ENGINEERING
TOMORROW

Application Guide

VACON® 1000

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Contents

1 Introduction

1.1 Purpose of this Application Guide

This Application Guide provides information for configuring the system, controlling the AC drive, accessing parameters, programming, and troubleshooting of the AC drive. It is intended for use by qualified personnel. Read and follow the instructions to use the drive safely and professionally. Pay particular attention to the safety instructions and general warnings that are provided in this manual and other documentation delivered with the drive.

1.2 Additional Resources

Other resources are available to understand advanced AC drive functions and operation.

- The VACON® 1000 Operating Guide provides detailed information for the installation, commissioning, and start-up of the drive.
- User guides for product options.

Supplementary publications and manuals are available from Danfoss. See www.danfoss.com for listings.

1.3 Manual Version

This manual is regularly reviewed and updated. All suggestions for improvement are welcome.

The original language of this manual is English.

Table 1: VACON® 1000 Application Guide Version

Version	Release date	Remarks
A	11.06.2021	First version

2 Overview

2.1 Control System

An example structure diagram of the control system is shown in Illustration 1. The number of power cells depends on the nominal voltage of the drive.

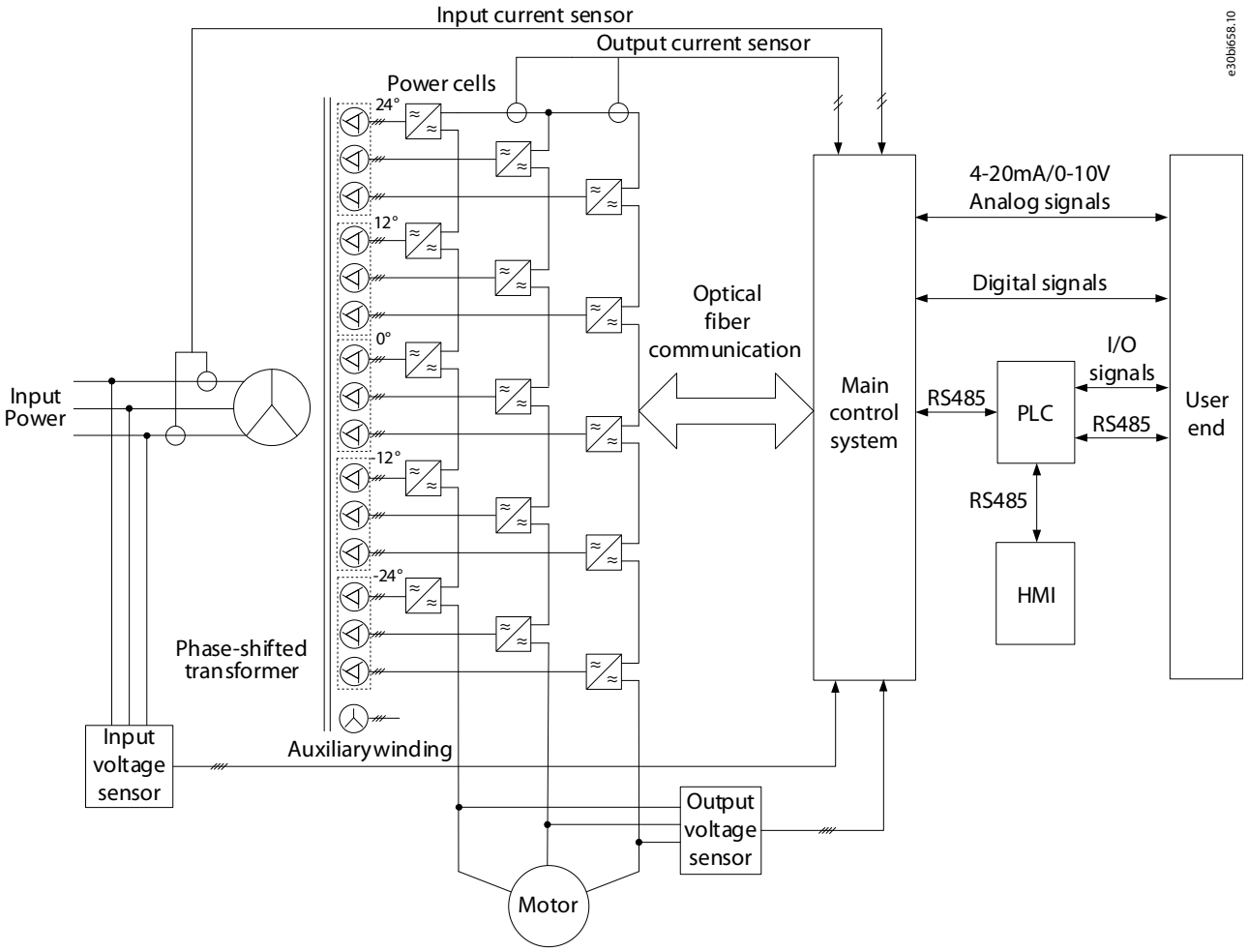

Illustration 1: Structure Diagram of the Control System

The main functions of the main control system include:

- Digital input and output
- Analog input and output
- PWM control signal generation of each power cell
- Encoding and decoding of the control signal
- System self-diagnosis
- Delivery of various implementation instructions
- Collection and handling of various failures
- Communication with external systems

To enhance the flexibility at the site application, a PLC is used for the logical processing of the internal switching signals, site operation signals, and status signals of the medium-voltage drive. The VACON® 1000 medium-voltage drive uses a high-quality PLC to:

- Accomplish the input and output drive signal control
- Protection and interlocking
- External failure detection

- Communication with the main control system
- Control of the human-machine interface

The HMI (Human-machine interface) is based on a high-definition liquid-crystal touch-type screen. It is easy to operate and is used to set functional parameters, display and record the system status, operation status, and faults through the connection to the PLC. See 3 Human-Machine Interface.

VACON® 1000 delivers high performance control accuracy using Vector Control. The ability to control motor flux and speed independently yields fast dynamic response to load fluctuations and high torque at low speeds, including during motor startup. The control diagram is shown in Illustration 2.

Both encoder and sensorless Vector Control approaches are available for selection. The speed sensors can be installed depending on actual application conditions. For cases without the speed sensors, the system can still provide fast dynamic responses and high output torque when the motor is running at low speed.

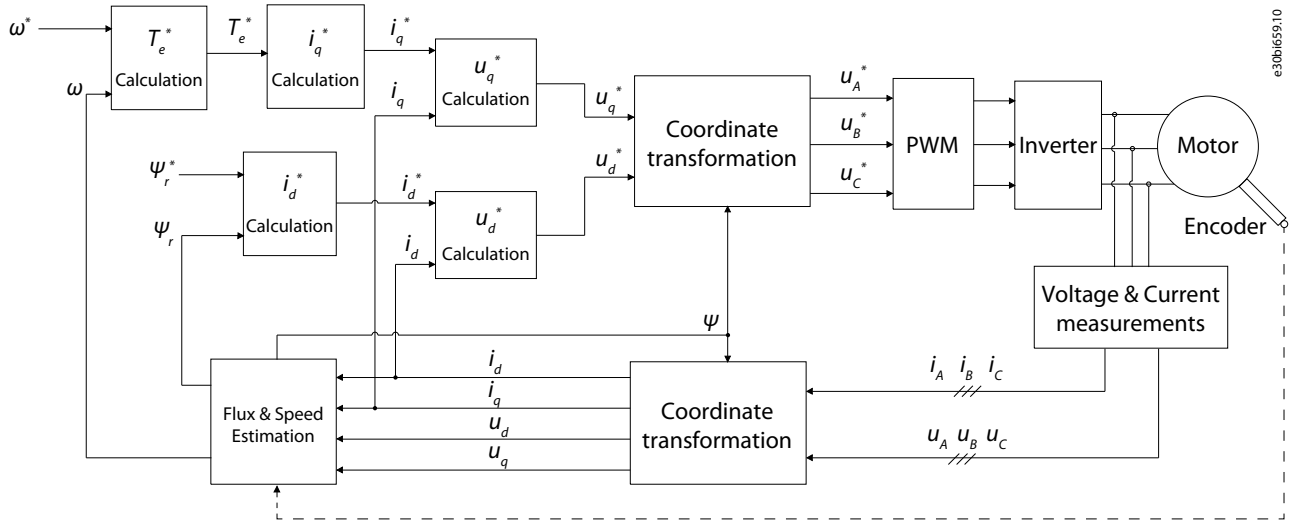

Illustration 2: Vector Control Diagram

2.2 Application Wiring Example

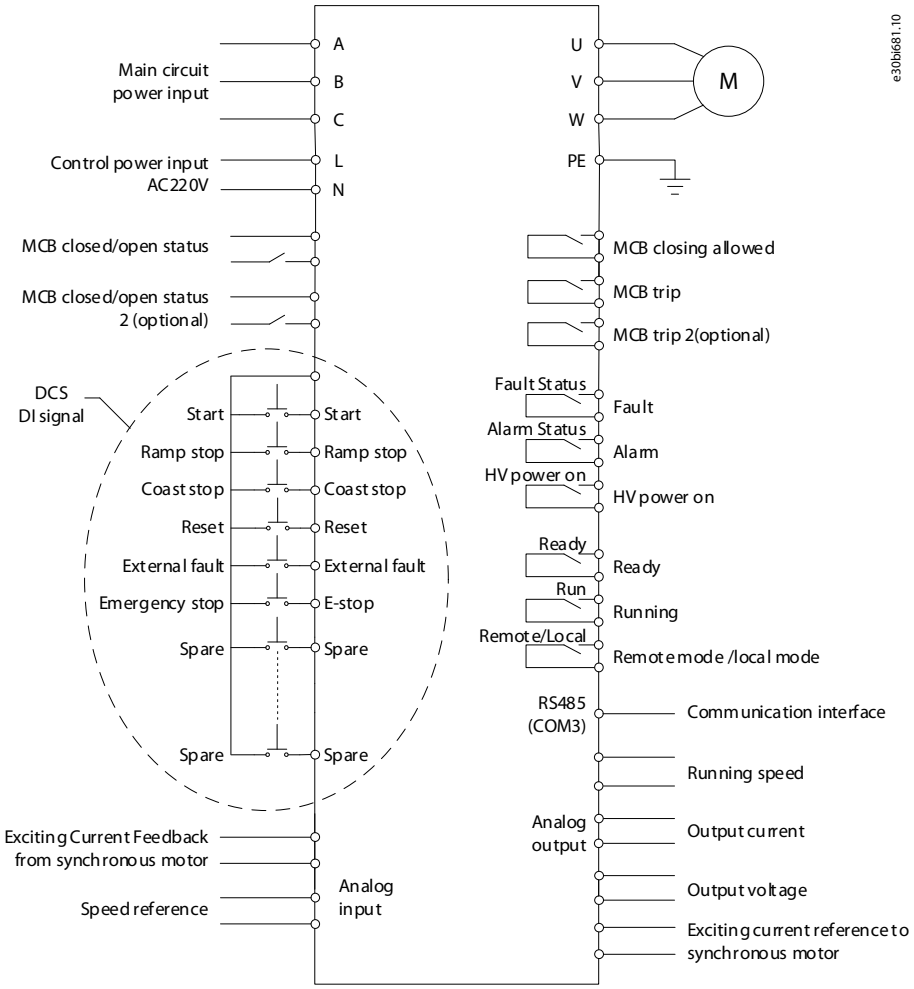

Illustration 3: Typical Application Wiring Diagram

2.3 VACON® 1000 PC Tool

The VACON® 1000 PC Tool is an Ethernet-based computer-assisted software. Only one network cable is needed, and the monitoring and fault diagnosis of the drive can be completed with this software.

The VACON® 1000 PC Tool integrates some auxiliary functions that are often used during normal operation and commissioning.

- The status display panel shows the running status of the drive in real time.
- The waveform display function allows the direct observation of the internal variables when the drive is running.
- The parameter management function allows the direct modification or saving of the current system parameters on the computer.
- The fault analysis function can process the fault information in the DSP cache, list the fault content of the system, and the time of occurrence, and show the waveform of the system input and output near the fault point.

In addition to these functions, the VACON® 1000 PC Tool also provides commissioning auxiliary functions and DSP program update functions.

Minimum requirements for the VACON® 1000:

- Operating system: Windows 10
- Processor: Intel® Core™ i5-6300U CPU @2.40 GHz 2.50 GHz
- RAM: 8.00 GB

3 Human-Machine Interface

3.1 The VACON® 1000 HMI

By using a high-quality touch-screen HMI (human-machine interface), simple and visual operation are possible to achieve for all the functions of VACON® 1000, such as:

- Parameter setting
- Operation status
- Fault diagnosis

To ensure operation safety, the user interface is protected by password that only opens up for authorized operators.

3.2 HMI Homepage

The homepage of the VACON® 1000 HMI is shown in Illustration 4. The homepage shows:

- Single-line diagram
- System status
- Dashboard

Access the submenus from the menu on the left side of the homepage, and the control panel from the icon in the lower right corner.

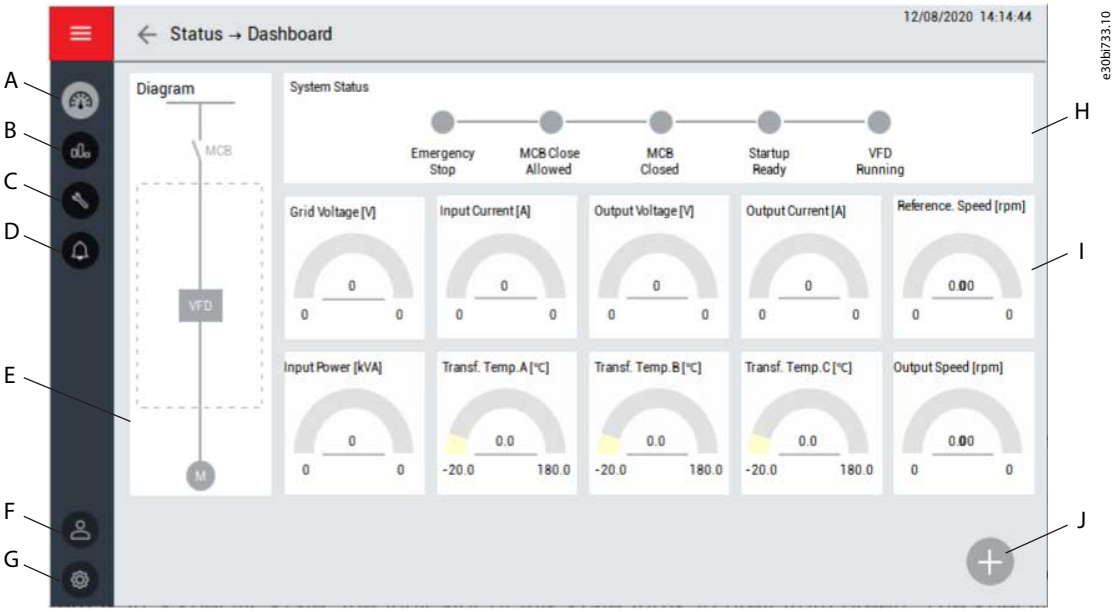

Illustration 4: HMI Homepage

A	Status	F	Administration
B	Graphs & Reports	G	Tool Settings
C	Setup & Service	H	System Status
D	Events	I	Dashboard
E	Single-line diagram	J	Control panel

3.2.1 System Status

When the system is in a specific state, the indicator of this state turns from gray to green.

- Emergency stop: The emergency Stop button on the control cabinet is pressed down.
- MCB close allowed: The system is ready, but the HV breaker is not closed.
  - The MCB can be closed.

- MCB closed: The input HV breaker is closed.
- Startup ready: HV power of the drive is on and internal diagnosis is done.
  - There is a delay of 22 s after the HV power is turned on. The DSP transmits the "operation request" signal after transmitting the main control ready state.
- VFD running: The VACON® 1000 is running and the main control system has no active faults.

3.2.2 Dashboard

The dashboard shows real-time values of the drive status:

- Grid voltage
- Input current
- Output voltage
- Output current
- Reference speed
- Input power
- Transformer temperature values
- Output speed

3.2.3 Single-line Diagram

The single-line diagram shows the status of each switch connected to the drive, such as breakers and contactors.

3.3 Control Panel

The control side panel includes the main controls for the drive. These controls can be used in HMI operation mode:

- To unlock the other function buttons in the control panel, press the *REQUEST* button. Otherwise the other function buttons are disabled.
- To start the drive, press the *START* button (in HMI operation mode). When the drive is running, this button is disabled. If the drive is at ramp stop state or stop state, this button is enabled, and can be used to restart the drive.
- To stop the drive, press the *STOP* button. Select either ramp stop or coast stop.
- Make the speed setting by numerical setting or slider.
- To reset the fault status of the drive, press the *RESET* button. When the drive is running, this button is disabled.

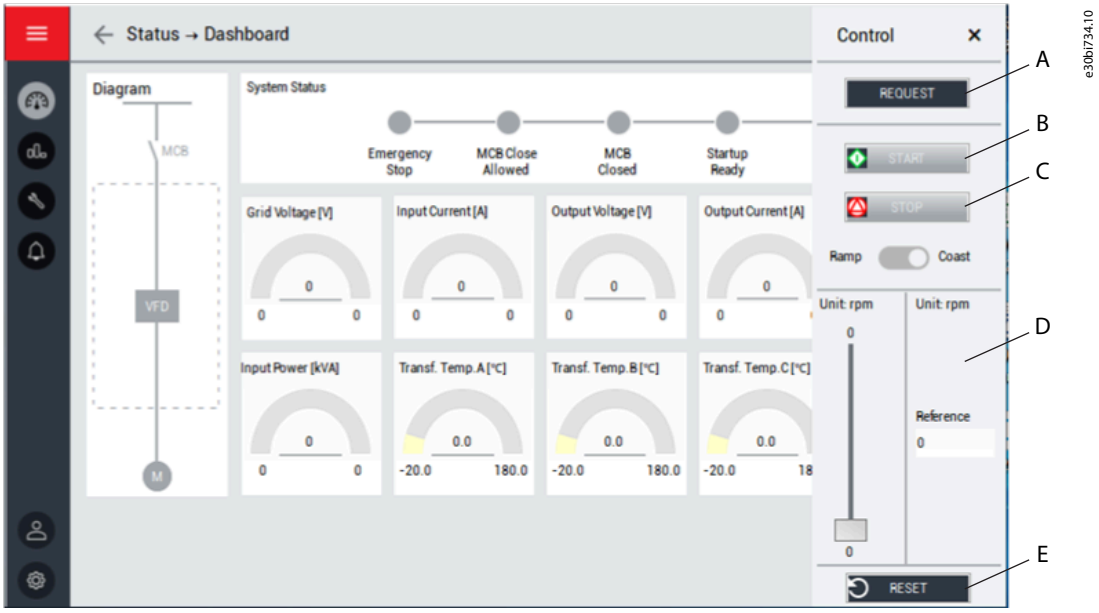

Illustration 5: Control Panel

A	Request	D	Speed setting
B	Start	E	Reset
C	Stop		

3.4 Status

To select one of the status submenus, press the *Status* button in the HMI menu:

- Dashboard
- Power cell status submenu
- Cooling fan status submenu

3.4.1 Power Cell

The power cell submenu shows the DC-link voltages and active fault codes of the power cells.

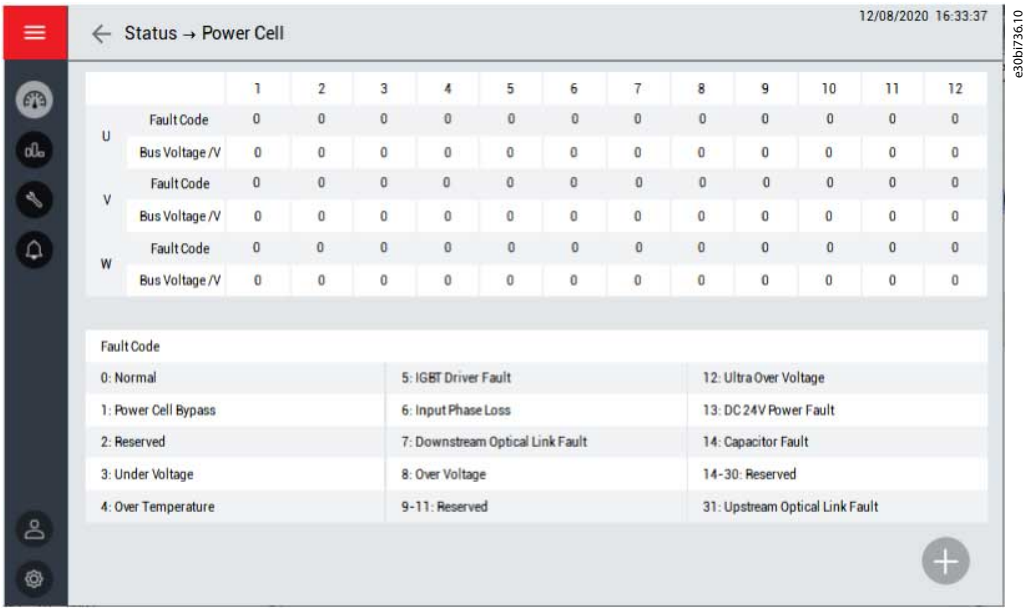

Illustration 6: Power Cell Submenu

3.4.2 Cooling Fan

The cooling fan submenu shows the status of all the cooling fans in the drive cabinets. The fans of the different cabinets are shown on separate tabs.

Actions available in this menu:

- Manual operation of the fans.
- Changing the running cycle/day.
- Recovery confirmation.

3.5 Graphs & Reports

The Graphs & reports submenu shows historical graphs of selected parameters. Four channels are available.

Each channel can show different parameters, such as:

- Input voltage
- Output voltage
- Input current
- Output current
- Reference speed

- Speed command
- Input power

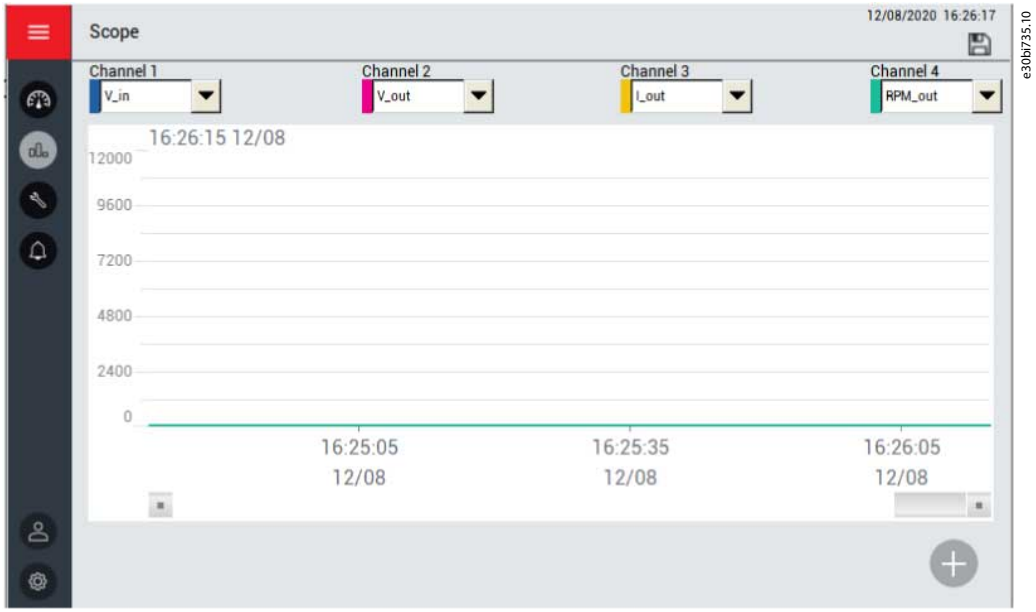

Illustration 7: Graphs & Reports Submenu

3.6 Setup & Service

The *Setup & Service* button in the HMI menu opens a submenu with the following system function settings:

- Operation mode
- Motor parameter
- Functions
- Protections
- I/O configuration
- System configuration
- PID setup
- Commissioning

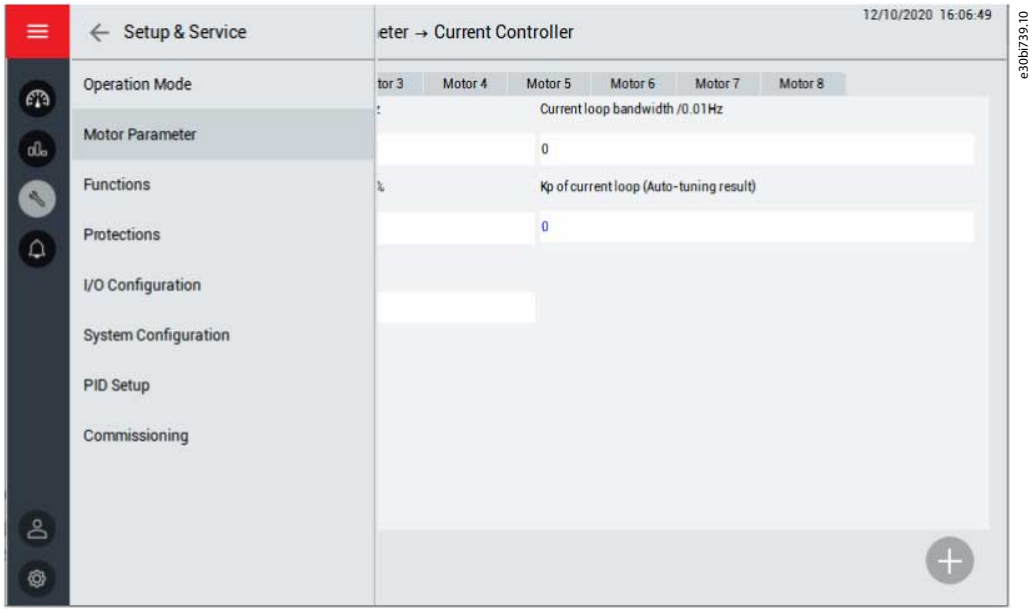

Illustration 8: Setup & Service Submenu

3.6.1 Operation Mode

Use this submenu to select the operation mode and the reference set.

Operation mode options:

- HMI: The drive is operated by HMI.
- Digital: The drive is operated by DCS (the remote digital control of the drive, see 2.2 Application Wiring Example for the specific interface definition).
- Communication: The drive is operated by communication, such as RS485 or Ethernet.

Reference set options:

- HMI: Speed is set by HMI.
- Analog: Speed is set by analog input.
- Digital: Speed is set by DCS (the remote digital control of the drive, see 2.2 Application Wiring Example for the specific interface definition).
- Communication: Speed is set by communication, such as RS485 or Ethernet.
- PID: Speed is adjusted automatically by PID module.

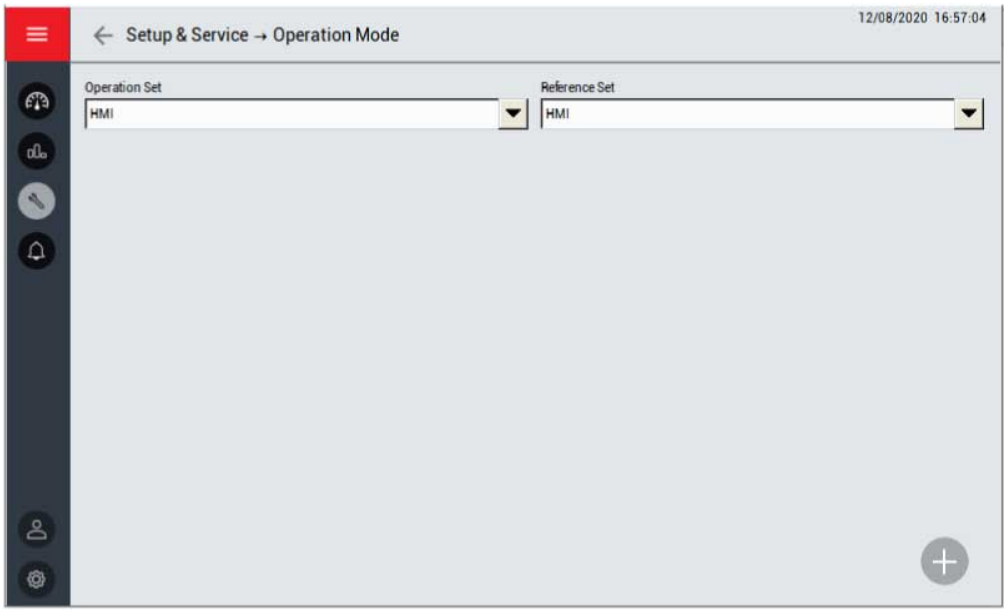

Illustration 9: Operation Mode Submenu

3.6.2 Motor Parameter

Use this submenu to select the motor parameters:

- Multi-motor configuration
  - Select different motors through HMI, digital input, or communication.
  - Set the maximum number of motors.
- Rated parameter
  - Set the rated frequency, rated speed, pole number, rated voltage, and rated current for different motors.
- Speed operation configuration
  - Set the rotation direction, maximum speed, and minimum speed for different motors.
- Auto tuning parameter
  - Check the parameters regarding auto tuning.
- Speed controller
- Flux controller

- Current controller
- Encoder
  - Input the specifications of the encoder for each motor.

3.6.3 Functions

Use this submenu to set the parameters for different functions. The parameters are divided into groups according to the functions.

3.6.4 Protections

Use this submenu to set the parameters for different protection functions. The parameters are divided into groups according to the protection functions.

3.6.5 PID Setup

Use this submenu to set the PID parameters.

- Analog Input Range: The range of the sensor.
- Proportional Gain (Kp): The magnified proportional value of the SV-PV error.
  - Unit: %
  - Set range: 0–30000
- Integral Gain (Ki): The magnified proportional value of an accumulation of each sampling time unit times the error value.
  - Unit: %
  - Set range: 0–30000
- Differential Gain (Kd): The magnified proportional value of an error variable of each sampling time unit.
  - Unit: %
  - Set range: 0–30000
- Upper Limit: If the upper limit is 900 RPM, the PID output stays at 900 RPM when the adjusting output value is above 900 RPM.
- Lower Limit: If the lower limit is 300 RPM, the PID output stays at 300 RPM when the adjusting output value is below 300 RPM.
- Error Band: The error band value is equal to the SV-PV deviation. If the difference between SV and PV is smaller than the error band, PID stops output and the drive maintains the current output speed.
- PID Output: The display of the actual PID output results.
- SV: The expected values of the user set.
- PV: The real value of the system output.
- Output Enable/Disable switch
- Start/Stop switch

Illustration 10: PID Setup Submenu

3.6.6 System Configuration

Use this submenu to set the system configuration parameters. The parameters are divided into groups according to the functions.

3.7 Events

Two submenus can be accessed by pushing the *Events* button in the HMI menu:

- Warning & Fault
- Event Log

3.7.1 Warning & Fault

The warning & fault submenu lists the real-time alarm and fault record of the drive during operation.

There are 2 different types of notification.

- An **alarm** informs of unusual operation on the drive. The alarm does not stop the drive. The system can be powered on, started, and operated normally.
- A **fault** stops the drive immediately. Reset the drive and find a solution to the problem. Do not operate the system until the problem has been found and corrected.

This page only shows general faults. To check the actual faults, see the "Event Log".

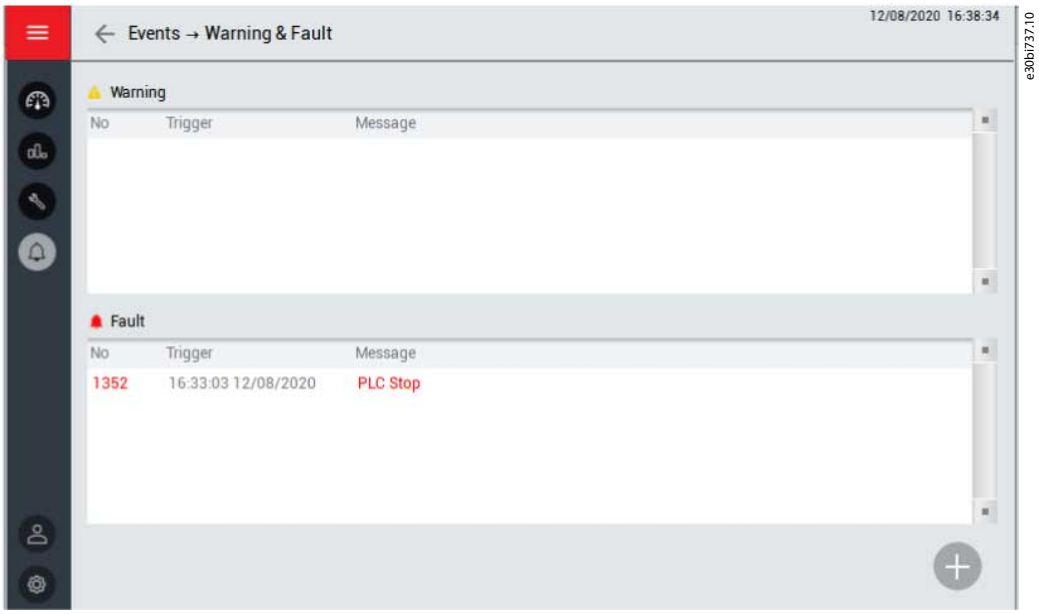

Illustration 11: Warning & Fault Submenu

3.7.2 Event Log

The event log submenu shows a record of all:

- Alarms
- Faults
- Operations (for example, starting and stopping the drive)

To save the event log, push the *Save* button in the upper right corner. The event log information is saved as a CSV-file to a USB storage device, which must be inserted separately. The USB port is at the back side of the HMI.

To delete the event log, push the *Delete* button in the upper right corner. This operation needs higher operation authority.

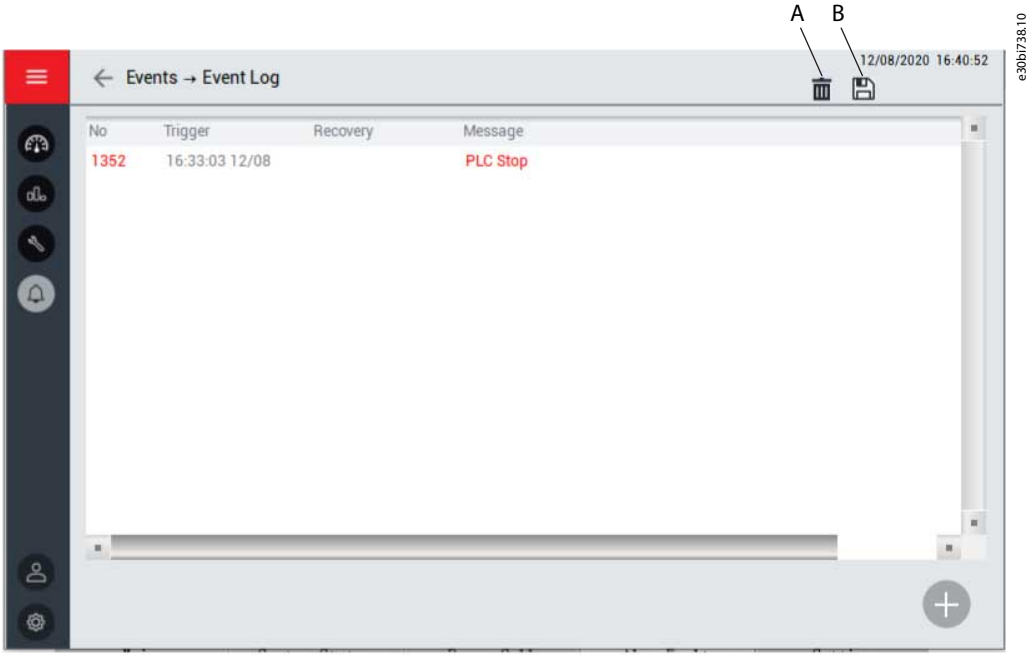

Illustration 12: Event Log Submenu

A	Delete event log
B	Save event log

3.8 Administration

Use the Administration submenu for password management. Two actions can be done in this submenu:

- Relogin
- Change password

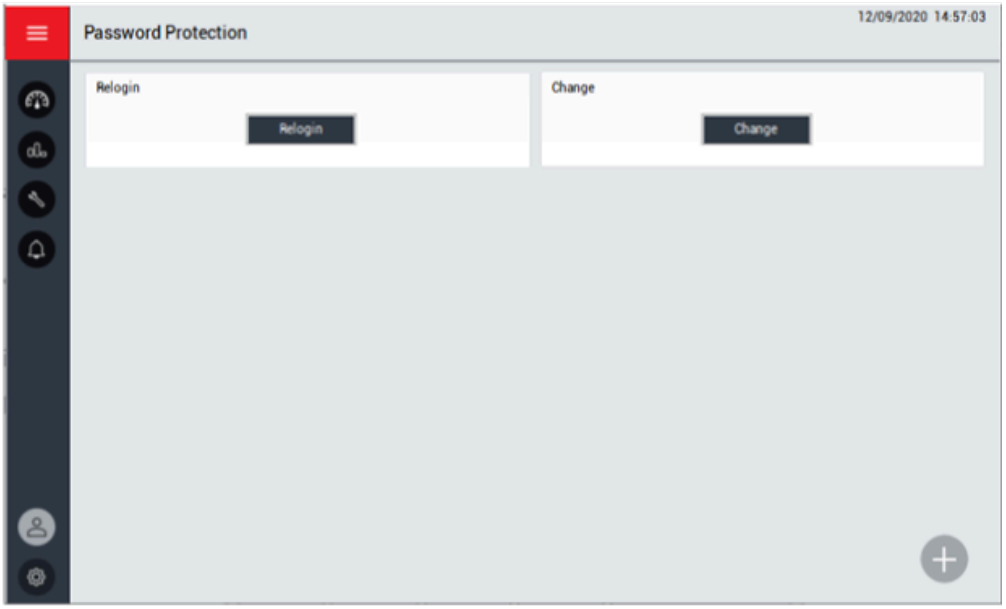

Illustration 13: Administration Submenu

To bring up the password dialog box, press the *Relogin* button. If the password input is incorrect, the dialog box remains until the password input is correct. The original password is provided in the product delivery.

Illustration 14: Password Dialog Box

VACON® 1000 has 3 user authority levels. To prevent malfunctions, the drive restricts important parameter changes by users without authorization.

- Level 1 authority limits operation to the buttons in the main interface. Parameter changes are not allowed.
- Level 2 authority limits operation to the buttons in the main interface, and changes to level 2 parameters.
- Level 3 authority limits operation to the buttons in the main interface, and changes to level 2 and 3 parameters.

To change the password, press the *Change* button. Users at a higher authority level can see and change the password of the user at a lower level.

Users at different levels can carry on corresponding operation on the system after entering the correct password. If the user forgets to exit the loading manually, the system is locked automatically in 5 minutes.

The required passwords are delivered during the commissioning of the drive.

If a password is lost, contact Danfoss.

3.9 Tool Settings

The tool settings submenu includes settings for the HMI.

- Language setting
- Software version
- HMI set

3.9.1 Language

Select the language of the HMI according to requirements.

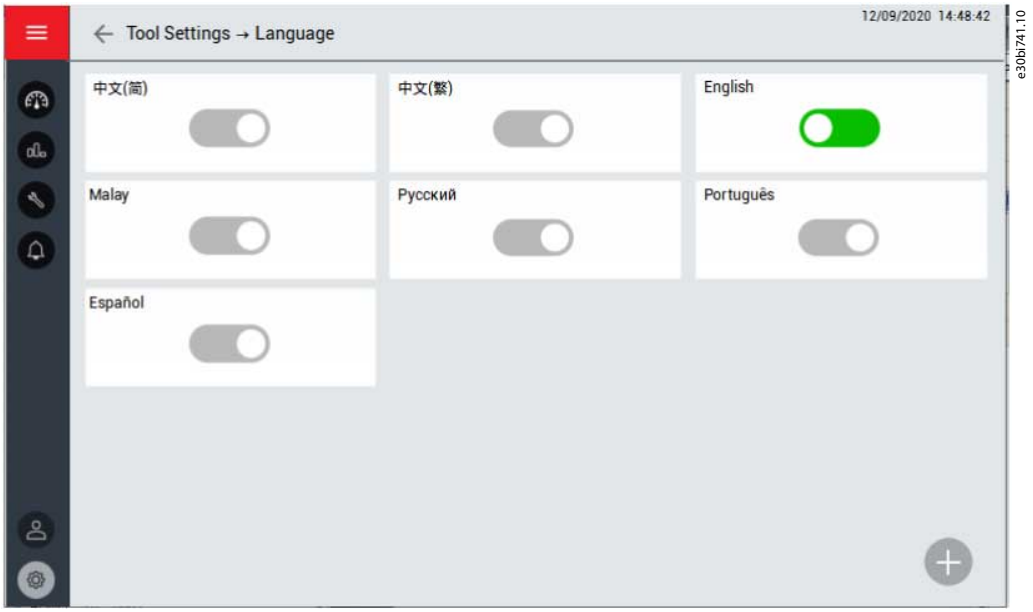

Illustration 15: Language Submenu

3.9.2 Software Version

This menu shows the software version information for the HMI, PLC, and DSP. Also the power cell version and optical fiber board version are available.

3.9.3 HMI Set

To adjust the brightness of the HMI screen, select *Brightness*.

To adjust the date and time setting, select *Date/Time*.

Illustration 16: HMI Set Submenu

4 Parameter Settings

4.1 System Parameters

Table 2: Basic Parameters

ID	Parameter	Min	Max	Unit	Default	Description
P0005	Rated output voltage	0	65535	V	6000	–
P0009	Level of continuous mode	3	12	–	6	–
P0155	Rated input voltage	0	65535	V	6000	–
P0174	Grid rated frequency	5000	6000	0.01 Hz	5000	–
P1068	Rated output current	20	2000	A	70	–

Table 3: Self-Diagnosis After High Power On

ID	Parameter	Min	Max	Unit	Default	Description
P0239	High voltage power-on self-diagnosis time	220	500	0.1 s	220	–

Table 4: Transformer

ID	Parameter	Min	Max	Unit	Default	Description
P0195	Transformer tap position	95	105	%	100	–

Table 5: Position of Output Central Point

ID	Parameter	Min	Max	Unit	Default	Description
P0498	Direction of output voltage	0	1	–	0	0=Forward 1=Reverse

Table 6: Power Cell Parameters

ID	Parameter	Min	Max	Unit	Default	Description
P0388	Power cell rated input voltage	300	800	V	690	–
P0867	Power cell rated output current	10	2000	A	70	–

Table 7: DCS Configuration

ID	Parameter	Min	Max	Unit	Default	Description
P0246	Fault output type	0	1	–	1	0=Pulse 1=Level
P0788	Start and stop mode	0	1	–	0	0=Normal start and stop 1=Start and stop with one button
P0789	Start signal definition	0	2	–	0	0=Pulse signal 1=Level signal • On=Start • Off=Free stop

ID	Parameter	Min	Max	Unit	Default	Description
						2=Level signal • On=Start • Off=Deceleration stop
P0790	DCS direction signal enable	0	1	–	0	0=Disable 1=Enable

Table 8: Running Mode

ID	Parameter	Min	Max	Unit	Default	Description
P0601	Running mode	1	4	–	1	1=U/f 2=SVC 3=SLVC (1)

[1] SVC: Space Vector Control, SLVC: Sensorless Vector Control.

Table 9: Sample Configuration

ID	Parameter	Min	Max	Unit	Default	Description
P0006	Coefficient of input voltage	0	65535	0.001	1000	–
P0007	Coefficient of output voltage	0	65535	0.001	1000	–
P0052	Output current sample rating	20	2000	A	70	Output Current sample board rating
P0055	Coefficient of input current	0	65535	0.001	1000	–
P0056	Coefficient of output current	0	65535	0.001	1000	–
P0228	Hall direction of input and output current	0	65535	–	0	Low four bits show 4 Halls direction, but value is decimal： • bit0= Output U phase • bit1= Output W phase • bit2= Input A phase • bit3= Input C phase Bit definition: • 0=Forward • 1=Reverse

Table 10: Electromagnetic Lock

ID	Parameter	Min	Max	Unit	Default	Description
P0045	Unlock time of electromagnetic lock after high voltage power off	300	1800	s	900	–
P0157	Time before electromagnetic lock unlock after high voltage power off	–	–	s	0	Read only
P0158	Electromagnetic lock operation	0	2	–	2	0=Locks 1=Open 2=Normal

Table 11: Cooling Fan

ID	Parameter	Min	Max	Unit	Default	Description
P0241	Fan redundancy enable	0	3	s	0	0=All disable 1=Power cell cabinet fan enable 2=Transformer cabinet fan enable 3=All enable
P0786	Fan start mode	0	1	–	0	0=High voltage power-on start 1=System running start
P0787	Customer fan power enable	0	1	–	0	0=Disable 1=Enable

Table 12: Precharge Cabinet

ID	Parameter	Min	Max	Unit	Default	Description
P0248	Start-up cabinet re-close waiting time	0	65535	s	60	–
P0285	Precharge mode	0	1	–	0	0=None 1=Start-up cabinet
P0286	Power-on threshold for start-up cabinet	650	850	‰	650	Permillage of rated input voltage

Table 13: Bypass Cabinet

ID	Parameter	Min	Max	Unit	Default	Description
P0244	Frequency threshold of system automatic by-pass	0	65535	%	20	Percentage of nominal motor speed
P0247	Automatic system bypass failure detection time	0	65535	100 ms	50	–
P0791	Bypass cabinet type	1	8	–	1	0=No bypass cabinet 1=Manual bypass Cabinet 2=Auto bypass cabinet 3=Synchronous transfer Cabinet

Table 14: Restore Factory Settings

ID	Parameter	Min	Max	Unit	Default	Description
P0002	Default factory setting	0	1	–	0	0=No action 1=Restore factory value

4.2 Motor Parameters

Table 15: Multi Motor Configuration

ID	Parameter	Min	Max	Unit	Default	Description
P0635	Motor selection mode	0	2	–	0	0=HMI 1=DI

ID	Parameter	Min	Max	Unit	Default	Description
						2=Communication
P0636	Motor selection	1	8	–	0	–
P0637	Maximum number of motor	1	8	–	8	–

Table 16: Motor Rated Parameters

ID	Parameter	Min	Max	Unit	Default	Description
P0074	Motor rated frequency	0	65535	0.01 Hz	5000	–
P0075	Motor rated speed	0	65535	RPM	993	–
P0409	Motor rated voltage	0	65535	V	6000	–
P0410	Motor rated current	0	65535	A	74	–
P0413	Motor pole number	2	65535	–	6	–

Table 17: Speed Operation Configuration

ID	Parameter	Min	Max	Unit	Default	Description
P0013	Motor rotation direction	0	2	–	0	0=Forward 1=Reverse 2=Two-way
P0076	Minimum speed	20	1000	‰	20	–
P0077	Maximum speed	20	3000	‰	1000	–
P0085	Digital input speed setting 1	0	65535	RPM	800	–
P0086	Digital input speed setting 2	0	65535	RPM	1200	–
P0087	Digital input speed setting 3	0	65535	RPM	1500	–
P0518	PWM turn off speed threshold of deceleration stop	0	100	‰	15	Thousandth ratio of motor rated speed

Table 18: Motor Model

ID	Parameter	Min	Max	Unit	Default	Description
P0414	Motor mutual inductance	0	65535	0.1 mH	4320	–
P0415	Motor leakage inductance	0	65535	0.1 mH	130	–
P0416	Motor stator resistance	0	65535	mΩ	702	–
P0417	Motor rotor resistance	0	65535	mΩ	345	–
P0441	Flux reference	0	65535	0.001 Wb	15200	–
P0442	Motor rated torque	0	65535	10 Nm	657	–
P1033	Moment inertia of auto tuning	0	65535	0.1 kgm^2	800	–
P1034	Friction coefficient of auto tuning	0	65535	0.001 Nmg	2620	–

Table 19: Speed Controller

ID	Parameter	Min	Max	Unit	Default	Description
P0394	Slip2 limit	0	100	%	10	–
P0420	Kp of SVC speed controller	–	–	–	1000	Read only
P0421	Ki of SVC speed controller	–	–	–	60	Read only
P0430	Kp of SLVC speed Controller	–	–	–	333	Read only
P0431	Ki of SLVC speed loop	–	–	–	20	Read only
P0438	Maximum torque limit	0	300	%	150	–
P0439	Braking torque limit	0	200	%	5	–
P0440	Speed threshold of braking torque switching	0	100	%	10	Percentage of motor rated speed
P0455	Coefficient of SVC speed controller Kp	0	65535	%	100	–
P0456	Coefficient of SVC speed controller Ki	0	65535	%	100	–
P0457	Coefficient of SLVC speed controller Kp	0	65535	%	33	–
P0458	Coefficient of SLVC speed controller Ki	0	65535	%	33	–
P0464	Kp of slip compensator controller	0	65535	0.01	200	–
P1041	Bandwidth of speed loop	60	600	rad/s	60	–

Table 20: Flux Controller

ID	Parameter	Min	Max	Unit	Default	Description
P0395	Leakage inductance voltage limit	0	65535	%	200	–
P0396	Delay time of given voltage for flux estimation	0	65535	µs	580	–
P0418	Flux loop bandwidth	0	65535	0.01 Hz	1000	–
P0422	Coefficient of flux controller Kp	0	65535	%	100	–
P0423	Coefficient of flux controller Ki	0	65535	%	100	–
P0426	Magnetizing current limit	0	200	%	125	–
P0432	Bandwidth of flux estimator filter for SLVC	0	65535	0.01 Hz	60	–
P0461	Kp of flux loop	–	–	–	73	Read only
P0462	Ki of flux loop	–	–	–	138	Read only
P0478	Premagnetizing enable	0	1	–	0	–
P0569	Frequency threshold to add leakage inductance voltage	10	1000	0.01 Hz	200	–
P0633	Flux compensation selection	0	1	–	1	–
P0634	Slope time of flux reference	0	65535	ms	1000	–

Table 21: Current Controller

ID	Parameter	Min	Max	Unit	Default	Description
P0419	Current loop bandwidth	0	65535	0.01 Hz	10000	–
P0424	Coefficient of current controller Kp	0	65535	%	100	–
P0425	Coefficient of current controller Kp	0	65535	%	100	–
P0428	Voltage limit of voltage controller	100	130	%	110	–
P0459	Kp of current loop	–	–	–	15	Read only
P0460	Ki of current loop	–	–	–	522	Read only
P0886	Bandwidth of current loop decouple filter	0	65535	0.01 Hz	1000	–
P0887	Adjustment coefficient of current loop decouple	0	100	%	100	–

Table 22: Encoder Configuration

ID	Parameter	Min	Max	Unit	Default	Description
P0545	Encoder resolution	0	65535	PPR	5000	–
P0546	Counting period of encoder M method	0	65535	µs	2500	–
P0547	Counting clock frequency of encoder T method	0	65535	MHz	8	–
P0550	Bandwidth of encoder speed filter	10	1000	Hz	100	–

4.3 Protection Parameters

Table 23: Input Overcurrent (Software)

ID	Parameter	Min	Max	Unit	Default	Description
P1100	Fault action configuration: Input Overcurrent (Software)	0	8	–	7	See 6.2 Fault Response Configuration.
P1073	Threshold of input overcurrent	0	1000	%	200	–

Table 24: Input Phase Loss

ID	Parameter	Min	Max	Unit	Default	Description
P1101	Fault action configuration: Input Phase Loss	0	8	–	7	See 6.2 Fault Response Configuration.
P1251	Fault duration time: Input Phase Loss	0	65535	ms	80	–
P0489	Voltage threshold of input phase loss	0	100	%	20	–

Table 25: Input Power Loss

ID	Parameter	Min	Max	Unit	Default	Description
P1102	Fault action configuration: Input Power Loss	0	8	–	7	See 6.2 Fault Response Configuration.
P0484	Voltage threshold of input power loss	100	900	‰	700	–

Table 26: Input Undervoltage

ID	Parameter	Min	Max	Unit	Default	Description
P1103	Fault action configuration: Input Undervoltage	0	8	–	1	See 6.2 Fault Response Configuration.
P1253	Fault duration time: Input Undervoltage	0	65535	ms	0	–
P0047	Threshold of input undervoltage	10	100	%	90	–

Table 27: Input Overvoltage

ID	Parameter	Min	Max	Unit	Default	Description
P1104	Fault action configuration: Input Overvoltage	0	8	–	7	See 6.2 Fault Response Configuration.
P1254	Fault duration time: Input Overvoltage	0	65535	ms	0	–
P0054	Threshold of input overvoltage	100	120	%	110	–

Table 28: Input Grounding

ID	Parameter	Min	Max	Unit	Default	Description
P1105	Fault action configuration: Input Grounding	0	8	–	7	See 6.2 Fault Response Configuration.
P1255	Fault duration time: Input Grounding	0	65535	100 ms	50	–
P0877	Voltage threshold of input grounding	0	100	%	70	–

Table 29: Input Sequence Fault

ID	Parameter	Min	Max	Unit	Default	Description
P1106	Fault action configuration: Input Sequence Fault	0	8	–	7	See 6.2 Fault Response Configuration.

Table 30: Output Overcurrent (Software)

ID	Parameter	Min	Max	Unit	Default	Description
P1108	Fault action configuration: Output Overcurrent (Software)	0	8	–	2	See 6.2 Fault Response Configuration.
P1258	Fault duration time: Output Overcurrent (Software)	0	65535	ms	0	–
P0046	Threshold of output overcurrent	0	1000	%	160	–

Table 31: Output Overload

ID	Parameter	Min	Max	Unit	Default	Description
P1109	Fault action configuration: Output Overload	0	8	–	2	See 6.2 Fault Response Configuration.
P1259	Fault duration time: Output Overload	0	65535	s	0	–
P0032	Duration time of output overload	10	300	s	60	–
P0062	Initial detect current of output overload	0	1000	%	105	–
P0088	Threshold of output overload	100	300	%	110	–
P0193	Detect time window for output overload protection	1	1200	s	600	–

Table 32: Output Phase Loss

ID	Parameter	Min	Max	Unit	Default	Description
P1110	Fault action configuration: Output Phase Loss	0	8	–	2	See 6.2 Fault Response Configuration.
P1260	Fault duration time: Output Phase Loss	0	65535	ms	80	–
P0068	1st threshold of output phase loss protection	0	100	%	25	–
P0198	2nd threshold of output phase loss	0	40	%	5	–

Table 33: Output Grounding

ID	Parameter	Min	Max	Unit	Default	Description
P1111	Fault action configuration: Output Grounding	0	8	–	2	See 6.2 Fault Response Configuration.
P1261	Fault duration time: Output Grounding	0	65535	ms	0	–
P0488	1st threshold of output grounding	0	100	%	33	–
P0197	2nd threshold of output grounding	0	20	%	10	–

Table 34: Output Phase Imbalance Alarm

ID	Parameter	Min	Max	Unit	Default	Description
P1112	Fault action configuration: Output Phase Imbalance Alarm	0	8	–	0	See 6.2 Fault Response Configuration.
P1262	Fault duration time: Output Phase Imbalance Alarm	0	65535	s	30	–
P1010	Active frequency of output phase imbalance protection	5	100	%	5	–
P1011	Threshold of output voltage imbalance alarm	0	1000	‰	15	–

Table 35: Output Phase Imbalance Fault

ID	Parameter	Min	Max	Unit	Default	Description
P1113	Fault action configuration: Output Phase Imbalance fault	0	8	–	2	See 6.2 Fault Response Configuration.
P1263	Fault duration time: Output Phase Imbalance Fault	0	65535	ms	1000	–
P1010	Active frequency of output phase imbalance protection	5	100	%	5	–
P1012	Threshold of output voltage imbalance fault	0	1000	‰	30	–

Table 36: Output Underload

ID	Parameter	Min	Max	Unit	Default	Description
P1114	Fault action configuration: Output Under Load	0	8	–	0	See 6.2 Fault Response Configuration.
P1264	Fault duration time: Output Under Load	0	65535	s	20	–
P1029	Flux weakening torque of underload	10	150	%	50	–
P1030	Zero speed torque of underload	5	150	‰	10	–

Table 37: Electronic Motor Thermal Protection

ID	Parameter	Min	Max	Unit	Default	Description
P1115	Fault action configuration: Electronic Motor Thermal Protection	0	8	–	0	See 6.2 Fault Response Configuration.
P1017	Motor ambient temperature	-20	100	°C	40	–
P1018	Motor zero speed cooling coefficient	5	150	%	40	–
P1019	Motor thermal time constant	0	12000	s	600	–
P1020	Motor thermal load capacity	10	150	%	100	–
P1021	Motor rated temperature rise	0	200	°C	80	–
P1022	Motor insulation grade	0	3	–	2	0=A 1=B 2=F 3=H
P1023	Motor allowed temperature rise coefficient	0	1000	0.01	100	–
P1024	Motor allowed temperature coefficient	0	1000	0.01	100	–

Table 38: Motor Stall

ID	Parameter	Min	Max	Unit	Default	Description
P1116	Fault action configuration: Motor Stall	0	8	–	0	See 6.2 Fault Response Configuration.
P1266	Fault duration time: Motor Stall	0	65535	s	60	–
P0572	Speed threshold of motor stall	0	1000	‰	17	–

Table 39: Motor Reverse

ID	Parameter	Min	Max	Unit	Default	Description
P1117	Fault action configuration: Motor Reverse	0	8	–	0	See 6.2 Fault Response Configuration.
P1267	Fault duration time: Motor Reverse	0	65535	s	0	–
P0013	Motor rotation direction	0	2	–	0	0=Forward 1=Reverse 2=Two-way

Table 40: Motor Overspeed

ID	Parameter	Min	Max	Unit	Default	Description
P1118	Fault action configuration: Motor Overspeed	0	8	–	2	See 6.2 Fault Response Configuration.
P1268	Fault duration time: Motor Overspeed	0	65535	s	10	–
P0579	Threshold of motor overspeed	1000	3000	‰	1200	–

Table 41: Motor Underspeed

ID	Parameter	Min	Max	Unit	Default	Description
P1119	Fault action configuration: Motor Underspeed	0	8	–	0	See 6.2 Fault Response Configuration.
P1269	Fault duration time: Motor Underspeed	0	65535	s	60	–
P0580	Threshold of underspeed	10	1000	‰	60	–

Table 42: Speed Setting Analog Loss

ID	Parameter	Min	Max	Unit	Default	Description
P1120	Fault action configuration: Speed Setting Analog Loss	0	8	–	1	See 6.2 Fault Response Configuration.
P1270	Fault duration time: Speed Setting Analog Loss	0	65535	ms	5000	–
P0201	Analog input 1 function selection	0	1	–	1	0=None 1=Speed setting
P0202	Analog input 2 function selection	0	1	–	0	0=None 1=Speed setting
P1072	Speed setting analog loss enable	0	1	–	1	0=Enable 1=Enable during running

Table 43: Encoder Abnormal

ID	Parameter	Min	Max	Unit	Default	Description
P1121	Fault action configuration: SVC Encoder Abnormal	0	8	–	2	See 6.2 Fault Response Configuration.
P1144	Fault action configuration: SLVC Encoder Abnormal	0	8	–	0	–
P1271	Fault duration time: Encoder Abnormal	0	65535	ms	200	–
P0398	Speed error threshold for encoder fault	0	100	%	5	–
P1083	Loss ratio threshold of encoder fault	0	100	%	10	–

Table 44: Input Overcurrent (Hardware)

ID	Parameter	Min	Max	Unit	Default	Description
P1122	Fault action configuration: Input Overcurrent (Hardware)	0	8	–	7	See 6.2 Fault Response Configuration.

Table 45: Output Overcurrent (Hardware)

ID	Parameter	Min	Max	Unit	Default	Description
P1123	Fault action configuration: Output Overcurrent (Hardware)	0	8	–	7	See 6.2 Fault Response Configuration.

Table 46: External Fault

ID	Parameter	Min	Max	Unit	Default	Description
P1124	Fault action configuration: External Fault	0	8	–	2	See 6.2 Fault Response Configuration.
P1274	Fault duration time: External Fault	0	65535	ms	0	–
P0101	Digital input channel 1 function selection	0	65535	–	2	1=Control mode 2=MCB status 3=External fault 4=System reset 5=Start command 6=Stop command 7=Motor accelerate 8=Motor decelerate 9=Emergency stop 10=Motor direction of rotation 14=KM2 status of 1# motor 15=KM4 status of 1# motor 16=Status of grid-connection switch 17=KM2 status of 2# motor 18=KM4 status of 2# motor 19=Lem power loss 20=Encoder Z signal
P0102	Digital input channel 2 function selection	0	65535	–	9	
P0103	Digital input channel 3 function selection	0	65535	–	0	
P0104	Digital input channel 4 function selection	0	65535	–	14	
P0105	Digital input channel 5 function selection	0	65535	–	15	
P0106	Digital input channel 6 function selection	0	65535	–	16	
P0107	Digital input channel 7 function selection	0	65535	–	19	
P0108	Digital input channel 8 function selection	0	65535	–	20	

Table 47: Current Sensor Power Fault

ID	Parameter	Min	Max	Unit	Default	Description
P1125	Fault action configuration: Current Sensor Power Fault	0	8	–	6	See 6.2 Fault Response Configuration.
P1275	Fault duration time: Current Sensor Power Fault	0	65535	ms	0	–

Table 48: Air Filter Clogged

ID	Parameter	Min	Max	Unit	Default	Description
P1205	PLC fault action configuration: Air Filter Clogged	1	1	–	1	See 6.2 Fault Response Configuration.

Table 49: Upstream Main Circuit Breaker Abnormal Open

ID	Parameter	Min	Max	Unit	Default	Description
P1206	PLC fault action configuration: Upstream Main Circuit Breaker Abnormal Open	5	5	–	5	See 6.2 Fault Response Configuration.

Table 50: HV Cabinet Door Open

ID	Parameter	Min	Max	Unit	Default	Description
P1207	PLC fault action configuration: HV Cabinet Door Open	7	7	–	7	See 6.2 Fault Response Configuration.

Table 51: External/Customer Control Power Loss

ID	Parameter	Min	Max	Unit	Default	Description
P1208	PLC fault action configuration: External/Customer Control Power Loss	1	1	–	1	See 6.2 Fault Response Configuration.

Table 52: Internal Control Power Loss

ID	Parameter	Min	Max	Unit	Default	Description
P1209	PLC fault action configuration: Internal Control Power Loss	1	1	–	1	See 6.2 Fault Response Configuration.

Table 53: Transformer Overtemperature Alarm

ID	Parameter	Min	Max	Unit	Default	Description
P0253	Transformer overtemperature alarm threshold	0	150	°C	95	–
P0254	Transformer overtemperature fault threshold	0	150	°C	110	–
P1210	PLC fault action configuration: Transformer Overtemperature Alarm	1	1	–	1	See 6.2 Fault Response Configuration.

Table 54: Transformer Overtemperature Fault

ID	Parameter	Min	Max	Unit	Default	Description
P0254	Transformer overtemperature fault threshold	0	150	°C	110	–
P1211	PLC fault action configuration: Transformer Overtemperature Fault	8	8	–	8	See 6.2 Fault Response Configuration.

Table 55: PLC-DSP Communication Failure

ID	Parameter	Min	Max	Unit	Default	Description
P1212	PLC fault action configuration: PLC-DSP Communication Failure	0	8	–	1	See 6.2 Fault Response Configuration.

Table 56: Cooling Fan Abnormal

ID	Parameter	Min	Max	Unit	Default	Description
P0241	Fan Redundancy	0	3	–	0	0=All disable 1=Power cell cabinet fan enable 2=Transformer cabinet fan enable 3=All enable
P1213	PLC fault action configuration: Cooling Fan Abnormal	0	8	–	1	See 6.2 Fault Response Configuration.

Table 57: UPS Undervoltage

ID	Parameter	Min	Max	Unit	Default	Description
P1214	PLC fault action configuration: UPS Undervoltage	1	1	–	1	See 6.2 Fault Response Configuration.

Table 58: Fan Internal Power Loss

ID	Parameter	Min	Max	Unit	Default	Description
P0241	Fan Redundancy	0	3	–	0	0=All disable 1=Power cell cabinet fan enable 2=Transformer cabinet fan enable 3=All enable
P1215	PLC fault action configuration: Fan Internal Power Loss	0	8	–	1	See 6.2 Fault Response Configuration.

Table 59: Fan External Power Loss

ID	Parameter	Min	Max	Unit	Default	Description
P0787	Customer fan power enable	0	1	–	0	0=Disable 1=Enable
P1216	PLC fault action configuration: Fan External Power Loss	0	8	–	1	See 6.2 Fault Response Configuration.

Table 60: Transformer Temperature Sensor Loss

ID	Parameter	Min	Max	Unit	Default	Description
P1217	PLC fault action configuration: Transformer Temperature Sensor Loss	0	8	–	1	See 6.2 Fault Response Configuration.

Table 61: PLC-HMI Communication Failure

ID	Parameter	Min	Max	Unit	Default	Description
P1219	PLC fault action configuration: PLC-HMI Communication Failure	1	1	–	1	See 6.2 Fault Response Configuration.

Table 62: Upstream Main Circuit Breaker Close Failure

ID	Parameter	Min	Max	Unit	Default	Description
P1220	PLC fault action configuration: Upstream Main Circuit Breaker Close Failure	7	7	–	7	See 6.2 Fault Response Configuration.

Table 63: Upstream Main Circuit Breaker Open Failure

ID	Parameter	Min	Max	Unit	Default	Description
P1221	PLC fault action configuration: Upstream Main Circuit Breaker Open Failure	7	7	–	7	See 6.2 Fault Response Configuration.

Table 64: Startup Cabinet Switch Abnormal Open

ID	Parameter	Min	Max	Unit	Default	Description
P1224	PLC fault action configuration: Startup Cabinet Switch Abnormal Open	7	7	–	7	See 6.2 Fault Response Configuration.
P0285	Precharge mode	0	1	–	0	0=None 1=Startup cabinet

Table 65: Startup Cabinet Switch Open Failure

ID	Parameter	Min	Max	Unit	Default	Description
P1225	PLC fault action configuration: Startup Cabinet Switch Open Failure	7	7	–	7	See 6.2 Fault Response Configuration.
P0285	Precharge mode	0	1	–	0	0=None 1=Startup cabinet

Table 66: Startup Cabinet Switch Close Failure

ID	Parameter	Min	Max	Unit	Default	Description
P1226	PLC fault action configuration: Startup Cabinet Switch Close Failure	7	7	–	7	See 6.2 Fault Response Configuration.
P0285	Precharge mode	0	1	–	0	0=None 1=Startup cabinet

Table 67: No Startup Cabinet Switch Close Command

ID	Parameter	Min	Max	Unit	Default	Description
P1228	PLC fault action configuration: No Startup Cabinet Switch Close Command	7	7	–	7	See 6.2 Fault Response Configuration.
P0285	Precharge mode	0	1	–	0	0=None 1=Startup cabinet

Table 68: Cooling Fan 2X Failure

ID	Parameter	Min	Max	Unit	Default	Description
P0241	Fan Redundancy	0	3	–	0	0=All disable 1=Power cell cabinet fan enable 2=Transformer cabinet fan enable 3=All enable
P1229	PLC fault action configuration: Cooling Fan21 Failure	1	1	–	1	See 6.2 Fault Response Configuration.
P1230	PLC fault action configuration: Cooling Fan22 Failure	1	1	–	1	
P1231	PLC fault action configuration: Cooling Fan23Failure	1	1	–	1	
P1232	PLC fault action configuration: Cooling Fan24 Failure	1	1	–	1	

Table 69: Number of Cooling Fans for Power Cell Cabinet is Insufficient

ID	Parameter	Min	Max	Unit	Default	Description
P0241	Fan Redundancy	0	3	–	0	0=All disable 1=Power cell cabinet fan enable 2=Transformer cabinet fan enable

ID	Parameter	Min	Max	Unit	Default	Description
						3=All enable
P1233	PLC fault action configuration: Number of Cooling Fan For Power Cell Cabinet Is Insufficient	0	8	–	1	See 6.2 Fault Response Configuration.

Table 70: Cooling Fan 3X Failure

ID	Parameter	Min	Max	Unit	Default	Description
P0241	Fan Redundancy	0	3	–	0	0=All disable 1=Power cell cabinet fan enable 2=Transformer cabinet fan enable 3=All enable
P1234	PLC fault action configuration: Cooling Fan31 Failure	1	1	–	1	See 6.2 Fault Response Configuration.
P1235	PLC fault action configuration: Cooling Fan32 Failure	1	1	–	1	
P1236	PLC fault action configuration: Cooling Fan33 Failure	1	1	–	1	
P1237	PLC fault action configuration: Cooling Fan34 Failure	1	1	–	1	

Table 71: Number of Cooling Fans for Transformer Cabinet is Insufficient

ID	Parameter	Min	Max	Unit	Default	Description
P0241	Fan Redundancy	0	3	–	0	0=All disable 1=Power cell cabinet fan enable 2=Transformer cabinet fan enable 3=All enable
P1237	PLC fault action configuration: Number of Cooling Fan For Transformer Cabinet Is Insufficient	0	8	–	1	See 6.2 Fault Response Configuration.

4.4 Analog and Digital Parameters

Table 72: Analog Input

ID	Parameter	Min	Max	Unit	Default	Description
P0065	Analog input filter	0	65535	–	10	Average calculation point
P0200	Speed given analog input filter bandwidth	0	65535	Hz	5	–
P0201	Analog input 1 function selection	0	1	–	1	0=None 1=Speed setting
P0202	Analog input 2 function selection	0	1	–	0	0=None 1=Speed setting
P0203	Analog input 1 zero point adjustment	0	65535	–	6485	6485=4 mA
P0204	Analog input 1 amplitude adjustment	0	65535	–	31999	31999=20 mA
P0205	Analog input 2 zero point adjustment	0	65535	–	6485	6485=4 mA

ID	Parameter	Min	Max	Unit	Default	Description
P0206	Analog input 2 amplitude adjustment	0	65535	–	31999	31999=20 mA
P0224	Average value of analog input 1	–	–	–	2	Read only
P0225	Average value of analog input 2	–	–	–	1	Read only
P0295	Analog input channels 1 range	0	65535	–	1523	–
P0296	Analog input channels 2 range	0	65535	–	1523	–

Table 73: Analog Output

ID	Parameter	Min	Max	Unit	Default	Description
P0207	Analog output channel 1 function selection	0	65535	–	27	1=Uain 2=Ubin 3=Ucin 4=Uuout 5=Uvout 6=Uwout 7=Iain 8=Icin 9=Iuout 10=Iwout 11=AI1 12=AI2 13=Uin_RMS 14=Uout_RMS 15=Iin_RMS 16=Iout_RMS 17=PFin 18=PFout 19=Pin 20=Pout 21=Qin 22=Qout 23=Sin 24=Sout 25=Efficiency 26=Speed target 27=Running speed
P0208	Analog output channel 2 function selection	0	65535	–	16	
P0209	Analog output channel 3 function selection	0	65535	–	14	
P0210	Analog output channel 4 function selection	0	65535	–	183	
P0227	Analog output signal selection	0	15	–	0	Low four bits shows 4 channel, but value is decimal： • bit0=Channel 1 • bit1=Channel 2 • bit2=Channel 3 • bit3=Channel 4 Bit definition: • 0=Current mode, 4–20 mA • 1=Voltage mode, 0–10 V

ID	Parameter	Min	Max	Unit	Default	Description
P0297	Analog output channels 1 range	0	65535	–	1490	–
P0298	Analog output channels 2 range	0	65535	–	148	–
P0299	Analog output channels 3 range	0	65535	–	9000	–
P0300	Analog output channels 4 range	0	65535	–	4096	–

4.5 Function Parameters

Table 74: Auto Tuning

ID	Parameter	Min	Max	Unit	Default	Description
P0591	Auto tuning mode	0	4	–	0	0=Disable 1=Identification with motor rotating 2=Identification without motor rotating 3=Use parameters provided by motor supplier 4=Use empirical parameters
P0592	Auto tuning execution status	0	2	–	0	Read only 0=None 1=tuning in process 2=Tuning finished
P0593	Auto tuning no-load running frequency	0	33000	0.01 Hz	5000	–
P0594	Auto tuning no-load running time	1	50	s	5	–
P0595	Auto tuning simulate stall running frequency	0	33000	0.01 Hz	5000	–
P0596	Auto tuning simulate stall running current	1	100	%	30	–
P0597	Auto tuning simulate stall running time	1	50	s	5	–
P0522	Kp for Auto tuning current controller	0	65535	0.01	30	–
P0523	Ki for Auto tuning current controller	0	65535	0.01	300	–
P0600	Auto tuning simulate stall running time	1	50	s	5	Waiting time from no load mode to stall mode
P1035	SLVC running speed of mechanical parameter identification	0	100	%	20	Percentage of motor rated speed
P1036	Torque reference of mechanical parameter identification	0	100	%	10	Percentage of motor rated torque
P1037	Speed sampling point 1	0	100	%	80	Percentage of motor rated speed
P1038	Speed sampling point 2	0	100	%	85	Percentage of motor rated speed
P1039	Speed sampling point 3	0	100	%	90	Percentage of motor rated speed

ID	Parameter	Min	Max	Unit	Default	Description
P1040	Speed sampling point 4	0	100	%	95	Percentage of motor rated speed
P1043	Free stop speed of mechanical parameter identification	50	150	%	100	Percentage of motor rated speed
P1044	Torque control maximum time of mechanical parameter identification	10	300	s	60	–
P1045	Mechanical parameter identification enable	0	1		1	0=Disable 1=Enable

Table 75: Forward/Reverse Run

ID	Parameter	Min	Max	Unit	Default	Description
P0013	Motor rotation direction	0	2	–	0	0=Forward 1=Reverse 2=Two-way

Table 76: Speed Ramps Selection

ID	Parameter	Min	Max	Unit	Default	Description
P1001	Speed ramps selection mode	0	2	–	0	0=HMI 1=DI 2=Communication
P1002	Speed ramps selection	0	2	–	0	0=Ramp 1 1=Ramp 2 2=Ramp 3
P1003	Acceleration time of ramp 1	1	3600	s	180	–
P1004	Acceleration time of ramp 2	1	3600	s	270	–
P1005	Acceleration time of ramp 3	1	3600	s	360	–
P1006	Deceleration time of ramp 1	1	3600	s	450	–
P1007	Deceleration time of ramp 2	1	3600	s	675	–
P1008	Deceleration time of ramp 3	1	3600	s	900	–
P0061	Minimum time of acceleration and deceleration	1	3600	s	60	–

Table 77: S-curve

ID	Parameter	Min	Max	Unit	Default	Description
P0475	S-curve enable	0	1	–	0	0=Disable 1=Enable
P0476	S-curve acceleration rising time	0	50	%	10	–

Table 78: Frequency Skipping

ID	Parameter	Min	Max	Unit	Default	Description
P0078	Frequency skipping point 1	100	33000	0.01 Hz	1500	–
P0079	Frequency skipping point 2	100	33000	0.01 Hz	2500	–
P0080	Frequency skipping point 3	100	33000	0.01 Hz	3500	–
P0081	Bandwidth of frequency skipping point 1	0	2000	0.01 Hz	0	–
P0082	Bandwidth of frequency skipping point 2	0	2000	0.01 Hz	0	–
P0083	Bandwidth of frequency skipping point 3	0	2000	0.01 Hz	0	–

Table 79: Multi-point U/f

ID	Parameter	Min	Max	Unit	Default	Description
P0089	Multi-point U/f enable	0	1	–	0	0=Disable 1=Enable
P0150	Frequency point 1 of multi-point U/f	0	33000	0.01 Hz	1000	–
P0151	Voltage point 1 of multi-point U/f	0	65535	V	1600	–
P0152	Frequency point 2 of multi-point U/f	0	33000	0.01 Hz	3000	–
P0153	Voltage point 2 of multi-point U/f	0	65535	V	5000	–

Table 80: Torque Boost

ID	Parameter	Min	Max	Unit	Default	Description
P0004	Torque boost voltage	0	300	‰	0	–

Table 81: AVR

ID	Parameter	Min	Max	Unit	Default	Description
P0031	AVR enable	0	1	–	0	0=Disable 1=Enable

Table 82: Dead-band Compensation

ID	Parameter	Min	Max	Unit	Default	Description
P0960	Dead-band compensation enable	0	1	–	0	0=Disable 1=Enable
P0961	Frequency lower limit of dead-band compensation	0	200	%	0	–
P0962	Frequency upper limit of dead-band compensation	0	200	%	50	–
P0963	Coefficient of dead-band compensation Kp	0	65535	%	100	–

Table 83: Jog

ID	Parameter	Min	Max	Unit	Default	Description
P0446	Jog enable	0	1	–	0	0=Disable

ID	Parameter	Min	Max	Unit	Default	Description
						1=Enable
P0447	Maximum target speed of Jog	10	1000	RPM	100	–
P0448	Acceleration time of Jog	1	3600	s	60	0=Rated
P0449	Deceleration time of Jog	1	3600	s	180	Rated=0

Table 84: Flying Start

ID	Parameter	Min	Max	Unit	Default	Description
P0160	Flying start enable	0	1	–	0	0=Disable 1=Enable
P0161	Direction of speed scanning	0	1	–	1	0=Unidirection 1=Bidirection
P0162	Residual voltage threshold for flying start	5	20	%	5	–
P0163	Voltage boost time of U/f mode for residual flying start	1	100	s	2	–
P0164	Voltage boost time of speed scanning	1	100	s	2	–
P0165	Initial frequency of speed scanning	0	300	%	100	–
P0166	Kp coefficient of speed scanning	0	65535	%	100	–
P0167	Ki coefficient of speed scanning	0	65535	%	100	–
P0168	Current stability threshold of speed scanning	0	100	%	20	–
P0169	Speed accuracy of speed scanning	0	100	%	5	–
P0170	Maximum time of speed scanning	0	300	s	30	–
P0171	Demagnetized time for rotary direction judgment of speed scanning	0	65535	s	10	–
P0172	Flying start result	–	–	–	0	bit0=Residual flying start failed bit1=Voltage boost timeout bit2=Current stable timeout bit3=Speed estimate failed bit10=Residual flying start succeeded bit11=Search start succeeded

Table 85: DC Braking

ID	Parameter	Min	Max	Unit	Default	Description
P0586	DC braking enable	0	1	–	0	0=Disable 1=Enable
P0587	DC braking current	0	100	%	50	–

ID	Parameter	Min	Max	Unit	Default	Description
P0588	DC braking start speed	0	100	%	10	–
P0589	DC braking time during start	0	100	s	10	–
P0590	DC braking time during deceleration stop	0	100	s	10	–

Table 86: Field Weakening

ID	Parameter	Min	Max	Unit	Default	Description
P0443	Field weakening enable	0	1	–	0	0=Disable 1=Enable
P0444	Start frequency of field weakening	0	150	%	100	–
P0445	Field weakening coefficient	0	100	%	90	–

Table 87: Energy Saving Operation

ID	Parameter	Min	Max	Unit	Default	Description
P1368	Energy saving operation enable	0	1	–	0	0=Disable 1=Enable
P1370	Coefficient of energy saving operation Ki	0	65535	%	100	–
P1371	Output limit of energy saving operation controller	0	100	%	60	–
P1372	Frequency lower limit of energy saving operation	0	100	%	10	–

Table 88: Droop Control

ID	Parameter	Min	Max	Unit	Default	Description
P1025	Droop coefficient	0	50	%	0	–
P1026	Dynamic droop time constant	0	32	s	0	–
P1027	Speed reference offset of droop	0	20	%	0	–
P1028	Droop mode	0	1	–	0	0=Normal 1=Linear

Table 89: Speed Feedforward

ID	Parameter	Min	Max	Unit	Default	Description
P1031	Speed feedforward enable	0	1	–	0	0=Disable 1=Enable
P1032	Filter bandwidth of speed feedforward	1	100	Hz	10	–

Table 90: Overvoltage Prevention During Deceleration

ID	Parameter	Min	Max	Unit	Default	Description
P0581	Overvoltage prevention during deceleration enable	0	1	–	0	0=Disable

ID	Parameter	Min	Max	Unit	Default	Description
						1=Enable
P0582	Udc upper threshold of overvoltage prevention during deceleration	500	1150	V	1050	–
P0583	Udc lower threshold of overvoltage prevention during deceleration	500	1150	V	1025	–
P0584	Torque attenuation coefficient of overvoltage prevention during deceleration	1	100	%	100	–

Table 91: Symmetrical Bypass

ID	Parameter	Min	Max	Unit	Default	Description
P0028	Maximum number of bypassed power cells per phase	0	3	–	0	–
P0059	Power cell bypass mode	0	2	–	0	0=Symmetrical bypass 1=Reserved 2=Negative sequence compensation
P0392	Maximum modulation ratio of symmetrical bypass	0	1154	0.001	1000	–

Table 92: Negative Sequence Compensation

ID	Parameter	Min	Max	Unit	Default	Description
P0028	Maximum number of bypassed power cells per phase	0	3	–	0	–
P0059	Power cell bypass mode	0	2	–	0	0=Symmetrical bypass 1=Reserved 2=Negative sequence compensation
P0809	Minimum operating power factor of negative sequence compensation	1	100	0.01	30	–
P0810	Coefficient of negative sequence controller Kp	0	65535	%	100	–
P0811	Coefficient of negative sequence controller Ki	0	65535	%	100	–
P0812	Filter bandwidth of negative sequence current	0	65535	0.1 Hz	10	–
P0813	Maximum modulation ratio of negative sequence compensation	0	1000	0.001	860	–
P0814	Minimum operating speed of negative sequence compensation	0	100	%	20	–

Table 93: Input Undervoltage Derating

ID	Parameter	Min	Max	Unit	Default	Description
P0492	Input undervoltage derating enable	0	1	–	1	0=Disable

ID	Parameter	Min	Max	Unit	Default	Description
						1=Enable
P0801	Voltage threshold of input undervoltage derating	0	100	%	90	–
P0802	Modulation ratio of speed deceleration for input undervoltage derating	100	120	0.01	115	–
P0803	Modulation ratio of speed maintenance for input undervoltage derating	100	120	0.01	113	–

Table 94: Low-voltage Ride Through

ID	Parameter	Min	Max	Unit	Default	Description
P0484	Threshold of input power loss	100	900	‰	700	–
P0890	Low voltage ride through enable	0	1	–	0	0=Disable 1=Enable
P0891	DC voltage lower limit of low voltage ride through	0	1300	V	400	–
P0892	Speed lower limit of low voltage ride through	0	100	%	5	–
P0893	Duration time of low voltage ride through	0	65535	ms	1000	–
P0894	Ki coefficient of low voltage ride through field weakening loop	0	65535	%	100	–
P0895	Kp coefficient of low voltage ride through voltage loop	0	65535	%	100	–

Table 95: Automatic Restart

ID	Parameter	Min	Max	Unit	Default	Description
P1352	Automatic restart enable	0	1	–	0	0=Disable 1=Enable
P1353	Reset waiting time of automatic restart	0	65535	0.1 s	5	–
P1354	Trial time of automatic restart	0	65535	0.1 s	600	–
P1355	Number of trials for automatic restart	1	10	–	4	–
P1356	Result of automatic restart	-	-	-	0	0=None 1=Number of trials over limit 2=Duration time of fault over limit of P1354 3=Drive did not stop while fault occurred 4=Drive did not run during restart 5=Output overcurrent occurred during flying start 6=Flying start failed 7=Permanent fault occurred 99=Automatic restart succeeded
P1357	Input undervoltage automatic restart	0	1	–	0	0=Disable 1=Enable
P1358	Input power loss automatic restart	0	1	–	0	0=Disable 1=Enable

ID	Parameter	Min	Max	Unit	Default	Description
P1359	Output overcurrent automatic restart	0	1	–	0	0=Disable 1=Enable
P1360	Output under load automatic restart	0	1	–	0	0=Disable 1=Enable
P1361	Speed setting analog loss automatic restart	0	1	–	0	0=Disable 1=Enable
P1362	Transformer temperature sensor loss automatic restart	0	1	–	0	0=Disable 1=Enable

Table 96: Synchronous Transfer

ID	Parameter	Min	Max	Unit	Default	Description
P0351	Synchronous transfer enable	0	1	–	0	0=Disable 1=Enable
P0350	Inductance of synchronous transfer	0	65535	0.1 mH	70	–
P0352	Switching on current threshold of synchronous transfer	1	100	%	20	–
P0353	Current error threshold of synchronous transfer	1	100	%	7	–
P0766	Fault flag of synchronous transfer	-	-	-	65535	Read only
P0767	Phase error threshold of synchronous transfer	0	65535	0.001 rad	10	–
P0768	Synchronous acceleration of synchronous transfer	1	65535	0.1 rad/s^2	5	–
P0769	Phase regulating slope of synchronous transfer	1	65535	0.01 rad/s	10	–
P0770	Voltage regulating slope of synchronous transfer	1	65535	V/s	100	–
P0771	Voltage error threshold of synchronous transfer	0	100	%	1	–
P0772	Speed error threshold of synchronous transfer	1	1000	‰	5	–
P0775	Kp coefficient of synchronous transfer	1	65535	%	100	–
P0776	Ki coefficient of synchronous transfer	1	65535	%	100	–
P0777	Maximum speed stable time of synchronous transfer	0	65535	s	200	–
P0778	Maximum voltage synchronize time of synchronous transfer	0	65535	s	10	–
P0779	Maximum load transfer time of synchronous transfer	0	65535	s	10	–
P0780	Reactor bypass switch option	0	2	–	0	0=W/O 2=W/I
P0782	Grid current sensor	0	1	–	0	0=W/O 1=W/I

ID	Parameter	Min	Max	Unit	Default	Description
P0783	1st condition of output current threshold without grid current sensor	0	100	%	20	–
P0784	2nd condition of output current threshold without grid current sensor	0	200	%	120	–
P0785	Phase compensation ratio of voltage synchronize for synchronous transfer	0	65535	‰	1000	–

Table 97: Low Temperature Start-up Enable

ID	Parameter	Min	Max	Unit	Default	Description
P1905	Low temperature start-up enable	0	1	–	0	0=Disable 1=Enable
P1906	Threshold of control cabinet low temperature fault	-200	500	0.1 °C	-130	–
P1907	Threshold 1 of control cabinet low temperature alarm	-200	500	0.1 °C	-100	–
P1908	Threshold 2 of control cabinet low temperature alarm	-200	500	0.1 °C	-50	–
P1912	Delay time of low temperature start-up	0	32000	0.1 s	18000	–
P1913	Threshold 3 of control cabinet low temperature alarm	-200	500	0.1 °C	0	–
P1914	Control cabinet temperature return difference	0	100	0.1 °C	20	–

Table 98: Control Cabinet Temperature Adjust

ID	Parameter	Min	Max	Unit	Default	Description
P1909	Control cabinet temperature adjust enable	0	1	–	0	0=Disable 1=Enable
P1910	Threshold of control cabinet overtemperature	0	750	0.1 °C	500	–
P1911	Delay time for control cabinet overtemperature trip	0	30000	Min	30	–

4.6 Multi Motor Parameter Storage

The VACON® 1000 provides parameter storage of eight motors. The function numbers in Table 99 show the storage region of the eight motors respectively.

Table 99: Storage Region of Multi Motors

Motor number	Parameter number
Motor 1	P2001–P2300
Motor 2	P2301–P2600
Motor 3	P2601–P2900
Motor 4	P2901–P3200
Motor 5	P3201–P3500

Motor number	Parameter number
Motor 6	P3501–P3800
Motor 7	P3801–P4100
Motor 8	P4101–P4400

The function numbers in Table 100 define the parameters of the 1st motor in the multi motor parameter storage region. For the parameters of the other motors, refer to the parameters of the 1st motor.

Note: All the function parameters in Table 100 are subject to be referred. The actual contents must be based on each system set.

Table 100: Parameters of 1st Motor

ID	Parameter	Min	Max	Unit	Default	Description
P2003	Motor1 rated voltage	3000	11000	V	6000	–
P2004	Motor1 rated speed	600	3600	RPM	993	–
P2005	Motor1 rated current	20	2000	A	74	–
P2006	Motor1 pole number	2	10	–	6	–
P2008	Motor1 rated torque	0	65535	10 Nm	657	–
P2011	Motor1 stator resistance	0	65535	mΩ	702	–
P2019	Motor1 flux reference	0	65535	0.001 Wb	15200	–
P2021	Motor1 coefficient of SVC speed controller Kp	0	65535	%	100	–
P2022	Motor1 coefficient of SVC speed controller Ki	0	65535	%	100	–
P2023	Motor1 coefficient of SLVC speed controller Kp	0	65535	%	100	–
P2024	Motor1 coefficient of SLVC speed controller Ki	0	65535	%	100	–
P2025	Motor1 coefficient of flux controller Kp	0	1000	%	100	–
P2026	Motor1 coefficient of flux controller Ki	0	1000	%	100	–
P2027	Motor1 coefficient of current controller Kp	0	1000	%	100	–
P2028	Motor1 coefficient of current controller Kp	0	1000	%	100	–
P2031	Motor1 magnetizing current limit	0	200	%	125	–
P2039	Motor1 threshold value of output overload	100	300	%	110	–
P2040	Motor1 initial detect current of output over load	0	1000	%	105	–
P2041	Motor1 duration time of output overload	1	300	s	60	–
P2042	Motor1 detect time window for output overload protection	1	1200	s	600	–
P2045	Motor1 threshold of output overcurrent	0	1000	%	160	–
P2051	Motor1 encoder resolution	1000	10000		5000	–
P2052	Motor1 frequency skipping point 1	100	7500	0.01 Hz	1500	–
P2053	Motor1 frequency skipping point 2	100	7500	0.01 Hz	2500	–
P2054	Motor1 frequency skipping point 3	100	7500	0.01 Hz	3500	–

ID	Parameter	Min	Max	Unit	Default	Description
P2055	Motor1 bandwidth of frequency skipping point 1	0	500	0.01 Hz	0	–
P2056	Motor1 bandwidth of frequency skipping point 2	0	500	0.01 Hz	0	–
P2057	Motor1 bandwidth of frequency skipping point 3	0	500	0.01 Hz	0	–
P2058	Motor1 digital input speed setting 1	0	3600	RPM	800	–
P2059	Motor1 digital input speed setting 2	0	3600	RPM	1200	–
P2060	Motor1 digital input speed setting 3	0	3600	RPM	1500	–
P2061	Motor1 frequency point 1 of multi-point U/f	100	7500	0.01 Hz	1000	–
P2062	Motor1 voltage point 1 of multi-point U/f	0	13200	V	1600	–
P2063	Motor1 frequency point 2 of multi-point U/f	100	7500	0.01 Hz	3000	–
P2064	Motor1 voltage point 2 of multi-point U/f	0	13200	V	5000	–
P2075	Motor1 voltage limit of voltage controller	100	130	%	110	–
P2141	Motor1 speed ramps selection	0	2	–	0	0=Ramp 1 1=Ramp 2 2=Ramp 3
P2142	Motor1 speed ramp 1 acceleration time	1	3600	s	180	–
P2143	Motor1 speed ramp 2 acceleration time	1	3600	s	270	–
P2144	Motor1 speed ramp 3 acceleration time	1	3600	s	360	–
P2145	Motor1 speed ramp 1 deceleration time	1	3600	s	450	–
P2146	Motor1 speed ramp 2 deceleration time	1	3600	s	675	–
P2147	Motor1 speed ramp 3 deceleration time	1	3600	s	900	–
P2148	Motor1 moment inertia of auto tuning	0	65535	0.1 kgm^2	800	–
P2149	Motor1 friction coefficient of auto tuning	0	65535	0.001 Nmg	2620	–
P2150	Motor1 analog input channels 1 range	0	65535	–	1523	–
P2151	Motor1 analog input channels 2 range	0	65535	–	1523	–
P2152	Motor1 analog output channels 1 range	0	65535	–	1490	–
P2153	Motor1 analog output channels 2 range	0	65535	–	148	–
P2154	Motor1 analog output channels 3 range	0	65535	–	9000	–
P2155	Motor1 analog output channels 4 range	0	65535	–	4096	–
P2156	Motor1 rotation direction	0	2	–	0	0=Forward 1=Reverse 2=Two-way
P2157	Motor1 minimum speed	20	1000	‰	20	–
P2158	Motor1 maximum speed	20	1500	‰	1000	–

ID	Parameter	Min	Max	Unit	Default	Description
P2241	Motor1 mutual inductance	0	65535	0.1 mH	4320	–
P2242	Motor1 leakage inductance	0	65535	0.1 mH	130	–
P2243	Motor1 rotor resistance	0	65535	mΩ	345	–

4.7 PID Setup

See also 3.6.5 PID Setup.

Procedure

1. To enable the PID function in the HMI, select *Setup & Service* > *Operation mode*, and press *PID*.
2. To enter the PID parameters settings, select *Setup & Service* > *PID Setup*.
3. Set the input analog range.

   The PID supports 0–10 V or 4–20 mA analog inputs as PID feedback signal. For example, if 4–20 mA represents 0–5 MPa, set the analog input range to 5.
4. Set the output upper and lower limit values according to the production process of the customer.

   - If the upper limit is 900 RPM, the PID output stays at 900 RPM when the adjusting output value is above 900 RPM.
   - If the lower limit is 300 RPM, the PID output stays at 300 RPM when the adjusting output value is below 300 RPM.
5. Set the error band.

   The error band value is equal to the SV-PV deviation. If the difference between SV and PV is smaller than the error band, PID stops output and the drive maintains the current output speed.
6. Set proportional gain to 1, integral gain to 1, and differential gain to 1.
7. Set SV to a value which is identical with the input analog range.
8. Press *START*, but do not press *Output Enable*.

   The PID output increases by a slope.
9. Adjust the integral gain to make the accelerated speed of PID output similar to the accelerated speed of the drive.
10. Set the SV value and press *Output Enable*.
11. Start the drive, and observe the PID adjustment speed.
    - If the PID adjustment is too fast, decrease the integral gain.
    - If the PID adjustment is too slow, increase the integral gain.

Example

If the drive cannot receive a PID analog feedback signal (4–20 mA), "PID analog feedback loss" occurs, and the drive keeps running under the current speed. If the "PID analog feedback loss" disappears, the PID resumes operation.

5 Parameter Descriptions

5.1 System Parameters

5.1.1 Transformer

5.1.1.1 (P0195) Transformer Tap Position

Use this parameter to select the tap position of the transformer between 95–105%.

- When the input voltage remains high, the transformer tap can be adjusted to +5% position, and the parameter P0195 must be set to 105%.
- When the input voltage remains low, the transformer tap can be adjusted to -5% position, and the parameter P0195 must be set to 95%.

5.1.2 Position of Output Central Point

5.1.2.1 (P0498) Direction of Output Voltage

Use this parameter to select the direction of the output voltage. The direction depends on the way the output voltage central point is connected to the power cells. The power cell busbar and cable connections are visible when facing the front of the power cell cabinet.

- If the output voltage central point is connected to the left side busbar of the power cells, set the parameter P0498 to 0 (Forward).
- If the output voltage central point is connected to the right side busbar of the power cells, set the parameter P0498 to 1 (Reverse).

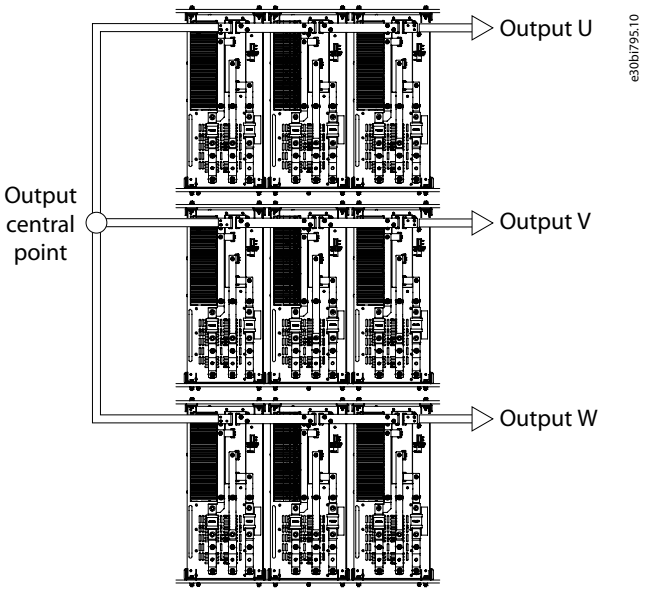

Illustration 17: Direction of Output Voltage

5.1.3 DCS Configuration

5.1.3.1 (P0790) DCS Direction Signal Enable

Use this parameter to enable or disable the DCS direction signal selection.

- P0790 = 1 (enable): The motor rotation direction is set by X7 of PLC digital input DIDO5 (0 = forward; 1 = Reverse).
- P0790 = 0 (disable): The motor rotation direction is set with parameter P0013.

5.1.4 Bypass Cabinet

5.1.4.1 (P0244) Frequency Threshold of System Automatic Bypass

Use this parameter to set the frequency threshold of the system automatic bypass.

5.1.4.2 (P0247) Automatic System Bypass Failure Detection Time

Use this parameter to set the failure detection time of the automatic system bypass.

5.1.4.3 (P0791) Bypass Cabinet Type

Use this parameter to select the type of the installed bypass cabinet.

- 0=No bypass cabinet
- 1=Manual bypass Cabinet
- 2=Auto bypass cabinet
- 3=Synchronous transfer Cabinet

When bypass cabinet type is 2 and a system bypass fault occurs, an auto bypass is executed if both of these conditions apply:

- The motor speed is above the frequency threshold of the system automatic bypass (P0244).
- The difference between motor speed and reference speed is less than 5%.

If these 2 conditions do not apply, the system trips and an “Auto bypass condition is not satisfied” fault is generated.

When the system auto bypass starts, if the bypass switches have not operated within the “Automatic system bypass failure detection time” (P0247), an auto bypass fault is generated.

5.1.5 Restore Factory Settings

5.1.5.1 (P0002) Default Factory Setting

If needed, use this parameter to set the system parameters of the drive to the default factory settings.

5.2 Motor Parameters

5.2.1 Multi Motor Configuration

When the drive is used as a multi-split soft starter, it can drive 8 motors at most.

Specify the motor by HMI, DI, or communication.

Motor selection cannot be changed while the drive is running.

5.2.1.1 (P0635) Motor Selection Mode

Use this parameter to set the motor selection mode.

- 0 = HMI. Do the motor selection with parameter P0636. See 5.2.1.2 (P0636) Motor Selection.
- 1 = DI. Do the motor selection with X2–X4 of PLC digital input DIDO5. See Table 101.
- 2 = Communication. Do the motor selection with RS485 or Ethernet. See Table 102.

If the motor selection mode is DI or communication, and the remote select motor command is different from the value of Motor selection (P0636) for over 5 s, a “Remote signal select motor failure” alarm is generated. System start is forbidden while the alarm is active.

Table 101: DI Mode of Motor Selection (0=Open, 1=Close)

Motor	X4	X3	X2
Motor 1	0	0	0
Motor 2	0	0	1
Motor 3	0	1	0
Motor 4	0	1	1

Motor	X4	X3	X2
Motor 5	1	0	0
Motor 6	1	0	1
Motor 7	1	1	0
Motor 8	1	1	1

Table 102: Communication Mode of Motor Selection

Motor	Communication data
Motor 1	1
Motor 2	2
Motor 3	3
Motor 4	4
Motor 5	5
Motor 6	6
Motor 7	7
Motor 8	8

5.2.1.2 (P0636) Motor Selection

Use this parameter to select the motor 1–8.

Motor selection cannot be changed while the drive is running.

5.2.1.3 (P0637) Maximum number of motors

Use this parameter to select the maximum number of motors.

When the drive is used as a multi-split soft starter, it can drive a maximum of 8 motors.

5.2.2 Motor Rated Parameters

5.2.2.1 (P0074) Motor Rated Frequency

Use this parameter to set the rated motor frequency according to the motor nameplate (the unit is 0.01 Hz).

5.2.2.2 (P0075) Motor Rated Speed

Use this parameter to set the rated motor speed according to the motor nameplate (the unit is RPM).

5.2.2.3 (P0409) Motor Rated Voltage

Use this parameter to set the rated motor voltage according to the motor nameplate (line voltage).

5.2.2.4 (P0410) Motor Rated Current

Use this parameter to set the rated motor current according to the motor nameplate.

5.2.2.5 (P0413) Motor Pole Number

Use this parameter to set the motor pole number according to the motor nameplate.

5.2.3 Speed Operation Configuration

5.2.3.1 (P0013) Motor Rotation Direction

Use this parameter to select the rotation direction of the motor. Set the parameter according to the actual working condition. The motor rotation direction can be set from local or remote.

To select the motor rotation direction with P0013, the DCS direction signal (P0790) must be disabled. See 5.1.3.1 (P0790) DCS Direction Signal Enable.

Table 103: Setting Mode of P0013 Motor Rotation Direction

Reference set	Operation mode			Valid value	
	HMI	Digital	Communication	U/f	VC[1]
HMI	Local	Remote	Remote	0/1	0/1/2
Digital	Local	Remote	Remote	0/1	0/1/2
Analog	Local	Remote	Remote	0/1	0/1
Communication	Local	Remote	Remote	0/1	0/1/2
PID	Local	Remote	Remote	0/1	0/1/2

[1] Vector Control

- If "Reference set" mode is HMI/Digital/Communication/PID, and if P0013 is 0, negative reference speed setting is forbidden.
- If P0013 is 1, positive reference speed setting is forbidden.
- If P0013 is 2, both positive and negative reference speed can be set.

Motor rotation direction cannot be changed when the drive is running.

If the DCS direction signal is enabled (P0790 = 1), and if the remote select motor direction command is different from P0013, and the duration time is over 5 s, a "remote signal select motor direction failure" alarm is generated, and system start is forbidden.

5.2.3.2 (P0076) Minimum Speed

Use this parameter to set the minimum speed of the motor. Set the parameter according to the requirements of the application.

5.2.3.3 (P0077) Maximum Speed

Use this parameter to set the maximum speed of the motor. Set the parameter according to the requirements of the application.

5.2.4 Motor Model

5.2.4.1 (P0441) Flux Reference

Use this parameter to set the flux reference value for the motor.

See 5.5.13 Field Weakening.

5.2.5 Speed Controller

5.2.5.1 (P0438) Maximum Torque Limit

Use this parameter to set the maximum torque limit for the drive.

5.2.5.2 (P0439) Braking Torque Limit

Use this parameter to set the torque limit during deceleration.

5.3 Protection Parameters

5.3.1 Input Overcurrent (Software)

If both these conditions apply, the Input overcurrent (software) fault is generated:

- Both the MCB and the switch of the startup cabinet are closed.
- The RMS value of the 3-phase input current is higher than the threshold of the input overcurrent (P1073).

5.3.2 Input Phase Loss

If the unbalanced degree of input voltage is higher than the voltage threshold of input phase loss (P4089) for the set duration (P1251), the input phase loss fault is generated.

5.3.3 Input Power Loss

If the voltage values of three input phases are all lower than the voltage threshold (P0484) while the MCB is closed, the input power loss fault is generated.

5.3.4 Input Undervoltage

If the RMS value of the 3-phase input voltage is lower than the set threshold value (P0047) for the set duration (P1253) while the MCB is closed, the input undervoltage fault is generated.

5.3.5 Input Overvoltage

If the RMS value of the 3-phase input voltage is higher than the set threshold value (P0054) for the set duration (P1254) while the MCB is closed, the input overvoltage fault is generated.

5.3.6 Input Grounding

If input phase loss does not occur, but the input zero-sequence voltage is higher than the set threshold (P0877) for the set duration (P1255), the input overvoltage fault is generated.

5.3.7 Input Sequence Fault

If the phase sequence of the input voltages is incorrect, the input sequence fault is generated.

5.3.8 Output Overcurrent (Software)

If the RMS value of the 3-phase output current is higher than the threshold (P0046) for the set duration (P1258), the output overcurrent (software) fault is generated.

5.3.9 Output Overload

While the output current is below the initial detect current of the output overload (P0062), the output overload is not detected, and the drive can run continuously. By default, the output overload condition is 115% (P0088×P0062) for 1 minute (P0032) every 10 minutes (P0193). If the load of the motor exceeds the threshold, the output overload fault is generated.

5.3.10 Output Phase Loss

If both these conditions apply, the output phase loss fault is generated:

- The difference between one phase output current and the maximum current of the three phases is larger than the 1st threshold of the output phase loss protection (P0068).
- The output current of this phase is less than the 2nd threshold of the output phase loss (P0198).

5.3.11 Output Grounding

If both these conditions apply, the output grounding fault is generated:

- The difference between one phase output voltage and the maximum voltage of the three phases is larger than the 1st threshold of the output grounding (P0488).
- The output voltage of this phase is less than the 2nd threshold of the output grounding (P0197).

5.3.12 Output Phase Imbalance Alarm

The system starts to detect output phase imbalance above the active frequency of output phase imbalance protection (P1010). If the cumulative time that the output unbalanced degree is above the alarm threshold (P1011) is more than the fault duration (P1262) during 10 minutes of continuous running, the output phase imbalance alarm is generated.

5.3.13 Output Phase Imbalance Fault

The system starts to detect output phase imbalance above the active frequency of output phase imbalance protection (P1010). Once the unbalanced degree of output voltage is above the threshold of output voltage imbalance fault (P1012), a counter starts to count the imbalance time. When the unbalanced degree is below the threshold (P1012) before the counter rises to the fault duration time of output phase imbalance fault (P1263), the timer counts reverse. If the time counter rises to the set duration (P1263), the output phase imbalance fault is generated.

5.3.14 Output Underload

Output underload is not detected:

- Below 5 Hz
- In U/f mode

Once the motor works in the underload area, a counter starts to count the underload time. When the underload fault disappears before the counter raises to the fault duration time of output underload (P1264), the timer counts reverse. If the time counter rises to the set duration (P1264), the output underload fault is generated.

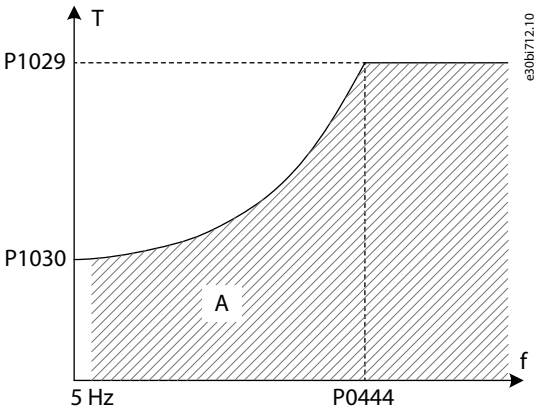

Illustration 18: Output Underload

A	Underload area	T	Torque
f	Frequency		

5.3.15 Electronic Motor Thermal Protection

When the calculated temperature or temperature rise is higher than the threshold, the electronic motor thermal protection fault is generated.

5.3.15.1 (P1017) Motor Ambient Temperature

Use this parameter to set the ambient temperature at the motor location.

5.3.15.2 (P1018) Motor Zero Speed Cooling Coefficient

Use this parameter to set the cooling factor at 0 speed. When speed is 0, P1018 is in relation to the point where the motor operates at P1020*P1018 of the rated motor current with the rated temperature rise (P1021).

5.3.15.3 (P1019) Motor Thermal Time Constant

The motor thermal time constant is the time during which the temperature rise becomes 63% of rated when the current is P1020 of rated. In different motors, the motor thermal time constant is different. The motor manufacturer can provide the data with the motor.

5.3.15.4 (P1020) Motor Thermal Load Capacity

Use this parameter to set the thermal load ability of the motor. At nominal speed, the load capacity is in relation to the point where the motor operates at the set % of rated motor current with the rated temperature rise (P1021).

5.3.15.5 (P1022) Motor Insulation Grade

The motor insulation grade describes different allowed motor temperatures and different allowed temperature rises under different ambient temperatures, which refer to NEMA MG1. If the reference standard for motors is different, the setting values of P1023 and P1024 must be modified. The parameters P1023 and P1024 adjust the motor temperature threshold and temperature rise threshold internally.

5.3.16 Motor Stall

In SVC/SLVC mode, the motor stall fault is generated if all the following conditions apply:

- Motor speed is less than the speed threshold of motor stall (P0572).
- Current reference speed is larger than the motor stall (P0572).
- Output torque is limited by maximum torque.

5.3.17 Motor Reverse

In SVC/SLVC mode, the motor reverse fault is generated if one of the following conditions applies:

- Motor speed is negative and motor rotation direction (P0013) is 0.
- Motor speed is positive and motor rotation direction (P0013) is 1.

5.3.18 Motor Overspeed

In SVC/SLVC mode, if the motor speed is higher than the threshold of motor overspeed (P0579) for the set duration (P1268), the motor overspeed fault is generated.

The value for motor overspeed (P0579) must be higher than the maximum speed (P0077).

5.3.19 Motor Underspeed

In SVC/SLVC mode, if the motor speed is lower than the threshold of underspeed (P0580) for the set duration (P1269), the motor underspeed fault is generated.

5.3.20 Speed Setting Analog Loss

If the enable setting (P1072) is 1, speed setting analog loss is not detected before running.

If AI1/AI2 loss occurs, and if the analog input 1/2 function selection (P0201/0202) is 1, the speed setting analog loss fault is generated.

5.3.21 Encoder Abnormal

If one of these conditions applies, the encoder abnormal fault is generated:

- The consecutive lost signal of encoder is higher than the speed error threshold for encoder fault (P0398).
- The error between encoder speed and estimated speed is higher than the speed error threshold for encoder fault (P0398).
- The encoder signal loss rate per cycle is higher than the loss ratio threshold of encoder fault (P1083).

5.3.22 Input Overcurrent (Hardware)

If the input current is larger than 210% of the input current sample rating, the input overcurrent (hardware) fault is generated.

5.3.23 Output Overcurrent (Hardware)

If the output current is larger than 210% of the output current sample rating, the output overcurrent (hardware) fault is generated.

5.3.24 External Fault

Connect the external fault signal wiring to the DI of the I/O board in the main controller, and set the corresponding parameter P0101–P0108 to 3. The switching node must be normal open. If the switching node opens, the external fault is generated.

5.3.25 Current Sensor Power Fault

If the LEM power board is not energized, the current sensor power fault is generated.

5.3.26 Air Filter Clogged

The fault is detected during fan operation. If the air filter is clogged for over 5 minutes, the air filter clogged fault is generated.

5.3.27 Upstream Main Circuit Breaker Abnormal Open

If an upstream main circuit breaker is open when the drive is running, the upstream main circuit breaker abnormal open fault is generated.

5.3.28 HV Cabinet Door Open

If an HV cabinet door is open for over 3 s, the HV Cabinet door open is generated.

5.3.29 External/Customer Control Power Loss

If external control power is lost for over 3 s, the external/customer control power loss fault is generated.

5.3.30 Internal Control Power Loss

If internal control power is lost for over 10 s after HV power-on, the internal control power loss fault is generated.

5.3.31 Transformer Overtemperature Alarm

If the phase temperature of the transformer is higher than the transformer overtemperature alarm threshold (P0253), but lower than the transformer overtemperature fault threshold (P0254), the transformer overtemperature alarm is generated.

5.3.32 Transformer Overtemperature Fault

If the phase temperature of the transformer is higher than the transformer overtemperature fault threshold (P0254), the transformer overtemperature fault is generated.

5.3.33 PLC-DSP Communication Failure

If the PLC loses communication with the DSP, the PLC-DSP communication failure is generated.

5.3.34 Cooling Fan Abnormal

Cooling fan abnormal is detected when fan redundancy (P0241) is set to 0 and a cooling fan is running. If a fan has a problem and the duration is more than 5 s, the cooling fan abnormal fault is generated.

5.3.35 UPS Undervoltage

If UPS undervoltage occurs and the duration is more than 3 s, the UPS undervoltage fault is generated.

5.3.36 Fan Internal Power Loss

The fan internal power loss fault is detected when fan redundancy (P0241) is set to 0 and a cooling fan is running. If the duration of the fault is more than 5 s, the fan internal power loss fault is generated.

5.3.37 Fan External Power Loss

The fan external power loss fault is detected when customer fan power enable (P0787) is set to 1. If the duration of the fault is more than 5 s, the fan external power loss fault is generated.

5.3.38 Transformer Temperature Sensor Loss

If the transformer temperature sensor of any phase is lost for over 3 s, the transformer temperature sensor loss fault is generated.

5.3.39 PLC-HMI Communication Failure

When a PLC-HMI communication failure occurs and the duration is more than 3 s, the PLC-HMI communication failure is generated.

When the PLC-HMI communication failure disappears, the fault is reset after 3 s.

5.3.40 Upstream Main Circuit Breaker Close Failure

If an upstream main circuit breaker is not closed in 3 s after sending the close command, the upstream main circuit breaker close failure is generated.

5.3.41 Upstream Main Circuit Breaker Open Failure

If an upstream main circuit breaker is not open in 3 s after sending the open command, the upstream main circuit breaker open failure is generated.

5.3.42 Startup Cabinet Switch Abnormal Open

The startup cabinet switch abnormal open is detected when the precharge mode (P0285) is set to 1. When the startup cabinet switch is closed after HV power-on, if the startup cabinet switch turns off without command before HV power-off, the startup cabinet switch abnormal open is generated.

5.3.43 Startup Cabinet Switch Open Failure

The startup cabinet switch open failure is detected when precharge mode (P0285) is set to 1. If the startup cabinet switch is not open in 3 s after sending an open command, the startup cabinet switch open failure is generated.

5.3.44 Startup Cabinet Switch Close Failure

The startup cabinet switch close failure is detected when precharge mode (P0285) is set to 1. If the startup cabinet switch is not closed in 3 s after sending a close command, the startup cabinet switch close failure is generated.

5.3.45 No Startup Cabinet Switch Close Command

The no startup cabinet switch close command is detected when precharge mode (P0285) is set to 1. After HV power-on, if a PLC-DSP communication failure occurs before the startup cabinet switch is closed, the no startup cabinet switch close command fault is generated.

5.3.46 Cooling Fan 2X Failure

Cooling fans 21–24 are installed in the power cell cabinet. The cooling fan faults are detected when fan redundancy (P0241) is set to 1 or 3, and cooling fans are running. If a cooling fan is abnormal and the duration is more than 5 s, the cooling fan2X failure is generated.

5.3.47 Number of Cooling Fans for Power Cell Cabinet is Insufficient

The number of cooling fans for power cell cabinet insufficient fault is detected when fan redundancy (P0241) is set to 1 or 3. The number of power cell cabinet fans is N. When the quantity of operating fans is less than N-1, the number of cooling fans for power cell cabinet is insufficient fault is generated.

5.3.48 Cooling Fan 3X Failure

Cooling fans 31–34 are installed in the transformer cabinet. The cooling fan faults are detected when fan redundancy (P0241) is set to 2 or 3, and cooling fans are running. If a cooling fan is abnormal and the duration is more than 5 s, the cooling fan 3X failure is generated.

5.3.49 Number of Cooling Fans for Transformer Cabinet is Insufficient

The number of cooling fans for transformer cabinet insufficient fault is detected when fan redundancy (P0241) is set to 2 or 3. The number of transformer cabinet fans is N. When the quantity of operating fans is less than N-1, the number of cooling fans for transformer cabinet is insufficient fault is generated.

5.4 Analog and Digital Parameters

5.4.1 Analog Input

5.4.1.1 (P0065) Analog Input Filter

Use this parameter to select the average calculation point for the analog input channels 1 and 2.

5.4.1.2 (P0200) Speed Given Analog Input Filter Bandwidth

Use this parameter to select the filter bandwidth for the analog input channels 1 and 2.

5.4.1.3 (P0201) Analog Input 1

Use this parameter to select the function of analog input 1.

5.4.1.4 (P0202) Analog Input 2

Use this parameter to select the function of analog input 2.

5.4.1.5 (P0203) Analog Input 1 Zero Point Adjustment

Use this parameter to adjust the zero point of analog input 1.

5.4.1.6 (P0204) Analog Input 1 Amplitude Adjustment

Use this parameter to adjust the amplitude of analog input 1.

5.4.1.7 (P0205) Analog Input 2 Zero Point Adjustment

Use this parameter to adjust the zero point of analog input 2.

5.4.1.8 (P0206) Analog Input 2 Amplitude Adjustment

Use this parameter to adjust the amplitude of analog input 2.

5.4.1.9 (P0224) Average Value of Analog Input 1

This parameter is used to show the filtering results of analog input channel 1. The information is read-only information without a default.

5.4.1.10 (P0225) Average Value of Analog Input 2

This parameter is used to show the filtering results of analog input channel 2. The information is read-only information without a default.

5.4.1.11 (P0295) Analog Input Channels 1 Range

Use this parameter to set the range of analog input channel 1.

5.4.1.12 (P0296) Analog Input Channels 2 Range

Use this parameter to set the range of analog input channel 2.

5.4.2 Analog Output

5.4.2.1 (P0207) Analog Output Channel 1 Function Selection

Use this parameter to select the function of analog output 1.

5.4.2.2 (P0208) Analog Output Channel 2 Function Selection

Use this parameter to select the function of analog output 2.

5.4.2.3 (P0209) Analog Output Channel 3 Function Selection

Use this parameter to select the function of analog output 3.

5.4.2.4 (P0210) Analog Output Channel 4 Function Selection

Use this parameter to select the function of analog output 4.

5.4.2.5 (P0297) Analog Output Channels 1 Range

Use this parameter to set the amplitude adjustment of analog output 1.

5.4.2.6 (P0298) Analog Output Channels 2 Range

Use this parameter to set the amplitude adjustment of analog output 2.

5.4.2.7 (P0299) Analog Output Channels 3 Range

Use this parameter to set the amplitude adjustment of analog output 3.

5.4.2.8 (P0300) Analog Output Channels 4 Range

Use this parameter to set the amplitude adjustment of analog output 4.

5.5 Function Parameters

5.5.1 Auto Tuning

5.5.1.1 (P0591) Auto Tuning Mode

Use this parameter to select the auto tuning mode.

- 0 = Disabled.
- 1 = Identification with motor rotating. There are 4 phases in the identification: no-load U/f operating, stall running, stator resistor identification, and mechanical parameters identification.
- 2 = Identification without motor rotating. There are 3 phases in the identification: stall running, stator resistor identification, and mechanical parameters identification.
- 3 = Use parameters provided by motor supplier. Set motor parameters manually to acquire Vector Control parameters through auto tuning.
- 4 = Use empirical parameters. Motor parameters and Vector Control parameters are calculated by empirical parameters.

It is recommended to use mode 1 to achieve higher precision motor parameters for Vector Control. In this situation, the mechanical connection between the motor and load must be disconnected.

When the motor cannot be driven by VF mode (because of mechanical resonance), or could not be disconnected from the load, it is recommended to use mode 2.

If the motor parameters are already known, it is recommended to use mode 3.

When mode 2, 3 or 4 is selected, mechanical parameter identification is disabled internally. When mode 3 or 4 is selected, the drive does not run during auto tuning.

When the running mode is VF, the drive can drive the motor without running auto tuning. But if flying start is requested with VF mode, the motor parameters must be achieved by running auto tuning to ensure the speed scanning accuracy of flying start. In this case, mode 2 is recommended.

5.5.2 Forward/Reverse Run

See 5.2.3.1 (P0013) Motor Rotation Direction.

5.5.3 Speed Ramps Selection

5.5.3.1 (P1001) Speed Ramps Selection Mode

Use this parameter to set the speed ramps selection mode.

- 0 = HMI. Select the speed ramp with P1002. See 5.5.3.2 (P1002) Speed Ramps Selection.
- 1 = DI. Select the speed ramp with X0 and X1 of PLC digital input DIDO5. See Table 104.
- 2 = Communication. Select the speed ramp with RS485 or Ethernet. See Table 105.

NOTICE

The speed ramp cannot be changed while the drive is running.

Table 104: DI Mode of Speed Ramps Selection

	X1	X0
Ramp 1	0	0
Ramp 2	0	1
Ramp 3	1	0
Reserve	1	1

Table 105: Communication Mode of Speed Ramps Selection

	Communication data
Ramp 1	0
Ramp 2	1
Ramp 3	2

5.5.3.2 (P1002) Speed Ramps Selection

Use this parameter to select the used speed ramp. To use this parameter to select the speed ramp, parameter P1001 must be set to 0 (HMI).

5.5.3.3 (P1003) Acceleration Time of Ramp 1

Use this parameter to set the time that is necessary for the output speed to increase from zero speed to rated speed (P0074).

5.5.3.4 (P1004) Acceleration Time of Ramp 2

Use this parameter to set the time that is necessary for the output speed to increase from zero speed to rated speed (P0074).

5.5.3.5 (P1005) Acceleration Time of Ramp 3

Use this parameter to set the time that is necessary for the output speed to increase from zero speed to rated speed (P0074).

5.5.3.6 (P1006) Deceleration Time of Ramp 1

Use this parameter to set the time that is necessary for the output speed to decrease from rated speed (P0074) to zero speed.

5.5.3.7 (P1007) Deceleration Time of Ramp 2

Use this parameter to set the time that is necessary for the output speed to decrease from rated speed (P0074) to zero speed.

5.5.3.8 (P1008) Deceleration Time of Ramp 3

Use this parameter to set the time that is necessary for the output speed to decrease from rated speed (P0074) to zero speed.

5.5.3.9 (P0061) Minimum Time of Acceleration and Deceleration

Use this parameter to limit the shortest acceleration and deceleration time of the drive output speed. If the set values of P1003–P1008 are lower than the limit, the acceleration or deceleration time is limited to the value of P0061.

⚠ C A U T I O N ⚠

RISK OF OVERCURRENT OR OVERVOLTAGE

If the acceleration time is set too short, it can cause an overcurrent failure. If the deceleration time is set too short, it can cause a voltage rise in the DC link, and more seriously, cause an overvoltage failure of the power cell.

- Set the acceleration and deceleration time according to the rotation inertia of the induction motor and load.

5.5.4 S-curve

5.5.4.1 (P0475) S-curve Enable

Use this parameter to enable the S-curve function.

- 0 = Disable
- 1 = Enable

If the S-curve function is enabled, it applies to all 3 speed ramps. See 5.5.3 Speed Ramps Selection.

5.5.4.2 (P0476) S-curve Acceleration Rising Time

Use this parameter to set the S-curve acceleration rising time.

The S-curve acceleration rising time is used to smooth the start of acceleration and the end of deceleration ramps.

- If the parameter is set to 0%, the ramp is linear.
- If the parameter is set to 1–50%, the ramp is S-shaped.

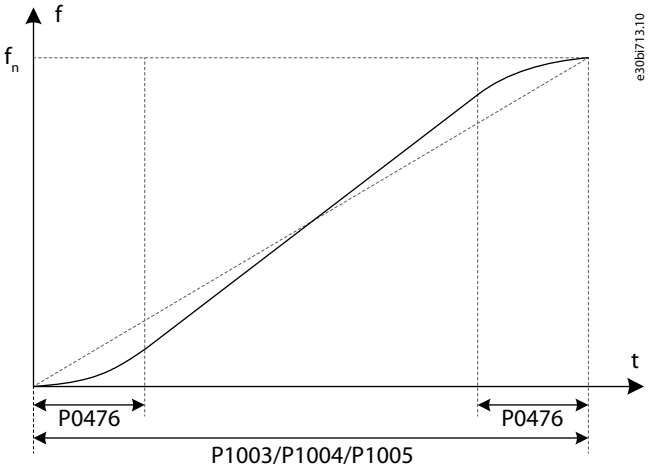

Illustration 19: S-curve

f	Frequency	t	Time
f_n	Nominal frequency		

5.5.5 Frequency Skipping

The frequency skipping function is used to avoid the system mechanical resonance point.

A total of 3 frequency skipping points are configured and two parameters are required to be configured to each skipping point:

- Frequency skipping point (P0078–P0080)
- Frequency skipping bandwidth (P0081–P0083)

When the reference frequency is within the frequency skipping area, the system automatically adjusts the target frequency to the upper limit value when the speed decreases, or to the lower limit value when the speed increases.

If a skipping point is not needed, set the frequency skipping point to a frequency higher than the maximum operation frequency, or set the bandwidth of frequency skipping to 0.

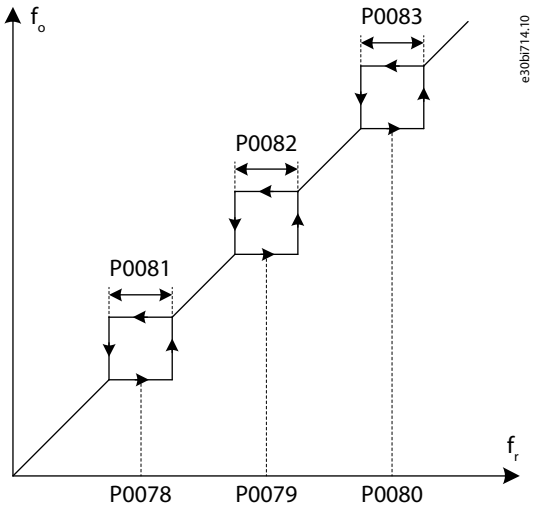

Illustration 20: Frequency Skipping

f_o	Output frequency

f_r	Reference frequency

5.5.6 Multi-point U/f

5.5.6.1 (P0089) Multi-point U/f Enable

Use this parameter to enable the multi-point U/f function.

Two points can be configured for the multi-point U/f function. Two parameters must be set for each U/f point:

- Frequency point 1 (P0150).
- Voltage point 1 (P0151).
- Frequency point 2 (P0152).
- Voltage point 2 (P0153).

The frequency and voltage of the two points must be smaller than the rated frequency f_n and rated voltage U_n. When the two points are set correctly, the U/f curve is as shown in Illustration 21.

If frequency point 1 or voltage point 1 is set to 0, the setting values are invalid, and the multi-point U/f function is ignored.

If frequency point 1 and voltage point 1 are valid, but frequency point 2 is smaller than frequency point 1, then point 2 is ignored.

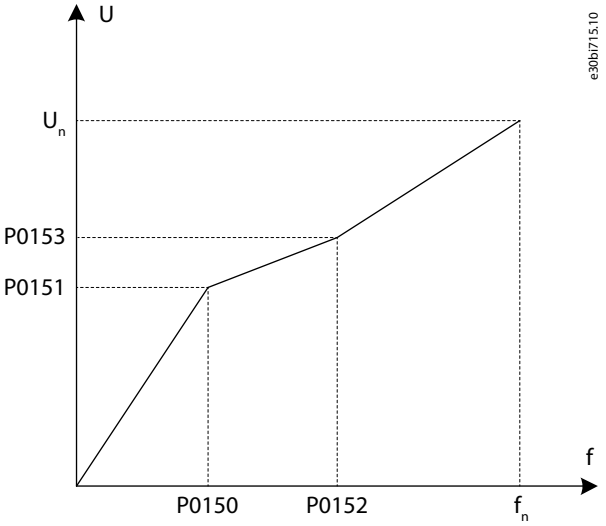

Illustration 21: Multi-point U/f

f	Output frequency	U	Output line voltage (RMS)
f_n	Nominal frequency	U_n	Nominal voltage

5.5.6.2 (P0150) Frequency Point 1 of Multi-point U/f

Use this parameter to set the frequency value for point 1 of the multi-point U/f function.

5.5.6.3 (P0151) Voltage Point 1 of Multi-point U/f

Use this parameter to set the voltage value for point 1 of the multi-point U/f function.

5.5.6.4 (P0152) Frequency Point 2 of Multi-point U/f

Use this parameter to set the frequency value for point 2 of the multi-point U/f function.

5.5.6.5 (P0153) Voltage Point 2 of Multi-point U/f

Use this parameter to set the voltage value for point 2 of the multi-point U/f function.

5.5.7 Torque Boost

5.5.7.1 (P0004) Torque Boost Voltage

Use this parameter to select the torque boost voltage

Torque boost is used to increase the output voltage during low-frequency operation and improve the low-frequency torque characteristics of U/f control.

The setting range of the torque boost voltage is 0–300‰. When the set value is 0, torque boost is disabled and there is no increase, but when the set value is 300‰, the increase range is maximum.

N O T I C E

A high torque boost voltage can cause start-up overcurrent.

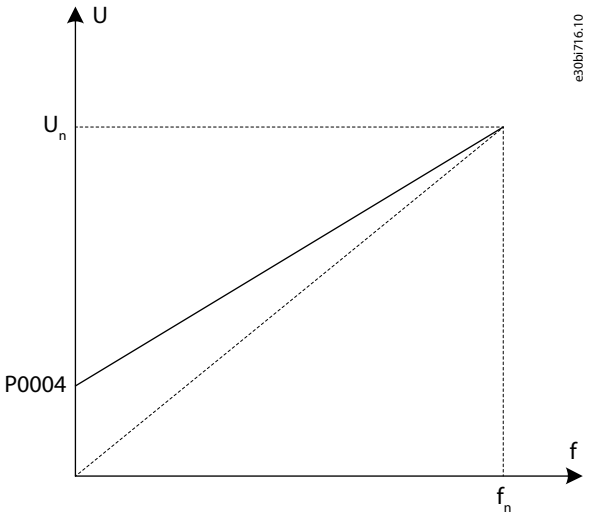

Illustration 22: Torque Boost

f	Output frequency	U	Output voltage
f_n	Nominal frequency	U_n	100% nominal voltage

5.5.8 AVR

5.5.8.1 (P0031) AVR Enable

Use this parameter to enable the automatic voltage regulation (AVR) function.

The AVR function refers to the automatic adjusting function of the output voltage. The output voltage becomes more stable and is not affected by grid fluctuation.

- When the AVR function is disabled, the output voltage changes with the change of the input voltage (or the DC-link voltage).
- When the AVR function is enabled, the output voltage does not change with the change of the input voltage (or the DC-link voltage). The output voltage basically keeps constant within the normal input voltage variation range.

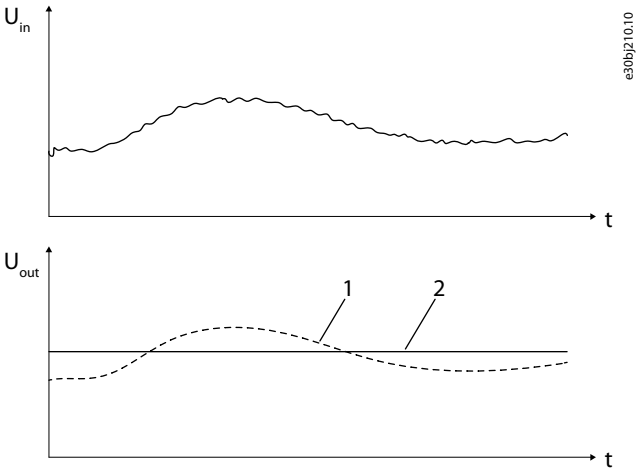

Illustration 23: AVR Function

1	AVR disabled
2	AVR enabled

5.5.9 Dead-band Compensation

5.5.9.1 (P0960) Dead-band Compensation Enable

Use this parameter to enable the dead-band compensation function.

The dead-band compensation function is used to eliminate mechanical vibration of the motor and to ensure normal operation in U/f mode. When the frequency upper limit of the dead-band compensation is higher than the mechanical oscillating frequency of the motor, mechanical vibration of the motor disappears.

This function only applies for U/f mode when executing auto tuning. Set P0601 "Running mode" to 1.

5.5.9.2 (P0961) Frequency Lower Limit of Dead-band Compensation

Use this parameter to set the frequency lower limit of dead-band compensation. Use the default value, or set the value smaller than the mechanical oscillating frequency of the motor.

5.5.9.3 (P0962) Frequency Upper Limit of Dead-band Compensation

Use this parameter to set the frequency upper limit of dead-band compensation. Set the value higher than the mechanical oscillating frequency of the motor.

5.5.9.4 (P0963) Coefficient of Dead-band Compensation Kp

Use this parameter to set the coefficient of dead-band compensation Kp.

If the mechanical vibration of the motor is weakening but not disappearing, increase P0963. For example, change the coefficient value from 100 to 150.

5.5.10 Jog

5.5.10.1 (P0446) Jog Enable

Use this parameter to enable the jog function.

- 0 = Disable
- 1 = Enable

When the jog function is enabled, at start the drive increases speed from 0 to the maximum target speed of jog (P0447). The acceleration time of the jog function is set with P0448. When the drive is stopped, the speed is decreased to 0 according to the deceleration time set with P0449.

5.5.10.2 (P0447) Maximum Target Speed of Jog

Use this parameter to set the maximum target speed of the jog function.

5.5.10.3 (P0448) Acceleration Time of Jog

Use this parameter to set the acceleration time of the jog function. The acceleration time is the setting time that is necessary for the output speed to increase from zero speed to rated speed.

5.5.10.4 (P0449) Deceleration Time of Jog

Use this parameter to set the deceleration time of the jog function. The deceleration time is the setting time that is necessary for the output speed to decrease from rated speed to zero speed.

5.5.11 Flying Start

5.5.11.1 (P0160) Flying Start Enable

Use this parameter to enable the flying start function. The flying start function refers to the start up under the condition that the load motor is not in a static state.

Motor parameters are used in the flying start function. If flying start is enabled in U/f mode, the motor parameters must be achieved by running auto tuning, to ensure the speed scanning accuracy of the flying start.

When the flying start function is enabled, the drive can automatically detect and control the current rotation speed of the load motor. Thus, the drive can accelerate or decelerate to the specified rotation speed without speed or position sensors such as photo-electric encoder.

5.5.11.2 (P0161) Direction of Speed Scanning

Use this parameter to select the direction of the speed scanning.

- P0161 = 0: The drive searches the motor speed according to the direction specified by P0013 "Rotation direction of the motor".
- P0161 = 1: The drive estimates the rotation direction of the motor, then searches the motor speed according to the rotation direction estimation result.

If P0161 is set to 1, and the motor stays at standstill before start, slow counter rotation can happen. If the motor always rotates in only one direction and reverse rotation is not wanted, set P0161 to 0.

5.5.11.3 (P0162) Residual Voltage Threshold for Flying Start

Use this parameter to select the residual voltage threshold for flying start.

When the residual voltage of the motor is greater than P0162, the drive starts through residual voltage phase lock. Otherwise, the drive starts through speed scanning.

5.5.11.4 (P0165) Initial Frequency of Speed Scanning

Use this parameter to select the initial frequency of speed scanning.

P0165 is the maximum scanning frequency. When the drive starts through speed scanning, the drive searches the motor speed from the initial frequency (P0165) to 0.

To avoid overcurrent during the speed scanning, the output current is limited below the rated current.

5.5.11.5 (P0166) Kp Coefficient of Speed Scanning

Use this parameter to select the Kp coefficient of speed scanning.

The Kp coefficient of speed scanning is a PI parameter ratio of speed scanning controller. The greater the PI parameters of speed scanning controller are, the faster the speed scans and the worse the stability is.

5.5.11.6 (P0167) Ki Coefficient of Speed Scanning

Use this parameter to select the Ki coefficient of speed scanning.

The Ki coefficient of speed scanning is a PI parameter ratio of speed scanning controller. The greater the PI parameters of speed scanning controller are, the faster the speed scans and the worse the stability is.

5.5.11.7 (P0168) Current Stability Threshold of Speed Scanning

Use this parameter to select the current stability threshold of speed scanning.

P0168 is the threshold to judge whether the speed scanning controller is stable. The greater the threshold is, the higher the success rate is, and the lower the steady accuracy of the controller is.

5.5.11.8 (P0169) Speed Accuracy of Speed Scanning

Use this parameter to select the speed accuracy of speed scanning.

P0169 is the threshold for speed scanning succeed judgment. The greater the speed accuracy threshold is, the higher the success rate is, and the lower the precision of scanning speed is.

5.5.11.9 (P0170) Maximum Time of Speed Scanning

Use this parameter to select the maximum time of speed scanning.

If the duration time of the speed scanning is more than P0170, flying start failure is generated.

5.5.11.10 (P0171) Demagnetized Time for Rotary Direction Judgment of Speed Scanning

Use this parameter to set the demagnetized time for rotary direction judgment of speed scanning.

If the direction of speed scanning (P0161) is set to two-way, and if the scanning speed is less than P0171, the drive searches the motor speed again in reverse direction.

5.5.11.11 (P0172) Flying Start Result

This parameter shows the result of the flying start function.

When the searching current is less than P0168, and the error between the scanning speed and estimated speed is less than P0169, the speed scanning is successful.

If any fault is generated during flying start, check the fault type in the *Warning & Fault* window, and troubleshoot the problem.

- If P0172 bit1 = 1: Increase P0170 "Maximum time of speed scanning". For example, change P0170 from 30 to 60.
- If P0172 bit2 = 1: Increase P0168 "Current stability threshold of speed scanning". For example, change P0168 from 10 to 20.
- If P0172 bit3 = 1: Increase P0169 "Speed accuracy of speed scanning". For example, change P0169 from 5 to 8.
- Otherwise, check if there is any other fault which stops the system and triggers flying start failure.

5.5.12 DC Braking

Use parameter P0586 to enable the DC braking function.

DC braking at start

DC braking at start is used to drive the motor to a standstill before a normal start. When the system receives a start command, the drive supplies the set output DC current (P0587) for the set duration (P0589).

Two parameters must be set for DC braking at start:

- DC braking current (P0587)
- DC braking time during start (P0589)

If DC braking at start is not required, set P0589 to 0.

DC braking at stop

DC braking at stop is used to brake the motor quickly during stop. When the system receives a stop command, the drive decreases the output speed to the DC braking start speed (P0588) and stops the output. After a fixed time, the drive supplies the set output DC current (P0587) for the set duration (P0590). If the system receives a coast stop command, the drive stops the output and does not implement DC braking anymore.

Three parameters must be set for DC braking at stop:

- DC braking current (P0587)
- DC braking start speed (P0588)
- DC braking time during deceleration stop (P0590)

If DC braking at stop is not required, set P0590 to 0.

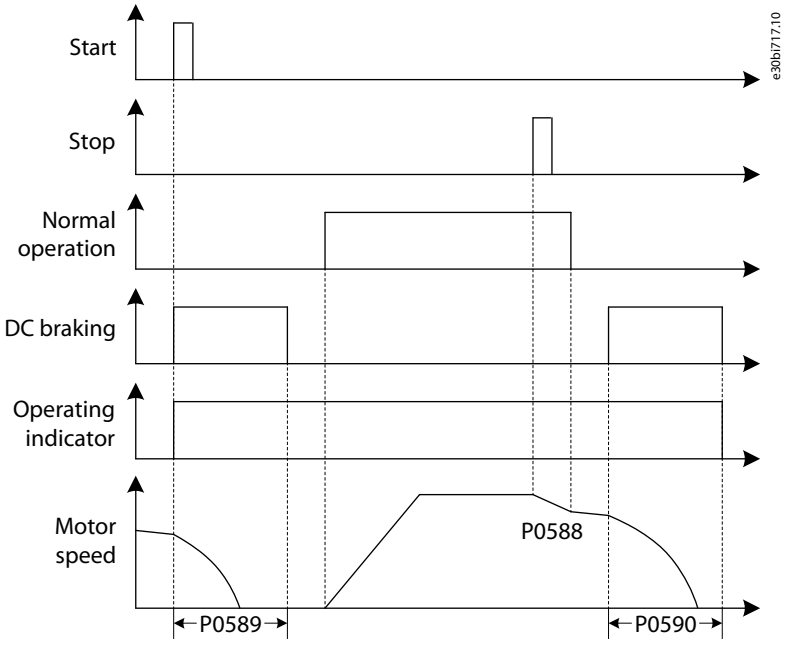

Illustration 24: DC Braking

⚠ C A U T I O N ⚠

RISK OF OVERHEATING OF THE MOTOR

Long DC braking duration and large DC braking current can overheat the motor.

5.5.13 Field Weakening

Use parameter P0443 to enable the field weakening function.

The field weakening function is applied to the load with constant power. When the drive operates below the start frequency of field weakening (P0444), the motor flux is controlled to a constant value (Flux reference, P0441). When the motor speed is above the start frequency of field weakening, the drive decreases flux to make the output voltage remain constant.

Use the field weakening coefficient (P0445) to adjust the function. If the output voltage rise in the field weakening area exceeds expectations, decrease the coefficient. If the output voltage drops, increase P0445. For example, if the output voltage at maximum speed (P0077) rises to 110% of the voltage at P0444, multiply the default value of P0445 by 0.91 (1/110%). Then start the drive, check the output voltage at field weakening area, and fine-tune the value of P0445, if necessary.

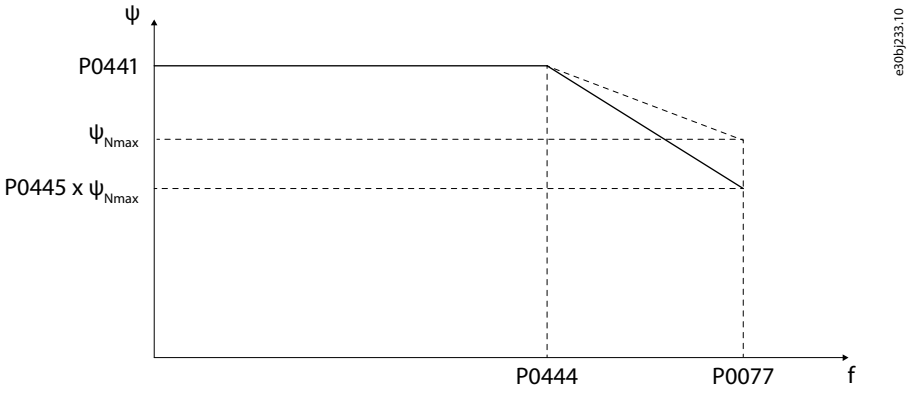

Illustration 25: Field Weakening Function

5.5.14 Energy Saving Operation

5.5.14.1 (P1368) Energy Saving Operation Enable

Use this parameter to enable the energy saving operation.

The energy saving operation function is used to decrease motor current to save energy and decrease the motor noise. This function can be used in applications such as fans and pumps.

When the motor runs under no load or light load, the drive reduces the output voltage automatically to decrease the output current and motor loss. If the load increases, to increase output current and to provide sufficient electromagnetic torque, the output voltage is boosted automatically until the motor flux recovers to the flux reference.

After the energy saving operation is enabled, the motor stator current is reduced. During the deceleration of the motor, the kinetic energy consumed by the motor is decreased, and more energy is fed back to the power units. To avoid DC-link overvoltage caused by the motor speed decrease, it is recommended to increase the deceleration time when the energy saving operation is enabled.

5.5.14.2 (P1370) Coefficient of Energy Saving Operation Ki

Use this parameter to set the coefficient of energy saving operation Ki. The coefficient is the Ki ratio of the energy saving controller. The greater the Ki parameter, the faster the control response is and the worse the stability is.

5.5.14.3 (P1371) Output Limit of Energy Saving Operation Controller

Use this parameter to set the output limit of energy saving operation controller. This parameter is the upper limit of the energy saving controller. When P1371 is increased, the drive can achieve better energy saving performance, but worse stability under light load.

5.5.14.4 (P1372) Frequency Lower Limit of Energy Saving Operation

Use this parameter to set the lower frequency limit of the energy saving operation. When output speed is below the value set with P1372, the energy saving operation is disabled.

5.5.15 Droop Control

5.5.15.1 (P1025) Droop Coefficient

Use this parameter to set the droop coefficient.

Droop coefficient is the speed drooping ratio under rated torque and rated speed.

If droop control is not required, set the droop coefficient to 0.

When synchronous transfer is enabled, droop control is disabled internally.

5.5.15.2 (P1026) Dynamic Droop Time Constant

Use this parameter to set the dynamic droop time constant.

When the dynamic droop time constant is set to 0, droop control is used to balance the load among mechanically connected motors.

When the dynamic droop time constant is set to another value, droop control is used to decrease current fluctuation when the load changes suddenly.

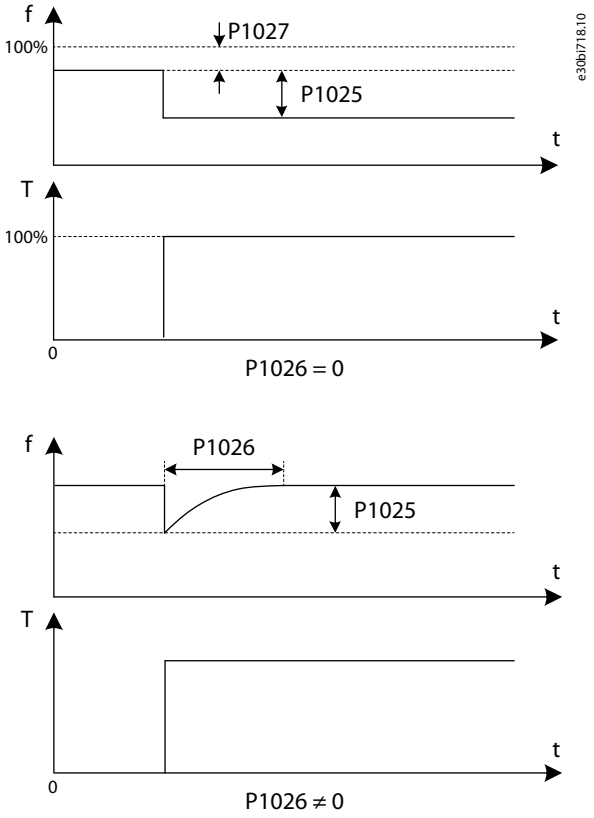

Illustration 26: Droop Control

f	Frequency	T	Torque
t	Time		

5.5.15.3 (P1027) Speed Reference Offset of Droop

Use this parameter to set the speed reference offset of droop control.

Speed reference offset of droop is the static offset percentage of the current speed reference.

If the dynamic droop time constant, P1026 ≠ 0, the speed reference offset of droop (P1027) is invalid.

5.5.15.4 (P1028) Droop Mode

Use this parameter to select the droop mode.

There are two operation modes for droop control:

- Normal (0) = The droop coefficient is constant.
- Linear (1) = The droop coefficient is removed linearly from rated speed to 0.

5.5.16 Speed Feedforward

Speed feedforward control can increase the dynamic response of the output speed under fast acceleration and fast deceleration. It is not recommended to use speed feedforward control if:

- The moment inertia and friction coefficient of the motor have not been provided by the motor manufacturer.
- The mechanical parameter identification of auto tuning has not been implemented.

Speed feedforward control is disabled internally if:

- Droop control is enabled.
- Energy saving operation is enabled.

5.5.17 Overvoltage Prevention During Deceleration

5.5.17.1 (P0581) Overvoltage Prevention During Deceleration Enable

Use this parameter to enable the overvoltage prevention during deceleration.

This function only applies for SVC or SLVC mode. Set P0601 "Running mode" to 2 or 3.

If the deceleration time is set to low, the overvoltage prevention during deceleration function is used to prevent an overvoltage of the DC link during the deceleration.

When the function is enabled, if the DC-link voltage rises beyond the set upper threshold (P0582) during deceleration, the drive outputs a zero torque to make the motor coast, until the voltage reduces beneath the set lower threshold (P0583). After the DC-link voltage reaches the lower threshold, the torque current is recovered, but the speed-reduction parameter is adjusted according to the decay proportion set with parameter P0584. Therefore, the speed of the drive starts to decelerate again from the current speed.

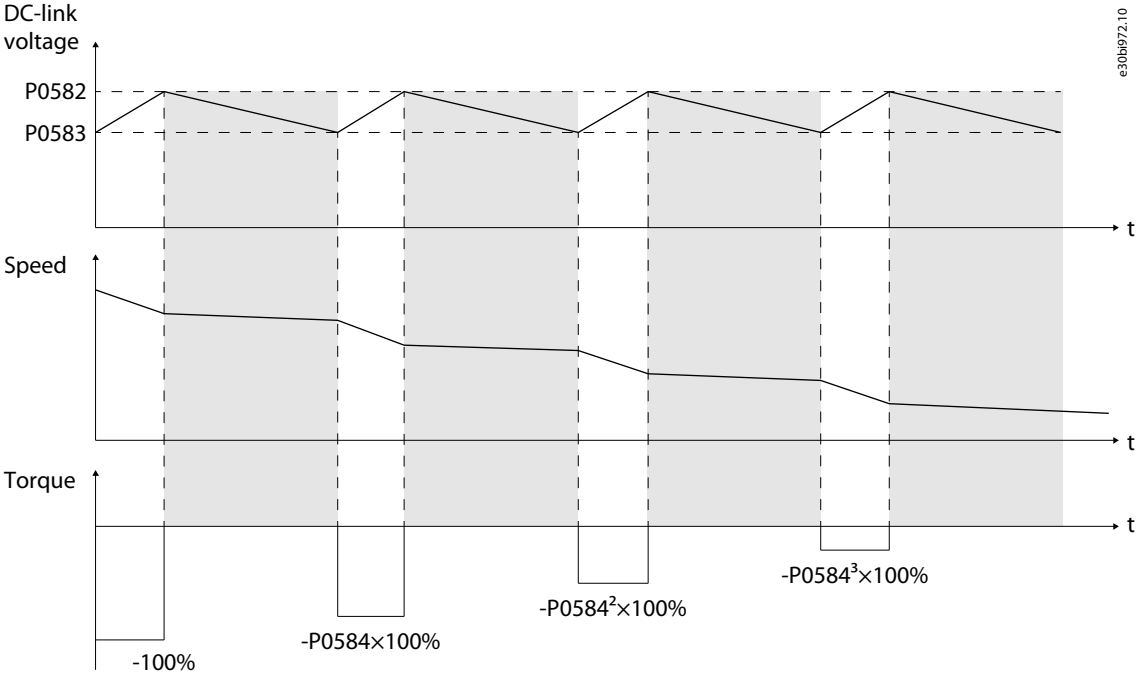

Illustration 27: Overvoltage Prevention During Deceleration

5.5.17.2 (P0582) Udc Upper Threshold of Overvoltage Prevention During Deceleration

Use this parameter to set the upper U_{DC} threshold of the overvoltage prevention during deceleration.

5.5.17.3 (P0583) Udc Lower Threshold of Overvoltage Prevention During Deceleration

Use this parameter to set the lower U_{DC} threshold of the overvoltage prevention during deceleration.

5.5.17.4 (P0584) Torque Attenuation Coefficient of Overvoltage Prevention During Deceleration

Use this parameter to set the torque attenuation coefficient of the overvoltage prevention during deceleration.

5.5.18 Symmetrical Bypass

In symmetrical bypass mode, once a failed power cell is bypassed, the power cells at the same level output zero voltage to make the drive keep normal operation.

5.5.18.1 (P0028) Maximum Number of Bypassed Power Cells per Phase

Use this parameter to select the maximum number of bypassed power cells per phase.

If power cell bypass during operation is not required, set P0028 to 0.

If the level of bypassed power units is higher than P0028, the fault “Bypassed cell quantity over limit” is generated.

5.5.18.2 (P0059) Power Cell Bypass Mode

Use this parameter to select the power cell bypass mode.

- 0 = Symmetrical bypass
- 1 = Reserved
- 2 = Negative sequence compensation

5.5.18.3 (P0392) Maximum Modulation Ratio of Symmetrical Bypass

Use this parameter to select the maximum modulation ratio of symmetrical bypass.

When the modulation ratio is above the maximum modulation ratio, the drive output speed is decreased automatically after a power cell bypass occurs, namely bypass derating. Therefore, the actual motor speed becomes lower than the specified speed.

When the modulation ratio is lower than the maximum modulation ratio, bypass derating is finished.

If another power cell bypass occurs during bypass derating, a bypass derating fault is generated.

5.5.19 Negative Sequence Compensation

When power cell bypass mode (P0059) is set to negative sequence compensation, once a failed power cell is bypassed, other power cells keep normal operation and an imbalance control is performed to restrain output negative sequence voltage.

When the modulation ratio is above the maximum modulation ratio (P0813), the drive output speed is decreased automatically after power cell bypass occurs, namely bypass derating. Therefore, the actual motor speed becomes lower than the specified speed.

When the modulation ratio is lower than the maximum modulation ratio (P0813), bypass derating is finished.

The operating thresholds of negative sequence compensation are:

- Minimum operating power factor for negative sequence compensation (P0809)
- Minimum operating speed for negative sequence compensation (P0814)

When the power factor or output speed is below the thresholds, the drive works in symmetrical bypass mode.

If another power cell bypass occurs during bypass derating, a bypass derating fault is generated.

5.5.20 Input Undervoltage Derating

70–90% is the detecting level of input undervoltage. If the voltage drop within 30% occurs while driving at high speed, the drive output speed is decreased automatically. Therefore, the actual motor speed becomes lower than the specified speed. When the input voltage recovers, the drive output speed increases to the reference speed.

If the output speed continues to fluctuate when an input undervoltage occurs, decrease the modulation ratio of speed maintenance for input undervoltage derating (P0803). For example, change the value from 113 to 100.

This function only applies for SVC or SLVC mode. Set P0601 "Running mode" to 2 or 3.

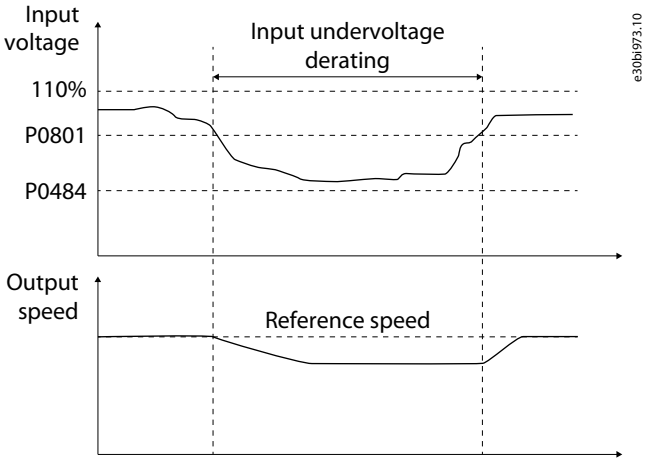

Illustration 28: Input Undervoltage Derating

5.5.21 Low-voltage Ride Through

If the grid falls below the threshold of input power loss (P0484), power can be regenerated from the motor side to stabilize the DC-link voltage. If these 3 conditions are met, the torque current is increased and the drive speed returns to its previous value:

- The grid voltage recovers in the set duration (P0893).
- The DC-link voltage is above the set lower voltage limit (P0891).
- The motor speed is above the set lower speed limit (P0892).

If these conditions are not met, an "LVRT failure" is generated.

If the ride through control is enabled, there is a large excitation inrush current in the input side when the grid voltage recovers. The power supply must have sufficient capacity to provide such a large instant current. Therefore, the drive does not require a startup cabinet when the ride through control is enabled.

If the power supply does not have sufficient capacity to provide such a large instant current, a startup cabinet can be installed. If the ride through control is disabled and if a startup cabinet is available, the startup cabinet trips once loss of power is detected.

This function only applies for SVC or SLVC mode. Set P0601 "Running mode" to 2 or 3.

5.5.22 Automatic Restart

If a fault appears, the drive stops the output and gives an alarm. The fault is reset automatically and the fault disappears after a delay period defined by parameter P1353. When the fault is reset, the trial time (P1354) starts to count, and the drive is started automatically by flying start.

During the trial time of the automatic restart, the next fault that occurs can be reset. The trial time count restarts again after the next fault is reset.

The automatic restart fault is generated if:

- The duration of the fault is above trial time of automatic restart (P1354).
- The number of faults during the trial time is higher than the number of trials for automatic restart (P1355).

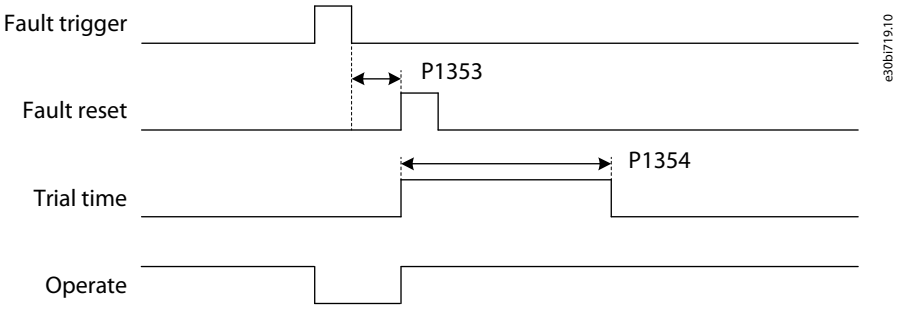

Illustration 29: Automatic Restart

⚠ C A U T I O N ⚠

Automatic restart function can cause danger.

– Select the automatic restart function according to application requirements.
When the automatic restart function is enabled, do not examine the drive, motor, or load after power loss until the MCB is properly tripped.

5.5.22.1 (P1357) Input Undervoltage Automatic Restart

Use this parameter to enable or disable automatic restart for input undervoltage faults.

When an input undervoltage occurs, the drive is not allowed to restart until the DC-link voltage recovers to the normal level.

If the input undervoltage automatic restart is enabled, the setting of Fault configuration: Input Undervoltage (P1103) is invalid.

If input undervoltage derating is enabled, input undervoltage fault automatic restart is invalid. Input undervoltage derating is enabled by default. If input undervoltage fault automatic restart is required, disable input undervoltage derating.

5.5.22.2 (P1358) Input Power Loss Automatic Restart

Use this parameter to enable or disable automatic restart for input power loss faults.

When an input power loss occurs, the drive is not allowed to restart until the DC-link voltage recovers to the normal level.

If the input power loss automatic restart is enabled, the setting of Fault configuration: Input power loss (P1102) is invalid.

If low-voltage ride-through is selected, input power loss automatic restart is valid only when a low-voltage ride-through fault is generated.

If input power loss automatic restart is selected, there is large excitation inrush current in the input side when the grid voltage recovers. The power supply must have sufficient capacity to provide such a large instantaneous current.

5.5.22.3 (P1359) Output Overcurrent Automatic Restart

Use this parameter to enable or disable automatic restart for output overcurrent faults.

If the output overcurrent automatic restart is enabled, the setting of Fault configuration: Output overcurrent (P1108) is invalid.

5.5.22.4 (P1360) Output Underload Automatic Restart

Use this parameter to enable or disable automatic restart for output underload faults.

If the output underload automatic restart is enabled, the setting of Fault configuration: Output underload (P1114) is invalid.

5.5.22.5 (P1361) Speed Setting Analog Loss Automatic Restart

Use this parameter to enable or disable automatic restart for speed setting analog loss faults.

If the speed setting analog loss automatic restart is enabled, the setting of Fault configuration: Speed setting analog loss (P1120) is invalid.

5.5.22.6 (P1362) Transformer Temperature Sensor Loss Automatic Restart

Use this parameter to enable or disable automatic restart for transformer temperature sensor loss faults.

If the transformer temperature sensor loss automatic restart is enabled, the setting of PLC fault configuration: Transformer temperature sensor loss (P1217) is invalid.

5.5.23 Synchronous Transfer

The synchronous transfer function is used to:

- Realize a smooth switch between the drive and grid.
- Avoid electric shock to the electrical network.
- Prolong working life of the electrical equipment.

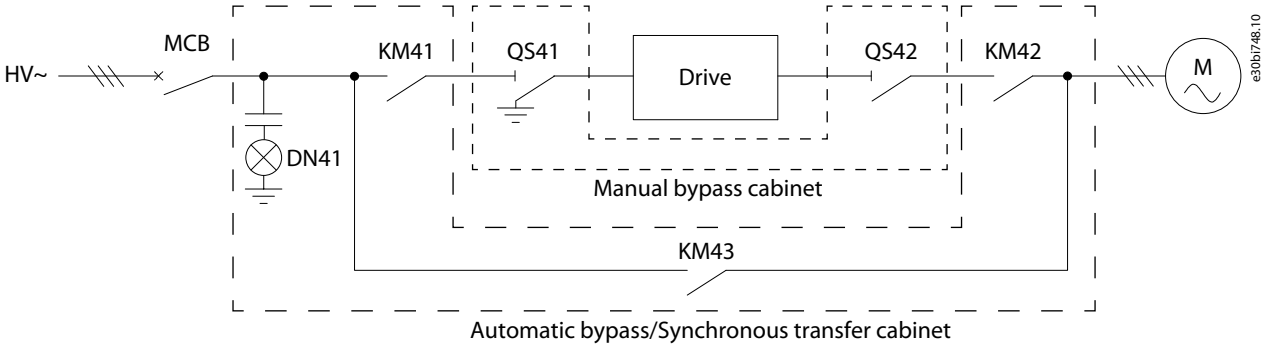

Illustration 30: Synchronous Transfer Cabinet Circuit Diagram

Process sequence of load transfer from the drive to the grid

- Initial state: KM41 and KM42 are closed, and KM43 is open.
- Acceleration to grid frequency:
  - When the drive to grid process starts, the system accelerates to the rated speed automatically based on the acceleration time setting.
  - After the acceleration, if the output speed error exceeds P0772 “Speed error threshold of synchronous transfer”, and cannot be stabilized in P0777 “Maximum speed stable time of synchronous transfer”, a speed stable timeout fault is generated.
  - If the output speed is stabilized, Vector Control is transferred to synchronous control, and the output frequency of the drive is adjusted to grid frequency gradually by the slope of P0768 “Synchronous acceleration of synchronous transfer”. When the output frequency is identical with the grid frequency, the acceleration phase is completed.
- Voltage synchronization:
  - The slopes of P0769 “Phase regulating slope of synchronous transfer” and P0770 “Voltage regulating slope of synchronous transfer” gradually adjust the phase and amplitude of the output voltage.
  - If the phase error and amplitude error between output voltage and grid voltage are below P0767 “Phase error threshold of synchronous transfer” and P0771 “Voltage error threshold of synchronous transfer” respectively, the voltage synchronization phase is completed.
  - If the grid current is sampled and sent to the drive, the drive to grid process is switched to the load transfer phase. If not, close KM43, stop output, open KM42, and the drive to grid process is over.
  - If the voltage synchronization phase cannot be completed in P0778 “Maximum voltage synchronize time of synchronous transfer”, a voltage synchronize timeout fault is generated.
- Synchronous transfer: After phase lock, KM43 is closed and the load transfer to grid is started.

- If the output current is stabilized within error of P0353 “Current error threshold of synchronous transfer”, open KM42, and the drive to grid process is over.
- If the duration of the load transfer exceeds P0779 “Maximum load transfer time of synchronous transfer”, a load transfer timeout fault is generated.

- Synchronous transfer finished: After the load transfer, KM42 and KM41 are opened.

Process sequence of load transfer from the grid to the drive

- Initial state: KM41 and KM42 are open, and KM43 is closed.
- Phase lock: KM41 is closed. The drive runs to grid frequency and starts to lock phase to grid voltage.
- Synchronous transfer: After phase lock, KM42 is closed and the load transfer to the drive is started.
  - If the grid current is not sampled, close KM42, and open KM43. The control mode of the drive is switched to VF/SVC/SLVC automatically, and the grid to drive process is over.
  - If grid current is sampled and sent to the drive, the load current is transferred from grid to the drive. If the output current is stabilized within the error of P0353 “Current error threshold of synchronous transfer”, open KM43. The control mode of the drive is switched to VF/SVC/SLVC automatically, and the grid to drive process is over.
  - If the duration of the load transfer exceeds P0779 “Maximum load transfer time of synchronous transfer”, a load transfer timeout fault is generated.
- Synchronous transfer finished: After the load transfer, KM43 is opened.

If any fault is generated during synchronous transfer, see 6.3.31 Fault Code 31 - Synchronous Transfer Failure.

5.5.23.1 (P0351) Synchronous Transfer Enable

Use this parameter to enable the synchronous transfer enable function.

5.5.23.2 (P0353) Current Error Threshold of Synchronous Transfer

Use this parameter to set the current error threshold of the synchronous transfer function.

For the load transfer to be completed, the output current must stabilize within the error threshold of P0353.

5.5.23.3 (P0767) Phase Error Threshold of Synchronous Transfer

Use this parameter to set the phase error threshold of the synchronous transfer function.

For the voltage synchronization phase to be completed, the phase error and amplitude error between output voltage and grid voltage must be below P0767 and P0771 respectively.

5.5.23.4 (P0768) Synchronous Acceleration of Synchronous Transfer

Use this parameter to set the synchronous acceleration of the synchronous transfer function.

In the acceleration to grid frequency, the output frequency of the drive is adjusted to grid frequency gradually by the slope of P0768.

5.5.23.5 (P0769) Phase Regulating Slope of Synchronous Transfer

Use this parameter to set the phase regulating slope of the synchronous transfer function.

In voltage synchronization, the slopes of P0769 and P0770 gradually adjust the phase and amplitude of the output voltage.

5.5.23.6 (P0770) Voltage Regulating Slope of Synchronous Transfer

Use this parameter to set the voltage regulating slope of the synchronous transfer function.

In voltage synchronization, the slopes of P0769 and P0770 gradually adjust the phase and amplitude of the output voltage.

5.5.23.7 (P0771) Voltage Error Threshold of Synchronous Transfer

Use this parameter to set the voltage error threshold of the synchronous transfer function.

For the voltage synchronization phase to be completed, the phase error and amplitude error between output voltage and grid voltage must be below P0767 and P0771 respectively.

5.5.23.8 (P0772) Speed Error Threshold of Synchronous Transfer

Use this parameter to set the speed error threshold of the synchronous transfer function.

After the acceleration to grid frequency, if the output speed error exceeds P0772, and cannot be stabilized in the time P0777, a speed stable timeout fault is generated.

5.5.23.9 (P0777) Maximum Speed Stable Time of Synchronous Transfer

Use this parameter to set the maximum speed stable time of the synchronous transfer function.

After the acceleration to grid frequency, if the output speed error exceeds P0772, and cannot be stabilized in the time P0777, a speed stable timeout fault is generated.

5.5.23.10 (P0778) Maximum Voltage Synchronize Time of Synchronous Transfer

Use this parameter to set the maximum voltage synchronize time of the synchronous transfer function.

If the voltage synchronization phase cannot be completed in P0778, a voltage synchronize timeout fault is generated.

5.5.23.11 (P0779) Maximum Load Transfer Time of Synchronous Transfer

Use this parameter to set the maximum load transfer time of the synchronous transfer function.

If the duration of the load transfer exceeds P0779, a load transfer timeout fault is generated.

5.5.24 Low Temperature Start-up Enable

Start-up in low temperatures is enabled with this function.

The parameter setting values for the low temperature alarms and faults must follow the rule: P1906<P1907<P1908<P1913.

The control cabinet temperature detection channel is CH4 of PLC TM1.

The conditions of "MCB close allowed"

- When the duration of the control power-on is less than P1912 “Delay time of low temperature start-up”:
  - If the control cabinet temperature is higher than P1913 “Threshold 3 of control cabinet low temperature alarm”, the MCB is allowed to close.
  - If the control cabinet temperature is less than P1913–P1914, the MCB close is forbidden, and a “Control cabinet low temperature alarm, MCB close forbidden” fault is generated.
- When the duration of the control power-on is more than P1912 “Delay time of low temperature start-up”:
  - If the control cabinet temperature is higher than P1907 “Threshold 1 of control cabinet low temperature alarm”, the MCB is allowed to close.
  - If the control cabinet temperature is lower than P1907–P1914, the MCB close is forbidden, and a “Control cabinet low temperature alarm, MCB close forbidden” fault is generated.

If the MCB is closed when the control cabinet temperature is lower than P1907–P1914, a “Control cabinet low temperature alarm” is generated.

The conditions of "Start-up ready"

- When the control cabinet temperature is higher than P1908 “Threshold 2 of control cabinet low temperature alarm”, the system is allowed to start.
- When the control cabinet temperature is less than P1908–P1914, the system start is forbidden, and a “Control cabinet low temperature alarm, start forbidden” fault is generated.

When the system is running and the control cabinet temperature is lower than P1908–P1914, a “Control cabinet low temperature alarm” is generated.

If the control cabinet temperature is less than P1906 “Threshold of control cabinet low temperature fault” for more than 5 s, a “Control cabinet low temperature fault” is generated and the MCB trips.

If “Control cabinet temperature sensor loss” occurs, MCB close and system start are forbidden.

5.5.25 Control Cabinet Temperature Adjust

Start up in higher temperatures is enabled with this function.

The control cabinet temperature detection channel is CH4 of PLC TM1.

When the control cabinet temperature is higher than P1910 “Threshold of control cabinet overtemperature”:

- If the duration is more than 5 min, the “Control cabinet overtemperature alarm” is generated.
- If the duration is more than P1911 “Delay time for control cabinet overtemperature trip”, the “Control cabinet overtemperature fault” is generated, and the MCB trips.

The cooling fan power detection signal is X10 of PLC DI1 (NC).

- If the signal is open for longer than 5 s, “Control cabinet cooling fan power loss” is generated.

The cooling fan start control signal is Y6 of PLC DO1.

- If the control cabinet temperature is higher than 42 °C for longer than 1 min, the cooling fan starts.
- If the control cabinet temperature is lower than 40 °C for longer than 1 min, the cooling fan stops.
- If "Control cabinet temperature sensor loss" occurs, the control cabinet cooling fan continues to run all the time.

6 Fault Tracing

6.1 Fault Types

When the control diagnostics of the drive find an unusual condition in the operation of the drive, the drive shows a notification about it. The notification can be seen on the display of the control panel. The display shows the number, the name, and a short description of the fault or alarm.

There are 2 different types of notification.

- An **alarm** informs of unusual operation on the drive. The alarm does not stop the drive. The system can be powered on, started, and operated normally.
- A **fault** stops the drive immediately. Reset the drive and find a solution to the problem. Do not operate the system until the problem has been found and corrected.

It is possible to configure different responses for some faults in the application. See 6.2 Fault Response Configuration.

To view specific information about alarms or faults, click *AlarmFault*.

Before contacting the distributor or the factory because of unusual operation, prepare some data. Write down the fault number and all other information on the display.

6.2 Fault Response Configuration

It is possible to configure different responses for some faults in the application. There are 9 valid combinations for alarm and fault action configuration.

Table 106: Fault Response Configurations for VACON® 1000

Configuration value	Detection enable	Alarm/Fault	Action (not running)	Action (running)
0	Disable	–	–	–
1	Enable	Alarm	No action	No action
2	Enable	Fault	No action	Coast stop
3	Enable	Fault	No action	Coast stop, and bypass system
4	Enable	Fault	No action	Deceleration and stop
5	Enable	Fault	No action	Trip MCB
6	Enable	Fault	No action	Trip MCB, and bypass system
7	Enable	Fault	Trip MCB	Trip MCB
8	Enable	Fault	Trip MCB	Trip MCB, and bypass system

6.3 Faults and Alarms

6.3.1 Fault Code 1 - Input Overcurrent (Software Fault)

Cause

The input current is higher than 150% of the rated current.

System default operation: Trip

Troubleshooting

- Check the input current.
- Check the set value.

6.3.2 Fault Code 2 - Input Phase Loss

Cause

One or more high-voltage input cables cannot supply primary power to the input transformer.

System default operation: Trip

Troubleshooting

- Check the input voltage.
- Check if the input cables are loose or disconnected.

6.3.3 Fault Code 3 - Input Power Loss

Cause

The voltage values of the 3 input phases are all lower than 70% of the rated value.

System default operation: Trip. System operation is configurable.

Troubleshooting

- Check the input voltage.

6.3.4 Fault Code 4 - Input Undervoltage

Cause

The effective value of the input voltage is lower than 90% of the rated value.

System default operation: Alarm. System operation is configurable.

Troubleshooting

- Check the input voltage.

6.3.5 Fault Code 5 - Input Overvoltage

Cause

The effective value of the input voltage is higher than 110% of the rated value.

System default operation: Trip

Troubleshooting

- Check the input voltage.

6.3.6 Fault Code 6 - Input Grounding

Cause

Input grounding occurs, and the duration time is above 5 s.

System default operation: Trip. System operation is configurable.

Troubleshooting

- Check the input cables, copper busbars, and transformer.

6.3.7 Fault Code 7 - Input Sequence Fault

Cause

The input cables are connected in reverse.

System default operation: Alarm. System operation is configurable.

Troubleshooting

- Check the sequence of the input cables.

6.3.8 Fault Code 8 - Output Overcurrent (Software Fault)

Cause

The output current is higher than 150% of the rated current.

System default operation: Coast stop. System operation is configurable.

Troubleshooting

- Check the output current.
- Check the set value.

6.3.9 Fault Code 9 - Output Overload

Cause

Constant torque: When the output current is higher than 150% of the rated current, allow for 1 minute overload every 10 minutes.

Variable torque: When the output current is higher than 120% of the rated current, allow for 1 minute overload every 10 minutes.

System default operation: Coast stop. System operation is configurable.

Troubleshooting

- Check the power grid voltage.
- Reset the rated current of the motor.
- Check the load and adjust the torque increase.
- Select proper motor.

6.3.10 Fault Code 10 - Output Phase Loss

Cause

The software detects that the output phase from the drive to motor is disconnected.

System default operation: Coast stop. System operation is configurable.

Troubleshooting

- Check if the output cables are loose or disconnected.

6.3.11 Fault Code 11 - Output Grounding

Cause

The software detects a grounding fault which is usually caused by an output grounding fault (phase-to-ground fault).

System default operation: Coast stop. System operation is configurable.

Troubleshooting

- Check that the external cables and the motor are grounded.
- Check the insulation of the motor and its cables.

6.3.12 Fault Code 12 - Output Phase Imbalance Alarm

Cause

During 10 minutes of continuous running time, the output imbalance is above 15‰ for a cumulative time of more than 30 s.

System default operation: Alarm. System operation is configurable.

Troubleshooting

- Check that the capacitance of the DC-link capacitors matches the specifications.
- Check that the voltage of the transformer secondary windings is balanced.

6.3.13 Fault Code 13 - Output Phase Imbalance Fault

Cause

The output imbalance is above 30‰ for over 1 s.

System default operation: Coast stop. System operation is configurable.

Troubleshooting

- Check that the capacitance of the DC-link capacitors matches the specifications.
- Check that the voltage of the transformer secondary windings is balanced.

6.3.14 Fault Code 14 - Output Underload

Cause

The software detects the motor operating in the underload area for longer than 20 s.

System default operation: Not detected. System operation is configurable.

Troubleshooting

- Check if the load of motor is too light.

6.3.15 Fault Code 15 - Electronic Motor Thermal Protection

Cause

The calculated temperature or temperature rise is higher than the setting value.

System default operation: Not detected. System operation is configurable.

Troubleshooting

- Check if the ambient temperature is high.
- Check if the load of the motor is heavy.

6.3.16 Fault Code 16 - Motor Stall

Cause

- The motor frequency/speed is below the set value.
- A torque limit condition is present.
- Both conditions occur simultaneously and the duration is above the stall time setting.

System default operation: Not detected. System operation is configurable.

Troubleshooting

- Check if the motor is overloaded.
- Check if there is a mechanical failure.
- Check if there are any other problems which make the motor jam.

6.3.17 Fault Code 17 - Motor Reverse

Cause

The motor is rotating in reverse.

System default operation: Not detected. System operation is configurable.

Troubleshooting

- Check the motor rotating status.

6.3.18 Fault Code 18 - Motor Overspeed

Cause

The speed of the motor is 120% of the maximum operational speed for longer than 10 s.

System default operation: Coast stop. System operation is configurable.

Troubleshooting

- Check the motor status.
- Check if the speed encoder is broken.

6.3.19 Fault Code 19 - Motor Underspeed

Cause

The speed of the motor is 6% of the minimum operational speed for longer than 60 s.

System default operation: Not detected. System operation is configurable.

Troubleshooting

- Check the motor status.
- Check if the speed encoder is broken.

6.3.20 Fault Code 20 - Analog Reference Loss

Cause

The analog input is disconnected.

System default operation: Alarm. System operation is configurable. The system continues to operate and keeps the last reference speed.

Troubleshooting

- Check the analog circuit.

6.3.21 Fault Code 21 - Encoder Abnormal

Cause

The encoder signal is lost or the error between encoder speed and estimated speed is higher than 5%.

System default operation: Coast stop during SVC, not detected during SLVC. System operation is configurable.

Troubleshooting

- Check if the encoder is operating normally.

6.3.22 Fault Code 22 - Input Overcurrent (Hardware Fault)

Cause

The input current is larger than 210% of the input current sample rating.

System default operation: Trip

Troubleshooting

- Check the input current.

6.3.23 Fault Code 23 - Output Overcurrent (Hardware Fault)

Cause

The output current is larger than 210% of the output current sample rating.

System default operation: Trip

Troubleshooting

- Check the output current.

6.3.24 Fault Code 24 - Current Sensor Power Fault

Cause

The LEM power board is not energized.

System default operation: Trip. System operation is configurable.

Troubleshooting

- Check the supply of the LEM power board.

6.3.25 Fault Code 25 - Bypassed Cell Quantity Over Limit

Cause

The quantity of bypassed power cells in one phase is above the setting value.

System default operation: Coast stop

Troubleshooting

- Check the power cells for faults.
- Check the quantity of bypassed power cells.
- Repair or replace the failed power cell.

6.3.26 Fault Code 26 - System Running with MCB Open

Cause

During operation, the MCB status digital input in the main controller I/O board is open.

System default operation: Coast stop

Troubleshooting

- Check the status of the MCB.

6.3.27 Fault Code 27 - Synchronous Switch Status Error

Cause

KM2 and KM4 are closed at the same time before synchronous transfer start.

System default operation: Trip

Troubleshooting

- Check the status of switches.

6.3.28 Fault Code 28 - Auto Tuning Failure

Cause

During auto tuning, a fault occurs or a stop command is received.

System default operation: Coast stop

Troubleshooting

- Check the fault record.

6.3.29 Fault Code 29 - Flying Start Failure

Cause

During flying start, a speed search failure occurs or any other fault is generated.

System default operation: Coast stop

Troubleshooting

- If a speed search failure caused the flying start failure, check the parameter of the flying start result for the reason for the flying start failure.
- If some other fault caused the flying start failure, check the fault record.

6.3.30 Fault Code 30 - Automatic Restart Failure

Cause

During the trial time of the automatic restart, the number of faults is higher than the maximum number of trials, or a permanent fault occurs.

System default operation: Trip

Troubleshooting

- Check the fault record.

6.3.31 Fault Code 31 - Synchronous Transfer Failure

Cause

One of the following occurs during synchronous transfer:

- Switch status/close/open failure.
- Speed stable timeout. Caused by load fluctuation, which can occur during acceleration to grid frequency in the drive to grid synchronization process.
- Voltage synchronous timeout. Caused by electric network fluctuation, which can occur during the voltage synchronization process.
- Load transfer timeout. Caused by load fluctuation, which can occur during the load transfer process.

System default operation: Trip

Troubleshooting

- If there is a switch status/close/open failure:
  - Check the status of the switches.
  - Check the wiring of the digital inputs/outputs.
  - Make sure that there are no problems with the breaker.
- If there is a speed stable timeout, modify parameter “Speed err threshold of synchronous transfer” (P0772).
- If there is a voltage synchronous timeout, modify one of these parameters:
  - “Phase error threshold of synchronous transfer” (P0767)
  - “Voltage error threshold of synchronous transfer” (P0771)
  - “Maximum voltage synchronize time of synchronous transfer” (P0778)
- If there is a load transfer timeout, modify one of these parameters:
  - “Current error threshold of synchronous transfer” (P0353)
  - “Maximum load transfer time of synchronous transfer” (P0779)

6.3.32 Fault Code 32 - Failure Of Motor Selection

Cause

The serial number of selected motor is wrong.

System default operation: Coast stop

Troubleshooting

- Check if the value of parameter “Motor selection” is larger than parameter “Maximum number of motor”.
- Check that the motor connected to the drive is the motor specified by parameter “Motor selection”.

6.3.33 Fault Code 33 - LVRT Failure

Cause

One of the following occurs during the low voltage ride through:

- The duration of power loss is more than 1 s.
- The DC-capacitor voltage is below 400 V.
- The motor speed is below 5%.

System default operation: Trip

Troubleshooting

- Check the parameter “Fault flag of low voltage ride through”.
- Modify the related parameters according to parameter “Fault flag of low voltage ride through”.

6.3.34 Fault Code 34 - Bypass Derating Failure

Cause

During bypass derating, another power cell bypass occurs.

System default operation: Coast stop

Troubleshooting

- If the quantity of bypassed power cells is not over the limit, reset and start the system.
- If the quantity of bypassed power cells is over the limit:
  - Check the fault of the power cell.
  - Check the quantity of the bypassed power cells.
  - Repair or replace the failed power cell.

6.3.35 Fault Code 35 - Input Current Sampling Fault

Cause

Input current is out of the current sampling scope.

System default operation: Trip

Troubleshooting

- Check the input current.

6.3.36 Fault Code 36 - Output Current Sampling Fault

Cause

Output current is out of the current sampling scope.

System default operation: Coast stop. System operation is configurable.

Troubleshooting

- Check the output current.

6.3.37 Fault Code 37 - Internal Control Power Loss

Cause

The back-up control power provided by the phase-shift transformer auxiliary winding is lost.

System default operation: Alarm

Troubleshooting

- Check the wiring and voltage of the back-up control power.
- Check that the corresponding switches are closed.
- Check that the corresponding relays work normally.

6.3.38 Fault Code 38 - External/Customer Control Power Loss

Cause

The external control power is lost.

System default operation: Alarm

Troubleshooting

- Check the wiring and voltage of the external control power.
- Check that the corresponding switches are closed.
- Check that the corresponding relays work normally.

6.3.39 Fault Code 39 - Control Power Loss Overtime

Cause

Both the external control power and the back-up power from the phase-shift transformer are lost simultaneously for more than 30 minutes.

System default operation: Trip

Troubleshooting

- Check the wiring and voltage of the external control power.
- Check the wiring and voltage of the internal back-up control power.
- Check that the corresponding switches are closed.
- Check that the corresponding relays work normally.

6.3.40 Fault Code 40 - UPS Undervoltage

Cause

The fault information is reported when the battery voltage is low.

System default operation: Alarm

Troubleshooting

- Check if the voltage of each battery is above 12 V.
- Check if the switch mode power supply module output voltage is 26 V.

6.3.41 Fault Code 41 - UPS Undervoltage Overtime

Cause

After the external control power and the back-up power from the phase-shift transformer are lost, the UPS undervoltage occurs for over 1 minute.

System default operation: Trip

Troubleshooting

- Check the wiring and voltage of the external control power.
- Check the wiring and voltage of the internal back-up control power.
- Check that the corresponding switches are closed.
- Check that the corresponding relays work normally.
- Find the reasons for UPS failure and restore the supply as soon as possible.

6.3.42 Fault Code 42 - HV Cabinet Door Open

Cause

The high-voltage cabinet door is open.

System default operation: Trip

- If the drive cabinet door is open before the high-voltage power-on, the closing allowed signal cannot be sent.
- If the drive cabinet door is opened during operation, the system stops immediately.

Troubleshooting

- Check the state of the drive cabinet doors.
- Check the position switch of the cabinet door and its contacts.

6.3.43 Fault Code 43 - Air Filter Clogged

Cause

Comparison with the set value of the internal cabinet air pressure: $P_{under} < P_{set}$ -25 pa. The reason can be the clogging of the air filter.

System default operation: Alarm

Troubleshooting

- Check if the air filter is clogged.
- Check if the air pressure sensor works normally.

6.3.44 Fault Code 44 - Cooling Fan Abnormal

Cause

Cooling fan motor winding overheating. To indicate this fault, the normally closed contact is opened.

System default operation: Alarm. System operation is configurable.

Troubleshooting

- Check if the fan rotates in reverse direction.
- Check if the fan is blocked.

6.3.45 Fault Code 45 - Fan Internal Power Loss

Cause

When the power of the cooling fan has a failure, the normally closed contact of the fan breaker is opened.

System default operation: Alarm. System operation is configurable.

Troubleshooting

- Check the fan breaker.
- Check whether the power supply circuit is normal.

6.3.46 Fault Code 46 - Fan External Power Loss

Cause

When there is a phase loss or undervoltage of the external fan power, this alarm is triggered.

System default operation: Alarm. System operation is configurable.

Troubleshooting

- Check the wiring and voltage of the external fan power.

6.3.47 Fault Code 47 - Cooling Fan Failure

Cause

The fan breaker is tripped or fan interior thermal relay is opened.

System default operation: Alarm

Troubleshooting

- Check the fan breaker.
- Check if the thermal relay is opened.
- Check if the fan is blocked.

6.3.48 Fault Code 48 - Transformer Overtemperature Alarm

Cause

The failure information is reported when the temperature of the transformer exceeds 95°C.

System default operation: Alarm

Troubleshooting

- Check if the ambient temperature is too high.
- Check that the cooling fans on top of the transformer are working normally.
- Check if the air filter is clogged.
- Check if the drive is in overload operation for a long time.
- Check if the temperature sensor is in good condition.

6.3.49 Fault Code 49 - Transformer Overtemperature Fault

Cause

The failure information is reported when the temperature of the transformer exceeds 110°C.

System default operation: Trip

Troubleshooting

- Check if the ambient temperature is too high.
- Check that the cooling fans on top of the transformer are working normally.
- Check if the air filter is clogged.
- Check if the drive is in overload operation for a long time.
- Check if the temperature sensor is in good condition.

6.3.50 Fault Code 50 - Transformer Temperature Sensor Loss

Cause

The three PT100 thermal resistors in transformer windings A, B, and C are connected to the PT thermometric module in the PLC. If the connection is loose, or one of the PT100 resistors in the transformer is damaged, the PLC detects the malfunction and reports the fault.

System default operation: Alarm. System operation is configurable.

Troubleshooting

- Check that the wiring is firmly connected.
- Check if one of the PT100 resistors is damaged.

6.3.51 Fault Code 51 - Emergency Stop

Cause

The emergency stop push button on the control cabinet door is pressed.

System default operation: Trip

Troubleshooting

- Release the emergency stop push button on control cabinet door.

6.3.52 Fault Code 52 - Remote Emergency Stop

Cause

The external emergency stop command is effective.

System default operation: No operation

Troubleshooting

- Release the remote emergency stop push button.

6.3.53 Fault Code 53 - PLC–DSP Communication Failure

Cause

The PLC disconnects with the main control system.

System default operation: Alarm. System operation is configurable. The system continues to operate at the reference speed set before the disconnection.

Troubleshooting

- Check the communication circuit.

6.3.54 Fault Code 54 - PLC–HMI Communication Failure

Cause

The PLC disconnects with the HMI.

System default operation: Alarm

Troubleshooting

- Check the communication circuit.

6.3.55 Fault Code 55 - Upstream Main Circuit Breaker Abnormal Open

Cause

When running, the drive receives the open signal of the high-voltage circuit breaker.

System default operation: Coast stop

Troubleshooting

- Check if the input high voltage exists.
- Check that the internal cabling is firm and correct.

6.3.56 Fault Code 56 - Upstream Main Circuit Breaker Open Failure

Cause

The upstream main circuit breaker did not open in over 3 s after receiving the opening signal.

System default operation: Alarm

Troubleshooting

- Check if the input high voltage exists.
- Check that the internal cabling is firm and correct.
- Check if the opening command is sent correctly.

6.3.57 Fault Code 57 - Startup Cabinet Switch Abnormal Open

Cause

After the drive high voltage is on and the start-up cabinet switch is closed, the start-up cabinet switch opens unexpectedly before the upstream main circuit breaker opens.

System default operation: Trip

Troubleshooting

- Check that the startup cabinet switch is normal.
- Check that the internal cabling is firm and correct.

6.3.58 Fault Code 58 - Startup Cabinet Switch Open Failure

Cause

The start-up cabinet switch did not open in over 3 s after receiving the opening signal.

System default operation: Trip

Troubleshooting

- Check that the start-up cabinet switch is normal.
- Check that the internal cabling is firm and correct.

6.3.59 Fault Code 59 - Startup Cabinet Switch Close Failure

Cause

The start-up cabinet switch did not close in over 3 s after receiving the closing signal.

System default operation: Trip

Troubleshooting

- Check that the start-up cabinet switch is normal.
- Check that the internal cabling is firm and correct.

6.3.60 Fault Code 60 - PLC–DSP Communication failure

Cause

Unable to close start-up cabinet. After the drive high voltage is on, and before the start-up cabinet switch is closed, the PLC disconnects with the main control system.

System default operation: Trip

Troubleshooting

- Check the wiring of the communication circuit.

6.3.61 Fault Code 61 - Auto Bypass Failure

Cause

Bypass cabinet switches did not operate correctly after receiving auto bypass signal.

System default operation: Trip

Troubleshooting

- Check that the bypass cabinet switch is normal.
- Check that the internal cabling is firm and correct.

6.3.62 Fault Code 62 - Auto Bypass Condition is not Satisfied

Cause

The operation status of the drive does not meet the bypass condition.

System default operation: Trip

Troubleshooting

- None.

6.3.63 Fault Code 63 - External Fault

Cause

To realize an external motor protection, the motor protection relay can be connected to one preset protection input of the drive.

System default operation: Coast stop. System operation is configurable.

Troubleshooting

- Check if the user terminal has fault signal output.
- Check that the wiring of the signal circuit is correct.

6.3.64 Fault Code 64 - Power Cell DC-link Undervoltage

Cause

The DC-link voltage is higher than 300 V, but lower than 580 V.

System default operation: Alarm

Troubleshooting

- Check if the high-voltage input is lower than the minimum allowed value.
- Check if the 3-phase input to the power cell is loose.
- Check that the fuse is in good condition.

6.3.65 Fault Code 65 - Power Cell Overtemperature

Cause

If the temperature of the cooling heat sink near the IGBT is higher than the designed value, the normally closed contact of the temperature sensor switch is disconnected.

System default operation: Trip. System operation is configurable.

Troubleshooting

- Check if the ambient temperature exceeds the allowed value.
- Check that the cooling fan on the top of the cabinet is working normally.
- Check if the inlet air filter is clogged.
- Check if the drive is in overload operation for a long time.
- Check that the power cell temperature relay works normally.

6.3.66 Fault Code 66 - Power Cell IGBT Driver Fault

Cause

The IGBT has a failure.

System default operation: Trip. System operation is configurable.

Troubleshooting

- Check that the power cell fault indicator is working normally.

6.3.67 Fault Code 67 - Power Cell Input Phase Loss

Cause

One of the three input phases is lost.

System default operation: Alarm. System operation is configurable. Detected in PL. Not detected in PU.

Troubleshooting

- Check if the 3-phase input of the power cell is loose.
- Check if the fuse is in good condition.
- Check the input voltage.

6.3.68 Fault Code 68 - Downstream Fiber Communication Fault

Cause

The power cell has not received the signals from the optical fiber communication board.

System default operation: Trip. System operation is configurable.

Troubleshooting

- Check that the optical fibers are in normal condition.
- Check if the joints of the optical fibers are loose or falling off.

6.3.69 Fault Code 69 - Power Cell DC-link Overvoltage

Cause

The DC-link voltage exceeds 1150 V.

System default operation: Trip. System operation is configurable.

Troubleshooting

- Check if the high-voltage input exceeds the maximum allowed value.
- If overvoltage occurs during deceleration, make the deceleration time of the drive longer.

6.3.70 Fault Code 70 - Power Cell DC-link Ultra Overvoltage

Cause

The DC-link voltage exceeds 1300 V.

System default operation: Trip

Troubleshooting

- Check if the high-voltage input exceeds the maximum allowed value.
- If overvoltage occurs during deceleration, make the deceleration time of the drive longer.

6.3.71 Fault Code 71 - Power Cell Control Power Fault

Cause

Power cell auxiliary power supply is abnormal.

System default operation: Trip. System operation is configurable.

Troubleshooting

- Power on again. If the cell still reports this fault, replace the power cell.

6.3.72 Fault Code 72 - Power Cell Capacitor Voltage Abnormal

Cause

The voltage of the middle capacitors is 40 V higher or lower than one third of DC-link voltage.

System default operation: Trip. System operation is configurable. Detected in PL. Not detected in PU.

Troubleshooting

- Check that the balance resistors are in good condition.
- Check that the DC-link capacitors are in good condition.

6.3.73 Fault Code 73 - Upstream Fiber Communication Fault

Cause

The optical fiber communication board has not received the signals from the power cell unit.

System default operation: Trip. System operation is configurable.

Troubleshooting

- Check if the optical fibers are damaged.
- Check if the joints of the optical fibers are loose.

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