RVBS

Variable Frequency Drive

Rev 1.0

Index

1. Introduction

1.1 Foreword

The RVBS is a variable frequency drive specifically designed to control:

- Industrial doors
- Entrances powered from induction motors

Configuration, programming as well as Run/Stop commands and speed reference are managed via any controller through a RS485 serial connection using the Modbus® protocol using a PC software.
We also dedicated an optional remote keypad for the configuration, or you can always do it directly via the PLC

1.2 Scope

This document is intended to provide information on how to use the RVBS SW and to set-up and configure the RVBS

Should there be any problems that cannot be solved with the information provided in this guide, contact your Carlo Gavazzi sales representative for further assistance.

1.3 Disclaimer

Carlo Gavazzi accepts no liability for any consequence resulting from inappropriate, negligent, incorrect installation or adjustment of parameters of the equipment. Nor can Carlo Gavazzi assume liability for recommendations that appear or are implied in the following description. The information in this document is not considered binding on any product warranty.

The contents of this guide are believed to be correct at the time of publishing. In the interests of commitment to a policy of continuous development and improvement, Carlo Gavazzi reserves the right to change the specification of the product or its performance, or the contents of this guide without prior notice.

1.4 Warning notice system

The symbols indicated below are used throughout this guide to indicate a particularly important subject or information on safety instructions, configuration and installation of the products covered by this guide.
It is strongly recommended that this guide is read thoroughly before using the products and that safety related recommendations are followed.

Danger
Indicates that death, severe personal injury, or property damage will result if proper precautions are not taken.

Warning
Indicates actions that if not observed may lead to damage of the products.

Information
Indicates general information related to the proper use of the products.

1.5 Qualified personnel

The product / system described in this documentation may be operated only by personnel qualified for the specific task that are also capable of identifying risks and avoid potential hazards when working with these products.
The RVBS features dangerous voltages and consequently failure to observe the instructions contend in this user manual may cause serious harm to people and damage to property.

1.6 Basic safety requirements

Always disconnect RVBS and external control circuits from the power supply before performing any maintenance activity.
After removal of power, allow enough time (typically 5 minutes) before touching any terminal on the RVBS as dangerous voltages might still be present.
As a rule, always check, using suitable equipment, that there is no dangerous voltage across the RVBS terminals.
Always make sure that the motor has reached a complete stop before doing any maintenance on the RVBS. Motor that are still rotating may produce dangerous voltages at the RVBS terminals even when it's not connected to the power supply.
Some parts of the RVBS may be hot. Coming in contact with such surfaces may cause burns.

1.7 Disposal

Information for users on the correct handling of waste of electrical and electron ic equipment (WEEE)

With reference to European Union directive 2002/96/EC issued on 27 January 2003 and the related national legislation, please note that:

- WEEE cannot be disposed of as municipal waste and such waste must be collected and disposed of separately
- The public or private waste collection systems defined by local legislation must be used. In addition, the equipment can be returned to the distributor at the end of its working life when buying new equipment
- The equipment may contain hazardous substances: the improper use or incorrect disposal of such may have negative effects on human health and on the environment
- The symbol (crossed-out wheelie bin) shown on the packaging and on the instruction, sheet indicates that the equipment has been introduced onto the market after 13 August 2005 and that it must be disposed of separately
- In the event of illegal disposal of electrical and electronic waste, the penalties are specified by local waste disposal legislation.

2. Customer Requirements

2.1 Commercial specifications

Section	Parameter	RVBS120055F	RVBS120075F
General data	Control mode	V/F control	
	Control method	Via Digital run/stop command input, analog input or Modbus RTU for speed reference	
	Frequency range	0 - 90 Hz	
	Configuration	Via serial port (Modbus RTU)	
	Parameter update	Via serial port (Modbus RTU)	
	Display	No	
	LED status indicators	2 (see position on Structure sheet)	
	Speeds (Maximum and minimum speeds)	Range 0 - 90 Hz	
	Speed resolution	1Hz	
	Nominal motor power	0.55 kW	0.75 kW
	Rated output current	2.7 Arms	5.0 Arms
	Input voltage range	Single phase: 200 - 240 VAC (+10%, -15%), 50/60 Hz	
	Output voltage range	Three phase: 0 - 240 VAC	
	Duty cycle	Continuous operation, 150% for 1 minute	

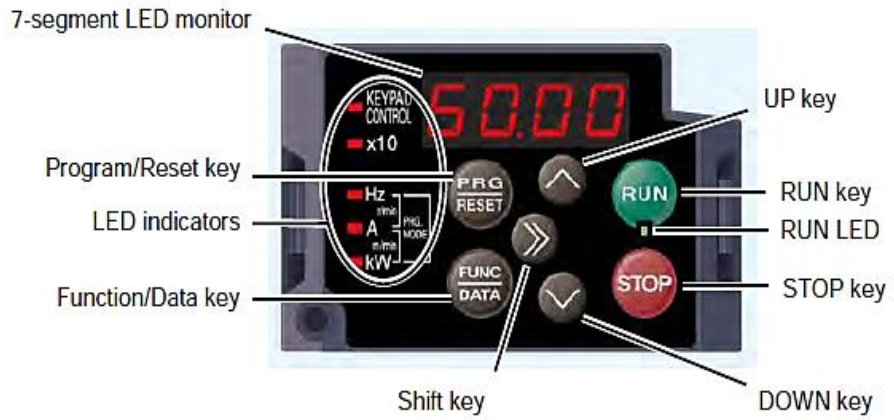
2.2 Functional specifications

Section	Parameter	RVBS120055F	RVBS120075F
Digital Inputs	**Digital inputs**	2	
	Digital input 1	Run/Stop	
	Digital input 2	Reset	
	Topology	24V, NPN	
Digital Outputs	**Digital outputs**	1	
	Digital output	Alarm relay	
	Relay rating	2 Arms @ 230 VAC, Changeover	
Analog I/O	Analog input	Speed command, 1EA	
	Analog output	Not available	
Protection	Protective functions	Overload, overcurrent, over temperature, overvoltage … motor protection	

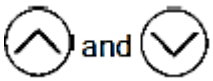
3. Keypad Operation

3.1 Names and functions of Keypad components

The Keypad allows you to run and stop the motor, display various data, configure function code data, monitor I/O signal states, maintenance information and alarm information.



Item	LED Monitor, Keys and LED indicators	Functions
LED Monitor		Four-digit, 7-segment LED monitor which displays the following according to the operation modes. ■ In Running mode: Running status information (e.g., output frequency, current and voltage) ■ In Programming mode: Menus, function codes and their data ■ In Alarm mode: Alarm code, which identifies the alarm factor that has activated the protective function
Operation Keys		Program/Reset key which switches the operation mode of the inverter ■ In Running mode: Pressing this key switches the inverter to Programming mode ■ In Programming mode: Pressing this key switches the inverter to Running mode ■ In Alarm mode: Pressing this key after removing the alarm factor resets the alarm and switches back to Running mode

		Function/Data key which switches the operations you want to do in each mode as follows: ■ *In Running mode:* Pressing this key switches the information to be displayed concerning the status of the inverter (output frequency (Hz), output current (A, output voltage (V), etc.) When a light alarm is displayed, holding down this key resets the light alarm and switches back to Running mode ■ *In Programming mode:* Pressing this key displays the function code or establishes the data entered with ∧ and ∨ ■ *In Alarm mode:* Pressing this keys displays the details of the problem indicated by the alarm code that has come up on the LED monitor
		RUN key. Press this key to run the motor
		STOPR key. Press this key to stop the motor
		UP and DOWN key. Press these keys to select the setting items and change the function code data display on the LED monitor
		Shift key. Press this key to shift the cursor to the right for entry of numerical value

3.2 Alphanumeric Characters on the LED Monitor

Character	7-segment	Character	7-segment	Character	7-segment	Character	7-segment
0	0	9	9	i	,	r	r
1	1	A	A	J	J	S	S
2	2	b	b	K	K	T	T
3	3	C	C	L	L	u	u
4	4	d	d	M	M	V	V
5	5	E	E	n	n	W	W
6	6	F	F	o	o	X	X
7	7	G	G	P	P	y	y
8	8	H	H	q	q	Z	Z
Special characters and symbols (numbers with decimal point, minus and underscore)							
0. - 9.	0. – 9.	-	-	_	_		

4. Software Functions

4.1 Communication

The configuration and the programming of the RVBS drive, as well as the run/stop commands and the speed reference are managed via RS-485 serial connection with ModBus RTU protocol.

4.1.1 Network address

The ModBus network address can be set from 1 to 255

Function code	Mod. add.	Description	Def.	Min	Max	U.M.	R/W
Y01	0x0401	RS-485 Communication 1 (Station address)	1	1	255	-	R/W

4.1.2 Communication setting

The transmission speed can be selected between 9600 and 38400 bit/s. All devices connected in the serial network must have the same communication baudrate and the same data communication parity.

Function code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
Y02	0x0402	Communication error processing	0	0	3	-	R/W
Y03	0x0403	Timer	20	0	600	s	R/W
Y04	0x0404	Baud rate	3	0	4		R/W
Y05	0x0405	Data length	0	0	0		R/W
Y06	0x0406	Parity check	3	3	3		R/W
Y07	0x0407	Stop bits	1	1	1		R/W
Y08	0x0408	No-response error detection time	0	0	60	s	R/W
Y09	0x0409	Response interval	1	0	100	s	R/W

4.1.3 ModBus commands

The RVBS drive only uses Registers (16 bit), not Boolean variables (coils). The ModBus functions implemented are as follows:

Function code (FC)	Function name
3	Read Holding Registers (8 registers maximum)
6	Preset Single Register
8	Diagnostics

To make a clear distinction between Modbus RTU function codes and the RVBS's function codes, the former will be hereinafter referred to as 'FC'.

The ModBus exceptions supported are:

Subcode	Item		Description	Order of priority
1	Improper 'FC'		The inverter received an unsupported FC. (See table 3.1.)	1
2	Improper address	Improper function code	An unused function code or a function code out of range was received. When the read/write data (except the first one) containing an unused function code. - During function reading Zero (0) will be read, which will not result in an error. - During continuous function writing The writing will be ignored, which will not result in an error.	2
		Improper number of data	- When the number of read/write data is not between 1 and 10. - No error will result when the value of the function code plus the number of data is beyond the setting range of the function code.	
		Diagnostic code error (maintenance code)	A value other than 0 was received although the sub-function code as the diagnostics was fixed to 0.	
3	Improper data	Data range error	The write data is beyond the permissible write range.	3*1
7	NAK	No right of writing	No right of writing by H28	
		Write disable	- Writing was attempted to the functions to which writing from RTU is prohibited or to which writing is disabled during operation.	

*1 The priority between sub code 3 and 7 depending on a cause of sub code 7.

4.1.4 ModBus communication error

Communication errors number and type, when detected, are monitored to indicate the trend of the communication. These errors are not memorized in the alarms log. In the following status variables are stored the last error type and errors counter. The list below shows the communication error including logical error, transmission error, and communications disconnection error.

Error category	Error name	Description	Error code
Logical error	Improper 'FC'	See "Table 2.d" shown in 2.1.3.	1(01H)
	Improper address		2(02H)
	Improper data		3(03H)
	NAK		7(07H)

Transmission error	CRC error	The frame to the local station is found unmatched in CRC collation.	71(47H)
	Parity error	The parity is unmatched.	72(48H)
	Other errors	Receiving errors other than the abovementioned (framing error, overrun error)	73(49H)
Communications disconnection error	Communications disconnection error	The inverter did not receive a normal frame addressed to local or to other stations within the communications disconnection time set with the function code.	-

Function code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
D11	0x050B	ModBus communication error	-	-	-	-	R

4.1.5 ModBus address control

The data corresponding to every ModBus address can be initialized using H01.

Function code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
H01	0x0301	Data Initialization	0	0	2	-	R/W

4.1.6 Modbus register map

Notification:
*1) When you make settings from the keypad, the incremental unit is restricted by the number of digits that the LED monitor can display. (Example) If the setting range is from -200.00 to 200.00, the incremental unit is:
"1" for -200 to -100, "0.1" for -99.9 to -10.0 and for 100.0 to 200.0, and "0.01" for -9.99 to -0.01 and for 0.00 to 99.99.
(Notation) N.S. means that corresponding model does not support the function specified.

Function Code	Comm Address [Hex]	Name	Description	Init Value (0.55kW/0.75kW)	Initialization Availability	R/W	Locked if drive is in RUN	Unit
Frequently used functions (F group)								
F00	0x0000	Data Protection	0: Disable both data protection and digital reference protection 1: Enable data protection and disable digital reference protection 2: Disable data protection and enable digital reference protection 3: Enable both data protection and digital reference protection	0	O	R/W	N	-
F01	0x0001	Frequency Command 1	0: UP/DOWN keys on keypad Keypad enters frequency reference data in to F29 1: Analog input	0	O	R/W	Y	-

F02	0x0002	Operation Method	1: Terminal command FWD or REV 2: RUN/STOP keys on keypad (forward) 3: RUN/STOP keys on keypad (reverse)	1	O	R/W	Y	-
F03	0x0003	Maximum Frequency 1	25.0 to 120.0	900	O	R/W	Y	0.1Hz
F04	0x0004	Base Frequency 1	25.0 to 120.0	500	O	R/W	Y	0.1Hz
F05	0x0005	Rated Voltage at Base Frequency 1	0: Output a voltage in proportion to input voltage 80 to 240: Output an AVR-controlled voltage	0	O	R/W	Y	Vrms
F06	0x0006	Maximum Output Voltage 1	80 to 240: Output an AVR-controlled voltage	230	O	R/W	Y	Vrms
F07	0x0007	Acceleration Time 1	0.01 to 655	500	O	R/W	N	0.01Sec.
F08	0x0008	Deceleration Time 1	0.01 to 655	500	O	R/W	N	0.01Sec.
F09	0x0009	Motor ETH Characteristic	1: For a general-purpose motor with shaft-driven cooling fan 2: For an inverter-driven motor with separately powered cooling fan	1	O	R/W	N	-
F10	0x000A	Motor ETH Level	0.00: Disable, 0.01 to 100.0 1 to 135% of the rated current (allowable continuous drive current) of the motor	210/329	O	R/W	N	0.01Arms
F11	0x000B	Motor ETH Thermal Time Constant	0.5 to 75.0	50	O	R/W	N	0.1Min.
F12	0x000C	Restart Mode after Momentary Power Failure (Mode selection)	0: Disable restart (Trip immediately) 1: Disable restart (Trip after a recovery from power failure) 2: Trip after decelerate-to-stop 4: Enable restart (Restart at the frequency at which the power failure occurred, for general loads) 5: Enable restart (Restart at the starting frequency)	1	O	R/W	N	-
F13	0x000D	Frequency Limiter (High)	0.0 to 120.0	1000	O	R/W	N	0.1Hz
F14	0x000E	Frequency Limiter (Low)	0.0 to 120.0	0	O	R/W	N	0.1Hz
F15	0x000F	DC Braking1 (Start Frequency)	0.0 to 60.0	0	O	R/W	N	0.1Hz
F16	0x0010	DC Braking1 (Level)	0 to 100 *2)	0	O	R/W	N	%
F17	0x0011	DC Braking1 (Time)	0.00 (Disable), 0.01 to 30.00	0	O	R/W	N	0.01Sec.
F18	0x0012	Starting Frequency1	0.1 to 60.0	10	O	R/W	N	0.1Hz
F19	0x0013	Starting Frequency1 (Holding time)	0.00 to 10.00	0	O	R/W	N	0.01Sec.
F20	0x0014	Stop Frequency	0.1 to 60.0	2	O	R/W	N	0.1Hz
F21	0x0015	Motor Sound (Carrier frequency)	2 to 10	4	O	R/W	N	kHz
F23	0x0017	Stop Frequency (Holding time)	0.00 to 10.00	0	O	R/W	N	0.01Sec.
F24	0x0018	Control Mode Selection 1	0: V/f control with slip compensation inactive 1: Dynamic torque vector control 2: V/f control with slip compensation active	1	O	R/W	Y	-
F25	0x0019	Current Limiter (Mode selection)	0: Disable (No current limiter works.) 1: Enable at constant	2	O	R/W	N	-

			speed (Disable during ACC/DEC) 2: Enable during ACC/constant speed operation					
F26	0x001A	Current Limiter (Level)	20 to 200 (The data is interpreted as the rated output current of the inverter for 100%.) *2)	180	O	R/W	N	%
F28	0x001C	Electronic Thermal Overload Protection for DBR (Usage Rate, %ED)	0.1 to 50.0	100	O	R/W	N	0.10 %
F29	0X001D	Digital Reference Frequency	0.00 to 120.00	0	O	R/W	N	0.01Hz
F30	0x001E	Torque Boost 1	0.0 ~ 20.0 (The percentage is relative to the F05 "Rated Voltage at Base Frequency 1")	50/35	O	R/W	N	0.10 %
F31	0x001F	Dynamic Braking Operation Selection	0: OFF; 1: ON (Dynamic braking function is active in RUN state); 2: ON (Dynamic braking function is active In both RUN and IDLE state)	2	O	R/W	N	-
F32	0x0020	Torque Boost 1 Mode Select	0: Variable torque load 1: Constant torque load 2: Auto-torque boost	1	O	R/W	Y	-

*2) The percentage is relative to the rated output current.

External I/O setting (E group)								
E01	0x0101	Terminal [DI1] Function 1	Selecting function *1* code data assigns the corresponding function to terminals [DI1], [DI2] as listed in the manual. [FWD] and {REV] function cannot support logic-inverted assignment (i.e. 1098, 1099)	98	O	R/W	Y	-
E02	0x0102	Terminal [DI2] Function 1		97	O	R/W	Y	-
E07	0x0107	Terminal [30A/B/C] Function	Selecting function code data assigns the corresponding function to terminals [Y1] and [30A/B/C] as listed in the manual.	99	O	R/W	Y	-
E10	0x010A	Frequency Arrival (Hysteresis width)	0.0 to 10.0	25	O	R/W	N	0.1Hz
E11	0x010B	Frequency Detection (Level)	0.0 to 120.0	600	O	R/W	N	0.1Hz
E12	0x010C	Frequency Detection (Hysteresis width)	0.0 to 120.0	10	O	R/W	N	0.1Hz
E13	0x010D	Coefficient for Speed Indication	0.01 to 200.0	3000	O	R/W	N	-
E14	0x010E	External Braking Signal (OFF current)	0 to 200	100	O	R/W	N	%
E15	0x010F	External Braking Signal (OFF frequency)	0.0 to 25.0	10	O	R/W	N	0.1Hz
E16	0x0110	External Braking Signal (OFF timer)	0.0 to 5.0	10	O	R/W	N	0.1Sec.
E17	0x0111	External Braking Signal (ON frequency)	0.0 to 25.0	10	O	R/W	N	0.1Hz
E18	0x0112	External Braking Signal (ON timer)	0.0 to 5.0	10	O	R/W	N	0.1Sec.
Control functions (C group)								
C10	0x60A	Analog Input Voltage Offset	-10.0 to 10.0	0	O	R/W	N	0.1%
C11	0x60B	Analog Input	0.0 to 200.0	1000	O	R/W	N	0.1%

		Voltage Gain						
C12	0x60C	Frequency at Minimum Analog Input	0.0 to F03 (Maximum Frequency 1)	0	O	R/W	Y	0.1 Hz
C13	0x60D	Frequency at Maximum Analog Input	0.0 to F03 (Maximum Frequency 1)	0	O	R/W	Y	0.1 Hz
C14	0x60E	Minimum Analog Input Offset	0.0 to 100.0	0	O	R/W	Y	0.1%
C15	0x60F	Maximum Analog Input	0.0 to 100.0	1000	O	R/W	Y	0.1%
C16	0x6010	Analog Input Start Frequency	0: C12: 1: 0Hz	0	O	R/W	Y	-
C17	0x6011	Analog Input Low-pass Filter Gain	1 to 8	4	O	R/W	Y	-
Motor parameter setting (P group)								
P01	0x0201	Motor (Rated capacity)	0.01 to 30.00	40/75	X	R/W	Y	0.01kW
P02	0x0202	Motor (Rated current)	0.00 to 100.0	210/329	X	R/W	Y	0.01A rms
P03	0x0203	Motor (Auto-tuning)	0: Disable 1: Tune when the motor stops (%R1, %X)	0	O	R/W	Y	-
P04	0x0204	Motor (No-load current)	0.00 to 50.00	152/211	X	R/W	Y	0.01A rms
P05	0x0205	Motor (%R1)	0.00 to 50.00	847/720	X	R/W	N	0.01 %
P06	0x0206	Motor (%X)	0.00 to 50.00	1134/894	X	R/W	N	0.01 %
P07	0x0207	Motor (Slip compensation gain for driving)	0.0 to 200.0	1000	O	R/W	N	0.1%
P08	0x0208	Motor (Slip compensation response time)	0.01 to 10.00	100	O	R/W	N	0.01Sec.
P09	0x0209	Motor (Slip compensation gain for braking)	0.0 to 200.0	1000	O	R/W	N	0.1%
P10	0x020A	Motor (Rated slip frequency)	0.00 to 15.00	240/233	O	R/W	Y	0.01Hz
Additional motor control functions (H group)								
H01	0x0301	Data Initialization	0: Disable initialization; 1: Initialize all function code data to the factory defaults; 2: Initialize motor 1 parameters	0	O	R/W	Y	-
H02	0x0302	Auto-reset (Times)	0: Disable; 1 to 10: Times	0	O	R/W	N	Times
H03	0x0303	Auto-reset (Reset interval)	0.5 to 20.0	50	O	R/W	N	0.1Sec.
H04	0x0304	Acceleration/Deceleration Pattern	0: Linear; 1: S-curve (Preset); 2: S-curve (User)	0	O	R/W	N	-
H05	0x0305	Rotational Direction Limitation	0: Disable; 1: Enable (Reverse rotation inhibited); 2: Enable (Forward rotation inhibited)	0	O	R/W	Y	-
H06	0x0306	Deceleration Mode	0: Normal deceleration; 1: Coast-to-stop	0	O	R/W	N	-
H07	0x0307	Instantaneous Overcurrent Limiting (Mode selection)	0: Disable; 1: Enable	1	O	R/W	N	-
H08	0x0308	1st S-Curve acceleration range (At starting)	0 ~ 50%	10	O	R/W	N	-
H09	0x0309	2nd S-Curve acceleration range (At arrival)		10	O	R/W	N	-
H10	0x030A	1st S-Curve deceleration range (At starting)		10	O	R/W	N	-
H11	0x030B	2nd S-Curve deceleration range (At arrival)		10	O	R/W	N	-

H12	0x030C	Overload Prevention Control	0.00: Follow deceleration time specified by F08/E09; 0.01 to 100.0: deceleration time; 999(by Keypad) or 32767(by Modbus): Disable	32767	O	R/W	N	0.01Hz/sec.
H13	0x030D	Deceleration Characteristics	0: Disable; 1: Enable	0	O	R/W	N	-
H14	0x030E	Maintenance Interval (M1)	0: Disable; 1 to 9999: interval (in units of 10 hours)	8760	O	R/W	N	10Hours
H15	0x030F	Preset Startup Count for Maintenance (M1)	0000: Disable; 0001 to FFFF: interval (hex.)	0	O	R/W	N	-
H16	0x0310	Output Current Fluctuation Damping Gain for Motor 1	0.00 to 5.00	80	O	R/W	N	-
H17	0x0311	Cumulative Run Time of Motor 1	0 to 9999 (in units of 10 hours)	0	X	R/W	Y	10Hours
H18	0x0312	DC Braking (Braking response mode)	0: Slow 1: Quick	0	O	R/W	N	-
H19	0x0313	Clear Alarm Data	0: Disable 1: Clear alarm data	0	O	R/W	N	-
H20	0x0314	Protection/Maintenance Function(Mode selection)	Bit 0: Lower the carrier frequency automatically (0: Disable; 1: Enable);Bit 1: Detect input phase loss (0: Disable; 1: Enable);Bit 2: Detect output phase loss (0: Disable; 1: Enable)	3	O	R/W	N	-
H21	0x0315	Automatic Deceleration (Anti-regenerative control) (Mode selection)	0: Disable 1: Enable (Lengthen the deceleration time to three times the specified time under voltage limiting control.) 4: Enable (Torque limit control: Disable force-to-stop processing.)	0	O	R/W	Y	
H22	0x0316	Automatic Deceleration (Frequency increment limit for braking)	0.0 to 120.0	50	O	R/W	Y	0.1Hz
H23	0x0317	Continuity of running (P)	0.000 to 10.000 Times 999(by keypad) or 0x7fff(by Modbus RTU): Automatic setting through Software	0x7fff	O	R/W	Y	0.001 Times
H24	0x0318	Continuity of running (I)	0.010 to 10.000 Sec. 0x7ffff: Automatic setting through Software	0x7fff	O	R/W	Y	0.001 Sec.
H25	0x0319	Restart Mode after Momentary Power Failure (Restart time)	0.1 to 10.0	5	O	R/W	Y	0.1Sec.
H26	0x031A	Restart Mode after Momentary Power Failure (Frequency fall rate)	0.00: F08 specifies fall rate 0.01 to 100.00 999(by keypad) or 0x7fff(by Modbus RTU): Automatic setting through Software	0x7fff	O	R/W	Y	0.01Hz/sec.
H27	0x031B	Restart Mode after Momentary Power Failure (Continuous running level)	200 to 300	235	O	R/W	Y	V

H28	0x031C	Communications Link Function (Mode selection)	Frequency command Run command 0: F01 F02 1: RS-485 F02 2: F01 RS-485 3: RS-485 RS-485	0	O	R/W	Y	
H29	0x031D	Startup Counter of Motor 1	Indication of cumulative startup count (0000 to FFFF in hex.)	-	X	R/W	Y	
H30	0x031E	Mock Alarm	0: Disable 1: Enable (Once a mock alarm occurs, the data automatically returns to 0.)	0	O	R/W	Y	
H31	0x031F	Cooling fan ON/OFF Control	0: Disable (Cooling fan is always ON); 1: Enable (Cooling fan is controlled automatically)	0	O	R/W	N	-
H32	0x0320	Cumulative Run Time of cooling Fan	Indication for replacement of cooling fan (0 to 9999, in units of 10 hours)	-	X	R/W	N	10 Hrs.
Communication setting (Y group)								
Y01	0x0401	RS-485 Communication 1 (Station address)	1 to 255	1	O	R/W	Y	-
Y02	0x0402	RS-485 Communication 1 (Communications error processing)	0: Immediately trip with alarm er8; 1: Trip with alarm er8 after running for the period specified by timer y03; 2: Retry during the period specified by timer y03. If the retry fails, trip with alarm er8. If it succeeds, continue to run; 3: Continue to run	0	O	R/W	N	-
Y03	0x0403	RS-485 Communication 1 (Timer)	0.0 to 60.0	20	O	R/W	N	Sec.
Y04	0x0404	RS-485 Communication 1 (Baud rate)	0: 9600 bps; 1: 19200 bps; 2: 38400 bps;	1	O	R/W	N	-
Y05	0x0405	RS-485 Communication 1 (Data length)	0: 8 bits	0	O	R/W	N	-
Y06	0x0406	RS-485 Communication 1 (Parity check)	3: None (1 stop bit for Modbus RTU)	3	O	R/W	N	-
Y07	0x0407	RS-485 Communication 1 (Stop bits)	1: 1 bit	1	O	R/W	N	-
Y08	0x0408	RS-485 Communication 1 (No-response error detection time)	0: No detection; 1 to 60: Time	0	O	R/W	N	Sec.
Y09	0x0409	RS-485 Communication 1 (Response interval)	0.00 to 1.00	1	O	R/W	N	0.01Sec.
Status variables (D group)								
D01	0x0501	Drive Status	0: Drive stop; 2: Drive acceleration; 3: Drive steady-state; 4: Drive deceleration; 7: Drive fault; 8: Drive reset; 12: Drive dc-brake; The others: Internal drive status		-	R	-	-
D02	0x0502	Alarm Code			-	R	-	-
D03	0x0503	Output Frequency			-	R	-	0.01Hz
D04	0x0504	Motor Current			-	R	-	0.01A rms

D05	0x0505	Motor Voltage			-	R	-	0.1Vrms
D06	0x0506	DC Bus Voltage			-	R	-	V
D07	0x0507	Drive Temperature			-	R	-	℃
D08	0x0508	Switch-on Time			X	R	-	Hours
D09	0x0509	Drive Run Time			X	R	-	Hours
D10	0x050A	Device Address			-	R	-	-
D11	0x050B	Modbus Communication Error			-	R	-	-
D12	0x050C	Latest Alarm Contents			-	R	-	-
D13	0x050D	Last Alarm Contents			-	R	-	-
D14	0x050E	Second Last Alarm Contents			-	R	-	-
D15	0x050F	Third Last Alarm Contents			-	R	-	-
D16	0x0510	Firmware Release			-	R	-	-

4.2 Motor control

Control mode of the inverter determines the way of itself to control the motor which operates door or compressor. RVBS adapts V/F control with two options to regulate speed of compressor. The options are described in below:

- V/f control with slip compensation inactive (F24=0) In this control, the inverter controls a motor by the voltage and frequency according to the V/f pattern specified by function codes.

- V/f control with slip compensation active (F24=2) Applying any load to an induction motor causes a rotational slip due to the motor characteristics, decreasing the motor rotation. The inverter's slip compensation facility first presumes the slip value of the motor based on the motor torque generated and raises the output frequency to compensate for the decrease in motor rotation. This prevents the motor from decreasing the rotation due to the slip. That is, this facility is effective for improving the motor speed control accuracy. The compensation value is specified by combination of function codes P10 (Rated slip frequency), P07 (Slip compensation gain for driving)) and P09 (Slip compensation gain for braking)

Function Code	Mod. Add.	Description	Def	Min	Max	U.M.	R/W
F24	0x0018	Control mode Selection 1	0	0	2	-	R/W

4.2.1 Output voltage & frequency setting

Output voltage & frequency of RVBS is determined by the parameters as follows:

- Maximum frequency 1 (F03)

  F03 specifies the maximum frequency (for motor 1) to limit the output frequency.

  ➢ Modifying F03 data to allow a higher reference frequency requires also changing F13 data specifying a frequency limiter (high).

- Base frequency 1 (F04)

  Set the rated frequency printed on the nameplate labeled on the motor.

- Rated voltage at base frequency (F05)

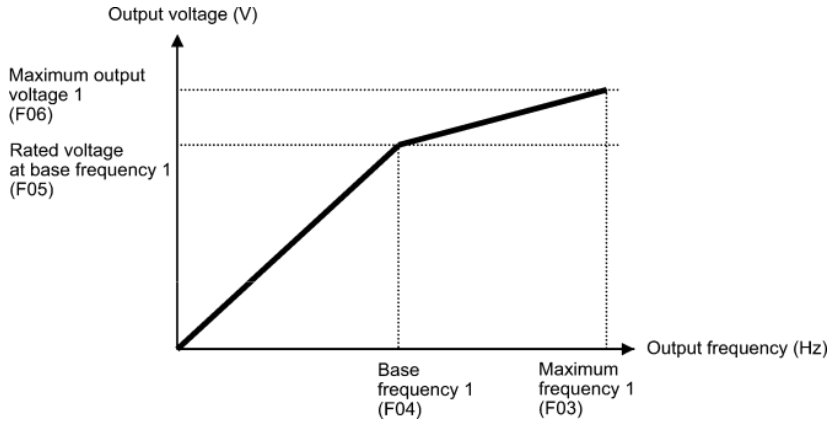
  Set "0" or the rated voltage printed on the nameplate labeled on the motor.

- If "0" is set, the rated voltage at base frequency is determined by the power source of the inverter. The output voltage will vary in line with any variance in input voltage.
- If the data is set to anything other than "0," the inverter automatically keeps the output voltage constant in line with the setting. When slip compensation function is active, the voltage settings should be equal to the rated voltage of the motor.

- Maximum Output Voltage (F06)

  Set the voltage for the maximum frequency 1 (F03).

- If F05 (Rated Voltage at Base Frequency 1) is set to "0," settings of F06 do not take effect.



< Output voltage & frequency defined via F03 to F06 >

Function Code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
F03	0x0003	Maximum Frequency 1	900	250	1200	0.1Hz	R/W
F04	0x0004	Base Frequency 1	500	250	1200	0.1Hz	R/W
F05	0x0005	Rated Voltage at Base Frequency 1	0	0	500	Vrms	R/W
F06	0x0006	Maximum Output Voltage 1	230	80	500	Vrms	R/W

4.2.2 Torque boost setting

F32 specifies V/f pattern, torque boost type for optimizing the operation in accordance with the characteristics of the load. F30 specifies the type of torque boost in order to provide sufficient starting torque.

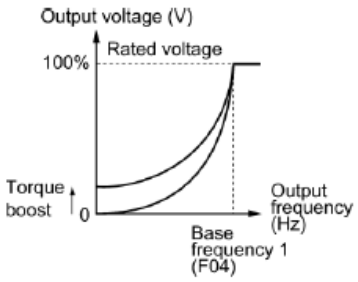
Data for F32	V/f pattern	Torque boost (F30)	Applicable load
0	Variable torque V/f pattern	Torque boost specified by F30	Variable torque load (General purpose fans and pumps)

1	Linear V/f pattern		Constant torque load
2		Auto boost	Constant torque load (To be selected if a motor may be over-excited at no load.)

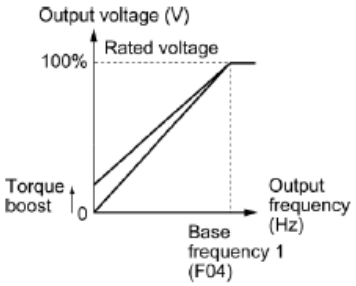
- Note: If a required "load torque + acceleration toque" is more than 50% of the rated torque, it is recommended to select the linear V/f pattern (factory default).

- V/f characteristics

The RVBS offers a variety of V/f patterns and torque boosts, which include V/f patterns suitable for variable torque load such as general fans and pumps or for special pump load requiring high starting torque. Two types of torque boost are available: manual and automatic.



< Variable torque V/f pattern (F32 = 0) >



< Linear V/f pattern (F32 = 1) >

When the variable torque V/f pattern is selected (F32 = 0), the output voltage may be low and insufficient voltage output may result in less output torque of the motor at a low frequency zone, depending on some characteristics of the motor itself and load. In such a case, it is recommended to select other options.

- Torque boost: Manual torque boost (F30)

In torque boost using F30, constant voltage is added to the basic V/f pattern, regardless of the load, to give the output voltage. To secure a sufficient starting torque, manually adjust the output voltage to optimally match the motor and its load by using F30. Specify an appropriate level that guarantees smooth start-up and yet does not cause over-excitation with no or light load.

Torque boost per F30 ensures high driving stability since the output voltage remains constant regardless of the load fluctuation.

Specify the F30 data in percentage to the rated voltage at base frequency 1 (F05). At factory shipment, F30 is preset to a level that provides approx. 100% of starting torque.

- Note: Specifying a high torque boost level will generate a high torque but may cause over-current due to over-excitation at no load. If you continue to drive the motor, it may overheat. To avoid such a situation, adjust torque boost to an appropriate level.

- Torque boost: Auto torque boost

This function automatically optimizes the output voltage to fit the motor with its load. Under light load, auto torque boost decreases the output voltage to prevent the motor from over-excitation. Under heavy load, it increases the output voltage to increase output torque of the motor.

- Note: Since this function relies also on the characteristics of the motor, set the base frequency 1 (F04), the rated voltage at base frequency 1 (F05), and other pertinent motor parameters (P01, P02 and P04 through P10) in line with the motor capacity and characteristics, or else perform auto-tuning (P03).

When a special motor is driven or the load does not have sufficient rigidity, the maximum torque might decrease, or the motor operation might become unstable. In such cases, do not use auto torque boost but choose manual torque boost per F30 (F32 = 0 or 1).

Function code	Mod. add.	Description	Def	Min	Max	U.M	R/W
F30	0x001E	Torque Boost 1	50/35	0	200	0.1%	R/W
F32	0x0020	Torque Boost 1 Mode Select	1	0	2	-	R/W

4.2.3 Frequency limiter

F13 and F14 specify the upper and lower limits of the output frequency, respectively.

- When you change the frequency limiter (High) (F13) in order to raise the reference frequency, be sure to change the maximum frequency (F03) accordingly.
- Maintain the following relationship among the data for frequency control: F13 > F14, F13 > F18, F13 > F20, and F03 > F14. Where, F18 is of the starting frequency and F20 is of the stop frequency. If you specify any wrong data for these function codes, the inverter may not run the motor at the desired speed or cannot start it normally.

Function Code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
F13	0x000D	Frequency Limiter (High)	1000	0	1200	0.1Hz	R/W
F14	0x000E	Frequency Limiter (Low)	0	0	1200	0.1Hz	R/W

4.2.4 Speed profile

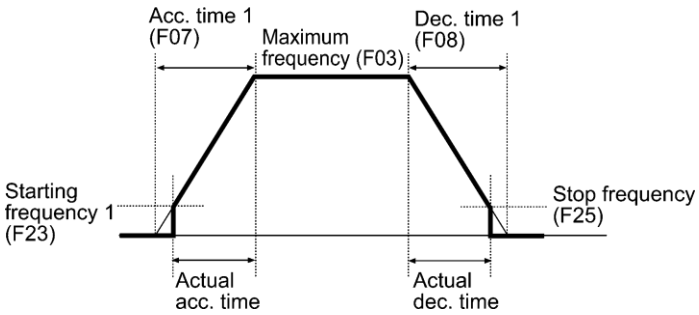
4.2.4.1 Acceleration/Deceleration

RVBS has been designed with a programmable speed profile for adaptation to the features requested on compressors control. The profile is designed by a linear ramp trends, defined via the acceleration/deceleration parameter.

- F07 specifies the acceleration time, the length of time the frequency increases from 0 Hz to the maximum frequency.
- F08 specifies the deceleration time, the length of time the frequency decreases from the maximum frequency down to 0 Hz.

➢ Selecting an S-shaped pattern with function code H04 (Acceleration/deceleration pattern) makes the actual acceleration/deceleration times longer than the specified ones. Refer to the paragraph 2.2.6 “S-curve acceleration/deceleration”.

➢ Specifying an improperly short acceleration/deceleration time may activate the current limiter or anti-regenerative control, resulting in a longer acceleration/ deceleration time than the specified one.



< Speed profile with linear acceleration/deceleration >

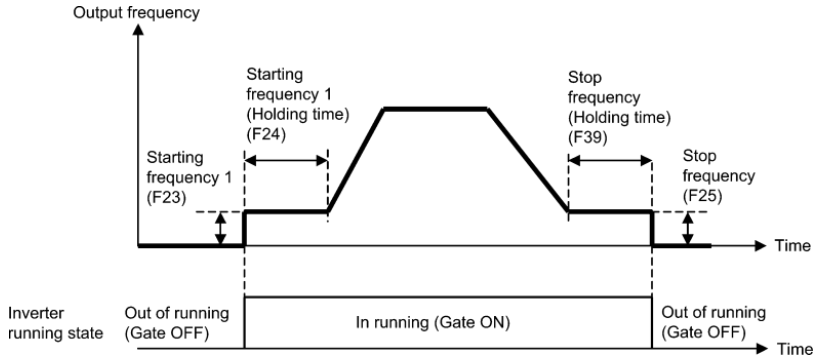
Function Code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
F07	0x0007	Acceleration Time 1	500	1	65500	0.01Sec.	R/W
F08	0x0008	Deceleration Time 1	500	1	65500	0.01Sec.	R/W

4.2.4.2 Start/Stop

At the startup of an RVBS, the initial output frequency is equal to the starting frequency 1 specified by F18. The inverter stops its output when the output frequency reaches the stop frequency specified by F20.

Set the starting frequency to a level at which the motor can generate enough torque for startup. Generally, set the motor's rated slip frequency as the starting frequency. In addition, to compensate for the delay time for the establishment of a magnetic flux in the motor, F19 specifies the holding time for the starting frequency. To stabilize the motor speed at the stop of the motor, F23 specifies the holding time for the stop frequency.

➢ If the starting frequency is lower than the stop frequency, the inverter will not output any power as long as the reference frequency does not exceed the stop frequency.



< Speed profile applying start/stop function >

Function Code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
F18	0x0012	Starting Frequency1	10	1	600	0.1Hz	R/W
F19	0x0013	Starting Frequency1 (Holding time)	0	0	1000	0.01Sec.	R/W
F20	0x0014	Stop Frequency	2	1	600	0.1Hz	R/W
F23	0x0017	Stop Frequency (Holding time)	0	0	1000	0.01Sec.	R/W

4.2.5 Motor sound

F21 allows to set the motor sound corresponding to carrier frequency.

Function code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
F21	0x0015	Motor Sound (Carrier frequency)	4	2	10	kHz	R/W

4.2.6 Deceleration mode

H06 specifies the deceleration mode to be applied when a run command is turned OFF.

Data for H06	Function
0	Normal deceleration The inverter decelerates and stops the motor according to deceleration commands specified by H04 (Acceleration/deceleration pattern), F08 (Deceleration time 1), and E09 (Deceleration time 2).
1	Coast-to-stop The inverter immediately shuts down its output, so the motor stops according to the inertia of the motor and machine and their kinetic energy losses.

- When reducing the reference frequency, the inverter decelerates the motor according to the deceleration commands even if H06 = 1 (Coast-to-stop).

Setting the H13 data to "1" (ON) enables forced brake control. If regenerative energy produced during deceleration of the motor and returned to the inverter exceeds the inverter's braking capability, an overvoltage trip will occur. The forced brake control increases the motor energy loss during deceleration, increasing the deceleration torque.

- This function is aimed at controlling the torque during deceleration; it has no effect if there is braking load.

Function Code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
H06	0x0306	Deceleration Mode	0	0	1	-	R/W
H13	0x030D	Deceleration Characteristics	0	0	1	-	R/W

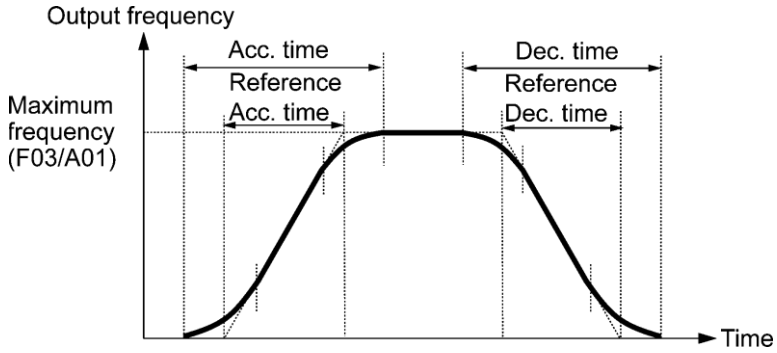
4.2.7 S-curve acceleration/deceleration

H04 specifies the acceleration and deceleration patterns (patterns to control output frequency).

- Linear acceleration/deceleration mode
  The inverter runs the motor with the constant acceleration and deceleration.
- S-curve acceleration/deceleration mode
  To reduce an impact that acceleration/deceleration would make on the machine (load), the inverter gradually accelerates or decelerates the motor in both starting and ending zones of acceleration/deceleration. Two types of S-curve acceleration/deceleration rates are available; 5% (preset) and (H08~H11) % (user) of the maximum frequency, which are shared by the four inflection points.

The acceleration/deceleration time command determines the duration of acceleration/ deceleration in the linear mode; hence, the actual acceleration/deceleration time is longer than the reference acceleration/deceleration time in the s-curve mode.

- Acceleration/deceleration time calculation
  - Setting of H04: 1 (preset), namely, the frequency change will be 10% or more of the maximum frequency
  - Acceleration or deceleration time (s) = (2 x 5/100 + 90/100+ 2 x 5/100) x (reference acceleration or deceleration time) = 1.1 x (reference acceleration or deceleration time)



< Speed profile in s-curve acceleration/deceleration mode >

Function Code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
H04	0x0304	Acceleration/Deceleration Pattern	0	0	2	-	R/W
H08	0x0308	1st S-Curve acceleration range (At starting)	10	0	50	-	R/W
H09	0x0309	2nd S-Curve acceleration range (At arrival)	10	0	50	-	R/W
H10	0x030A	1st S-Curve deceleration range (At starting)	10	0	50	-	R/W
H11	0x030B	2nd S-Curve deceleration range (At arrival)	10	0	50	-	R/W

4.2.8 Motor parameters

Motor parameters are needed to operate RVBS, motor, and load optimally.

- P01 specifies the rated capacity of the motor. Enter the rated value given on the nameplate of the motor.
- P02 specifies the rated current of the motor. Enter the rated value given on the nameplate of the motor.
- P03 makes the inverter automatically detect the motor parameters and saves them in its internal memory. Basically, it is not necessary to perform tuning when using a standard motor with a standard connection with the inverter.

  However, in any of the following cases, perform auto-tuning since the motor parameters are different from those of standard motors so as not to obtain the best performance under each of these controls: torque calculation monitoring, auto, slip compensation, and torque vector control.

  ✓ The motor to be driven is a non-standard motor.

  ✓ Cabling between the motor and the inverter is long.

  ✓ A reactor is inserted between the motor and the inverter.

P04 through P06 and P10 specify no-load current, %R1, %X, and rated slip frequency, respectively. Obtain the appropriate values from the test report of the motor or by calling the manufacturer of the motor. Performing auto-tuning automatically sets these parameters.

- No-load current (P04): Enter the value obtained from the motor manufacturer.
- %R1 (P05): Enter the value calculated by the following expression.

$$\%R1 = \frac{R1 + Cable\ R1}{V/(\sqrt{3} * I)}$$

where,

R1: Primary resistance of the motor (Ohm)

Cable R1: Resistance of the output cable (Ohm)

V: Rated voltage of the motor (V)

I: Rated current of the motor (A)

- %X (P06): Enter the value calculated by the following expression

$$R\% = \frac{X1 + X2 + \frac{XM}{X2 + XM} + Cable\ X}{V/(\sqrt{3} * I)}\ 100\ (\%)$$

Where,

X1: Primary leakage reactance of the motor (Ohm)

X2: Secondary leakage reactance of the motor (converted to primary) (Ohm)

XM: Exciting reactance of the motor (Ohm)

Cable X: Reactance of the output cable (Ohm)

V: Rated voltage of the motor (V)

I: Rated current of the motor (A)

(*) for reactance, choose the value at the base frequency 1 (F04).

- Rated slip frequency (P10): Convert the value obtained from the motor manufacturer to Hz using the following expression and enter the converted value (The motor rating given on the nameplate sometimes may show a larger value).

$$Rated\ slip\ frequency\ (Hz) = \frac{(Synchronous\ speed - Rated\ speed)}{Synchronous\ speed} * Base\ frequency$$

P07 and P09 determine the slip compensation amount in % for driving and braking, individually. Specification of 100% fully compensates for the rated slip of the motor. Excessive compensation (100%) may cause a system oscillation, so carefully check the operation on the actual machine.

- P08 determines the response time for slip compensation. Basically, there is no need to modify the default setting.

Function code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
P01	0x0201	Motor (Rated capacity)	40/75	1	3000	0.01kW	R/W
P02	0x0202	Motor (Rated current)	210/329	0	10000	0.01Arms	R/W
P03	0x0203	Motor (Auto-tuning)	0	0	1	-	R/W
P04	0x0204	Motor (No-load current)	152/211	0	5000	0.01Arms	R/W
P05	0x0205	Motor (%R1)	847/720	0	5000	0.01%	R/W
P06	0x0206	Motor (%X)	1134/894	0	5000	0.01%	R/W

P07	0x0207	Motor (Slip compensation gain for driving)	1000	0	2000	0.1%	R/W
P08	0x0208	Motor (Slip compensation response time)	100	1	1000	0.01Sec.	R/W
P09	0x0209	Motor (Slip compensation gain for braking)	1000	0	2000	0.1%	R/W
P10	0x020A	Motor (Rated slip frequency)	240/233	0	1500	0.01Hz	R/W

4.2.9 Commands

4.2.9.1 Restart mode

F12 specifies the action to be taken by the inverter such as trip and restart in the event of a momentary power failure.

- Restart mode after momentary power failure (Mode selection) (F12)

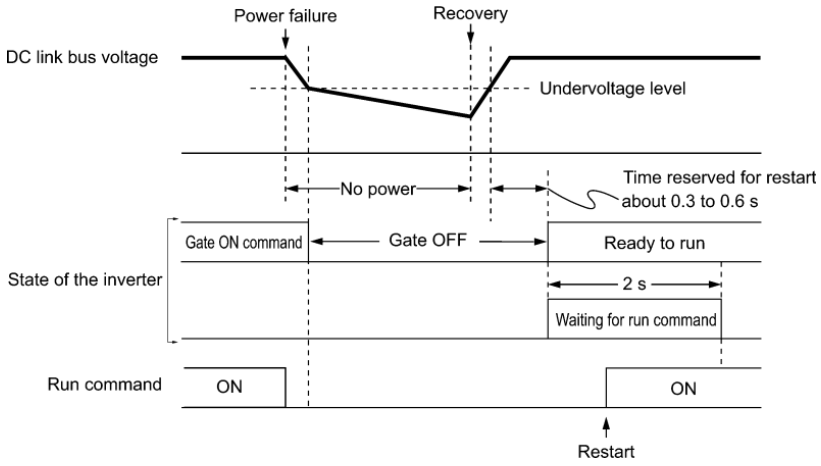
Data for F12	Mode	Description
0	Disable restart (Trip immediately)	As soon as the DC link bus voltage drops below the under-voltage detection level due to a momentary power failure, the inverter issues under voltage alarm LU and shuts down its output so that the motor enters a coast-to-stop state.
1	Disable restart (Trip after recovery from power failure)	As soon as the DC link bus voltage drops below the under-voltage detection level due to a momentary power failure, the inverter shuts down its output so that the motor enters a coast-to-stop state, but it does not enter the under-voltage state or issue under voltage alarm LU. The moment the power is restored, an under-voltage alarm LU is issued, while the motor remains in a coast-to-stop state.
2	Trip after decelerate-to-stop	As soon as the DC link bus voltage drops below the continuous running level due to a momentary power failure, decelerate-to-shop control is invoked. Decelerate-to-stop control regenerates kinetic energy from the load's moment of inertia, slowing down the motor and continuing the deceleration operation. After decelerate-to-stop operation, an under-voltage alarm LU is issued. (Available in the ROM version 0500 or later.)
4	Enable restart (Restart at the frequency at which the power failure occurred, for general loads)	As soon as the DC link bus voltage drops below the under-voltage detection level due to a momentary power failure, the inverter saves the output frequency being applied at that time and shuts down the output so that the motor enters a coast-to-stop state. If a run command has been input, restoring power restarts the inverter at the output frequency saved during the last power failure processing. This setting is ideal for applications with a moment of inertia large enough not to slow down the motor quickly, such as fans, even after the motor enters a coast-to-stop state upon occurrence of a momentary power failure.
5	Enable restart (Restart at the starting frequency, for low-inertia load)	After a momentary power failure, restoring power and then entering a run command restarts the inverter at the starting frequency specified by function code F18. This setting is ideal for heavy load applications such as pumps, having a small moment of inertia, in which the motor speed quickly goes down to zero as soon as it enters a coast-to-stop state upon occurrence of a momentary power failure.

- Restart mode after momentary power failure (Basic operation)

  The inverter recognizes a momentary power failure upon detecting the condition that DC link bus voltage goes below the under-voltage detection level, while the inverter is running. If the load of the motor is light and the duration of the momentary power failure is extremely short, the voltage drop may not be great enough for a momentary power failure to be recognized, and the motor may continue to run uninterrupted.

  Upon recognizing a momentary power failure, the inverter enters the restart mode (after a recovery from momentary power failure) and prepares for restart. When power is restored, the inverter goes through an initial charging stage and enters the ready-to-run state. When a momentary power failure occurs, the power supply voltage for external circuits such as relay sequence circuits may also drop so as to turn the run command OFF. In consideration of such a situation, the inverter waits 2 seconds for a run command input after the inverter enters a ready-to-run state. If a run command is received within 2 seconds, the inverter begins the restart processing in accordance with the F12 data (Mode selection). If no run command has been received within 2-second wait period, the inverter cancels the restart mode (after a recovery from momentary power failure) and needs to be started again from the ordinary starting frequency. Therefore, ensure that a run command is entered within 2 seconds after a recovery of power, or install a mechanical latch relay.

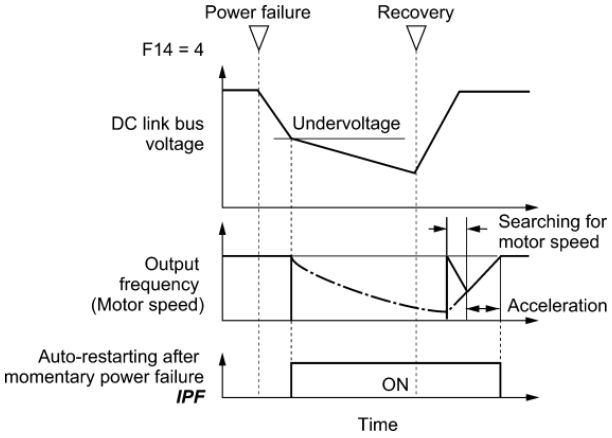
  When run commands are entered via the keypad, the above operation is also necessary for the mode (F02 = 1) in which the rotational direction is determined by the terminal command, FWD or REV. In the modes where the rotational direction is fixed (F02 = 2 or 3), it is retained inside the inverter so that the restart will begin as soon as the inverter enters the ready-to-run state.



< Overall restart sequence after momentary power failure >

During a momentary power failure, the motor slows down. After power is restored, the inverter restarts at the frequency just before the momentary power failure. Then, the current limiting function

works, and the output frequency of the inverter automatically decreases. When the output frequency matches the motor speed, the motor accelerates up to the original output frequency. See the figure below. In this case, the instantaneous over-current limiting must be enabled (H07 = 1).



< Restart sequence after momentary power failure with motor speed >

- Restart mode after momentary power failure (Restart time) (H25)

H25 specifies the time period from momentary power failure occurrence until the inverter reacts for restarting process.

If the inverter starts the motor while motor's residual voltage is still in a high level, a large inrush current may flow, or an overvoltage alarm may occur due to an occurrence of temporary regeneration. For safety, therefore, it is advisable to set H25 to a certain level so that restart will take place only after the residual voltage has dropped to a low level. Note that even when power is restored, restart will not take place until the restart time (H25) has elapsed.

➢ Factory default

By factory default, H25 is set at one of the values shown below according to the inverter capacity. Basically, you do not need to change H25 data. However, if the long restart time causes the flow rate of the pump to overly decrease or causes any other problem, you might as well reduce the setting to about a half of the default value. In such a case, make sure that no alarm occurs.

Inverter capacity (kW)	Factory default of H25 (Restart time in seconds)
0.1 to 7.5	0.5

- Restart mode after momentary power failure (Frequency fall rate) (H26)

During restart after a momentary power failure, if the inverter output frequency and the idling motor speed cannot be harmonized with each other, an over-current will flow, activating the over-current limiter. If it happens, the inverter reduces the output frequency to match the idling motor speed according to the reduction rate (Frequency fall rate: Hz/s) specified by H26.

Data for H26	Inverter's action for the output frequency fall
0.00	Follow the selected deceleration time
0.01 to 100.00 (Hz/s)	Follow data specified by H26
999	Follow the setting of the PI processor in the current limiter. (The PI constant is prefixed inside the inverter.)

- If the frequency fall rate is too high, regeneration may take place at the moment the motor rotation matches the inverter output frequency, causing an overvoltage trip.
- On the contrary, if the frequency fall rate is too low, the time required for the output frequency to match the motor speed (duration of current limiting action) may be prolonged, triggering the inverter overload prevention control.

Function code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
F12	0x000C	Restart Mode after Momentary Power Failure (Mode selection)	1	0	5	-	R/W
H25	0x0319	Restart Mode after Momentary Power Failure (Restart time)	5	1	100	0.1Sec.	R/W
H26	0x031A	Restart Mode after Momentary Power Failure (Frequency fall rate)	0x7fff	0	0x7fff	0.01Hz/sec.	R/W
H27	0x031B	Restart Mode after Momentary Power Failure (Continuous running level)	235	200	300	V	R/W

4.2.9.2 Reset mode

H02 and H03 specify the auto-reset function that makes the inverter automatically attempt to reset the tripped state and restart without issuing an alarm even if any protective function subject to reset is activated and the inverter enters the forced-to-stop state (tripped state).

If the protective function works in excess of the times specified by H02, the inverter will issue an alarm and not attempt to auto-reset the tripped state. The list below is the recoverable alarm statuses to be retried.

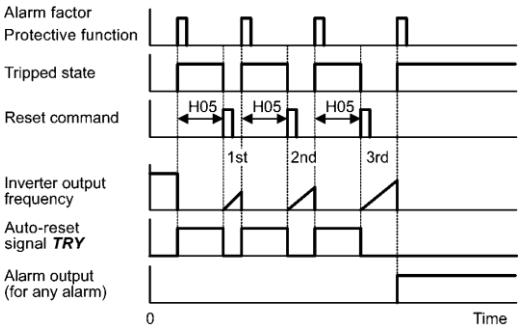
Alarm status	Alarm code:	Alarm status	Alarm code
Overcurrent protection	OC1, OC2 or OC3	Motor overheated	OH4
Over voltage protection	OU1, OU2 or OU3	Motor overloaded	OL1
Heat sink overheated	OH1	Inverter overloaded	OLU
Braking resistor overheated	dbH		

- Number of reset times (H02)

H02 specifies the number of reset times for the inverter to automatically attempt to escape from the tripped state. When H02 = 0, the auto-reset function will not be activated.

- Reset interval (H03)

After the reset interval specified by H03 from when the inverter enters the tripped state, it issues a reset command to auto-reset the tripped state. Refer to the timing scheme diagram below.



< Timing scheme for failed retry (No. of reset times: 3) >

Function code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
H02	0x0302	Auto-reset (Times)	0	0	10	Times	R/W
H03	0x0303	Auto-reset (Reset interval)	50	5	200	0.1Sec.	R/W

4.2.10 DC-brake function

F15 through F17 specify the DC braking that prevents motor 1 from running by inertia during decelerate-to-stop operation. If the motor enters a decelerate-to-stop operation by turning OFF the run command or by decreasing the reference frequency below the stop frequency, the inverter activates the DC braking by flowing a current at the braking level (F16) during the braking time (F17) when the output frequency reaches the DC braking starting frequency (F15). Setting the braking time (F17) to "0.00" disables the DC braking.

- Braking starting frequency (F15):

F15 specifies the frequency at which the DC braking starts its operation during motor decelerate-to-stop state.

- Generally, set the motor rated slip frequency or so to F15. Setting an extremely large value makes the control unstable; according to conditions, it activates an overvoltage protection.

- Braking level (F16):

F16 specifies the output current level to be applied when the DC braking is activated. The function code data should be set, assuming the rated output current of the inverter as 100%, in increments of 1%.

- Conversion formula

$$Setting\ value\ (\%) = \frac{I_{DB}\ (A)}{I_{ref}(A)} * 100$$

- Example: If setting IDB (A) of 4.2 A with standard applicable motor capacity of 0.75 kW

$$Setting\ value\ (\%) = \frac{4.2\ (A)}{5.0\ (A)} * 100 = 84$$

- Braking time (F17)

F17 specifies the braking period that activates DC braking.

- Braking response mode (H18)

H18 specifies the DC braking response mode.

Data for H18	Characteristics	Note
0	Slow response. Slows the rising edge of the current, thereby preventing reverse rotation at the start of DC braking.	Insufficient braking torque may result at the start of DC braking.
1	Quick response. Quickens the rising edge of the current, thereby accelerating the build-up of the braking torque.	Reverse rotation may result depending on the moment of inertia of the mechanical load and the coupling mechanism.

Function code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
F15	0x000F	DC Braking1 (Start Frequency)	0	0	600	0.1Hz	R/W
F16	0x0010	DC Braking1 (Level)	0	0	100	%	R/W
F17	0x0011	DC Braking1 (Time)	0	0	3000	0.01Sec.	R/W
H18	0x0313	DC Braking (Braking response mode)	0	0	1	-	R/W

4.2.11 Status variables

The status variables are the read-only type and supply information regarding the status of the RVBS including control, maintenance, and network or other general information. For example, the variables inform regarding the drive temperature, frequency/current/voltage supplied, the DC bus voltage, the number of drive switch-on hours, the number of functioning hours with the motor running for entire period and for the period from last alarm. Regarding the characteristic data of the RVBS, firmware version is available.

The frequency reference set via analog input is displayed in function code D17

Function Code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
D01	0x0501	Drive Status	-	-	-	-	R
D02	0x0502	Alarm Code	-	-	-	-	R
D03	0x0503	Output Frequency	-	-	-	0.01Hz	R
D04	0x0504	Motor Current	-	-	-	0.01Arms	R
D05	0x0505	Motor Voltage	-	-	-	0.1Vrms	R
D06	0x0506	DC Bus Voltage	-	-	-	V	R
D07	0x0507	Drive Temperature	-	-	-	℃	R
D08	0x0508	Switch-on Time	-	-	-	Hours	R
D09	0x0509	Drive Run Time	-	-	-	Hours	R
D10	0x050A	Device Address	-	-	-	-	R

D11	0x050B	Modbus Communication Error	-	-	-	-	R
D12	0x050C	Latest Alarm Contents	-	-	-	-	R
D13	0x050D	Last Alarm Contents	-	-	-	-	R
D14	0x050E	Second Last Alarm Contents	-	-	-	-	R
D15	0x050F	Third Last Alarm Contents	-	-	-	-	R
D16	0x0510	Firmware Release	-	-	-	-	R
D17	0x011	Analog Input Frequency Reference	-	-	-	0.01Hz	R[k1]

4.3 External I/O

4.3.1 Input terminal function assignment

Function codes E01 and E02 is available for assigning function to DI1 and DI2.

- Run forward -- FWD (Function code data = 98) Turning this terminal command ON runs the motor in the forward direction; turning it OFF decelerates it to stop.

- Run reverse -- REV (Function code data = 99) Turning this terminal command ON runs the motor in the reverse direction; turning it OFF decelerates it to stop.

Function code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
E01	0x0101	Terminal [DI1] Function 1	98	0	1097	-	R/W
E02	0x0102	Terminal [DI2] Function 2	97	0	1097	-	R/W

4.3.2 Output terminal function assignment

E7 assign output signals (listed on the next page) to general-purpose, programmable output terminals [30A/B/C]. These function codes can also switch the logic system between normal and negative to define the property of those output terminals so that the inverter logic can interpret either the ON or OFF status of each terminal as active. The factory default settings are "Active ON."

Terminals [30A/B/C] are single-pole double-throw (Form C) relay outputs. In normal logic, if an alarm occurs, the relay will be energized so that [30A] and [30C] will be closed, and [30B] and [30C] opened. In negative logic, the relay will be de-energized so that [30A] and [30C] will be opened, and [30B] and [30C] closed. This may be useful for the implementation of failsafe power systems.

- When a negative logic is employed, all output signals are active (e.g., an alarm would be recognized) while the inverter is powered OFF. To avoid causing system malfunctions by this, interlock these signals to keep them ON using an external power supply. Furthermore, the validity of these output signals is not guaranteed for approximately 1.5 seconds after power-on, so introduce such a mechanism that masks them during the transient period.
- Terminals [30A/B/C] use mechanical contacts that cannot stand frequent ON/OFF switching.

The table below lists functions that can be assigned to terminal [30A/B/C]. For simple explanations, the examples shown below are all written for the normal logic (Active ON).

Function code data		Functions assigned	Symbol
Active ON	Active OFF		
99	1099	Alarm output (for any alarm)	ALM

- Alarm output -- ARM (Function code data = 99)

If any alarm presents on RVBS, the alarm output signal is ON.

Function code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
E07	0x0107	Terminal [30A/B/C] Function	99	0	1099	-	R/W

4.3.3 Analog input setting - compressor application

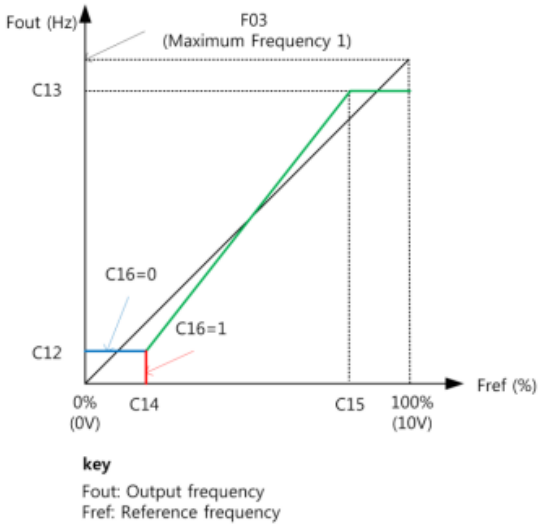
RVBS supports the frequency command to source external analog voltage input port which allows 0V to 10V by setting F01=1. The analog input is processed to be used for frequency reference following next parameters setting: - Analog Input Voltage Offset (C10) C10 specifies real time editable offset factor for analog input voltage. - Analog Input Voltage Gain (C11) C11 specifies real time editable gain factor for analog input voltage. - Frequency at Minimum Analog Input (C12) When Frequency Command Source is set to the Analog input (F01=1), this parameter determines the Analog input frequency reference (D17) at minimum analog input voltage, 0 V. - Frequency at Maximum Analog Input (C13) When Frequency Command Source is set to the terminal input (F01=1), this parameter determines the Analog input frequency reference (D17) at maximum analog input voltage, 10 V.

- Minimum Analog Input Offset (C14) C14 specifies offsets the minimum analog input reference corresponding to C12.

- Example: if set to 10%, minimum analog voltage value becomes 1 V.

- Maximum Analog Input Offset (C15) C15 specifies offsets the maximum analog input reference corresponding to C13.

- Example: if set to 90%, maximum analog voltage value becomes 9V. For any reference above C15, the inverter holds the value in C13.



< Output frequency according to analog input voltage and its setting >

- Analog Input Start Frequency (C16) C16 specifies the start frequency of inverter when F01=1 as follows: 丨0: Select Value in C12; 1: Select 0 Hz.

C16 determines the analog input frequency reference (D17) for any analog voltage input below C12.

- Analog Input Low-pass Filter Gain (C17)

C17 specifies the number of sampling of filter analog input to help reducing noise on signal

Function Code	Mod. add.	Description	Def	Min	Max	U.M	R/W
C10	0x060A	Analog Input Voltage Offset	0	-100	100	0.1%	R/W
C11	0x060B	Analog Input Voltage Gain	1000	0	2000	0.1%	R/W
C12	0x060C	Frequency at Minimum Analog Input	0	0	F03	0.1Hz	
C13	0x060D	Frequency at Maximum Analog Input	0	0	F03	0.1Hz	
C14	0x060E	Minimum Analog Input Offset	0	0	1000	0.1%	
C15	0x060F	Maximum Analog Input Offset	1000	0	1000	0.1%	
C16	0x0610	Analog Input Start Frequency	0	0	1	-	
C17	0x0611	Analog Input Low-pass Filter Gain	4	1	8	-	

4.4 Protective functions

4.4.1 Current limitation

When the output current of the inverter exceeds the level specified by the current limiter (F26), the inverter automatically manages its output frequency to prevent a stall and limit the output current. (Refer to the paragraph 2.5.2 Instantaneous over-current limitation)

If F25 = 1, the current limiter is enabled only during constant speed operation. If F25 = 2, the current limiter is enabled during both of acceleration and constant speed operation. Choose F25 = 1 if you need to run the

inverter at full capability during acceleration and to limit the output current during constant speed operation.

F26 specifies the output current level to determine whether to limit the output current. The function code data should be set, assuming the rated output current of the inverter as 100%, in increments of 1%.

[Conversion formula]

$$Setting\ value\ (\%) = \frac{I_{limit}(A)}{I_{ref}(A)} * 100$$

- Example: If setting I_{limit} (A) of 4.2 A with standard applicable motor capacity of 0.75 kW

$$Setting\ value\ (\%) = \frac{4.2\ (A)}{5.0\ (A)} * 100 = 84$$

- Mode selection (F25)

F25 selects the motor running state in which the current limiter will be active.

Data for F25	Running states that enable the current limiter		
	During acceleration	During constant speed	During deceleration
0	Disable	Disable	Disable
1	Disable	Enable	Disable
2	Enable	Enable	Disable

- Level (F26)

F26 specifies the operation level at which the output current limiter becomes activated, in ratio to the inverter rating.

- Note: Since the current limit operation with F25 and F26 is performed by software, it may cause a delay in control. If you need a quick response, specify a current limit operation by hardware (H07 = 1) at the same time.
- Note: If an excessive load is applied when the current limiter operation level is set extremely low, the inverter will rapidly lower its output frequency. This may cause an overvoltage trip or dangerous turnover of the motor rotation due to undershooting

Function code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
F25	0x0019	Current Limiter (Mode selection)	2	0	2	-	R/W
F26	0x001A	Current Limiter (Level)	180	20	200	%	R/W

4.4.2 Instantaneous over-current limitation

H07 specifies whether the inverter invokes the current limit processing or enters the over-current trip when its output current exceeds the instantaneous over-current limiting level. Under the current limit processing, the inverter immediately turns OFF its output gate to suppress the further current increase and continues to control the output frequency.

Data for H07	Function
0	Disable An over-current trip occurs at the instantaneous over-current limiting level.
1	Enable The current limiting operation is effective.

- If any problem occurs when the motor torque temporarily drops during current limiting processing, it is necessary to cause an over-current trip (H07 = 0) and actuate a mechanical brake at the same time.
- The similar function is the current limiter specified by F25 and F26. The current limiter (F25, F26) implements the current control by software, so an operation delay occurs. When you have enabled the current limiter (F25, F26), also enable the instantaneous over-current limiting with H07 to obtain a quick response current limiting.
- Depending on the load, extremely short acceleration time may activate the current limiting to suppress the increase of the inverter output frequency, causing hunting (undesirable oscillation of the system) or activating the inverter overvoltage trip. When specifying the acceleration time, therefore, you need to consider machinery characteristics and moment of inertia of the load.

Function code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
H07	0x0307	Instantaneous Over-current Limiting (Mode selection)	1	0	1	-	R/W

4.4.3 Motor overload prevention

H12 specifies the decelerating rate of the output frequency to prevent a trip from occurring due to an overload. This control decreases the output frequency of the inverter before the inverter trips due to a heat sink overheat or inverter overload (with an alarm indication of OH1 or OLU, respectively). It is useful for equipment such as pumps where a decrease in the output frequency leads to a decrease in the load and it is necessary to keep the motor running even when the output frequency drops.

Data for H12	Function
0.00	Decelerate the motor by deceleration time 1 (F08) or 2 (E09)
0.01 to 100.00	Decelerate the motor by deceleration rate from 0.01 to 100.00 (Hz/s)
999	Disable overload prevention control

- Note: In equipment where a decrease in the output frequency does not lead to a decrease in the load, the overload prevention control is of no use and should not be enabled

Function code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
H12	0x030C	Overload Prevention Control	32767	0	32767	0.01Hz/sec.	R/W

4.4.4 Electronic motor overload

F09 through F11 specify the thermal characteristics of the motor for its electronic thermal overload protection that is used to detect overload conditions of the motor. F09 selects the motor cooling mechanism to specify its characteristics, F10 specifies the overload detection current, and F11 specifies the thermal time constant.

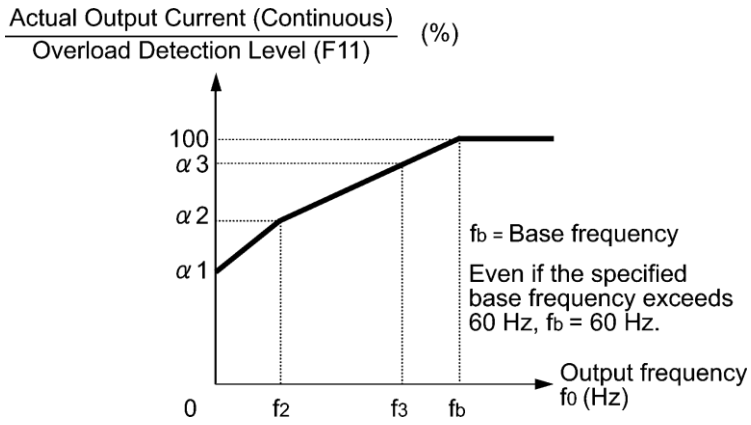
- To disable the electronic thermal overload protection, set function code F10 to "0.00."

  - Motor characteristics (F09)

F09 selects the cooling mechanism of the motor-- shaft-driven or separately powered cooling fan.

Data for F09	Function
1	For a general-purpose motor with shaft-driven cooling fan. (The cooling effect will decrease in low frequency operation.)
2	For an inverter-driven motor with separately powered cooling fan. (The cooling effect will be kept constant regardless of the output frequency.)

The figure below shows operating characteristics of the electronic thermal overload protection when F09 = 1. The characteristic factors α1 through α3 as well as their corresponding switching frequencies f2 and f3 vary with the characteristics of the motor. Also, Actual Output Current (Continuous) means the detection level of output current that electronic thermal overload protection activates above.



< Cooling characteristics of motor with shaft-driven cooling fan >

The tables below list the factors determined by the motor capacity (P01).

Nominal applied motor (kW)	Thermal time constant □ (Factory default)	Reference current for setting the thermal time constant (Imax)	Output frequency for motor characteristic factor		Characteristic factor		
			f2	f3	□1	□2	□3
0.1 to 0.75	5 min	Allowable continuous current 150%	5 Hz	7 Hz	75%	85%	100%

When F09 = 2, the cooling effect is not decreased by the output frequency so that the overload detection level is a constant value without reduction (F10).

  - Overload detection level (F10)

F10 specifies the detection level (in amperes) at which the electronic thermal overload protection becomes activated. In general, set F10 to the rated current of motor when driven at the base frequency (i.e., 1.0 to 1.1 multiple of the rated current of motor 1 (P02)). To disable the electronic thermal overload protection, set F10 to "0.00: Disable."

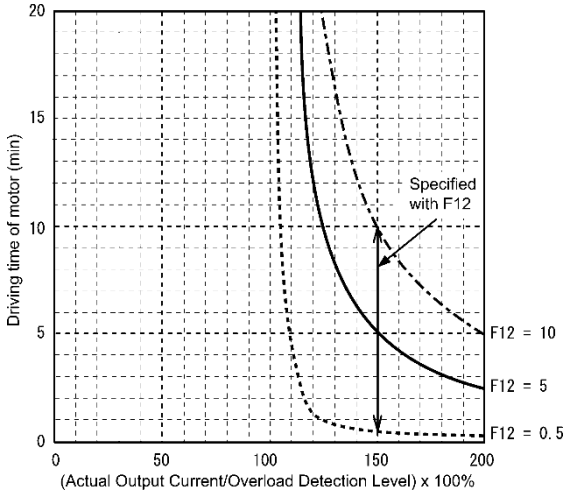
- Thermal time constant (F11)

F11 specifies the thermal time constant of the motor. If the current of 150% of the overload detection level specified by F10 flows for the time specified by F11, the electronic thermal overload protection becomes activated to detect the motor overload. The thermal time constant for general-purpose motors is approx. 5 minutes by factory default.

- Data setting range: 0.5 to 75.0 (minutes) in increments of 0.1 (minute)(Example) When the F11 data is set at "5.0" (5 minutes)

As shown below, the electronic thermal overload protection is activated to detect an alarm condition (alarm code OL1) when the output current of 150% of the overload detection level (specified by F10) flows for 5 minutes, and 120% for approx. 12.5 minutes.

The actual time required for issuing a motor overload alarm tends to be shorter than the specified value, considering the time period from when the output current exceeds the allowable continuous drive current (100%) until it reaches 150% of the overload detection level.



< Example of thermal overload detection characteristics >

Function code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
F09	0x0009	Motor ETH Characteristic	1	1	2	-	R/W
F10	0x000A	Motor ETH Level	210/329	0	567	0.01Arms	R/W
F11	0x000B	Motor ETH Thermal Time Constant	50	5	750	0.1Min.	R/W

4.4.5 Anti-regenerative control

H21 specifies the anti-regenerative control. In inverters not equipped with a PWM converter or braking resistor, if regenerative energy returned exceeds the inverter's braking capability, an overvoltage trip occurs.

In case of H21 = 1: when the DC link bus voltage exceeds the preset voltage limiting level, the inverter lengthens the deceleration time to three times the specified time to decrease the deceleration torque to 1/3. In this way, the inverter reduces the regenerative energy tentatively. This control applies only in deceleration. When the load on the motor results in a braking effect, the control does not have any effect.

In case of H21 = 2 or 4: The inverter controls the output frequency to keep the braking torque at around 0 N·m in both acceleration/deceleration and constant speed running phases in order to avoid an overvoltage trip.

Since increasing the output frequency too much under anti-regenerative control is dangerous, the inverter has a torque limiter (Frequency increment limit for braking) that can be specified by H22. The torque limiter limits the inverter's output frequency to less than "Reference frequency + H22 setting."

Note that the torque limiter activated restrains the anti-regenerative control, resulting in a trip with an overvoltage alarm in some cases. Increasing the H22 data (0.0 to 400.0 Hz) makes the anti-regenerative control capability high.

Addition, during deceleration triggered by turning the run command OFF, the anti-regenerative control increases the output frequency so that the inverter may not stop the load depending on the load state (huge moment of inertia, for example). To avoid that, H21 provides a choice of cancellation of the anti-regenerative control to apply when three times the specified deceleration time is elapsed, thus decelerating the motor.

Data for H21	Function
0	Disable
1	Enable (Lengthen the deceleration time to three times the specified time under voltage limiting control.)
4	Enable (Torque limit control: Disable force-to-stop processing.)

Function code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
H21	0x0315	Automatic Deceleration (Anti-regenerative control) (Mode selection)	0	0	4	-	R/W
H22	0x0316	Automatic Deceleration (Frequency increment limit of braking)	50	0	1200	0.1Hz	R/W

4.5 Auxiliary function

4.5.1 Data protection

F00 specifies whether to protect function code data (except F00) and digital reference data (such as frequency command) from accidentally getting changed by pressing the ⌃ / ⌄ keys.

Data for F00	Function
0	Disable both data protection and digital reference protection, allowing you to change both function code data and digital reference data with the ⌃ / ⌄ keys.
1	Enable data protection and disable digital reference protection, allowing you to change digital reference data with the ⌃ / ⌄ keys. But you cannot change function code data (except F00).
2	Disable data protection and enable digital reference protection, allowing you to change function code data with the ⌃ / ⌄ keys. But you cannot change digital reference data.
3	Enable both data protection and digital reference protection, not allowing you to change function code data or digital reference data with the ⌃ / ⌄ keys.

Enabling the protection disables the ⌃ / ⌄ keys to change function code data.

To change F00 data, simultaneous keying of STOP + ⌃ (from 0 to 1) or STOP + ⌄ (from 1 to 0) keys is required.

➢ Even when F00 = 1 or 3, function code data can be changed via the communications link.

Function code	Mod. Add.	Description	Def	Min	Max	U.M.	R/W
F00	0x0000	Data Protection	0	0	3	-	R/W

4.5.2 Operation mode

F01 sets the command source that specifies reference frequency 1.

Data for F01	Function
0	Enable ⌃ / ⌄ keys on the keypad. (Refer to Chapter 3 “OPERATION USING THE KEYPAD.”)

➢ In addition to the frequency command sources described above, higher priority command sources including communications link and multistep frequency are provided.

F02 selects the source that specifies a run command for running the motor.

Data for F02	Run Command Source	Description
1	External signals	Enable terminal command FWD or REV to run and stop the motor.
2	Keypad (Forward rotation)	Enable RUN / STOP keys to run and stop the motor. Note that this runs command enables only the forward rotation. There is no need to specify the rotation direction.
3	Keypad (Reverse rotation)	Enable RUN / STOP keys to run and stop the motor. Note that this runs command enables only the reverse rotation. There is no need to specify the rotation direction.

- When function code F02 = 1, the "Run forward" FWD and "Run reverse" REV terminal commands must be assigned to terminals [FWD] and [REV], respectively.
- When the FWD or REV is ON, the F02 data cannot be changed.
- When assigning the FWD or REV to terminal [FWD] or [REV] with F02 being set to "1," be sure to turn the target terminal OFF beforehand; otherwise, the motor may unintentionally rotate.
- In addition to the run command sources described above, higher priority command sources including communications link are provided.

Function code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
F01	0x0001	Frequency Command 1	1	0	0	-	R/W
F02	0x0002	Operation Method	1	1	3	-	R/W

4.5.3 Cooling fan control

To prolong the life of the cooling fan and reduce fan noise during running, the cooling fan stops when the temperature inside the inverter drops below a certain level while the inverter stops. However, since frequent switching of the cooling fan shortens its life, the cooling fan is kept running for 10 minutes once it is started. H31 specifies whether to keep running the cooling fan all the time or to control its ON/OFF as organized in below table:

Data for H31	Cooling fan ON/OFF
0	Disable (Cooling fan always ON)
1	Enable (Cooling fan is controlled automatically)

Function Code	Mod. add.	Description	Def	Min	Max	U.M	R/W
H31	0x031F	Cooling Fan ON/OFF Control	0	0	1	-	R/W
H32	0x0320	Cumulative Run Time of Cooling Fan	-	0	9999	10 Hrs	R/W

5. Alarms

5.1 Alarm code

RVBS trigger an alarm in the situation that it senses the malfunction itself defined in below table. The table shows supported alarm code values and corresponding explanation of those alarms. In addition, when an alarm is issued, the red LED will switch ON and flash according to the table below. To check the type of ModBus communication error, check the function code D11.

Function code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
D02	0x0502	Alarm code	-	-	-	-	R

Value	Keypad Indication	Description	LED flashes
1	OC1	Instantaneous over-current (during acceleration)	5
2	OC2	Instantaneous over-current (during deceleration)	
3	OC3	Instantaneous over-current (during steady state)	
6	OU1	Over-voltage (during acceleration)	3
7	OU2	Over-voltage (during deceleration)	
8	OU3	Over-voltage (during steady state)	
10	LU	Under-voltage	
17	OH1	Heatsink overheated	7
23	OL1	Motor overload	
25	OLU	Inverter overload	
31	Er1	Memory error	Fully ON
33	Er3	CPU error	Fully ON
37	Er7	Tuning error	2
38	Er8	RS-485 communications error	1
46	OPL	Output phase loss	9
51	ErF	Data saving error during under-voltage	1
254	Err	Mock alarm	4

The alarm code is presented in two ways as follows:

- LED flashes

RVBS has two LED on its circuit board. One is green LED, and the other is red LED. The green LED always flashes as long as the power of RVBS is supplied. The Red LED only flashes when alarm presents. It stays off on the condition of normal operation.

- Function code

The newest alarm of RVBS present in the Alarm code (D02). The most recent 4 alarms are memorized in a FIFO type alarms queue (D12 to D15). Namely, the last alarm memorized is visible in the Alarm 1 status variable (D12).

Function code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
D02	0x0502	Alarm Code	-	-	-	-	R
D12	0x050C	Latest Alarm Contents	-	-	-	-	R
D13	0x050D	Last Alarm Contents	-	-	-	-	R
D14	0x050E	Second Last Alarm Contents	-	-	-	-	R
D15	0x050F	Third Last Alarm Contents	-	-	-	-	R

5.2 Alarm operation

H30 causes the inverter to generate a mock alarm in order to check whether external sequences function correctly at the time of machine setup.

Setting the H30 data to "1" displays mock alarm err on the LED monitor. It also issues alarm output ALM (if assigned to a digital output terminal specified by E06 or E07). (Accessing the H30 data requires simultaneous keying of "STOP key + ^ key.") After that, the H30 data automatically reverts to "0," allowing you to reset the alarm.

Just as for data (alarm history and relevant information) of those alarms that could occur in running the inverter, the inverter saves mock alarm data, enabling you to confirm the mock alarm status.

To clear the mock alarm data, use H19. (Accessing the H19 data requires simultaneous keying of "STOP key + ^ key.") H19 data automatically reverts to "0" after clearing the alarm data.

Function code	Mod. add.	Description	Def	Min	Max	U.M.	R/W
H19	0x0314	Clear Alarm Data	0	0	1	-	R/W
H30	0x031E	Mock Alarm	0	0	1	-	R/W

5.3 Alarm map

Name	Description		Alarm code	Alarm output [30A, B, C]
Overcurrent protection Short-circuit protection Ground fault protection	- Stops the inverter output to protect the inverter from an overcurrent resulting from overload. - Stops the inverter output to protect the inverter from an overcurrent due to a short circuit in the output circuit. - Stops the inverter output to protect the inverter from an overcurrent due to a ground fault in the output circuit. This protection is effective only when the inverter starts. If you turn on the inverter without removing the ground fault, this protection may not work.	During acceleration During deceleration During running at constant speed	OC1 OC2 OC3	Yes
Overvoltage protection	Stops the inverter output upon detection of overvoltage (400 VDC for 200 V series) in the DC link bus. This protection is not assured if excess AC line voltage is applied inadvertently.	During acceleration During deceleration During running at constant speed (Stopped)	OU1 OU2 OU3	Yes
Under voltage protection	Stops the inverter output when the DC link bus voltage drops below the under-voltage level (200 VDC for 200 V series). However, when F12 = 4 or 5, no alarm is output even if the DC link bus voltage drops.		LU	Yes (Note)
Output phase loss protection	Detects breaks in inverter output wiring at the start of running and during running, stopping the inverter output.		OPL	Yes
Overheat protection - heatsink	- Stops the inverter output upon detecting excess heat sink temperature in case of cooling fan failure or overload.		OH1	Yes
Overload protection	Stops the inverter output according to the inverter heat sink temperature and the switching element temperature calculated from the output current.		OLU	Yes
Electronic thermal overload relay	Stops the inverter output in accordance with the setting of the electronic thermal overload relay to protect the motor. This function protects general-purpose motors and inverter motors over the entire frequency range. * The operation level and thermal time constant (0.5 to 75.0 minutes) can be set.		OL1	Yes
Stall prevention	Operates if the inverter's output current exceeds the instantaneous overcurrent limit level, avoiding tripping of the inverter (during constant speed operation or during acceleration).		—	—
Alarm relay output (for any fault)	The inverter outputs a relay contact signal when the inverter issues an alarm and stops the inverter output. < Alarm Reset > The alarm stop state is reset by the digital input signal ***RST***. < Saving the alarm history and detailed data > The information on the previous 4 alarms can be saved and displayed.		—	Yes
Memory error	The inverter checks memory data after power-on and when the data is written. If a memory error is detected, the inverter stops.		Er1	Yes
CPU error	If the inverter detects a CPU error caused by noise or some other factor, the inverter stops.		Er3	Yes
Tuning error	Stops the inverter output when a tuning failure, interruption, or abnormal tuning result is detected during tuning of motor parameters.		Er7	Yes
RS-485 communication error	Upon detection of an RS-485 communications error, the inverter stops its output.		Er8	Yes

Data save error during under voltage	If the data could not be saved during activation of the under-voltage protection function, the inverter displays the alarm code.	ErF	Yes
Retry function	When the inverter stops due to a trip, this function automatically resets the inverter and restarts it. (The number of retries and the latency between stop and reset can be specified.)	—	—
Surge protection	Protects the inverter against surge voltages which might appear between one of the power lines for the main circuit and the ground.	—	—
Protection against momentary power failure	Upon detection of a momentary power failure lasting 15 ms or more, this function stops the inverter output. If "restart after momentary power failure" is selected, this function invokes a restart process when power has been restored within a predetermined period.	—	—
Overload prevention control	In the event of overheating of the cooling fan or an overload condition (alarm display: OH1 or OLU), the output frequency of the inverter is reduced to keep the inverter from tripping.	—	—
Mock alarm	A mock alarm can be generated with keypad operations to check the failure sequence.	Err	Yes

(Note) No alarm output depending upon the data setting of the function code.