VACON 20 COLD PLATE
AC DRIVES

MULTIPURPOSE APPLICATION MANUAL

VACON
DRIVEN BY DRIVES

INDEX

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1. VACON 20 CP MULTIPURPOSE APPLICATION

The Vacon 20 Cold Plate drive contains a preloaded application for instant use.

The parameters of this application are listed in chapter 2.2 of this manual and explained in more detail in chapter 3.

1.1 SPECIFIC FUNCTIONS OF VACON MULTIPURPOSE APPLICATION

The Vacon Multipurpose allows flexible use of Vacon 20 Cold Plate frequency converters.

Features

The drive can be controlled through I/O terminals, a fieldbus or the optional keypad.Two programmable control places and sources for the frequency reference are available, for easy local/remote control.

Frequency reference can be direct (analogue input, preset speeds, motor potentiometer, fieldbus) or controlled by the internal PID regulator.

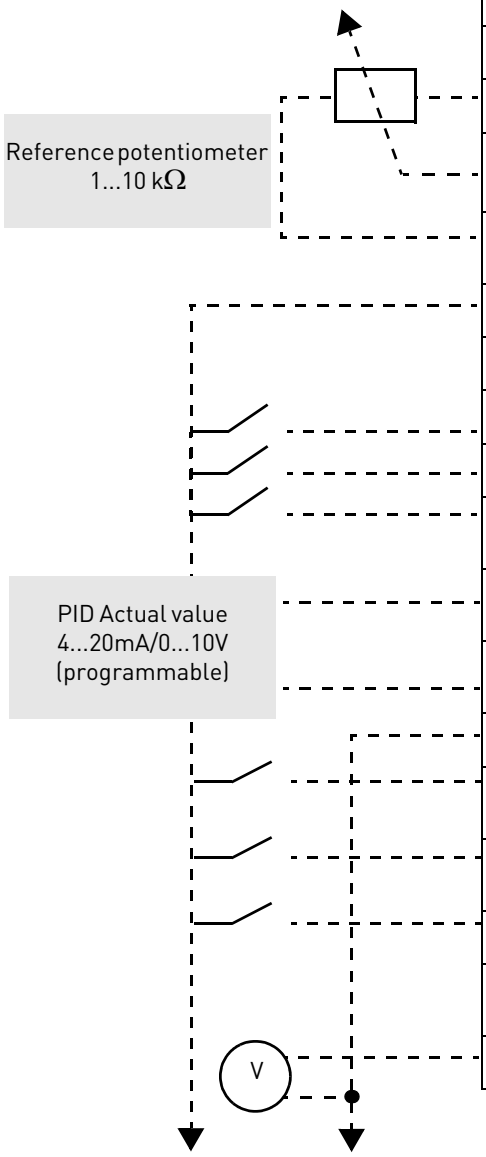
PID setpoint and actual value are totally programmable. A "sleep" function is available, with possibility of pressure boost and check of the losses before entering the stand-by state.

All the functionalities can be controlled through a fieldbus.

The motor identification function allows automatic optimization of the voltage/frequency curve, for a optimal torque response also at low motor speed.

It is possible to install one optional board for I/O expansion.

1.2 EXAMPLE OF CONTROL CONNECTIONS



Standard I/O board			
Terminal		Signal	Default
A	RS485	Serial bus, negative	
B	RS485	Serial bus, positive	
1	+10 Vref	Reference output	
2	AI1+	Analogue input, voltage or current*	Voltage
3	AI1-	Analogue input common (current)	
6	24Vout	24V aux. voltage	
7	GND	I/O ground	
8	DI1	Digital input 1	Start FWD
9	DI2	Digital input 2	Start REV
10	DI3	Digital input 3	Preset Speed B0
4	AI2+	Analogue input, voltage or current*	Current
5	AI2-	Analogue input common (current)	
13	DO1-	Digital Output Common	
14	DI4	Digital input 4	Preset Speed B1
15	DI5	Digital input 5	Fault reset
16	DI6	Digital input 6	Ramp 2
18	AO1+	Analogue signal (+output)	Output frequency
20	DO1+	Digital output +	Ready

*Selectable with DIP switches, see Vacon 20 Cold Plate Installation Manual

Table 1. Connection example, standard I/O board

To Relay board
1 or 2

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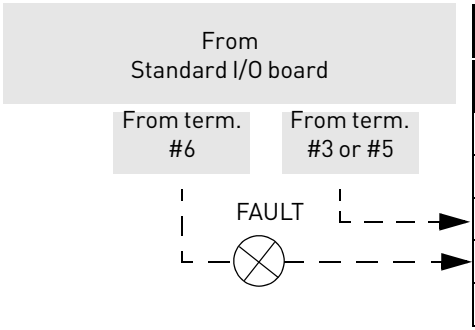

Relay board 1				Default
Terminal		Signal		
22	RO1/2 CM		Relay output 1	RUN
23	RO1/3 NO			
24	RO1/1 NC		Relay output 1	FAULT
25	RO1/2 CM			
26	RO1/3 NO			

Table 2. Connection example, Relay terminals

1.3 OPTIONAL BOARDS

One optional I/O expansion board can be installed into the slot on the right side of the drive. The following boards are supported:

OPTB1: 6 Digital Inputs-Outputs
The first 3 terminals are reserved as digital inputs (DIE1, DIE2, DIE3). The second 3 terminals can be used as inputs (DIE4, DIE5, DIE6) or digital outputs (DOE4, DOE5, DOE6).

The number of terminals used as input must be declared in parameter P2.25 (hidden if the board is not installed).

This number determines the higher value for the selection of the digital input connected to a certain logical function. It also changes the visibility of parameters for the selection of digital outputs function (P6.9, P6.10, P6.11).

OPTB2: 1 Thermistor Input, 2 Relays Outputs
Response to thermistor fault can be programmed with parameter P9.16.

Relays functions can be programmed with parameters P6.9, P6.10 (hidden if the board is not installed).

OPTB4: 1 Analogue Input, 2 Analogue Outputs
One more input is available as frequency reference.

Two more outputs are available to monitor motor/drive signals.

OPTB5: 3 Relays Outputs
Relays functions can be programmed with parameters P6.9, P6.10, P6.11 (hidden if the board is not installed).

OPTB9: 5 Digital Inputs, 1 Relay Output
The higher value for the selection of the digital input connected to a certain logical function is set to 11.

Relay functions can be programmed with parameters P6.9 (hidden if the board is not installed).

2. DESCRIPTION OF GROUPS

2.1 MONITOR GROUP: MENU M0N

Vacon 20 Cold Plate AC drive provides you with a possibility to monitor the actual values of parameters and signals as well as statuses and measurements. Some of the values to be monitored are adjusted.

See Table 3 in which the basic monitoring values are presented.

Code	Monitoring value	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	Calculated shaft torque
V1.6	Motor shaft power	%	5	Total power consumption of AC drive
V1.7	Motor voltage	V	6	
V1.8	Motor temperature	%	9	Calculated motor temperature
V1.9	DC link voltage	V	7	
V1.10	Unit temperature	°C	8	Heatsink temperature
V1.11	Board temperature	°C	1825	Power board temperature
V1.12	Analogue input 1	%	13	Analogue input AI1
V1.13	Analogue input 2	%	14	Analogue input AI2
V1.14	Exp. Analogue input	%	1837	Analogue input on OPTB4
V1.15	Analogue output 1	%	26	Analogue output
V1.16	Exp. Analogue out 1	%	1838	Analogue output 1 on OPTB4
V1.17	Exp. Analogue out 1	%	1839	Analogue output 2 on OPTB4
V1.18	DIN1, DIN2, DIN3		15	Digital inputs status
V1.19	DIN4, DIN5, DIN6		16	Digital inputs status
V1.20	DIE1, DIE2, DIE3		1835	Digital inputs on OPTB1 status
V1.21	DIE4, DIE5, DIE6		1836	Digital inputs on OPTB1 status
V1.22	R01, R02, DO		17	Digital outputs status
V1.23	E01, E02, EO3		1852	Expansion board digital outputs status
V1.24	Process variable		29	Scaled process variable See parameter P7.10
V1.25	PID setpoint	%	20	PID controller setpoint
V1.26	PID error value	%	22	PID controller error
V1.27	PID feedback	%	21	PID controller actual value
V1.28	PID output	%	23	PID controller output

Table 3. Monitoring menu items

NOTE!	Values V1.25-28 are hidden when PID output is not used as frequency reference. Values V1.14, V1.16, V1.17 are hidden when OPTB4 expansion board is not installed. Value V1.23 is hidden when no expansion board with available outputs is installed.

2.2 PARAMETER GROUPS

The Multipurpose Application embodies the following parameter groups:

Menu and Parameter group	Description
Group Basic Parameters: Menu PAR G1	Basic settings
Group Advanced Settings: Menu PAR G2	Advanced parameter settings
Group Analogue inputs: Menu PAR G3	Analogue input programming
Group Digital inputs: Menu PAR G4	Digital input programming
Group Analogue outputs: Menu PAR G5	Analogue outputs programming
Group Digital outputs: Menu PAR G6	Digital output programming
Group Supervisions: Menu PAR G7	Prohibit frequencies programming
Group Motor Control: Menu PAR G8	Motor control and U/f parameters
Group Protections: menu PAR G9	Protections configuration
Group Automatic reset: Menu PAR G10	Auto reset after fault configuration
Group Fieldbus: Menu PAR G11	Fieldbus data out parameters
Group PID-controller: Menu Par G12	Parameters for PID Controller.

Table 4. Parameter groups

Column explanations:

Code = Location indication on the keypad; Shows the operator the 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
ID = ID number of the parameter
Description= Short description of parameter values or its function
= The parameter may be changed only in Stop state

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2.2.1 GROUP BASIC PARAMETERS: MENU PAR G1

Code	Parameter	Min	Max	Unit	Default	ID	Description
P1.1	Minimum frequency	0.00	P1.2	Hz	0.00	101	Minimum allowed frequency reference
P1.2	Maximum frequency	P1.1	320.00	Hz	50.00	102	Maximum allowed frequency reference
P1.3	Acceleration time 1	0.1	300.0	s	3.0	103	Defines the time required for the output frequency to increase from zero frequency to maximum frequency
P1.4	Deceleration time 1	0.1	300.0	s	3.0	104	Defines the time required for the output frequency to decrease from maximum frequency to zero frequency
P1.5	Motor current limit	0.2 x I_H	2 x I_H	A	I_H	107	Maximum motor current from AC drive
P1.6	Motor nominal voltage	180	500	V	400	110	Find this value U_n on the rating plate of the motor. This parameter sets the voltage at the field weakening point to 100% * U_{nMotor}. Note also used connection (Delta/Star).
P1.7	Motor nominal frequency	8.00	320.00	Hz	50.00	111	Find this value f_n on the rating plate of the motor.
P1.8	Motor nominal speed	24	19200	rpm	1440	112	Find this value n_n on the rating plate of the motor.
P1.9	Motor nominal current	0.2 x I_H	2 x I_H	A	I_H	113	Find this value I_n on the rating plate of the motor.
P1.10	Motor Cos Phi	0.30	1.00		0.85	120	Find this value on the rating plate of the motor
P1.11	Control Place Selection	0	2		0	125	Run and direction control: 0 = I/O terminals 1 = Keypad 2 = Fieldbus
P1.12	Frequency reference selection	0	5-6*		0	1819	Selection of reference source: 0 = AI1 1 = AI2 2 = PID reference 3 = Motor potentiometer 4 = Keypad 5 = Fieldbus 6 = Expansion AI1 (*)6 is available when expansion board OPTB4 is installed
P1.13	Start function	0	1		0	505	0=Ramping 1=Flying start
P1.14	Stop function	0	1		0	506	0=Coasting 1=Ramping

P1.15	U/f optimization	0	1		0	109	0 = Not active 1 = Auto torque boost
P1.16	Show Advanced parameters	0	1		0	115	0 = only Basic 1 = All groups

Table 5. Basic parameters.

2.2.2 GROUP ADVANCED SETTINGS: MENU PAR G2

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.1	Start/Stop logic	0	3		0	300	**Logic = 0:** Start sgn 1 = Start Forward Start sgn 2 = Start Backward **Logic =1:** Start sgn 1 = Start Start sgn 2 = Reverse **Logic = 2:** Start sgn 1 = Start pulse Start sgn 2 = Stop pulse **Logic = 3:** Start sgn 1 = Start Forward (edge) Start sgn 2 = Start Backward (edge)
P2.2	Preset frequency 1	0.00	P1.2	Hz	10.00	105	Multistep speed 1
P2.3	Preset frequency 2	0.00	P1.2	Hz	15.00	106	Multistep speed 2
P2.4	Preset frequency 3	0.00	P1.2	Hz	20.00	126	Multistep speed 3
P2.5	Preset frequency 4	0.00	P1.2	Hz	25.00	127	Multistep speed 4
P2.6	Preset frequency 5	0.00	P1.2	Hz	30.00	128	Multistep speed 5
P2.7	Preset frequency 6	0.00	P1.2	Hz	40.00	129	Multistep speed 6
P2.8	Preset frequency 7	0.00	P1.2	Hz	50.00	130	Multistep speed 7
P2.9	Acceleration time 2	0.1	3000.0	s	10.0	502	Time from 0 to max frequency
P2.10	Deceleration time 2	0.1	3000.0	s	10.0	503	Time from 0 to max frequency
P2.11	Acceleration time 2 freq. threshold	0.00	P1.2	Hz	0.00	527	Threshold for auto change from acc1 to acc2
P2.12	Deceleration time 2 freq. threshold	0.00	P1.2	Hz	0.00	528	Threshold for auto change from dec1 to dec2
P2.13	Ramp shape	0.0	10.0	s	0.0	500	Rounded speed profile.
P2.14	Control place 2 selection	0	2		0	1806	Alternative control place: 0: I/O terminals 1: Keypad 2: Fieldbus

P2.15	Frequency reference 2 selection	0	5-6*		1	1820	Selection of ref source 2 0 = AI1 1 = AI2 2 = PID 3 = Motor potentiometer 4 = Keypad reference 5 = Fieldbus 6 = Expansion AI (*)6 is available when expansion board OPTB4 is installed
P2.16	Motor potentiometer ramp time	1	50	Hz/s	5	331	Rate of change in the motor potentiometer reference when increased or decreased.
P2.17	Motor potentiometer reset	0	2		0	367	Motor potentiometer frequency reference reset logic. 0 = No reset 1 = Reset if stopped or powered down 2 = Reset if powered down
P2.18	Skip frequency range 1 low limit	0.00	P1.2	Hz	0.00	509	0 = Not used
P2.19	Skip frequency range 1 high limit	0.00	P1.2	Hz	0.00	510	0 = Not used
P2.20	Skip frequency range 2 low limit	0.00	P1.2	Hz	0.00	511	0 = Not used
P2.21	Skip frequency range 1 low limit	0.00	P1.2	Hz	0.00	512	0 = Not used
P2.22	Keypad stop button	0	1		1	114	0 = Limited function of Stop button 1 = Stop button always enabled
P2.23	Keypad direction	0	1		0	123	Motor rotation when control place is keypad 0 = Forward 1 = Reverse
P2.24	OPTB1 Digital inputs	3	6		6	1829	Number of terminals used as digital inputs. The parameter is visible only when OPTB1 board is installed

Table 6. Advanced settings group.

NOTE!	Visibility of the group depends on P1.16.

2.2.3 GROUP ANALOGUE INPUTS: MENU PAR G3

Code	Parameter	Min	Max	Unit	Default	ID	Description
P3.1	AI1 signal range	0	1		0	379	0 = 0...10V / 0...20mA 1 = 2...10V / 4...20mA
P3.2	AI1 custom. min	-100.00	100.00	%	0.00	380	Custom range min setting 20% = 4-20 mA/2-10 V
P3.3	AI1 custom. max	-100.00	300.00	%	100.00	381	Custom range max setting
P3.4	AI1 signal filter time	0.0	10.0	s	0.1	378	Filter time for analogue input
P3.5	AI2 signal range	0	1		1	390	0 = 0...10V / 0...20mA 1 = 2...10V / 4...20mA
P11	AI2 custom. min	-100.00	100.00	%	0.00	391	See P3.2
P3.7	AI2 custom. max	-100.00	300.00	%	100.00	392	See P3.3
P3.8	AI2 signal filter time	0.0	10.0	s	0.1	389	See P3.4
P3.9	Exp. AI signal range	0	1		0	1841	0 = 0...10V / 0...20mA 1 = 2...10V / 4...20mA
P3.10	Exp. AI custom. min	-100.00	100.00	%	0.00	1842	Custom range min signal level
P3.11	Exp. AI custom. max	-100.00	300.00	%	100.00	1843	Custom range max signal level
P3.12	Exp. AI signal filter time	0.0	10.0	s	0.1	1844	Filter time for analogue input

Table 7. Analogue inputs group.

NOTE!	Visibility of the group depends on P1.16. Parameters P3.9 - P3.12 are shown only when expansion board OPTB4 is installed.

2.2.4 GROUP DIGITAL INPUTS: MENU PAR G4

Code	Parameter	Min	Max	Unit	Default	ID	Description
P4.1	Start signal 1	0	6*		1	403	Start signal 1 when control place is I/O 1 (FWD) See P2.1 for function. 0: not used 1: DIN1 2: DIN2 3: DIN3 4: DIN4 5: DIN5 6: DIN6
P4.2	Start signal 2	0	6*		2	404	Start signal 2 when control place is I/O 1 (REV). See P2.1 for function. See P4.1 for selections.
P4.3	Reverse	0	6*		0	412	Independent from P2.1 See P4.1 for selections
P4.4	External fault close	0	6*		0	405	Fault if signal high See P4.1 for selections
P4.5	External fault open	0	6*		0	406	Fault is signal low See P4.1 for selections
P4.6	Fault reset	0	6*		5	414	Resets all active faults
P4.7	Run enable	0	6*		0	407	Must be on to set drive in Ready state
P4.8	Preset frequency selection 0	0	6*		3	419	Binary selector for Preset speeds (0-7).
P4.9	Preset frequency selection 1	0	6*		4	420	Binary selector for Preset speeds (0-7).
P4.10	Preset frequency selection 2	0	6*		0	421	Binary selector for Preset speeds (0-7).
P4.11	Acc/dec ramp selection	0	6*		6	408	Activates ramp 2 See P4.1 for selections
P4.12	Motor potentiometer UP	0	6*		0	418	Reference increase See P4.1 for selections
P4.13	Motor potentiometer DOWN	0	6*		0	417	Reference decrease See P4.1 for selections
P4.14	Control Place 2	0	6*		0	1813	Activates control place 2 See P4.1 for selections
P4.15	Frequency reference 2	0	6*		0	1814	Activates reference 2 See P4.1 for selections
P4.16	PID fixed setpoint 2	0	6*		0	431	Activates setpoint 2 See P4.1 for selections

Table 8. Digital inputs parameters.

NOTE!	*(*)The maximum value is higher when an optional board with digital inputs is installed (see chapter 1.3). Parameter is automatically reset if value is greater than present limit.*
NOTE!	Visibility of the group depends on P1.16.

2.2.5 GROUP ANALOGUE OUTPUTS: MENU PAR G5

Code	Parameter	Min	Max	Unit	Default	ID	Description
P5.1	AO1 function	0	8		2	307	0 = Not used (fixed 100%) 1 = Freq. reference (0-fmax) 2 = Output freq. (0 -fmax) 3 = Motor speed (0 - Speed max) 4 = Output current (0-I_{nMotor}) 5 = Motor torque (0-T_{nMotor}) 6 = Motor power (0-P_{nMotor}) 7 = PID output (0-100%) 8 = Filedbus(0-10000)
P5.2	AO1 minimum	0	1		0	310	0 = 0 mA 1 = 4 mA
P5.3	AO1 Output scale	0,0	1000,0	%	100.0	311	Scaling factor
P5.4	AO1 filter time	0.00	10.00	s	0.10	308	Filtering time of analogue output signal. 0 = No filtering
P5.5	Exp. AO1 function	0	8		2	1844	See P5.1
P5.6	Exp. AO1 minimum	0	1		0	1845	0 = 0 mA 1 = 4 mA
P5.7	Exp. AO1 Output scale	0,0	1000,0	%	100.0	1846	Scaling factor
P5.8	Exp. AO1 filter time	0.00	10.00	s	0.10	1847	Filtering time of analogue output signal. 0 = No filtering
P5.9	Exp. AO2 function	0	8		2	1848	See P5.1
P5.10	Exp. AO2 minimum	0	1		0	1849	0 = 0 mA 1 = 4 mA
P5.11	Exp. AO2 Output scale	0,0	1000,0	%	100.0	1850	Scaling factor
P5.12	Exp. AO2 filter time	0.00	10.00	s	0.10	1851	Filtering time of analogue output signal. 0 = No filtering

Table 9. Analogue outputs parameters.

NOTE!	Visibility of the group depends on P1.16. Parameters P5.5 - P5.12 are shown only when expansion board OPTB4 is installed.

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2.2.6 GROUP DIGITAL OUTPUTS: MENU PAR G6

Code	Parameter	Min	Max	Unit	Default	ID	Description
P6.1	R01 function	0	13		2	313	Function selection for R01: 0 = Not used 1 = Ready 2 = Run 3 = General fault 4 = General fault inverted 5 = Warning 6 = Reversed 7 = At speed 8 = Output freq. supervision 9 = Output current superv. 10 = Analogue input superv. 11 = Fieldbus 1 12 = Fieldbus 2 13 = External brake
P6.2	R02 function	0	13		3	314	See P6.1
P6.3	DO1 function	0	13		1	312	See P6.1
P6.4	R01 ON delay	0.00	320.00	s	0.00	458	ON delay for relay
P6.5	R01 OFF delay	0.00	320.00	s	0.00	459	OFF delay for relay
P6.6	RO1 inversion	0	1		0	1804	0 = no inversion 1 = inverted
P6.7	R02 ON delay	0.00	320.00	s	0.00	460	See P6.4
P6.8	R02 OFF delay	0.00	320.00	s	0.00	461	See P6.5
P6.9	Exp. ROE1/DOE4 function	0	13		0	1826	Parameter visible when a I/O expansion board is installed. See P6.1 for selection
P6.10	Exp. ROE2/DOE5 function	0	13		0	1827	Parameter visible when a I/O expansion board is installed. See P6.1 for selection
P6.11	Exp. ROE3/DOE6 function	0	13		0	1828	Parameter visible when a I/O expansion board is installed. See P6.1 for selection

Table 10. Digital outputs parameters.

NOTE!	Visibility of the group depends on P1.16.

2.2.7 GROUP SUPERVISIONS: MENU PAR G7

Code	Parameter	Min	Max	Unit	Default	ID	Description
P7.1	Output frequency supervision	0	2		0	315	0: not used 1: Low limit 2: High limit
P7.2	Frequency supervision limit	0.00	P1.2	Hz	0.00	316	Output frequency supervision threshold
P7.3	Current supervision limit	0.00	2 x I_H	A	0.00	1811	Current supervision threshold
P7.4	Analogue input supervision	0	2		0	356	0: AI1 1: AI2 2: AIE (if option OPTB4)
P7.5	AI supervision ON level	0.00	100.00	%	80.00	357	ON threshold AI supervision
P7.6	AI supervision OFF level	0.00	100.00	%	40.00	358	OFF threshold AI supervision
P7.7	External brake open frequency	0.00	10.00	Hz	2.00	1808	Frequency threshold for brake open
P7.8	External brake open current	0.0	100.0	%	30.0	1810	Current threshold for brake open
P7.9	External brake close frequency	0.00	10.00	Hz	2.00	1809	Frequency threshold for brake close (Start = 0)
P7.10	Process display source selection	0	5		2	1036	Selection of variable proportional to process: 0 = PID feedback value 1 = Output frequency 2 = Motor speed 3 = Motor torque 4 = Motor power 5 = Motor current
P7.11	Process display decimal digits	0	3		1	1035	Decimals on display
P7.12	Process display max value	0	32000		100	1034	Process display max value(it depends on P7.11: with zero decimal digit the max value is 32000; with 1 decimal digit the max value is 3200,0)

Table 11. Supervision parameters.

NOTE!	Visibility of the group depends on P1.16.

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2.2.8 GROUP MOTOR CONTROL: MENU PAR G8

Code	Parameter	Min	Max	Unit	Default	ID	Description
P8.1	Motor control mode	0	1		0	600	0 = Frequency control 1 = Speed control
P8.2	Field Weakening Point frequency	30.00	320.00	Hz	50.00	602	Field weakening point frequency
P8.3	Field Weakening Point voltage	10.00	200.00	%	100.00	603	Voltage at FWP as % of Motor nominal voltage
P8.4	U/f ratio selection(*)	0	2		0	108	0 = linear 1 = quadratic 2 = programmable
P8.5	U/f midpoint frequency(*)	0.00	P8.2	Hz	50.00	604	Midpoint frequency for programmable U/f curve
P8.6	U/f midpoint voltage(*)	0.00	P8.3	%	100.00	605	Midpoint voltage for programmable U/f curve
P8.7	Zero frequency voltage(*)	0.00	40.00	%	0.00	606	Voltage at 0,00 Hz as % of Motor nominal voltage
P8.8	Switching frequency	1.5	16.0	kHz	6.0	601	Motor noise can be minimized using a high switching frequency. Increasing the switching frequency reduces the capacity of the drive. It is recommended to use a lower frequency when the motor cable is long in order to minimize capacitive currents in the cable.
P8.9	Brake chopper	0	2		0	504	0 = Disabled 1 = Enabled in RUN 2 = Enabled in READY
P8.10	Brake chopper level	600	900	V	765	1807	DC-link voltage to start chopper.
P8.11	DC brake current	0.3 x I_H	2 x I_H	A	I_H	507	Defines the current injected into the motor during DC-braking. 0 = Disabled
P8.12	DC braking time at stop	0.00	600.00	s	0.00	508	Determines if braking is ON or OFF and the braking time of the DC-brake when the motor is stopping.
P8.13	Frequency to start DC braking at ramp stop	0.10	10.00	Hz	1.50	515	The output frequency at which the DC-braking is applied.
P8.14	Start magnetizing time	0.00	600.00	s	0.00	516	This parameter defines the time for how long DC current is fed to motor before acceleration starts.
P8.15	RS voltage drop(*)	0.00	100.00	%	0.00	662	Voltage drop on the motor windings as % of Motor nominal voltage
P8.16	Motor Identification	0	1		0	631	0 = not active 1 = standstill identification (to activate, RUN command within 20s)

P8.17	Overvoltage controller	0	1		0	1853	0 = Enabled 1 = Disabled
P8.18	Undervoltage controller	0	1		0	1854	0 = Enabled 1 = Disabled
P8.19	Switching frequency controller	0	1		0	1855	0 = Enabled 1 = Disabled

Table 12. Motor control parameters.

NOTE!	(*) Parameter is automatically set by motor identification.
NOTE!	Visibility of the group depends on P1.16.

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2.2.9 GROUP PROTECTIONS: MENU PAR G9

NOTE!	Visibility of the group depends on P1.16.

Parameters of Motor thermal protection (P9.11 to P9.14)

The motor thermal protection is to protect the motor from overheating. The 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 chapter 1.

	If you use long motor cables (max. 100m) together with small drives (≤1.5 kW) the motor current measured by the drive can be much higher than the actual motor current due to capacitive currents in the motor cable. Consider this when setting up the motor thermal protection functions.
	The calculated model does not protect the motor if the airflow to the motor is reduced by blocked air intake grill. The model starts from zero if the control board is powered off.

Parameters of Stall protection (P9.4 to P9.6)

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, P9.5 (*Stall time*) and P9.6 (*Stall frequency limit*). If the current is as high as the P1.5 (Current Limit) and the current limiter has reduced the output frequency below the P9.6 for the time P9.5 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.

	If you use long motor cables (max. 100m) together with small drives (≤1.5 kW) the motor current measured by the drive can be much higher than the actual motor current due to capacitive currents in the motor cable. Consider this when setting up the motor thermal protection functions.

Parameters of Underload protection (P9.7 to P9.10)

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 P9.8 (Underload protection: Field weakening area load) and P9.9 (*Underload protection: Zero frequency load*), see below. The underload curve is a squared curve set between the zero fre-

quency 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_L 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.

If you use long motor cables (max. 100m) together with small drives (≤1.5 kW) the motor current measured by the drive can be much higher than the actual motor current due to capacitive currents in the motor cable. Consider this when setting up the motor thermal protection functions.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P9.1	Analogue input fault (< 4mA)	0	4		0	700	0 = No action 1 = Warning 2 = Fault 3 = Warning if Start active 4 = Fault if Start active
P9.2	Analogue input fault delay	0.0	10.0	s	0.5	1430	Time limit
P9.3	Earth fault	0	2		2	703	0 = No action 1 = Warning 2 = Fault
P9.4	Motor stall fault	0	2		1	709	See P9.3
P9.5	Stall time limit	0.0	300.0	s	5.0	711	This is the maximum time allowed for a stall stage.
P9.6	Stall frequency limit	0.10	320.00	Hz	15.00	712	For a stall state to occur, the output frequency must have remained below this limit for a certain time.
P9.7	Underload fault	0	2		0	713	See P9.3
P9.8	Underload protection: Field weakening area load	10.0	150.0	%	50.0	714	This parameter gives the value for the minimum torque allowed when the output frequency is above the field weakening point.
P9.9	Underload fault: Zero frequency load	5.0	150.0	%	10.0	715	This parameter gives value for the minimum torque allowed with zero frequency.
P9.10	Underload fault: Time limit	1.0	300.0	s	20.0	716	This is the maximum time allowed for an underload state to exist.
P9.11	Motor thermal fault	0	2		2	704	See P9.3
P9.12	Motor ambient temperature factor	-20	40	°C	40	705	Ambient temperature in °C
P9.13	Motor thermal zero speed cooling	0.0	150.0	%	40.0	706	Defines the cooling factor at zero speed in relation to the point where the motor is running at nominal speed without external cooling.

P9.14	Motor thermal time constant	1	200	min	45	707	The time constant is the time within which the calculated thermal stage has reached 63% of its final value.
P9.15	Fieldbus communication fault	0	4		2	733	See P9.1
P9.16	Thermistor fault	0	4		2	732	See P9.1
P9.17	Parameter edit lock	0	1		0	1805	0 = Edit enabled 1 = Edit disabled

Table 13. Protections settings

2.2.10 GROUP AUTOMATIC RESET: MENU PAR G10

Code	Parameter	Min	Max	Unit	Default	ID	Description
P10.1	Automatic reset	0	1		0	731	0 = Disabled 1 = Enabled
P10.2	Wait time	0.10	10.0	s	0.50	717	Wait time before the first reset is executed.
P10.3	Trial time	0.00	60.0	s	30.00	718	When the trial time has elapsed, and the fault is still active, the drive will trip to fault.
P10.4	Number of trials	1	10		3	759	NOTE: Total number of trials (irrespective of fault type)
P10.5	Restart function	0	2		0	719	The start mode for Automatic reset is selected with this parameter: 0 = Ramp 1 = Flying start 2 = According to par. P1.13

Table 14. Autoreset settings.

NOTE!	Visibility of the group depends on P1.16.

2.2.11 GROUP FIELDBUS: MENU PAR G11

Code	Parameter	Min	Max	Unit	Default	ID	Description
P11.1	Fieldbus Data OUT 1 selection	0	12		0	852	Variable mapped on PD1: 0 = Output current 1 = Motor speed 2 = Motor current 3 = Motor voltage 4 = Motor torque 5 = Motor power 6 = DC-link voltage 7 = Active fault code 8 = Analogue AI1 9 = Analogue AI2 10 = Digital inputs state 11 = PID feedback value 12 = PID setpoint
P11.2	Fieldbus Data OUT 2 selection	0	12		1	853	Variable mapped on PD2. See P11.1
P11.3	Fieldbus Data OUT 3 selection	0	12		2	854	Variable mapped on PD3. See P11.1
P11.4	Fieldbus Data OUT 4 selection	0	12		4	855	Variable mapped on PD4. See P11.1
P11.5	Fieldbus Data OUT 5 selection	0	12		5	856	Variable mapped on PD5. See P11.1
P11.6	Fieldbus Data OUT 6 selection	0	12		3	857	Variable mapped on PD6. See P11.1
P11.7	Fieldbus Data OUT 7 selection	0	12		6	858	Variable mapped on PD7. See P11.1
P11.8	Fieldbus Data OUT 8 selection	0	12		7	859	Variable mapped on PD8. See P11.1
P11.9	Aux CW Data IN sel.	0	6		0	1821	PDI for Aux CW 0: Not used 1: PDI1 2: PDI2 3: PDI3 4: PDI4 5: PDI5
P11.10	PID Setpoint Data IN sel.	0	6		1	1822	PDI for PID Setpoint See P11.9
P11.11	PID Feedback Data IN sel.	0	6		2	1823	PDI for PID Feedback See P11.9
P11.12	Analogue Out CTRL Data IN sel.	0	6		3	1824	PDI for Analogue Out CTRL See P11.9

Table 15. Fieldbus data mapping.

NOTE!	Visibility of the group depends on P1.16.

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2.2.12 GROUP PID-CONTROLLER: MENU PAR G12

Code	Parameter	Min	Max	Unit	Default	ID	Description
P12.1	Setpoint source selection	0	3		0	332	0 = Fixed setpoint 1/2 1 = AI1 2 = AI2 3 = Fieldbus
P12.2	Fixed setpoint 1	0.0	100.0	%	50.0	167	Fixed setpoint 1
P12.3	Fixed setpoint 2	0.0	100.0	%	50.0	168	Fixed setpoint 2
P12.4	Feedback source selection	0	3		0	334	0 = AI1 1 = AI2 2 = Fieldbus 3 = AI1- AI2
P12.5	Feedback minimum	0.0	50.0	%	0.0	336	Value at minimum signal
P12.6	Feedback maximum	10.0	300.0	%	100.00	337	Value at maximum signal
P12.7	PID gain	0.0	1000.0	%	100.00	118	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%.
P12.8	PID integration time	0.00	320.00	s	10.00	119	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.
P12.9	PID derivation time	0.00	10.00	s	0.00	132	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%.
P12.10	Regulation inversion	0	1		0	340	0 = Normal (Feedback < Setpoint -> Increase PID output) 1 = Inverted (Feedback < Setpoint -> Decrease PID output)
P12.11	PID max error	0.0	100.0	%	100.0	1812	Limit on error
P12.12	Sleep frequency limit	0.00	P1.2	Hz	0.00	1016	Drive goes to sleep mode when the output frequency stays below this limit for a time greater than that defined by parameter *Sleep delay*.
P12.13	Sleep delay	0	3600	s	30	1017	The minimum amount of time the frequency has to remain below the Sleep level before the drive is stopped.
P12.14	Wake-up level	0.0	100.0	%	5.0	1018	Defines the level for the PID feedback value wake-up.
P12.15	Sleep setpoint boost	0.0	50.0	%	10.0	1815	Referred to setpoint
P12.16	Sleep max loss	0.0	50.0	%	5.0	1816	Referred to feedback after boost
P12.17	Sleep boost time	0	60	s	10	1817	Boost time after P12.13
P12.18	Sleep loss check time	1	300	s	30	1818	After boost time P12.16

Table 16. PID controller parameters.

NOTE!	This group is hidden when PID output is not used as frequency reference.

2.2.13 KEYPAD REFERENCE: MENU REF

This menu is automatically entered when pressing the LOC/REM keypad and shows the frequency reference in Local control mode.

The reference is also active when selected as main reference (P1.12=4) or as secondary reference (P2.15=4).

Value is limited between min frequency P1.1 and max frequency P1.2.

In Local mode, or when keypad is the active control place (P1.11=1 or P2.14=1), direction of rotation is determined with P2.23.

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3. PARAMETER DESCRIPTION

Due to its user-friendliness and simplicity of use, the most parameters only require a basic description which is given in the parameter tables in chapter 2.2.

In this chapter, you will find additional information on certain most advanced parameters. Should you not find the information you need contact your distributor.

3.1 BASIC PARAMETERS

P1.5 MOTOR CURRENT LIMIT

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

When the current limit is active the drive output frequency is decreased.

NOTE: This is not an overcurrent trip limit.

P1.11 CONTROL PLACE SELECTION

Run and direction control. A second control place is programmable in P2.10.

0: I/O terminals

1: Keypad

2: Fieldbus

P1.12 FREQUENCY REFERENCE SELECTION

Defines the source of frequency reference. A second reference source is programmable in P2.10.

0: Analogue input AI1

1: Analogue input AI2

2: PID control

3: Motorpotentiometer

4: Keypad

5: Fieldbus

6: Expansion AI (only with board OPTB4)

P1.13 START FUNCTION

0: Ramping

1: Flying start

P1.14 STOP FUNCTION

Selection number	Selection name	Description
0	Coasting	The motor is allowed to stop on its own inertia. The control by the drive is discontinued and the drive current drops to zero as soon as the stop command is given.
1	Ramp	After the Stop command, the speed of the motor is decelerated according to the set deceleration parameters to zero speed.

NOTE: fall of Enable signal, when configured, always determines stop by coasting.

P1.15 U/F CURVE OPTIMIZATION

0: Not used

1: Automatic voltage boost (improves motor torque).

P1.16 SHOW ADVANCED PARAMETERS

0: Only Basic group (and PI Control if function is used)

1: All parameters groups are visible.

3.2 ADVANCED SETTINGS

P2.1 START/DIRECTION LOGIC

These logics are based on Start sgn1 and Start sgn 2 signals (defined with P4.1 and P4.2). Usually they are coupled to inputs DIN1 and DIN2.

Values 0...3 offer possibilities to control the starting and stopping of the AC drive with digital signal connected to digital inputs.

The selections including the text 'edge' 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 to I/O control. **The Start/Stop contact must be opened before the motor can be started.**

The used stop mode is *Coasting* in all examples.

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Selection number	Selection name	Note
0	Start sgn 1: Start Forward Start sgn 2: Start Backward	The functions take place when the contacts are closed.

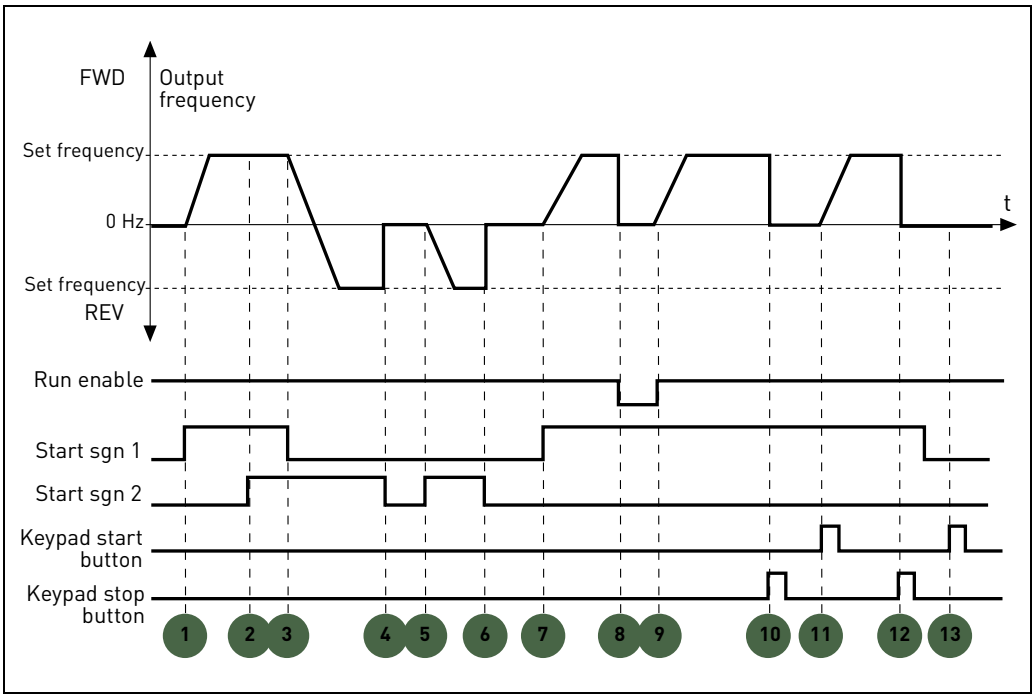

Figure 1. Start/Stop logic = 0.

Explanations:

1	Start sgn 1 activates causing the output frequency to rise. The motor runs forward.	**8**	Run enable signal is set to FALSE, which drops the frequency to 0. The run enable signal is configured with parameter P4.7.
2	Start sgn 2 activates which, however, has no effect on the output frequency because the first selected direction has the highest priority.	**9**	Run enable signal is set to TRUE, which causes the frequency to rise towards the set frequency because Start sgn 1 is still active.
3	Start sgn 1 is inactivated which causes the direction to start changing (FWD to REV) because Start sgn 2 is still active.	**10**	Keypad stop button is pressed and the frequency fed to the motor drops to 0. (This signal only works if P2.22 Keypad stop button = 1)
4	Start sgn 2 inactivates and the frequency fed to the motor drops to 0.	**11**	The drive starts through pushing the Start button on the keypad.
5	Start sgn 2 activates again causing the motor to accelerate (REV) towards the set frequency.	**12**	The keypad stop button is pushed again to stop the drive.
6	Start sgn 2 inactivates and the frequency fed to the motor drops to 0.	**13**	The attempt to start the drive through pushing the Start button is not successful because Start sgn 1 is inactive.
7	Start sgn 1 activates and the motor accelerates (FWD) towards the set frequency		

Selection number	Selection name	Note
1	Start sgn 1: Start Forward Start sgn 2: Reverse	The functions take place when the contacts are closed.

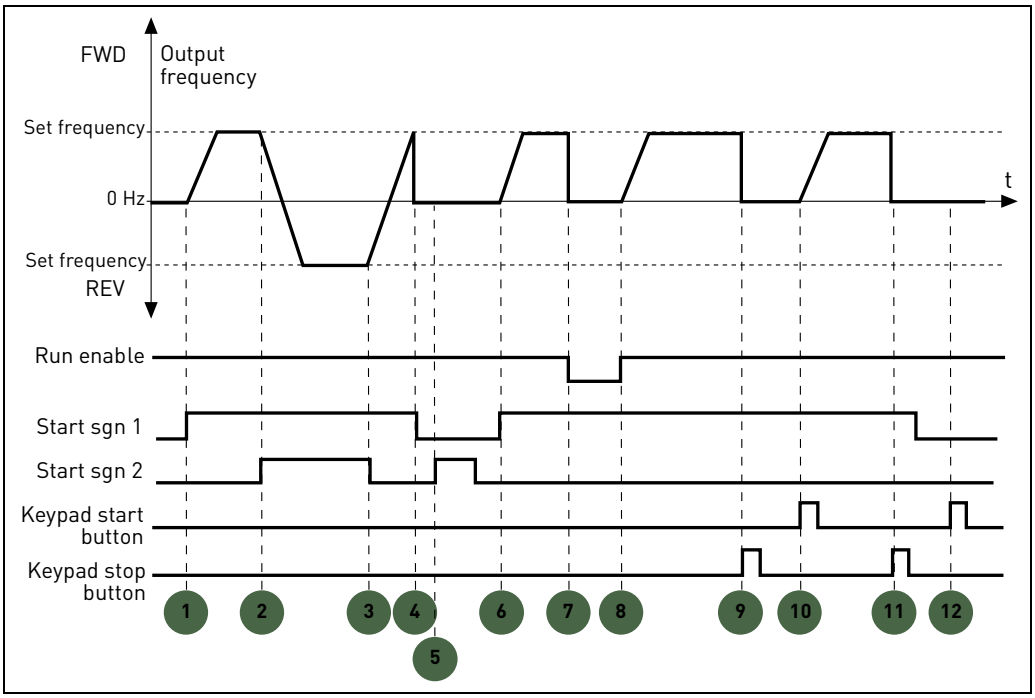

Figure 2. Start/Stop logic = 1.

Explanations:

1	Start sgn 1 activates causing the output frequency to rise. The motor runs forward.	**7**	Run enable signal is set to FALSE, which drops the frequency to 0. The run enable signal is configured with parameter P4.7.
2	Start sgn 2 activates which causes the direction to start changing (FWD to REV).	**8**	Run enable signal is set to TRUE, which causes the frequency to rise towards the set frequency because Start sgn 1 is still active.
3	Start sgn 2 is inactivated which causes the direction to start changing (REV to FWD) because Start sgn 1 is still active.	**9**	Keypad stop button is pressed and the frequency fed to the motor drops to 0. (This signal only works if P2.22 Keypad stop button = Yes)
4	Also Start sgn 1 inactivates and the frequency drops to 0.	**10**	The drive starts through pushing the Start button on the keypad.
5	Despite the activation of Start sgn 2, the motor does not start because Start sgn 1 is inactive.	**11**	The drive is stopped again with the stop button on the keypad.
6	Start sgn 1 activates causing the output frequency to rise again. The motor runs forward because Start sgn 2 is inactive.	**12**	The attempt to start the drive through pushing the Start button is not successful because Start sgn 1 is inactive.

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Selection number	Selection name	Note
2	Start sgn 1: Start pulse Start sgn 2: Stop pulse	The functions take place on the rising edge of the Star pulse and on the falling edge of the Stop pulse.

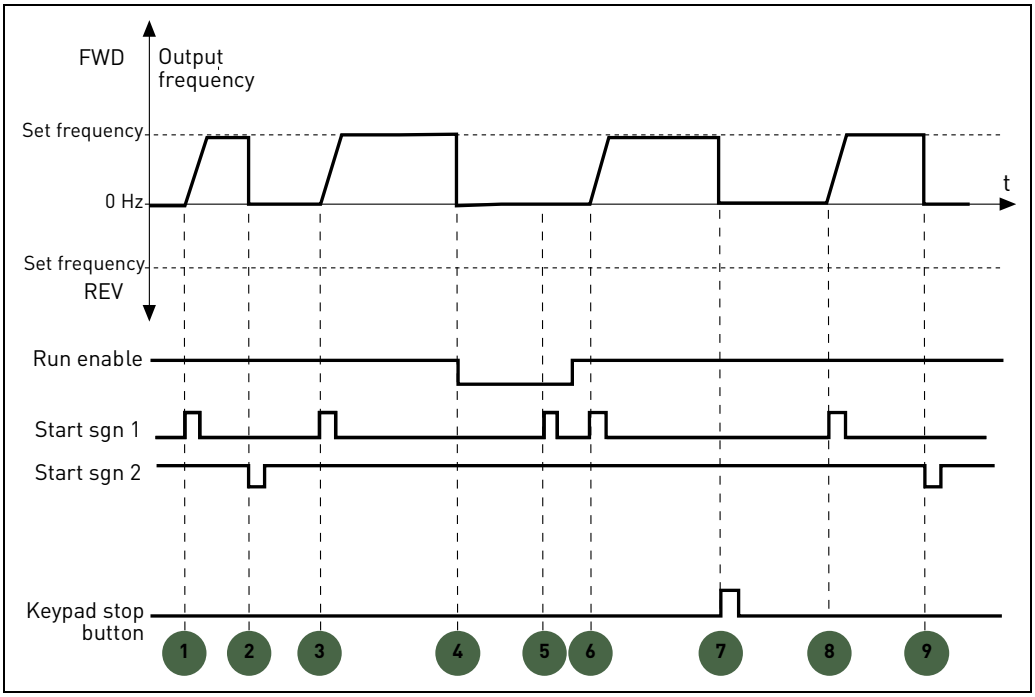

Figure 3. Start/Stop logic = 2.

Explanations:

1	Start sgn 1 activates causing the output frequency to rise. The motor runs forward.	**6**	Start sgn 1 activates and the motor accelerates (FWD) towards the set frequency because the Run enable signal has been set to TRUE.
2	Start sgn 2 inactivates causing the frequency to drop to 0.	**7**	Keypad stop button is pressed and the frequency fed to the motor drops to 0. (This signal only works if P2.22 Keypad stop button = Yes)
3	Start sgn 1 activates causing the output frequency to rise again. The motor runs forward.	**8**	Start sgn 1 activates causing the output frequency to rise again. The motor runs forward.
4	Run enable signal is set to FALSE, which drops the frequency to 0. The run enable signal is configured with parameter P4.7.	**9**	Start sgn 2 inactivates causing the frequency to drop to 0.
5	Start attempt with Start sgn 1 is not successful because Run enable signal is still FALSE.		

Selection number	Selection name	Note
3	Start sgn 1: Start Forward (edge) Start sgn 2: Start Backward (edge)	Shall be used to exclude the possibility of an unintentional start. The Start/Stop contact must be opened before the motor can be restarted.

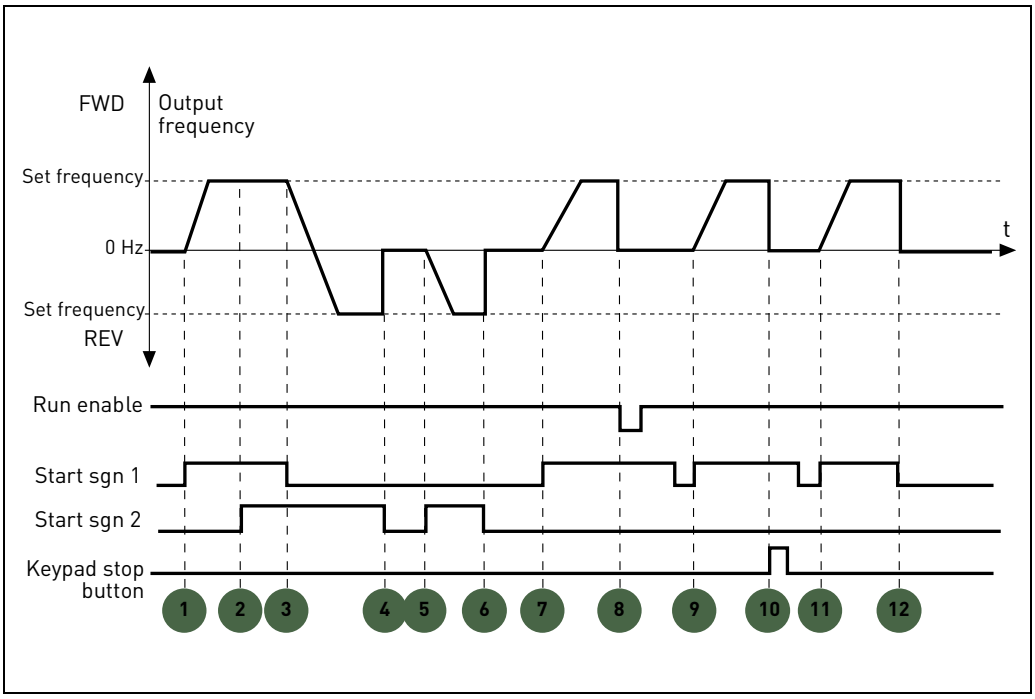

Figure 4. Start/Stop logic = 3.

Explanations:

1	Start sgn 1 activates causing the output frequency to rise. The motor runs forward.	**7**	Start sgn 1 activates and the motor accelerates (FWD) towards the set frequency
2	Start sgn 2 activates which, however, has no effect on the output frequency because the first selected direction has the highest priority.	**8**	Run enable signal is set to FALSE, which drops the frequency to 0. The run enable signal is configured with parameter P4.7.
3	Start sgn 1 is inactivated which causes the direction to start changing (FWD to REV) because Start sgn 2 is still active.	**9**	Run enable signal is set to TRUE, which, unlike if value 0 is selected for this parameter, has no effect because rising edge is required to start even if Start sgn 1 is active.
4	Start sgn 2 inactivates and the frequency fed to the motor drops to 0.	**10**	Keypad stop button is pressed and the frequency fed to the motor drops to 0. (This signal only works if P2.22 Keypad stop button = Yes)
5	Start sgn 2 activates again causing the motor to accelerate (REV) towards the set frequency.	**11**	Start sgn 1 is opened and closed again which causes the motor to start.
6	Start sgn 2 inactivates and the frequency fed to the motor drops to 0.	**12**	Start sgn 1 inactivates and the frequency fed to the motor drops to 0.

P2.2 TO

P2.8 PRESET FREQUENCY 1 TO 7

You can use the preset frequency parameters to define certain frequency references in advance. These references are then applied by activating/inactivating digital inputs connected to parameters P4.8, P4.9 and P4.10 (binary code). The values of the preset frequencies are automatically limited between the minimum and maximum frequencies.

Required action			Activated frequency
B2	B1	B0	Preset frequency 1
B2	B1	B0	Preset frequency 2
B2	B1	B0	Preset frequency 3
B2	B1	B0	Preset frequency 4
B2	B1	B0	Preset frequency 5
B2	B1	B0	Preset frequency 6
B2	B1	B0	Preset frequency 7

Table 17. Selection of preset frequencies; ■ = input activated

P2.9 ACCELERATION TIME 2

P2.10 DECELERATION TIME 2

Ramp 2 is activated through digital input defined in P4.11 or through fieldbus. Automatic selection based on output frequency is also available.

P2.11 THRESHOLD ACCELERATION TIME 2

P2.12 THRESHOLD DECELERATION TIME 2

If P2.11 is not 0, acceleration time 2 is activated when output frequency is higher than the value.

If P2.12 is not 0, deceleration time 2 is activated when output frequency is higher than the value.

P2.13 S RAMP SHAPE

When value is greater than zero, acceleration and deceleration ramps have a S shape. The parameter is the time needed to reach full acc/dec.

The start and end of acceleration and deceleration ramps can be smoothed with this parameter. 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 P1.3 and P1.4.

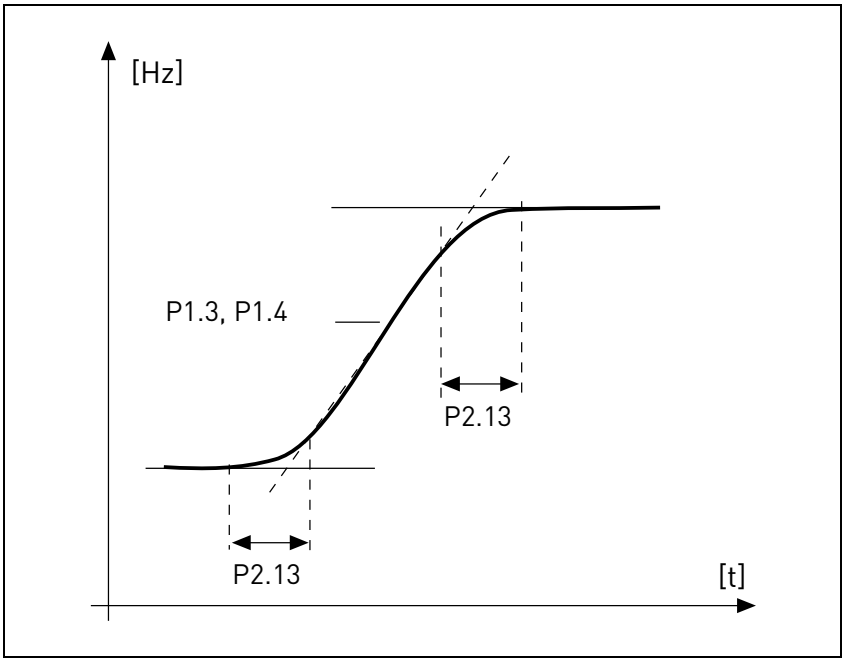

Figure 5. Acceleration/deceleration (S-shaped).

These parameters are used to reduce mechanical erosion and current spikes when the reference is changed.

P2.14 CONTROL PLACE SELECTION 2

Alternative Run and direction control. Activated by digital input defined in P4.14.

0: I/O terminals

1: Keypad

2: Fieldbus

P2.15 FREQUENCY REFERENCE SELECTION 2

Alternative source of frequency reference. Activated by digital input defined in P4.15 or field-bus.

0: Analogue input AI1

1: Analogue input AI2

2: PID control

3: Motorpotentiometer

4: Keypad

5: Fieldbus

6: Expansion AI (only with board OPTB4)

P2.24 OPTB1 DIGITAL INPUTS

This parameter is shown only when OPTB1 board is installed.

The number of terminals used as input should be programmed, so that the maximum value for parameters of group Digital Inputs is set accordingly.

Parameters for optional digital output functions are shown, if the number of inputs is lower then 6.

3.3 ANALOGUE INPUTS

P3.1 AI1 RANGE

P3.5 AI2 RANGE

Range of the electrical signal.

0: 0-100%: 0...10V or 0... 20mA

1: 20-100%: 2...10V or 4... 20mA

P3.4 AI1 FILTER TIME

P3.8 AI2 FILTER TIME

Low pass filter time constant, to reduce noise. When this parameter is given a value greater than 0 the function that filters out disturbances from the incoming analogue signal is activated.

NOTE: Long filtering time makes the regulation response slower!

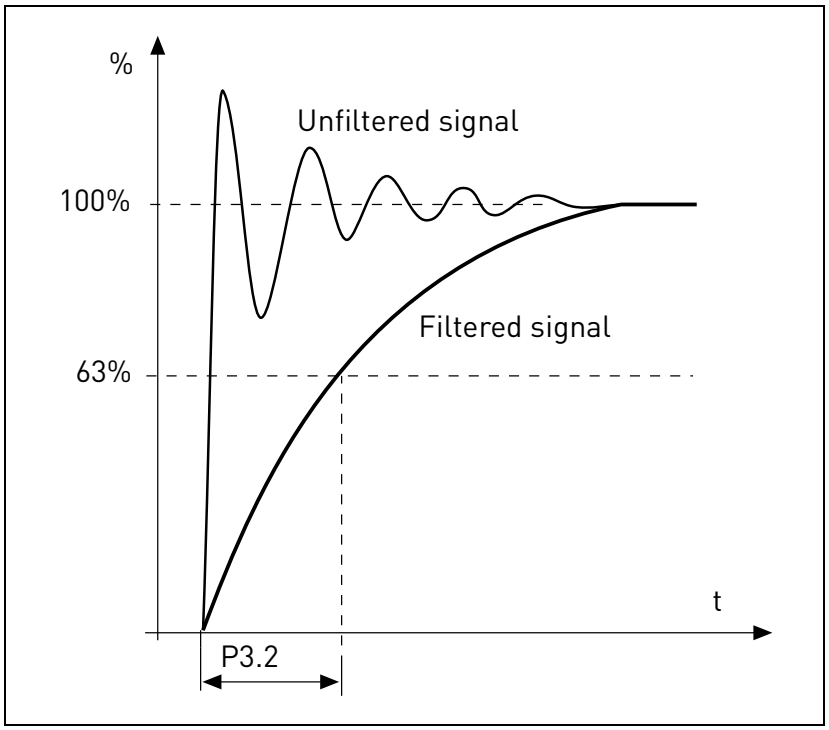

Figure 6.AI1 signal filtering.

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3.4 DIGITAL INPUTS

P4.7 RUN ENABLE

Motor stops by coasting if the signal is missing.

Note: The drive is not in Ready state when Enable is low.

3.5 ANALOGUE OUTPUT

P5.1 ANALOGUE OUTPUT FUNCTION

Signal coupled to analogue output.

Table 18. Analogue output signals.

Selection	Selection name	Value corresponding to maximum output
0	Not used	output always fixed at 100%
1	Frequency reference	Max frequency(P1.2)
2	Output frequency	Max frequency(P1.2)
3	Motor speed	Motor nominal speed
4	Motor current	Motor nominal current
5	Motor torque	Motor nominal torque (absolute value)
6	Motor power	Motor nominal power (absolute value)
7	PID output	100%
8	Fieldbus control	10000

3.6 DIGITAL OUTPUTS

P6.1 TO

P6.3 RO1, RO2 AND DO1 SIGNAL SELECTION

Function for relays and digital output.

Table 19. Functions for digital relays.

Selection	Selection name	Description
0	Not used	
1	Ready	The frequency converter is ready to operate
2	Run	The frequency converter operates (motor is running)
3	General fault	A fault trip has occurred
4	General fault inverted	A fault trip has **not** occurred
5	General alarm	
6	Reversed	The reverse command has been selected
7	At speed	The output frequency has reached the set reference
8	Frequency supervision	Output frequency is over/under the limit set with parameters P6.9 and P6.10
9	Current supervision	Motor current is over the limit set with parameter P6.11
10	Analogue inputs supervision	Analogue inputs selected with parameter P6.12 is over/under the limits set in P6.13 and P6.14
11	Fieldbus bit 1	Bit from fieldbus Aux Control word
12	Fieldbus bit 2	Bit from fieldbus Aux Control word
13	External brake	The drive is running and the thresholds for brake open have been reached

P6.4 RO1 ON DELAY

P6.5 RO1 OFF DELAY

Possible delays for ON/OFF transitions.

P6.6 RO1 INVERSION

Inversion of relay state.

P6.7 RO2 ON DELAY

P6.8 RO2 OFF DELAY

Possible delays for ON/OFF transitions.

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P6.9 TO

P6.11 EXPANSION RO1/DO4, RO2/DO5, RO3/DO6 SIGNAL SELECTION

These parameters are visible only when an expansion board with outputs is installed (to see table below). Relays are available on boards OPT-B2, B5 and B9.

Digital outputs are available on board OPTB1, if less than 6 terminals are used as inputs.

Table 20. Digital outputs available with OPTB boards

		OPTB1	OPTB2	OPTB5	OPTB9
P6.9	ROE1/DOE4	visible if P2.24 < 4	visible	visible	visible
P6.10	ROE2/DOE5	visible if P2.24 < 5	visible	visible	-
P6.11	ROE3/DOE6	visible if P2.24 < 6	-	visible	-

3.7 SUPERVISIONS

P7.7 EXTERNAL BRAKE OPEN FREQUENCY

P7.8 EXTERNAL BRAKE OPEN CURRENT

Thresholds that must be reached for external brake open at start.

Note: if a digital output has been programmed for brake control, the frequency reference is internally limited to P7.7 + 0.1Hz until the brake is opened.

P7.9 EXTERNAL BRAKE CLOSE FREQUENCY

The brake is closed when the start command is low and output frequency is below this threshold. The brake is also closed whenever the drive is no more in Run state.

P7.10 PROCESS DISPLAY SOURCE

Monitor V1.24 can show a process value, proportional to a variable measured by the drive. Source variables are:

0: PID actual value (max: 100%)

1: output frequency (max: Fmax)

2: motor speed (max: Speed at Fmax)

3: motor torque (max: Tnom)

4: motor power (max: Pnom)

5: motor current (max: Inom)

P7.11 PROCESS DISPLAY DECIMAL DIGITS

Number of decimals shown on monitor V1.24 and also on parameter P7.12.

P7.12 PROCESS DISPLAY MAX VALUE

Value shown on V1.24 when source variable is at its maximum. Proportionality is kept if the source overtakes the maximum.

3.8 MOTOR CONTROL

P8.1 MOTOR CONTROL MODE

0: Frequency control

1: Speed control (sensorless control)

In speed control, the motor slip is compensated.

P8.2 FIELD WEAKENING POINT

Output frequency corresponding to max voltage.

Note: if P1.7 Nominal Frequency is changed, P8.2 will be set at same value.

P8.3 FIELD WEAKENING POINT VOLTAGE

Motor voltage when frequency is above FWP, defined as % of nominal voltage.

Note: if P1.6 Nominal Voltage is changed, P8.3 will be set at 100%.

P8.4 U/F SELECTION

0: linear

The voltage of the motor changes linearly as a function of output frequency from zero frequency voltage P8.7 to the field weakening point (FWP) voltage P8.3 at FWP frequency P8.2 This default setting should be used if there is no special need for another setting.

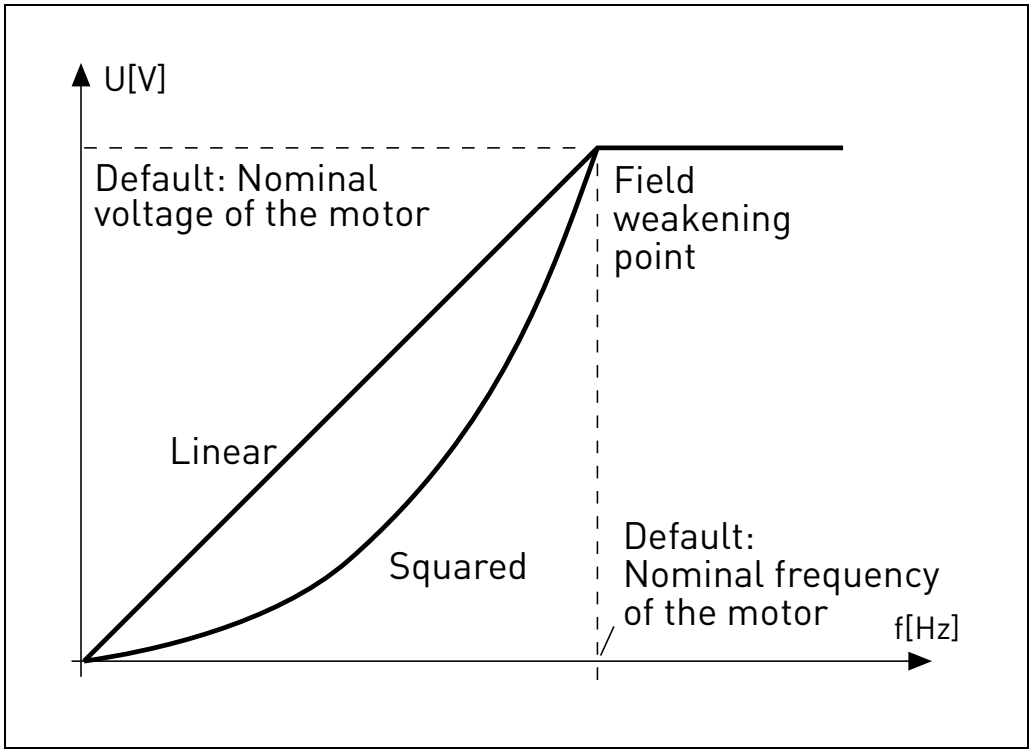

Figure 7. Linear and quadratic curve of the motor voltage.

1: quadratic

(from voltage P8.7 at 0Hz, to voltage P8.3 at P8.2 frequency)

The voltage of the motor changes from zero point voltage P8.7 following a squared curve form from zero to the field weakening point P8.3. The motor runs under-magnetized below the field weakening point and produces less torque. Squared U/f ratio can be used in applications where torque demand is proportional to the square of the speed, e.g. in centrifugal fans and pumps.

2: programmable

The U/f curve can be programmed with three different points: Zero frequency voltage (P1), Midpoint voltage/frequency (P2) and Field weakening point (P3).

Programmable U/f curve can be used if more torque is needed at low frequencies. The optimal settings can automatically be achieved with Motor identification run.

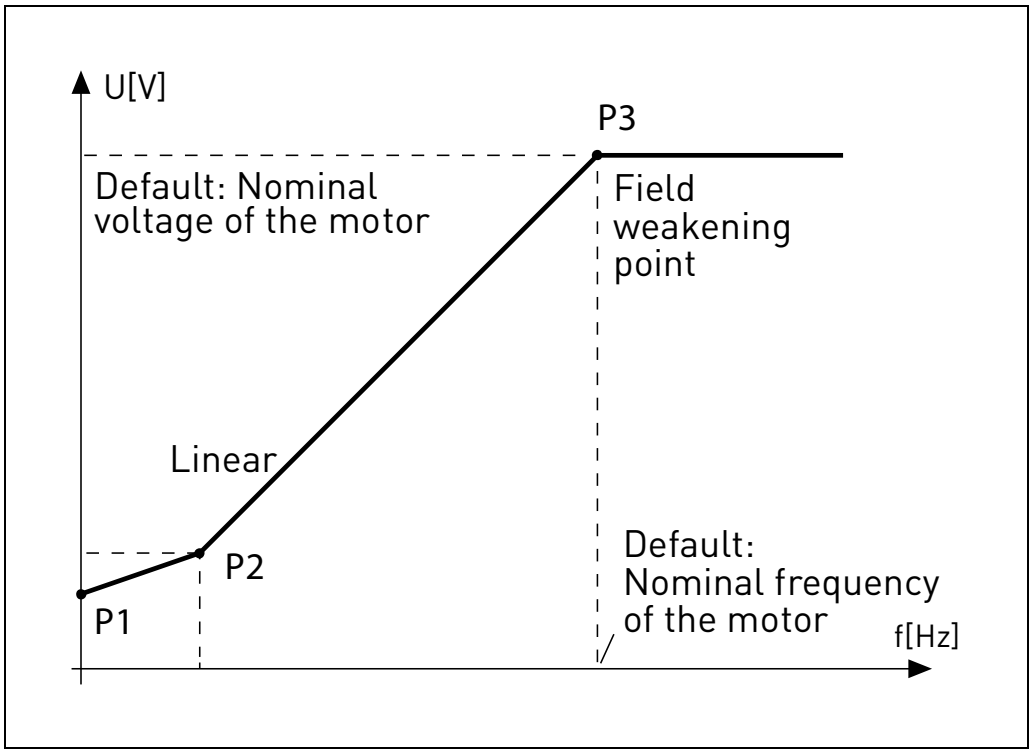

Figure 8. Programmable curve.

P8.5 U/F MID POINT FREQUENCY

Enabled if P8.4= 2.

Note: motor identification automatically sets this parameter.

P8.6 U/F MID POINT VOLTAGE

Enabled if P8.4= 2.

Note: motor identification automatically sets this parameter.

P8.7 VOLTAGE AT F0

Motor voltage at frequency zero.

Note: motor identification automatically sets this parameter.

P8.8 SWITCHING FREQUENCY

PWM frequency. Values above default can cause thermic overload of the drive.

P8.9 BRAKE CHOPPER

0: Chopper disabled

1: Chopper enabled in Run state

2: Chopper enabled in Ready state

P8.10 BRAKE CHOPPER LEVEL

DC link voltage above which chopper is activated.

P8.11 DC BRAKING CURRENT

DC current injected at start or stop.

P8.12 STOP DC CURRENT TIME

Time for DC current injection at stop.

P8.13 STOP DC CURRENT FREQUENCY

DC current injection starts below this frequency.

P8.14 START DC BRAKE TIME

Time for DC current injection at start.

P8.15 RS VOLTAGE DROP

Voltage drop on stator windings, at motor nominal current, defined as % of nominal voltage. Value affects motor torque estimation, slip compensation and voltage boost.

Note: it is suggested not to program manually the value, but to perform motor identification procedure that automatically sets the value.

P8.16 MOTOR IDENTIFICATION

This procedure measures motor stator resistance and automatically sets U/f characteristic, to obtain good torque also at low speed.

0: not active

1: standstill identification

Run command must be given and hold high within 20s after programming the value 1. The motor does not rotate and the drive will automatically exit run state at the end of the measurements.

Note: the drive exits run state only, if the measured current exceeds 55% of the motor nominal current.

Procedure sets the following parameters: P8.4, P8.5, P8.6, P8.7, P8.15.

Note: optimized U/f settings will cause motor current values comparable to nominal one, also at very low speed. External cooling of the motor is needed if the motor works in this condition for significant time.

P8.17 OVERVOLTAGE CONTROLLER

Overvoltage regulator automatically increases deceleration ramp time if the internal DC link voltage is too high.

0: enabled

1: disabled

P8.18 UNDERVOLTAGE CONTROLLER

Undervoltage regulator automatically decelerates the motor if the internal DC link voltage is too low.

0: enabled

1: disabled

P8.19 SWITCHING FREQUENCY CONTROLLER

Switching frequency regulator automatically decreases the PWM frequency if the unit temperature is too high.

0: enabled

1: disabled

3.9 PROTECTIONS

P9.1 ANALOGUE INPUT FAULT (AI< 4MA)

0: No action

1: Warning

2: Fault

3: Warning if Start active

4: Fault if Start active

Analogue reference below 4mA.

P9.2 ANALOGUE INPUT FAULT DELAY

Delay as filter on fault generation

P9.3 EARTH FAULT

0: No action

1: Warning

2: Fault

Output currents sum not zero.

P9.4 MOTOR STALL FAULT

0: No action

1: Warning

2: Fault

This is an overload protection. Stall is recognized by maximum motor current (=P1.5) and low output frequency.

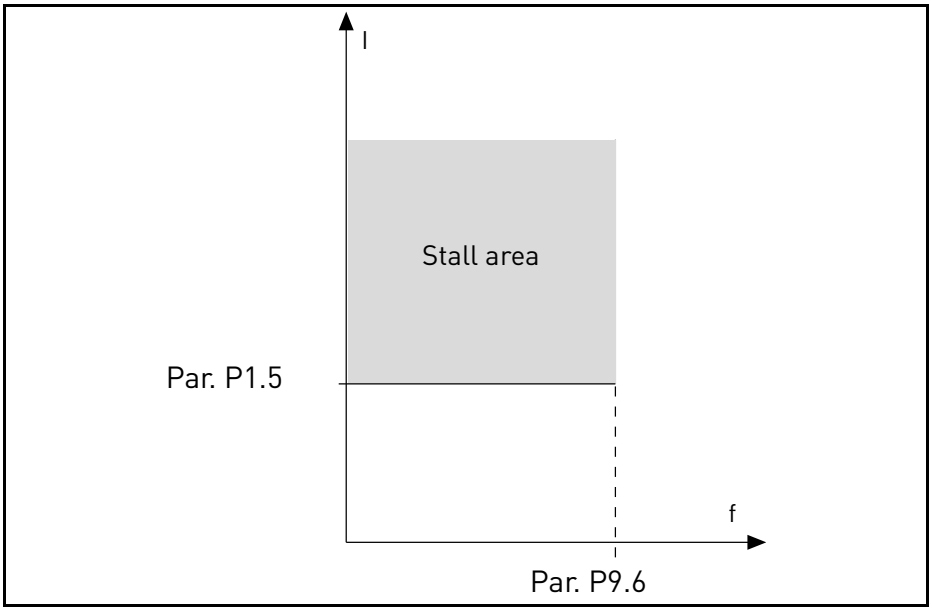

Figure 9. Stall characteristic settings.

P9.5 STALL TIME LIMIT

This time can be set between 0.0 and 300.0 s.

This is the maximum time allowed for all 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.

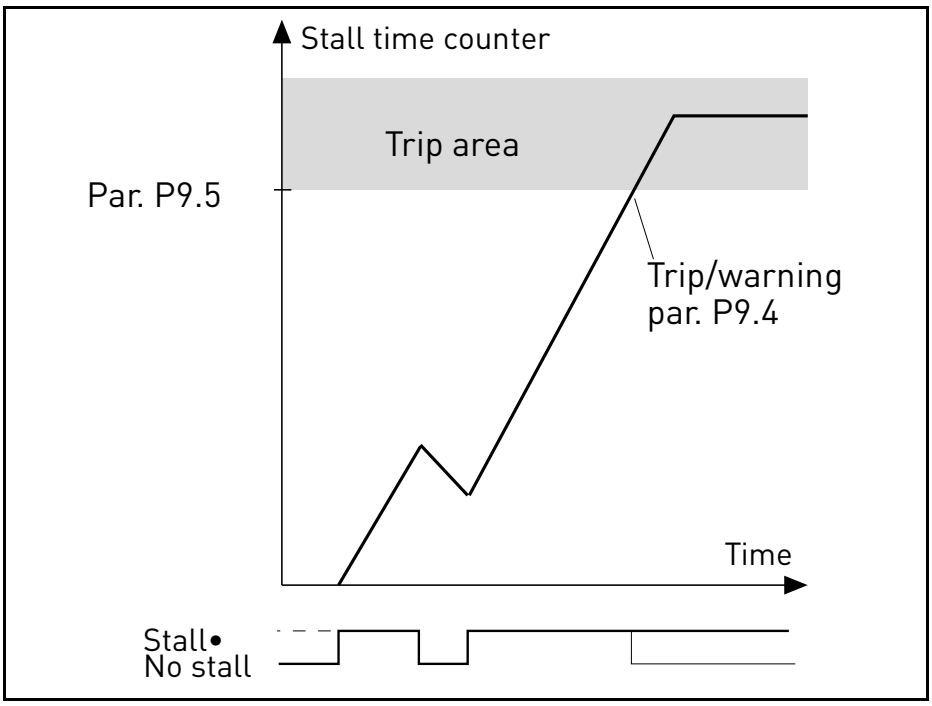

Figure 10. Stall time count.

P9.6 STALL FREQUENCY LIMIT

Stall is recognized when the current limiter has reduced the output frequency below P9.6, for the time in P9.5.

P9.7 UNDERLOAD FAULT

0: No action

1: Warning

2: Fault

Underload is recognized when torque is above the minimum curve defined by P9.8 and P9.9, for the programmed time P9.10.

P9.8 UNDERLOAD FAULT: FIELD WEAKENING AREA LOAD

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

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

If you change parameter P1.9 (*Motor nominal current*) this parameter is automatically restored to the default value.

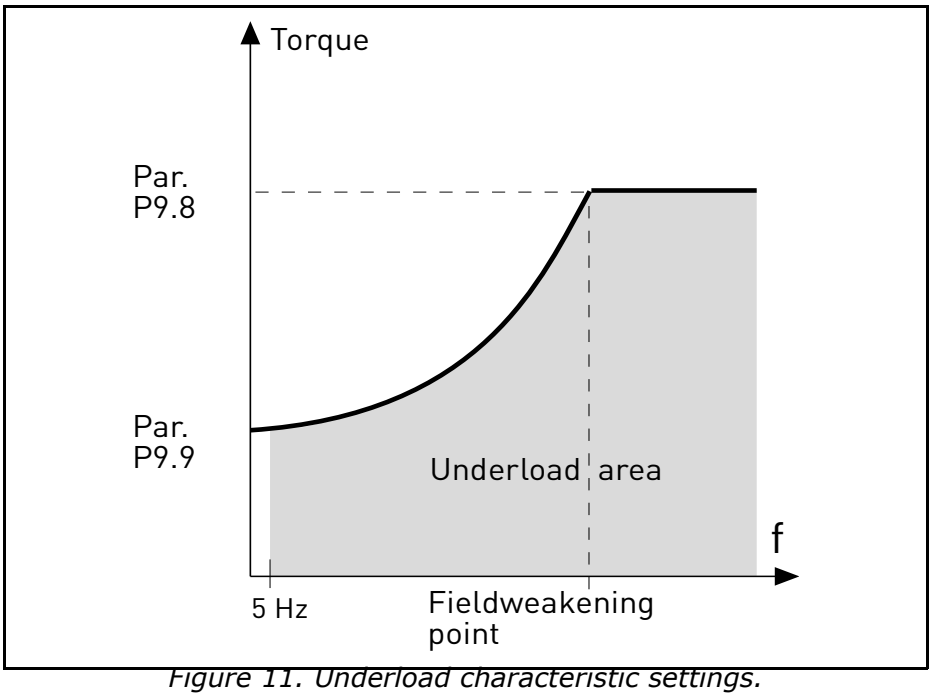

Figure 11. Underload characteristic settings.

P9.9 UNDERLOAD FAULT: ZERO FREQUENCY LOAD

P9.10 UNDERLOAD FAULT: TIME LIMIT

Definition of minimum load at nominal and zero speed zero. Fault condition delay. This time can be set between 1.0 and 300.0 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 P9.7). If the drive is stopped the underload counter is reset to zero.

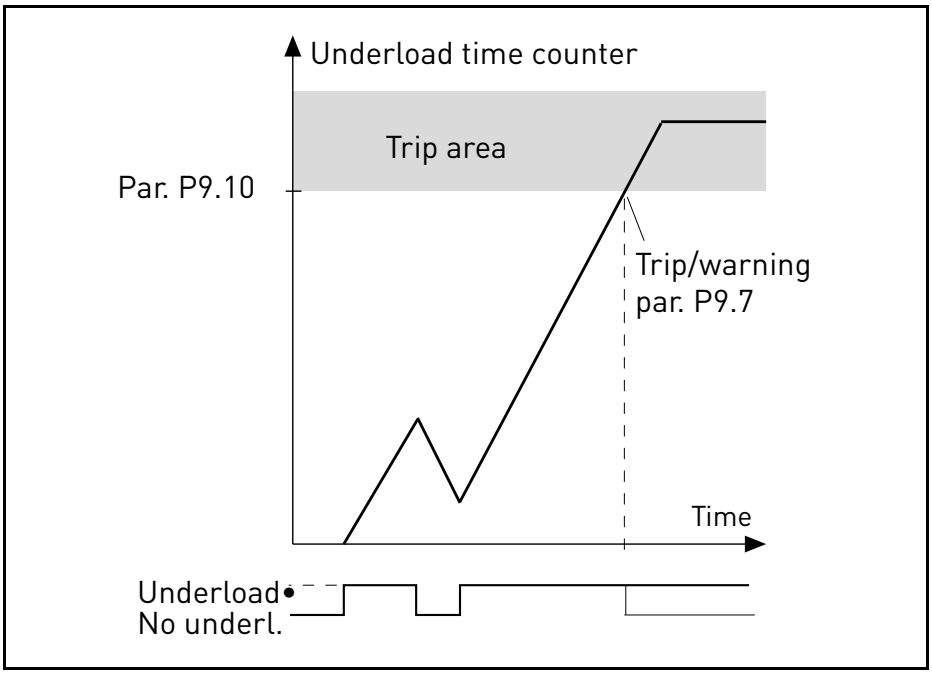

Figure 12. Underload time counter.

P9.11 MOTOR THERMAL FAULT

0: No action

1: Warning

2: Fault

This is a software protection, based on time integral of current.

P9.12 MOTOR AMBIENT TEMPERATURE FACTOR

Change if environment is not standard.

P9.13 MOTOR THERMAL ZERO SPEED COOLING

Defines the cooling factor at zero speed in relation to the point where the motor is running at nominal speed without external cooling. See Figure 13.

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).

Setting this parameter does not affect the maximum output current of the drive which is determined by parameter P1.5 alone.

The corner frequency for the thermal protection is 70% of the motor nominal frequency (P1.7).

Set 100% if the motor has independent fan or cooling. Set 30-40% if the fan is on motor shaft.

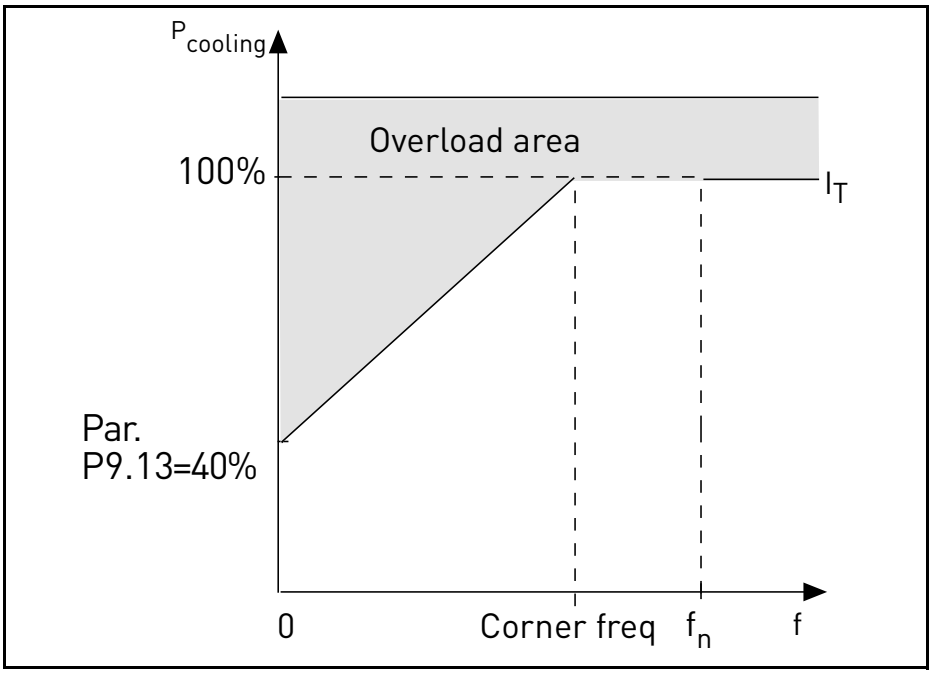

Figure 13. Motor thermal current I_T curve.

P9.14 MOTOR THERMAL TIME CONSTANT

Time at nominal current, to reach nominal temperature.

The time constant is the time within which the calculated thermal stage has reached 63% of its final value. The bigger the frame and/or slower the speed of the motor, the longer the time constant.

The motor thermal time is specific to the motor design and it varies between different motor manufacturers. The default value of the parameter varies from size to size.

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 2*t6. If the drive is in stop stage the time constant is internally increased to three times the set parameter value. The cooling in stop stage is based on convection and the time constant is increased.

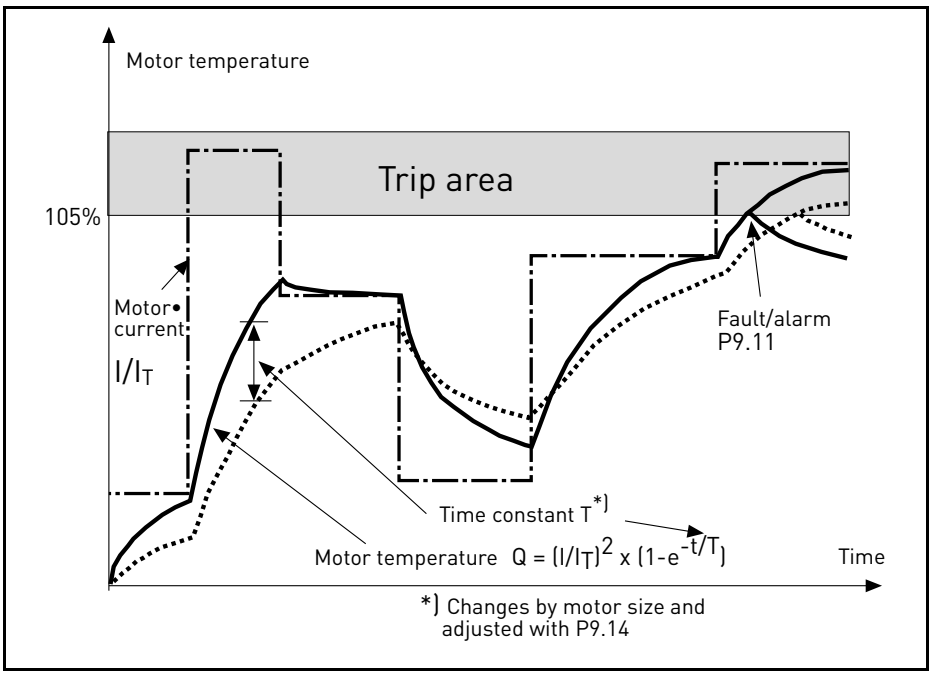

Figure 14. Motor temperature calculation.

P9.15 FIELDBUS COMMUNICATION FAULT

0: No action

1: Warning

2: Fault

Communication lost.

P9.16 THERMISTOR FAULT

0: No action

1: Warning

2: Fault

Impedance on thermistor input (optional board OPTB2) is above fault threshold.

P9.17 PARAMETER EDIT LOCK

0: Edit enabled

1: Edit disabled

3.10 AUTOMATIC RESET

P10.1 AUTOMATIC RESET

0: Disabled

1: Enabled

The automatic reset function deletes fault state when the fault cause has been eliminated and the wait time P10.2 has elapsed. Parameter P10.4 determines the maximum number of automatic resets that can be effected during the trial time set by parameter P10.3. The time count starts from the first automatic reset. If the number of faults detected during the trial time exceeds the values of trials, the fault status becomes permanent and a reset command is needed.

P10.2 WAIT TIME

Time after which the converter attempts to restart the motor automatically after the fault has been eliminated.

P10.3 TRIAL TIME

Total time for reset attempts.

P10.4 NUMBER OF TRIALS

Trials attempted during time P9.18.

P10.5 RESTART FUNCTION

Start function after an automatic fault reset.

0: Start with ramp

1: Flying start

2: As defined in P1.13

3.11 FIELDBUS

P11.1 TO

P11.8 FIELDBUS DATA OUT 1 - 8 SEL

Parameter couples read only variables to output process data 1.

0: output frequency

1: motor speed

2: motor current

3: motor voltage

4: motor torque

5: motor power

6: DC link voltage

7: active fault code

8: analogue AI1

9: analogue AI2

10: digital inputs state

11: PID actual value

12: PID setpoint

P11.9 AUX CW DATA IN SEL

Parameter defines the input process data coupled to Aux Control Word.

0: not used

1: PDI1

2: PDI2

3: PDI3

4: PDI4

5: PDI5

P11.10 PID SETPOINT DATA IN SEL

Parameter defines the input process data coupled to PID setpoint. Selections as P11.9.

P11.11 PID FEEDBACK DATA IN SEL

Parameter defines the input process data coupled to PID actual value. Selections as P11.9.

P11.11 ANALOGUE OUT CTRL DATA IN SEL

Parameter defines the input process data coupled to analogue output control. Selections as P11.9.

3.12 PID-CONTROLLER

Parameters of this group are hidden unless the regulator is used as frequency reference (P1.12= or P2.15=2)

P12.1 SETPOINT SOURCE SELECTION

0: fixed setpoint 1-2

1: analogue AI1

2: analogue AI2

3: fieldbus

P12.2 FIXED SETPOINT 1

P12.3 FIXED SETPOINT 2

Programmable setpoints. Setpoint 2 is activated with digital input defined in P4.16.

P12.4 FEEDBACK SOURCE SELECTION

0: analogue AI2

1: analogue AI1

2: fieldbus

3: AI2-AI1 (differential)

P12.5 FEEDBACK VALUE MIN

P12.6 FEEDBACK VALUE MAX

Minimum and maximum feedback values, corresponding to minimum and maximum of the signal.

P12.7 PID GAIN

Proportional gain. If set to 100%, a variation of 10% on error causes a variation of 10% on regulator output.

P12.8 PID INTEGRATION TIME

Integral time constant. If set to 1s, a variation of 10% on error will cause a variation of 10% on regulator output after 1s.

P12.9 PID DERIVATION TIME

Derivative time. If set to 1s, a variation of 10% in 1s on error causes a variation of 10% on regulator output.

P12.10 REGULATION INVERSION

0: direct control. Frequency increased is setpoint > feedback

1: inverted control. Frequency increased is setpoint < feedback

P12.11 PID max Error

If lower than 100%, determines a limit on max error. Useful to avoid excessive reaction at motor startup.

P12.12 Sleep frequency limit

This function will put the drive into sleep mode if the setpoint is reached and the output frequency stays below the sleep limit for a longer time than that set with the Sleep Delay (P12.13). This means that the start command remains on, but the run request is turned off. When the PID error value goes below, or above, the wake-up level depending on the set acting mode (P12.10) the drive will activate the run request again if the start command is still on.

P12.13 Sleep delay

Time of working at minimum frequency, before entering sleep condition.

P12.14 Wake up level

The drive exits from sleep if the error exceeds this value. Direction of regulation (P12.10) is internally considered.

P12.15 Sleep setpoint boost

P12.16 Sleep boost time

P12.17 Sleep max loss

P12.18 Sleep loss check time

These parameters manage a more complex sleep sequence. After the time in P12.13, the setpoint is increased of the term in P12.15, for the time in P12.16. This will cause an higher output frequency. Frequency reference is then forced at minimum frequency and the feedback value is sampled.

If the variation on actual value stays then lower than P12.17 for the time in P12.18, the drive will enter sleep condition.

If this sequence is not needed, to program P12.15=0%, P12.16=0s, P12.17=50%, P12.18=1s.

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