *(2.2.7.4, 2.2.6.11)*

Contact open: Direction forward
Contact closed: Direction reverse

413 ***Jogging speed*** ***67*** *(2.2.7.16, 2.2.6.12)*

Contact closed: Jogging speed selected for frequency reference
See parameter ID124.
Default programming: A.4.

414 ***Fault reset*** ***67*** *(2.2.7.10, 2.2.6.13)*

Contact closed: All faults are reset.

415 ***Acceleration/Deceleration prohibited*** ***67*** *(2.2.7.14, 2.2.6.14)*

Contact closed: No acceleration or deceleration possible until the contact is opened.

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416 ***DC-braking*** **67** *(2.2.7.15, 2.2.6.15)*

Contact closed: In STOP mode, the DC braking operates until the contact is opened.

417 ***Motor potentiometer DOWN*** **67** *(2.2.7.8, 2.2.6.16)*

Contact closed: Motor potentiometer reference DECREASES until the contact is opened.

418 ***Motor potentiometer UP*** **67** *(2.2.7.9, 2.2.6.17)*

Contact closed: Motor potentiometer reference INCREASES until the contact is opened.

419 ***Preset speed 1*** **6** *(2.2.7.5)*
420 ***Preset speed 2*** **6** *(2.2.7.6)*
421 ***Preset speed 3*** **6** *(2.2.7.7)*

Parameter values are automatically limited between the minimum and maximum frequencies (parameters ID101 and ID102).

422 ***AI1/AI2 selection*** **6** *(2.2.7.17)*

With this parameter you can select either AI1 or AI2 signal for frequency reference.

423 ***Start A signal*** **7** *(2.2.6.1)*

Start command from control place A.
Default programming: A.1

424 ***Start B signal*** **7** *(2.2.6.2)*

Start command from control place B.
Default programming: A.4

425 ***Control place A/B selection*** **7** *(2.2.6.3)*

Contact open: Control place A
Contact closed: Control place B
Default programming: A.6

426 ***Autochange 1 interlock*** **7** *(2.2.6.18)*

Contact closed: Interlock of autochange drive 1 or auxiliary drive 1 activated.
Default programming: A.2.

427 ***Autochange 2 interlock*** **7** *(2.2.6.19)*

Contact closed: Interlock of autochange drive 2 or auxiliary drive 2 activated.
Default programming: A.3.

428 ***Autochange 3 interlock*** **7** *(2.2.6.20)*

Contact closed: Interlock of autochange drive 3 or auxiliary drive 3 activated.

429 ***Autochange 4 interlock*** **7** *(2.2.6.21)*

Contact closed: Interlock of autochange drive 4 or auxiliary drive 4 activated.

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430 ***Autochange 5 interlock*** ***7*** *(2.2.6.22)*

Contact closed: Interlock of autochange drive 5 activated.

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431 ***PID reference 2*** ***7*** *(2.2.6.23)*

Contact open: PID controller reference selected with parameter ID332.
Contact closed: PID controller keypad reference 2 selected with par. ID371.

432 ***Ready*** ***67*** *(2.3.3.1, 2.3.1.1)*

The variable speed drive is ready to operate.

433 ***Run*** ***67*** *(2.3.3.2, 2.3.1.2)*

The variable speed drive operates (the motor is running).

434 ***Fault*** ***67*** *(2.3.3.3, 2.3.1.3)*

A fault trip has occurred.
Default programming: A.1.

435 ***Inverted fault*** ***67*** *(2.3.3.4, 2.3.1.4)*

No fault trip has occurred.

436 ***Warning*** ***67*** *(2.3.3.5, 2.3.1.5)*

General warning signal.

437 ***External fault or warning*** ***67*** *(2.3.3.6, 2.3.1.6)*

Fault or warning depending on par. ID701.

438 ***Reference fault or warning*** ***67*** *(2.3.3.7, 2.3.1.7)*

Fault or warning depending on parameter ID700.

439 ***Overtemperature warning*** ***67*** *(2.3.3.8, 2.3.1.8)*

The heatsink temperature exceeds +70°C.

440 ***Reverse*** ***67*** *(2.3.3.9, 2.3.1.9)*

The Reverse command has been selected.

441 ***Unrequested direction*** ***67*** *(2.3.3.10, 2.3.1.10)*

Motor rotation direction is different from the requested one.

442 ***At speed*** ***67*** *(2.3.3.11, 2.3.1.11)*

The output frequency has reached the set reference.

443 ***Jogging speed*** ***67*** *(2.3.3.12, 2.3.1.12)*

Jogging speed selected.

444 ***External control place*** ***67*** *(2.3.3.13, 2.3.1.13)*

Control from I/O terminal selected (Menu **M3**; par. ID125).

445 ***External brake control*** ***67*** *(2.3.3.14, 2.3.1.14)*

External brake ON/OFF control with programmable delay.

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446 ***External brake control, inverted*** ***67*** *(2.3.3.15, 2.3.1.15)*

External brake ON/OFF control; Output active when brake control is OFF.

447 ***Output frequency limit 1 supervision*** ***67*** *(2.3.3.16, 2.3.1.16)*

The output frequency goes outside the set supervision low limit/high limit (see parameters ID315 and ID316)

448 ***Output frequency limit 2 supervision*** ***67*** *(2.3.3.17, 2.3.1.17)*

The output frequency goes outside the set supervision low limit/high limit (see parameters ID346 and ID347)

449 ***Reference limit supervision*** ***67*** *(2.3.3.18, 2.3.1.18)*

Active reference goes beyond the set supervision low limit/high limit (see parameters ID350 and ID351).

450 ***Temperature limit supervision*** ***67*** *(2.3.3.19, 2.3.1.19)*

Variable speed drive heatsink temperature goes beyond the set supervision limits (see parameters ID354 and ID355).

451 ***Torque limit supervision*** ***67*** *(2.3.3.20, 2.3.1.20)*

The motor torque goes beyond the set supervision limits (see parameters ID348 and ID349).

452 ***Motor thermal protection*** ***67*** *(2.3.3.21, 2.3.1.21)*

Motor thermistor initiates a overtemperature signal which can be led to a digital output.

NOTE: This parameter will not work unless you have ATV78 WV3A78203 connected.

454 ***Motor regulator activation*** ***67*** *(2.3.3.23, 2.3.1.23)*

Overvoltage or overcurrent regulator has been activated.

455 ***Fieldbus input data 1 (FBFixedControlWord, bit 3)*** ***67*** *(2.3.3.24, 2.3.1.24)*
456 ***Fieldbus input data 2 (FBFixedControlWord, bit 4)*** ***67*** *(2.3.3.25, 2.3.1.25)*
457 ***Fieldbus input data 3 (FBFixedControlWord, bit 5)*** ***67*** *(2.3.3.26, 2.3.1.26)*

The data from the fieldbus (FBFixedControlWord) can be led to variable speed drive digital outputs.

458 ***Autochange 1/Auxiliary drive 1 control*** ***7*** *(2.3.1.27)*

Control signal for autochange/auxiliary drive 1.
Default programming: B.1

459 ***Autochange 2/Auxiliary drive 2 control*** ***7*** *(2.3.1.28)*

Control signal for autochange/auxiliary drive 2.
Default programming: B.2

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460 ***Autochange 3/Auxiliary drive 3 control*** ***7*** *(2.3.1.29)*

Control signal for autochange/auxiliary drive 3. If three (or more) auxiliary drives are used, we recommend to connect nr 3, too, to a relay output. Since the VW3A78201 board only has two relay outputs it is advisable to purchase an I/O expander board with extra relay outputs.

461 ***Autochange 4/Auxiliary drive 4 control*** ***7*** *(2.3.1.30)*

Control signal for autochange/auxiliary drive 4. If three (or more) auxiliary drives are used, we recommend to connect nr 3 and 4, too, to a relay output. Since the VW3A78202 board only has two relay outputs it is advisable to purchase an I/O expander board with extra relay outputs.

462 ***Autochange 5 control*** ***7*** *(2.3.1.31)*

Control signal for autochange drive 5.

463 ***Analogue input supervision limit*** ***67*** *(2.3.3.22, 2.3.1.22)*

The selected analogue input signal goes beyond the set supervision limits (see parameters ID372, ID373 and ID374).

464 ***Analogue output 1 signal selection*** ***234567*** *(2.3.1, 2.3.5.1, 2.3.3.1)*

Connect the AO1 signal to the analogue output of your choice with this parameter. For more information about the TTF programming method.

471 ***Analogue output 2 signal selection*** ***234567*** *(2.3.12, 2.3.22, 2.3.6.1, 2.3.4.1)*

Connect the AO2 signal to the analogue output of your choice with this parameter. For more information about the TTF programming method.

472 ***Analogue output 2 function*** ***234567*** *(2.3.13, 2.3.23, 2.3.6.2, 2.3.4.2)*
473 ***Analogue output 2 filter time*** ***234567*** *(2.3.14, 2.3.24, 2.3.6.3, 2.3.4.3)*
474 ***Analogue output 2 inversion*** ***234567*** *(2.3.15, 2.3.25, 2.3.6.4, 2.3.4.4)*
475 ***Analogue output 2 minimum*** ***234567*** *(2.3.16, 2.3.26, 2.3.6.5, 2.3.4.5)*
476 ***Analogue output 2 scaling*** ***234567*** *(2.3.17, 2.3.27, 2.3.6.6, 2.3.4.6)*

For more information on these five parameters, see the corresponding parameters for the analogue output 1 on pages 137 to 138.

477 ***Analogue output 2 offset*** ***67*** *(2.3.6.7, 2.3.4.7)*

Add –100.0 to 100.0% to the analogue output.

478 ***Analogue output 3, signal selection*** ***67*** *(2.3.7.1, 2.3.5.1)*

See ID464.

479 ***Analogue output 3, function*** ***67*** *(2.3.7.2, 2.3.5.2)*

See ID307.

480 ***Analogue output 3, filter time*** ***67*** *(2.3.7.3, 2.3.5.3)*

See ID308.

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481 ***Analogue output 3 inversion*** ***67*** *(2.3.7.4, 2.3.5.4)*

See ID309.

482 ***Analogue output 3 minimum*** ***67*** *(2.3.7.5, 2.3.5.5)*

See ID310.

483 ***Analogue output 3 scaling*** ***67*** *(2.3.7.6, 2.3.5.6)*

See ID311.

484 ***Analogue output 3 offset*** ***67*** *(2.3.7.7, 2.3.5.7)*

See ID375.

485 ***Torque limit*** ***6*** *(2.2.6.5)*

See par. ID399 for the selections.

486 ***Digital output 1 signal selection*** ***6*** *(2.3.1.1)*

Connect the delayed DO1 signal to the digital output of your choice with this parameter. For more information about the TTF programming method.

487 ***Digital output 1 on-delay*** ***6*** *(2.3.1.3)*
488 ***Digital output 1 off-delay*** ***6*** *(2.3.1.4)*

With these parameters you can set on- and off-delays to digital outputs.

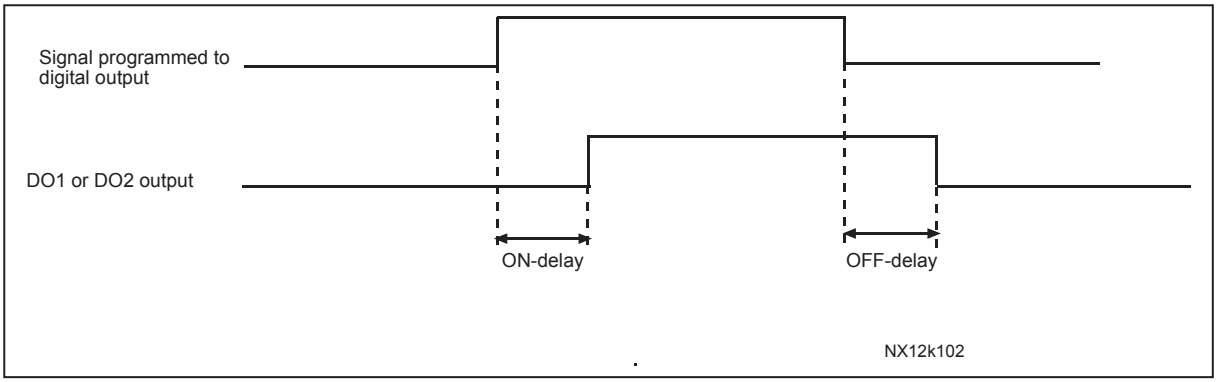


Figure 8-40. Digital outputs 1 and 2, on- and off-delays

489 ***Digital output 2 signal selection*** ***6*** *(2.3.2.1)*

See ID486.

490 ***Digital output 2 function*** ***6*** *(2.3.2.2)*

See ID312.

491 ***Digital output 2 on-delay*** ***6*** *(2.3.2.3)*

See ID487.

492 ***Digital output 2 off-delay*** ***6*** *(2.3.1.4)*

See ID488.

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493 ***Adjust input*** ***6*** *(2.2.1.4)*

With this parameter you can select the signal, according to which the frequency reference to the motor is fine adjusted.

0 Not used
1 Analogue input 1
2 Analogue input 2
3 Analogue input 3
4 Analogue input 4
5 Signal from fieldbus (FBProcessDataIN)

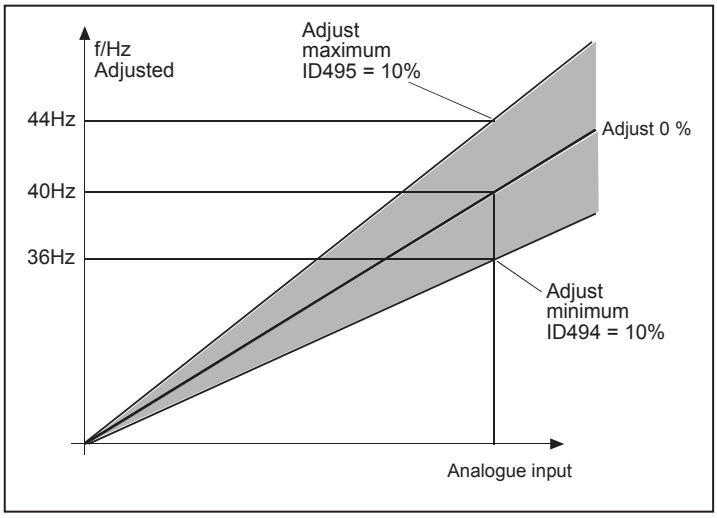


Figure 8-41. An example of adjust input

494 ***Adjust minimum*** ***6*** *(2.2.1.5)*
495 ***Adjust maximum*** ***6*** *(2.2.1.6)*

These parameters define the minimum and maximum of adjusted signals. See Figure 8-41.

496 ***Parameter Set 1/Set 2 selection*** ***6*** *(2.2.7.21)*

With this parameter you can select between Parameter Set 1 and Set 2. The input for this function can be selected from any slot. The procedure of selecting between the sets is explained in ATV78 User's Manual, Chapter 7.3.6.3.
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.

498 ***Start pulse memory*** ***3*** *(2.2.24)*

Giving a value for this parameter determines if the present RUN status is copied when the control place is changed from A to B or vice versa.

0 = The RUN status is not copied
1 = The RUN status is copied

In order for this parameter to have effect, parameters ID300 and ID363 must have been set the value **3**.

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500	***Acceleration/Deceleration ramp 1 shape***	***234567***	*(2.4.1)*
501	***Acceleration/Deceleration ramp 2 shape***	***234567***	*(2.4.2)*

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…10 seconds for this parameter produces an S-shaped acceleration/deceleration. The acceleration time is determined with parameters ID103/ID104 (ID502/ID503).

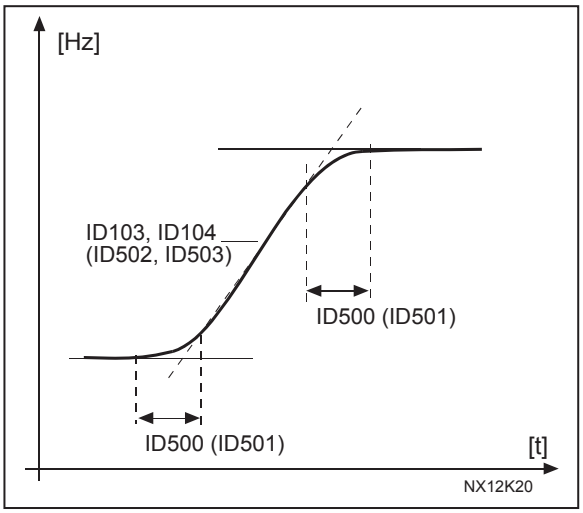


Figure 8-42. Acceleration/Deceleration (S-shaped)

502	***Acceleration time 2***	***234567***	*(2.4.3)*
503	***Deceleration time 2***	***234567***	*(2.4.4)*

These values correspond to the time required for the output frequency to accelerate from the zero frequency to the set maximum frequency (par. ID102). 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. ID301).

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504 ***Brake chopper*** ***234567*** *(2.4.5)*

0 = No brake chopper used
1 = Brake chopper in use and tested when running. Can be tested also in READY state
2 = External brake chopper (no testing)
3 = Used and tested in READY state and when running
4 = Used when running (no testing)

When the variable speed drive is decelerating the motor, the inertia of the motor and the load are fed into an external brake resistor. This enables the variable speed drive to decelerate the load with a torque equal to that of acceleration (provided that the correct brake resistor has been selected). See separate Brake resistor installation manual.

505 ***Start function*** *(2.4.6)*

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

Flying start:
1 The variable speed drive 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.

506 ***Stop function*** *(2.4.7)*

Coasting:
0 The motor coasts to a halt without any control from the variable speed drive, 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, the motor coasts to a halt without any control from the variable speed drive.

Normal stop: Coasting/ Run Enable stop: ramping
3 The motor coasts to a halt without any control from the variable speed drive. However, when Run Enable signal is selected, 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.

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507 ***DC-braking current*** ***234567*** *(2.4.8)*

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

508 ***DC-braking time at stop*** ***234567*** *(2.4.9)*

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 ID506.

0 DC-brake is not used
>0 DC-brake is in use and its function depends on the Stop function, (param. ID506). The DC-braking time is determined with this parameter.

Par. ID506 = 0; Stop function = Coasting:

After the stop command, the motor coasts to a stop without control of the variable speed drive.

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 ID508 determines the braking time. When the frequency is ≤10% of the nominal, the braking time is 10% of the set value of parameter ID508.

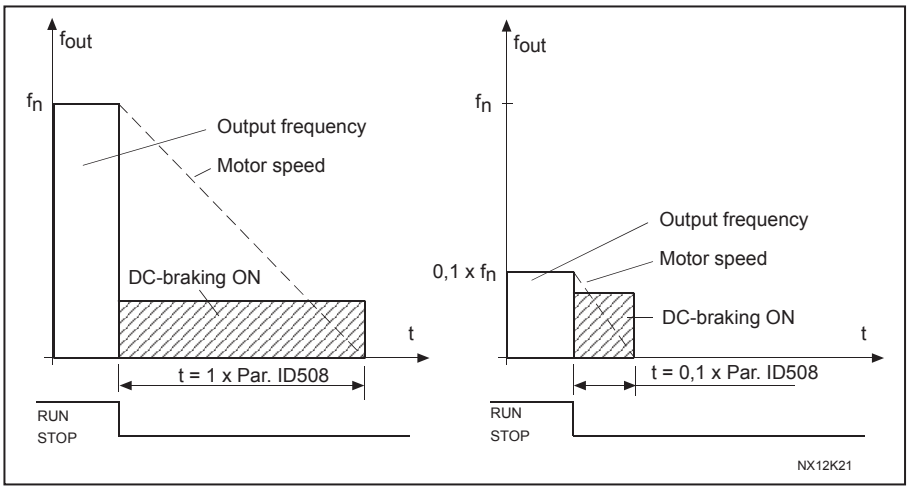


Figure 8-43. DC-braking time when Stop mode = Coasting.

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Par. ID506 = 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 ID515, where the DC-braking starts.

The braking time is defined with parameter ID508. If high inertia exists, it is recommended to use an external braking resistor for faster deceleration.

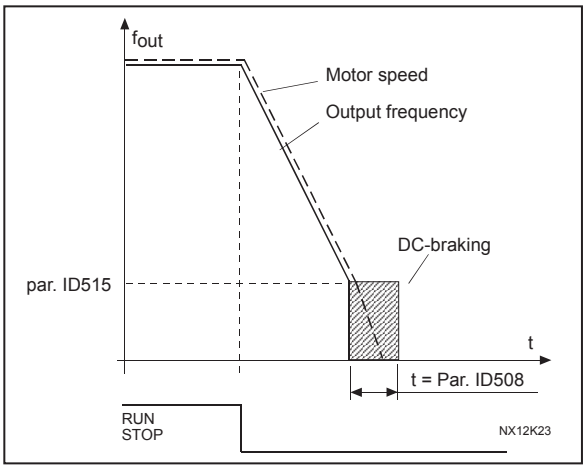


Figure 8-44. DC-braking time when Stop mode = Ramp

509 ***Prohibit frequency area 1; Low limit 234567*** *(2.5.1)*
510 ***Prohibit frequency area 1; High limit 234567*** *(2.5.2)*
511 ***Prohibit frequency area 2; Low limit 34567*** *(2.5.3)*
512 ***Prohibit frequency area 2; High limit 34567*** *(2.5.4)*
513 ***Prohibit frequency area 3; Low limit 34567*** *(2.5.5)*
514 ***Prohibit frequency area 3; High limit 34567*** *(2.5.6)*

In some systems it may be necessary to avoid certain frequencies because of mechanical resonance problems. With these parameters it is possible to set limits for the "skip frequency" region.

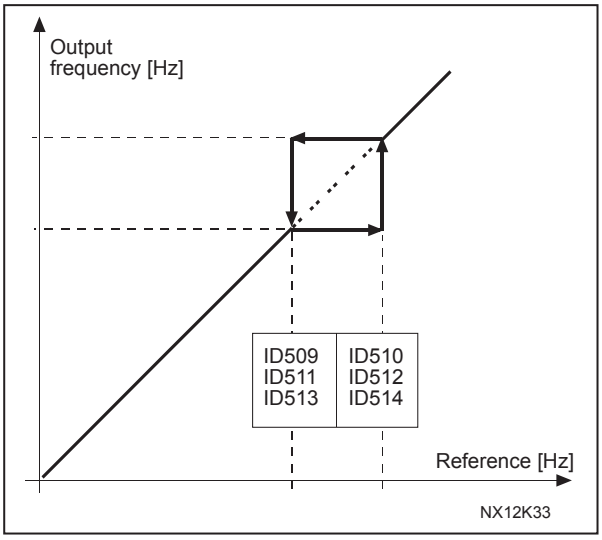


Figure 8-45. Example of prohibit frequency area setting.

515 ***DC-braking frequency at stop 234567*** *(2.4.10)*

The output frequency at which the DC-braking is applied. See Figure 8-45.

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516 ***DC-braking time at start*** ***234567*** *(2.4.11)*

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 ID505.

518 ***Acceleration/deceleration ramp speed scaling ratio between prohibit frequency limits*** ***234567*** *(2.5.3, 2.5.7)*

Defines the acceleration/deceleration time when the output frequency is between the selected prohibit frequency range limits (parameters ID509 and ID510). The ramping speed (selected acceleration/ deceleration time 1 or 2) is multiplied with this factor. E.g. value 0.1 makes the acceleration time 10 times shorter than outside the prohibit frequency range limits.

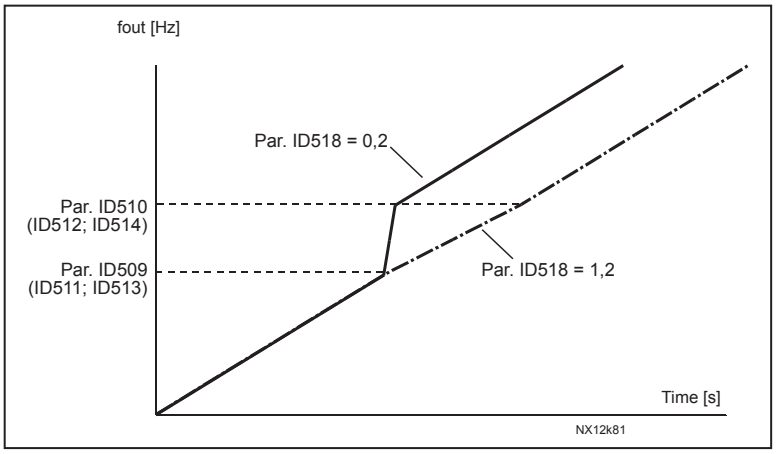


Figure 8-46. Ramp speed scaling between prohibit frequencies

519 ***Flux braking current*** ***234567*** *(2.4.13)*

Defines the flux braking current value. This value can be set between $0.4*I_H$ and the Current limit.

520 ***Flux brake*** ***234567*** *(2.4.12)*

Instead of DC braking, flux braking is a useful form of braking with motors ≤15kW.
When braking is needed, the frequency is reduced and the flux in the motor is increased, which in turn increases the motor's capability to brake. Unlike DC braking, the motor speed remains controlled during braking.

The flux braking can be set ON or OFF.

0 = Flux braking OFF
1 = Flux braking ON

Note: Flux braking converts the energy into heat at the motor, and should be used intermittently to avoid motor damage.

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521 ***Motor control mode 2*** ***6*** *(2.6.12)*

With this parameter you can set another motor control mode. Which mode is used is determined with parameter ID164.
For the selections, see parameter ID600.

600 ***Motor control mode*** ***234567*** *(2.6.1)*

ATV78:

0 Frequency control: The I/O terminal and keypad references are frequency references and the variable speed drive 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 variable speed drive controls the motor speed compensating the motor slip (accuracy ± 0,5%).

The following selections are available for Telemecanique ATV78F drives only, except for selection **2** which is available in the Multi-Purpose Control Application for ATV78 drives also.

2 Torque control In torque control mode, the references are used to control the motor torque.

3 Speed crtl (closed loop) The I/O terminal and keypad references are speed references and the variable speed drive controls the motor speed very accurately comparing the actual speed received from the tachometer to the speed reference (accuracy ±0.01%).

4 Torque crtl (closed loop) The I/O terminal and keypad references are torque references and the variable speed drive controls the motor torque.

5 Frequency control (advanced open loop)

Frequency control with better performance at lower speeds.

6 Speed control (advanced open loop)

Speed control with better performance at lower speeds.

601 ***Switching frequency*** ***234567*** *(2.6.9)*

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

602 ***Field weakening point*** ***234567*** *(2.6.4)*

The field weakening point is the output frequency at which the output voltage reaches the set (ID603) maximum value.

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603 ***Voltage at field weakening point*** ***234567*** *(2.6.5)*

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 ID109, ID108, ID604 and ID605.
When the parameters ID110 and ID111 (nominal voltage and nominal frequency of the motor) are set, the parameters ID602 and ID603 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 ID110 and ID111.

604 ***U/f curve, middle point frequency*** ***234567*** *(2.6.6)*

If the programmable U/f curve has been selected with parameter ID108 this parameter defines the middle point frequency of the curve. See Figure 8-2.

605 ***U/f curve, middle point voltage*** ***234567*** *(2.6.7)*

If the programmable U/f curve has been selected with the parameter ID108 this parameter defines the middle point voltage of the curve. See Figure 8-2.

606 ***Output voltage at zero frequency*** ***234567*** *(2.6.8)*

If the programmable U/f curve has been selected with the parameter ID108 this parameter defines the zero frequency voltage of the curve. See Figure 8-2.

607 ***Overvoltage controller*** ***234567*** *(2.6.10)*

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.
0 Controller switched off
1 Controller switched on (no ramping) = Minor adjustments of OP frequency are made
2 Controller switched on (with ramping) = Controller adjusts OP freq. up to max.freq.

608 ***Undervoltage controller*** ***234567*** *(2.6.11)*

See par. ID607.
Note: Over-/undervoltage trips may occur when controllers are switched out of operation.

0 Controller switched off
1 Controller switched on

609 ***Torque limit*** ***6*** *(2.10.1)*

With this parameter you can set the torque limit control between 0.0 – 400.0 %.

610 ***Torque limit control P-gain*** ***6*** *(2.10.2)*

This parameter defines the gain of the torque limit controller.

611 ***Torque limit control I-gain*** ***6*** *(2.10.3)*

This parameter determines the I-gain of the torque limit controller.

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612 ***CL: Magnetizing current*** ***234567*** *(2.6.15.1, 2.6.12.1)*

Set here the motor magnetizing current (no-load current).

613 ***CL: Speed control P gain*** ***234567*** *(2.6.15.2, 2.6.12.2)*

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

614 ***CL: Speed control I time*** ***234567*** *(2.6.15.3, 2.6.12.3)*

Sets the integral time constant for the speed controller. Increasing the I-time increases stability but lengthens the speed response time.

615 ***CL: Zero speed time at start*** ***234567*** *(2.6.15.9, 2.6.12.9)*

After giving the start command the drive will remain at zero speed for the time defined by this parameter. The ramp will be released to follow the set frequency/speed reference after this time has elapsed from the instant where the command is given. See chapter 2 in the Appendices.

616 ***CL: Zero speed time at stop*** ***234567*** *(2.6.15.10, 2.6.12.10)*

The drive will remain at zero speed with controllers active for the time defined by this parameter after reaching the zero speed when a stop command is given. This parameter has no effect if the selected stop function (ID506) is *Coasting*.

617 ***CL: Current control P gain*** ***234567*** *(2.6.15.17, 2.6.12.17)*

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.

618 ***CL: Encoder filter time*** ***234567*** *(2.6.15.15, 2.6.12.15)*

Sets the filter time constant for speed measurement.
The parameter can be used to eliminate encoder signal noise. Too high a filter time reduces speed control stability.

619 ***CL: Slip adjust*** ***234567*** *(2.6.15.6, 2.6.12.6)*

The motor name plate speed is used to calculate the nominal slip. This value is used to adjust the voltage of motor when loaded. The name plate speed is sometimes a little inaccurate and this parameter can therefore be used to trim the slip. Reducing the slip adjust value increases the motor voltage when the motor is loaded.

620 ***CL: Load drooping*** ***234567*** *(2.6.15.4, 2.6.12.4)*

The drooping function enables speed drop as a function of load. This parameter sets that amount corresponding to the nominal torque of the motor.

621 ***CL: Startup torque*** ***234567*** *(2.6.15.11, 2.6.12.11)*

Choose here the startup torque.
Torque Memory is used in crane applications. Startup Torque FWD/REV can be used in other applications to help the speed controller.
0 = Not Used
1 = TorqMemory
2 = Torque Ref
3 = Torq.Fwd/Rev

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622 ***AOL: Minimum current*** ***234567*** *(2.6.16.2, 2.6.13.2)*

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

623 ***AOL: Flux reference*** ***234567*** *(2.6.16.3, 2.6.13.3)*

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

625 ***AOL: Zero speed current*** ***234567*** *(2.6.16.1, 2.6.13.1)*

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

626 ***CL: Acceleration compensation*** ***234567*** *(2.6.15.5, 2.6.12.5)*

Sets the inertia compensation to improve speed response during acceleration and deceleration. The time is defined as acceleration time to nominal speed with nominal torque. This parameter is active also in advanced open loop mode.

627 ***CL: Magnetizing current at start*** ***234567*** *(2.6.15.7, 2.6.12.7)*

628 ***CL: Magnetizing time at start*** ***234567*** *(2.6.15.8, 2.6.12.8)*

Set here the rise time of magnetizing current.

632 ***AOL: U/f boost*** ***234567*** *(2.6.16.5, 2.6.13.5)*

Boost voltage at Frequency Limit to increase flux and torque.

633 ***CL: Start-up torque, forward*** ***234567*** *(2.6.15.12, 2.6.12.12)*

Sets the start-up torque for forward direction if selected with par. ID621.

634 ***CL: Start-up torque, reverse*** ***234567*** *(2.6.15.13, 2.6.12.13)*

Sets the start-up torque for reverse direction if selected with par. ID621.

635 ***AOL: Frequency limit*** ***234567*** *(2.6.16.4, 2.6.13.4)*

Corner frequency for transition to standard U/f control. The value is given in % of motor nominal frequency.

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636 ***Minimum frequency for Open Loop torque control*** ***6*** *(2.10.8)*

Defines the frequency limit below which the variable speed drive operates in *frequency control mode*.
Because of the nominal slip of the motor, the internal torque calculation is inaccurate at low speeds where is it recommended to use the frequency control mode.

637 ***Speed controller P gain, Open Loop*** ***6*** *(2.6.13)*

Defines the P gain for the speed controlled in Open Loop control mode.

638 ***Speed controller I gain, Open Loop*** ***6*** *(2.6.14)*

Defines the I gain for the speed controlled in Open Loop control mode.

639 ***Torque controller P gain*** ***6*** *(2.10.9)*

Defines the P gain of the torque controller.

640 ***Torque controller I gain*** ***6*** *(2.10.10)*

Defines the I gain of the torque controller.

641 ***Torque reference selection*** ***6*** *(2.10.4)*

Defines the source for torque reference.
0 Not used
1 Analogue input 1
2 Analogue input 2
3 Analogue input 3
4 Analogue input 4
5 Analogue input 1 (joystick)
6 Analogue input 2 (joystick)
7 From keypad, parameter R3.5
8 Fieldbus

642 ***Torque reference scaling, maximum value*** ***6*** *(2.10.5)*
643 ***Torque reference scaling, minimum value*** ***6*** *(2.10.6)*

Scale the custom minimum and maximum levels for analogue inputs within -300,0…300,0%.

644 ***Torque speed limit*** ***6*** *(2.10.7)*

With this parameter the maximum frequency for the torque control can be selected.
0 Maximum frequency, par. ID102
1 Selected frequency reference
2 Preset speed 7, par. ID130

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700 ***Response to the 4mA reference fault*** ***234567*** *(2.7.1)*

0 = No response
1 = Warning
2 = Warning, the frequency from 10 seconds back is set as reference
3 = Warning, the Preset Frequency (Par. ID728) is set as reference
4 = Fault, stop mode after fault according to ID506
5 = Fault, stop mode after fault always by coasting
A warning or a fault action and message is generated if the 4…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.

701 ***Response to external fault*** ***234567*** *(2.7.3)*

0 = No response
1 = Warning
2 = Fault, stop mode after fault according to ID506
3 = Fault, stop mode after fault always by coasting
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.

702 ***Output phase supervision*** ***234567*** *(2.7.6)*

0 = No response
1 = Warning
2 = Fault, stop mode after fault according to ID506
3 = Fault, stop mode after fault always by coasting
Output phase supervision of the motor ensures that the motor phases have an approximately equal current.

703 ***Earth fault protection*** ***234567*** *(2.7.7)*

0 = No response
1 = Warning
2 = Fault, stop mode after fault according to ID506
3 = Fault, stop mode after fault always by coasting
Earth fault protection ensures that the sum of the motor phase currents is zero. The overcurrent protection is always working and protects the variable speed drive from earth faults with high currents.

704 ***Motor thermal protection*** ***234567*** *(2.7.8)*

0 = No response
1 = Warning
2 = Fault, stop mode after fault according to ID506
3 = Fault, stop mode after fault always by coasting

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%.

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705 ***Motor thermal protection: Motor ambient temp. factor*** ***234567***
(2.7.9)

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

706 ***Motor thermal protection: Motor cooling factor at zero speed*** ***234567***
(2.7.10)

The current can be set between 0—150.0% x I_{nMotor}. This parameter sets the value for thermal current at zero frequency. See Figure 8-47.

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, par. ID113 (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 ID107 alone.

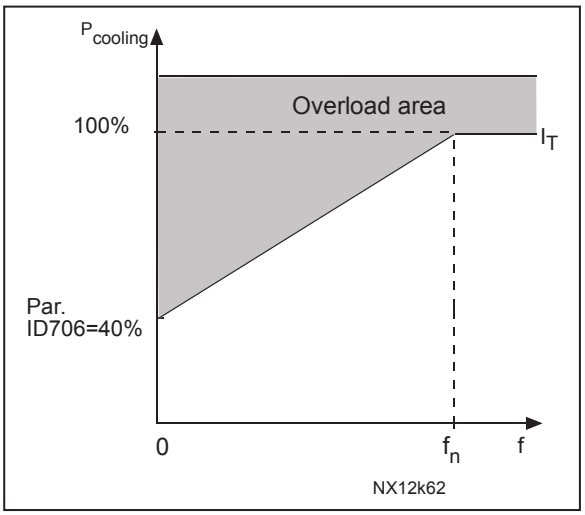


Figure 8-47. Motor thermal current I_T curve

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707 ***Motor thermal protection: Time constant*** ***234567*** *(2.7.11)*

This time can be set between 1 and 200 minutes.

This is the thermal time constant of the motor. The bigger the motor, the bigger 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 8-48.

708 ***Motor thermal protection: Motor duty cycle 234567*** *(2.7.12)*

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

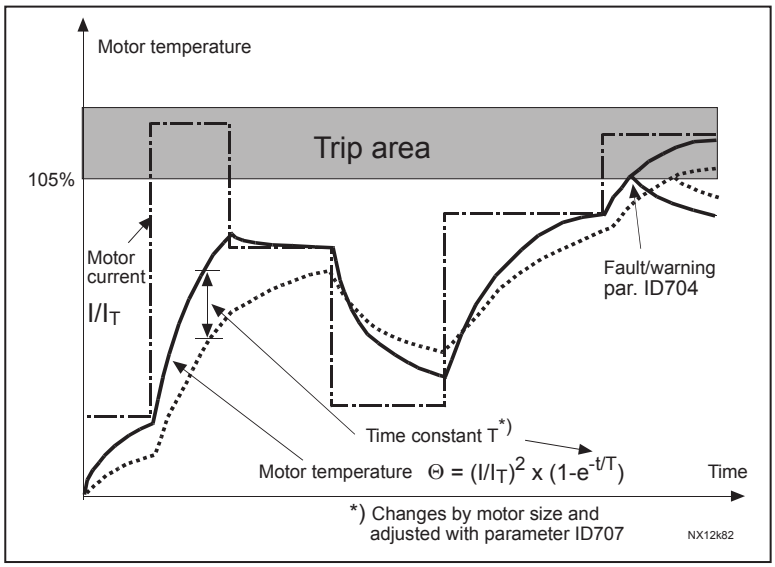


Figure 8-48. Motor temperature calculation

709 ***Stall protection*** ***234567*** *(2.7.13)*

0 = No response
1 = Warning
2 = Fault, stop mode after fault according to ID506
3 = Fault, stop mode after fault always by coasting

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

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710 ***Stall current limit*** ***234567*** *(2.7.14)*

The current can be set to 0.1…I_{nMotor}*2. For a stall stage to occur, the current must have exceeded this limit.
The software does not allow entering a greater value than I_{nMotor}*2. If parameter ID113 Nominal current of motor is changed, this parameter is automatically restored to the default value (I_L).

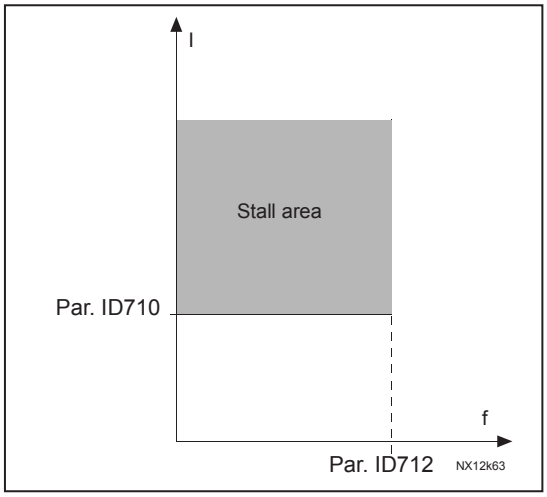


Figure 8-49. Stall characteristics settings

711 ***Stall time 234567*** *(2.7.15)*

This time can be set between 1.0 and 120.0s.
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 ID709).

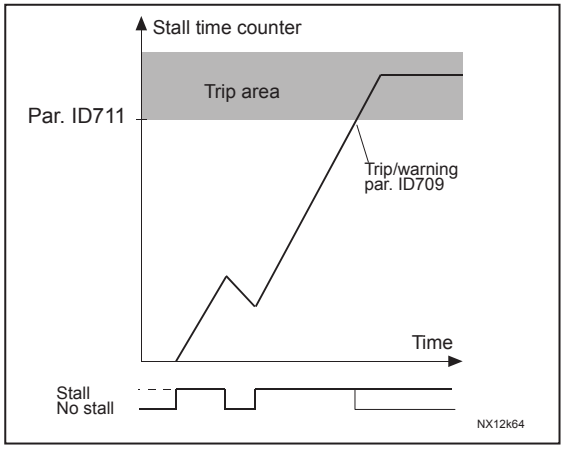


Figure 8-50. Stall time count

712 ***Stall frequency limit*** ***234567*** *(2.7.16)*

The frequency can be set between 1-f_{max} (ID102).
For a stall state to occur, the output frequency must have remained below this limit.

713 ***Underload protection*** ***234567*** *(2.7.17)*

0 = No response
1 = Warning
2 = Fault, stop mode after fault according to ID506
3 = Fault, stop mode after fault always by coasting

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.

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714 ***Underload protection, field weakening area load 234567*** *(2.7.18)*

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.

If you change parameter ID113 (Motor nominal current) this parameter is automatically restored to the default value.

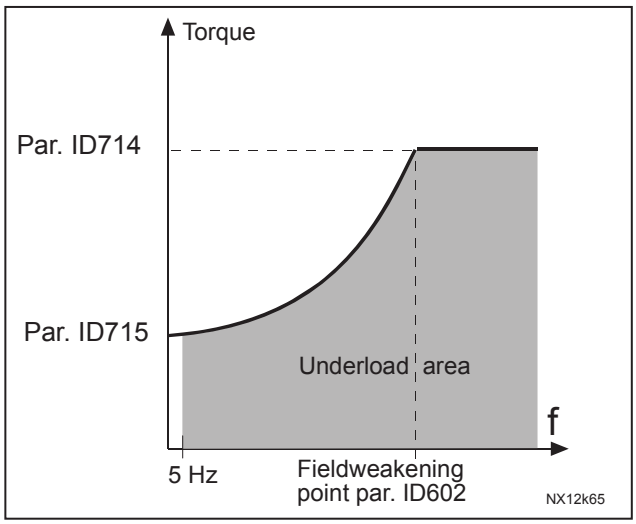


Figure 8-51. Setting of minimum load

715 ***Underload protection, zero frequency load 234567*** *(2.7.19)*

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 8-51.

If you change the value of parameter ID113 (Motor nominal current) this parameter is automatically restored to the default value.

716 ***Underload time 234567*** *(2.7.20)*

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 ID713). If the drive is stopped the underload counter is reset to zero.

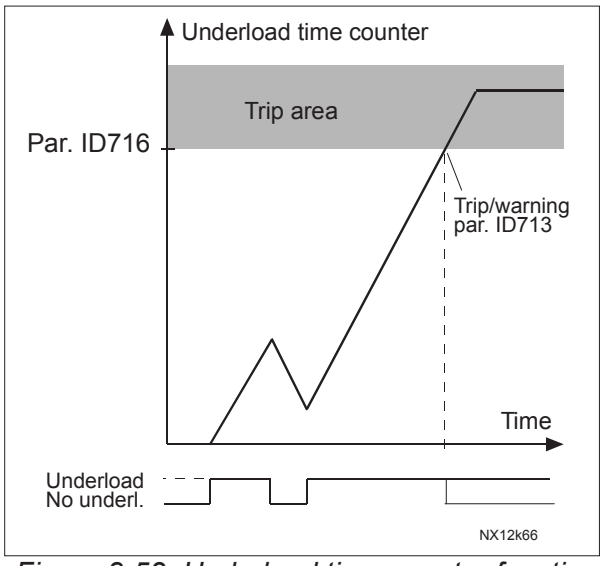


Figure 8-52. Underload time counter function

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717 ***Automatic restart: Wait time 234567*** *(2.8.1)*

Defines the time before the variable speed drive tries to automatically restart the motor after the fault has disappeared.

718 ***Automatic restart: Trial time 234567*** *(2.8.2)*

The Automatic restart function restarts the variable speed drive when the faults selected with parameters ID720 to ID725 have disappeared and the waiting time has elapsed.

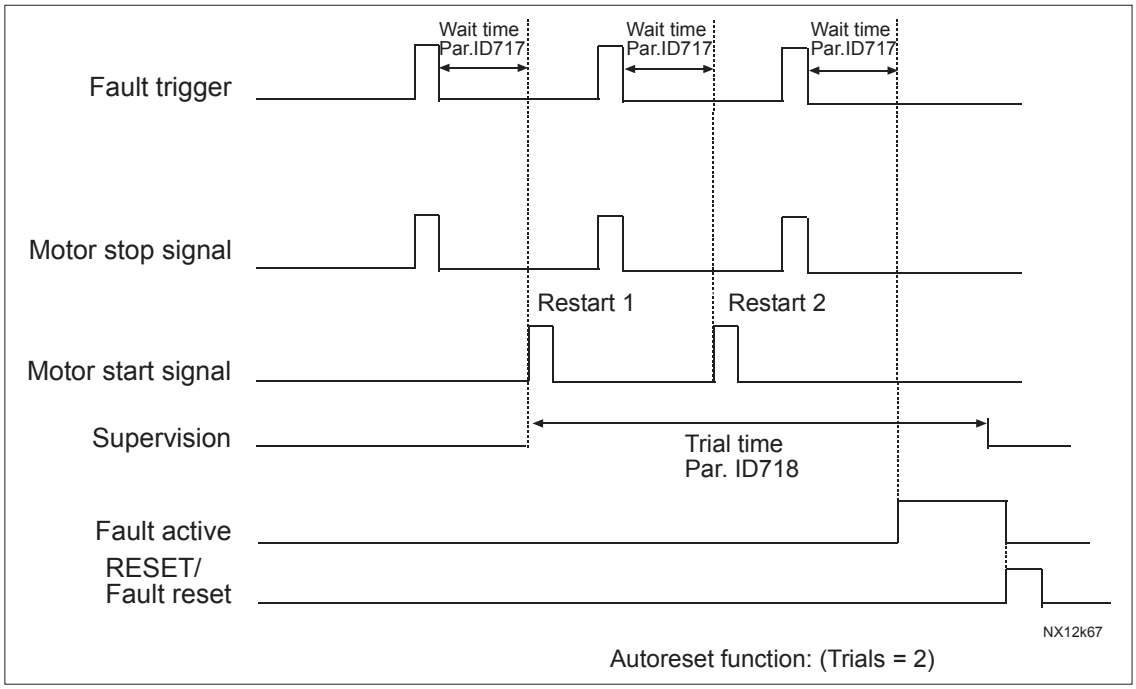


Figure 8-53. Example of Automatic restarts with two restarts

Parameters ID720 to ID725 determine the maximum number of automatic restarts during the trial time set by parameter ID718. The time count starts from the first autorestart. If the number of faults occurring during the trial time exceeds the values of parameters ID720 to ID725 the fault state becomes active. Otherwise the fault is cleared after the trial time has elapsed and the next fault start the trial time count again.

If a single fault remains during the trial time, a fault state is true.

719 ***Automatic restart: Start function 234567*** *(2.8.3)*

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 ID505

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720 ***Automatic restart: Number of tries after undervoltage fault trip 234567*** *(2.8.4)*

This parameter determines how many automatic restarts can be made during the trial time set by parameter ID718 after and undervoltage trip.

0 = No automatic restart
>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.

721 ***Automatic restart: Number of tries after overvoltage trip 234567*** *(2.8.5)*

This parameter determines how many automatic restarts can be made during the trial time set by parameter ID718 after an overvoltage trip.

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

722 ***Automatic restart: Number of tries after overcurrent trip 234567*** *(2.8.6)*

(NOTE! IGBT temp fault also included)
This parameter determines how many automatics restarts can be made during the trial time set by ID718.

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

723 ***Automatic restart: Number of tries after reference trip 234567*** *(2.8.7)*

This parameter determines how many automatics restarts can be made during the trial time set by ID718.

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

725 ***Automatic restart: Number of tries after external fault trip 234567*** *(2.8.9)*

This parameter determines how many automatics restarts can be made during the trial time set by ID718.

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

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726 ***Automatic restart: Number of tries after motor temperature fault trip*** ***234567*** *(2.8.8)*

This parameter determines how many automatics restarts can be made during the trial time set by ID718.

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

727 ***Response to undervoltage fault*** ***234567*** *(2.7.5)*

1 = Warning
2 = Fault, stop mode after fault according to ID506
3 = Fault, stop mode after fault always by coasting

For the undervoltage limits, see Telemecanique ATV78 User's Manual, Table 4-2.

728 ***4mA reference fault: preset frequency reference*** ***234567*** *(2.7.2)*

If the value of parameter ID700 is set to 3 and the 4mA fault occurs then the frequency reference to the motor is the value of this parameter.

730 ***Input phase supervision*** ***234567*** *(2.7.4)*

0 = No response
1 = Warning
2 = Fault, stop mode after fault according to ID506
3 = Fault, stop mode after fault always by coasting

The input phase supervision ensures that the input phases of the variable speed drive have an approximately equal current.

731 ***Automatic restart*** ***1*** *(2.20)*

The Automatic restart is taken into use with this parameter.

0 = Disabled
1 = Enabled

The function resets the following faults (max. three times) (see Telemecanique ATV78 User's Manual, Chapter 9):

- Overcurrent (F1)
- Overvoltage (F2)
- Undervoltage (F9)
- Variable speed drive overtemperature (F14)
- Motor overtemperature (F16)
- Reference fault (F50)

732 ***Response to thermistor fault*** ***234567*** *(2.7.21)*

0 = No response
1 = Warning
2 = Fault, stop mode after fault according to ID506
3 = Fault, stop mode after fault always by coasting
Setting the parameter to **0** will deactivate the protection.

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733 ***Response to fieldbus fault*** ***234567*** *(2.7.22)*

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 ID732.

734 ***Response to slot fault*** ***234567*** *(2.7.23)*

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

See parameter ID732.

738 ***Automatic restart: Number of tries after underload fault trip*** *(2.8.10)*

This parameter determines how many automatic restarts can be made during the trial time set by parameter ID718.

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

739 ***Number of PT100 inputs in use*** ***567*** *(2.7.24)*

If you have a PT100 input board installed in your variable speed drive you can choose here the number of PT100 inputs in use. See also the Telemecanique I/O boards manual.
Note: If the selected value is greater than the actual number of used PT100 inputs, the display will read 200ºC. If the input is short-circuited the displayed value is –30ºC.

740 ***Response to PT100 fault*** ***567*** *(2.7.25)*

0 = No response
1 = Warning
2 = Fault, stop mode after fault according to ID506
3 = Fault, stop mode after fault always by coasting

741 ***PT100 warning limit*** ***567*** *(2.7.26)*

Set here the limit at which the PT100 warning will be activated.

742 ***PT100 fault limit*** ***567*** *(2.7.27)*

Set here the limit at which the PT100 fault (F56) will be activated.

850 ***Fieldbus reference minimum scaling*** ***6*** *(2.9.1)*
851 ***Fieldbus reference maximum scaling*** ***6*** *(2.9.2)*

Use these two parameters to scale the fieldbus reference signal.
Setting value limits: 0 ≤ par. ID850 ≤ ID851 ≤ ID102. If par. ID851 = 0 custom scaling is not used and the minimum and maximum frequencies are used for scaling.
The scaling takes place as presented in Figure 8-10.

Note: Using this custom scaling function also affects the scaling of the actual value.

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852 to 859 ***Fieldbus data out selections 1 to 8*** ***6*** *(2.9.3 to 2.9.10)*

Using these parameters, you can monitor any monitoring or parameter from the fieldbus.
Enter the ID number of the item you wish to monitor for the value of these parameters.

Some typical values:

	Output frequency		Digital inputs 1,2,3 statuses
	Motor speed		Digital inputs 4,5,6 statuses
	Motor current		Digital and relay output statuses
	Motor torque		Frequency reference
	Motor power		Analogue output current
	Motor voltage		AI3
	DC link voltage		AI4
	Unit temperature		AO1 (expander board)
	Motor temperature		AO2 (expander board)
	AI1		Active fault 1
	AI2		

Table 8-12.

1001 ***Number of auxiliary drives*** ***7*** *(2.9.1)*

With this parameter the number of auxiliary drives in use will be defined. The functions controlling the auxiliary drives (parameters ID458 to ID462) can be programmed to relay outputs or digital output. By default, one auxiliary drive is in use and it is programmed to relay output RO1 at B.1.

1002 ***Start frequency, auxiliary drive 1*** ***7*** *(2.9.2)*

The frequency of the drive controlled by the variable speed drive must exceed the limit defined with these parameters with 1 Hz before the auxiliary drive is started. The 1 Hz overdraft makes a hysteresis to avoid unnecessary starts and stops. See Figure 8-54. See also parameters ID101 and ID102, page 122.

1003 ***Stop frequency, auxiliary drive 1*** ***7*** *(2.9.3)*

The frequency of the drive controlled by the variable speed drive must fall with 1Hz below the limit defined with these parameters before the auxiliary drive is stopped. The stop frequency limit also defines the frequency to which the frequency of the drive controlled by the variable speed drive is dropped after starting the auxiliary drive. See Figure 8-54.

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1004	***Start frequency, auxiliary drive 2***	***7***	*(2.9.4)*
1005	***Stop frequency, auxiliary drive 2***	***7***	*(2.9.5)*
1006	***Start frequency, auxiliary drive 3***	***7***	*(2.9.6)*
1007	***Stop frequency, auxiliary drive 3***	***7***	*(2.9.7)*
1008	***Start frequency, auxiliary drive 4***	***7***	*(2.9.8)*
1009	***Stop frequency, auxiliary drive 4***	***7***	*(2.9.9)*

See ID's 1002 and 1003.

1010 ***Start delay of auxiliary drives*** ***7*** *(2.9.10)*

The frequency of the drive controlled by the variable speed drive must remain above the start frequency of the auxiliary drive for the time defined with this parameter before the auxiliary drive is started. The delay defined applies to all auxiliary drives. This prevents unnecessary starts caused by momentary start limit exceedings. See Figure 8-54.

1011 ***Stop delay of auxiliary drives*** ***7*** *(2.9.11)*

The frequency of the drive controlled by the variable speed drive must remain below the stop limit of the auxiliary drive for the time defined with this parameter before the drive is stopped. The delay defined applies to all auxiliary drives. This prevents unnecessary stops caused by momentary falls below the stop limit.

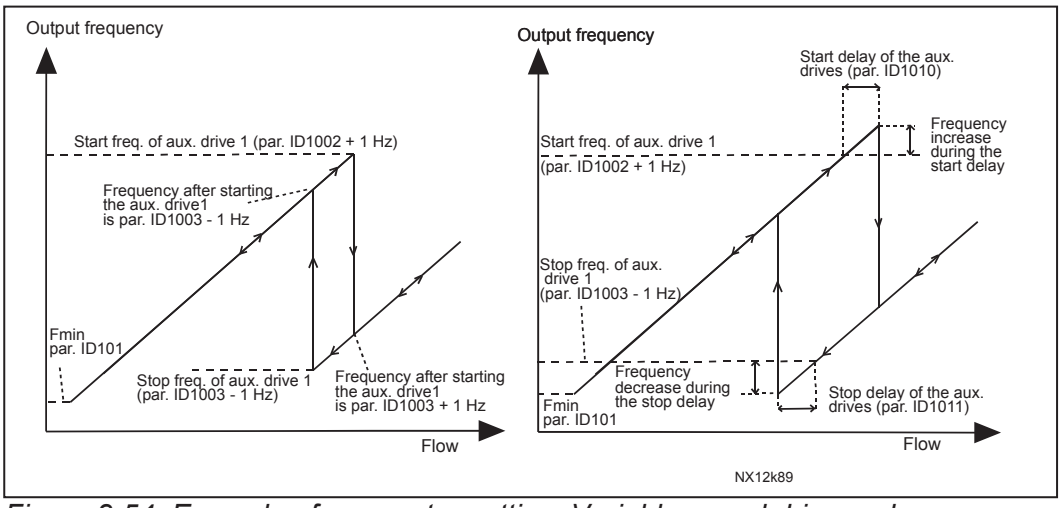


Figure 8-54. Example of parameter setting; Variable speed drive and one auxiliary drive

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1012	***Reference step after start of auxiliary drive 1***	***7***	*(2.9.12)*
1013	***Reference step after start of auxiliary drive 2***	***7***	*(2.9.13)*
1014	***Reference step after start of auxiliary drive 3***	***7***	*(2.9.14)*
1015	***Reference step after start of auxiliary drive 4***	***7***	*(2.9.15)*

The reference step will be automatically added to the reference value always when the corresponding auxiliary drive is started. With the reference steps e.g. the pressure loss in the piping caused by the increased flow can be compensated.

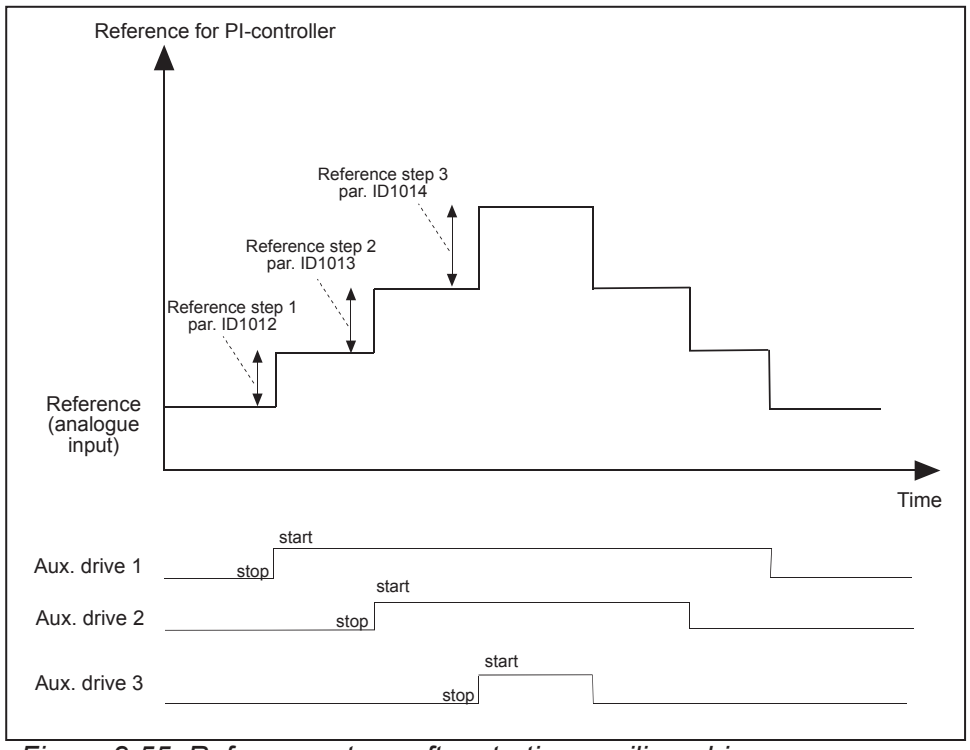


Figure 8-55. Reference steps after starting auxiliary drives

1016	***Sleep frequency***	***57***	*(2.1.15)*

The variable speed drive is stopped automatically if the frequency of the drive falls below the S*leep level* defined with this parameter for a time greater than that determined by parameter ID1017. During the Stop state, the PID controller is operating switching the variable speed drive to Run state when the actual value signal either falls below or exceeds (see par. ID1019) the *Wake-up level* determined by parameter ID1018. See Figure 8-56.

1017	***Sleep delay***	***57***	*(2.1.16)*

The minimum amount of time the frequency has to remain below the Sleep level before the variable speed drive is stopped. See Figure 8-56.

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1018 Wake-up level 57 *(2.1.17)*

The wake-up level defines the level below which the actual value must fall or which has to be exceeded before the Run state of the variable speed drive is restored.

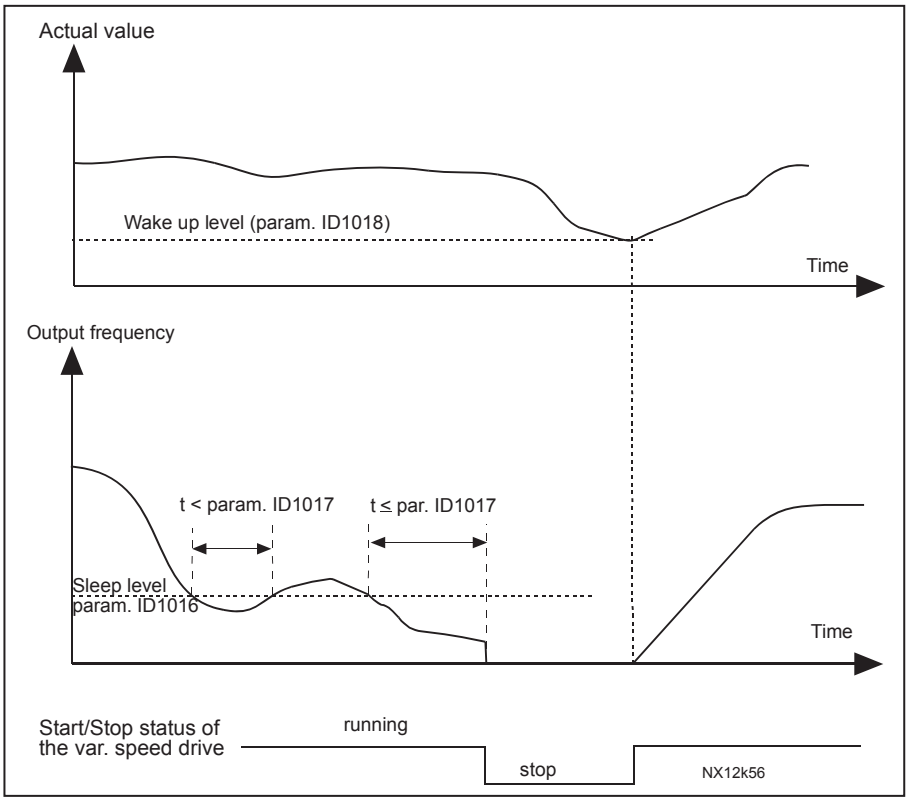


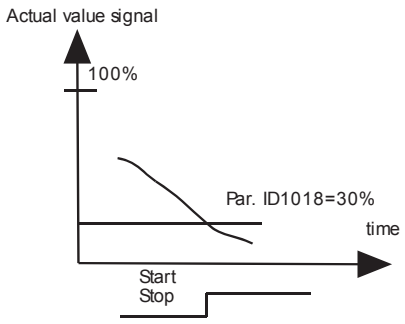
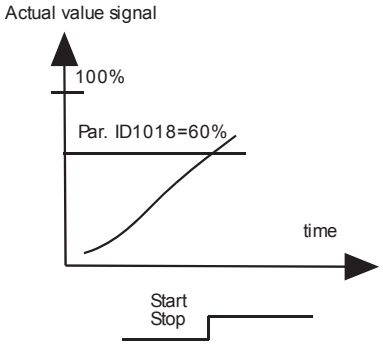
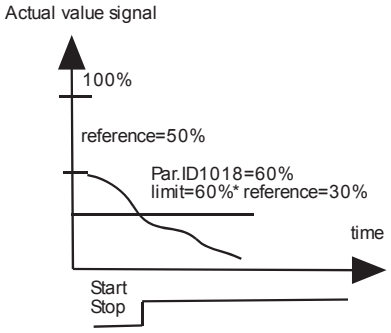
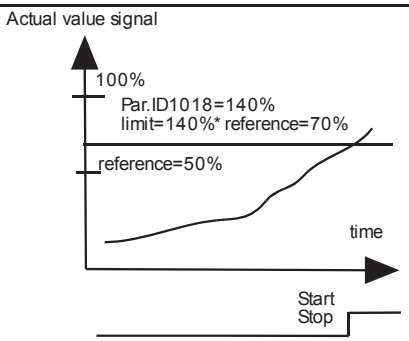
Figure 8-56. Variable speed drive sleep function

1019 Wake-up function 57 *(2.1.18)*

This parameter defines whether the restoration of the Run state occurs when the actual value signal falls below or exceeds the *Wake-up level* (par. ID1018). See Figure 8-56 and Figure 8-57 on page 192.

The application 5 has selections **0-1** and application 7 selections **0-3** available.

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Par. value	Function	Limit	Description
0	Wake-up happens when actual value goes below the limit	The limit defined with parameter ID1018 is in percent of the maximum actual value	
1	Wake-up happens when actual value exceeds the limit	The limit defined with parameter ID1018 is in percent of the maximum actual value	
2	Wake up happens when actual value goes below the limit	The limit defined with parameter ID1018 is in percent of the current value of the reference signal	
3	Wake up happens when actual value exceeds the limit	The limit defined with parameter ID1018 is in percent of the current value of the reference signal	

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Figure 8-57. Selectable wake-up functions

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1020 PID controller bypass 7 *(2.9.16)*

With this parameter, the PID controller can be programmed to be bypassed. Then the frequency of the controlled drive and the starting points of the auxiliary drives are defined according to the actual value signal.

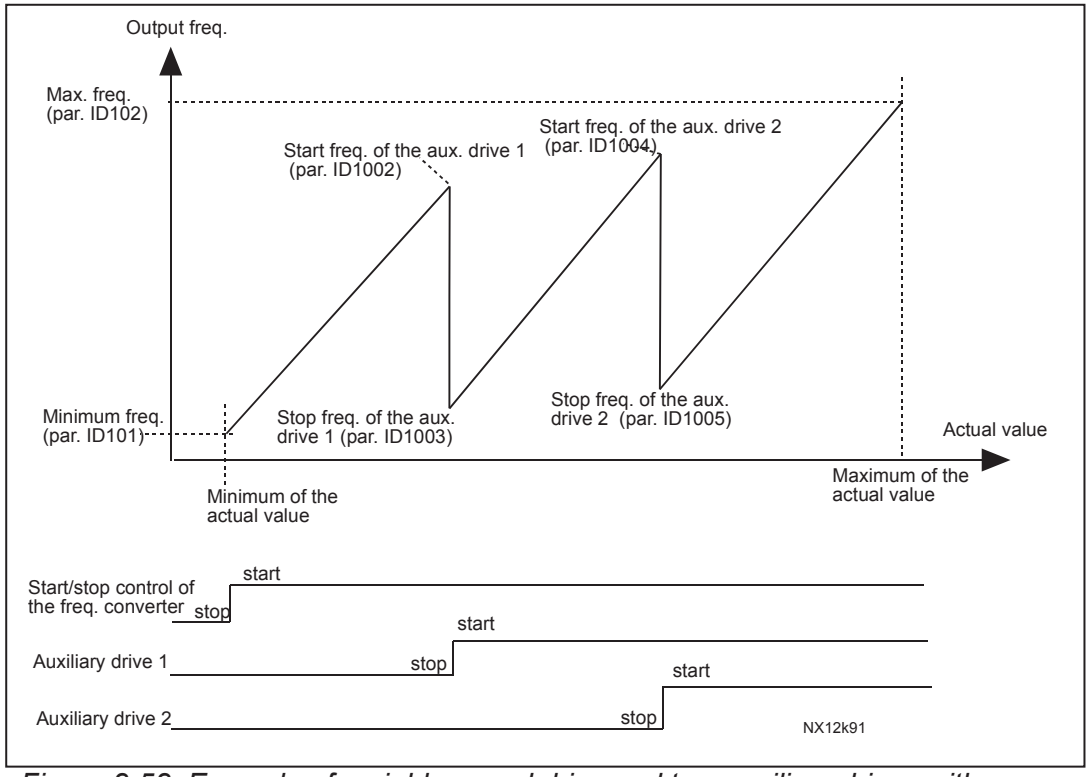


Figure 8-58. Example of variable speed drive and two auxiliary drives with bypassed PID controller

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1021	***Analogue input selection for input pressure measurement 7***	*(2.9.17)*
1022	***Input pressure high limit 7***	*(2.9.18)*
1023	***Input pressure low limit 7***	*(2.9.19)*
1024	***Output pressure drop value 7***	*(2.9.20)*

In pressure increase stations there may be need for decreasing the output pressure if the input pressure decreases below a certain limit. The input pressure measurement which is needed is connected to the analogue input selected with parameter ID1021. See Figure 8-59.

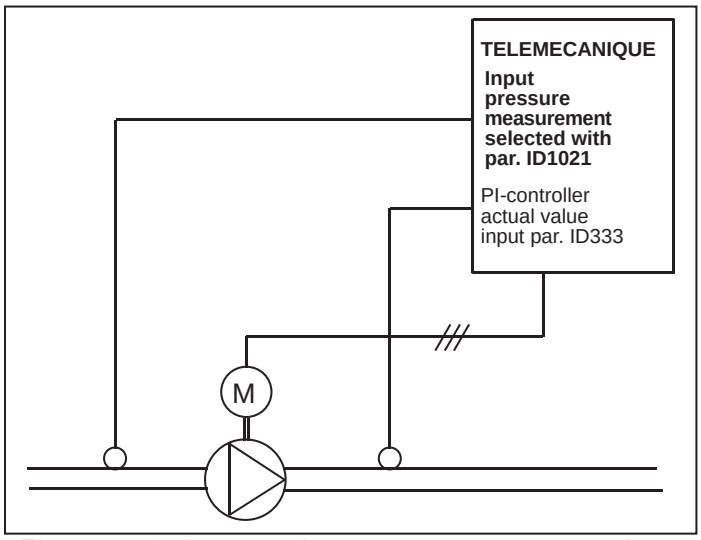


Figure 8-59. Input and output pressure measuring

With parameters ID1022 and ID1023 the limits for the area of the input pressure, where the output pressure is decreased, can be selected. The values are in percent of the input pressure measurement maximum value. With parameter ID1024 the value for the output pressure decrease within this area can be set. The value is in percent of the reference value maximum. See Figure 8-60.

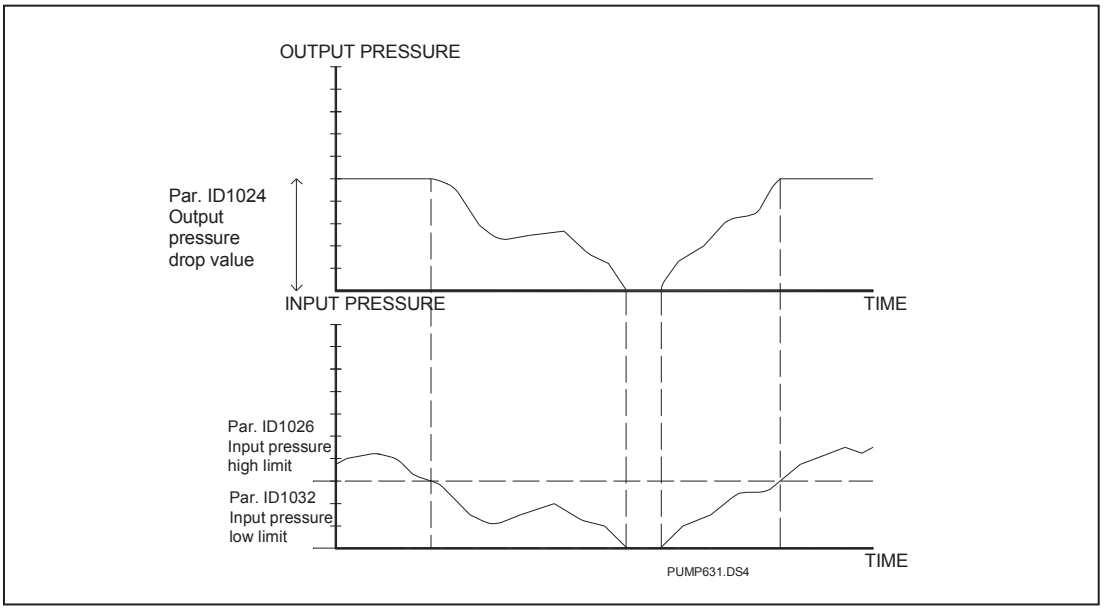


Figure 8-60. Output pressure behaviour depending on input pressure and parameter settings

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1025	***Frequency drop delay after starting auxiliary drive***	***7***	*(2.9.21)*
1026	***Frequency increase delay after stopping auxiliary drive***	***7***	*(2.9.22)*

If the speed of auxiliary drive increases slowly (e.g. in soft starter control) then a delay between the start of auxiliary drive and the frequency drop of the variable speed drive will make the control smoother. This delay can be adjusted with parameter ID1025.
In the same way, if the speed of the auxiliary drives decreases slowly a delay between the auxiliary drive stop and the frequency increase of the variable speed drive can be programmed with parameter ID1026. See Figure 8-61.
If either of the values of parameters ID1025 and ID1026 is set to maximum (300,0 s) no frequency drop nor increase takes place.

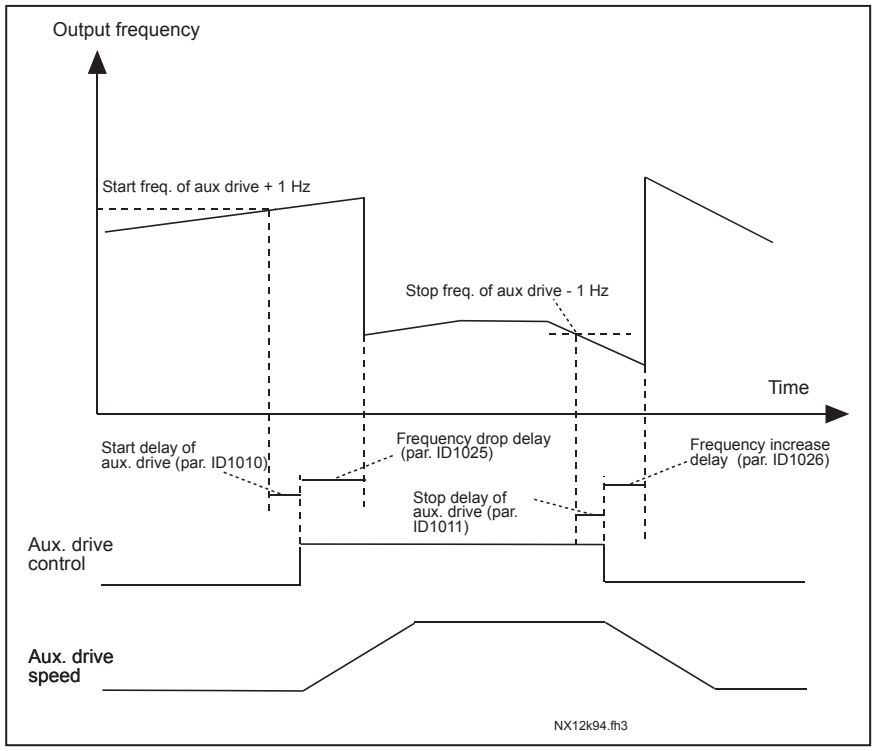


Figure 8-61. Frequency drop and increase delays

1027	***Autochange***	***7***	*(2.9.24)*

0 Autochange not used
1 Autochange used

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1028 Autochange/interlocks automatics selection 7 *(2.9.25)*

0 Automatics (autochange/interlockings) applied to auxiliary drives only

The drive controlled by the variable speed drive remains the same. Only the mains contactor is needed for each drive. See Figure 8-62.

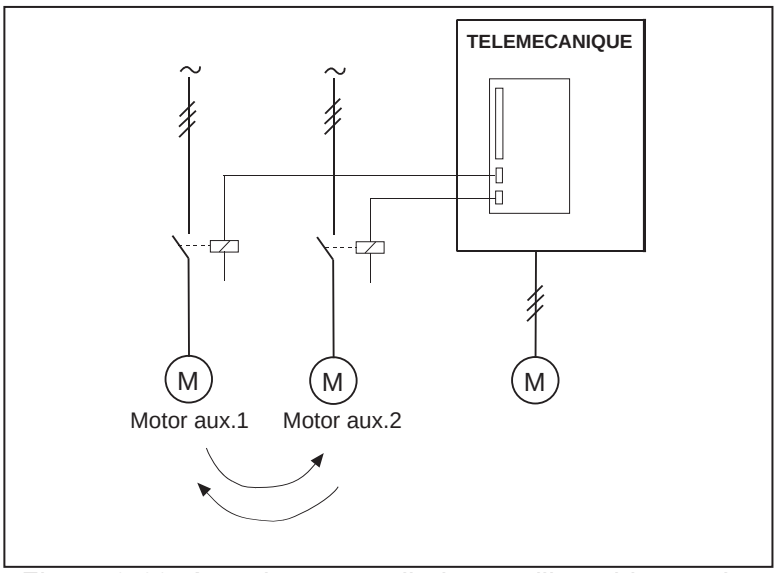


Figure 8-62. Autochange applied to auxiliary drives only.

1 All drives included in the autochange/interlockings sequence

The drive controlled by the variable speed drive is included in the automatics and two contactors are needed for each drive to connect it to the mains or the variable speed drive. See Figure 8-63.

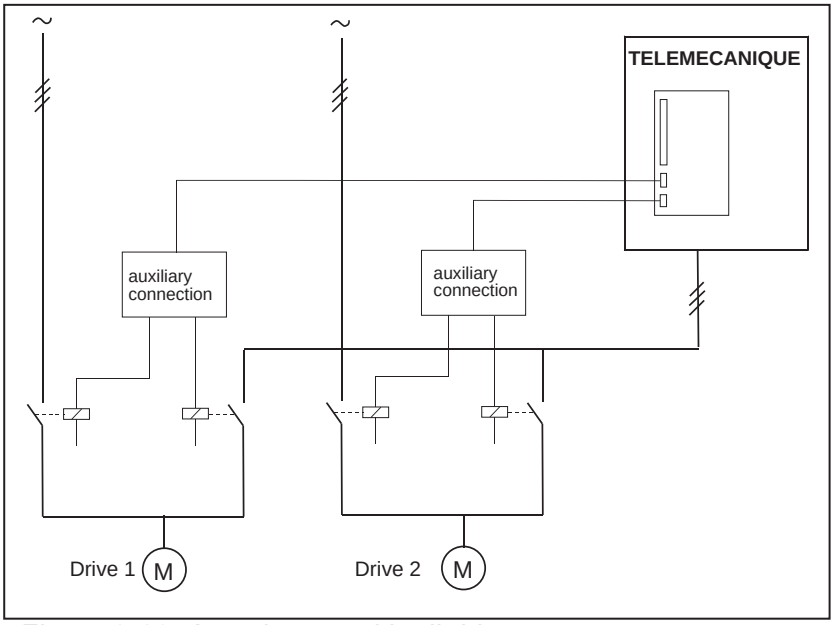


Figure 8-63. Autochange with all drives

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1029 Autochange interval 7 *(2.9.26)*

After the expiry of the time defined with this parameter, the autochange function takes place if the capacity used lies below the level defined with parameters ID1031 (*Autochange frequency limit*) and ID1030 (*Maximum number of auxiliary drives*). Should the capacity exceed the value of ID1031, the autochange will not take place before the capacity goes below this limit.

The time count is activated only if the Start/Stop request is active.
The time count is reset after the autochange has taken place.

See Figure 8-64.

1030 Maximum number of auxiliary drives 7 *(2.9.27)*
1031 Autochange frequency limit 7 *(2.9.28)*

These parameters define the level below which the capacity used must remain so that the autochange can take place.

This level is defined as follows:

If the number of running auxiliary drives is smaller than the value of parameter ID1030 the autochange function can take place.

If the number of running auxiliary drives is equal to the value of parameter ID1030 and the frequency of the controlled drive is below the value of parameter ID1031 the autochange can take place.

If the value of parameter ID1031 is 0.0 Hz, the autochange can take place only in rest position (Stop and Sleep) regardless of the value of parameter ID1030.

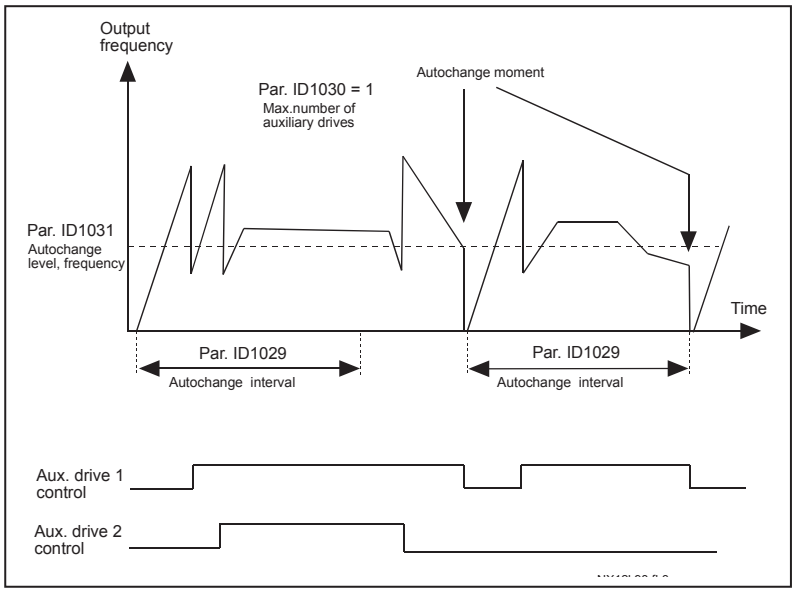


Figure 8-64. Autochange interval and limits

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1032 ***Interlock selection*** ***7*** *(2.9.23)*

With this parameter you can activate or deactivate the feedback signal from the drives. The interlock feedback signals come from the switches that connect the motors to the automatic control (variable speed drive), directly to the mains or place them to off-state. The interlock feedback functions are connected to the digital inputs of the variable speed drive. Program parameters ID426 to ID430 to connect the feedback functions to the digital inputs. Each drive must be connected to its own interlock input. The Pump and fan control controls only those motors whose interlock input is active.

0 Interlock feedback not used

The variable speed drive receives no interlock feedback from the drives

1 Update of autochange order in Stop

The variable speed drive receives interlock feedback from the drives. In case one of the drives is, for some reason, disconnected from the system and eventually re-connected, it will be placed last in the autochange line without stopping the system. However, if the autochange order now becomes, for example, [P1 → P3 → P4 → P2], it will be updated in the next Stop (autochange, sleep, stop, etc.)

Example:
[P1 → P3 → P4] → [P2 LOCKED] → [P1 → P3 → P4 → P2] → [SLEEP] → [P1 → P2 → P3 → P4]

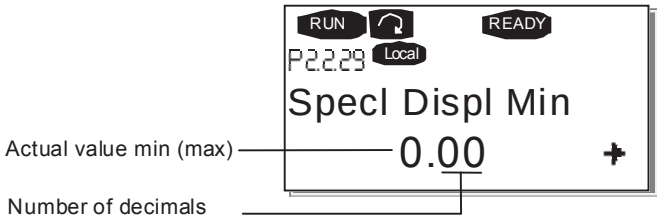
2 Update of order immediately

The variable speed drive receives interlock feedback from the drives. At re-connection of a drive to the autochange line, the automatics will stop all motors immediately and re-start with a new set-up.

Example:
[P1 → P2 → P4] → [P3 LOCKED] → [STOP] → [P1 → P2 → P3 → P4]

1033 ***Actual value special display minimum*** ***7*** *(2.9.29)*
1034 ***Actual value special display maximum*** ***7*** *(2.9.30)*
1035 ***Actual value special display decimals*** ***7*** *(2.9.31)*

With these parameters the minimum and maximum values as well as the number of decimals of the actual value special display ca be set. Find the actual value display in menu ***M1,*** *Monitoring values*.



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8.1 Keypad control parameters

Unlike the parameters listed above, these parameters are located in the **M3** menu of the control keypad. The reference parameters do not have an ID number.

114 ***Stop button activated*** *(3.4, 3.6)*

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 ID125.

125 ***Control Place*** *(3.1)*

The active control place can be changed with this parameter. For more information, see Telemecanique ATV78 User's Manual, Chapter 7.3.3.1.

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).

123 ***Keypad Direction*** *(3.3)*

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.

For more information, see ATV78 User's Manual, Chapter 7.3.3.3.

R3.2 ***Keypad Reference*** *(3.2)*

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.*** For more information, see ATV78 User's Manual, Chapter 7.3.3.2.

R3.4 ***PID reference 1 57*** *(3.4)*

The PID controller keypad reference can be set between 0% and 100%. This reference value is the active PID reference if parameter ID332 = 2.

R3.5 ***PID reference 2 57*** *(3.5)*

The PID controller keypad reference 2 can be set between 0% and 100%. This reference is active if the DIN5 function=13 and the DIN5 contact is closed.

R3.5 ***Torque reference 6*** *(3.5)*

Define here the torque reference within 0.0…100.0%.

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9. Appendices

9.1 External brake control with additional limits (ID's 315, 316, 346 to 349, 352, 353)

The external brake used for additional braking can be controlled through parameters ID315, ID316, ID346 to ID349 and ID352/ID353. Selecting On/Off Control for the brake, defining the frequency or torque limit(s) the brake should react to and defining the Brake-On/-Off delays will allow an effective brake control See Figure 9.1-1.

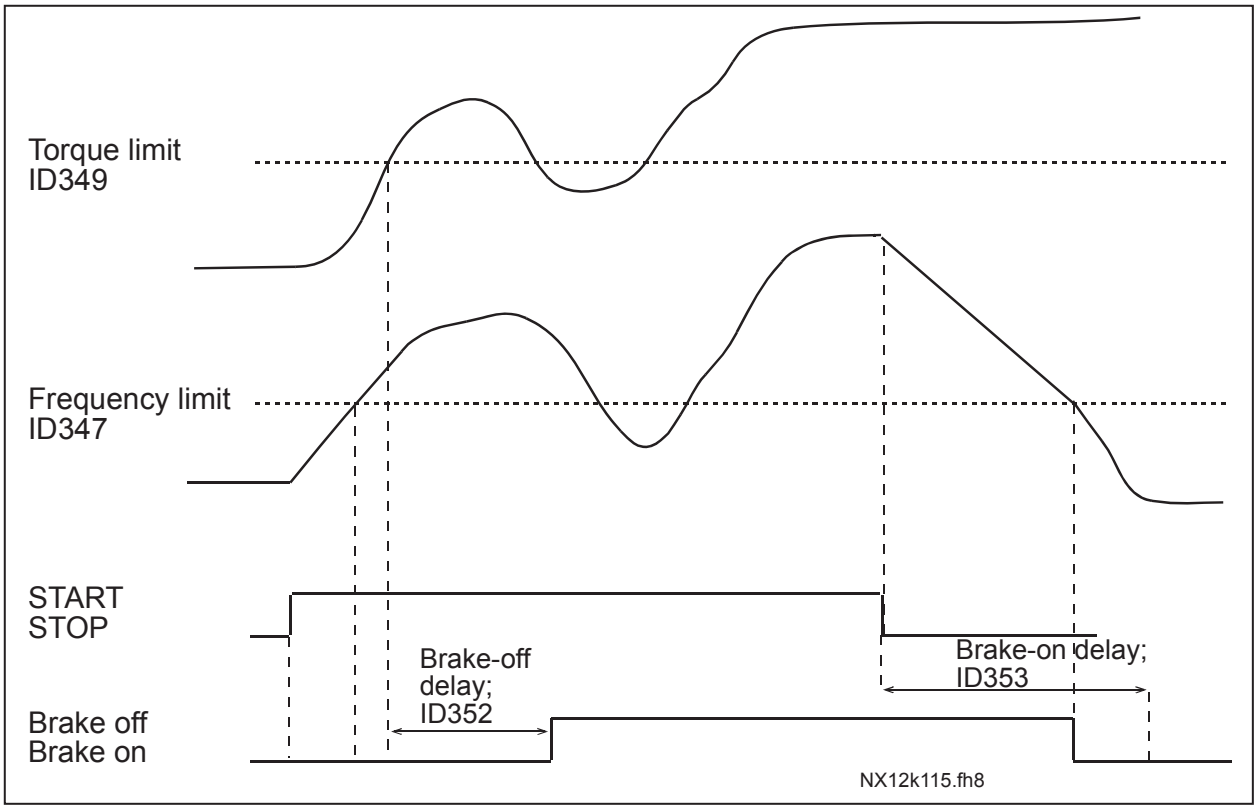


Figure 9.1-1. Brake control with additional limits

In Figure 9.1-1 above, the brake control is set to react to both the torque supervision limit (par. ID349) and frequency supervision limit (ID347). Additionally, the same frequency limit is used for both brake-off and brake-on control by giving parameter ID346 the value **4**. Use of two different frequency limits is also possible. Then parameters ID315 and ID346 must be given the value **3**.

Brake-off: In order for the brake to release, three conditions must be fulfilled: 1) the drive must be in Run state, 2) the torque must be over the set limit (if used) and 3) the output frequency must be over the set limit (if used).
Brake-on: Stop command activates the brake delay count and the brake is closed when the output frequency falls below the set limit (ID315 or ID346). As a precaution, the brake closes when the brake-on delay expires, at the latest.
Note: A fault or Stop state will close the brake immediately without a delay.

See Figure 9.1-1. Brake control with additional limits. Brake control with additional limits

It is strongly advisable that the brake-on delay be set longer than the ramp time in order to avoid damaging of the brake.

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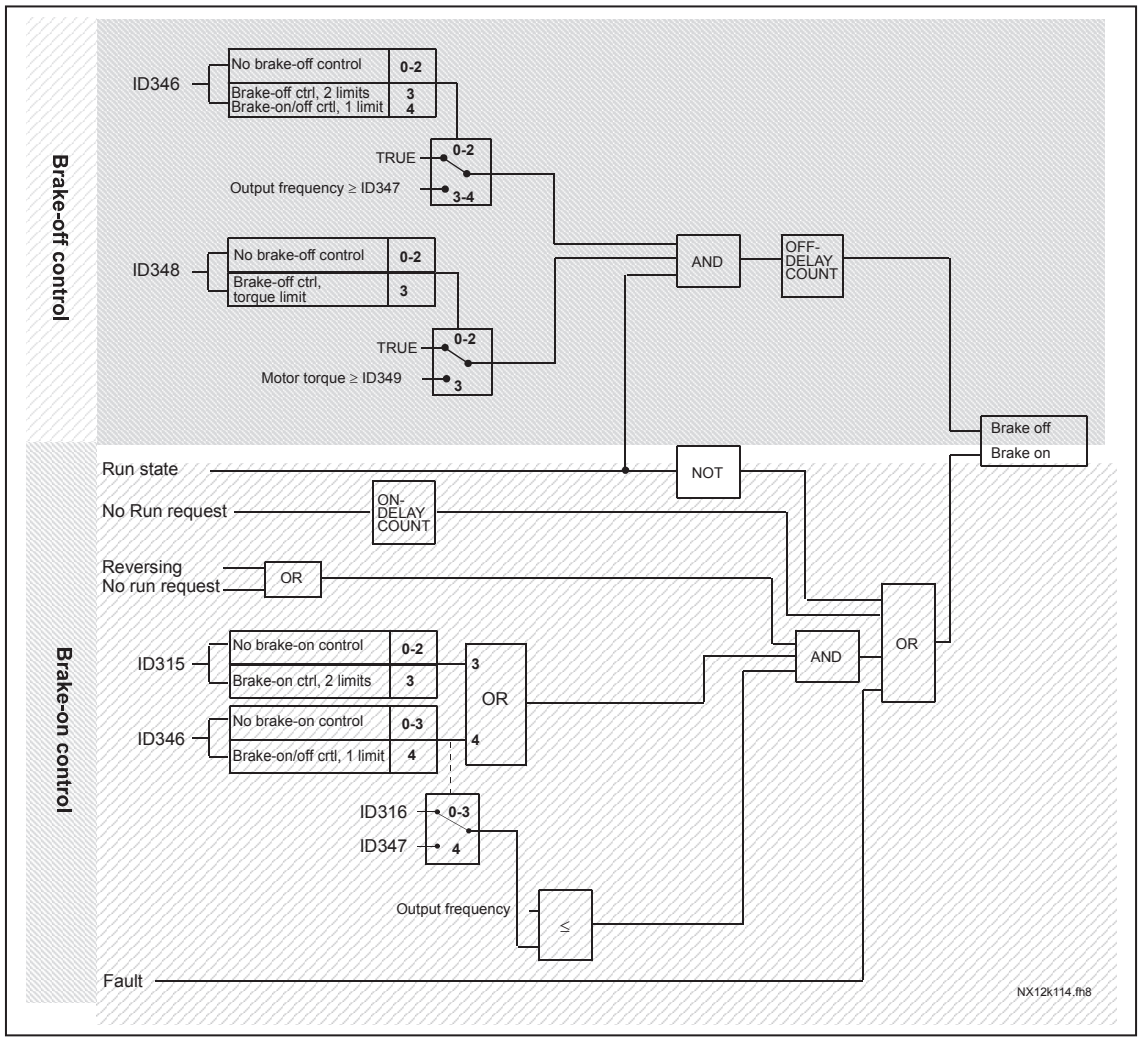


Figure 9.1-2. Brake control logic

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9.2 Closed loop parameters (ID's 612 to 621)

Select the Closed loop control mode by setting value **3** or **4** for parameter ID600.
Closed loop control mode is used when enhanced performance near zero speed and better static speed accuracy with higher speeds are needed. Closed loop control mode is based on "rotor flux oriented current vector control". With this controlling principle, the phase currents are divided into a torque producing current portion and a magnetizing current portion. Thus, the squirrel cage induction machine can be controlled in a fashion of a separately excited DC motor.

Note: These parameters can be used with ATV78 drive only.

EXAMPLE:

Motor Control Mode = 3 (Closed loop speed control)

This is the usual operation mode when fast response times, high accuracy or controlled run at zero frequencies are needed. Encoder board should be connected to slot C of the control unit. Set the encoder P/R-parameter (P7.3.1.1). Run in open loop and check the encoder speed and direction (V7.3.2.2). Change the direction parameter (P7.3.1.2) or switch the phases of motor cables if necessary. Do not run if encoder speed is wrong. Program the no-load current to parameter ID612 and set parameter ID619 (Slip Adjust) to get the voltage slightly above the linear U/f-curve with the motor frequency at about 66% of the nominal motor frequency. The Motor Nominal Speed parameter (ID112) is critical. The Current Limit parameter (ID107) controls the available torque linearly in relative to motor nominal current.

9.3 Advanced Open Loop parameters (ID's 622 to 625, 632, 635)

Select the Advanced Open Loop control mode by setting value **5** or **6** for parameter ID600.
The Advanced Open Loop control mode finds similar implementations as the Closed Loop control mode above. However, the control accuracy of the Closed Loop control mode is higher than that of the Advanced Open Loop control mode.

EXAMPLE:

Motor Control Mode = 5 Frequency control (Advanced open loop) and 6 Speed control (Advanced open loop)

The motor is running at current vector control at low frequencies. At frequencies above the frequency limit, the motor is in frequency control. The default current value is 120% at zero frequency. Use linear U/f-curve (ID108). 120% starting torque should now be possible. Sometimes increasing the frequency limit (ID635) will improve the run. The Frequency limit is the critical point. Increase the zero frequency point to get enough current at frequency limit.

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9.4 Parameters of motor thermal protection (ID's 704 to 708):

General

The motor thermal protection is to protect the motor from overheating. The Telemecanique 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 ATV78 User's Manual, Chapter 7.3.1.



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

9.5 Parameters of Stall protection (ID's 709 to 712):

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, ID710 (Stall current) and ID712 (Stall frequency limit). 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.

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9.6 Parameters of Underload protection (ID’s 713 to 716):

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 ID714 (Field weakening area load) and ID715 (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_H 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.

9.7 Fieldbus control parameters (ID’s 850 to 859)

The Fieldbus control parameters are used when the frequency or the speed reference comes from the fieldbus (Modbus, Profibus, DeviceNet etc.). With the Fieldbus Data Out Selection 1…8 you can monitor values from the fieldbus.

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