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OMRON

Inverter

MX2/RX/LX Series

Drive Programming

User's Manual

3G3MX2 Series
3G3RX Series
3G3LX Series
CX-Drive

I580-E2-01

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Introduction

Thank you for purchasing the Inverter/Servo support tool CX-Drive and 3G3MX2/3G3RX/3G3LX Series Inverter.

This manual describes the specifications and operating methods of the Drive Programming for the inverter.

When you use this product, refer to the MX2 Series User's Manual (I570-E2) or the RX User's Manual (I560-E2), besides the CX-Drive Operation Manual (W453).

Intended Readers

This manual is intended for the following personnel, who must also have knowledge of electrical systems (an electrical engineer or the equivalent).

- Personnel in charge of introducing FA systems.
- Personnel in charge of designing FA systems.
- Personnel in charge of installing and connecting FA systems.
- Personnel in charge of managing FA systems and facilities.

Notice

This manual contains information you need to know to use the Drive Programming.

Before using this product, read this manual and gain a full understanding of the information provided herein.

After you finished reading this manual, keep it in a convenient place so that it can be referenced at any time.

Make sure this manual is delivered to the end user.

Manual Configuration

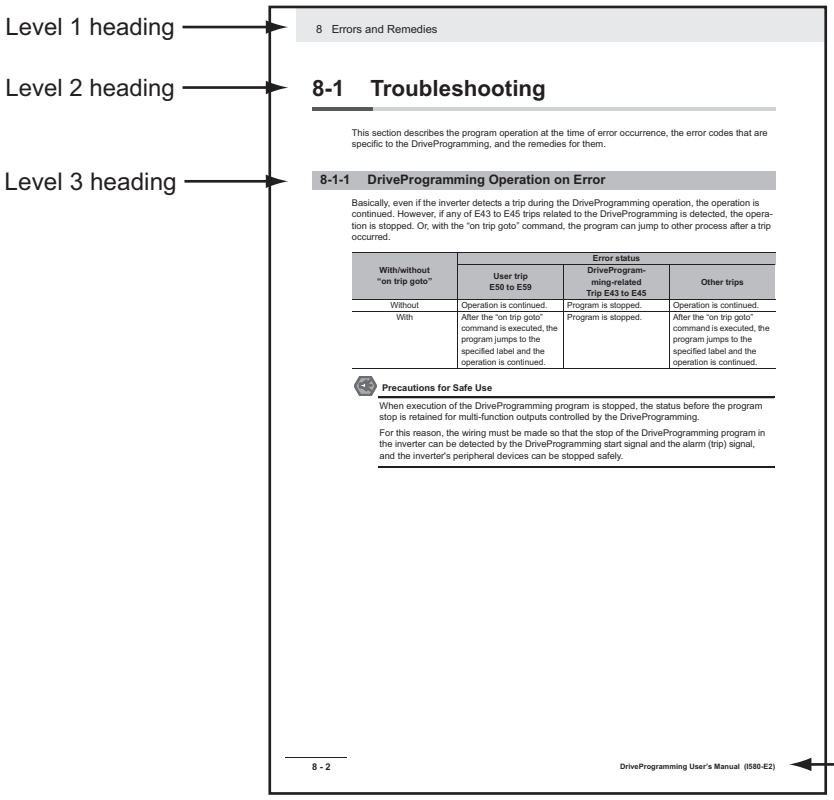
This manual is compiled section by section for user's convenience as follows.

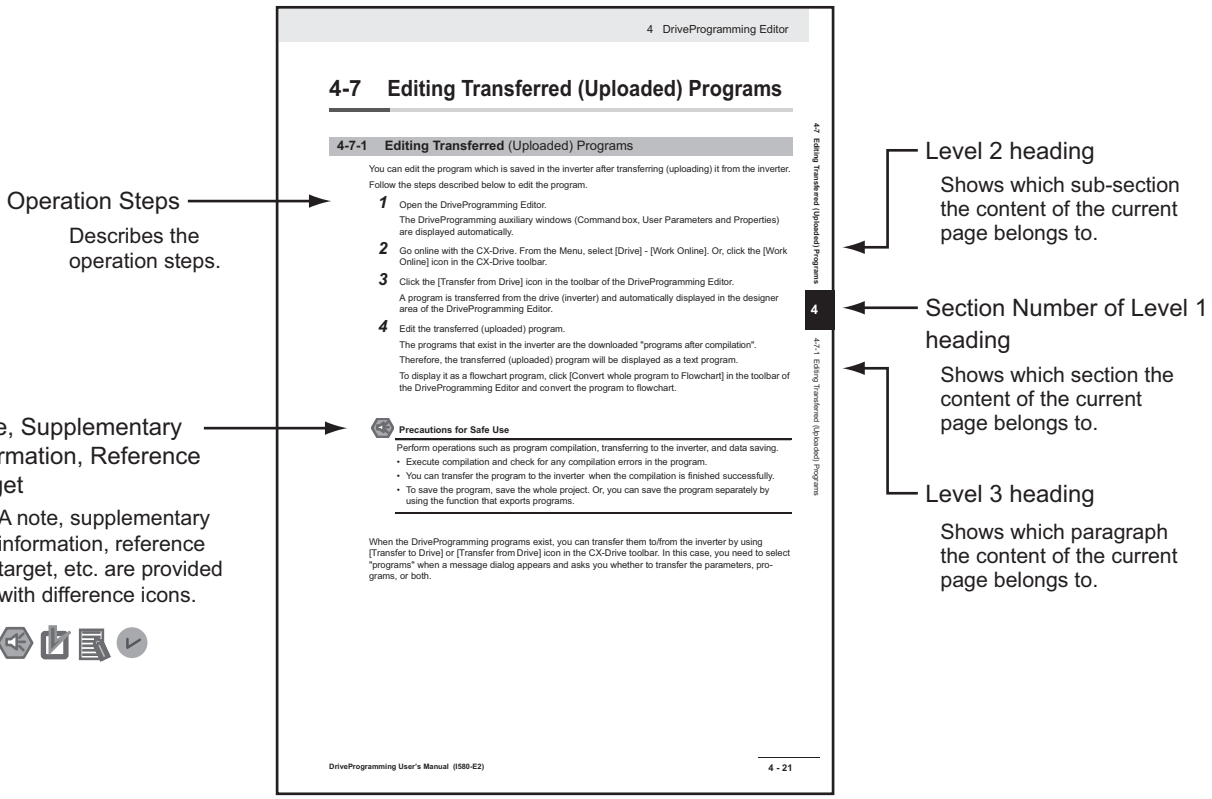
Section		Overview
Section 1	Overview	This section describes an overview and the system configuration of the Drive Programming.
Section 2	Specifications	This section describes the specifications of the Drive Programming.
Section 3	Operation Procedure for Drive Programming	This section describes the operation procedure of the Drive Programming, related parameters, and program structures.
Section 4	Drive Programming Editor	This section describes how to start the Drive Programming Editor, saving and loading data, and details on parts of the Editor.
Section 5	Drive Programming User Variables	This section describes the user variables provided for Drive Programming.
Section 6	Drive Programming Commands	This section describes the commands provided for Drive Programming.
Section 7	Precautions for Use of Parameters for Drive Programming	This section describes the precautions for use of parameters for the Drive Programming.
Section 8	Errors and Remedies	This section describes the program operation at the time of error occurrence, the errors that are specific to the Drive Programming, as well as the causes and remedies.
Section 9	LX inverter	This section describes the LX inverter specific functions.

Manual Structure

Page Structure

The following page structure and symbol icons are used in this user's manual.





Note The above page is only a sample for illustrative purposes. It is not the actual content of the manual.

Special Information

Special information in this user's manual is classified as follows:

Precautions for Safe Use

Precautions on what to do and what not to do to ensure safe usage of the product.

Precautions for Correct Use

Precautions on what to do and what not to do to ensure proper operation and performance.

Additional Information

Additional information to read as required.

This information is provided to increase understanding or make operation easier.

Version Information

Information on differences in specifications and functionality for inverters with different unit versions and for different versions of the CX-Drive is given.

Sections in this Manual

1 Overview
2 Specifications
3 Operation Procedure for Drive Programming
4 Drive Programming Editor
5 Drive Programming User Variables
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Terms and Conditions Agreement

WARRANTY

- The warranty period for the Software is one year from the date of purchase, unless otherwise specifically agreed.
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APPLICABLE CONDITIONS

USER SHALL NOT USE THE SOFTWARE FOR THE PURPOSE THAT IS NOT PROVIDED IN THE ATTACHED USER MANUAL.

CHANGE IN SPECIFICATION

The software specifications and accessories may be changed at any time based on improvements and other reasons.

ERRORS AND OMISSIONS

The information in this manual has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical, or proofreading errors, or omissions.

Safety Precautions

Indications and Meanings of Safety Information

In this manual, the following precautions and signal words are used to provide information to ensure the safe use of the Drive Programming.

The information provided here is vital to safety. Strictly observe the precautions provided.

Meanings of Signal Words

WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. Additionally, there may be severe property damage.
Caution	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.

Alert Symbols in this Document

	⃠ This symbol indicates a prohibited item (an item you must not do). The specific instruction is indicated using an illustration or text inside or near ⃠. The symbol shown to the left indicates "disassembly prohibited."
	△ This symbol indicates danger and caution. The specific instruction is indicated using an illustration or text inside or near △. The symbol shown to the left indicates "beware of electric shock."
	△ This symbol indicates danger and caution. The specific instruction is indicated using an illustration or text inside or near △. The symbol shown to the left indicates "non-specific general danger."
	△ This symbol indicates caution (warnings included). The specific instruction is indicated using an illustration or text inside or near △. The symbol shown to the left indicates "risk of hot surface."
	● This symbol indicates a compulsory item (an item that must be done). The specific instruction is indicated using an illustration or text inside or near ●. The symbol shown to the left indicates "general compulsory items."
	● This symbol indicates a compulsory item (an item that must be done). The specific instruction is indicated using an illustration or text inside or near ●. The symbol shown to the left indicates "grounding required."

⚠ WARNING

	Turn off the power supply and implement wiring correctly. Not doing so may result in a serious injury due to an electric shock.
	Wiring work must be carried out only by qualified personnel. Not doing so may result in a serious injury due to an electric shock.
	Do not change wiring and slide switches, put on or take off Operator and optional devices, replace cooling fans while the input power is being supplied. Doing so may result in a serious injury due to an electric shock.
	Be sure to ground the unit. Not doing so may result in a serious injury due to an electric shock or fire. (200-V class: type-D grounding, 400-V class: type-C grounding)
	Do not remove the terminal cover during the power supply and 10 minutes after the power shut off. Doing so may result in a serious injury due to an electric shock.
	Do not operate the Operator or switches with wet hands. Doing so may result in a serious injury due to an electric shock.
	Inspection of the inverter must be conducted after the power supply was turned off. Not doing so may result in a serious injury due to an electric shock. The main power supply is not necessarily shut off even if the emergency shut off function is activated.
	Do not touch the inverter fins, braking resistors and the motor, which become too hot during the power supply and for some time after the power shut off. Doing so may result in a burn.

⚠ Caution

	Do not connect resistors to the terminals (+1, P/+2, N/–) directly. Doing so might result in a small-scale fire, heat generation, or damage to the unit.
	Install a stop motion device to ensure safety. Not doing so might result in a minor injury. (A holding brake is not a stop motion device designed to ensure safety.)
	Be sure to use a specified type of braking resistor/regenerative braking unit. In case of a braking resistor, install a thermal relay that monitors the temperature of the resistor. Not doing so might result in a moderate burn due to the heat generated in the braking resistor/regenerative braking unit. Configure a sequence that enables the inverter power to turn off when unusual over eating is detected in the braking resistor/regenerative braking unit.
	The Inverter has high voltage parts inside which, if short-circuited, might cause damage to itself or other property. Place covers on the openings or take other precautions to make sure that no metal objects such as cutting bits or lead wire scraps go inside when installing and wiring.
	Take safety precautions such as setting up a molded-case circuit breaker (MCCB) that matches the Inverter capacity on the power supply side. Not doing so might result in damage to property due to the short circuit of the load.
	Do not dismantle, repair or modify the product. Doing so may result in an injury.

Precautions for Safe Use

Operation and Adjustment

- If a parameter is set incorrectly when starting up, adjusting, maintaining, or replacing, an unexpected operation may occur. Perform the operation after enough confirmation.
- If the Drive Programming stops during multi-function output, the output status is held. Take safety precautions such as stopping peripheral devices.
- If the clock command is used in the Drive Programming, an unexpected operation may occur due to weak battery of the LCD Digital Operator.

  Take measures such as detecting a weak battery by a check that the clock data returns to the initial setting and stopping the inverter or programs.

  When the LCD Digital Operator is removed or disconnected, Drive Programming is in a waiting status by the clock command.
- When using the Drive Programming, check that program data is downloaded successfully before starting operation.

Regulations and Standards

To export (or provide to nonresident aliens) any part of this product that falls under the category of goods (or technologies) for which an export certificate or license is mandatory according to the Foreign Exchange and Foreign Trade Control Law of Japan, an export certificate or license (or service transaction approval) according to this law is required.

Related Manuals

You need information on the devices connected for operating this product.

Please see the manuals below for related product information.

Name	Catalog number
MX2 User's Manual	I570-E2
RX User's Manual	I560-E2
CX-Drive Operation Manual	W453

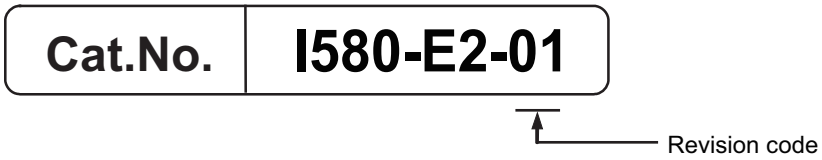
Additional Information

For the inverter operation, refer to the MX2 User's Manual (I570-E2) or the RX User's Manual (I560-E2).

Revision History

The manual revision code is a number appended to the end of the catalog number found on the front and back covers.

Example



Revision code	Revision date	Revised Content
01	August 2014	Original production

1

Overview

This section describes an overview and the system configuration of the Drive Programming.

1-1 Overview of Drive Programming 1-2
1-2 Preparation and System Configuration 1-4

1-1 Overview of Drive Programming

The Drive Programming is the simple sequence function built into the inverter.

To create sequence programs and check their status, you use the Inverter/Servo supporting tool, CX-Drive.

Transfer (download) the created programs to the 3G3MX2/3G3RX Series Inverter so that the stand-alone inverter can perform simple sequence control.

Features of Drive Programming

The Drive Programming has the following features.

- The Drive Programming supports both flowchart and text language method programming.
- You can create a program divided into up to five tasks.
- Five tasks can be processed in parallel.
- It is possible to execute user programs externally by settings of multi-function input terminals.
- You can use the multi-function I/O terminals by allocating them to the parameters.
- The Digital Operator enables you to change the settings of the frequency, acceleration/deceleration time, and other parameters (variables) that require on-site adjustment by specifying the user parameters (P100 to P131), without connecting the computer.
- Because user programs are stored in the internal EEPROM of the inverter, you can start a program immediately after the inverter power supply is turned on.
- The optional LCD Digital Operator (Model: 3G3AX-OP05) has a built-in clock function. By purchasing and connecting the LCD Digital Operator, you can create programs that use the LCD Digital Operator's clock function.

  MX2

  You cannot connect the 3G3MX2 Series Inverters with the LCD Digital Operator (Model: 3G3AX-OP05). Therefore, the clock function is not available.

Precautions for Safe Use

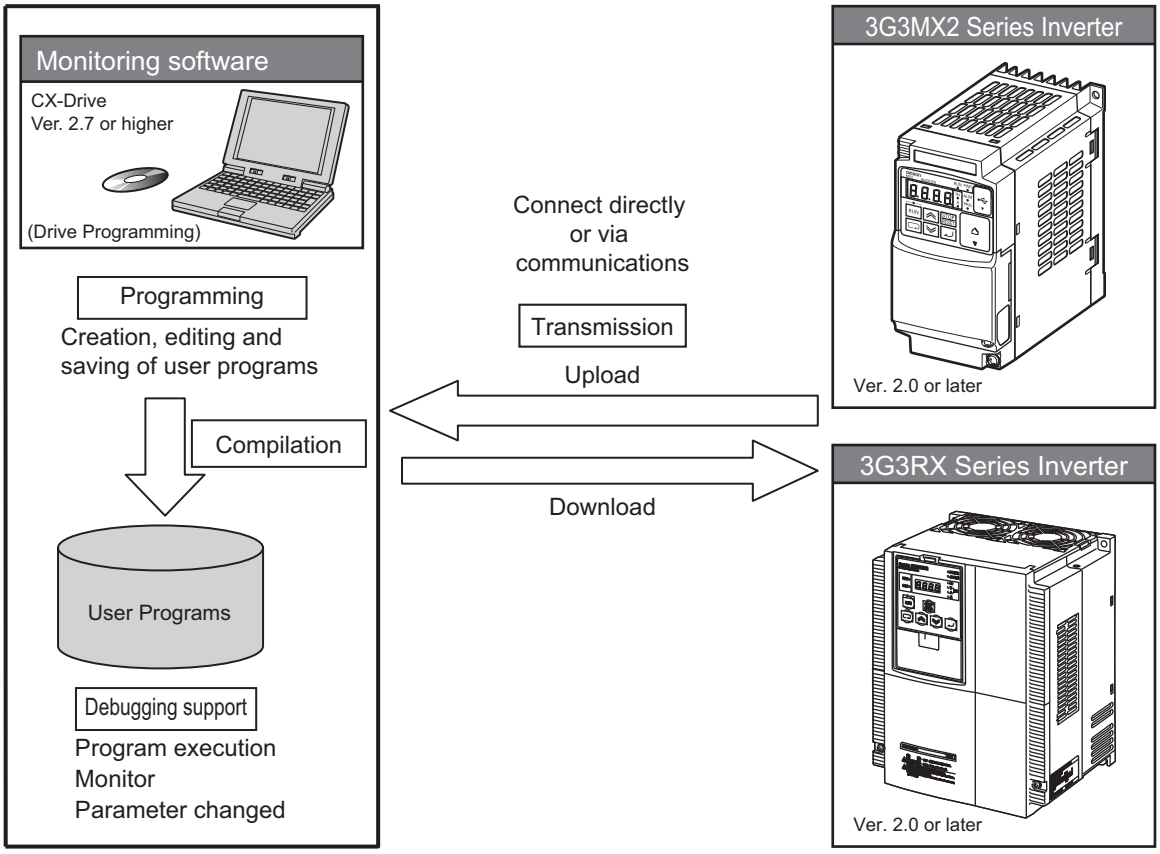
If the clock command is used in the Drive Programming, an unexpected operation may occur due to weak battery of the LCD Digital Operator.

Take measures such as detecting a weak battery by a check that the clock data returns to the initial setting and stopping the inverter or programs.

When the LCD Digital Operator is removed or disconnected, Drive Programming is in a waiting status by the clock command.

The following table shows the main functions of the Drive Programming Editor available in CX-Drive.

Function	Description
Programming	Supports the creation, editing, saving, reading, and printing of user programs.
Compilation	Performs check of user programs and generates intermediate codes.
Transfer	Downloads a user program to the inverter. Uploads a user program from the inverter.
Debugging support	Starts and stops the execution of a program. The user can check the inverter status monitor etc.


Monitoring software
CX-Drive
Ver. 2.7 or higher
(Drive Programming)
Programming
Creation, editing and saving of user programs
Compilation
User Programs
Debugging support
Program execution
Monitor
Parameter changed
Connect directly or via communications
Transmission
Upload
Download
3G3MX2 Series Inverter
Ver. 2.0 or later
3G3RX Series Inverter
Ver. 2.0 or later

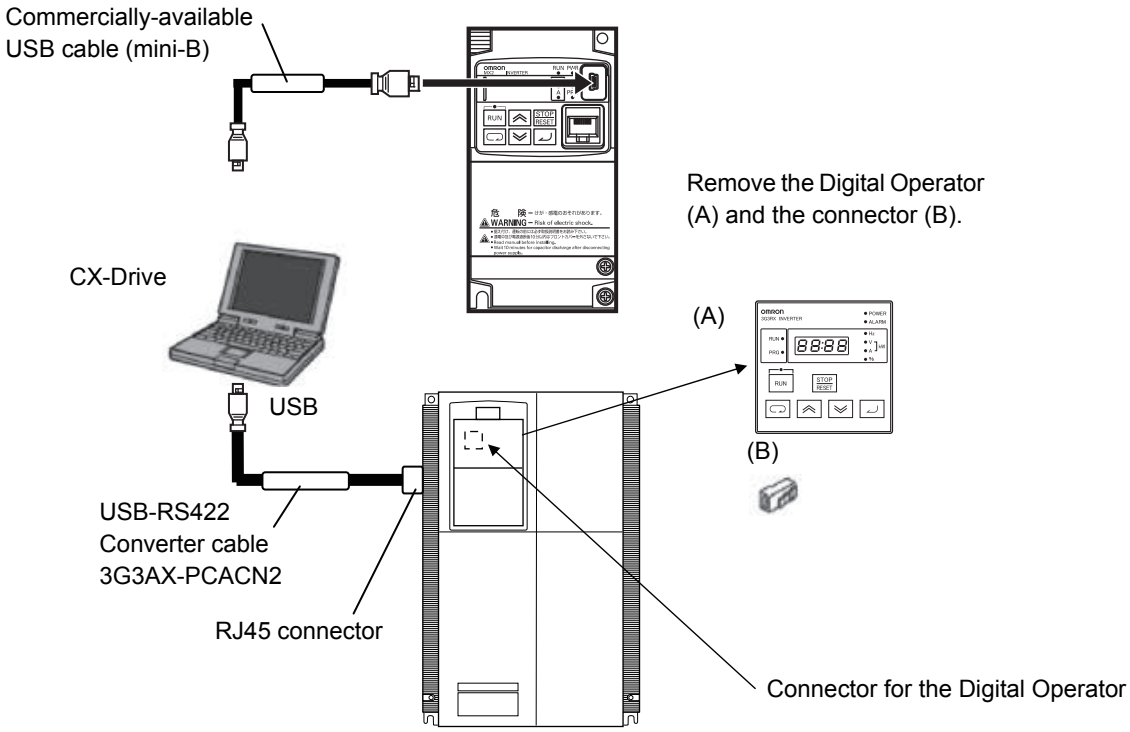
1-2 Preparation and System Configuration

You must prepare the following items to create user programs with functions of the Drive Programming in CX-Drive and execute the programs in the 3G3MX2/3G3RX Series Inverter.

- 3G3MX2/3G3RX Series Inverter (Ver. 2.0 or later)
- Personal computer (PC) (Windows system)

32-bit PC	64-bit PC
Windows XP SP3, Windows Vista, and Windows 7	Windows Vista and Windows 7

- The CX-Drive requires the following versions.
  MX2: Version 2.8 or higher for 3G3MX2 Series Inverter
  RX: Version 2.7 or higher for 3G3RX Series Inverter
  (The CX-Drive is included in the FA Integrated Tool Package, CX-One.)
- Prepare the following PC-inverter connection cable.
  MX2: Commercially-available USB cable (mini-B)
  RX: USB to RJ-45 Converter Cable (Model: 3G3AX-PCACN2)



Version Information

- Only the 3G3MX2/3G3RX Series Inverters have the Drive Programming function.
  Be sure to check the version (Ver. 2.0 or later) printed on the nameplate of the inverter because the conventional models of 3G3MX2/3G3RX Series Inverters do not have the function.
- The Drive Programming function is included in the following or higher versions of the CX-Drive.
  If the version of your CX-Drive is lower, you need to upgrade the version.
  MX2: Version 2.8 or higher (with version 2.7 or lower, operation is not possible.)
  RX: Version 2.7 or higher (with version 2.6 or lower, operation is not possible.)

Additional Information

For how to install or upgrade the CX-Drive, refer to the CX-Drive Operation Manual (W453).

EtherCAT/CompoNet/DeviceNet Communications

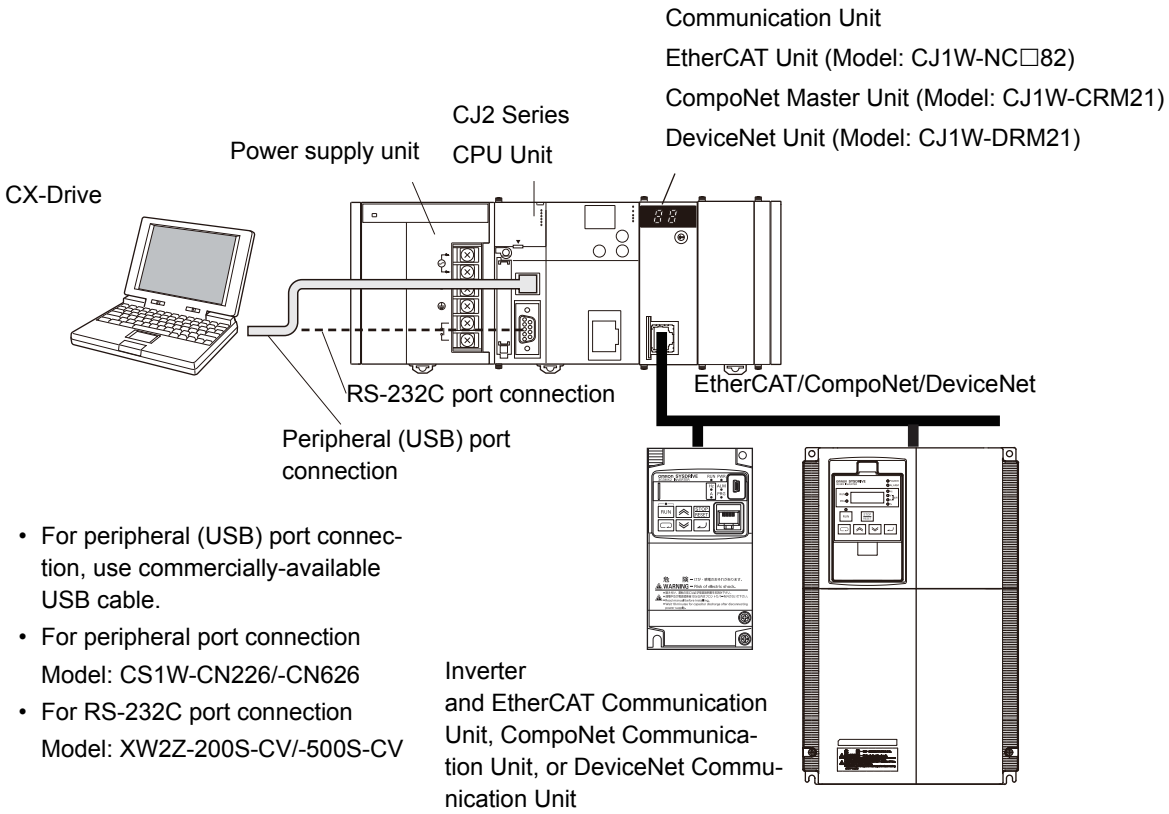
The CX-Drive can be connected to the inverter via communication through the Position Control Unit (Model: CJ1W-NC□82) of EtherCAT master, CompoNet Master Unit (Model: CJ1W-CRM21/CS1W-CRM21), or DeviceNet Unit (Model: CJ1W-DRM21/CS1W-DRM21-V1) mounted to the programmable controller.

To establish communication connection between the inverter and the CX-Drive through the programmable controller, you must configure the following settings in the CX-Drive in advance.

- Select properties of the drive project, and click [Settings] under [Drive Type] to set the option board type to the inverter communication unit.
- Select properties of the drive project, and select the connection network under [Connection type].

  Then, click [Settings] to set the network configuration under the [Network] and the connection method to connect CX-Drive and PLC under [Gateway PLC].

● Configuration



- For peripheral (USB) port connection, use commercially-available USB cable.
- For peripheral port connection
  Model: CS1W-CN226/-CN626
- For RS-232C port connection
  Model: XW2Z-200S-CV/-500S-CV

Install the CX-Drive in your Windows personal computer. Connect the computer with the programmable controller, and go online with the inverter via EtherCAT, CompoNet or DeviceNet communications.

When the online connection is established, you can use the Drive Programming Editor to create user programs and transfer (download) them to the inverter.

2

Specifications

This section describes the specifications of the Drive Programming.

2-1 Specifications 2-2

2-1 Specifications

The following table shows the specifications related to the Drive Programming.

Item		Specifications	
Program specifications	Programming language	Flowchart and text language method	
	Input device	Windows personal computer (OS: Windows XP-SP3, Windows Vista, or Windows 7)	
	Program capacity	1,024 steps max.: 6 KB (1,024 steps max. for a total of 5 tasks)	
	Programming support function	Functions supported in Inverter/Servo support tool CX-Drive • Program editing and display • Program compilation (Program syntax check) • Program downloading, uploading, and all clear	
	Execution format	• Execution by interpreter • Execution cycle: 2 ms/step (5 commands executable through 5-task parallel processing) • Subroutine call supported (Nesting in 8 levels max.)	
Input/output functions	External input	Drive Programming start	Select in the Drive Programming Function Selection (A017) • Start/stop via multi-function input PRG terminal (A017 = 01) MX2: Allocate to the Multi-function Input S1 to S7 Selection (C001 to C007). RX: Allocate to the Multi-function Input S1 to S8 Selection (C001 to C008) • Start/stop at power on/off (A017=02)
		Multi-function Input	MX2: X(00) to X(07)/8 points • Multi-function input S1 to S7 terminals • X(07) is for the pulse train input RP terminal (enabled only when P003 = 02) RX: X(00) to X(07)/8 points • Multi-function input S1 to S8 terminals
		Frequency reference input (Multi-function analog input)	XA(0): 0 to 10 V (FV terminal) XA(1): 4 to 20 mA (FI terminal) XA(2): MX2: No applicable function RX: −10 to 10 V (FE terminal)
	External output	Multi-function output/multi-function relay output	MX2: Y(00) to Y(02)/3 points • Multi-function output P1 and P2 terminals • Multi-function relay output terminals (MA, MB) RX: Y(00) to Y(05)/6 points • Multi-function output P1 to P5 terminals • Multi-function relay output terminals (MA, MB)
		Monitor output (Multi-function digital output)	YA(0): PWM output in 6.4 ms cycle (MP terminal)
		Monitor output (Multi-function analog output)	YA(1): 0 to 10 V (AM terminal) YA(2): MX2: No applicable function RX: 4 to 20 mA (AMI terminal)

Item		Specifications
Commands	Program control commands	• Loop ("for") • Unconditional branch ("goto") • Time control ("wait") • Conditional branch ("if then", "ifs then", "select case", "until", "while") • Subroutine ("call", "sub") • Others ("entry", "end", "inc", "dec")
	Arithmetic commands	• Four arithmetic operations (+, −, *, and /) • Remainder ("mod") and assignment (=) • Absolute value ("abs") • Logical operations ("or", "and", "xor", "not")
	I/O control	• Multi-function I/O (bit input, word input, bit output, and word output) • Reads inverter input terminals • Reads/writes inverter output terminals
	Timer control	Contacts control by timer and timer counter control
	Parameter control	• Changes setting data of specified parameter number • Saves parameter setting data in EEPROM RX only: current time reading (once/continuous)
	Inverter control	• Executes and stops forward/reverse operation • Generates a trip by the Drive Programming (E50 to E59/10 points) • Frequency reference and acceleration/deceleration time settings
Function variable	User parameter variable	U(00) to U(31)/32 points
	Internal user variable	UL(00) to UL(07)/8 points
	Frequency reference variable	SET-Freq
	Acceleration time variable	ACCEL
	Deceleration time variable	DECEL
	Inverter monitor variable	The monitor functions (d001 to d102) for the inverter are available as variables. MX2 and RX: FM, Iout, Dir, PID-FB, F-CNV, Tmon, Vout, Power, RUN-Time, ON-Time, POS, STATUS, DCV, ERR-CNT, ERR(1) to ERR(6), and UMon(0) to UMon(2)
	Multi-function input variable	The function options of the Multi-function Input S1 Selection (C001) for the inverter are available. MX2 and RX: FW, RV, CF1, CF2, CF3, CF4, JG, DB, SET, TCH, FRS, EXT, USP, CS, SFT, AT, RS, STA, STP, F-R, PID, PIDC, UP, DWN, UDC, OPE, SF1, SF2, SF3, SF4, SF5, SF6, SF7, OLR, TL, TRQ1, TRQ2, BOK, LAC, PCLR, ADD, F-TM, ATR, KHC, AHD, CP1, CP2, CP3, ORL, ORG, and SPD MX2 only: RS485, HLD, ROK, and DISP RX only: SET3, CAS, PPI, ORT, STAT, SON, FOC, FOT, ROT, PCNT, and PCC

Item		Specifications
Function variable	Multi-function output variable	The function options of the Multi-function Output P1 Selection (C021) for the inverter are available. MX2 and RX: RUN, FA1, FA2, OL, OD, AL, FA3, OTQ, UV, TRQ, RNT, ONT, THM, BRK, BER, ZS, DSE, POK, FA4, FA5, OL2, ODc, OIDc, FBV, NDc, LOG1, LOG2, LOG3, WAC, WAF, FR, OHF, LOC, IRDY, FWR, RVR, MJA, WCO, and WCOI MX2 only: FREF, REF, SETM, and EDM RX only: IP, O2Dc, LOG4, LOG5, LOG6, and WCO2
	Input terminal variable	MX2: X(00) to X(07)/8 points Note: X(07) is for the Pulse Train Input RP Selection (enabled only when P003 = 02) RX: X(00) to X(07)/8 points
	Output terminal variable	MX2: Y(00) to Y(02)/3 points RX: Y(00) to Y(05)/6 points
	Internal user contact	UB(0) to UB(7)/8 points
	Timer output contact	TD(0) to TD(7)/8 points
	Timer counter variable	TC(0) to TC(7)/8 points
	Analog input terminal variable	MX2: XA(0) and XA(1) RX: XA(0) to XA(2)
	Analog output terminal variable	MX2: YA(0) and YA(1) RX: YA(0) to YA(2)

3

Operation Procedure for Drive Programming

This section describes the operation procedure of the Drive Programming, related parameters, and program structures.

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3-2 Parameters Related to Drive Programming 3-5

3-3 Program Structure 3-13

3-3-1 Tasks 3-13
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3-1 Operation Procedure

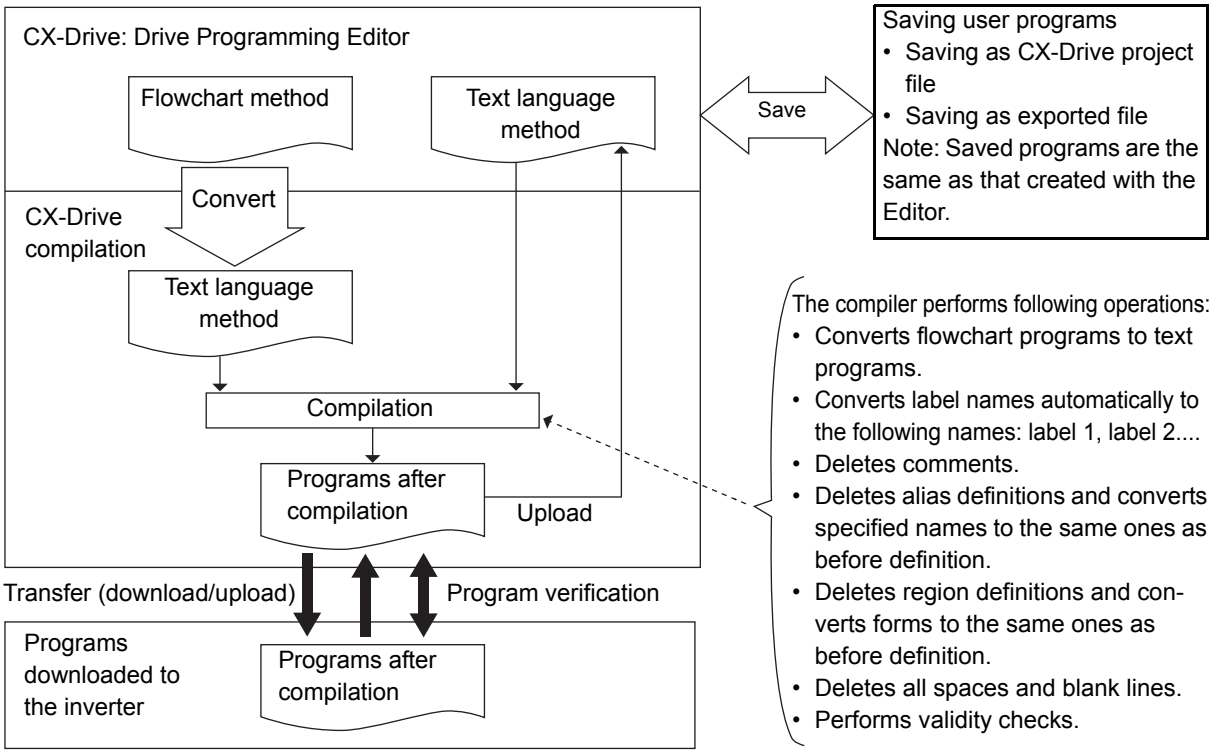
The following figure shows the flow of procedure from programming to executing programs with the Drive Programming.

Item	Reference
Programming	P. 3-3
↓	
Compiling Programs	P. 3-3
↓	
Downloading Programs	P. 3-4
↓	
Selecting Drive Programming Functions	P. 3-4
↓	
Starting Programs	P. 3-4

Create Drive Programming programs by the Drive Programming Editor in the Inverter/Servo support tool, CX-Drive.

The following figure shows the flow of procedure from programming to transferring (downloading) to the inverter.

For details on operation and other information, refer to *Section 4 Drive Programming Editor*.



Programming

You can create user programs in the flowchart method or the text language method. It is also possible to select between two methods for each task or subroutine.

Use the Drive Programming Editor in CX-Drive to input user programs.

Drive Programming Editor consists of the Drive Programming area, Toolbox window, Block Parameter window, Properties window, and Output window.

- In the Drive Programming area, you can create programs in the flowchart method or text language method.
- The Toolbox window displays the command blocks in categories.
- In the Block Parameter window, you can set parameters that are used when the program execution is started.
- In the Properties window, you can edit the properties of a block which is currently selected in flowchart.
- The Output window displays compilation errors and warnings after a compilation is finished.

Compiling Programs

Programs created in the Drive Programming area are compiled and converted into the final "programs after compilation". Then, the programs are transferred (downloaded) to the inverter.

The compiler performs checks for the items such as program validity, program syntax, parameter input limitation and maximum number of steps. If there is any input which is not permitted, the compilation is stopped and an error message is displayed.

The compiler also performs the operations as shown below, and creates the final "programs after compilation". Therefore, if you transfer (upload) the program once saved in the inverter to the CX-Drive, the program which is read out is the "program after compilation". While its operation is the same as before compilation, its form and contents are partially different.

- Converts flowchart programs to text programs.
- Automatically converts the label names specified in the program to the following names: label 1, label 2...
- Deletes comments entered in the program.
- Deletes alias definitions and converts specified names to the same ones as before definition.
- Deletes region definitions and converts forms to the same ones as before definition.
- Deletes all spaces and blank lines in the program.
- Performs validity checks.

Precautions for Correct Use

- The specified comments, alias definitions and region definitions are deleted when a compilation is performed for program conversion or transferring (downloading) to the inverter.

  To save those contents, save the program before you execute program conversion or you transfer (download) the program to the inverter.

  You can save the program by saving the whole project in the CX-Drive or export file of the program.
- Program verification means a comparison between "program after compilation" and the program inside the inverter. Therefore, comments, alias definitions, region definitions, etc. are not verified.

Downloading Programs

Download compiled programs to the inverter and save them in the EEPROM of the inverter.

You can start programs saved in the EEPROM after turning on the power supply, without using the tool (CX-Drive).

Selecting Drive Programming Functions

Set Drive Programming Function Selection (A017) to Enabled (01 or 02) to use the Drive Programming function. You can change the Drive Programming Function Selection (A017) even when the operation is in progress.

Parameter No.	Function name	Data	Description
A017	Drive Programming Function Selection	00: Disabled (default setting)	Disables the Drive Programming function. Programs are not executed. If you change the setting to 00 (Disabled) during program execution, the program will be stopped.
		01: Enabled (Start/stop via multi-function input PRG terminal)	Starts the Drive Programming program when the multi-function input terminal*1 which is set to 82 (PRG) is turned ON.
		02: Enabled (Start/stop at power on/off)	Starts the Drive Programming program automatically after the inverter power supply is turned on. If you change the setting to 02 (Enabled) while the program is stopped, the program will be started.

*1. Multi-function input terminals for MX2 are S1 to S7, and for RX are S1 to S8.

Starting Programs

When the Drive Programming Function Selection (A017) is set to 01 (Enabled: Start/stop via multi-function input PRG terminal), set one of Multi-function Input S1 to S7/S8 Selection to 82 (PRG). The program is started when the multi-function input terminal set to PRG is turned ON. The program execution continues while the PRG terminal is ON and stops when the terminal is turned OFF.

When the Drive Programming Function Selection (A017) is set to 02, the program is started right after the setting is completed. The program will also be started automatically at next power on.

Once the program reaches “end” command after it was started and a series of processes was completed, the program is not executed unless it is restarted.

To repeat the program, create a loop program so that the program does not reach “end” command.

The downloaded Drive Programming program is saved in the EEPROM of the inverter. Therefore, after downloading, you can start the program without using the support tool.

Parameter No.	Function name	Data	Description
C001 to C007	MX2 and RX: Multi-function Input S1 to S7 Selection	82: PRG (Drive Programming start)	When the Drive Programming Function Selection (A017) is set to 01 (Enabled: Start/stop via multi-function input PRG terminal), the program is started via the multi-function input terminal with this setting.
C008	RX only: Multi-function Input S8 Selection		

3-2 Parameters Related to Drive Programming

This section describes the inverter parameters that are related to the Drive Programming.

Selecting Drive Programming Functions

Set the Drive Programming Function Selection (A017) to Enabled (01 or 02) to use the Drive Programming function. You can change the Drive Programming Function Selection (A017) even when the operation is in progress.

Parameter No.	Function name	Data	Description
A017	Drive Programming Function Selection	00: Disabled (default setting)	Disables the Drive Programming function. Programs are not executed. If you change the setting to 00 (Disabled) during program execution, the program will be stopped.
		01: Enabled (Start/stop via multi-function input PRG terminal)	Starts the Drive Programming program when the multi-function input terminal*1 which is set to 82 (PRG) is turned ON.
		02: Enabled (Start/stop at power on/off)	Starts the Drive Programming program automatically after the inverter power supply is turned on. If you change the setting to 02 (Enabled) while the program is stopped, the program will be started.
C001 to C007	MX2 and RX: Multi-function Input S1 to S7 Selection	82: PRG (Drive Programming start)	When the Drive Programming Function Selection (A017) is set to 01 (Enabled: Start/stop via multi-function input PRG terminal), the program is started via the multi-function input terminal with this setting.
C008	RX only: Multi-function Input S8 Selection		

*1. Multi-function input terminals for MX2 are S1 to S7, and for RX are S1 to S8.

Initializing Programs

To initialize the Drive Programming program downloaded to the inverter, select 04 (Clear fault monitor + initialize data + Clear Drive Programming) for the Initialization Selection (b084), and execute initialization by Initialization Execution (b180).

Parameter No.	Function name	Data	Description
b084	Initialization Selection	04: Clear fault monitor + initialize data + Clear Drive Programming	Select 04 to initialize the Drive Programming program as well.
b180	Initialization Execution	01: Execute initialization	Executes initialization of the selected data.

RUN Command Selection Setting

Use FW (forward) and RV (reverse) variables to control RUN commands through the Drive Programming program. Be sure to set the RUN Command Selection (A002/A202) to 01 (Control circuit terminal block) when you use FW or RV variable.

You can control through the program regardless of the setting 00 (FW: Forward) (for MX2 only) or 01 (RV: Reverse) in Multi-function Input Selection.

The relationship between the following items is OR:

MX2: The program's RUN command and the multi-function input terminal set to 00 (FW: Forward).

RX: The program's RUN command and the forward RUN command terminal FW and the multi-function input terminal set to 01 (RV: Reverse).

MX2:

Parameter No.	Function name	Data	Description
A002/ A202	1st/2nd RUN Command Selection	01: Control circuit terminal block (Drive Programming) 02: Digital Operator 03: Modbus communication 04: Option 1 05: Option 2	Select 01 (Control circuit terminal block) to control the RUN command through the program with FW or RV variable. If you select other setting, FW and RV variable are disabled.
C001 to C007	Multi-function Input S1 to S7 Selection	00: FW (Forward) 01: RV (Reverse)	The relationship between the program's RUN command and the RUN command via the control circuit terminal block is OR.

RX:

- Forward RUN command : the forward RUN command terminal FW (the relationship between the program's RUN command and the RUN command via the control circuit terminal block is OR.)

Parameter No.	Function name	Data	Description
A002	RUN Command Selection	01: Control circuit terminal block (Drive Programming) 02: Digital Operator 03: Modbus communication 04: Option 1 05: Option 2	Select 01 (Control circuit terminal block) to control the RUN command through the program with FW or RV variable. If you select other setting, FW and RV variable are disabled.
C001 to C008	Multi-function Input S1 to S8 Selection	01: RV (Reverse)	The relationship between the program's RUN command and the RUN command via the control circuit terminal block is OR.

Setting Inverter I/O Functions

In the Drive Programming, you can use the inverter's I/O functions (multi-function I/O and analog I/O) as the I/O functions of the program.

To use the I/O functions, it is necessary to set each I/O function according to the purpose.

This section describes how to set I/O functions for the Drive Programming.

By configuring the following settings, you can control I/O functions by the function variables of the Drive Programming.

In the case that you use the functions for purpose other than Drive Programming I/O functions, refer to the MX2 User's Manual (I570-E2) or the RX User's Manual (I560-E2).

MX2:

Parameter No.	Function name	Data	Description
A001/ A201	1st/2nd Frequency Reference Selection	07: Drive Programming	Use this setting to specify the inverter frequency reference by the function variables of the Drive Programming. If you select any other option than 01 (Control circuit terminal block), the analog inputs (FV, FI) will be disconnected from the frequency reference and you can use them as the analog inputs XA(00) and XA(01) for the Drive Programming.
C001 to C007	Multi-function Input S1 to S7 Selection	56 to 62: MI1 to MI7 (General-purpose input 1 to 7)	Set 56 to 62 (MI1 to MI7) to use the terminals for the general-purpose inputs for the Drive Programming. The parameter settings correspond to the function variables X(00) to X(06).
P003	Pulse Train Input RP Selection	02: MI8 (General-purpose input 8 for Drive Programming)	Set 02: MI8 (General-purpose input 8 for Drive Programming) to use the RP terminal for the general-purpose input for the Drive Programming. The RP terminal corresponds to the function variable X(07).
C021 and C022	Multi-function Output P1 and P2 Selection	44 to 46: MO1 to MO3 (General-purpose output 1 to 3)	Set 44 to 46 (MO1 to MO3) to use the terminals for the general-purpose outputs for the Drive Programming. You can control the multi-function output terminals by changing the corresponding function variables Y(00) to Y(02) to ON/OFF.
C026	Multi-function Relay Output (MA, MB) Function Selection		
C027	MP Selection	12: Drive Programming (YA(0))	Set 12 (Drive Programming) to use the terminal for the general-purpose pulse output YA(0) for the Drive Programming.
C028	AM Selection	13: Drive Programming (YA(1))	Set 13 (Drive Programming) to use the terminal for the general-purpose analog output (voltage) YA(1) for the Drive Programming.
P031	Acceleration/Deceleration Time Input Type	03: Drive Programming	Set this parameter to control the acceleration/deceleration time through the Drive Programming.

Precautions for Correct Use

- Even if you select MI1 to MI7 (General-purpose input 1 to 7) for the Multi-function Input S1 to S7 Selection, you can select NO (NO contact) or NC (NC contact) for the Multi-function Input S1 to S7 Operation Selection (C011 to C017).
- Even if you select MO1 to MO3 (General-purpose output 1 to 3) for the Multi-function Output P1 and P2 Selection or for the Multi-function Relay Output (MA, MB) Function Selection, you can select NO (NO contact) or NC (NC contact) for the Multi-function Output P1 and P2 Operation Selection (C031, C032) or for the Multi-function Relay Output (MA, MB) Operation Selection (C036).
- In the Drive Programming, the analog I/O functions are allocated to XA(0), XA(1), YA(0) and YA(1). You can monitor the analog I/O status in the programs by using these function variables regardless of the settings for A001, A201, C027 and C028.
- In the Drive Programming programs, you cannot monitor the status of multi-function I/O terminals for which the general-purpose I/Os are not set in C001 to C007, C021, C022 or C026.

RX:

Parameter No.	Function name	Data	Description
A001	Frequency Reference Selection	07: Drive Programming	• Use this setting to specify the inverter frequency reference by the function variables of the Drive Programming. • If you select any other option than 01 (Control circuit terminal block), the analog inputs (FV, FI, FE) will be disconnected from the frequency reference and you can use them as the analog inputs XA(00) to XA(02) for the Drive Programming.
C001 to C008	Multi-function Input S1 to S8 Selection	56 to 63: MI1 to MI8 (General-purpose input 1 to 8)	• Set 56 to 63 (MI1 to MI8) to use the terminals for the general-purpose inputs for the Drive Programming. • The parameter settings correspond to the function variables X(00) to X(07).
C021 to C025	Multi-function Output P1 to P5 Selection	44 to 49: MO1 to MO6 (General-purpose output 1 to 6)	• Set 44 to 49 (MO1 to MO6) to use the terminals for the general-purpose outputs for the Drive Programming. • You can control the multi-function output terminals by changing the corresponding function variables Y(00) to Y(05) to ON/OFF.
C026	Multi-function Relay Output (MA, MB) Function Selection		
C027	MP Selection	12: Drive Programming (YA(0))	Set 12 (Drive Programming) to use the terminal for the general-purpose pulse output YA(0) for the Drive Programming.
C028	AM Selection	13: Drive Programming (YA(1))	Set 13 (Drive Programming) to use the terminal for the general-purpose analog output (voltage) YA(1) for the Drive Programming.
C029	AMI Selection	14: Drive Programming (YA(2))	Set 14 (Drive Programming) to use the terminal for the general-purpose pulse analog output (current) YA(2) for the Drive Programming.
P031	Acceleration/Deceleration Time Input Type	03: Drive Programming	Set this parameter to control the acceleration/deceleration time through the Drive Programming.

Precautions for Correct Use

- Even if you select MI1 to MI8 (General-purpose input 1 to 8) for the Multi-function Input S1 to S8 Selection, you can select NO (NO contact) or NC (NC contact) for the Multi-function Input S1 to S8 Operation Selection (C011 to C018).
- Even if you select MO1 to MO6 (General-purpose output 1 to 6) for the Multi-function Output P1 to P5 Selection or for the Multi-function Relay Output (MA, MB) Function Selection, you can select NO (NO contact) or NC (NC contact) for the Multi-function Output P1 to P5 Operation Selection (C031 to C035) or for the Multi-function Relay Output (MA, MB) Operation Selection (C036).
- If you enable the emergency shutoff function of the 3G3RX Series Inverter (SW1 = ON), the Multi-function Input S1 Selection (C001) will be set to 18 (RS) and the Multi-function Input S3 Selection (C003) will be set to 64 (EMR) automatically. In this condition, the Multi-function Input S3/S4 Operation Selection (C011/C013) are fixed to NO (NO contact) and NC (NC contact) respectively and you cannot change them.

  To allocate general-purpose inputs to Multi-function Input S1/S3 Selection, disable the emergency shutoff function.
- In the Drive Programming, the analog I/O functions are allocated to XA(0) to XA(2), and YA(0) to YA(2). You can monitor the analog I/O status in the programs by using these function variables regardless of the settings for A001, C027 to C029.
- In the Drive Programming programs, you cannot monitor the status of multi-function I/O terminals for which the general-purpose I/Os are not set in C001 to C008 and C021 to C026.

Monitor Function of Drive Programming

The following functions are provided to monitor the status of the Drive Programming.

Precautions for Correct Use

- For the data that exceeds four digits, the upper four digits of the data is displayed on the Digital Operator, as shown below.

  A dot at the end of number represents the decimal point position. You can use this to figure out the number of digits.

  Display for data 0 to 9,999: 0. to 9999.

  Display for data 10,000 to 65,535: 1000 to 6553

  Display for data −1,230,000 and 1,230,000: −123 and 1230
- Since the Digital Operator displays only upper four digits, you cannot check or set lower digits of data.

  Use the CX-Drive to check or set the data that exceeds four digits.

Parameter No.	Function name	Data	Description
d023	Program Counter (Drive Programming)	0 to 1,024	Displays the line number of the program during the Drive Programming execution. The numbers that are displayed are the line numbers of task 1 (the leftmost tab on the Drive Programming Editor). • The line numbers of the "program after compilation" are displayed. • The number of line for which a subroutine execution is in progress is also displayed. Note: While program execution is stopped, "0000" is displayed.
d024	Program Number Monitor (Drive Programming)	1	Displays the downloaded program number.
d025	User Monitor 0 (Drive Programming)	−2,147,483,647 to 2,147,483,647	This monitor function corresponds to the function variable UMon(0) and can display any data in the program.
d026	User Monitor 1 (Drive Programming)	−2,147,483,647 to 2,147,483,647	This monitor function corresponds to the function variable UMon(1) and can display any data in the program.
d027	User Monitor 2 (Drive Programming)	−2,147,483,647 to 2,147,483,647	This monitor function corresponds to the function variable UMon(2) and can display any data in the program.

User Parameters of Drive Programming

Up to 32 parameters are provided as the user parameters for the Drive Programming.

Use these parameters for various purposes such as program initial data setting, parameter for adjustment, and saving calculation results.

Precautions for Correct Use

- For the data that exceeds four digits, the upper four digits of the data is displayed on the Digital Operator, as shown below.

  A dot at the end of number represents the decimal point position. You can use this to figure out the number of digits.

  Display for data 0 to 9,999: 0. to 9999.

  Display for data 10,000 to 65,535: 1000 to 6553

  Display for data −1,230,000 and 1,230,000: −123 and 1230
- As the Digital Operator displays only upper four digits, you cannot check or set lower digits of data.

  Use the CX-Drive to check or set the data that exceeds four digits.

Parameter No.	Function name	Data	Description
P100	Drive Programming User Parameter U00	0 to 65,535	• These user parameters correspond to the function variables U(00) to U(28). • You can change the data by using the Digital Operator. The changed data is saved in the EEPROM. • The set data will be saved in the EEPROM when the Write to EEPROM command is executed in the Drive Programming.
P101	Drive Programming User Parameter U01		
P102	Drive Programming User Parameter U02		
P103	Drive Programming User Parameter U03		
P104	Drive Programming User Parameter U04		
P105	Drive Programming User Parameter U05		
P106	Drive Programming User Parameter U06		
P107	Drive Programming User Parameter U07		
P108	Drive Programming User Parameter U08		
P109	Drive Programming User Parameter U09		
P110	Drive Programming User Parameter U10		
P111	Drive Programming User Parameter U11		
P112	Drive Programming User Parameter U12		
P113	Drive Programming User Parameter U13		

Parameter No.	Function name	Data	Description
P114	Drive Programming User Parameter U14	0 to 65,535	• These user parameters correspond to the function variables U(00) to U(28). • You can change the data by using the Digital Operator. The changed data is saved in the EEPROM. • The set data will be saved in the EEPROM when the Write to EEPROM command is executed in the Drive Programming.
P115	Drive Programming User Parameter U15		
P116	Drive Programming User Parameter U16		
P117	Drive Programming User Parameter U17		
P118	Drive Programming User Parameter U18		
P119	Drive Programming User Parameter U19		
P120	Drive Programming User Parameter U20		
P121	Drive Programming User Parameter U21		
P122	Drive Programming User Parameter U22		
P123	Drive Programming User Parameter U23		
P124	Drive Programming User Parameter U24		
P125	Drive Programming User Parameter U25		
P126	Drive Programming User Parameter U26		
P127	Drive Programming User Parameter U27		
P128	Drive Programming User Parameter U28		
P129	Drive Programming User Parameter U29		
P130	Drive Programming User Parameter U30		
P131	Drive Programming User Parameter U31		

3-3 Program Structure

In the Drive Programming for 3G3MX2/3G3RX Series Inverter, you can create a maximum of five tasks.

The created tasks are processed in parallel.

By dividing one application into several processes and allocating them to multiple tasks, you can adjust execution condition, execution order, etc. for each process. Furthermore, parallel task processing can provide shorter processing time.

3-3-1 Tasks

Task is a unit of program executed in the Drive Programming.

For 3G3MX2/3G3RX Series Inverter, you can create a program which consists of up to five tasks.

- All tasks are started simultaneously.
- In the order of task from 1 to 5, one command of each task (one line of the "program after compilation") is executed in 2-ms processing time.
- All function variables such as user parameters are shared among the tasks. For transmission of information between tasks, use the user parameters, internal user contacts, etc.
- At the end of 2-ms processing time, the operation result of each task is reflected to the inverter operation, external output, etc. At the same time, the status of the inverter and external input terminals, etc. are read in.
- When the "end" command is executed, the task is completed and waits for the next start.

3-3-2 Subroutines

Subroutine is a separated program processing executed only when it is called.

Subroutines are useful to organize your program into parts that you can execute multiple times in the same task or reuse in other programs.

In the Drive Programming, it is necessary to insert subroutines into each task. They cannot be shared among the tasks.

It is possible to call a subroutine from another subroutine (nesting).

However, the maximum nesting of subroutines is eight levels.

3-3-3 Task Processing

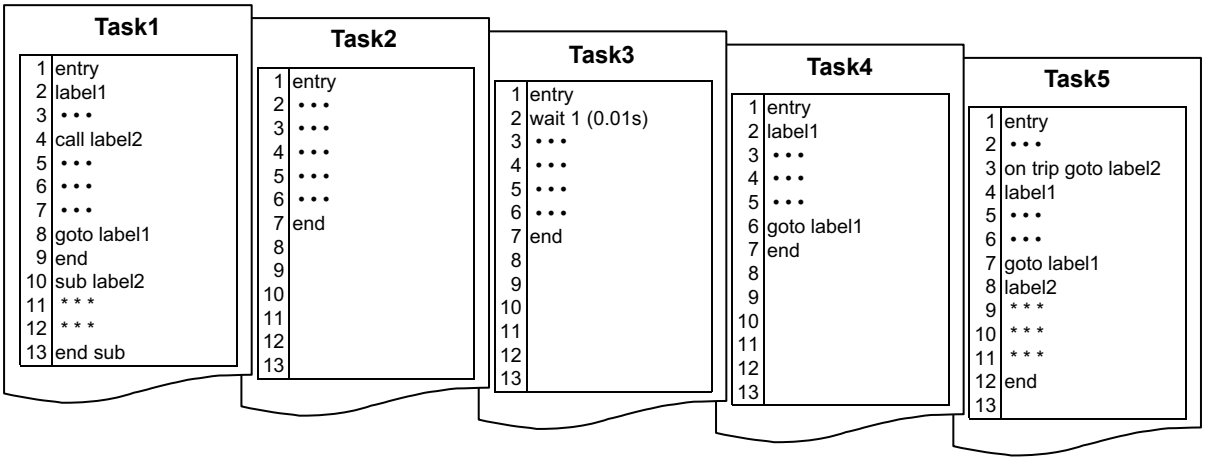
UP to five tasks are started simultaneously, and one command of each task (one line of the "program after compilation") is executed in 2-ms processing time. The following figure Programs After Compilation (Example) shows the flow of the program processing.

- All tasks are started simultaneously.
- In the order of task from 1 to 5, one command of each task (one line of the "program after compilation") is executed in 2-ms processing time.
- All function variables such as user parameters are shared among the tasks.
- At the end of 2-ms processing time, the operation result of each task is reflected to the inverter operation, external output, etc. At the same time, the status of the inverter and external input terminals, etc. are read in.
- As shown in Task 1, if a subroutine is called by the “call” command, the statement of the subroutine will be executed from the next step of processing.

- As shown in Task 2, if the “end” command is executed, the task will be finished and wait for the next start.
- As shown in Task 3, if the “wait” command is executed, the task will be repeatedly executed until a certain condition is met.
- As shown in Task 4, if you create a loop by using the “goto” command, the task process will be continuously repeated.
- As shown in Task 5, if the “on trip goto” command is executed once, the processing data will be stored in the inverter.

  The program jumps to the “goto” destination immediately after a trip occurred.

● Programs After Compilation (Example)



● Program Processing Flow

Processing time [ms]	Task1 Line No.	Task1	Task2 Line No.	Task2	Task3 Line No.	Task3	Task4 Line No.	Task4	Task5 Line No.	Task5
2	1	entry	1	entry	1	entry	1	entry	1	entry
4	2	label1	2	- - -	2	wait 1 (0.01s)	2	label1	2	- - -
6	3	- - -	3	- - -	2	wait 1 (0.01s)	3	- - -	3	on trip goto label2
8	4	call label2	4	- - -	2	wait 1 (0.01s)	4	- - -	4	label1 [Trip occurred]
10	10	sub label2	5	- - -	2	wait 1 (0.01s)	5	- - -	5	label2
12	11	* * *	6	- - -	2	wait 1 (0.01s)	6	goto label1	6	* * *
14	12	* * *	7	end	3	- - -	2	label1	7	* * *
16	13	end sub			4	- - -	3	- - -	2	* * *
18	5	- - -			5	- - -	4	- - -	3	end
20	6	- - -			6	- - -	5	- - -	8	
22	7	- - -			7	end	6	goto label1	9	
24	8	goto label1					2	label1	10	
26	2	label1					3	- - -	11	
28	3	- - -					4	- - -	12	
30	4	call label2					5	- - -		
32	10	sub label2					6	goto label1		
34	11	* * *					2	label1		
36	12	* * *					3	- - -		
38	13	end sub					4	- - -		

Label2 is executed due to occurrence of an inverter trip.

Program Counter (d023) display

3-3-4 Drive Programming Start/Stop and Task Operation

You set the start/stop method of the Drive Programming programs in the Drive Programming Function Selection (A017).

● Start

- When the Drive Programming Function Selection (A017) is set to 01 (Enabled: Start/stop via multi-function input PRG terminal):

  The program starts when the multi-function input terminal set to PRG is turned ON.
- When the Drive Programming Function Selection (A017) is set to 02 (Enabled: Start/stop at power on/off):

  The program starts when the power supply for the inverter is turned ON.

● Stop

- When the Drive Programming Function Selection (A017) is set to 01 (Enabled: Start/stop via multi-function input PRG terminal):

  The program stops when the multi-function input terminal set to PRG is turned OFF.
- When the Drive Programming Function Selection (A017) is set to 02 (Enabled: Start/stop at power on/off):

  The program stops when the power supply for the inverter is turned OFF.

Also, regardless of the A017 setting, the Drive Programming program stops if any of E43 to E45 trips is detected due to a program error, or when the “end” command is executed in all tasks.

Precautions for Safe Use

When the Drive Programming program is stopped, the status before the program stop is retained for multi-function outputs controlled by the Drive Programming

For this reason, configure the system so that the stop of the Drive Programming program in the inverter can be detected by the Drive Programming start signal and the alarm (trip) signal, and the inverter's peripheral devices can be stopped safely.

Precautions for Correct Use

The following are the status of function variables when the Drive Programming program is stopped. Take necessary measures in consideration of each status.

- For the multi-function outputs (the inverter's actual output terminals), the status before the program stop is retained.

  However, the output terminals that are not set to MO1 to MO6 (general-purpose outputs of the Drive Programming) operate as the inverter's normal multi-function outputs.
- When the Drive Programming function is selected for the frequency reference, acceleration/deceleration time or analog outputs, the set values for these functions before the program stop are retained.
- The data of the user parameter variables, internal user variables and internal user contacts before the program stop is retained.
- The status of the inverter's actual input terminals such as the multi-function and analog input terminals is not retained but always updated.
- The data of the multi-function output variables (function bits such as RUN, FA1 and AL) and inverter monitor variables is not retained but always updated according to the status of the inverter.
- Only the Drive Programming's multi-function input variables (function bits such as FW, RV and CF1) and timer variables are cleared at the same time as the program stop, and all data are changed to zero.

When the Drive Programming function is started/stopped through the CX-Drive, the value of the inverter parameter, Drive Programming Function Selection (A017) is temporarily changed to 02 (start) or 00 (stop) only in the RAM data.

Take the following measures after you started/stopped the Drive Programming function through the CX-Drive.

- Turn ON the power supply for the inverter again and return the value of A017 to that saved in the EEPROM.
- Do not perform the following EEPROM saving operations before you turn ON the power supply for the inverter.
  - Transferring (downloading) a part of parameters from the CX-Drive.
  - Issuing the “enter” command via the Modbus communication or a communication option.

When the Drive Programming program is started, five tasks are started simultaneously.

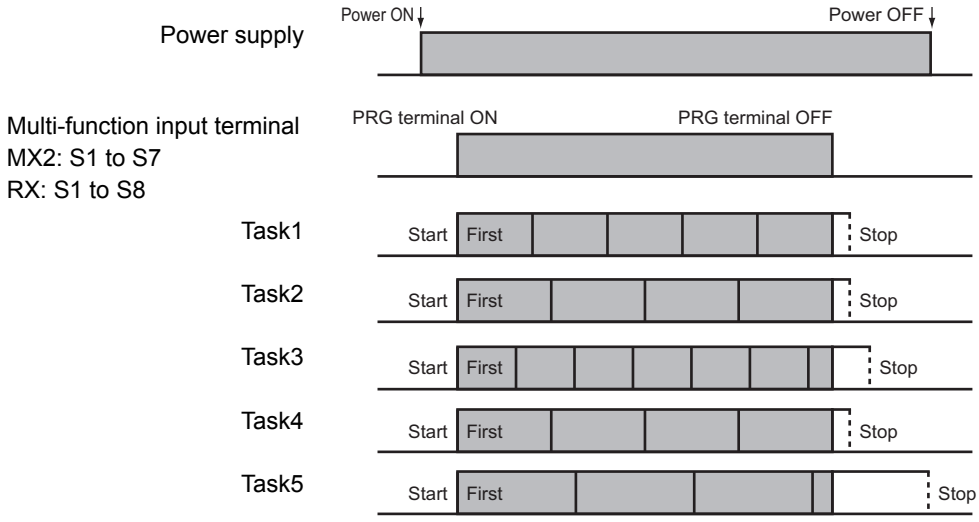
If you create a loop construction in a task by using commands such as the “goto”, the task will repeat the loop after it is started.

When the Drive Programming program is stopped, five tasks are stopped simultaneously.

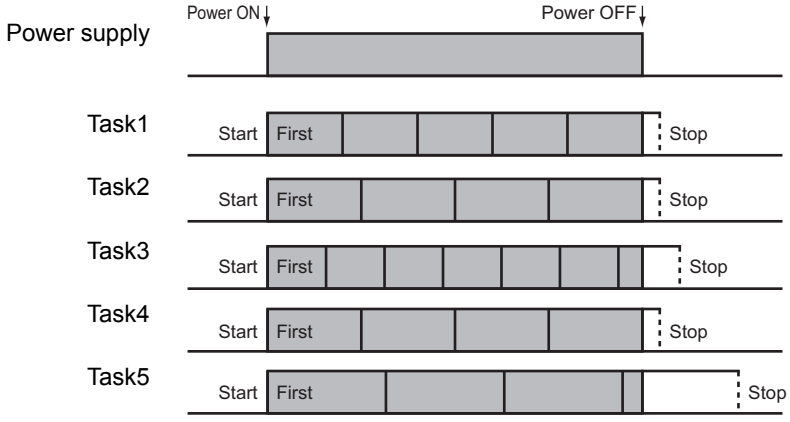
If the program is stopped while the Motor is running, the Motor will be stopped according to the setting for the Stop Selection (b091) (deceleration stop or free-run stop).

The task operations for different settings are shown below.

● When the Drive Programming Function Selection (A017) is set to 01 (Enabled):



● When the Drive Programming Function Selection (A017) is set to 02 (Enabled):



3-3-5 Drive Programming Restart

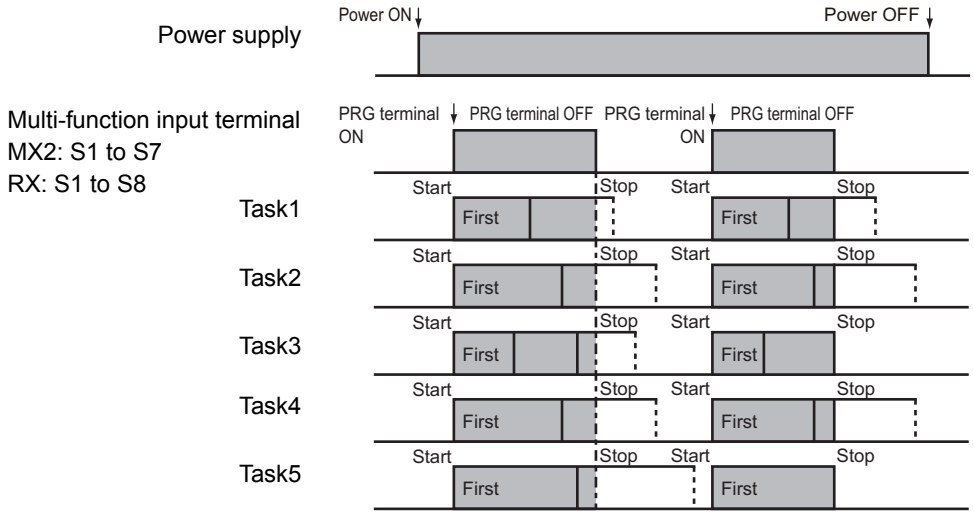
You can restart the stopped program by performing the following operations. When the program is restarted, all tasks are started simultaneously from the beginning.

- When the Drive Programming Function Selection (A017) is set to 01 (Enabled: Start/stop via multi-function input PRG terminal): a reset input via the control circuit terminal while the PRG terminal is ON, or turning ON the PRG terminal again.
- When the Drive Programming Function Selection (A017) is set to 02 (Enabled: Start/stop at power on/off): a reset input via the control circuit terminal, or turning ON the power supply for the inverter again.

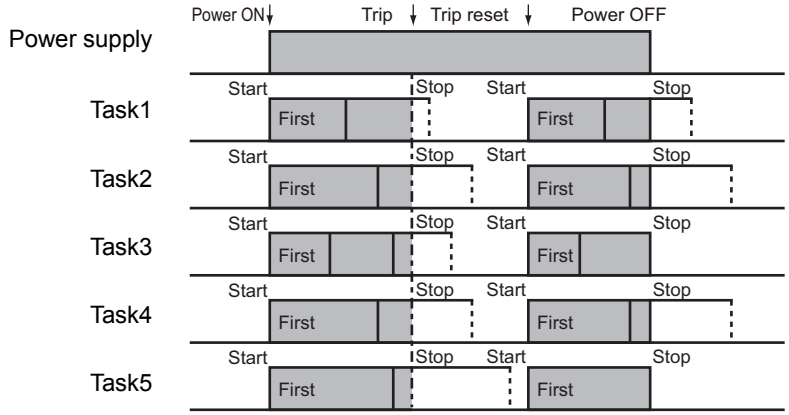
Precautions for Correct Use

- You cannot restart the Drive Programming by pressing the STOP/RESET key of the Digital Operator or the LCD Digital Operator (optional). Set one of the Multi-function input terminals (MX2: S1 to S7/RX: S1 to S8) to 18 (RS: Reset) and turn ON that terminal.
- To restart the Drive Programming by reset input, set the Reset Selection (C102) to the value other than 03 (Trip reset only). You cannot restart the Drive Programming when 03 (Trip reset only) is set.
- When the Reset Selection (C102) is set to 00 (Trip reset at power-on) or 01 (Trip reset at power-off), the Drive Programming can be restarted by a reset input even when there is no trip.

● Restart when the Drive Programming Function Selection (A017) is set to 01 (Enabled):



● Restart after trip when the Drive Programming Function Selection (A017) is set to 02 (Enabled) (without “on trip goto” command):



3-3-6 Task Operation on Trip

Basically, even if the inverter detects a trip during the Drive Programming operation, the operation is continued. However, if any of E43 to E45 trips related to the Drive Programming is detected, the operation is stopped.

Or, with the “on trip goto” command, the program can jump to other process after a trip occurred.

With/without “on trip goto”	Error status		
	User trip E50 to E59	Drive Programming related trip E43 to E45	Other trips
Without	Operation is continued.	Program is stopped.	Operation is continued.
With	After the “on trip goto” command is executed, the program jumps to the specified label and the operation is continued.	Program is stopped.	After the “on trip goto” command is executed, the program jumps to the specified label and the operation is continued.

For details on the trips E43 to E59, refer to *Section 8 Errors and Remedies*.

4

Drive Programming Editor

This section describes how to start the Drive Programming Editor, saving and loading data, and details on parts of the Editor.

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4-1 Starting Drive Programming Editor

To create Drive Programming programs, you use the Drive Programming Editor in the support tool for the Inverter/Servomotor, CX-Drive.

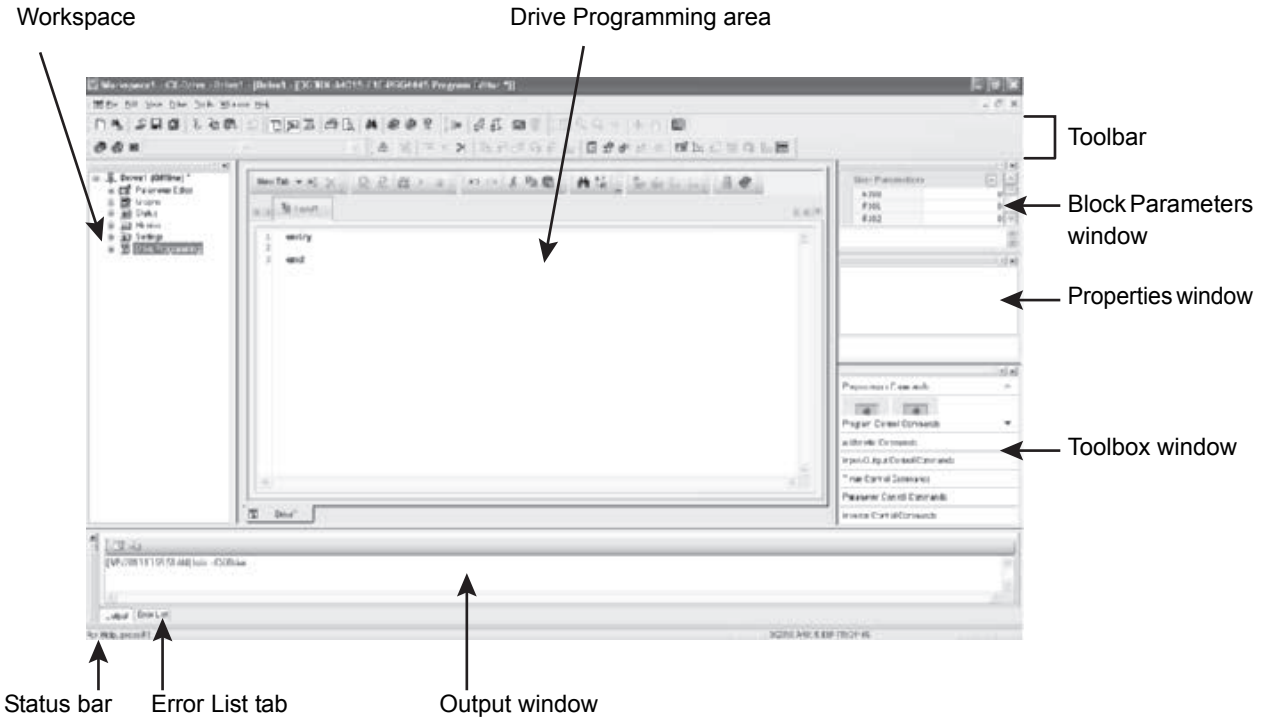
This section explains the configuration of the Drive Programming Editor in the CX-Drive and the operations you carry out before starting the Drive Programming Editor.

Precautions for Correct Use

- The Drive Programming function is included in the following or higher versions of the CX-Drive.
  If the version of your CX-Drive is lower, you need to upgrade the version.
  MX2: Version 2.8 or higher (with version 2.7 or lower, operation is not possible.)
  RX: Version 2.7 or higher (with version 2.6 or lower, operation is not possible.)
- A password is required when you start the Drive Programming Editor in the CX-Drive for the first time.
  Please contact your OMRON representative.

CX-Drive and Drive Programming Editor Screen Layout

The Drive Programming Editor is included as one of the functions of the support tool for the Inverter/Servomotor, CX-Drive. When the Drive Programming Editor is started, the screen layout of the CX-Drive will be changed as shown below.



Starting CX-Drive

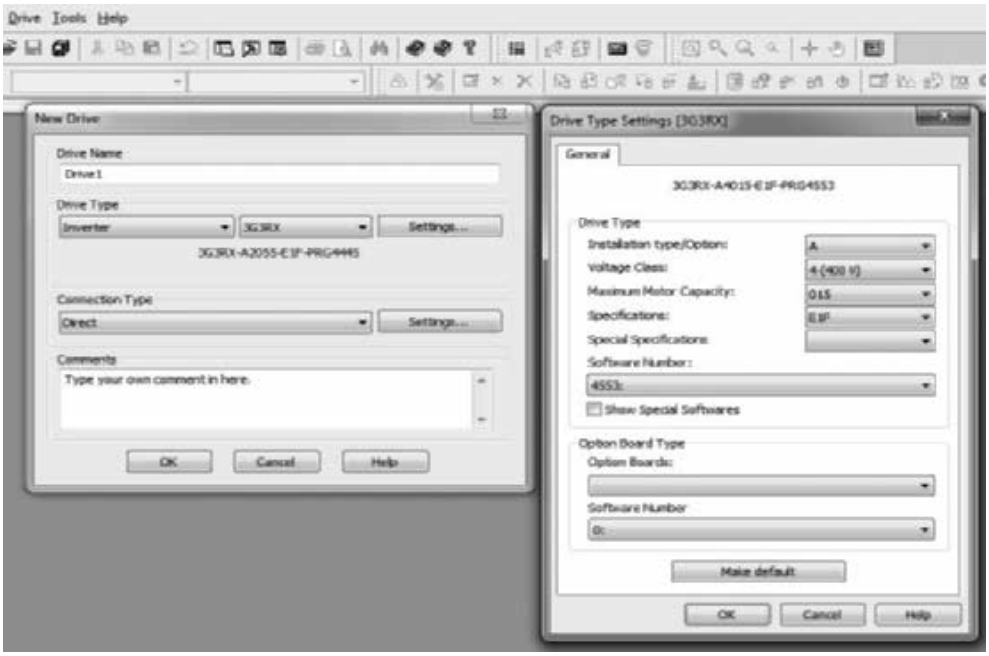
Use the following method to start the CX-Drive: from the Windows [Start] Menu, select [All Programs] - [OMRON] - [CX-One] - [CX-Drive]. Click the CX-Drive icon in the CX-Drive folder.

After the CX-Drive is started, select [File] from the CX-Drive Menu and click [New] to create a new CX-Drive file. The [New Drive] dialog box will appear.

Select 3G3MX2 or 3G3RX series from the pull-down list under the [Drive Type]. Click the [Settings] button to the right.

In the [Drive Type Settings] dialog box, set [Installation Type/Option], [Voltage Class], and [Maximum Motor Capacity].

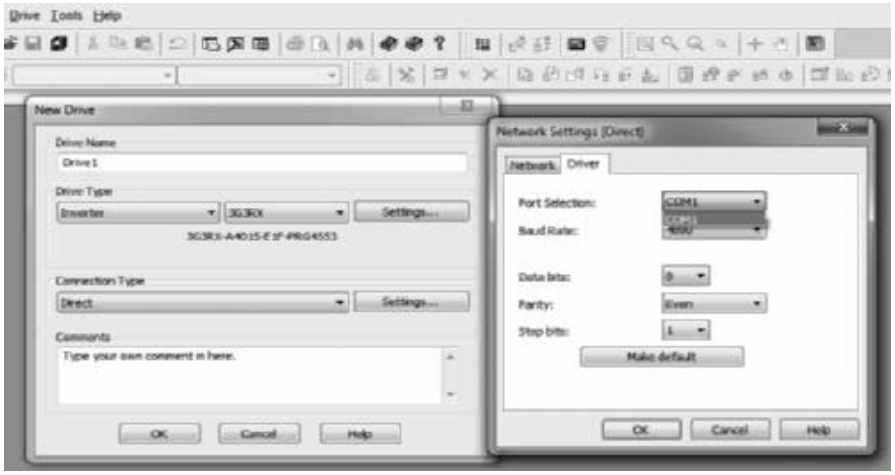
After setting these items, click the [OK] button to close the [Drive Type Settings] dialog box.



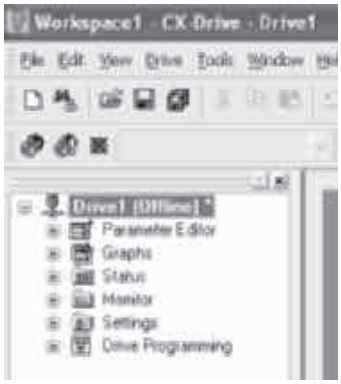
In the [New Drive] dialog box, you set the connection type for the CX-Drive and the inverter.

Under the [Connection Type], select [Direct] and click the [Settings] button to the right.

On the [Driver] tab page, set the [Port Selection] to the port name of the computer on which the CX-Drive is installed.



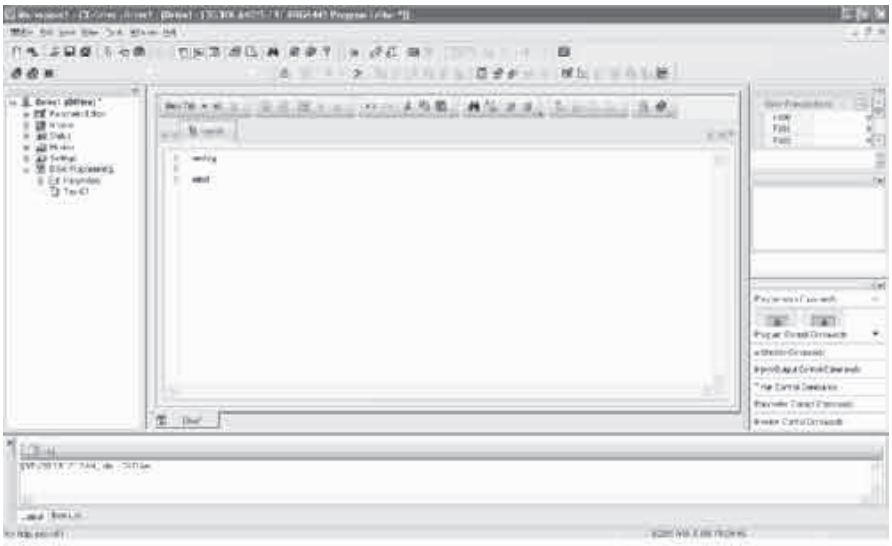
After setting these items, click the [OK] button and close all dialog boxes. The new project is registered in the workspace.



Starting Drive Programming Editor

There are three ways to display the Drive Programming Editor:

- Double click the [Drive Programming] in the workspace.
- Click button on the CX-Drive toolbar.
- From the [Drive] Menu, select [Program] - [Program Editor].



Precautions for Correct Use

To start the Drive Programming Editor for the first time after you started the CX-Drive, a password is required.

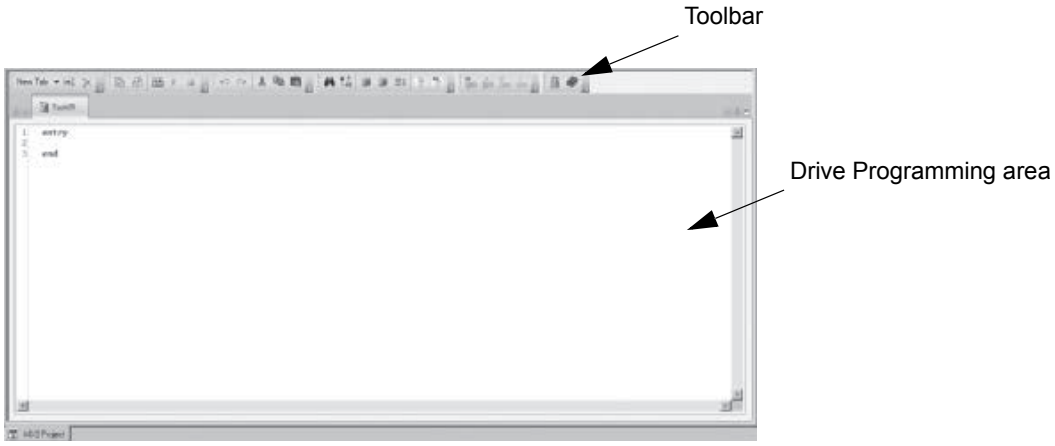
Please contact with your sales representative to request the access code, and enter it in the following dialog box.

4-2 Parts of Drive Programming Editor

This section provides the detailed information on each function of the Editor and windows related to the Drive Programming in the CX-Drive.

4-2-1 Drive Programming Editor

The Drive Programming Editor is the main widow for the Drive Programming function.



This window consists of the toolbar in which common commands are included and the Drive Programming area in which the program is displayed as text or flowchart.

4-2-2 Toolbar

The Drive Programming Editor provides the following commands:

● Common commands

Command	Icon	Description
New Task (flowchart)		Creates a new flowchart task for the program. Task is a unit of program executed in the Drive Programming.
New Task (text)		Creates a new text task for the program. Task is a unit of program executed in the Drive Programming.
New Subroutine (flowchart)		Creates a new flowchart subroutine. A subroutine is a part of the program which is executed only when it is called.
New Subroutine (text)		Creates a new text subroutine. A subroutine is a part of the program which is executed only when it is called.
Rename Current Task		Renames the current task or subroutine.
Delete Current Task		Deletes the current task or subroutine.
Undo		Undoes the latest change.
Redo		Redoes the undone operation.

Command	Icon	Description
Transfer to Drive		Compiles the program and, if there are no errors, transfers (downloads) it to the drive (inverter).
Transfer from Drive		Transfers (uploads) the program from the drive (inverter) to the Drive Programming Editor.
Compile		Compiles the program in the Drive Programming area. Compile errors and warnings that occurred in the program will be displayed on the Error List tab page in the Output window.
Start		Starts the program in the inverter. The CX-Drive will first compare the program in the inverter with the program in the Drive Programming area. The program will be started only when they are the same. If they differ, the program will not be started. This starting method for the program is enabled only when the CX-Drive is connected. To start the program with a stand-alone inverter, be sure to set the Drive Programming Function Selection (A017).
Stop		Stops the program in the inverter. This operation is performed independently of the program on the Drive Programming area in the CX-Drive.
Set Program Number		Sets a program number from 0 to 9,999. After the program is transferred (downloaded) to the drive (inverter), the program number is updated and you can see that by the Program Number Monitor (Drive Programming) (d024).
Set Password		Enables to set, change or delete the program password.
Help		Displays the CX-Drive help.

● Commands for the flowchart program

Command	Icon	Description
Zoom in		Increases the zoom level.
Zoom out		Decreases the zoom level.
Zoom Reset		Restores the zoom to its initial value.
Select Mode		Selects one or more blocks[*1] of the program by dragging with the mouse cursor.
Pan Mode		By dragging, moves the field of the view in any direction while keeping the same scale.
Horizontal Align Left		Aligns horizontally the left sides of the currently selected blocks[*1].
Horizontal Align Middle		Aligns horizontally the middles of the currently selected blocks[*1].
Horizontal Align Right		Aligns horizontally the right sides of the currently selected blocks[*1].
Vertical Align Top		Aligns vertically the top sides of the currently selected blocks[*1].
Vertical Align Middle		Aligns vertically the middles of the currently selected blocks[*1].

Command	Icon	Description
Vertical Align Bottom		Aligns vertically the bottoms of the currently selected blocks[*1].
Orientation		Selects an orientation for connecting the blocks[*1].
Auto-arrange		Arranges the blocks[*1] of the flowchart automatically in the currently selected orientation.
Show Contacts		Switches display/hide of the contacts of the blocks[*1].
Show		Enables to select a display style of the program from options below. • Text only • Icon only • Icon and text • Name, icon and arguments

*1. A unit of display on the flowchart is called "Block". A block consists of a command, or a command and a label attached to the command.

● Commands for the text program

Command	Icon	Description
Find		Looks for a text in the Drive Programming Editor.
Replace		Replaces a text in the Drive Programming Editor.
Increment Indentation		Increases the indentation of the selected text.
Decrement Indentation		Decreases the indentation of the selected text.
Format selected text		Formats automatically the selected text.
Comment selected text		Transforms the selected lines of text to comments.
Uncomment selected text		Uncomments the selected lines of text.

● Program conversion

You can convert a flowchart program to a text program, and vice versa.

When a conversion is performed, the program is once compiled. Note that if a compilation error occurs, the conversion will not be completed.

Also, comments, alias definition, region definition, etc. are deleted when a compilation is performed for conversion. The operation does not change, however, the forms and contents of the program are partially changed.

Command	Icon	Description
Convert Text to Flowchart		Converts current text task/subroutine to flowchart.
Convert whole program to Flowchart		Converts whole program to flowchart.

Command	Icon	Description
Convert Flowchart to Text		Converts current flowchart task/subroutine to text.
Convert whole program to Text		Converts whole program to text.

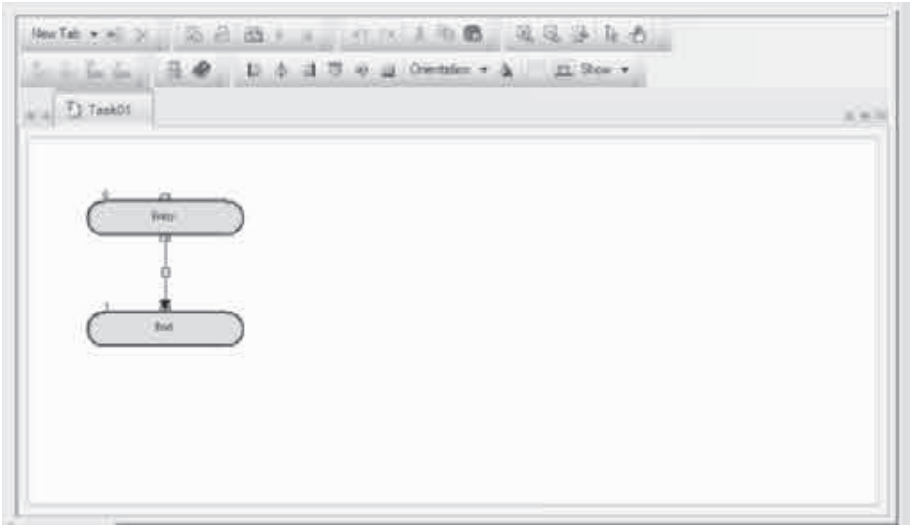
● Shortcut keys

You can use the following keyboard shortcuts in the Drive Programming area.

Shortcut	Description
Ctrl + X	Cut
Ctrl + C	Copy
Ctrl + V	Paste
Ctrl + Z	Undo
Ctrl + Y	Redo
Ctrl + A	Select all
Ctrl + F	Find and replace
Ctrl + space	Command list
Tab	Select next (flowchart only)
Arrow Keys	Move selected block
Home	Scroll to top (flowchart only)
End	Scroll to bottom (flowchart only)
Page Up	Move the cursor to line head
Page Down	Move the cursor to end of the line
+	Zoom in
−	Zoom out

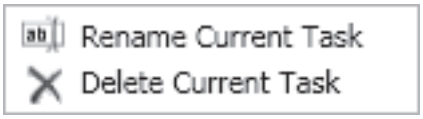
4-2-3 Drive Programming Area

The Drive Programming area displays the current design of the program.



This area may have different pages, organized in tabs. Each tab is either a task or a subroutine in flowchart or text.

By right-clicking the tab title, you can delete or rename a task or a subroutine.



Flowchart Program

In the flowchart program method, a unit of display is called "Block".

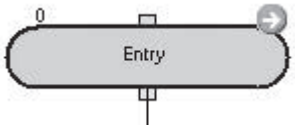
You create a program by placing more than one block in the area and setting interaction between them.

In a flowchart program, when a program is compiled successfully, an icon with a white arrow in a green circle highlights the starting point of each flowchart task.

Also, after the program is compiled successfully, the block number will appear on the upper left of each block.

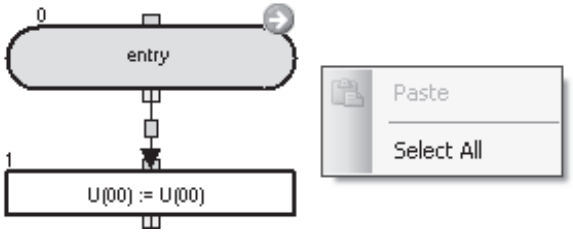
Block numbers are the consecutive numbers starting with "0". A block number is given to each block of the whole program.

The numbers do not match the line numbers of the program converted to text.

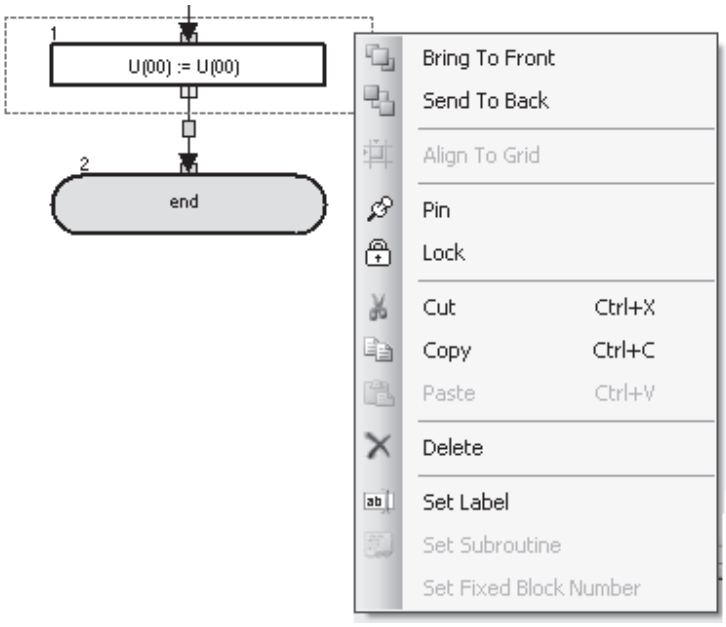


The Output window will indicate if the program is compiled successfully. For programs compiled with errors, a red icon with an exclamation mark identifies the erroneous blocks in the flowchart program. Placing the mouse on the error icon displays the compile error, which you can see in the Error List in the Output window.

If you right-click on a blank area in the flowchart, a popup menu will be displayed. It allows you to paste blocks that you copied last, or to select all the blocks.



If you right-click on a flowchart block, a popup menu with more options will appear.



The following table shows the menu commands available in the flowchart program.

Command	Description
[Bring To Front]	Places the selected block graphically in front of other blocks.
[Send To Back]	Places the selected block graphically in back of other blocks.
[Pin]	Fixes the selected block to its current position in the graph. It will not be moved in drag operations.
[Lock]	Acts like [Pin] and, besides, sets the properties of the block as read-only.
[Cut]	Deletes the selected block and saves it in the clipboard, for further pasting.
[Copy]	Saves the selected block in the clipboard, for further pasting.
[Paste]	Puts the contents previously copied in the clipboard into the design area. Note that you can also paste them as images in other applications.
[Set Label]	Sets the label name for the selected block.
[Set Subroutine]	Sets the subroutine name for the selected block. This menu command is available only for blocks for which you can set subroutines.

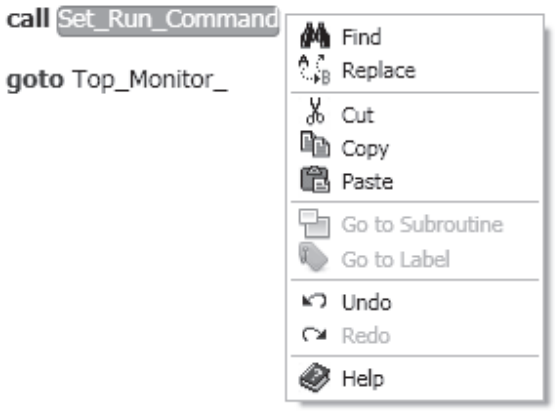
Text Program

In the text program method, you create a program by using text language.

For text programs that were not compiled successfully, the program errors will be displayed in the Output window. The statement with errors will be highlighted with a red line.

```
Dummy_UL01 := A038
```

Right-click the selected text to display a popup menu.



The following table shows the menu commands available in the text program.

Command	Description
[Find]	Looks for the selected text on the program code.
[Replace]	Replaces the selected text on the program code.
[Cut]	Deletes the selected text and saves it in the clipboard, for further pasting.
[Copy]	Saves the selected text in the clipboard, for further pasting.
[Paste]	Puts the contents previously copied in the clipboard into the design area. Note that you can also paste them as images in other applications.
[Go to Subroutine]	Jumps to the selected text subroutine.
[Go to Label]	Jumps to the selected text label.
[Undo]	Undoes the latest change.
[Redo]	Redoes the undone operation.
[Help]	Displays the CX-Drive help.

4-2-4 Toolbox Window

The Toolbox window allows you to add blocks to the Drive Programming area by drag and drop. It displays the blocks supported for a particular command, organized in categories.

The Toolbox is displayed when the Drive Programming Editor is started. You can also show or hide it by clicking [Drive Programming] - [Toolbox] in the [View] Menu.

The Toolbox window is displayed by default at the right side of the CX-Drive.

You can separate the window by double-clicking the title bar (wide frame of the window).

You can also select its display style by right-clicking on it with the mouse. Three styles are available: large icons, small icons, and list. In any style, a short help text will be shown when you place the mouse cursor on a block.

Click on any category title to display the blocks which belong to that category.

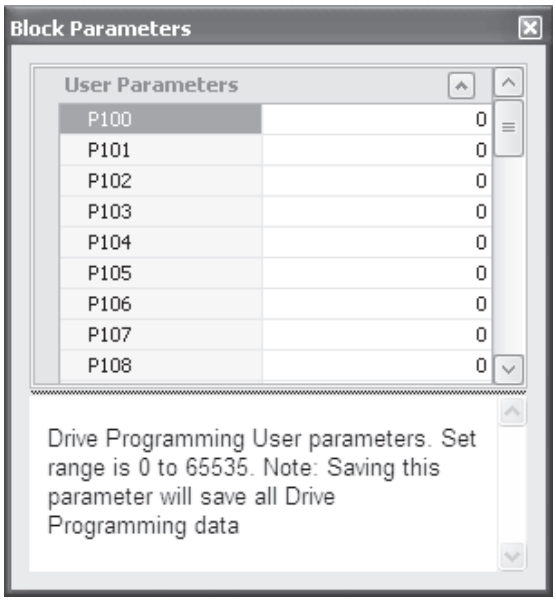
4-2-5 Block Parameters Window

The Block Parameters window allows you to edit Drive Programming user parameters which act as variables of the program. The displayed parameters are organized in categories.

The Block Parameters is displayed when the Drive Programming Editor is started. You can also show or hide it by clicking [Drive Programming] - [Block Parameters] in the [View] Menu.

The Block Parameters window is displayed by default at the right side of the CX-Drive.

You can separate the window by double-clicking the title bar (wide frame of the window).



To change the value of a parameter, place the cursor at its row and click on the edition box to the right of its number. Enter the new value. A warning will be displayed if the entered value exceeds the valid range.

At the lower part of the window, a help text for the user parameters is displayed.

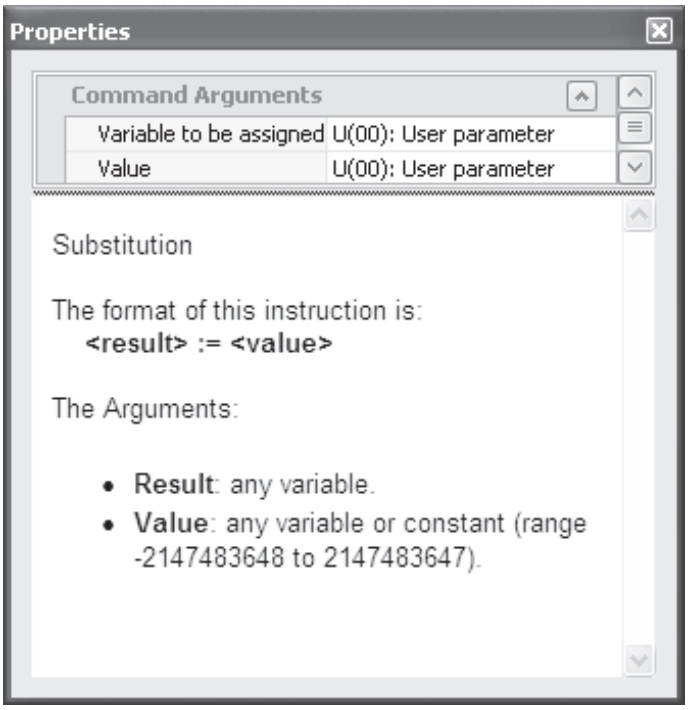
4-2-6 Properties Window

The Properties window allows you to edit the properties of the block which is currently selected in the flowchart program.

The Properties is displayed when the Drive Programming Editor is started. You can also show or hide it by clicking [Drive Programming] - [Properties] in the [View] Menu.

The Properties window is displayed by default at the right side of the CX-Drive.

You can separate the window by double-clicking the title bar (wide frame of the window).



To change one block command argument, select the block in the flowchart and place the cursor on the section where you want to edit in the Properties window.

- If the block argument has options, click on the current value to display icon at the rightmost side. Click or double-click the current value to unfold the available options in the pulldown menu.
- If the block argument does not have options, click its current value and enter the new one to change the value. A warning will be displayed if the entered value exceeds the valid range.
- If the block argument can have both an option and a custom value, you can set a value directly by clicking the current value. Also, double-clicking the current value will unfold the available options in the pulldown menu.

4-2-7 Error List Tab in Output Window

The list of errors related to the Drive Programming is displayed when you click the Error List tab in the Output window.

The error list shows the compilation errors and warnings of the program currently created with the Drive Programming Editor after it is compiled.

If any compilation errors is shown, the program is not correctly compiled.

In this case, transferring to the inverter or converting between flowchart and text is not performed.

Even in the case of successful compilation, warnings may be displayed to show points to correct in the program.

The error list is updated automatically every time a compilation is completed, and fixed errors and warnings are cleared.

The Output window is displayed by default at the bottom of the CX-Drive.

You can separate the window by double-clicking the title bar (wide frame of the window).

[Errors] button switches the display of errors in the list.

[Warnings] button switches the display of warnings in the list.

[Messages] button switches the display of informative messages in the list.

The messages in the list contain the following information:

Information	Description
Date	Shows the date and time when the error occurred.
Component	Identifies the block with an error.
Name	Shows names or descriptions of the error or warning message.

4-3 Adding, Deleting and Renaming Tasks

The Drive Programming Editor will display an empty task by default when it is started from the CX-Drive.

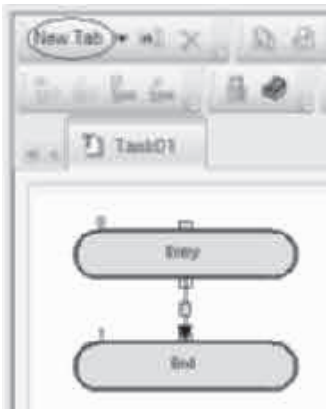
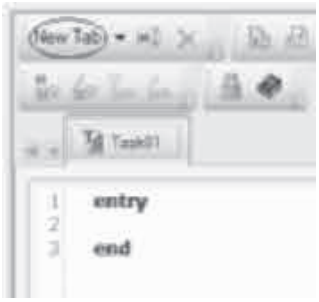
To add a new task, select [New Tab] in the toolbar of the Drive Programming Editor,

and select [New Task (flowchart)] or [New Task (text)].

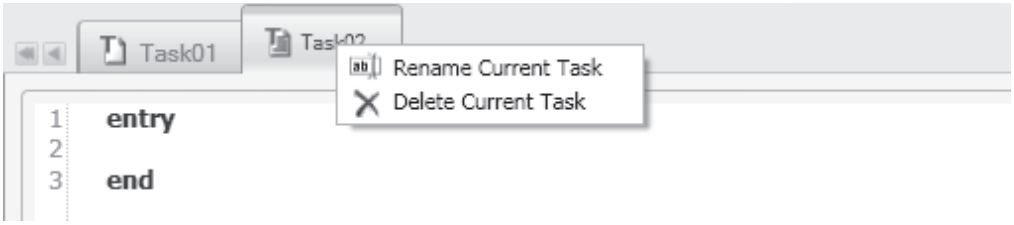
A new task appears on the Drive Programming Editor.

Among the displayed tasks, the task which is closer to the leftmost side takes higher priority in processing in a 2-ms period.

All tasks must begin with "entry" command, and finish with "end" command.

Flowchart	Text
	

You can delete or rename the selected task by right-clicking on its tab in the Drive Programming Editor.



4-4 Inserting, Deleting and Calling Subroutines

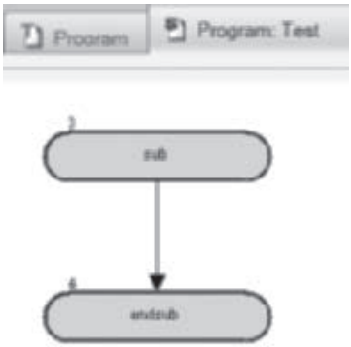
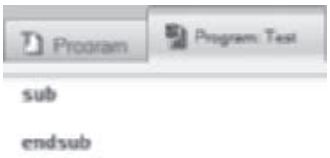
To insert a subroutine, select the tab of the task in which you want to insert a subroutine, and select [New Tab] - [New Subroutine (flowchart)] or [New Subroutine (text)] in the toolbar of the Drive Programming Editor.

A new subroutine appears on the Drive Programming Editor.

Similar to tasks, you can delete or rename a subroutine by right-clicking on its tab.

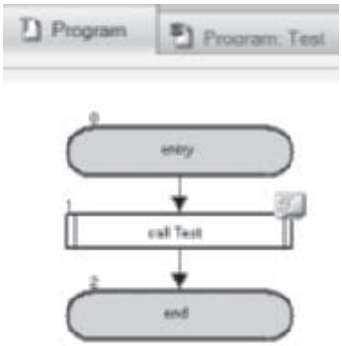
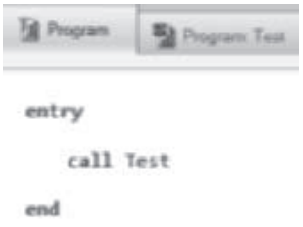
The subroutine name is displayed as "Task name: Subroutine name", next to the task name to which the subroutine belongs.

All subroutines must begin with "sub" command, and finish with "endsub" command.

Flowchart	Text
	

To execute a subroutine, specify the subroutine name in the "call" command.

It is only possible to call a subroutine that belongs to the task. Tasks cannot share the same subroutine. To use a subroutine with multiple tasks, insert the same subroutine in each task.

Flowchart	Text
	

4-5 Creating Flowchart Programs

When you create a Drive Programming program, you can select flowchart or text for each task or subroutine.

Follow the steps described below to create a flowchart program.

1 Open the Drive Programming Editor.

The Drive Programming auxiliary windows (Toolbox, Block Parameters, Properties and Error List tab) are displayed automatically.

2 From [New Tab] in the toolbar, select [New Task (flowchart)] or [New Subroutine (flowchart)].

3 Select commands from the Toolbox window and move them to the Drive Programming Editor by drag-and-drop.

On the upper left of each block placed on the Editor, the block number will appear after the compilation is finished.

Block numbers are the consecutive numbers starting with "0". A block number is given to each block of the whole program.

Block numbers do not match the line numbers of the program converted to text.

4 Click the block to edit its properties.

In the Properties window, edit arguments that are associated with the block.

5 Connect the blocks according to the program sequence.

You can connect a block with another by dragging from one's orange-colored contact to another's green-colored contact.

6 Edit user parameters in the Block Parameters window.

7 Perform operations such as program compilation, transferring to the inverter, and data saving.

Execute compilation and check for any compilation errors in the program.

You can transfer the program to the inverter when the compilation is finished successfully.

To save the program, save the whole project. Or, you can save the program separately by using the function that exports programs.

4-6 Creating Text Programs

When you create a Drive Programming program, you can select flowchart or text for each task or subroutine.

Follow the steps described below to create a text program.

1 Open the Drive Programming Editor.

The Drive Programming auxiliary windows (Toolbox, Block Parameters, Properties and Error List tab) are displayed automatically.

2 From [New Tab] in the toolbar, select [New Task (text)] or [New Subroutine (text)].

3 There are three ways to edit text program codes:

- Manual typing
- Calling the text command list (Ctrl + space)
- Dragging and dropping commands from Toolbox window

4 Set arguments of each command.

The required arguments are displayed with a green background for the commands that are dragged and dropped from the Toolbox window and the commands selected from the text command list (Ctrl + space).

Set each argument to complete the command.

Each time you edit a command by manual typing, the popup support will appear to help you complete the command. For details on each command, refer to *Section 6 Drive Programming Commands*.

You need not care about unnecessary lines and spaces when creating a program because they will be deleted by program compilation.

5 Perform operations such as program compilation, transferring to the inverter, and data saving.

Execute compilation and check for any compilation errors in the program.

You can transfer the program to the inverter when the compilation is finished successfully.

To save the program, save the whole project. Or, you can save the program separately by using the function that exports programs.

4-7 Editing Transferred (Uploaded) Programs

You can edit the program which is transferred (uploaded) from the inverter.

Follow the steps described below to edit the program.

1 Open the Drive Programming Editor.

The Drive Programming auxiliary windows (Toolbox, Block Parameters and Properties) are displayed automatically.

2 Go online with the CX-Drive. From the Menu, select [Drive] - [Work Online]. Or, click the [Work Online] icon in the CX-Drive toolbar.

3 Click the [Transfer from Drive] icon in the toolbar of the Drive Programming Editor.

A program is transferred from the drive (inverter) and automatically displayed in the Drive Programming area of the Drive Programming Editor.

4 Edit the transferred (uploaded) program.

"Programs after compilation" are downloaded to the inverter.

Therefore, the transferred (uploaded) program will be displayed as a text program.

To display it as a flowchart program, click [Convert whole program to Flowchart] in the toolbar of the Drive Programming Editor and convert the program to flowchart.

5 Perform operations such as program compilation, transferring to the inverter, and data saving.

Execute compilation and check for any compilation errors in the program.

You can transfer the program to the inverter when the compilation is finished successfully.

To save the program, save the whole project. Or, you can save the program separately by using the function that exports programs.

When the Drive Programming programs exist, you can transfer them to/from the inverter by using [Transfer to Drive] or [Transfer from Drive] icon in the CX-Drive toolbar. In this case, you need to select "programs" when a message dialog appears and asks you whether to transfer the parameters, programs, or both.

4-8 Saving Programs

There are two ways to save programs created with the Drive Programming function as described below.

Select a way suitable for your purpose.

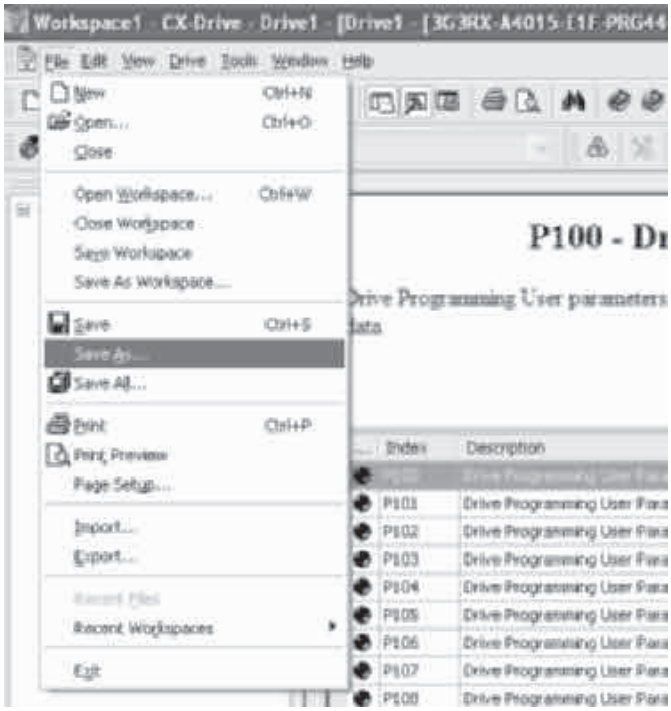
● Saving whole CX-Drive project

By saving the whole project created with the CX-Drive, you can save all drive data including the Drive Programming program.

Click [File] in the Menu bar, select [Save As] and enter the file name.

When a saved project is opened, the Drive Programming program included in the project is automatically loaded.

You can display the program by double-clicking the Drive Programming in the Workspace and start the Drive Programming Editor.

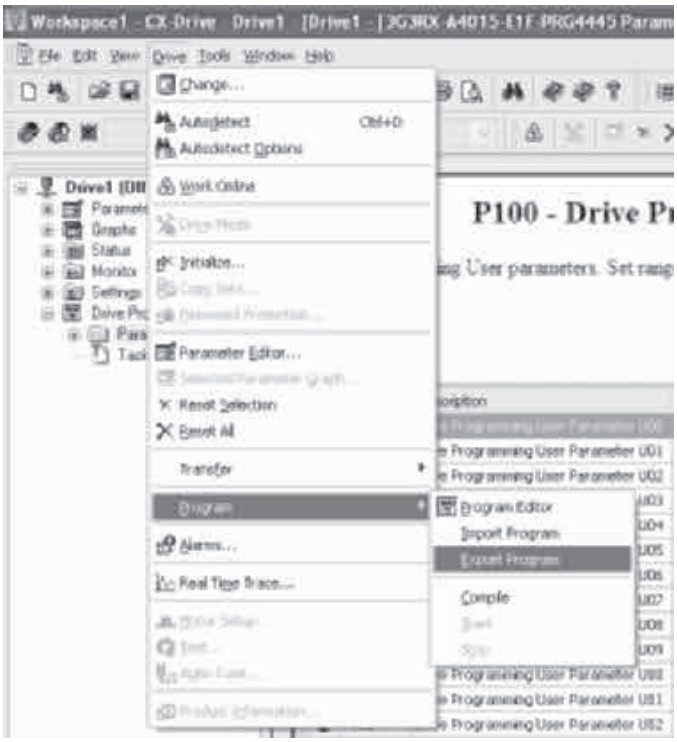


● Saving Dive Programming program by export

You can save a Drive Programming program separately.

Click [Drive] in the Menu bar, select [Program] - [Export Program] and enter the file name. CX-Drive separates the program from other drive information and saves the program only.

To import the exported program files into the CX-Drive, click [Drive] in the Menu bar, select [Program] - [Import Program] and select the file name.



4-9 Transferring and Verifying Programs

Program transfer and verification are possible between the inverter and the Drive Programming function of the CX-Drive. At the same time, you can also execute parameter transfer and verification.

Transfer (from PC to Inverter)

The created programs are compiled (program-checked) and transferred (downloaded) to the inverter if there is no error.

From the [Drive] Menu, select [Transfer]- [To Drive] to transfer (download) data.

Transfer (from Inverter to PC)

The programs and parameters in the inverter are transferred (uploaded) to the Drive Programming.

From the [Drive] Menu, select [Transfer]- [From Drive] to transfer (upload) data.

Verification (between PC and Inverter)

The Drive Programming programs and parameters are compared with the data in the inverter.

From the [Drive] Menu, select [Transfer] - [Compare with Drive] to execute verification.

Partial Transfer (from PC to Inverter)

From the [Drive] Menu, select [Transfer] - [Selection To Drive] to transfer (download) the selected data.

Partial Transfer (from Inverter to PC)

From the [Drive] Menu, select [Transfer] - [Selection From Drive] to transfer (upload) the selected data.

4-10 Executing Programs (Drive Programming Function Selection)

There are two ways to execute programs after you transferred (downloaded) them to the inverter as described below.

Executing Program via CX-Drive

Executing via CX-Drive is a convenient way to debug the created program.

Use icon in the toolbar of the Drive Programming Editor to start the program. To stop the program, use icon. Note that executing program via the CX-Drive is enabled only when the following conditions are met.

- When the CX-Drive is connected to the inverter.

  Once the program is started, it does not stop even if the CX-Drive is disconnected. Therefore, when executing the program, make sure that you can stop the inverter immediately by turning off the power supply, etc.
- When the program in the CX-Drive matches the program in the inverter through verification after compilation.
- The program stop is executed regardless of the program in the CX-Drive.

Executing Program in Applications

You execute the program by setting the inverter parameter, the Drive Programming Function Selection (A017).

Once the program reaches "end" command after a series of processes was completed, the program is not executed unless it is restarted.

To repeat the program, create a loop program so that the program does not reach “end” command.

If the Drive Programming function is stopped while the Motor is running, the Motor will be stopped according to the setting for the Stop Selection (b091) (deceleration stop or free-run stop).

Parameter No.	Function name	Data	Description
A017	Drive Programming Function Selection	00: Disabled (default setting)	Disables the Drive Programming function. Programs are not executed. If you change the setting to 00 (Disabled) during program execution, the program will be stopped.
		01: Enabled (Start/stop via multi-function input PRG terminal)	The Drive Programming program is started when the multi-function input terminal[*1] set to 82 (PRG) is turned ON.
		02: Enabled (Start/stop at power on/off)	Starts the Drive Programming program automatically after the inverter power supply is turned on. If you change the setting to 02 (Enabled) while the program is stopped, the program will be started.

Parameter No.	Function name	Data	Description
C001 to C007	MX2 and RX: Multi-function Input S1 to S7 Selection	82: PRG (Drive Programming start)	When the Drive Programming Function Selection (A017) is set to 01 (Enabled: Start/stop via multi-function input PRG terminal), the program is started via the multi-function input terminal with this setting.
C008	RX only: Multi-function Input S8 Selection		

*1. Multi-function input terminals for MX2 are S1 to S7, and for RX are S1 to S8.

Precautions for Safe Use

When execution of the Drive Programming program is stopped, the status before the program stop is retained for multi-function outputs controlled by the Drive Programming.

For this reason, configure the system so that the stop of the Drive Programming program in the inverter can be detected by the Drive Programming start signal and the alarm (trip) signal, and the inverter's peripheral devices can be stopped safely.

Precautions for Correct Use

The following are the status of function variables when the Drive Programming program is stopped. Take necessary measures in consideration of each status.

- For the multi-function outputs (the inverter's actual output terminals), the status before the program stop is retained.

  However, the output terminals that are not set to MO1 to MO6 (general-purpose outputs of the Drive Programming) operate as the inverter's normal multi-function outputs.
- When the Drive Programming function is selected for the frequency reference, acceleration/deceleration time or analog outputs, the set values for these functions before the program stop are retained.
- The data of the user parameter variables, internal user variables and internal user contacts before the program stop is retained.
- The status of the inverter's actual input terminals such as the multi-function and analog input terminals is not retained but always updated.
- The data of the multi-function output variables (function bits such as RUN, FA1 and AL) and inverter monitor variables is not retained but always updated according to the status of the inverter.
- Only the Drive Programming's multi-function input variables (function bits such as FW, RV and CF1) and timer variables are cleared at the same time as the program stop, and all data are changed to zero.

When the Drive Programming function is started/stopped through the CX-Drive, the value of the inverter parameter, Drive Programming Function Selection (A017) is temporarily changed to 02 (start) or 00 (stop) only in the RAM data.

Take the following measures after you started/stopped the Drive Programming function through the CX-Drive.

- Turn ON the power supply for the inverter again and return the value of A017 to that saved in the EEPROM.
- Do not perform the following EEPROM saving operations before you turn ON the power supply for the inverter.
  - Transferring (downloading) a part of parameters from the CX-Drive.
  - Issuing the "enter" command via the Modbus communication or a communication option.

When A017 is set to 02, stop the running program that was started at power ON before you restart the program via the CX-Drive.

If any program that was started at power ON is running, the CX-Drive cannot restart the program.

In the CX-Drive, if you click the button to start the program when inverter is already in operation, the following message will be displayed in the final step.

"The program is running, so it cannot be transferred to the drive."

If you click [OK] here, the program is started forcibly regardless of the operation status of the inverter.

Before you start the program, check the status of the equipment and ensure safety.

4-11 Other Useful Functions

Converting Flowchart to Text

There are two ways to convert flowchart programs to text programs.

Command	Icon	Description
Convert Flowchart to Text		Converts current flowchart task or subroutine to text.
Convert Whole Program to Text		Converts whole program to text.

Precautions for Correct Use

- When a flowchart program is converted to a text program, the program is once compiled. If a compilation error occurs, the conversion fails.
- On the upper left of each block in the flowchart program, the block number will appear after the compilation is finished.

  Block numbers are the consecutive numbers starting with "0". A block number is given to each block of the whole program.

  Block numbers do not match the line numbers of the program converted to text.

Converting Text to Flowchart

There are two ways to convert text programs to flowchart programs.

Command	Icon	Description
Convert Text to Flowchart		Converts current text task or subroutine to flowchart.
Convert Whole Program to Flowchart		Converts whole program to flowchart.

Precautions for Correct Use

- When a text program is converted to a flowchart program, the program is once compiled. If a compilation error occurs, the conversion fails.
- On the upper left of each block in the flowchart program, the block number will appear after the compilation is finished.

  Block numbers are the consecutive numbers starting with "0". A block number is given to each block of the whole program.

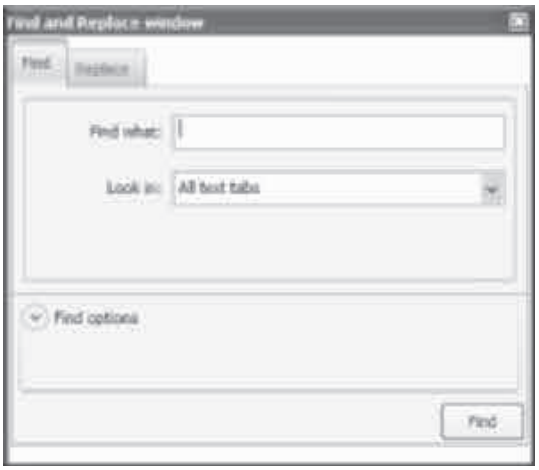
  Block numbers do not match the line numbers of the program converted to text.
- Comments, alias definition, region definition, etc. created in the text program are deleted when a compilation is performed for conversion. The operation does not change, however, the forms and contents of the program are partially changed.

Find and Replace Functions

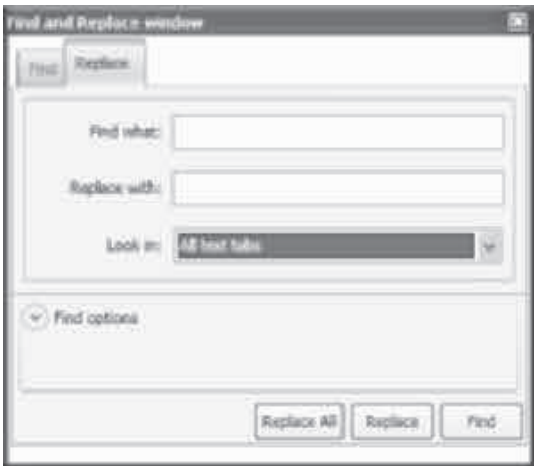
Find and replace functions are only available in text programs. You can look for or replace any character strings inside the text program by using the find and replace functions.

To use the Find function, click icon or press the shortcut keys Ctrl + F and select [Find] tab.

To use the Replace function, click icon or press the shortcut keys Ctrl + F and select [Replace] tab.



Find



Replace

Adding Comments (Text Program)

You can add comments to text tasks or subroutines. You cannot add comments to flowchart programs. To add a comment in a text line, type the comment after putting a ' (single quote) mark. Comments are displayed in green.

● Example

```
#alias global Time as U(10)              ' Timer time
#alias global AppTimer as TD(0)          ' Timer TD(0)
#alias global Temp as UL(05)             ' Internal use
```

Precautions for Correct Use

- The comments created in a text program are deleted when the program is transferred (downloaded) to the inverter or compiled for program conversion. To save the created comments, save the program before you execute program compilation. You can save the program by saving the whole project in the CX-Drive or export file of the program.
- In the verification process, the "program after compilation" is compared with the program inside the inverter. Therefore, the comments, alias definitions, region definitions, etc. are not verified.

Alias Definition (Text Program)

You can define aliases before the "entry" command in a task of the text program. You cannot define aliases in a subroutine or flowchart program.

Alias definition refers to specifying names for parameters, variables, commands and numeric constants.

By using the alias definition, you can handle these names specified in the program in the same way as parameters, variables, commands and numeric values. This is useful for enhancing program readability.

- **Local alias**: you can use this definition with currently selected task or subroutine. You cannot use it with other tasks or subroutines in the program. The format of the local alias definition in a task is shown below.

```
#alias local alias as replacement
```

● Example

```
#alias local ON_ as 1
#alias local OFF_ as 0
#alias local Monitor_1 as UMon(0)
#alias local MaxFrequency as A004
#alias local Count as U(00)
#alias local Dummy_1 as UL(00)

entry
```

- **Global alias**: you can use this definition with all tasks and subroutines in the program. You can set alias definitions in any of up to five tasks. The format of the global alias definition is shown below.

```
#alias global alias as replacement
```

● Example

```
#alias global const_100 as 100
#alias global Acceleration as F002
#alias global Deceleration as F003
#alias global Time as U(10)
#alias global AppTimer as TD(0)
#alias global Temp as UL(05)

entry
```

Precautions for Correct Use

- The alias definition created in the text program is deleted when the program is compiled for transferring (downloading) to the inverter or for program conversion. The specified names are converted to the normal names and numeric values. To save the created alias definition, save the program before you execute program compilation. You can save the program by saving the whole project in the CX-Drive or export file of the program.
- In the verification process, the "program after compilation" is compared with the program inside the inverter. Therefore, the comments, alias definitions, region definitions, etc. are not verified.
- For alias definitions, you cannot use the variables or commands that are already used. If you do this, a compile error will be displayed.

Region Definition (Text Program)

You can define regions in tasks or subroutines of the text program. You cannot define regions in flow-chart programs.

Region definition refers to dividing a program into groups of lines by specifying their areas.

By using the region definition, you can divide a program into parts and fold each of them in the display. This helps the program look easy to read.

● Example

```
#region Alias

#alias global const_100 as 100
#alias global Acceleration as F002
#alias global Deceleration as F003
#alias global Time as U(10)
#alias global AppTimer as TD(0)
#alias global Temp as UL(05)

#endregion

entry

#region Start

    Acceleration := const_100
    Deceleration := const_100
    Time := 500
    Temp := 10000
    set-freq := 1000
    Fw := 1

#endregion

#region Stop...
```

Precautions for Correct Use

- The region definition created in the text program is deleted when the program is compiled for transferring (downloading) to the inverter or for program conversion.

  To save the created region definition, save the program before you execute program compilation. You can save the program by saving the whole project in the CX-Drive or export file of the program.
- In the verification process, the "program after compilation" is compared with the program inside the inverter. Therefore, the comments, alias definitions, region definitions, etc. are not verified.

5

Drive Programming User Variables

This section describes the user variables provided for Drive Programming.

5-1 User Variables and User Parameters 5-2
5-2 Input/Output Terminal Variables 5-5
5-3 Timer Variables 5-10
5-4 Inverter Setting Variables 5-12
5-5 Inverter Monitor Variables 5-14
5-6 Multi-function Input Variables 5-17
5-7 Multi-function Output Variables 5-20

5-1 User Variables and User Parameters

The following variables are provided for creating programs: User parameter variables, internal user variables, and internal user contacts.

Use these variables for the program user interface, initial data for calculation, data saving during calculation, data saving, etc.

User Parameter Variables U(00) to U(31)

The Drive Programming user parameter variables U(00) to U(31) are the unsigned 1-word variables.

The Drive Programming user parameters U00 to U31 (P100 to 131) for the inverter correspond to the Drive Programming user parameter variables U(00) to U(31), respectively. Use these variables for the following applications.

Application	Description
User interface	Use the variables as parameters to adjust calculation results. You can adjust them using the inverter parameters (P100 to P131) according to the status of application.
Initial data for calculation	You can use the user parameter variables U(00) to U(31) as the variables for calculation. The data of parameters P100 to P131 saved in the EEPROM can be used as the initial data for calculation.
Data saving during calculation	You can use the variables for saving data temporarily while the calculation is in progress.
Data saving	By using the “eepwrt” command, you can store the calculation result in the EEPROM to save it after turning off the power supply. With the parameters U(29) to U(31), the calculation result is stored in the EEPROM automatically during power interruption of the inverter. The saved data can be used as the initial data when the power supply is turned on again.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
U(00) to U(31)	User parameter variable (corresponding to P100 to P131)	0 to 65,535	0	–	Unsigned 1 word	R/W

- The data of the parameters P100 to P131 saved in the EEPROM are automatically set to the user parameter variables U(00) to U(31) when the power is turned on.
- By monitoring the parameters P100 to P131, you can check the data of the user parameter variables U(00) to U(31) after the program execution is started. Note that the data displayed on the Digital Operator is the data at the moment when it is displayed. To update the data, once display the parameter number and then display the data again.
- When you change the parameters P100 to P131 by the Digital Operator and press the Enter key, the changed data is saved in the EEPROM and reflected in the current user parameter variables U(00) to U(31). The data saved in the EEPROM is set to the variables U(00) to U(31) automatically when the power supply is turned on again.
- Even if the data of the user parameter variables U(00) to U(31) is changed in the program, the changed data is not saved in the EEPROM for the parameters P100 to P131.
- To save in the EEPROM the data set to the user parameter variables U(00) to U(31) in the program, execute the “eepwrt” command and then the “ChgParam” command and specify the data you want to save. The data is saved in the EEPROM area that is allocated to the parameters P100 to P131.
- Only for the user parameter variables U(29) to U(31), the data is saved automatically during power interruptions. The data is saved in the EEPROM for the corresponding parameters P129 to P131. The data of the user parameter variables U(00) to U(28) is not saved during the power interruption.

Precautions for Correct Use

When the Drive Programming program is stopped, the data of the user parameter variables before the program stop is retained. When the program execution is started again, the process begins with the retained data.

Internal User Variables UL(00) to UL(07)

The Drive Programming's internal user variables UL(00) to UL(07) are the signed 2-word variables.

Use these variables for saving data during calculations such as four arithmetic operations.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
UL(00) to UL(07)	Internal user variable	–2,147,483,648 to 2,147,483,647	0	–	Signed 2 words	R/W

- The internal user variables UL(00) to UL(07) are cleared to zero when the power supply is turned on.
  Any data saving measure like EEPROM is not provided.
- To set initial data, create a program in which the initial data is set to UL(00) to UL(07).
- To move the upper word data of the internal user variables UL(00) to UL(07) to the 1-word size user parameter variables U(00) to U(31), use the following operation.

  Assign the positive upper word data: U(00) = UL(00)/65536

  Assign the negative upper word data: U(00) = UL(00)/65535

  The lower word data will move to U(00) when U(00) = UL(00) is executed.

Precautions for Correct Use

When the Drive Programming program is stopped, the data of internal user variables before the program stop is retained. When the program execution is started again, the process begins with the retained data.

Internal User Contacts UB(0) to UB(7)

The Drive Programming's internal user contacts UB(0) to UB(7) are the bit-access variables.

Use these variables for saving data during bit operations.

You can also use the variable UBw as a word-access data which contains the internal user contacts UB(0) to UB(7) in its lower byte.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
UB(0) to UB(7)	Internal user contact (bit access)	0: OFF 1: ON	0	–	bit	R/W

- You can use the internal user contacts UB(0) to UB(7) as bit-size variables.
- UB(0) to UB(7) are cleared to zero when the power supply is turned ON.
  Any data saving measure like EEPROM is not provided.
- To set initial data, create a program in which the initial data is set to UB(0) to UB(7).

Function variable	Description	Data range	Default data	Unit	Data size	R/W
UBw	Internal user contact (word access)	0 to 255	0	–	Unsigned 1 word	R/W

- The internal user contact (word access) UBw is a function to use the internal user contacts UB(0) to UB(7) as a word-size variable.
- The internal user contacts UB(0) to UB(7) are set in the lower byte. For the upper byte data, zero is read out. If any data is written to the upper byte, the data is ignored.

Bit	8 to 15	7	6	5	4	3	2	1	0
Function	Not used	UB(7)	UB(6)	UB(5)	UB(4)	UB(3)	UB(2)	UB(1)	UB(0)

Precautions for Correct Use

When the Drive Programming program is stopped, the data of internal user contacts before the program stop is retained. When the program execution is started again, the process begins with the retained data.

5-2 Input/Output Terminal Variables

This section describes the variables provided for using the following inverter terminals for the Drive Programming function: Multi-function input terminals, multi-function output terminals, multi-function relay outputs, analog input terminals, and analog output terminals. Use these variables as the interface between the inverter's peripheral devices and the Drive Programming function.

Input Terminal Variables X(00) to X(07)

You can use the inverter's multi-function input terminals as the input terminal variables X(00) to X(07) for the Drive Programming function by setting these multi-function input terminals to the general-purpose input MI1 to MI8.

You can also use the input terminal variables X(00) to X(07) as word-access data, which are set to the lower byte by using the variable Xw.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
X(00) to X(07)	Input terminal variable (bit access)	0: OFF 1: ON	0	–	bit	R

MX2:

- The status of the multi-function input terminals S1 to S7 and pulse train input RP terminal is captured and set as bit-size variables.

  This variable is read-only.
- When the Multi-function Input S1 to S7 Selection (C001 to C007) are set to 56 to 62 (MI1 to MI7: General-purpose input), and the Pulse Train Input RP Selection (P003) is set to 02 (MI8: General-purpose input 8 for Drive Programming), the status of the input terminals S1 to S7 and the RP terminal is captured and set as the input terminal variables X(00) to X(07) of the Drive Programming.

  Numbers are given to the input terminal variables X(00) to X(07) according to the numerical order of the set general-purpose inputs MI1 to MI7, not the terminal numbers S1 to S7.

RX:

- The status of the multi-function input terminals S1 to S8 is captured and set as bit-size variables. This variable is read-only.
- When the Multi-function Input S1 to S8 Selection (C001 to C008) are set to 56 to 63 (MI1 to MI8: General-purpose input), the status of the input terminals S1 to S8 is captured and set as the input terminal variables X(00) to X(07) of the Drive Programming.

  Numbers are given to the input terminal variables X(00) to X(07) according to the numerical order of the set general-purpose inputs MI1 to MI8, not the terminal numbers S1 to S8.

Function variable	Setting for Multi-function Input Selection and Pulse Train Input RP Selection (MX2: C001 to C007 and P003/RX: C001 to C008)
X(00)	56: MI1
X(01)	57: MI2
X(02)	58: MI3
X(03)	59: MI4
X(04)	60: MI5
X(05)	61: MI6
X(06)	62: MI7
X(07)	MX2 P003 = 02/RX 63: MI8

Function variable	Description	Data range	Default data	Unit	Data size	R/W
Xw	Input terminal variable (word access)	0 to 255	0	–	Unsigned 1 word	R

- The input terminal variable (word access) Xw is a function to use the input terminal variables X(00) to X(07) as a word-size variable. This variable is read-only.
- The input terminal variables X(00) to X(07) are set to the lower byte. For the upper byte and unused input terminal variables, zero is read out.

Bit	8 to 15	7	6	5	4	3	2	1	0
Function	Not used	X(07)	X(06)	X(05)	X(04)	X(03)	X(02)	X(01)	X(00)

Precautions for Correct Use

- When the Drive Programming program is stopped, the status of the input terminal variables is not retained but updated according to the status of actual input terminals.
- Even when you set MI1 to MI8 (genera-purpose input 1 to 8) for the Multi-function Input terminals (MX2: S1 to S7/RX: S1 to S8), you can select NO (NO contact) or NC (NC contact) for the Multi-function Input S1 to S7 Operation Selection (MX2: C011 to C017/RX: C011 to C018).

Output Terminal Variables MX2: Y(00) to Y(02)/RX: Y(00) to Y(05)

You can use the inverter's multi-function output terminals as the output terminal variables MX2: Y(00) to Y(02)/RX: Y(00) to Y(05) for the Drive Programming function by setting the multi-function output terminals to the general-purpose outputs MX2: MO1 to MO3/RX: MO1 to MO6.

You can also use the input terminal variables Y(00) to Y(05) as word-access data, which are set to the lower byte by using the variable Yw.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
MX2: Y(00) to Y(02) RX: Y(00) to Y(05)	Output terminal variable (bit access)	0: OFF 1: ON	0	–	bit	R

MX2:

- You can control the status of the multi-function output terminals P1 and P2 and the multi-function relay output terminals (MA and MB) as bit-size variables.
- By setting the Multi-function Output P1 and P2 Selection (C021 and C022) or the Multi-function Relay Output (MA, MB) Function Selection (C026) to 44 to 46 (MO1 to MO3: General-purpose output), you can control the output terminals P1 and P2 or the relay output terminals (MA and MB) as the output terminal variables Y(00) to Y(02) of the Drive Programming. Numbers are given to the output terminal variables Y(00) to Y(02) according to the numerical order of the set general-purpose inputs MO1 to MO3, not the terminal numbers P1, P2, MA or MB.
- The maximum number of the general-purpose outputs for the 3G3MX2 Series Inverter is three (MO1 to MO3).

RX:

- You can control the status of the multi-function output terminals P1 to P5 and the multi-function relay output terminals (MA and MB) as bit-size variables.
- By setting the Multi-function Output P1 to P5 Selection (C021 to C025) or the Multi-function Relay Output (MA, MB) Function Selection (C026) to 44 to 49 (MO1 to MO6: General-purpose output), you can control the output terminals P1 to P5 or the relay output terminals (MA and MB) as the output terminal variables Y(00) to Y(05) of the Drive Programming. Numbers are given to the output terminal variables Y(00) to Y(05) according to the numerical order of the set general-purpose outputs MO1 to MO6, not the terminal numbers P1 to P5, MA or MB.

Function variable	Setting for Multi-function Output Selection (MX2: C021, C022 and C026/RX: C021 to C026)
Y(00)	MX2 and RX 44: MO1
Y(01)	MX2 and RX 45: MO2
Y(02)	MX2 and RX 46: MO3
Y(03)	RX only 47: MO4
Y(04)	RX only 48: MO5
Y(05)	RX only 49: MO6

Function variable	Description	Data range	Default data	Unit	Data size	R/W
Yw	Output terminal variable (word access)	0 to 255	0	–	Unsigned 1 word	R

- The output terminal variables (word access) Yw is a function to use the output terminal variables MX2: Y(00) to Y(02)/RX: Y(00) to Y(05) as a word-size variable.
- The output terminal variables Y(00) to Y(05) are set in the lower byte. For the upper byte and unused output terminal variables, zero is read out. If any data is written to the upper byte, the data is ignored.

Model	Bit	8 to 15	7	6	5	4	3	2	1	0
MX2	Function	Not used	Not used	Not used	Not used	Not used	Not used	Y(02)	Y(01)	Y(00)
RX	Function	Not used	Not used	Not used	Y(05)	Y(04)	Y(03)	Y(02)	Y(01)	Y(00)

Precautions for Safe Use

When the Drive Programming program is stopped, the status before the program stop is retained for multi-function outputs controlled by the Drive Programming.

For this reason, configure the system so that the stop of the Drive Programming program in the inverter can be detected by the Drive Programming start signal and the alarm (trip) signal, and the inverter's peripheral devices can be stopped safely.

Precautions for Correct Use

- When the Drive Programming program is stopped, the data of the output terminal variables before the program stop is retained. When the program execution is started again, the process begins with the retained data.

  However, the outputs with MO1 to MO6 (General-purpose output) not set for the Drive Programming are controlled as the inverter's multi-function outputs independently of the program.
- If multiple tasks use the same multi-function terminal, the output status of the task which is executed last will be effective. Considering safe control, we recommend you to avoid using multiple tasks for control.
- Even if you select MO1 to MO6 (General-purpose output 1 to 6) for the Multi-function Output Selection (MX2: P1 and P2/RX: P1 to P5) or for the Multi-function Relay Output (MA, MB) Function Selection, you can select NO (NO contact) or NC (NC contact) for the Multi-function Output Operation Selection (MX2: C031 and C032/RX: C031 to C035) or for the Multi-function Relay Output (MA, MB) Operation Selection (C036).

Analog Input Terminal Variables XA(0) to XA(2)

You can use the inverter's frequency reference input (analog voltage input) FV terminal and the frequency reference input (analog current input) FI terminal as the analog input terminal variables XA(0) and XA(1) of the Drive Programming function.

For the 3G3RX Series Inverter, it is also possible to use the frequency reference auxiliary input (analog voltage input) FE terminal as the analog input terminal variable XA(2) of the Drive Programming function.

You can continuously monitor the status of the analog inputs regardless of the parameter settings.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
XA(0)	MX2 and RX: Analog input terminal variable (between FV and FC terminals: 0 to 10 V input)	0 to 10,000	0	0.01%	Unsigned 1 word	R
XA(1)	MX2 and RX: Analog input terminal variable (between FI and FC terminals: 4 to 20 mA input)					
XA(2)	RX only: Analog input terminal variable (between FE and FC terminals: −10 to 10 V input)	−10,000 to 10,000			Signed 1 word	

- The analog input terminal variables XA(0) and XA(1) are unsigned 1-word variables, and XA(2) is a signed 1-word variable. This variable is read-only.
- The variables are displayed in increments of 0.01% as a percentage of the maximum analog input 10 V or 20 mA.
- You can allocate inverter functions to the analog input terminals with the inverter parameters as shown below. Select a function in each parameter.

  If you use the analog input terminals only for the Drive Programming, do not select the analog input terminal in the following parameters.

  MX2: A001, A201, A005, A076, A079, A141, A142, b040, and P033

  RX: A001, A005, A006, A076, A079, A141, A142, b040, and P033
- To adjust the analog inputs, use the following inverter parameters: (FV: A011 to A016, FI: A101 to A105, and FE: A111 to A114).

Precautions for Correct Use

When the Drive Programming program is stopped, the status of the analog input terminal variables is not retained but updated according to the status of actual input terminals.

Analog Output Terminal Variables YA(0) to YA(2)

You can use the inverter's multi-function digital output (PWM output) MP terminal and the multi-function analog output (voltage output) AM terminal as the analog output terminal variables YA(0) and YA(1) of the Drive Programming function.

For the 3G3RX Series Inverters, it is also possible to use the multi-function analog output (current output) AMI terminal as the analog output terminal variables YA(2) of the Drive Programming function.

You can continuously monitor the status of the analog outputs regardless of the parameter settings.

To control the analog outputs via the Drive Programming function, select Drive Programming for the setting of the inverter parameters MP Selection (C027), AM Selection (C028) and AMI Selection (C029).

Function variable	Description	Data range	Default data	Unit	Data size	R/W
YA(0)	MX2 and RX: Analog output terminal variable (MP terminal: 6.4 ms cycle, PWM output)	0 to 10,000	0	0.01%	Unsigned 1 word	R/W
YA(1)	MX2 and RX: Analog output terminal variable (AM terminal: 0 to 10 V output)					
YA(2)	RX only: Analog output terminal variable (AMI terminal: 4 to 20 mA output)					

- The analog output terminal variables YA(0) to YA(2) are unsigned 1-word variables.
- Set the variables in increments of 0.01% as a percentage of the maximum output duty, 10 V or 20 mA.
- Select Drive Programming for the setting of the inverter parameters MP Selection (C027), AM Selection (C028) and AMI Selection (C029) to control the analog output terminals via the Drive Programming function. Even if you do not select Drive Programming for the parameters, it is possible to monitor the status of the analog output terminals.

Function variable	Parameter Setting
YA(00)	Set the MP Selection (C027) to 12 (Drive Programming: YA(0))
YA(01)	Set the AM Selection (C028) to 13 (Drive Programming: YA(1))
YA(02)	Set the AMI Selection (C029) to 14 (Drive Programming: YA(2))

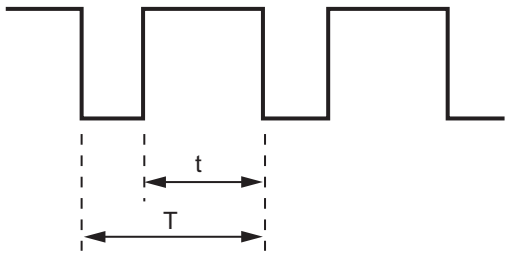
- Use the inverter parameters (C105 to C107, C109 and C110) to adjust analog output.

Precautions for Correct Use

- When the Drive Programming program is stopped, the data of the analog output terminal variables before the program stop is retained. When the program execution is started again, the process begins with the retained data. However, the outputs with the Drive Programming not set are controlled as the inverter's analog outputs independently of the program.
- The multi-function digital output (PWM output) MP terminal provides PWM signal outputs.

  The terminal outputs the value of 0.00 to 100.00% (variable) as the pulse width (duty ratio t/T) in a 6.4 ms cycle.

PWM output



Cycle T: Constant (6.4 ms)

Duty ratio t/T: Variable

5-3 Timer Variables

This section describes the timer variables provided for the Drive Programming's timer control commands.

Timer Variables TC(0) to TC(7) and TD(0) to TD(7)

These are the timer counter variables and the timer output contacts used in the timer control commands of the Drive Programming.

When the timer output contact is specified in the timer control command “delay on/off” or “timer set”, the timer counter variable corresponding to the specified contact starts counting. When the counter reaches the specified value, the timer output contact is turned ON.

When the variables are not used in the timer control commands, they acts as the free-running counters.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
TC(0) to TC(7)	Timer counter variable	0 to 2,147,483,647	0	10 ms	Unsigned 2 words	R

- The timer counter variables TC(0) to TC(7) are unsigned 2-word variables. This variable is read-only.
- The timer counter variables TC(0) to TC(7) correspond to the timer output contacts TD(0) to TD(7), respectively.
- The timer counter variables TC(0) to TC(7) act as the 31-bit free-running counters. They start counting with zero when the program is started and count up every 10 ms.
- When the timer output contact is specified in the “delay on/off” command or the “timer set” command, the corresponding timer counter variable among TC(0) to TC(7) acts as the counter for timer control.

  When the command is executed, the variable TC(0) to TC(7) is cleared to zero and count up every 10 ms. When they reach the specified values, the counting stops.
- When the “timer off” command is executed, the corresponding timer counter variable is cleared to zero, and it starts the operation as the 31-bit free-running counter and counts up every 10 ms.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
TD(0) to TD(7)	Timer output contact (bit access)	0: OFF 1: ON	0	–	bit	R

- The timer output contacts TD(0) to TD(7) are bit-size variables. This variable is read-only.
- When the program is started, the values of the timer output contacts TD(0) to TD(7) are cleared to zero.
- The timer output contacts TD(0) to TD(7) start their operation after they are specified in the “delay on/off” command or the “timer set” command. TD(0) to TD(7) are set to 0 (OFF) when the corresponding timer counter variables are cleared to zero. When the timer counter variable reaches the specified value, the contact is set to "1" (ON) and the status is retained. If the “timer off” command is executed, the status of TD(0) to TD(7) are cleared to zero.
- When the timer counter variables TC(0) to TC(7) operate as free-running counters, the status of corresponding timer output contacts TD(0) to TD(7) do not change.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
TDw	Timer output contact (word access)	0 to 255	0	0.01 Hz	Unsigned 1 word	R

- The timer output contact (word access) TDw is a function to use the timer output contacts TD(0) to TD(7) as a word-size variable. This variable is read-only.
- The timer output contacts TD(0) to TD(7) are set in the lower byte. Zero is read out for upper byte data.

Bit	8 to 15	7	6	5	4	3	2	1	0
Function	Not used	TD(7)	TD(6)	TD(5)	TD(4)	TD(3)	TD(2)	TD(1)	TD(0)

Precautions for Correct Use

If the Drive Programming program is stopped, the data of the timer counter variables and the timer output contacts is not retained but cleared to zero.

5-4 Inverter Setting Variables

This section describes the variables provided for setting inverter's frequency reference and acceleration/deceleration time.

Use these variables to control the inverter via the Drive Programming program.

Frequency Reference Variable SET-Freq

When you directly control the frequency reference by the Drive Programming function, set the inverter's parameter Frequency Reference Selection to 07 (Drive Programming) to enable the frequency reference variable SET-Freq.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
SET-Freq	Frequency reference variable	0 to 40,000	0	0.01 Hz	Unsigned 1 word	R/W

- The frequency reference variable SET-Freq is an unsigned 1-word variable.
- The variable is enabled only when you set the Frequency Reference Selection to 07 (Drive Programming).

  MX2: Set in the 1st/2nd Frequency Reference Selection (A001/A201).
  Allocate one of the Multi-function Input S1 to S7 Selection (C001 to C007) to 08 (SET: 2nd control) to switch the control.

  RX: Set in the Frequency Reference Selection (A001). Switching between 1st/2nd/3rd controls is not allowed.

- The frequency reference variable SET-Freq is cleared to zero when the power supply is turned ON.
  Any data saving measure like EEPROM is not provided.
- To set initial data, create a program in which the initial data is set to SET-Freq.
- The range of frequency that the inverter can actually output is from the Starting Frequency (b082) to the maximum frequency.
  If the set data is out of range, the inverter operates as follows.
  - Less than Starting Frequency (b082)

    MX2 and RX: Operates at the frequency of 0.00 Hz.

    RX only: When the 1st Control Method (A044) is set to 04 (0SLV: 0-Hz sensorless vector control) or 05 (V2: Sensor vector control), the Starting Frequency (b082) is disabled and the specified frequency is output.

  - More than maximum frequency

    MX2: Limits the frequency reference to the value set in the 1st/2nd Maximum Frequency (A004/A204).

    RX: Limits the frequency reference to the value set in the 1st/2nd/3rd Maximum Frequency (A004/A204/A304).

- You can monitor the frequency reference set in the frequency reference variable SET-Freq by using the inverter's parameter Output Frequency Setting/Monitor (F001).

Precautions for Correct Use

When the Drive Programming program is stopped, the data of the frequency reference variable before the program stop is retained. When the program execution is started again, the process begins with the retained data.

Acceleration/deceleration Time Variables ACCEL and DECEL

When you directly control the acceleration/deceleration time of the frequency reference by the Drive Programming function, set the inverter's parameter Acceleration/Deceleration Time Input Type (P031) to 03 (Drive Programming) to enable the acceleration time variable ACCEL and the deceleration time variable DECEL.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
ACCEL	Acceleration time variable	MX2: 0 to 360,000 RX: 1 to 360,000	Parameter Setting	0.01 second	Unsigned 2 words	R/W
DECEL	Deceleration time variable					

- The acceleration time variable ACCEL and the deceleration time variable DECEL are unsigned 2-word variables.
- The acceleration time variable ACCEL and the deceleration time variable DECEL are enabled only when you set the Acceleration/Deceleration Time Input Type (P031) to 03 (Drive Programming).
- Only when the program is started for the first time after the power supply is turned ON, the value set in the inverter's acceleration/deceleration time parameters are set for the Drive Programming's acceleration time variable ACCEL and deceleration time variable DECEL.

  MX2: The acceleration/deceleration time for the 1st/2nd Acceleration Time 1 (F002/F202) and the 1st/2nd Deceleration Time 1 (F003/F203) are set according to the 1st/2nd control selection.

  RX: The acceleration/deceleration time for the 1st/2nd/3rd Acceleration Time 1 (F002/F202/F302) and 1st/2nd/3rd Deceleration Time 1 (F003/F203/F303) are set according to the 1st/2nd/3rd control selection.

- The data set in the acceleration time variable ACCEL and deceleration time variable DECEL are not saved in the EEPROM.

  If you want to save the data, use the “eepwrt” command to save it in the user parameter variables or in the EEPROM for the inverter's acceleration/deceleration time parameters.
- The internal processing for the acceleration/deceleration time is performed in 40 ms cycles. Even if the value of the acceleration time variable ACCEL or the deceleration time variable DECEL is changed in the program, it takes up to 40 ms until the change is reflected in operation.
- In the following cases, the data that is set in the program is not reflected and the previously set data is used for operation: the data set for the acceleration time variable ACCEL or the deceleration time variable DECEL is out of range, or 0 is set for the 3G3RX Series Inverter.

Precautions for Correct Use

When the Drive Programming program is stopped, the data of the acceleration time variable ACCEL and deceleration time variable DECEL before the program stop is retained. When the program execution is started again, the process begins with the retained data.

5-5 Inverter Monitor Variables

You can use the inverter's internal monitor function and status monitor function as the variables of the Drive Programming function.
For details on each monitor function, refer to the MX2 User's Manual (I570-E2) or the RX User's Manual (I560-E2).
Note that the data unit used for the inverter may be different from that for Drive Programming. Be sure to use the following units.

● MX2 and RX

Function variable	Description	Data range	Default data	Unit	Data size	R/W
FM	Output Frequency Monitor [d001]	0 to 40,000	–	0.01 Hz	Unsigned 1 word	R

Use this function to monitor the inverter output frequency. The monitored data is equivalent to the data of the Output Frequency Monitor (d001). This variable is read-only.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
Iout	Output Current Monitor (d002)	0 to 9,999	–	0.1%	Unsigned 1 word	R

Use this function to monitor the inverter output current. The monitored data is equivalent to the data of the Output Current Monitor (d002). The data is displayed in increments of 0.1% as a percentage of the rated current of the inverter. This variable is read-only.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
Dir	RUN Direction Monitor (d003)	0: Stop 1: Forward 2: Reverse	–	–	Unsigned 1 word	R

Use this function to monitor the operation direction of the inverter. The monitored data is equivalent to the data of the RUN Direction Monitor (d003). This variable is read-only.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
PID-FB	PID Feedback Value Monitor (d004)	0 to 133,333	–	0.01%	Unsigned 2 words	R

Use this function to monitor the PID feedback value. The monitored data is equivalent to the data of the PID Feedback Value Monitor (d004). This variable is read-only.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
F-CNV	Output Frequency Monitor (After Conversion) (d007)	0 to 3,999,600	–	0.01	Unsigned 2 words	R

Use this function to monitor the output frequency after conversion. The monitored data is equivalent to the data of the Output Frequency Monitor (After Conversion) (d007). This variable is read-only.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
Tmon	Output Torque Monitor (d012)	–200 to 200	–	%	Unsigned 1 word	R

Use this function to monitor the output torque. The monitored data is equivalent to the data of the Output Torque Monitor (d012). This variable is read-only.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
Vout	Output Voltage Monitor (d013)	0 to 6,000	–	0.1 V	Unsigned 1 word	R

Use this function to monitor the output voltage. The monitored data is equivalent to the data of the Output Voltage Monitor (d013). This variable is read-only.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
Power	Input Power Monitor (d014)	0 to 9,999	–	0.1 kW	Unsigned 1 word	R

Use this function to monitor the input power. The monitored data is equivalent to the data of the Input Power Monitor (d014). This variable is read-only.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
RUN-Time	Total RUN Time Monitor (d016)	0 to 999,999	–	Time	Unsigned 2 words	R

Use this function to monitor the total operation time. The monitored data is equivalent to the data of the Total RUN Time Monitor (d016). This variable is read-only.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
ON-Time	Total Power ON Time Monitor (d017)	0 to 999,999	–	Time	Unsigned 2 words	R

Use this function to monitor the total power ON time. The monitored data is equivalent to the data of the Total Power ON Time Monitor (d017). This variable is read-only.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
UMon(0) to UMon(2)	User Monitor 0 to 2 (d025 to d027)	–2,147,483,647 to 2,147,483,647	0	–	Signed 2 words	R/W

The Drive Programming's user monitor variables UMon(0) to UMon(2) are the signed 2-word variables. If any data is set in the user monitor variables UMon(0) to UMon(2) in the Drive Programming program, the data can be displayed through the inverter's user monitor parameters (d025, d026 and d027). Use this function to externally display the calculation status of the program.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
POS	Current Position Monitor (d030)	–268,435,455 to 268,435,455 (–1,073,741,823 to 1,073,741,823)*1	–	1	Signed 2 words	R

Use this function to monitor the current position. The monitored data is equivalent to the data of the Current Position Monitor (d030).

*1. The range of display shown in ( ) is for RX only.

This range of display is used when the V2 Control Mode Selection (P012) is set to 03 (HAPR: High-resolution absolute position control mode).

Function variable	Description	Data range	Default data	Unit	Data size	R/W
ERR-CNT	Fault Counter (d080)	0 to 65,535	–	Times	Unsigned 1 word	R

Use this function to monitor the inverter's total number of faults. The monitored data is equivalent to the data of the Fault Counter (d080). This variable is read-only.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
ERR(1) to ERR(6)	Fault Monitor 1 to 6 (d081 to 086)	0 to 127	–	–	Unsigned 1 word	R

Use this function to monitor the data of the last six trips of the inverter. The monitored data is equivalent to the data of the Fault Monitor 1 to 6 (d081 to 086). This variable is read-only. The trip data is displayed with a code, which is the same as that in the Inverter Fault Monitor Factor List used in the inverter's Modbus communications.

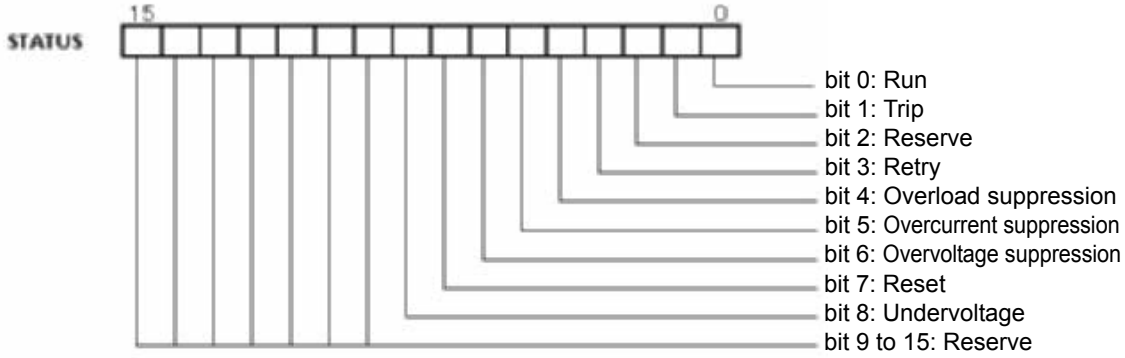
Function variable	Description	Data range	Default data	Unit	Data size	R/W
DCV	DC Voltage Monitor (d102)	0 to 10,000	–	0.1 V	Unsigned 1 word	R

Use this function to monitor the inverter's internal DC voltage. The monitored data is equivalent to the data of the DC Voltage Monitor (d102). This variable is read-only.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
STATUS	Inverter status monitor	–	–	–	Unsigned 1 word	R

Use this function to monitor the inverter's status.

Each bit corresponds to the following status. This variables is read-only.



5-6 Multi-function Input Variables

You can execute the functions allocated to the multi-function input terminals by the Drive Programming program. The following variables correspond to the functions which can be allocated to the multi-function input terminals.

If any of the variables is set to 1 (ON), the corresponding function is enabled in the same way as when the multi-function input terminal is turned ON.

If any of the variables is set to 0 (OFF), the corresponding function is disabled. You can execute the functions by the program even if you do not allocate the functions to the Multi-function Input Selection (MX2: C001 to C007/RX: C001 to C008). The Reference column in the following table shows the function setting data for the inverter. For details on each function, refer to the MX2 User's Manual (I570-E2) or the RX User's Manual (I560-E2).

● Example

If you set FW (forward) to 1, the forward RUN command is executed.

FW: = 1 the inverter starts forward operation.

FW: = 0 the inverter stops forward operation and starts deceleration.

Precautions for Correct Use

- If the Drive Programming program is stopped, the data of the multi-function input variables is not retained but cleared to zero.
- The variable FW (forward) and RV (reverse) are enabled only when the inverter's RUN Command Selection (A002) is set to 01 (Control circuit terminal block). The inverter does not operate with other setting options.
- Even if you set the variable FW (forward) or RV (reverse) to 1 immediately after turning on the power supply, the setting is ignored and neither forward or reverse operation is performed. Set 0, and then set 1 again. To avoid this operation, create a program that has one second of wait time after turning on the power supply, with such as “wait” command.
- Only for the variable AT (Analog input switching), it is required to set the Multi-function Input Selection (MX2: C001 to C007/RX: C001 to C008). To use the variable AT (Analog input switching), set one of the Multi-function Input Selection parameters to 16 (AT: Analog input switching). If you do not set it, the expected operation is not performed even if the variable AT (Analog input switching) is set to 1 in the program.
- The relationship between the inverter's multi-function input function set in the Multi-function Input Selection and the multi-function input variable is logical OR.

● MX2 and RX

Function variable	Description	R/W	Reference
FW	Forward	R/W	MX2: C001 to C007 = 00 RX: FW terminal
RV	Reverse	R/W	C001 to C008 = 01
CF1 to CF4	Multi-step speed setting binary 1 to 4	R/W	C001 to C008 = 02 to 05
JG	Jogging	R/W	C001 to C008 = 06
DB	External DC injection braking	R/W	C001 to C008 = 07
SET	2nd Control	R/W	C001 to C008 = 08
TCH (2CH)*1	2-step acceleration/deceleration	R/W	C001 to C008 = 09
FRS	Free-run stop	R/W	C001 to C008 = 11
EXT	External trip	R/W	C001 to C008 = 12
USP	Power recovery restart prevention function	R/W	C001 to C008 = 13

Function variable	Description	R/W	Reference
CS	Commercial switching	R/W	C001 to C008 = 14
SFT	Soft lock	R/W	C001 to C008 = 15
AT	(Analog input switching)	R/W	C001 to C008 = 16
RS	Reset	R/W	C001 to C008 = 18
STA	3-wire start	R/W	C001 to C008 = 20
STP	3-wire stop	R/W	C001 to C008 = 21
F-R (F/R)*1	3-wire forward/reverse	R/W	C001 to C008 = 22
PID	PID disabled	R/W	C001 to C008 = 23
PIDC	PID integral reset	R/W	C001 to C008 = 24
UP	Remote operation accelerated	R/W	C001 to C008 = 27
DWN	Remote operation decelerated	R/W	C001 to C008 = 28
UDC	Remote operation data clear	R/W	C001 to C008 = 29
OPE	Forced operator function	R/W	C001 to C008 = 31
SF1 to SF7	Multi-step speed setting bit 1 to 7	R/W	C001 to C008 = 32 to 38
OLR	Overload limit switching	R/W	C001 to C008 = 39
TL	Torque limit enabled	R/W	C001 to C008 = 40
TRQ1 and 2	Torque limit switching 1 and 2	R/W	C001 to C008 = 41 and 42
BOK	Brake confirmation	R/W	C001 to C008 = 44
LAC	LAD cancel	R/W	C001 to C008 = 46
PCLR	Current position clear	R/W	C001 to C008 = 47
ADD	Set frequency A145 addition	R/W	C001 to C008 = 50
F-TM	Forced terminal block	R/W	C001 to C008 = 51
ATR	Torque reference input permission	R/W	C001 to C008 = 52
KHC	Integrated power clear	R/W	C001 to C008 = 53
AHD	Analog command held	R/W	C001 to C008 = 65
CP1 to 3	Position command selection 1 to 3	R/W	C001 to C008 = 66 to 68
ORL	Origin search limit signal	R/W	C001 to C008 = 69
ORG	Origin search startup signal	R/W	C001 to C008 = 70
SPD	Speed/Position switching	R/W	C001 to C008 = 73

*1. The shortened name of the function option for multi-function input is different from the function variable name. The shortened name of the function option for multi-function input is shown in ( ).

● MX2 only

Function variable	Description	R/W	Reference
RS485 (485)*1	Start co-inverter communication	R/W	C001 to C007 = 81
HLD	Retain output frequency	R/W	C001 to C007 = 83
ROK	Permission of RUN command	R/W	C001 to C007 = 84
DISP	Display fixed	R/W	C001 to C007 = 86

*1. The shortened name of the function option for multi-function input is different from the function variable name. The shortened name of the function option for multi-function input is shown in ( ).

● RX only

Function variable	Description	R/W	Reference
SET3	3rd Control	R/W	C001 to C008 = 17
CAS	Control gain switching	R/W	C001 to C008 = 26
PPI	P/PI switching	R/W	C001 to C008 = 43
ORT	Orientation	R/W	C001 to C008 = 45
STAT	Pulse train position command input permission	R/W	C001 to C008 = 48
SON	Servo ON	R/W	C001 to C008 = 54
FOC	Preliminary excitation	R/W	C001 to C008 = 55
FOT	Forward driving stop	R/W	C001 to C008 = 71
ROT	Reverse driving stop	R/W	C001 to C008 = 72
PCNT	Pulse counter	R/W	C001 to C008 = 74
PCC	Pulse counter clear	R/W	C001 to C008 = 75

5-7 Multi-function Output Variables

You can execute the functions which can be allocated to the multi-function output terminals by using the Drive Programming program. The following variables correspond to the functions which can be allocated to the multi-function output terminals.

Setting each variable to 1 (ON) or 0 (OFF) causes the same operation as when the multi-function output function turns the multi-function output terminal ON/OFF. You can monitor the status on the program even if you do not set each function in the parameters Multi-function Output Selection (MX2: C021 and C022/RX: C021 to C025) or Multi-function Relay Output (MA, MB) Function Selection (C026). The Reference column in the following table shows the function setting data for the inverter. For details on each function, refer to the MX2 User's Manual (I570-E2) or the RX User's Manual (I560-E2).

Precautions for Correct Use

When the Drive Programming program is stopped, the status of the multi-function output variables is not retained but updated according to the actual function status.

● MX2 and RX

Function variable	Description	R/W	Reference
RUN	Signal during RUN	R	C021 to C026 = 00
FA1	Constant speed arrival signal	R	C021 to C026 = 01
FA2	Set frequency exceeded signal	R	C021 to C026 = 02
OL	Overload warning	R	C021 to C026 = 03
OD	Excessive PID deviation	R	C021 to C026 = 04
AL	Alarm signal	R	C021 to C026 = 05
FA3	Set-frequency only signal	R	C021 to C026 = 06
OTQ	Overtorque/Undertorque signal	R	C021 to C026 = 07
UV	Signal during undervoltage	R	C021 to C026 = 09
TRQ	Torque limit	R	C021 to C026 = 10
RNT	RUN time over	R	C021 to C026 = 11
ONT	Power ON time over	R	C021 to C026 = 12
THM	Electronic thermal warning	R	C021 to C026 = 13
BRK	Brake release	R	C021 to C026 = 19
BER	Brake error	R	C021 to C026 = 20
ZS	0 Hz detection signal	R	C021 to C026 = 21
DSE	Excessive speed deviation	R	C021 to C026 = 22
POK	Position ready	R	C021 to C026 = 23
FA4	Set frequency exceeded signal 2	R	C021 to C026 = 24
FA5	Set-frequency only signal 2	R	C021 to C026 = 25
OL2	Overload warning 2	R	C021 to C026 = 26
ODc	Analog FV disconnection detection	R	C021 to C026 = 27
OIDc	Analog FI disconnection detection	R	C021 to C026 = 28
FBV	PID feedback comparison signal	R	C021 to C026 = 31
NDc	Communications disconnection detection	R	C021 to C026 = 32
LOG1	Logic operation output 1	R	C021 to C026 = 33
LOG 2	Logic operation output 2	R	C021 to C026 = 34
LOG 3	Logic operation output 3	R	C021 to C026 = 35
WAC	Capacitor life warning signal	R	C021 to C026 = 39
WAF	Cooling fan life warning signal	R	C021 to C026 = 40
FR	Starting contact signal	R	C021 to C026 = 41
OHF	Cooling fin overheat warning	R	C021 to C026 = 42

Function variable	Description	R/W	Reference
LOC	Low current signal	R	C021 to C026 = 43
IRDY	Operation ready	R	C021 to C026 = 50
FWR	Forward run signal	R	C021 to C026 = 51
RVR	Reverse run signal	R	C021 to C026 = 52
MJA	Fatal fault signal	R	C021 to C026 = 53
WCO	Window comparator FV	R	C021 to C026 = 54
WCOI	Window comparator FI	R	C021 to C026 = 55

● MX2 only

Function variable	Description	R/W	Reference
FREF	Frequency command source	R	C001 to C007 = 58
REF	RUN command source	R	C001 to C007 = 59
SETM	Motor 2 selection	R	C001 to C007 = 60
EDM	Safety device monitor	R	C001 to C007 = 62

● RX only

Function variable	Description	R/W	Reference
IP	Signal during momentary power interruption	R	C021 to C026 = 08
O2Dc	Analog FE disconnection detection	R	C021 to C026 = 29
LOG 4	Logic operation output 4	R	C021 to C026 = 36
LOG 5	Logic operation output 5	R	C021 to C026 = 37
LOG 6	Logic operation output 6	R	C021 to C026 = 38
WCO2	Window comparator FE	R	C021 to C026 = 56

6

Drive Programming Commands

This section describes the commands provided for Drive Programming.

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6-1 Command Categories

The commands are divided into the following categories.

- Program control commands
- Arithmetic operation and logical operation commands
- I/O control commands
- Timer control commands
- Parameter control commands
- Inverter control commands

6-2 Command Format

Each command consists of the command and its arguments (0 up to 5).

An example is shown below.

Command	Argument 1	Argument 2	Argument 3	Argument 4	Argument 5	Description
entry						Indicates the beginning of the program.

If there is no argument, the cell is blank.

Command	Argument 1	Argument 2	Argument 3	Argument 4	Argument 5	Description
wait	<wait time>					<wait time> Waits for (wait time × 0.01) seconds.

There is one argument for the “wait” command. In this argument, input a wait time (variable or constant).

Command	Argument 1	Argument 2	Argument 3	Argument 4	Argument 5	Description
while	<condition>					Executes <command set> while <condition> is met.
<command set>						The command set that is executed while <condition> is met.
wend						Goes to the “while” (loop).

For the “while” command, set a condition in the argument. (For details, refer to *Conditions* on page 6-6.)

Between “while” and “wend”, write the command set that is executed while <condition> is met.

6-3 Command List

Program Control Commands

Command	Argument 1	Argument 2	Argument 3	Argument 4	Argument 5	Description
entry						Indicates the beginning of the task.
end						Indicates the end of the task.
call	<subroutine>					Jumps to <subroutine>.
sub	<subroutine>					Indicates the beginning of the subroutine.
end sub						Indicates the end of the subroutine.
goto	<label>					Jumps to <label> unconditionally.
on trip goto	<label>					Jumps to <label> when a trip occurs.
if	<condition>			goto	<label>	Jumps to <label> when the condition is met.
if	<condition>			then		Starts the “if” structure. If <condition> is met, it executes <command set 1> right after this command until the “else” command, and goes to the next step after the “endif”. If <condition> is not met, it executes <command set 2> right after the “else” command until the “endif” command, and goes to the next step after the “endif”.
<command set 1>						The command set that is executed when <condition> is met.
else						Starts the commands when <condition> is not met.
<command set 2>						The command set that is executed when <condition> is not met.
endif						Ends the “if” structure.

Command	Argument 1	Argument 2	Argument 3	Argument 4	Argument 5	Description
select	<condition variable>					Executes the commands after the “case” command when <condition variable> is equal to <condition value>.
case	<condition value 1>					Starts the commands assigned to the condition value.
<command set 1>						The command set assigned to <condition value 1>
[“case” condition value n] [<command set n>]						You can set one or more conditions with “case”.
case else						Starts the commands assigned to the values other than the condition value.
<command set>						The command set assigned to the values other than <condition value>
end select						Ends the “case” syntax.
for	<variable>	<start value>	<end value>	<incremental value>		Starts a loop from <start value> until <end value> with <incremental value>.
<command set>						The command set that is executed repeatedly
next						Goes to “for” (loop).
while	<condition>					Executes <command set> while the <condition> is met.
<command set>						The command set that is executed while <condition> is met.
wend						Goes to “while” (loop).
until	<condition>					Executes <command set> until <condition> is met.
<command set>						The command set that is executed while <condition> is not met.
loop						Goes to “until” (loop).
wait	<wait time>					<wait time> Waits for (wait time × 0.01) seconds.
wait	<condition>					Waits until <condition> is met.

Additional Information

For the format of <condition>, refer to *Conditions* on page 6-6.

Conditions

Command	Argument 1	Argument 2	Argument 3	Argument 4	Argument 5	Description
Condition	<variable 1/ constant>	=	<variable 2/ constant>			TRUE if <variable 1/constant> is equal to <variable 2/constant>.
	<variable 1/ constant>	<	<variable 2/ constant>			TRUE if <variable 1/constant> is less than <variable 2/ constant>.
	<variable 1/ constant>	<=	<variable 2/ constant>			TRUE if <variable 1/constant> is equal to or less than <variable 2/constant>.
	<variable 1/ constant>	>	<variable 2/ constant>			TRUE if <variable 1/constant> is greater than <variable 2/ constant>.
	<variable 1/ constant>	>=	<variable 2/ constant>			TRUE if <variable 1/constant> is equal to or greater than <variable 2/constant>.
	<variable 1/ constant>	<>	<variable 2/ constant>			TRUE if <variable 1/constant> is not equal to <variable 2/constant>.

Arithmetic Operation and Logical Operation Commands

Command	Argument 1	Argument 2	Argument 3	Argument 4	Argument 5	Description
Arithmetic operation	<variable 1>	: =	<variable 2/ constant>			Assigns <variable 2/constant> to <variable 1>.
	<variable 1>	: =	<variable 2/ constant>	+	<variable 3/ constant>	Adds <variable 2/constant> and <variable 3/constant> and assigns the result to <variable 1>.
	<variable 1>	: =	<variable 2/ constant>	–	<variable 3/ constant>	Subtracts <variable 3/constant> from <variable 2/constant> and assigns the result to <variable 1>.
	<variable 1>	: =	<variable 2/ constant>	*	<variable 3/ constant>	Multiplies <variable 2/constant> by <variable 3/constant> and assigns the result to <variable 1>.
	<variable 1>	: =	<variable 2/ constant>	/	<variable 3/ constant>	Divides <variable 2/constant> by <variable 3/constant> and assigns the result to <variable 1>.

Command	Argument 1	Argument 2	Argument 3	Argument 4	Argument 5	Description
Remainder for division	<variable 1>	: =	<variable 2/ constant>	mod	<variable 3/ constant>	Divides <variable 2/constant> by <variable 3/constant> and assigns the remainder to <variable 1>.
Absolute value	<variable 1>	: = abs	<variable 2/ constant>			Assigns the absolute value of <variable 2/constant> to <variable 1>.
Logical operation	<variable 1>	: =	<variable 2/ constant>	and	<variable 3/ constant>	Performs a logical AND operation on <variable 2/constant> and <variable 3/constant> and assigns the result to <variable 1>.
	<variable 1>	: =	<variable 2/ constant>	or	<variable 3/ constant>	Performs a logical OR operation on <variable 2/constant> and <variable 3/constant> and assigns the result to <variable 1>.
	<variable 1>	: =	<variable 2/ constant>	xor	<variable 3/ constant>	Performs a logical exclusive OR operation on <variable 2/constant> and <variable 3/constant> and assigns the result to <variable 1>.
	<variable 1>	: = not	<variable 2/ constant>			Reverses the bit of <variable 2/constant> and assigns the result to <variable 1>.

Increment and Decrement Commands

Command	Argument 1	Argument 2	Argument 3	Argument 4	Argument 5	Description
Increment	inc	<variable>				Adds 1 to <variable>.
Decrement	Dec	<variable>				Subtracts 1 from <variable>.

I/O control commands

Command	Argument 1	Argument 2	Argument 3	Argument 4	Argument 5	Description
Input terminal variable assignment	<variable>	: =	X(i)			Set current state of the input terminal X(i) to <variable>. 0 = off, 1 = on
	<variable>	: =	Xw			Set the current state of the Xw to <variable> in units of words.

Command	Argument 1	Argument 2	Argument 3	Argument 4	Argument 5	Description
Output terminal variable output	Y(**)	: =	<variable/ constant>			Outputs data to the output terminal Y(**) in units of bits. 0 = off, 1 = on
	Yw	: =	<variable/ constant>			Outputs data to the output terminal in units of words.
Multi-function input variable output	<Multi-function input variable>	: =	<variable/ constant>			Outputs data to the multi-function input variable. 0 = off, 1 = on
Multi-function output variable assignment	<variable>	: =	<Multi-function output variable>			Assigns the status of the multi-function output variable to <variable>. 0 = off, 1 = on
Internal user contact control	<variable>	: =	UB(i)			Assigns the internal user contact information to <variable>. 0 = off, 1 = on
	<variable>	: =	UBw			Assigns the internal user contact information to <variable> in units of words.
	UB(**)	: =	<variable/ constant>			Outputs data to the internal user contact in units of bits. 0 = off, 1 = on
	UBw	: =	<variable/ constant>			Outputs data to the internal user contact in units of words.

Timer Control Commands

Command	Argument 1	Argument 2	Argument 3	Argument 4	Argument 5	Description
delay	on/off	<variable 1>	TD(i)	<variable 2/ constant>		Sets <variable 2/constant> for the specified timer and starts the timer. Changes <variable 1> to ON or OFF after the time of <variable 2/constant> elapsed. At the same time, it changes TD(i) to ON.
timer set	TD(*)	<variable/ constant>				Sets <variable/constant> for the specified timer and starts the timer. Changes TD(i) to ON after the time of <variable/constant> elapsed.
timer off	TD(*)					Stops the specified timer.

Parameter Control Commands

Command	Argument 1	Argument 2	Argument 3	Argument 4	Argument 5	Description
ChgParam	<parameter>	: =	<variable/ constant>			Replaces the content of <parameter> with <variable/constant>.
MonParam	<variable>	: =	<parameter>			Assigns the content of <parameter> to <variable>.
eepwrt						Issues a request for writing to the inverter's EEPROM when the following parameter writing command is executed (only once).
ChgParam	<parameter>	: =	<variable/ constant>			Replaces the content of <parameter> with <variable/constant> and save it in the EEPROM simultaneously.
rtcset*1	on/off	<variable>				Assigns clock information of the LCD Digital Operator to <variable>.

*1. The “rtcset” command is provided only for the 3G3RX Series Inverter.

The 3G3MX2 Series Inverters cannot use the “rtcset” command because they do not connect with the LCD Digital Operator (Model: 3G3AX-OP05).

Inverter Control Commands

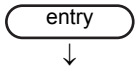
Command	Argument 1	Argument 2	Argument 3	Argument 4	Argument 5	Description
FW	: =	1				Operates the inverter in the forward direction.
RV	: =	1				Operates the inverter in the reverse direction.
stop						Decelerates the inverter to a stop. Note: This command acts as a reset when the inverter is in a trip state.
trip	<variable/ constant>					Issues a user trip according to <variable/ constant>.
SET-Freq	: =	<variable/ constant>				Assigns <variable/constant> (× 0.01 Hz) to the inverter frequency reference variable.
ACCEL	: =	<variable/ constant>				Assigns <variable/constant> (× 10 ms) to the inverter acceleration time variable.
DECEL	: =	<variable/ constant>				Assigns <variable/constant> (× 10 ms) to the inverter deceleration time variable.

6-4 Program Control Commands

Entry

Command	Description	Argument
	Indicates the beginning of the task.	---

Format

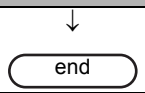
Flowchart method	Text language method
	entry

Note It is necessary to have this command at the begging of each task.

End

Command	Description	Argument
	Indicates the end of the task.	---

Format

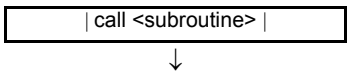
Flowchart method	Text language method
	end

Note It is necessary to have this command at the end of each task.

Call

Command	Description	Argument
	Jumps to <subroutine>.	**Subroutine**: subroutine is identified by a name or alias that you define.

Format

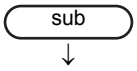
Flowchart method	Text language method
	call <subroutine>

Note 1. When execution of the subroutine is completed, the next command line after the “call” command is executed.

2. To set the subroutine name for the “call” command in flowchart, right-click the command and select [Set Subroutine] from the menu. Select from the displayed options.

Sub

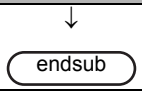
Command	Description	Argument
	Indicates the beginning of the subroutine.	---

Format	
Flowchart method	**Text language method**
	sub

Note It is necessary to have this command at the beginning of each subroutine.

End sub

Command	Description	Argument
	Indicates the end of the subroutine.	---

Format	
Flowchart method	**Text language method**
	endsub

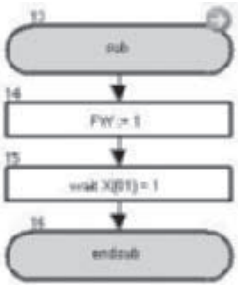
Note It is necessary to have this command at the end of each subroutine.

● Example

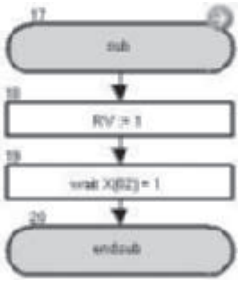
Flowchart

Main

Main: RunFW



Main: RunRV



Text

Main

```
entry
    set-freq := 6000
    UB(0) := 1
:Loop_
    if UB(0) = 1 then
        call RunFW
    else
        call RunRV
    endif
    stop
    wait RUN = 0
    UB(0) := not UB(0)
    goto Loop_
end
```

Main: RunFW

```
sub
    FW := 1
    wait X(01) = 1
endsub
```

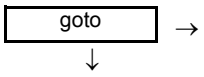
Main: RunRV

```
sub
    RV := 1
    wait X(02) = 1
endsub
```

Block number	Operation
1 and 2	Sets the inverter output frequency to 60.00 Hz and changes the internal user contact UB(0) to ON.
3 to 7	If UB(0) is ON, it executes the subroutine RunFW. If UB(0) is OFF, it executes the subroutine RunRV.
8 to 11	When execution of the subroutine is completed, it stops the inverter, waits for RUN to change to OFF, reverses UB(0), and returns to block 3.
13 to 16	Operates the inverter in the forward direction and waits with the “wait” command until X(01) changes to ON. (subroutine: RunFW)
17 to 20	Operates the inverter in the reverse direction and waits with the “wait” command until X(02) changes to ON. (subroutine: RunRV)

Go To

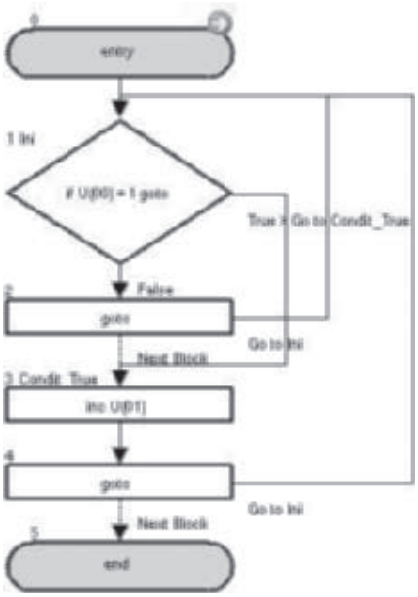
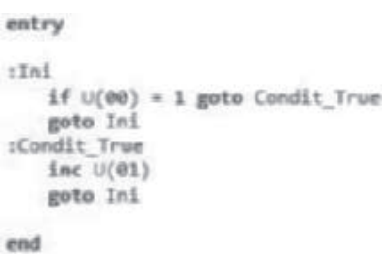
Command	Description	Argument
	Jumps to <label> unconditionally.	**Label**: a name that is used to identify a particular function block in the task.

Format	
Flowchart method	**Text language method**
	goto <label>

Note 1. This command must be connected to the command that is executed next. This is necessary to clarify the program flow.

2. To set the label name in flowchart, right-click the command and select [Set Label] from the menu. You can specify any name.

● Example

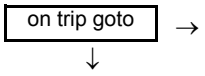
Flowchart	Text
	

```
entry

:Ini
   if U(00) = 1 goto Condit_True
   goto Ini
:Condit_True
   inc U(01)
   goto Ini

end
```

Block number	Operation
1	If U(00) is 1, it jumps to the block 3: Condit_True. If U(00) is 0, it goes to the next block 2.
2	Jumps to the block 1: Ini unconditionally.
3	Adds 1 to U(01).
4	Jumps to the block 1: Ini unconditionally.

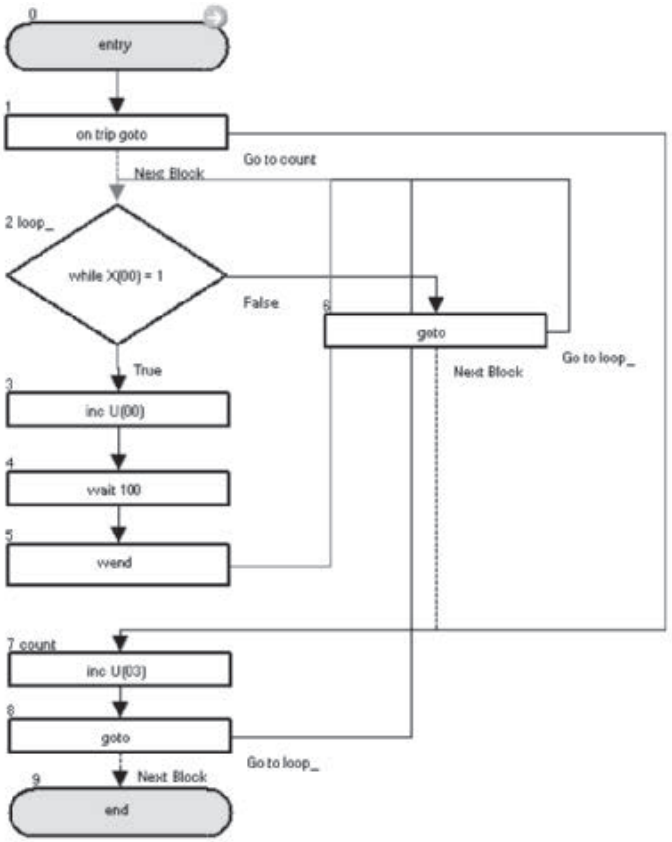
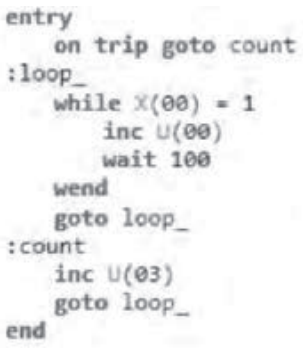
On Trip

Command	Description	Argument
	Jumps to <label> when a trip occurs in the inverter.	**Label**: a name that is used to identify a particular function block in the task.

Format	
Flowchart method	**Text language method**
	on trip goto <label>

Note 1. The “on trip goto” command branches the processing when a trip occurs in the inverter.
2. Once the “on trip goto” command is executed, the execution log is saved in the inverter, and every scanned trip status is checked. When the program reaches the next step after a trip occurred, it jumps to the destination of “goto” command. If there is no trip, nothing is executed.
3. If the “end” command in the task is executed, the “on trip goto” command is canceled and the program does not branch even if a trip occurs.
4. Once the program branches with the “on trip goto” command, it will not branch again under any conditions. Be sure to restart the program after the program branches once with the “on trip goto” command.
5. To set the label name in flowchart, right-click the command and select [Set Label] from the menu. You can specify any name.

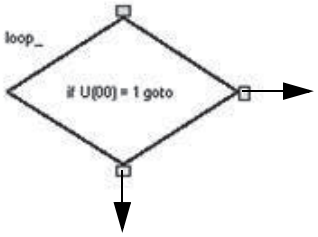
● Example

Flowchart	Text
	


```
entry
    on trip goto count
:loop_
    while X(00) = 1
        inc U(00)
        wait 100
    wend
    goto loop_
:count
    inc U(03)
    goto loop_
end
```

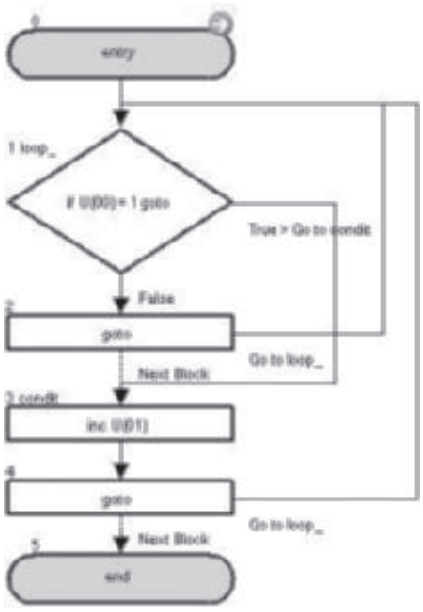
Block number	Operation
1	Executes the “on trip goto” command once so that the program jumps to the block 7: count if a trip occurs.
2 to 6	If X(00) is 1, it adds 1 to U(00), waits for 1.00 second with the “wait” command, and returns to the block 2: loop_. If X(00) is 0, jumps to the block 2: loop_ unconditionally.
7 to 8	Adds 1 to U(03) and jumps to the block 2: loop_ unconditionally.

If		
Command	**Description**	**Argument**
	Jumps to <label> when <condition> is met.	**Condition**: a comparison between two variables or constants with the format <left hand value> <comparison operator> <right hand value>. • Left hand value: any variable or constant (range −128 to 127) • Comparison operator: =, <, >, <=, >=, or <> • Right hand value: any variable or constant (range −128 to 127) **Label**: a name that is used to identify a particular function block in the task.

Format	
Flowchart method	**Text language method**
	if <condition> goto <label>

Note To set the label name in flowchart, right-click the command and select [Set Label] from the menu. You can specify any name.

● Example

Flowchart	Text
	entry :loop_ if U(00) = 1 goto condit goto loop_ :condit inc U(01) goto loop_ end

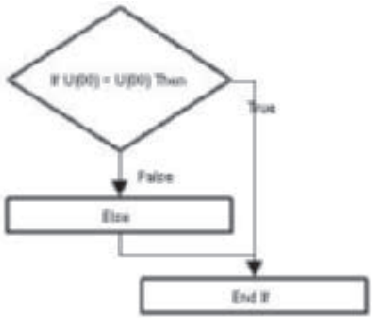
Block number	Operation
1	If U(00) is 1, it jumps to the block 3: condit. If U(00) is not 1, it goes to the next block 2.
2	Jumps to the block 1: loop_ unconditionally.
3 to 4	Adds 1 to U(01) and jumps to the block 1: loop_ unconditionally.

Ifs/Else/End If

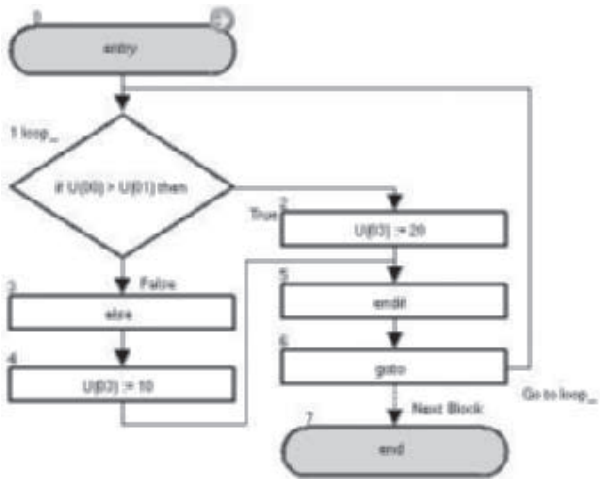
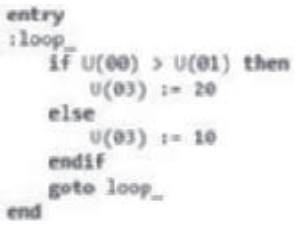
Command	Description	Argument
	If <condition> is met, it executes <command set 1> right after this command until the “else” command, and goes to the next step after the “endif” command. If <condition> is not met, it executes <command set 2> right after the “else” command until the “endif” command, and goes to the next step after the “endif” command.	**Condition**: a comparison between two variables or constants with the format <left hand value> <comparison operator> <right hand value>. • Left hand value: any variable or constant (range −128 to 127) • Comparison operator: =, <, >, <=, >=, or <> • Right hand value: any variable or constant (range −128 to 127) **Command set 1**: one or more commands until the “else” command. It can contain nested commands (up to eight levels). **Command set 2**: one or more commands until the “endif” command. It can contain nested commands (up to eight levels).

Format

Flowchart method	Text language method

	if <condition> then
	<command set 1>
	else
	<command set 2>
	endif

● Example

Flowchart	Text
	

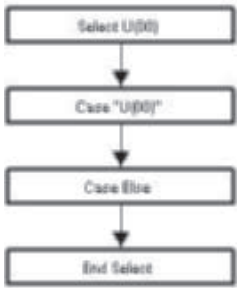
```
entry
:loop_
    if U(00) > U(01) then
        U(03) := 20
    else
        U(03) := 10
    endif
    goto loop_
end
```

Block number	Operation
1 to 5	If U(00) is greater than U(01), it assigns 20 to U(03) right after the “if” and jumps to the “endif” command. If U(00) is not greater than U(01), it assigns 10 to U(03) right after the “else” command and goes to the “endif” command.
6	Jumps to the block 1: loop_ unconditionally.

Select/Case/Case Else/EndSelect

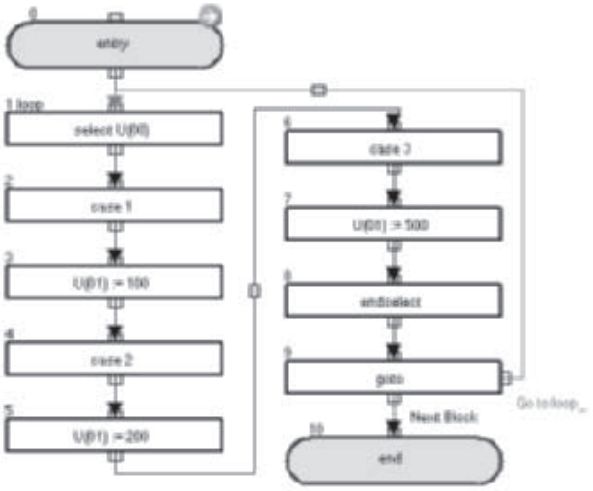
Command	Description	Argument
	Allows the execution of multiple program sections depending on the variable value. Executes <command set n> when <condition variable> matches <condition value n> of any “case” command. Executes <command set for others> (“case else”) when <condition variable> does not match any of condition values of the “case” commands. This command is useful when you need to select among multiple options based on a <condition variable>. This command is also useful to organize programs when it is used with the “call” commands that calls subroutines.	**Condition variable**: a condition variable you use Condition value n: any variable or constant (range −128 to 127) **Command set n**: one or more commands until next “case” or “endselect” command. It can contain nested commands (up to eight levels).

Format

Flowchart method	Text language method
	select <condition variable> case <condition value 1> <command set 1> … case <condition value n> <command set n> … case else <command set for others> endselect

Note A "select” is counted as nesting level 1.
A set of "select” to “endselect” used in a subroutine is counted as nesting level 2.

● Example

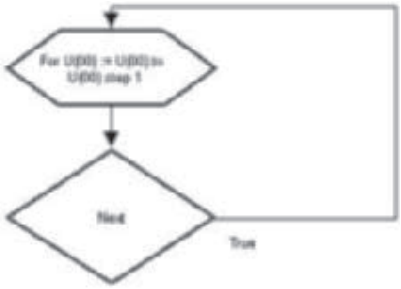
Flowchart	Text
	:loop_ select U(00) case 1 U(01) := 100 case 2 U(01) := 200 case 3 U(01) := 500 endselect goto loop_ end

Block number	Operation
1 to 8	Based on the value of U(00), 100 is assigned to U(01) if U(00) is 1, and 200 is assigned to U(01) if U(00) is 2. In the case 3, 500 is assigned to U(01) and the program jumps to the “endselect” command.
9	Jumps to the block 1: loop_ unconditionally.

For/Next

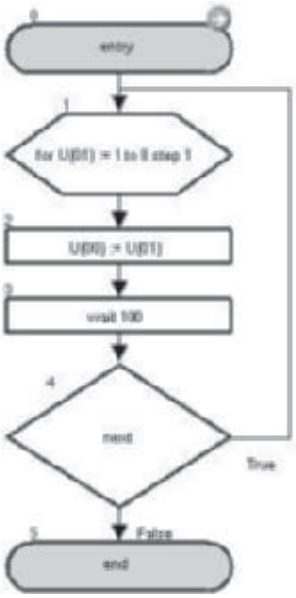
Command	Description	Argument
	Executes <command set> repeatedly until <variable> started with <start value> reaches <end value>. In every time of execution, <incremental value> is added to <variable>. When the “next” command is executed, a judgment with <end value> is executed and <incremental value> is added to <variable>.	**Variable**: any variable **Start value**: initial value. This is the value assigned to the variable in the first loop. Constant (range −128 to 127) **End value**: a value to exit the loop. Constant (range −128 to 127) **Incremental value**: the variable is incremented by this value in each loop. Constant (range −128 to 127) **Command set**: one or more commands until the “next” command. It can contain nested commands (up to eight levels).

Format

Flowchart method	Text language method
	for <variable> : = <start value> to <end value> step <incremental value> <command set> next

● Example

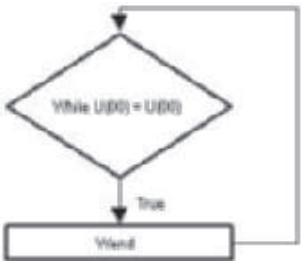
Flowchart	Text

	`entry`
	`  for U(01) := 1 to 8 step 1`
	`  U(00) := U(01)`
	`  wait 100`
	`  next`
	`end`

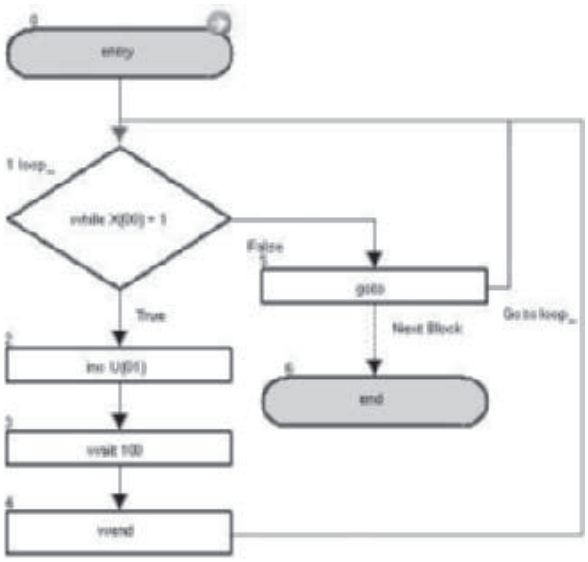
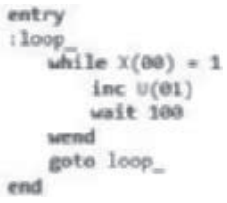
Block number	Operation
1 to 4	Assigns 1 to U(01) and the value of U(01) to U(00). Waits for 1.00 second with the “wait” command. If U(01) is less than 8, 1 is added to U(01) and the next command after “for” is executed. Goes to the next step after the “next” command if U(01) is equal to or greater than 8.

While/Wend

Command	Description	Argument
	Executes <command set> while a condition is met.	**Condition**: a comparison between two variables or constants with the format <left hand value> <comparison operator> <right hand value>. • Left hand value: any variable or constant (range −128 to 127) • Comparison operator: =, <, >, <=, >=, or <> • Right hand value: any variable or constant (range −128 to 127) **Command set**: one or more commands until the “wend” command. It can contain nested commands (up to eight levels).

Format	
Flowchart method	**Text language method**
	while <condition> <command set> wend

● Example

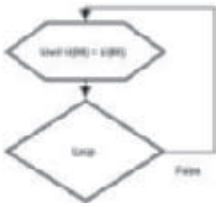
Flowchart	Text
	

```
entry
:loop_
   while X(00) = 1
      inc U(01)
      wait 100
   wend
   goto loop_
end
```

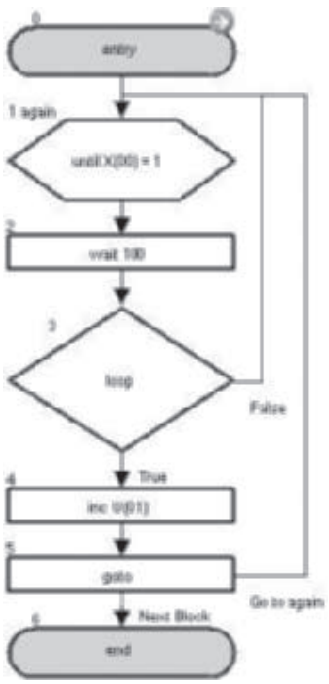
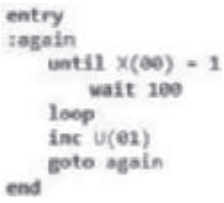
Block number	Operation
1 to 4	If X(00) is 1, it adds 1 to U(01), waits for 1.00 second with the “wait” command, and jumps to the “while” command. If X(00) is not 1, it executes the next command after the “wend” command.
5	Jumps to the block 1: loop_ unconditionally.

Until/Loop

Command	Description	Argument
	Executes <command set> until <condition> is met.	**Condition**: a comparison between two variables or constants with the format <left hand value> <comparison operator> <right hand value>. • Left hand value: any variable or constant (range −128 to 127) • Comparison operator: =, <, >, <=, >=, or <> • Right hand value: any variable or constant (range −128 to 127) **Command set**: one or more commands until the “loop” command. It can contain nested commands (up to eight levels).

Format	
Flowchart method	**Text language method**
	until <condition> <command set> loop

● Example

Flowchart	Text
	


```
entry
:again
    until X(00) = 1
        wait 100
    loop
    inc U(01)
    goto again
end
```

Block number	Operation
1 to 3	If X(00) is not 1, it waits for 1.00 second with the “wait” command and jumps to the “until” command. If X(00) is 1, it executes the “loop” command and goes to the next command.
4 to 5	Adds 1 to U(00) and jumps to the block 1: again unconditionally.

Wait

Command	Description	Argument
	Makes the program wait for specified seconds or until a condition is met.	**Value**: any variable or constant (specified time × 10 ms) Wait time value (0 to 32767 × 10 ms) **Condition**: a comparison between two variables or constants with the format <left hand value> <comparison operator> <right hand value>. • Left hand value: any variable or constant (range 0 to 127) • Comparison operator: =, <, >, <=, >=, or <> • Right hand value: any variable or constant (range 0 to 127)

Format	
Flowchart method	**Text language method**
wait <value> or <condition> ↓	wait <value> or <condition>

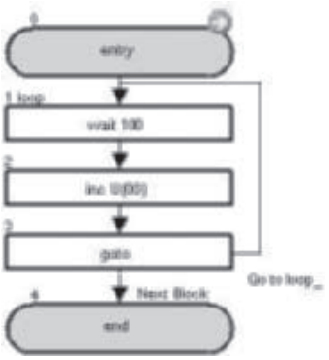
Note 1. With the “wait” command, the program does not go to next command and waits until the set wait time elapses or set condition is met. Therefore, the task processing is not executed during the wait time of the “wait” command. If there is any processing which requires periodic monitoring, separate it and assign it to another task so that it is executed periodically without using the “wait” command.

2. Do not set a negative value for the constant used in the “wait” command.

   Otherwise, the program cannot check if the wait time elapsed or the condition is met, and it continuously stops at the “wait” command without performing any operation.

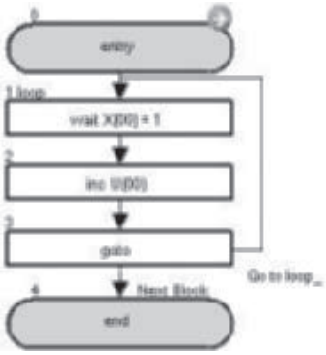
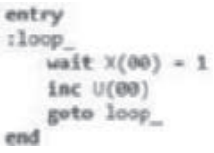
3. The “wait” command is not an accurate way to measure time. To measure time accurately, use the internal timer or the clock function of the LCD Digital Operator.

● A program example in which the wait time is set with <value>: the program waits at the “wait” command for the period of time set in <value>.

Flowchart	Text
	entry :loop_ wait 100 inc U(00) goto loop_ end

Block number	Operation
1	Waits for 1.00 second with the “wait” command.
2 to 3	Adds 1 to U(00) and unconditionally jumps to 1: loop_ to wait one more second.

- **A program example in which the condition to end the wait state is set in <condition>: the program waits until the condition is met.**

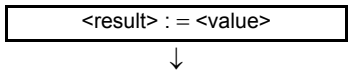
Flowchart	Text
	

Block number	Operation
1	Waits until X(00) changes to 1.
2 to 3	Adds 1 to U(00) and jumps to the block 1: loop_ unconditionally.

6-5 Arithmetic Operation and Logical Operation Commands

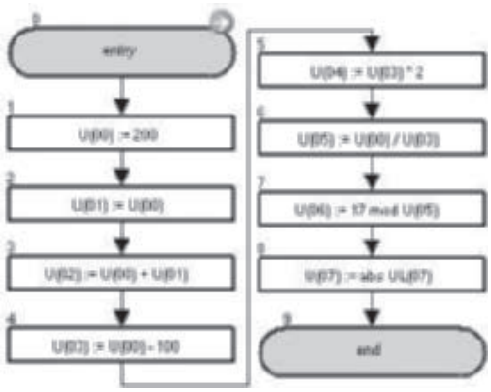
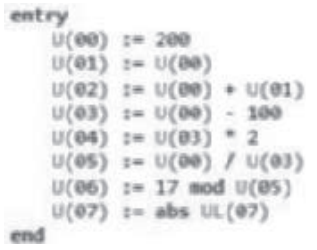
= (Substitution)

Command	Description	Argument
	Assigns <value> to <result>.	**Result**: any variable **Value**: any variable or constant (range –2,147,483,648 to 2,147,483,647)

Format	
Flowchart method	**Text language method**
	<result> : = <value>

Note If an overflow or underflow occurs, the Drive Programming detects it as an error. Take necessary measures in the application so that they do not occur.

● Example

Flowchart	Text
	

Block number	Operation
1	Assigns 200 to U(00).
2	Assigns the value of U(00) to U(01).
3	Assigns the sum of U(00) and U(01) to U(02).
4	Assigns the difference between U(00) and 100 to U(03).
5	Assigns the product of U(03) and 2 to U(04).
6	Assigns the quotient of U(00) and U(03) to U(05).
7	Assigns the remainder after dividing 17 by U(05) to U(06).
8	Assigns the absolute value of UL(07) to U(07).

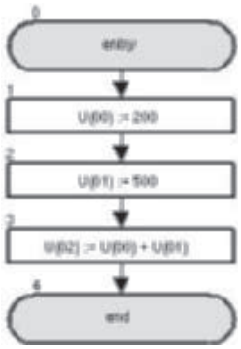
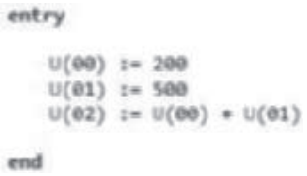
+ (Addition)

Command	Description	Argument
	Adds <value 1> and <value 2>.	**Result**: any variable **Value 1**: any variable or constant (range −128 to 127) **Value 2**: any variable or constant (range −2,147,483,648 to 2,147,483,647)

Format	
Flowchart method	**Text language method**
<result> : = <value 1> + <value 2> ↓	<result> : = <value 1> + <value 2>

Note If an overflow or underflow occurs, the Drive Programming detects it as an error. Take necessary measures in the application so that they do not occur.

● Example

Flowchart	Text
	

Block number	Operation
1	Assigns 200 to U(00).
2	Assigns 500 to U(01).
3	Assigns the sum of U(00) and U(01) to U(02).

− (Subtraction)

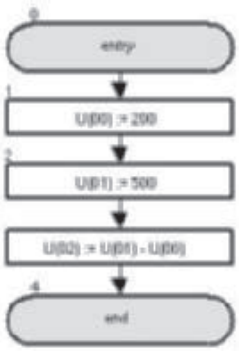
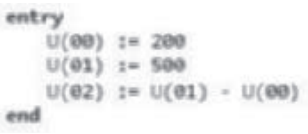
Command	Description	Argument
	Subtracts <value 2> from <value 1>.	**Result**: any variable **Value 1**: any variable or constant (range −128 to 127) **Value 2**: any variable or constant (range −2,147,483,648 to 2,147,483,647)

Format

Flowchart method	Text language method
<result> : = <value 1> − <value 2> ↓	<result> : = <value 1> − <value 2>

Note If an overflow or underflow occurs, the Drive Programming detects it as an error. Take necessary measures in the application so that they do not occur.

● Example

Flowchart	Text
	


```
entry
    U(00) := 200
    U(01) := 500
    U(02) := U(01) - U(00)
end
```

Block number	Operation
1	Assigns 200 to U(00).
2	Assigns 500 to U(01).
3	Assigns the difference between U(01) and U(00) to U(02).

* (Multiplication)

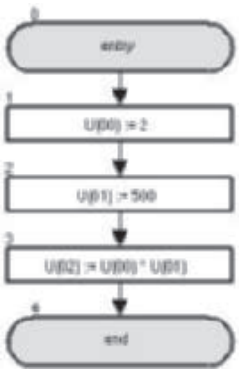
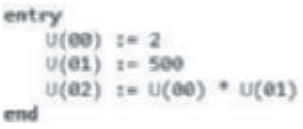
Command	Description	Argument
	Multiplies <value 1> by <value 2>.	**Result**: any variable **Value 1**: any variable or constant (range −128 to 127) **Value 2**: any variable or constant (range −2,147,483,648 to 2,147,483,647)

Format

Flowchart method	Text language method
<result> : = <value 1> * <value 2> ↓	<result> : = <value 1> * <value 2>

Note If an overflow or underflow occurs, the Drive Programming detects it as an error. Take necessary measures in the application so that they do not occur.

● Example

Flowchart	Text
	


```
entry
    U(00) := 2
    U(01) := 500
    U(02) := U(00) * U(01)
end
```

Block number	Operation
1	Assigns 2 to U(00).
2	Assigns 500 to U(01).
3	Assigns the product of U(00) and U(01) to U(02).

/ (Division)

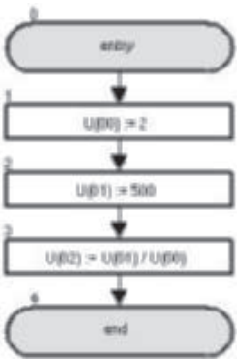
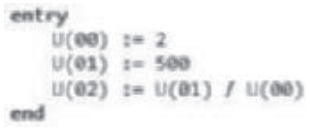
Command	Description	Argument
	Divides <value 1> by <value 2>.	**Result**: any variable **Value 1**: any variable or constant (range −128 to 127) **Value 2**: any variable or constant (range −2,147,483,648 to 2,147,483,647)

Format

Flowchart method	Text language method
<result> : = <value1> / <value2> ↓	<result> : = <value1> / <value2>

Note If an overflow, underflow, or division by zero occurs, the Drive Programming detects it as an error. Take necessary measures in the application so that they do not occur.

● Example

Flowchart	Text
	


```
entry
    U(00) := 2
    U(01) := 500
    U(02) := U(01) / U(00)
end
```

Block number	Operation
1	Assigns 2 to U(00).
2	Assigns 500 to U(01).
3	Assigns the quotient of U(01) and U(00) to U(02).

Mod (Modulo-division)

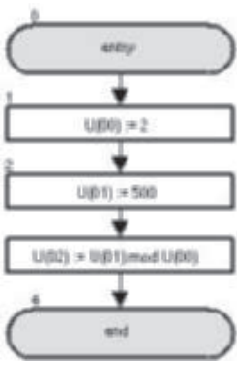
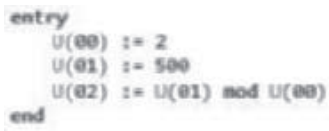
Command	Description	Argument
	Remainder for division of <value 1> by <value 2>.	**Result**: any variable **Value 1**: any variable or constant (range −128 to 127) **Value 2**: any variable or constant (range −2,147,483,648 to 2,147,483,647)

Format

Flowchart method	Text language method
<result> : = <value 1> mod <value 2> ↓	<result> : = <value 1> mod <value 2>

Note If an overflow, underflow, or division by zero occurs, the Drive Programming detects it as an error. Take necessary measures in the application so that they do not occur.

● Example

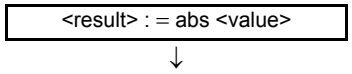
Flowchart	Text
	


```
entry
    U(00) := 2
    U(01) := 500
    U(02) := U(01) mod U(00)
end
```

Block number	Operation
1	Assigns 2 to U(00).
2	Assigns 500 to U(01).
3	Assigns the remainder for division of U(01) and U(00) to U(02).

Abs (Absolute value)

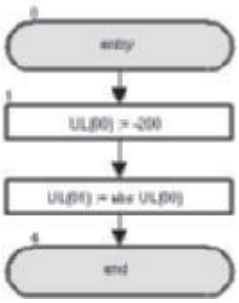
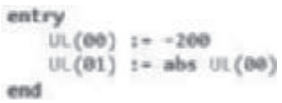
Command	Description	Argument
	Finds the absolute value of <value>.	**Result**: any variable **Value**: any variable or constant (Range −2,147,483,647 to 2,147,483,647)

Format	
Flowchart method	**Text language method**
	<result> : = abs <value>

Note 1. If an overflow or underflow occurs, the Drive Programming detects it as an error. Take necessary measures in the application so that they do not occur.

2. If the variable or the constant is the maximum negative value, −2,147,483,648, it is not possible to convert it to an absolute value. The value −2,147,483,648 is recognized as a negative number as it is.

● Example

Flowchart	Text
	

Block number	Operation
1	Assigns −200 to UL(00).
2	Assigns the absolute value of UL(00) to UL(01).

And (Logical AND)

Command	Description	Argument
	Logical AND on <value 1> and <value 2> in binary format and (Logical AND)	**Result**: any variable **Value 1**: any variable or constant (range −128 to 127) **Value 2**: any variable or constant (range −2,147,483,648 to 2,147,483,647)

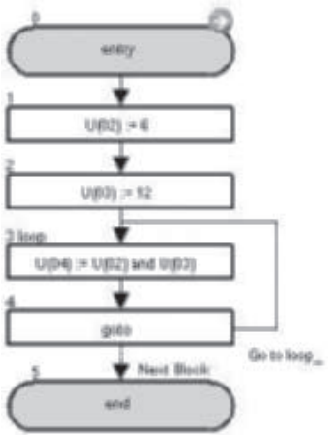
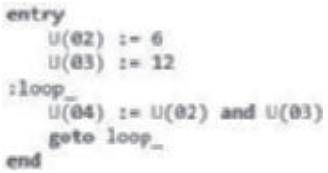
Value 1	Value 2	Result
0	0	0
0	1	0
1	0	0
1	1	1

Format

Flowchart method	Text language method
<result> : = <value 1> and <value 2> ↓	<result> : = <value 1> and <value 2>

Note If an overflow or underflow occurs, the Drive Programming detects it as an error. Take necessary measures in the application so that they do not occur.

● Example

Flowchart	Text
	

Block number	Operation
1	Assigns 6 to U(02).
2	Assigns 12 to U(03).
3	Assigns 4 (binary: 00000100), which is the result of logical AND on 6 (U(02) binary: 00000110) and 12 (U(03) binary: 00001100), to U(04).
4	Jumps to the block 3: loop_ unconditionally.

Or (Logical OR)

Command	Description	Argument
	Logical OR on <value 1> and <value 2> in binary format or (Logical OR)	**Result**: any variable **Value 1**: any variable or constant (range –128 to 127) **Value 2**: any variable or constant (range –2,147,483,648 to 2,147,483,647)

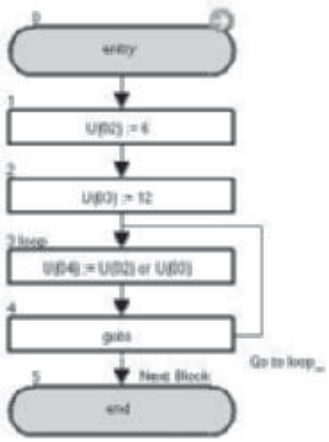
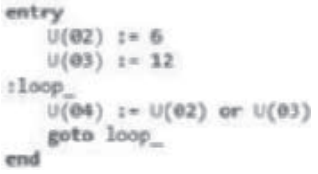
Value 1	Value 2	Result
0	0	0
0	1	1
1	0	1
1	1	1

Format

Flowchart method	Text language method
<result> : = <value 1> or <value 2> ↓	<result> : = <value 1> or <value 2>

Note If an overflow or underflow occurs, the Drive Programming detects it as an error. Take necessary measures in the application so that they do not occur.

● Example

Flowchart	Text
	


```
entry
    U(02) := 6
    U(03) := 12
:loop_
    U(04) := U(02) or U(03)
    goto loop_
end
```

Block number	Operation
1	Assigns 6 to U(02).
2	Assigns 12 to U(03).
3	Assigns 14 (binary: 00001110), which is the result of logical OR on 6 (U(02) binary: 00000110) and 12 (U(03) binary: 00001100), to U(04).
4	Jumps to the block 3: loop_ unconditionally.

XOr (Logical exclusive OR)

Command	Description	Argument
	Logical exclusive OR on <value 1> and <value 2> in binary format. XOr (Logical exclusive OR)	**Result**: any variable **Value 1**: any variable or constant (range −128 to 127) **Value 2**: any variable or constant (range −2,147,483,648 to 2,147,483,647)

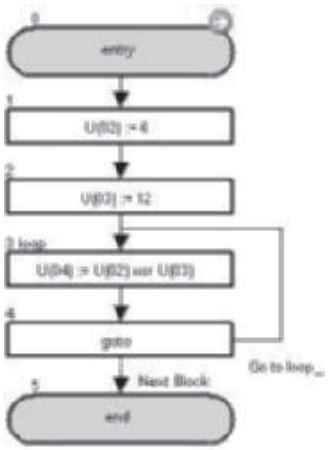
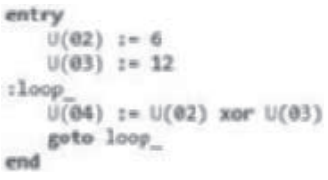
Value 1	Value 2	Result
0	0	0
0	1	1
1	0	1
1	1	0

Format

Flowchart method	Text language method
<result> : = <value 1> xor <value 2> ↓	<result>: = <value 1> xor <value 2>

Note If an overflow or underflow occurs, the Drive Programming detects it as an error. Take necessary measures in the application so that they do not occur.

● Example

Flowchart	Text
	


```
entry
    U(02) := 6
    U(03) := 12
:loop_
    U(04) := U(02) xor U(03)
    goto loop_
end
```

Block number	Operation
1	Assigns 6 to U(02).
2	Assigns 12 to U(03).
3	Assigns 10 (binary: 00001010), which is the result of logical exclusive OR on 6 (U(02) binary: 00000110) and 12 (U(03) binary: 00001100), to U(04).
4	Jumps to the block 3: loop_ unconditionally.

Not (Negation in binary format)

Command	Description	Argument
	Negation on <value 1> in binary format (bit reversal) not (Negation)	**Result**: any variable except variables with bit data size*1 **Value**: any variable except variables and constants with bit data size*1 (range –2,147,483,648 to 2,147,483,647)

Value 1	Result
0	1
1	0

Format

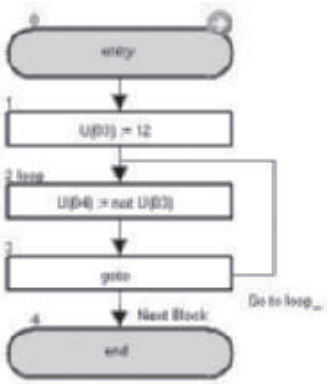
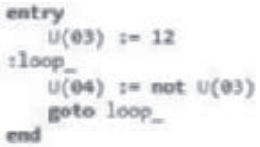
Flowchart method	Text language method
<result> : = not <value> ↓	<result> : = not <value>

*1. You cannot obtain a correct result with commands such as UB(1) = not UB(0).
Use “xor” command to reverse variables with bit data size as shown in the following examples.

- Example 1: UB(1) = UB(0) xor 1
- Example 2: UB(2) = X(00) xor 1

Note If an overflow or underflow occurs, the Drive Programming detects it as an error. Take necessary measures in the application so that they do not occur.

● Example

Flowchart	Text
	


```
entry
    U(03) := 12
:loop_
    U(04) := not U(03)
    goto loop_
end
```

Block number	Operation
1	Assigns 12 to U(03).
2	Assigns 65523 (binary: 111110011), which is the result of negation (bit reversal) on 12 (U(03) binary: 00000110), to U(04).
3	Jumps to the block 3: loop_ unconditionally.

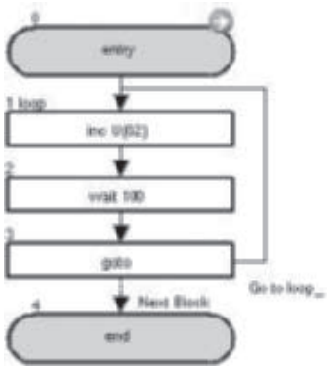
Inc (Increment by 1)

Command	Description	Argument
	Increments <value> by 1.	**Value**: any variable

Format	
Flowchart method	**Text language method**
inc <value> ↓	inc <value>

Note If an overflow or underflow occurs, the Drive Programming detects it as an error. Take necessary measures in the application so that they do not occur.

● Example

Flowchart	Text
	


```
entry
:loop_
    inc U(02)
    wait 100
    goto loop_
end
```

Block number	Operation
1	Adds 1 to U(02).
2	Waits for 1.00 second with the “wait” command.
3	Jumps to the block 1: loop_ unconditionally.

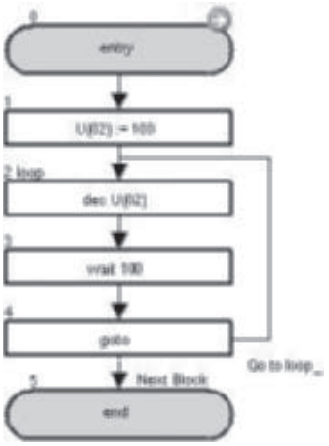
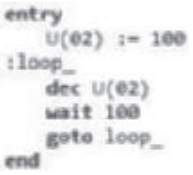
Dec (Decrement by 1)

Command	Description	Argument
	Decrements <value> by 1.	**Value**: any variable

Format	
Flowchart method	**Text language method**
dec <value> ↓	dec <value>

Note If an overflow or underflow occurs, the Drive Programming detects it as an error. Take necessary measures in the application so that they do not occur.

● Example

Flowchart	Text
	


```
entry
   U(02) := 100
:loop_
   dec U(02)
   wait 100
   goto loop_
end
```

Block number	Operation
1	Assigns 100 to U(02).
2	Subtracts 1 from U(02).
3	Waits for 1.00 second with the “wait” command.
4	Jumps to the block 2: loop_ unconditionally.

6-6 I/O Control Commands

Use these I/O control commands to control inputs and outputs. Although you can control I/Os with the = (Assignment) command, the I/O control commands can efficiently use the program capacity because their arguments require smaller data size.

var = X(i)		
Command	**Description**	**Argument**
	Assigns one bit of the status of the input terminal variable to <variable>.	**variable**: any variable (the variable value is 0 or 1) i: input terminal variable (range 00 to 07)

Format	
Flowchart method	**Text language method**
<variable> : = X(i) ↓	<variable> : = X(i)

Note The input terminal variable is a variable that detects the status of the inverter's input terminal. The following settings are required. The numerical order of input terminal variables follows the numerical order of the set general-input numbers.

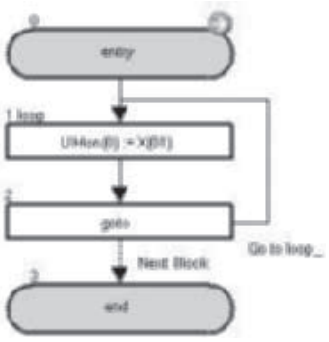
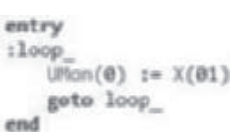
MX2: Set the Multi-function Input S1 to S7 Selection (C001 to C007) to 56 to 62 (MI1 to MI7: General-purpose input). Set the Pulse Train Input RP Selection (P003) to 02 (MI8: General-purpose input 8 for Drive Programming).

RX: Set the Multi-function Input S1 to S8 Selection (C001 to C008) to 56 to 63 (MI1 to MI8: General-purpose input).

<Assignment example>
X(00) = MI1 (function No. 56)
X(01) = MI2 (function No. 57)
X(02) = MI3 (function No. 58)
X(03) = MI4 (function No. 59)
X(04) = MI5 (function No. 60)
X(05) = MI6 (function No. 61)
X(06) = MI7 (function No. 62)
X(07) = MI8 (MX2: P003 = 02/RX: function No. 63)

Note For details, refer to *5-2 Input/Output Terminal Variables* on page 5-5.

● Example

Flowchart	**Text**
	

In the above example, the status of the input terminal X(01) is monitored with the parameter UMon(0) (d025).

Block number	**Operation**
1	Assigns X(01) to UMon(0).
2	Jumps to the block 1: loop_ unconditionally.

var = Xw		
Command	**Description**	**Argument**
	Assigns the status of the input terminal variable to <variable> in units of words.	**Variable**: any variable

Format	
Flowchart method	**Text language method**
<variable> : = Xw ↓	<variable> : = Xw

Note The input terminal variable is a variable that detects the status of the inverter's input terminal. The following settings are required. The numerical order of input terminal variables follows the numerical order of the set general-input numbers.

MX2: Set the Multi-function Input S1 to S7 Selection (C001 to C007) to 56 to 62 (MI1 to MI7: General-purpose input). Set the Pulse Train Input RP Selection (P003) to 02 (MI8: General-purpose input 8 for Drive Programming).

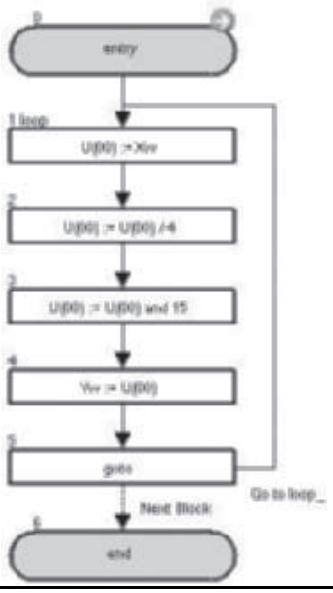
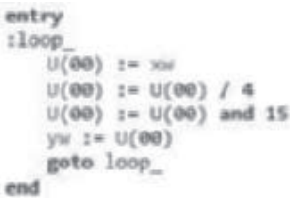
RX: Set the Multi-function Input S1 to S8 Selection (C001 to C008) to 56 to 63 (MI1 to MI8: General-purpose input).

When the data is assigned in units of words, zero is read out for the upper byte data and unset input terminal variables.

<Assignment example>
X(00) = MI1 (function No. 56) to Xw = 1 (bit 0)
X(01) = MI2 (function No. 57) to Xw = 2 (bit 1)
X(02) = MI3 (function No. 58) to Xw = 4 (bit 2)
X(03) = MI4 (function No. 59) to Xw = 8 (bit 3)
X(04) = MI5 (function No. 60) to Xw = 16 (bit 4)
X(05) = MI6 (function No. 61) to Xw = 32 (bit 5)
X(06) = MI7 (function No. 62) to Xw = 64 (bit 6)
X(07) = MI8 (MX2: P003 = 02/RX: function No. 63) to Xw = 128 (bit 7)

For details, refer to *5-2 Input/Output Terminal Variables* on page 5-5.

● Example

Flowchart	Text
	

```
entry
:loop_
    U(00) := Xw
    U(00) := U(00) / 4
    U(00) := U(00) and 15
    Yw := U(00)
    goto loop_
end
```

In the above example, the status of the input terminals X(02) to X(05) is captured and output to the output terminals Y(00) to Y(03).

Block number	Operation
1	Assigns the value of Xw (value of input terminal) to U(00).
2	Divides the value of U(00) by 4 (2-bit right shift) to assign X(02) to bit 0.
3	Performs a logical AND operation on U(00) and 15 (binary: 00001111) and changes the bits higher than X(06) to zero.
4	Assigns U(00) to Yw.
5	Jumps to the block 1: loop_ unconditionally.

Y(i) = value

Command	Description	Argument
	Outputs data to the output terminal variable in units of bits.	**i**: output terminal variable (range 0 to 6) **Value**: any variable or constant

Format	
Flowchart method	**Text language method**
Y(i) : = <value> ↓	Y(i) : = <value>

Note The output terminal variable is a variable that controls the status of the inverter's output terminal. The following settings are required. The numerical order of the output terminal variables follows the numerical order of the set general-output numbers.

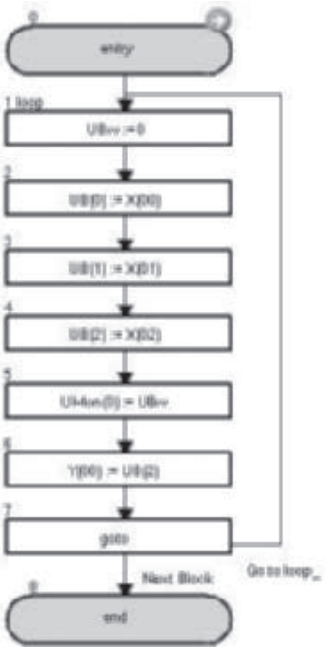
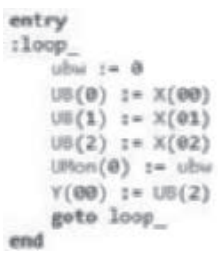
MX2: Set the Multi-function Output P1 and P2 Selection (C021 and C022) and the Multi-function Relay Output (MA, MB) Function Selection (C026) to 44 to 46 (MO1 to MO3: General-purpose output).

RX: Set the Multi-function Output P1 to P5 Selection (C021 to C025) and the Multi-function Relay Output (MA, MB) Function Selection (C026) to 44 to 49 (MO1 to MO6: General-purpose output).

<Assignment example>
Y(00) = MO1 (multi-function No. 44)
Y(01) = MO2 (multi-function No. 45)
Y(02) = MO3 (multi-function No. 46)
Y(03) = MO4 (RX only: multi-function No. 47)
Y(04) = MO5 (RX only: multi-function No. 48)
Y(05) = MO6 (RX only: multi-function No. 49)

For details, refer to *5-2 Input/Output Terminal Variables* on page 5-5.

● Example

Flowchart	Text
	

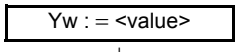
```
entry
:loop_
    ubw := 0
    UB(0) := X(00)
    UB(1) := X(01)
    UB(2) := X(02)
    UMon(0) := ubw
    Y(00) := UB(2)
    goto loop_
end
```

In the above example, the status of X(00) to X(02) is monitored with the parameter UMon(0) (d025), and X(02) is output to Y(00).

Block number	Operation
1	Assigns 0 to UBw.
2 to 4	Assigns the variables X(00) to X(02) to the variables UB(0) to UB(2).
5	Assigns UBw to UMon(0).
6	Assigns UB(2) to Y(00).
7	Jumps to the block 1: loop_ unconditionally.

Yw = value

Command	Description	Argument
	Outputs data to the output terminal variable in units of words. Reflect each bit in corresponding output.	**Value**: any variable or constant

Format	
Flowchart method	**Text language method**
	Yw : = <value>

Note The output terminal variable is a variable that controls the status of the inverter's output terminal. The following settings are required. The numerical order of the output terminal variables follows the numerical order of the set general-output numbers.

MX2: Set the Multi-function Output P1 and P2 Selection (C021 and C022) and the Multi-function Relay Output (MA, MB) Function Selection (C026) to 44 to 46 (MO1 to MO3: General-purpose output).

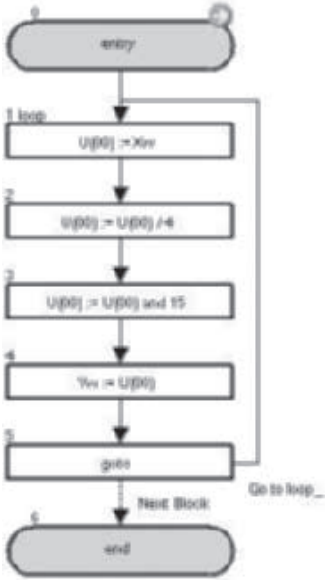
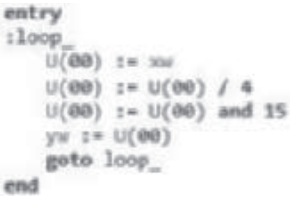
RX: Set the Multi-function Output P1 to P5 Selection (C021 to C025) and the Multi-function Relay Output (MA, MB) Function Selection (C026) to 44 to 49 (MO1 to MO6: General-purpose output).

When the data is assigned in units of words, zero is read out for the upper byte data and unset input terminal variables. If there is any setting, the setting is ignored.

<Assignment example>
Yw = 1 (bit 0) to Y(00) = MO1 (multi-function No. 44)
Yw = 2 (bit 1) to Y(01) = MO2 (multi-function No. 45)
Yw = 4 (bit 2) to Y(02) = MO3 (multi-function No. 46)
Yw = 8 (bit 3) to Y(03) = MO4 (RX only: multi-function No. 47)
Yw = 16 (bit 4) to Y(04) = MO5 (RX only: multi-function No. 48)
Yw = 32 (bit 5) to Y(05) = MO6 (RX only: multi-function No. 49)

For details, refer to *5-2 Input/Output Terminal Variables* on page 5-5.

● Example

Flowchart	Text
	

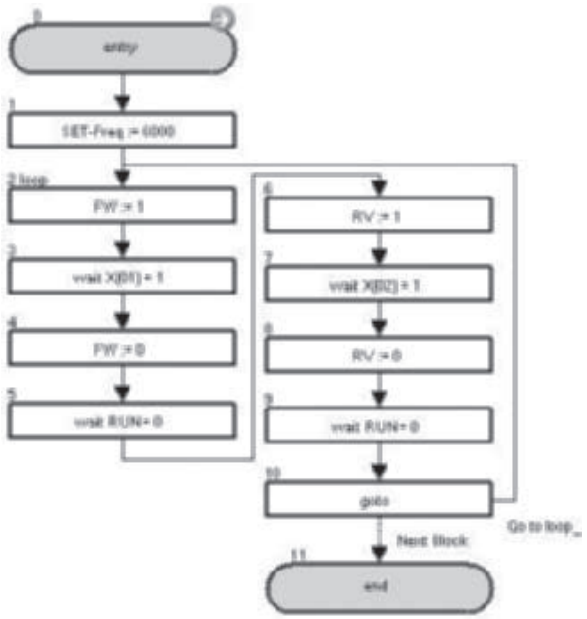
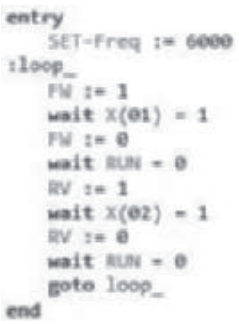
```
entry
:loop_
    U(00) := Xw
    U(00) := U(00) / 4
    U(00) := U(00) and 15
    Yw := U(00)
    goto loop_
end
```

In the above example, the status of the input terminals X(02) to X(05) is captured and output to the output terminals Y(00) to Y(03).

Block number	Operation
1	Assigns the value of Xw (value of input terminal) to U(00).
2	Divides the value of U(00) by 4 (2-bit right shift) to assign X(02) to bit 0.
3	Performs a logical AND operation on U(00) and 15 (binary: 00001111) and changes the bits higher than X(06) to zero.
4	Assigns U(00) to Yw.
5	Jumps to the block 1: loop_ unconditionally.

func = value		
Command	**Description**	**Argument**
	Assigns <value> to the multi-function input variable.	**Function**: any function bit of the multi-function input variable (refer to *5-6 Multi-function Input Variables* on page 5-17 for details on each bit.) **Value**: any variable or constant
Format		
Flowchart method		**Text language method**
<function> : = <value> ↓		<function> : = <value>

● Example

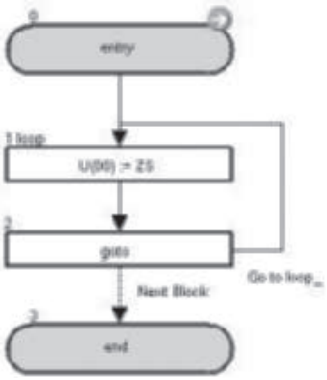
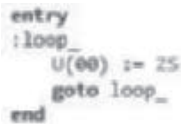
Flowchart	**Text**
	

In the above example, the following operation is repeated: a forward operation is performed at 60.00 Hz until X(01) changes to ON. Then, a reverse operation is performed until X(02) changes to ON.

Block number	Operation
1	Sets the output frequency to 60.00 Hz.
2	Operates the inverter in the forward direction.
3 to 5	Waits until X(01) changes to ON, stops the inverter and waits with the “wait” command until the inverter completely stops.
6	Operates the inverter in the reverse direction.
7 to 9	Waits until X(02) changes to ON, stops the inverter and waits with the “wait” command until the inverter completely stops.
10	Jumps to the block 2: loop_ unconditionally.

var = func		
Command	**Description**	**Argument**
	Assigns the status of the multi-function output variable to <variable>.	**Variable**: any variable **Function**: any bit of the multi-function output variable
Format		
Flowchart method		**Text language method**
<variable> : = <function> ↓		<variable> : = <function>
For details, refer to *5-7 Multi-function Output Variables* on page 5-20.		

● Example

Flowchart	Text
	

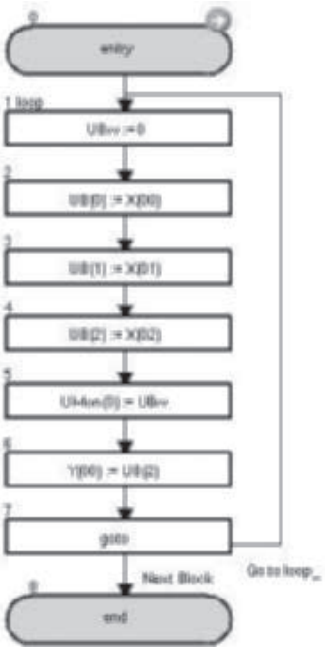
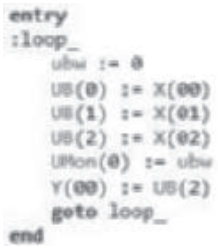

```
entry
:loop_
   U(00) := ZS
   goto loop_
end
```

In the above example, 1 is assigned to U(00) when ZS (0 Hz detection signal) is ON, and 0 is assigned to U(00) when ZS (0 Hz detection signal) is OFF.

Block number	Operation
1	Assigns the status of ZS to U(00).
2	Jumps to the block 1: loop_ unconditionally.

var = UB(i)		
Command	**Description**	**Argument**
	Assigns one bit of the value of the internal user contact to <variable>.	**Variable**: any variable (value of the variable is 0 or 1.) **i**: internal user contact number (range 0 to 7)
Format		
Flowchart method		**Text language method**
<variable> : = UB(i) ↓		<variable> : = UB(i)

● Example

Flowchart	**Text**
	


```
entry
:loop_
    ubw := 0
    UB(0) := X(00)
    UB(1) := X(01)
    UB(2) := X(02)
    UMon(0) := ubw
    Y(00) := UB(2)
    goto loop_
end
```

In the above example, the status of X(00) to X(02) is monitored with the parameter UMon(0) (d025), and X(02) is output to Y(00).

Block number	Operation
1	Assigns 0 to UBw.
2 to 4	Assigns the variables X(00) to X(02) to the variables UB(0) to UB(2).
5	Assigns UBw to UMon(0).
6	Assigns UB(2) to Y(00).
7	Jumps to block 1: loop_ unconditionally.

var = UBw

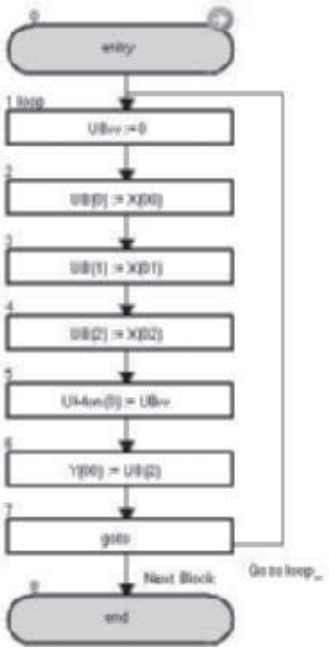
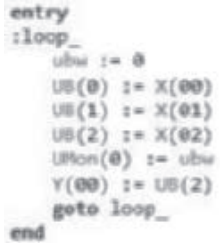
Command	Description	Argument
	Assigns the value of the internal user contact to <variable> in units of words.	**Variable**: any variable

Format	
Flowchart method	**Text language method**
<variable> : = UBw ↓	<variable> : = UBw

Note When the data is assigned in units of words, zero is read out for the unused upper byte. If there is any setting, the setting is ignored.

UB(0) to UBw = 1 (bit 0)
UB(1) to UBw = 2 (bit 1)
UB(2) to UBw = 4 (bit 2)
UB(3) to UBw = 8 (bit 3)
UB(4) to UBw = 16 (bit 4)
UB(5) to UBw = 32 (bit 5)
UB(6) to UBw = 64 (bit 6)
UB(7) to UBw = 128 (bit 7)

● Example

Flowchart	Text
	

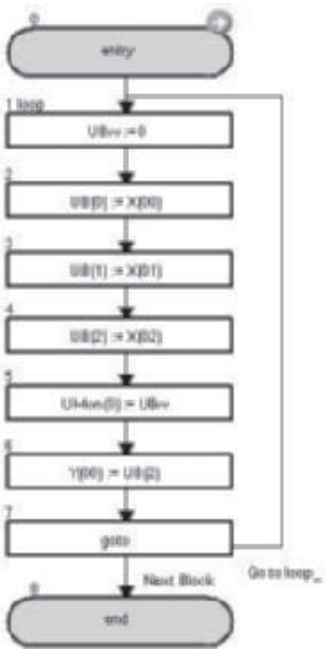
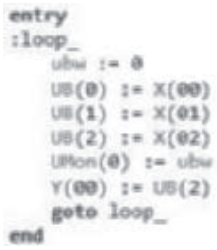

```
entry
:loop_
    ubw := 0
    UB(0) := X(00)
    UB(1) := X(01)
    UB(2) := X(02)
    UMon(0) := ubw
    Y(00) := UB(2)
    goto loop_
end
```

In the above example, the status of X(00) to X(02) is monitored with the parameter UMon(0) (d025), and X(02) is output to Y(00).

Block number	Operation
1	Assigns 0 to UBw.
2 to 4	Assigns the variables X(00) to X(02) to the variables UB(0) to UB(2).
5	Assigns UBw to UMon(0).
6	Assigns UB(2) to Y(00).
7	Jumps to the block 1: loop_ unconditionally.

UB(i) = value		
Command	**Description**	**Argument**
	Assigns <value> to the internal user contact.	**i**: internal user contact number (range 0 to 7) **Value**: any variable or constant
Format		
Flowchart method		**Text language method**
UB(i) : = <value> ↓		UB(i) : = <value>

● Example

Flowchart	Text
	

In the above example, the status of X(00) to X(02) is monitored with the parameter UMon(0) (d025), and X(02) is output to Y(00).

Block number	Operation
1	Assigns 0 to UBw.
2 to 4	Assigns the variables X(00) to X(02) to the variables UB(0) to UB(2).
5	Assigns UBw to UMon(0).
6	Assigns UB(2) to Y(00).
7	Jumps to the block 1: loop_ unconditionally.

UBw = value

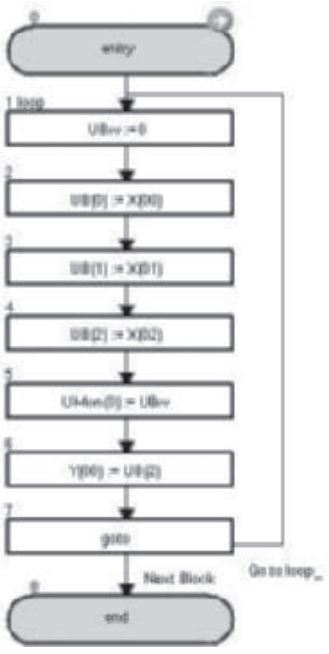
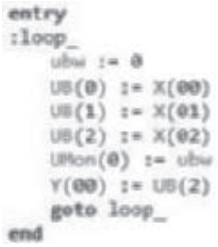
Command	Description	Argument
	Assigns <value> to the internal user contact in units of words.	**Value**: any variable or constant

Format	
Flowchart method	**Text language method**
UBw : = <value> ↓	UBw : = <value>

Note When the data is assigned in units of words, zero is read out for the unused upper byte. If there is any setting, the setting is ignored.

UBw = 1 (bit 0) to UB(0)
UBw = 2 (bit 1) to UB(1)
UBw = 4 (bit 2) to UB(2)
UBw = 8 (bit 3) to UB(3)
UBw = 16 (bit 4) to UB(4)
UBw = 32 (bit 5) to UB(5)
UBw = 64 (bit 6) to UB(6)
UBw = 128 (bit 7) to UB(7)

● Example

Flowchart	Text
	

```
entry
:loop_
    ubw := 0
    UB(0) := X(00)
    UB(1) := X(01)
    UB(2) := X(02)
    UMon(0) := ubw
    Y(00) := UB(2)
    goto loop_
end
```

In the above example, the status of X(00) to X(02) is monitored with the parameter UMon(0) (d025), and X(02) is output to Y(00).

Block number	Operation
1	Assigns 0 to UBw.
2 to 4	Assigns the variables X(00) to X(02) to the variables UB(0) to UB(2).
5	Assigns UBw to UMon(0).
6	Assigns UB(2) to Y(00).
7	Jumps to the block 1: loop_ unconditionally.

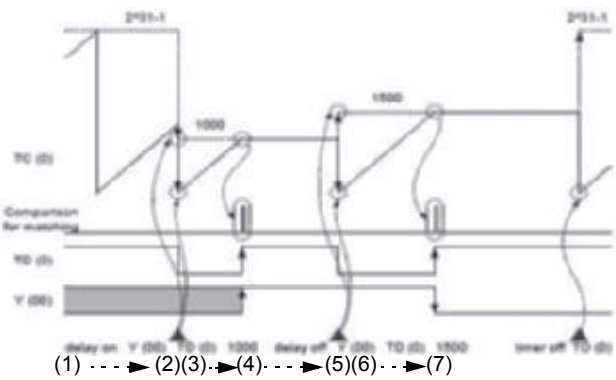
6-7 Timer Control Commands

Delay on/off		
Command	**Description**	**Argument**
	Starts the timer(k). The the timer counter TC(k) is started with 0 and incremented every 10 ms until it reaches <value 2>. When <value 2> is reached, the timer contact TD(k) changes to ON and the processing (on or off) specified for <value 1> is executed.	**on/off**: operation setting (on/off) after the delay time **Value 1**: any contact variable or variable **Value 2**: any variable or constant (specified time × 10 ms) **TD(k)**: the timer output contact of the timer that you use (range of k is 0 to 7)
Format		
Flowchart method		**Text language method**
delay on/off <value 1> TD(k) <value 2> ↓		delay on/off <value 1> TD(k) <value 2>

Note 1. The timer (k) is started when the “delay on/off” command is executed. If TD(k) is ON, it is changed to OFF when the timer (k) is started. However, the variable of <value 1> does not change from its original value.
After the timer (k) is started, the program goes to the next command.

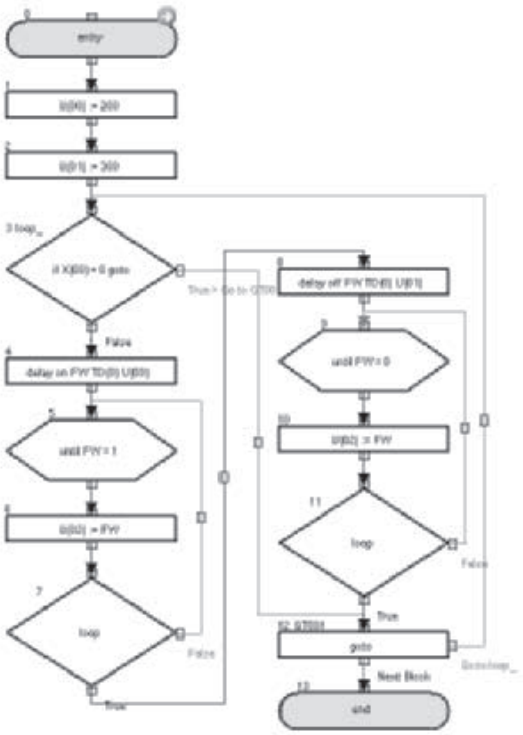
2. When the “delay on/off” command is executed, the data of <value 1>, TD(k) and <value 2> are saved internally. Even if the variable values set to <value 1> and <value 2> are changed after the “delay on/off” command is executed, the operation of the command does not change.
3. After the “delay on/off” command is executed, if the same timer (k) is restarted before its processing is completed, the ongoing processing is canceled and the timer (k) is started with the new settings. Therefore, create a program so that the timer (k) which is started once is not restarted until its processing is completed.
4. You can monitor the data of the started timer (k) with the timer counter variable TC(k). Check the completion of the timer processing with the timer output contact TD(k) (changes ON at completion).

● Timing chart



(1) The timer is in a free-run state.
(2) The “delay on” command is started.
(3) The delay operation is in progress.
(4) The time elapsed.
(5) The “delay off” command is started.
(6) The delay operation is in progress.
(7) The time elapsed.

● Example

Flowchart	Text
	entry U(00) := 200 U(01) := 300 :loop_ if X(00) = 0 goto GT001 delay on FW TD(0) U(00) until FW = 1 U(02) := FW loop delay off FW TD(0) U(01) until FW = 0 U(02) := FW loop :GT001 goto loop_ end

In the above example, when X(00) is not 0, a forward operation is started with the “delay on” command and the operation is stopped with the “delay off” command.

Block number	Operation
1	Assigns 200 to U(00).
2	Assigns 300 to U(01).
3	Jumps to the block 8: GT001 if X(00) is 0. Goes to the next step if X(00) is not 0.
4	Starts the timer (0) for the set value U(00) with the “delay on” command.
5 to 7	Assigns the status of FW to U(02) until FW changes to 1. Goes to the next step when FW changes to 1.
8	Starts the timer (0) for the set value U(01) with the “delay off” command.
9 to 11	Assigns the status of FW to U(02) until FW changes to 0. Goes to the next step when FW changes to 0.
12	Jumps to the block 3: loop_ unconditionally.

Timer set		
Command	**Description**	**Argument**
	Starts the timer (k). The the timer counter TC(k) is started with 0 and incremented every 10 ms until it reaches <value>. When <value> is reached, the timer contact TD(k) changes to ON.	**TD(k)**: the timer output contact of the timer that you use (range of k is 0 to 7) **Value**: any variable or constant (specified time × 10 ms)
Format		
Flowchart method		**Text language method**
timer set TD(k) <value> ↓		timer set TD(k) <value>

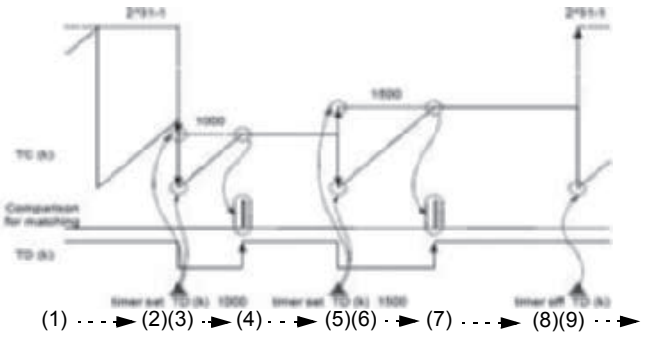
Note 1. The timer (k) is started when the “timer set” command is executed. If TD(k) is ON, it is changed to OFF when the timer (k) is started. After the timer (k) is started, the program goes to the next command.

2. When the “timer set” command is executed, the data of TD(k) and <value> are saved internally. Even if the variable values set to <value> is changed after the “timer set” command is executed, the operation of the command does not change.

3. After the “timer set” command is executed, if the same timer (k) is restarted before its processing is completed, the ongoing processing is canceled and the timer (k) is started with the new settings. Therefore, create a program so that the timer (k) which is started once is not restarted until its processing is completed.

4. You can monitor the data of the started timer (k) with the timer counter variable TC(k). Check the completion of the timer processing with the timer output contact TD(k) (changes ON at completion).

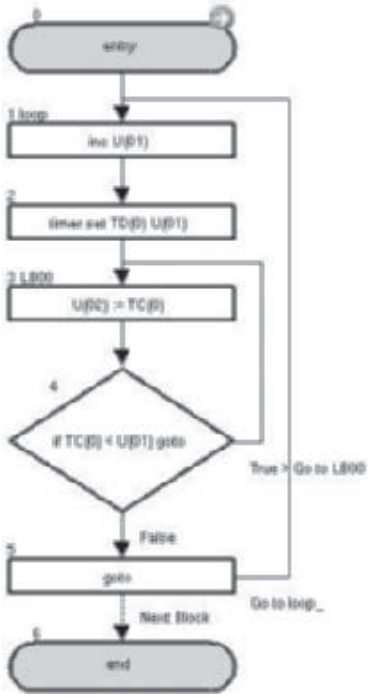
● Timing chart



(1) The timer is in a free-run state.
(2) The “timer set” command is started.
(3) The delay operation is in progress.
(4) The time elapsed.
(5) The “timer set” command is started.
(6) The delay operation is in progress.
(7) The time elapsed.
(8) The “timer off” command is started.
(9) The timer is in a free-run state.

● Example

Flowchart	Text

	`entry`
	`:loop_`
	`  inc U(01)`
	`  timer set TD(0) U(01)`
	`:LB00`
	`  U(02) := TC(0)`
	`  if TC(0) < U(01) goto LB00`
	`  goto loop_`
	`end`

In the above example, the set value of TD(0) is incremented by 1 every time the timer execution is completed, and the time required for each loop gets longer every execution. The current value of the timer is reflected in U(02).

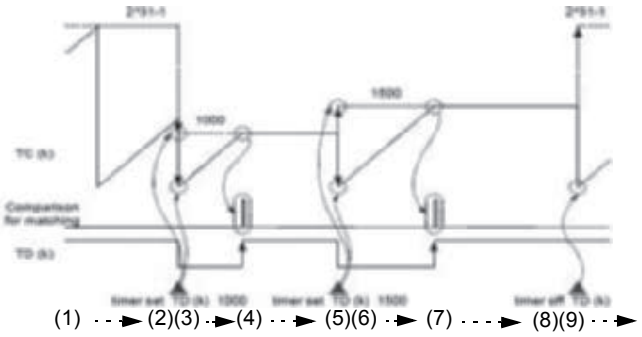
Block number	Operation
1	Adds 1 to U(01).
2	Starts the timer (0) for the “timer set” command with the set value U(01).
3	Assigns the current value TC(0) of the timer (0) to U(02).
4	Jumps to the block 3: LB00 if the current value TC(0) of the timer (0) is less than the set value U(01). In other cases, the program goes to the next step.
5	Jumps to the block 1: loop_ unconditionally.

Timer Off

Command	Description	Argument
	Resets the timer counter TC(k) to 0 and starts the timer in free-run mode.	**TD(k)**: the timer output contact of the timer that you use (range of k is 0 to 7)

Format	
Flowchart method	**Text language method**
timer off TD(k) ↓	timer off TD(k)

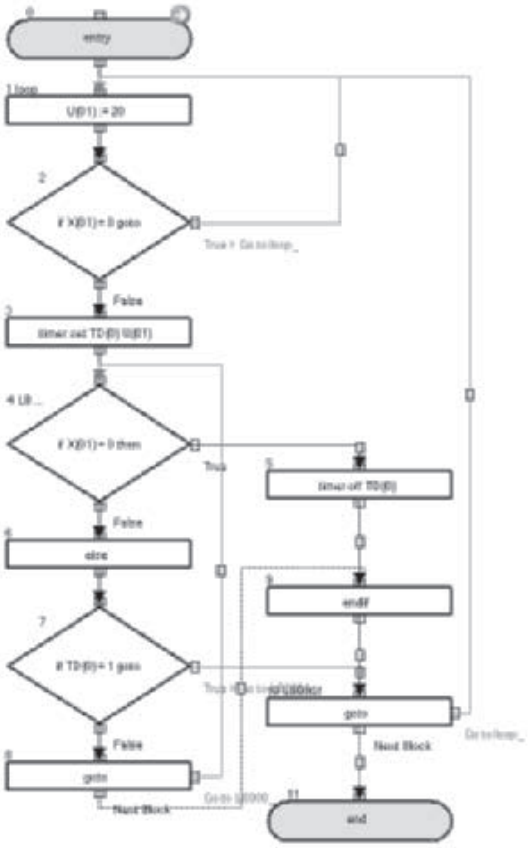
● Timing chart



(1) The timer is in a free-run state.
(2) The “timer set” command is started.
(3) The delay operation is in progress.
(4) The time elapsed.
(5) The “timer set” command is started.
(6) The delay operation is in progress.
(7) The time elapsed.
(8) The “timer off” command is started.
(9) The timer is in a free-run state.

● Example

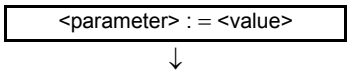
Flowchart	Text

	entry
	:loop_
	U(01) := 20
	if X(01) = 0 goto loop_
	timer set TD(0) U(01)
	:LB000_
	if X(01) = 0 then
	timer off TD(0)
	else
	if TD(0) = 1 goto LB0001_
	goto LB000_
	endif
	:LB0001_
	goto loop_
	end

In the above example, the start/end operation of the timer (0) is repeated when X(01) is not 0. If X(01) changes to 0, the timer is stopped and X(01) is monitored.

Block number	Operation
1	Assigns 20 to U(01).
2	Jumps to the block 1: loop_ if X(01) is 0. Goes to the next step if X(01) is not 0.
3	Starts the timer (0) for the “timer set” command with the set value U(01).
4 to 9	Monitors X(01) and jumps to the block 10: LB0001_ when TD(0) is 1 and X(01) is not 0. When X(01) changes to 0, the timer (0) stops and the program goes to the next step.
10	Jumps to the block 1: loop_ unconditionally.

6-8 Parameter Control Commands

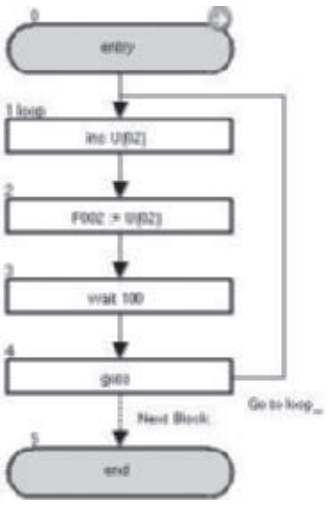
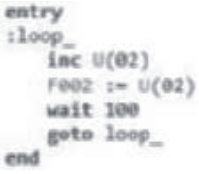
ChgParam		
Command	**Description**	**Argument**
	Changes the data of the inverter parameter specified in <parameter> to <value>. You can change any inverter parameter.	**Parameter**: parameter code (Fxxx, Axxx, bXXX, Cxxx, Hxxx, or Pxxx) **Value**: any variable or constant
Format		
Flowchart method		**Text language method**
		<parameter> : = <value>

Note 1. Similar to the settings with the inverter's Digital Operator, each parameter has the following restrictions. If any of the event listed in the restrictions occurs, the inverter detects the command error 1 (E45) and the Drive Programming program is stopped. For details on restrictions for each parameter, refer to *Section 7 Precautions for Use of Parameters for Drive Programming* and the MX2 User's Manual (I570-E2) or the RX User's Manual (I560-E2).

- Data that exceeds the setting range was set to the parameter.
- A matching error occurred between the parameter to set and relevant parameters.
- A function which is not available with the selected mode was set.
- The parameter that cannot be changed during operation was changed during operation.
- A parameter was set while parameter data change is prohibited with the Soft Lock Selection (b031).

2. Even if you change the set parameter data by using the “ChgParam” command, the data of the corresponding parameter is not changed in the EEPROM. To change the data both in the program and in the EEPROM, execute the “ChgParam” command immediately after the “eepwrt” command.

● Example

Flowchart	Text
	

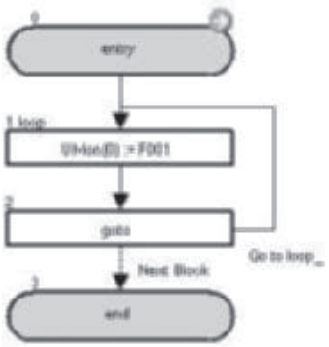
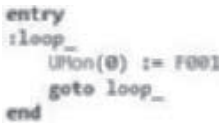
```
entry
:loop_
    inc U(02)
    F002 := U(02)
    wait 100
    goto loop_
end
```

In the above example, the value of F002 (1st Acceleration Time 1) is incremented by 1 every second.

Block number	Operation
1	Adds 1 to U(02).
2	Assigns U(02) to the parameter F002.
3	Waits for 1.00 second with the “wait” command.
4	Jumps to the block 1: loop_ unconditionally.

MonParam		
Command	**Description**	**Argument**
	Assigns the content of the inverter parameter specified in <parameter> to <variable>.	**Parameter**: parameter code (Fxxx, Axxx, bxxx, Cxxx, dxxx, Hxxx, or Pxxx) **Variable**: any variable
Format		
Flowchart method		**Text language method**
<variable> : = <parameter> ↓		<variable> : = <parameter>

● Example

Flowchart	Text
	

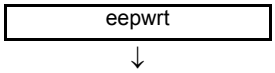

```
entry
:loop_
   UMon(0) := F001
   goto loop_
end
```

In the above example, the value of the parameter F001 (Output Frequency Setting/Monitor) is assigned to the parameter UMon(0) (d025) (User Monitor) and monitored.

Block number	Operation
1	Assigns the parameter F001 to UMon(0).
2	Jumps to the block 1: loop_ unconditionally.

EepWrt

Command	Description	Argument
	Enables the “ChgParam” command executed immediately after this command to write data in the EEPROM.	---

Format	
Flowchart method	**Text language method**
	eepwrt

Note 1. Set the parameter data with the “ChgParam” command immediately after executing the “eepwrt” command.

The parameter data is changed in the program, and also saved in the EEPROM. You can use the data saved in the EEPROM as the initial data when you turn on the power supply again. If you do not execute the “ChgParam” command immediately after the “eepwrt” command, the data is not saved in the EEPROM. Also, if you execute two “ChgParam” commands immediately after the “eepwrt” command, the latter “ChgParam” command cannot save the data in the EEPROM.

2. Each “eepwrt” command requires up to 10-ms processing time. The task in which the “eepwrt” command is executed waits until the “eepwrt” command is completed and then goes to the next command.
3. Avoid executing the “eepwrt” commands simultaneously in multiple tasks or executing them in a row. Each “eepwrt” command requires up to 10-ms processing time. If you execute the “eepwrt” commands in a row, the second command is executed after the first one is completed. During that time, the task which executed the “eepwrt” commands in a row does not goes to the next command and enters a waiting state. If multiple “eepwrt” commands are executed in a row, processing for other tasks may be delayed or an error may be detected due to insufficient processing time.
4. If you execute the “eepwrt” command within a second after turning on the power supply, the processing is not performed correctly.

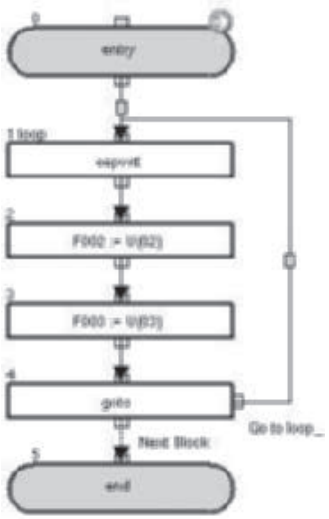
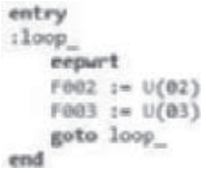
   Create a program that has one second of wait time with such as the “wait” command after turning on the power supply.
5. The inverter's built-in EEPROM has a limit on the number of writing (approximately 100,000 times).

   Therefore, if you use the “eepwrt” command frequently, the inverter's service life may be shortened. Consider taking the following measures in the program.

   - Create a program so that the latest data before turning off the power supply is written to the EEPROM.
   - Create a program so that writing to the EEPROM is performed only when the data such as parameters are changed.
   - Use the user parameter variables U(29) to U(31) to save the data when the power supply is turned off.
6. When it is necessary to save consecutively more than one parameter in the EEPROM with the "EepWrt" command, at least 30 ms or more may be required as the interval of execution between each EepWrt command.

   The next page shows a possible example.

● Example: (when you save only F002 in the EEPROM)

Flowchart	Text
	


```
entry
:loop_
    eepwrt
    F002 := U(02)
    F003 := U(03)
    goto loop_
end
```

In the above example, the parameter F002 is changed to the value of U(02) and saved in the EEPROM. F003 is changed to the value of U(03), however, it is not saved in the EEPROM.

Block number	Operation
1	Sets to save the data in the EEPROM for the following “ChgParam” command.
2	Assigns U(02) to the parameter F002. The data is also saved in the EEPROM because the “eep-wrt” command is executed immediately before this command.
3	Assigns U(03) to the parameter F003. This value is not saved in the EEPROM.
4	Jumps to the block 1: loop_ unconditionally.

RX only: RtcSet

Command	Description	Argument
	Sets a 6-byte clock data sent from the LCD Digital Operator in the variable. This data corresponds to year, month, day, day of the week, hour and minute. The hexadecimal variable value corresponds to year, month, day, day of the week, hour and minute (decimal). rtcset on: continuously updates the 6-byte data. rtcset off: updates the 6-byte data only once.	**On/off**: continuous/once **User variable**: any user parameter variable or internal user variable U(xx) or UL(xx)

Format

Flowchart method	Text language method
rtcset on/off <user variable> ↓	rtcset on/off <user variable>

Note 1. This function uses the clock function of the LCD Digital Operator (optional). If you execute the “rtcset on/off” command when the LCD Digital Operator is not connected, its processing does not finish and the whole program enters a waiting state for the command. Therefore, we recommend you to create a program in which the “rtcset on” command is started only once right after the start of the program and the clock data is always output to the specified variable.

2. When the LCD Digital Operator is shipped, its clock time is set to the default data (2009/1/1/THU 00:00). Set the clock time accurately before you use the “rtcset on/off” command. Also, remember that the clock function has a time error (per month: −1.5 to 1.5 minutes) when you use this command.
3. The BCD data is output in units of bytes when the “rtcset on/off” command is executed.
   The days of the week, Sunday to Saturday are represented as 00 to 06, respectively. However, you cannot detect the BCD data using the user parameter variable U(k) or the internal user variable. When you create a program, note that the BCD data is detected as hexadecimal data and converted to the decimal data in the Drive Programming Editor and the Digital Operator.
4. When the “rtcset on/off” U(k) is executed, the data is set in the following order from upper bytes.
   You must ensure continuous three user parameter variables including U(k).

User parameter variable	Upper byte	Lower byte
U(k)	Year BCD data	Month BCD data
U(k+1)	Day BCD data	Day of the week BCD data
U(k+2)	Hour BCD data	Minute BCD data

5. When the “rtcset on/off” UL(k) is executed, the data is set in the following order from upper bytes.
   You must ensure continuous two internal user variables including UL(k).

User parameter variable	Upper word		Lower word	
	Upper byte	Lower byte	Upper byte	Lower byte
UL(k)	Year BCD data	Month BCD data	Day BCD data	Day of the week BCD data
UL(k+1)	Hour BCD data	Minute BCD data	0 (padding)	0 (padding)

6. You must perform the installation and removal of the Digital Operator with the inverter power supply shut off. Otherwise, a fault may occur.
   If an error that causes disconnection from the LCD Digital Operator occurs, the clock data is retained for at least 1 minute and 45 seconds. Therefore, it is possible to execute the “rtcset on/off” command within 1 minute and 45 seconds after disconnection. Although, when the time exceeds 1 minute and 45 seconds, the clock function processing does not finish and the whole program enters a waiting state for the command. When the connection with the LCD Digital Operator is restored, the program goes to the next step. To prevent the whole program from entering a waiting state, create a program so that the “rtcset on” command is started only once when the program is started and the specified variable is always output to the clock data. Do not execute the “rtcset on/off” command for checking time in the program. Instead, use the specified variable. When the time exceeds 1 minute and 45 seconds after disconnection, an all-zero data is output to the specified variable.
7. When the battery of the LCD Digital Operator gets weak, the Operator cannot maintain the clock data any longer. The data is maintained with the control circuit power supply while the power supply for the inverter is on. However, when the power supply is turned on again, the clock data returns to the initial data (2009/1/1 THU 00:00).

Precautions for Safe Use

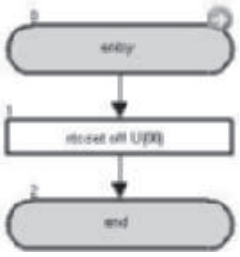
If the clock command is used in the Drive Programming, an unexpected operation may occur due to weak battery of the LCD Digital Operator.

Take measures such as detecting a weak battery by a check that the clock data returns to the initial setting and stopping the inverter or programs.

When the LCD Digital Operator is removed or disconnected, Drive Programming is in a waiting status by the clock command.

● Example

Flowchart	Text

	`entry`
	`  rtcset off U(00)`
	`end`

If you execute this program example on October 18th (Thursday) of 2012 at 2:29 P.M., then U(00), U(01) and U(02) will be displayed on the Drive Programming Editor and the Digital Operator as follows:

User parameter variable	Clock function BCD data (actual hexadecimal data)	Display (converts hexadecimal BCD data to decimal)	Meaning of clock function BCD data
U(00)	1210	4624	"12" for year 2012, "10" for October
U(01)	1804	6148	"18" for 18th day, "04" for Thursday
U(02)	1429	5161	"14" for 2 p.m., "29" for 29 minutes

6-9 Inverter Control Commands

Run FW

Command	Description	Argument
	Makes the inverter start a forward operation. This command is a shortcut of the “func = value” command which is previously set as “FW : = 1”.	---

Format	
Flowchart method	**Text language method**
FW : = 1 ↓	FW : = 1

Run RV

Command	Description	Argument
	Makes the inverter start a reverse operation. This command is a shortcut of the “func = value” command which is previously set as “RV : = 1”.	---

Format	
Flowchart method	**Text language method**
RV : = 1 ↓	RV : = 1

Stop FW

Command	Description	Argument
	Makes the inverter decelerate to stop from a forward operation. This command is a shortcut of the “func = value” command which is previously set as “FW : = 0”.	---

Format	
Flowchart method	**Text language method**
FW : = 0 ↓	FW : = 0

Stop RV

Command	Description	Argument
	Makes the inverter decelerate to stop from a reverse operation. This command is a shortcut of the “func = value” command which is previously set as “RV : = 0”.	---

Format	
Flowchart method	**Text language method**
RV : = 0 ↓	RV : = 0

Version Information

The “Stop FW” and “Stop RV” command are added to CX-Drive version 2.9 or higher. Either update the CX-Drive software or use the following I/O control command “func = value” as a substitute.

Stop (func = value)

Command	Description	Argument
	Makes the operating inverter decelerate to stop by using the “func = value” command. Refer to *"func = value" in 6-6 I/O Control Commands* on page 6-40. <value> is assigned to the selected <function> variable.	**function**: select either of the following variables. ”FW”: In a forward operation by the “Run FW” ”RV”: In a reverse operation by the “Run RV” **value**: set 0 (stop) for deceleration to stop the inverter.

Format

Flowchart method	Text language method	
	(Forward operation)	(Reverse Operation)
(Forward operation) FW : = 0 or (Reverse Operation) RV : = 0 ↓ ↓	FW : = 0	RV : = 0

Precautions for Correct Use

- If the Drive Programming program is stopped, the status of the variables FW (forward) and RV (reverse) is not retained but cleared to zero.
- The variable FW (forward) and RV (reverse) are enabled only when the inverter's 1st RUN Command Selection (A002) is set to 01 (Control circuit terminal block). The operation is not performed with other setting options.
- If you set the variable FW (forward) or RV (reverse) to 1 immediately after turning on the power supply, the setting is ignored and neither forward nor reverse operation is performed. Set 0 first, and then set 1 again. To avoid this operation, create a program that has one second of wait time with such as “wait” command after turning on the power supply.

Stop

Command	Description	Argument
	Makes the operating inverter decelerate and stop. When a trip is detected by the inverter, this command acts as a reset.	---

Format	
Flowchart method	**Text language method**
stop ↓	stop

Note 1. The “stop” command has the same function as the STOP/RESET key of the Digital Operator.
This command makes the operating inverter decelerate and stop. When a trip is detected by the inverter, this command acts as a reset.

2. To prevent the “stop” command from acting as a reset, set the inverter's STOP Key Selection (b087) to 01 (Disabled). With this setting, while the “stop” command makes the inverter decelerate and stop, a reset is not performed. However, note that the Digital Operator's STOP/RESET key will be disabled.

3. Since the “stop” command may act as a reset and cause the Digital Operator's STOP/RESET key to be disabled, we recommend you to use the previously mentioned Stop (func = value) command to stop the inverter.

Set Freq

Command	Description	Argument
	Sets the frequency of the Inverter. This command is a = (Assign) command whose left-hand side is set to the frequency reference variable SET-Freq. Unit: 0.01 Hz	**Value**: any variable or constant (range 0 to 40,000)

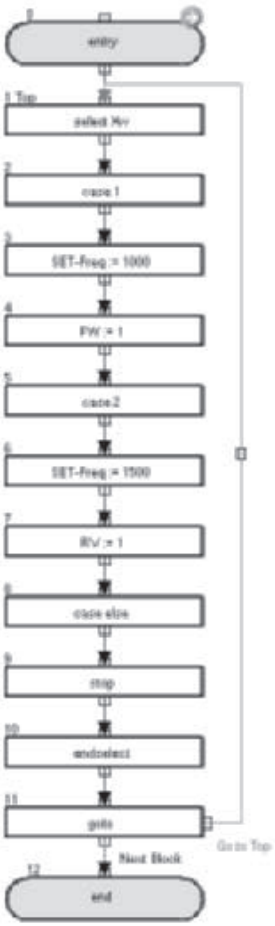
Format	
Flowchart method	**Text language method**
SET-Freq : = <value> ↓	SET-Freq : = <value>

Note 1. The range of frequency that the inverter can actually output is from the Starting Frequency (b082) to the maximum frequency.
If the set data is out of range, the inverter operates as follows.

- Less than Starting Frequency (b082)
  MX2 and RX: Operates at the frequency of 0.00 Hz.
  RX only: When the 1st Control Method (A044) is set to 04 (0SLV: 0-Hz sensorless vector control) or 05 (V2: Sensor vector control), the Starting Frequency (b082) is disabled and the specified frequency is output.
- More than maximum frequency
  MX2: Limits the frequency reference to the value set in the 1st/2nd Maximum Frequency (A004/A204).
  RX: Limits the frequency reference to the value set in the 1st/2nd/3rd Maximum Frequency (A004/A204/A304).

2. When the Drive Programming program is stopped, the data of the frequency reference variable before the program stop is retained. When the program execution is started again, the process begins with the retained data.

● Example

Flowchart	Text
	entry :Top select Xw case 1 SET-Freq := 1000 FW := 1 case 2 SET-Freq := 1500 RV := 1 case else stop endselect goto Top end

In the above example, if the general-input contact Xw is 1, the motor runs at 10 Hz in the forward direction. If the general-input contact Xw is 2, the motor runs at 15 Hz in the reverse direction. With other values, the motor stops.

Block number	Operation
1	After the "select" command, the program branches to the following “case” commands depending on the value of Xw. Branches to the “case 1” if Xw = 1, to the “case 2” if Xw = 2, and to the “case else” if Xw = a value other than 1 and 2.
2 to 4	Executes if Xw = 1. Sets the frequency reference variable to 10.00 Hz, operates the inverter in the forward direction, and executes the next steps after the “endselect” command.
5 to 7	Executes if Xw = 2. Sets the frequency reference variable to 15.00 Hz, operates the inverter in reverse direction, and executes the next steps after “endselect” command.
8 to 10	Executes if Xw = a value other than 1 and 2. Stops the inverter and executes the next steps after the “endselect” command.
11	Jumps to the block 1: Top unconditionally.

Trip

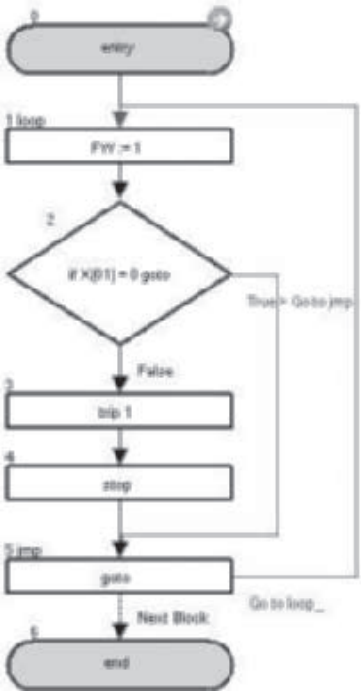
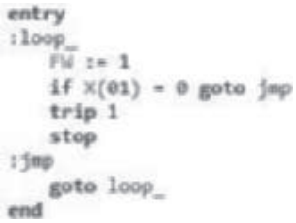
Command	Description	Argument
	Generates the inverter trip. The inverter stops when it detects a trip.	**Value**: any variable or constant (range 0 to 9) 0 to 9 correspond to the alarm code E50 to E59.

Format	
Flowchart method	**Text language method**
trip <value> ↓	trip <value>

Note 1. Even if an inverter trip occurs in one task, the Drive Programming program does not stop the other possible tasks in the program, and the processing is continued.

2. You can set 10 or greater values by using any variable and constant (up to 127), however, even if a trip occurs, the displayed error code will always be E59.

● Example

Flowchart	Text
	

```
entry
:loop_
   FW := 1
   if X(01) = 0 goto jmp
   trip 1
   stop
:jmp
   goto loop_
end
```

In the above example, a user trip occurs in the inverter when the input terminal variable X(01) is set to ON.

Block number	Operation
1	Operates the inverter in the forward direction.
2	If X(01) is 0, jumps to the block 5: jmp. If X(01) is not 0, the program goes to the next step.
3	Generates the user trip 1 in the inverter.
4	Stops the inverter.
5	Jumps to the block 1: loop_ unconditionally.

Accel

Command	Description	Argument
	Sets the inverter acceleration time. This command is a =(Assign) command whose left-hand side is set to the acceleration time variable ACCEL. Unit: 10 ms	**Value**: any variable or constant (MX2: range 0 to 360,000/RX: range 1 to 360,000)

Format

Flowchart method	Text language method
ACCEL : = <value> ↓	ACCEL : = <value>

Decel

Command	Description	Argument
	Sets the inverter deceleration time. This command is a =(Assign) command whose left-hand side is set to the deceleration time variable DECEL. Unit: 10 ms	**Value**: any variable or constant (MX2: range 0 to 360,000/RX: range 1 to 360,000)

Format

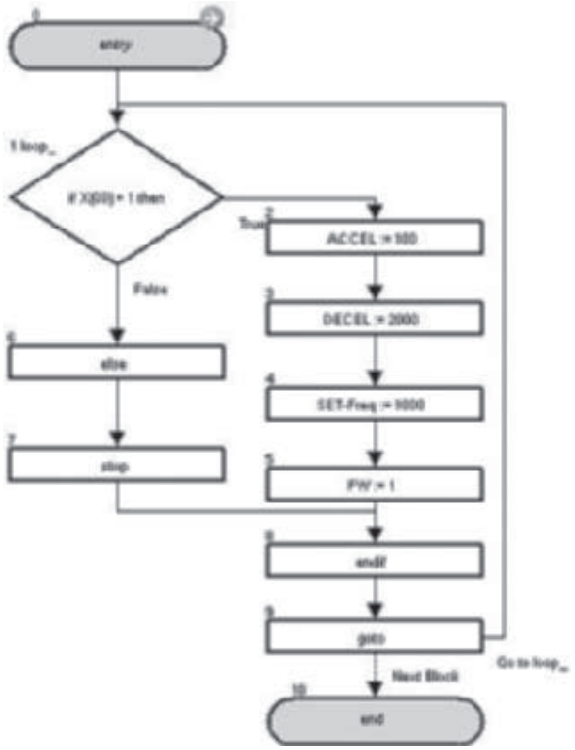
Flowchart method	Text language method
DECEL : = <value> ↓	DECEL : = <value>

Precautions for Correct Use

- The acceleration time variable ACCEL and the deceleration time variable DECEL are enabled only when you set the Acceleration/Deceleration Time Input Type (P031) to 03 (Drive Programming).
- In the following cases, the data that is set in the program is not reflected and the previously set data is used for operation: the data set for the acceleration time variable ACCEL or the deceleration time variable DECEL is out of range, or 0 is set for the 3G3RX Series Inverter.
- When the Drive Programming program is stopped, the data of the acceleration time variable ACCEL and deceleration time variable DECEL before the program stop is retained. When the program execution is started again, the process begins with the retained data.

● Example

Flowchart	Text

	entry
	:loop_
	if X(00) = 1 then
	accel := 100
	decel := 2000
	set-freq := 1000
	fw := 1
	else
	stop
	endif
	goto loop_
	end

In the above example, the acceleration time is set to 1.00 second and the deceleration time is set to 20.00 seconds when the input terminal variable X(00) is set to ON.

Block number	Operation
1 to 6	If X(00) is 1, the acceleration time is set to 1.00 second, the deceleration time is set to 20.00 seconds, and the output frequency is set to 10.00 Hz. The inverter is operated in the forward direction. If X(00) is not 1, the program goes to the next step after the “else” command.
7 to 8	Stops the inverter.
9	Jumps to the block 1: loop_ unconditionally.

7

Precautions for Use of Parameters for Drive Programming

This section describes the precautions for use of parameters for the Drive Programming.

7-1 Inverter Parameters Affected by Setting Order 7-2

7-2 Parameters Affected by Rated Current [%] 7-4

7-3 Parameters Affected by PID Enabled/Disabled 7-5

7-1 Inverter Parameters Affected by Setting Order

In some cases, the setting range of the parameters are restricted by the setting data of other parameters.

The following are the representative examples.

For details, refer to the MX2 User's Manual (I570-E2) or the RX User's Manual (I560-E2).

Parameter No.	Description	Data
A003	1st Base Frequency	30. to 1st Maximum Frequency (A004)
A004	1st Maximum Frequency	MX2: 1st Base Frequency (A003) to 400. RX: 30. to 400.
A203	2nd Base Frequency	30. to 2nd Maximum Frequency (A204)
A204	2nd Maximum Frequency	MX2: 2nd Base Frequency (A203) to 400. RX: 30. to 400.
A303	RX only: 3rd Base Frequency	30. to 3rd Maximum Frequency (A304)
A304	RX only: 3rd Maximum Frequency	30. to 400.
A013	FV Start Ratio	0. to FV End Ratio (A014)
A014	FV End Ratio	FV Start Ratio (A013) to 100.
A103	FI Start Ratio	0. to FI End Ratio (A104)
A104	FI End Ratio	FI Start Ratio (A103) to 100.
A113	RX only: FE Start Ratio	−100. to FE End Ratio (A114)
A114	RX only: FE End Ratio	FE Start Ratio (A113) to 100.
A020	1st Multi-step Speed Reference 0	0.00/Starting Frequency to 1st Maximum Frequency (A004)
A220	2nd Multi-step Speed Reference 0	0.00/Starting Frequency to 2nd Maximum Frequency (A204)
A320	RX only: 3rd Multi-step Speed Reference 0	0.00/Starting Frequency to 3rd Maximum Frequency (A304)
A021 to A035	Multi-step Speed Reference 1 to 15	0.00/Starting Frequency to 1st Maximum Frequency (A004)
b015	Free-electronic Thermal Frequency 1	0. to Free-electronic Thermal Frequency 2
b017	Free-electronic Thermal Frequency 2	Free-electronic Thermal Frequency 1 to Free-electronic Thermal Frequency 3
b019	Free-electronic Thermal Frequency 3	Free-electronic Thermal Frequency 2 to 400.
b051	Starting Voltage on Power Interruption	0.0 to 999.9/1000.
b052	Deceleration Hold Level on Power Interruption	0.0 to 999.9/1000.
b060	Window Comparator FV Upper Limit Level	Set an upper limit level. Setting range: 0. to 100. Lower limit: Lower limit level (b061) + Hysteresis width (b062) × 2
b061	Window Comparator FV Lower Limit Level	Set a lower limit level. Setting range: 0. to 100. Upper limit: Upper limit level (b060) − Hysteresis width (b062) × 2
b062	Window Comparator FV Hysteresis Width	Set a hysteresis width for the upper and lower limit levels. Setting range: 0. to 10. Upper limit: (Upper limit level (b060) − Lower limit level (b061)) /2

Parameter No.	Description	Data
b063	Window Comparator FI Upper Limit Level	Set an upper limit level. Setting range: 0. to 100. Lower limit: Lower limit level (b064) + Hysteresis width (b065) x 2
b064	Window Comparator FI Lower Limit Level	Set a lower limit level. Setting range: 0. to 100. Upper limit: Upper limit level (b063) − Hysteresis width (b065) x 2
b065	Window Comparator FI Hysteresis Width	Set a hysteresis width for the upper and lower limit levels. Setting range: 0. to 10. Upper limit: (Upper limit level (b063) − Lower limit level (b064)) /2
b066	RX only: Window Comparator FE Upper Limit Level	Set an upper limit level. Setting range: −100. to 100. Minimum value: Lower limit level (b067) + Hysteresis width (b068) × 2
b067	RX only: Window Comparator FE Lower Limit Level	Set a lower limit level. Setting range: −100. to 100. Maximum value: Upper limit level (b066) − Hysteresis width (b068) × 2
b068	RX only: Window Comparator FE Hysteresis Width	Set a hysteresis width for the upper and lower limit levels. Setting range: 0. to 10. Maximum value: (Upper limit level (b066) − Lower limit level (b067)) /2
b100	Free V/f Frequency 1	0. to Free V/f Frequency 2 (b102)
b102	Free V/f Frequency 2	0. to Free V/f Frequency 3 (b104)
b104	Free V/f Frequency 3	0. to Free V/f Frequency 4 (b106)
b106	Free V/f Frequency 4	0. to Free V/f Frequency 5 (b108)
b108	Free V/f Frequency 5	0. to Free V/f Frequency 6 (b110)
b110	Free V/f Frequency 6	0. to Free V/f Frequency 7 (b112)
b112	Free V/f Frequency 7	0. to 400.

7-2 Parameters Affected by Rated Current [%]

In the case of parameters for which a current value is set, the parameter's default data and setting range are restricted by the rated current of the inverter.

When you set those parameters, set a percentage [%] of the inverter rated current in the Drive Programming program.

The following are the representative examples.

For details, refer to the MX2 User's Manual (I570-E2) or the RX User's Manual (I560-E2).

Parameter No.	Description	Data
b012	1st Electronic Thermal Level	0.20 to 1.00 × Rated current
b212	2nd Electronic Thermal Level	0.20 to 1.00 × Rated current
b312	RX only: 3rd Electronic Thermal Level	0.20 to 1.00 × Rated current
b022	1st Overload Limit Level	<Heavy load> 0.20 to 2.00 × Rated current (0.4 to 55 kW) 0.20 to 1.80 × Rated current (75 to 132 kW) <Light load> 0.20 to 1.50 × Rated current
b222	MX2 only: 2nd Overload Limit Level	
b025	1st Overload Limit Level 2	
b028	Frequency Pull-in Restart Level	
b126	Brake Release Current	0.20 to 2.00 × Rated current (0.4 to 55 kW) 0.20 to 1.80 × Rated current (75 to 132 kW)
C030	Digital Current Monitor Reference Value	<Heavy load> 0.20 to 2.00 × Rated current <Light load> 0.20 to 1.50 × Rated current
C039	Low Current Detection Level	<Heavy load> 0.00 to 2.00 × Rated current (0.4 to 55 kW) 0.00 to 1.80 × Rated current (75 to 132 kW) <Light load> 0.00 to 1.50 × Rated current
C041	1st Overload Warning Level	0.0: Function not active <Heavy load> 0.00 to 2.00 × Rated current (0.4 to 55 kW) 0.00 to 2.00 × Rated current (75 to 132 kW) <Light load> 0.00 to 1.50 × Rated current
C241	MX2 only: 2nd Overload Warning Level	
C111	1st Overload Warning Level 2	<Heavy load> 0.00 to 2.00 × Rated current (0.4 to 55 kW) 0.00 to 1.80 × Rated current (75 to 132 kW) <Light load> 0.00 to 1.50 × Rated current

7-3 Parameters Affected by PID Enabled/Disabled

The set values are scaled by the settings for A071/A075.

Parameter No.	Description	Data	
		A071 = 01 or 02	**A071 = 00**
A011	FV Start Frequency	Converted value = set value × (A075)	Set value
A012	FV End Frequency	Converted value = set value × (A075)	Set value
A020	1st Multi-step Speed Reference 0	Converted value = set value × (A075)	Set value
A021	Multi-step Speed Reference 1	Converted value = set value × (A075)	Set value
A022	Multi-step Speed Reference 2	Converted value = set value × (A075)	Set value
A023	Multi-step Speed Reference 3	Converted value = set value × (A075)	Set value
A024	Multi-step Speed Reference 4	Converted value = set value × (A075)	Set value
A025	Multi-step Speed Reference 5	Converted value = set value × (A075)	Set value
A026	Multi-step Speed Reference 6	Converted value = set value × (A075)	Set value
A027	Multi-step Speed Reference 7	Converted value = set value × (A075)	Set value
A028	Multi-step Speed Reference 8	Converted value = set value × (A075)	Set value
A029	Multi-step Speed Reference 9	Converted value = set value × (A075)	Set value
A030	Multi-step Speed Reference 10	Converted value = set value × (A075)	Set value
A031	Multi-step Speed Reference 11	Converted value = set value × (A075)	Set value
A032	Multi-step Speed Reference 12	Converted value = set value × (A075)	Set value
A033	Multi-step Speed Reference 13	Converted value = set value × (A075)	Set value
A034	Multi-step Speed Reference 14	Converted value = set value × (A075)	Set value
A035	Multi-step Speed Reference 15	Converted value = set value × (A075)	Set value
A101	FI Start Frequency	Converted value = set value × (A075)	Set value
A102	FI End Frequency	Converted value = set value × (A075)	Set value
A145	Frequency Addition Amount Setting	Converted value = set value × (A075)	Set value
A220	2nd Multi-step Speed Reference 0	Converted value = set value × (A075)	Set value
A320	RX only: 3rd Multi-step Speed Reference 0	Converted value = set value × (A075)	Set value
F001	Output Frequency Setting/Monitor	Converted value = set value × (A075)	Set value
d004	PID Feedback Value Monitor	Converted value = feedback value × (A075)	Feedback value

8

Errors and Remedies

This section describes the program operation at the time of error occurrence, the errors that are specific to the Drive Programming, as well as the causes and remedies.

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8-1-1 Drive Programming Operation on Error 8-2
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8-1-3 Alarm Code List 8-4

8-1 Troubleshooting

This section describes the program operation at the time of error occurrence, the error codes that are specific to the Drive Programming, and the remedies for them.

8-1-1 Drive Programming Operation on Error

Basically, even if the inverter detects a trip during the Drive Programming operation, the operation is continued. However, if any of E43 to E45 trips related to the Drive Programming is detected, the operation is stopped. Or, with the “on trip goto” command, the program can jump to other process after a trip occurred.

With/without “on trip goto”	Error status		
	User trip E50 to E59	Drive Programming related trip E43 to E45	Other trips
Without	Operation is continued.	Program is stopped.	Operation is continued.
With	After the “on trip goto” command is executed, the program jumps to the specified label and the operation is continued.	Program is stopped.	After the “on trip goto” command is executed, the program jumps to the specified label and the operation is continued.

Precautions for Safe Use

When the Drive Programming program is stopped, the status before the program stop is retained for multi-function outputs controlled by the Drive Programming.

For this reason, configure the system so that the stop of the Drive Programming program in the inverter can be detected by the Drive Programming start signal and the alarm (trip) signal, and the inverter's peripheral devices can be stopped safely.

8-1-2 Drive Programming Operation on Error Reset

The Drive Programming operation on error reset varies with the reset input method and the setting for the Reset Selection (C102). The following table shows the operation for each case.

● Reset input method

- To restart the Drive Programming, set the Multi-function Input Selection (MX2: C001 to C007/RX: C001 to C008) to 18 (RS (Reset)) and turn ON the corresponding input terminal.
- You cannot restart the Drive Programming by pressing the STOP/RESET key of the Digital Operator or the LCD Digital Operator (optional).

● Reset Selection (C102)

- To restart the Drive Programming by reset input, it is necessary to set the Reset Selection (C102) to the value other than 03 (Trip reset only). You cannot restart the Drive Programming when 03 (Trip reset only) is set.
- When the Reset Selection (C102) is set to 00 (Trip reset at power-on) or 01 (Trip reset at power-off), the Drive Programming can be restarted by a reset input even when there is no trip.
- When the Reset Selection (C102) is set to 02 (Enabled only during trip), the Drive Programming can be restarted only when there is a trip detected by the inverter.
  It does not restart with a reset input when there is no trip in the inverter.

Operation	Program status	Trip status	Reset with control terminal			Reset with Operator's STOP/RESET key		
			C102 = 00 or 01	C102 = 02	C102 = 03	C102 = 00 or 01	C102 = 02	C102 = 03
Drive Programming operation*1	During run	Normal status	Restart	Keep run	Keep run	Keep run	Keep run	Keep run
		During trip	Restart	Restart	Keep run	Keep run	Keep run	Keep run
	During stop	Normal status	Restart	Keep stop*2	Keep stop*2	Keep stop*2	Keep stop*2	Keep stop*2
		During trip	Restart	Restart	Keep stop*2	Keep stop*2	Keep stop*2	Keep stop*2
Inverter's reset operation		Normal status	Reset	Disabled	Disabled	Reset	Disabled	Disabled
		During trip	Reset	Reset	Reset*3	Reset	Reset	Reset*3

*1. The table assumes that the PRG terminal is ON in the case that the Drive Programming Function Selection (A017) is set to 01. If the PRG terminal is OFF, the Keep stop operation applies to all cases, because the program does not run.

*2. To restart the program, set the Drive Programming Function Selection to 00 (Disabled) first, and then change it to 02 (Enabled (Start/stop at power on/off)). Also, you can restart it by turning ON the PRG terminal again, if A017 = 01.

*3. If C102 = 03, only the trip is cleared by the reset operation. The internal calculation data such as current values are not initialized.

8-1-3 Alarm Code List

This section describes the alarm codes that are specific to the Drive Programming, as well as the causes and remedies.

For other errors, refer to the MX2 User's Manual (I570-E2) or the RX User's Manual (I560-E2).

Alarm code	Alarm (cause of inverter trip)	Possible cause	Check	Remedy
E43	Invalid command	The terminal PRG was turned ON although no program was downloaded into the inverter.	Upload the program and check if it actually exists in the inverter.	Create the program again and download it to the inverter.
E44	Nesting count error	A subroutine is nested over eight levels.	Upload the program and check the number of nesting levels.	Correct the program so that the number of nesting levels is eight or less.
		The “for next” command is nested over eight levels.		
		The “if” command is nested over eight levels.		
E45	Command error 1	The jump destination of the “goto” command points to the “next” command that terminates the “for” or other loop.	Check if the jump destination of the “goto” command is an command that terminates a loop.	Correct the jump destination of the “goto” command.
		The variable referenced through U(i), etc. could not be found.	Check the numeric value specified for U(i). $00 \leq i \leq 31$	Correct the variable value for U(i), or, restrict the data range of the variable for U(i).
		A four arithmetic operation results in the following error: Overflow, underflow, or division by zero	Check the program and identify the command which causes overflow, underflow, or division by zero.	Correct the program so that its four arithmetic operation does not cause overflow, underflow, or division by zero.
		The “ChgParam” command results in the following error: • Change to a parameter that does not exist • The written value is out of the setting range • Change of a parameter value that cannot be changed during inverter operation • Change of a parameter value that is protected against change by the Soft Lock Selection (when this setting is enabled)	• Check the parameter or the value to write to the parameter. • In the case that an error occurs during inverter operation, check if the parameter can be changed during inverter operation. • Check the setting of the Soft Lock Selection (b031).	• Correct the parameter or the value to write to the parameter so that it is within the setting range. • Disable the soft lock function. • If the parameter can be changed during operation, change the setting of the Soft Lock Selection (b031) to 10 to enable a parameter change during inverter operation.

9

LX inverter

This section describes the LX inverter specific functions.

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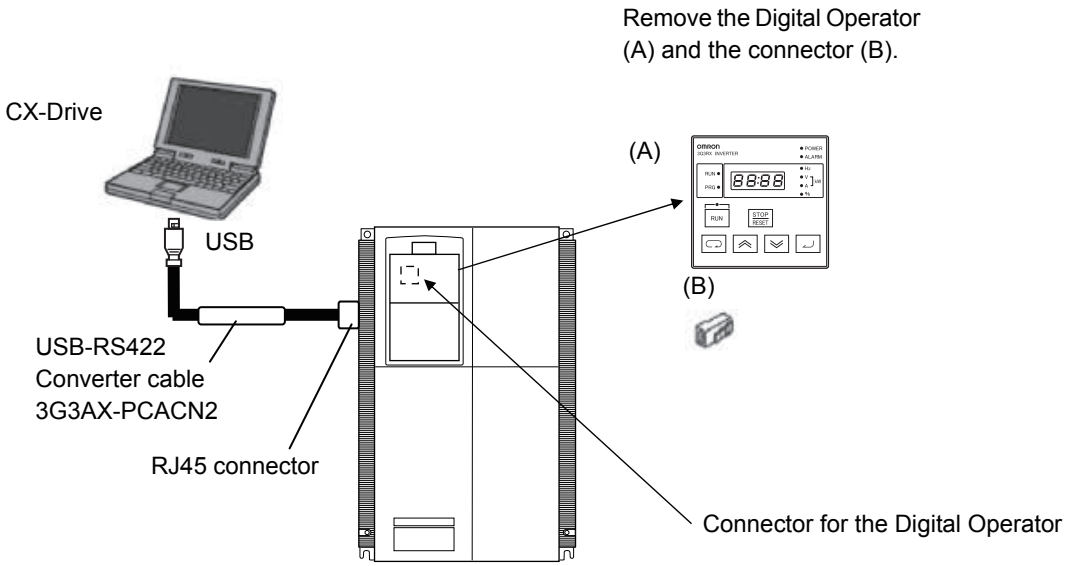
9-1 Preparation and System Configuration

You must prepare the following items to create user programs with functions of the Drive Programming in CX-Drive and execute the programs in the 3G3LX Series Inverter.

- 3G3LX Series Inverter
- Personal computer (PC) (Windows system)

32-bit PC	64-bit PC
Windows XP SP3, Windows Vista, and Windows 7	Windows Vista and Windows 7

- The CX-Drive requires the version 2.5 or higher for 3G3LX Series Inverter
  (The CX-Drive is included in the FA Integrated Tool Package, CX-One.)
- Prepare the following PC-inverter connection cable.
  USB to RJ-45 Converter Cable (Model: 3G3AX-PCACN2 or USB CONVERTERCABLE)



Version Information

- The Drive Programming function is included in the following or higher versions of the CX-Drive.
  If the version of your CX-Drive is lower, you need to upgrade the version.
  LX: Version 2.5 or higher (with version 2.4 or lower, operation is not possible.)

Additional Information

For how to install or upgrade the CX-Drive, refer to the CX-Drive Operation Manual (W453).

9-2 Specifications

The following table shows the specifications related to the Drive Programming:

Item		Specifications	
Program specifications	Programming language	Flowchart and text language method	
	Input device	Windows personal computer (OS: Windows XP-SP3, Windows Vista, or Windows 7)	
	Program capacity	1,024 steps max.: 6 KB (1,024 steps max. for a total of 5 tasks)	
	Programming support function	Functions supported in CX-Drive: • Program editing and display • Program compilation (Program syntax check) • Program downloading, uploading, and all clear	
	Execution format	• Execution by interpreter • Execution cycle: 2 ms/step (5 commands executable through 5-task parallel processing) • Subroutine call supported (Nesting in 8 levels max.)	
Input/output functions	External input	Multi-function Input	X(00) to X(06)/7 points • Multi-function input S1 to S7 terminals
		Frequency reference input (Multi-function analog input)	XA(0): 0 to 10 V (O terminal)
			XA(1): 4 to 20 mA (OI terminal)
			XA(2): −10 to 10 V (O2 terminal)
	External output	Multi-function output/multi-function relay output	Y(00) to Y(03)/4 points • Multi-function output P1 and P3 terminals • Multi-function relay output terminal (RY)
		Monitor output (Multi-function digital output)	YA(0): PWM output in 6.4 ms cycle (FM terminal)
		Monitor output (Multi-function analog output)	YA(1): 0 to 10 V (AM terminal)
			YA(2): 4 to 20 mA (AMI terminal)
Commands	Program control commands	• Loop ("for") • Unconditional branch ("goto") • Time control ("wait") • Conditional branch ("if then", "ifs then", "select case", "until", "while") • Subroutine ("call", "sub") • Others ("entry", "end", "inc", "dec")	
	Arithmetic commands	• Four arithmetic operations (+, −, *, and /) • Remainder ("mod") and assignment (=) • Absolute value ("abs") • Logical operations ("or", "and", "xor", "not")	
	I/O control	• Multi-function I/O (bit input, word input, bit output, and word output) • Reads inverter input terminals • Reads/writes inverter output terminals	
	Timer control	Contacts control by timer and timer counter control	
	Parameter control	• Changes setting data of specified parameter number • Saves parameter setting data in EEPROM	

Item		Specifications
Commands	Inverter control	• Executes and stops forward/reverse operation • Generates a trip by the Drive Programming (E50 to E59/10 points) • Frequency reference and acceleration/deceleration time settings
Function variable	User parameter variable	U(00) to U(31)/32 points
	Internal user variable	UL(00) to UL(07)/8 points
	Frequency reference variable	SET-Freq
	Acceleration time variable	ACCEL
	Deceleration time variable	DECEL
	Inverter monitor variable	FM, Iout, Dir, PID-FB, F-CNV, Tmon, Vout, Power, RUN-Time, ON-Time, POS, STATUS, DCV, ERR-CNT, ERR(1) to ERR(6), and UMon(0) to UMon(2)
	Multi-function input variable	The function options of the Multi-function Input S1 Selection (C001) for the inverter are available. UP, DWN, SPD1, SPD2, SPD3, SET, FRS, EXT, SFT, RS, OLR, TL, TRQ1, TRQ2, PCLR, EMP, INSP, RL, COK, BOK, FP1 to FP6, PAL, TCL, LVS, NFS, PRG, CMC, GS1, and GS2
	Multi-function output variable	The function options of the Multi-function Output P1 Selection (C021) for the inverter are available. RUN, FA1, FA2, OL, AL, FA3, OTQ, IP, UV, TRQ, RNT, ONT, THM, ZS, POK, FA4, FA5, OL2, TH-C, NDc, WAC, WAF, FR, OHF, LOC, IRDY, FWR, RWR, MJA, CON, BRK, UPS, UPD, GMON, MPS, and SEQ
	Input terminal variable	X(00) to X(06)/7 points
	Extended I/O option input variable	X(07) to X(11)/5 points (with 3G3AX-EIO-E expansion card)
	Output terminal variable	Y(00) to Y(03)/4 points
	Extended I/O option output variable	Y(04) to Y(06)/3 points (with 3G3AX-EIO-E expansion card)
	Internal user contact	UB(0) to UB(7)/8 points
	Timer output contact	TD(0) to TD(7)/8 points
	Timer counter variable	TC(0) to TC(7)/8 points

9-3 Drive Programming Editor

9-3-1 Executing a Program

You execute the program by setting the inverter parameter, the Drive Programming Function Selection (F025).

Once the program reaches "end" command after a series of processes was completed, the program is not executed unless it is restarted.

To repeat the program, create a loop program so that the program does not reach “end” command.

Parameter No.	Function name	Data	Description
F025	Drive Programming Function Selection	00: Disabled (default setting)	Disables the Drive Programming function. Programs are not executed. If you change the setting to 00 (Disabled) during program execution, the program will be stopped.
		01: Enabled (Start/stop at power on/off)	Starts the Drive Programming program automatically after the inverter power supply is turned on. If you change the setting to 01 (Enabled) while the program is stopped, the program will be started.
F026	Drive Programming RUN Trigger Selection	00: TRM (“PRG” terminal)	Drive Programming program will run by terminal. Set terminal to PRG function.
		01: PARAM (setting F025 = enable)	Drive Programming program will run if F025 = enable
C001 to C007	Multi-function Input S1 to S7 Selection	76: PRG (Drive Programming start)	When the Drive Programming Function Selection (F025) is set to 01 (Enabled: Start/stop at power on/off), the program is started via the multi-function input terminal with this setting.

9-4 Drive Programming User Variables

9-4-1 Input/Output Terminal Variables

Input Terminal Variables X(00) to X(11)

You can use the inverter's multi-function input terminals as the input terminal variables X(00) to X(11) for the Drive Programming function by setting these multi-function input terminals to the general-purpose input MI1 to MI12.

You can also use the input terminal variables X(00) to X(11) as word-access data, which are set to the lower byte by using the variable Xw.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
X(00) to X(11)	Input terminal variable (bit access)	0: OFF 1: ON	0	–	bit	R

- The status of the multi-function input terminals S1 to S7 is captured and set as bit-size variables. This variable is read-only.
- When the Multi-function Input S1 to S7 Selection (C001 to C007) are set to 49 to 60 (MI1 to MI11: General-purpose input), the status of the input terminals S1 to S7 is captured and set as the input terminal variables X(00) to X(11) of the Drive Programming.

  Numbers are given to the input terminal variables X(00) to X(11) according to the numerical order of the set general-purpose inputs MI1 to MI11, not the terminal numbers S1 to S7.

Function variable	Setting for Multi-function Input Selection (C001 to C007)
X(00)	49: MI1
X(01)	50: MI2
X(02)	51: MI3
X(03)	52: MI4
X(04)	53: MI5
X(05)	54: MI6
X(06)	55: MI7
X(07)	56: MI8
X(08)	57: MI9
X(09)	58: MI10
X(10)	59: MI11
X(11)	60: MI12

Function variable	Description	Data range	Default data	Unit	Data size	R/W
Xw	Input terminal variable (word access)	0 to 255	0	–	Unsigned 1 word	R

- The input terminal variable (word access) Xw is a function to use the input terminal variables X(00) to X(11) as a word-size variable. This variable is read-only.
- The input terminal variables X(00) to X(11) are set to the lower byte. For the upper byte and unused input terminal variables, zero is read out.

Bit	12 to 15	11	10	9	8	7	6	5	4	3	2	1	0
Function	Not used	X(11)	X(10)	X(09)	X(08)	X(07)	X(06)	X(05)	X(04)	X(03)	X(02)	X(01)	X(00)

Precautions for Correct Use

- When the Drive Programming program is stopped, the status of the input terminal variables is not retained but updated according to the status of actual input terminals.
- Even when you set MI1 to MI12 (general-purpose input 1 to 12) for the Multi-function Input terminals, you can select NO (NO contact) or NC (NC contact) for the Multi-function Input S1 to S7 Operation Selection (C011 to C017).

Output Terminal Variables Y(00) to Y(06)

You can use the inverter's multi-function output terminals as the output terminal variables Y(00) to Y(06) for the Drive Programming function by setting the multi-function output terminals to the general-purpose outputs MO1 to MO7.

You can also use the input terminal variables Y(00) to Y(06) as word-access data, which are set to the lower byte by using the variable Yw.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
Y(00) to Y(06)	Output terminal variable (bit access)	0: OFF 1: ON	0	–	bit	R

- You can control the status of the multi-function output terminals 11 to 13 and the multi-function relay output terminal (RY) as bit-size variables.
- By setting the Multi-function Output 11 to 13 Selection (C021 to C023) or the Multi-function Relay Output (RY) Function Selection (C026) to 35 to 41 (MO1 to MO7: General-purpose output), you can control the output terminals 11 to 13 or the relay output terminal (RY) as the output terminal variables Y(00) to Y(06) of the Drive Programming. Numbers are given to the output terminal variables Y(00) to Y(06) according to the numerical order of the set general-purpose outputs MO1 to MO7, not the terminal numbers 11 to 13, RY.

Function variable	Setting for Multi-function Output Selection (C021, C022, C023 and C026)
Y(00)	35: MO1
Y(01)	36: MO2
Y(02)	37: MO3
Y(03)	38: MO4
Y(04)	39: MO5
Y(05)	40: MO6
Y(06)	41: MO7

Function variable	Description	Data range	Default data	Unit	Data size	R/W
Yw	Output terminal variable (word access)	0 to 255	0	–	Unsigned 1 word	R

- The output terminal variables (word access) Yw is a function to use the output terminal variables Y(00) to Y(06) as a word-size variable.
- The output terminal variables Y(00) to Y(06) are set in the lower byte. For the upper byte and unused output terminal variables, zero is read out. If any data is written to the upper byte, the data is ignored.

Bit	7 to 15	6	5	4	3	2	1	0
Function	Not used	Y(06)	Y(05)	Y(04)	Y(03)	Y(02)	Y(01)	Y(00)

Precautions for Safe Use

When the Drive Programming program is stopped, the status before the program stop is retained for multi-function outputs controlled by the Drive Programming.

For this reason, configure the system so that the stop of the Drive Programming program in the inverter can be detected by the Drive Programming start signal and the alarm (trip) signal, and the inverter's peripheral devices can be stopped safely.

Precautions for Correct Use

- When the Drive Programming program is stopped, the data of the output terminal variables before the program stop is retained. When the program execution is started again, the process begins with the retained data.

  However, the outputs with MO1 to MO7 (General-purpose output) not set for the Drive Programming are controlled as the inverter's multi-function outputs independently of the program.
- If multiple tasks use the same multi-function terminal, the output status of the task which is executed last will be effective. Considering safe control, we recommend you to avoid using multiple tasks for control.
- Even if you select MO1 to MO7 (General-purpose output 1 to 7) for the Multi-function Output Selection (11 to 13) or for the Multi-function Relay Output (RY) Function Selection, you can select NO (NO contact) or NC (NC contact) for the Multi-function Output Operation Selection (C031 and C033) or for the Multi-function Relay Output (RY) Operation Selection (C036).

Analog Input Terminal Variables XA(0) to XA(2)

You can use the inverter's frequency reference input (analog voltage input) O terminal, the frequency reference input (analog current input) OI terminal and the frequency reference auxiliary input (analog voltage input) O2 terminal as the analog input terminal variables XA(0) to XA(2) of the Drive Programming function.

You can continuously monitor the status of the analog inputs regardless of the parameter settings.

Function variable	Description	Data range	Default data	Unit	Data size	R/W
XA(0)	Analog input terminal variable (O terminal: 0 to 10 V input)	0 to 10,000	0	0.01%	Unsigned 1 word	R
XA(1)	Analog input terminal variable (OI terminal: 4 to 20 mA input)					
XA(2)	Analog input terminal variable (O2 terminal: -10 to 10 V input)	−10,000 to 10,000			Signed 1 word	

- The analog input terminal variables XA(0) and XA(1) are unsigned 1-word variables, and XA(2) is a signed 1-word variable. This variable is read-only.
- The variables are displayed in increments of 0.01% as a percentage of the maximum analog input 10 V or 20 mA.
- To adjust the analog inputs, use the following inverter parameters: (O: A150 to A154, OI: A155 to A159, and O2: A160 to A163).

Precautions for Correct Use

When the Drive Programming program is stopped, the status of the analog input terminal variables is not retained but updated according to the status of actual input terminals.

Analog Output Terminal Variables YA(0) to YA(2)

You can use the inverter's multi-function digital output (PWM output) FM terminal, the multi-function analog output (voltage output) AM terminal and the multi-function analog output (current output) AMI terminal as the analog output terminal variables YA(0) to YA(2) of the Drive Programming function.

You can continuously monitor the status of the analog outputs regardless of the parameter settings.

To control the analog outputs via the Drive Programming function, select Drive Programming for the setting of the inverter parameters FM Selection (C027), AM Selection (C028) and AMI Selection (C029).

Function variable	Description	Data range	Default data	Unit	Data size	R/W
YA(0)	Analog output terminal variable (FM terminal: 6.4 ms cycle, PWM output)	0 to 10,000	0	0.01%	Unsigned 1 word	R/W
YA(1)	Analog output terminal variable (AM terminal: 0 to 10 V output)					
YA(2)	Analog output terminal variable (AMI terminal: 4 to 20 mA output)					

- The analog output terminal variables YA(0) to YA(2) are unsigned 1-word variables.
- Set the variables in increments of 0.01% as a percentage of the maximum output duty, 10 V or 20 mA.
- Select Drive Programming for the setting of the inverter parameters FM Selection (C027), AM Selection (C028) and AMI Selection (C029) to control the analog output terminals via the Drive Programming function. Even if you do not select Drive Programming for the parameters, it is possible to monitor the status of the analog output terminals.

Function variable	Parameter Setting
YA(00)	Set the FM Selection (C027) to 14 (Drive Programming: YA(0))
YA(01)	Set the AM Selection (C028) to 15 (Drive Programming: YA(1))
YA(02)	Set the AMI Selection (C029) to 16 (Drive Programming: YA(2))

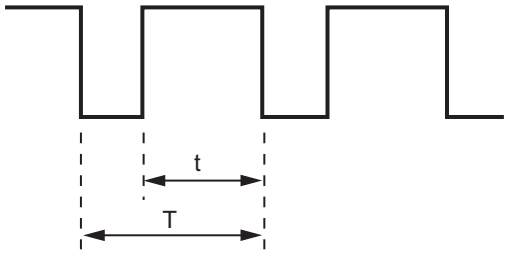
- Use the inverter parameters (C105 to C107, C109 and C110) to adjust analog output.

Precautions for Correct Use

- When the Drive Programming program is stopped, the data of the analog output terminal variables before the program stop is retained. When the program execution is started again, the process begins with the retained data. However, the outputs with the Drive Programming not set are controlled as the inverter's analog outputs independently of the program.
- The multi-function digital output (PWM output) FM terminal provides PWM signal outputs.

  The terminal outputs the value of 0.00 to 100.00% (variable) as the pulse width (duty ratio t/T) in a 6.4 ms cycle.

PWM output



Cycle T: Constant (6.4 ms)

Duty ratio t/T: Variable

9-4-2 Multi-function Input Variables

Function variable	Description	R/W	Reference
UP	Upward RUN	R/W	C001 to C007 = 00
DWN	Downward RUN	R/W	C001 to C007 = 01
SPD1	Multi-speed 1 setting	R/W	C001 to C007 = 02
SPD2	Multi-speed 2 setting	R/W	C001 to C007 = 03
SPD3	Multi-speed 3 setting	R/W	C001 to C007 = 04
SET	2nd Control	R/W	C001 to C007 = 08
FRS	Free-run stop	R/W	C001 to C007 = 11
EXT	External trip	R/W	C001 to C007 = 12
SFT	Soft lock	R/W	C001 to C007 = 15
RS	Reset	R/W	C001 to C007 = 18
OLR	Change OL-level	R/W	C001 to C007 = 32
TL	Torque limit enable	R/W	C001 to C007 = 33
TRQ1	Change Torque limit 1	R/W	C001 to C007 = 34
TRQ2	Change Torque limit 2	R/W	C001 to C007 = 35
PCLR	Clear the current position	R/W	C001 to C007 = 40
KHC	Kwh clear	R/W	C001 to C007 = 46
X(00) to X(11)	Drive Programming MI1 to MI12	R/W	C001 to C007 = 49 to 60
EMP	Em-Power operation	R/W	C001 to C007 = 61
INSP	Inspection	R/W	C001 to C007 = 62
RL	Releveling	R/W	C001 to C007 = 63
COK	Contactor check signal	R/W	C001 to C007 = 64
BOK	Brake check signal	R/W	C001 to C007 = 65
FP1 to FP6	Floor position 1 to 6	R/W	C001 to C007 = 66 to 71
PAL	Auto learning data latch trigger	R/W	C001 to C007 = 72
TCL	Torque bias latch trigger	R/W	C001 to C007 = 73
LVS	Levelling signal	R/W	C001 to C007 = 74

Function variable	Description	R/W	Reference
NFS	Near floor signal	R/W	C001 to C007 = 75
PRG	Program run	R/W	C001 to C007 = 76
CMC	Control mode change	R/W	C001 to C007 = 77
GS1	Gate suppress 1	R/W	C001 to C007 = 78
GS2	Gate suppress 2	R/W	C001 to C007 = 79

Note The LX inverter functions are available for the digital multifunction input terminals P140 to P144 (Multi-Input [ExIN1-5) with the 3G3AX-EIO-E extra I/O board.

9-4-3 Multi-function Output Variables

Function variable	Description	R/W	Reference
RUN	Signal during RUN	R	C021 to C023, C026: 00
FA1	Constant speed arrival signal	R	C021 to C023, C026: 01
FA2	Set frequency exceeded signal	R	C021 to C023, C026: 02
OL	Overload warning	R	C021 to C023, C026: 03
AL	Alarm signal	R	C021 to C023, C026: 05
FA3	Set frequency only signal	R	C021 to C023, C026: 06
OTQ	Overtorque/Undertorque signal	R	C021 to C023, C026: 07
IP	Signal during momentary power interruption	R	C021 to C023, C026: 08
UV	Signal during undervoltage	R	C021 to C023, C026: 09
TRQ	Torque limit	R	C021 to C023, C026: 10
RNT	RUN time over	R	C021 to C023, C026: 11
ONT	Power ON time over	R	C021 to C023, C026: 12
THM	Electronic thermal warning	R	C021 to C023, C026: 13
ZS	0 Hz detection signal	R	C021 to C023, C026: 14
POK	Position ready	R	C021 to C023, C026: 16
FA4	Set frequency exceeded signal 2	R	C021 to C023, C026: 17
FA5	Set frequency only signal	R	C021 to C023, C026: 18
OL2	Overload warning 2	R	C021 to C023, C026: 19
TH-C	Thermal alarm signal	R	C021 to C023, C026: 20
NDc	Communications disconnection detection	R	C021 to C023, C026: 23
WAC	Capacitor life warning signal	R	C021 to C023, C026: 30
WAF	Cooling fan life warning signal	R	C021 to C023, C026: 31
FR	Starting contact signal	R	C021 to C023, C026: 32
OHF	Cooling fin overheat warning	R	C021 to C023, C026: 33
LOC	Low current signal	R	C021 to C023, C026: 34
Y(00) to Y(06)	Drive Programming MO1 to MO7	R	C021 to C023, C026: 35 to 41
IRDY	Operation ready	R	C021 to C023, C026: 44
FWR	Forward run signal	R	C021 to C023, C026: 45
RWR	Reverse run signal	R	C021 to C023, C026: 46
MJA	Fatal fault signal	R	C021 to C023, C026: 47
CON	Contactor control signal	R	C021 to C023, C026: 51
BRK	Brake control signal	R	C021 to C023, C026: 52
UPS	UPS protect direction search status	R	C021 to C023, C026: 54
UPD	UPS protect direction	R	C021 to C023, C026: 55
GMON	Gate suppress monitor	R	C021 to C023, C026: 56
MPS	Magnet pole position search	R	C021 to C023, C026: 57
SEQ	SEQ error	R	C021 to C023, C026: 58

Note The LX inverter functions are available for the digital multifunction output terminals P145 to P147 (Multi-Output [ExOUT1-3) with the 3G3AX-EIO-E extra I/O board.

9-5 Drive Programming Commands

9-5-1 I/O Control Commands

var = X(i)		
Command	**Description**	**Argument**
	Assigns one bit of the status of the input terminal variable to <variable>.	**variable**: any variable (the variable value is 0 or 1) i: input terminal variable (range 00 to 11)

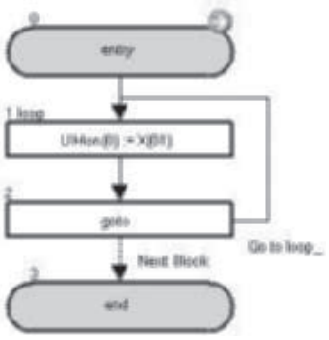
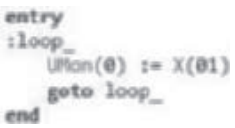
Format	
Flowchart method	**Text language method**
<variable> : = X(i) ↓	<variable> : = X(i)

Note The input terminal variable is a variable that detects the status of the inverter's input terminal. The following settings are required. The numerical order of input terminal variables follows the numerical order of the set general-input numbers.

Set the Multi-function Input S1 to S7 Selection (C001 to C007) to 49 to 60 (MI1 to MI12: General-purpose input).

<Assignment example>
X(00) = MI1 (function No. 49)
X(01) = MI2 (function No. 50)
X(02) = MI3 (function No. 51)
X(03) = MI4 (function No. 52)
X(04) = MI5 (function No. 53)
X(05) = MI6 (function No. 54)
X(06) = MI7 (function No. 55)
X(07) = MI8 (function No. 56)
X(08) = MI9 (function No. 57)
X(09) = MI10 (function No. 58)
X(10) = MI11 (function No. 59)
X(11) = MI12 (function No. 60)

● Example

Flowchart	Text
	


```
entry
:loop_
    UMon(0) := X(01)
    goto loop_
end
```

In the above example, the status of the input terminal X(01) is monitored with the parameter UMon(0) (d025).

Block number	Operation
1	Assigns X(01) to UMon(0).
2	Jumps to the block 1: loop_ unconditionally.

var = Xw

Command	Description	Argument
	Assigns the status of the input terminal variable to <variable> in units of words.	**Variable**: any variable

Format

Flowchart method	Text language method
<variable> : = Xw ↓	<variable> : = Xw

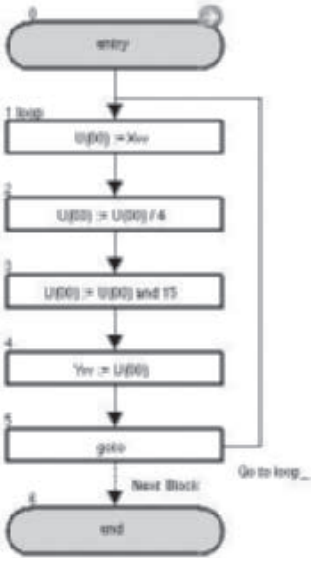
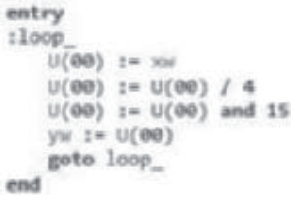
Note The input terminal variable is a variable that detects the status of the inverter's input terminal. The following settings are required. The numerical order of input terminal variables follows the numerical order of the set general-input numbers.

Set the Multi-function Input S1 to S7 Selection (C001 to C007) to 49 to 60 (MI1 to MI12: General-purpose input).

When the data is assigned in units of words, zero is read out for the upper byte data and unset input terminal variables.

<Assignment example>
X(00) = MI1 (function No. 49) to Xw = 1 (bit 0)
X(01) = MI2 (function No. 50) to Xw = 2 (bit 1)
X(02) = MI3 (function No. 51) to Xw = 4 (bit 2)
X(03) = MI4 (function No. 52) to Xw = 8 (bit 3)
X(04) = MI5 (function No. 53) to Xw = 16 (bit 4)
X(05) = MI6 (function No. 54) to Xw = 32 (bit 5)
X(06) = MI7 (function No. 55) to Xw = 64 (bit 6)
X(07) = MI8 (function No. 56) to Xw = 128 (bit 7)
X(08) = MI9 (function No. 57) to Xw = 256 (bit 8) (only if expanded I/O for LX is used)
X(09) = MI10 (function No. 58) to Xw = 512 (bit 9) (only if expanded I/O for LX is used)
X(10) = MI11 (function No. 59) to Xw = 1024 (bit 10) (only if expanded I/O for LX is used)
X(11) = MI12 (function No. 60) to Xw = 2048 (bit 11) (only if expanded I/O for LX is used)

● Example

Flowchart	Text
	


```
entry
:loop_
    U(00) := xw
    U(00) := U(00) / 4
    U(00) := U(00) and 15
    yw := U(00)
    goto loop_
end
```

In the above example, the status of the input terminals X(02) to X(05) is captured and output to the output terminals Y(00) to Y(03).

Block number	Operation
1	Assigns the value of Xw (value of input terminal) to U(00).
2	Divides the value of U(00) by 4 (2-bit right shift) to assign X(02) to bit 0.
3	Performs a logical AND operation on U(00) and 15 (binary: 00001111) and changes the bits higher than X(06) to zero.
4	Assigns U(00) to Yw.
5	Jumps to the block 1: loop_ unconditionally.

Y(i) = value		
Command	**Description**	**Argument**
	Outputs data to the output terminal variable in units of bits.	**i**: output terminal variable (range 0 to 6) **Value**: any variable or constant

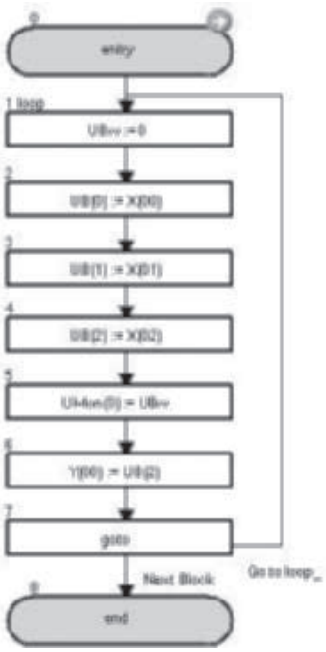
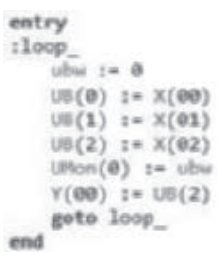
Format	
Flowchart method	**Text language method**
Y(i) : = <value> ↓	Y(i) : = <value>

Note The output terminal variable is a variable that controls the status of the inverter's output terminal. The following settings are required. The numerical order of the output terminal variables follows the numerical order of the set general-output numbers.

Set the Multi-function Output 11 to 13 Selection (C021 to C023) and the Multi-function Relay Output (RY) Function Selection (C026) to 35 to 41 (MO1 to MO7: General-purpose output).

<Assignment example>
Y(00) = MO1 (multi-function No. 35)
Y(01) = MO2 (multi-function No. 36)
Y(02) = MO3 (multi-function No. 37)
Y(03) = MO4 (multi-function No. 38)
Y(04) = MO5 (multi-function No. 39)
Y(05) = MO6 (multi-function No. 40)
Y(06) = MO7 (multi-function No. 41)

● Example

Flowchart	Text
	


```
entry
:loop_
    ubw := 0
    UB(0) := X(00)
    UB(1) := X(01)
    UB(2) := X(02)
    UMon(0) := ubw
    Y(00) := UB(2)
    goto loop_
end
```

In the above example, the status of X(00) to X(02) is monitored with the parameter UMon(0) (d025), and X(02) is output to Y(00).

Block number	Operation
1	Assigns 0 to UBw.
2 to 4	Assigns the variables X(00) to X(02) to the variables UB(0) to UB(2).
5	Assigns UBw to UMon(0).
6	Assigns UB(2) to Y(00).
7	Jumps to the block 1: loop_ unconditionally.

Yw = value

Command	Description	Argument
	Outputs data to the output terminal variable in units of words. Reflect each bit in corresponding output.	**Value**: any variable or constant

Format	
Flowchart method	**Text language method**
Yw : = <value> ↓	Yw : = <value>

Note The output terminal variable is a variable that controls the status of the inverter's output terminal. The following settings are required. The numerical order of the output terminal variables follows the numerical order of the set general-output numbers.

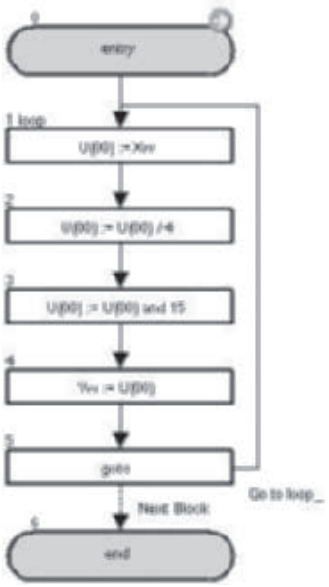
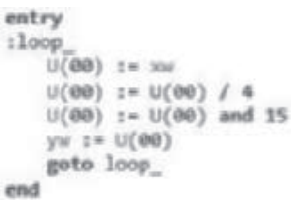
Set the Multi-function Output 11 to 13 Selection (C021 to C023) and the Multi-function Relay Output (RY) Function Selection (C026) to 35 to 41 (MO1 to MO7: General-purpose output).

When the data is assigned in units of words, zero is read out for the upper byte data and unset input terminal variables. If there is any setting, the setting is ignored.

<Assignment example>

Yw = 1 (bit 0) to Y(00) = MO1 (multi-function No. 35)
Yw = 2 (bit 1) to Y(01) = MO2 (multi-function No. 36)
Yw = 4 (bit 2) to Y(02) = MO3 (multi-function No. 37)
Yw = 8 (bit 3) to Y(03) = MO4 (multi-function No. 38) (only if expanded I/O for LX is used)
Yw = 16 (bit 4) to Y(04) = MO5 (multi-function No. 39) (only if expanded I/O for LX is used)
Yw = 32 (bit 5) to Y(05) = MO6 (multi-function No. 40) (only if expanded I/O for LX is used)
Yw = 64 (bit 6) to Y(06) = MO7 (multi-function No. 41) (only if expanded I/O for LX is used)

● Example

Flowchart	Text
	


```
entry
:loop_
    U(00) := Xw
    U(00) := U(00) / 4
    U(00) := U(00) and 15
    yw := U(00)
    goto loop_
end
```

In the above example, the status of the input terminals X(02) to X(05) is captured and output to the output terminals Y(00) to Y(03).

Block number	Operation
1	Assigns the value of Xw (value of input terminal) to U(00).
2	Divides the value of U(00) by 4 (2-bit right shift) to assign X(02) to bit 0.
3	Performs a logical AND operation on U(00) and 15 (binary: 00001111) and changes the bits higher than X(06) to zero.
4	Assigns U(00) to Yw.
5	Jumps to the block 1: loop_ unconditionally.

9-5-2 Inverter Control Commands

UP

Command	Description	Argument
	Makes the inverter start a forward operation. This command is a shortcut of the “func = value” command which is previously set as “UP : = 1”.	---

Format	
Flowchart method	**Text language method**
UP : = 1 ↓	UP : = 1

DWN

Command	Description	Argument
	Makes the inverter start a reverse operation. This command is a shortcut of the “func = value” command which is previously set as “DWN : = 1”.	---

Format	
Flowchart method	**Text language method**
DWN : = 1 ↓	DWN : = 1

Accel

Command	Description	Argument
	Sets the inverter acceleration time. This command is a =(Assign) command whose left-hand side is set to the acceleration time variable ACCEL. Unit: 10 ms	**Value**: any variable or constant (range 1 to 360,000)

Format	
Flowchart method	**Text language method**
ACCEL : = <value> ↓	ACCEL : = <value>

Note The A052 parameter must be set to value 03 (Drive Programming) for the command to become effective.

Decel		
Command	**Description**	**Argument**
	Sets the inverter deceleration time. This command is a =(Assign) command whose left-hand side is set to the deceleration time variable DECEL. Unit: 10 ms	**Value**: any variable or constant (range 1 to 360,000)
Format		
Flowchart method		**Text language method**
DECEL : = <value> ↓		DECEL : = <value>

Note The A052 parameter must be set to value 03 (Drive Programming) for the command to become effective.

9-6 Precautions for Use of Parameters for Drive Programming

9-6-1 Parameters Affected by Rated Current (%)

Parameter No.	Description	Data
b012	1st Electronic Thermal Level	0.20 to 1.00 x Rated current
b212	2nd Electronic Thermal Level	
b016	Free Setting Electronic Thermal Current 1	0.0 to Rated current
b018	Free Setting Electronic Thermal Current 2	
b020	Free Setting Electronic Thermal Current 3	
b022	1st Overload Limit Level	<Heavy load> 0.20 to 2.00 x Rated current <Light load> 0.20 to 1.50 x Rated current
b025	1st Overload Limit Level 2	
C039	Low Current Detection Level	<Heavy load> 0.00 to 2.00 x Rated current <Light load> 0.00 to 1.50 x Rated current
C041	1st Overload Warning Level	0.0: Function not active <Heavy load> 0.00 to 2.00 x Rated current <Light load> 0.00 to 1.50 x Rated current
C111	1st Overload Warning Level 2	<Heavy load> 0.00 to 2.00 x Rated current <Light load> 0.00 to 1.50 x Rated current

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Automatización Eléctrica
Especialistas en Automatización

Below is a list of articles with direct links to our shop Electric Automation Network where you can see:

- Quote per purchase volume in real time.
- Online documentation and datasheets of all products.
- Estimated delivery time enquiry in real time.
- Logistics systems for the shipment of materials almost anywhere in the world.
- Purchasing management, order record and tracking of shipments.

To access the product, click on the green button.

Product	Code	Reference	Product link
Industrial Career Final / Push Block contacts 2NC	160871	A22-02	Buy on EAN
Control System, Module Master / Slave DeviceNet	258836	CJ1W-DRM21	Buy on EAN
Control system, CompoNet Master Module	315606	CJ1W-CRM21	Buy on EAN
Drives, Option Card / Out (LX)	355362	3G3AX-EIO-E	Buy on EAN
Control System, Module Master / Slave DeviceNet	296523	CS1W-DRM21-V1	Buy on EAN
Control System, Master Module Componet	296522	CS1W-CRM21	Buy on EAN
Control system, PC Cable 2m	224557	CS1W-CN226	Buy on EAN