INOVANCE

MD500-PLUS Series

General-Purpose AC Drive

Software Guide

Data code: 19011580 A03

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Preface

Introduction

The MD500-PLUS series AC drive is a general-purpose high-performance current vector control AC drive designed to control and regulate the speed and torque of three-phase AC asynchronous motors and permanent magnet synchronous motors.

The MD500-PLUS series AC drive can be used to drive textile machines, paper machines, wire drawing machines, machine tools, packaging machines, food machines, fans, water pumps, and other automated production equipment.

This guide introduces parameters, detailed parameter functions, typical applications, and communication and fault codes of the AC drive.

More Documents

Name	Data Code	Description
MD500-PLUS Series General-Purpose AC Drive Quick Installation and Commissioning Guide	19011581	Describes the installation, wiring, commissioning, troubleshooting, parameters, and fault codes of the AC drive.
MD500-PLUS Series General-Purpose AC Drive Hardware Guide	19011578	Describes the composition, technical specifications, components, dimensions, options (including installation accessories, cables, and peripheral electrical components), and extension cards of the MD500-PLUS series AC drive, as well as routine maintenance and repair, and certifications and standards of the AC drive.
MD500-PLUS Series General-Purpose AC Drive Installation Guide	19011582	Describes the installation dimensions, space design, specific installation steps, wiring requirements, routing requirements, and option installation requirements of the AC drive, as well as common EMC problem solving recommendations.
MD500-PLUS Series General-Purpose AC Drive Commissioning Guide	19011579	Describes the software tools, processes, and specific steps of debugging and commissioning of the AC drive, as well as troubleshooting, fault codes, and parameters related to the AC drive.

Revision History

Date	Version	Description
September 2021	A03	Corrected errors.
November 2020	A01	Corrected errors.
July 2020	A00	First release.

Document Acquisition

This guide is not delivered with the AC drive. You can obtain the PDF version of this document using the following method:

Log in to Inovance's website (*http://en.inovance.cn/*), choose **Support** > **Download**, perform keyword search, and download the PDF file.

1 Parameters

1.1 List of Function Parameters

If FP-00 is set to a non-zero value (password protection is enabled), the parameter menu is accessible in parameter mode and user-modification mode only after the correct password is entered. To disable password protection, set FP-00 to 0.

If a password is set to lock the operating panel, password authentication is required every time you access the parameter menu for reading or writing parameter values using the operating panel. During communication, the values of parameters (excluding parameters in groups FP and FF) can be read and written without password authentication.

Password protection is not available for the parameter menu in user-defined mode.

Groups F and A include standard function parameters. Group U includes the monitoring parameters. The following symbols are used in the parameter table:

- ☆: The parameter can be modified when the AC drive is in the stop or running state.
- ★: The parameter cannot be modified when the AC drive is in the running state.
- ●: The parameter represents the actual measured value and cannot be modified.
- *: The parameter is a factory parameter and can be set only by Inovance.

Para. No.	Name	Value Range	Default	Unit	Property
Group F0: Basic Parameters					
F0-00	G/P type display	1: G type (constant-torque load)	Model dependent	-	●
F0-01	Motor 1 control mode	0: Sensorless vector control (SVC) 1: Feedback vector control (FVC) 2: V/f control 3: Reserved 4: Reserved 5: PMVVC (applicable only to synchronous motors)	0	-	★
F0-02	Command source selection	0: Operating panel 1: Terminal 2: Communication	0	-	★

Para. No.	Name	Value Range	Default	Unit	Property
F0-03	Main frequency source X selection	0: Digital setting (preset frequency (F0-08) that can be changed by pressing UP/DOWN, non-retentive upon power failure) 1: Digital setting (preset frequency (F0-08) that can be changed by pressing UP/DOWN, retentive at power failure) 2: AI1 3: AI2 4: AI3 5: Pulse reference (DI5) 6: Multi-reference 7: Simple PLC 8: PID 9: Communication 10: Reserved	0	-	★
F0-04	Auxiliary frequency reference Y selection	0: Digital setting (preset frequency (F0-08) that can be changed by pressing UP/DOWN, non-retentive upon power failure) 1: Digital setting (preset frequency (F0-08) that can be changed by pressing UP/DOWN, retentive at power failure) 2: AI1 3: AI2 4: AI3 5: Pulse reference (DI5) 6: Multi-reference 7: Simple PLC 8: PID 9: Communication 10: Reserved	0	-	★
F0-05	Range selection of auxiliary frequency reference (Y) upon superposition	0: Relative to maximum frequency 1: Relative to main frequency X	0	-	☆
F0-06	Range value of auxiliary frequency reference (Y) upon superposition	0% to 150%	100	%	☆

Para. No.	Name	Value Range	Default	Unit	Property
F0-07	Final frequency reference setting selection	Ones (position): 0: Main frequency reference X 1: Main and auxiliary operation result (based on tens position) 2: Switchover between main frequency X and auxiliary frequency Y 3: Switchover between main frequency X and the main and auxiliary operation result 4: Switchover between auxiliary frequency Y and the main and auxiliary operation result Tens (position): 0: Main + Auxiliary 1: Main – Auxiliary 2: Max. (main, auxiliary) 3: Min. (main, auxiliary) 4: Main x Auxiliary	0	-	☆
F0-08	Preset frequency	0.00 to the maximum frequency (F0-10)	50.00 Hz	Hz	☆
F0-09	Running direction selection	0: Default direction 1: Opposite to the default direction	0	-	☆
F0-10	Maximum frequency	50.00–599.00 Hz	50.00 Hz	Hz	★
F0-11	Source of frequency upper limit	0: Frequency upper limit (F0-12) 1: AI1 2: AI2 3: AI3 4: Pulse reference (DI5) 5: Communication 6: Multi-speed reference	0	-	★
F0-12	Frequency upper limit	Frequency reference lower limit (F0-14) to the maximum frequency (F0-10)	50.00 Hz	Hz	☆
F0-13	Frequency upper limit offset	0.00 Hz to the maximum frequency (F0-10)	0.00 Hz	Hz	☆
F0-14	Frequency lower limit	0.00 Hz to the frequency upper limit (F0-12)	0.00 Hz	Hz	☆
F0-15	Carrier frequency	0.8–16.0 kHz	Model dependent	kHz	☆
F0-16	Carrier frequency adjusted with temperature	0: No 1: Yes	1	-	☆
F0-17	Acceleration time 1	0.0–6500.0s	20.0s	s	☆
F0-18	Deceleration time 1	0.0–6500.0s	20.0s	s	☆
F0-19	Acceleration/ Deceleration time unit	0: 1s 1: 0.1s 2: 0.01s	1	-	★

Para. No.	Name	Value Range	Default	Unit	Property
F0-21	Offset frequency of auxiliary frequency source upon superposition	0 to value of F0-10	0.00 Hz	Hz	☆
F0-22	Frequency reference resolution	1: 0.1 Hz 2: 0.01 Hz	2 Hz	Hz	★
F0-23	Retentive memory for digital setting of frequency upon power off	0: Disabled 1: Enabled	0	-	☆
F0-25	Acceleration/ Deceleration time base frequency	0: Maximum frequency (F0-10) 1: Target frequency 2: 100 Hz	0	-	★
F0-26	Base frequency for UP/ DOWN modification during running	0: Running frequency 1: Target frequency	0	-	★
F0-27	Main frequency coefficient	0.00% to 100.00%	10.00%	%	☆
F0-28	Auxiliary frequency coefficient	0.00% to 100.00%	10.00%	%	☆
Group F1: Motor 1 Parameters					
F1-00	Motor type selection	0: Common asynchronous motor 1: Variable frequency asynchronous motor 2: Synchronous motor	0	-	★
F1-01	Rated motor power	0.1–1000.0 kW	Model dependent	kW	★
F1-02	Rated motor voltage	1–2000 V	Model dependent	V	★
F1-03	Rated motor current	0.01–655.35 A (power: ⩽ 55 kW) 0.1–6553.5 A (power: > 55 kW)	Model dependent	A	★
F1-04	Rated motor frequency	0.01–600.00 Hz	Model dependent	Hz	★
F1-05	Rated motor speed	1–65535 RPM	Model dependent	RPM	★
F1-06	Asynchronous/ Synchronous motor stator resistance	0.001–65.535 Ω (power: ⩽ 55 kW) 0.0001–6.5535 Ω (power: > 55 kW)	Model dependent	Ω	★
F1-07	Asynchronous motor rotor resistance	0.001 (power: ⩽ 55 kW) 0.0001 (power: > 55 kW)	Model dependent	Ω	★
F1-08	Asynchronous motor leakage inductance	0.01–655.35 mH (power: ⩽ 55 kW) 0.001–65.535 mH (power: > 55 kW)	Model dependent	mH	★
F1-09	Asynchronous motor mutual inductance	0.1–6553.5 mH (power: ⩽ 55 kW) 0.01–655.35 mH (power: > 55 kW)	Model dependent	mH	★

Para. No.	Name	Value Range	Default	Unit	Property
F1-10	Asynchronous motor no-load current	0.1–6553.5 A (the maximum current is specified by F1-03)	Model dependent	A	★
F1-11	Asynchronous motor core saturation coefficient 1	50.0% to 100.0%	86.0%	%	☆
F1-12	Asynchronous motor core saturation coefficient 2	100.0% to 150.0%	130.0%	%	☆
F1-13	Asynchronous motor core saturation coefficient 3	100.0% to 170.0%	140.0%	%	☆
F1-14	Asynchronous motor core saturation coefficient 4	100.0% to 180.0%	150.0%	%	☆
F1-17	Synchronous motor axis D inductance	0.01–655.35 mH (power: ⩽ 55 kW) 0.001–65.535 mH (power: > 55 kW)	Model dependent	mH	★
F1-18	Synchronous motor axis Q inductance	0.01–655.35 mH (power: ⩽ 55 kW) 0.001–65.535 mH (power: > 55 kW)	Model dependent	mH	★
F1-19	Synchronous motor back EMF coefficient	0.0–6553.5 V	Model dependent	V	★
F1-20	Filter time constant (PMVVC)	0.003% to 65.535%	0.100 V	%	☆
F1-21	Oscillation suppression gain (PMVVC)	0–65535	100	-	☆
F1-23	Percentage of the frictional moment	0.00% to 100.00%	0.00%	%	★
F1-24	Number of motor pole pairs	0–65535	2	-	☆
F1-26	Auto-tuning direction (inertia auto-tuning and synchronous motor auto-tuning)	0: Reverse run 1: Forward run	1	-	★
F1-27	Encoder pulses per revolution	1–20000	1024	-	★
F1-28	Encoder type	0: ABZ incremental encoder 1: 23-bit encoder 2: Resolver	1	-	★
F1-29	PG signal filter	0: Non-adaptive filter 1: Adaptive filter 2: Fixed interlock 3: Automatic interlock	1	-	★
F1-30	Encoder wiring flag	Ones (position): AB signal direction or rotational direction Tens (position): Reserved	0	-	★
F1-31	Encoder zero position angle	0.0° to 359.9°	0.0°	°	★

Para. No.	Name	Value Range	Default	Unit	Property
F1-32	Motor gear ratio numerator	1–65535	1	-	★
F1-33	Motor gear ratio denominator	1–65535	1	-	★
F1-34	Number of pole pairs of resolver	1–32	1	-	★
F1-36	PG open circuit detection	0: Disabled 1: Enabled	1	-	★
F1-37	Auto-tuning selection	0: No auto-tuning 1: Static auto-tuning on partial parameters of the asynchronous motor 2: Dynamic auto-tuning on all parameters of the asynchronous motor 3: With-load auto-tuning on all parameters of the asynchronous motor 4: Asynchronous motor inertia auto-tuning (only in FVC mode) 11: Static auto-tuning on partial parameters of the synchronous motor (excluding back EMF) 12: No-load dynamic auto-tuning on all parameters of the synchronous motor 13: Static auto-tuning on all parameters of the synchronous motor (excluding the encoder installation angle) 14: Synchronous motor inertia auto-tuning (only in FVC mode)	0	-	★
Group F2: Motor 1 Vector Control Parameters					
F2-00	Low-speed speed loop Kp	1–200	30 (asynchronous motor) or 20 (synchronous motor)	-	☆
F2-01	Low-speed speed loop Ti	0.001–10.000s	0.500s	s	☆
F2-02	Switchover frequency 1	0.00 to switchover frequency 2 (F2-05)	5.00 Hz	Hz	☆
F2-03	High-speed speed loop Kp	1–200	20	-	☆
F2-04	High-speed speed loop Ti	0.001–10.000s	1.000s	s	☆
F2-05	Switchover frequency 2	Value of F2-02 to the maximum frequency	10.00 Hz	Hz	☆
F2-06	VC slip compensation gain	50% to 200%	100%	%	☆
F2-07	Speed loop feedback filter time	0.000–0.100s	0.004s	s	☆

Para. No.	Name	Value Range	Default	Unit	Property
F2-09	Torque upper limit source in speed control (motoring)	0: Digital setting (F2-10) 1: AI1 2: AI2 3: AI3 4: Pulse reference (DI5) 5: Communication 6: Min. (AI1, AI2) 7: Max. (AI1, AI2)	0	-	☆
F2-10	Digital setting of torque upper limit in speed control (motoring)	0.0% to 200.0%	150.0%	%	☆
F2-11	Torque upper limit source in speed control (generating)	0: Digital setting (F2-10) 1: AI1 2: AI2 3: AI3 4: Pulse reference (DI5) 5: Communication 6: Min. (AI1, AI2) 7: Max. (AI1, AI2) 8: Digital setting (F2-12)	0	-	☆
F2-12	Torque upper limit settings in speed control (generating)	0.0% to 200.0%	150.0%	%	☆
F2-13	Low-speed current loop Kp adjustment	0.1–10.0	1.0	-	☆
F2-14	Low-speed current loop Ki adjustment	0.1–10.0	1.0	-	☆
F2-15	High-speed current loop Kp adjustment	0.1–10.0	1.0	-	☆
F2-16	High-speed current loop Ki adjustment	0.1–10.0	1.0	-	☆
F2-17	Speed loop Kp upon zero speed lock	1–100	30	-	☆
F2-18	Speed loop Ti upon zero speed lock	0.001–10.000s	0.500s	s	☆
F2-19	Inertia compensation gain	1–200	1	-	☆
F2-20	Speed loop switchover frequency upon zero speed lock	0 to value of F2-02	0.05 Hz	Hz	☆
F2-21	Maximum output voltage coefficient	100% to 110%	100	-	☆
F2-23	Zero speed lock	0: Disabled 1: Enabled	0	-	★

Para. No.	Name	Value Range	Default	Unit	Property
F2-24	Overvoltage suppression Kp in vector control mode	0–1000	40	-	☆
F2-25	Acceleration compensation gain	0–200	0	-	●
F2-26	Acceleration rate compensation filter time	0–500	10	-	●
F2-27	Overvoltage suppression in vector control mode	0: Disabled 1: Enabled	1	-	☆
F2-28	Cut-off frequency of torque filter reference	50–1000 Hz	500 Hz	Hz	☆
F2-29	Synchronous motor initial angle detection current	50–180	80	-	☆
F2-30	Speed loop parameter auto-calculation	0: Disabled 1: Enabled	0	-	★
F2-31	Expected speed loop bandwidth (high speed)	0–3 Hz	0 Hz	Hz	☆
F2-32	Expected speed loop bandwidth (low speed)	1–10000 Hz	100 Hz	Hz	☆
F2-33	Expected speed loop bandwidth (zero speed)	1–10000 Hz	100 Hz	Hz	☆
F2-34	Damping ratio of expected speed loop (unchanged generally)	0.100–65.000	1.000	-	☆
F2-35	System inertia (equivalent to the start time)	0.001–50.000s	Model dependent	s	★
F2-36	Motor inertia (kg x m^2)	0.001–50.000 kg x m^2	Model dependent	kg x m^2	★
F2-37	Inertia auto-tuning maximum frequency	20% to 100%	80%	%	★
F2-38	Inertia auto-tuning acceleration time	1.0–50.0s	10.0s	s	★
F2-39	Bandwidth 1 of speed loop dynamic optimization test	1.0–200.0 Hz	5.0 Hz	Hz	●
F2-40	Bandwidth 2 of speed loop dynamic optimization test	1.0–200.0 Hz	10.0 Hz	Hz	●
F2-41	Bandwidth 3 of speed loop dynamic optimization test	1.0–100.0 Hz	15.0 Hz	Hz	●

Para. No.	Name	Value Range	Default	Unit	Property
F2-42	Bandwidth 4 of speed loop dynamic optimization test	1.0–200.0 Hz	20.0 Hz	Hz	●
F2-43	Inertia auto-tuning and dynamic speed reference	0–100	30	-	★
F2-44	Rotor time constant check	0: Disabled 1: Enabled	0	-	●
F2-45	Torque amplitude of rotor time constant check	10% to 100%	30%	%	●
F2-46	Number of times of rotor constant check	1–6	3	-	●
F2-47	Inertia auto-tuning	0: Disabled 1: Enabled	0	-	★
F2-48	Speed loop bandwidth during inertia auto-tuning	0.1–100.0 Hz	10.0 Hz	Hz	★
F2-49	Back EMF calculation	0: Disabled 1: Enabled	1	-	●
F2-50	Inertia auto-tuning mode	0: Acceleration/Deceleration mode 1: Triangular wave mode	0	-	★
F2-51	Acceleration/ Deceleration coefficient of inertia auto-tuning	0.1–10.0	1.0	-	★
F2-52	Decoupling control	0: Disabled 1: Enabled	0	-	★
F2-53	Power limit selection during generating	0: Disabled 1: Enabled	0	-	★
F2-54	Power limit during generating	0.0% to 200.0%	20.0%	%	★
F2-55	Flux closed loop and torque linearity optimization in FVC mode	Ones (position): Flux closed loop in torque control mode 0: Disabled 1: Enabled Tens (position): Flux closed loop in speed control mode 0: Disabled 1: Enabled Hundreds (position): Torque upper limit and torque linearity in speed control mode 0: Disabled 1: Enabled	10	-	★
F2-56	AC drive output current upper limit	0.0% to 170.0%	150.0	%	★

Para. No.	Name	Value Range	Default	Unit	Property
Group F3: V/f Control Parameters					
F3-00	V/F curve setting	0: Linear V/f curve 1: Multi-point V/f curve 2: Square V/f curve 3: 1.2-power V/f curve 4: 1.4-power V/f curve 6: 1.6-power V/f curve 8: 1.8-power V/f curve 10: V/f complete separation mode 11: V/f half separation mode	0	-	★
F3-01	Torque boost	0.0% to 30.0% 0.0%: Automatic torque boost	Model dependent	%	☆
F3-02	Cutoff frequency of torque boost	0 to the maximum frequency	50.00 Hz	Hz	★
F3-03	Multi-point V/f frequency 1	0 to value of F3-05	0.00 Hz	Hz	★
F3-04	Multi-point V/f voltage 1	0.0% to 100.0%	0.0%	%	★
F3-05	Multi-point V/f frequency 2	F3-03 to F3-07	0.00 Hz	Hz	★
F3-06	Multi-point V/f voltage 2	0.0% to 100.0%	0.0%	%	★
F3-07	Multi-point V/f frequency 3	F3-05 to F1-04	0.00 Hz	Hz	★
F3-08	Multi-point V/f voltage 3	0.0% to 100.0%	0.0%	%	★
F3-09	V/f slip compensation gain	0.0% to 200.0%	0.0%	%	☆
F3-10	V/f overexcitation gain	0–200	64	-	☆
F3-11	V/f oscillation suppression gain	0–100	Model dependent	-	☆
F3-12	Oscillation suppression gain mode	0: Disabled 3: Enabled	3	-	★
F3-13	Voltage source for V/f separation	0: Digital setting (F3-14) 1: AI1 2: AI2 3: AI3 4: Pulse reference (DI5) 5: Multi-reference 6: Simple PLC 7: PID 8: Communication	0	-	☆
F3-14	Voltage digital setting for V/f separation	0 to value of F1-02	0 V	V	☆
F3-15	Voltage rise time of V/f separation	0.0–1000.0s	0.0s	s	☆
F3-16	Voltage decline time of V/f separation	0.0–1000.0s	0.0s	s	☆

Para. No.	Name	Value Range	Default	Unit	Property
F3-17	Stop mode selection for V/f separation	0: Frequency and voltage decline to 0 independently 1: Frequency declines after voltage declines to 0	0	-	★
F3-18	V/f overcurrent stall action current	50% to 200%	150%	%	★
F3-19	V/f overcurrent stall selection	0: Disabled 1: Enabled	1	-	★
F3-20	V/f overcurrent stall suppression gain	0–100	20	-	☆
F3-21	Compensation coefficient of V/f speed multiplying overcurrent stall action current	50% to 200%	50	-	★
F3-22	V/f overvoltage stall protective voltage	200.0–2000.0 V	770.0 V	V	★
F3-23	V/f overvoltage stall selection	0: Disabled 1: Enabled	1	-	★
F3-24	Frequency gain for V/f overvoltage stall suppression	0–100	30	-	☆
F3-25	Voltage gain for V/f overvoltage stall suppression	0–100	30	-	☆
F3-26	Frequency rise threshold during overvoltage stall	0–50 Hz	5	-	★
F3-27	Slip compensation time constant	0.1–10.0	0.5	-	☆
F3-28	V/f parameter auto-tuning inertia coefficient	0.00–10.00	0.10	-	★
F3-33	Online torque compensation gain	80–150	100	-	★
Group F4: Input Terminal Parameters					

Para. No.	Name	Value Range	Default	Unit	Property
F4-00	DI1 function selection	0: No function 1: Forward run (FWD) 2: Reverse run (REV) 3: Three-wire control 4: Forward jog (FJOG) 5: Reverse jog (RJOG) 6:Terminal (UP) 7:Terminal (DOWN) 8: Coast to stop 9: Fault reset (RESET) 10: Running pause 11:NO input of external fault 12: Multi-reference terminal 1 13: Multi-reference terminal 2 14: Multi-reference terminal 3 15: Multi-reference terminal 4 16:Terminal 1 for acceleration/ deceleration selection 17: Terminal 2 for acceleration/ deceleration selection 18: Frequency source switchover 19: UP and DOWN setting clear (terminal, operation panel) 20: Command source switchover terminal 21: Acceleration/Deceleration inhibited 22: PID pause 23: PLC state reset 24: Wobble pause 25:Counter input (DIO1) 26: Counter reset 27: Length count input (DIO1) 28: Length reset 29: Torque control inhibited 30: Pulse input 31: Reserved 32: Immediate DC braking 33: NC input of external fault	1	-	★

Para. No.	Name	Value Range	Default	Unit	Property
(continued)	(continued)	34: Frequency modification enable 35: PID action direction reversal 36: External stop terminal 1 37: Command source switchover terminal 2 38: PID integral pause 39: Switchover between main frequency source X and preset frequency 40: Switchover between auxiliary frequency source Y and preset frequency 41: Motor selection 42: Position lock enabled 43: PID parameter switchover 44: User-defined fault 1 45: User-defined fault 2 46: Speed control/Torque control switchover 47: Emergency stop 48: External STOP terminal 2 49: Deceleration DC braking 50: Clear the current running time 51: Two-wire/three-wire control switchover 52: Electromagnetic shorting 53: Thickness overlaying 54: Roll diameter reset 55: Initial roll diameter 1 56: Initial roll 2 57: Pre-charge 58: Winding/Unwinding switchover 59: Winding diameter calculation disabled 60: Exit tension control 61: Terminal tension rise 62: Thickness selection 1 63: Thickness selection 2 64–89: Reserved 90: Water cooling system fault 91: Low liquid level fault 92: Revolution count reset 93: DI running enabled	1	-	★
F4-01	DI2 function selection	0–93	4	-	★
F4-02	DI3 function selection	0–93	9	-	★
F4-03	DI4 function selection	0–93	12	-	★
F4-04	DI5 function selection	0–93	13	-	★
F4-05	DI6 function selection	0–93	0	-	★

Para. No.	Name	Value Range	Default	Unit	Property
F4-06	DI7 function selection	0–93	0	-	★
F4-07	DI8 function selection	0–93	0	-	★
F4-08	DI9 function selection	0–93	0	-	★
F4-09	DI10 function selection	0–93	0	-	★
F4-10	DI filter time	0.000–1.000s	0.010s	s	☆
F4-11	Terminal control mode	0: Two-wire mode 1 1: Two-wire mode 2 2: Three-wire mode 1 3: Three-wire mode 2	0	-	★
F4-12	Terminal UP/DOWN change rate	0.001–65.535 Hz/s	1.000 Hz/s	Hz/s	☆
F4-13	AI curve 1 minimum input	–1000 to value of F4-15	–10.00 V	V	☆
F4-14	Percentage corresponding to AI curve 1 minimum input	–100.0% to +100.0%	–100.0%	%	☆
F4-15	AI curve 1 maximum input	Value of F4-13 to 1000	10.00 V	V	☆
F4-16	Percentage corresponding to AI curve 1 maximum input	–100.0% to +100.0%	100.0%	%	☆
F4-17	AI1 fitter time	0.00–10.00s	0.10s	s	☆
F4-18	AI curve 2 minimum input	–10.00 V to value of F4-20	–10.00 V	V	☆
F4-19	Percentage corresponding to AI curve 2 minimum input	–100.0% to +100.0%	–100.0%	%	☆
F4-20	AI curve 2 maximum input	Value of F4-18 to 10.00 V	10.00 V	V	☆
F4-21	Percentage corresponding to AI curve 2 maximum input	–100.0% to +100.0%	100.0%	%	☆
F4-22	AI2 fitter time	0.00–10.00s	0.10s	s	☆
F4-23	AI curve 3 minimum input	–10.00 V to value of F4-25	–10.00 V	V	☆
F4-24	Percentage corresponding to AI curve 3 minimum input	–100.0% to +100.0%	–100.0%	%	☆
F4-25	AI curve 3 maximum input	Value of F4-23 to 10.00 V	10.00 V	V	☆
F4-26	Percentage corresponding to AI curve 3 maximum input	–100.0% to +100.0%	100.0%	%	☆
F4-27	AI3 fitter time	0.00–10.00s	0.10s	s	☆
F4-28	Pulse minimum input	0 to value of F4-30	0.00 kHz	kHz	☆

Para. No.	Name	Value Range	Default	Unit	Property
F4-29	Percentage corresponding to pulse minimum input	–100.0% to +100.0%	0.0%	%	☆
F4-30	Pulse maximum input	Value of F4-28 to 10000	100 Hz	kHz	☆
F4-31	Percentage corresponding to pulse maximum input	–100.0% to +100.0%	100.0%	%	☆
F4-32	Pulse filter time	0.00–10.00s	0.10s	s	☆
F4-33	AI curve selection	Ones (position): 1:Curve 1 (two points) 2: Curve 2 (two points) 3: Reserved 4:Curve 4 (four points) 5: Curve 5 (four points) Tens (position): 1: Curve 1 (two points) 2: Curve 2 (two points) 3: Reserved 4: Curve 4 (four points) 5: Curve 5 (four points) Hundreds (position): 1: Curve 1 (two points) 2: Curve 2 (two points) 3: Reserved 4: Curve 4 (four points) 5:Curve 5 (four points)	321	-	☆
F4-34	Setting for the AI lower than the minimum input	Ones (position): 0: Percentage corresponding to minimum input 1: 0.0% Tens (position): 0: Percentage corresponding to minimum input 1: 0.0% Hundreds (position): 0: Percentage corresponding to minimum input 1: 0.0%	0	-	☆
F4-35	DI1 delay	0.0–3600.0s	0.0s	s	☆
F4-36	DI2 delay	0.0–3600.0s	0.0s	s	☆
F4-37	DI3 delay	0.0–3600.0s	0.0s	s	☆

Para. No.	Name	Value Range	Default	Unit	Property
F4-38	DI valid mode setting 1	Ones (position): DI1 active mode 0: Active high 1: Active low Tens (position): DI2 active mode The options are the same as those of DI1. Hundreds (position): DI3 active mode The options are the same as those of DI1. Thousands (position): DI4 active mode The options are the same as those of DI1. Ten thousands (position): DI5 active mode The options are the same as those of DI1.	0	-	★
F4-39	DI valid mode setting 2	Ones (position): DI1 active mode 0: Active high 1: Active low Tens (position): DI2 active mode The options are the same as those of DI1. Hundreds (position): DI3 active mode The options are the same as those of DI1. Thousands (position): DI4 active mode The options are the same as those of DI1. Ten thousands (position): DI5 active mode The options are the same as those of DI1.	0	-	★
F4–42	AI input range selection	0: –10 V to +10 V 1: 0–10 V	0	-	★
Group F5: Output Terminal Parameters					

Para. No.	Name	Value Range	Default	Unit	Property
F5-01	Extension card relay output function selection	0: No output 1: AC drive running 2: Fault output (stop at fault) 3: Frequency level detection FDT1 output 4: Frequency reach 5: Zero-speed running (no output at stop) 6: Motor overload pre-warning 7: AC drive overload pre-warning 8: Set count value reach 9: Designated count value reach 10: Length reach 11: PLC cycle completed 12: Accumulative running time reach 13: Frequency limited 14:Torque limited 15: Ready to run 16: AI1 > AI2 17: Frequency upper limit reach 18: Frequency lower limit reach (operation related) 19: Undervoltage output 20: Communication 21: Reserved 22: Reserved 23: Zero-speed running 2 (at stop) 24: Accumulative power-on time reach 25: Frequency level detection FDT2 output 26: Frequency 1 reach 27: Frequency 2 reach 28:Current 1 reach 29: Current 2 reach 30: Timing reach 31: AI1 input limit exceeded 32: Output load loss	0	-	☆

Para. No.	Name	Value Range	Default	Unit	Property
(continued)	(continued)	33: Reverse run 34: Zero current state 35: IGBT temperature reach 36: Output current limit exceeded 37: Frequency lower limit reach (having output at stop) 38: Alarm output (direct output at fault or alarm) 39: Current over-temperature pre-warning 40: Current running time reach 41: Fault output 2 42: Fault output 3 43: Position lock succeeded 46: Brake release output	0	-	☆
F5-02	Control board relay function selection (T/A1-T/B1-TC1)	0–46	2	-	☆
F5-03	Control board relay function selection (T/A2-TC2)	0–46	0	-	☆
F5-04	DO1 function selection	0–46	0	-	☆
F5-05	Extension card DO2 output selection	0–46	4	-	☆
F5-07	AO1 function selection	0: Running frequency 1: Frequency reference 2: Output current 3: Output torque 4: Output power 5: Output voltage 6: Pulse input (100.0% corresponds to 100.00 kHz) 7: AI1 8: AI2 9: AI3 10: Length 11: Count value 12: Communication 13: Motor speed 14: Output current (100.0% corresponds to 1000.0 A) 15: Output voltage (100.0% corresponds to 1000.0 V) 16: Output torque (directional) 19: Taper output 20: Roll diameter output 21: Tension output	0	-	☆

Para. No.	Name	Value Range	Default	Unit	Property
F5-08	AO2 function selection	0–21	1	-	☆
F5-10	AO1 zero offset coefficient	–100.0% to +100.0%	0.0%	%	☆
F5-11	AO1 gain	–10.00 to +10.00	1.00	-	☆
F5-12	AO2 zero offset coefficient	–100.0% to +100.0%	0.0%	%	☆
F5-13	AO2 gain	–10.00 to +10.00	1.00	-	☆
F5-17	Extension card relay output delay	0.0–3600.0s	0.0s	s	☆
F5-18	Relay 1 output delay	0.0–3600.0s	0.0s	s	☆
F5-19	Relay 2 output delay	0.0–3600.0s	0.0	s	☆
F5-20	DO1 output delay	0.0–3600.0s	0.0s	s	☆
F5-21	Extension card DO2 output delay	0.0–3600.0s	0.0s	s	☆
F5-22	DO active mode selection	Ones (position): Extension card relay 0: Positive logic 1: Negative logic Tens (position): Control board relay 1 0: Positive logic 1: Negative logic Hundreds (position): Control board relay 2 0: Positive logic 1: Negative logic Thousands (position): Control board DO1 0: Positive logic 1: Negative logic Ten thousands (position): Extension card DO2 0: Positive logic 1: Negative logic	0	-	☆
Group F6: Start/Stop Control Parameters					
F6-00	Startup mode	0: Direct start 1: Flying start (asynchronous motor) 2: vector pre-excited start (asynchronous motor)	0	-	☆
F6-01	Speed tracking	0: From stop frequency 1: From 50 Hz 2: From the maximum frequency 3: Reserved	0	-	★
F6-02	Speed of speed tracking	1–100	20	-	☆
F6-03	Startup frequency	0.00–10.00 Hz	0.00 Hz	Hz	☆
F6-04	Startup frequency hold time	0.0–100.0s	0.0s	s	★

Para. No.	Name	Value Range	Default	Unit	Property
F6-05	DC braking current at startup/Pre-excitation current	0% to 150%	0%	%	★
F6-06	DC braking time at startup/Pre-excitation time	0.0–100.0s	0.0s	s	★
F6-07	Acceleration/ Deceleration mode	0: Linear acceleration/deceleration 1: S-curve acceleration/deceleration	0	-	★
F6-08	Time proportion of S-curve start segment	0.0% to 70.0%	30.0%	%	★
F6-09	Time proportion of S-curve end segment	0.0% to 70.0%	30.0%	%	★
F6-10	Stop mode	0: Decelerate to stop 1: Coast to stop	0	-	☆
F6-11	Starting frequency of DC braking at stop	0.00 Hz to the maximum frequency (F0-10)	0.00 Hz	Hz	☆
F6-12	Waiting time of DC braking at stop	0.0–100.0s	0.0s	s	☆
F6-13	DC braking current at stop	0% to 150%	0%	%	☆
F6-14	DC braking time at stop	0.0–100.0s	0.0s	s	☆
F6-15	Brake usage	0% to 100%	100%	%	★
F6-16	Closed loop current Kp of speed tracking	0–1000	500	-	☆
F6-17	Closed loop current Ki of speed tracking	0–1000	800	-	☆
F6-18	Current of speed tracking	30–200	100	-	☆
F6-21	Demagnetization time	0.00–10.00s	1.00s	s	☆
F6-22	Start pre-torque setting	0.0% to 200%	0.0%	%	☆
F6-26	Electromagnetic shorting current	0% to 200%	100%	%	☆
F6-27	Electromagnetic shorting start time	0.0–100.0s	0.0s	s	★
F6-28	Electromagnetic shorting stop time	0.0–100.0s	0.0s	s	★
F6-29	Electromagnetic shorting voltage reserve	20.0–100.0 V	200	V	★
F6-30	Trial current for synchronous motor speed tracking	50–500	100	-	★

Para. No.	Name	Value Range	Default	Unit	Property
F6-31	Minimum tracking frequency for synchronous motor speed tracking	0.0–100.0	0.0	-	★
F6-32	Angle compensation for synchronous motor speed tracking	0–360	0	-	★
F6-33	Proportion of synchronous motor speed tracking	0.1–10.0	1.0	-	★
F6-34	Integral synchronous motor speed tracking	0.1–10.0	1.0	-	★
F6-35	Maximum current limit for DC braking	80% to 135%	80%	%	★
F6-36	Speed loop feedforward torque setting	–200.0% to +200.0%	0.0%	%	☆
Group F7: Operating Panel and LED Display Parameters					
F7-01	MF.K key function selection	0: MF.K key disabled 1: Switchover between operating panel control and remote control (terminal I/O control or communication control) 2: Switchover between forward and reverse run 3: Forward jog 4: Reverse jog	0	-	★
F7-02	STOP/RES key function	0: STOP/RES key enabled only in operating panel control mode 1: STOP/RES key enabled in any operating mode	0	-	☆
F7-03	LED display of parameters during operation 1	Bit00: Running frequency (Hz) Bit01: Frequency reference (Hz) Bit02: Bus voltage (V) Bit03: Output voltage (V) Bit04:Output current (A) Bit05: Output power (kW) Bit06: Output torque (%) Bit07:DI state Bit08: DO state Bit09: AI1 voltage (V) Bit10: AI2 voltage (V) Bit11: Reserved Bit12: Count value Bit13: Length value Bit14: Load speed display Bit15: PID reference	0x001F	-	☆

Para. No.	Name	Value Range	Default	Unit	Property
F7-04	LED display of parameters during operation 2	Bit00: PID feedback Bit01: PLC stage Bit02: Pulse input reference (kHz) Bit03: Running frequency 2 (Hz) Bit04: Remaining running time Bit05: AI1 voltage before correction Bit06: AI2 voltage before correction Bit07: Reserved Bit08: Linear speed Bit09: Current power-on time (Hour) Bit10: Current running time (Min) Bit11: Pulse input reference (Hz) Bit12: Communication Bit13: Encoder feedback speed Bit14: Display of main frequency X Bit15: Display of auxiliary frequency Y	0x0000	-	☆
F7-05	LED display of parameters at stop	Bit00: Frequency reference (Hz) Bit01: Bus voltage (V) Bit02: DI state Bit03: DO state Bit04: AI1 voltage (V) Bit05: AI2 voltage (V) Bit06: Reserved Bit07: Count value Bit08: Length value Bit09: PLC stage Bit10: Load speed display Bit11: PID reference Bit12: Pulse input reference (kHz)	0x0033	-	☆
F7-06	Load speed display coefficient	0.0001–6.5000	1.0000	-	☆
F7-07	Heatsink temperature of IGBT	0.0°C to 99.9°C	-	°C	●
F7-08	Product SN	510	-	-	●
F7-09	Accumulative running time	0–65535 h	-	h	●
F7-10	Performance software version	0.00	0.01	-	●
F7-11	Function software version	0	-	-	●

Para. No.	Name	Value Range	Default	Unit	Property
F7-12	Number of decimal places for load speed display	Ones (position): Number of decimal places for the value of U0-14 0: 0 1: 1 2: 2 3: 3 Tens (position): Number of decimal places for the value of U0-19/U0-29 1: 1 2: 2	11	-	☆
F7-13	Accumulative power-on time	0–65535 h	-	h	●
F7-14	Accumulative power consumption	0° to 65535°	-	°	●
F7-15	Temporary performance software version	0	-	-	●
F7-16	Temporary function software version	0	-	-	●
Group F8: Auxiliary Parameters					
F8-00	Jog frequency	0 to the maximum frequency (F0-10)	2.00 Hz	Hz	☆
F8-01	Jog acceleration time	0.0–6500.0s	20.0s	s	☆
F8-02	Jog deceleration time	0.0–6500.0s	20.0s	s	☆
F8-03	Acceleration time 2	0.0–6500.0s	200	s	☆
F8-04	Deceleration time 2	0.0–6500.0s	200	s	☆
F8-05	Acceleration time 3	0.0–6500.0s	200	s	☆
F8-06	Deceleration time 3	0.0–6500.0s	200	s	☆
F8-07	Acceleration time 4	0.0–6500.0s	200	s	☆
F8-08	Deceleration time 4	0.0–6500.0s	200	s	☆
F8-09	Jump frequency 1	0.00 to the maximum frequency (F0-10)	0.00 Hz	Hz	☆
F8-10	Jump frequency 2	0.00 to the maximum frequency (F0-10)	0.00 Hz	Hz	☆
F8-11	Jump frequency amplitude	0.00–5.00 Hz	0.00 Hz	Hz	☆
F8-12	Forward/Reverse run switchover dead zone time	0.0–3000.0s	0.0s	s	☆
F8-13	Reverse run enable	0: Reverse running allowed 1: Reverse running inhibited	0	-	☆
F8-14	Running mode when frequency reference lower than frequency lower limit	0: Frequency lower limit 1: Stop 2: Zero speed running 3: Coast to stop	0	-	☆
F8-15	Mechanical braking frequency	0.00–10.00 Hz	0.00 Hz	Hz	☆

Para. No.	Name	Value Range	Default	Unit	Property
F8-16	Accumulative power-on time threshold	0–65000 h	0 h	h	☆
F8-17	Accumulative running time threshold	0–65000 h	0 h	h	☆
F8-18	Startup protection selection	0: Disabled 1: Enabled	0	-	☆
F8-19	Frequency detection value (FDT1)	0 to the maximum frequency (F0-10)	50.00 Hz	Hz	☆
F8-20	Frequency detection hysteresis (FDT1)	0.0% to 100.0%	5.0%	%	☆
F8-21	Detection width for frequency reach	0.0% to 100.0%	0.0%	%	☆
F8-22	Jump frequency selection during acceleration/ deceleration	0: Disabled 1: Enabled	0	-	☆
F8-23	Action selection upon accumulative running time reach	0–1	0	-	●
F8-24	Action selection upon accumulative power-on time reach	0–1	0	-	●
F8-25	Switchover frequency of acceleration time 1 and acceleration time 2	0 to the maximum frequency (F0-10)	0.00 Hz	Hz	☆
F8-26	Switchover frequency of deceleration time 1 and deceleration time 2	0 to the maximum frequency (F0-10)	0.00 Hz	Hz	☆
F8-27	Jog preferred	0: Disabled 1: Enabled	0	-	☆
F8-28	Frequency detection value (FDT2)	0 to the maximum frequency (F0-10)	50.00 Hz	Hz	☆
F8-29	Frequency detection hysteresis (FDT2)	0.0% to 100.0%	5.0%	%	☆
F8-30	Detection value for frequency reach 1	0 to the maximum frequency (F0-10)	50.00 Hz	Hz	☆
F8-31	Detection width for frequency reach 1	0.0% to 100.0%	0.0%	%	☆
F8-32	Detection value for frequency reach 2	0 to the maximum frequency (F0-10)	50.00 Hz	Hz	☆
F8-33	Detection width for frequency reach 2	0.0% to 100.0%	0.0%	%	☆
F8-34	Zero current detection level	0.0% to 300.0%	5.0%	%	☆
F8-35	Zero current detection delay	0.01–600.00s	0.10s	s	☆

Para. No.	Name	Value Range	Default	Unit	Property
F8-36	Output overcurrent threshold	0.0% to 300.0%	200.0%	%	☆
F8-37	Output overcurrent detection delay	0.00–600.00s	0.00s	s	☆
F8-38	Detection level of current 1	0.0% to 300.0%	100.0%	%	☆
F8-39	Detection width of current 1	0.0% to 300.0%	0.0%	%	☆
F8-40	Detection level of current 2	0.0% to 300.0%	100.0%	%	☆
F8-41	Detection width of current 2	0.0% to 300.0%	0.0%	%	☆
F8-42	Timing function	0: Disabled 1: Enabled	0	-	★
F8-43	Timing duration source	0: Timing duration (specified by F8-44) 1: AI1 2: AI2	0	-	★
F8-44	Timing duration	0.0–6500.0 min	0.0 min	min	★
F8-45	AI1 input voltage lower limit	0.00 V to value of F8-46	3.10 V	V	☆
F8-46	AI1 input voltage upper limit	Value of F8-45 to 11.00 V	6.80 V	V	☆
F8-47	IGBT temperature reach	0°C to 100°C	75°C	°C	☆
F8-48	Cooling fan working mode	0: Working during drive running 1: Working continuously	0	-	☆
F8-49	Wakeup frequency	Value of F8-51 to the maximum frequency (F0-10)	0.00 Hz	Hz	☆
F8-50	Wakeup delay	0.0–6500.0s	0.0s	s	☆
F8-51	Sleep frequency	0 to value of F8-49	0.00 Hz	Hz	☆
F8-52	Sleep delay	0.0–6500.0s	0.0s	s	☆
F8-53	Current running time threshold	0.0–6500.0 min	0.0 min	min	☆
F8-54	STO selection	0: Disabled 1: Enabled	0	-	★
F8-55	Deceleration time for emergency stop	0.0–6500.0s	0.0s	s	☆
F8-56	LED operating panel jog	0	0	-	●
Group F9: Fault and Protection Parameters					
F9-00	AC drive overload protection	0: Disabled 1: Enabled	0	-	☆
F9-01	Motor overload protection gain	0.20–10.00	1.00	-	☆
F9-02	Motor overload pre-warning coefficient	50% to 100%	80%	%	☆

Para. No.	Name	Value Range	Default	Unit	Property
F9-04	Overvoltage threshold	350.0–820.0 V	820.0 V	V	☆
F9-05	Voltage dip suppression time	0.0–600.0s	0.5s	s	☆
F9-06	Output phase loss detection before startup	0: Disabled 1: Enabled	0	-	☆
F9-07	Detection of short-circuit to ground	0: No detection 1: Detection before power-on 2: Detection before running 3: Detection before power-on and running	1	-	★
F9-08	Braking unit applied voltage	200.0–2000.0 V	760.0 V	V	☆
F9-09	Fault auto reset times	0–20	0	-	☆
F9-10	DO action during auto fault reset	0: Not act 1: Act	0	-	☆
F9-11	Automatic fault reset interval	0.1–100.0s	1.0s	s	☆
F9-12	Input phase loss/ Contactor pickup protection	Ones (position): Input phase loss protection selection 0: Input phase loss detection inhibited 1: Input phase loss detected by software and hardware 2: Input phase loss detected by software 3: Input phase loss detected by hardware Tens (position): Contactor close/Fan fault protection 0: Inhibited 1: Enabled	11	-	☆
F9-13	Restart interval upon fault reset	0.0–600.0s	10.0s	s	☆
F9-14	1st fault type	0–99	-	-	●
F9-15	2nd fault type	0–99	-	-	●
F9-16	3rd (latest) fault type	0–99	-	-	●
F9-17	Frequency upon 3rd (latest) fault	0.00–655.35 Hz	-	Hz	●
F9-18	Current upon 3rd (latest) fault	0.0–6553.5 A	-	A	●
F9-19	Bus voltage upon 3rd (latest) fault	0.0–6553.5 V	-	V	●
F9-20	Input terminal state upon 3rd (latest) fault	0–9999	-	-	●
F9-21	Output terminal state upon 3rd (latest) fault	0–9999	-	-	●

Para. No.	Name	Value Range	Default	Unit	Property
F9-22	AC drive state upon 3rd (latest) fault	0–65535	-	-	●
F9-23	Power-on time upon 3rd (latest) fault	0–65535	-	-	●
F9-24	Running time upon 3rd (latest) fault	0.0–6553.5	-	-	●
F9-25	IGBT temperature upon 3rd (latest) fault	0–999	-	-	●
F9-26	Fault subcode upon 3rd (latest) fault	0–65535	-	-	●
F9-27	Frequency upon 2nd fault	0.00–655.35 Hz	-	Hz	●
F9-28	Current upon 2nd fault	0.0–6553.5 A	-	A	●
F9-29	Bus voltage upon 2nd fault	0.0–6553.5 V	-	V	●
F9-30	Input terminal state upon 2nd fault	0–9999	-	-	●
F9-31	Output terminal state upon 2nd fault	0–9999	-	-	●
F9-32	AC drive state upon 2nd fault	0–65535	-	-	●
F9-33	Power-on time upon 2nd fault	0–65535	-	-	●
F9-34	Running time upon 2nd fault	0.0–6553.5	-	-	●
F9-35	IGBT temperature upon 2nd fault	0–999	-	-	●
F9-36	Fault subcode upon 2nd fault	0–65535	-	-	●
F9-37	Frequency upon 1st fault	0.00–655.35 Hz	-	Hz	●
F9-38	Current upon 1st fault	0.0–6553.5 A	-	A	●
F9-39	Bus voltage upon 1st fault	0.0–6553.5 V	-	V	●
F9-40	Input terminal state upon 1st fault	0–9999	-	-	●
F9-41	Output terminal state upon 1st fault	0–9999	-	-	●
F9-42	AC drive state upon 1st fault	0–65535	-	-	●
F9-43	Power-on time upon 1st fault	0–65535	-	-	●
F9-44	Running time upon 1st fault	0.0–6553.5	-	-	●

Para. No.	Name	Value Range	Default	Unit	Property
F9-45	IGBT temperature upon 1st fault	0–999	-	-	●
F9-46	Fault subcode upon 1st fault	0–65535	-	-	●
F9-47	Fault protection action selection 0	Ones (position): Value of E02/E03/E04 0: Coast to stop 2: Fault reset Tens (position): Value of E05/E06/E07 0: Coast to stop 2: Fault reset Hundreds (position): Value of E08 0: Coast to stop Thousands (position): Value E09 0: Coast to stop 2: Fault reset Ten thousands (position): Value of E10 0: Coast to stop 2: Fault reset	0	-	★
F9-48	Fault protection action selection 1	Ones (position): Value of E11 0: Coast to stop 1: Decelerate to stop 2: Fault reset 4: Warning 5: Canceled Tens (position): Value of E12 0: Coast to stop 1: Decelerate to stop 2: Fault reset 4: Warning 5: Canceled Hundreds (position): Value of E13 0: Coast to stop 1: Decelerate to stop 2: Fault reset 4: Warning 5: Canceled Thousands (position): Value of E14 0: Coast to stop Ten thousands (position): Value of E15 0: Coast to stop 1: Decelerate to stop 3: Electromagnetic shorting 4: Warning 5: Canceled	0	-	★

Para. No.	Name	Value Range	Default	Unit	Property
F9-49	Fault protection action selection 2	Ones (position): Value of E16 0: Coast to stop 1: Decelerate to stop 4: Warning 5: Canceled Tens (position): Value of E17 0: Coast to stop 1: Decelerate to stop 4: Warning 5: Canceled Hundreds (position): Value of E18 0: Coast to stop Thousands (position): Value of E19 0: Coast to stop 3: Electromagnetic shorting 4: Warning 5: Canceled Ten thousands (position): Value of E20 0: Coast to stop 3: Electromagnetic shorting 4: Warning 5: Canceled	0	-	★
F9-50	Fault protection action selection 3	Ones (position): Reserved 0: Coast to stop Tens (position): Value of E63 0: Coast to stop 1: Decelerate to stop 4: Warning 5: Canceled Hundreds (position): Value of E23 0: Coast to stop 5: Canceled Thousands (position): Value of E24 0: Coast to stop 5: Canceled Ten thousands (position): Value of E25 0: Coast to stop 1: Decelerate to stop 4: Warning 5: Canceled	5040	-	★

Para. No.	Name	Value Range	Default	Unit	Property
F9-51	Fault protection action selection 4	Ones (position): Value of E26 0: Coast to stop 1: Decelerate to stop 4: Warning 5: Canceled Tens position: Value of E27 0: Coast to stop 1: Decelerate to stop 3: Electromagnetic shorting 4: Warning 5: Canceled Hundreds (position): Value of E28 0: Coast to stop 1: Decelerate to stop 3: Electromagnetic shorting 4: Warning 5: Canceled Thousands (position): Value of E29 0: Coast to stop 1: Decelerate to stop 4: Warning 5: Canceled Ten thousands (position): Value of E30 0: Coast to stop 1: Decelerate to stop 4: Warning 5: Canceled	51111	-	★

Para. No.	Name	Value Range	Default	Unit	Property
F9-52	Fault protection action selection 5	Ones (position): Value of E31 0: Coast to stop 1: Decelerate to stop 4: Warning 5: Canceled Tens (position): Value of E40 0: Coast to stop 2: Fault reset Hundreds (position): Value of E41 0: Coast to stop 1: Decelerate to stop 4: Warning 5: Canceled Thousands (position): Value of E42 0: Coast to stop 1: Decelerate to stop 2: Fault reset 3: Electromagnetic shorting 4: Warning 5: Canceled Ten thousands (position): Value of E43 0: Coast to stop 1: Decelerate to stop 3: Electromagnetic shorting 4: Warning 5: Canceled	101	-	★
F9-53	Fault protection action selection 6	Ones (position): Value of E45 0: Coast to stop 1: Decelerate to stop 4: Warning 5: Canceled Tens (position): Value of E60 0: Coast to stop 1: Decelerate to stop 4: Warning 5: Canceled Hundreds (position): Value of E61 0: Coast to stop 1: Decelerate to stop 4: Warning 5: Canceled Thousands (position): Value of E62 0: Coast to stop 5: Canceled Ten thousands (position): Reserved 5: Canceled	0	-	★

Para. No.	Name	Value Range	Default	Unit	Property
F9-54	Frequency selection for continuing to run upon fault	0: Current running frequency 1: Frequency reference 2: Frequency upper limit 3: Frequency lower limit 4: Backup frequency upon abnormality	1	-	☆
F9-55	Backup frequency reference	0.0% to 100.0%	100.0%	%	☆
F9-57	Motor overtemperature protection threshold	0°C to 200°C	110°C	°C	☆
F9-58	Motor overtemperature pre-warning threshold	0°C to 200°C	90°C	°C	☆
F9-59	Power dip ride-through function selection	0: Disabled 1: Decelerate 2: Decelerate to stop 3: Voltage dip depression	0	-	★
F9-60	Threshold for recovering from power dip ride-through	80% to 100%	85%	%	☆
F9-61	Duration for judging voltage recovery from power dip ride-through	0.0–100.0s	0.5s	s	☆
F9-62	Threshold for enabling power dip ride-through	60% to 100%	80%	%	☆
F9-63	Runaway protection time in FVC mode	0–10000	0	-	★
F9-64	Load loss detection level	0.0% to 100.0%	10.0%	%	☆
F9-65	Load loss detection time	0.0s–60.0s	1.0s	s	☆
F9-67	Overspeed threshold	0.0% to 50.0%	5.0%	%	☆
F9-68	Overspeed detection time	0.0–60.0	1.0	-	☆
F9-69	Excessive speed deviation threshold	0.0% to 50.0%	20.0%	%	☆
F9-70	Detection time of excessive speed deviation	0.0s–60.0s	5.0s	s	☆
F9-71	Power dip ride-through gain	0–100	40	-	☆
F9-72	Power dip ride-through integral coefficient	0–100	30	-	☆
F9-73	Deceleration time of power dip ride-through	0.0–300.0s	20.0s	s	☆
Group FA: Process Control PID Parameters					

Para. No.	Name	Value Range	Default	Unit	Property
FA-00	PID reference source	0: Digital setting of PID (FA-01) 1: AI1 2: AI2 3: AI3 4: Pulse reference (DI5) 5: Communication 6: Multi-reference	0	-	☆
FA-01	Digital setting of PID	0.0% to 100.0%	50.0%	%	☆
FA-02	PID feedback source	0: AI1 1: AI2 2: AI3 3: AI1 – AI2 4: Pulse reference (DIO1) 5: Communication 6:AI1 + AI2 7: Max. (|AI1|, |AI2|) 8: Min. (|AI1|, |AI2|) 9: Reserved	0	-	☆
FA-03	PID action direction	0: Forward 1: Reverse	0	-	☆
FA-04	PID reference and feedback range	0–65535	1000	-	☆
FA-05	Proportional gain Kp1	0.0–1000.0	20.0	-	☆
FA-06	Integral time Ti1	0.01–100.00s	2.00s	s	☆
FA-07	Derivative time Td1	0.000–10.000s	0.000s	s	☆
FA-08	PID output limit in reverse direction	0 to the maximum frequency (F0-10)	2.00 Hz	Hz	☆
FA-09	PID deviation limit	0.0% to 100.0%	0.0%	%	☆
FA-10	PID differential limit	0.00% to 100.00%	0.10%	%	☆
FA-11	PID reference change time	0.00–650.00s	0.00s	s	☆
FA-12	PID feedback filter time	0.00–60.00s	0.00s	s	☆
FA-13	PID deviation gain	0.0% to 100.0%	1	%	☆
FA-14	PID optimization	0–100	0	-	☆
FA-15	Proportional gain Kp2	0.0–1000.0	20.0	-	☆
FA-16	Integral time Ti2	0.01–100.00s	2.00s	s	☆
FA-17	Derivative time Td2	0.000–10.000s	0.000s	s	☆

Para. No.	Name	Value Range	Default	Unit	Property
FA-18	PID parameter switchover condition	0: No switchover 1: Switchover by DI 2: Automatic switchover based on deviation 3: Switchover based on running frequency 6: Automatic adjustment based on roll diameter 7: Automatic adjustment based on maximum roll diameter percentage	0	-	☆
FA-19	PID parameter switchover deviation 1	0 to value of FA-20	20.0%	%	☆
FA-20	PID parameter switchover deviation 2	Value of FA-19 to 1000	80.0%	%	☆
FA-21	PID initial value	0.0% to 100.0%	0.0%	%	☆
FA-22	Hold time of PID initial value	0.00–650.00s	0.00s	s	☆
FA-23	Maximum deviation between two PID outputs in forward direction	0.00% to 100.00%	1.00%	%	☆
FA-24	Maximum deviation between two PID outputs in reverse direction	0.00% to 100.00%	1.00%	%	☆
FA-25	PID integral property	0: Disabled 1: Enabled	0		☆
FA-26	Detection level of PID feedback loss	0.0% to 100.0%	0.0%	%	☆
FA-27	Detection time of PID feedback loss	0.0–20.0s	0.0s	s	☆
Group Fb: Wobble, Fixed Length and Count Parameters					
Fb-00	Wobble setting mode	0: Relative to central frequency 1: Relative to maximum frequency	0	-	☆
Fb-01	Wobble amplitude	0.0% to 100.0%	0.0%	%	☆
Fb-02	Jump frequency amplitude	0.0% to 50.0%	0.0%	%	☆
Fb-03	Wobble cycle	0.1–3000.0s	10.0s	s	☆
Fb-04	Triangular wave rise time coefficient	0.1% to 100.0%	50.0%	%	☆
Fb-05	Set length	0–65535 m	1000 m	m	☆
Fb-06	Actual length	0–65535 m	0 m	m	☆
Fb-07	Number of pulses per meter	0.1–6553.5	100.0	-	☆
Fb-08	Set count value	1–65535	1000	-	☆
Fb-09	Designated count value	1–65535	1000	-	☆

Para. No.	Name	Value Range	Default	Unit	Property
Fb-10	Revolution count reset mode	0: Edge trigger 1: Level trigger	0	-	☆
Fb-11	Revolution count reset signal	0: Disable 1: Enable	0	-	☆
Fb-12	Revolution count retentive at power failure	0: No 1: Yes	0	-	☆
Fb-13	Revolution count clear	0–65535	0	-	☆
Fb-14	Transmission ratio numerator	1–65535	1	-	☆
Fb-15	Transmission ratio denominator	1–65535	1	-	☆
Fb-16	Actual running revolutions	0–65535	0	-	●
Fb-17	Running revolutions	0–65535	0	-	●
Fb-18	Running revolution accuracy	0: 1 revolution 1: 0.1 revolution	0	-	☆
Fb-19	Revolution recording direction	0: Forward 1: Reverse	0	-	☆
Group FC: Multi-reference and Simple PLC Parameters					
FC-00	Multi-reference 0	–100.0% to +100.0%	0.0%	%	☆
FC-01	Multi-reference 1	–100.0% to +100.0%	0.0%	%	☆
FC-02	Multi-reference 2	–100.0% to +100.0%	0.0%	%	☆
FC-03	Multi-reference 3	–100.0% to +100.0%	0.0%	%	☆
FC-04	Multi-reference 4	–100.0% to +100.0%	0.0%	%	☆
FC-05	Multi-reference 5	–100.0% to +100.0%	0.0%	%	☆
FC-06	Multi-reference 6	–100.0% to +100.0%	0.0%	%	☆
FC-07	Multi-reference 7	–100.0% to +100.0%	0.0%	%	☆
FC-08	Multi-reference 8	–100.0% to +100.0%	0.0%	%	☆
FC-09	Multi-reference 9	–100.0% to +100.0%	0.0%	%	☆
FC-10	Multi-reference 10	–100.0% to +100.0%	0.0%	%	☆
FC-11	Multi-reference 11	–100.0% to +100.0%	0.0%	%	☆
FC-12	Multi-reference 12	–100.0% to +100.0%	0.0%	%	☆
FC-13	Multi-reference 13	–100.0% to +100.0%	0.0%	%	☆
FC-14	Multi-reference 14	–100.0% to +100.0%	0.0%	%	☆
FC-15	Multi-reference 15	–100.0% to +100.0%	0.0%	%	☆
FC-16	Simple PLC running mode	0: Stop after running for one cycle 1: Keep final values after running for one cycle 2: Repeat after running for one cycle	0	-	☆

Para. No.	Name	Value Range	Default	Unit	Property
FC-17	Retentive memory selection of simple PLC	Ones (position): Retentive upon power failure 0: No 1: Yes Tens (position): Retentive upon stop 0: No 1: Yes	0	-	☆
FC-18	Running time of PLC reference 0	0.0–6553.5s (h)	0.0s (h)	s (h)	☆
FC-19	Acceleration/ Deceleration time of PLC reference 0	0: Group 1 acceleration/deceleration time (F0-17 and F7-18) 1: Group 2 acceleration/deceleration time (F8-03 and F8-04) 2: Group 3 acceleration/deceleration time (F8-05 and F8-06) 3: Group 4 acceleration/deceleration time (F8-07 and F8-08)	0	-	☆
FC-20	Running time of PLC reference 1	0.0–6553.5s (h)	0.0s (h)	s (h)	☆
FC-21	Acceleration/ Deceleration time of PLC reference 1	0: Group 1 acceleration/deceleration time (F0-17 and F7-18) 1: Group 2 acceleration/deceleration time (F8-03 and F8-04) 2: Group 3 acceleration/deceleration time (F8-05 and F8-06) 3: Group 4 acceleration/deceleration time (F8-07 and F8-08)	0	-	☆
FC-22	Running time of PLC reference 2	0.0–6553.5s (h)	0.0s (h)	s (h)	☆
FC-23	Acceleration/ Deceleration time of PLC reference 2	0: Group 1 acceleration/deceleration time (F0-17 and F7-18) 1: Group 2 acceleration/deceleration time (F8-03 and F8-04) 2: Group 3 acceleration/deceleration time (F8-05 and F8-06) 3: Group 4 acceleration/deceleration time (F8-07 and F8-08)	0	-	☆
FC-24	Running time of PLC reference 3	0.0–6553.5s (h)	0.0s (h)	s (h)	☆
FC-25	Acceleration/ Deceleration time of PLC reference 3	0: Group 1 acceleration/deceleration time (F0-17 and F7-18) 1: Group 2 acceleration/deceleration time (F8-03 and F8-04) 2: Group 3 acceleration/deceleration time (F8-05 and F8-06) 3: Group 4 acceleration/deceleration time (F8-07 and F8-08)	0	-	☆

Para. No.	Name	Value Range	Default	Unit	Property
FC-26	Running time of PLC reference 4	0.0–6553.5s (h)	0.0s (h)	s (h)	☆
FC-27	Acceleration/ Deceleration time of PLC reference 4	0: Group 1 acceleration/deceleration time (F0-17 and F7-18) 1: Group 2 acceleration/deceleration time (F8-03 and F8-04) 2: Group 3 acceleration/deceleration time (F8-05 and F8-06) 3: Group 4 acceleration/deceleration time (F8-07 and F8-08)	0	-	☆
FC-28	Running time of PLC reference 5	0.0–6553.5s (h)	0.0s (h)	s (h)	☆
FC-29	Acceleration/ Deceleration time of PLC reference 5	0: Group 1 acceleration/deceleration time (F0-17 and F7-18) 1: Group 2 acceleration/deceleration time (F8-03 and F8-04) 2: Group 3 acceleration/deceleration time (F8-05 and F8-06) 3: Group 4 acceleration/deceleration time (F8-07 and F8-08)	0	-	☆
FC-30	Running time of PLC reference 6	0.0–6553.5s (h)	0.0s (h)	s (h)	☆
FC-31	Acceleration/ Deceleration time of PLC reference 6	0: Group 1 acceleration/deceleration time (F0-17 and F7-18) 1: Group 2 acceleration/deceleration time (F8-03 and F8-04) 2: Group 3 acceleration/deceleration time (F8-05 and F8-06) 3: Group 4 acceleration/deceleration time (F8-07 and F8-08)	0	-	☆
FC-32	Running time of PLC reference 7	0.0–6553.5s (h)	0.0s (h)	s (h)	☆
FC-33	Acceleration/ Deceleration time of PLC reference 7	0: Group 1 acceleration/deceleration time (F0-17 and F7-18) 1: Group 2 acceleration/deceleration time (F8-03 and F8-04) 2: Group 3 acceleration/deceleration time (F8-05 and F8-06) 3: Group 4 acceleration/deceleration time (F8-07 and F8-08)	0	-	☆
FC-34	Running time of PLC reference 8	0.0–6553.5s (h)	0.0s (h)	s (h)	☆

Para. No.	Name	Value Range	Default	Unit	Property
FC-35	Acceleration/ Deceleration time of PLC reference 8	0: Group 1 acceleration/deceleration time (F0-17 and F7-18) 1: Group 2 acceleration/deceleration time (F8-03 and F8-04) 2: Group 3 acceleration/deceleration time (F8-05 and F8-06) 3: Group 4 acceleration/deceleration time (F8-07 and F8-08)	0	-	☆
FC-36	Running time of PLC reference 9	0.0–6553.5s (h)	0.0s (h)	s (h)	☆
FC-37	Acceleration/ Deceleration time of PLC reference 9	0: Group 1 acceleration/deceleration time (F0-17 and F7-18) 1: Group 2 acceleration/deceleration time (F8-03 and F8-04) 2: Group 3 acceleration/deceleration time (F8-05 and F8-06) 3: Group 4 acceleration/deceleration time (F8-07 and F8-08)	0	-	☆
FC-38	Running time of PLC reference 10	0.0–6553.5s (h)	0.0s (h)	s (h)	☆
FC-39	Acceleration/ Deceleration time of PLC reference 10	0: Group 1 acceleration/deceleration time (F0-17 and F7-18) 1: Group 2 acceleration/deceleration time (F8-03 and F8-04) 2: Group 3 acceleration/deceleration time (F8-05 and F8-06) 3: Group 4 acceleration/deceleration time (F8-07 and F8-08)	0	-	☆
FC-40	Running time of PLC reference 11	0.0–6553.5s (h)	0.0s (h)	s (h)	☆
FC-41	Acceleration/ Deceleration time of PLC reference 11	0: Group 1 acceleration/deceleration time (F0-17 and F7-18) 1: Group 2 acceleration/deceleration time (F8-03 and F8-04) 2: Group 3 acceleration/deceleration time (F8-05 and F8-06) 3: Group 4 acceleration/deceleration time (F8-07 and F8-08)	0	-	☆
FC-42	Running time of PLC reference 12	0.0–6553.5s (h)	0.0s (h)	s (h)	☆

Para. No.	Name	Value Range	Default	Unit	Property
FC-43	Acceleration/ Deceleration time of PLC reference 12	0: Group 1 acceleration/deceleration time (F0-17 and F7-18) 1: Group 2 acceleration/deceleration time (F8-03 and F8-04) 2: Group 3 acceleration/deceleration time (F8-05 and F8-06) 3: Group 4 acceleration/deceleration time (F8-07 and F8-08)	0	-	☆
FC-44	Running time of PLC reference 13	0.0–6553.5s (h)	0.0s (h)	s (h)	☆
FC-45	Acceleration/ Deceleration time of PLC reference 13	0: Group 1 acceleration/deceleration time (F0-17 and F7-18) 1: Group 2 acceleration/deceleration time (F8-03 and F8-04) 2: Group 3 acceleration/deceleration time (F8-05 and F8-06) 3: Group 4 acceleration/deceleration time (F8-07 and F8-08)	0	-	☆
FC-46	Running time of PLC reference 14	0.0–6553.5s (h)	0.0s (h)	s (h)	☆
FC-47	Acceleration/ Deceleration time of PLC reference 14	0: Group 1 acceleration/deceleration time (F0-17 and F7-18) 1: Group 2 acceleration/deceleration time (F8-03 and F8-04) 2: Group 3 acceleration/deceleration time (F8-05 and F8-06) 3: Group 4 acceleration/deceleration time (F8-07 and F8-08)	0	-	☆
FC-48	Running time of PLC reference 15	0.0–6553.5s (h)	0.0s (h)	s (h)	☆
FC-49	Acceleration/ Deceleration time of PLC reference 15	0: Group 1 acceleration/deceleration time (F0-17 and F7-18) 1: Group 2 acceleration/deceleration time (F8-03 and F8-04) 2: Group 3 acceleration/deceleration time (F8-05 and F8-06) 3: Group 4 acceleration/deceleration time (F8-07 and F8-08)	0	-	☆
FC-50	PLC running time unit	0: s (second) 1: h (hour)	0	-	☆

Para. No.	Name	Value Range	Default	Unit	Property
FC-51	Multi-reference 0 source	0: Multi-reference 0 (FC-00) 1: AI1 2: AI2 3: AI3 4: Pulse reference (DI5) 5: PID 6: Preset frequency (value of F0-08 that can be changed by pressing UP/DOWN)	0	-	☆
Group Fd: Communication Parameters					
Fd-00	Baud rate	0: 300 bps 1: 600 bps 2: 1200 bps 3: 2400 bps 4: 4800 bps 5: 9600 bps 6: 19200 bps 7: 38400 bps 8: 57600 bps 9: 115200 bps	5	-	☆
Fd-01	Modbus data format	0: No check (8-N-2) 1: Even parity check (8-E-1) 2: Odd parity check (8-O-1) 3: 8-N-1	0	-	☆
Fd-02	Local address	0: Broadcast address 1–247	1	-	☆
Fd-03	Response delay	0–20 ms	2 ms	ms	☆
Fd-04	Modbus timeout time	0.0s (invalid) 0.1–60.0 s	0.0s	s	☆
Fd-06	Communication fault reset	0: Disabled 1: Enabled	1	-	★
Fd-09	CANopen/CANlink communication state	Ones: CANopen 0: Stop 1: Initialized 2: Pre-running 8: Running Tens: CANlink 0: Stop 1: Initialized 2: Pre-running 8: Running	2	-	●
Fd-10	Switchover between CANopen and CANlink	1: CANopen 2: CANlink	1	-	★
Fd-11	CANopen402 selection	0: Disabled 1: Enabled	0	-	★

Para. No.	Name	Value Range	Default	Unit	Property
Fd-12	CAN baud rate	0: 20 kbps 1: 50 kbps 2: 100 kbps 3: 125 kbps 4: 250 kbps 5: 500 kbps 6:1 Mbps	5	-	★
Fd-13	CAN station number	1–127	1	-	★
Fd-14	Number of CAN frames received per unit of time	0–65535	0	-	●
Fd-15	Maximum value of node reception error counter	0–65535	0	-	●
Fd-16	Maximum value of node transmission error counter	0–65535	0	-	●
Fd-17	Bus disconnection times per unit of time	1–65535	0	-	●
Fd-94	Modbus software version	0–65535	0	-	●
Fd-95	CANlink software version	0–65535	0	-	●
Fd-96	CANopen software version	0–65535	0	-	●
Group FE: User-defined Parameters					
FE-00	User-defined parameter 0	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	7017	-	☆
FE-01	User-defined parameter 1	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	7016	-	☆
FE-02	User-defined parameter 2	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-03	User-defined parameter 3	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-04	User-defined parameter 4	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆

Para. No.	Name	Value Range	Default	Unit	Property
FE-05	User-defined parameter 5	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-06	User-defined parameter 6	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-07	User-defined parameter 7	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-08	User-defined parameter 8	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-09	User-defined parameter 9	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-10	User-defined parameter 10	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-11	User-defined parameter 11	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-12	User-defined parameter 12	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-13	User-defined parameter 13	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-14	User-defined parameter 14	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-15	User-defined parameter 15	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-16	User-defined parameter 16	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆

Para. No.	Name	Value Range	Default	Unit	Property
FE-17	User-defined parameter 17	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-18	User-defined parameter 18	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-19	User-defined parameter 19	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-20	User-defined parameter 20	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	6768	-	☆
FE-21	User-defined parameter 21	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	6769	-	☆
FE-22	User-defined parameter 22	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-23	User-defined parameter 23	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-24	User-defined parameter 24	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-25	User-defined parameter 25	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-26	User-defined parameter 26	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-27	User-defined parameter 27	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-28	User-defined parameter 28	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆

Para. No.	Name	Value Range	Default	Unit	Property
FE-29	User-defined parameter 29	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-30	User-defined parameter 30	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
FE-31	User-defined parameter 31	F0-00 to FP-*xx* A0-00 to A*x*-*xx* U0-*xx* to U0-*xx* U3-00 to U3-*xx*	0	-	☆
Group FP: User Parameters					
FP-00	User password	0–65535	0	-	●
FP-01	Parameter initialization	0: No action 1:Restore default settings (mode 1) 2: Clear records 4: Back up current user parameters 501: Restore user backup parameters 503:Restore default settings (mode 2)	1	-	☆
FP-02	Parameter group display	Ones (position): Group U display 0: Hide 1: Display Tens (position): Group A display 0: Hide 1: Display Hundreds (position): Group B display 0: Hide 1:Display Thousands (position): Group C display 0: Hide 1: Display	111	-	☆
FP-03	User parameter group display	Ones (position): User-defined parameter group display 0: Hide 1: Display Tens (position): User-modified parameter group display 0: Hide 1: Display	11	-	☆
FP-04	Parameter modification property	0: Modifiable 1: Not modifiable	0	-	☆
Group A0: Torque Control and Restricting Parameters					
A0-00	Speed/Torque control mode	0: Speed control 1: Torque control	0	-	★

Para. No.	Name	Value Range	Default	Unit	Property
A0-01	Torque reference source	0: Digital setting of drive torque upper limit (A0-03) 1: AI1 2: AI2 3: AI3 4: Reserved 5: Communication setting (1000H) 6: Min. (AI1, AI2) 7: Max. (AI1, AI2)	0	-	★
A0-03	Torque digital setting	–200.0% to +200.0%	100.0%	%	☆
A0-04	Torque filter time	0.000–5.000s	0.000s	s	☆
A0-05	Speed limit digital setting	-120.0% to 120.0%	0.0%	%	☆
A0-06	Frequency modulation coefficient in window mode	0.0–50.0	0.0	-	☆
A0-07	Acceleration time (torque)	0.00–650.00s	1.00s	s	☆
A0-08	Deceleration time (torque)	0.00–650.00s	1.00s	s	☆
A0-09	Speed limit reference source	0: A0-05 1: Frequency source	0	-	☆
A0-10	Speed limit offset/ Windows frequency	0 to the maximum frequency (F0-10)	5.00	-	☆
A0-11	Effective mode of speed limit offset	0: Bidirectional offset valid 1: Unidirectional offset valid 2: Windows mode	1	-	★
A0-12	Acceleration time (frequency)	0.0–6500.0s	1.0s	s	☆
A0-13	Deceleration time (frequency)	0.0–6500.0s	1.0s	s	☆
A0-14	Torque mode switchover	0: No switchover 1: Switched to speed control at stop 2: Target torque at stop being 0	1	-	★
Group A1: Virtual DI/DO Parameters					
A1-00	VDI1 function selection	Same as F4-00	0	-	★
A1-01	VDI2 function selection	Same as F4-00	0	-	★
A1-02	VDI3 function selection	Same as F4-00	0	-	★
A1-03	VDI4 function selection	Same as F4-00	0	-	★
A1-04	VDI5 function selection	Same as F4-00	0	-	★

Para. No.	Name	Value Range	Default	Unit	Property
A1-05	VDI active state source	Ones (position): 0: Parameter setting (A1-06) 1:DO state 2: DI state Tens (position): 0:Parameter setting (A1-06) 1: DO state 2: DI state Hundred (position): 0: Parameter setting (A1-06) 1: DO state 2: DI state Thousands (position): 0:Parameter setting (A1-06) 1: DO state 2: DI state Ten thousands (position): 0: Parameter setting (A1-06) 1: DO state 2: DI state	0	-	★
A1-06	Selection of VDI active state	Ones (position): 0: Inactive 1: Active Tens (position): 0: Inactive 1: Active Hundreds (position): 0: Inactive 1: Active Thousands (position): 0: Inactive 1: Active Ten thousands (position): 0: Inactive 1: Active	0	-	☆
A1-07	Function selection for AI1 used as DI	Same as F4-00	0	-	★
A1-08	Function selection for AI2 used as DI	Same as F4-00	0	-	★
A1-09	Function selection for AI3 used as DI	Same as F4-00	0	-	★

Para. No.	Name	Value Range	Default	Unit	Property
A1-10	Active mode selection (AI as DI)	Ones (position): 0: Active high 1: Active low Tens (position): 0: Active high 1: Active low Hundreds (position): 0: Active high 1: Active low	0	-	★
A1-11	VDO1 function selection	0: No output 1: AC drive running 2: Fault output (stop at fault) 3: Frequency level detection FDT1 output 4: Frequency reach 5: Zero-speed running (no output at stop) 6: Motor overload pre-warning 7: AC drive overload pre-warning 8: Set count value reach 9: Designated count value reach 10: Length reach 11: PLC cycle completed 12: Accumulative running time reach 13: Frequency limited 14:Torque limited 15: Ready to run 16: AI1 > AI2 17: Frequency upper limit reach 18: Frequency lower limit reach (operation related) 19: Undervoltage output 20: Communication 21: Reserved 22: Reserved 23: Zero-speed running 2 (at stop) 24: Accumulative power-on time reach 25: Frequency level detection FDT2 output 26: Frequency 1 reach 27: Frequency 2 reach 28:Current 1 reach 29: Current 2 reach 30: Timing reach 31: AI1 input limit exceeded 32: Output load loss	0	-	☆

Para. No.	Name	Value Range	Default	Unit	Property
(continued)	(continued)	33: Reverse run 34: Zero current state 35: IGBT temperature reach 36: Output current limit exceeded 37: Frequency lower limit reach (having output at stop) 38: Alarm output (direct output at fault or alarm) 39: Current over-temperature pre-warning 40: Current running time reach 41: Fault output 2 42: Fault output 3 43: Position lock succeeded 46: Brake release output	0	-	☆
A1-12	VDO2 function selection	Same as A1-11	0	-	☆
A1-13	VDO3 function selection	Same as A1-11	0	-	☆
A1-14	VDO4 function selection	Same as A1-11	0	-	☆
A1-15	VDO5 function selection	Same as A1-11	0	-	☆
A1-16	VDO1 output delay	0.0–3600.0s	0.0s	s	☆
A1-17	VDO2 output delay	0.0–3600.0s	0.0s	s	☆
A1-18	VDO3 output delay	0.0–3600.0s	0.0s	s	☆
A1-19	VDO4 output delay	0.0–3600.0s	0.0s	s	☆
A1-20	VDO5 output delay	0.0–3600.0s	0.0s	s	☆
A1-21	VDO active mode selection	Ones (position): VDO1 0: Positive logic 1: Negative logic Tens (position): VDO2 0: Positive logic 1: Negative logic Hundreds (position): VDO3 0: Positive logic 1: Negative logic Thousands (position): VDO4 0: Positive logic 1: Negative logic Ten thousands (position): VDO5 0: Positive logic 1: Negative logic	0	-	☆
Group A5: Control Optimization Parameters					
A5-00	DPWM switchover frequency upper limit	0 to the maximum frequency (F0-10)	12.00 Hz	Hz	☆

Para. No.	Name	Value Range	Default	Unit	Property
A5-01	PWM modulation mode	0: Asynchronous modulation 1: Reserved 2: Synchronous modulation mode 2 3: Synchronous modulation mode 3	0	-	☆
A5-02	Dead-zone compensation mode selection	0: No compensation 1: Compensation mode 1 2: Compensation mode 2	2	-	★
A5-03	Random PWM depth	0–10	0	-	☆
A5-04	Fast current limit	0: Disabled 1: Enabled	0	-	☆
A5-05	Sampling delay	1–13	5	-	☆
A5-06	Undervoltage threshold	150.0–700.0 V	350.0 V	V	☆
A5-07	SVC optimization selection	0: No optimization 1: Optimization mode 1 2: Optimization mode 2	1	-	★
A5-08	Dead-zone time adjustment (reserved)	100% to 200%	150%	%	★
A5-09	Overmodulation selection (reserved)	0: Not start 1: Start	0	-	●
A5-10	Narrow pulse control selection (reserved)	0: Not start 1: Start	0	-	●
A5-11	Switching frequency and modulation optimization selection	Ones (position): 0: DPWM (5-segment SVPWM) or CPWM (7-segment SVPWM) selected automatically based on the frequency specified by A5-00 1: CPWM Tens (position): Reserved	10	-	☆
A5-13	Bus voltage in function part	100–20000	5310	-	●
A5-14	Temperature correction	0: Disabled 1: Enabled	0	-	★
A5-16	Display parameter address 1	0–100	0	-	●
A5-17	Display parameter address 2	0–100	1	-	●
A5-18	Display parameter address 3	0–100	2	-	●
A5-19	Display parameter address 4	0–100	3	-	●
A5-21	Low speed carrier frequency	0.0–16.0	0.0	-	☆

Para. No.	Name	Value Range	Default	Unit	Property
A5-22	Dead-zone compensation auto-tuning	0: Disabled 1: Enabled	0 (synchronous motor) 1 (asynchronous motor)	-	★
Group A6: AI Curve Setting Parameters					
A6-00	Curve 4 minimum input	–10.00 V to value of A6-02	0.00 V	V	☆
A6-01	Percentage corresponding to curve 4 minimum input	–100.0% to +100.0%	0.0%	%	☆
A6-02	Curve 4 inflexion point 1 input	Value of A6-00 to value of A6-04	3.00 V	V	☆
A6-03	Percentage corresponding to curve 4 inflexion point 1 input	–100.0% to +100.0%	30.0%	%	☆
A6-04	Curve 4 inflexion point 2 input	Value of A6-02 to value of A6-06	6.00 V	V	☆
A6-05	Percentage corresponding to curve 4 inflexion point 2 input	–100.0% to +100.0%	60.0%	%	☆
A6-06	Curve 4 maximum input	Value of A6-04 to 10.00 V	10.00 V	V	☆
A6-07	Percentage corresponding to curve 4 maximum input	–100.0% to +100.0%	100.0%	%	☆
A6-08	Curve 5 minimum input	–10.00 V to value of A6-10	–10.00 V	V	☆
A6-09	Percentage corresponding to curve 5 minimum input	–100.0% to +100.0%	–100.0%	%	☆
A6-10	Curve 5 inflexion point 1 input	Value of A6-08 to value of A6-12	–3.00 V	V	☆
A6-11	Percentage corresponding to curve 5 inflexion point 1 input	–100.0% to +100.0%	–30.0%	%	☆
A6-12	Curve 5 inflexion point 2 input	Value of A6-10 to value of A6-14	3.00 V	V	☆
A6-13	Percentage corresponding to curve 5 inflexion point 2 input	–100.0% to +100.0%	30.0%	%	☆
A6-14	Curve 5 maximum input	Value of A6-12 to 10.00 V	10.00 V	V	☆
A6-15	Percentage corresponding to curve 5 maximum input	–100.0% to +100.0%	100.0%	%	☆
A6-16	AI1 gain	–10.00 to +10.00	1.00	-	☆
A6-17	AI1 offset	–100.0% to +100.0%	0.0%	%	☆
A6-18	AI2 gain	–10.00 to +10.00	1.00	-	☆

Para. No.	Name	Value Range	Default	Unit	Property
A6-19	AI2 offset	–100.0% to +100.0%	0.0%	%	☆
A6-20	AI3 gain	–10.00 to +10.00	1.00	-	☆
A6-21	AI3 offset	–100.0% to +100.0%	0.0%	%	☆
A6-22	AI encoder disconnection detection threshold	0.0% to 100.0%	0.0%	%	☆
A6-23	AI encoder disconnection detection time	0.0–6553.5s	0.0s	s	☆
A6-24	Jump point of AI1 setting	–100.0% to +100.0%	0.0%	%	☆
A6-25	Jump amplitude of AI1 setting	0.0% to 100.0%	0.1%	%	☆
A6-26	Jump point of AI2 setting	–100.0% to +100.0%	0.0%	%	☆
A6-27	Jump amplitude of AI2 setting	0.0% to 100.0%	0.1%	%	☆
A6-28	Jump point of AI3 setting	–100.0% to +100.0%	0.0%	%	☆
A6-29	Jump amplitude of AI3 setting	0.0% to 100.0%	0.1%	%	☆
Group A9: Vector Control Supplementary Parameters					
A9-00	Online auto-tuning on the rotor time constant of the asynchronous motor	0: Disabled 1: Enabled	0	-	☆
A9-01	Rotor resistance gain for asynchronous motor auto-tuning in FVC mode	0–100	5	-	☆
A9-02	Rotor resistance start frequency for asynchronous motor auto-tuning in FVC mode	2–100 Hz	7 Hz	Hz	☆
A9-03	Magnetic field efficient for asynchronous motor observation in FVC mode	30–150	40	-	☆
A9-04	Maximum torque limit coefficient for the asynchronous motor field-weakening range	30–150	80	-	☆
A9-05	Speed filter of asynchronous motor in SVC mode	5–32 ms	15 ms	ms	☆

Para. No.	Name	Value Range	Default	Unit	Property
A9-06	Asynchronous motor speed feedback handling in SVC mode	0: No operation 1: Minimum synchronization frequency limited based on load change 2: Fixed current output during low-speed running 3: Fixed current output during low-speed running	0	-	☆
A9-07	Magnetic field regulation bandwidth of asynchronous motor in SVC mode	0.0–8.0	2.0	-	☆
A9-08	Low-speed running current of asynchronous motor in SVC mode	30–170	100	-	☆
A9-09	Switchover frequency of output fixed current of asynchronous motor in SVC mode	2.0–100.0 Hz	7.0 Hz	Hz	☆
A9-10	Coefficient of speed fluctuation for suppression of asynchronous motor in SVC mode	0–6	3	-	☆
A9-11	Acceleration/ Deceleration time of asynchronous motor in SVC mode	0.1–3000.0s	50.0s	s	☆
A9-12	Quick auto-tuning of stator resistance before asynchronous motor startup	0: Disabled 1: Enabled	0	-	☆
A9-13	Quick auto-tuning of stator resistance coefficient 1 of asynchronous motor	0–65535	10	-	★
A9-14	Quick auto-tuning of stator resistance coefficient 2 of asynchronous motor	0–65535	10	-	★
A9-15	Quick auto-tuning of stator resistance coefficient 3 of asynchronous motor	0–65535	0	-	★
A9-17	Synchronous motor real-time angle	0.0–359.9	0.0	-	●

Para. No.	Name	Value Range	Default	Unit	Property
A9-18	Initial angle detection of synchronous motor	0: Detected every run 1: Not detected 2: Detected upon initial power-on	0	-	☆
A9-20	Flux weakening mode selection	0: Automatic mode 1: Synchronous motor adjustment mode 2: Synchronous motor hybrid mode 3: Disabled	1	-	★
A9-21	Flux weakening gain of synchronous motor	0–50	5	-	☆
A9-22	Output voltage upper limit margin of synchronous motor	0% to 50%	5%	%	☆
A9-23	Maximum force adjustment gain of synchronous motor	20% to 300%	100%	%	☆
A9-24	Exciting current adjustment gain calculated by synchronous motor	40% to 200%	100%	%	☆
A9-25	Estimated synchronous motor speed integral gain in SVC mode	5% to 1000%	30%	%	☆
A9-26	Estimated synchronous motor speed proportional gain in SVC mode	5% to 300%	20%	%	☆
A9-27	Estimated synchronous motor speed filter in SVC mode	10–2000	100	-	☆
A9-28	Minimum carrier frequency of synchronous motor in SVC mode	0.8 to value of F0-15	2.0	-	☆
A9-29	Low speed excitation current of synchronous motor in SVC mode	0% to 80%	30%	%	☆
A9-35	Performance fault subcode upon 1st fault	0–65535	0	-	●
A9-36	Performance fault subcode upon 2nd fault	0–65535	0	-	●
A9-37	Performance fault subcode upon 3rd fault	0–65535	0	-	●
A9-40	Low-speed closed-loop current selection (PMVVC)	0: Disabled 1: Enabled	0	-	★

Para. No.	Name	Value Range	Default	Unit	Property
A9-41	Low-speed closed-loop current (PMVVC)	30% to 200%	50%	%	★
A9-42	Oscillation suppression damping coefficient (PMVVC)	0% to 500%	100%	%	☆
A9-43	Initial position compensation angle (PMVVC)	0–5	0	-	★
A9-44	Initial position compensation angle of synchronous motor	0.0–360.0	0.0	-	☆
A9-45	Synchronous motor low-speed handling	0: Disabled 1: Enabled	0	-	★
A9-46	Switchover frequency for synchronous motor low-speed handling	0.01 Hz to the maximum frequency (F0-10)	5.00	Hz	★
A9-47	Synchronous motor low-speed handling current	10–200	100	-	★
A9-48	Synchronous motor low-speed handling feedback suppression coefficient	0–300	32	-	★
A9-49	Synchronous motor energy-saving control	0: Disabled 1: Enabled	0	-	★
A9-50	Maximum flux weakening current limit margin	200–1000	1000	-	★
A9-51	Advanced settings for asynchronous motor parameter auto-tuning	Ones (position): 1: Rotor resistance and leakage inductance DC offset selection Tens (position) 1: New rotor resistance and leakage inductance auto-tuning algorithm Hundreds (position): 1: New mutual inductance static auto-tuning algorithm	111	-	★
A9-52	U0-06 feedback torque selection	0: Motoring torque being positive and generating torque being negative 1: Torque direction being positive in the case of positive speed direction; torque direction being negative in the case of negative speed direction	1	-	☆
A9-54	Transistor voltage drop	0–10000	700	-	★
A9-55	Dead-zone time 0	0–10000	352	-	★
A9-56	Dead-zone time 1	0–10000	1052	-	★

Para. No.	Name	Value Range	Default	Unit	Property
A9-57	Dead-zone time 2	0–10000	1270	-	★
A9-58	Dead-zone time 3	0–10000	1358	-	★
A9-59	Dead-zone time 4	0–10000	1404	-	★
A9-60	Dead-zone time 5	0–10000	1449	-	★
A9-61	Dead-zone time 6	0–10000	1661	-	★
A9-62	Dead-zone time 7	0–10000	1689	-	★
A9-63	Dead-zone compensation current 0	0–10000	94	-	★
A9-64	Dead-zone compensation current 1	0–10000	376	-	★
A9-65	Dead-zone compensation current 2	0–10000	658	-	★
A9-66	Dead-zone compensation current 3	0–10000	940	-	★
A9-67	Dead-zone compensation current 4	0–10000	1222	-	★
A9-68	Dead-zone compensation current 5	0–10000	1504	-	★
A9-69	Dead-zone compensation current 6	0–10000	3478	-	★
A9-70	Dead-zone compensation current 7	0–10000	5452	-	★
Group AC: AI/AO Correction Parameters					
AC-00	AI1 measured voltage 1	–10.000 V to +10.000 V	Corrected before delivery	V	☆
AC-01	AI1 displayed voltage 1	–10.000 V to +10.000 V	Corrected before delivery	V	☆
AC-02	AI1 measured voltage 2	–10.000 V to +10.000 V	Corrected before delivery	V	☆
AC-03	AI1 displayed voltage 2	–10.000 V to +10.000 V	Corrected before delivery	V	☆
AC-04	AI2 measured voltage 1	–10.000 V to +10.000 V	Corrected before delivery	V	☆
AC-05	AI2 displayed voltage 1	–10.000 V to +10.000 V	Corrected before delivery	V	☆
AC-06	AI2 measured voltage 2	–10.000 V to +10.000 V	Corrected before delivery	V	☆
AC-07	AI2 displayed voltage 2	–10.000 V to +10.000 V	Corrected before delivery	V	☆
AC-08	AI3 measured voltage 1	–10.000 V to +10.000 V	Corrected before delivery	V	☆
AC-09	AI3 displayed voltage 1	–10.000 V to +10.000 V	Corrected before delivery	V	☆

Para. No.	Name	Value Range	Default	Unit	Property
AC-10	AI3 measured voltage 2	–10.000 V to +10.000 V	Corrected before delivery	V	☆
AC-11	AI3 displayed voltage 2	–10.000 V to +10.000 V	Corrected before delivery	V	☆
AC-12	AO1 measured voltage 1	–10.000 V to +10.000 V	Corrected before delivery	V	☆
AC-13	AO1 target voltage 1	–10.000 V to +10.000 V	Corrected before delivery	V	☆
AC-14	AO1 measured voltage 2	–10.000 V to +10.000 V	Corrected before delivery	V	☆
AC-15	AO1 target voltage 2	–10.000 V to +10.000 V	Corrected before delivery	V	☆
AC-16	AO2 measured voltage 1	–10.000 V to +10.000 V	Corrected before delivery	V	☆
AC-17	AO2 target voltage 1	–10.000 V to +10.000 V	Corrected before delivery	V	☆
AC-18	AO2 measured voltage 2	–10.000 V to +10.000 V	Corrected before delivery	V	☆
AC-19	AO2 target voltage 2	–10.000 V to +10.000 V	Corrected before delivery	V	☆
AC-28	AO1 measured current 1	0.000–20.000 mA	4.000 mA	mA	☆
AC-29	AO1 target current 1	0.000–20.000 mA	4.000 mA	mA	☆
AC-30	AO1 measured current 2	0.000–20.000 mA	16.000 mA	mA	☆
AC-31	AO1 target current 2	0.000–20.000 mA	16.000 mA	mA	☆
Group AF: Process Data Address Mapping Parameters					
AF-00	RPDO1-SubIndex0-H	0–65535	0	-	☆
AF-01	RPDO1-SubIndex0-L	0–65535	0	-	☆
AF-02	RPDO1-SubIndex1-H	0–65535	0	-	☆
AF-03	RPDO1-SubIndex1-L	0–65535	0	-	☆
AF-04	RPDO1-SubIndex2-H	0–65535	0	-	☆
AF-05	RPDO1-SubIndex2-L	0–65535	0	-	☆
AF-06	RPDO1-SubIndex3-H	0–65535	0	-	☆
AF-07	RPDO1-SubIndex3-L	0–65535	0	-	☆
AF-08	RPDO2-SubIndex0-H	0–65535	0	-	☆
AF-09	RPDO2-SubIndex0-L	0–65535	0	-	☆
AF-10	RPDO2-SubIndex1-H	0–65535	0	-	☆
AF-11	RPDO2-SubIndex1-L	0–65535	0	-	☆
AF-12	RPDO2-SubIndex2-H	0–65535	0	-	☆
AF-13	RPDO2-SubIndex2-L	0–65535	0	-	☆
AF-14	RPDO2-SubIndex3-H	0–65535	0	-	☆
AF-15	RPDO2-SubIndex3-L	0–65535	0	-	☆
AF-16	RPDO3-SubIndex0-H	0–65535	0	-	☆

Para. No.	Name	Value Range	Default	Unit	Property
AF-17	RPDO3-SubIndex0-L	0–65535	0	-	☆
AF-18	RPDO3-SubIndex1-H	0–65535	0	-	☆
AF-19	RPDO3-SubIndex1-L	0–65535	0	-	☆
AF-20	RPDO3-SubIndex2-H	0–65535	0	-	☆
AF-21	RPDO3-SubIndex2-L	0–65535	0	-	☆
AF-22	RPDO3-SubIndex3-H	0–65535	0	-	☆
AF-23	RPDO3-SubIndex3-L	0–65535	0	-	☆
AF-24	RPDO4-SubIndex0-H	0–65535	0	-	☆
AF-25	RPDO4-SubIndex0-L	0–65535	0	-	☆
AF-26	RPDO4-SubIndex1-H	0–65535	0	-	☆
AF-27	RPDO4-SubIndex1-L	0–65535	0	-	☆
AF-28	RPDO4-SubIndex2-H	0–65535	0	-	☆
AF-29	RPDO4-SubIndex2-L	0–65535	0	-	☆
AF-30	RPDO4-SubIndex3-H	0–65535	0	-	☆
AF-31	RPDO4-SubIndex3-L	0–65535	0	-	☆
AF-32	TPDO1-SubIndexO-H	0–65535	0	-	☆
AF-33	TPDO1-SubIndexO-L	0–65535	0	-	☆
AF-34	TPDO1-SubIndex1-H	0–65535	0	-	☆
AF-35	TPDO1-SubIndex1-L	0–65535	0	-	☆
AF-36	TPDO1-SubIndex2-H	0–65535	0	-	☆
AF-37	TPDO1-SubIndex2-L	0–65535	0	-	☆
AF-38	TPDO1-SubIndex3-H	0–65535	0	-	☆
AF-39	TPDO1-SubIndex3-L	0–65535	0	-	☆
AF-40	TPDO2-SubIndex0-H	0–65535	0	-	☆
AF-41	TPDO2-SubIndex0-L	0–65535	0	-	☆
AF-42	TPDO2-SubIndex1-H	0–65535	0	-	☆
AF-43	TPDO2-SubIndex1-L	0–65535	0	-	☆
AF-44	TPDO2-SubIndex2-H	0–65535	0	-	☆
AF-45	TPDO2-SubIndex2-L	0–65535	0	-	☆
AF-46	TPDO2-SubIndex3-H	0–65535	0	-	☆
AF-47	TPDO2-SubIndex3-L	0–65535	0	-	☆
AF-48	TPDO3-SubIndex0-H	0–65535	0	-	☆
AF-49	TPDO3-SubIndex0-L	0–65535	0	-	☆
AF-50	TPDO3-SubIndex1-H	0–65535	0	-	☆
AF-51	TPDO3-SubIndex1-L	0–65535	0	-	☆
AF-52	TPDO3-SubIndex2-H	0–65535	0	-	☆
AF-53	TPDO3-SubIndex2-L	0–65535	0	-	☆
AF-54	TPDO3-SubIndex3-H	0–65535	0	-	☆
AF-55	TPDO3-SubIndex3-L	0–65535	0	-	☆
AF-56	TPDO4-SubIndex0-H	0–65535	0	-	☆
AF-57	TPDO4-SubIndex0-L	0–65535	0	-	☆
AF-58	TPDO4-SubIndex1-H	0–65535	0	-	☆
AF-59	TPDO4-SubIndex1-L	0–65535	0	-	☆

Para. No.	Name	Value Range	Default	Unit	Property
AF-60	TPDO4-SubIndex2-H	0–65535	0	-	☆
AF-61	TPDO4-SubIndex2-L	0–65535	0	-	☆
AF-62	TPDO4-SubIndex3-H	0–65535	0	-	☆
AF-63	TPDO4-SubIndex3-L	0–65535	0	-	☆
AF-66	Number of valid RPDOs	0–65535	0	-	☆
AF-67	Number of valid TPDOs	0–65535	0	-	☆
Group B0: Control Mode, Linear Speed, and Roll Diameter Parameters					
B0-00	Tension control mode	0: Disabled 1: Open loop torque control 2: Closed loop speed control 3: Closed loop torque control 4: Constant linear speed control	0	-	★
B0-01	Winding mode	0: Winding 1: Unwinding	0	-	☆
B0-02	Unwinding reverse tightening selection	0: Disabled 0.1–500.0 m/min	0.0 m/min	m/min	☆
B0-03	Mechanical transmission ratio	0.00–300.00	1.00	-	☆
B0-04	Linear speed input source	0: No output 1: AI1 2: AI2 3: AI3 4: Pulse input (DI5) 5: Communication(1000H)	0	-	★
B0-05	Maximum linear speed	0.0–6500.0 m/min	1000.0 m/min	m/min	☆
B0-06	Minimum linear speed for winding diameter calculation	0.0–6500.0 m/min	20.0 m/min	m/min	☆
B0-07	Roll diameter calculation method	0: Calculated based on linear speed 1:Calculated based on accumulative thickness 2: AI1 3: AI2 4: AI3 5: Pulse input (DI5) 6: Communication 7: Specified by B0-14	0	-	★
B0-08	Maximum roll diameter	0.1–6000.0 mm	500.0 mm	mm	☆
B0-09	Reel diameter	0.1–6000.0 mm	100.0 mm	mm	☆
B0-10	Initial roll diameter source	0: Specified by B0-11 to B0-13 1: AI1 2: AI2 3: AI3 4: Communication	0	-	★
B0-11	Initial roll diameter 1	0.1–6000.0 mm	100.0 mm	mm	☆
B0-12	Initial roll diameter 2	0.1–6000.0 mm	100.0 mm	mm	☆

Para. No.	Name	Value Range	Default	Unit	Property
B0-13	Initial roll diameter 3	0.1–6000.0 mm	100.0 mm	mm	☆
B0-14	Current roll diameter	0.1–6000.0 mm	100.0 mm	mm	☆
B0-15	Roll diameter filter time	0.00–10.00s	5.00s	s	☆
B0-16	Winding diameter change rate	0.0–1000.0	0.0	-	☆
B0-17	Roll diameter change direction limit	0: Disabled 1: Decrease disabled during winding, and increase disabled during unwinding	0	-	☆
B0-18	Roll diameter reset during running	0–1	0	-	☆
B0-19	Pre-charge frequency gain	–100.0% to +100.0%	0.0%	%	☆
B0-20	Pre-charge torque limit source	0: Based on the value of F2-09 1: Based on tension control torque	1	-	★
B0-21	Pre-charge torque correction	–100.0% to +100.0%	0.0	%	☆
B0-22	Pre-charge roll diameter calculation delay (reserved)	0.1–6500.0s	10.0s	s	☆
B0-23	Pre-charge acceleration time	0.0–6000.0s	20.0s	s	☆
B0-24	Pre-charge deceleration time	0.0–6000.0s	20.0s	s	☆
B0-25	Pre-charge roll diameter calculation function	0: Disabled 1: Enabled	0	-	☆
B0-26	Winding frequency limit	0.0% to 100.0%	50.0	%	☆
B0-27	Winding frequency limit offset	0.00–100.00 Hz	5.00 Hz	Hz	☆
B0-28	B0-00 set to 2: close-loop speed control range limit selection B0-00 not set to 2: limit for the winding frequency upper limit	B0-00 set to 2: 0: Limited based on the values of B0-26 and B0-27 (subject to the frequency upper limit) 1: Limited to the value of B0-27 B0-00 not set to 2: 0: Disabled (subject to the frequency upper limit) 1: Limited based on the values of B0-26 and B0-27	0	-	☆
B0-29	Pulses per revolution	1–60000	1	-	☆
B0-30	Revolutions per layer	1–10000	1	-	☆
B0-31	Material thickness reference source	0: Digital setting 1: AI1 2: AI2 3: AI3	0	-	☆

Para. No.	Name	Value Range	Default	Unit	Property
B0-32	Material thickness 0	0.01–100.00 mm	0.01 mm	mm	☆
B0-33	Material thickness 1	0.01–100.00 mm	0.01 mm	mm	☆
B0-34	Material thickness 2	0.01–100.00 mm	0.01 mm	mm	☆
B0-35	Material thickness 3	0.01–100.00 mm	0.01 mm	mm	☆
B0-36	Maximum thickness	0.01–100.00 mm	1.00 mm	mm	☆
B0-38	Closed-loop speed control limit selection	0: Torque calculated through PID only 1: Torque calculated through main + PID	0	-	★
B0-40	Minimum torque limit in pre-charge mode	0.0% to 100.0%	0.0%	%	☆
B0-41	Constant linear speed input source	0: AI1 1: AI2 2: AI3 3: Pulse reference (DI5) 4: Communication	0	-	★
Group B1: Tension Reference Parameters					
B1-00	Tension reference source	0: Specified by B0-01 1: AI1 2: AI2 3: AI3 4: Pulse reference (DI5) 5: Communication	0	-	★
B1-01	Tension digital setting	0–65000	50 N	N	☆
B1-02	Maximum tension	0–65000	500 N	N	☆
B1-03	Zero-speed threshold	0.0% to 20.0%	0.0%	%	☆
B1-04	Zero-speed tension rise	0.0% to 100.0%	0.0%	%	☆
B1-05	Frequency acceleration time in torque control mode	0.0–6500.0s	0.0s	s	☆
B1-06	Frequency deceleration time in torque control mode	0.0–6500.0s	0.0s	s	☆
B1-07	Friction force compensation	0.0% to 50.0%	0.0%	%	☆
B1-08	Mechanical inertia compensation coefficient	0–65535 N•m^2	0 N•m^2	N•m^2	☆
B1-09	Acceleration inertia compensation gain	0.0% to 200.0%	100.0%	%	☆
B1-10	Deceleration inertia compensation gain	0.0% to 200.0%	100.0%	%	☆
B1-11	Material density	0–65535 kg/m^3	0 kg/m^3	kg/m^3	☆
B1-12	Material width	0–65535 mm	0 mm	mm	☆
B1-13	Inertia compensation exit delay	0–100 ms	0 ms	ms	☆

Para. No.	Name	Value Range	Default	Unit	Property
B1-14	Transition frequency for zero speed compensation	0.00–200.00 Hz	2.00 Hz	Hz	☆
B1-15	Open-loop torque reverse	0: Disabled 1: Enabled	0	-	☆
B1-16	Tension closed-loop torque control limit	0.0% to 200.0%	100.0	%	☆
B1-17	Friction force compensation correction coefficient	–50.0 to +50.0	0.0	-	☆
B1-18	Friction force compensation curve	0: Compensate based on linear speed synchronous frequency 1: Compensate based on linear speed 2: Multi-friction compensation curve 1 3: Multi-friction compensation curve 2	0	-	★
B1-19	Multi-friction force compensation torque 1	0.0–50.0	0.0	-	☆
B1-20	Multi-friction force compensation torque 2	0.0–50.0	0.0	-	☆
B1-21	Multi-friction force compensation torque 3	0.0–50.0	0.0	-	☆
B1-22	Multi-friction force compensation torque 4	0.0–50.0	0.0	-	☆
B1-23	Multi-friction force compensation torque 5	0.0–50.0	0.0	-	☆
B1-24	Multi-friction force compensation torque 6	0.0–50.0	0.0	-	☆
B1-25	Multi-friction force compensation inflection point 1	0 to the maximum frequency (F0-10)	0.00 Hz	Hz	☆
B1-26	Multi-friction force compensation inflection point 2	0 to the maximum frequency (F0-10)	0.00 Hz	Hz	☆
B1-27	Multi-friction force compensation inflection point 3	0 to the maximum frequency (F0-10)	0.00 Hz	Hz	☆
B1-28	Multi-friction force compensation inflection point 4	0 to the maximum frequency (F0-10)	0.00 Hz	Hz	☆
B1-29	Multi-friction force compensation inflection point 5	0 to the maximum frequency (F0-10)	0.00 Hz	Hz	☆
B1-30	Multi-friction force compensation inflection point 6	0 to the maximum frequency (F0-10)	0.00 Hz	Hz	☆

Para. No.	Name	Value Range	Default	Unit	Property
B1-31	Tension setup at pre-speed	0: Disabled 1: Enabled	0	-	★
B1-32	Tension setup dead zone	0.0% to 100.0%	2.0%	%	☆
B1-33	Pre-speed of tension setup	0.00 Hz to value of F0-10	0.10 Hz	Hz	☆
B1-34	Terminal tension rise ratio	0.0% to 500.0%	50.0	-	☆
B1-35	Rise revocation transition time	0.0–50.0s	0.0	-	☆
B1-37	Initial roll diameter auto-tuning selection	0: Disabled 1: Enabled	0	-	★
B1-38	Rod length	1–65535 mm	300 mm	mm	★
B1-39	Rod angle	0.1° to 360°	40.0°	°	★
Group B2: Taper Parameters					
B2-00	Taper curve selection	0: Curve 1: Linear	0	-	★
B2-01	Tension taper source selection	0: Specified by B2 02 1: AI1 2: AI2 3: AI3 4: Communication(1000H)	0	-	★
B2-02	Digital setting of taper	0.0% to 100.0%	0.0%	%	☆
B2-03	Correction coefficient of taper compensation	0–10000 mm	0 mm	mm	☆
B2-04	Closed-loop tension taper selection (reserved)	0: Enabled 1: Disabled	0	-	★
B2-05	Maximum external taper source	0: Specified by B2-06 1: AI1 2: AI2 3: AI3 4: Communication	0	-	★
B2-06	Maximum external taper setting	0.0% to 100.0%	100.0%	%	☆
B2-07	Number of straight taper inflexion points (reserved)	0–5	5	-	☆
B2-08	Taper at minimum roll diameter	0.0% to 100.0%	100.0	%	☆
B2-09	Linear taper switchover point 1	Value of B0-09 to value of B0-08	150.0	-	☆
B2-10	Taper of switchover point 1	0.0% to 100.0%	100.0	%	☆

Para. No.	Name	Value Range	Default	Unit	Property
B2-11	Linear taper switchover point 2	Value of B2-09 to value of B0-08	200.0	-	☆
B2-12	Taper of switchover point 2	0.0% to 100.0%	90.0	%	☆
B2-13	Linear taper switchover point 3	Value of B2-11 to value of B0-08	250.0	-	☆
B2-14	Taper of switchover point 3	0.0% to 100.0%	80.0	%	☆
B2-15	Linear taper switchover point 4	Value of B2-13 to value of B0-08	300.0	-	☆
B2-16	Taper of switchover point 4	0.0% to 100.0%	70.0	%	☆
B2-17	Linear taper switchover point 5	Value of B2-15 to value of B0-08	400.0	-	☆
B2-18	Taper of switchover point 5	0.0% to 100.0%	50.0	%	☆
B2-19	Taper at maximum roll diameter	0.0% to 100.0%	30.0	%	☆
Group B6: Communication Free Mapping Configuration					
B6-00	Source address 1	0–57362	0	-	☆
B6-01	Mapping address 1	0–20494	0	-	☆
B6-02	Write gain 1	0.00–100.00	10.00	-	☆
B6-03	Read gain 1	0.00–100.00	0.10	-	☆
B6-04	Source address 2	0–65535	0	-	☆
B6-05	Mapping address 2	0–65535	0	-	☆
B6-06	Write gain 2	0.00–100.00	0.00	-	☆
B6-07	Read gain 2	0.00–100.00	0.00	-	☆
B6-08	Source address 3	0–65535	0	-	☆
B6-09	Mapping address 3	0–65535	0	-	☆
B6-10	Write gain 3	0.00–100.00	0.00	-	☆
B6-11	Read gain 3	0.00–100.00	0.00	-	☆
B6-12	Source address 4	0–65535	0	-	☆
B6-13	Mapping address 4	0–65535	0	-	☆
B6-14	Write gain 4	0.00–100.00	0.00	-	☆
B6-15	Read gain 4	0.00–100.00	0.00	-	☆
B6-16	Source address 5	0–65535	0	-	☆
B6-17	Mapping address 5	0–65535	0	-	☆
B6-18	Write gain 5	0.00–100.00	0.00	-	☆
B6-19	Read gain 5	0.00–100.00	0.00	-	☆
B6-20	Source address 6	0–65535	0	-	☆
B6-21	Mapping address 6	0–65535	0	-	☆
B6-22	Write gain 6	0.00–100.00	0.00	-	☆

Para. No.	Name	Value Range	Default	Unit	Property
B6-23	Read gain 6	0.00–100.00	0.00	-	☆
B6-24	Source address 7	0–65535	0	-	☆
B6-25	Mapping address 7	0–65535	0	-	☆
B6-26	Write gain 7	0.00–100.00	0.00	-	☆
B6-27	Read gain 7	0.00–100.00	0.00	-	☆
B6-28	Source address 8	0–65535	0	-	☆
B6-29	Mapping address 8	0–65535	0	-	☆
B6-30	Write gain 8	0.00–100.00	0.00	-	☆
B6-31	Read gain 8	0.00–100.00	0.00	-	☆
B6-32	Source address 9	0–65535	0	-	☆
B6-33	Mapping address 9	0–65535	0	-	☆
B6-34	Write gain 9	0.00–100.00	0.00	-	☆
B6-35	Read gain 9	0.00–100.00	0.00	-	☆
B6-36	Source address 10	0–65535	0	-	☆
B6-37	Mapping address 10	0–65535	0	-	☆
B6-38	Write gain 10	0.00–100.00	0.00	-	☆
B6-39	Read gain 10	0.00–100.00	0.00	-	☆
B6-40	Source address 11	0–65535	0	-	☆
B6-41	Mapping address 11	0–65535	0	-	☆
B6-42	Write gain 11	0.00–100.00	0.00	-	☆
B6-43	Read gain 11	0.00–100.00	0.00	-	☆
B6-44	Source address 12	0–65535	0	-	☆
B6-45	Mapping address 12	0–65535	0	-	☆
B6-46	Write gain 12	0.00–100.00	0.00	-	☆
B6-47	Read gain 12	0.00–100.00	0.00	-	☆
B6-48	Source address 13	0–65535	0	-	☆
B6-49	Mapping address 13	0–65535	0	-	☆
B6-50	Write gain 13	0.00–100.00	0.00	-	☆
B6-51	Read gain 13	0.00–100.00	0.00	-	☆
B6-52	Source address 14	0–65535	0	-	☆
B6-53	Mapping address 14	0–65535	0	-	☆
B6-54	Write gain 14	0.00–100.00	0.00	-	☆
B6-55	Read gain 14	0.00–100.00	0.00	-	☆
B6-56	Source address 15	0–65535	0	-	☆
B6-57	Mapping address 15	0–65535	0	-	☆
B6-58	Write gain 15	0.00–100.00	0.00	-	☆
B6-59	Read gain 15	0.00–100.00	0.00	-	☆
B6-60	Source address 16	0–65535	0	-	☆
B6-61	Mapping address 16	0–65535	0	-	☆
B6-62	Write gain 16	0.00–100.00	0.00	-	☆

Para. No.	Name	Value Range	Default	Unit	Property
B6-63	Read gain 16	0.00–100.00	0.00	-	☆
B6-64	Source address 17	0–65535	0	-	☆
B6-65	Mapping address 17	0–65535	0	-	☆
B6-66	Write gain 17	0.00–100.00	0.00	-	☆
B6-67	Read gain 17	0.00–100.00	0.00	-	☆
B6-68	Source address 18	0–65535	0	-	☆
B6-69	Mapping address 18	0–65535	0	-	☆
B6-70	Write gain 18	0.00–100.00	0.00	-	☆
B6-71	Read gain 18	0.00–100.00	0.00	-	☆
B6-72	Source address 19	0–65535	0	-	☆
B6-73	Mapping address 19	0–65535	0	-	☆
B6-74	Write gain 19	0.00–100.00	0.00	-	☆
B6-75	Read gain 19	0.00–100.00	0.00	-	☆
B6-76	Source address 20	0–65535	0	-	☆
B6-77	Mapping address 20	0–65535	0	-	☆
B6-78	Write gain 20	0.00–100.00	0.00	-	☆
B6-79	Read gain 20	0.00–100.00	0.00	-	☆
B6-80	Source address 21	0–65535	0	-	☆
B6-81	Mapping address 21	0–65535	0	-	☆
B6-82	Write gain 21	0.00–100.00	0.00	-	☆
B6-83	Read gain 21	0.00–100.00	0.00	-	☆
B6-84	Source address 22	0–65535	0	-	☆
B6-85	Mapping address 22	0–65535	0	-	☆
B6-86	Write gain 22	0.00–100.00	0.00	-	☆
B6-87	Read gain 22	0.00–100.00	0.00	-	☆
B6-88	Source address 23	0–65535	0	-	☆
B6-89	Mapping address 23	0–65535	0	-	☆
B6-90	Write gain 23	0.00–100.00	0.00	-	☆
B6-91	Read gain 23	0.00–100.00	0.00	-	☆
B6-92	Source address 24	0–65535	0	-	☆
B6-93	Mapping address 24	0–65535	0	-	☆
B6-94	Write gain 24	0.00–100.00	0.00	-	☆
B6-95	Read gain 24	0.00–100.00	0.00	-	☆
B6-96	Source address 25	0–65535	0	-	☆
B6-97	Mapping address 25	0–65535	0	-	☆
B6-98	Write gain 25	0.00–100.00	0.00	-	☆
B6-99	Read gain 25	0.00–100.00	0.00	-	☆
Group U0: Basic Monitoring Parameters					
U0-00	Running frequency (Hz)	0.00–320.00 Hz	-	Hz	

Para. No.	Name	Value Range	Default	Unit	Property
U0-01	Frequency reference (Hz)	0.00–320.00 Hz	-	Hz	
U0-02	Bus voltage (V)	0.0–3000.0 V	-	V	
U0-03	Output voltage (V)	0–1140 V	-	V	
U0-04	Output current (A)	0.00–655.35 A (AC drive power: ⩽ 55 kW) 0.0–6553.5 A (AC drive power: > 55 kW)	-	A	
U0-05	Output power (kW)	0.0–3276.7 kW	-	kW	
U0-06	Output torque (%)	–200.0% to +200.0%	-	%	
U0-07	DI state	0x0000 to 0x7FFF	-		
U0-08	DO state	0x0000 to 0x03FF	-		
U0-09	AI1 voltage (V)	0.00–10.57 V	-	V	
U0-10	AI2 voltage (V)	0.00–10.57 V	-	V	
U0-11	AI3 voltage (V)	0.00–10.57 V	-	V	
U0-12	Count value	1–65535	-		
U0-13	Length value	1–65535	-		
U0-14	Load speed display	0 to rated motor speed	-		
U0-15	PID reference	0–65535	-		
U0-16	PID feedback	0–65535	-		
U0-17	PLC stage	0–15	-		
U0-18	Pulse input reference (kHz)	0.00–100.00 kHz	-	kHz	
U0-19	Feedback speed (Hz)	–500.0 Hz to +500.0 Hz (tens position of the value of F7-12: 1)/ –320.00 Hz to +320.00 Hz (tens position of the value of F7-12: 2)	-	Hz	
U0-20	Remaining running time	0.0–6500.0 min	-	min	
U0-21	AI1 voltage before correction	0.000–10.570 V	-	V	
U0-22	AI2 voltage (V)/current (mA) before correction	0.000–10.570 V 0.000–20.000 mA	-	V	
U0-23	AI3 voltage before correction	–10.570 V to +10.570 V	-	V	
U0-24	Linear speed	0–65535	-	m/min	
U0-25	Current power-on time	0–65000 min	-	min	
U0-26	Current running time	0.0–6500.0 min	-	min	
U0-27	Pulse input reference (Hz)	0–65535 Hz	-	Hz	
U0-28	Communication	-100.00% to 100.00%	-	%	

Para. No.	Name	Value Range	Default	Unit	Property
U0-29	Encoder feedback speed (Hz)	–320.00 Hz to 320.00 Hz (tens position of the value of F7-12: 2)/ –500.0 Hz to 500.0 Hz (tens position of the value of F7-12: 1)	-	Hz	
U0-30	Display of main frequency X	0.00–500.00 Hz	-	Hz	
U0-31	Display of auxiliary frequency Y	0.00–500.00 Hz	-	Hz	
U0-32	Any memory address	0–65535	-		
U0-33	Synchronous motor rotor position	0.0° to 359.9°	-	°	
U0-34	Motor temperature	0°C to 200°C	-	°C	
U0-35	Target torque (%)	–200.0% to +200.0%	-	%	
U0-36	Resolver position	0–4095	-		
U0-37	Power factor angle	0.0–6553.5	-		
U0-38	ABZ position	0–65535	-		
U0-39	Target voltage upon V/f separation	0 V to rated motor voltage	-	V	
U0-40	Output voltage upon V/f separation	0 V to rated motor voltage	-	V	
U0-41	DI state display	0–65535	-		
U0-42	DO state display	0–65535	-		
U0-43	DI function state display 1 (functions 01 to 40)	0–65535	-		
U0-44	DI function state display 2 (functions 41 to 80)	0–65535	-		
U0-45	Fault information	0–51	-		
U0-46	Inverter unit temperature	0	-	°C	
U0-47	PTC channel voltage before correction	0	-		
U0-48	PTC channel voltage after correction	0	-		
U0-49	Number of offset pulses of position lock	0	-		
U0-50	Roll diameter	0	-	mm	
U0-51	Tension (after taper setting)	0	-	N	
U0-58	Z signal counting	0–65535	-		
U0-59	Frequency reference (%)	-100.00% to 100.00%	-	%	

Para. No.	Name	Value Range	Default	Unit	Property
U0-60	Running frequency (%)	-100.00% to 100.00%	-	%	
U0-61	AC drive state		-		
U0-62	Current fault code	0–99	-		
U0-63	Running frequency (after droop)	0	-	Hz	
U0-64	Back EMF	0	-	V	
U0-65	Stator resistance auto-tuning upon startup	0	-		
U0-66	Communication extension card model	0–65535	-		
U0-67	Communication extension card software version	0–65535	-		
U0-68	AC drive state on the communication extension card	0–65535	-		
U0-69	Frequency transmitted to the communication extension card/0.01 Hz	0.00–655.35	-		
U0-70	Speed transmitted to the communication extension card/RPM	0–65535	-		
U0-71	Current specific to communication extension card (A)	0–65535	-		
U0-72	Communication card error state	0–65535	-		
U0-73	Target torque before filter	0	-		
U0-74	Target torque after filter	0	-		
U0-75	Torque reference after acceleration/ deceleration	0	-		
U0-76	Torque upper limit in the motoring state	0	-		
U0-77	Torque upper limit in the generating state	0	-		
U0-80	EtherCAT slave name	0	-		
U0-81	EtherCAT slave alias	0	-		
U0-82	EtherCAT ESM transmission fault code	0	-		
U0-83	EtherCAT XML file version	0	-		
U0-84	Times of EtherCAT synchronization loss	0	-		

Para. No.	Name	Value Range	Default	Unit	Property
U0-85	Maximum error value and invalid frames of EtherCAT port 0 per unit time	0	-		
U0-86	Maximum error value and invalid frames of EtherCAT port 1 per unit time	0	-		
U0-87	Maximum forwarding error of EtherCAT port per unit time	0	-		
U0-88	Maximum EtherCAT data frame processing unit error per unit time	0	-		
U0-89	Maximum link loss of EtherCAT port per unit time	0	-		
U0-96	Status parameter 1 (performance transmission)	0	-		
U0-97	Status parameter 2 (performance transmission)	0	-		
Group U1: Tension Control Monitoring Parameters					
U1-00	Linear speed	0	-	m/min	
U1-01	Current roll diameter	0	-	mm	
U1-02	Linear speed synchronous frequency	0	-	Hz	
U1-03	PID output frequency	0	-	N	
U1-04	Current tension reference	0	-	N	
U1-05	Tension reference after taper setting	0	-	-	
U1-06	Open-loop torque	0	-	-	
U1-07	PID output torque	0	-	-	
U1-08	Tension control mode	0	-	-	
U1-09	PID reference	0	-	-	
U1-10	PID feedback	0	-	-	
U1-11	Kp output	0	-	mm	
U1-12	Ki output	0	-	Hz	
U1-13	Kd output	0	-	Hz	
U1-14	Tension time	0	-	-	
U1-15	Winding/Unwinding mode	0	-	-	

1.2 List of Monitoring Parameters

Table 1–1 Monitoring parameters

Para. No.	Name	Basic Unit	Communication Address
Group U0: Basic Monitoring Parameters			
U0-00	Running frequency (Hz)	0.01 Hz	7000H
U0-01	Frequency reference (Hz)	0.01 Hz	7001H
U0-02	Bus voltage (V)	0.1 V	7002H
U0-03	Output voltage (V)	1 V	7003H
U0-04	Output current (A)	0.1 A	7004H
U0-05	Output power (kW)	0.1 kW	7005H
U0-06	Output torque (%)	0.1%	7006H
U0-07	DI state	1	7007H
U0-08	DO state	1	7008H
U0-09	AI1 voltage (V)	0.01 V	7009H
U0-10	AI2 voltage (V)	0.01 V	700AH
U0-11	AI3 voltage (V)	0.01 V	700BH
U0-12	Count value	1	700CH
U0-13	Length value	1	700DH
U0-14	Load speed display	1	700EH
U0-15	PID reference	1	700FH
U0-16	PID feedback	1	7010H
U0-17	PLC stage	1	7011H
U0-18	Pulse input reference (kHz)	0.01 kHz	7012H
U0-19	Feedback speed (Hz)	0.01 Hz	7013H
U0-20	Remaining running time	0.1 min	7014H
U0-21	AI1 voltage before correction	0.001 V	7015H
U0-22	AI2 voltage (V)/current (mA) before correction	0.001 V	7016H
U0-23	AI3 voltage before correction	0.001 V	7017H
U0-24	Linear speed	1 m/min	7018H
U0-25	Current power-on time	1 min	7019H
U0-26	Current running time	0.1 min	701AH
U0-27	Pulse input reference (Hz)	1 Hz	701BH
U0-28	Communication	0.01%	701CH
U0-29	Encoder feedback speed (Hz)	0.01 Hz	701DH
U0-30	Display of main frequency X	0.01 Hz	701EH
U0-31	Display of auxiliary frequency Y	0.01 Hz	701FH
U0-32	Any memory address	1	7020H
U0-33	Synchronous motor rotor position	0.1°	7021H
U0-34	Motor temperature	1°C	7022H

Para. No.	Name	Basic Unit	Communication Address
U0-35	Target torque (%)	0.1%	7023H
U0-36	Resolver position	1	7024H
U0-37	Power factor angle	0.1	7025H
U0-38	ABZ position	1	7026H
U0-39	Target voltage upon V/f separation	1 V	7027H
U0-40	Output voltage upon V/f separation	1 V	7028H
U0-41	DI state display	1	7029H
U0-42	DO state display	1	702AH
U0-43	DI function state display 1 (functions 01 to 40)	1	702BH
U0-44	DI function state display 2 (functions 41 to 80)	1	702CH
U0-45	Fault information	1	702DH
U0-46	Inverter unit temperature	1°C	702EH
U0-47	PTC channel voltage before correction	0.001	702FH
U0-48	PTC channel voltage after correction	0.001	7030H
U0-49	Number of offset pulses of position lock	1	7031H
U0-50	Roll diameter	1 mm	7032H
U0-51	Tension (after taper setting)	1 N	7033H
U0-58	Z signal counting	1	703AH
U0-59	Frequency reference (%)	0.01%	703BH
U0-60	Running frequency (%)	0.01%	703CH
U0-61	AC drive state	1	703DH
U0-62	Current fault code	1	703EH
U0-63	Running frequency (after droop)	0.01 Hz	703FH
U0-64	Back EMF	0.1 V	7040H
U0-65	Stator resistance auto-tuning upon startup	1	7041H
U0-66	Communication extension card model	1	7042H
U0-67	Communication extension card software version	1	7043H
U0-68	AC drive state on the communication extension card	1	7044H
U0-69	Frequency transmitted to the communication extension card/0.01 Hz	1	7045H
U0-70	Speed transmitted to the communication extension card/RPM	1	7046H
U0-71	Current specific to communication extension card (A)	1	7047H
U0-72	Communication card error state	1	7048H
U0-73	Target torque before filter	0.1	7049H
U0-74	Target torque after filter	0.1	704AH

Para. No.	Name	Basic Unit	Communication Address
U0-75	Torque reference after acceleration/ deceleration	0.1	704BH
U0-76	Torque upper limit in the motoring state	0.1	704CH
U0-77	Torque upper limit in the generating state	0.01	704DH
U0-80	EtherCAT slave name	1	7050H
U0-81	EtherCAT slave alias	1	7051H
U0-82	EtherCAT ESM transmission fault code	1	7052H
U0-83	EtherCAT XML file version	0.01	7053H
U0-84	Times of EtherCAT synchronization loss	1	7054H
U0-85	Maximum error value and invalid frames of EtherCAT port 0 per unit time	1	7055H
U0-86	Maximum error value and invalid frames of EtherCAT port 1 per unit time	1	7056H
U0-87	Maximum forwarding error of EtherCAT port per unit time	1	7057H
U0-88	Maximum EtherCAT data frame processing unit error per unit time	1	7058H
U0-89	Maximum link loss of EtherCAT port per unit time	1	7059H
U0-96	No-load current of asynchronous motor vector online observation	0.1	7060H
U0-97	Mutual inductance of asynchronous motor vector online observation	0.1	7061H
Group U1: Tension Control Monitoring Parameters			
U1-00	Linear speed	0.1 m/min	7100H
U1-01	Current roll diameter	0.1 mm	7101H
U1-02	Linear speed synchronous frequency	0.01 Hz	7102H
U1-03	PID output frequency	0.01 N	7103H
U1-04	Current tension reference	1 N	7104H
U1-05	Tension reference after taper setting	1	7105H
U1-06	Open-loop torque	0.1	7106H
U1-07	PID output torque	0.1	7107H
U1-08	Tension control mode	1	7108H
U1-09	PID reference	0.1	7109H
U1-10	PID feedback	0.1	710AH
U1-11	Kp output	1 mm	710BH
U1-12	Ki output	1 Hz	710CH
U1-13	Kd output	1 Hz	710DH
U1-14	Tension time	1	710EH
U1-15	Winding/Unwinding mode	1	710FH
Group U2: Position Control Monitoring Parameters			
U2-60	Real-time position deviation during position control	1	723CH

Para. No.	Name	Basic Unit	Communication Address
U2-61	Valid home tag	1	723DH
U2-62	Home position (low 16 bits)	1	723EH
U2-63	Home position (high 16 bits)	1	723FH
U2-64	Z signal position (low 16 bits)	1	7240H
U2-65	Z signal position (high 16 bits)	1	7241H
U2-66	Current position reference segment	0.01	7242H
U2-67	Proximity output flag	1	7243H
U2-68	Completion output flag	1	7244H
U2-69	Position control mode	1	7245H
U2-70	Pulses per revolution of encoder	0.01	7246H
U2-71	Pulses per revolution of spindle	1	7247H
U2-72	Pulses per revolution of motor	1	7248H
U2-73	Current encoder indexing	1	7249H
U2-74	Current encoder indexing (angle)	1	724AH
U2-75	Communication running frequency (%)	1	724BH
U2-76	Communication position reference	1	724CH
U2-77	Communication position reference	1	724DH
U2-78	Position control state	1	724EH
U2-79	Real-time position deviation during position control	1	724FH
U2-80	Relative home position direction	1	7250H
U2-81	Relative home position deviation (low 16 bits)	1	7251H
U2-82	Relative home position deviation (high 16 bits)	1	7252H
U2-83	Position	1	7253H
U2-84	Speed	1	7254H
U2-85	Current spindle indexing	1	7255H
U2-86	Current spindle indexing (angle)	1	7256H
U2-87	Position control pause	1	7257H
U2-88	Communication command word 731EH data	1	7258H
U2-89	Position lock operation flag in position control	1	7259H
U2-90	Position control frequency upper limit	0.01	725AH
U2-91	Static spindle flag	1	725BH
U2-92	Home loss counting during home correction	1	725CH
U2-93	Encoder Z signal counter	1	725DH
U2-95	Encoder pulse counting (low 16 bits)	1	725FH
U2-96	Encoder pulse counting (high 16 bits)	1	7260H
U2-98	AC drive operation mode	1	7262H
U2-99	Position control frequency reference	1	7263H

2 Functions

2.1 Drive Configuration

2.1.1 Command Sources

2.1.1.1 Setting Command Sources

Commands are used to control operations of the AC drive, such as start, stop, forward run, reverse run, and jogging. Command sources include the operating panel, terminals, and communication. You can select the command source through F0-02.

Para. No.	Function	Default	Value Range	Description
F0-02	Command source selection	0	0: Operating panel 1: Terminal 2: Communication	Defines the source of control commands, including start/stop, forward run, reverse run, and jog. 0: Operating panel Control commands are input using the RUN, STOP/RES, and MF.K keys on the operating panel. This mode is suitable for initial commissioning. 1: Terminal Control commands are input through DI terminals of the AC drive. This mode is suitable for most applications. 2: Communication Control commands are input through remote communication. The AC drive must be equipped with a communication card to communicate with the host controller. This mode is suitable for remote control and centralized control on multiple devices or systems.

2.1.1.2 Setting Commands Through the Operating Panel

Set F0-02 to 0 and use the RUN and STOP/RES keys on the operating panel to control the AC drive.

- Press RUN to start the AC drive (the RUN indicator is on).
- When the AC drive is running, press STOP/RES to stop the AC drive (the RUN indicator is off).

2.1.1.3 Setting Commands Through Communication

You can set F0-02 to 2 to select communication as the command source for controlling start/stop of the AC drive.

The AC drive supports communication with the host controller through six communication protocols: Modbus, PROFIBUS-DP, CANopen, CANlink, PROFINET, and EtherCAT. Only one communication protocol is supported at a time. To enable communication as the command source, you must install a communication card to the AC drive.

The AC drive supports six optional communication cards. If Modbus, PROFIBUS-DP, CANopen, PROFINET, or EtherCAT is used, set F0-28 (communication protocol selection) to select an applicable serial communication protocol. The CANlink protocol is valid all the time.

When the AC drive is controlled through serial communication, the host controller must send a write command to the AC drive. The following takes the Modbus protocol as an example to illustrate the process of sending commands through communication.

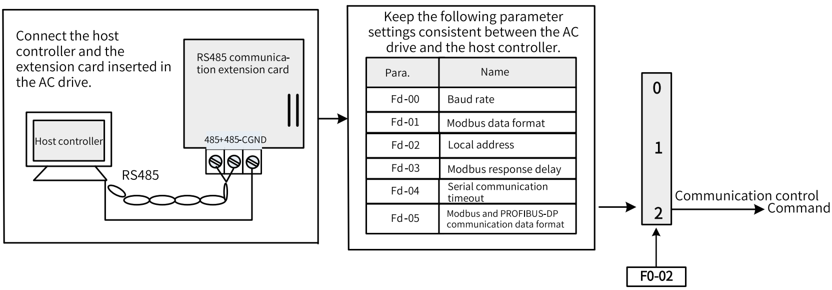


Figure 2-1 Setting commands through communication

To make the AC drive run in reverse direction, the host controller sends the write command 01 06 20 00 00 02 03 CB. The following table shows the meaning of each byte in the command. The command is in hexadecimal format. For other communication addresses and control commands, see "Appendix B: Communication Data Address Definition and Modbus Protocol".

Command	Meaning
01H (editable)	AC drive address
06H	Write command
2000H	Control command communication address
02H (reverse run)	Control command
03CBH	CRC

The following table shows the relationship between master commands and slave responses:

Master Command		Slave Response	
ADDR	01H	ADDR	01H
CMD	06H	CMD	06H
Parameter address high bits	20H	Parameter address high bits	20H
Parameter address low bits	00H	Parameter address low bits	00H
Data content high bits	00H	Data content high bits	00H
Data content low bits	02H	Data content low bits	02H
CRC high bits	03H	CRC high bits	03H
CRC low bits	CBH	CRC low bits	CBH

2.1.1.4 Setting Commands Through Terminals

Set F0-02 to 1 to use terminals to control start and stop of the AC drive.

Set F4-11 to select a terminal control mode. The AC drive supports four terminal control modes: two-wire mode 1, two-wire mode 2, three-wire mode 1, and three-wire mode 2.

Para. No.	Function	Default	Value Range	Description
F4-11	Terminal control mode	0	0: Two-wire mode 1 1: Two-wire mode 2 2: Three-wire mode 1 3: Three-wire mode 2	Defines the four different modes used to control the AC drive operation through external terminals.

You can use any one of multi-functional input terminals DI1 to DI10 as external input terminals. That is, set parameters F4-00 to F4-09 to select functions for input terminals DI1 to DI10. For details about function definition, see "F4-00 (DI1) to F4-09 (DI10) Terminal Function" in "Appendix C Parameters".

Two-wire mode 1

Two-wire mode 1: Set F4-11 to 0. This is the most commonly used two-wire mode.

For example, DI1 is assigned with the function of forward run, and DI2 is assigned with the function of reverse run. Connect the forward run switch to DI1 and the reverse run switch to DI2.

Para. No.	Name	Value	Description
F4-11	Terminal control mode	0	Two-wire mode 1
F4-00	DI1 function selection	1	Forward run (FWD)
F4-01	DI2 function selection	2	Reverse run (REV)

In this mode, When SW1 closes and SW2 opens, the motor runs in the forward direction. When SW1 opens and SW2 closes, the motor runs in the reverse direction. When SW1 and SW2 both open or close, the motor stops, as shown in the following figure.

SW1	SW2	Command
1	0	Forward
0	1	Reverse
1	1	Stop
0	0	Stop

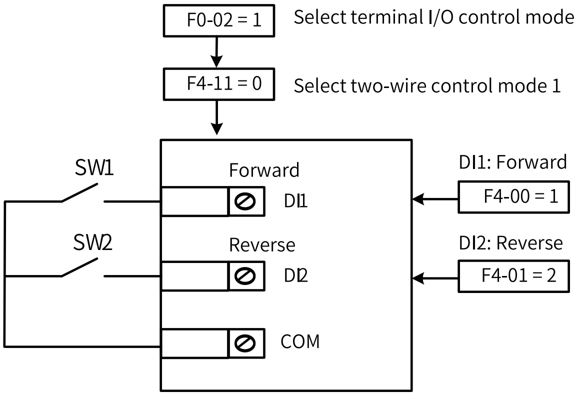


Figure 2-2 Wiring and parameter settings for two-wire mode 1

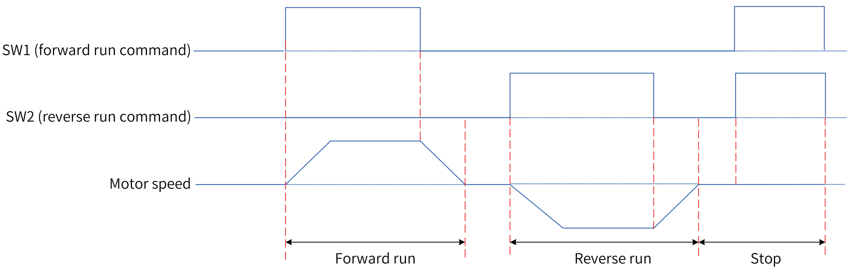


Figure 2-3 Sequence of two-wire mode 1 (normal condition)

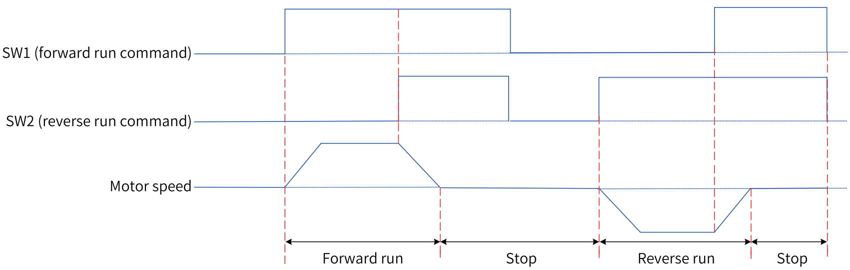


Figure 2-4 Sequence of two-wire mode 1 (abnormal condition)

Two-wire mode 2

For example, DI1 is assigned with the command function, and DI2 is assigned with the forward/reverse run switchover function. Set the parameters according to the following table.

Para. No.	Name	Value	Description
F4-11	Terminal control mode	1	Two-wire mode 2
F4-00	DI1 function selection	1	Command
F4-01	DI2 function selection	2	Forward/Reverse run

In this mode, when SW1 closes, the motor runs. When SW2 opens, the motor runs in the forward direction. When SW2 closes, the motor runs in the reverse direction. When SW1 opens, the motor stops no matter SW2 opens or closes, as shown in the following figure.

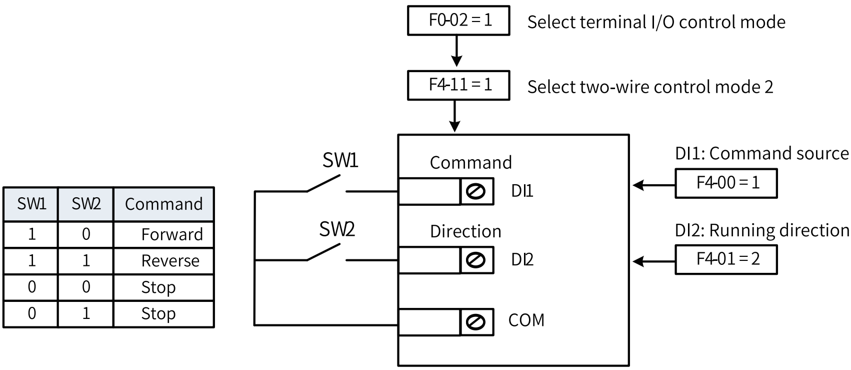


Figure 2-5 Wiring and parameter settings for two-wire mode 2

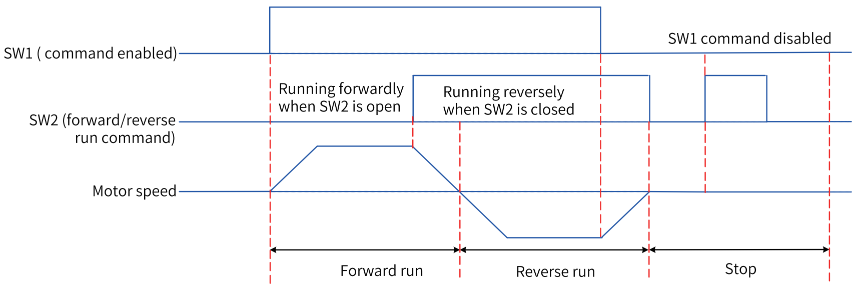


Figure 2-6 Sequence of two-wire mode 2

Three-wire mode 1

For example, DI3 is assigned with the three-wire operation control function, DI1 is assigned with the forward run function, and DI2 is assigned with the reverse run function. In this control mode, start and stop of the AC drive must be controlled by the keys on the AC drive. Connect the start/stop key to DI3, the forward run key to DI1, and the reverse run key to DI2. Set the parameters according to the following table.

Para. No.	Name	Value	Description
F4-11	Terminal control mode	2	Three-wire mode 1
F4-00	DI1 function selection	1	Forward run (FWD)
F4-01	DI2 function selection	2	Reverse run (REV)
F4-02	DI3 function selection	3	Three-wire operation control

SW3 is a normally-closed key and SW1 and SW2 are normally-open keys. When SW3 is in the closed state, the AC drive runs in the forward direction if SW1 closes, or runs in the reverse direction if SW2 closes. The AC drive stops immediately after SW3 opens. SW3 must remain closed during start and operation of the AC drive. Commands from SW1 or SW2 take effect immediately after SW1 or SW2 closes.

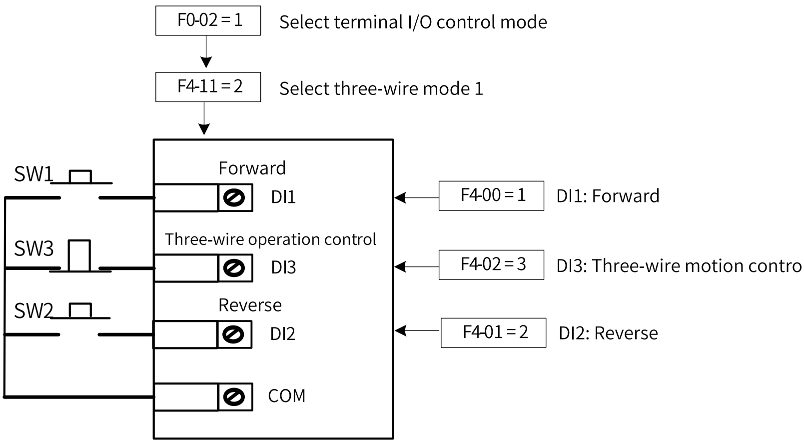


Figure 2-7 Wiring and parameter settings for three-wire mode 1

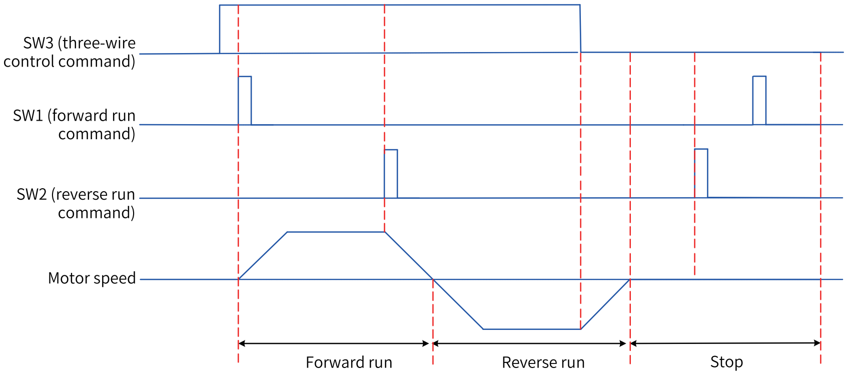


Figure 2-8 Sequence of three-wire mode 1

Three-wire mode 2

For example, DI3 is assigned with the three-wire operation control function, DI1 is assigned with the command function, and DI2 is assigned with the forward/reverse run switchover function. Connect the start/stop key to DI3, the run key to DI1, and the forward/reverse run key to DI2. Set the parameters according to the following table.

Para. No.	Name	Value	Description
F4-11	Terminal control mode	3	Three-Wire Mode 2
F4-00	DI1 function selection	1	Command
F4-01	DI2 function selection	2	Forward/Reverse run
F4-02	DI3 function selection	3	Three-wire operation control

When SW3 is in the closed state and SW1 closes, the AC drive runs in the forward direction if SW2 opens, or in the reverse direction if SW2 closes. The AC drive stops immediately after SW3 opens. SW3 must remain closed during start and operation of the AC drive. Commands from SW1 take effect immediately after SW1 closes.

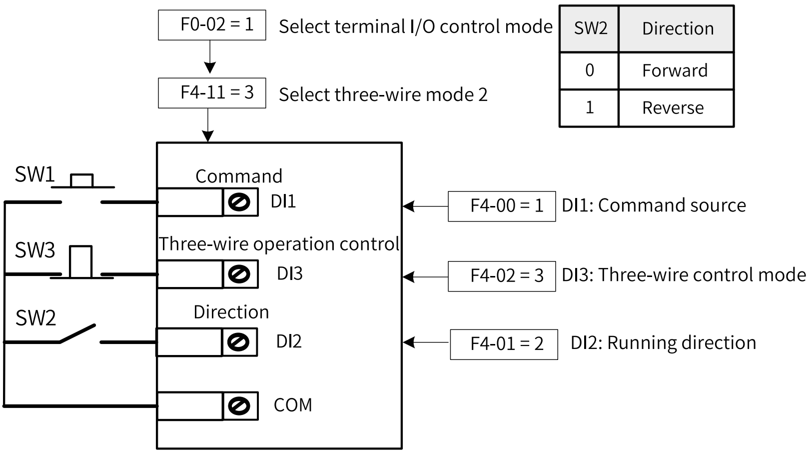


Figure 2-9 Wiring and parameter settings for three-wire mode 2

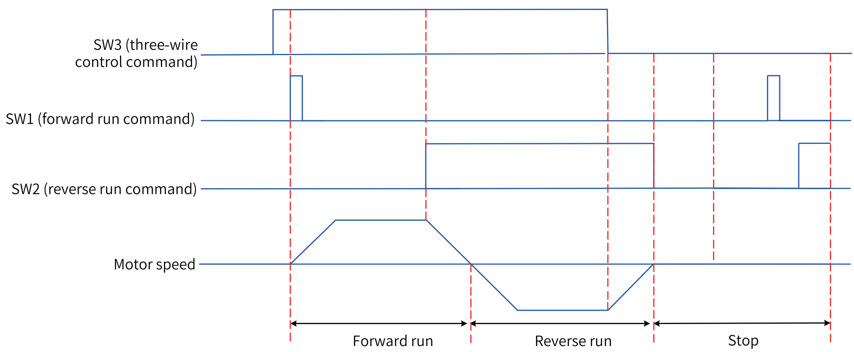


Figure 2-10 Sequence of three-wire mode 2

2.1.2 Frequency Reference Setting

2.1.2.1 Frequency Reference Input Mode

The AC drive supports three frequency reference input modes: main frequency reference, auxiliary frequency reference, and superposition of main and auxiliary frequencies.

2.1.2.2 Selecting the Main Frequency Input Mode

The AC drive supports ten kinds of main frequency reference input modes: digital setting (non-retentive at power failure), digital setting (retentive at power failure), AI1, AI2, AI3, pulse input, multi-reference, simple PLC, PID, and communication. You can set F0-03 (0 to 9) to select the input mode.

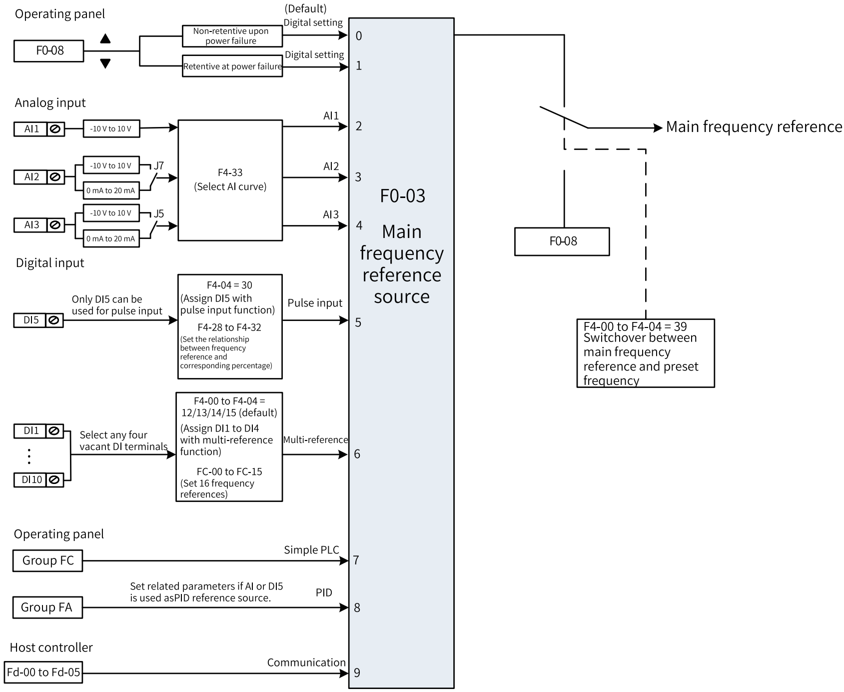


Figure 2-11 Main frequency reference selection

Para. No.	Name	Value Range	Default
F0-03	Main frequency source X selection	0: Digital setting (preset frequency (F0-08), editable through UP/ DOWN, and non-retentive upon power failure) 1: Digital setting (preset frequency (F0-08), editable through UP/ DOWN, and retentive at power failure) 2: AI1 3: AI2 4: AI3 5: Pulse reference (DI5) 6: Multi-reference 7: Simple PLC 8: PID 9: Communication 10: Reserved	0

2.1.2.3 Setting the Main Frequency Through the Operating Panel

The main frequency can be set through the operating panel in two modes:

- F0-23 = 0 (non-retentive at power failure): When the AC drive is powered on again after stop or power failure, the frequency value reverts to the preset value (F0-08).

  F0-08 (preset frequency) can be changed by pressing the or key on the operating panel or by using the UP/DOWN terminals. However, in this mode, changes made to the frequency value will be cleared after the AC drive stops.
- F0-23 = 1 (retentive at power failure): When the AC drive is powered on again after power failure, the frequency reverts to the value set before power failure. F0-08

  (preset frequency) can be changed by pressing the or key on the operating panel or by using the UP/DOWN terminals. In this mode, changes made to the frequency value will be retained after the AC drive stops.
  For example, assume that F0-08 is set to 40 Hz and then increased to 45 Hz by

  using the key on the operating panel. If F0-23 is set to 0 (non-retentive), the target frequency reverts to 40 Hz (value of F0-08) after the AC drive stops. If F0-23 is set to 1 (retentive), the target frequency is still 45 Hz after the AC drive stops.

Note

Distinguish this parameter from F0-23 (Retentive memory of digital setting frequency upon stop). F0-23 determines whether the frequency setting is retained or cleared after the AC drive stops. F0-23 is related only to the stop state of the AC drive, rather than power failure.

Related parameters:

Para. No.	Function	Default	Value Range
F0-08	Preset frequency	50.00 Hz	0.00 Hz to max. frequency (F0-10)
F0-10	Max. frequency	50.00 Hz	50.00 Hz to 600.00 Hz

Para. No.	Function	Default	Value Range
F0-23	Retentive memory of digital setting frequency upon stop	0	0: Non-retentive 1: Retentive

2.1.2.4 Setting the Main Frequency Through AI Terminals

The main frequency can be set by using three analog input (AI) terminals: AI1, AI2, and AI3. If F0-03 is set to 2, AI1 is used to set the main frequency. If F0-03 is set to 3, AI2 is used to set the main frequency. If F0-03 is set to 4, AI3 is used to set the main frequency.

Each AI terminal that used to set the frequency source supports five types of AI curves. The AI curve is used to define the relationship between the analog input voltage (or current) and the corresponding setting.

Procedure	Parameters	Description
(Step 1) Set AI curves: Set the relationship between voltage/ current input on the AI terminals and the set values.	F4-13 to F4-16	Curve 1 setting
	F4-18 to F4-21	Curve 2 setting
	F4-23 to F4-27	Curve 31 setting
	A6-00 to A6-07	Curve 4 setting
	A6-08 to A6-15	Curve 5 setting
	F4-34	Setting for the AI lower than the minimum input (When an AI terminal is used as the frequency reference, 100.0% of the voltage/current input corresponds to the max. frequency F0-10.)
(Step 2) Select AI curves for the AI terminals: Select AI curves and set the filter time.	F4-33	AI curve selection (You can select any AI curve for an AI terminal. Generally, use the default value (F4-33 = 321), indicating curve 1 for AI1, curve 2 for AI2, and curve 3 for AI3.)
	F4-17, F4-22, F4-27	Filter time of AI1 to AI3
(Step 3) Select an AI terminal to define the frequency source: Select an AI terminal used to input frequency references based on terminal characteristics.	F0-03 (Main frequency reference input selection)	Set F0-03 to 2. AI1 is used as the source.
		Set F0-03 to 3. AI2 is used as the source. In this case, voltage input or current input can be selected by using the jumper cap J7 on the control board.
		Set F0-03 to 4. AI3 is used as the source. In this case, voltage input or current input can be selected by using the jumper cap J5 on the control board.

Setting AI Curves

Five types of AI curves are available, among which curve 1, curve 2, and curve 3 are two-point curves that are set through parameters F4-13 to F4-27. Curve 4 and curve 5 are four-point curves that are set through parameters of group A6.

In the following example, AI curve 1 is selected and set through F4-13 to F4-16.

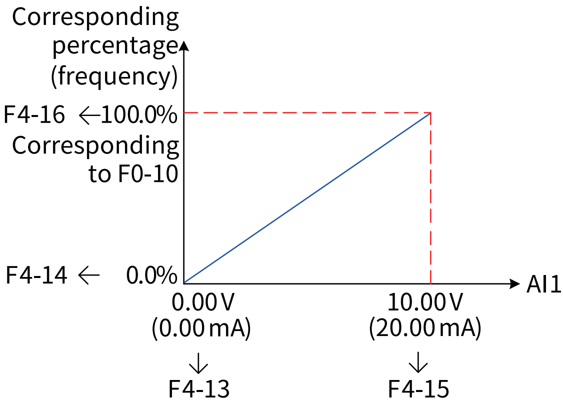


Figure 2-12 Settings of AI curve 1

When an AI terminal is used as the frequency reference, the voltage/current input that corresponds to 100.0% of the setting indicates the percentage to the maximum frequency (F0-10). When the AI is current input, 1 mA current corresponds to 0.5 V voltage, and 0 mA to 20 mA current corresponds to –10 V to +10 V current.

Curve 2 and curve 3 are set in the same way as curve 1. Parameters F4-18 to F4-21 are used to set curve 2, and parameters F4-23 to F4-26 are used to set curve 3.

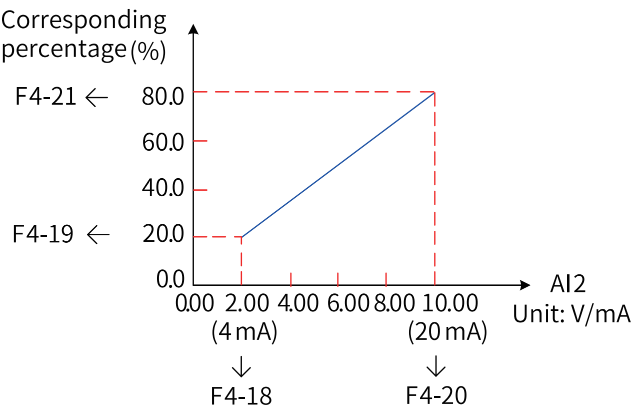


Figure 2-13 Settings of AI curve 2

Curve 4 and curve 5 provide functions similar to those of curves 1 to 3, except that curves 1 to 3 are straight lines, whereas curve 4 and curve 5 are four-point curves. The x axis of AI curves 4 and 5 represents the analog input voltage (or current), and the y axis represents the set value corresponding to the analog input, that is, the percentage to the maximum frequency (F0-10). Curves 4 and 5 each include four points: the minimum input point, inflexion point 1, inflexion point 2, and the maximum input point. A6-00 corresponds to the x axis of minimum input, that is, the minimum analog input voltage (or minimum analog input current).

When setting curve 4 and curve 5, ensure that the minimum input voltage, inflexion point 1 input voltage, inflexion point 2 input voltage, and maximum input voltage are set in ascending order. Parameters A6-00 to A6-07 are used to set curve 4, and parameters A6-08 to A6-15 are used to set curve 5.

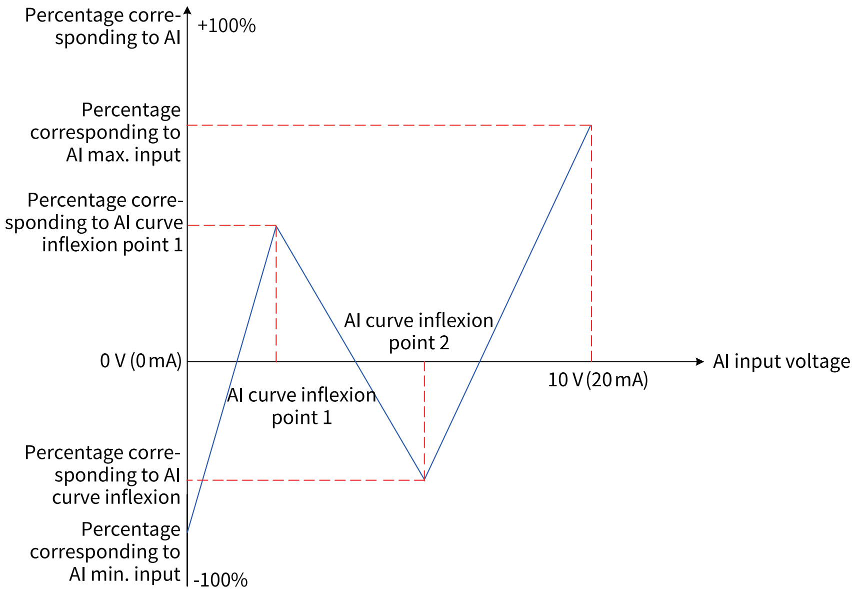


Figure 2-14 Settings of curve 4 and curve 5

Selecting AI curves for AI terminals

The curves of terminals AI1 and AI2 are determined by the ones and tens positions of F4-33 respectively. The two AI terminals can use any of the five curves.

A longer AI filter time enhances the anti-interference capability but leads to slower response to frequency adjustment. A shorter filter time enables faster response to frequency adjustment but weakens the anti-interference capability. When analog input is subject to interference in the application environment, increase the filter time to stabilize the analog value detected. However, a long filter time slows down the response to analog input detection. Therefore, set an appropriate filter time based on the actual application environment.

Setting an AI terminal as the main frequency

The control board provides three AI terminals: AI1 to AI3. AI1 provides voltage input of –10 V to +10 V. AI2 and AI3 provide voltage input of –10 V to +10 V or current input of 0 mA to 20 mA. Jumpers J7 and J5 on the control board can be used to switch between voltage input and current input for AI2 and AI3, respectively. The following describes how to set each AI terminal as the main frequency source.

For example, assume that curve 1 is selected for AI1 (the ones position of F4-33 is set to 1), AI1 voltage input is selected as the frequency source, and the input voltage range of 2 V to 10 V needs to be mapped to correspond to 10 Hz to 40 Hz. In this case, set the parameters according to the following figure.

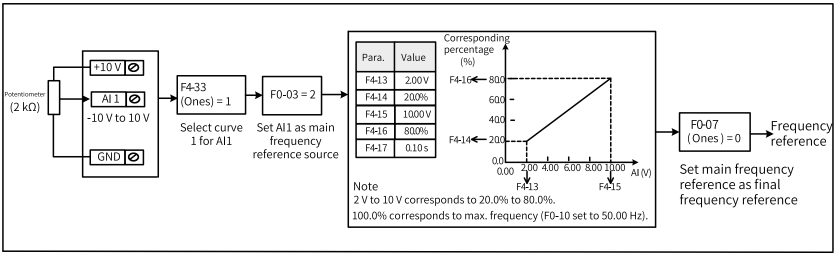


Figure 2-15 Parameter settings for AI1 voltage input as the main frequency reference

AI2 can provide analog voltage input (–10 V to 10 V) or analog current input (0 mA to 20 mA).

When AI2 provides analog current input of 0 mA to 20 mA, the corresponding input voltage ranges from –10 V to +10 V. If the input current ranges from 4 mA to 20 mA, 4 mA current corresponds to 2 V voltage, and 20 mA current corresponds to 10 V voltage.

For example, assume that curve 2 is selected for AI2 (the tens position of F4-33 is set to 2), AI2 current input is used as the frequency source, and the input current range of 4 mA to 20 mA needs to correspond to a frequency range of 0 Hz to 50 Hz. In this case, set the parameters according to the following figure.

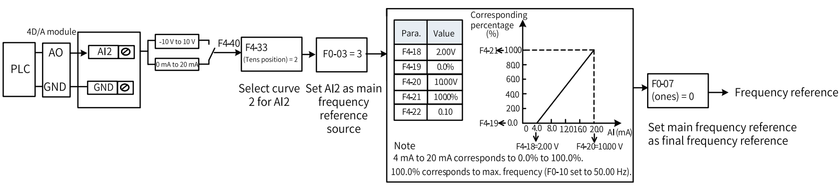


Figure 2-16 Parameter settings for AI2 current input as the main frequency reference

2.1.2.5 Setting the Main Frequency Through Multi-Reference

When F0-03 is set to 6, multi-reference is used as the main frequency. This mode is applicable to scenarios where only several frequency values are needed instead of continuous frequency adjustment.

The multi-reference mode supports 16 frequencies, which can be set through combinations of input signals from the four DI terminals. You can also use fewer than four DI terminals. In this case, missing digits are populated with 0.

The relationship between the reference quantity and DI terminal quantity is as follows:

- Two references: one DI terminal K1
- Three to four references: two DI terminals K1 and K2
- Five to eight references: three DI terminals K1, K2, and K3
- Nine to sixteen references: four DI terminals K1, K2, K3, and K4

Frequency references required are set through parameters in group FC, as listed in the following table.

Para. No.	Function	Default	Value Range	Description
FC-00	Multi-reference 0	0.00%	–100.0% to +100.0%	A reference value is a percentage to the maximum frequency. The sign of the value determines the running direction of the AC drive. A negative value indicates reverse running. The default acceleration time and deceleration time are the values of F0-17 and F0-18, respectively.
FC-01	Multi-reference 1	0.00%	–100.0% to +100.0%	
FC-02	Multi-reference 2	0.00%	–100.0% to +100.0%	
FC-03	Multi-reference 3	0.00%	–100.0% to +100.0%	
FC-04	Multi-reference 4	0.00%	–100.0% to +100.0%	
FC-05	Multi-reference 5	0.00%	–100.0% to +100.0%	
FC-06	Multi-reference 6	0.00%	–100.0% to +100.0%	
FC-07	Multi-reference 7	0.00%	–100.0% to +100.0%	
FC-08	Multi-reference 8	0.00%	–100.0% to +100.0%	
FC-09	Multi-reference 9	0.00%	–100.0% to +100.0%	
FC-10	Multi-reference 10	0.00%	–100.0% to +100.0%	
FC-11	Multi-reference 11	0.00%	–100.0% to +100.0%	
FC-12	Multi-reference 12	0.00%	–100.0% to +100.0%	
FC-13	Multi-reference 13	0.00%	–100.0% to +100.0%	
FC-14	Multi-reference 14	0.00%	–100.0% to +100.0%	
FC-15	Multi-reference 15	0.00%	–100.0% to +100.0%	
FC-51	Multi-reference 0 source	0	0 to 6	0: FC-00 1: AI1 2: AI2 3: AI3 4: Reserved 5: PID 6: Set through preset frequency (F0-08), editable through UP/DOWN

When using multi-reference as the main frequency reference, assign DI terminals with functions 12...15, as shown in the following table.

Para. No.	Name	Value	Description
F4-01	DI2 function	12	Multi-reference terminal 1
F4-03	DI4 function	13	Multi-reference terminal 2
F4-06	DI7 function	14	Multi-reference terminal 3
F4-07	DI8 function	15	Multi-reference terminal 4

Example

In the following figure, DI2, DI4, DI7, and DI8 are used as multi-reference input terminals. They each contribute one bit to a 4-bit binary value, and different combinations of the bits represent different frequencies. When values of (DI2, DI4, DI7, DI8) are (0, 0, 1, 0), they constitute a value of 2. In this case, the frequency value set through FC-02 is selected. (See Table 6-1 for details about frequency selection.) Then, the target running frequency is calculated automatically by using the formula (FC-02) x (F0-10). The following figure shows the frequency setting.

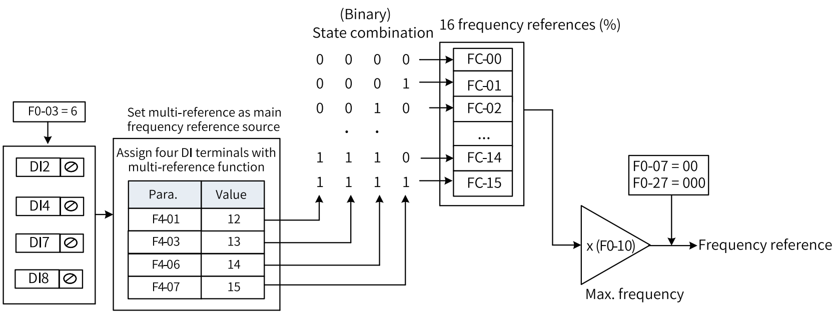


Figure 2-17 Frequency setting in multi-speed mode

The four multi-reference terminals can make up 16 state combinations, corresponding to 16 reference values, as listed in the following table.

Table 2–1 Description of multi-reference function

K4	K3	K2	K1	Reference	Corresponding Parameter
OFF	OFF	OFF	OFF	Multi-reference 0	FC-00 (FC-51 = 0)
OFF	OFF	OFF	ON	Multi-reference 1	FC-01
OFF	OFF	ON	OFF	Multi-reference 2	FC-02
OFF	OFF	ON	ON	Multi-reference 3	FC-03
OFF	ON	OFF	OFF	Multi-reference 4	FC-04
OFF	ON	OFF	ON	Multi-reference 5	FC-05
OFF	ON	ON	OFF	Multi-reference 6	FC-06
OFF	ON	ON	ON	Multi-reference 7	FC-07
ON	OFF	OFF	OFF	Multi-reference 8	FC-08
ON	OFF	OFF	ON	Multi-reference 9	FC-09

K4	K3	K2	K1	Reference	Corresponding Parameter
ON	OFF	ON	OFF	Multi-reference 10	FC-10
ON	OFF	ON	ON	Multi-reference 11	FC-11
ON	ON	OFF	OFF	Multi-reference 12	FC-12
ON	ON	OFF	ON	Multi-reference 13	FC-13
ON	ON	ON	OFF	Multi-reference 14	FC-14
ON	ON	ON	ON	Multi-reference 15	FC-15

2.1.2.6 Setting the Main Frequency Through Simple PLC

Step 1: Set F0-03 to 7 to select simple PLC as the main frequency reference.

Step 2: Set parameters FC-00...FC-15 and FC-18...FC-49 to define the running time and acceleration/deceleration time for each reference.

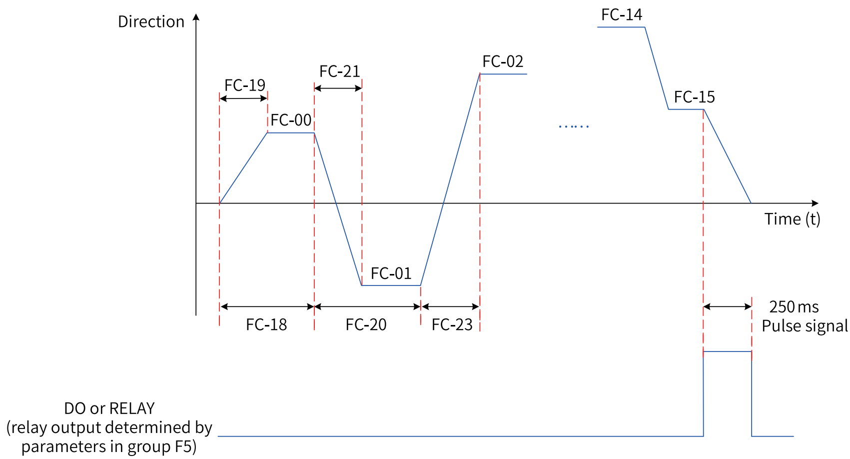


Figure 2-18 Simple PLC as the main frequency source

Step 3: Set FC-16 to select the simple PLC operation mode.

Step 4: Set FC-17 to determine whether to retain the PLC operation stage and operating frequency upon power failure or stop.

2.1.2.7 Setting the Main Frequency Through PID

PID control is a common process control method, which calculates the proportion, integral, and derivative of the difference between feedback signals and target signals of the controlled variable, and adjusts the output frequency of the AC drive accordingly to create a closed-loop system to stabilize the controlled variable at the target value. Generally, PID output can be used as the running frequency for on-site closed-loop process control applications, such as closed-loop pressure control and closed-loop tension control.

- Proportional gain Kp: When there is a deviation between the PID input and output, the PID regulator adjusts the output to reduce the deviation of the controlled variable. The deviation reduction speed depends on the proportionality coefficient Kp. A greater Kp value means faster deviation reduction. However, a large Kp value often causes oscillation, especially in the case of long hysteresis. A smaller Kp value means lower probability of oscillation. However, a small Kp value leads to slow adjustment. (Proportional gain of 100.0 means that the PID regulator adjusts the output frequency reference at an amplitude of the maximum frequency when the deviation between the PID feedback value and preset value is 100.0%.)
- Integral time Ti: Ti determines the intensity of integral adjustment by the PID regulator. A shorter integral time means stronger integral adjustment by the PID regulator. (The integral time refers to the amount of time that the integral regulator spends on continuous adjustment at an amplitude of the maximum frequency when the deviation between the PID feedback value and preset value is 100.0%.)
- Derivative time Td: Td determines the intensity of deviation change rate adjustment by the PID regulator. A longer derivative time means stronger deviation change rate adjustment by the PID regulator. (The derivative time refers to the period during which the feedback value changes by 100.0%, and the differential regulator adjusts the output frequency reference at an amplitude of the maximum frequency.)

Example

Step 1: Set both F0-03 and F0-04 to 8 to use PID as the main and auxiliary frequency input sources.

Step 2: Set FA-00 to select the source of PID target reference. When FA-00 is set to 0, you need to set FA-01 (PID digital setting). The value 100% of this parameter corresponds to the maximum PID feedback.

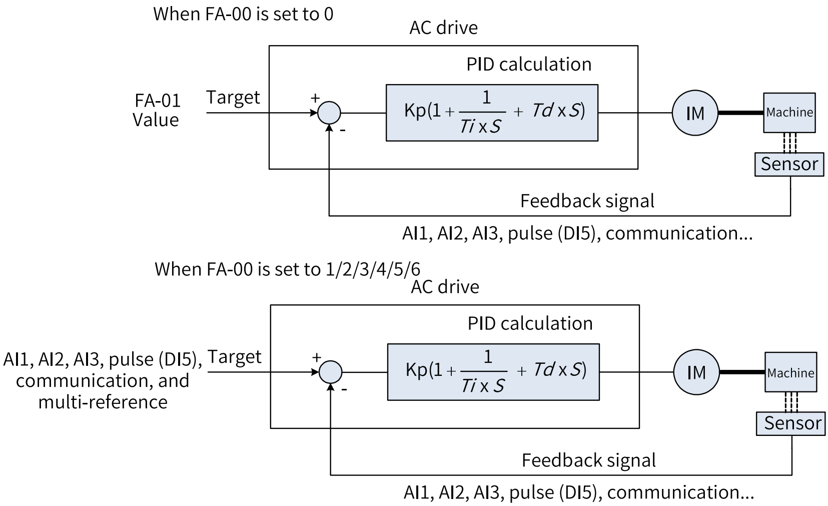


Figure 2-19 Block diagram of process PID control

Step 3: Set FA-02 to select the PID feedback source.

Step 4: Set FA-03 to select the PID action direction.

The following figure shows the logic of the PID control parameter setting.

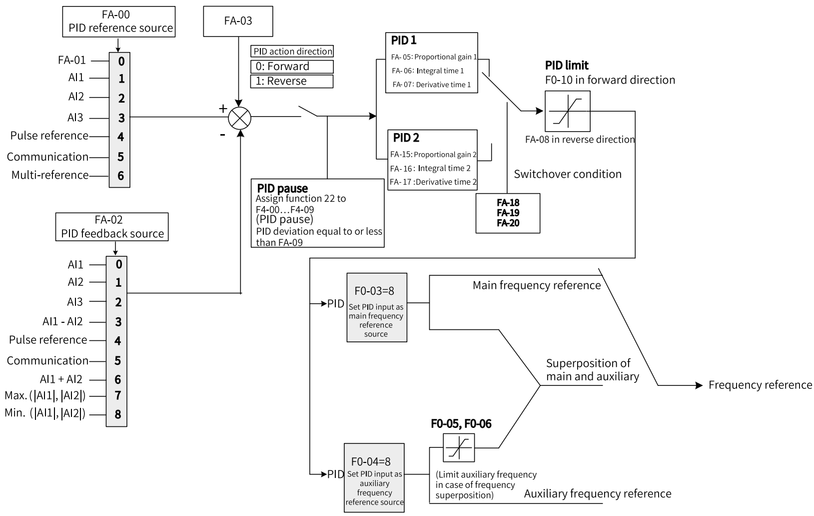


Figure 2-20 Block diagram of process PID control parameter settings

The upper limit, lower limit, and range of the output frequency are as follows when PID is used as the main frequency reference (for example, PID alone or main and PID together used as the frequency source).

When the reverse cut-off frequency is 0 or reverse running is inhibited (that is, in one of the following three conditions):

(1) FA-08 = 0, F8-13 = 0; (2) FA-08 = 0, F8-13 = 1; (3) FA-08 ≠ 0, F8-13 = 1

Output upper limit = Frequency upper limit

Output lower limit = Frequency lower limit

Output range = Frequency lower limit to frequency upper limit (F0-14 to F0-12)

When the reverse cut-off frequency is not 0 and reverse running is allowed (FA-08 ≠ 0, F8-13 = 0):

Output upper limit = Frequency upper limit Output lower limit = Frequency lower limit: -Reverse cut-off frequency

Output range = -Reverse cut-off frequency to +frequency upper limit (-FA-08 to +F0-12)

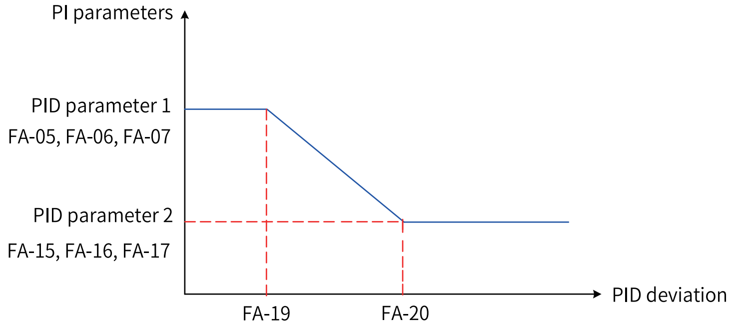


Figure 2-21 PID parameter switchover

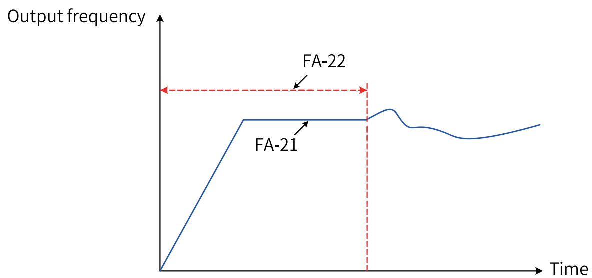


Figure 2-22 PID initial value function

2.1.2.8 Setting the Main Frequency Through Communication

The AC drive supports six communication protocols: Modbus, PROFIBUS-DP, CANopen, CANlink, PROFINET, and EtherCAT.

- When PROFIBUS-DP, PROFINET, EtherCAT, or CANopen (CANopen extension card) is selected, set Fd-00 to 9 and set Fd-01 to 3.
- When a CANlink card is used for CANopen communication, set Fd-10 to 1. Use Fd-12 to set the CAN communication baud rate and Fd-13 to set the CAN station number.
- When a CANlink card is used for CANlink communication, set Fd-10 to 2. Use Fd-12 to set the CAN communication baud rate and Fd-13 to set the CAN station number.
- When Modbus is used for communication, use Fd-00, Fd-01, and Fd-02 to set the baud rate, data format, and local address, respectively.

Example

Step 1: Set F0-03 to 9 to select communication as the main frequency reference source.

Step 2: Use the host controller to send a write command to the AC drive.

The following takes Modbus as an example to illustrate how to set the main frequency through communication. For example, to set the frequency reference to 10000 through communication, send the write command 01 06 10 00 27 10 97 36.

The following table shows the meaning of each byte in the command.

Byte	Meaning
01H (editable)	AC drive address
06H	Write command
1000H	Frequency reference address
2710H (10000 in decimal)	Target frequency
9736H	CRC check

Similarly, to set the frequency reference to –10000 through communication, send the write command 01 06 10 00 D8 F0 D7 4E. In this command, D8F0 is the lowest four bits of the hexadecimal number converted from –10000.

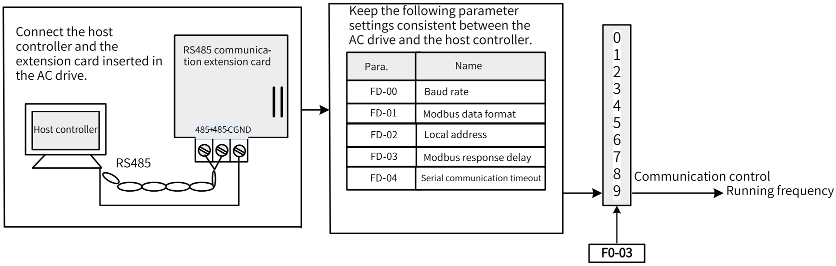


Figure 2-23 Parameter settings when the main frequency reference is set through communication

Table 2–2 Relationship between master commands and slave responses

Master Command		Slave Response	
ADDR	01H	ADDR	01H
CMD	06H	CMD	06H
Parameter address high bits	10H	Parameter address high bits	10H
Parameter address low bits	00H	Parameter address low bits	00H
Data content high bits	27H	Data content high bits	27H
Data content low bits	10H	Data content low bits	10H
CRC high bits	97H	CRC high bits	97H
CRC low bits	36H	CRC low bits	36H

The frequency reference range set through communication is –10000 to +10000 (in decimal), corresponding to –100.00% (negative max. frequency) to +100.00% (positive max. frequency). Suppose that F0-10 (maximum frequency) is set to 50 Hz. In this case, if the frequency reference in write command is 2710H, which is 10000 in decimal, the frequency reference that is written is 50 x 100% = 50 Hz.

2.1.2.9 Selecting Auxiliary Frequency Reference Input Mode

The AC drive supports ten sources of auxiliary frequency references: digital setting (non-retentive upon power failure), digital setting (retentive at power failure), AI1, AI2, AI3, pulse input, multi-reference, simple PLC, PID, and communication. You can set F0-04 (0 to 9) to select a source.

When the auxiliary frequency reference is used independently for frequency setting, it is set in the same way as the main frequency reference. The following figure shows the logic block diagram. When the auxiliary frequency reference is used together with the main frequency reference for frequency setting, see "Setting the Frequency Based on Main and Auxiliary Frequency References".

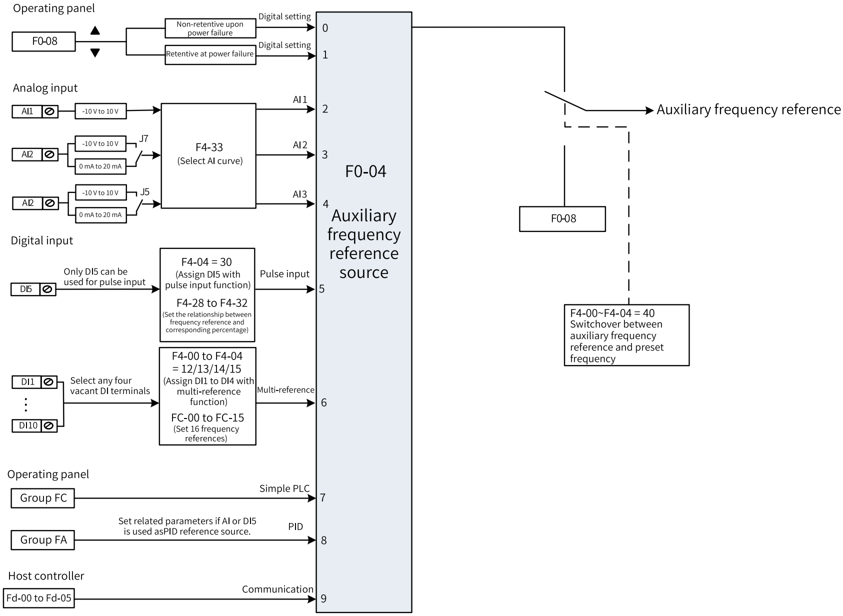


Figure 2-24 Auxiliary frequency reference source selection

Para. No.	Name	Value Range	Default
F0-04	Auxiliary frequency source Y selection	0: Digital setting (preset frequency (F0-08), editable through UP/ DOWN, non-retentive upon power failure) 1: Digital setting (preset frequency (F0-08), editable through UP/ DOWN, retentive at power failure) 2: AI1 3: AI2 4: AI3 5: Pulse reference (DI5) 6: Multi-reference 7: Simple PLC 8: PID 9: Communication 10: Reserved	0

2.1.2.10 Selecting Frequency Superposition Input Mode

The main and auxiliary frequency references can be used together for frequency setting. You can use F0-07 to set the relationship between the target frequency and the main and auxiliary frequency references. The following four kinds of relationship are available.

Table 2–3 Relationship between the target frequency and the main and auxiliary frequency references

No.	Relationship Between the Target Frequency and the Main and Auxiliary Frequency References	
1	Main frequency reference	The main frequency reference is used as the target frequency reference.
2	Auxiliary frequency reference	The auxiliary frequency reference is used as the target frequency reference.
3	Calculation of main and auxiliary frequencies	Four calculation methods are supported: Main frequency + Auxiliary frequency, Main frequency - Auxiliary frequency, Max. (main frequency, auxiliary frequency), and Min. (main frequency, auxiliary frequency).
4	Frequency switchover	The final frequency reference is selected from or switched among the preceding three references through DI terminal. In this mode, assign DI function 18 (Frequency source switchover) to the DI terminal.

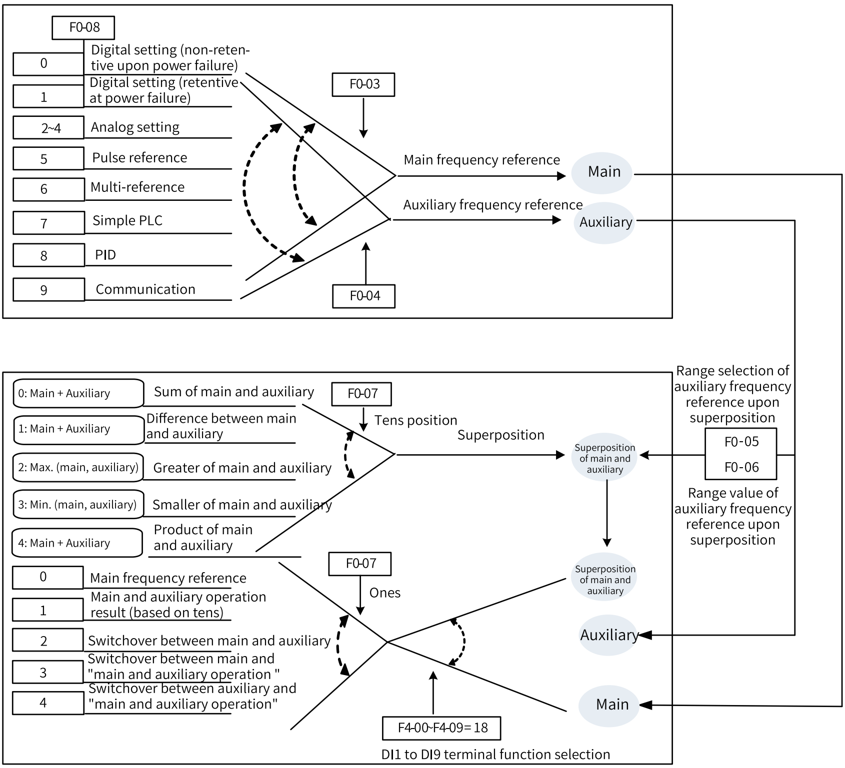


Figure 2-25 Superposition of main and auxiliary frequency references

Table 2–4 Superposition of main and auxiliary frequency references

Calculation Method	Main Frequency Source Selection	Auxiliary Frequency Source Selection	Description
+	Digital setting	AI, pulse reference, multi-reference, simple PLC, or communication	1. UP/DOWN adjustment is invalid. 2. Output range: F0-08 + Auxiliary frequency reference
	AI, pulse reference, multi-reference, simple PLC, or communication	Digital setting	1. UP/DOWN adjustment is valid. 2. Output range: Main frequency reference + UP/DOWN
	Digital setting	PID	1. UP/DOWN adjustment is invalid. 2. Digital setting is 0. 3. Output range: Auxiliary frequency reference
	PID	Digital setting	1. UP/DOWN adjustment is invalid. 2. Digital setting is 0. Output range: Main frequency reference
	AI, multi-reference, simple PLC, or communication	PID	1. UP/DOWN adjustment is invalid. 2. The frequency lower limit is invalid. 3. Output range: Main frequency reference + Auxiliary frequency reference
	PID	AI, pulse reference, multi-reference, simple PLC, or communication	1. UP/DOWN adjustment is invalid. 2. Output: Auxiliary frequency reference
-/x/Max/Min	Digital setting	Digital setting	1. UP/DOWN adjustment is valid. 2. Output range: Main frequency reference + UP/DOWN adjustment, same as digital setting in single frequency source mode

Calculation Method	Main Frequency Source Selection	Auxiliary Frequency Source Selection	Description
Single frequency source	Any	Any	1. When digital setting is used, UP/DOWN adjustment is invalid, and the initial frequency value is F0-08. 2. PID is invalid if used. 3. Simple PLC is invalid if used. 4. When digital setting is used for both main and auxiliary frequency references, the main frequency reference is valid, the auxiliary reference is invalid, and UP/DOWN adjustment is valid.
	Digital setting	-	1. UP/DOWN adjustment is valid. 2. Output: Main frequency value + UP/DOWN adjustment 3. UP/DOWN adjustment range: (Frequency upper limit - Main frequency) to (Frequency lower limit - Main frequency) 4. UP/DOWN adjustment cannot reverse the frequency direction.
	PID	-	1. The frequency lower limit is invalid. 2. PID output range: PID output lower limit to frequency upper limit 3. When reverse running is inhibited and the PID output lower limit is set to a negative value, 0 is the PID output lower limit.
	Other sources		None

Para. No.	Function	Default	Value Range
F0-05	Range selection of auxiliary frequency source Y upon superposition	0	0: Relative to max. frequency 1: Relative to main frequency reference
F0-06	Range value of auxiliary frequency reference Y upon superposition	100%	0% to 150%

These two parameters are used to limit the range of the auxiliary frequency and active only when “Main frequency + Auxiliary frequency” applies.

Para. No.	Function	Default	Value Range
F0-27	Main frequency coefficient	10.00%	0.00% to 100.00%
F0-28	Auxiliary frequency coefficient	10.00%	0.00% to 100.00%

These two parameters are used only in calculation of Main frequency x Auxiliary frequency. Assume that the main frequency is Frq1, and the auxiliary frequency is Frq2, the target frequency is calculated as follows:

Frq = (Frq1 x F0-27) x (Frq2 x F0-28)

2.1.2.11 Setting the Frequency Reference Limits

Frequency upper limit is used to control the maximum frequency if the motor is not allowed to run at a frequency above a specific value.

Frequency lower limit is used to control the minimum frequency if the motor is not allowed to run at a frequency below a specific value.

Maximum frequency is used to control the Max. output frequency.

Source of frequency reference upper limit is used to select the source of the frequency upper limit.

Frequency upper limit offset is used to set the offset of the frequency upper limit. This parameter takes effect only when the source of the frequency upper limit is AI.

Para. No.	Function	Default	Value Range
F0-10	Max. frequency	50.00 Hz	50.00 Hz to 600.00 Hz
F0-11	Source of frequency upper limit	0	0: F0-12 (Frequency upper limit) 1: AI1 2: AI2 3: AI3 4: Pulse reference (DI5) 5: Communication 6: Multi-reference
F0-12	Frequency upper limit	50.00 Hz	Frequency lower limit (F0-14) to max. frequency (F0-10)
F0-13	Frequency upper limit offset	0.00 Hz	0.00 Hz to max. frequency (F0-10)
F0-14	Frequency lower limit	0.00 Hz	0.00 Hz to frequency upper limit (F0-12)

2.1.2.12 SOperation at Frequencies lower Than the Lower Limit

Frequency lower limit indicates the minimum frequency at which the motor is allowed to run.

If the frequency of the AC drive is set to a value below the frequency lower limit (F0-14), set F8-14 to select the action of the AC drive. Four actions are supported: run at frequency lower limit, stop, run at zero speed, and coast to stop.

- 0: Frequency lower limit
  If the running frequency is below the frequency lower limit, the AC drive runs at the frequency lower limit.

- 1: Stop
  If the running frequency is below the frequency lower limit, the AC drive stops.

- 2: Run at zero speed
  If the running frequency is below the frequency lower limit, the AC drive runs at zero speed.

- 3: Coast to stop
  If the running frequency is below the frequency lower limit, the AC drive coasts to stop.

Para. No.	Function	Default	Value Range	Description
F8-14	Action when frequency is below the lower limit	0	0: Run at frequency lower limit 1: Stop 2: Run at zero speed 3: Coast to stop	-

2.1.2.13 Setting the Main Frequency Through Pulses

When F0-03 is set to 5, the input pulse is selected as the main frequency. When the main frequency source is set to pulse reference (DI5), the pulse reference must be obtained from multi-functional input terminal DI5. Specifications of the pulse reference signal are as follows:
voltage range: 9 V to 30 V
frequency range: 0 Hz to 100 Hz

Procedure:

Step 1: Set F0-03 to 5 to select "Pulse reference" as the main frequency source. In this mode, the pulse reference must be obtained from multi-functional input terminal DI5.

Step 2: Set F4-04 to 30 to assign DI5 with the "Pulse frequency input" function.

Step 3: Set F0-07 to 00 to select "Main frequency reference" as the frequency reference superposition mode.

Step 4: Set the pulse reference curve. Set F4-28...F4-32 to determine the relationship between pulse input from DI5 and corresponding percentage. The relationship is shown as a two-point straight line.

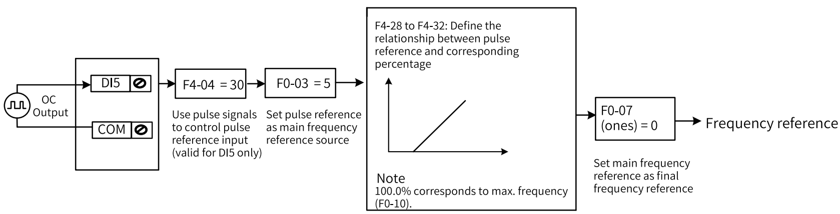


Figure 2-26 Parameter settings for pulse input as the main frequency source

Step 5: Set F4-32 to select the filter time of pulse frequency.

Set F4–32 to well balance the response speed and anti-interference capability. If quick response is required, reduce the parameter value. If the onsite interference is high, increase the parameter value.

A long filter time enhances the anti-interference capability, but slows down the response to adjustments. A short filter time speeds up the response to adjustments, but weakens the anti-interference capability. When onsite pulse signal is subject to interference in the application environment, increase the filter time to stabilize the detected pulse signals. However, a long filter time slows down the response to pulse signal detection. Therefore, set an appropriate filter time based on the actual application environment.

2.1.3 Start and Stop Modes

2.1.3.1 Start Mode

The AC drive supports three start modes: direct start, flying start, and pre-excitation start. Set F6-00 to select an AC drive start mode.

Direct start

When F6-00 is set to 0, the AC drive uses the direct start mode. This mode is applicable to most loads.

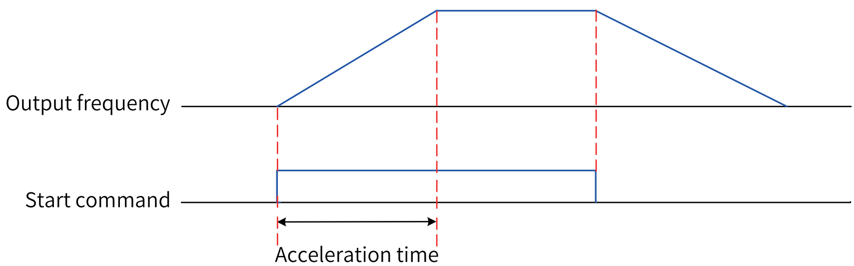


Figure 2-27 Sequence of direct start

Start after reaching the starting frequency hold time is applicable to lifting loads, such as elevators and cranes.

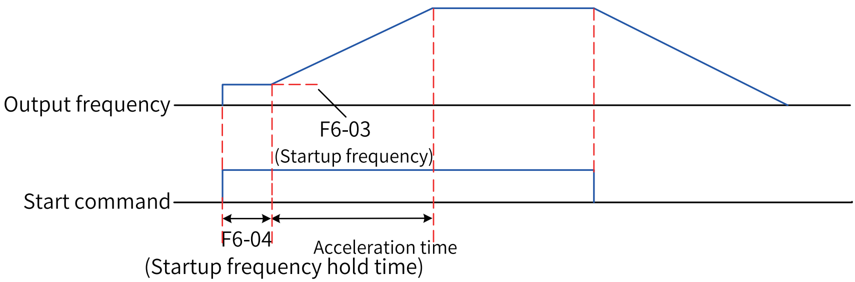


Figure 2-28 Sequence of start after reaching start frequency hold time

Direct start after DC braking is applicable to scenarios where the motor may rotate upon start of the AC drive.

If the DC braking time is set to 0, the AC drive starts running at the starting frequency. If the DC braking start time is not 0, the AC drive performs DC braking before starting to run at the starting frequency. This mode is applicable to most low-inertia loads and scenarios where the motor may rotate upon start.

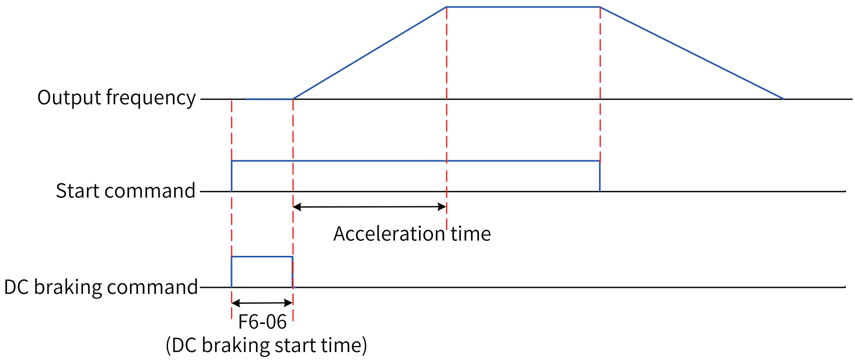


Figure 2-29 Sequence of start after DC braking

Start after DC braking is suitable for driving loads such as elevators and lifting machines. Start after reaching starting frequency hold time is suitable for driving equipment that requires a starting torque, for example, cement mixers. The following figure shows the frequency curve during start.

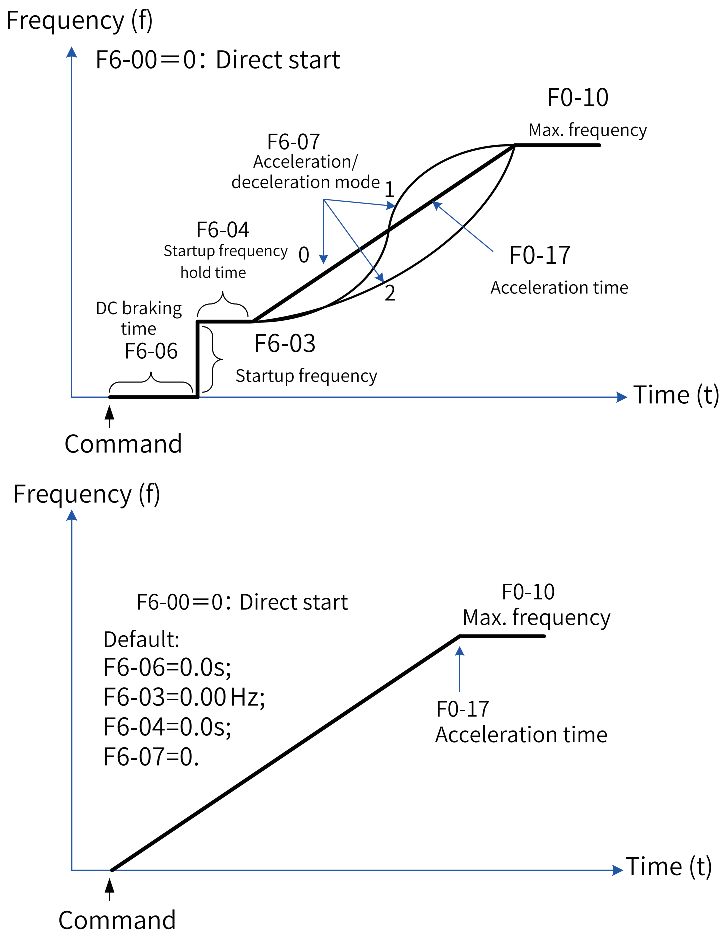


Figure 2-30 Direct start

Flying start

When F6-00 is set to 1, the AC drive uses the flying start mode. In this mode, the AC drive first determines the motor rotation speed and direction, and then starts at the detected frequency of the motor. This mode is applicable to high-inertia mechanical loads.

If the motor is still rotating due to inertia before startup of the AC drive, this start mode can prevent overcurrent upon startup. This mode is valid only in vector control mode. The following figure shows the frequency curve during startup.

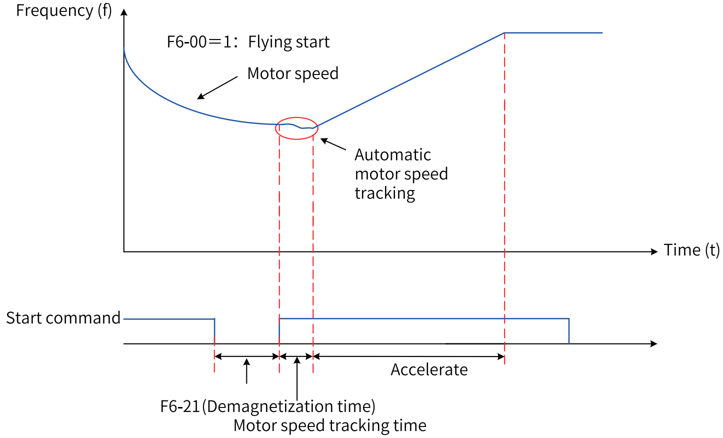


Figure 2-31 Flying start

Pre-excitation start

When F6-00 is set to 2, the AC drive uses the pre-excitation start mode. This mode is applicable only to the SVC and FVC control modes of asynchronous motors. In this mode, the motor is pre-excited before the AC drive starts, which speeds up response of the motor and reduces the starting current. The sequence diagram of this mode is the same as that of start after DC braking.

It is recommended that the pre-excitation current be set to 1.5 x the no-load current (F1-10), but in no case exceeds the rated motor current. If the pre-excitation current is equal to the no-load current (F1-10), the optimal pre-excitation time is three x the rotor time constant. The rotor time constant is calculated using the following formula:
Mutual inductance (F1-09) + Leakage inductance (F1-08)/Rotor resistance (F1-07).

The unit of mutual inductance and leakage inductance is L, and the unit of rotor resistance is Ω. If the pre-excitation current is higher than the no-load current, decrease the pre-excitation time proportionally, and vice versa.

2.1.3.2 Stop Mode

The AC drive supports two stop modes: decelerate to stop and coast to stop. You can set F6-10 to select a stop mode as needed.

Para. No.	Function	Default	Value Range	Description
F6-10	Stop mode	0	0: Decelerate to stop 1: Coast to stop	0: Decelerate to stop After the stop command takes effect, the AC drive reduces the output frequency based on the deceleration time and stops when the frequency decreases to zero. 1: Coast to stop After the stop command takes effect, the AC drive immediately stops output. Then, the motor coasts to stop following mechanical inertia.
F6-11	Starting frequency of DC braking at stop	0.00 Hz	0.00 Hz to max. frequency (F0-10)	In a decelerate-to-stop process, the AC drive starts DC braking when the running frequency drops to this frequency.
F6-12	Waiting time of DC braking at stop	0.0s	0.0s to 100.0s	When the running frequency decreases to the starting frequency of DC braking at stop, the AC drive stops output and then starts DC braking. Such delay is intended to prevent faults such as overcurrent from occurring when DC braking starts at a high speed.
F6-13	DC braking current at stop	0%	0% to 150%	The higher the DC braking current at stop, the higher the DC braking current, and the higher the braking force. The setpoint 100% corresponds to the rated motor current, with an upper limit being 80% of the rated current of the AC drive. You can use F6-34 to set the current upper limit. The maximum current upper limit can be set to 135% of the rated current of the AC drive.
F6-14	DC braking time at stop	0.0s	0.0s to 100.0s	Defines the hold time of DC braking. The setpoint 0 indicates DC braking is disabled.

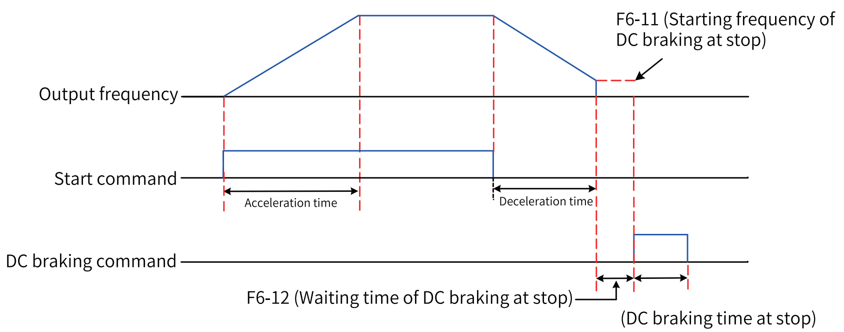


Figure 2-32 Sequence of DC braking at stop

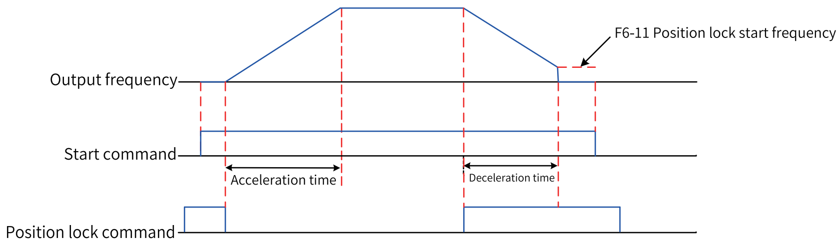


Figure 2-33 Sequence of position lock

Decelerate to stop

When F6-10 is set to 0, the AC drive decelerates to stop. After the stop command takes effect, the AC drive reduces the output frequency based on the deceleration time and stops when the frequency decreases to zero.

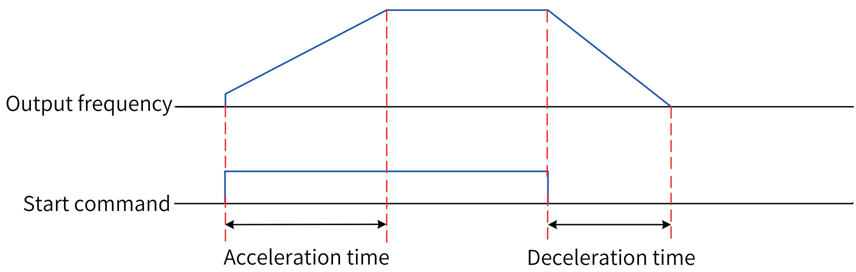


Figure 2-34 Sequence of decelerate-to-stop

Coast to stop

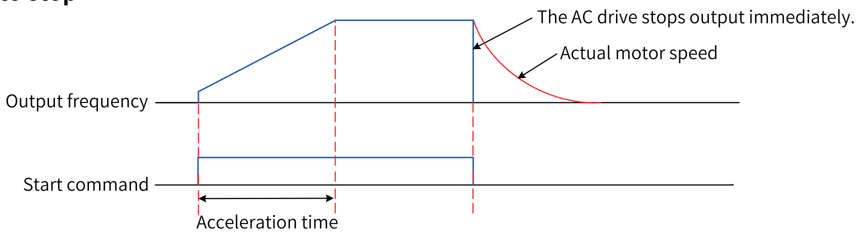


Figure 2-35 Sequence of coast-to-stop

2.1.3.3 Acceleration/Deceleration Time Setting

Acceleration time is the time that an AC drive needs to accelerate from zero frequency to the acceleration/deceleration time base frequency (F0-25). Deceleration time is the time that an AC drive needs to decelerate from the acceleration/deceleration time base frequency (F0-25) to zero frequency.

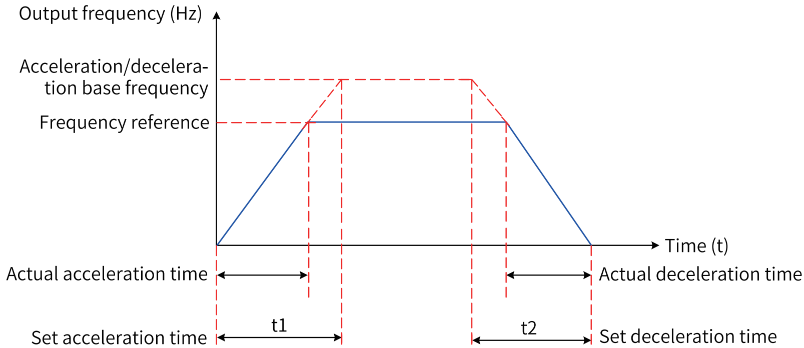


Figure 2-36 Acceleration/deceleration time

The AC drive provides four groups of acceleration/deceleration time, which can be selected by using DI terminal functions 16 and 17. The four groups of time is set through the following parameters:

Group 1: F0-17 and F0-18

Group 2: F8-03 and F8-04

Group 3: F8-05 and F8-06

Group 4: F8-07 and F8-08

Example

In the following example, DI7 and DI8 are used to switch among different groups of acceleration/deceleration time.

1. Set F4-06 and F4-07 to use DI7 and DI8 for switchover.

Para. No.	Name	Value	Description
F4-06	DI7 function	16	Acceleration/Deceleration time selection terminal 1
F4-07	DI8 function	17	Acceleration/Deceleration time selection terminal 2

2. Set four groups of acceleration/deceleration time parameters to set the acceleration/deceleration time.

DI8 State	DI7 State	Acceleration/Deceleration Time Selection
OFF	OFF	Group 1: F0-17 and F0-18 (Acceleration time 1)
OFF	ON	Group 2: F8-03 and F8-04 (Acceleration time 2. For details, see F0-17 and F0-18.)
ON	OFF	Group 3: F8-05, F8-06 (Acceleration time 3. For details, see F0-17 and F0-18.)
ON	ON	Group 4: F8-07 and F8-08 (Acceleration time 4. For details, see F0-17 and F0-18.)

3. Set F0-19 to select the acceleration/deceleration time unit. When the value of F0–19 changes, the decimal places in the four groups of acceleration/deceleration time change, and the corresponding acceleration/deceleration time also changes.
4. Set F6-07 (Acceleration/Deceleration mode). F6–07is used to set the frequency change mode during start/stop of the AC drive.
   - 0: The output frequency increases or decreases linearly.
   - 1: The output frequency increases or decreases following the S-curve in real time when the target frequency changes. Details must be set through F6-08 and F6-09. This mode is applicable to scenarios requiring supreme riding comfort and real-time response.
5. Set F6-08 and F6-09 to select the time proportion of S-curve at start and time proportion of S-curve at end. The values of F6-08 and F6-09 must meet the following condition: F6-08 + F6-09 ⩽ 100.0%

2.2 Motor Configuration

2.2.1 Asynchronous Motor Auto-Tuning

Motor auto-tuning is used to obtain motor parameters.

Motor auto-tuning includes static auto-tuning on partial parameters of the asynchronous motor, dynamic auto-tuning on all parameters of the asynchronous motor, and with-load auto-tuning on all parameters of the asynchronous motor.

Para. No.	Function	Default	Value Range	Description
F1-37	Auto-tuning selection	0	0: No auto-tuning	Motor auto-tuning is disabled.
			1: Static auto-tuning on partial parameters of asynchronous motor	This method is applicable to scenarios where the motor cannot be disconnected from load and dynamic auto-tuning is not allowed. Auto-tuning is performed on partial motor parameters including F1-06 (asynchronous motor stator resistance), F1-07 (asynchronous motor rotor resistance), and F1-08 (asynchronous motor leakage inductance).
			2: Dynamic auto-tuning on all parameters of asynchronous motor	This method is applicable to scenarios where This method is applicable to scenarios where the motor can be easily disconnected from the application system. Auto-tuning is performed on all the motor parameters: F1-06 (asynchronous motor stator resistance), F1-07 (asynchronous motor rotor resistance), F1-08 (asynchronous motor leakage inductance), F1-09 (asynchronous motor mutual inductance), and F1-10 (asynchronous motor no-load current).
			3: With-load auto-tuning on all parameters of asynchronous motor	This method (also called asynchronous motor static complete auto-tuning) is applicable to scenarios where the motor cannot be disconnected from load and dynamic complete auto-tuning is not allowed. Auto-tuning is performed on all the motor parameters: F1-06 (asynchronous motor stator resistance), F1-07 (asynchronous motor rotor resistance), F1-08 (asynchronous motor leakage inductance), F1-09 (asynchronous motor mutual inductance), F1-10 (asynchronous motor no-load current), and F1-30 (encoder phase sequence).

The following table compares the auto-tuning effects of these methods.

Table 2–5 Motor auto-tuning methods

Auto-tuning Method	Applicable Scenario	Effect
Static auto-tuning on partial parameters of asynchronous motor	The motor cannot be disconnected from load and dynamic auto-tuning is not allowed.	Good
Dynamic auto-tuning on all parameters of asynchronous motor	This method is applicable to scenarios where the motor can be easily disconnected from the application system.	Best
With-load auto-tuning on all parameters of asynchronous motor	The motor cannot be disconnected from load and dynamic complete auto-tuning is not allowed.	Better

In addition to the three auto-tuning methods, you can also input motor parameters manually.

You can perform motor auto-tuning either through commands from the operating panel or communication. You can set F0-02 to select commands.

For the Modbus, PROFIBUS, and CANopen protocols, the PKW parameters support auto-tuning but the PZD parameters do not. To use communication control for motor auto-tuning, set F1-37 or A2-37 to select an auto-tuning mode, and then enter the command.

Example

In the following example, parameters of motor 1 (F0-24 is set to 0, indicating that motor parameter group 1 is selected) are used to illustrate motor auto-tuning methods. For auto-tuning on motor 2, set F0-24 to 1 (motor parameter group 2) and follow the steps of auto-tuning on motor 1, using the A2 group parameters.

- Procedure of static auto-tuning on partial parameters of asynchronous motor

Table 2–6 Procedure of static auto-tuning on partial parameters of asynchronous motor

Step	Description
1	Power on the AC drive, and then set F0-02 to 0 to select the operating panel as command source.
2	Enter motor parameters (F1-00 to F1-05) according to its nameplate.
3	Set F1-37 to 1 (static auto-tuning on partial parameters of asynchronous motor) and press "ENTER" on the operating panel. The display on the panel is: 
4	Press and hold the RUN key for longer than 3s. The motor auto-tuning starts. The RUN indicator is steady on. The TUNE/TC indicator blinks. The motor does not rotate but the AC drive energizes the motor. When the preceding display disappears and the operating panel returns to normal parameter display state, auto-tuning is completed. Parameters F1-06 to F1-08 are obtained.

- Procedure of dynamic auto-tuning on all parameters of asynchronous motor
  When the AC drive is connected to a motor with constant output or used in a scenario requiring high precision, use dynamic complete auto-tuning after separating the motor from the load, to achieve the best auto-tuning effect.

Table 2–7 Procedure of dynamic auto-tuning on all parameters of asynchronous motor

Step	Description
1	Power on the AC drive, and then set F0-02 to 0 to select the operating panel as command source.
2	Enter motor parameters (F1-00 to F1-05) according to its nameplate.
3	If F0-01 is set to 1 (feedback vector control, FVC), enter encoder parameters (F1-27, F1-28, and F1-30).

Step	Description
4	Set F1-37 to 2 (dynamic auto-tuning on all parameters of asynchronous motor) and press "ENTER" on the operating panel. The display on the panel is: 
5	Press and hold the RUN key for longer than 3s. The motor auto-tuning starts. The RUN indicator is steady on. The TUNE/TC indicator blinks. The AC drive drives the motor to accelerate/decelerate and run in the forward/reverse direction, and performs auto-tuning. When the preceding display disappears and the operating panel returns to normal parameter display state, auto-tuning is completed. Parameters F1-06 to F1-10 and F1-30 are obtained.

- With-load auto-tuning on all parameters of asynchronous motor
  Use with-load auto-tuning on all parameters of asynchronous motor when the motor cannot be separated from the load.

Table 2–8 Procedure of asynchronous motor static complete auto-tuning

Step	Description
1	Power on the AC drive, and then set F0-02 to 0 to select the operating panel as command source.
2	Enter motor parameters (F1-00 to F1-05) according to its nameplate.
3	Set F1-37 to 3 (static auto-tuning on all parameters of asynchronous motor) and press "ENTER" on the operating panel. The display on the panel is: 
4	Press and hold the RUN key for longer than 3s. The motor auto-tuning starts. The RUN indicator is steady on. The TUNE/TC indicator blinks. The motor does not rotate but the AC drive energizes the motor. When the preceding display disappears and the operating panel returns to normal parameter display state, auto-tuning is completed. Parameters F1-06 to F1-10 are obtained.

2.2.2 Synchronous Motor Auto-Tuning

Motor auto-tuning is used to obtain motor parameters.

Synchronous motor auto-tuning includes static auto-tuning on partial parameters of synchronous motor (back EMF is not auto-tuned), no-load dynamic auto-tuning on all parameters of synchronous motor, and static auto-tuning on all parameters of synchronous motor.

Para. No.	Function	Default	Value Range	Description
F1-37	Auto-tuning selection	0	0: No auto-tuning	Motor auto-tuning is disabled.
			11: Static auto-tuning on partial parameters of synchronous motor (back EMF is not auto-tuned)	SVC and PMVVC: Auto-tuning is performed on partial motor parameters, including stator resistance and DQ shaft inductance. The motor does not rotate during auto-tuning. FVC: Auto-tuning is performed on partial motor parameters, including stator resistance, DQ shaft inductance, and encoder zero position angle. If a resolver or 23-bit encoder is used, the motor does not rotate during auto-tuning. If an ABZ encoder is used, the motor rotates for a short period of time during auto-tuning.
			12: No-load dynamic auto-tuning on all parameters of synchronous motor	The motor must be disconnected from load during auto-tuning. SVC and PMVVC: Auto-tuning is performed on all motor parameters, including stator resistance, DQ shaft inductance, and back EMF. The motor rotates during auto-tuning. FVC: Auto-tuning is performed on all motor parameters, including stator resistance, DQ shaft inductance, back EMF, encoder zero position angle, and encoder phase sequence. The motor rotates during auto-tuning.
			13: Static auto-tuning on all parameters of synchronous motor	SVC, PMVVC and FVC: Auto-tuning is performed on partial motor parameters, including stator resistance and DQ shaft inductance. The motor does not rotate during auto-tuning.

The following table compares the effects of these motor auto-tuning methods.

Table 2–9 Motor auto-tuning methods

Auto-tuning Method	Applicable Scenario	Effect
Static auto-tuning on partial parameters of synchronous motor	The motor cannot be disconnected from load and dynamic auto-tuning is not allowed. After auto-tuning, manually set the back EMF (SVC and PMVVC) and encoder phase sequence.	Better
No-load dynamic auto-tuning on all parameters of synchronous motor	This method is applicable to scenarios where the motor can be easily disconnected from the application system.	Best
Static auto-tuning on all parameters of synchronous motor	The motor cannot be disconnected from load and motor rotation is not allowed. After auto-tuning, manually set the back EMF (SVC and PMVVC), encoder zero position angle (FVC), and encoder phase sequence (FVC).	Good

In addition to the preceding three auto-tuning methods, you can also input motor parameters manually.

In addition to using the LED panel as the command source for motor auto-tuning, you can also use an external LCD panel (set F0-02 to 0), DI terminals (set F0-02 to 1) or communication control (set F0-02 to 2) as the command source for motor auto-tuning.

For the Modbus, PROFIBUS, and CANopen protocols, the PKW parameters support auto-tuning but the PZD parameters do not. To use communication control for motor auto-tuning, set F1-37 to select an auto-tuning mode, and then enter the command.

Example

- Procedure of static auto-tuning on partial parameters of synchronous motor

Table 2–10 Procedure of static auto-tuning on partial parameters of synchronous motor

Step	Description
1	Power on the AC drive, and then set F0-02 to 0 to select the operating panel as command source.
2	Enter motor parameters (F1-00 to F1-05) according to its nameplate.
3	Set F1-37 to 11 (static auto-tuning on partial parameters of synchronous motor) and press "ENTER" on the operating panel. The display on the panel is: 
4	Press and hold the RUN key for longer than 3s. The motor auto-tuning starts. The RUN indicator is steady on, the TUNE/TC indicator blinks, and the AC drive energizes the motor. When the preceding display disappears and the operating panel returns to normal parameter display state, auto-tuning is completed. Parameters F1-06, F1-17, F1-18, and F1-31 (FVC) are obtained. Manually set F1-19 (SVC and PMVVC) and F1-30 (FVC).

- Procedure of no-load dynamic auto-tuning on all parameters of synchronous motor

  When the AC drive is connected to a motor with constant output or used in a scenario requiring high precision, use dynamic complete auto-tuning after separating the motor from the load, to achieve the best auto-tuning effect.

Table 2–11 Procedure of dynamic auto-tuning on all parameters of synchronous motor

Step	Description
1	Power on the AC drive, and then set F0-02 to 0 to select the operating panel as command source.
2	Enter motor parameters (F1-00 to F1-05) according to its nameplate.
3	If F0-01 is set to 1 (feedback vector control, FVC), enter encoder parameters (F1-27 and F1-28).
4	Set F1-37 to 12 (no-load dynamic auto-tuning on all parameters of synchronous motor) and press "ENTER" on the operating panel. The display on the panel is: 
5	Press and hold the RUN key for longer than 3s. The motor auto-tuning starts. The RUN indicator is steady on, the TUNE/TC indicator blinks, and the AC drive energizes the motor. When the preceding display disappears and the operating panel returns to normal parameter display state, auto-tuning is completed. Parameters F1-06, F1-17, F1-18, F1-19, F1-30 (FVC), and F1-31 (FVC) are obtained.

- Procedure of static auto-tuning on all parameters of synchronous motor

Use this auto-tuning method when the motor is not allowed to rotate during auto-tuning.

Table 2–12 Procedure of static auto-tuning on all parameters of synchronous motor

<table>
<tr><th>Step</th><th>Description</th></tr>
<tr><td>1</td><td>Power on the AC drive, and then set F0-02 to 0 to select the operating panel as command source.</td></tr>
<tr><td>2</td><td>Enter motor parameters (F1-00 to F1-05) according to its nameplate.</td></tr>
<tr><td>3</td><td>Set F1-37 to 13 (static auto-tuning on all parameters of synchronous motor) and press "ENTER" on the operating panel. The display on the panel is:

</td></tr>
<tr><td>4</td><td>Press and hold the RUN key for longer than 3s. The motor auto-tuning starts. The RUN indicator is steady on, the TUNE/TC indicator blinks, and the AC drive energizes the motor.
When the preceding display disappears and the operating panel returns to normal parameter display state, auto-tuning is completed.
Parameters F1-06, F1-17, and F1-18 are obtained.
Manually set F1-19 (SVC and PMVVC), F1-31 (FVC), and F1-30 (FVC).</td></tr>
</table>

2.3 Control Interfaces

2.3.1 DI Terminal Functions

The AC drive is delivered with a number of multi-functional DI terminals (DI5 can be used as the pulse input terminal). You can select any DI function for each DI terminal.

Table 2–13 Parameters

<table>
<tr><th>Para. No.</th><th>Function</th><th>Default</th><th>Value Range</th><th>Description</th></tr>
<tr><td>F4-00</td><td>DI1 function</td><td>1</td><td rowspan="10">0 to 93</td><td rowspan="10">See *"Table 2–14 Functions of DI terminals" on page 118*.</td></tr>
<tr><td>F4-01</td><td>DI2 function</td><td>4</td></tr>
<tr><td>F4-02</td><td>DI3 function</td><td>9</td></tr>
<tr><td>F4-03</td><td>DI4 function</td><td>12</td></tr>
<tr><td>F4-04</td><td>DI5 function</td><td>13</td></tr>
<tr><td>F4-05</td><td>DI6 function</td><td>0</td></tr>
<tr><td>F4-06</td><td>DI7 function</td><td>0</td></tr>
<tr><td>F4-07</td><td>DI8 function</td><td>0</td></tr>
<tr><td>F4-08</td><td>DI9 function</td><td>0</td></tr>
<tr><td>F4-09</td><td>DI10 function</td><td>0</td></tr>
<tr><td>F4-10</td><td>DI filter time</td><td>0.010s</td><td>0.000s to 1.000s</td><td>Set the delay time of the AC drive when the status of DI terminals changes.
Only DI1 and DI2 support delay time setting.</td></tr>
</table>

Para. No.	Function	Default	Value Range	Description
F4-38	DI active mode setting 1	00000	Ones: DI1 active mode 0: Active high 1: Active low Tens: DI2 active mode (0 or 1, the options are the same as those of DI1). Hundreds: DI3 active mode (0 or 1, the options are the same as those of DI1). Thousands: DI4 active mode (0 or 1, the options are the same as those of DI1). Ten thousands: DI5 active mode (0 or 1, the options are the same as those of DI1).	The active mode for terminals DI1 to DI5 is set through the ones, tens, hundreds, thousands, and ten thousands positions of this parameter, respectively. 0: Active high The DI terminal (DI1 to DI5) is active when being connected to COM and inactive when being disconnected from COM. 1: Active low The DI terminal (DI1 to DI5) is inactive when being connected to COM and active when being disconnected from COM.
F4-39	DI active mode setting 2	00000		

Table 2–14 Functions of DI terminals

Value	Function	Detailed Description
0	No function	Set 0 for reserved terminals to avoid malfunction.
1	Forward run	The AC drive runs in the forward direction. (FWD indicates forward.) In two-wire mode 1 (F4-11 set to 0), activating the terminal sets the AC drive to forward run. In two-wire mode 2 (F4-11 set to 1), activating the terminal gives a running command.
2	Reverse run	The terminal is used to set the AC drive to reverse run. (REV indicates reverse.) In three-wire mode 1 (F4-11 set to 2), activating the terminal sets the AC drive to reverse run. In three-wire mode 2 (F4-11 set to 3), activating the terminal sets the forward/reverse run direction.
3	Three-wire operation control	This function is available only when the AC drive runs in three-wire control mode. To use a terminal as the command source, set F4-11 (terminal control mode) to 2 (three-wire mode 1) or 3 (three-wire mode 2), and set this parameter to 3. The three-wire control modes include three-wire mode 1 and three-wire mode 2.
4	Forward jog (FJOG)	The terminal is used to set the AC drive to FJOG mode. In jog mode, the AC drive runs at low speed for a short time, which is typically used for maintenance and commissioning of field equipment.
5	Reverse jog (RJOG)	The terminal is used to set the AC drive to RJOG mode.
6	Terminal UP	Activating the terminal gives a frequency increase command when the frequency is set using a terminal. If the terminal is active, the effect is equivalent to holding down the  key. If the terminal is inactive, the effect is equivalent to releasing the  key.
7	Terminal DOWN	Activating the terminal gives a frequency decrease command when the frequency is set using a terminal. If the terminal is active, the effect is equivalent to holding down the  key. If the terminal is inactive, the effect is equivalent to releasing the  key.

Value	Function	Detailed Description
8	Coast to stop	Activating the terminal gives a coast to stop command, upon receiving which the AC drive stops output immediately, allowing the load to stop following mechanical inertia. When the AC drive stops output, the motor is powered off, and the system enters free braking. Since the stop time is determined by the inertia of the system, this is also called inertia stop.
9	Fault reset (RESET)	Resets a faulty AC drive. The terminal has the same function as that of the "STOP/RES" key on the operating panel. This function can remotely reset the AC drive upon a fault.
10	RUN pause	When the terminal is active with this functions, the AC drive decelerates to stop, and the settings of all the running parameters, such as the PLC, wobble, and PID parameters, are saved. When the terminal is inactive, the AC drive resumes its running state as recorded.
11	Normally open (NO) input of external fault	When the terminal is active, the AC drive reports the Err15 alarm upon receiving an external signal.
12	Multi-reference terminal 1	Multi-reference is selected as the main frequency source. You can set the 16 states of the four terminals to 16 speeds or 16 other references. This function is applicable to applications where continuous adjustment of the AC drive running frequency is not required and only several frequency values are required.
13	Multi-reference terminal 2	
14	Multi-reference terminal 3	
15	Multi-reference terminal 4	
16	Acceleration/ Deceleration time selection terminal 1	Four groups of acceleration/deceleration time can be selected through combinations of four states of these two terminals. The acceleration time is the time required by the AC drive to accelerate from zero frequency to the acceleration/deceleration time base frequency (F0-25). The deceleration time is the time required by the AC drive to decelerate from the acceleration/deceleration base frequency (F0-25) to zero frequency.
17	Acceleration/ Deceleration time selection terminal 2	
18	Frequency source switchover	The terminal is used to switch between input methods of the frequency reference. The frequency reference is set through F0-07 (final frequency reference setting selection).
19	UP and DOWN setting clear	When the operating panel is used as the main frequency source, this terminal function can be used to clear the frequency change made through the  or  key on the operating panel or the terminal UP or DOWN functions (6 or 7) and resume the main frequency specified by the F0-08 parameter.
20	Command source switchover terminal 1	With the command source set to terminal control (F0-02 set to 1), activating the terminal switches from terminal control to operating panel control. With the command source set to communication control (F0-02 set to 2), activating the terminal switches from communication control to operating panel control.
21	Acceleration/ Deceleration disabled	The terminal is used to keep the AC drive at the current running frequency regardless of changes of the external input frequency (unless a stop command is received).
22	PID pause	The terminal is used to suspend PID control temporarily, so that the AC drive keeps the current output frequency with no more PID tuning on the frequency source.
23	PLC state reset	The terminal is used to reset the AC drive to the initial state of simple PLC.

Value	Function	Detailed Description
24	Wobble pause	In the wobble process, the terminal being active suspends the wobble function, so that the AC drive provides output at the central frequency.
25	Counter input	In the counting process, the terminal being active inputs the pulses counted by the counter.
26	Counter reset	In a counting process, the terminal being active resets the counter.
27	Length count input	In a fixed length process, the terminal being active inputs the length count.
28	Length reset	In a fixed length process, the terminal being active resets the length.
29	Torque control inhibited	When the terminal is active, the AC drive is switched from the torque control mode to the speed control mode. When the terminal is inactive, the AC drive resumes the torque control mode.
30	Pulse input	This function must be selected when DI5 is used for pulse input.
32	Immediate DC braking	The terminal is used to set the AC drive to immediate DC braking. DC braking means that the AC drive outputs DC to the stator winding of the asynchronous motor to form a static magnetic field to set the motor to braking with energy consumption. In this state, the rotor cuts the static magnetic field to generate braking torque, which stops the motor quickly.
33	Normally closed (NC) input of external fault	When the terminal is active, the AC drive reports the Err15 alarm upon receiving an external signal.
34	Frequency modification enable	When the terminal is active, frequency modification is enabled. When the terminal is inactive, frequency modification is disabled.
35	PID action direction reversal	The terminal is used to reverse the PID action direction specified by FA-03.
36	External stop terminal 1	If the command source is set to operating panel control (F0-02 is set to 0), the terminal is used to stop the AC drive. This function is the same as that of the STOP/RES key on the operating panel.
37	Control command switchover terminal 2	The terminal is used to switch the AC drive between terminal control and communication control. If the command source is set to terminal control, the system is switched to communication control when this terminal is active. With the command source set to communication control, the terminal being active switches the system to terminal control.
38	PID integral pause	The PID integral adjustment function is paused. The PID proportion adjustment and differential adjustment functions are still available.
39	Switchover between main frequency and preset frequency	Switches the main frequency to the preset frequency (F0-08).
40	Switchover between auxiliary frequency and preset frequency	Switches the auxiliary frequency to the preset frequency (F0-08).
41	Motor selection	The terminal is used for motor selection. When the terminal is active, motor 2 is selected. When the terminal is inactive, motor 1 is selected.
42	Position lock	When the terminal is active, the AC drive decelerates to 0 Hz and then enters the position lock state.

Value	Function	Detailed Description
43	PID parameter switchover	If the PID parameter switchover condition is set to "switchover by DI" (FA-18 is set to 1), the PID parameters are FA-05 to FA-07 (proportional gain Kp1, integral time Ti1, and derivative time Td1) when the terminal is inactive, or FA-15 to FA-17 (proportional gain Kp2, integral time Ti2, and derivative time Td2) when the terminal is active.
44	User-defined fault 1	The AC drive reports the E27.00 alarm and proceeds according to the value of F9-49 (fault protection action selection).
45	User-defined fault 2	The AC drive reports the E28.0 alarm and proceeds according to the value of F9-49 (fault protection action selection).
46	Speed control/ torque control switchover	The AC drive is switched between the speed control mode and the torque control mode. If A0-00 (speed/torque control mode) is set to 0, the torque control mode is used when the terminal is active, and the speed control mode is used when the terminal is inactive. If A0-00 (speed/torque control mode) is set to 1, the speed control mode is used when the terminal is active, and the torque control mode is used when the terminal is inactive.
47	Emergency stop	Upon an emergency, the AC drive decelerates to stop within the deceleration time for emergency stop specified by F8-55. In V/f control mode, if the deceleration time for emergency stop is 0s, the AC drive decelerates to stop within the minimum unit time. The terminal does not need to be kept in the closed state. Even if it stays closed only for a short moment, the AC drive will come to an emergency stop. Different from general deceleration, the emergency stop action prevents the AC drive from restarting even if the emergency stop input terminal is opened after the deceleration time for emergency stop expires and the run signal is still active on the AC drive terminal. To restart the AC drive in this case, disconnect the running terminal and input the run command.
48	External stop terminal 2	The AC drive decelerates to stop regardless of the command source (operation panel, terminal, or communication control). In this mode, the deceleration time is fixed to deceleration time 4 (F8-08).
49	Deceleration DC braking	The AC drive decelerates to the DC braking frequency during stop (F6-11) before starting DC braking.
50	Clear the current running time	The terminal is used to clear the current running time of the AC drive. If the current running time is less than the value of F8-53 (current running time threshold, which is greater than 0), and the terminal is active in the process, the current running time is cleared. If the current running time is greater than the value of F8-53 (greater than 0), the current running time is not cleared regardless of whether the terminal is active.
51	Two-wire/three-wire control switchover	The terminal is used to switch the AC drive between the two-wire control mode and three-wire control mode, specifically: to three-wire mode 1 from two-wire mode 1 (F4-11 set to 0) . to three-wire mode 2 from two-wire mode 2 (F4-11 set to 1). to two-wire mode 1 from three-wire mode 1 (F4-11 set to 2) to two-wire mode 2 from three-wire mode 2 (F4-11 set to 3)
52	Electromagnetic shorting	When the terminal is active, the AC drive enters the electromagnetic shorting state.
53	Thickness accumulation	When roll diameter is calculated based on accumulative thickness, the terminal is used to record the number of revolutions.
54	Roll diameter reset	When the terminal is active, the initial roll diameter is reset. The initial roll diameter is reset upon reel replacement when the tension mode is used.

Value	Function	Detailed Description
55	Initial roll diameter 1	In the tension mode, you can combine terminals to select the initial roll diameter B0-11/12/13. When terminals of both initial roll diameter 1 and initial roll diameter 2 are inactive, the minimum roll diameter B0-09 is used as the initial roll diameter. When only the terminal of initial roll diameter 1 is active, B0-11 is used as the initial roll diameter. When only the terminal of initial roll diameter 2 is active, B0-12 is used as the initial roll diameter. When terminals of both initial roll diameter 1 and initial roll diameter 2 are active, B0-13 is used as the initial roll diameter.
56	Initial roll diameter 2	
57	Pre-drive	When the terminal is activated, the AC drive is switched to the pre-charge speed control mode. This function is used to synchronize the linear speed for the axis that requires automatic reel replacement when the tension mode is used. When the terminal is deactivated after reel replacement, the tension control can function properly.
58	Winding/ unwinding switchover	This function is used to switch between winding and unwinding when the tension mode is used.
59	Roll diameter calculation disabled	When the terminal is activated, the roll diameter calculation is disabled. This function is used to disable roll diameter calculation to prevent automatic reel replacement and pre-charge from affecting roll diameter calculation when the tension mode is used.
60	Exiting tension mode	This function is used to exit the tension control mode.
61	Terminal tension rise	When the terminal is activated, the tension torque is increased by a certain ratio. After the DI terminal is deactivated, the boost part will be canceled gradually based on time.
62	Thickness selection 1	In tension mode, you can combine terminals to select the thickness B0-32/33/34/35. When terminals of both thickness selection 1 and thickness selection 2 are inactive, thickness B0-32 is selected. When only the terminal of thickness selection 1 is active, thickness B0-33 is selected. When only the terminal of thickness selection 2 is active, thickness B0-34 is selected. When terminals of both thickness selection 1 and thickness selection 2 are active, thickness B0-35 is selected.
63	Thickness selection 2	
90	Water cooling system fault	When the water cooling system of T13 models has a fault, the terminal receives the signal and the AC drive reports the E64 alarm.
91	Low liquid level fault	When the liquid in the water tank of T13 models is too low, the terminal receives the signal and the AC drive reports the A63 alarm.
92	Revolution number reset	The number of revolutions counted will be cleared after this terminal is activated.
93	DI command enabled	When this function is selected for the terminal, the AC drive does not run when the terminal is inactive. The AC drive runs in the position lock state when no command is received and the terminal is active. The AC drive runs normally when a command is received and the terminal is active.

2.3.2 DO Terminal Functions

Table 2–15 Parameters

Para. No.	Function	Default	Value Range	Description
F5-01	Extension card relay output function selection	0	0 to 46	See *"Table 2–16 Functions of DO terminals" on page 124*.
F5-02	Control board relay function selection (T/A1-T/B1-TC1)	2		
F5-03	Control board relay function selection (T/A2-TC2)	0		
F5-04	DO1 function selection	0		
F5-05	Extension card DO2 output selection	4		
F5-17	Extension card relay output delay	0.0s	0.0s to 3600.0s	Indicates the output delay of relay on the extension card. F5-01 outputs the active signal only after the set delay time expires.
F5-18	Relay 1 output delay	0.0s	0.0s to 3600.0s	Indicates the delay of relay 1 on the control board. F5-02 outputs the active signal only after the set delay time expires.
F5-19	Relay 2 output delay	0.0	0.0 to 3600.0	Indicates the delay of relay 2 on the control board. F5-03 outputs the active signal only after the set delay time expires.
F5-20	DO1 output delay	0.0s	0.0s to 3600.0s	Indicates the delay of DO1 output. F5-04 outputs the active signal only after the set delay time expires.

Para. No.	Function	Default	Value Range	Description
F5-21	Extension card DO2 output delay	0.0s	0.0s to 3600.0s	Indicates the delay of DO2 output on the extension card. F5-05 outputs the active signal only after the set delay time expires.
F5-22	DO active mode selection	0	Ones: Extension card relay 0: Positive logic 1: Negative logic Tens: Control board relay 1 0: Positive logic 1: Negative logic Hundreds: Control board relay 2 0: Positive logic 1: Negative logic Thousands: Control board DO1 0: Positive logic 1: Negative logic Ten thousands: Control board DO2 0: Positive logic 1: Negative logic	The active mode for DO terminals are set through the ones, tens, hundreds, thousands, and ten thousands positions of F5-01 to F5-05. 0: Positive logic (equivalent to a normally open contact) Active: The DO terminal and COM/CME terminal are connected inside the AC drive. Inactive: The DO terminal and COM/CME terminal are disconnected. 1: Negative logic (equivalent to a normally closed contact) Active: The DO terminal and COM/CME terminal are disconnected. Inactive: The DO terminal and COM/CME terminal are connected inside the AC drive.

Table 2–16 Functions of DO terminals

Value	Function	Description
0	No output	The DO terminal has no function.
1	AC drive running	The DO terminal outputs the active signal when the AC drive is in the running state and with an output frequency, which can be zero.
2	Fault output (coast-to-stop fault)	The DO terminal outputs the active signal when the AC drive stops due to a fault.
3	Frequency level detection 1	The DO terminal outputs the active signal when the running frequency exceeds the frequency detection value and stops outputting the active signal when the running frequency is lower than the result of the detection value minus the frequency detection hysteresis (FDT, which equals the product of F8-19 multiplied by F8-20).
4	Frequency reach	The DO terminal outputs the active signal when the running frequency of the AC drive is within a particular range (Target frequency±Product of the value of F8-21 multiplied by the maximum frequency).
5	Running at zero speed (no output at stop)	The DO terminal outputs the active signal when the AC drive is running with the output frequency being 0. The DO terminal outputs the inactive signal when the AC drive is stopped.
6	Motor overload pre-warning	When detecting that the motor load has exceeded the pre-warning threshold specified by F9-02 (overload pre-warning coefficient), the DO terminal outputs the active signal before an overload protection action is taken.

Value	Function	Description
7	AC drive overload pre-warning	The DO terminal outputs the active signal 10 seconds before AC drive overload protection is performed.
8	Set count value reach	In a counting process, the DO terminal outputs the active signal when the count reaches the value of Fb-08.
9	Designated count value reach	In a counting process, the DO terminal outputs the active signal when the count reaches the value of Fb-09.
10	Length reach	The DO terminal outputs the active signal when the detected length exceeds the value of Fb-05 in the fixed length function.
11	Simple PLC cycle completed	The terminal set for this function outputs a pulse signal with width of 250 ms when simple PLC completes one cycle.
12	Accumulative running time reach	The DO terminal outputs the active signal when the accumulative running time of the AC drive exceeds the value of F8-17 (accumulative running time threshold).
13	Frequency limited	The DO terminal outputs the active signal when the frequency reference exceeds the upper limit or lower limit and the output frequency of the AC drive reaches the upper limit or lower limit.
14	Torque limited	The DO terminal outputs the active signal when the output torque reaches the torque limit if the AC drive works in speed control mode.
15	Ready to RUN	The DO terminal outputs the active signal if no exception occurs after the AC drive is powered on.
16	AI1 > AI2	The DO terminal outputs the active signal when the value of analog input AI1 is greater than that of AI2.
17	Frequency upper limit reach	The DO terminal outputs the active signal when the running frequency reaches the upper limit (F0-12).
18	Frequency lower limit reach (no output at stop)	The DO terminal outputs the inactive signal regardless of whether the running frequency has reached the lower limit when F8-14, which specifies the running mode when the frequency reference is lower than the lower limit, is set to 1 (stop). When F8-14 is set to 0 (run at the lower limit frequency) or 2 (run at zero speed) and the running frequency reaches the lower limit, the DO terminal outputs the active signal.
19	Undervoltage state	The DO terminal outputs the active signal when the AC drive is in undervoltage state.
20	Communication	Activation and deactivation of the terminal is controlled through the communication address 0x2001.
21	Positioning completed	The DO terminal outputs the active signal when positioning is completed.
22	Proximity	The DO terminal outputs the active signal upon proximity.
23	Running at zero speed 2 (having output at stop)	The DO terminal outputs the active signal when the AC drive is running with the output frequency being 0. The DO terminal outputs the active signal when the AC drive is stopped.
24	Accumulative power-on time reach	The DO terminal outputs the active signal when the accumulative power-on time (F7-13) of the AC drive exceeds the accumulative power-on time threshold (F8-16).
25	Frequency level detection 2	The DO terminal outputs the active signal when the running frequency exceeds the frequency detection value and stops outputting the active signal when the running frequency is lower than the result of the threshold minus the frequency detection hysteresis, which equals the product of the value of F8-28 multiplied by the value of F8-29.

Value	Function	Description
26	Frequency 1 reach	The DO terminal outputs the active signal when the running frequency of the AC drive is within the frequency detection range of F8-30 (detection value for frequency reach 1). Frequency detection range: F8-30 – F8-31 x F0-10 (maximum frequency) to F8-30 + F8-31 x F0-10
27	Frequency 2 reach	The DO terminal outputs the active signal when the running frequency of the AC drive is within the frequency detection range of F8-32 (detection value for frequency reach 2). Frequency detection range: F8-32 – F8-33 x F0-10 (maximum frequency) to F8-32 + F8-33 x F0-10
28	Current 1 reach	The DO terminal outputs the active signal when the output current of the AC drive is within the current detection range of F8-38 (detection level of current 1). Current detection range: F8-38 – F8-39 x F1-03 (rated motor current) to F8-38 + F8-39 x F1-03
29	Current 2 reach	The DO terminal outputs the active signal when the output current of the AC drive is within the current detection range of F8-40 (detection level of current 2). Current detection range: F8-40 – F8-41 x F1-03 (rated motor current) to F8-40 + F8-41 x F1-03
30	Timing reach	The DO terminal outputs the active signal when the current running time of the AC drive reaches the set time if the timing function (F8-42) is enabled. The timing duration is set through F8-43 and F8-44.
31	AI1 input limit exceeded	The DO terminal outputs the active signal when the value of AI1 is above F8-46 (AI1 input voltage upper limit) or below F8-45 (AI1 input voltage lower limit).
32	Load loss	The DO terminal outputs the active signal when the AC drive is in load lost state.
33	Reverse running	The DO terminal outputs the active signal when the AC drive is in reverse running state.
34	Zero current state	The DO terminal outputs the active signal when the output current of the AC drive remains in the zero current range for a period longer than the value of F8-35 (zero current detection delay). Zero current detection range: 0 to F8-34 x F1-03
35	IGBT temperature reach	The DO terminal outputs the active signal when the IGBT heatsink temperature (F7-07) reaches the IGBT temperature threshold (F8-47).
36	Output current limit violation	The DO terminal outputs the active signal when the output current of the AC drive remains higher than the value of F8-36 (output limit violation threshold) for a period longer than the value of F8-37 (output overcurrent detection delay).
37	Frequency lower limit reach (having output at stop)	The DO terminal outputs the active signal when the running frequency reaches the lower limit (F0-14). The DO terminal outputs the active signal even when the AC drive is stopped.
38	Alarm (all faults)	The DO terminal outputs the active signal when the AC drive is faulty, and the fault protection action selection is "continue to run". For details about fault protection actions, see the description of parameters F9-47 to F9-50.
39	Motor overtemperature	The DO terminal outputs the active signal when the motor temperature reaches the value of F9-58 (motor overtemperature pre-warning threshold). (You can check the motor temperature using U0-34.)
40	Current running time reach	The DO terminal outputs the active signal when the current running time of the AC drive exceeds the value of F8-53 (current running time threshold).

Value	Function	Description
41	Fault output 2	The DO terminal outputs the active signal when an AC drive fault (except the undervoltage fault) occurs.
42	Fault output 3	The DO terminal outputs the active signal when an AC drive fault occurs.
43	Position lock enabled	The DO terminal outputs the active signal when the number of offset pulses of position lock is less than the value of F6-25 and the AC is running with position lock.
44	Brake output	The DO terminal outputs the active signal for 5s when the AC drive is in the stop state, the running frequency is lower than the frequency reference, and the value of F8-15 (braking frequency) is not 0 or the braking frequency is switched to that in the first locked output.
46	Brake release output	The DO terminal outputs the active signal in case of position lock during deceleration or when a running command is received and running is enabled.

2.3.3 VDI

The virtual digital input (VDI) terminals have the same functions as DI terminals, and can be used as multi-functional digital input terminals.

There are three VDI sources:

- A1-06: This source is used to enable DI terminals in communication scenarios, where physical DIs are not used. The relationship between the digits of A1-06 and the VDIs are as follows: the ones position of A1-06 corresponds to VDI1...the ten thousands position of A1-06 corresponds to VDI5.
- DO state: has two DO terminals. DIO1 corresponds to VDI1, and DIO2 corresponds to VDI2.
- DI state: The relationship between the DIs and the VDIs are as follows: DI1 - VDI1, DI2 - VDI2, DIO1 - VDI4, and DIO2 - VDI5.

Example

The following examples show how to use VDIs:

- Example 1: When A1-05 (VDI active state source) is set to 00001 (DO is used as the source), the following function needs to be implemented: Generate an alarm and stop the AC drive when the AI1 input exceeds the upper limit or lower limit. The setting procedure is as follows:

Step	Parameter Setting
1	Set the VDI1 function to "user-defined fault 1" (set A1-00 to 44).
2	Set the DIO1 function to "AI input limit exceeded" (set F5-04 to 31).
3	Set the VDI1 state source to DO (set A1-05 to 00001).

After the preceding steps, DIO1 output is in ON state, and the VDI1 input terminal is active when AI1 input exceeds the upper limit or lower limit. VDI1 of the AC drive receives user-defined fault 1, generates the alarm E27.00, and the AC drive stops.

- Example 2: In a communication scenario, implement emergency stop through the VDI without using physical DI.

Step	Parameter Setting
1	Set the VDI1 function to "emergency stop" (set A1-00 to 47).
2	Set the VDI1 active state source to parameters (set A1-05 to 00000).
3	Modify the ones position of A1-06 through communication.

After the preceding steps, emergency stop can be implemented by setting the ones position of A1-06 to 1.

Related parameters

Para. No.	Function	Default	Value Range	Description
A1-00	VDI1 function	0	0 to 93	Same as F4-00
A1-01	VDI2 function	0		
A1-02	VDI3 function	0		
A1-03	VDI4 function	0		
A1-04	VDI5 function	0		
A1-05	VDI active state source	00000	Ones: 0: A1-06 1: DO state 2: DI state Tens: 0: A1-06 1: DO state 2: DI state Hundreds: 0: A1-06 1: DO state 2: DI state Thousands 0: A1-06 1: DO state 2: DI state Ten thousands 0: A1-06 1: DO state 2: DI state	The VDIx (x ranges from 1 to 5) state is set through the ones to ten thousands positions of this parameter. 0: Decided by the state of VDOx. The state of VDI depends on the state of VDO. VDIx and VDOx (x ranges from 1 to 5) are one-to-one mapped. 1: Decided by A1-06. The state of VDIx (x ranges from 1 to 5) is set through the binary bits of A1-06.
A1-06	Selection of VDI active state	00000	Ones: 0: Disabled 1: Enabled Tens: 0: Disabled 1: Enabled Hundreds: 0: Disabled 1: Enabled Thousands 0: Disabled 1: Enabled Ten thousands 0: Disabled 1: Enabled	The VDIx (x ranges from 1 to 5) state is set through the ones to ten thousands positions of this parameter.

2.3.4 AI

The AC drive is equipped with three multi-functional analog input (AI) terminals by default. To use AIs as DIs, the following parameters need to be set. When AI input voltage is higher than 7 V, AI is in high level state. When AI input voltage is lower than 3 V, AI is in low level state. AI is in hysteresis state when AI input voltage is between 3 V and 7 V. The following figure shows the relationship between AI input voltage and DI state.

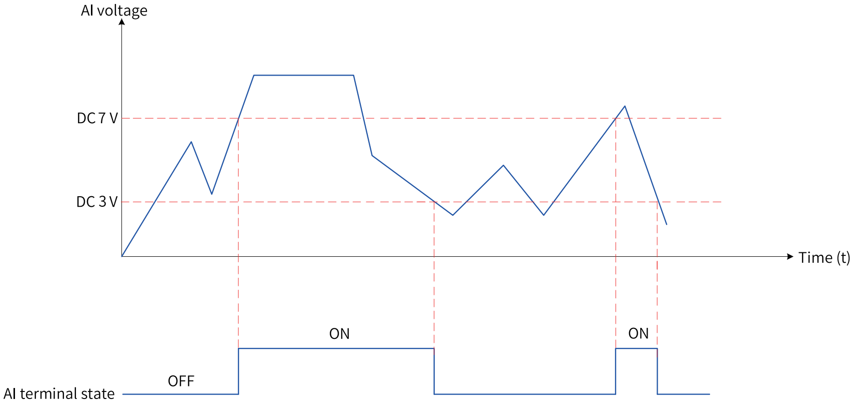


Figure 2-37 Relationship between AI input voltage and DI state

Table 2–17 Related parameters

Para. No.	Function	Default	Value Range	Description
A1-07	Function selection for AI1 used as DI	0	0 to 93	Same as F4-00
A1-08	Function selection for AI2 used as DI	0		
A1-09	Function selection for AI3 used as DI	0		
A1-10	Active state selection for AI used as DI	00	Ones: AI1 0: Active high 1: Active low Tens: AI2 (0 or 1, the options are the same as that of the ones position) Hundreds: AI3 (0 or 1, the options are the same as that of the ones position)	When the AI terminal level is high, the AI terminal is active if the corresponding digit of A1-10 is set to 0, and inactive if the corresponding digit of A1-10 is set to 1. When the AI terminal level is low, the AI terminal is active if the corresponding digit of A1-10 is set to 0, and inactive if the corresponding digit of A1-10 is set to 1.

2.3.5 AO

The AC drive is equipped with two analog output (AO) terminals by default. The following parameters are used to rectify the zero drift of analog output and the deviation of output amplitude. They can also be used to customize AO output curves as needed.

Table 2–18 Related parameters

Para. No.	Function	Default	Value Range	Description
F5-07	AO1 function	0	0: Running frequency 1: Frequency reference 2: Output current 3: Output torque 4: Output power 5: Output voltage 6: Pulse input (100.0% corresponds to 100.0 kHz) 7: AI1 8: AI2 9: AI3 10: Length 11: Count value 12: Communication 13: Motor speed 14: Output current (100.0% corresponds to 1000.0 A) 15: Output voltage (100.0% corresponds to 1000.0 V) 16: Output torque (directional) 19: Taper output 20: Roll diameter output 21: Tension output	For details, see *"Table 2–19 Relationship between pulse output/analog output functions and ranges" on page 132*.
F5-08	AO2 function	1		
F5-10	AO1 zero offset coefficient	0.0%	–100.0% to +100.0%	On the AO curve, if b indicates zero offset, k indicates gain, and X indicates standard output, the actual output Y is (kX + b). The zero offset coefficient 100% of AO1 and AO2 corresponds to 10 V (or 20 mA). The standard output refers to the value corresponding to the analog output of 0 to 10 V (or 0 to 20 mA) with no zero offset or gain adjustment. Zero offset = Zero offset coefficient x 10 V (or 20 mA) The AC drive supports two AO output channels, where AO1 is equipped on the control board, and AO2 needs to be provided through an extension card. AO1 and AO2 can be used to indicate the internal running parameters in the analog mode. The indicated parameters are defined by F5-07 and F5-08.
F5-11	AO1 gain	1.00	–10.00 to +10.00	

Para. No.	Function	Default	Value Range	Description
F5-12	AO2 zero offset coefficient	0.0%	-100.0% to 100.0%	On the AO curve, if b indicates zero offset, k indicates gain, and X indicates standard output, the actual output Y is (kX + b). The zero offset coefficient 100% of AO1 and AO2 corresponds to 10 V (or 20 mA). The standard output refers to the value corresponding to the analog output of 0 to 10 V (or 0 to 20 mA) with no zero offset or gain adjustment. Zero offset = Zero offset coefficient x 10 V (or 20 mA) The AC drive supports two AO output channels, where AO1 is equipped on the control board, and AO2 needs to be provided through an extension card. AO1 and AO2 can be used to indicate the internal running parameters in the analog mode. The indicated parameters are defined by F5-07 and F5-08.
F5-13	AO2 gain	1.00	-10.00 to 10.00	On the AO curve, if b indicates zero offset, k indicates gain, and X indicates standard output, the actual output Y is (kX + b). The zero offset coefficient 100% of AO1 and AO2 corresponds to 10 V (or 20 mA). The standard output refers to the value corresponding to the analog output of 0 to 10 V (or 0 to 20 mA) with no zero offset or gain adjustment. Zero offset = Zero offset coefficient x 10 V (or 20 mA) The AC drive supports two AO output channels, where AO1 is equipped on the control board, and AO2 needs to be provided through an extension card. AO1 and AO2 can be used to indicate the internal running parameters in the analog mode. The indicated parameters are defined by F5-07 and F5-08.
F5-23	AO1 mode selection	0	0: Voltage output 1: Current output	The AO1 output signal is voltage output or current output.

The AO ranges from 0 V to 10 V (0% to 100%). When the AO output function is set to 1 (frequency setting), and the AC drive frequency is set to 50% of the maximum frequency, the output voltage of the AO terminal is 5 V (50% x 10 V).

Table 2–19 Relationship between pulse output/analog output functions and ranges

Value	Function	Value Range
0	Running frequency	0% to 100.0% (Max. output frequency F0-10)
1	Frequency reference	0 to max. output frequency
2	Output current	0% to 100% (twice the rated motor current)

Value	Function	Value Range
3	Motor output torque	0% to 100% (twice the rated motor torque) (absolute value, a percentage of the rated motor torque)
4	Output power	0% to 100% (twice the rated motor power)
5	Output voltage	0% to 100% (1.2 times the rated motor voltage)
6	Pulse input	0.01 kHz to 100.00 kHz. 100% corresponds to 100.00 kHz.
7	AI1	–10 V to +10 V. 100% corresponds to +10 V.
8	AI2	–10 V to +10 V (or 0 mA to 20 mA). 100% corresponds to +10 V.
9	AI3	–10 V to +10 V (or 0 mA to 20 mA). 100% corresponds to +10 V.
10	Length	0% to 100.0% (maximum set length Fb-05)
11	Count value	0% to 100.0% (maximum count value Fb-08)
12	Communication	0.0% to 100.0% (AO communication)
13	Motor speed	0.0% to 100.0% (Max. output frequency F0-10)
14	Output current	0.0 A to 1000.0 A. 100.0% corresponds to 1000.0 A.
15	Output voltage	0.0 V to 1000.0 V.100% corresponds to 1000.0 V.
16	Output torque of the motor (actual value, a percentage of the rated motor torque)	0% (–twice the rated motor torque) to 100% (+twice the rated motor torque). 50% corresponds to 0.
19	Taper output	-
20	Roll diameter output	100.0% corresponds to B0-08 which specifies the maximum roll diameter.
21	Tension output	100.0% corresponds to B1-02 which specifies the maximum tension.

The following is an example of how to calculate the AO zero offset coefficient (F5-10) and AO gain (F5-11):

Assume that AO is the running frequency, and the rectified output needs to be 8 V (Y1) when frequency is 0 Hz (X1) and 4 V (Y2) when frequency is 40 Hz (X2).

Gain formula:

$$K = \frac{(Y1-Y2) \text{ x } Xmax}{(X1-X2) \text{ x } Ymax}$$

Zero offset coefficient formula:

$$b= \frac{(X1 \text{ x } Y2)(-X2 \text{ x } Y1)}{(X1-X2) \text{ x } Ymax} \times 100\%$$

Xmax (Max. output frequency) is 50 Hz (assuming that the maximum frequency F0-10 is 50 Hz), and Ymax (voltage) is 10 V.

In this case, AO gain (F5-11) is –0.5 and AO zero offset coefficient (F5-10) is 80%.

Table 2–20 Relationship between AO signal types and maximum values (Ymax)

Output Signal	Corresponding Max. Value (Ymax)
Voltage	10 V
Current	20 mA

Table 2–21 Relationship between AO contents and maximum values (Xmax)

Output of AO	Corresponding Max. Value (Xmax)
Running frequency	Max. output frequency
Frequency reference	Max. output frequency
Output current	Twice the rated motor current
Output torque (absolute value)	Twice the rated motor torque
Output power	Twice the rated power
Output voltage	1.2 times the rated AC drive voltage
Pulse input	100.00 kHz
AI1	10 V
AI2	10 V or 20 mA
AI3	10 V or 20 mA
Length	Maximum set length
Count value	Maximum count value
Communication	100.0%
Motor speed	Rotation speed corresponding to the Max. output frequency
Output current	1000.0 A
Output voltage	1000.0 V
Output torque (actual value)	Twice the rated motor torque

2.4 Control Performance

2.4.1 V/f Curve Setting

Table 2–22 Setting parameters of linear, multi-point, and square V/f curves

Para. No.	Function	Default	Value Range	Description
F3-00	V/f curve setting	0	0: Linear V/f curve 1: Multi-point V/f curve 2: Square V/f curve 3: 1.2-power V/f curve 4: 1.4-power V/f curve 6: 1.6-power V/f curve 8: 1.8-power V/f curve 10: Complete V/f separation 11: Incomplete V/f separation	0: Linear V/f curve The output voltage and output frequency of the AC drive change linearly at frequencies lower than the rated frequency. This curve is applicable to common mechanical drive applications such as large inertia fan acceleration, punch presses, centrifuges, and water pumps. 1: Multi-point V/f curve Frequency points are in the range of 0.00 Hz to the rated motor frequency, and voltage points are in the range of 0.0% to 100.0%, corresponding to the voltage range of 0 V to the rated motor voltage. Generally, the voltage and frequency values are set based on load characteristics of the motor. The parameter settings must meet the following condition: Value of F3-03 ⩽ Value of F3-05 ⩽ Value of F3-07. 2: Square V/f curve The output voltage of the AC drive changes quadratically with the output frequency at frequencies lower than the rated frequency. This curve is applicable to light loads that seldom change, such as fans and water pumps. 3: 1.2-power V/f curve The output voltage of the AC drive changes 1.2-power quadratically with the output frequency at frequencies lower than the rated frequency. 4: 1.4-power V/f curve The output voltage of the AC drive changes 1.4-power quadratically with the output frequency at frequencies lower than the rated frequency.

Para. No.	Function	Default	Value Range	Description
(Continued)				6: 1.6-power V/f curve The output voltage of the AC drive changes 1.6-power quadratically with the output frequency at frequencies lower than the rated frequency. 8: 1.8-power V/f curve The output voltage of the AC drive changes 1.8-power quadratically with the output frequency at frequencies lower than the rated frequency. 10: Complete V/f separation The output frequency and output voltage of the AC drive are independent of each other. The output frequency is determined by the frequency source, and the output voltage is determined by the voltage source for V/f separation. This mode is typically applicable to applications such as motor torque control. 11: Incomplete V/f separation In this mode, the voltage is proportional to the frequency. The proportional relationship can be set through the voltage source, and the relationship between voltage and frequency is also related to the rated motor voltage and rated motor frequency in group 1. Assume that the power source input is X (0% to 100%). The output voltage of the AC drive and the frequency can be calculated using the following formula: V/f = 2 x X x (Rated motor voltage)/(Rated motor frequency)
F3-01	Torque boost	Model dependent	0.0 to 30.0 0.0%: Automatic torque boost	The torque boost function is generally applicable to the AC drive at low frequency. The output torque of the AC drive in V/f control mode is proportional to the frequency. Under the condition of low frequency, the torque of the motor is very low when the motor runs at low speed. The output voltage of the AC drive can be increased through this parameter, thereby increasing the current and output torque. Set this parameter to a moderate level to avoid triggering the overload protection.
F3-02	Cutoff frequency of torque boost	50.00 Hz	0.00 Hz to max. frequency	When the running frequency reaches the cutoff frequency of torque boost, the torque boost function is disabled.

Para. No.	Function	Default	Value Range	Description
F3-03	Multi-point V/f frequency 1	0.00 Hz	0.00 Hz to F3-05	-
F3-04	Multi-point V/f voltage 1	0.0%	0.0% to 100.0%	
F3-05	Multi-point V/f frequency 2	0.00 Hz	F3-03 to F3-07	
F3-06	Multi-point V/f voltage 2	0.0%	0.0% to 100.0%	
F3-07	Multi-point V/f frequency 3	0.00 Hz	F3-05 to rated motor frequency (F1-04)	
F3-08	Multi-point V/f voltage 3	0.0%	0.0% to 100.0%	

Linear V/f curve

The following figure shows a general constant-torque linear V/f curve:

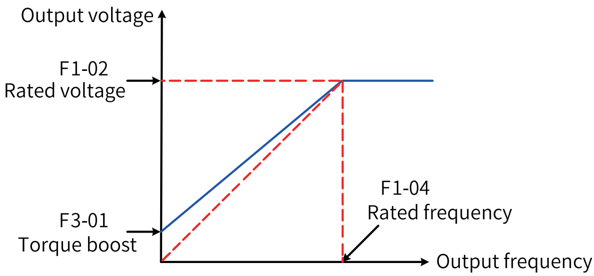


Figure 2-38 General constant-torque linear V/f curve

The output voltage changes linearly with the output frequency at frequencies lower than the rated frequency. This curve is applicable to general mechanical drive scenarios such as large-inertia fan acceleration, punch presses, centrifuges and pumps.

Multi-point V/f curve

The following figure shows a user-defined multi-point V/f curve:

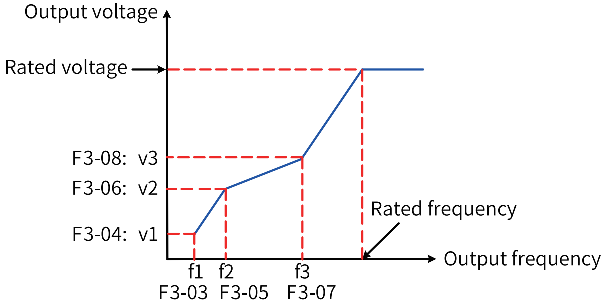


Figure 2-39 User-defined multi-point V/f curve

F3-03 to F3-08 are used to define a multi-point V/f curve. In this case, frequency points are in the range of 0.00 Hz to the rated motor frequency, and voltage points are in the range of 0.0% to 100%, corresponding to voltage range of 0 V to the rated motor voltage. Generally, voltage and frequency setpoints are set based on load characteristics of the motor. Ensure the following setting: F3-03 ⩽ F3-05 ⩽ F3-07. To ensure correct setting, the AC drive restricts the relationship of F3-03, F3-05 and F3-07. Set F3-07 first, then F3-05 and finally F3-03.

Square V/f curve

The following figure shows a variable torque square V/f curve:

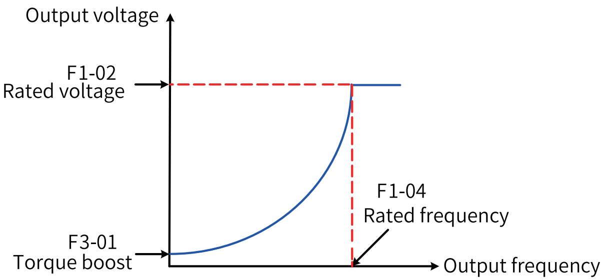


Figure 2-40 Variable torque square V/f curve

The output voltage changes quadratically with the output frequency at frequencies lower than the rated frequency. This curve is applicable to light loads that seldom change, such as fans and pumps.

Table 2–23 Setting parameters of V/f separation curve

Para. No.	Function	Default	Value Range	Description
F3-13	Voltage source for V/f separation	0	0: Digital setting (F3-14) 1: AI1 2: AI2 3: AI3 4: Pulse reference (DI5) 5: Multi-reference 6: Simple PLC 7: PID 8: Communication Note: The value 100.0% corresponds to the rated motor voltage.	This parameter is used to set the target voltage in the voltage and frequency separation mode. 0: Digital setting (F3-14) F3-14 (voltage digital setting for V/f separation) can be used to set the V/f separation voltage. 1: AI1 The V/f separation voltage is input through AI1. The frequency is calculated based on the current or voltage signal input through AI1 according to the set AI curve. 2: AI2 The V/f separation voltage is input through AI2. The frequency is calculated based on the current or voltage signal input through AI2 according to the set AI curve. 3: AI3 The V/f separation voltage is input through AI3. The frequency is calculated based on the current or voltage signal input through AI3 according to the set AI curve. The AC drive comes with two AI terminals, and the AI3 terminal needs to be provided through an I/O extension card. 4: Pulse reference (DI5)
(Continued)				The V/f separation voltage is set through DI5. The frequency is calculated based on the curve of relationship between the pulse frequency and running frequency. 5: Multi-reference When multi-reference is configured as the source for V/f separation voltage, setpoints can be configured by combining DI terminal states in a variety of ways. The four multi-reference terminals can make up 16 state combinations, corresponding to 16 reference values (percentage x maximum frequency) in group FC. 6: Simple PLC The V/f separation voltage is set through simple PLC. For details, see description of the simple PLC function. 7: PID The V/f separation voltage is set through PID. For details, see description of the PID function. 9: Communication The main frequency value is set through communication. The running frequency is input through remote communication. The AC drive must be equipped with a communication card to communicate with the host controller. This mode is suitable for remote control or centralized control on multiple devices or systems.

Para. No.	Function	Default	Value Range	Description
F3-14	Voltage digital setting for V/f separation	0 V	0 V to rated motor voltage (F1-02)	The setting range is 0 V to the rated voltage.
F3-15	Voltage rise time of V/f separation	0.0s	0.0s to 1000.0s Note: This parameter indicates the time required for voltage to rise from 0 V to the rated motor voltage.	Indicates the time required for the output voltage to rise from 0 to the set V/f separation voltage.
F3-16	Voltage decline time of V/f separation	0.0s	0.0s to 1000.0s Note: This parameter indicates the time required for voltage to rise from 0 V to the rated motor voltage.	Indicates the time required for the output voltage to decline from the set V/f separation voltage to 0.
F3-17	Stop mode selection for V/f separation	0	0: Frequency and voltage decline to 0 independently 1: Frequency declines after voltage declines to 0	0: Frequency and voltage decline to 0 independently 1: Frequency declines after voltage declines to 0

The voltage rise time of V/f separation is the time required for the output voltage to increase from 0 to the rated motor voltage. It is t1 in the following figure.

The voltage decline time of V/f separation is the time required for the output voltage to decline from the rated motor voltage to 0. It is t2 in the following figure.

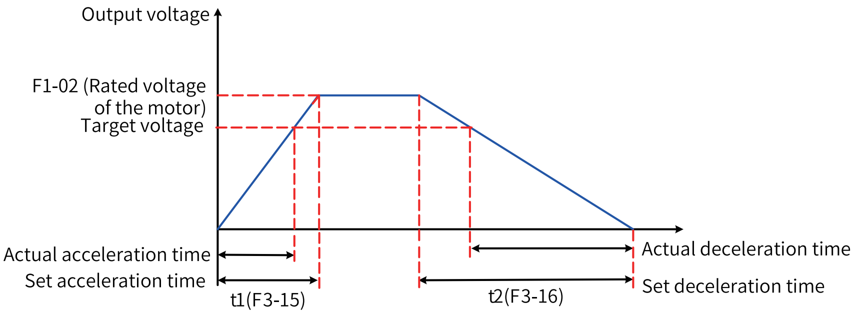


Figure 2-41 V/f separation curve

2.4.2 Output Current (Torque) Limit

During acceleration, operation at constant speed, or deceleration, if the current exceeds the overcurrent stall action current (default: 150%, indicating 1.5 times the rated AC drive current), the current limit mechanism is activated. In this case, the output frequency decreases until the current drops below the overcurrent stall action current. Then, the output frequency increases toward the target frequency. Therefore, the acceleration is prolonged. If the actual acceleration time cannot meet your requirement, increase the value of overcurrent stall action current (F3-18) accordingly.

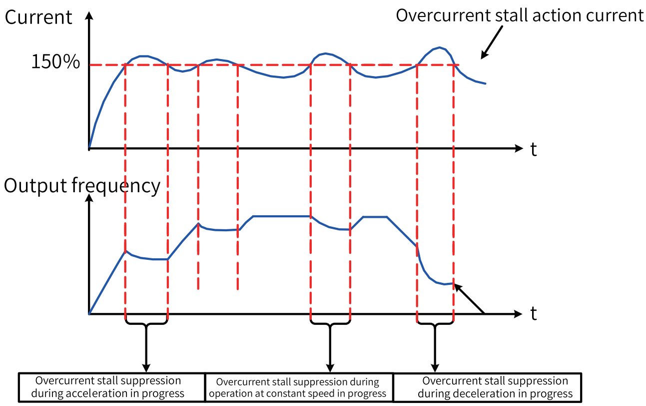


Figure 2-42 Overcurrent stall action

Table 2–24 Related parameters

Para. No.	Function	Default	Value Range	Description
F3-18	V/f overcurrent stall action current	150%	50% to 200%	When the motor current reaches this value, the AC drive starts the overcurrent stall function. The default value is 150%, corresponding to 1.5 times the rated current of the AC drive.
F3-19	V/f overcurrent stall selection	1	0: Disabled 1: Enabled	Used to enable/disable the V/f overcurrent stall function.
F3-20	V/f overcurrent stall suppression gain	20	0 to 100	When the current exceeds the overcurrent stall action current, the overcurrent stall function is enabled and the output frequency decreases. After the current falls below the overcurrent stall action current, the output frequency increases to the target frequency, which prolongs the actual acceleration automatically. A greater value of this parameter means better suppression effect.
F3-21	Compensation coefficient of V/f speed multiplying overcurrent stall action current	50%	50% to 200%	This parameter is used to reduce the overcurrent stall action current during high-speed operation. It is invalid when set to 50%. The recommended value for F3-18 in the field-weakening range is 100%.

When the frequency is high, motor drive current is small, and overcurrent stall action current can result in greater motor speed dip compared with situations when the frequency is below the rated level. To improve motor running performance, lower the overcurrent stall action current for situations when the frequency is above the rated level. This helps to improve acceleration performance and prevent motor stall in high-frequency applications with large load inertia multiple field weakening requirements, such as centrifuges.

When the frequency is above the rated level, overcurrent stall action current = (fn/fs) x k x LimitCur

In the formula, fs is the running frequency, fn is the rated motor frequency, k is the value of F3-21 (compensation coefficient of speed multiplying overcurrent stall action current), and LimitCur is the value of F3-18 (overcurrent stall action current).

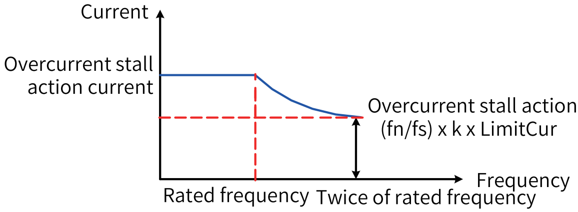


Figure 2-43 Speed multiplying overcurrent stall action current

Note

For high-power motors with carrier frequency below 2 kHz, lower the overcurrent stall action current. Otherwise, the pulse-by-pulse current limit function is enabled before the overcurrent stall prevention function as ripple current increases, resulting in insufficient torque output.

2.4.3 Overvoltage Stall Suppression

When bus voltage rises above the value set in F3-22 (overvoltage stall protective voltage), the motor enters the generating state (motor speed is greater than the output frequency). In this case, the overvoltage stall function is activated to prevent trip by adjusting the output frequency to extend deceleration time. If actual deceleration time cannot satisfy the requirement, increase the overexcitation gain.

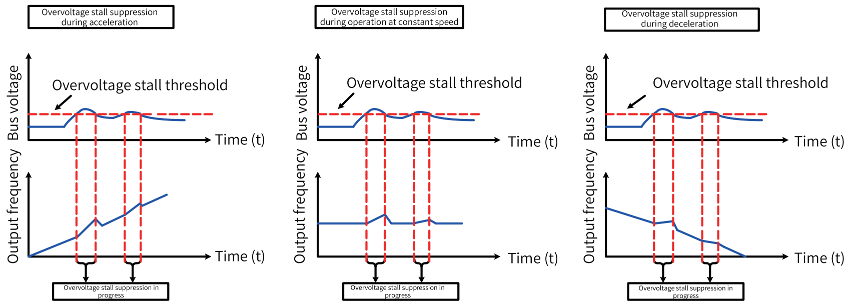


Figure 2-44 Overvoltage stall action

Para. No.	Function	Default	Value Range	Description
F3-22	V/f overvoltage stall protective voltage	770.0 V	200.0 V to 2000.0 V	F3-22 has the same function as F9-04.
F3-23	V/f overvoltage stall selection	1	0: Disabled 1: Enabled	0: Disabled 1: Enabled (overvoltage stall gain enabled by default)
F3-24	Frequency gain for V/f overvoltage stall suppression	30	0 to 100	Increasing F3-24 improves the control over bus voltage, but may result in output frequency fluctuation. If the output frequency fluctuates greatly, reduce F3-24. F3-24 has the same function as F9-03 (overvoltage stall gain).
F3-25	Voltage gain for V/f overvoltage stall suppression	30	0 to 100	This parameter is used to suppress the bus voltage. Increasing the parameter value can reduce the overshoot of the bus voltage.
F3-26	Frequency rise threshold during overvoltage stall	5 Hz	0 Hz to 50 Hz	The running frequency may increase when the overvoltage stall suppression function is enabled. This parameter is used to limit the increase of the running frequency.
F3-10	V/f overexcitation gain	64	0 to 200	A larger overexcitation gain means better suppression effect. When a braking resistor, additional braking unit, or energy feedback unit is used, set this parameter to 0. Failure to comply may result in overcurrent during operation.
F3-11	V/f oscillation suppression gain	Model dependent	0 to 100	A larger oscillation gain means better suppression effect.

Note

Observe the following requirements when using the braking resistor or energy feedback unit.

- Set F3–10 (Overexcitation gain) to 0. Failure to comply may lead to overcurrent during operation.
- Set F3–23 (Overvoltage stall selection) to 0. Failure to comply may prolong the deceleration time.

2.4.4 Speed Loop

Speed loop PI parameters are divided into low-speed and high-speed groups. When the running frequency is lower than switchover frequency 1 (F2-02), F2-00 and F2-01 are used as speed loop PI parameters. When the running frequency is higher than switchover frequency 2 (F2-05), F2-03 and F2-04 are used as speed loop PI parameters. When the running frequency is between F2-02 and F2-05, PI parameters are obtained from linear switchover between the two groups of PI parameters, as shown in the following figure.

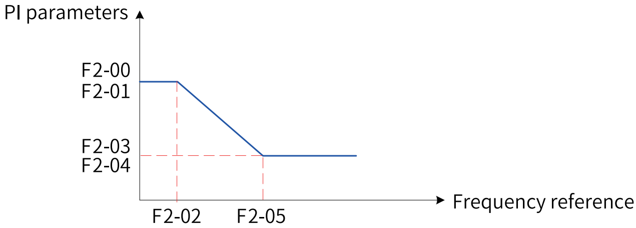


Figure 2-45 Speed loop PI parameter switchover

You can adjust the dynamic speed response characteristic of vector control by setting the proportional factor and integral time of the speed regulator.

Dynamic response of the speed loop can be improved by increasing the proportional gain or reducing the integral time. Be aware that this may lead to system oscillation.

Recommended method: If the factory settings cannot meet your requirements, increase the proportional gain first to ensure that the system does not oscillate, and then reduce the integral time to ensure quick system response and small overshoot.

Note

Improper PI parameter settings may lead to a high overshoot. Even worse, overvoltage may occur when overshoot drops.

Increasing the value of F2-07 can improve motor stability, but slows down dynamic response. Reducing the value of F2-07 can speed up dynamic response, but may cause motor oscillation. The default settings is applicable in most cases.

Para. No.	Function	Default	Value Range	Description
F2-00	Low-speed speed loop Kp	30	1 to 200	This is the PID control parameter Kp for the speed loop, which affects the response speed of the motor speed. A larger Kp value indicates higher sensitivity and more intensive tuning. A smaller Kp value indicates lower sensitivity and less intensive tuning. The low-speed speed loop Kp is effective at low speed.
F2-01	Low-speed speed loop Ti	0.500s	0.001s to 10.000s	The reciprocal of the speed loop integral time constant is the integral gain. The speed loop integral time constant affects the steady-state speed error of the motor and the stability of the speed loop system. If the speed loop integral time constant increases, the speed loop response slows down. For quicker response, a larger speed loop proportional gain is required. The low-speed speed loop Ti is effective at low speed.
F2-02	Switchover frequency 1	5.00 Hz	0.00 to switchover frequency 2 (F2-05)	Speed loop PI parameters are divided into low-speed and high-speed groups. When the running frequency is lower than switchover frequency 1 (F2-02), F2-00 and F2-01 are tuned. When the running frequency is higher than switchover frequency 2 (F2-05), F2-03 and F3-04 are tuned. If the running frequency is between switchover frequency 1 and switchover frequency 2, the speed loop PI parameters switch linearly between the two groups of PI parameters. This parameter must be set less than switchover frequency 2 (F2-05).
F2-03	High-speed speed loop Kp	20	1 to 200	This is the PID control parameter Kp for the speed loop, which affects the response speed of the motor speed. A larger Kp value indicates higher sensitivity and more intensive tuning. A smaller Kp value indicates lower sensitivity and less intensive tuning. The high-speed speed loop Kp is effective at high speed.
F2-04	High-speed speed loop Ti	1.00s	0.01s to 10.00s	The reciprocal of the speed loop integral time constant is the integral gain. The speed loop integral time constant affects the steady-state speed error of the motor and the stability of the speed loop system. If the speed loop integral time constant increases, the speed loop response slows down. For quicker response, a larger speed loop proportional gain is required. The high-speed speed loop Ti is effective at high speed.

Para. No.	Function	Default	Value Range	Description
F2-05	Switchover frequency 2	10.00 Hz	F2-02 to max. frequency	Speed loop PI parameters are divided into low-speed and high-speed groups. When the running frequency is lower than switchover frequency 1 (F2-02), F2-00 and F2-01 are tuned. When the running frequency is higher than switchover frequency 2 (F2-05), F2-03 and F3-04 are tuned. If the running frequency is between switchover frequency 1 and switchover frequency 2, the speed loop PI parameters switch linearly between the two groups of PI parameters. This parameter must be set less than switchover frequency 2 (F2-05).
F2-07	Speed feedback filter time	0.004s	0.000s to 0.100s	In FVC mode (F0-01 set to 1), the speed loop feedback filter time is effective. Adjusting the parameter can improve the motor stability. A larger value indicates better motor stability but slower dynamic response, and a smaller value indicates faster dynamic response. A small value of this parameter may result in motor oscillation. Generally, the motor stability meets requirements, and you do not need to modify this parameter.

2.4.5 Slip Adjustment in Vector Control Mode

In vector control mode (F0-01 is set to 0 or 1), this parameter can be used to adjust the speed stability accuracy. For example, increase this parameter when the running frequency of the motor is lower than the output frequency of the AC drive.

In FVC (F0-01 is set to 1) mode, this parameter can be used to adjust output current of the AC drive. For example, decrease this parameter gradually when a high-rate AC drive is used to control a motor with low load capacity. Note: The default settings is applicable in most cases.

Para. No.	Function	Default	Value Range	Description
F2-06	VC slip compensation gain	100%	50% to 200%	In SVC mode, this parameter can be used to adjust the speed stability accuracy. For example, increase this parameter when the running frequency of the motor is lower than the output frequency of the AC drive. In FVC mode, this parameter can be used to adjust output current of the AC drive. For example, decrease this parameter gradually when a high-rate AC drive is used to control a motor with low load capacity. You do not need to change the value of this parameter in most cases.

2.4.6 Over-Excitation in Vector Control Mode

For high-inertia loads, vector control over-excitation can speed up the motor deceleration. A larger over-excitation gain means better improvement. However, vector control over-excitation increases the output current of the AC drive.

Para. No.	Function	Default	Value Range	Description
F2-08	VC deceleration over-excitation gain	64	0 to 200	-

2.4.7 Torque Upper Limit

The following table describes the torque upper limit settings for vector control (FVC or SVC).

Para. No.	Function	Default	Value Range	Description
F2-09	Torque upper limit source in speed control (motoring)	0	0: Digital setting (F2-10) 1: AI1 2: AI2 3: AI3 4: Pulse reference (DI5) 5: Communication 6: Min. (AI1, AI2) 7: Max. (AI1, AI2)	0: Digital setting (F2-10) The torque upper limit in speed control is input through digital terminals and the value is determined by F2-10 (digital setting of torque upper limit in speed control). 1: AI1 The torque upper limit in speed control is input through AI1. The frequency is calculated based on the current or voltage signal input through AI1 according to the set AI curve. 2: AI2 The torque upper limit in speed control is input through AI2. The frequency is calculated based on the current or voltage signal input through AI2 according to the set AI curve. 3: AI3 The torque upper limit in speed control is input through AI3. The frequency is calculated based on the current or voltage signal input through AI3 according to the set AI curve. 4: Pulse reference (DI5) The torque upper limit in speed control is input through DI5 (pulse frequency). The frequency is calculated based on the curve of relationship between the pulse frequency and running frequency. 5: Communication The main frequency value is set through communication. The running frequency is input through remote communication. The AC drive must be equipped with a communication card to communicate with the host controller. This channel is applicable to remote control and centralized control of multiple devices or systems. 6: Min. (AI1, AI2) The torque upper limit is the minimum input through AI1 and AI2. 7: Max. (AI1, AI2) The torque upper limit is the maximum input through AI1 and AI2.
F2-10	Digital setting of torque upper limit in speed control (motoring)	150.0%	0.0% to 200.0%	The torque upper limit under the motoring state takes the rated current of AC drive as the base value.

Para. No.	Function	Default	Value Range	Description
F2-11	Torque upper limit source in speed control (generating)	0	0: Digital setting (F2-10) 1: AI1 2: AI2 3: AI3 4: Pulse reference (DI5) 5: Communication 6: Min. (AI1, AI2) 7: Max. (AI1, AI2) 8: Digital setting (F2-12)	0: Digital setting (F2-10) The torque upper limit in speed control is input through digital terminals and the value is determined by F2-10 (digital setting of torque upper limit in speed control). 1: AI1 The torque upper limit in speed control is input through AI1. The frequency is calculated based on the current or voltage signal input through AI1 according to the set AI curve. 2: AI2 The torque upper limit in speed control is input through AI2. The frequency is calculated based on the current or voltage signal input through AI2 according to the set AI curve. 3: AI3 The torque upper limit in speed control is input through AI3. The frequency is calculated based on the current or voltage signal input through AI3 according to the set AI curve. 4: Pulse reference (DI5) The torque upper limit in speed control is input through DI5 (pulse frequency). The frequency is calculated based on the curve of relationship between the pulse frequency and running frequency. 5: Communication The main frequency value is set through communication. The running frequency is input through remote communication. The AC drive must be equipped with a communication card to communicate with the host controller. This channel is applicable to remote control and centralized control of multiple devices or systems. 6: Min. (AI1, AI2) The torque upper limit is the minimum input through AI1 and AI2. 7: Max. (AI1, AI2) The torque upper limit is the maximum input through AI1 and AI2. 8: Digital setting (F2-12) When F2-12 is set to 8, the torque upper limit in speed control is input through digital terminals.
F2-12	Torque upper limit settings in speed control (generating)	150.0%	0.0% to 200.0%	The torque upper limit under the generating state takes the rated current of AC drive as the base value.

Eight torque upper limit sources are available in speed control mode. In motoring state, the torque upper limit source is selected through F2-09; in generating state, the torque upper limit source is selected through F2-11.

In speed control mode, if F2-11 is set to 1 to 8, the torque upper limit is distinguished between the motoring state and generating state. In motoring state, the full range of torque upper limit is set through F2-10. In generating state, the full range of torque upper limit is set through F2-12.

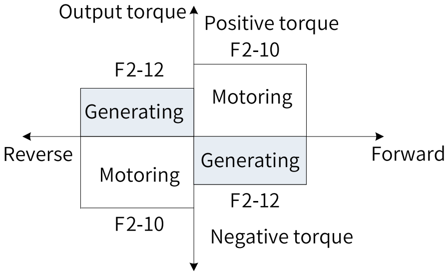


Figure 2-46 Torque upper limit in speed control mode

Para. No.	Function	Default	Value Range	Description
F2-53	Power limit selection during generating	0	0: Disabled 1: Enabled	-
F2-54	Power upper limit during generating	Model dependent	0.0% to 200.0%	-

In applications such as cam, quick acceleration/deceleration and sudden unloading without using a braking resistor, enable the power limit during generating to reduce bus voltage overshoot during motor braking so as to prevent overvoltage. F2-54 (power upper limit during generating) is a percentage to the rated motor power. If overvoltage still occurs after power limit during generating is enabled, decrease F2-54.

2.4.8 Torque Control

Para. No.	Function	Default	Value Range	Description
A0-00	Speed/Torque control mode	0	0: Speed control 1: Torque control	Two control modes, speed control and torque control, are provided under vector control (FVC or SVC).
A0-01	Torque reference source	0	0: Digital setting (A0-03) 1: AI1 2: AI2 3: AI3 4: Pulse reference 5: Communication (1000H) 6: Min. (AI1, AI2) 7: Max. (AI1, AI2)	Defines the torque reference source. Eight torque reference sources are available.

Para. No.	Function	Default	Value Range	Description
A0-03	Torque digital setting	100.0%	–200.0% to +200.0%	Used for digital setting in the torque control mode. Torque reference is a relative value. 100.0% corresponds to rated AC drive torque, and the AC drive output torque can be viewed in U0-7. The motor output torque can be viewed in U0-06, where 100.0% corresponds to rated motor torque. The torque value range is –200.0% to +200.0%, which means that the maximum torque of the AC drive is twice the rated motor torque. When the parameter value is a positive number, the AC drive runs in the forward direction. When the parameter value is a negative number, the AC drive runs in the reverse direction.
A0-04	Torque filter time	0.000s	0 to the value of 5.000s	Specifies the torque filter time.
A0-05	Speed limit digital setting	0.0%	–120.0% to +120.0%	-
A0-07	Acceleration time (torque)	1.00s	0.00s to 650.00s	-
A0-08	Deceleration time (torque)	1.00s	0.00s to 650.00s	-
A0-09	Speed limit reference source	0	0: Set through A0-05 1: Frequency source setting	-
A0-10	Speed limit offset	5.00	0 to max. frequency (F0-10)	-
A0-11	Effective mode of speed limit offset	1	0: Bidirectional offset effective 1: Unidirectional offset effective 2: Window mode	-
A0-12	Acceleration time (frequency)	1.0s	0.0s to 6500.0s	-
A0-13	Deceleration time (frequency)	1.0s	0.0s to 6500.0s	-
A0-14	Torque mode switchover	1	0: No switchover 1: Switchover to speed control at stop 2: Target torque at stop being 0	-

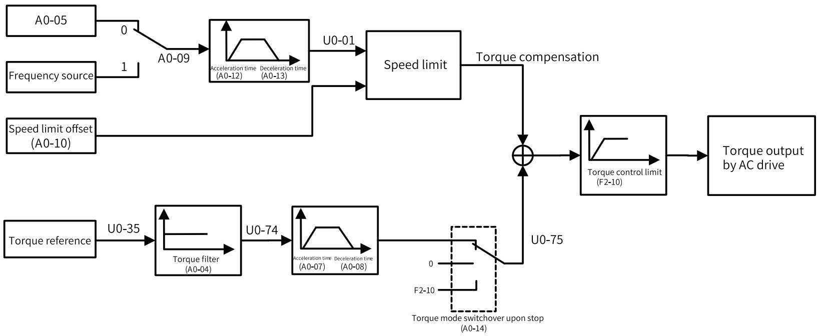


Figure 2-47 Torque control system

1. Selecting speed/torque control mode (A0-00)
   A0-00 determines whether the AC drive is in speed control or torque control.

   Multi-functional DI terminals provide two torque control functions: torque control disabling (function 29) and speed/torque control switchover (function 46). The two terminals must be used together with parameter A0-00 to implement switchover between speed control and torque control.

   When the speed control/torque control terminal (function 46) is disabled, the control mode is determined by A0-00. When the terminal is enabled, the control mode is reverse to A0-00.

   When the torque control disabling terminal is enabled, the AC drive works in speed control mode.

2. Setting torque reference in torque control (A0-01, A0-03)
   A0-01 is used to select a torque reference source. Eight sources are supported.

   The torque reference is a relative value. The value 100.0% corresponds to the rated motor torque. (Check U0-06 to obtain the motor output torque, and the value 100% corresponds to the rated motor torque.) The torque value range is –200.0% to +200.0%, which means that the maximum torque of the AC drive is twice the rated motor torque.

3. Setting frequency limit in torque control (A0-05, A0-09, A0-10, and A0-11)
   In torque control mode, the frequency limit can be set through A0-05 or the frequency source, depending on the value of A0-09.

4. Setting the frequency upper limit acceleration time (A0-12) and deceleration time (A0-13)
   In torque control mode, if the load torque is less than the motor output torque, the motor speed keeps increasing. To prevent runaway or other incidents of the

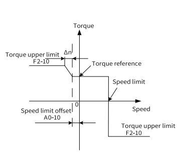
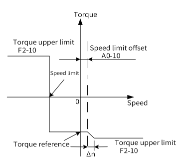
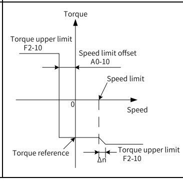
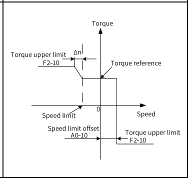
mechanical system, limit the maximum motor speed in torque control mode. That is, set the frequency limit in torque control.

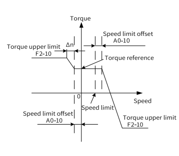
5. Setting the torque limit acceleration/deceleration time (A0-07, A0-08)
   In torque control, the difference between the motor output torque and the load torque determines the speed change rate of the motor and load. Sharp change of motor rotational speed may result in noise or excessive mechanical stress. Setting an appropriate torque acceleration/deceleration time can ensure stable change of the motor speed. The torque acceleration time is the time required for the output torque to increase from 0 to A0-03, and the torque deceleration time is the time required for the output torque to decrease from A0-03 to 0.

   Setting the torque acceleration/deceleration time is not suitable for torque control with a small startup torque. In a scenario requiring fast torque change, set the torque acceleration/deceleration time to 0.00s.

   For example, assume that one load is driven by two motors. To balance the load level of the two motors, set one drive as master in speed control and set the other as slave in torque control. The slave will follow output torque of the master as its torque reference, which requires quick response to the master output torque. In this case, set acceleration/deceleration time of the slave in torque control to 0.00s.

Table 2–25 Speed limit/Speed limit offset

Item	Operating Conditions			
Command	Forward	Forward	Forward	Forward
Torque reference direction	+	-	-	+
Speed limit direction	+	-	+	-
Normal operation direction	Forward	Reverse	Forward	Reverse
Unidirectional speed limit offset (A0-11 is set to 1)				

<table>
<tr><th>Item</th><th colspan="4">Operating Conditions</th></tr>
<tr><td>Bidirectional speed limit offset
(A0-11 is set to 0)</td>
<td>
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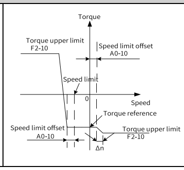
<td>
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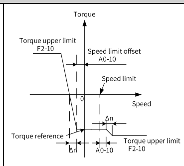
<td>
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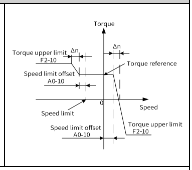
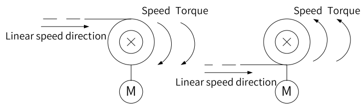
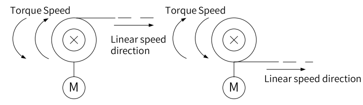
<td>
</td></tr>
<tr><td>Example</td>
<td colspan="2">Winding machine

</td>
<td colspan="2">Unwinding machine

</td></tr>
</table>

2.4.9 Current Loop

Current loop PI parameters for vector control are divided into low-speed and high-speed groups. These parameters can be automatically obtained through auto-tuning on all parameters of asynchronous motor and generally do not need to be modified.

The dimension of the current loop integral regulator is integral gain rather than integral time. A large current loop PI gain may result in oscillation of the entire control loop. In the case of severe current oscillation or torque fluctuation, manually reduce the PI proportional gain or integral gain.

Para. No.	Function	Default	Value Range	Description
F2-13	Low-speed current loop Kp adjustment	1.0	0.1 to 10.0	The value is obtained automatically through motor auto-tuning.
F2-14	Low-speed current loop Ki adjustment	1.0	0.1 to 10.0	
F2-15	High-speed current loop Kp adjustment	1.0	0.1 to 10.0	
F2-16	High-speed current loop Ki adjustment	1.0	0.1 to 10.0	

2.4.10Improving Performance of Field-Weakening Range

Para. No.	Function	Default	Value Range	Description
F2-21	Maximum output voltage coefficient	105%	100% to 110%	Indicates the boost capacity on the basis of maximum voltage of the AC drive. Increasing F2-21 improves the maximum loading capacity in motor field-weakening range, but increases motor current ripple and motor temperature. Decreasing F2-21 weakens the maximum loading capacity in motor field-weakening range, but reduces motor current ripple and motor temperature. Generally, this parameter needs no adjustment.

2.4.11FVC Operation and Performance Improvement

Table 2–26 Procedure of setting speed control in FVC mode

Procedure	Para.	Description
Check the AC drive wiring.	-	If the AC drive reports E19.00 during motor auto-tuning, check whether the AC drive wiring and motor parameter settings are correct.
Set motor parameters.	F1-01, F1-02, F1-03, F1-04, F1-05	
Set the encoder type and pulses per revolution.	F1-27, F1-28	If the AC drive reports E20.00, check whether the encoder and PG card are working properly.
Select a control mode.	F0-01	-
Set the motor auto-tuning function.	F1-37	Dynamic auto-tuning on all parameters of asynchronous motor takes some time. Wait until this process is completed before proceeding to the next step. Dynamic auto-tuning on all parameters of asynchronous motor is recommended (set F1-37 to 2). When using this auto-tuning mode, remove the load from the motor so that the motor can reach a high speed. If the load cannot be removed from the motor (for example, motor of a crane), use static auto-tuning on all motor parameters (set F1-37 to 3).
Set the command source and frequency reference source.	F0-02, F0-03	-
Perform a trial run.	A0-00 = 0	-

Table 2–27 Procedure of setting torque control in FVC mode

Procedure	Para.	Description
Check the AC drive wiring.	-	If the AC drive reports E19.00 during motor auto-tuning, check whether the AC drive wiring and motor parameter settings are correct.
Set motor parameters.	F1-01, F1-02, F1-03, F1-04, F1-05	
Set the encoder type and pulses per revolution.	F1-27, F1-28	If the AC drive reports E20.00, check whether the encoder and PG card are working properly.
Select a control mode.	F0-01	-
Set the motor auto-tuning function.	F1-37	Dynamic auto-tuning on all parameters of asynchronous motor takes some time. Wait until this process is completed before proceeding to the next step. Dynamic auto-tuning on all parameters of asynchronous motor is recommended (set F1-37 to 2). When using this auto-tuning mode, remove the load from the motor so that the motor can reach a high speed. If the load cannot be removed from the motor (for example, motor of a crane), use static auto-tuning on all motor parameters (set F1-37 to 3).
Set the command source.	F0-02	-
Set the torque control parameters.	A0-00, A0-01, A0-03, A0-05	-
Perform a trial run.	-	-

Speed loop setting

The motor may oscillate or generate abnormal noise when running below the rated frequency if the speed loop gains are set too high. In this case, reduce the speed loop gains (reduce the values of F2-00 and F2-03, and increase the values of F2-01 and F2-04).

If the system speed overshoot is high during rapid acceleration, increase the speed loop proportional gain Kp (increase the values of F2-00 and F2-03) and reduce the speed loop integral gain Ki (increase the values of F2-01 and F2-04).

In a winding/unwinding scenario, the roll diameter changes in inverse proportion to the motor speed. Therefore, when the roll diameter is large, increase the speed loop gain at low speed to ensure dynamic response of the system (increase the value of F2-00 and reduce the value of F2-01).

For a load running at an extremely low speed (for example, a milling machine running at 0.01 Hz), ensure smooth running by increasing the speed loop gains, especially the integral gain (increase the value of F2-00 and reduce the value of F2-01).

Note

In scenarios with poor encoder feedback signals, the speed loop gains cannot be too high. Otherwise, the dynamic response speed of the system is affected. In this case, first take measures to improve the quality of encoder feedback signals (for example, separate power cables of the motor from signal cables of the encoder, and ensure good grounding of the system). Otherwise, directly reducing the speed loop gains will slow down dynamic response of the system, degrading the system operation performance.

Current loop setting

Current loop parameters can be automatically obtained after auto-tuning on all parameters of asynchronous motor and generally do not need to be modified. However, you can fine tune these parameters in the following conditions:

When a motor running in FVC mode oscillates or generates abnormal noise, and the oscillation or noise cannot be completely removed by reducing the speed loop gains, moderately reduce the current loop gains (reduce the values of F2-13, F2-14, F2-15, and F2-16).

If the system requires a low overshoot, the speed loop gains cannot be too low. In this case, if the motor oscillates or generates abnormal noise when running in FVC mode, moderately reduce the current loop gains (reduce the values of F2-13, F2-14, F2-15, and F2-16).

Solutions to FVC exceptions during high-speed operation

FVC oscillation or running exceptions may occur when a motor runs at a high frequency (for example, above 200 Hz). In this case, use the V/f control mode at the same frequency and check whether the feedback frequency (U0-29) is the same as the frequency reference. If there is a large difference (greater than 4 Hz) between the two frequency values, the cause may be encoder signal distortion (non-orthogonal or abnormal duty cycle) or signal filtering on the PG card. Take the following measures:

Replace the encoder. Check whether the original encoder is damaged or installed incorrectly, and whether the encoder model supports the current pulse frequency.

If measures have been taken to prevent encoder signal distortion, high filter capacitance of the PG card may cause signal receiving errors. In this case, set F1-27 properly for PG signal filtering.

Shortening acceleration/deceleration time in FVC mode

During rapid acceleration/deceleration, the actual acceleration/deceleration time is longer than the preset value. To shorten the acceleration/deceleration time, take the following measures:

To shorten the motor acceleration time, increase the torque upper limit in FVC control (moderately increase the value of F2-10, but in no case greater than 180%). Although increasing the torque upper limit can shorten the motor acceleration time, this operation leads to an increase of the motor current, which is more likely to cause faults such as overload.

Use appropriate braking resistors to shorten the deceleration time.

Limiting bus voltage to prevent overvoltage in FVC mode

In high inertia or rapid deceleration scenarios, overvoltage faults often occur during deceleration. The optimization measures are the same as those used in V/f control mode. The same parameters are used in the two modes.

2.4.12Auxiliary Control

Para. No.	Function	Default	Value Range	Description
A5-00	DPWM switchover frequency upper limit	12.00 Hz	0 to max. frequency (F0-10)	The AC drive supports two PWM modes: CPWM and DPWM. When the running frequency is higher than A5-00 (switchover frequency), the DPWM mode is used. When the running frequency is lower than A5-00 (switchover frequency), the CPWM mode is used. The DPWM mode can improve the AC drive efficiency, whereas the CPWM mode can reduce motor noise. Increasing parameter A5-00 to max. frequency will reduce motor noise.
A5-01	PWM modulation mode	0	0: Asynchronous modulation 1: Synchronous modulation 2: Synchronous modulation mode 2 3: Synchronous modulation mode 3	When the result of the carrier frequency divided by the running frequency is less than 10, output current oscillation or large current harmonic may occur. To reduce the current harmonic, set this parameter to 1 (synchronous modulation). 0: Asynchronous modulation This mode is used when the carrier frequency is not synchronized with the signal wave frequency. Usually, the carrier frequency is kept unchanged, and the carrier ratio changes with the signal wave frequency. 1: Synchronous modulation This mode is used when the carrier frequency is synchronized with the signal wave frequency. Usually, the carrier frequency and signal frequency change simultaneously, and therefore the carrier ratio remains unchanged. In this case, a set number of transverse SPWM pulses are generated in a given period, leading to good symmetry of the equivalent sine wave. 2: Synchronous modulation mode 2 3: Synchronous modulation mode 3
A5-03	Random PWM depth	0	0: Random PWM invalid 1 to 10: Random PWM depth	To reduce motor noise, set A5-03 to a value other than 0. A large value means better effect of noise reduction. However, an excessively-large value may affect motor control. Therefore, set this parameter to 1 first during commissioning and then increase it by 1 each time based on the field application.

2.4.13Encoder Signal Processing

The PG card of the AC drive supports programmable filtering of encoder signals.

Para. No.	Function	Default	Value Range	Description
F1-29	PG signal filter	1	0 to 3	This parameter is used to set the filter mode.

- 0: Non-adaptive filter
  The filter coefficient of the PG card is fixed and small. This filter mode is applicable to scenarios with low or no interference, or high-speed applications.
- 1: Adaptive filter
  The filter coefficient of the PG card can be adjusted automatically. This filter mode has a strong interference-resistant capability, especially when the encoder feedback frequency is lower than 100 kHz. This mode is suitable for scenarios with high interference. This mode is enabled by default.
- 2: Fixed interlock
  This mode adds the capability to eliminate encoder feedback signal edge jitter on the basis of adaptive filter. It is applicable to scenarios where encoder feedback signals have jitter at the edge.
- 3: Automatic interlock
  The PG card automatically switches between adaptive filter and fixed interlock to adapt to zero-speed running and non-zero-speed running. This mode prevents the fixed interlock function from mistakenly recognizing and eliminating valid signals as edge jitter during zero-speed running.

Table 2–28 Encoder disconnection detection

Para. No.	Function	Default	Value Range	Description
F1-36	PG open circuit detection	0	0: Disabled 1: Enabled	-

The PG card of the MD500-PLUS series AC drive supports encoder disconnection detection. This function is valid only for encoders with differential interfaces, and can be used to detect signals of phase A, phase B, and phase Z. If the PG card is connected only to phase A and phase B, the AC drive reports E20.00. In this case, disable encoder disconnection detection. Otherwise, the AC drive keeps reporting this error.

2.4.14Synchronous Motor VVC+

Para. No.	Name	Value Range	Default	Description
F0-01	Motor 1 control mode	0: Sensorless vector control (SVC) 1: Feedback vector control (FVC) 2: V/f control 5: VVC+ control (for synchronous motor only)	0	-
F1-20	Filter time constant (for VVC)	0.003 V to 65.535 V	0.100 V	This parameter specifies the filter time constant in VVC mode.
F1-21	Oscillation suppression gain (for VVC)	0 to 65535	100	This parameter specifies oscillation suppression gain in VVC mode.
F1-24	Number of motor pole pairs	0 to 65535	2	-
F3-01	Torque boost	0.0%: Automatic torque boost 0.1% to 30.0%	Model dependent	The torque boost function is generally applicable to the AC drive at low frequency. The output torque of the AC drive in V/f control mode is proportional to the frequency. Under the condition of low frequency, the torque of the motor is very low when the motor runs at low speed. The output voltage of the AC drive can be increased through this parameter, thereby increasing the current and output torque. Set this parameter to a moderate level to avoid triggering the overload protection.
A9-40	Low-speed closed-loop current selection (for VVC)	0: Disabled 1: Enabled	0	-
A9-41	Low-speed closed-loop current (for VVC)	30% to 200% (rated motor current)	50%	-
A9-42	Oscillation suppression damping coefficient (for VVC)	0 to 500	100%	-
A9-43	Initial position compensation angle (for VVC)	0 to 5	0	-

2.4.15Synchronous Motor Electromagnetic Shorting

Electromagnetic shorting at start/stop

The sequence of start and stop signals for the "decelerate to stop" or "coast to stop" mode is shown in the following figure.

- Set the "electromagnetic shorting time at stop" to a non-zero value to enable the electromagnetic shorting function. In this case, electromagnetic shorting is performed with the maximum current limit (relative to the rated peak current of the motor) defined by F6-26 after the motor decelerates to the frequency defined by F6-11. The electromagnetic shorting function is also limited by the rated peak current of the AC drive.
- DC braking is not available. Only electromagnetic shorting is available for braking of synchronous motors.

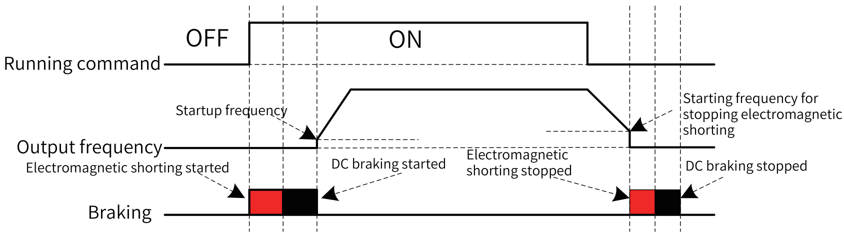


Figure 2-48 Sequence of start/stop function

DI terminal electromagnetic shorting

The sequence of the electromagnetic shorting signals of DI terminals for the "decelerate to stop" or "coast to stop" is shown in the following figure.

Note

When electromagnetic shorting is selected for the DI terminal, avoid electromagnetic shorting upon start/stop.

The priority of electromagnetic shorting/DC braking state is lower than that of the start signal.

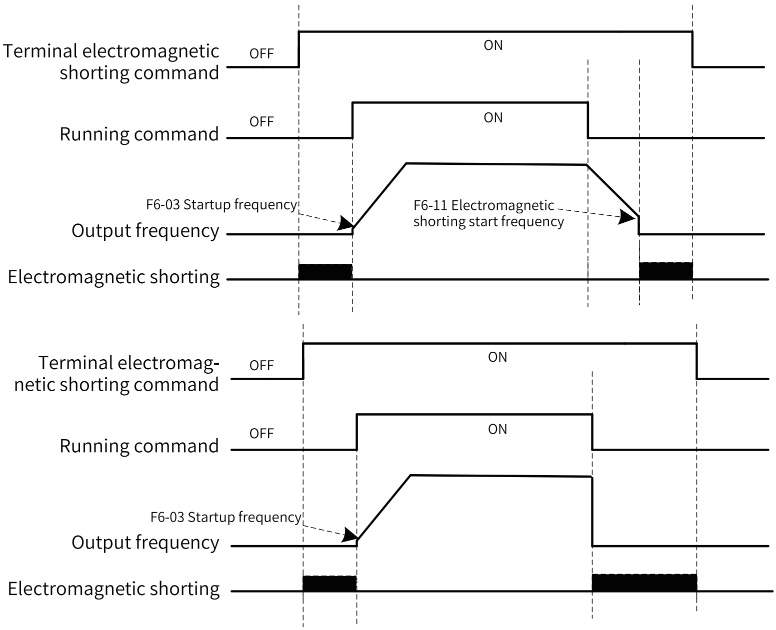


Figure 2-49 Sequence of DI terminal electromagnetic shorting

Electromagnetic shorting triggered by faults

Actions upon occurrence of the following faults can be set to "stop at electromagnetic shorting" (for synchronous motor only).

- E11 external fault
- E19 auto-tuning fault
- E20 encoder disk fault
- E27 and E28 user-defined faults
- E42 excessive speed deviation fault
- E43 overspeed fault

Method: Take external faults as an example. Set the ten thousands position of F9-48 to 3 to enable electromagnetic shorting for E11 fault.

This function is applicable to scenarios where a synchronous motor, such as a wire drawing machine, requires fast stop protection.

Related parameters

Para. No.	Name	Value Range	Default
F6-26	Electromagnet shorting current	0% to 200%	100%
F6-27	Electromagnetic shorting time at start	0.0s to 100.0s	0.0s

Para. No.	Name	Value Range	Default
F6-28	Electromagnetic shorting time at stop	0.0s to 100.0s	0.0s
F6-11	Starting frequency of DC braking at stop	0.00 Hz to max. frequency (F0-10)	0.00 Hz

2.4.16Wobble Control Function

The wobble function means the output frequency wobbles up and down around the frequency reference (set through F0-07). This function is applicable to textile industry and chemical fiber industry, as well as scenarios where horizontal movement and winding are required.

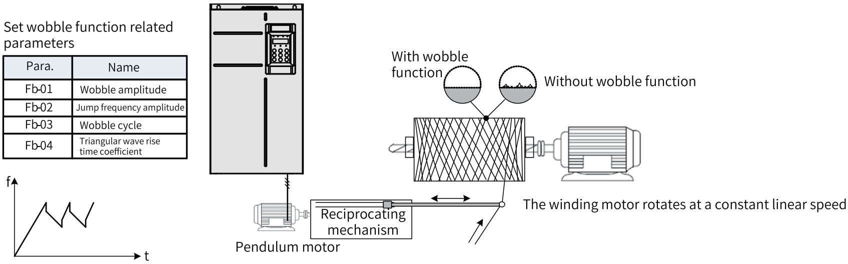


Figure 2-50 Wobble application

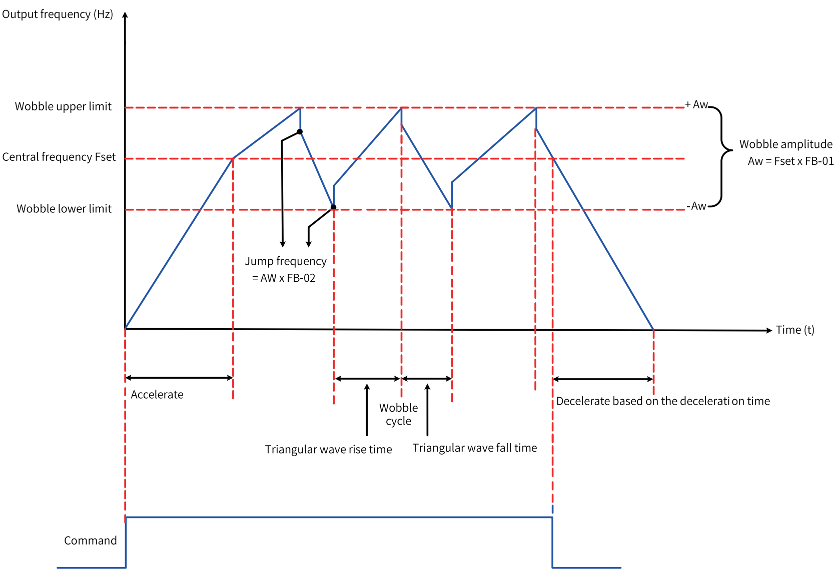


Figure 2-51 Working principle of wobble

Table 2–29 Related parameters

Para. No.	Function	Default	Value Range	Description
Fb-00	Wobble setting mode	0	0: Relative to central frequency 1: Relative to max. frequency	0: Relative to central frequency (F0-07: final frequency reference setting selection): It is a variable wobble system and the wobble changes with the central frequency (frequency reference). 1: Relative to max. frequency (F0-10: max. frequency): It is a fixed wobble system and the wobble is calculated based on the maximum frequency.
Fb-01	Wobble amplitude	0.0%	0.0% to 100.0%	When Fb-01 is set to 0, the wobble function is disabled.
Fb-02	Jump frequency amplitude	0.0%	0.0% to 50.0%	Used to determine the wobble amplitude and jump frequency. The wobble running frequency is limited by the frequency upper limit and frequency lower limit.
Fb-03	Wobble cycle	10.0s	0.1s to 3000.0s	Time of a complete wobble cycle.
Fb-04	Triangular wave rise time coefficient	50.0%	0.1% to 100.0%	Ratio (in percentage) of triangular wave rise time to wobble cycle (Fb-03)

1. Wobble amplitude calculation
   When Fb-00 is set to 0 (relative to central frequency), wobble amplitude AW is calculated according to the following formula: AW = Frequency reference source (F0-07) x Wobble amplitude (Fb-01).

   When Fb-00 is set to 1 (relative to max. frequency), wobble amplitude AW is calculated according to the following formula: AW = Max. frequency (F0-10) x Wobble amplitude (Fb-01).

2. Jump frequency calculation
   In the wobble mode, the jump frequency is a value relative to AW, namely, Jump frequency = AW x Jump frequency amplitude (Fb-02).

   When Fb-00 is set to 0 (relative to central frequency), the jump frequency is a variable value.

   When Fb-00 is set to 1 (relative to max. frequency), the jump frequency is a fixed value.

3. Triangular wave rise/fall time calculation
   Triangular wave rise time = Fb-03 (Wobble cycle) x Fb-04 (Triangular wave rise time coefficient, unit: s)

   Triangular wave fall time = Fb-03 (Wobble cycle) x (1 - Fb-04 (Triangular wave rise time coefficient, unit: s))

   (Wobble cycle = Triangular wave rise time + Triangular wave fall time)

2.4.17Fixed Length Control Function

The AC drive supports fixed length control in which the length pulses can be collected by DI5 only, which requires DI5 to be assigned with function 27 (length count input).

Para. No.	Function	Default	Value Range	Description
Fb-05	Set length	1000 m	0 m to 65535 m	Used to set the length value to be controlled in the fixed length control mode.
Fb-06	Actual length	0 m	0 m to 65535 m	The actual length is a monitored value. Actual length (Fb-06) = Number of pulses sampled by DI/Number of pulses per meter (Fb-07)
Fb-07	Number of pulses per meter	100.0	0.1 to 6553.5	The number of pulses output per meter. The length pulses can be sampled by DI5 if DI5 is assigned with function 27 (length count input) (set F4-04 to 27).

In the following figure, actual length is a monitored value. Actual length (Fb-06) = Number of pulses sampled by DI/Number of pulses per meter (Fb-07). When actual length (Fb-06) exceeds the set length (Fb-05), the relay or DO terminal assigned with function 10 outputs a "length reach" active signal. Length reset can be implemented through the multi-functional DI terminal assigned with function 28 (length reset). The following figure shows how to set the parameters for this function.

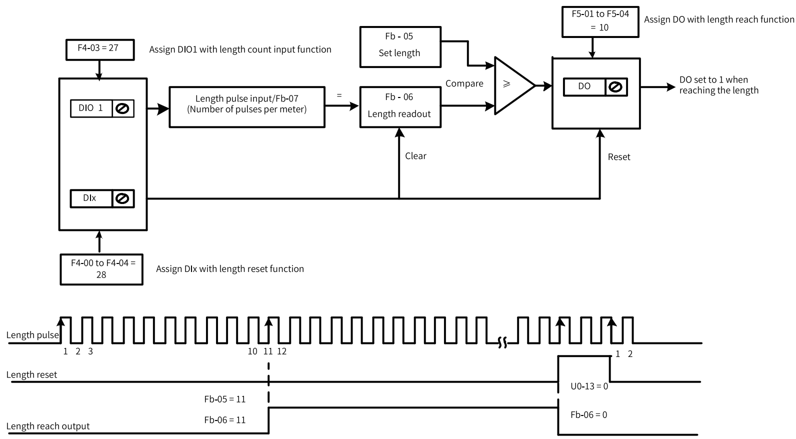


Figure 2-52 Fixed length

Para. No.	Name	Value	Description
F4-04	DI5 function selection	27	Length count input
F4-00 to F4-09 (any one)	DI1 to DI10 function selection (any one)	28	Length reset
F5-01 to F5-05 (any one)	Terminal output function selection (any one)	10	Length reach

In the fixed length control mode, direction cannot be obtained, and only length can be calculated according the number of pulses. An automatic stop system can be implemented by feeding the output length reach T/A-T/B signal from relay to the stop input terminal of the AC drive.

2.4.18Count Function

A DI terminal is needed to collect the count value (a DI5 terminal must be used in case of high pulse frequency). Assign the DI terminal with function 25 (counter input).

Para. No.	Function	Default	Value Range	Description
Fb-08	Set count value	1000	1 to 65535	When the count value reaches Fb-08, the multi-functional DO terminal outputs a "set count value reach" active signal.
Fb-09	Designated count value	1000	1 to 65535	When the count value reaches Fb-09, the multi-functional DO terminal outputs a "designated count value reach" active signal. Fb-09 must be lower than or equal to Fb-08 (set count value).

As shown in the following figure, a DI terminal is needed to collect the count value. Assign the DI terminal with function 25 (counter input). When the count value reaches Fb-08 (set count value), the multi-functional DO terminal outputs a "set count value reach" active signal. When the count value reaches Fb-09, the multi-functional DO outputs a "designated count value reach" active signal.

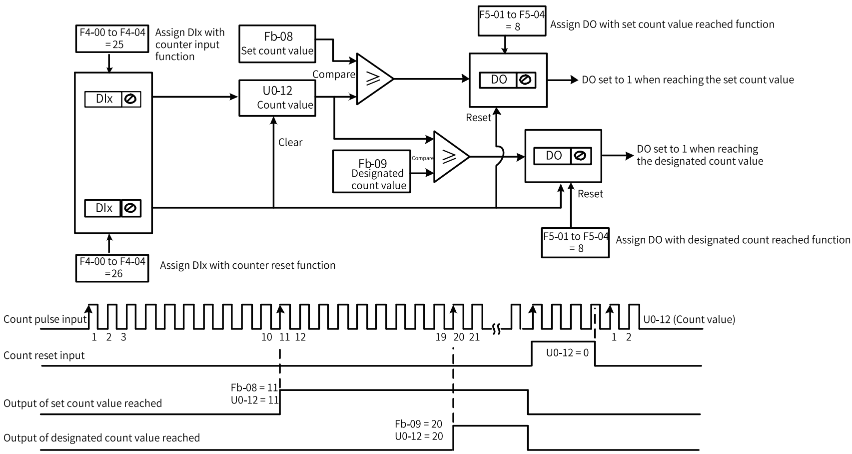


Figure 2-53 Count function

Para. No.	Name	Value	Description
F4-00 to F4-09 (any one)	DI1 to DI10 function selection (any one)	25	Counter input
F4-00 to F4-09 (any one)	DI1 to DI10 function selection (any one)	26	Counting reset
F5-01 to F5-04 (any one)	Terminal output function selection (any one)	8	Set count value reach
F5-01 to F5-04 (any one)	Terminal output function selection (any one)	9	Designated count value reach

- A DI5 terminal must be used in the case of high pulse frequency.
- One DO terminal can be assigned with either the "set count value reach" function or the "designated count value reach" function.
- When the AC drive is in RUN/STOP state, the counter keeps counting till reaching the "set count value".
- The count value is retentive at power failure.
- An automatic stop system can be implemented by feeding the output count value reach signal from DO to the stop input terminal of the AC drive.

2.4.19PID Adjustment Methods

This section describes general rules for PID parameter adjustment, which can be used as reference for adjusting closed-loop control PID parameters (FA-05 to FA-07, and FA-15 to FA-17) and speed loop PI parameters (F2-00, F2-01, F2-03, and F2-04).

1. In case of slow response, increase Kp.

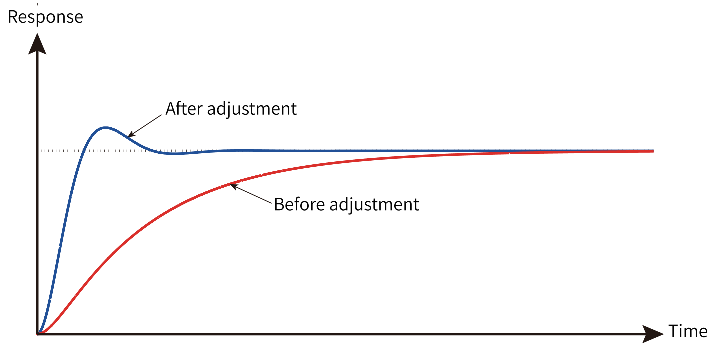


Figure 2-54 Response-time trend after increasing Kp

2. In case of frequent oscillation, reduce Kp.

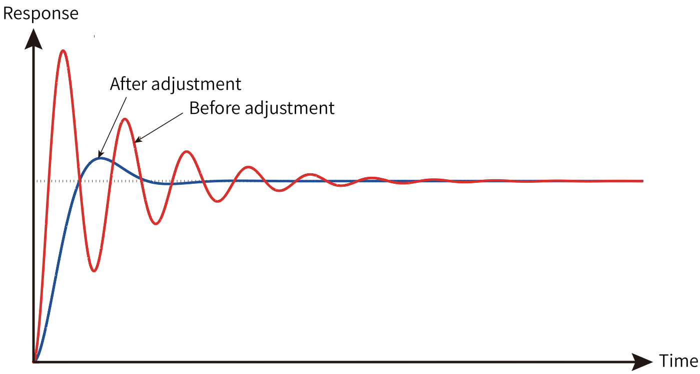


Figure 2-55 Response-time trend after decreasing Kp

3. In case of large overshoot and slow fluctuation, increase Ti.

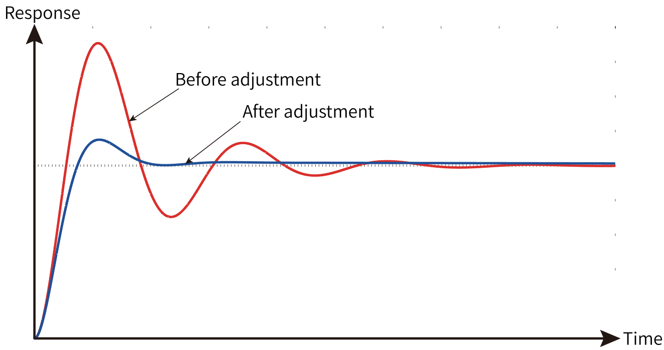


Figure 2-56 Response-time trend after increasing Ti

4. In case of large static difference and slow response at load fluctuation, increase Kp or decrease Ti.

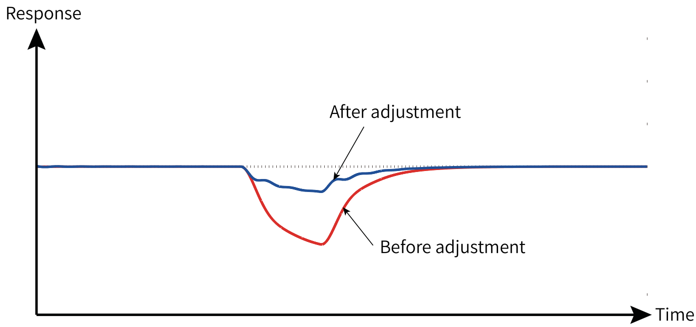


Figure 2-57 Response-time trend after increasing Kp at load fluctuation

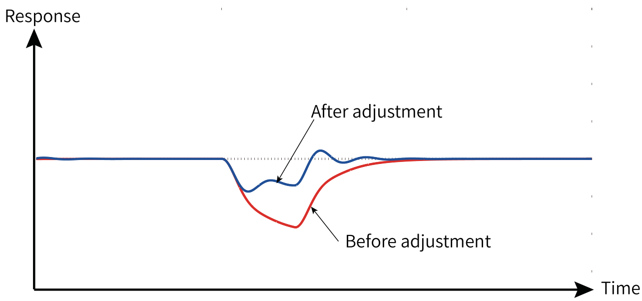


Figure 2-58 Response-time trend after decreasing Ti at load fluctuation

5. The system stability can be improved by incorporating derivative time Td properly (excessive proportion may cause interference and oscillation).

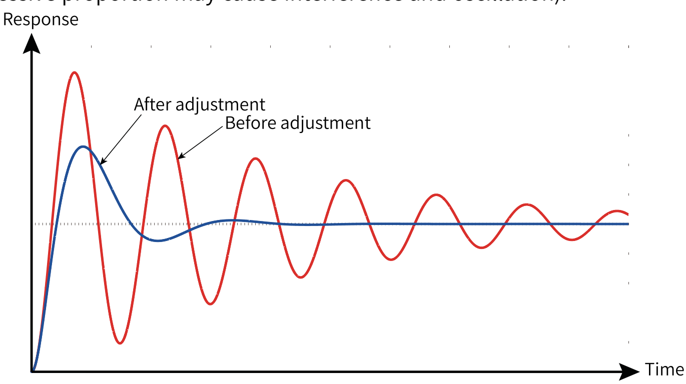


Figure 2-59 Response-time trend after incorporating Td

2.5 Application Control

2.5.1 Jogging

In some scenarios, the AC drive needs to run in jog mode for device testing. In jog running mode, the startup mode is direct startup (F6-00 is set to 0), and the stop mode is decelerate to stop (F6-10 is set 0). The following figure shows the relationship between output frequency and acceleration/deceleration time in jog running mode.

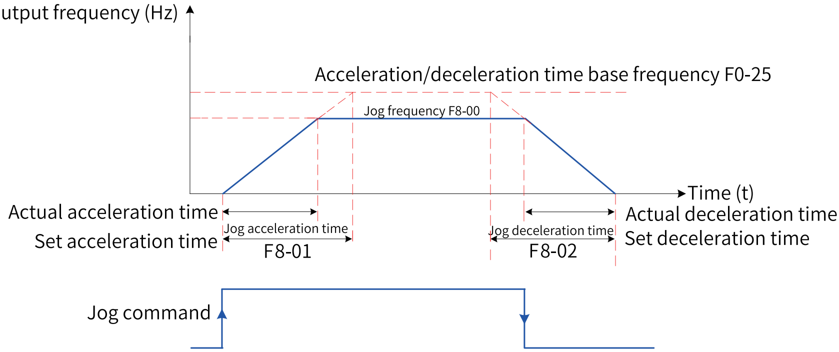


Figure 2-60 Jogging

Parameters

Para. No.	Function	Default	Value Range	Description
F0-02	Command source selection	0	0: Operating panel control 1: Terminal I/O control 2: Communication control	-
F0-25	Acceleration/Deceleration time base frequency	1	0: Max. frequency (F0-10) 1: Target frequency 2: 100 Hz	-
F7-01	MF.K key function selection	0	0: MF.K key disabled 1: Switchover between operating panel control and remote control (terminal I/O control or communication control) 2: Switchover between forward and reverse run 3: Forward jog 4: Reverse jog	-
F8-00	Jog frequency	2.00 Hz	0 to max. frequency (F0-10)	-
F8-01	Jog acceleration time	20.0s	0.0s to 6500.0s	-
F8-02	Jog deceleration time	20.0s	0.0s to 6500.0s	-
F8-13	Reverse run enable	0	0: Reverse running allowed 1: Reverse running inhibited	-
F8-27	Jog preferred	0	0: Disabled 1: Enabled	-

Example

In the following example, operating panel is used as the jog command source to illustrate how to set the parameters for jog running.

Table 2–30 Parameter settings for jog running through the LED operation panel

Step	Forward jog	Reverse jog
1	Set F7-01 to 3 to assign the MF.K key with forward jog.	Set F7-01 to 4 to assign the MF.K key with reverse jog. Set F8-13 (reverse run control) to 0 to allow reverse run.
2	Set F0-02 (command source selection) to 0 to select operating panel as command source.	Set F0-02 (command source selection) to 0 to select operating panel as command source.
3	Set F8-00 (jog frequency), F8-01 (jog acceleration time), and F8-02 (jog deceleration time) properly.	Set F8-00 (jog frequency), F8-01 (jog acceleration time), and F8-02 (jog deceleration time) properly.
4	In stop status, press down the MF.K key and the AC drive will start to jog in the forward direction. Release the MF.K key and the AC drive will decelerate to stop.	In stop status, press down the MF.K key and the AC drive will start to jog in the reverse direction. Release the MF.K key and the AC drive will decelerate to stop.

2.5.2 Frequency Detection

2.5.2.1 Multi-Speed Reference

In multi-reference mode, combinations of different DI terminal states correspond to different frequency references.

Table 2–31 Procedure of configuring multi-speed as frequency reference

Procedure	Para.	Description
Step 1: Select multi-speed as the frequency reference.	F0-03	Set F0-03 to 6.
Step 2: Set the quantity of references.	None.	A maximum of 16 references are supported, requiring four DI terminals. The relationship between the reference quantity and DI terminal quantity is as follows: Two references: one DI terminal K1 Three to four references: two DI terminals K1 and K2 Five to eight references: three DI terminals K1, K2, and K3 Nine to sixteen references: four DI terminals K1, K2, K3, and K4
Step 3: Set the multi-speed function for DI terminals.	F4-00 to F4-09	Multi-reference terminal K1: Set to 12
		Multi-reference terminal K2: Set to 13
		Multi-reference terminal K3: Set to 14
		Multi-reference terminal K4: Set to 15
Step 4: Set the frequency for each reference[Note]	FC-00 to FC-15	Set the frequency for each reference, in percentage. 100% corresponds to max. frequency F0-10.
	F0-10	When frequency reference is set to multi-speed, 100% of the parameters FC-00 to FC-15 corresponds to max. frequency F0-10.

[Note] The four multi-reference terminals can make up 16 state combinations, corresponding to 16 frequency reference values, as listed in the following table.

Table 2–32 Combinations of multi-speed terminals

K4	K3	K2	K1	Reference	Max. Frequency (%)
OFF	OFF	OFF	OFF	Multi-reference 0	FC-00
OFF	OFF	OFF	ON	Multi-reference 1	FC-01
OFF	OFF	ON	OFF	Multi-reference 2	FC-02
OFF	OFF	ON	ON	Multi-reference 3	FC-03
OFF	ON	OFF	OFF	Multi-reference 4	FC-04
OFF	ON	OFF	ON	Multi-reference 5	FC-05
OFF	ON	ON	OFF	Multi-reference 6	FC-06
OFF	ON	ON	ON	Multi-reference 7	FC-07
ON	OFF	OFF	OFF	Multi-reference 8	FC-08
ON	OFF	OFF	ON	Multi-reference 9	FC-09
ON	OFF	ON	OFF	Multi-reference 10	FC-10
ON	OFF	ON	ON	Multi-reference 11	FC-11
ON	ON	OFF	OFF	Multi-reference 12	FC-12
ON	ON	OFF	ON	Multi-reference 13	FC-13
ON	ON	ON	OFF	Multi-reference 14	FC-14
ON	ON	ON	ON	Multi-reference 15	FC-15

2.5.2.2 Frequency Detection (FDT)

This function is used to set detection thresholds of output frequency and sets hysteresis for the frequency detection function. The hysteresis is effective only in deceleration. Detection hysteresis is not supported in acceleration. The following figure shows the FDT function.

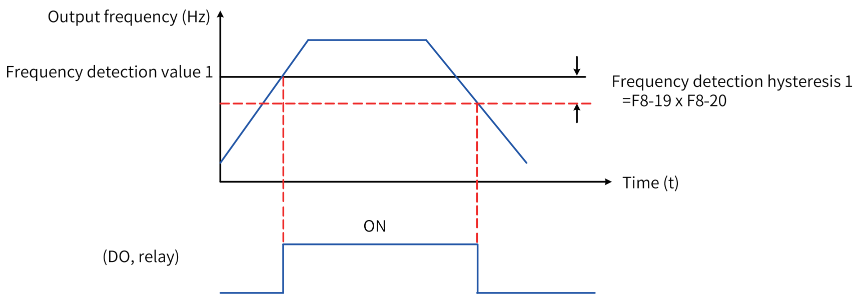


Figure 2-61 FDT

Table 2–33 FDT

Para. No.	Function	Default	Value Range	Description
F8-19	Frequency detection value (FDT1)	50.00 Hz	0 to max. frequency (F0-10)	When the running frequency is above the frequency detection value (FDT1), the DO terminal outputs the active signal. When the running frequency is below the result of the frequency detection value (FDT1) minus the frequency detection hysteresis (FDT1), the DO terminal outputs the inactive signal. The valid range is 0.00 Hz to F0-10 (max. frequency).
F8-20	Frequency detection hysteresis (FDT1)	5.0%	0.0% to 100.0%	Frequency detection hysteresis (FDT1) = F8-19 x F8-20 When the running frequency is above F8-19, the DO terminal outputs the active signal. When the running frequency is below a specific value (F8-19 - F8-19 x F8-20), the DO terminal outputs the inactive signal.
F8-28	Frequency detection value (FDT2)	50.00 Hz	0 to max. frequency (F0-10)	When the running frequency is above the frequency detection value (FDT2), the DO terminal outputs the active signal. When the running frequency is below the result of the frequency detection value(FDT2) minus the frequency detection hysteresis (FDT2), the DO terminal outputs the inactive signal. The valid range is 0.00 Hz to F0-10 (max. frequency).
F8-29	Frequency detection hysteresis (FDT2)	5.0%	0.0% to 100.0%	Frequency detection hysteresis (FDT2) = F8-28 x F8-29 When the running frequency is above F8-28, the DO terminal outputs the active signal. When the running frequency is below a specific value (F8-28 - F8-28 x F8-29), the DO terminal outputs the inactive signal.

2.5.2.3 Jump Frequency

You can set the jump frequency to enable the AC drive to avoid mechanical resonance point of load. The AC drive supports two jump frequencies. If both of them are set to 0, the jump frequency function is disabled.

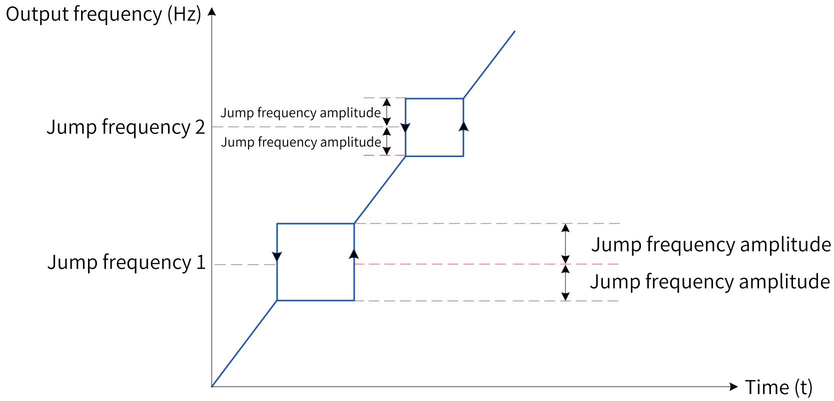


Figure 2-62 Jump frequency

In the preceding figure, when the running frequency approaches the jump frequency during acceleration, the AC drive runs for a period at the current running frequency and then jumps over the jump frequency. The jump range is twice F8-11 (jump frequency amplitude).

When the running frequency approaches the jump frequency during deceleration, the AC drive runs for a period at the current running frequency and then jumps over the jump frequency. The jump range is twice F8-11 (jump frequency amplitude).

Related parameters

Para. No.	Function	Default	Value Range	Description
F8-09	Jump frequency 1	0.00 Hz	0.00 to max. frequency (F0-10)	You can set the jump frequency to enable the AC drive to avoid mechanical resonance point of load. This parameter specifies the first jump frequency. If it is set to 0, the first frequency jump function is disabled.
F8-10	Jump frequency 2	0.00 Hz	0.00 to max. frequency (F0-10)	You can set the jump frequency to enable the AC drive to avoid mechanical resonance point of load. This parameter specifies the second jump frequency. If it is set to 0, the second frequency jump function is disabled.

Para. No.	Function	Default	Value Range	Description
F8-11	Jump frequency amplitude	0.00 Hz	0.00 Hz to 5.00 Hz	When the running frequency approaches the jump frequency during acceleration, the AC drive runs for a period at the current running frequency and then jumps over the jump frequency. The jump range is twice F8-11 (jump frequency amplitude). When the running frequency approaches the jump frequency during deceleration, the AC drive runs for a period at the current running frequency and then jumps over the jump frequency. The jump range is twice F8-11 (jump frequency amplitude).
F8-22	Enabling/ Disabling the jump frequency during acceleration and deceleration	0	0: Disabled 1: Enabled	Used to enable or disable the jump frequency function during acceleration/deceleration. If this parameter is set to 0, when the running frequency approaches the jump frequency during acceleration/ deceleration, the AC drive continues running at the current frequency. If this parameter is set to 1, when the running frequency approaches the jump frequency during acceleration/ deceleration, the AC drive jumps over the jump frequency. The jump range is twice F8-11 (jump frequency amplitude).

2.5.2.4 Reverse Frequency Inhibition

You can set F8-13 to disable reverse frequency. The following figure shows the diagram of disabling reverse frequency.

The motor rotation direction is set through F0-09. By editing F0-09, you can change the motor rotation direction without changing motor wiring. Editing this parameter is equivalent to exchanging any two of the motor U, V, W cables.

Note

After the parameter is initialized, the original rotation direction of the motor is resumed. Exercise cautions when using this function if motor rotation direction change is prohibited after system commissioning is complete.

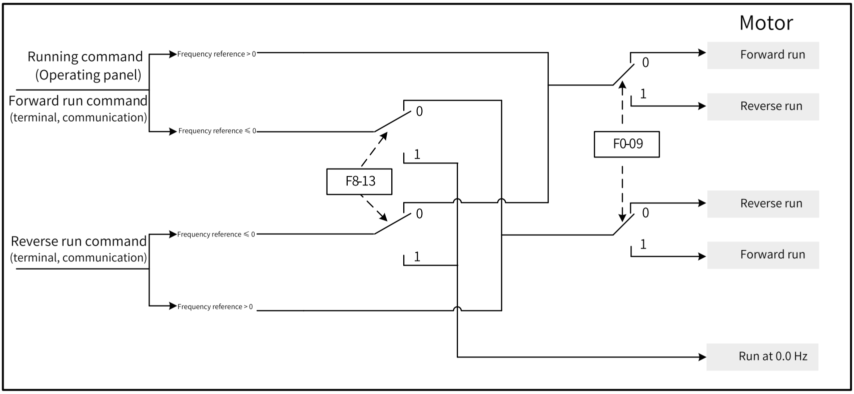


Figure 2-63 Reverse frequency inhibition

Related parameters

Para. No.	Function	Default	Value Range	Description
F8-13	Reverse run enable	0	0: Reverse running allowed 1: Reverse running inhibited	When F8-13 is set to 0, enter a reverse command to the AC drive and the motor will run at zero frequency.
F0-09	Running direction selection	0	0: Default direction 1: Opposite to the default direction	You can change the rotation direction of the motor by editing this parameter without changing the motor wiring. Editing this parameter is equivalent to changing any two of the motor's U, V, W wires.

2.5.2.5 Detection Width for Frequency Reach

You can use F8-21 to set the detection width for frequency reach. The following figure shows the timing diagram of this function.

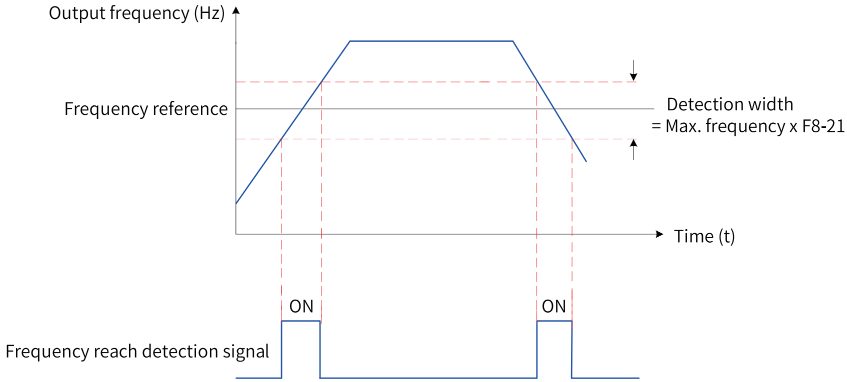


Figure 2-64 Sequence of detection width for frequency reach

Related parameter

Para. No.	Function	Default	Value Range	Description
F8-21	Detection Width for Frequency Reach	0.00%	0.00% to 100.00% (max. frequency)	Numeric value of detection width for frequency reach = F8-21 (detection width for frequency reach) x F0-10 (max. frequency). The DO terminal outputs the active signal when the running frequency of the AC drive is in the specific range (Frequency reference±F0-10 x F8-21).

2.5.2.6 Switchover Frequency of Acceleration/Deceleration Time

This function is used to switch the acceleration/deceleration time based on the running frequency range when the AC drive is running.

The following figure shows acceleration/deceleration time switchover. During acceleration, acceleration time 2 is selected if the running frequency is below F8-25, and acceleration time 1 is selected if the running frequency is above F8-25. During deceleration, deceleration time 1 is selected if the running frequency is above F8-26, and deceleration time 2 is selected if the running frequency is below F8-26.

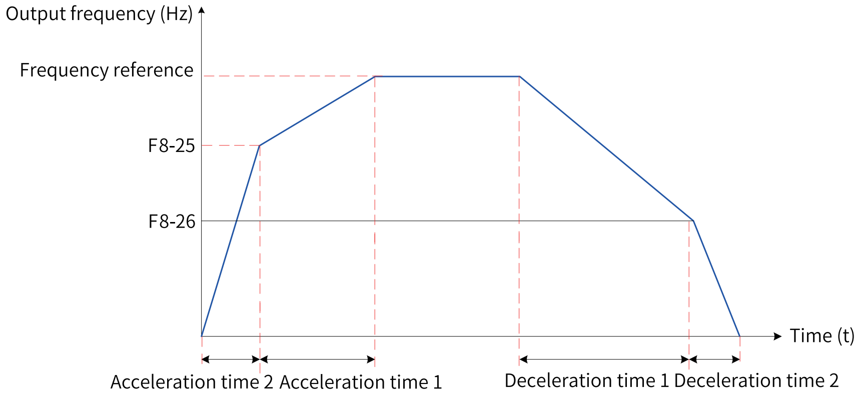


Figure 2-65 Switchover of acceleration/deceleration time

This function is valid only when motor 1 is selected (F0-24 (motor parameter group selection) is set to 0) and the DI terminal function is not set to 16 (acceleration/deceleration time selection terminal 1) or 17 (acceleration/deceleration time selection terminal 2).

Related parameters

Para. No.	Function	Default	Value Range	Description
F8-25	Switchover frequency of acceleration time 1 and acceleration time 2	0.00 Hz	0 to max. frequency (F0-10)	This function is used to switch the acceleration/deceleration time based on the running frequency range when the AC drive is running. This function is valid only when motor 1 is selected (F0-24 (motor parameter group selection) is set to 0) and the DI terminal function is not set to 16 (acceleration/deceleration time selection terminal 1) or 17 (acceleration/deceleration time selection terminal 2). The valid range is 0.00 Hz to F0-10 (max. frequency).
F8-26	Switchover frequency of deceleration time 1 and deceleration time 2	0.00 Hz	0 to max. frequency (F0-10)	

2.5.2.7 Detection Value for Frequency Reach

The DO terminal outputs the active signal when the running frequency of the AC drive is within the range of the detection value for frequency reach plus or minus the detection width for frequency reach.

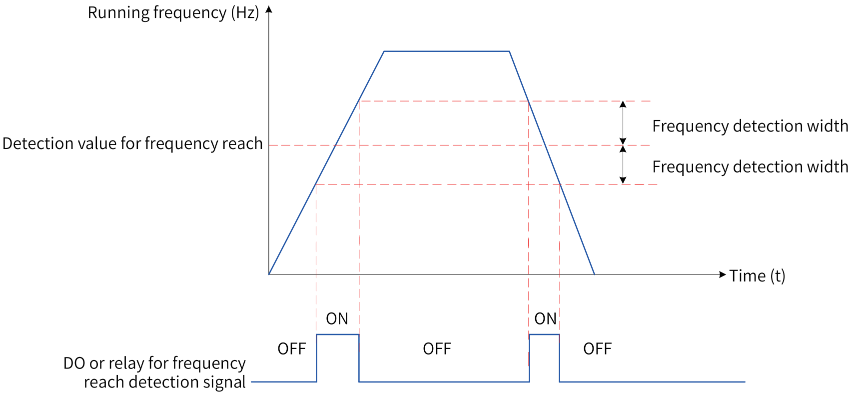


Figure 2-66 Detection of frequency reach

Related parameters

Para. No.	Function	Default	Value Range	Description
F8-30	Detection value for frequency reach 1	50.00 Hz	0 to max. frequency (F0-10)	When the running frequency is in the frequency detection range, the DO terminal outputs the active signal. The valid range is 0.00 Hz to F0-10 (max. frequency).
F8-31	Detection width for frequency reach 1	0.0%	0.0% to 100.0%	Numeric value of detection width for frequency reach 1 = F0-10 (max. frequency) x F8-31 Frequency detection range = F8-30 (detection value for frequency reach 1)±F8-31 (detection width for frequency reach 1) x F0-10 (max. frequency)
F8-32	Detection value for frequency reach 2	50.00 Hz	0 to max. frequency (F0-10)	When the running frequency is in the frequency detection range, the DO terminal outputs the active signal. The valid range is 0.00 Hz to F0-10 (max. frequency).
F8-33	Detection width for frequency reach 2	0.0%	0.0% to 100.0%	Numeric value of detection width for frequency reach 2 = F0-10 (max. frequency) x F8-33 Frequency detection range = F8-32 (detection value for frequency reach 2)±F8-33 (detection width for frequency reach 2) x F0-10 (max. frequency)

2.5.3 Current Detection

2.5.3.1 Zero Current Detection

The DO outputs the active signal when the output current of the AC drive remains at or below F8-34 (zero current detection level) for a period greater than the value of F8-35 (zero current detection delay).

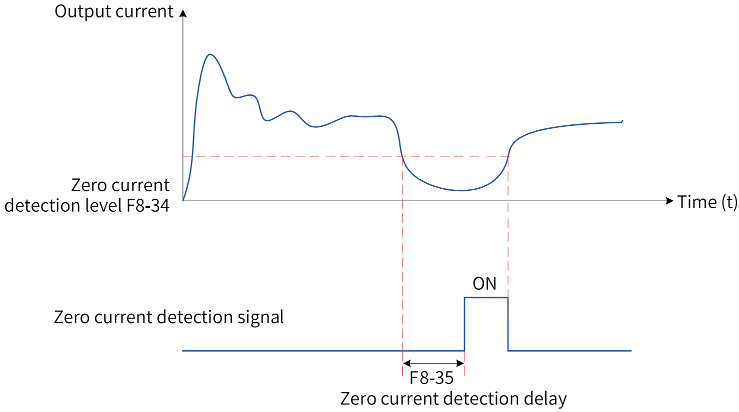


Figure 2-67 Zero current detection

Related parameters

Para. No.	Function	Default	Value Range	Description
F8-34	Zero current detection level	5.0%	0.0% to 300.0% (rated motor current)	The DO outputs the active signal when the output current of the AC drive remains at or below F8-34 (zero current detection level) for a period greater than the value of F8-35 (zero current detection delay).
F8-35	Zero current detection delay	0.10s	0.00s to 600.00s	

2.5.3.2 Output Current Limit Violation

The DO terminal outputs the active signal when the output current of the AC drive remains above F8-36 (output limit violation threshold) for a period greater than the value of F8-37 (output overcurrent detection delay).

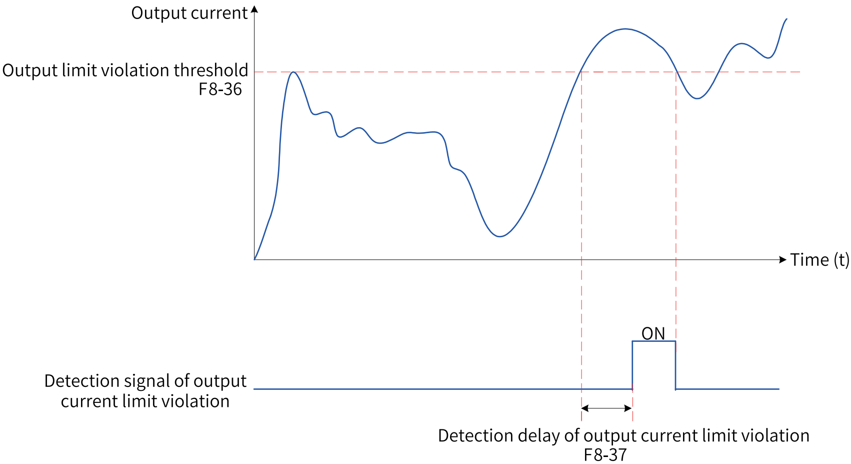


Figure 2-68 Detection of output current limit violation

Related parameters

Para. No.	Function	Default	Value Range	Description
F8-36	Output overcurrent threshold	200.0%	0.0% (no detection) 0.1% to 300.0% (rated motor current)	The DO terminal outputs the active signal when the output current of the AC drive remains above F8-36 (output current threshold) for a period greater than the value of F8-37 (output overcurrent detection delay).
F8-37	Output overcurrent detection delay	0.00s	0.00s to 600.00s	

2.5.3.3 Detection Level of Current

The DO terminal outputs the active signal when the output current of the AC drive is within the range of "Detection level of current 1±Detection width of current 1 x Rated motor current".

The AC drive supports two sets of current detection levels and current detection widths. The following figure shows the function.

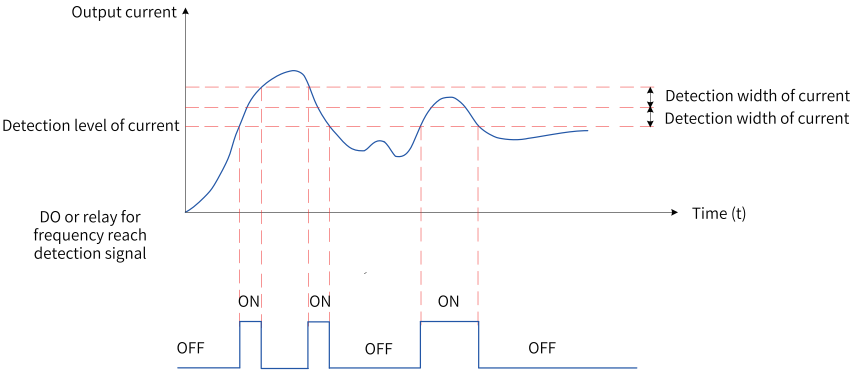


Figure 2-69 Timing diagram of detection level of current

Related parameters

Para. No.	Function	Default	Value Range	Description
F8-38	Detection level of current 1	100.0%	0.0% to 300.0% (rated motor current)	The DO terminal outputs the active signal when the output current of the AC drive is in the range of F8-38±F8-39 x F1-03, where F8-38 is detection level of current 1, F8-39 is detection width of current 1, and F1-03 is rated motor current.
F8-39	Detection width of current 1	0.0%	0.0% to 300.0% (rated motor current)	Numeric value of detection width of current 1 = F8-39 (detection width of current 1) x F1-03 (rated motor current)
F8-40	Detection level of current 2	100.0%	0.0% to 300.0% (rated motor current)	The DO terminal outputs the active signal when the output current of the AC drive is in the range of (F8-40±F8-39) x F1-03, where F8-40 is detection level of current 2, F8-39 is detection width of current 1, and F1-03 is rated motor current.
F8-41	Detection width of current 2	0.0%	0.0% to 300.0% (rated motor current)	Numeric value of detection width of current 2 = F8-41 (detection width of current 2) x F1-03 (rated motor current)

2.5.4 Forward/Reverse Run Switchover Dead Zone Time

This function is used to specify the transition period when the output is 0 Hz during forward/reverse run switchover of the AC drive. The transition period is called forward/reverse run switchover dead zone time, which can be set through F8-12.

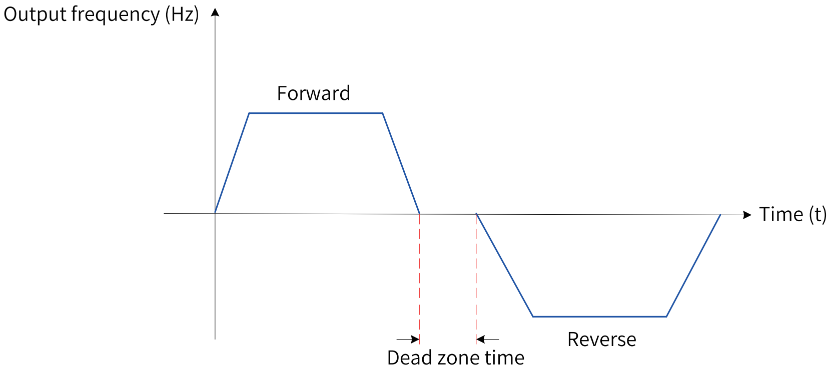


Figure 2-70 Forward/reverse run switchover dead zone time

Related parameter

Para. No.	Function	Default	Value Range	Description
F8-12	Forward/Reverse run switchover dead zone time	0.0s	0.0s to 3000.0s	Used to set the transition period when the output is 0 Hz during forward/reverse run switchover of the AC drive.

2.5.5 Timing Function

The timer starts from 0 upon startup of the AC drive. When the timing duration (F8-44) expires, the AC drive automatically stops, and the DO terminal outputs the active signal. You can use U0-20 to view the remaining running time.

- The DO terminal outputs the active signal when the accumulative power-on time (F7-13) of the AC drive exceeds the accumulative power-on time threshold (F8-16).
- The DO terminal outputs the active signal when the accumulative running time (F7-09) of the AC drive exceeds the accumulative running time threshold (F8-17).

Related parameters

Para. No.	Function	Default	Value Range	Description
F8-42	Timing function	0	0: Disabled 1: Enabled	When F8-42 (timing function) is set to 1 and the running time of the AC drive reaches the specified timing duration, the DO terminal outputs the active signal. The timing duration is set through F8-43 and F8-44.
F8-43	Timing duration source	0	0: F8-44 1: AI1 2: AI2	If this parameter is set to 0, the timing duration is determined by F8-44. If this parameter is set to 1, the timing duration can be calculated through the following formula: Timing duration = (AI1 voltage/10 V) x F8-44. 100% of the analog input range corresponds to the value of F8-44. If this parameter is set to 2, the timing duration can be calculated through the following formula: Timing duration = (AI2 voltage/10 V) x F8-44. 100% of the analog input range corresponds to the value of F8-44.
F8-44	Timing duration	0.0 min	0.0 min to 6500.0 min	The timing duration is set through F8-43 and F8-44.

Table 2–34 Power-on time threshold

Para. No.	Function	Default	Value Range	Description
F8-16	Accumulative power-on time threshold	0 h	0 h to 65000 h	Used to set the accumulative power-on time threshold of the AC drive. When F7-13 (accumulative power-on time) exceeds F8-16 (accumulative power-on time threshold), the DO terminal outputs the active signal.

Table 2–35 Running time reach

Para. No.	Function	Default	Value Range	Description
F8-17	Accumulative running time threshold	0 h	0 h to 65000 h	Used to set the accumulative running time threshold of the AC drive. When F7-09 (accumulative running time) exceeds F8-17 (accumulative running time threshold), the DO terminal outputs the active signal.

2.5.6 Upper and Lower Limits of AI1 Voltage Protection

Para. No.	Function	Default	Value Range	Description
F8-45	AI1 input voltage lower limit	3.10 V	0.00 V to F8-46	If AI1 input is above F8-46 or below F8-45, the DO terminal of the AC drive outputs the active signal of "AI1 input limit exceeded".
F8-46	AI1 input voltage upper limit	6.80 V	F8-45 to 10.00 V	

2.5.7 IGBT Temperature

Para. No.	Function	Default	Value Range	Description
F8-47	IGBT temperature threshold	75°C	0°C to 100°C	The DO terminal outputs the active signal when the heatsink temperature of the IGBT reaches F8-47.
F7-07	Heatsink temperature of IGBT	-	0.0°C to 99.9°C	Used to indicate the heatsink temperature of the IGBT.

2.5.8 Cooling Fan Working Mode

Para. No.	Function	Default	Value Range	Description
F8-48	Cooling fan working mode	0	0: Working during drive operation	When this parameter is set to 0, the fan works during operation of the AC drive. When the AC drive stops, the fan works if heatsink temperature is above 40°C and stops if heatsink temperature is below 40°C.
			1: Working continuously	When this parameter is set to 1, the fan keeps working after power-on.

2.6 Tension Control

2.6.1 Control Mode Selection

Select a proper tension control mode and winding mode based on actual situations. Correct running direction setting is necessary for proper tension control.

Para. No.	Name	Default	Value Range	Description
B0-00	Tension control mode	0	0: Disabled	Similar to general functions of the AC drive, basic operations such as parameter auto-tuning and direction judgment must be performed in this mode.
			1: Tension open-loop torque control	Tension/position detection and feedback are not required. In torque control mode, the AC drive calculates the target torque to control the tension on materials. Use FVC to achieve optimal control effect.
			2: Tension closed-loop speed control	Tension/position detection and feedback are required. In speed control mode, the AC drive superposes PID closed-loop operation frequency according to the synchronous frequency calculated based on the linear speed and roll diameter. In this way, the target frequency is updated in real time to realize the tension or position stability. SVC, V/f or FVC can be selected.
			3: Tension closed-loop torque control	Tension detection and feedback are required. In torque control mode, the target torque can be calculated based on PID adjustment or main + PID adjustment to implement tension control. Use FVC to achieve optimal control effect.
			4: Constant linear speed control	In speed control mode, the AC drive adjusts its running frequency according to the change in roll diameter to ensure constant linear speed of the system. SVC, V/f or FVC can be selected.

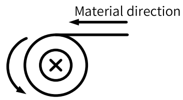
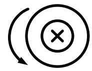
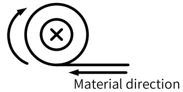
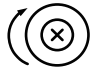
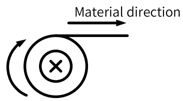
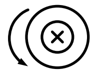
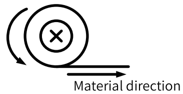
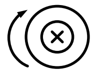
When DI function 60 (exit tension control) is activated, settings in the preceding modes become invalid and the AC drive exits the tension control mode.

Para. No.	Name	Default	Value Range	Description
B0-01	Winding mode	0	0: Winding	This parameter is used together with function 58 of the DI terminal (winding/unwinding switchover terminal) to determine the winding mode. When the winding/unwinding switchover terminal is disabled, the winding mode setting is the same as the parameter setting. When the winding/unwinding switchover terminal is enabled, the winding mode setting is opposite to the parameter setting.
			1: Unwinding	

Para. No.	Name	Default	Value Range	Description
F0-09	Running direction selection	0	0: Default direction	Set this parameter properly to ensure normal winding/unwinding function. See the following description for how to determine the direction.
			1: Reverse of the default direction	

Judging the running direction

When B0-00 is set to 1 (tension control mode disabled), the AC drive runs in speed control mode and its running direction should be the same as the target winding direction (opposite to the target unwinding direction). Otherwise, edit the parameter to correct the direction. Check the running direction according to the following figure.

Winding Mode	With-load Running Direction	No-load Running Direction (Speed Control Mode)
Winding		
		
Unwinding		
		

Note

For the first run, determine the running direction and set the parameter properly. When the switchover between winding and unwinding is required, modify B0-01 directly, or change the state of the winding/unwinding switching terminal without modifying B0-01 (otherwise, misfunction may occur).

2.6.2 Tension Open-Loop Torque Control

In this mode, no swing rod (floating roller) or tension sensor is required, no closed tension loop is formed, but the tension accuracy is slightly poor. This control mode is applicable to scenarios where tension accuracy is not critical.

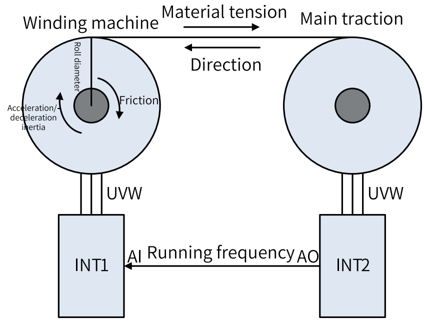


Figure 2-71 Application of tension open-loop torque control

In the preceding figure, the winding machine runs in tension open-loop torque control mode. The roll diameter is calculated based on the linear speed and the target torque is updated based on the set material tension and current roll diameter. You can set the friction compensation torque and dynamic inertia compensation torque as needed to improve the tension control effect.

2.6.3 Tension Closed-Loop Torque Control

In this mode, a tension sensor is used to feed back the material tension and the target frequency is regulated in closed-loop mode to ensure constant tension.

The main + PID mode or pure PID mode can be configured as needed. The main + PID mode incorporates the operation torque in tension open-loop torque mode, whereas the pure PID mode achieves constant tension control through torque adjustment by pure PID. To optimize dynamic response, enable friction and inertia compensation. This mode is applicable to materials with regular elasticity or applications with small speed adjustment margin.

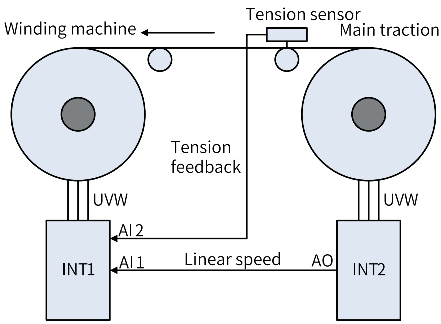


Figure 2-72 Application of tension closed-loop torque control

In the preceding figure, when the winding machine works in closed-loop torque control mode, two AI signal channels receive tension sensor signals and main traction motor running frequency signals, respectively. When tension is controlled in the "open-loop tension reference plus tension sensor regulation" mode, the torque of friction and inertia compensation can be set as needed.

When a tension sensor is used to control tension of elastic materials, the closed-loop speed control mode can also be used.

2.6.4 Tension Closed-Loop Speed Control

In this mode, a swing rod (floating roller) or tension sensor is used to feed back material tension. The output frequency of the AC drive is regulated in the closed-loop mode to ensure stable swing rod position or constant tension. The tension is controlled by linear speed synchronous frequency and PID closed-loop frequency. This mode is applicable to scenarios where the speed can be adjusted (the system has an swing rod for pre-charge) or the material can be pulled and stretched.

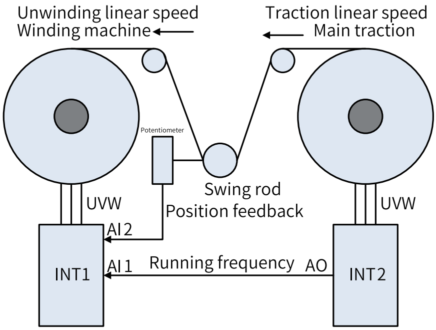


Figure 2-73 Application of tension closed-loop speed control

As shown in the preceding figure, when the winding machine works in closed-loop speed control mode, two AI signal channels receive swing rod position potentiometer signals and main traction motor running frequency signals, respectively. The roll diameter is calculated based on linear speed control. The target frequency depends on the main frequency calculated based on linear speed synchronous frequency and the closed-loop regulation based on swing rod position feedback.

The general-purpose AC drive supports main frequency + PID as the frequency source. In tension control mode, the roll diameter is calculated in real time to facilitate matching between the main frequency and linear speed. Therefore, the tension control stability and speed are improved.

2.6.5 Roll Diameter Calculation

Roll diameter is a required parameter in any tension control mode. Select a proper calculation method and set the related parameters correctly to ensure accuracy of the roll diameter. Otherwise, the tension control function may fail.

Para. No.	Name	Default	Value Range	Description
B0-07	Roll diameter calculation method	0	0: Calculated based on linear speed	This calculation method is independent of material thickness. The roll diameter is calculated based on linear speed and running frequency in real time, so the error is not accumulated. Note: This calculation method is applicable to central winding/unwinding instead of surface winding/ unwinding. *"Figure 2–74 Surface winding/unwinding" on page 191* is a diagram of typical surface winding/ unwinding, where the AC drive shaft is not coaxial with the winding/winding shaft, so the roll diameter cannot be calculated based on linear speed.
			1: Calculated based on accumulative thickness	This calculation method does not require linear speed. The roll diameter is calculated based on the accumulative material thickness and revolution calculation signals. The calculation result is stable, but the error is accumulated. Set the following parameters for this application: ● Material thickness: B0-31 to B0-36 ● Revolution calculation signal source: Function 61 of the DI terminal (revolution count signal) ● Operation relationship: B0-29 (number of pulses per revolution) and B0-30 (revolutions per layer, for wire rods)
			2: AI1	The roll diameter can be obtained through one of methods 2 to 6. These methods can be used in scenarios where the roll diameter is directly measured by using a sensor or calculated outside the AC drive. When the preceding calculation methods are used, the maximum roll diameter (B0-08) must be set correctly based on the per-unit relationship. When AI1 is enabled (B0-07 is set to 2), 100.0% AI1 input must correspond to the maximum roll diameter (B0-08).
			3: AI2	
			4: AI3	
			5: Pulse input (DI5)	
			6: Communication (1000H)	
			7: Digital setting (B0-14)	When calculation method 7 is used, the roll diameter is directly set through B0-14 and used for additional communication address or manual roll diameter setting.

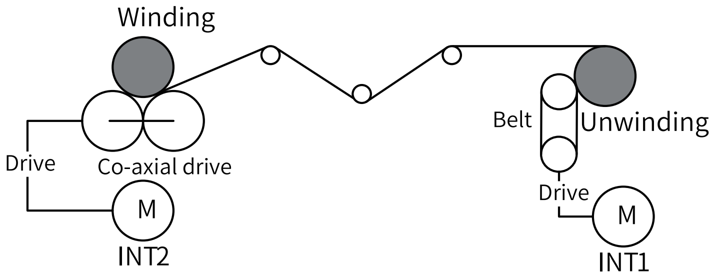


Figure 2-74 Surface winding/unwinding

Para. No.	Name	Default	Value Range	Description
B0-08	Maximum roll diameter	500.0 mm	0.1 mm to 6000.0 mm	The actual full roll diameter. In the tension control mode, this parameter provides the following functions: 1. Setting the upper limit for roll diameter calculation; 2. Calibrating values related to roll diameter(see B0-07 and B0-10); 3. Resetting the optional unwinding roll diameter (see B0-10).

Para. No.	Name	Default	Value Range	Description
B0-09	Reel diameter	100.0 mm	0.1 mm to 6000.0 mm	The actual reel diameter. In the tension control mode, this parameter provides the following functions: 1. Setting the lower limit for roll diameter calculation; 2. Resetting the optional winding roll diameter (see B0-10).

<table>
<tr><th>Para. No.</th><th>Name</th><th>Default</th><th>Value Range</th><th>Description</th></tr>
<tr><td rowspan="5">B0-10</td><td rowspan="5">Initial roll diameter source</td><td rowspan="5">0</td><td>0: B0-11 to B0-13</td><td>Parameter B0-10 is used to select an input channel of the initial roll diameter. When B0-10 is set to 0, the source of initial roll diameter is dependent on functions 55 and 56 (initial roll diameter selection terminal) of the DI terminal and related to the winding mode.
By default, the source of initial roll diameter is set to B0-08 or B0-09, depending on the winding mode. For the relationship between the initial winding sources and settings, see "Table 2–36 Relationship between the initial winding sources and settings" on page 192.</td></tr>
<tr><td>1: AI1</td><td rowspan="4">The initial roll diameter can be obtained through calculation methods 1 to 4. When the preceding calculation methods are used, the maximum roll diameter (B0-08) must be set correctly based on the per-unit relationship.</td></tr>
<tr><td>2: AI2</td></tr>
<tr><td>3: AI3</td></tr>
<tr><td>4: Communication (1000H)</td></tr>
</table>

Table 2–36 Relationship between the initial winding sources and settings

DI2	DI1	Initial roll diameter source
0	0	B0-09 (winding) or B0-08 (unwinding)
0	1	B0-11
1	0	B0-12
1	1	B0-13

Note

When the system is shut down due to reel replacement, running faults, or other reasons, the roll diameter often changes. To ensure accurate roll diameter during startup of the system, roll diameter reset must be performed by enabling the function 54 of the DI terminal (roll diameter reset).

Para. No.	Name	Default	Value Range	Description
B0-11	Initial roll diameter 1	100.0 mm	0.1 mm to 6000.0 mm	Initial roll diameters 1 to 3. See B0-10.
B0-12	Initial roll diameter 2	100.0 mm	0.1 mm to 6000.0 mm	
B0-13	Initial roll diameter 3	100.0 mm	0.1 mm to 6000.0 mm	
B0-14	Current roll diameter	100.0 mm	0.1 mm to 6000.0 mm	This parameter shows the current roll diameter in real time. The current roll diameter can be modified by editing this parameter, and the roll diameter calculation result will overwrite this parameter (unless B0-07 is set to 7). This method can also be used to reset the roll diameter.
B0-18	Roll diameter reset during running	0	0: Disabled 1: Enabled	This parameter can be used to enable roll diameter reset during operation.

Table 2–37 Parameters for roll diameter calculation based on linear speed (they affect roll diameter calculation only when B0-07 is set to 0)

Para. No.	Name	Default	Value Range	Description
B0-03	Mechanical transmission ratio	1.00	0.01 to 300.00	This parameter specifies the ratio of motor speed to reel speed. Set B0-03 based on the mechanical transmission structure. When the roll diameter is calculated based on linear speed (B0-07 is set to 0), a larger value of B0-03 means a larger roll diameter, and vice versa. According to this rule, the parameter can be corrected according to the deviation between the calculated roll diameter and the actual value.
B0-06	Minimum linear speed for roll diameter calculation	20.0 m/min	0.1 m/min to 6500.0 m/min	This parameter is enabled only when B0-07 is set to 0. When the linear speed is lower than the value of B0-06, the current roll diameter is maintained. When the linear speed is higher than the value of B0-06, the roll diameter is re-calculated. This parameter can be used to address inaccurate roll diameter calculation for low-frequency operation and acceleration.

Para. No.	Name	Default	Value Range	Description
B0-15	Roll diameter filter time	5.00s	0.00s to 10.00s	This parameter is enabled only when B0-07 is set to 0. You can set B0-15 to filter roll diameter calculation results and suppress roll diameter jitter. A larger value of B0-15 means smoother calculated roll diameter and longer delay in roll diameter changes. Rule: When the roll diameter changes linearly, the time that the calculated roll diameter lags behind the actual roll diameter is basically equal to this parameter value.
B0-16	Roll diameter change rate	0	0: Disabled 0.1 mm/s to 1000.0 mm/s	This parameter is enabled only when B0-07 is set to 0. You can set B0-16 to a non-zero value to limit the change of roll diameter per unit of time and prevent abnormally fast change. An excessively low roll diameter change rate may result in large delay in roll diameter calculation. Set the change rate properly based on the actual conditions, for example, based on the maximum change rate corresponding to the linear speed of 100.0 m/min.
B0-17	Roll diameter change direction limit	0	0: Disabled 1: Decrease inhibited during winding, and increase inhibited during unwinding	This parameter is enabled only when B0-07 is set to 0. You can set B0-17 to limit the roll diameter change direction. Use this function only when B0-16 is set properly; otherwise, abnormal roll diameter fluctuation may occur and result in a large deviation of the roll diameter calculation result.

Table 2–38 Parameters for roll diameter calculation based on accumulative thickness (they affect roll diameter calculation only when B0-07 is set to 1)

Para.	Name	Default	Value Range	Description
B0-29	Number of pulses per revolution	1	1 to 60000	This parameter specifies the number of pulses per revolution of the reel.
B0-30	Revolutions per layer	1	1 to 10000	This parameter specifies the number of revolutions for each layer of winded materials, generally used for wire rods. For wire rods, set B0-30 to 1.

Para.	Name	Default	Value Range	Description
B0-31	Material thickness reference source	0	0: Digital setting 1: AI1 2: AI2 3: AI3	You can set B0-31 to select a source of material thickness. 0: Digital setting When B0-31 is set to 0, the material thickness is affected by DI terminal functions 62 and 63 (the material thickness selection terminals). Example: When B0-31 is set to 0, set DI1 to DI terminal function 62 and DI2 to DI terminal function 63. For material thickness, see *"Table 2–39 Material thickness" on page 195*. The initial roll diameter can be obtained through calculation methods 1 to 3. When the preceding calculation methods are used, the maximum material thickness (B0-36) must be set correctly based on the per-unit relationship.
B0-32	Material thickness 0	0.01 mm	0.00 mm to 100.00 mm	Material thickness 0 to 3. See B0-31.
B0-33	Material thickness 1	0.01 mm	0.00 mm to 100.00 mm	
B0-34	Material thickness 2	0.01 mm	0.00 mm to 100.00 mm	
B0-35	Material thickness 3	0.01 mm	0.00 mm to 100.00 mm	
B0-36	Maximum material thickness	1.00 mm	0.00 mm to 100.00 mm	Maximum material thickness. See B0-31.

Table 2–39 Material thickness

DI2	DI1	Initial Roll Diameter Source
0	0	Depending on B0-32
0	1	Depending on B0-33
1	0	Depending on B0-34
1	1	Depending on B0-35

2.6.6 Linear Speed

In closed-loop speed control mode, the winding synchronous frequency reference is calculated based on linear speed. Linear speed is required in roll diameter calculation. Linear speed can also be used for pre-charge, inertia compensation, friction compensation, and other functions. Therefore, linear speed is an important part of tension control.

Para. No.	Name	Default	Value Range	Description
B0-04	Linear speed input source	0	0: No input 1: AI1 2: AI2 3: AI3 4: Reserved 5: Communication (1000H)	0: No input 1 to 5: The maximum linear speed must be set properly based on per-unit relationship.
B0-05	Maximum linear speed	1000.0 m/min	0.0 m/min to 6500.0 m/min	Used to set the maximum linear speed Corresponds to the actual linear speed when B0-04 is set to 1, 2, 3, 4 or 5 (100.0% input). The maximum linear speed is not necessarily the same as the one required for production. Distinguish two parameters when you set them. When the roll diameter is calculated based on linear speed (B0-07 is set to 0), a larger value of this parameter means larger roll diameter, and vice versa. According to this rule, the parameter can be corrected according to the deviation between the calculated roll diameter and the actual value.
B0-41	Source of constant linear speed	0	0: AI1 1: AI2 2: AI3 3: Reserved 4: Communication (1000H)	Used to select the target linear speed source in constant linear speed control mode. Similarly, this parameter is also calibrated based on the maximum linear speed (B0-05).

2.6.7 Constant Linear Speed Control

Different from preceding modes, this mode is applicable to scenarios where no specific traction is used to directly control the material tension; instead, the winding or unwinding machine runs at a constant linear speed and serves as the traction motor, and the material tension is controlled by the winding/unwinding operation.

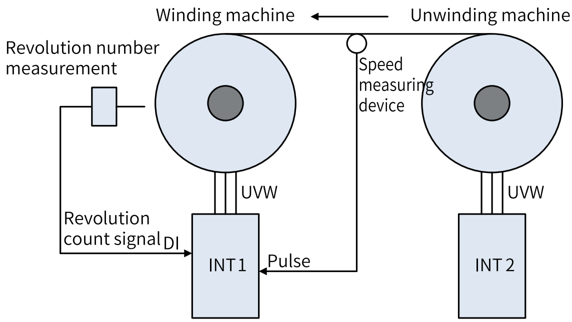


Figure 2-75 Application of constant linear speed control

In the preceding figure, the winding machine serves as the traction motor. To make the system run at a constant linear speed, the roll diameter must be calculated in either of the following two modes:

1. Assign the DI terminal with the revolution count signal function to calculate the roll diameter in thickness overlying mode based on revolution count signals.
2. Install a speed measuring device to measure the material linear speed and calculate the roll diameter based on the measured linear speed. Update the target frequency based on the target linear speed and current roll diameter to make the system run at a constant linear speed.

Note: the preceding typical applications are only given to describe the applicable scenarios of the four tension control modes. Other modes may be selected based on the actual conditions if the basic conditions are met.

2.6.8 Application Restrictions

Table 2–40 Required conditions for tension control modes

Function/Restriction	Roll Diameter[Note 1]	Linear Speed	Control Feedback
1. Tension open-loop torque control	Required	Not required[Note 2]	Not required
2. Tension closed-loop speed control	Required	Required	Required
3. Tension closed-loop torque control	Required	Not required	Required
4. Constant linear speed control	Required	Not required	Not required

Note 1: If the roll diameter is calculated based on linear speed control (B0-07 is set to 0), the linear speed is required.

Note 2: Inertia and friction compensation is associated with linear speed, so the linear speed is required in such applications.

2.6.9 Tension Setting

In either open-loop torque control mode (B0-00 is set to 1) or closed-loop torque control mode (B0-00 is set to 3), tension control is implemented by controlling the output torque. Therefore, a target tension must be set based on material characteristics and production requirements.

Para. No.	Name	Default	Value Range	Description
B1-00	Tension setting source	0	0: B1-01 1: AI1 2: AI2 3: AI3 4: Pulse reference (DI5) 5: Communication (1000H)	0: B1-01 (digital setting) 1 to 5: Indicates the ratio (in percentage) of the target tension to the maximum tension. The maximum tension (B1-02) must be set properly based on the per-unit relationship.
B1-01	Digital setting of tension	50 N	0 N to 65000 N	Used to set the tension through digital setting. For details, see mode 0 of B1-00.
B1-02	Maximum tension	200 N	0 N to 65000 N	Used to select the maximum tension. B1-02 corresponds to the tension when B1-00 is set to 1, 2, 3, 4 or 5 (100.0% input). When the actual tension does not meet requirements, corrections can be performed by editing this parameter without changing AI, pulse input signals or curves.

2.6.10PID Closed-Loop Adjustment

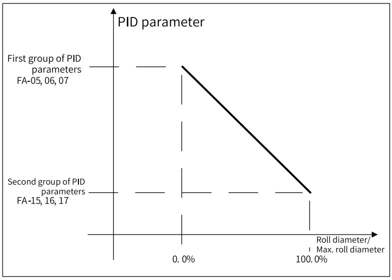
In closed-loop speed control mode (B0-00 is set to 2) and closed-loop torque control mode (B0-00 is set to 3), PID closed-loop control based on the open-loop reference is important to ensure control accuracy. Therefore, the parameters for PID closed-loop control must be set properly.

When B0-00 is set to 2 or 3, Group FA parameters required for closed-loop control, such as PID reference source, PID feedback source, PID direction, and PID proportional and integral parameters, need to be set properly based on actual conditions.

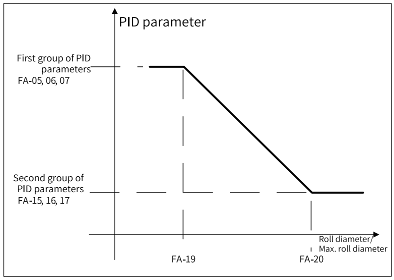
Only some particular PID parameters are introduced here. For details of standard parameters, see descriptions of Group FA parameters.

The roll diameter based PID parameter switchover function is added for the tension control mode.

Para. No.	Name	Default	Value Range	Description
FA-18	PID parameter switchover condition	0	0: No switchover 1: Switchover by DI 2: Automatic switchover based on deviation 3: Switchover based on running frequency 6: Automatic adjustment based on roll diameter 7: Adjustment based on percentage of max. roll diameter	Used for switchover between two groups of PID parameters. 0: No switchover Switchover is disabled. 1: Switchover by DI Assign the DI terminal with function 43 (PID parameter switchover). When this terminal is disabled, parameter group 1 (FA-05 to FA-07) is used. When this terminal is enabled, parameter group 2 (FA-15 to FA-17) is used. 2: Automatic switchover based on deviation When the absolute value of the deviation between the reference and feedback values is less than FA-19 (PID parameter switchover deviation 1), parameter group 1 is used for PID control. When the absolute value of the deviation between the reference and feedback values is greater than FA-20 (PID parameter switchover deviation 2), parameter group 2 is used for PID control. When the absolute value of the deviation between the reference and feedback values is between FA-19 and FA-20, the linear interpolated values of the two groups of PID parameters are used. 3: Switchover based on running frequency Auto switchover is implemented based on the running frequency of the AC drive. 6: Automatic adjustment based on roll diameter In this automatic switchover mode, when the current roll diameter changes between the maximum roll diameter (B0-08) and minimum roll diameter (B0-09), the linear interpolated values of the two groups of PID parameters are used. The minimum roll diameter corresponds to the first group of parameters (FA-05 to FA-07), and the maximum roll diameter corresponds to the second group of parameters (FA-15 to FA-17). 7: Adjustment based on percentage of max. roll diameter In this automatic switchover mode, when the current roll diameter changes between the result of the maximum roll diameter (B0-08) multiplied by FA-20 and the result of the maximum roll diameter (B0-08) multiplied by FA-19, the linear interpolated values of the two groups of PID parameters are used.



6: Automatic adjustment 1 based on roll diameter



7: Automatic adjustment 2 based on roll diameter

Figure 2-76 Automatic adjustment based on roll diameter

2.6.11Winding Speed Limits and Unwinding Tightening in Reverse Direction

These parameters are valid only in torque mode (B0-00 is set to 1 or 3).

No.	Scenario	Description
1	Winding scenarios where the winding speed is not limited (subject to the frequency upper limit).	B0-28 = 0 The winding speed is subject to the frequency upper limit.
2	Winding scenarios where the winding speed is limited.	B0-28 = 1 The winding speed limit is calculated according to the following formula, where the synchronous frequency is the running frequency of the winding machine that matches the current linear speed: Winding frequency upper limit = Synchronous frequency x (1 + B0-26) + B0-27 See *"Table 2–41 Parameters" on page 201*.
3	Unwinding scenarios where revers tightening is disabled	B0-02 = 0
4	Unwinding scenarios where revers tightening is enabled	Reverse tightening at fixed linear speed can be enabled through B0-02. See *"Table 2–41 Parameters" on page 201*.

Table 2–41 Parameters

Para. No.	Name	Default	Value Range	Description
B0-26	Winding frequency limit	50.0%	0.0% to 100.0%	Limit percentage (a percentage of the linear speed synchronous frequency)
B0-27	Winding frequency limit offset	5.00 Hz	0.00 Hz to 100.00 Hz	Limit offset (fixed frequency)
B0-02	Unwinding tightening in reverse direction	0	0: Disabled 0.1 m/min to 500.0 m/min	When B0-02 is set to 0, at zero material speed, the unwinding reel has no output and the material is not tightened. When B0-02 is set to a value between 0.1 m/min to 500.0 m/min, under no-load conditions or if the material is in loose state, the unwinding reel runs at the set linear speed in the reverse direction; at zero material speed, the unwinding real maintains output and the material is tightened.

2.6.12PID Adjustment Limit

This function is valid only in closed-loop mode (B0-00 is set to 2 or 3).

No.	Scenario	Description
1	The closed-loop speed control mode is used and the closed-loop limit is associated with the synchronous frequency.	B0-28 = 0 Closed-loop adjustment limit = Linear speed synchronous frequency x B0-26 + B0-27
2	The closed-loop speed control mode is used and the closed-loop limit is set to a fixed frequency.	B0-28 = 1 Closed-loop adjustment limit = B0-27 See *"Table 2–42 Parameters" on page 201*.
3	The closed-loop torque control mode is used and the closed-loop limit is set to a fixed torque.	The limit is set through B1-16 and the value is a percentage of the motor rated torque. See *"Table 2–42 Parameters" on page 201*.

Table 2–42 Parameters

Para. No.	Name	Default	Value Range	Description
B0-26	Winding frequency limit	50.0%	0.0% to 100.0%	Limit percentage (a percentage of the linear speed synchronous frequency)
B0-27	Winding frequency limit offset	5.00 Hz	0.00 Hz to 100.00 Hz	Limit offset (fixed frequency)
B1-16	Tension closed-loop torque control limit	100.0%	0.0% to 200.0%	Used to limit the ratio (in percentage) of the closed-loop torque control value to the open-loop control torque reference in the closed-loop torque control mode (B0-00 is set to 3).

2.6.13 Tension Torque Compensation

This part is only applicable to the torque control mode. The parameters in this part shall be set properly to optimize the tension control effect, improve the tension stability, and optimize the system response speed.

These parameters can be set for the open-loop torque control mode (B0-00 = 1) and are generally omitted for the closed-loop torque control mode (B0-00 = 3).

Running friction compensation parameters

When the motor runs stably, the output torque is transferred to material tension and rotation friction. If the rotation friction cannot be ignored, the output torque needs compensation for friction.

Para. No.	Name	Default	Value Range	Description
B1-07	Friction force compensation coefficient	0.0%	0.0% to 50.0%	In tension control mode, the AC drive automatically sets the target torque according to the tension reference and roll diameter. The target torque is increased (winding)/decreased (unwinding) according to B1-07 to offset the effect of friction on material tension. This parameter corresponds to the percentage of rated torque of the AC drive.
B1-17	Friction force compensation correction coefficient	0.0%	-50.0% to +50.0%	In most scenarios, friction may vary with running frequency. If the ideal friction compensation effect cannot be realized by setting B1-07, set B1-17 together. For details, see B1-18. This parameter corresponds to the percentage of rated torque of the AC drive.
B1-18	Friction force compensation curve	0	0: Running frequency 1: Linear speed 2: Multi-friction compensation curve 1 3: Multi-friction compensation curve 2	Five friction compensation modes are available to meet the complex friction change rule. 0: Running frequency In some scenarios, the friction changes with the system running frequency. When B1-18 is set to 0, the friction compensation value is determined using the following formula: Friction compensation torque = B1-07 x (1 + Frequency converted based on linear speed/ Maximum frequency x B1-17) 1: Linear speed This mode is similar to mode 0. The friction compensation is based on linear speed and the friction compensation value is determined using the following formula: Friction compensation torque = B1-07 x (1 + Linear speed/Maximum linear speed x B1-17) 2: Multi-friction compensation curve 1 In some scenarios, the friction does not change linearly with the running frequency. The friction compensation correction can be based on a multi-friction compensation curve to obtain the dynamic friction compensation value by using the frequency converted based on linear speed. For details, see B1-19 to B1-24. 3: Multi-friction compensation curve 2 Compared with compensation curve 1, compensation curve 2 is more flexible but needs more parameters. For details, see B1-19 to B1-30 in *"Figure 2–80 DI torque boost function" on page 208*.

Para. No.	Name	Default	Value Range	Description
B1-19	Multi-friction compensation torque 1	0.0%	0.0% to 50.0%	-
B1-20	Multi-friction compensation torque 2	0.0%	0.0% to 50.0%	-
B1-21	Multi-friction compensation torque 3	0.0%	0.0% to 50.0%	-
B1-22	Multi-friction compensation torque 4	0.0%	0.0% to 50.0%	-
B1-23	Multi-friction compensation torque 5	0.0%	0.0% to 50.0%	-
B1-24	Multi-friction compensation torque 6	0.0%	0.0% to 50.0%	-
B1-25	Multi-friction compensation inflexion point 1	0.00 Hz	0.00 Hz to max. frequency	-
B1-26	Multi-friction compensation inflexion point 2	0.00 Hz	0.00 Hz to max. frequency	-
B1-27	Multi-friction compensation inflexion point 3	0.00 Hz	0.00 Hz to max. frequency	-
B1-28	Multi-friction compensation inflexion point 4	0.00 Hz	0.00 Hz to max. frequency	-
B1-29	Multi-friction compensation inflexion point 5	0.00 Hz	0.00 Hz to max. frequency	-
B1-30	Multi-friction compensation inflexion point 6	0.00 Hz	0.00 Hz to max. frequency	-

The preceding parameters are used for multi-friction compensation curves 1 and 2.

When B1-18 is set to 2, parameters B1-19 to B1-24 are enabled; when B1-18 is set to 3, parameters B1-19 to B1-30 are enabled.

The change curves of friction compensation values are as shown in the following two figures. You can set B1-18 based on actual conditions:

When B1-18 is set to 2, friction compensation curve 1 is as follows:

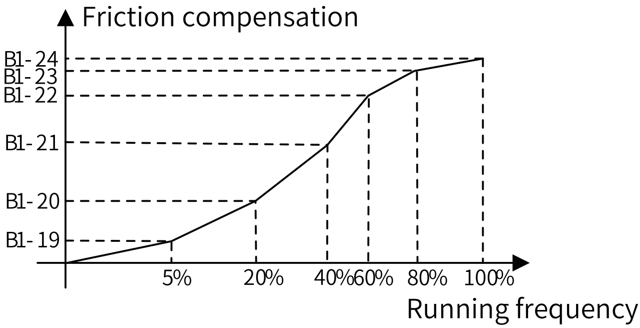


Figure 2-77 Friction compensation curve 1

When B1-18 is set to 3, friction compensation curve 2 is as follows:

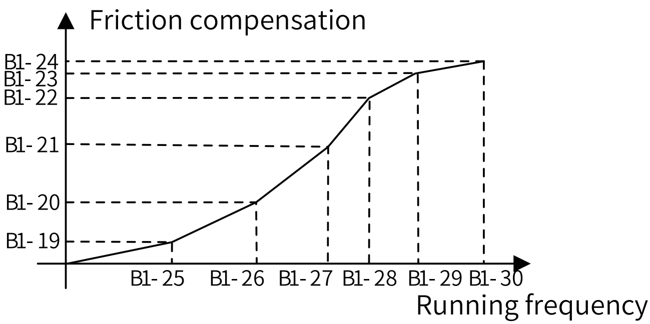


Figure 2-78 Friction compensation curve 2

Startup friction compensation parameters

In some scenarios, the reel is subject to large startup friction, which makes system difficult to start. In this case, torque compensation can be provided during startup and canceled once the system runs properly to ensure constant tension.

Para. No.	Name	Default	Value Range	Description
B1-03	Zero-speed threshold	0.0%	0.0% to 20.0%	When the running frequency is lower than the value of this parameter, startup friction compensation is enabled based on B1-04. When the running frequency is higher than the value of this parameter, startup friction compensation is disabled.
B1-04	Zero-speed tension boost	0.0%	0.0% to 100.0%	This parameter corresponds to the percentage of tension reference and must be set properly according to the range of allowable material tension. Set this parameter to a possible minimal value on the premise of ensuring normal startup.
B1-14	Transition frequency for zero speed compensation	2.00 Hz	0.00 Hz to 200.00 Hz	This parameter supports smooth switchover of tension boost in zero speed.

The preceding three parameters can be used together for static friction compensation, as shown below.

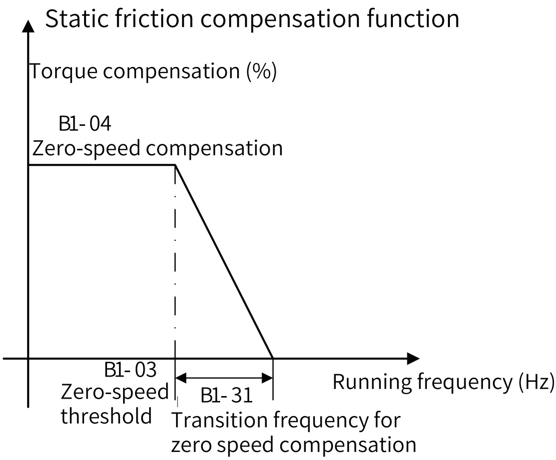


Figure 2-79 Static friction compensation

Inertia compensation parameters

In the open-loop torque control mode, the output torque provides material tension and overcomes rotation inertia of the system during acceleration or deceleration.

In any of the following cases, consider inertia compensation:

1. Small material tension during acceleration of winding
2. haha
3. Large material tension during deceleration of winding
4. Large material tension during acceleration of unwinding

5. Small material tension during deceleration of unwinding

The inertia of a winding/unwinding system consists of mechanical inertia and material inertia. The parameter can be set according to the value mapping between mechanical inertia and material inertia. If the material is heavy and the reel is light, only the parameters related to material inertia need to be set, and vice versa.

Note

Accurate linear speed is required for inertia compensation.

Para. No.	Name	Default	Value Range	Description
B1-08	Mechanical flywheel inertia	0 NM^2	0 NM^2 to 65535 NM^2	Set B1-08 based on the actual mechanical flywheel inertia. For general cylindrical mechanical reels, the theoretical value of mechanical flywheel inertia can be obtained using the following formula: $GD_m^2 = \frac{\pi g}{8i^2}\gamma b(D^4 - D_0^4)$ Where, g is the gravitational acceleration (9.8 m/s^2), γ is the density of machine materials, b is the length of the mechanical reel, D and D_0 are respectively the outer diameter and inner diameter (0 for a solid reel) of the mechanical reel, and i is the transmission ratio. The international system of units (SI) is applied. The setting value can be adjusted according to the actual change of material tension during acceleration or deceleration.
B1-11	Material density	0 kg/m^3	0 kg/m^3 to 65535 kg/m^3	Set B1-11 and B1-12 based on the material properties. Ensure accurate setting of B0-03 (mechanical transmission ratio). The AC drive automatically calculates the flywheel inertia according to the material density, material width, reel diameter, and material roll diameter.
B1-12	Material width	0 mm	0 mm to 65535 mm	
B1-09	Acceleration inertia compensation gain	100.0%	0.0% to 200.0%	An inevitable deviation exists between the theoretical inertia and the actual inertia, so the inertia compensation effect may not be ideal even after the inertia parameters are set. To address this, set B1-09 and B1-10 for fine tuning to optimize the control effect. Taking winding acceleration as an example, if the material tension is low, increase the value of B1-09 to improve the compensation effect, and vice versa. The winding deceleration case follows the same rule. This set of parameters facilitates commissioning.
B1-10	Deceleration inertia compensation gain	100.0%	0.0% to 200.0%	

Terminal tension boost

In some scenarios, customized torque boost is required.

When the DI terminal (assigned with function 61) is activated, the tension torque is boosted. After the DI terminal is deactivated, the boost part is canceled gradually.

Para. No.	Name	Default	Value Range	Description
B1-34	Terminal tension boost ratio	50.0%	0.0% to 500.0%	-
B1-35	Boost cancellation transition time	0.0s	0.0s to 50.0s	-

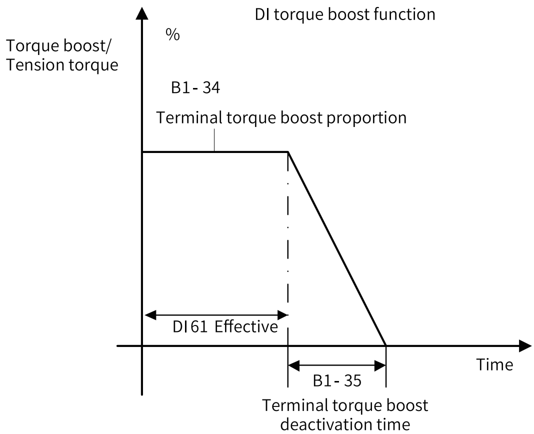


Figure 2-80 DI torque boost function

Torque direction control parameters

Para. No.	Name	Default	Value Range	Description
B1-15	Open-loop torque reverse	0	0: Disabled 1: Enabled	This parameter is valid only when B0-00 is set to 1 or 3. When friction compensation and inertia compensation are added, the calculated torque value is likely to be negative. You can set B1-15 to select the solution for reverse torque. Torque direction is controlled by default. You can set B1-15 to 1 to enable reverse torque.

2.6.14Taper

In some scenarios, the tension should be reduced with the increase of the roll diameter to ensure smooth winding. For this purpose, set taper parameters properly. This group of parameters is valid only in the winding mode (B0-01 is set to 0).

Para. No.	Name	Default	Value Range	Description
B2-00	Taper curve selection	0	0: Curve 1: Multi-taper	Used to select the taper curve generation mode. 0: Curve The taper curve is generated based on the taper setting and the correction coefficient of taper compensation (B2-03). For details, see B2-03. 1: Multi taper For details, see B2-08 to B2-19.
B2-01	Tension taper source	0	0: B2-02 1: AI1 2: AI2 3: AI3 4: Communication (1000H)	0: B2-02 (digital setting) 1 to 3: Set based on AI1 to AI3. 4: Set through the communication address 1000H.
B2-02	Digital setting of taper	0.0%	0.0% to 100.0%	Used to set the taper through digital setting. For details, see mode 0 of B2-01.
B2-03	Correction coefficient of taper compensation	0 mm	0 mm to 10000 mm	Used to set the correction coefficient of taper compensation. You can set the preceding parameters to set the curve taper based on the taper setting. The taper value can be determined by using the following formula (multiple modes are available and the following gives a typical example): F = F_0 x {1 - K x [1 - (D_0 + D_1)/(D + D_1)]} Where, F is the tension after taper is set; F_0 is the tension before taper is set, determined by B1-00; K is the taper value, determined by B2-01; D_0 is the reel diameter set through B0-09; D is the current roll diameter set through B0-14; D_1 is the correction coefficient of taper compensation.
B2-05	Maximum external taper source	0	0: B2-06 1: AI1 2: AI2 3: AI3 4: Communication	In some scenarios, material tension is determined by external actuators. The external taper output function can be use to control the external actuators to achieve proper the tension taper. The maximum external taper determines FMP or AO (F5-06 to F5-08). For the external taper output (function 19), the maximum taper output is the value obtained under no-load conditions. The source of external taper is set through this parameter. 0: B2-06 (digital setting) 1 to 3: Set based on AI1 to AI3. 4: Set through the communication address 1000H.
B2-06	Maximum external taper setting	100.0%	0.0% to 100.0%	Used to set the maximum external taper (digital setting). For details, see mode 0 of B2-05.

Para. No.	Name	Default	Value Range	Description
B2-08	Taper at minimum roll diameter	100.0%	0.0% to 100.0%	-
B2-09	Linear taper switchover point 1	150.0 mm	B0-09 to B0-08	-
B2-10	Taper of switchover point 1	100.0%	0.0% to 100.0%	-
B2-11	Linear taper switchover point 2	200.0 mm	B2-09 to B0-08	-
B2-12	Taper of switchover point 2	90.0%	0.0% to 100.0%	-
B2-13	Linear taper switchover point 3	250.0 mm	B2-11 to B0-08	-
B2-14	Taper of switchover point 3	80.0%	0.0% to 100.0%	-
B2-15	Linear taper switchover point 4	300.0 mm	B2-13 to B0-08	-
B2-16	Taper of switchover point 4	70.0%	0.0% to 100.0%	-
B2-17	Linear taper switchover point 5	400.0 mm	B0-15 to B0-08	-
B2-18	Taper of switchover point 5	50.0%	0.0% to 100.0%	-
B2-19	Taper at maximum roll diameter	30.0%	0.0% to 100.0%	-

The following figure shows a multi-point linear taper curve, where the ordinate represents the ratio of tension after taper is set to original tension, and the abscissa represents the roll diameter. You can set the preceding parameters to obtain a multi-liner taper curve.

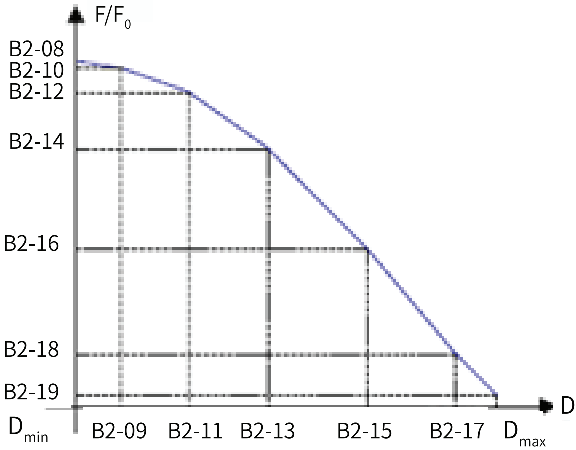


Figure 2-81 Multi-point linear taper curve

2.6.15Pre-drive

The pre-drive function is applied to automatic reel replacement scenarios. To achieve a shockless roll change, ensure that the linear speed of the new roll matches that of the material when replacing a full roll with a new roll. For this purpose, enable function 57 (Pre-drive terminal) of the DI terminal and set the pre-drive parameters properly.

Accurate linear speed and roll diameter are required for this function.

Para. No.	Name	Default	Value Range	Description
B0-19	Pre-drive frequency gain	0.0%	–100.0% to +100.0%	For pre-drive, the running frequency is automatically calculated based on the linear speed and roll diameter to ensure matching with the linear speed of the material. For small deviation of linear speed, set B0-19 to increase or decrease the running frequency during pre-drive, ensuring accurate linear speed matching.
B0-20	Pre-drive torque limit source	0	0: F2-09 1: Based on tension control torque	In torque control mode, the system automatically calculates the target torque to meet the requirements on material tension. In regular mode, set the target torque through F2-09. This parameter provides the preceding sources of target torque in the pre-drive mode. You can select one according to your needs. 0: Set the target torque based on F2-09. 1: Set the target torque based on the open-loop torque control mode (for mode 1 and mode 3 only).
B0-21	Pre-drive torque correction	0.0%	–100.0% to +100.0%	This function is activated when B0-20 is set to 1, and is used to correct the tension control torque in the pre-drive mode. To prevent slow pre-drive acceleration due to a small torque limit when B0-20 is set to 1, set a lower torque limit in pre-drive mode.
B0-40	Minimum torque limit in pre-drive mode	0.0%	0.0% to 100.0%	Settings of these functions correspond to the acceleration/deceleration time at minimum roll diameter. When the roll diameter increases, increase the acceleration/deceleration time proportionally to avoid impact caused by excessively quick acceleration/deceleration at a large roll diameter.
B0-23	Pre-drive acceleration time	0.0%	0.0s to 6500.0s	
B0-24	Pre-drive deceleration time	1.0s	0.0s to 6500.0s	
B0-25	Pre-drive roll diameter calculation function	0	0: Disabled 1: Enabled	This parameter is valid only when B0-07 is set to 1. When the roll diameter is calculated based on accumulative thickness, the roll diameter increases/decreases with the number of revolutions. Set B0-25 to 1 to avoid accumulative error caused by invalid roll diameter calculation in the pre-drive mode. You can set this parameter according to the actual operations.

2.6.16Constant Linear Speed Mode

In this mode, the running frequency for winding and unwinding is automatically calculated based on the set target linear speed.

Para. No.	Name	Default	Value Range	Description
B0-41	Constant linear speed input source	0	0: AI1 1: AI2 2: AI3 3: Pulse reference (DI5) 4: Communication	0 to 2: Set through AI terminals. 3: Pulse input. 4: Set through the communication address 1000H.
B0-19	Pre-charge frequency gain	0.0%	–100.0% to +100.0%	For pre-charge, the running frequency is automatically calculated based on the linear speed and roll diameter to ensure matching with the linear speed of the material. For small deviation of linear speed, set B0-19 to increase or decrease the running frequency during pre-charge, ensuring accurate linear speed matching.

2.6.17Optimization Parameters for Control Mode

Parameters for tension setup at zero speed in closed-Loop control mode

Generally, the AC drive can run without the need for additional configuration of closed-loop control.

Configure the following parameters in scenarios demanding accurate tension setup at zero speed or roll diameter auto-tuning during tension setup at zero speed.

Para. No.	Name	Default	Value Range	Description
B1-31	Tension setup at pre-speed	0	0: Disabled 1: Enabled	In closed-loop control mode, if B1-31 is set to 0, the tension setup at pre-speed function is disabled. If B1-31 is set to 1, the tension setup at pre-speed function is enabled.
B1-32	Tension setup dead zone	2.0%	0.0% to 100.0%	When the tension setup at pre-speed function is enabled and PID feedback is below B1-32, PID calculation stops.
B1-33	Pre-speed of tension setup	0.10 Hz	0.00 Hz to F0-10	Used to set the running frequency in scenarios where the tension setup at pre-speed function is enabled but the system is not in the tension setup dead zone.

For details about tension setup at zero speed, see *"Figure 2–82 Diagram of tension setup at zero speed" on page 214*. You can set B1-31 to 1 to enable the tension setup at pre-speed function and set B1-32 to define the tension setup dead zone.

When PID feedback is below the tension setup dead zone, PID calculation stops and the reel runs at a fixed frequency to slowly wind the material.

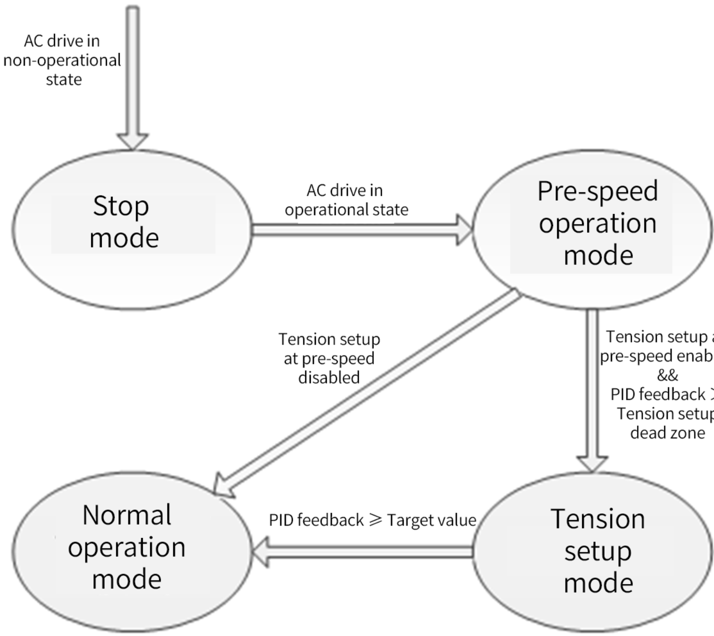


Figure 2-82 Diagram of tension setup at zero speed

Parameters for initial roll diameter auto-tuning

When the tension setup at pre-speed function is enabled, you can also enable the initial roll diameter auto-tuning function. During tension setup, the AC drive auto-tunes the initial roll diameter to remove the need for roll diameter reset or initial roll diameter input (for tension setup at zero speed in FVC mode only).

Para. No.	Name	Default	Value Range	Description
B1-37	Initial roll diameter auto-tuning selection	0	0: Disabled 1: Enabled	When the tension setup at pre-speed function is enabled, you can also enable the initial roll diameter auto-tuning function for the AC drive to auto-tune the initial roll diameter. This function is applicable to rod control only. This function is enabled when B1-37 is set to 1, and disabled when B1-37 is set to 0.
B1-38	Rod length	300 mm	1 mm to 65535 mm	The rod length after the initial roll diameter is auto-tuned.
B1-39	Rod angle	40°	0.1° to 360.0°	The rod angle after the initial roll diameter is auto-tuned.

Parameters for tension closed-loop torque control mode

You can set the tenson in closed-loop torque control mode by using PID alone or main torque + PID.

Para. No.	Name	Default	Value Range	Description
B0-38	Closed-loop speed control limit selection	0	0: Torque calculated through pure PID 1: Torque calculated through main + PID	The main torque is the torque calculated when B0-00 is set to 1. In pure PID mode, the set friction and inertia compensation are still valid, but the tension torque is invalid. In main + PID mode, set the tension corresponding to the condition that the PID feedback value indicates 100.0% and input B1-02.

2.6.18Related I/O Functions

Functions of DI terminals

You can select DI functions by using parameters F4-00 to F4-09 or virtual DI terminals.

1. DI function 53: Revolution count signal
   When roll diameter is calculated based on accumulative thickness, set this function for the DI terminal to input revolution count signals from the terminal.
2. DI function 54: Roll diameter reset
   Roll diameter reset during reel replacement is necessary for tension control. It ensures accurate roll diameter at the moment when the system is started after reel replacement, and also ensures normal system startup and proper material tension.
3. DI functions 55 and 56: Initial roll diameter selection terminals 1 and 2
   These functions provide initial roll diameter switchover modes to meet different requirements for different reels or materials. For details of use, see B0-10.
4. DI function 57: Pre-charge input terminal
   When the terminal is activated, the AC drive is switched to the pre-charge speed control mode. When the terminal is deactivated after reel replacement, the tension control can function properly.
5. DI function 58: Winding/unwinding switchover
   Winding/unwinding switchover is performed without modifying the parameter, greatly facilitating the operation. For details of use, see B0-01.
6. DI function 59: Roll diameter calculation disabled
   When the terminal is activated, the roll diameter calculation is disabled.
7. DI function 60: Tension control mode disabled

When the terminal is activated, the system exits the tension control mode and the AC drive restores general AC drive functions (the frequency source and torque source are enabled based on the general AC drive functions).

8. DI function 61: Terminal tension rise
   When the terminal is activated, the tension torque is increased by a certain ratio. After the DI terminal is deactivated, the boost part will be canceled gradually based on time.

9. DI functions 62 and 63: Thickness selection terminals 1 and 2
   These functions provide material thickness switchover modes to meet different requirements for materials with different thickness. For details of use, see B0-31.

AO/Pulse output functions

In addition to the AC drive, PLC or actuators also affect the tension control function. The AC drive supports output of variables related to tension control, enriching means to realize the tension control function.

You can select AO/pulse output functions by setting F5-06 to F5-08.

1. Output function 19: External taper output
   When the tension taper control is required and the material tension is determined by the external actuator, you can enable this function to output taper.

2. Output function 20: Roll diameter output
   When the roll diameter is calculated in the AC drive and the calculation result needs to be output, you can enable this function to output the result.

3. Output function 21: Tension output
   You can enable this function to output the tension reference of the AC drive. The actual valid tension after taper calculation is calibrated based on the maximum tension (B1-02).

2.6.19Monitoring

You can set F7-04 and F7-05 to enable the display of the roll diameter or tension at stop or during operation.

Para. No.	Name	Value Range	Description
F7-03	LED display of parameters during operation 1	Bit00: Running frequency (Hz) Bit01: Frequency reference (Hz) Bit02: Bus voltage (V) Bit03: Output voltage (V) Bit04: Output current (A) Bit05: Output power (kW) Bit06: Output torque (%) Bit07: DI state Bit08: DO state Bit09: AI1 voltage (V) Bit10: AI2 voltage (V) Bit11: Reserved Bit12: Count value Bit13: Length value Bit14: Load speed display Bit15: PID reference	To show a parameter during operation, set the corresponding bit to 1, and set F7-03 to its hexadecimal equivalent.
F7-04	LED display of parameters during operation 2	Bit00: PID feedback Bit01: PLC stage Bit02: Pulse input reference (kHz) Bit03: Running frequency 2 (Hz) Bit04: Remaining running time Bit05: AI1 voltage before correction (V) Bit06: AI2 voltage before correction (V) Bit07: Reserved Bit08: Linear speed Bit09: Current power-on time (Hour) Bit10: Current running time (Min) Bit11: Pulse input reference (Hz) Bit12: Communication reference Bit13: Encoder feedback speed Bit14: Display of main frequency X Bit15: Display of auxiliary frequency Y	To show a parameter during operation, set the corresponding bit to 1, and set F7-04 to its hexadecimal equivalent.
F7-05	LED display of parameters at stop	Bit00: Frequency reference (Hz) Bit01: Bus voltage (V) Bit02: DI state Bit03: DO state Bit04: AI1 voltage (V) Bit05: AI2 voltage (V) Bit06: Reserved Bit07: Count value Bit08: Length value Bit09: PLC stage Bit10: Load speed display Bit11: PID reference Bit12: Pulse input reference (kHz)	To show a parameter at stop, set the corresponding bit to 1, and set F7-05 to its hexadecimal equivalent.

The following table lists monitoring parameters, which can be monitored through an operating panel or in the background in real time.

Table 2–43 Monitoring parameters

Para. No.	Name	Unit	Description
U1-00	Linear speed	0.1 m/min	
U1-01	Current roll diameter	0.1 mm	
U1-02	Linear speed synchronous frequency	0.01 Hz	
U1-03	PID output frequency	0.01 N	
U1-04	Current tension reference	1 N	
U1-05	Tension reference after taper	1 N	
U1-06	Open-loop torque	0.1%	
U1-07	PID output torque	0.1%	
U1-08	Tension control mode	1	Tens: Used to specify the tension control mode of the system. 0: Non-tension control mode 1: Tension open-sloop torque control 2: Tension closed-loop speed control 3: Tension closed-loop torque control 4: Constant linear speed control 5: Pre-charge
U1-09	PID reference	0.1%	
U1-10	PID feedback	0.1%	
U1-11	Kp output	1	
U1-12	Ki output	1	
U1-13	Kd output	1	
U1-14	Tension time	1	
U1-15	Winding/Unwinding mode	1	Used to specify the tension control mode of the system. 0: Winding 1: Unwinding

Note

For better control effect, conduct commissioning based on the measurements obtained using a speed measuring device or tape and comparison between such measurements with related monitoring parameters.

2.7 Fault and Protection

2.7.1 Startup Protection

When F8-18 is set to 1, startup protection is enabled to prevent the motor from responding to a command upon power-on or fault reset of the AC drive.

The startup protection works in the following two scenarios:

- If a command is issued upon power-on of the AC drive (for example, the terminals used as the command source are ON before power-on), the AC drive does not respond to the command. Instead, the AC drive responds only after the command is canceled and re-issued.
- If a command is issued upon fault reset of the AC drive, the AC drive does not respond to the command. Instead, the AC drive responds only after the command is canceled and re-issued.

Related parameter

Para. No.	Function	Default	Value Range	Description
F8-18	Startup protection selection	0	0: Disabled 1: Enabled	The AC drive comes with startup protection. This helps to avoid unexpected motor running at power-on or fault reset.

2.7.2 Undervoltage and Overvoltage Thresholds and Fast Current Limit Protection

When the bus voltage falls below A5-06 or exceeds A5-09, the AC drive generates an alarm.

Related parameters

Para. No.	Function	Default	Value Range	Description
A5-06	Undervoltage threshold	350.0 V	150.0 V to 700.0 V	When the bus voltage falls below A5-06, the AC drive generates an alarm (E05.00 to E07.00, or E09.00).
F9-04	Overvoltage threshold	820 V	350.0 V to 820.0 V	When the bus voltage exceeds F9-04, the AC drive generates an alarm (E05.00 to E07.00).
A5-04	Fast current limit	1	0: Disabled 1: Enabled	This function is used to minimize the overcurrent faults, ensuring normal operation of the AC drive. Disable this function in hoist applications such as cranes.

2.7.3 Phase Loss Protection

Para. No.	Function	Default	Value Range	Description
F9-06	Output phase loss detection before startup	0	0: Disabled 1: Enabled	Output phase loss detection takes several seconds when the AC drive is running. If startup with phase loss brings risks or the motor needs to run at a low frequency, enable this function to quickly detect phase loss before startup. This function is not recommended for scenarios with rigid requirements on startup time.
F9-48	Fault protection action selection 1	10050	Ones: E11 0: Coast to stop 1: Decelerate to stop 2: Fault reset 4: Warning 5: Canceled Tens: E12 0: Coast to stop 1: Decelerate to stop 2: Fault reset 4: Warning 5: Canceled Hundreds: E13 0: Coast to stop 1: Decelerate to stop 2: Fault reset 4: Warning 5: Canceled Thousands: E14 0: Coast to stop Ten thousands: E15 0: Coast to stop 1: Decelerate to stop 3: Electromagnetic shorting 4: Warning 5: Canceled	The fault protection actions are set through the ones, tens, hundreds, thousands, and ten thousands positions of this parameter. 0: coast to stop The AC drive coasts to stop. 1: Decelerate to stop The AC drive decelerates to stop. 2: Fault reset The AC drive will be restarted upon a fault. 3: Electromagnetic shorting The AC drive enters the electromagnetic shorting state. 4: Warning The AC drive continues to run. 5: Canceled The fault is ignored.

2.7.4 Overtemperature Protection

Related parameters

Para. No.	Function	Default	Value Range	Description
F9-57	Motor overtemperature protection threshold	110°C	0°C to 200°C	Used to set the motor overtemperature protection threshold. When the motor temperature exceeds the value of F9-57 (motor overtemperature protection threshold), the AC drive generates the motor overtemperature alarm (E45.00) and responds based on the fault protection action selection 2 (F9-48).
F9-58	Motor overtemperature pre-warning threshold	90°C	0°C to 200°C	Used to set the motor overtemperature pre-warning threshold. When the motor temperature exceeds the value of F9-58 (motor overtemperature pre-waring threshold), the DO terminal assigned with function 39 (motor overtemperature) outputs the active signal.

2.7.5 Overload Protection

To provide effective protection for motors with different loads, set the motor overload protection gain properly based on the overload capacity of a motor. The motor overload protection curve is an inverse time lag curve, as shown in the following figure.

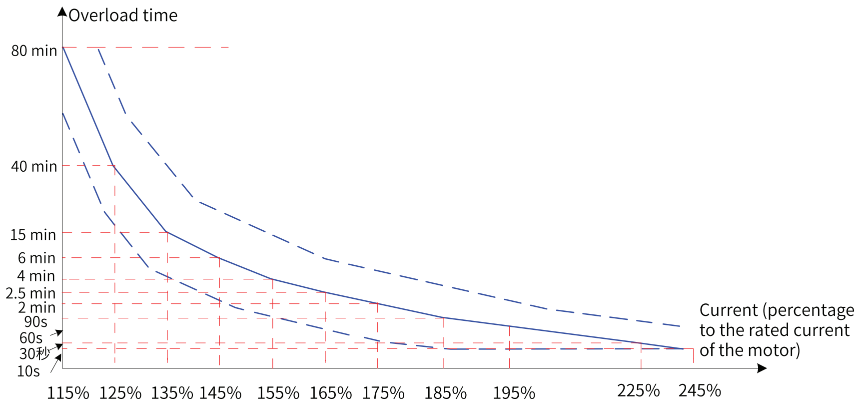


Figure 2-83 Inverse time lag curve of motor overload protection

When the motor running current reaches 175% of the rated motor current and lasts for 2 minutes, E11.00 (motor overload) is reported. When the motor running current reaches 115% of the rated motor current and lasts for 80 minutes, E11.00 is reported.

1. Example 1

- Assume that the rated motor current is 100 A. If F9-01 is set to 1.00, according to the preceding figure, the AC drive reports a motor overload alarm (E11.00) after the motor runs at 125% of 100 A (125 A) continuously for 40 minutes.
- If F9-01 is set to 1.20, according to the preceding figure, the AC drive reports a motor overload alarm (E11.00) after the motor runs at 125% of 100 A (125 A) continuously for 48 minutes (40 x 1.2).

Note

The maximum overload time is 80 minutes and the minimum overload time is 10 seconds.

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2. Example 2

Assume that the application requires an overload alarm when the motor runs at 150% of rated motor current for 2 minutes. According to the motor overload protection curve, 150% (I) of the rated motor current is between 145% (I1) and 155% (I2) of the rated motor current. As the overload time is 6 minutes (T1) at the 145% point and 4 minutes (T2) at the 155% point, the overload time at 150% of the rated motor current is 5 minutes under the default settings. The overload time is calculated using the following formula:

T = T1 + (T2 - T1) x (I - I1)/(I2 - I1) = 4 + (6 - 4) x (150% - 145%)/(155% - 145%) = 5 minutes

Therefore, to have an overload alarm reported when the motor runs at 150% of rated motor current for 2 minutes, set the motor overload protection gain (F9-01) to 0.4 (2/5 = 0.4).

Caution

Set F9–01 properly based on the actual overload capacity of the motor. Note that setting F9–01 to an excessively high value may easily result in motor damage caused by overtemperature without warning.

Motor overload pre-warning coefficient: When the motor overload detection level reaches the value of this parameter, the corresponding multi-functional output terminal (DO) or fault relay outputs a motor overload pre-warning signal. The value of this parameter is a percentage of the time during which the motor runs continuously at an overload point without triggering an overload alarm.

On the condition that F9-01 (motor overload protection gain) is set to 1.00 and F9-02 (motor overload pre-warning coefficient) is set to 80%, when the motor running current reaches 145% of the rated motor current and the motor runs at this level for 4.8 minutes (80% x 6), the multi-functional DO terminal or fault relay outputs a motor overload pre-warning signal.

The motor overload pre-warning function enables the control system to receive a pre-warning signal from a DO terminal before motor overload protection is triggered. The pre-warning coefficient determines how long in advance the AC drive triggers a pre-warning ahead of motor overload protection. A larger coefficient means later transmission of the pre-warning signal. When the accumulative output current of the AC drive exceeds the product of overload time (value Y on the inverse time lag curve of motor overload protection) multiplied by the motor overload pre-warning coefficient (F9-02), the multi-functional DO terminal of the AC drive outputs a motor overload pre-warning signal. When F9-02 is set to 100%, the motor overload pre-warning signal is transmitted the same time when overload protection is triggered.

Related parameters

Para. No.	Function	Default	Value Range	Description
F9-00	AC drive overload protection	0	0: Disabled 1: Enabled	Used to enable or disable the motor overload protection function. The AC drive judges whether the motor is overloaded based on the inverse time-lag curve. When motor overload is detected, the AC drive reports an overload fault. 0: Disabled Motor overload protection is disabled. When this parameter is set to 0, install a thermal relay upstream the motor for protection. 1: Enabled Motor overload protection is enabled.
F9-01	Motor overload protection gain	1.00	0.20 to 10.00	The value of motor overload protection gain is calculated according to the percentage of time during which the motor runs continuously at a certain overload point without reporting an overload fault. This parameter is used to adjust the actual overload fault report time of the AC drive when motor overload occurs.
F9-02	Motor overload pre-warning coefficient	80%	50% to 100%	The value of motor overload pre-warning coefficient is calculated according to the percentage of time during which the motor runs continuously at a certain overload point without reporting overload pre-warning. This function is used to send a pre-warning signal to the control system through a DO terminal before the motor overload protection is triggered. This signal is used to determine how long in advance to send the pre-warning signal before the motor overload protection is triggered. A larger coefficient means later transmission of the pre-warning signal. When the accumulative output current of the AC drive exceeds the product of overload time (value Y on the inverse time lag curve of motor overload protection) multiplied by the motor overload pre-warning coefficient (F9-02), the multi-functional DO terminal of the AC drive outputs a motor overload pre-warning signal.

2.7.6 Load Loss Protection

You can set the ten thousands position of F9-51 to enable load loss detection. The AC drive takes the load loss protection action after running at an output current below the load loss detection level (F9-64) continuously for a period of the load loss detection time (F9-65). Once the load recovers during protection, the AC drive accelerates to the frequency reference.

Para. No.	Function	Default	Value Range	Description
F9-51	Fault protection action 4	51111	-	-
F9-64	Load loss detection level	10.0%	0.0% to 100.0%	
F9-65	Load loss detection time	1.0s	0.1s to 60.0s	

2.7.7 Overspeed Protection

The overspeed protection is valid only when the FVC mode is selected for the AC drive (F0-01 is set to 1).

When this protection is enabled, if detected motor speed exceeds the maximum frequency (F0-10) and the excess is greater than the value of F9-67 (overspeed threshold) for a period longer than the time set in F9-68 (overspeed detection time), the AC drive reports an alarm (E43.00) and acts according to F9-50 (overspeed protection action).

When F9-68 (overspeed detection time) is set to 0.0s, the overspeed detection function is disabled.

Related parameters

Para. No.	Function	Default	Value Range	Description
F9-67	Overspeed threshold	20.0%	0.0% to 50.0% (max. frequency)	-
F9-68	Overspeed detection time	1.0s	0.0s to 60.0s	

2.7.8 Excessive Speed Deviation Protection

The excessive speed deviation protection function is valid only when the FVC mode is selected for the AC drive (F0-01 is set to 1).

When this protection is enabled, if the AC drive detects that the deviation between the actual motor running frequency and the frequency reference stays above the excessive speed deviation threshold (F9-69) for a period longer than the detection time of excessive speed deviation (F9-70), the AC drive generates an alarm of E42.00 (excessive speed deviation) and takes an action based on the setting of fault protection action selection (F9-50).

If F9-70 (detection time of excessive speed deviation) is set to 0.0s, the excessive speed deviation detection function is disabled.

Related parameters

Para.	Function	Default	Value Range	Description
F9-69	Excessive speed deviation threshold	20.0%	0.0% to 50.0% (max. frequency)	-
F9-70	Detection time of excessive speed deviation	5.0s	0.0s to 60.0s	

2.7.9 Power Dip Ride-Through

The power dip ride-through function ensures continuous system running at occurrence of instantaneous power failure. When the system experiences a power failure, the AC drive makes the motor work in the generating state to keep the bus voltage around the "threshold for enabling power dip ride-through". This function prevents the AC drive from stopping due to input undervoltage, as shown in the following figure.

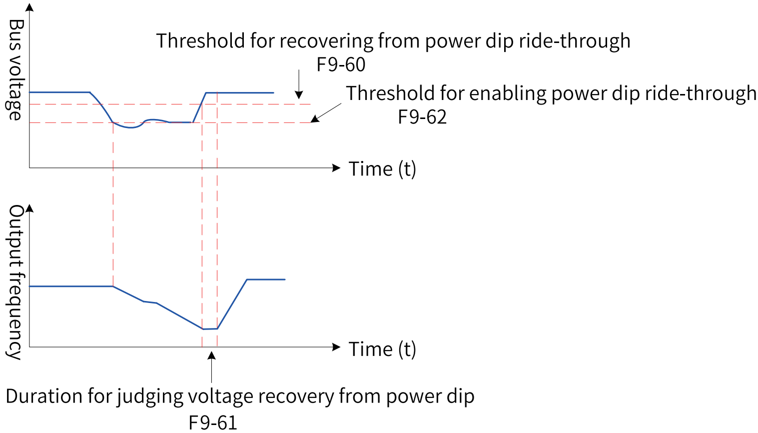


Figure 2-84 Power dip ride-through

In the "bus voltage constant control" mode, when the grid resumes power supply, the AC drive restores the target output frequency based on the acceleration time. In the "decelerate to stop mode", when the grid resumes power supply, the AC drive decelerates to 0 Hz and stops, and will restart only after receiving a start command.

Related parameters

Para. No.	Function	Default	Value Range	Description
F9-59	Power dip ride-through function selection	0	0: Disabled 1: Decelerate 2: Decelerate to stop 3: Voltage dip depression	The function enables the AC drive to keep running at occurrence of instantaneous power failure. When the system experiences a power failure, the AC drive makes the motor work in the generating state to keep the bus voltage around the "threshold for enabling power dip ride-through". This function prevents the AC drive from stopping due to input undervoltage. 0: Disabled Power dip ride-through is disabled. 1: Bus voltage constant control When the system experiences a power failure, the AC drive keeps the bus voltage around the "threshold for enabling power dip ride-through". In this mode, when the power grid resumes power supply, the AC drive restores the target output frequency based on the acceleration time. 2: Decelerate to stop When the system experiences a power failure, the AC drive decelerates to stop. In this mode, when the power grid resumes power supply, the AC drive continues decelerating to 0 Hz and stops, and will restart only after receiving a start command. 3: Voltage dip depression This function prevents AC drive stop caused by undervoltage when instantaneous power failure occurs due to voltage dip. You can use F9-66 to set a voltage dip suppression time.
F9-60	Threshold for recovering from power dip ride-through	85%	80% to 100%	Used to set the "threshold for recovering from power dip ride-through" for the AC drive. 100% corresponds to 540 V. This value is slightly lower than the bus voltage before power failure. Upon grid power failure, the bus voltage is maintained around F9-62 (threshold for enabling power dip ride-through). When the power supply recovers, the bus voltage rises from F9-62 (threshold for enabling power dip ride-through) to F9-60 (threshold for recovering from power dip ride-through). During this period, the output frequency of the AC drive keeps decreasing until the bus voltage reaches F9-60 (threshold for recovering from power dip ride-through).
F9-61	Duration for judging voltage recovery from power dip	0.5s	0.0s to 100.0s	Used to set the time required for the bus voltage to rise from F9-60 (threshold for recovering from power dip ride-through) to the voltage before power failure.

Para. No.	Function	Default	Value Range	Description
F9-62	Threshold for enabling power dip ride-through	80%	60% to 100%	Used to set the voltage level at which the bus voltage is maintained upon power failure. Upon power failure, the bus voltage is maintained around F9-62 (threshold for enabling power dip ride-through).
F9-71	Power dip ride-through gain	0 to 100	40	This parameter is valid in the "bus voltage constant control" (F9-59 is set to 1) mode only. If undervoltage is likely to occur during power dip ride-through, increase the power dip ride-through gain and the power dip ride-through integral coefficient.
F9-72	Power dip ride-through integral coefficient	0 to 100	30	
F9-73	Deceleration time of power dip ride-through	0.0s to 300.0s	20.0s	This parameter is valid in the "decelerate to stop" (F9-59 is set to 2) mode only. When the bus voltage is below F9-62, the AC drive decelerates to stop. The deceleration time is determined by this parameter instead of F0-18.

2.7.10Fault Reset

In the case of an undervoltage fault (E09.00), the AC drive resets automatically when the bus voltage restores to the normal range. This reset is not counted in the number of fault auto reset times. In the case of a short circuit to ground (E23.00), the AC drive AC does not support automatic or manual reset, and you need to reset the AC drive by powering it off and then powering it on again. Fault protection action selection is required when the number of fault auto reset times is reached.

Related parameters

Para. No.	Function	Default	Value Range	Description
F9-09	Fault auto rehset times	0	0 to 20	This parameter is used to set the number of automatic resets for the AC drive if the fault protection action is set to automatic reset. If the fault persists after the specified number of automatic resets, the AC drive retains the fault state.
F9-10	DO action during auto fault reset	1	0: Not act 1: Act	If the AC drive is enabled to reset automatically upon faults, F9-10 can be used to determine whether the DO terminal (function 2) acts during an automatic reset.
F9-11	Auto fault reset interval	1.0s	0.1s to 100.0s	This parameter is used to set the delay of auto reset after the AC drive detects a fault.

2.7.11Fault Protection Action Selection

Four fault protection actions are defined for the AC drive: coast to stop, decelerate to stop, warning, and canceled, listed in descending order of fault severity.

When the fault protection action is set to "warning", the operating panel shows Axx.xx when a fault occurs, for example, 

.

When the fault protection action is set to "canceled", no message is displayed on the operating panel when a fault occurs. Exercise caution when setting this action.

Related parameters

Para. No.	Function	Default	Value Range	Description
F9-48	Fault protection action selection 1	10050	Ones: E11 0: Coast to stop 1: Decelerate to stop 2: Fault reset 4: Warning 5: Canceled Tens: E12 (same as the ones) Hundreds: E13 (same as the ones) Thousands: E14 0: Coast to stop Ten thousands: E15 0: Coast to stop 1: Decelerate to stop 3: Electromagnetic shorting 4: Warning 5: Canceled	The fault protection actions are set through the ones, tens, hundreds, thousands, and ten thousands positions of this parameter. 0: Coast to stop The AC drive coasts to stop. 1: Decelerate to stop The AC drive decelerates to stop. 2: Fault reset The AC drive will be restarted upon a fault. 3: Electromagnetic shorting The AC drive enters the electromagnetic shorting state. 4: Warning The AC drive continues to run. 5: Canceled The fault is ignored.
F9-49	Fault protection action selection 2	00050	Ones: E16 0: Coast to stop 1: Decelerate to stop 4: Warning 5: Canceled Tens: E17 (same as the ones) Hundreds: E18 0: Coast to stop Thousands: E19 0: Coast to stop 3: Electromagnetic shorting 4: Warning 5: Canceled Ten thousands: E20 (same as the thousands)	Same as F9-48

Para. No.	Function	Default	Value Range	Description
F9-50	Fault protection action selection 3	25000	Ones: Reserved 0: Coast to stop Tens: E63 0: Coast to stop 1: Decelerate to stop 4: Warning 5: Canceled Hundreds: E23 0: Coast to stop 5: Canceled Thousands: E24 0: Coast to stop 5: Canceled Ten thousands: E25 0: Coast to stop 1: Decelerate to stop 4: Warning 5: Canceled	Same as F9-48
F9-51	Fault protection action selection 4	51111	Ones: E26 0: Coast to stop 1: Decelerate to stop 4: Warning 5: Canceled Tens: E27 0: Coast to stop 1: Decelerate to stop 3: Electromagnetic shorting 4: Warning 5: Canceled Hundreds: E28 (same as the tens) Thousands: E29 (same as the ones) Ten thousands: E30 (same as the ones)	Same as F9-48

Para. No.	Function	Default	Value Range	Description
F9-52	Fault protection action selection 5	00101	Ones: E31 0: Coast to stop 1: Decelerate to stop 4: Warning 5: Canceled Tens: E40 0: Coast to stop 2: Fault reset Hundreds: E41 (same as the ones) Thousands: E42 0: Coast to stop 1: Decelerate to stop 2: Fault reset 3: Electromagnetic shorting 4: Warning 5: Canceled Ten thousands: E43 0: Coast to stop 1: Decelerate to stop 3: Electromagnetic shorting 4: Warning 5: Canceled	Same as F9-48
F9-53	Fault protection action selection 6	05500	Ones: E45 0: Coast to stop 1: Decelerate to stop 4: Warning 5: Canceled Tens: E60 (same as the ones) Hundreds: E61 (same as the ones) Thousands: E62 0: Coast to stop 5: Canceled Ten thousands: Reserved 5: Canceled	Same as F9-48

Para. No.	Function	Default	Value Range	Description
F9-54	Frequency selection for continuing to run upon fault	0	0: Current running frequency 1: Frequency reference 2: Frequency upper limit 3: Frequency lower limit 4: Backup frequency upon abnormality	Used to select the frequency when the AC drive is faulty. If a fault occurs during the operation of the AC drive and the fault protection action is set to "continue to run", the AC drive displays A** and continues to run at the frequency set through F9-54.
F9-55	Backup frequency upon abnormality	100.0%	0.0% to 100.0% (maximum frequency F0-10)	Used to set the backup frequency of the AC drive upon fault. If a fault occurs during the operation of the AC drive and the fault protection action is set to "run at the backup frequency" (F9-54 is set to 4), the AC drive displays A** and continues to run at the backup frequency.

2.7.12Detection of Short-Circuit to Ground

Para. No.	Function	Default	Value Range	Description
F9-07	Detection of short-circuit to ground	1	0: No detection 1: Detection upon power-on 2: Detection before running 3: Detection upon power-on and before running	-

2.8 Monitoring

The monitoring function enables you to view AC drive state in the LED display area on the operating panel. You can monitor AC drive state in the following two ways:

1. When the AC drive is in the stop or running state, press the key on the operating panel to switch between bits of F7-03, F7-04, or F7-05, to view multiple state parameters on the panel.
   The running state involves 32 running state parameters, the display of which can be set through binary bits of F7-03 (LED display of parameters during operation 1) and F7-04 (LED display of parameters during operation 2). The stop state involves 13 stop state parameters, the display of which can be set through binary bits of F7-05 (LED display of parameters at stop).

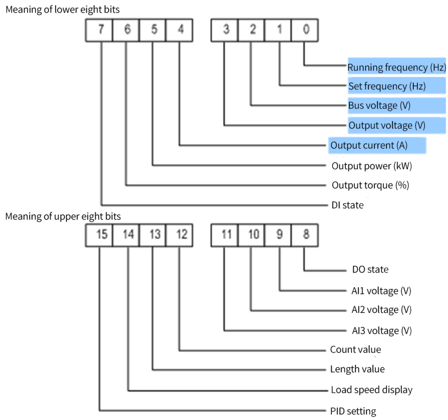
   For example, to view a running state parameter (such as running frequency, bus voltage, output voltage, output current, output power, and PID reference) on the panel:

Set the bit of F7-03 (LED display of parameters during operation 1) corresponding to that parameter to 1. Convert the binary number to hexadecimal equivalent, and set the hexadecimal number in F7-03. For details about the conversion method, see *"Table 2–45 Binary-to-hexadecimal conversion" on page 235*. Press the key on the operating panel to switch between bits of F7-03 to view parameter settings.

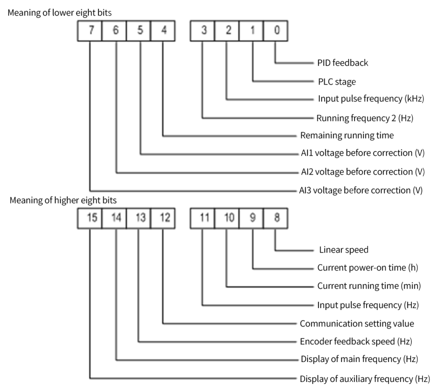
You can view other monitoring parameters in the same way. Relationship between monitoring parameters and bits of F7-03, F7-04, and F7-05 is summarized in the following table.

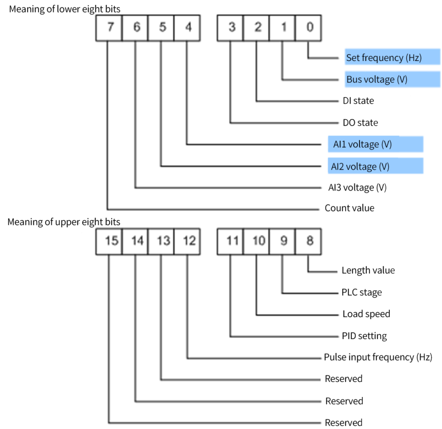
Table 2–44 Relationship between state parameters and bytes of F7-03, F7-04, and F7-05

<table>
<tr><th>Para. No.</th><th>Function</th><th>Default</th><th>Value Range</th><th>Description</th></tr>
<tr><td>F7-03</td><td>LED display of parameters during operation 1</td><td>1F</td><td>0000 to FFFF</td><td>To show a parameter during operation, set the corresponding bit to 1, and set F7-03 to its hexadecimal equivalent.



Note: Shaded parameters are displayed by default.</td></tr>
<tr><td>F7-04</td><td>LED display of parameters during operation 2</td><td>0</td><td>0000 to FFFF</td><td>To show a parameter during operation, set the corresponding bit to 1, and set F7-04 to its hexadecimal equivalent.


</td></tr>
</table>

Para. No.	Function	Default	Value Range	Description
F7-05	LED display of parameters at stop	33	0000 to FFFF	To show a parameter at stop, set the corresponding bit to 1, and set F7-05 to its hexadecimal equivalent.  Note: Shaded parameters are displayed by default.

Note

When the AC drive is powered on again after power-off, the parameters selected before power-off are displayed.

The monitoring parameters corresponding to each bit in F7-03, F7-04, and F7-05 do not completely correspond to all the monitoring parameters in group U0. If parameters to be monitored cannot be found in F7-03, F7-04 and F7-05, view them in group U0.

Convert a binary number to a hexadecimal number in the following way:

From right to left, every four binary digits corresponds to one hexadecimal digit. Use a leading zero if the highest bit is not a fourth bit. Then, convert the binary number into decimal equivalent, 0000-1111 correspond to 0-15 in decimal and 0-F in hexadecimal. Convert each decimal number to a hexadecimal one according to the following decimal-to-hexadecimal conversion table.

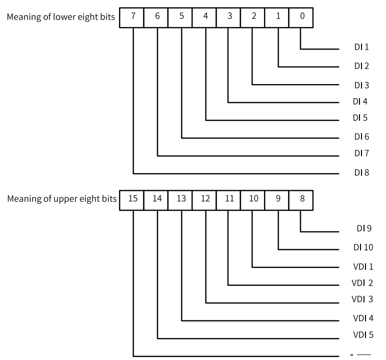
For example, the binary number 011 1101 1111 1001 is turned into 0011 1101 1111 1001 by adding a leading zero, and then converted to 3DF9 according to the following table.

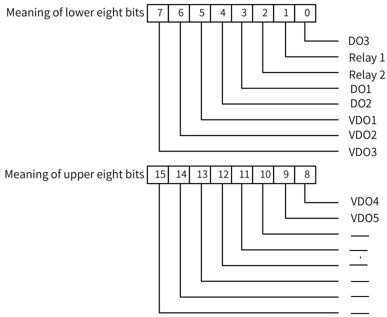
Table 2–45 Binary-to-hexadecimal conversion

Binary	1111	1110	1101	1100	1011	1010	1001	1000	0111	0110	0101	0100	0011	0010	0001	0000
Dec.	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Hex.	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0

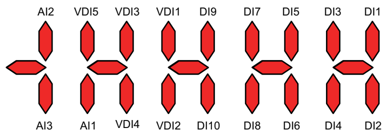
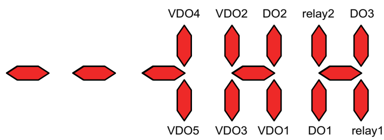
2. Select group U0 directly on the operating panel to view related state parameters. *"Table 2–46 Group U0: monitoring parameters" on page 236*Monitoring parameters in table 3-46 are read only.

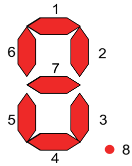
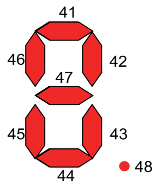
Table 2–46 Group U0: monitoring parameters

Para. No.	Function	Basic Unit	Value Range	Description
U0-00	Running frequency (Hz)	0.01 Hz	0.00 Hz to 320.00 Hz	Shows the absolute value of the running frequency of the AC drive.
U0-01	Frequency reference (Hz)	0.01 Hz	0.00 Hz to 320.00 Hz	Shows the absolute value of the frequency reference of the AC drive.
U0-02	Bus voltage (V)	0.1 V	0.0 V to 3000.0 V	Shows the bus voltage of the AC drive.
U0-03	Output voltage (V)	1 V	0 V to 1140 V	Shows the output voltage of the AC drive during operation.
U0-04	Output current (A)	0.01 A	0.00 A to 655.35 A (AC drive power ⩽ 55 kW) 0.0 A to 6553.5 A (AC drive power > 55 kW))	Shows the output current of the AC drive during operation.
U0-05	Output power (kW)	0.1 kW	0.0–3276.7 kW	Shows the output power of the AC drive during operation.
U0-06	Output torque (%)	0.10%	–200.0% to +200.0%	Shows the output torque of the AC drive during operation. The value is a percentage of the rated motor torque.
U0-07	DI state	1	0x0000 to 0x7FFF	Shows the input state value of the current DI terminal. Each bit of the binary number converted from this value corresponds to one DI signal. The value 1 indicates that the input is high level. The value 0 indicates that the input is low level. Each bit corresponds to an input terminal in the following pattern: 

Para. No.	Function	Basic Unit	Value Range	Description
U0-08	DO state	1	0x0000 to 0x03FF	Shows the output state value of the current DO terminal. Each bit of the binary number converted from this value corresponds to one DO signal. The value 1 indicates that the output is high level. The value 0 indicates that the output is low level. Each bit corresponds to an output terminal in the following pattern: 
U0-09	AI1 voltage (V)	0.01 V	0.00 V to 10.57 V	-
U0-10	AI2 voltage (V)	0.01 V/0.01 mA	0.00 V to 10.57 V 0.00 mA to 20.00 mA	You can set F4-40 to select voltage input or current input.
U0-11	AI3 voltage (V)	0.01 V	0.00 V to 10.57 V	-
U0-12	Count value	1	1 to 65535	Shows the count value in the counting function.
U0-13	Length value	1	1 to 65535	Shows the length in the fixed-length function.
U0-14	Load speed display	Determined by the ones position of F7-12	0 to rated motor speed	Shows the load speed.
U0-15	PID reference	1	0 to 65535	PID reference value = PID reference (percentage) x FA-04 (PID reference feedback range)
U0-16	PID feedback	1	0 to 65535	PID feedback value = PID feedback reference (percentage) x FA-04 (PID reference feedback range)
U0-17	PLC stage	1	0 to 15	There are a total of 16 stages.
U0-18	Pulse input reference (kHz)	0.01 kHz	0.00 kHz to 100.00 kHz	Shows the high-speed pulse sampling frequency of DI5.
U0-19	Feedback speed (Hz)	0.01 Hz	–500.0 Hz to +500.0 Hz (tens position of F7-12 set to 1) –320.00 Hz to +320.00 Hz (tens position of F7-12 set to 2)	When the tens position of F7-12 (number of decimal places for load speed display) is set to 1, U0-19 has one decimal place and the displayed value range is –500.0 Hz to +500.0 Hz. When the tens position of F7-12 is set to 2, U0-19 has two decimal places and the displayed value range is -320.00 Hz to +320.00 Hz.
U0-20	Remaining running time	0.1 min	0.0 min to 6500.0 min	Shows remaining running time during timing.

Para. No.	Function	Basic Unit	Value Range	Description
U0-21	AI1 voltage before correction	0.001 V	0.000 V to 10.570 V	Shows the actual AI sampling voltage/current value. Linear correction is performed to reduce the deviation between the sampling voltage/current and the actual voltage/current. For voltage/current after correction, see U0-09 and U0-10.
U0-22	AI2 voltage (V)/ current (mA) before correction	0.001 V/0.01 mA	0.000 V to 10.570 V 0.000 mA to 20.000 mA	
U0-23	AI3 voltage before correction	0.001 V	–10.570 V to +10.570 V	
U0-24	Linear speed	1 m/min	0 m/min to 65535 m/min	
U0-25	Current power-on time	1 min	0 min to 65000 min	-
U0-26	Current running time	0.1 min	0.0 min to 6500.0 min	-
U0-27	Pulse input reference (Hz)	1 Hz	0 Hz to 65535Hz	Shows DI5 high-speed pulse sampling frequency. It is the same as U0-18, except for difference in units.
U0-28	Communication	0.01%	–100.00% to +100.00%	Shows data written through communication address 0x1000. The base value of the percentage is determined by the value of communication address 0x1000.
U0-29	Encoder feedback speed (Hz)	0.01 Hz	–320.00 Hz to +320.00 Hz (tens position of F7-12 set to 2)	Shows the motor running frequency measured by the encoder. When the tens position of F7-12 (number of decimal places for load speed display) is set to 2, U0-29 has two decimal places and the displayed value range is –320.00 Hz to +320.00 Hz.
			–500.0 Hz to +500.0 Hz (tens position of F7-12 set to 1)	When the tens position of F7-12 is set to 1, U0-29 has one decimal place and the displayed value range is –500.0 Hz to +500.0 Hz.
U0-30	Display of main frequency X	0.01 Hz	0.00 Hz to 500.00 Hz	Shows the main frequency reference.
U0-31	Display of auxiliary frequency Y	0.01 Hz	0.00 Hz to 500.00 Hz	Shows the auxiliary frequency reference.
U0-32	Any memory address	1	0 to 65535	-
U0-33	Synchronous motor rotor position	0.1	0.0° to 359.9°	-
U0-34	Motor temperature	1°C	0°C to 200°C	Shows the motor temperature sampled through AI3. For details about motor temperature measurement, see the description of F9-56 (type of motor temperature sensor).
U0-35	Target torque (%)	0.10%	–200.0% to +200.0%	Shows the current torque upper limit reference, which is a percentage of the rated motor torque.
U0-36	Resolver position	1	0 to 4095	-

Para. No.	Function	Basic Unit	Value Range	Description
U0-37	Power factor angle	0.1°	0° to 65535°	Shows the current power factor angle.
U0-38	ABZ position	1	0 to 65535	Shows the number of phase-A and phase-B pulses of the ABZ encoder. This value is four times the number of pulses that the encoder runs. For example, if the display is 4000, the actual number of pulses that the encoder runs is 4000/4 = 1000. The value increases when encoder rotates in forward direction and decreases when encoder rotates in reverse direction. After increasing to 65535, the value increase restarts from 0. After decreasing to 0, the value decrease restarts from 65535. You can check whether the encoder is correctly installed by viewing this parameter.
U0-39	Target voltage upon V/f separation	1 V	0 V to rated motor voltage	Shows the target output voltage when the AC drive runs in the V/f separation state.
U0-40	Output voltage upon V/f separation	1 V	0 V to rated motor voltage	Shows the actual output voltage when the AC drive runs in the V/f separation state.
U0-41	DI state display	1	0 to 65535	DI terminal state display: ON indicates high level; OFF indicates low level. 
U0-42	DO state display	1	0 to 65535	DO terminal state display: ON indicates high level; OFF indicates low level. 

Para. No.	Function	Basic Unit	Value Range	Description
U0-43	DI function state display 1 (functions 01 to 40)	1	0 to 65535	Shows validity of terminal functions 1 to 40. There are five LEDs on the operating panel, representing the following functions from right to left: functions 1 to 8, 9 to 16, 17 to 24, 25 to 32, and 33 to 40. Each LED corresponds to eight functions, as shown in the following figure. The LEDs indicate states of DI terminal functions. ON indicates high level; OFF indicates low level. 
U0-44	DI function state display 2 (functions 41 to 80)	1	0 to 65535	Shows validity of terminal functions 41 to 59. There are five LEDs on the operating panel, representing the following functions from right to left: functions 41 to 48, 49 to 56, and 57 to 59. Each LED corresponds to eight functions, as shown in the following figure. The LEDs indicate states of DI terminal functions. ON indicates high level; OFF indicates low level. 
U0-45	Fault subcode	1	0 to 51	Shows fault subcodes.
U0-46	Inverter unit temperature	1°C	0	Used to indicate the heatsink temperature of the IGBT.
U0-47	PTC channel voltage before correction	0.001	0	-
U0-48	PTC channel voltage after correction	0.001	0	-
U0-49	Number of offset pulses of position lock	1	0	Pulse difference between the initial position of position lock and the current position.
U0-50	Roll diameter	1 mm	0	The current roll diameter
U0-51	Tension (after taper setting)	1 N	0	Tension reference after taper setting

Para. No.	Function	Basic Unit	Value Range	Description
U0-58	Z signal counting	1	0 to 65535	Shows phase-Z counting of the current ABZ or UVW encoder. The value increases or decreases by 1 every time the encoder rotates one revolution forwardly or reversely. You can check whether the encoder is correctly installed by viewing this parameter.
U0-59	Frequency reference	0.01%	–100.00% to +100.00%	Shows the current frequency reference. The value is a percentage of the maximum frequency (F0-10) of the AC drive.
U0-60	Running frequency (%)	0.01%	–100.00% to +100.00%	Shows the current running frequency reference. The value is a percentage of the maximum frequency (F0-10) of the AC drive.
U0-61	AC drive state	1	Bit1, Bit0	0: Stop; 1: Forward; 2: Reverse
			Bit3, Bit2	0: Constant; 1: Accelerate; 2: Decelerate
			Bit4	0: Bus voltage normal; 1: Undervoltage
U0-62	Current fault code	1	0 to 99	-
U0-63	Running frequency (after droop)	0.01 Hz	0	-
U0-64	Back EMF	0.1 V	0	The back EMF of the motor
U0-65	Stator resistance auto-tuning upon startup	1	0	-
U0-66	Communication extension card model	1	0 to 65535	-
U0-67	Communication extension card software version	1	0 to 65535	-

Para. No.	Function	Basic Unit	Value Range	Description
U0-68	AC drive state on the communication extension card	1	Bit0	0: Stop; 1: Run
			Bit1	0: Forward run; 1: Reverse run
			Bit2	Indicates whether any fault occurs to the AC drive. 0: No fault 1: Fault
			Bit3	Indicates whether the running frequency reaches the frequency reference. 0: Not reach 1: Reach
			Bit4	Indicates whether DP communication is normal 0: Normal 1: Abnormal
			Bit5	Communication control as the reference source for the AC drive
			Bit6	Communication control as the command source for the AC drive
			Bit7	Speed control/torque control
			Bit8 to Bit15	Fault code (main code). See specific fault description.
U0-69	Frequency transmitted to the communication extension card/ 0.01 Hz	1	0.00 to 655.35	-
U0-70	Speed transmitted to the communication extension card/ RPM	1	0 to 65535	-
U0-71	Current specific to communication extension card (A)	1	0 to 65535	-
U0-72	Communication card error state	1	0 to 65535	-
U0-73	Target torque before filter	0.1	-	Target torque not filtered in the torque control mode.
U0-74	Target torque after filter	0.1%	-200.0% to +200.0%	Target torque filtered in the torque control mode.
U0-75	Torque reference after acceleration/ deceleration	0.1%	-200.0% to +200.0%	Torque reference after acceleration/deceleration in the torque control mode.

Para. No.	Function	Basic Unit	Value Range	Description
U0-76	Torque upper limit in the motoring state	0.1%	0.0% to 200.0%	The torque upper limit under the motoring state takes the rated current of AC drive as the base value.
U0-77	Torque upper limit in the generating state	0.01%	-	The torque upper limit under the generating state takes the rated current of AC drive as the base value.

2.9 User Settings

2.9.1 User-Defined Parameters

Group FE (consisting of parameters FE-00 to FE-29) is used to define frequently-used parameters to facilitate operations such as viewing and modification. Up to 30 user-defined parameters can be set.

- If the displayed value is F0-00, no parameter is defined. In the user-defined parameter mode, you can use FE-00 to FE-31 in sequence to define which parameters to display and skip any parameter by setting the value to F0-00.
- Displayed values U3-17 and U3-16 indicate PZD1 (AC drive command word) in communication control and PZD2 (AC drive target frequency) in communication control, respectively.

Related parameters

Para. No.	Function	Default	Value Range	Description
FP-03	Setting the display of user parameters	11	Ones: Display of user-defined parameters 0: Not displayed 1: Displayed Tens: Display of user-modified parameters 0: Not displayed 1: Displayed	-
FE-00	User parameter 0	F0-01	F0-00 to FP-xx A0-00 to Ax-xx U0-xx to U0-xx U3-00 to U3-xx	-
FE-01	User parameter 1	F0-02		-
FE-02	User parameter 2	F0-03		-
FE-03	User parameter 3	F0-07		-
FE-04	User parameter 4	F0-08		-
FE-05	User parameter 5	F0-17		-
FE-06	User parameter 6	F0-18		-
FE-07	User parameter 7	F3-00		-
FE-08	User parameter 8	F3-01		-
FE-09	User parameter 9	F4-00		-
FE-10	User parameter 10	F4-01		-
FE-11	User parameter 11	F4-02		-
FE-12	User parameter 12	F5-04		-
FE-13	User parameter 13	F5-07		-
FE-14	User parameter 14	F6-00		-
FE-15	User parameter 15	F6-10		-
FE-16	User parameter 16	F0-00		-
FE-17	User parameter 17	F0-00		-
FE-18	User parameter 18	F0-00		-
FE-19	User parameter 19	F0-00		-
FE-20	User parameter 20	F0-00		-
FE-21	User parameter 21	F0-00		-
FE-22	User parameter 22	F0-00		-
FE-23	User parameter 23	F0-00		-
FE-24	User parameter 24	F0-00		-
FE-25	User parameter 25	F0-00		-
FE-26	User parameter 26	F0-00		-
FE-27	User parameter 27	F0-00		-
FE-28	User parameter 28	F0-00		-
FE-29	User parameter 29	F0-00		-
FE-30	User parameter 30	F0-00		-
FE-31	User parameter 31	F0-00		-

2.9.2 Sleep and Wakeup

Sleep is also known as hibernation. Any time period within 24 hours can be set as a sleep period, during which the AC drive stops running and sleeps.

Wakeup is a process that the AC drive wakes up from the sleep state and starts to run.

To use the sleep and wakeup functions, set the wakeup frequency, sleep frequency, and sleep duration. Generally, set the wakeup frequency (F8-49) equal to or greater than the sleep frequency (F8-51). If the wakeup frequency and the sleep frequency are both 0.00 Hz, the sleep and wakeup functions are disabled.

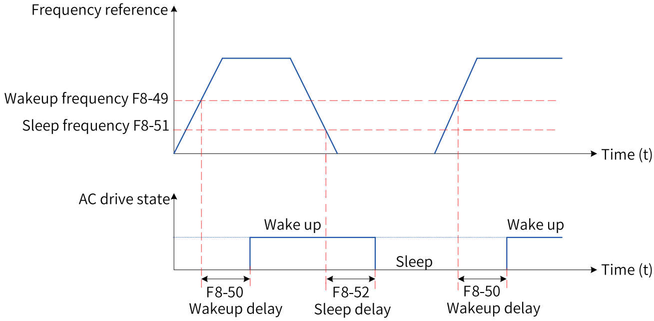


Figure 2-85 Sleep and wakeup function setting

Note

When sleep is enabled during PID operation, you can set FA-28 (selection of PID operation at stop) to 1 to continue the PID operation or to 0 to stop PID operation.

Related parameters

Para. No.	Function	Default	Value Range	Description
F8-49	Wakeup frequency	0.00 Hz	Sleep frequency (F8-51) to max. frequency (F0-10)	If the AC drive is in the sleep state and can respond to a command, when the frequency reference is equal to or higher than F8-49 (wakeup frequency), the AC drive wakes up after a period defined by F8-50 (wakeup delay).
F8-50	Wakeup delay	0.0s	0.0s to 6500.0s	
F8-51	Sleep frequency	0.00 Hz	0.00 Hz to wakeup frequency (F8-49)	During AC drive running, when the frequency reference is equal to or lower than F8-51 (sleep frequency), the AC drive enters the sleep state and decelerates to stop after a period defined by F8-52 (sleep delay).
F8-52	Sleep delay	0.0s	0.0s to 6500.0s	

2.9.3 Current Running Time Threshold

Para.	Function	Default	Value Range	Description
F8-53	Current running time threshold	0.0 min	0.0 min to 6500.0 min	The DO terminal outputs the active signal when the current running time reaches the value of F8-53. This parameter is valid only for the current AC drive running. Previous running time is not accumulated.
F8-55	Deceleration time for emergency stop	Model dependent	0.0s to 6500.0s	The F8-55 parameter specifies the deceleration time for emergency stop of the terminal. The emergency stop function enables the AC drive to decelerate within the specified deceleration time. In the V/f mode, when the deceleration time is 0s, the AC drive decelerates within the minimum unit time.

3 Communication

3.1 Parameter Communication Address

3.1.1 Parameter Introduction

The AC drive supports six communication protocols: Modbus-RTU, CANopen, CANlink, PROFIBUS-DP, PROFINET, and EtherCAT. The user-programmable card and point-to-point communication are derived from the CANlink protocol. The host controller can implement control such as monitoring and parameter viewing and modification on the AC drive through their protocols. The communication data is classified into parameter data and non-parameter data. The non-parameter data includes operation commands, operation status, operation parameters, and alarm information.

Parameter data

Para. Data	Group F (read-write)	F0, F1, F2, F3, F4, F5, F6, F7, F8, F9, FA, Fb, FC, Fd, FE, FF
	Group A (read-write)	A0, A1, A2, A3, A4, A5, A6, A7, A8, A9, AA, AB, AC, AD, AE, AF

Communication addresses of parameter data are defined as follows:

1. When parameter data is read through communication
   For groups F0 to FF and A0 to AF, the high 16 bits of the communication address indicate the group number and the low 16 bits indicate the parameter number.

   Example:

   A communication address of F0-16 is F010H, where F0H represents group F0 and 10H is the hexadecimal data format of serial number 16 in the group.

   A communication address of AC-08 is AC08, where ACH represents group AC and 08H is the hexadecimal data format of serial number 8 in the group.

2. When parameter data is written through communication
   For groups F0 to FF, whether the high 16 bits in the communication address are 00 to 0F or F0 to FF is decided by whether the parameter is to be written to EEPROM. The low 16 bits indicate the parameter number in the group.

   For example, to write F0-16:

   If the parameter will not be written to EEPROM, the communication address is 0010H.

   If the parameter will be written to EEPROM, the communication address is F010H.

For groups A0 to AF, whether the high 16 bits in the communication address are 40 to 4F or A0 to AF is decided by whether the parameter is to be written to EEPROM. The low 16 bits indicate the parameter number in the group.

For example, to write AC-08:

If the parameter will not be written to EEPROM, the communication address is 4C08H.

If the parameter will be written to EEPROM, the communication address is AC08H.

Non-parameter data

Non-Parameter Data	Status data (read-only)	Group U (monitoring parameters), AC drive fault description, and AC drive operation status
	Control parameter (write-only)	Control commands, communication references, DO control, AO1 control, AO2 control, high-speed pulse (FMP) output control, and parameter initialization

1. Status data
   Status data includes group U (monitoring parameters), AC drive fault description, and AC drive operation status.
   - Group U (monitoring parameters)
     The high 16 bits of a communication address of U0 to UF is 70 to 7F and the low 16 bits indicate the parameter number in the group. For example, the communication address of U0-11 is 700BH.
   - AC drive fault description
     When the AC drive fault description is read via communication, the communication address is 8000H. The host controller can obtain the current fault code of the AC drive by reading the address. For the fault code description, see definition of F9-14.
   - AC drive operation status
     When the AC drive running status is read via communication, the communication address is 3000H. The host controller can obtain the current operation status of the AC drive by reading the address. The operation status is defined in the following table.

Communication Address of AC Drive's Operation Status	Status Definition
3000H	1: Forward run
	2: Reverse run
	3: Stop

2. Control Parameters

Control parameters include control commands, communication references, DO control, AO1 control, AO2 control, and parameter initialization

- Control command

  When F0-02 (command source) is set to 2 (communication control), the host controller can implement control such as start/stop of the AC drive by using the communication address. The control commands are defined in the following table.

Communication Address of AC Drive's Operation Status	Status Definition
2000H	1: Forward run 2: Reverse run 3: Forward jog 4: Reverse jog 5: Coast to stop 6: Decelerate to stop 7: Fault reset

- Communication

  Communication references include data set through communication such as frequency source, torque upper limit source, V/f separation voltage source, PID reference source, and PID feedback source. The communication address is 1000H. The range is -10000 to +10000 and the corresponding value range is -100.00% to +100.00%.

- DO control

  When a DO terminal is assigned with function 20 (communication), the host controller can implement control on DO terminals of the AC drive through the communication address. Control on DO terminals of the AC drive is defined as follows:

Communication Address of DO Control	Command Content
2001H	Bit0: DO1 output control Bit1: DO2 output control Bit2: RELAY1 output control Bit3: RELAY2 output control Bit4: FMR output control Bit5: VDO1 Bit6: VDO2 Bit7: VDO3 Bit8: VDO4 Bit9: VDO5

- AO1 control, AO2 control, and high-speed pulse (FMP) output control

When AO1, AO2, and FMP are assigned with function 12 (communication), the host controller can implement control on AO and high-speed pulse output through the communication addresses. The definition is provided in the following table.

Communication Address of Output Control		Command Content
AO1	2002H	0 to 7FFF indicates 0% to 100%.
AO2	2003H	
FMP	2004H	

- Parameter initialization
  This function is used when parameters needs to be initialized on the AC drive by using the host controller.

  If FP-00 (user password) is set to a non-zero value, password verification is required. The host controller performs parameter initialization within 30s after successful password verification.

  The communication address of password verification through communication is 1F00H. Directly write the correct user password to this address to perform password verification. The communication address of parameter initialization through communication is 1F01H, as defined in the following table.

Communication Address of Parameter Initialization	Command Definition
1F01H	1: Restore default settings 2: Clear records 4: Restore user backup parameters 501: Back up current user parameters

3.1.2 Modbus Communication Protocol

Overview

The AC drive provides RS485 communication interfaces and supports the Modbus-RTU slave communication protocol. You can implement centralized control, such as setting commands, modifying parameters, and reading running state and fault information of the AC drive, by using a computer or PLC.

This protocol defines the content and format of transmitted messages during serial communication, including master polling (or broadcasting) format and master coding method (parameters for action requirements, transmission data, and error check). Slave response uses the same structure and includes action confirmation, returned data, and error check. If an error occurs when the slave receives a message, or the slave cannot complete the action required by the master, the slave returns a fault message as a response to the master.

Application

The AC drive is connected to a "single-master multi-slave" PC or PLC control network with RS485 bus.

Hardware interface

The RS485 extension card MD38TX1 must be inserted into the AC drive.

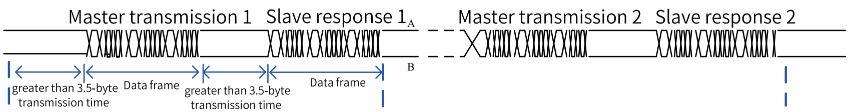
Topology

The system consists of a single master and multiple slaves. In the network, each communication device has a unique slave address. One of the devices (usually a PC host controller, a PLC, or an HMI) is the master and initiates communication to perform parameter read or write operations on slaves. Other devices (slaves) provide data to respond to query or operations from the master. Only one device is allowed to transmit data at a time, whereas other devices should be in data receiving status.

The address range of the slaves is 1 to 247, and 0 is a broadcast address. A slave must have a unique address in the network.

Communication transmission mode

The asynchronous serial and half-duplex transmission mode is used. During asynchronous serial communication, data is sent frame by frame in the form of message. According to the Modbus-RTU protocol, an interval of at least 3.5-byte transmission time marks the end of the previous message. A new message starts to be sent after this interval.



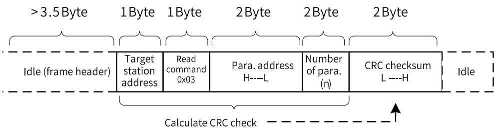
The communication protocol used by the AC drive is the Modbus-RTU slave communication protocol, which allows the AC drive to provide data to respond to "query/command" from the master or execute actions according to "query/ command" from the master.

The master can be a PC, an industrial control device, or a PLC. The master can communicate with a single slave or send broadcast messages to all slaves. When the master communicates with a single slave, the slave needs to return a message (response) to "query/command" from the master. For a broadcast message sent by the master, the slaves need not return a response.

3.1.3 Communication Data Frame Structure

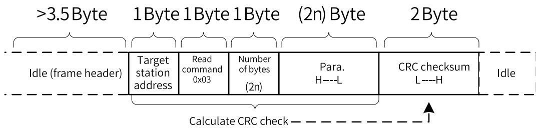
The following figure shows the Modbus-RTU communication date. The AC drive supports read and write of word-type parameters only. The read command is 0x03, the write command is 0x06, and the multi-write command is 0x10. The AC drive does not support read and write of bytes or bits.

Frame of read command from the master

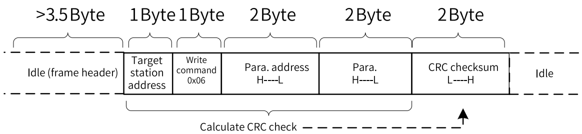


Theoretically, the host controller can read multiple continuous parameters at a time (that is, n is up to 12). Do not stride over the last parameter in this parameter group; otherwise, an error will be returned.

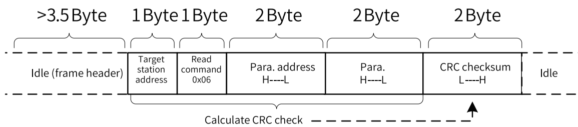
Frame of slave response to read command



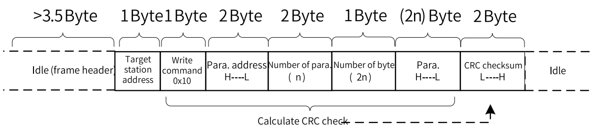
Frame of write command from the master



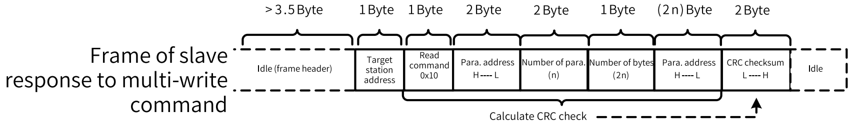
Frame of slave response to write command



Frame of multi-write command from the master



Multi-write is the same as multi-read and up to 12 parameters can be continuously written.



If the slave detects a communication frame error or read/write failure due to other causes, the slave returns a frame of error.

Note

No response is returned for CRC check error.

A read error returned from the slave is 0x83. A write error returned from the slave is 0x86. A multi-write error returned from the slave is 0x90.

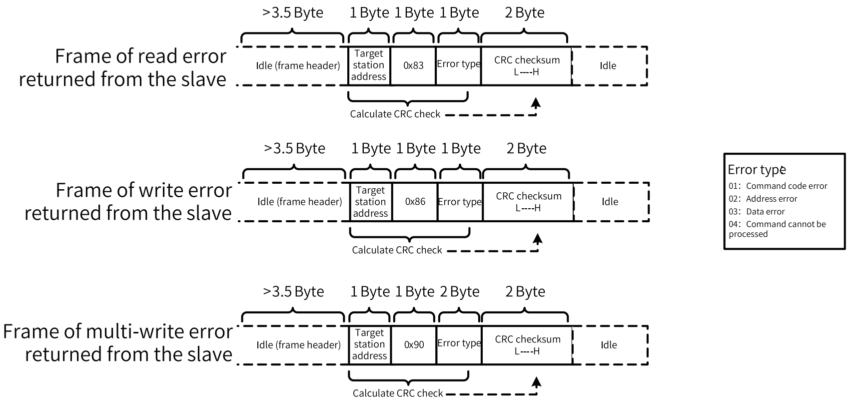


Table 3–1 Data frame fields

Frame header (START)	Idle time greater than 3.5-byte transmission time
Slave address (ADR)	Communication address range: 1 to 247; 0 = Broadcast
Command code (CMD)	03: Read slave parameters; 06: Write slave parameters; 10: Multi-write slave parameters
Parameter address (H)	Internal parameter address of the AC drive, expressed in hexadecimal. Parameters are divided into parameter type and non-parameter type (for example, operation status parameters and operation commands). See the definition of addresses. Low-order bytes follow high-order bytes during transmission.
Parameter address (L)	
Parameter count (H)	Number of parameters read in this frame. The value 1 indicates reading one parameter. Low-order bytes follow high-order bytes during transmission. According to this protocol, only one parameter can be rewritten at a time without this field.
Parameter count (L)	

Data bytes	The data length, which is twice the number of parameters
Data (H)	Response data or data to be written. Low-order bytes follow high-order bytes during transmission.
Data (L)	
CRC low bit	Detection value: CRC16 check value. High-order bytes follow low-order bytes during transmission. For details of the calculation method, see the description of CRC in this section.
CRC high bit	
END	3.5-byte transmission time

CRC check:

Cyclical Redundancy Check (CRC) uses the RTU frame format. A Modbus message includes a CRC-based error check field. The CRC field is used to check content of the entire message. The CRC field contains two bytes, making up a 16-bit binary value. The CRC field is calculated by the transmitting device, and then added to the message. The receiving device recalculates a CRC value after receiving the message, and compares the calculated value with the CRC value in the received CRC field. If the two CRC values are unequal, a transmission error occurs.

The CRC is first stored to 0xFFFF. Then a procedure is invoked to process the successive 8-bit bytes in the message and the value in the register. Only the eight bits in each character are used for the CRC. The start bit, stop bit, and the parity bit do not apply to the CRC.

During generation of the CRC, each eight-bit character is in exclusive-OR (XOR) with the content in the register. Then, the result is shifted in the direction of the least significant bit (LSB), with a zero filled into the most significant bit (MSB) position. The LSB is extracted and examined. If the LSB is 1, the register then performs XOR with a preset value. If the LSB is 0, no XOR is performed. This process is repeated until eight shifts have been performed. After the last (eighth) shift, the next eight-bit byte is in XOR with the register's current value, and the process repeats for another eight shifts as described above. The final value of the register, after all the bytes of the message have been applied, is the CRC value.

When CRC is added in a message, high-order bytes follow low-order bytes. The CRC simple function is as follows:

```
unsigned int crc_chk_value (unsigned char *data_value,unsigned char length)
{
unsigned int crc_value=0xFFFF;
int i;
while (length–)
{
crc_value^=*data_value++;
for (i=0;i<8;i++)
```

```
{
if (crc_value&0x0001)
{
crc_value= (crc_value>>1) ^0xa001;
}
else
{
crc_value=crc_value>>1;
}
}
}
return (crc_value);
 }
```

Definition of communication parameter addresses:

R/W parameter (some parameters cannot be modified as they are manufacturer-specific parameters or for monitoring purpose only.)

3.1.4 Parameter Address Expression Rules

The parameter group number and parameter number are used to express a parameter address.

High-order bytes: F0 to FF (group F), A0 to AF (group A), and 70 to 7F (group U)

Low-order bytes: 00 to FF

For example, the communication address of F3-12 is expressed as 0xF30C.

Group FF: Parameters cannot be read or modified. Group U: Parameters are ready-only and cannot be modified.

Some parameters cannot be modified when the AC drive is running. Some parameters cannot be modified regardless of the status of the AC drive. When modifying a parameter, pay attention to the range, unit, and description of the parameter.

Parameter Group No.	Communication Access Address	Modified RAM Parameter Address Through Communication
F0 to FE	0xF000 to 0xFEFF	0x0000 to 0x0EFF
A0 to AC	0xA000 to 0xACFF	0x4000 to 0x4CFF
U0	0x7000 to 0x70FF	

Note

Frequent storage to the EEPROM reduces its service life. Therefore, in communication mode, change values of certain parameters in RAM rather than storing the setting.

For parameters in group F, you only need to change the high-order F of the parameter address to 0. For parameters in group A, you only need to change the high-order A of the parameter address to 4.

The parameter addresses are expressed as follows:

High-order bytes: 00 to 0F (group F) and 40 to 4F (group A)

Low-order bytes: 00 to FF

Example:

If parameter F3-12 is not to be stored into EEPROM, the address is expressed as 030C. If parameter A0-05 is not to be stored into EEPROM, the address is expressed as 4005. This address indicates that the parameter can only be written to RAM, and is invalid when being read.

The following table lists some stop/run parameters.

Para. Address	Description	Para. Address	Description
1000H	*Communication (decimal) -10000 to +10000	1010H	PID reference
1001H	Running frequency	1011H	PID feedback
1002H	Bus voltage	1012H	PLC process
1003H	Output voltage	1013H	Pulse input frequency (basic unit: 0.01 kHz)
1004H	Output current	1014H	Feedback speed (basic unit: 0.1 Hz)
1005H	Output power	1015H	Remaining running time
1006H	Output torque	1016H	AI1 voltage before correction
1007H	Running speed	1017H	AI2 voltage before correction
1008H	DI input indication	1018H	AI3 voltage before correction
1009H	DO output indication	1019H	Linear speed
100AH	AI1 voltage	101AH	Current power-on time
100BH	AI2 voltage	101BH	Current running time
100CH	AI3 voltage	101CH	Pulse input frequency (basic unit: 1 Hz)

Para. Address	Description	Para. Address	Description
100DH	Count value input	101DH	Current communication (read-only)
100EH	Length value input	101EH	Actual feedback speed
100FH	Load speed	101FH	Display of main frequency X
–	–	1020H	Display of auxiliary frequency Y

Note

A communication reference is a percentage expressed as a fraction of the maximum frequency (F0-10). +10000 and –10000 correspond to +100.00% and –100.00% respectively. For torque dimension data, this percentage is F2-10 or A2-48 (digital setting of torque upper limit of the first or second motor).

Control command input to AC drive (write-only):

Command Word Address	Command Definition
2000H	0001: Forward run
	0002: Reverse run
	0003: Forward jog
	0004: Reverse jog
	0005: Coast to stop
	0006: Decelerate to stop
	0007: Fault reset

Read AC drive state (read-only):

State Word Address	State Word Function
3000H	0001: Forward run
	0002: Reverse run
	0003: Stop

Parameter locking password check: If an actual password value is returned, password check succeeds. (If no password is set, namely, the password is 0, 0000H is returned.)

Password Address	Password Content
1F00H	*****

DO terminal control (write-only)

Command Address	Command Content
2001H	Bit0: DO1 output control Bit1: DO2 output control Bit2: RELAY1 output control Bit3: RELAY2 output control Bit4: FMR output control Bit5: VDO1 Bit6: VDO2 Bit7: VDO3 Bit8: VDO4 Bit9: VDO5

AO1 control (write-only):

Command Address	Command Content
2002H	0 to 7FFF indicates 0% to 100%.

AO2 control (write-only):

Command Address	Command Content
2003H	0 to 7FFF indicates 0% to 100%.

Pulse output control (write-only):

Command Address	Command Content
2004H	0 to 7FFF indicates 0% to 100%.

AC drive fault description:

AC Drive Fault Address	AC Drive Fault Information	
8000H	0000: No fault 0001: Reserved 0002: Overcurrent during acceleration 0003: Overcurrent during deceleration 0004: Overcurrent during operation at constant speed 0005: Overvoltage during acceleration 0006: Overvoltage during deceleration 0007: Overvoltage during operation at constant speed 0008: Pre-charge resistor overload 0009: Undervoltage fault 000A: AC drive overload 000B: Motor overload 000C: Input phase loss 000D: Output phase loss 000E: IGBT overtemperature 000F: External fault 0010: Communication fault 0011: Contactor fault 0012: Current detection fault 0013: Motor auto-tuning fault 0014: Encoder/PG card fault	0015: Parameter read-write error 0016: AC drive hardware fault 0017: Motor short circuit to ground 0018: Reserved 0019: Reserved 001A: Running time reach 001B: User-defined fault 1 001C: User-defined fault 2 001D: Power-on time reach 001E: Load lost 001F: PID feedback loss during operation 0028: Fast current limit timeout 0029: Motor switchover fault during operation 002A: Excessive speed deviation 002B: Motor overspeed 002D: Motor overtemperature 005A: Encoder PPR reference error 005B: Encoder not connected 005C: Initial position error 005E: Speed feedback error

3.1.5 Group Fd: Communication Parameters

Parameter Fd-00 is used to set a data transmission rate between the host controller and the AC drive. Note that the baud rate of the host controller must be consistent with that of the AC drive. Otherwise, communication will fail. A high baud rate means faster communication speed.

Para. No.	Name	Default	Value Range
Fd-00	Baud rate	5005	Ones (Modbus) 0: 300 bps 1: 600 bps 2: 1200 bps 3: 2400 bps 4: 4800 bps 5: 9600 bps 6: 19200 bps 7: 38400 bps 8: 57600 bps 9: 115200 bps

The data format of the host controller must be consistent with that of the AC drive. Otherwise, communication will fail.

Para. No.	Name	Default	Value Range
Fd-01	Data format	0	0: No check <8,N,2> 1: Even parity check <8,E,1> 2: Odd parity check <8,O,1> 3: No check <8,N,1>

When the local address is set to 0 (broadcast address), the broadcasting function of the host controller is implemented. The local address is unique (except the broadcast address) and is the precondition to implementing point-to-point communication between the host controller and the AC drive.

Para. No.	Name	Default	Value Range
Fd-02	Local address	1	1 to 247 0: Broadcast address

Response delay: Indicates the interval from the end of data receiving by the AC drive to the start of data transmission to the host controller. If the response delay is shorter than the system processing time, the former is subject to the latter. Otherwise, after the system finishes data processing, the system waits until the response delay time expires before sending the data to the host controller.

Para. No.	Name	Default	Value Range
Fd-03	Response delay	2 ms	0 ms to 20 ms

When this parameter is set to 0.0s, the system does not detect communication timeout.

When the interval between communication messages exceeds the communication timeout time, the system reports a communication fault (Err16). The parameter is generally set to invalid. In applications with continuous communication, you can use this parameter to monitor the communication state.

Para. No.	Name	Default	Value Range
Fd-04	Communication timeout time	0.0s	0.0s (invalid) 0.1s to 60.0s

4 Fault Codes

4.1 List of Fault Codes

The following faults may occur during use of the AC drive. Rectify the faults by taking actions described in the following table.

Table 4–1 Fault codes

Fault Name	Display	Possible Cause	Action
Overcurrent during acceleration	E02.00	Grounded or short-circuited output circuit of the AC drive	Check whether the motor or relay contactor is short-circuited.
		Auto-tuning missing in SVC or FVC control mode	Set motor parameters according to the motor nameplate and perform motor auto-tuning.
		Excessively short acceleration time	Increase the acceleration time (F0-17).
		Inappropriate overcurrent stall suppression	Ensure that overcurrent stall suppression (F3-19) is enabled. If the value of F3-18 (overcurrent stall suppression level) is too large, adjust it to a level between 120% and 160%. If the value of F3-20 (overcurrent stall suppression gain) is too small, adjust it to a level between 20 and 40.
		Inappropriate customized torque boost or V/f curve	Adjust the customized torque boost or V/f curve.
		Startup of an already running motor	Use flying start or restart the motor.
		External interference to the AC drive	View the fault records to check whether the fault current ever reached the overcurrent suppression level (F3-18). If not, check for external interference source. If no external interference source is found, consider damages to the driver board or Hall device and contact Inovance for replacement.
Overcurrent during deceleration	E03.00	Grounded or short-circuited output circuit of the AC drive	Check whether the motor is short-circuited or open-circuited.
		Auto-tuning missing in SVC or FVC control mode	Set motor parameters according to the motor nameplate and perform motor auto-tuning.
		Excessively short deceleration time	Increase the deceleration time (F0-18).
		Inappropriate overcurrent stall suppression	Ensure that overcurrent stall suppression (F3-19) is enabled. If the value of F3-18 (overcurrent stall suppression level) is too large, adjust it to a level between 120% and 150%. If the value of F3-20 (overcurrent stall suppression gain) is too small, adjust it to a level between 20 and 40.
		Missing braking unit or braking resistor	Install a braking unit and a braking resistor.
		External interference to the AC drive	View the fault records to check whether the fault current ever reached the overcurrent suppression level (F3-18). If not, check for external interference source. If no external interference source is found, consider damages to the driver board or Hall device and contact Inovance for replacement.

Fault Name	Display	Possible Cause	Action
Overcurrent during operation at constant speed	E04.00	Grounded or short-circuited output circuit of the AC drive	Check whether the motor is short-circuited or open-circuited.
		Auto-tuning missing in SVC or FVC control mode	Set motor parameters according to the motor nameplate and perform motor auto-tuning.
		Inappropriate overcurrent stall suppression	Ensure that overcurrent stall suppression (F3-19) is enabled. If the value of F3-18 (overcurrent stall suppression level) is too large, adjust it to a level between 120% and 150%. If the value of F3-20 (overcurrent stall suppression gain) is too small, adjust it to a level between 20 and 40.
		Inadequate power rating of the AC drive	If the running current exceeds the rated motor current or rated output current of the AC drive during stable running, replace the AC drive with one with a higher power rating.
		External interference to the AC drive	View the fault records to check whether the fault current ever reached the overcurrent suppression level (F3-18). If not, check for external interference source. If no external interference source is found, consider damages to the driver board or Hall device and contact Inovance for replacement.
Overvoltage during acceleration	E05.00	High input grid voltage	Adjust the voltage to the normal range.
		External force driving the motor during acceleration	Cancel the external force or install a braking resistor. If the value of F3-26 (frequency rise threshold during overvoltage suppression) is too small, adjust it to a level between 5 Hz to 15 Hz when an external force drives the motor.
		Inappropriate overvoltage suppression	Ensure that overvoltage suppression (F3-23) is enabled. If the value of F3-22 (overvoltage suppression) is too large, adjust it to a level between 700 V and 770 V. If the value of F3-24 (frequency gain for overvoltage suppression) is too small, adjust it to a level between 30 and 50.
		Missing braking unit or braking resistor	Install a braking unit and a braking resistor.
		Excessively short acceleration time	Increase the acceleration time.

Fault Name	Display	Possible Cause	Action
Overvoltage during deceleration	E06.00	Inappropriate overvoltage suppression	Ensure that overvoltage suppression (F3-23) is enabled. If the value of F3-22 (overvoltage suppression) is too large, adjust it to a level between 700 V and 770 V. If the value of F3-24 (frequency gain for overvoltage suppression) is too small, adjust it to a level between 30 and 50.
		External force driving the motor during deceleration	Cancel the external force or install a braking resistor. If the value of F3-26 (frequency rise threshold during overvoltage suppression) is too small, adjust it to a level between 5 Hz to 15 Hz when an external force drives the motor.
		Excessively short deceleration time	Increase the deceleration time.
		Missing braking unit or braking resistor	Install a braking unit and a braking resistor.
Overvoltage during operation at constant speed	E07.00	Inappropriate overvoltage suppression	Ensure that overvoltage suppression (F3-23) is enabled. If the value of F3-22 (overvoltage suppression) is too large, adjust it to a level between 700 V and 770 V. If the value of F3-24 (frequency gain for overvoltage suppression) is too small, adjust it to a level between 30 and 50.
		External force driving the motor during operation.	Cancel the external force or install a braking resistor. If the value of F3-26 (frequency rise threshold during overvoltage suppression) is too small, adjust it to a level between 5 Hz to 15 Hz when an external force drives the motor.
Undervoltage	E09.00	Instantaneous power failure	Enable the power dip ride-through function (F9-59).
		AC drive input voltage out of range	Adjust the voltage to the normal range.
		Abnormal bus voltage	Contact Inovance for technical support.
		Abnormal rectifier, IGBT driver board, or IGBT control board	Contact Inovance for technical support.

Fault Name	Display	Possible Cause	Action
AC drive overload	E10.00	Excessively heavy load or stalled motor	Reduce the load and check the motor and mechanical conditions.
		Inadequate power rating of the AC drive	Use an AC drive with a higher power rating.
		Auto-tuning missing in SVC or FVC control mode	Set motor parameters according to the motor nameplate and perform motor auto-tuning.
		Excessively high torque boost (F3-01) in V/f control mode	Decrease the value of F3-01 in increments of 1.0% or set F3-01 to 0 (automatic torque boost).
		Output phase loss on the AC drive	Check the output wiring of the AC drive.
Motor overload	E11.00	Inappropriate F9-01 (motor overload protection gain) setting.	Increase the value of F9-01 to prolong the motor overload time.
		Excessively heavy load or stalled motor	Reduce the load and check the motor and mechanical conditions.
Input phase loss	E12.00	Input phase loss	Ensure proper input RST cables and three-phase input voltage.
Output phase loss	E13.00	Motor fault	Check whether the motor is open-circuited.
		Abnormal lead wire connecting the AC drive to the motor	Rectify external faults.
		Unbalanced three-phase output of the AC drive during motor operation	Ensure proper functioning of the motor three-phase winding.
		Abnormal driver board or IGBT	Contact Inovance for technical support.
IGBT overtemperature	E14.00	High ambient temperature	Lower the ambient temperature.
		Blocked air filter	Clean the air filter.
		Damaged fan	Replace the damaged fan.
		Damaged IGBT thermistor	Contact Inovance for technical support.
		Damaged IGBT	Contact Inovance for technical support.
External fault	E15.01	External fault signal input to the multi-function DI terminal (normally open)	Rectify the external fault, and ensure that the mechanical condition allows restart (F8-18) and reset the operation.
	E15.02	External fault signal input to the multi-function DI terminal (normally closed)	Rectify the external fault, and ensure that the mechanical condition allows restart (F8-18) and reset the operation.

Fault Name	Display	Possible Cause	Action
Communication fault	E16.01	Modbus communication timeout	Ensure proper wiring of the RS485 communication cable. Ensure proper settings of Fd-04 and PLC communication cycle.
	E16.11	CANopen communication timeout	Ensure proper connection of the CAN communication cable. Check the values of Fd-15 to Fd-17 and confirm interference.
	E16.12	Inconsistency between PDO mapping configured for CANopen and the actual mapping	Check the PDO mapping of parameters in group AF.
	E16.21	CANlink heartbeat timeout	Ensure proper connection of the CAN communication cable. Check the values of Fd-15 to Fd-17 and confirm interference.
	E16.22	CANlink station number conflict	Change the value of Fd-13 to make CANlink station numbers different from each other.
Contactor fault	E17.00	Abnormal driver board and power supply	Replace the driver board or power supply board.
		Abnormal contactor	Replace the contactor.
		Abnormal lightning protection board	Replace the lightning protection board.
Damaged current sampling circuit	E18.00	Abnormal AC drive current sampling	Power on the main circuit.
			If the Hall sensor or sampling current circuit is damaged, contact Inovance.

Fault Name	Display	Possible Cause	Action
Motor auto-tuning fault	E19.02	Fault in auto-tuning on the synchronous motor magnetic pole position angle	Check for motor disconnection and output phase loss.
	E19.06	Fault in auto-tuning on the stator resistance	Check for motor disconnection. Set F1-03 (rated motor current) according to the motor nameplate.
	E19.07		
	E19.08		
	E19.09	Fault in auto-tuning on the asynchronous motor transient leakage inductance	Check for motor disconnection and output phase loss. Ensure that the motor is connected properly.
	E19.10		
	E19.11	Inertia auto-tuning fault	Set F1-03 (rated motor current) according to the motor nameplate. Increase the value of F2-43 (inertia auto-tuning and dynamic speed reference).
	E19.20	Timeout of auto-tuning on the synchronous motor no-load zero position angle	Check the Z feedback signal.
	E19.23	Fault in auto-tuning on the synchronous motor magnetic pole position	Set F1-03 (rated motor current) according to the motor nameplate. Decrease the value of F2-29 (synchronous motor initial angle detection current).
	E19.24	Errors in auto-tuning on the asynchronous motor transient leakage inductance	Check whether the AC drive is rated at low power. If yes, use an AC drive with a proper power rating matching the motor power.

Fault Name	Display	Possible Cause	Action
Encoder fault	E20.00	Encoder disconnected	Restore connection. Ensure proper wiring of the PG cable. Ensure proper wiring of the PG cable and power supply. Ensure consistency between the encoder pulses per revolution and the value of F1-27. Ensure proper wiring of the AB signal cable.
	E20.01	Encoder fault	
	E20.02	Encoder disconnected	
	E20.03	Encoder fault during synchronous motor no-load auto-tuning	
	E20.04	Encoder fault during synchronous motor no-load auto-tuning	
	E20.06	Encoder fault during synchronous motor with-load auto-tuning	
	E20.07	Encoder fault during synchronous motor no-load auto-tuning	
	E20.08	Encoder fault during synchronous motor no-load auto-tuning	
	E20.09	Encoder fault during synchronous motor auto-tuning	Check the encoder Z signal and wiring of the PG card.
	E20.10	Synchronous motor encoder fault	
	E20.11	The encoder is faulty during asynchronous motor FVC no-load auto-tuning.	Ensure that the encoder is properly connected. Ensure consistency between the encoder pulses per revolution and the value of F1-27.
	E20.12	Excessive deviation between the encoder feedback speed and the speed estimated by SVC	Check for encoder disconnection. Ensure proper setting of motor parameters. Ensure that motor auto-tuning is performed.
	E20.13	Resolver disconnected	Check the wiring of the resolver.
	E20.17	23-bit encoder disconnected	Check the wiring of the resolver.
EEPROM read/write fault	E21.01	EEPROM read/write abnormality	For communication write parameters, ensure proper mapping between parameters and RAM addresses. If the EEPROM chip is damaged, contact Inovance to replace the control board.
	E21.02		
	E21.03		
	E21.04		

Fault Name	Display	Possible Cause	Action
Motor auto-tuning error	E22.00	Auto-tuned stator resistance out of range	Correctly set F1-02 (rated motor voltage) and F1-03 (rated motor current) in group F1 according to the motor nameplate.
	E22.01	Auto-tuned asynchronous motor rotor resistance out of range	Ensure that auto-tuning is performed after the motor stops.
	E22.02	Auto-tuned asynchronous motor no-load current and mutual inductance out of range If this alarm is reported, the AC drive calculates the mutual inductance and no-load current values based on known motor parameters. The calculated values may not be optimal values.	Set motor parameters in group F1 according to the motor nameplate. Ensure that the motor has no load before auto-tuning.
	E22.03	Auto-tuned synchronous motor back EMF out of range	Set F1-02 (rated motor voltage) according to the motor nameplate. Ensure that the motor has no load before auto-tuning.
	E22.04	Inertia auto-tuning fault	Set F1-03 (rated motor current) according to the motor nameplate.
Short-circuited to ground	E23.00	Motor short-circuited to ground	Check and, if necessary, replace the motor cables and motor.
Motor inter-phase short circuit	E24.00	Motor inter-phase short circuit	Check whether a two-phase short circuit occurs on the output UVW.
Rectifier fault	E25.00	Rectifier fault	Rectify corresponding faults, such as input phase loss and overtemperature. 1: Operation enabled 2: Incoming circuit breaker feedback 3: Auxiliary circuit breaker feedback 4: Leakage protection switch feedback If there is no feedback signal, an alarm is reported. 6: Inverter unit operation inhibited 7: Inverter unit coast-to-stop 8: User-defined inverter unit stop An alarm is reported in this mode.
Accumulative running time reach	E26.00	The accumulative running time has reached the reference value.	Clear the record through parameter initialization.
User-defined fault 1	E27.00	User-defined fault 1 signals input to the multi-function DI terminal	Reset.
		User-defined fault 1 signals input through the virtual I/O function	Reset.
User-defined fault 2	E28.00	User-defined fault 2 signals input to the multi-function DI terminal	Reset.
		User-defined fault 2 signals input through the virtual I/O function	Reset.

Fault Name	Display	Possible Cause	Action
Accumulative power-on time reach	E29.00	Accumulative power-on time reaching the reference value	Clear the record through parameter initialization.
Load lost	E30.00	Running current of the AC drive less than the value of F9-64	Check for load disconnection and mismatching between the values of F9-64 and F9-65 and actual working conditions.
PID feedback loss during operation	E31.00	PID feedback less than the value of FA-26	Check the PID feedback signals or set FA-26 to a proper value.
Pulse-by-pulse current limit fault	E40.00	Excessively heavy load or stalled motor	Reduce the load and check the motor and mechanical conditions.
		Inadequate power rating of the AC drive	Use an AC drive with a higher power rating.
Excessive speed deviation	E42.00	Incorrect setting of encoder parameters	Set encoder parameters properly.
		Missing auto-tuning on parameters	Perform motor parameter auto-tuning.
		Inappropriate setting of F9-69 and F9-70	Set the parameters correctly based on actual conditions.
Motor overspeed	E43.00	Incorrect setting of encoder parameters	Set encoder parameters properly.
		Missing auto-tuning on parameters	Perform motor parameter auto-tuning.
		Inappropriate setting of F9-67 and F9-68	Set the parameters correctly based on actual conditions.
Motor overtemperature	E45.00	Temperature sensor loosely connected	Check the wiring of the temperature sensor.
		High motor temperature	Increase the carrier frequency or take other heat dissipation measures to cool the motor.
		Excessively low value of F9-57 (motor overtemperature protection threshold)	Adjust the threshold to a level between 90°C and 100°C.
STO fault	E47.00	STO fault	Check whether the STO function (F8-54) is enabled.
			If the function is enabled, check whether the IGBT terminals STO1 and STO2 have 24 V input.
AC drive overtemperature	E60.00	High internal temperature of the AC drive	Replace the fan in the AC drive.
			Contact Inovance.
Braking transistor overload	E61.00	Excessively low resistance of the braking resistor	Use a braking resistor with higher resistance.
Braking transistor short circuit	E62.00	Braking transistor short circuit	Ensure proper functioning of the braking transistor.
			Check whether an external braking resistor is provided.
Low liquid level alarm	A63.00	Low liquid level of the water tank	Add coolant.

Fault Name	Display	Possible Cause	Action
Water cooling system fault	E64.00	Water-cooling system control unit fault	Reset.
			Replace the control unit.

Shenzhen Inovance Technology Co., Ltd.

Add.: Building E, Hongwei Industry Park, Liuxian Road,
Baocheng No. 70 Zone, Bao'an District, Shenzhen

Tel: +86-755-2979 9595
Fax: +86-755-2961 9897
http://www.inovance.com

Suzhou Inovance Technology Co., Ltd.
Add.: No. 16 Youxiang Road, Yuexi Town, Wuzhong
District, Suzhou 215104, P.R. China

Tel: +86-755-2979 6666
Fax: +86-755-2961 6720
http://www.inovance.com

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