TOSHIBA
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6F8C1221

Unified Controller

nv Series

type1

Functional Manual

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Introduction

The unified controller nv series is an industrial use controller equipped with TC-net I/O, which is the duplex loop network with transfer rate 100Mbps, capable of unified use for instrumentation and electric control featuring high speed processing, reliability and economy. Among nv series, the type1 controller is a sequencer type controller mainly used for high-speed sequence control.

This document describes mainly the following contents related to the functions of the unified controller nv series type1.

- Configuration of controller
  This chapter describes the system configuration for sequence control, the composition of the controller unit, its I/O configuration, and the network configuration.
- Control operation
  This chapter describes the operation mode of the controller unit, its arithmetic processing, etc.
- Tasks
  This chapter describes the tasks. The types of tasks, their processing contents and degeneracy are explained in this chapter.
- Variables
  This chapter explains the variables handled by tasks.
- Inputs and Outputs
  This chapter describes the input to/output from I/O by task.
- nV-Tool support functions
  This chapter describes the functions operated from nV-Tool connected to the controller such as the change of module parameters, monitoring and online change.
- RAS function
  This chapter describes the RAS functions of the controller such as log information.

Also refer to the following related descriptions other than this document.

- Unified Controller nv series Controller Unit Instruction Manual 6F8C1220
- Unified Controller nv series TC-net 100 (TN8) Module Instruction Manual 6F8C1360
- Unified Controller nv series Ethernet (EN811) Module Instruction Manual 6F8C1358
- Unified Controller nv series High-speed serial I/O system TC-net I/O Instruction Manual 6F8C1240
- Unified Controller nv series & Integrated Controller V series Programming Instructions (LD/FDD/SFC/ST) 6F8C1226
- Unified Controller nv series & Integrated Controller V series Engineering Tool4 -Basic- 6F8C1290

Use Regulation

- This product is not developed or manufactured for the system including the equipment directly related to human life (note 1). Do not use the product for that purpose.
- When using this product to the system that is related to the safety of human and seriously affects the maintenance of public function (note 2), contact our sales section as the necessary special consideration (note 3) is required for the system operation, its maintenance and management.

(Note 1) The equipment directly related to human life means the following:

- Medical equipment such as life sustaining equipment and equipment for operation.

(Note 2) The system that is related to the safety of human and seriously affects the maintenance of public function means the following:

- Main equipment control system for nuclear power plant, safety protection system of nuclear facility, other system important for safety.
- Operation control system of mass transportation system and aviation control system.

(Note 3) Special consideration means the sufficient consultation with our engineers to establish safe system (fool proof design, fail safe design, redundancy design).

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● The Rules on Notation

This document uses following symbols for the rules on notation for better understanding.

◆ **Important:** Describes the matters that need special attention for appropriate product handling.

◆ **Note:** Describes the matters to be observed for appropriate product handling.

◇ **Supplementary:** Describes the supplementary matters to the described contents

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Chapter 1
Configuration of Controller

The unified controller nv series type1 controller PU811 can be used in single system configuration or in duplex system configuration.

This chapter describes the configuration beginning from system configuration to network configuration.

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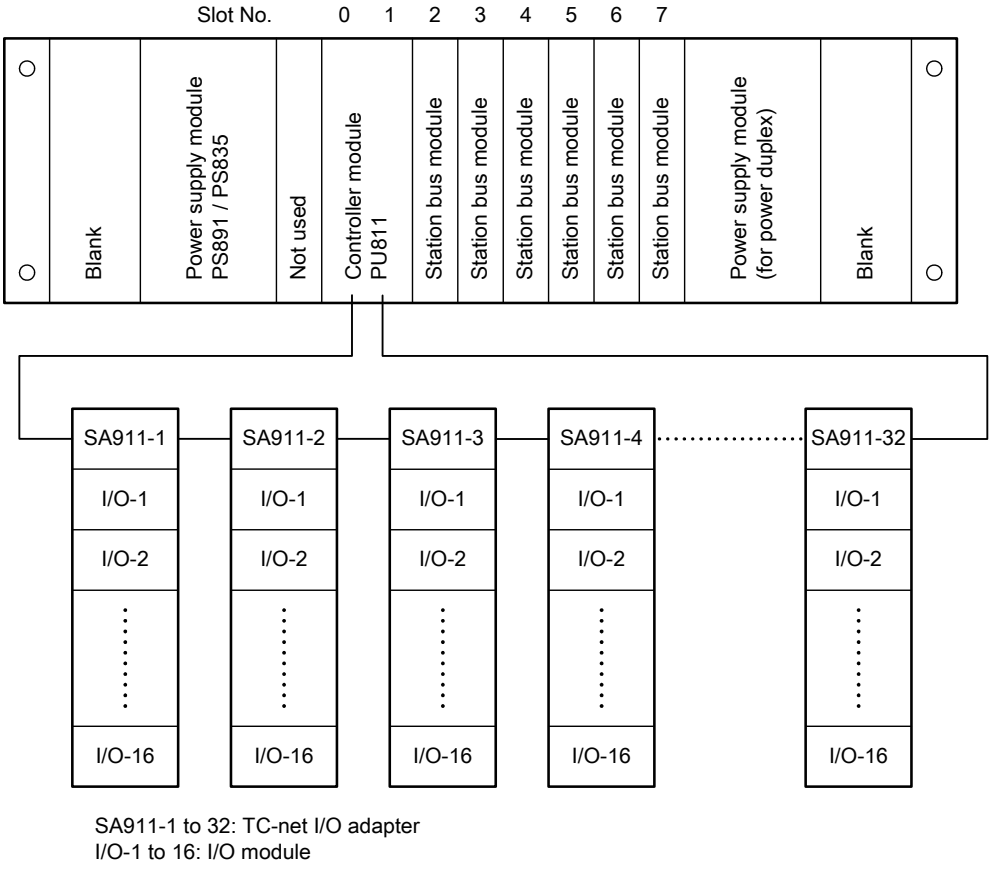
1.1 System Configuration

1.1.1 Single system configuration

In single system configuration, power supply module, controller module and station bus module are installed into base unit (BU816).

I/O signals are connected to the high-speed serial TC-net I/O module adopting remote I/O method.

■ Base unit for single system (BU816)



SA911-1 to 32: TC-net I/O adapter
I/O-1 to 16: I/O module

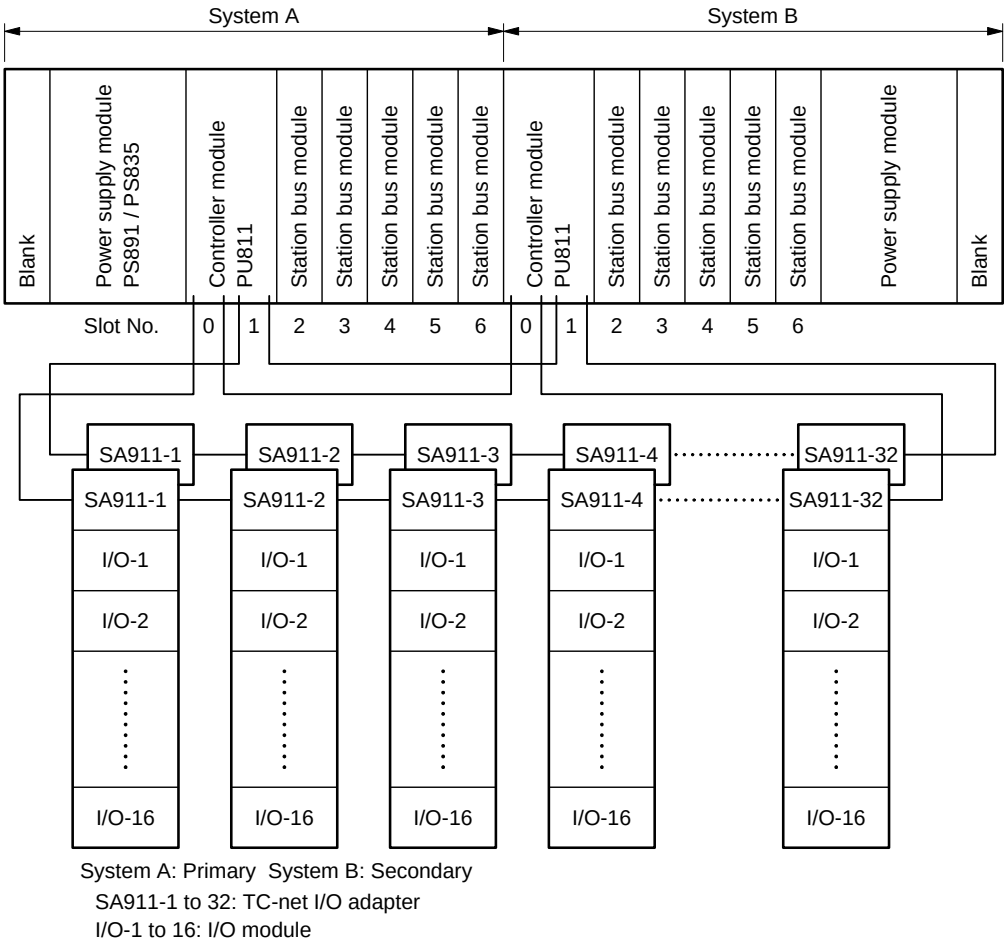
Fig. 1-1 Base unit for single system (BU816)

1.1.2 Duplex system configuration

The duplex system is a system with duplex basic units of the controller. The duplex system has two basic units of the controller of the same configuration. When an error occurs on one controller, the control of the system is switched to another controller.

In the duplex system, the running system (that currently is executing the control) is called as the on-line system, the waiting system (that is in standby status and executing diagnosis) is called as the standby system, and the other system (the system other than the running system and the standby system) is called as the off-line system respectively. When these systems are started up at the same time, the system that is assigned to the on-line system taking priority to other systems is called as the primary system, and the system that is assigned to standby is called as the secondary system.

■ Duplex configuration (BU825)



System A: Primary System B: Secondary
SA911-1 to 32: TC-net I/O adapter
I/O-1 to 16: I/O module

Fig. 1-2 One chassis duplex configuration (BU825)

◆ **Important**

- For duplex system configuration, be sure to configure the high-speed serial TC-net I/O loop as dual loops configuration.

1

1.2 Controller Unit Configuration

Fig. 1-3 shows the modules that can be installed to the base unit.

Base unit (BU816)

Base unit (BU825)

	Slot 0-1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7
Controller module							
PU811	○	—	—	—	—	—	—
Station bus module (Transmission module) (Note 1)							
EN8** (Ethernet)	—	○	○	○	○	○	○
TN8**(TC-net 100)	—	○	○	○	○	○	○

(Note 1) Maximum 4 transmission modules can be installed.
*Refer to Bus Module Description for ** in the pet name.

Fig.1-3 Modules that can be installed to the base unit

◆ **Important**

- When CPU is installed to the system A (primary side) of the duplex base unit (BU825), the system can operate as a single system, however, if CPU is installed to the system B (secondary side), the system cannot operate as the single system.

1.3 I/O Configuration

I/O signals are connected to the high-speed serial TC-net I/O module adopting remote I/O method. Also existing G3 I/O can be connected using G3 I/O adapter.

1.3.1 High-speed serial TC-net I/O series configuration

■ Single system configuration

For the controller of single system configuration, the high-speed serial TC-net I/O loop configuration is connected as a single loop configuration as shown in the following figure.

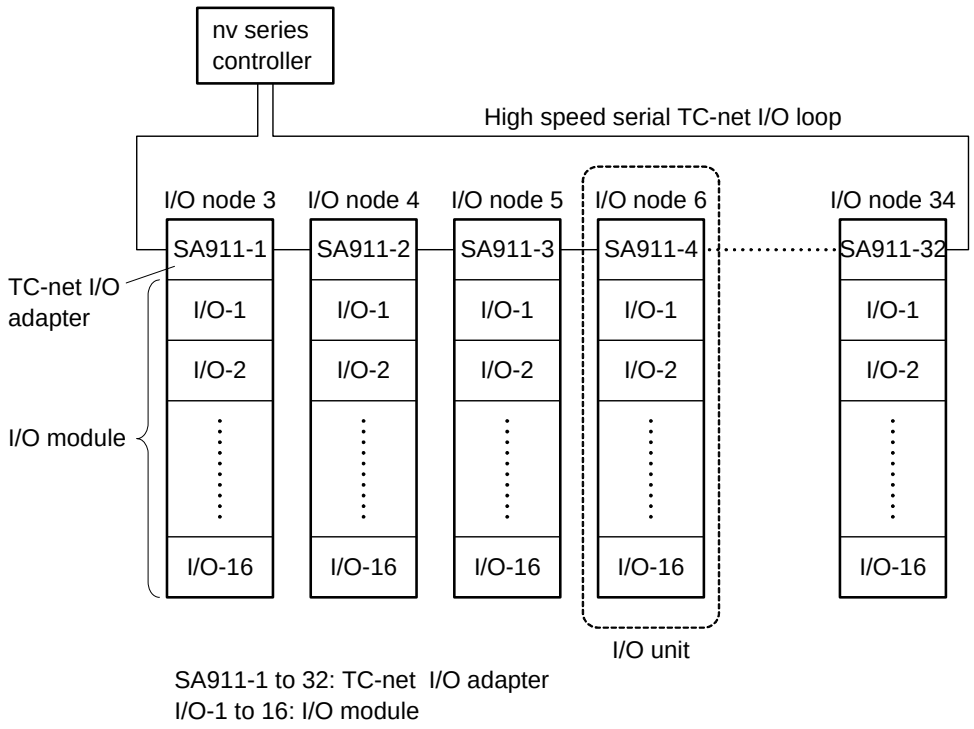


Fig. 1-4 Single system configuration

◆ Important

- Be sure to connect to Loop A (LOOP-A) side of the controller.

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■ Duplex system configuration

For the controller of duplex system configuration, the high-speed serial TC-net I/O loop configuration is connected as a dual loops configuration as shown in the following figure.

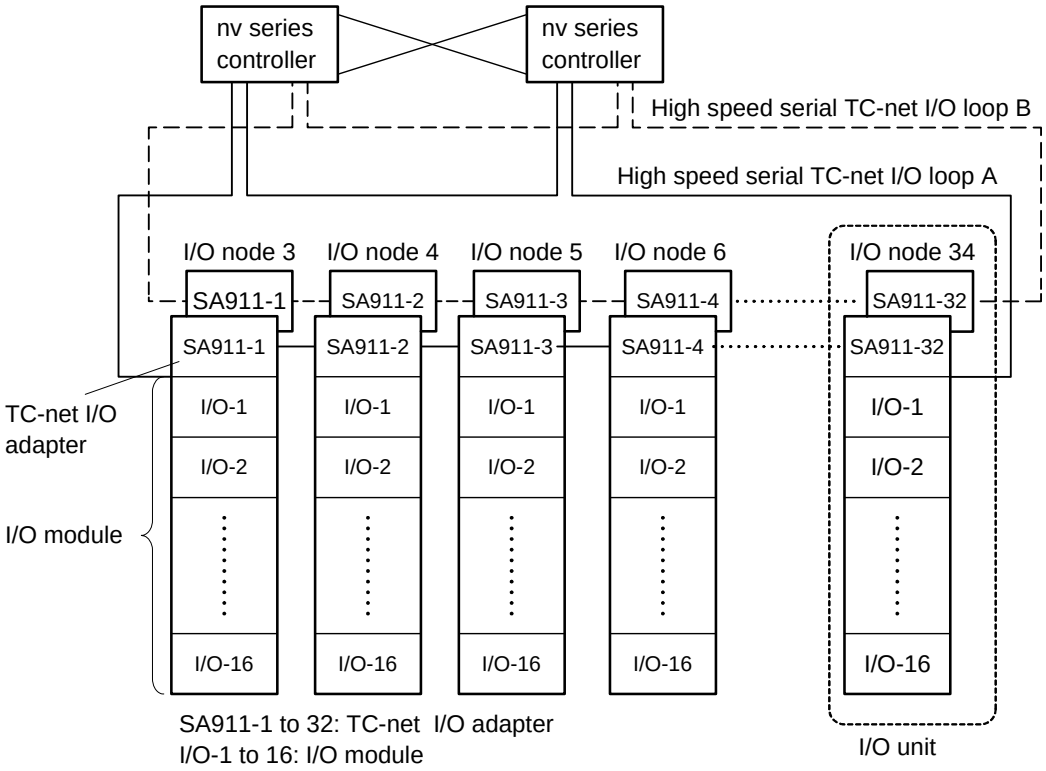

Fig. 1-5 Duplex system configuration

◆ Important

- For duplex system configuration, be sure to configure the high-speed serial TC-net I/O loop as dual loops configuration.

Table 1-1 High-speed serial TC-net I/O supporting specification

	Single system configuration	Duplex system configuration
Loop configuration	1 loop	2 loops
Nodes	max. 32 nodes	
Node no.	3 to 34	
Units per one node	1 unit	
Number of installable I/O modules per unit	max. 16 modules	
Number of installable special I/O modules (Note 1)	max. 16 modules/controller	

(Note 1) Special I/O module means the module for FL-net, MODBUS and Ethernet. Refer to High-speed Serial I/O System TC-net I/O Instruction Manual (6F8C1240) for the details.

1.4 Network Configuration

The unified controller nv series supports the de facto standard network.

Therefore the system can be configured to the system scale. An example of system configuration is shown in Fig. 1-6.

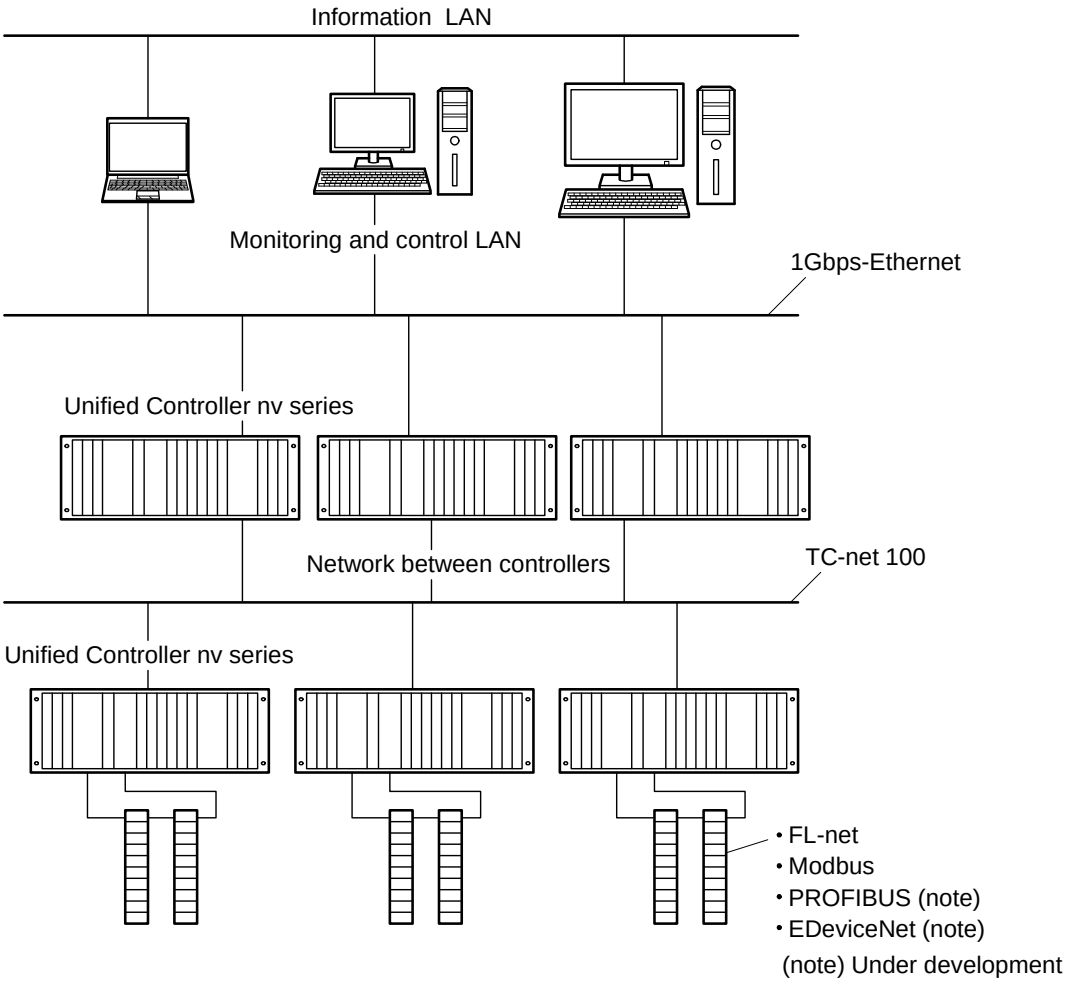

Fig. 1-6 System configuration

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Chapter 2
Operation of Main Unit

This chapter describes the basic operation of the unified controller nv series type1 controller main unit

Fig. 2-1 shows the front view of the controller module PU811 of type1 controller.

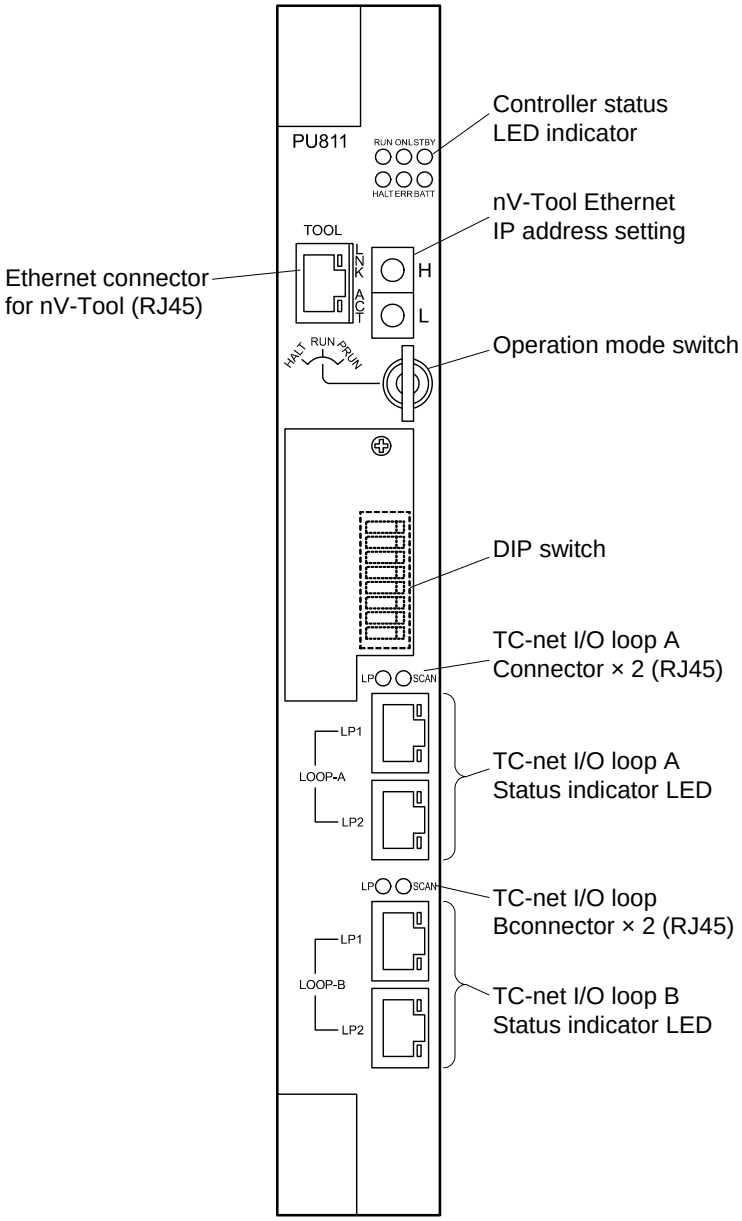

Fig. 2-1 Controller module PU811 front view

2.1 Basic Operation Flow

Fig. 2-2 shows the basic operation flow of the unified controller nv series type1 controller main unit.

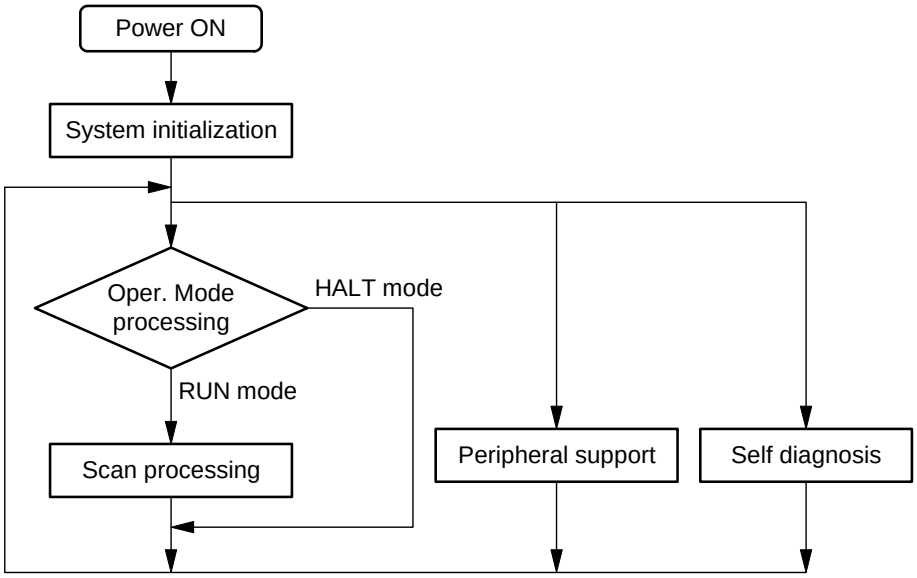

Fig. 2-2 Basic operation flow

When turning on the power, the type1 controller executes the system initialization at first, and then operation mode processing if no error occurs during initialization. After the operation mode processing, scan processing is executed if the conditions to run in the RUN mode are established. Scan processing is the processing to execute user programs that are the function of the type1 controller main unit. If the conditions to run in the RUN mode are not established, the system status becomes the HALT mode where programs are disabled to run.

The peripheral support processing is to accept the requests from nV-Tool and computer link and to process the response to them. This process is executed in the interval between each scan processing.

The self diagnosis processing is executed individually in each process. Fig. 2-2 shows the self diagnosis processing executed in the interval between each scan processing.

This chapter describes the contents of system initialization processing, operation mode processing, scan processing and peripheral support processing. The self diagnosis processing is described in Chapter 6 RAS Functions.

2.2 System Initialization Processing

The system initialization processing is a processing executed at first after power on. In this processing self diagnosis of hardware and its initialization are executed. After that the system is initialized.

Fig. 2-3 shows the flow of the process. The contents of each step in the flow are described below.

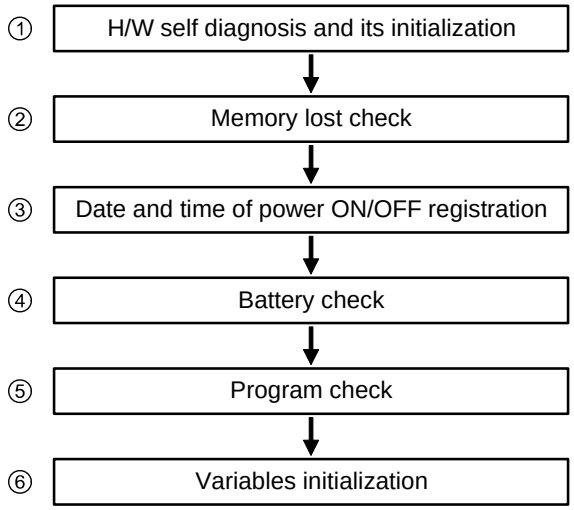

Fig. 2-3 System initialization processing flow

① Self diagnosis of controller hardware and its initialization
In the self diagnosis of controller hardware system ROM check, system RAM check and initialization setting are carried out. If any error is detected by these checks, the result is indicated in 6-point LED indicator and the following processing is not executed.

Refer to Table 6-6 in 6.4.2 Error indication LED for the cause. When the check result is normal, peripheral LSI check and its initialization, calendar LSI check and sequence arithmetic processor (LP) check are executed.

② Memory lost check
Whether or not the contents of the battery backed up memory (program and control data) are lost is checked. If they are lost memory is cleared and error log is registered, and the processing that follows the memory lost check continues executing. Further when the other system in the duplexing operation is running in individual operation, the own system receives equalization and enters into standby operation.

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◇ **Supplementary**

- Shutdown processing
  Memory lost occurs caused by improper shutdown processing other than by low battery voltage.
  Shutdown means the processing to save the contents of program and control data to battery backed up memory.
  This shutdown processing is enabled only when the power for battery back up is fully charged. If the charging is not completed, the shutdown processing is not executed and the contents of the memory are lost. Be sure to check that the charging of battery back up power is completed with the LED indicator on the front panel (refer to 2.3.4) and turn off the power.

③ Date and time of power ON/OFF registration
The last date and time when power was OFF is registered into the event log. Further, the present date and time read out from calendar LSI is registered as the power ON date and time. The present date and time is set to special register
(S register) (SW [16] to [22]).

④ Battery check
Whether or not the back up battery for program and control data is installed (in the controller) is checked as well as its voltage. If the back up battery is not installed, the message “No battery” is registered into the error log and the battery alarm flag (S [261]. B [0]) in the special register (S register) is set.
If the battery voltage is lower than the defined value, the message “Low voltage” is registered into the error log and the battery alarm flag (S [261]. B [1]) in the special register (S register) is set.

⑤ Program check
The contents of program running on the memory (RAM) is checked with BCC (block check character).

⑥ Variables initialization
Variables are initialized in start-up mode.
Refer to 4.3 Variables initialization

2.3 Operation Mode Processing

2.3.1 Types of operation mode

In operation mode processing, memory status, operation mode switch status and operation mode change request sent from peripheral device (nV-Tool, transmission equipment) are checked to decide the operation mode of the controller.

Roughly speaking, there are three operation modes of the controller, namely RUN mode, HALT mode and ERROR mode. Among these modes, the ERROR mode is a mode for the system status to enter into when any of diagnosis results is judged to be unable to continue the predetermined operation. Operation mode transition condition is not set only by these operation modes described here.

In the HALT mode, DL-WAIT mode of memory cleared status is provided other than the ordinary HALT, and in RUN mode ODD-RUN mode for single operation and MASTER-RUN mode for duplexing operation are provided. (Refer to Fig. 2-4.)

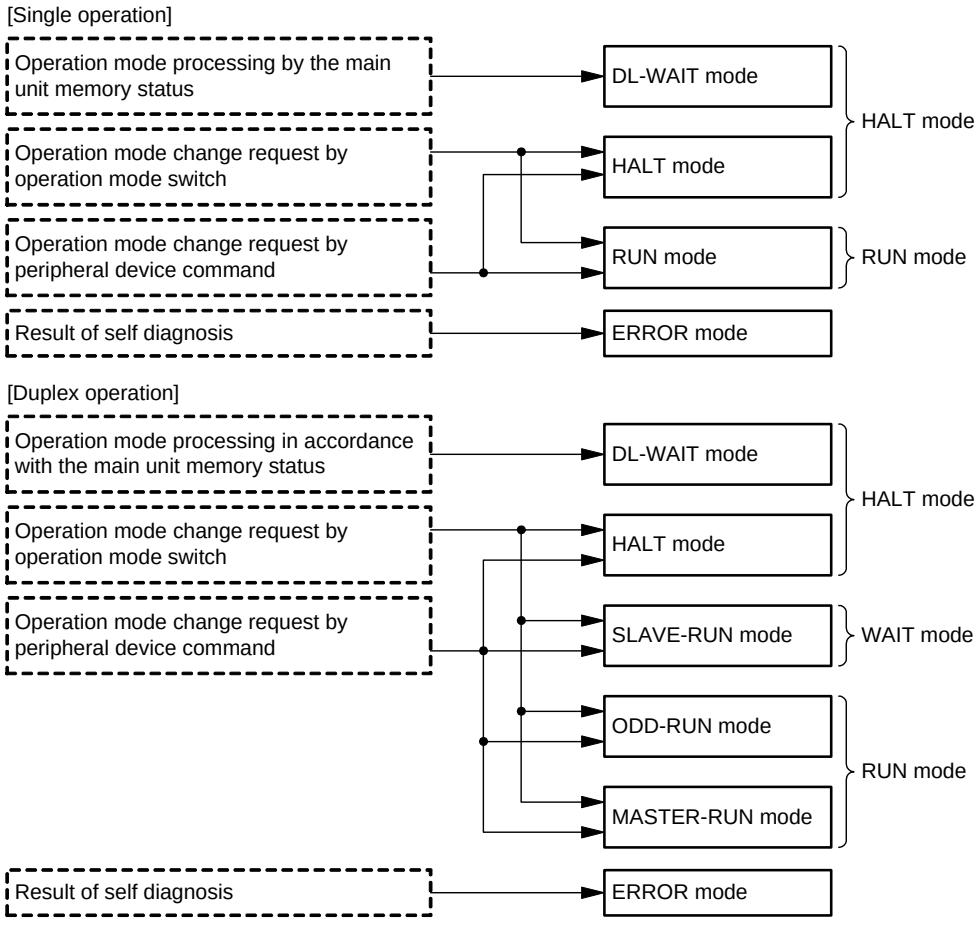


Fig. 2-4 Operation mode processing

2.3.2 Function of each operation mode

The function of each operation mode is described in the following table.

Table 2-1 Operation mode (1)

Mode	Operation
INZ	System is in initializing status. After turning on the power, system executes the process necessary for operation. This mode is to pass only, without repeat.
DL-WAIT	System is in the status of waiting downloading. The system status in this mode is the status where the system configuration information necessary to start executing is not on the memory. This mode is cancelled by downloading the system configuration information from the nV-Tool. When RUN is requested, the operation mode transitions.
TRS-HALT-RUN	This mode is to initialize I/O devices. In TRS-HALT-RUN mode, configuration of the main unit module is checked and high-speed serial TC-net I/O is initialized. This path is traced when the system mode changes to RUN mode.
TRS-RUN-HALT	Operation mode where I/O devices are stopped. This path is traced when the system mode transitions from RUN to HALT.
HALT	Operation mode to prepare/change the program. In HALT mode, program execution and I/O processing are stopped. Operation mode processing is executed regularly (for every 20 ms) and the peripheral support processing and self diagnosis processing are moved to the unoccupied time.
RUN/MASTER-RUN/ ODD-RUN common	The system enters into RUN mode after main unit module installation status check, user variation initialization, program check and scan processing have been executed. In RUN mode, operation mode processing, batch I/O processing and program execution are repeated. This process is called the scan processing. The scan processing is described in Section 2.4 Scan processing and Chapter 3 Tasks in detail.
MASTER-RUN	In MASTER-RUN mode, the online operation status of duplex system is indicated. Also program and tracking sending are executed. (Note 2) (Remark) This operation mode is maintained unless any of the following occurs: 1) the standby system is halted, 2) forced outage (Note 1) is selected, 3) system down occurs due to error. When the standby system is halted, the own system enters into individual operation (ODD-RUN).

(Note 1) he controller executes the program based on the downloaded information.
Forced outage means the case when the operation mode switch is turned from RUN to HALT, HALT is selected from the nV-Tool, or when forced switching of duplex system is selected.

(Note 2) Tracking is a function that equalizes the data in the online system controller and in the standby system controller. Refer to 2.7.2 Tracking function for the details.

Table 2-1 Operation mode (2)

Mode	Operation
SLAVE-RUN	The SLAVE-RUN mode indicates the standby operation status of the duplex system. The system executes tracking reception and maintains the waiting status of the duplex system. (Remark) When the online system is halted in this operation mode, the own system sets itself to individual operation (ODD-RUN) and maintains the operation of the controller.
ODD-RUN	In this operation mode the system runs in individual operation mode to execute the program. (Remark) When the other system is selected to RUN in this operation mode, the own system executes equalizing transmission and then transitions to online operation status (MASTER-RUN) and the whole system returns to duplex status.
EQL-SEND-RUN	Equalization transmission is executed in this operation mode. (Note 3) (Remark) When the own system is running in individual operation (ODD-RUN) and the other system is selected to RUN, this operation mode is executed. The own system transitions to online operation status (MASTER-RUN) after equalization transmission and the whole system becomes duplex status.
EQL-RCV-RUN	Equalization reception is executed in this operation mode. (Remark) When the other system is running in individual operation (ODD-RUN) and the own system in halt status (HALT) is selected to RUN, the equalization reception (RECV) is executed. The own system sets itself to standby operation status (SLAVE-RUN) after equalization reception and the whole system becomes duplex status.
TRS-ERR	TST-ERR mode is a mode that the system passes through when it transitions from RUN to ERR.
ERR	When any error was detected in various self diagnosis processes and the error could not be restored by the predetermined retry processing, the system is judged to be unable to recover normal operation and transitions to this operation mode. In the ERR mode only error reset command from the nV-Tool and the reset operation by the operation mode switch become valid (The system recovers HALT mode by error reset command) .

(Note 3) Equalization is a function that equalizes various pieces of information such as the setting information, program information and variables information of the online system controller and of the standby system controller. Refer to 2.7.1 Full equalization function for the detail. The word equalization includes two types of equalization: full equalization and partial equalization. If it is written simply as equalization without explicit expression, it means the full equalization.

2.3.3 Transition condition of operation mode

The outline of the operation mode transition is shown in Fig. 2-5 and Fig. 2-6.

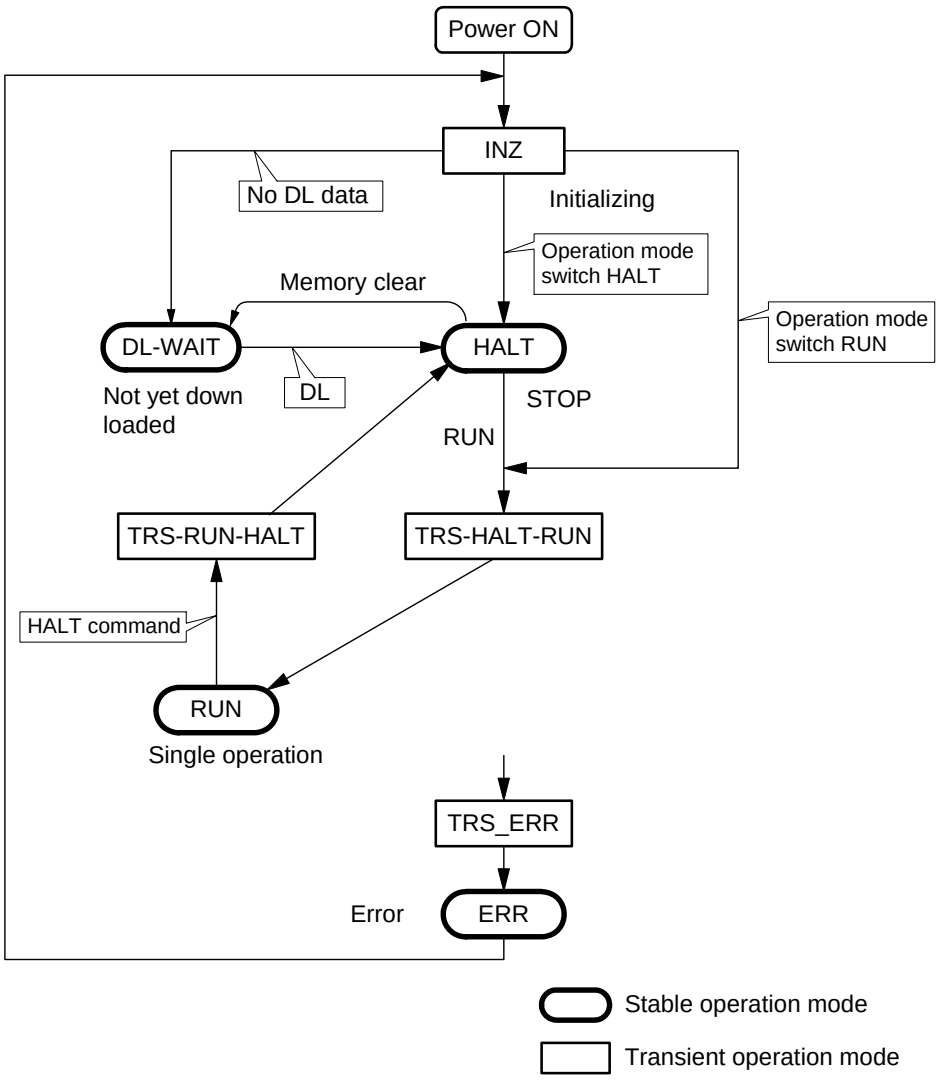


Fig. 2-5 Operation mode transition in single operation

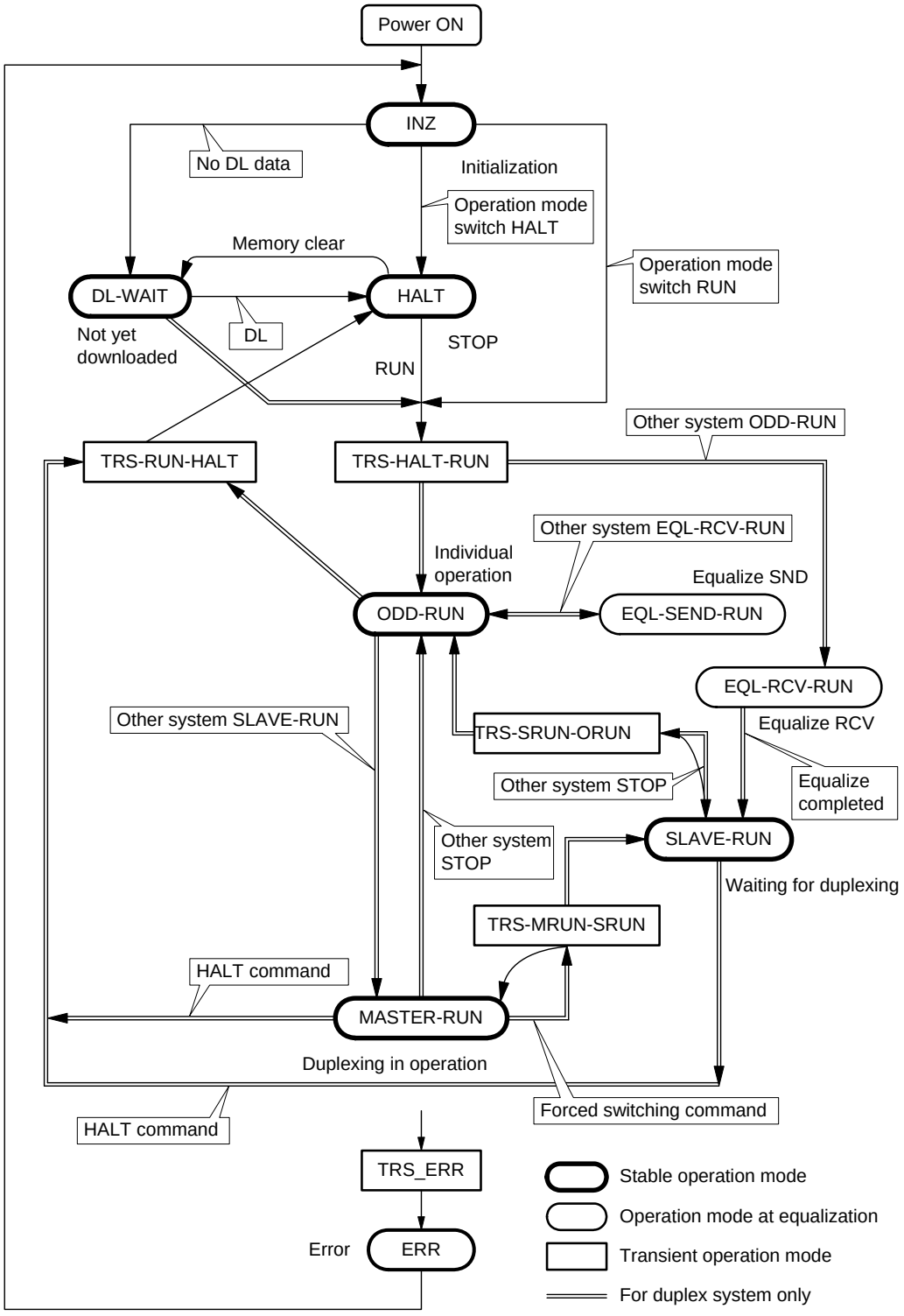


Fig. 2-6 Operation mode transition in duplex operation

The conditions to enter stably into these operation modes (operation mode transition conditions) are described in Table 2-2 through 2-6.

- Oblique line indicates that it does not depend on the status of the operation mode switch.
- Among the factors in operation mode transition, the expression with an arrow such as “Oper. Mode Sw → XX” means that the operation mode switch is switched to the position XX.
- The expression “Command XX” means to execute the command XX sent from the peripheral device.
- Switching the operation mode switch between RUN ↔ P-RUN does not affect the operation mode (However, protection status is switched).

The transition conditions to each operation mode are described below.

■ Transition conditions to DL-WAIT mode
The transition conditions to DL-WAIT mode are indicated in Table 2-2.

Table 2-2 Transition conditions to DL-WAIT mode

Status before operation		Factors for operation mode transition	Operation mode after transition	Remark
Operation mode	Operation mode SW.			
Power OFF		Power ON and Not yet downloaded	DL-WAIT	After INZ processing
		Power ON and DIP SW 1 and 2 ON		
HALT		Command “MEMORY CLEAR”	DL-WAIT	—

Table 2-3 Transition conditions to HALT mode

Status before operation		Factors for operation mode transition	Operation mode after transition	Remark
Operation mode	Operation mode SW.			
Power OFF	HALT	Power ON	HALT	After INZ processing
ERROR		Command “ERROR RESET”		—
		Operation mode SW. HALT → RUN		—
RUN ODD-RUN MASTER-RUN	RUN	Operation mode SW. RUN → HALT		—
	RUN/P-RUN	Command “HALT”		

■ Transition conditions to ODD-RUN mode
The transition conditions to ODD-RUN mode are indicated in Table 2-4.

Table 2-4 Transition conditions to ODD-RUN mode

Status before operation			Factors for operation mode transition	Operation mode after transition
Operation mode	**Operation mode SW.**	**Operation mode of other system**		
Power OFF	RUN/P-RUN	Power OFF, HALT, DL-WAIT, ERR	Power ON	ODD-RUN
HALT	HALT		Operation mode SW. HALT → RUN	
	RUN/P-RUN		Command RUN	
MASTER-RUN	RUN/P-RUN	SLAVE-RUN	Other system in power OFF status, HALT, DL-WAIT, ERR	
SLAVE-RUN	RUN/P-RUN	MASTER-RUN	Other system in power OFF status, HALT, DL-WAIT, ERR	

■ Transition conditions to MASTER-RUN mode
The transition conditions to MASTER-RUN mode are indicated in Table 2-5.

Table 2-5 Transition conditions to MASTER-RUN mode

Status before operation			Factors for operation mode transition	Operation mode after transition
Operation mode	**Operation mode SW.**	**Operation mode of other system**		
Power OFF	RUN/P-RUN	SLAVE-RUN	Power ON of both system	MASTER-RUN
ODD-RUN	RUN/P-RUN		Other system in SLAVE-RUN	

■ Transition conditions to SLAVE-RUN mode
The transition conditions to SLAVE-RUN mode are indicated in Table 2-6.

Table 2-6 Transition conditions to SLAVE-RUN mode

Status before operation			Factors for operation mode transition	Operation mode after transition
Operation mode	**Operation mode SW.**	**Operation mode of other system**		
Power OFF	RUN	ODD-RUN	Power ON	SLAVE-RUN
HALT	HALT		Operation mode SW → RUN	
	RUN		Command RUN	
DL-WAIT	RUN		Command RUN or Operation mode SW → RUN	

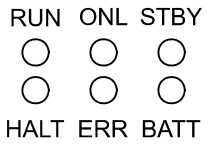
2.3.4 Status indication LED on the front panel

Front panel of the controller module is equipped with controller status LED indicators. These LED indicators light in accordance with the operation mode of the controller as shown in Table 2-7.

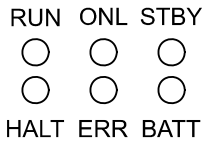
The TC-net I/O loop status LED indicators light as shown in Table 2-8.

Table 2-7 Controller status LED indicators

[Single operation]

LED name	Color	Off	Blink	On	LED layout
RUN	GRN	HALT/DL-WAIT/ ERR mode	While operating in simulation mode	RUN mode	
ONL	GRN	HALT/DL-WAIT/ RUN/ ERR mode			
STBY	GRN	HALT/DL-WAIT/ RUN/ ERR mode			
HALT	GRN	RUN/ERR mode	DL-WAIT	HALT	
ERR	RED	Other than ERR	ERR (Note 1)	ERR (Note 2)	
BATT	GRN	Low battery or battery not installed	Battery normal and charging battery back up power	Battery normal and charging battery back up power completed	

[Duplex operation]

LED name	Color	Off	Blink	On	LED layout
RUN	GRN	HALT/DL-WAIT/ ERR mode	While operating in simulation mode	ODD-RUN/ MASTER-RUN/ SLAVE-RUN/ EQL-SEND-RUN/ EQL-RCV-RUN mode	
ONL	GRN	HALT/DL-WAIT/ SLAVE-RUN/ EQL-RCV-RUN ERR mode	EQL-SEND-RUN	ODD-RUN/ MASTER-RUN	
STBY	GRN	HALT/DL-WAIT/ ODD-RUN/ MASTER-RUN EQL-SEND-RUN ERR mode	EQL-RCV-RUN	SLAVE-RUN	
HALT	GRN	ODD-RUN/ MASTER-RUN EQL-SEND-RUN/ SLAVE-RUN/ EQL-RCV-RUN ERR mode	DL-WAIT	HALT	
ERR	RED	Other than ERR	ERR (Note 1)	ERR (Note 2)	
BATT	GRN	Low battery or battery not installed	Battery normal and charging battery back up power	Battery normal and charging battery back up power completed	

(Note 1) Refer to 6.4.2 Error Indication by LED.
(Note 2) Check the cause of ERR with special register (S register) or error log.

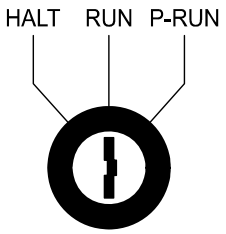
Table 2-8 TC-net I/O loop status LED indicators

LED name	Color	Off	Blink	On	LED layout
LP	GRN	I/O bus status or not connected		I/O loop status	LP◯ ◯SCAN
SCAN	GRN	Scan transmission stopped		Scan transmission	

2.3.5 Operation mode switch

Use of the controller operation mode switch is described in Table 2-9.

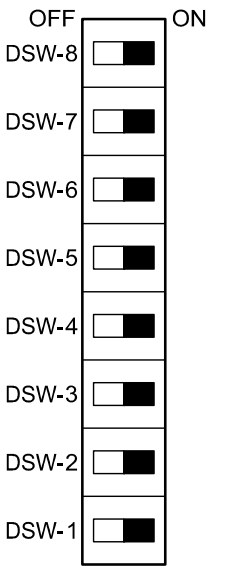
Table 2-9 operation mode switch

Switch position	Operation mode	Operation mode SW. layout
HALT	When the operation mode switch is switched from RUN or P-RUN to HALT, the operation mode of the main unit becomes HALT mode. Turning on the power with the operation mode switch set to HALT starts up the system in HALT mode. RUN command from the nV-Tool is accepted only when the operation mode switch is set to RUN or P-RUN.	
RUN	When the operation mode switch is switched from HALT to RUN, the operation mode of the main unit becomes RUN mode. In this case, the operation mode does not change when the operation mode switch is switched from P-RUN to RUN.	
P-RUN	P-RUN means Protected RUN. The operation mode in P-RUN is the same as that of RUN, however, in P-RUN the writing of whole program becomes unable.	

2.3.6 DIP switch

DIP switches on the controller front panel are capable to specify the settings indicated in Table 2-10.

Table 2-10 DIP switch specification

No.	Name	Function	OFF	ON	DIP switch layout
1	DSW-1	Memory clear	Not operate	Both ON: memory clear	
2	DSW-2	Memory clear	Not operate		
3	DSW-3	(System reserve)	To be set to OFF		
4	DSW-4	(System reserve)	To be set to OFF		
5	DSW-5	nV-Tool Ethernet IP address selection	5 6 OFF OFF: 172.16.64.** OFF ON: 192.168.0.**		
6	DSW-6				
7	DSW-7	(System reserve)	To be set to OFF		
8	DSW-8	(System reserve)	To be set to OFF		

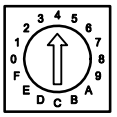
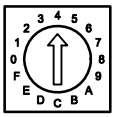
◆ Important

- Program and control data are initialized if power ON or error reset is carried out specifying memory clear.
- Be sure to cancel the specifying memory clear and operate the controller.

2.3.7 Ethernet IP address setting switch for nV-Tool

The Ethernet IP address setting switch for nV-Tool installed to the controller can specify the contents described in Table 2-11. Rotary switch sets the lower three digits of Ethernet IP address for nV-Tool connection “172. 16. 64. **” or “192. 168. 0. **”.

Table 2-11 Specification by Engineering tool Ethernet IP address setting switch

No.	Name	Contents		Switch layout
0	RSW-0	Upper digits (0 to F) of least three digits of the Ethernet IP address of nV-Tool that is converted to hexadecimal.	172.16.64.**	 H
			192.168.0.**	
1	RSW-1	Lower digits (0 to F) of least three digits of the Ethernet IP address of nV-Tool that is converted to hexadecimal.	172.16.64.**	 L
			192.168.0.**	

◆ **Important**

- Set either of Ethernet IP address of nV-Tool “172. 16. 64. **” or “192. 168. 0. **” with DIP switch No.5 and No.6.
  “**” =0 cannot be specified.

2.3.8 Operation mode register record

Each operation mode is recorded to the special register (S register) SW [14] and SW [15] with value.

The value corresponding to each mode is indicated in Table 2-12.

Table 2-12 Register display of operation mode

Controller status / Special register / Operation mode type		Own system operation mode	Other system operation mode	Own system operation mode
		SW[14]	S[280].B[0]-S[280].B[7]	SW[15]
INZ		01H		0H
HALT	DL-WAIT	31H		1H
	TRS-HALT-RUN	38H		
	HALT	32H		
	SLAVE-RUN	3AH		
	EQL-RCV-RUN	3CH		
RUN	RUN	C1H		2H
	MATER-RUN	C3H		
	ODD-RUN	C2H		
	EQL-SEND-RUN	C6H		
ERR		F1H		6H

2.4 Scan Processing

This section describes the scan processing that is a basic function of the controller.

As described in 2.3 Operation mode processing, when the mode transition conditions to switch to RUN mode in the operation mode processing user global variables/local variables initialization (if needed), main unit module installation status check, program check and module parameter check are executed and the system enters into scan processing. In the scan processing, batch I/O processing and program execution processing are repeated.
Fig. 2-7 shows the flow of the scan processing.

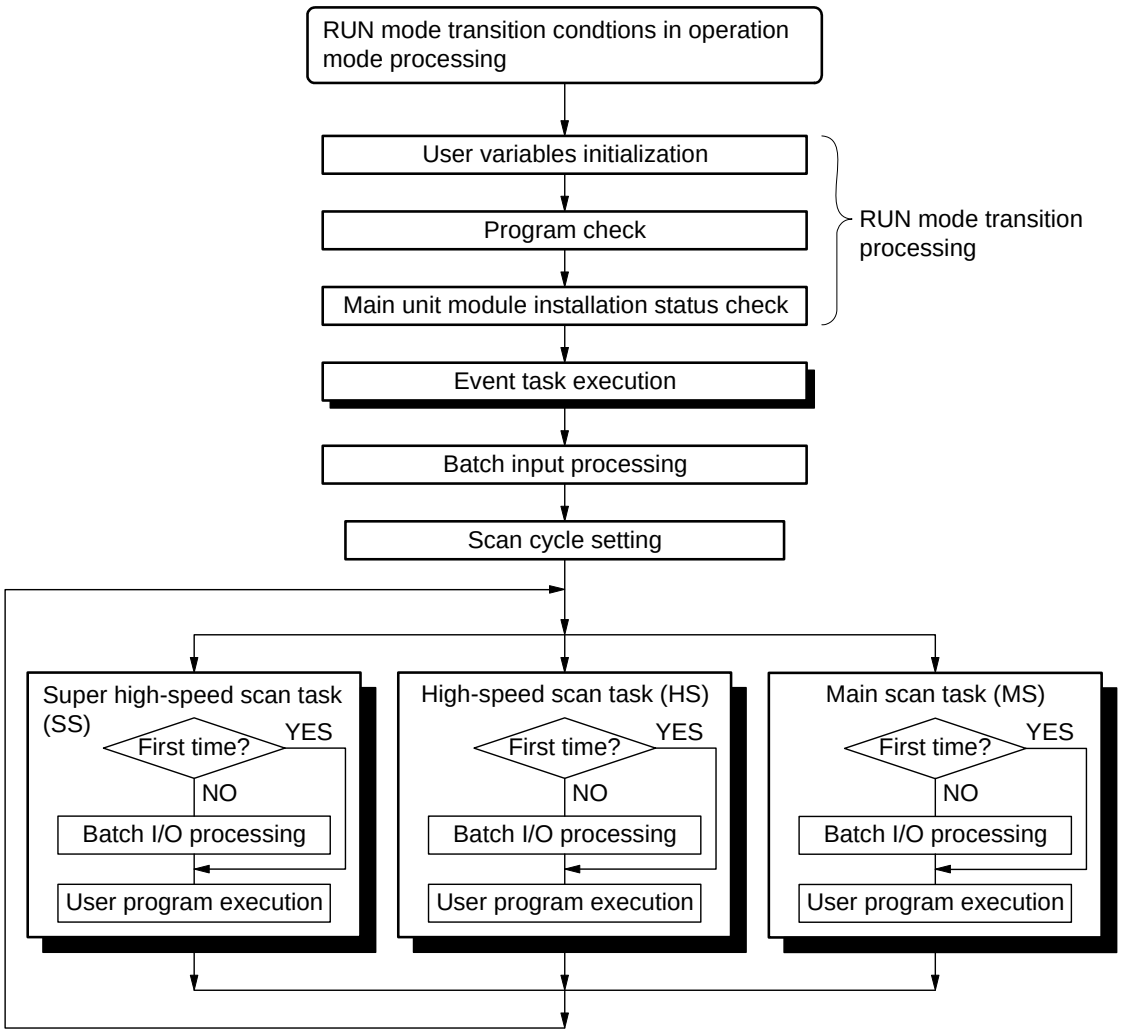


Fig. 2-7 Flow of scan processing

One cycle from batch I/O processing to program execution is called as one scan. The time required for one scan is called scan cycle (or scan time).

2.4.1 Scan cycle

The controller uses fixed time scanning method to execute the scan processing at a predetermined time cycle. Setting range of the cycle is 0.5 to 500 ms (0.1 ms unit) for super speed scan task, 0.5 to 500 ms (0.1 ms unit) for high-speed scan task and 0.5 to 1000 ms (0.1 ms unit).
The operation of the fixed time scan processing is indicated in Fig. 2-8.

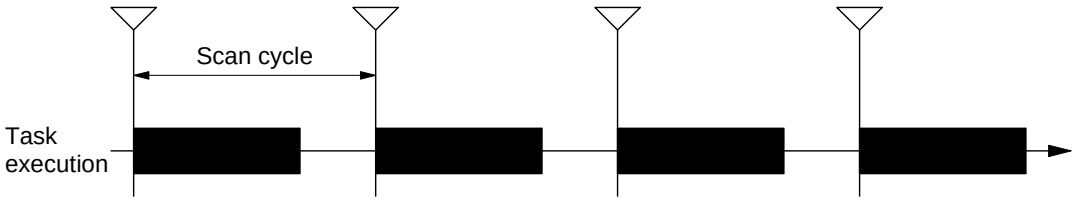


Fig. 2-8 Scanning operation

Scan cycle is set by specifying the items to be scanned in the controller parameters from the nV-Tool.
When the processing time for a scan task exceeds 1 scan cycle, the floating scan cycle is adopted and scan congestion flag is set. When the cycle of the floating scan returns within the set cycle, the congestion flag is reset and the system returns to original setting scan cycle. (Refer to Fig. 2-9.)

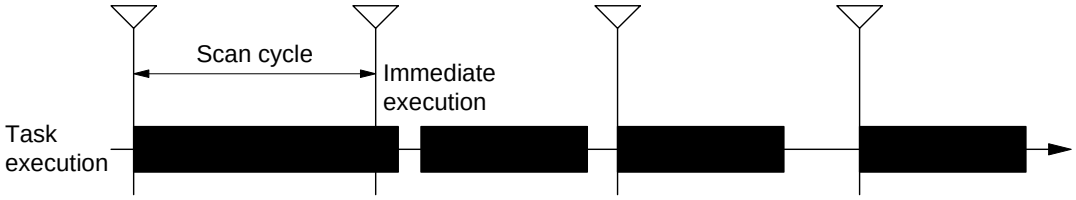


Fig. 2-9 Scan congestion

2.4.2 Batch I/O

The status of external signal input to the input module is read in to input variable (%I) and the status of the output variable (%Q) is output to the output module. This processing is called as batch I/O processing as the processing is executed in a batch before execution of SS/HS/MS task program.
Refer to 3.4 Inputs and outputs for the details.

2.4.3 Program execution

Instruction word in the program memory is read one by one and the contents of the output register are overwritten referring to the contents of the control data. This is a basic function of sequence controller.
Refer to Chapter 3 Tasks for the details.

2.5 Peripheral Support Function

The peripheral support processing interprets the request command sent from the peripheral devices (nV-Tool, computer link, transmission device), executes the requested processing and carries out the response.

As the execution of the program is handled by the sequence arithmetic processor (LP), main CPU has an empty time with no execution. Main CPU executes the peripheral support processing in this empty time. (Refer to Fig. 2-10.)

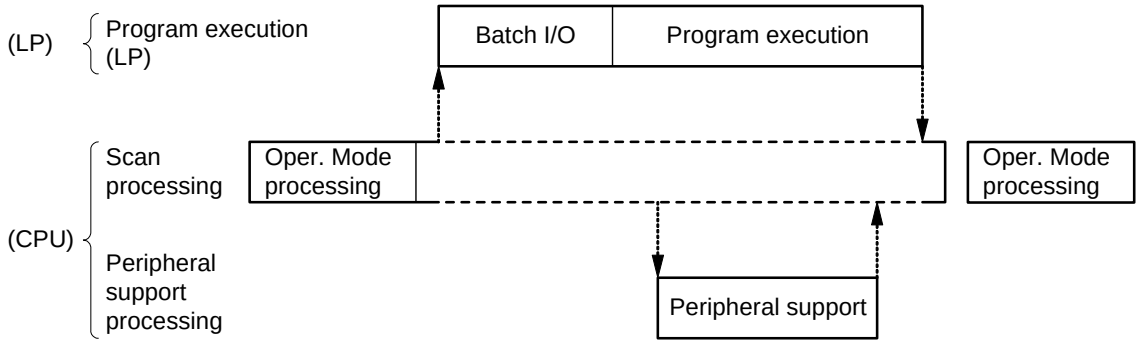


Fig. 2-10 Peripheral support processing

2.6 Duplex Operation

This section describes the operation of the status transition of duplex system.

2.6.1 Power on start-up

■ Simultaneous start up of controllers in both systems

The operation when both controllers of primary and secondary sides were turned on simultaneously is described using Fig. 2-11.

When both controllers of primary and secondary sides were started up at the same time, the primary side controller executes the initial setting of I/O modules for the preparation to operate as online and temporarily enters into individual operation. The primary side controller executes the program and starts to control.

① The secondary side controller is in standby status waiting for equalization reception.

② When the secondary side controller becomes waiting for equalization reception, the primary side controller starts equalization transmission. Through this process the both controllers are equalized.

③ When completing the equalization transmission, the primary side controller starts individual operation temporarily and executes program.

④ When the secondary side controller has completed the equalization reception and the primary side controller starts individual operation, the secondary side controller starts standby operation.

⑤ When the secondary side controller starts standby operation, the primary side controller starts online operation and the system becomes duplex status. In the duplex status the primary side controller that is operating as the online system executes tracking transmission for the equalization of data to the secondary side controller that is operating as the standby system.

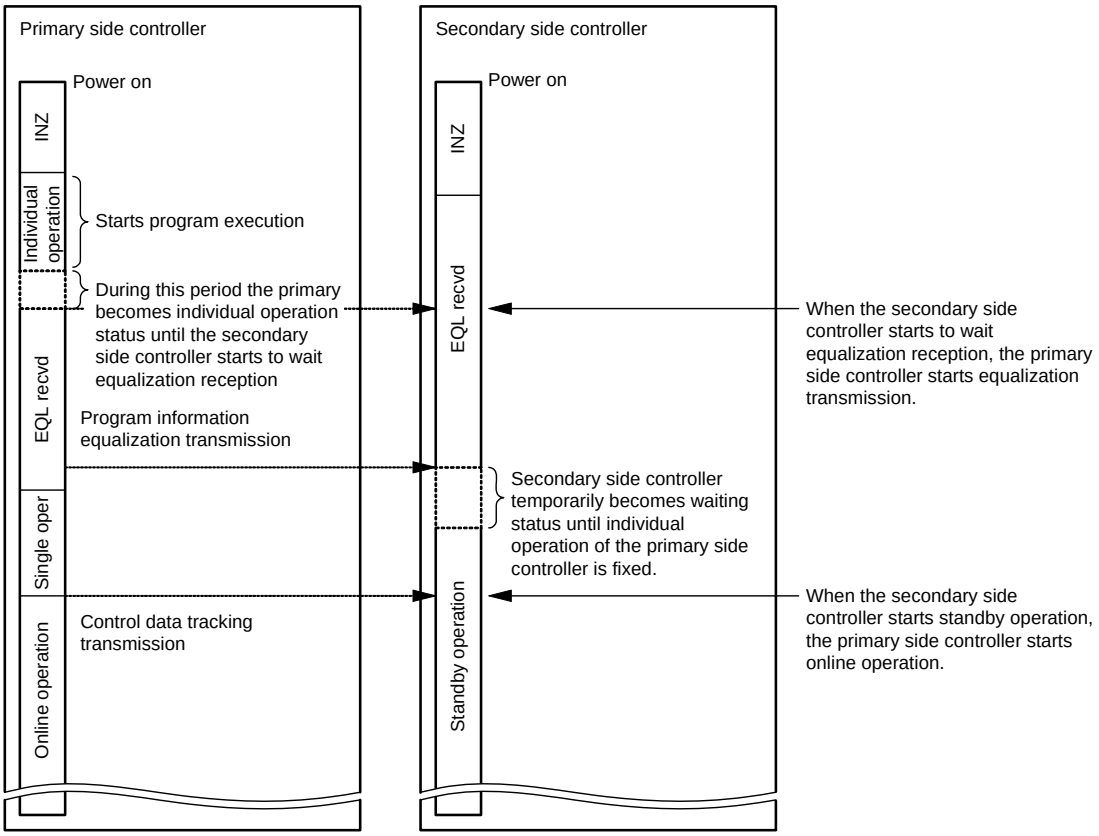


Fig. 2-11 Duplexing control of primary and secondary simultaneous start up

■ Following start up by one system

The operation when the controller of one side of the system is in individual operation and the controller of the other side is started up following to the previously started-up controller is described using Fig. 2-12.

① When the primary side controller is already running in individual operation and the secondary side controller is turned on later, the secondary side controller becomes waiting for equalization reception.

② When the secondary side controller becomes waiting for equalization reception, the primary side controller starts to send equalization transmission. Through this process the both controllers are equalized.

③ When the secondary side controller has completed the equalization reception, it starts standby operation.

④ When the primary side controller detects that the secondary side controller started standby operation, the primary side controller starts online operation and the system becomes duplex status. In the duplex status the primary side controller that is operating as the online system executes tracking transmission for the equalization of data to the secondary side controller that is operating as the standby system.

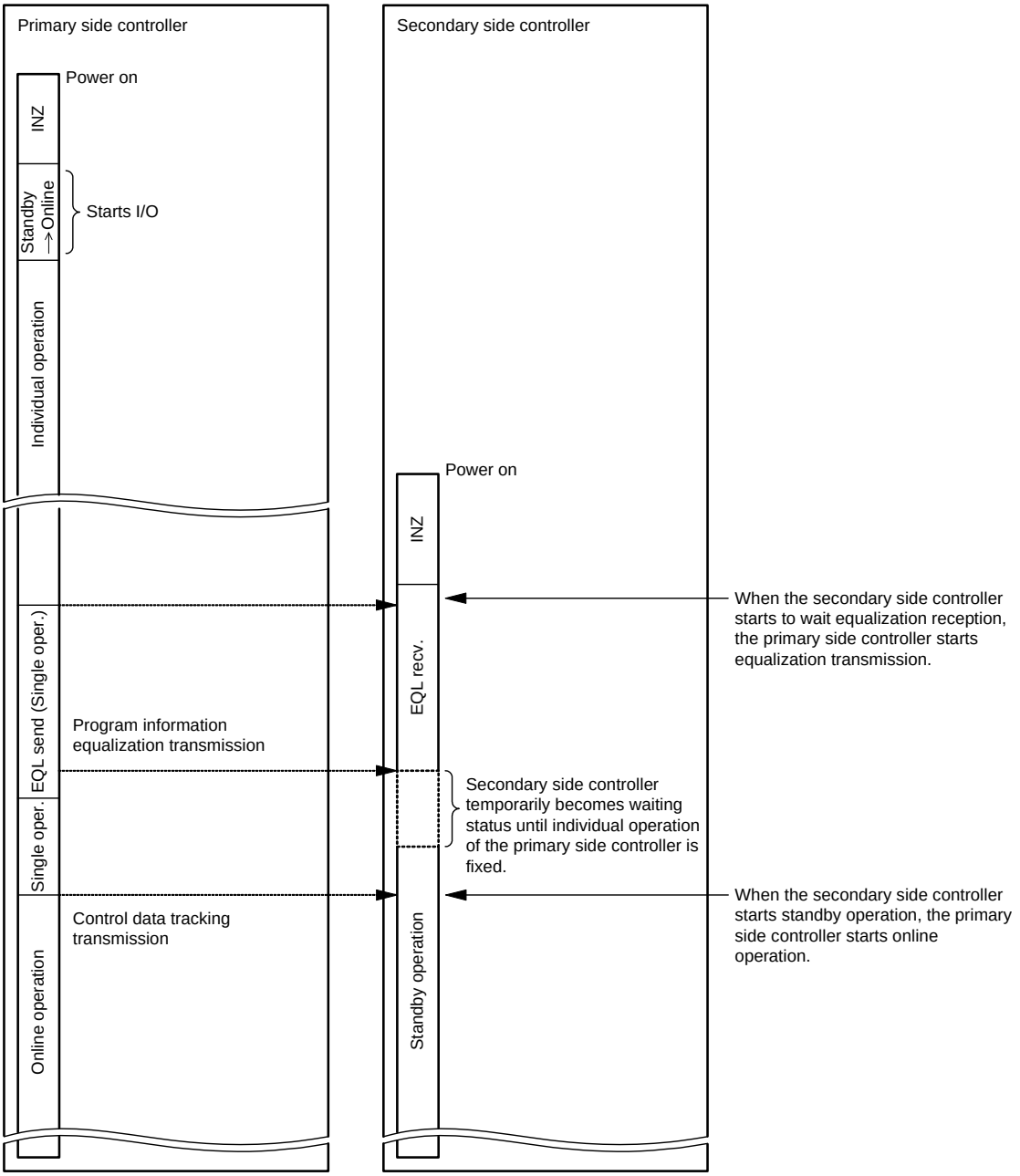


Fig. 2-12 Duplex control of following start up by one system

2.6.2 Switch operation of duplexing

■ Switching operation of duplexing due to halt of online system

Fig. 2-13 shows the operation of switching the duplexing status that occurs when the online system is halted forcibly during duplex status of controllers.

<Switching operation of duplexing due to halt of online system>

① The system becomes halted due to error immediately when a fatal error occurs in the primary side controller in online operation.

② The secondary side controller in standby operation starts individual operation immediately when it detects the halt of the primary side controller, and continues to execute the control by the program that is under execution by the primary side controller. The continuation of control by program is carried out based on the data transferred by tracking function.

<Recovery of duplex status by cancelling error>

① When the error down is cancelled, the controller executes the self diagnosis similar to that of start-up by power on. When no error is detected, the system temporarily becomes normal halt status. When RUN request is sent again, the system becomes waiting equalization reception.

② The secondary side controller in individual operation starts equalization transmission when it detects that the primary side controller becomes waiting the equalization reception. During this period the equalization of the primary and secondary side controller is carried out. The control by executing the program is continued during the equalization.

③ The primary side controller enters into standby operation after the equalization reception is completed.

④ The secondary side controller starts to execute online operation and recovers duplex status when the primary side controller enters into standby operation.

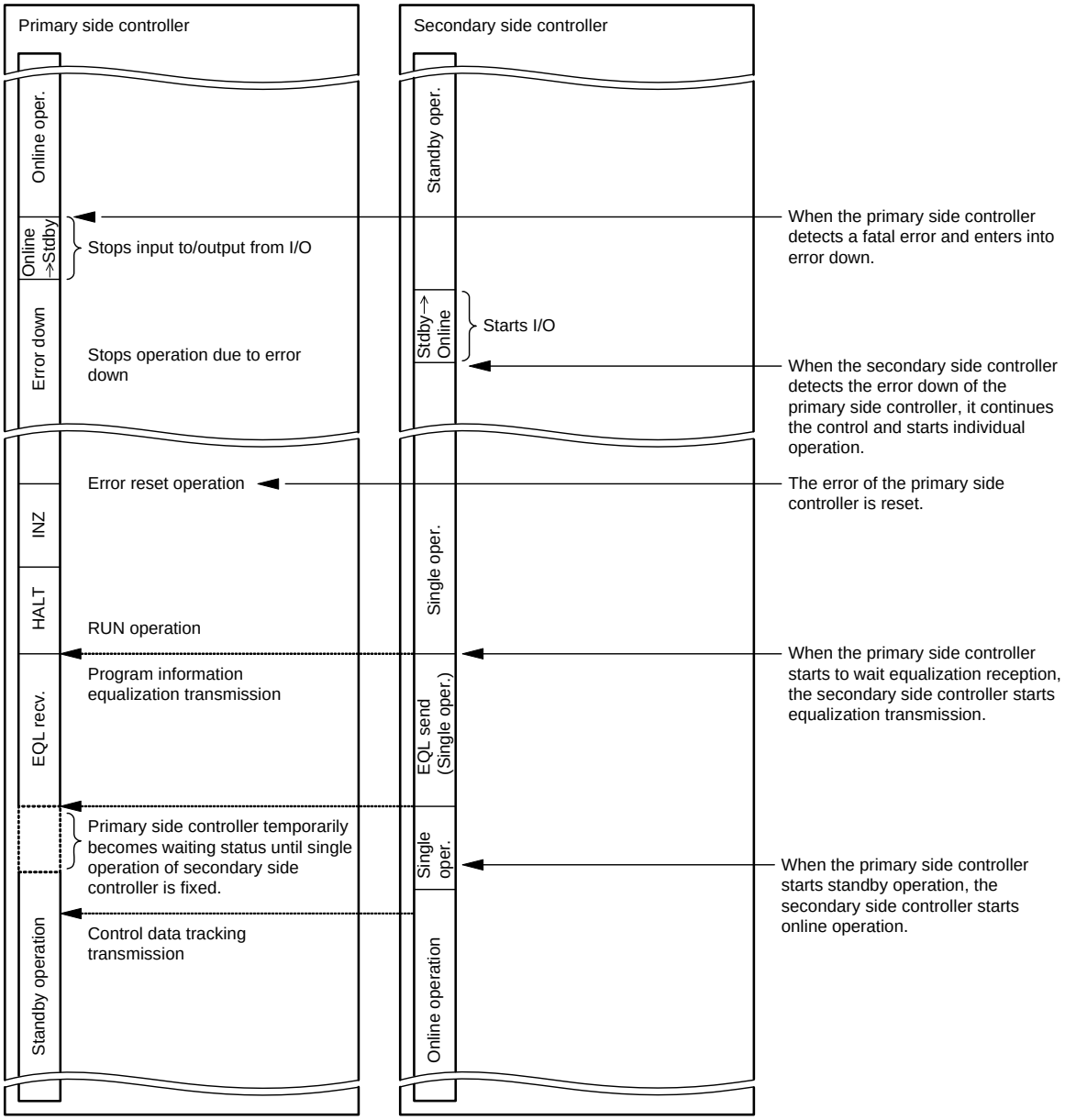


Fig. 2-13 Duplexing control of switching duplex status due to halt of online system

■ Forced switching operation of duplex status

Online system and standby system can be switched with each other by requesting the forced switching of duplex status if the controllers are operating in duplex status. The request of forced switching of duplex status can be executed from the nV-Tool.

Fig. 2-14 shows the forced operation of switching the duplexing status that occurs when the online system is halted forcibly during duplex status of controllers.

Fig. 2-14 shows the operation when the forced switching of duplex status is requested from the nV-Tool.

① When the nV-Tool requests the primary side controller in online operation, the primary side controller in online operation enters into standby status immediately

◇ **Supplementary**

- The forced switching of duplex status can be requested only to the controller in online operation.

② When the secondary side controller in standby operation detects that the controller in online operation enters into temporary waiting status, the secondary side controller executes switching I/O and starts individual operation.

③ When the primary side controller in temporary waiting status detects that the secondary side controller enters into individual operation, the primary side controller starts standby operation.

④ When the secondary side controller detects that the primary side controller starts standby operation, the secondary side controller starts online operation and recovers the duplex status. And the switching of online system and the standby system is completed. The control by executing the program is continued during the switching of online and standby systems.

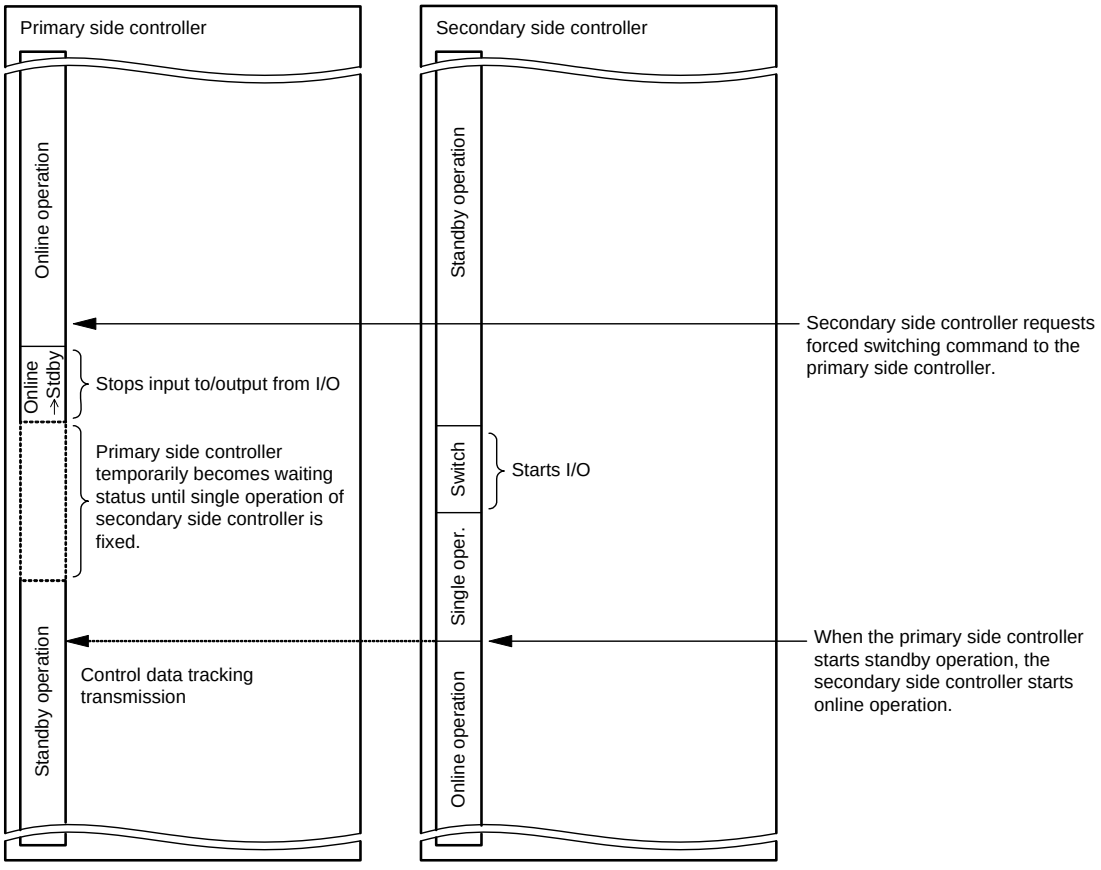


Fig. 2-14 Duplex control at forced switching of duplex system

2.6.3 System down conditions for duplex system and its avoidance

There are two cases for the situation of possible duplex system down (both-systems down): the case when an error occurs in the common part and the case of multiple inconceivable abnormal factors occur at the same time.

The common part corresponds to I/O module and program.

When any error occurs in I/O module the I/O module in failure can be separated from the system by I/O degeneracy function. The I/O degeneracy function can avoid both-systems down.

When any error occurs in program, the program where the error occurs can be separated from the system by program degeneracy function. The program degeneracy function can avoid both-systems down.

◆ Important

- The duplex function equipped to this equipment is function for single failure. It is not guaranteed to work properly under the multiple errors occurring at the same time.
  The customer is requested to take measures such as to equip final interlock to the system so that the system does not sustain fatal damage in case when both-systems down occurs.

2.6.4 Example of mode transition for duplexing control

Case 1: Turn on the power of both the primary and the secondary controllers at the same time.
After turning on, the equalization is carried out from the primary to the secondary. The online operation is carried out by the primary, and the standby operation by the secondary respectively.

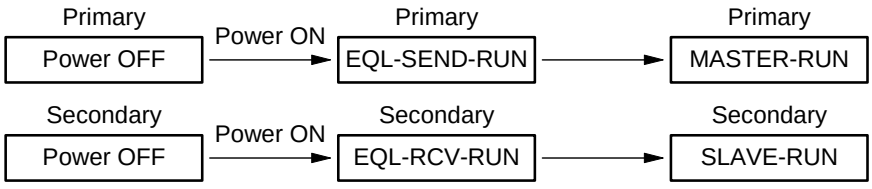


Fig. 2-15 Duplexing control Case 1

Case 2-1: Turn on the power of the secondary after turning on the power of the primary.
If the power of the secondary is turned on during the individual operation of the primary, the equalization is carried out from the primary to the secondary. The online operation is carried out by the primary, and the standby operation by the secondary respectively.

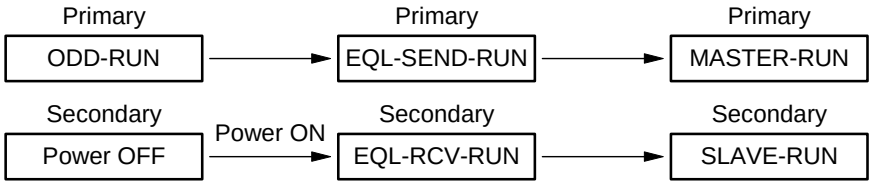


Fig. 2-16 Duplexing control Case 2-1

Case 2-1' : When the secondary is instructed to RUN while in its HALT status in Case 2-1, the system operates in the same manner.

Case 2-2: Turn on the power of the primary after turning on the power of the secondary.
If the power of the primary is turned on during the individual operation of the secondary, the equalization is carried out from the secondary to the primary. The online operation is carried out by the secondary, and the standby operation by the primary respectively.

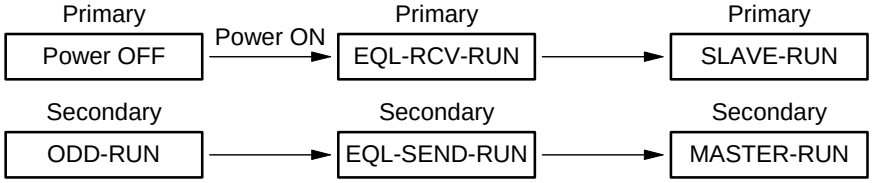


Fig. 2-17 Duplexing control Case 2-2

Case 2-2' : When the primary is instructed to RUN while in its HALT status in Case 2-2, the system operates in the same manner.

Case 3: Other system is instructed to RUN from the status where the download is not yet completed.
When the secondary that does not download the program/data from nV-Tool (DL-WAIT) and is instructed to RUN while primary is running in individual operation, the equalization is carried out from the primary to the secondary and online operation is carried out by the primary, and the standby operation by the secondary respectively.
The similar operation is carried out for the case where the primary and the secondary are reversed.

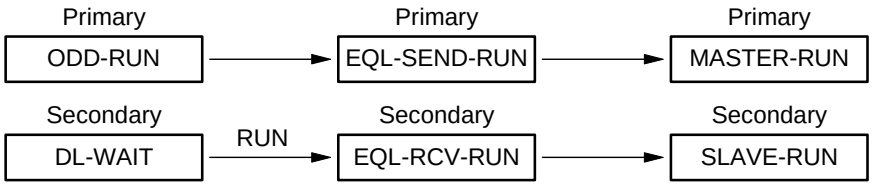


Fig. 2-18 Duplexing control Case 3

2

Case 4-1: Online error down in duplex operation
When the online becomes error down during duplex operation, the standby system becomes standby operation.
If the online system is controlled by the secondary, the same operation is carried out.

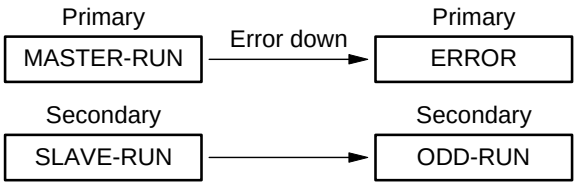


Fig. 2-19 Duplexing control Case 4-1

Case 4-1' : When the online becomes HALT during in duplexing operation, the standby system becomes individual operation.

Case 4-2: Standby error down in duplex operation
When standby system becomes error-down during duplex operation, the online system becomes individual operation.

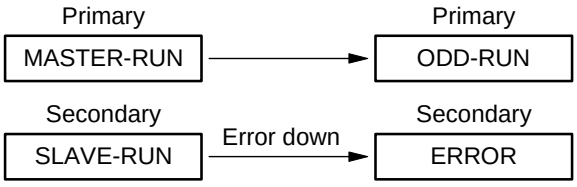


Fig. 2-20 Duplexing control Case 4-2

Case 4-2' : When the standby system becomes HALT during in duplex operation, the online system becomes individual operation.

Case 5: Forced switching instructed during duplex operation
When the online system is instructed for forced switching of duplex status by nV-Tool during operation in duplex status, the online system is switched to standby system and the standby system to the online system respectively.
This operation can be instructed only to the online system.
When the online system is the secondary, the similar operation is carried out.

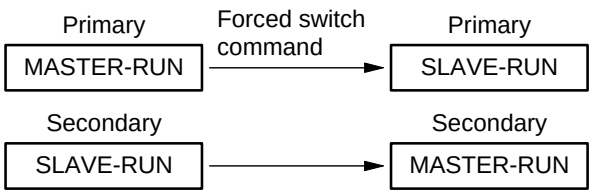


Fig. 2-21 Duplexing control Case 5

2.7 Tracking

The controller is equipped with the following three tracking functions.

- Full equalization function
- Tracking function
- Partial equalization function

2.7.1 Full equalization function

When the duplexing is started up, all pieces of information such as program, controller parameters (system configuration, controller setting information, program information, variable information, I/O registration information) and user global variables are transferred to the standby system controller to equalize the controllers of online system and the standby system. This function is called as full equalization. Fig. 2-22 indicates the types of variables to be equalized by full equalization.

- Program
- Controller parameters
- User global variables
- Date and time

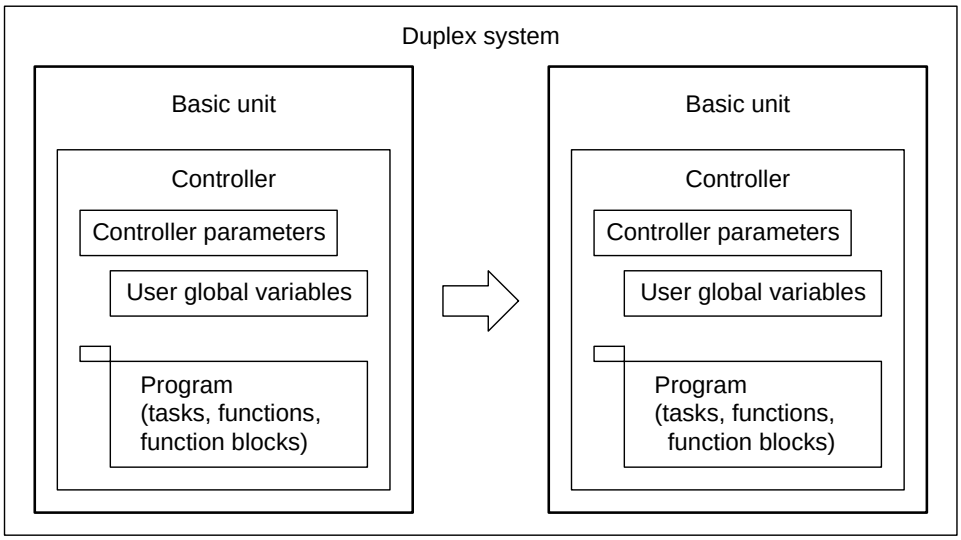


Fig. 2-22 Concept of full equalization function

2.7.2 Tracking function

When the controller is operating in duplex status part of (data part of) global variables and local variables are transferred from the online system controller to the standby system controller to equalize the online system controller and the standby system controller. This function is called as tracking function.

The data equalized by the tracking function is transferred synchronized with each scan task (super speed scan task, high speed scan task, main scan task).

Each data is transferred to the standby system after the execution of the program of the task to be transferred synchronized.

Fig. 2-23 shows the types of variables transferred by the tracking function.

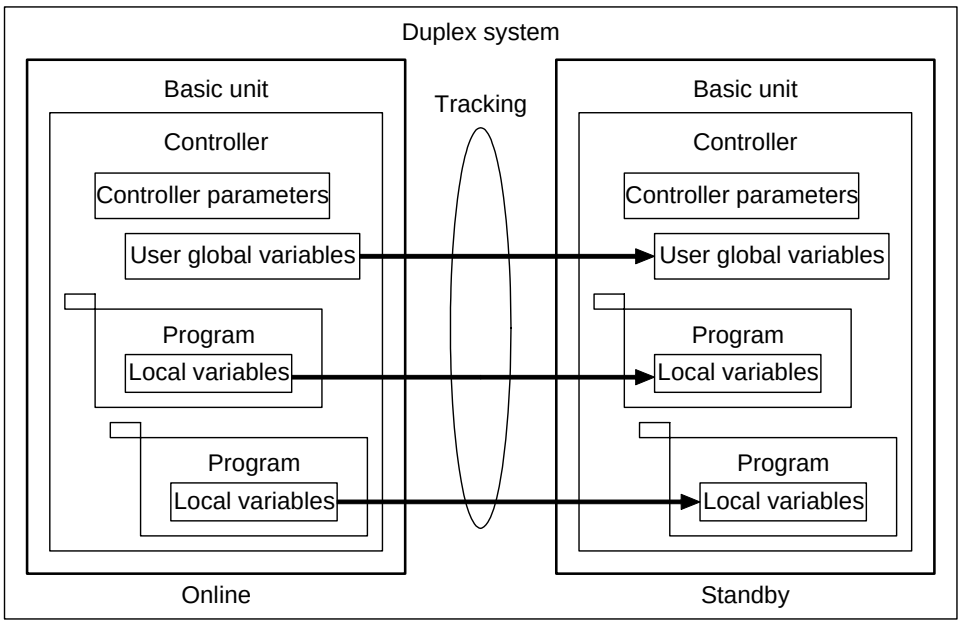


Fig. 2-23 Concept of tracking function

The details of the variables of tracking objects are indicated in Table 2-13.

Table 2-13 Types of tracking data

Name	Use	Transfer timing
Local variable	Local variables of program (held)	Each task (Note 1)
Data register (D register)	Variable that can be defined by user freely	Each task
User global variable	Variable that can be defined by user freely	Each task
Index register		Each task (Note 2)

(Note 1) Transfers only the variables declared as tracking variables in SS/HS/MS task.
(Note 2) Transfers only the index registers used by SS/HS/MS task.

The data register (D register) and the transferred area (from top to word size) of user global variables can be specified with the module parameter setting screen of the nV-Tool.

Table 2-14 Transfer specification of tracking data

Item		Default	Setting value	Remark
DW register				Data register (D register)
Transferred area	Top No.	0	0 to 8191	
	Word size	0	0 to 8192	
User global variable				
Transferred area	Region index	Total region	Total region, Region 1 to 4, Not specify	
	Region index 1 (top)	0	0 to 262143	
	Region 1 (word size)	0	0 to 32768	
	Region index 2 (top)	0	0 to 262143	
	Region 2 (word size)	0	0 to 32768	
	Region index 3 (top)	0	0 to 262143	
	Region 3 (word size)	0	0 to 32768	
	Region index 4 (top)	0	0 to 262143	
	Region 4 (word size)	0	0 to 32768	

◇ **Supplementary**

- (Note) Index register transmission depends on the tracking specification of the task.

Table 2-15 Tracking data size

Item	Tracking amount	Max. restriction size
SS task	SW [266] SW [267]	64 KW
HS task	SW [268] SW [269]	64 KW
MS task	SW [270] SW [271]	128 KW

2.7.3 Partial equalization function

When the controller is operating in duplex status and the change is made to program, system setting parameters and variables of the nV-Tool and online system controller, the same change is made to the standby system controller for the equalization. This function is called as partial equalization function.

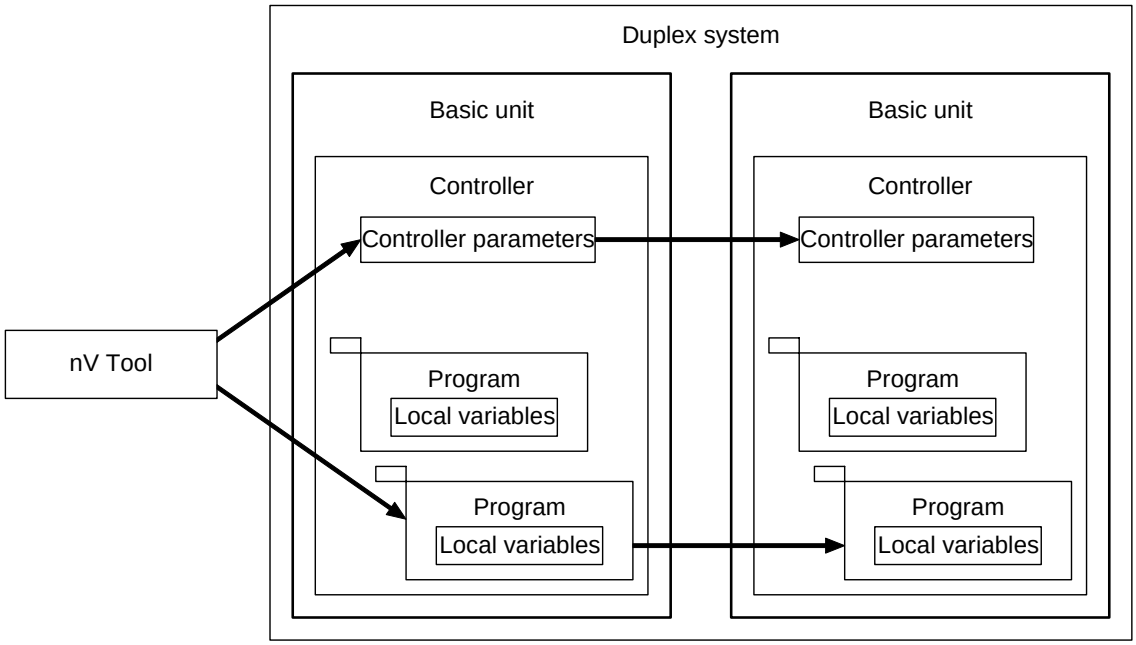


Fig. 2-24 Concept of partial equalization function

Local variables and global variable cannot be change by the partial equalization. If you want to equalize these variables of the online system controller to the one of the standby system, set the variables as the object of tracking.

Chapter 3
Tasks

This chapter describes the outline of task, its type and the management of the task executed by controller.

3.1 What is a Task?

Task can be composed by one or more programs depending on the object as shown in Fig. 3-1.

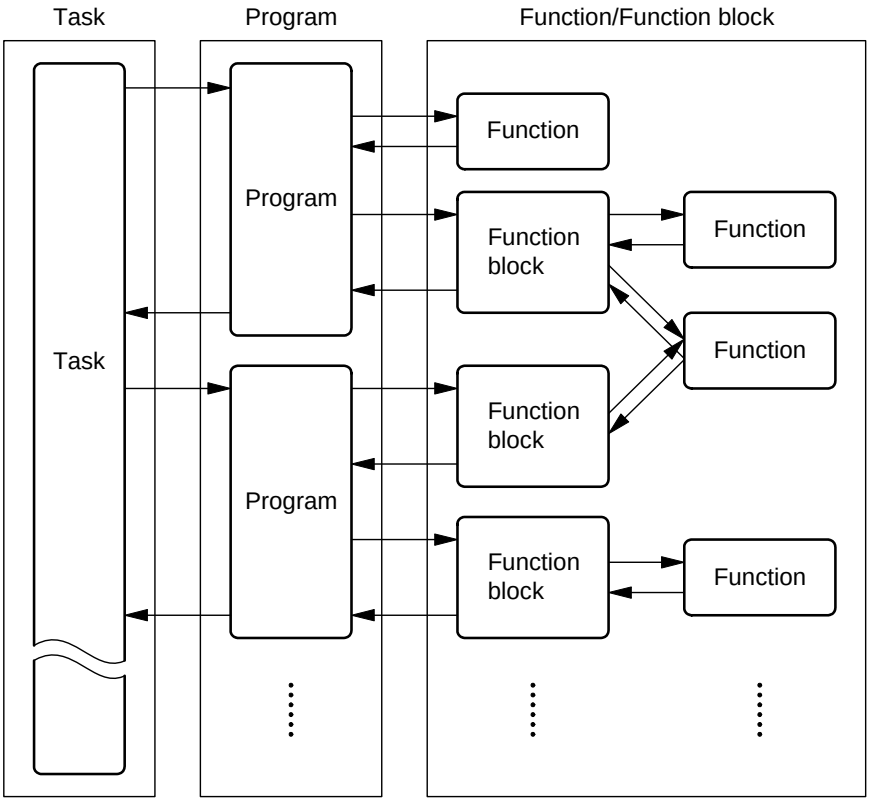


Fig. 3-1 Concept of task

■ Task

The unified controller nv series executes the program for each task. Any program can be executed by registering the program into the task.

■ Program

A program is composed of the combination of the main body of the program and its function and the function blocks. The function and the function blocks can be used in common by two or more programs and function blocks.

■ Function

When a specific input argument is input and executed, a function outputs a result. That is, when the same input value is input, a function always outputs the same operation result. It has no internal memory.

Function block (FB)

Function block (FB) outputs one or more values when executed. Since the values of output variables and internal variables are always held until next execution, the execution of FB to the same argument does not necessarily generate the same output.

Program organization unit (POU)

Programs, functions and function blocks are called as program organization unit (POU) as a generic name.

3.2 Task Type

Unified controller nv series has six types of tasks: two types of event tasks, 3 types of scan tasks and RIO task for special use. Four tasks are selected from these six tasks depending on the use.

Table 3-1 Event tasks

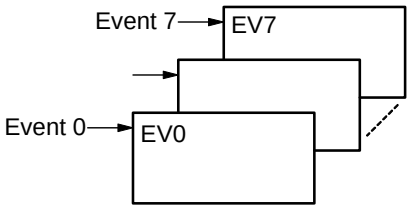
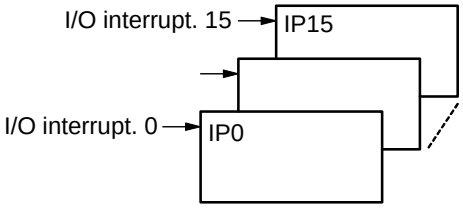
Type	Contents	No. of tasks	No. of programs	Concept
Event task (EV)	Tasks related to system status	8	1 (each task)	
I/O interruption task (IP)	The task executed according to interruption request when I/O data change is detected.	16	1 (each task)	

Table 3-2 Scan task (1)

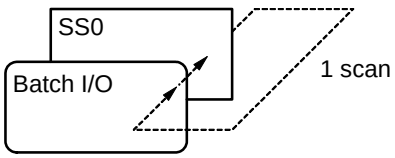
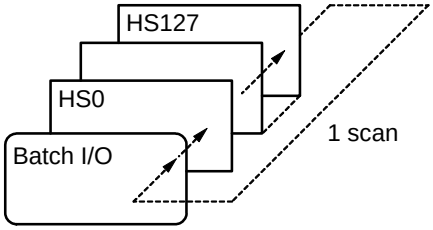
Type	Contents	No. of tasks	No. of programs	Concept
Super speed scan task (SS)	Sequence task executed regularly. Executed with highest priority among scan tasks.	1	1	Scan cycle: 0.5 to 500 ms (by 0.1ms) 
High speed scan task (HS)	Sequence task executed regularly. Executed with intermediate priority among scan tasks.	1	128	Scan cycle: 0.5 to 500 ms (by 0.1ms) 

Table 3-2 Scan task (2)

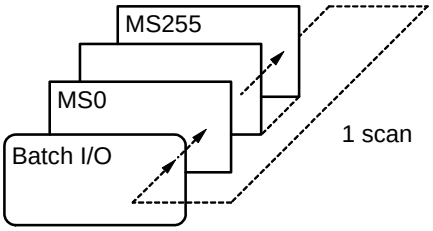
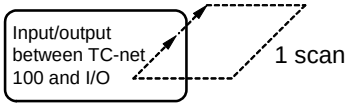
Type	Contents	No. of tasks	No. of programs	Concept
Main scan task (MS)	Sequence task executed regularly. Normally this task is executed.	1	256	Scan cycle: 0.5 to 1000 ms (by 0.1ms) 

Table 3-3 Task for special use

Type	Contents	No. of tasks	No. of programs	Concept
RIO task (RIO)	Task executed input/ output between TC-net 100and I/O	1	—	Scan cycle: 0.5 to 500 ms (by 0.1ms) 

3.2.1 Event task (EV)

Event task is started up when system status changes such as the time of system initialization and system degeneracy.

The event tasks are listed in Table 3-4.

Table 3-4 Event task

No.	Item	Start-up timing	Use
0	Initialization	Starts up when the system becomes RUN status.	Initializes the system at start-up.
1	Reserved	—	—
2	Reserved	—	—
3	Duplex status switching	Starts up when the system status changes from standby to online.	Initializes the system at switching the duplexed status (initializes station bus module, etc.)
4	I/O degeneracy	Starts up when I/O error is detected in batch I/O.	Controller operation at the I/O degeneracy can be specified.
5	Program degeneracy	Starts up when program degeneracy occurs (program execution error (such as illegal command)).	Controller operation at the time of program degeneracy can be specified
6	I/O degeneracy recovery	Starts up when I/O recovers to normal from degeneracy.	Controller operation at the recovery from I/O degeneracy can be specified.
7	Reserved	—	—

3.2.2 I/O interruption task (IP)

IP is the task that is started up when the data of registered I/O using nV-Tool changed.

I/O interruption task can be created for 16 tasks (1 program for 1 task).

Refer to 3.4.3 I/O interruption function for the details.

3.2.3 Super speed scan task (SS)

Super speed scan task is a scan task that is executed at a super speed scan cycle. The super speed scan task can be created for 1 task (1 program for 1 task).

3.2.4 High speed scan task (HS)

High speed scan task is a scan task that is executed at a high speed scan cycle.

The high speed scan task can be created for 1 task (128 programs for 1 task).

3.2.5 Main scan task (MS)

Main scan task is a scan task that is executed at a main scan cycle.

Main scan task can be created for 1 task (256 programs for 1 task).

3.2.6 RIO task (RIO)

RIO task is a task that has a function to execute input/output between the high speed serial TC-net I/O and the scan memory of the information/control network TC-net 100, base on the registered information using nV-Tool.

Different from the other tasks, this task cannot register any program.

3.3 Task Execution Control

3.3.1 Task execution based on priority

Four types of tasks can be executed in parallel according to the priority of the tasks (this function is called as multi-task function). This function enables to realize the optimum control for the control object.

Task allocation according to the task priority is indicated in Table 3-5.

Table 3-5 Task allocation according to the priority

Task priority (Note 1)		Task type	Single configuration	Duplex configuration
High ↑	0	EV	Either EV or IP is selected	EV
		IP		
	1	SS	Either SS or IP is selected	Either SS or IP is selected
		IP		
	2	HS	Either HS or RIO is selected	HS
		RIO		
Low ↓	3	MS	MS	MS

(Note 1) IP tasks cannot be selected for the both of task priority level 0 and 1.

Tasks are executed according to task priority as described below. The task with high priority is executed given with the priority to the task with low priority. This management is most obvious in case when the task with high priority is executed while the task with low priority is in execution.

Fig. 3-2 shows a case when the main scan task (MS) is in execution at portion ①. The high speed scan task (HS), which has higher priority to MS, is executed and suspends the execution of the MS task temporarily to execute HS with higher priority.

At portions ② and ③, I/O interruption task is executed while HS task or MS task is in execution. In this case HS task or MS task is suspended temporarily and I/O interruption task (IP) with higher priority is executed.

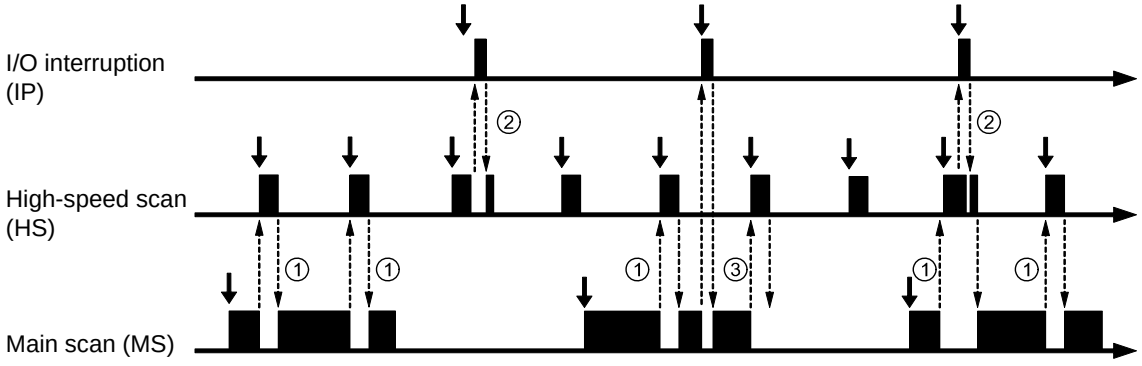


Fig. 3-2 Execution example base on priority

3.3.2 Execution of event-related task

Event-related task includes event task (EV) and I/O interruption task (IP).

There are 8 tasks in the event task (EV) and 16 tasks in the I/O interruption task (IP) respectively.

Each task allows registering one program to the task.

Table 3-6 Event-related tasks

Task type	Task name	No. tasks	Remark
Event	EV	8	1 program / task
I/O interruption	IP	16	1 program / task

Event-related tasks are executed once at each event occurrence.

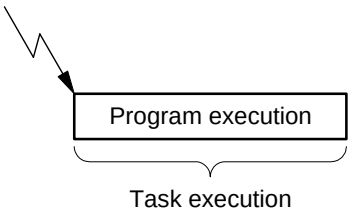


Fig. 3-3 Execution of event-related task

3.3.3 Execution of scan-related task

Scan-related task includes three tasks, namely, main scan task (MS), high-speed scan task (HS) and super speed scan task (SS).

Scan-related task operates when the execution enable/disable (Run/Stop) and the scan cycle are set by nV-Tool. During the task execution, batch I/O, program execution and synchronous processing are executed repeatedly for each scan cycle.

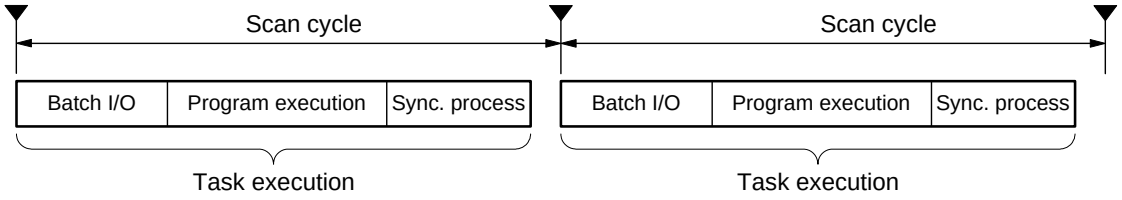


Fig. 3-4 Execution of scan-related task

Batch I/O

In this process, inputting and outputting between I/O and the program before executing program.

Refer to 3.4 I/O input/output for the details.

Program execution

Programs registered to task entry number are executed in the order of task entry number sequentially.

For example, the execution order of the main scan task programs are as below:

In the order of task entry number, MS0 → MS1 → MS2 → ... MS254 → MS255

Task entry numbers are allocated for the tasks as indicated in the following table.

Table 3-7 Scan-related tasks

Task type	Task name	Task entry number	Remark
Super speed scan	SS	0	1 program / task
High speed scan	HS	0 to 127	128 programs / task
Main scan	MS	0 to 255	256 programs / task

Synchronous processing

This process carries out those synchronous to the scan such as online change of program.

3.3.4 Grouping and sub scheduling of MS tasks

The programs of main task are enabled to specify grouping and sub scheduling.

Sub scheduling is a function to execute all programs in a group at a scan cycle multiplied by integer number of the scan cycle set to the group. This function is used when different execution cycle is requested for each program.

Grouping is a function to divide the programs into several groups and execute the programs for each group by shifting the scan cycle by one scan.

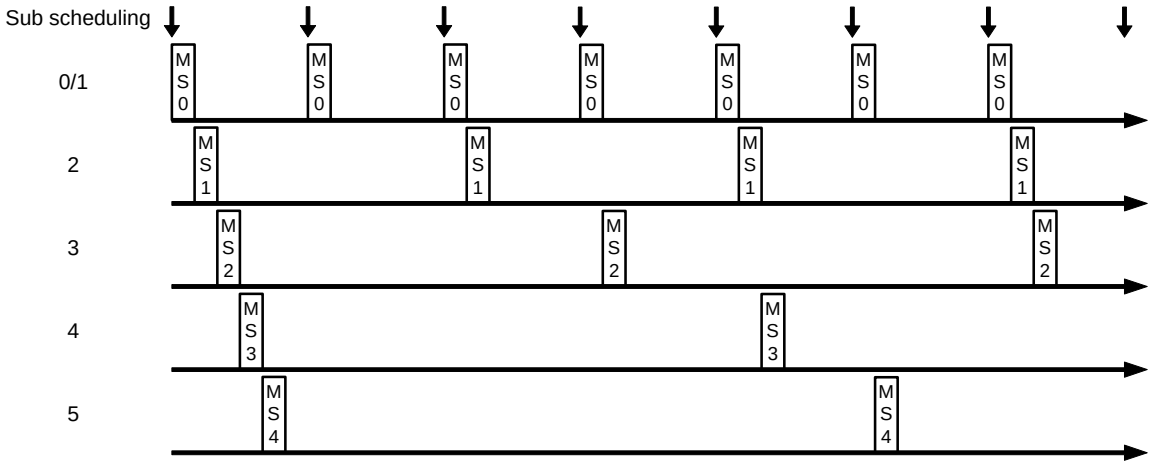


Fig. 3-5 Example of Sub scheduling

When sub scheduling is specified, if a lot of programs exist in the same cycle it causes congestion. The congestion can be avoided by adjustment of execution timing by grouping.

When the programs are specified for grouping, program execution cycle can be adjusted (shifted) by the multiple of integer number of a scan cycle for each group. The example to use sub scheduling and grouping is indicated below.

In Fig. 3-6, sub scheduling value 2 is set to each program (MS0, MS1, MS2, MS3 and MS4). From the execution status all programs do not complete their execution to cause congestion.

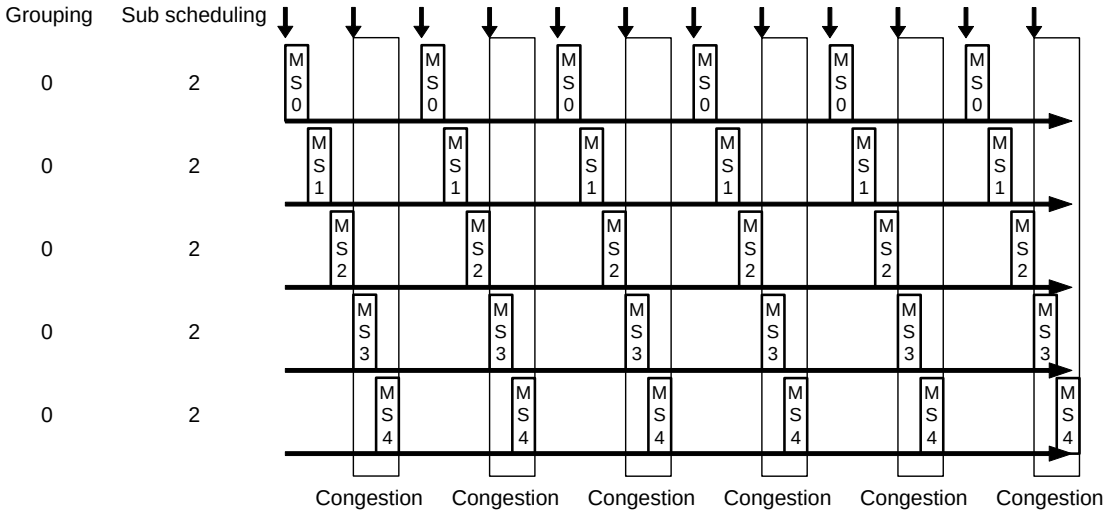


Fig. 3-6 Example of sub scheduling and grouping - 1

In Fig. 3-7, setting each program to five grouping (1 for MS0, 2 for MS1, 3 for MS2, 4 for MS3 and 5 for MS4) solves the congestion shown in the precedent example.

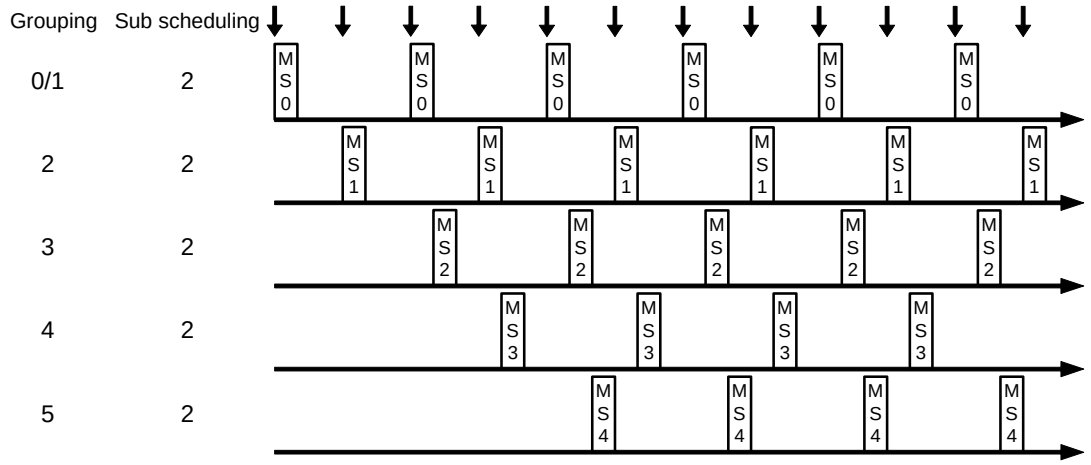


Fig. 3-7 Example of sub scheduling and grouping - 2

◇ Supplementary

- When sub scheduling is changed for setting during operation (RUN) it is reflected immediately. However, the relation with other programs (the relative execution order) does not become the same as that of the start up.
- Grouping is executed only at start up for operation (RUN). If grouping is changed for its setting during operation (RUN) it is not reflected. Therefore, DO NOT change the setting of sub scheduling and grouping during operation (RUN).
- Setting grouping 0 (no grouping) acts as grouping 1.
- Setting range is 0 to 10000 for both of grouping and sub scheduling.

3.3.5 Execution of RIO task

RIO task is a task with function to execute I/O input and output between the high-speed serial TC-net I/O and the scan memory of information/control network TC-net 100, based on the information registered by nV-Tool.

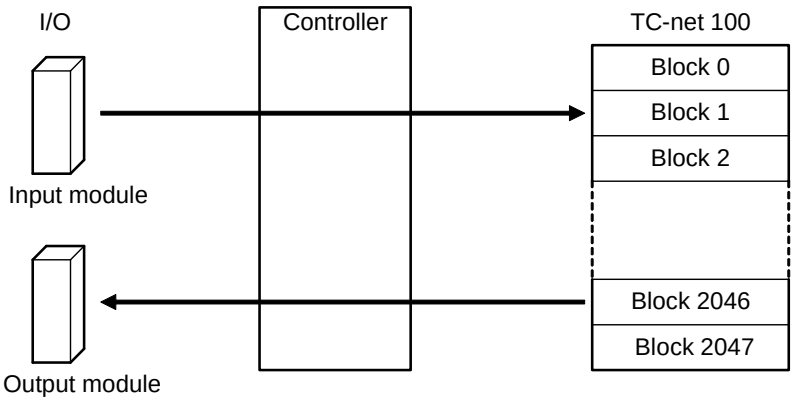


Fig. 3-8 I/O input and output between scan memory of TC-net 100

Input/output cycle of RIO task is specified with RIO scan cycle and RIO mid speed I/O division number, both of which are nV-Tool setting items. RIO task I/O input/output is executed with two cycles of high-speed (RIO scan cycle) and mid speed (RIO scan cycle × RIO mid speed I/O division number) as shown in Fig. 3-9.

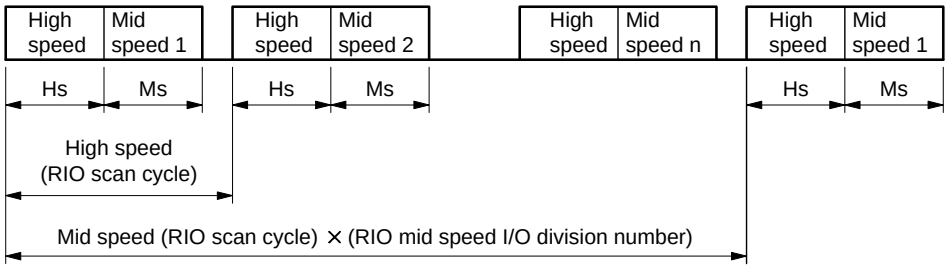


Fig. 3-9 RIO task execution

Hs: I/O data group allocated to high speed I/O
Execution time = (High speed I/O word number × 3.5 μs) + 10 μs

Ms: I/O data group allocated to mid speed I/O / RIO mid speed I/O division number
Execution time = (Mid speed I/O word number / mid speed I/O division number) × 3.5 μs + 10μs

◇ **Supplementary**

- Set RIO scan cycle to the value with a margin taking the execution time for the task with priority higher than RIO tasks into account, so that scan congestion does not occur. Present scan time can be checked using the execution time measurement function described in later 5.3.1.

■ Error processing

- I/O module error
  When an error is detected in I/O input/output, you can specify whether the system is shut down, or the I/O with an error is isolated from the system (I/O degeneracy) and other I/O input/output is continued for execution, depending on the importance of the I/O module with an error.

  When input module error is detected, scan memory status of information/control network TC-net 100 holds the value of the precedent scan.

  You can set whether to shut down the system due to error or to carry out I/O degeneracy for each I/O node from nV-Tool. Refer to module parameter setting of nV-Tool.

  ◆ Important

  - This setting is very important for the system configuration. Be sure to carry out the setting to fail-safe side.
  - I/O degeneracy is set for the unit of I/O module.
  - I/O module set for I/O degeneracy is not accessed. Therefore the I/O is not updated.
  - When I/O error is recovered, I/O degeneracy is cancelled (I/O recovery).

- Information/control network TC-net 100 scan block unhealthy
  In this case, “0” (zero) is output to the corresponding output module.
- TC-net 100 module error
  System is shut down (error down).

3.3.6 Task congestion and task scan time error

Scan congestion is monitored in scan task and RIO task execution. When the task execution is not completed within the set scan cycle, it is regarded as scan congestion and minor error is displayed. (Refer to Chapter 6, RAS functions.)

Example of Fig. 3-10 indicates the status when main scan task execution is prolonged by high speed scan task and I/O interruption task execution resulting in main scan congestion.

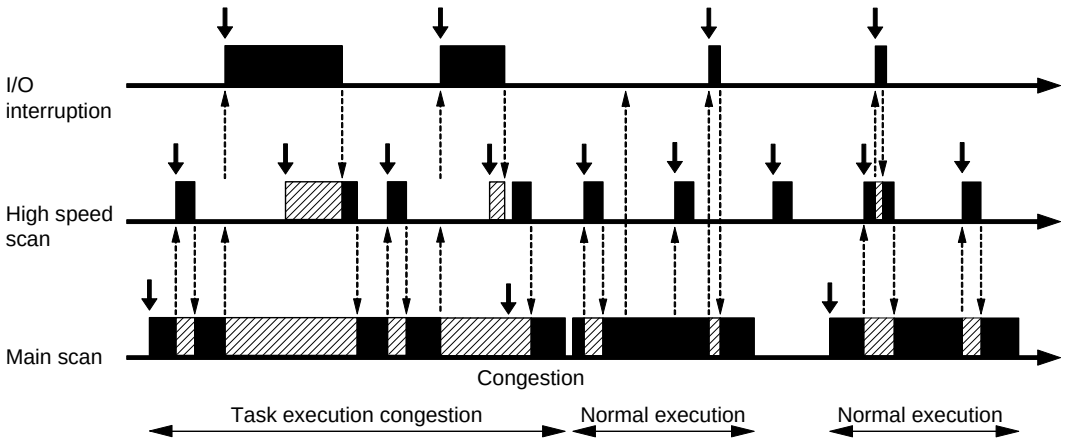


Fig. 3-10 Example of scan congestion

Other than scan congestion, task executing status is monitored. When task execution is not completed within double of the scan cycle by any reason, it is regarded as scan time error and the system is shut down (error down).

◇ **Supplementary**

- Scan-related tasks are the tasks to carry out basic processing of the system. Chronic occurrence of scan task congestion is not preferable. Set the scan cycle to the value with sufficient margin so that scan congestion does not occur.
  Present scan time can be checked using the execution time measurement function described in later 5.3.1.

3.4 I/O Input/Output

The controller has two types of I/O input/output, namely batch input/output and direct input/output.

Batch input/output, the former, is a function to input/output the data of I/O module collectively in accordance with the input/output information registered in advance. Direct input/output, the latter, is a function to input/output the data of I/O module directly from the program.

3.4.1 Batch input/output

■ Batch input/output processing and scan cycle

Batch input/output processing is synchronized with each scan task and carries out input/output processing before execution of each program. Therefore I/O input data does not change during the execution of the program.

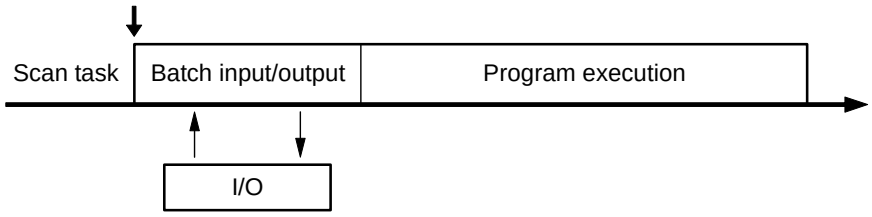


Fig. 3-11 Execution timing of batch input/output processing

◇ Supplementary

DO NOT use the variables as far as possible that are used for batch input/output by other tasks.

- When the variables that are used for batch input/output by the task with priority higher than the own task, it is not guaranteed that the I/O input data do not change during program execution, which is a merit of batch input/output.
- When the variables that are used for batch input/output by the task with priority lower than the own task, control with good response may become unable.

■ Batch input/output processing and input/output (IQ) register

In the batch input/output processing, the data input/output is carried out between I/O module and IQ register for controller global variables. When referring to the data input/output to/from the program through batch input/output processing, refer to IQ register. IQ register corresponds to I/O module for every 1W (word).

Input/output information is saved into the internal information called as I/O connection, and includes type/place of I/O module, direction of input/output, and input/output status. These pieces of information are generated automatically when the I/O module is registered. The contents of the I/O connection can be seen using the I/O variables screen of nV-Tool.

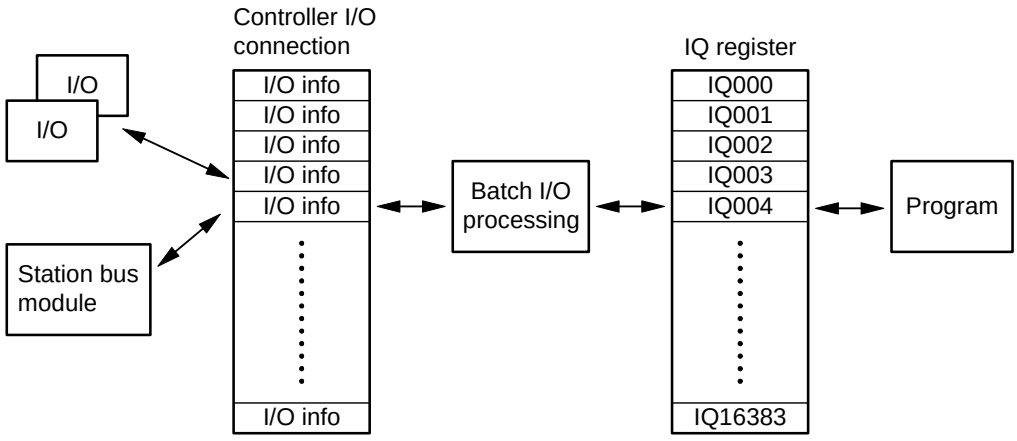


Fig. 3-12 Batch input/output processing and IQ register

■ Allocation of IQ register and I/O module

When a variable is registered to each signal of I/O module, IQ register is automatically allocated to the variable.

Allocation range of IQ register is decided at every type of I/O module in advance as shown in Table 3-8.

Table 3-8 Register allocation of IQ register for I/O module type

	Connection type	IQ register top number (Note 1)	Number of IQ registers (Note 1)	I/O Interruption
I/O	High speed serial TC-net I/O, digital input	0	1024	Available
	High speed serial TC-net I/O, analog input	1024	1024	Available
	High speed serial TC-net I/O, digital output	2048	1024	Available
	High speed serial TC-net I/O, analog output	3072	1024	Available
	High speed serial TC-net I/O Special I/O input/output	4096	4096	Available
	G3 input	8192	2048	Available
	G3 output	10240	1024	Available
	Drive equipment input/output	15360	1024	Available
Station bus module	Reserved	11264	2048	Available
	Station global input/output	13312	1024	Unavailable
	TC-net input/output	14336	1024	Available

(Note 1) IQ register top number and number of IQ registers are the default values. These numbers can be changed according to the using status.

■ Batch input/output performance

Batch I/O time = I/O input/output time + Station bus module input/output time

I/O input/output time: Input/output word number of each I/O described in Table 3-8 Register allocation of IQ register for I/O module type × 1μs

Station bus module input/output time: Input/output word number of station bus module described in Table 3-8 Register allocation of IQ register for I/O module type × 2μs

Input/output word number can be checked from the number of %IQ register in use of I/O connection region change screen.

3.4.2 Direct input/output

Direct input/output means to input/output directly from instruction word of a program to I/O module. (Note 1)

Direct input/output is enabled to input/output the data of I/O module directly without passing through batch input/output, and to input/output the latest data at the time.

(Note 1) The I/O of this controller uses remote I/O. So actually I/O module is not accessed directly.

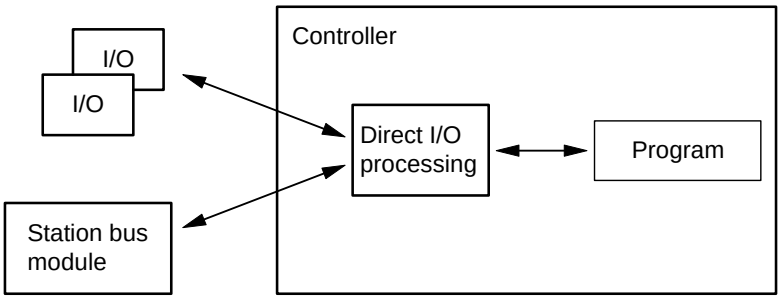


Fig. 3-13 Direct input/output processing

3.4.3 I/O interruption function

■ Detection of I/O status change

The change in I/O scan data is detected. It enables to execute I/O interruption task (IP task). However, the setting of I/O status change detection needs to be connected with I/O interruption task in advance. The connection between I/O status change and I/O interruption task is specified using CPU module of nV-Tool, “Module Parameter” > “Status change notify”.

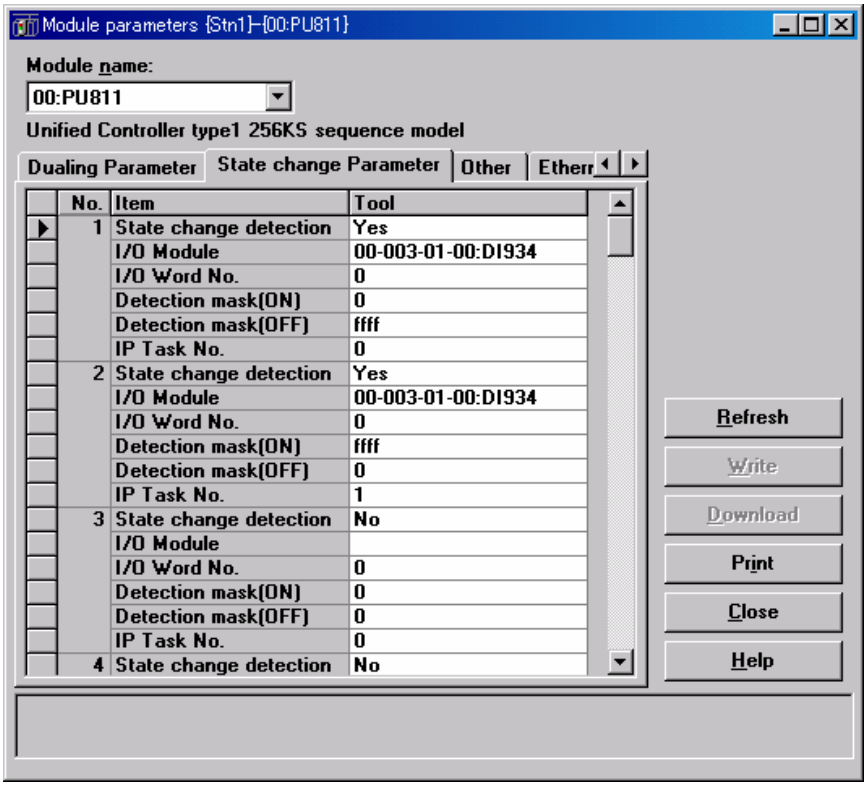


Fig. 3-14 Setting of I/O status change detection

Table 3-9 Setting contents of I/O status change

Item	Contents
Status change detection	Registers to detect/not to detect the status change. The number that is registered to detect status change is the object of detection.
Objective I/O module	Specifies the registered I/O module of which status change is to be detected.
I/O word No.	Specifies the word No. of the registered I/O module of which status change is to be detected.
Detection mask (at ON) (4 digits hexadecimal)	Registers the bit of which change to ON to be the detection object using hexadecimal expression for the corresponding word. Objective bit is specified as below. 1: to detect status change, 0: not to detect status change.
Detection mask (at OFF) (4 digits hexadecimal)	Registers the bit of which change to OFF to be the detection object using hexadecimal expression for the corresponding word. Objective bit is specified as 1: to detect status change, 0: not to detect status change.
IP task No.	Registers which IP task (0 to 15) of the controller is notified.

Status change detection is allowed up to 32 settings at maximum.

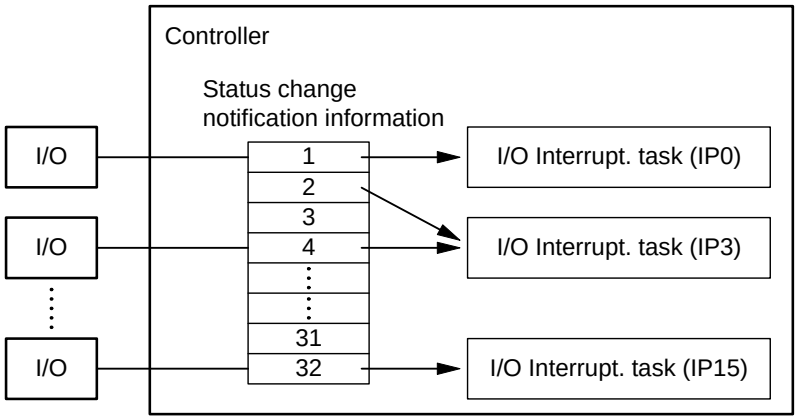


Fig. 3-15 Structure of I/O interruption function (I/O interruption module)

■ Status change interruption from TC-net 100 module

TC-net 100 module enables to detect the change in scan data and execute I/O interruption task (IP task). TC-net 100 module needs to be connected with I/O interruption task (I/O task) in advance.

The connection between TC-net 100 module and I/O interruption task is specified using TC-net 100 module of nV-Tool, “Module Parameter” > “Status change”.

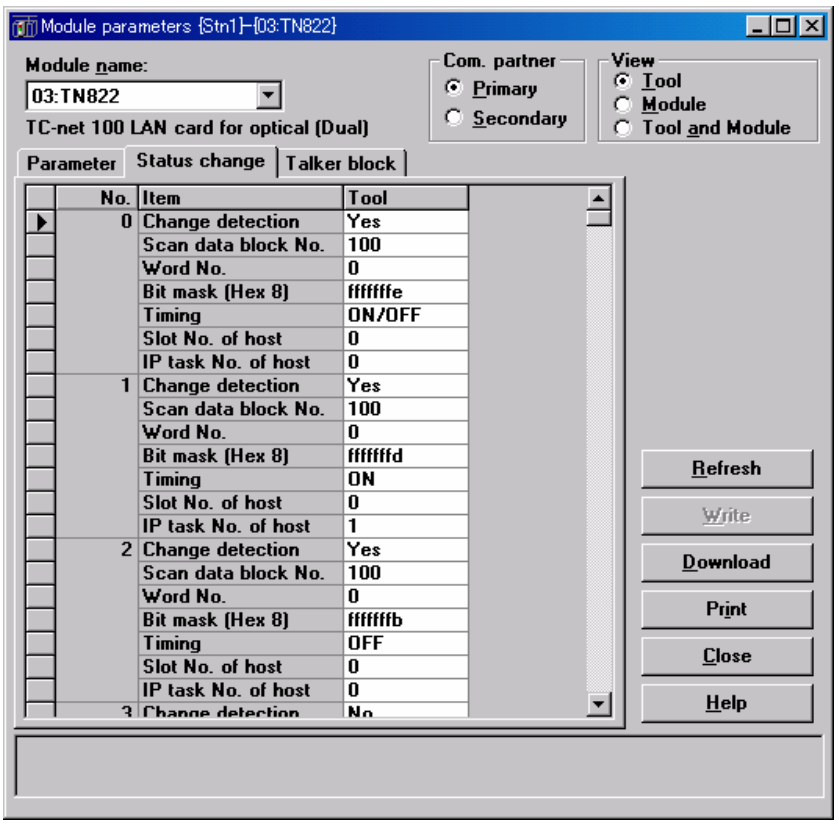


Fig. 3-16 Module parameter of TC-net 100 module

Table 3-10 Setting contents of TC-net 100 module status change

Item	Contents
Status change detection	Registers to detect/not to detect the status change. The number that is registered to detect status change is the object of detection.
Scan data Block No.	Specifies the Block No. of scan data of which status change is to be detected. The objective blocks are the Block 0 to 2047.
Scan data Word No.	Specifies the Word No. of scan data of which status change is to be detected. The objective words are the Word 0 to 63. As the words are registered by 2 words as a unit, the registered words are 0, 2, 4, ··· , 60, and 62.
Scan data bit mask (Hexadecimal, 8 digits)	Registers the bit of which change to ON to be the detection object for the corresponding word. Objective bit is specified as below. 0: to detect status change, 1: not to detect status change.
Change detection timing	Registers how the corresponding bit changes to detect the bit. ON, OFF, ON/OFF can be specified.
Notified controller Slot No.	Registers the Slot No. (0 to 7) of the controller to which the notification is sent when any change occurs to the specified status change detection No. point (Point No.)
Notified controller IP task No.	Registers to which IP task (0 to 15) of the notified controller the notification is sent.

Status change detection is allowed up to 128 settings at maximum.

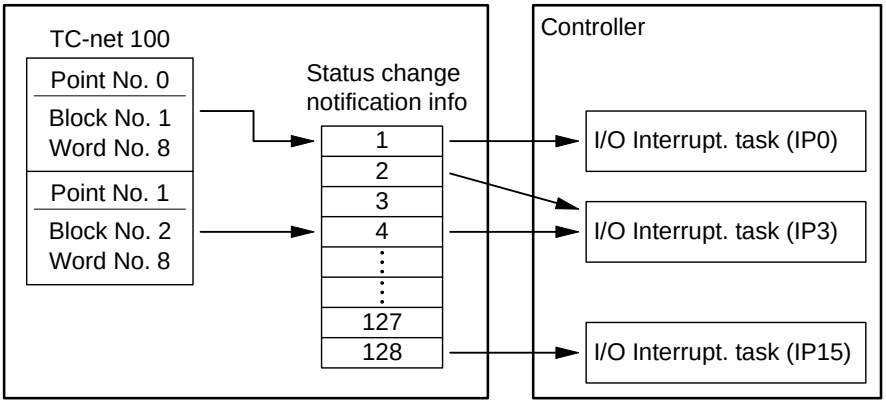


Fig. 3-17 Structure of I/O interruption function (TC-net 100 module)

■ IP task sharing between I/O and TC-net 100 module

In the connection of status change and I/O interruption task (IP task), I/O status change detection and the interruption from TC-net 100 module can be allocated to the same IP task (Ex.①). Also the interruption from TC-net 100 module can be allocated to the same IP task in the status change detection No. (Point No.) (Ex.②)　GET_IP_INF command is used to judge with which factor the IP task is generated. (Refer to the instruction word manual for the details.) At the head of IP task the status change detection information is read. Allocation of processing using the information enables sharing of IP task.

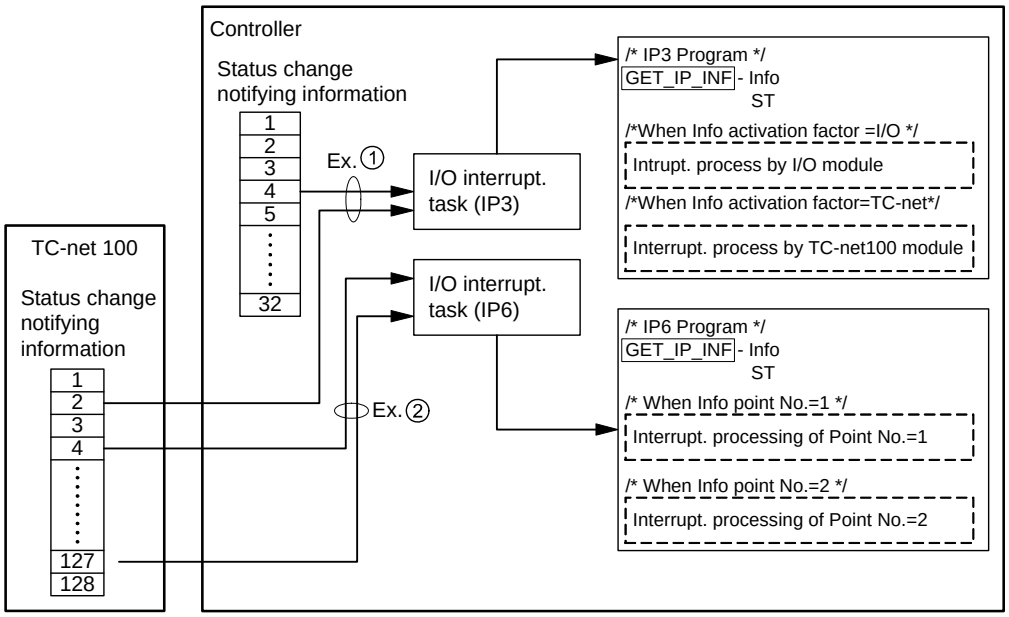


Fig. 3-18　IP task sharing

3.5 Degeneracy Function

Degeneracy function is a function that when any error occurs inside the controller the function related to the error is isolated from the controller and other functions are continued to execute.

Degeneracy function has two types: I/O degeneracy and program degeneracy.

You can set whether to enable or to disable the degeneracy from nV-Tool.

◆ Important

- Degeneracy function is a useful function to configure an instrumentation system. However, when this function is used for sequence control requiring high speed control, task execution cycle is disturbed for a moment or task scan congestion occurs at the occurrence of degeneracy action.

3.5.1 I/O degeneracy

I/O degeneracy function is a function that when any error occurs to any I/O module, only the module is isolated and input/output of other I/O modules are continued to be executed.

Specify “Degeneracy” or “No degeneracy” of I/O degeneracy setting for each I/O node, using nV-Tool, from the controller specifying [Module Parameter] – [Controller operation specification] – [I/O Degeneracy] and [I/O node] – [I/O Degeneracy].

Input/output to I/O module has two types: batch input/output and direct input/output. The concept of I/O degeneracy at input/output to/from each I/O module is indicated in Fig. 3-19 for each type of input/output.

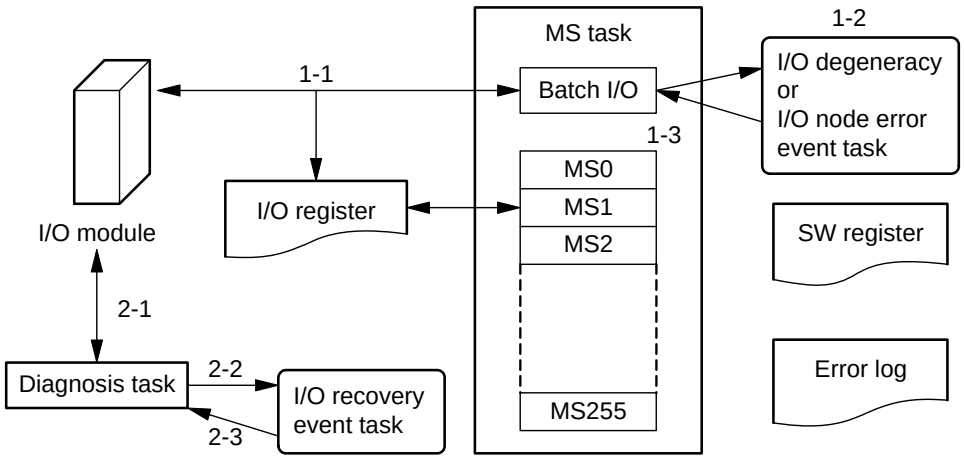


Fig. 3-19 Concept of I/O degeneracy

3.5.2 I/O degeneracy at batch input/output

I/O degeneracy at batch input/output is carried out in the order of 1-1, 1-2 and 1-3 in Fig. 3-19.

1-1 : Access error is detected during batch input/output
- Error log is registered.
- I/O degeneracy event task (EV4) is started up.
  (In case of I/O node error, I/O node error event task (EV7) is started.)

1-2 : I/O degeneracy event task (EV4)
- Whether to carry out I/O degeneracy or to shut down the system due to error down is set to SW [347], based on the information of the card where I/O access error occurred. (SW[340] to SW[346])

1-3 : I/O degeneracy occurrence
- I/O degeneracy processing is carried out in accordance with the information set by I/O degeneracy event task (EV4)
- Error log (I/O degeneracy) is registered.

3.5.3 I/O recovery processing

I/O recovery processing is carried out in the order of 2-1, 2-2 and 2-3 in Fig. 3-19.

2-1 : I/O access error recovery detection (recovery check is made only to the card where error occurred)
- Error log (I/O degeneracy) is registered.
- The information of the card of which access error was recovered is set to SW [350] to SW [356].
- I/O recovery event task (EV6) is started.

2-2 : I/O recovery event task (EV6) processing
- Judgment whether or not other I/O cards are recovered is made based on the information of the card of which I/O access error was recovered. I/O recovery command request is sent when recovering the I/O card.

2-3 : I/O recovery processing
- I/O recovery processing is carried out in accordance with the information set by recovery event task (EV6)
- Error log (I/O degeneracy recovery) is registered.

◇ Supplementary

- When no event task exists, only the I/O module of which error/recovery was detected by the system is carried out for degeneracy/recovery.
- I/O degeneracy is carried out for I/O module as a unit.
- Input/output to the I/O carried out for I/O degeneracy. Therefore I/O data of the I/O is not updated.
- When input/output is carried out directly to the I/O in degeneracy, input/output is carried out not to the I/O but to the batch I/O register instead.
- Refer to 4.1.6 Special register (S register) for the details.

3.5.4 Program degeneracy

Program degeneracy is a function that when any error occurs to any program, only that program is isolated and other programs are continued to run.

To use this function, from nV-Tool select “Module Parameter” - “Program Degeneracy” and set “Yes”.

3

3.5.5 In case of program execution error

The concept of program degeneracy when program execution error occurs is indicated in Fig. 3-20.

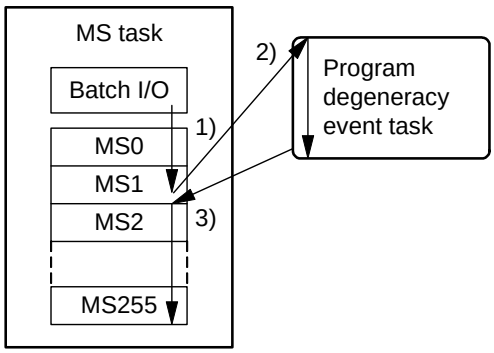


Fig. 3-20 Concept of program degeneracy

1) When program execution error is detected
   - Error log (program execution error) is registered.
   - Program degeneracy information is set to SW [328] to SW [330].
   - Program degeneracy task (EV5) is started.

2) Program degeneracy task (EV5) processing
   - Execution of related programs is prohibited (by program control command (EN_P/DIS_P)), based on the program degeneracy information.
   - Whether to carry out program degeneracy or to shut down the system due to error down is set to SW [332].

3) Program degeneracy processing
   - Program degeneracy processing is carried out in accordance with the information set by program degeneracy event task (EV5).
   - Error log (program degeneracy) is registered.
   - Program degeneracy status is set to SW [300] to SW [327].

◇ **Supplementary**

- When a program execution error occurs, the commands after the step of the program where the error occurred are not executed.
- Down load the program again to recover from program degeneracy.

3.6 Program Management

When a program is downloaded, the program is assigned to the memory in the controller for each program organization unit (POU). Memory region to be assigned is divided into blocks of a constant size. Number of program steps that can be saved in a block is 32 steps. The concept of the memory region is indicated in Fig. 3-21.

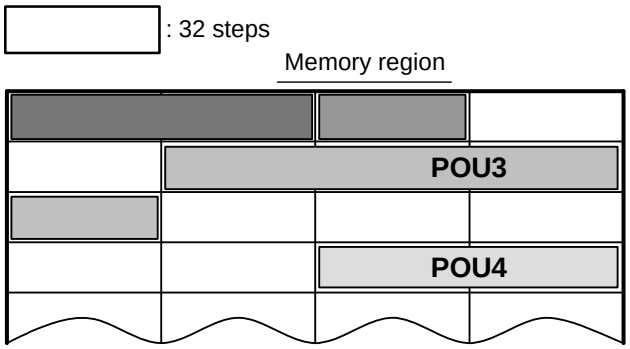
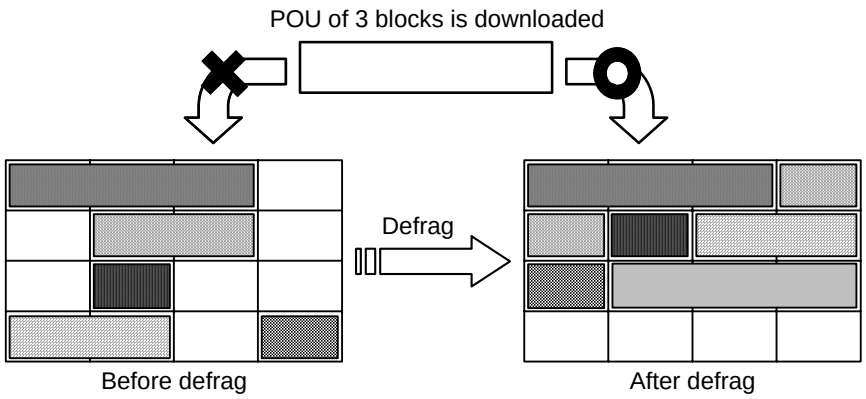


Fig. 3-21 Concept of memory region

One POU is saved in the consecutive memory regions (blocks). Two or more POUs are never saved in a block.

Therefore, when downloading POU of 50 steps, it occupies 2 blocks on the memory, that is, 64 steps memory region.

Further, since POU occupies consecutive blocks, repetitive download causes to generate vacant memory regions. To improve the efficiency of memory region, POU and vacant memory regions are re-arranged and the vacant regions are combined into one place. This memory region optimization is called defrag (defragmentation). The concept of defrag is indicated in Fig. 3-22.



In this figure, the right end of the memory region and the left end of the next row is continuous.

Fig. 3-22 Concept of defrag

Chapter 4
Variables

This chapter describes the basic instruction to operation type1 related to variables as a means to identify data item.

4.1 What is the Variable?

A variable is a means to identify data items of which content can be referred and changed through the actual I/O and the memory in the controller from program.

To be concrete, nV-Tool assigns variable name to actual I/O and memory in the controller so that they can be referred and changed from program. The variables include local variables and global variables (controller variable, station variable and network variable). You have always to aware of types of the variable and its effective range (scope) to write a program.

Following are the variables that can be operated on unified controller nv series.

4.2 Types of the Variable

The concept of the variable is shown in Fig. 4-1.

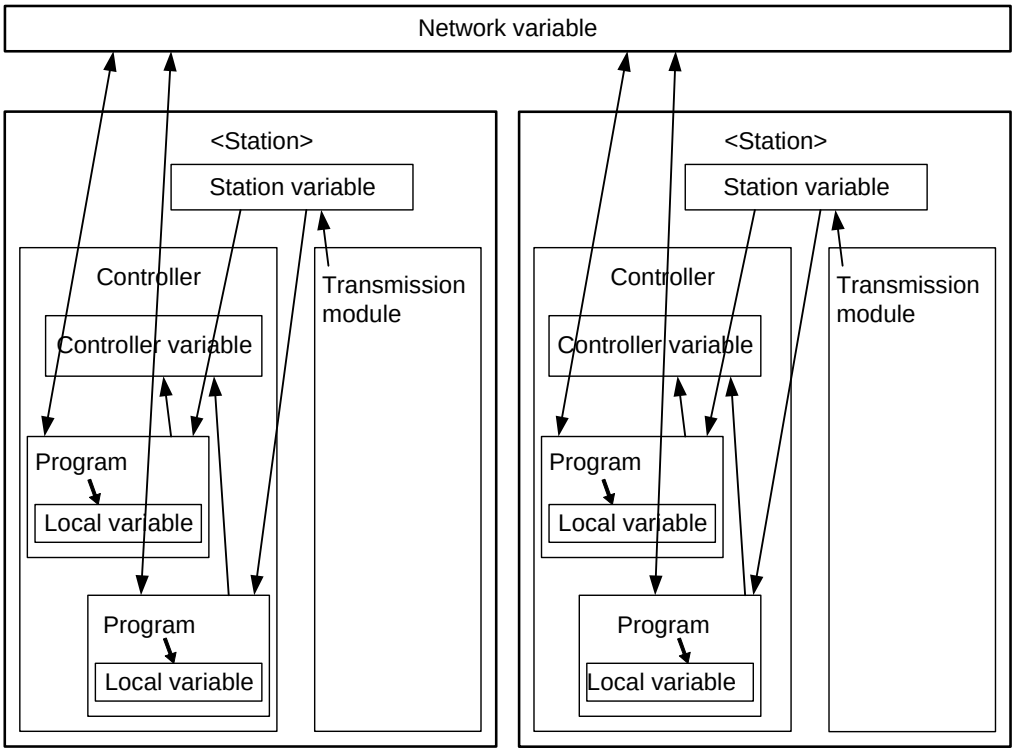


Fig. 4-1 Concept of variables

■ Local variable

Local variable is a variable that can be used only by the program including the variables. This variable is used as the variable characteristic to the program.

■ Controller variable

Controller variable is a variable used globally. This variable is used to exchange information and data between different programs in the controller. The effective range of the variable is only within the controller where the variable is used.

The controller variable includes the original variables of the controller (special register, data register), user global variable defined by the user and I/O variable.

- Original variables of the controller
  Original variables include special register (S/SW) and data register (D/DW/DD/DF).

  - Special register (S register)
    S register is a variable prepared to enable the program to refer to the operating condition of the controller or intervene in the operating condition.

Note

- DO NOT try to set those other than disclosed in Appendix A.2 Special register (S register).

  - Data register variable (D register)
    D register is a variable to interface with other equipment (human interface equipment).

- User global variable
  This global variable can be defined by user freely for its name and structure of the variable.

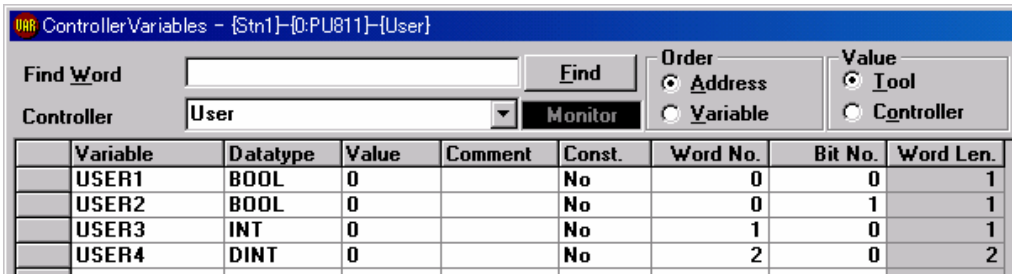


Fig. 4-2 User global variable screen

- I/O variable
  I/O variable is capable of referring to I/O data with the symbol assigned to each point of I/O module. I/O variable corresponds to IQ register updated by batch input/output processing. (A value input/output synchronized with scan task)

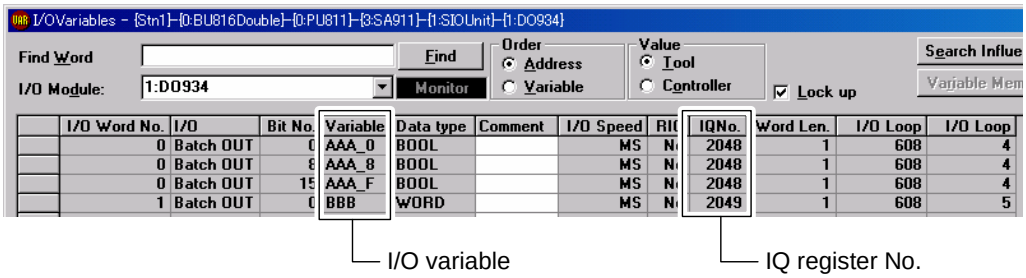


Fig. 4-3 I/O variable screen

When an underscore (_) is attached at the end of the I/O variable name, it means that an input/output is carried out at program execution. This is called direct I/O specification.

I/O variables also can be expressed in a program as following.

(This expression is called as direct notation and each symbol means as below □: IQ register no. (IQ No.)　△: Bit number (Bit No.)).

%IX□.△: Bit access of input variable

%QX□.△: Bit access of output variable

%IW□: Word access of input variable

%QW□: Word access of output variable

%ID□: Double word access of input variable

%QD□: Double word access of output variable

Example of notation :%IX8.5, %QX12.3, %IW9, %QW13, %ID16, %QD20, ···

■ Station variable

This is a variable used globally within a station and used to refer the information and data of the transmission module in the station. The effective range of the variable is only within the station where the variable is used.

■ Network variable

This variable is a variable to be controlled uniformly in the system and available when stations are connected through scan transmission. It is used to exchange the information and data between different stations. The effective range of the variable is only within the system where the variable is used.

Those that can become network variable is limited to scan transmission memory of TC-net and FL-net.

4.3 Initialization of the Variable

Initialization of the variable can be selected from the following initializing methods. Select the start-up mode (initializing method) appropriate for the use of the controller.

■ Initialization of global variable

Specify whether the global variable is cleared to zero or not (i.e. previous value is held) at the transition of controller operation mode to RUN mode.

nV-Tool setting is carried out as below:

From the controller, select “Module Parameter” > “Controller Operation” > “Global Variable Initialize”

■ Initialization of local variable

Specify whether the local variable is cleared to zero or not (i.e. previous value is held) at the transition of controller operation mode to RUN mode.

nV-Tool setting is carried out as below:

From the controller, select “Module Parameter” > “Controller Operation” > “Local Variable Initialize”

4.4 Initialization Timing of the Variable

Initialization timing for the system to execute is following:

- Turning on power
- Transition of operating mode to RUN mode

The contents of variable initialization are indicated in Table 4-1, 4-2 and 4-3.

Initialization executed by the user is carried out by initializing event task (EV0) after transition to RUN mode.

Table 4-1 Variable initialization at power on

Variable		Value
Local variable		Previous value
Local variable (NonTracking)		Previous value
Controller variable	User global variable	Previous value
	Special register (S)	Initialized by the system
	Data register (D)	Previous value
	I/O variable	Previous value
Station variable		Initialized by the system
Network variable		Initialized by the system

Table 4-2 Local variable initialization at transition to RUN mode

Variable	Local variable initialization	
	Executed	Not executed
Local variable	Zero clear	Previous value (Note 1)
Local variable (Non tracking) (Note 2)	Zero clear	

(Note 1) Local variable area generated automatically by standard function block (for example, previous value saving area for stand up edge detection command) is cleared to zero.

(Note 2) This is a local variable that does not carry out tracking at duplex system. However, this variable is also cleared to zero when switching the duplex system.

Table 4-3 Global variable initialization at transition to RUN mode

Variable		Global variable initialization	
		Executed	Not executed
Controller variable	User global variable	Zero clear	Previous value
	Special register (S)	Initialized by the system	
	Data register (D)	Previous value	
	I/O variable	Input is changed with the latest data (Note 1), output is cleared to zero (Note 2)	
Station variable		Initialized by the system	
Network variable		Initialized by the system	

(Note 1) Input device data of forced input uses previous value.
(Note 2) Output is made after execution of user program execution.

◆ Note

- When “Not initialize” is selected to local variable and global variable, carry out initialization appropriate to the system by initializing event task (EV0).
- When “Hold Previous Value” is selected for I/O output module, design the program so that the operation can be continued.
  For example, set the operation result as a user global variable and set the user global variables not initialized. Or, perform such initializing processing that initializing event task (EV0) sets IQ resister to the feedback value of I/O module.

4.5 Size of the Variable

The size of the variable is shown in Table 4-4.

Table 4-4 Size of variable

Variable		Size
Local variable		246K Word (Note 1)
Controller global variable	User global variable	10K Word (Note 1)
	Special register (S)	1K Word
	Data register (D)	8K Word
	I/O variable	16K Word
Station variable		Depends on the transmission module specification
Network variable		Depends on the transmission module specification

(Note 1) Local variable size and User global variable size in the above table are the default values.
The sum of local variable size and the User global variable size is 256k word. The allocation can be changed by nV-Tool.

4

Chapter 5
nV-Tool Support Function

nV-Tool support function is enabled to monitor the status of the controller connected to nV-Tool and change the setting information.

5.1 Module Parameters

Module parameters are important information to decide the operation of the controller main unit.

Module parameters include the controller operation specification, task execution specification, information on duplexing, status change notification, other, Ethernet, I/O loop and I/O node. You can specify the operation of type1 controller appropriate to its use.

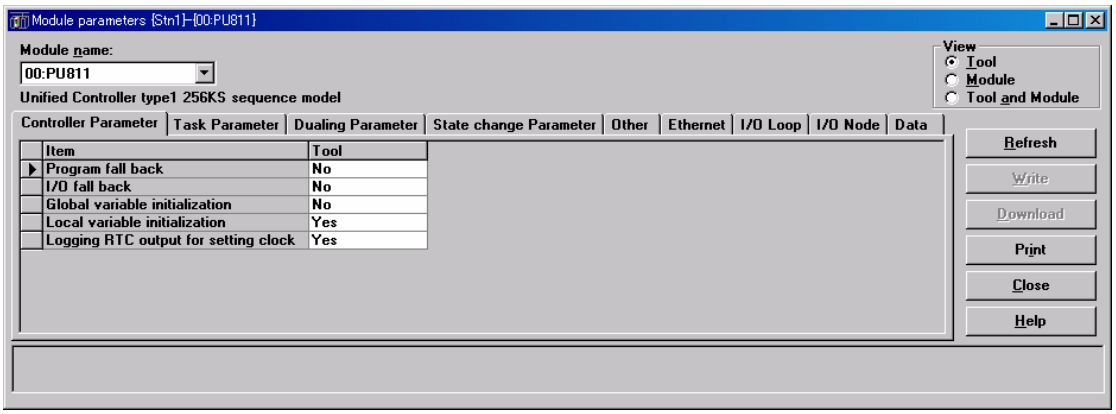


Fig. 5-1 Module parameters setting screen

5.1.1 Controller operation specification

Following basic operations of the controller are specified as below.

■ Program degeneracy

Program degeneracy is a function that when any error occurs to any program, only that program is isolated and other programs are continued to run. Set whether to use or not the program degeneracy function.

Refer to 3.5.4 Program degeneracy for the details.

■ I/O degeneracy

I/O degeneracy function is a function that when any error occurs to any I/O module, only the module is isolated and input/output of other I/O modules are continued to be executed. Set whether to use or not the I/O degeneracy function.

Refer to 3.5.1 I/O degeneracy for the details.

■ Global variable initialization specification

Set whether to initialize or not the global variable at starting up in RUN mode.

Refer to 4.3 Initialization of Variables for the details of the variables to be initialized.

■ Local variable initialization specification

Set whether to initialize or not the local variable at starting up in RUN mode.

Refer to 4.3 Initialization of Variables for the details of the variables to be initialized.

■ Output of time setting by program to log

Set whether to output or not the event log when the time is set by Real Time Clock (RTC) command.

◇ **Supplementary**

- The system that executes RTC command at a regular cycle has a possibility that its event log will soon become full with time setting logs.

5.1.2 Task execution specification

Set one out of four task priority levels to each task and task parameter.

Task priority allocation is indicated in Table 5-1.

Table 5-1 Task priority allocation

Task priority (Note 1)		Task type	Single configuration	Duplex configuration
High ↕ Low	0	EV	Select either EV or IP	EV
		IP		
	1	SS	Select either SS or IP	Select either SS or IP
		IP		
	2	HS	Select either HS or RIO	HS
		RIO		
	3	MS	MS	MS

(Note 1) IP task cannot be selected to both of Priority 0 and Priority 1.

Task parameter allocation is indicated in Table 5-2.

Table 5-2 Task parameter setting

Parameter \ Task	EV	IP	SS	HS	RIO	MS
Task type	○	○	○	○	○	○
Execution setting	—	—	○	○	○	○
Scan cycle	—	—	○	○	○	○
RIO mid speed I/O division no.	—	—	—	—	○	—

Task type: Set task type to be allocated to each task priority
Execution setting: Set task execution/stop
Scan cycle: Set the scan cycle by 0.1 ms
SS, HS, RIO: 0.5 to 500.0 ms, MS: 0.5 to 1000.0 ms
RIO mid speed I/O division no.: Set 2 to 64.
Refer to 3.3.5 RIO task execution for the details.

◆ **Note**

- When setting MS task, be sure to set the task to operated
  If task execution is set for execution specification, be sure to register a program to the task.

5.1.3 Information on duplexing

Set the operation in duplex system.

■ System alarm in duplex operation

Specify whether to notify or not the alarm of minor failure when the secondary becomes online in duplex system configuration.

- When NORMAL is specified (default setting)
  Minor Failure alarm is notified when the secondary becomes online.
- When SPECIAL is specified
  It is not regarded as failure when the secondary becomes online.

■ Auto restart

Specify whether to restart automatically or not the system when the controller is shut down due to error down.

- When NO RESTART is specified
  System is stopped in the error down status. Restoration needs the intervene by human.

- When RESTART STDBY SYSTEM ONLY is specified
  System is automatically restarted when in error down. If the other system is in operating, the own system restarts automatically.
- When RESTART is specified
  System is automatically restarted when in error down, irrespective of the operation mode of other system.

◆ **Important**

- This controller is unable to select operation with I/O status inconsistency.

■ Operation with I/O status inconsistency

This is a function to specify whether to continue the operation of standby system or to shut down the standby system when an SIO that seems normal from online system but looks abnormal from standby system. This function specifies the operation in case I/O loop seems abnormal by four or more points.

- When CONTINUE OPERATION is specified
  The system continues its operation.
- When ERROR DOWN is specified
  The standby system is shut down due to error down.

◆ **Important**

- This controller is unable to select operation with I/O status inconsistency.

■ Tracking information

Specify the tracking specification of global variable area for each task.

＜MS task＞

- User global variable
  Specify ALL AREAS/NO TRACKING, or maximum four areas (top address and size) for tracking.
- D register
  Specify ALL AREAS/NO TRACKING, or an area (top address and size) for tracking.

＜HS task＞

- User global variable
  Specify an area (top address and size) for tracking.
- D register
  Specify an area (top address and size) for tracking.

＜SS task＞

- User global variable
  Specify an area (top address and size) for tracking.

- D register
  Specify an area (top address and size) for tracking.

◆ Note

- Amount of tracking has a limit depending on the task. Set the tracking within the limit.
  MS task: 128KW, HS task: 64KW, SS task: 64KW
  Refer to Appendix A-2 Special register, SW[266] to SW[271] for the actual tracking amount.

5.1.4 Status change notification

Set this when you want to start IP task if process data changes.

Data status change can be detected for maximum 32 point (1 Word for a point).

1) Status change detection
   Set YES or NO to detect status change for each 1W.
2) Objective I/O module
   Set the I/O module of which status change to be detected.
3) I/O Word No.
   Set the Word No. of which status change to be detected.
4) Detection mask (for ON detection)
   Set which bit in 1W process data set in previous 2) and 3) is detected for its change to ON (Set “1” to the bit of which status change to ON to be detected).
5) Detection mask (for OFF detection)
   Set which bit in 1W process data set in previous 2) and 3) is detected for its change to OFF (Set “1” to the bit of which status change to OFF to be detected).
6) IP task No.
   Set which IP task is to be started when the status change is detected for above 1) through 5).

5.1.5 Other

Specify the computer link via Ethernet.

■ Computer link

Setting items of computer link are indicated in Table 5-3.

Table 5-3 Setting items of computer link

Item	
Ethernet slot No.	Since Ethernet modules can be installed to the controller unit up to four modules, specify to which Ethenet module to be connected with installation slot no. (2 to 7)
UDP port No.	Specify UDP Port No. for computer link. (1024 to 65535)

◇ **Supplementary**

- Computer link function use the set UDP Port No. as following:
  UDP Port No. : Computer link receive port
  UDP Port No.＋1: Computer link send Port
  UDP Port No.＋2: Reserved
- The number of UDP Port No. that can be set to a slot is one. If two or more settings are made to the same slot, the computer link for the second Port No. or later cannot be established.

5.1.6 Ethernet

Set the Ethernet IP address for nV-Tool.

Register the setting suitable to the DIP switch setting at the front panel and Ethernet IP address setting switch for nV-Tool.

Table 5-5 Ethernet setting items for nV-Tool connection

	DIP switch 5	DIP switch 6	DIP switch 5	DIP switch 6
	OFF	OFF	OFF	ON
IP address type	Class B type		Class C type	
IP address primary	172.16.64.** (Note 1)		192.168.0.** (Note 1)	
Subnet mask primary	255.255.192.0		255.255. 255.0	
IP address secondary	172.16.64.** (Note 1)		192.168.0.1** (Note 1)	
Subnet mask secondary	255.255.192.0		255.255.255.0	

(Note 1) Set to the value (hexadecimal) set by Ethernet IP address setting switch at the front panel of the controller converted to decimal value.

5.1.7 I/O loop

Set the I/O loop information on the I/O loop connected to TC-net I/O loop of the controller.

- I/O loop number
  Specify the number of I/O loops.
  Normally, specify I/O loop number = 1 for single configuration,
  and I/O loop number = 2 for duplex configuration.
- I/O loop high speed scan cycle (0.1ms)
  Set the high speed scan cycle of I/O loop
- I/O loop high speed healthy check time (1ms)
  Set the high speed healthy check time for I/O loop.
- I/O loop mid speed Scan cycle (1ms)
  Set the mid speed scan cycle I/O loop.
- I/O loop mid speed healthy check time (1ms)
  Set the mid speed healthy check time I/O loop.

◇ **Supplementary**

- Default setting is recommended for the settings mentioned above.
- Changing this setting needs full understanding of high serial TC-net I/O.
- Excessive abnormality detection or delayed abnormality detection may occur depending on the setting value.

5.1.8 I/O node

Set the I/O node information under the TC-net I/O loop of the controller for each node.

- I/O degeneracy
  Set YES or NO of I/O degeneracy for each node.
  Refer to 3.5.1 I/O degeneracy for the details of I/O degeneracy function.
- I/O bus healthy check time (1 ms)
  Set the healthy check time of I/O bus.

◇ **Supplementary**

- Changing this setting needs full understanding of high serial TC-net I/O.
- Excessive abnormality detection or delayed abnormality detection may occur depending on the setting value.

5.2 Programming Support Function

5.2.1 Backup/Restore

This function can be executed only in HALT mode and when the operation mode switch is set to the position other than P-RUN.

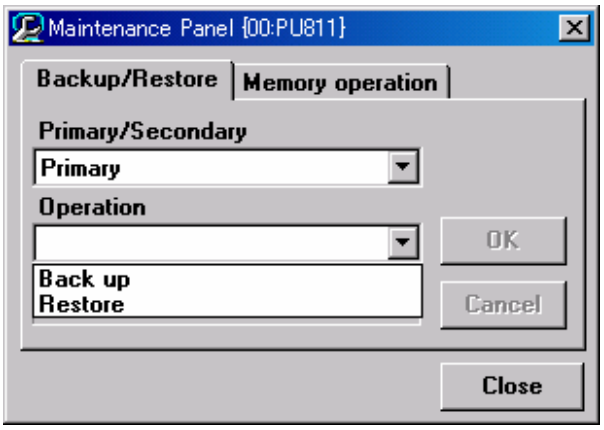


Fig. 5-2 Maintenance panel (backup / restore)

■ Back up

All programs and control data are saved in nV-Tool.

■ Restore (available only in DL-WAIT mode)

Programs and control data saved by back up are transferred to type1 controller main unit.

5.2.2 Memory operation

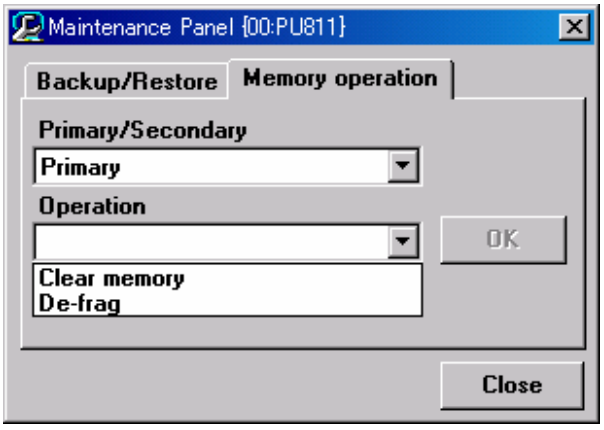


Fig. 5-3 Maintenance panel (memory operation)

■ Memory clear

When memory clear is executed, memory for program (RAM) is initialized and the memory for control data (RAM) is cleared.

◆ Important

- When memory clear is carried out the configuration information necessary to start execution is also cleared. So the system mode transitions to DL-WAIT mode. To execute the program after this transition, configuration information, global variables and programs need to be downloaded from nV-Tool.

■ Defrag

When defrag command is executed, POU in the memory for program (RAM) and instance in the memory for control data (RAM) are relocated (i.e. space area is gathered into one position) to optimize the contents of RAM.

◇ Supplementary

- Defrag cannot be executed in the duplex operation status of duplex configuration. To execute defrag in the duplex configuration, carry out the defrag in ODD-RUN mode or in HALT mode.
- Defrag execution while in online operation relocates the contents of RAM at every one scan. Consequently it takes long time for processing.

5.3 Execution Status Monitor

The controller main unit supports the following three functions to monitor the scan control execution status of type1 controller.

- Run time measurement function
- Program monitoring function
- Data value monitoring function

5.3.1 Run time measurement

The following run times are measured. This data can be checked from nV-Tool "Module parameters" > "Data". Refer to Fig. 5.5.

- Scan time ····· Present value, minimum, maximum (at 0.01 msec cycle)
- Task execution time of each task · Present value, minimum, maximum (at 0.01 msec cycle)
- LP execution time of each task ···· Present value, minimum, maximum (at 0.01 msec cycle)

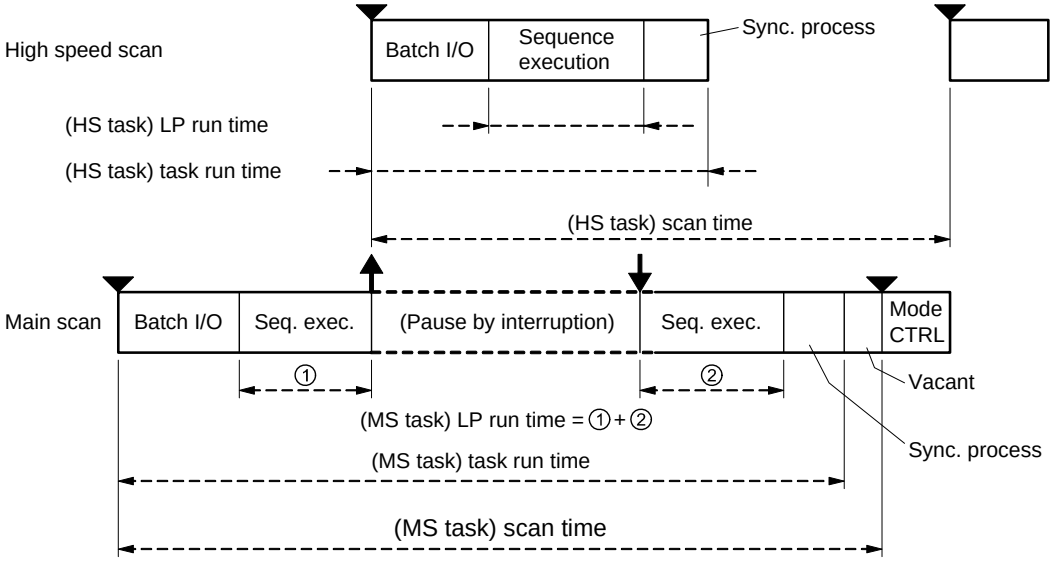


Fig. 5-4 Run time measured area

◇ **Supplementary**

- Scan time includes all of scan overhead and the interruption occurred during scan.
- Task run time of each task includes the time for pause by interruption.

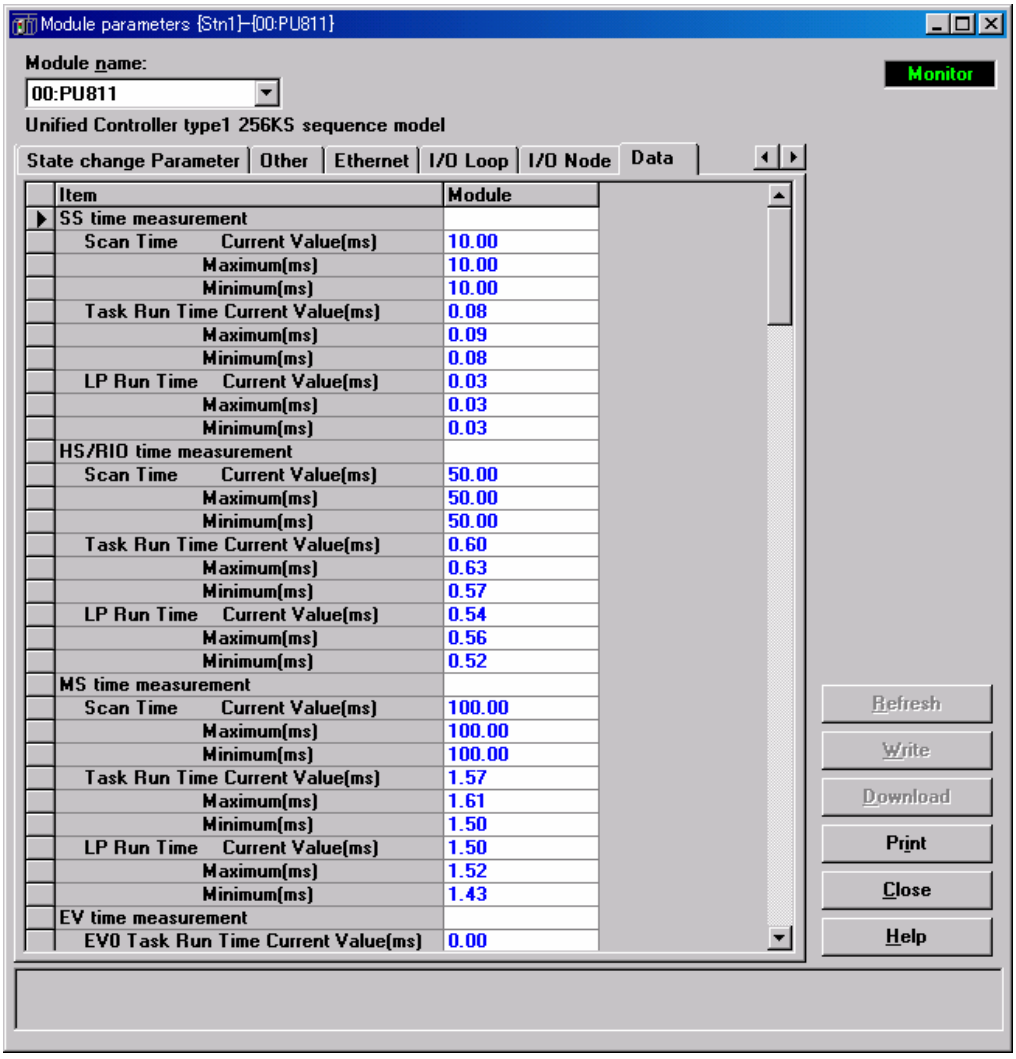


Fig. 5-5 Run time measurement function

5.3.2 Program monitor

nV-Tool can trace the execution status of the circuit range under program monitoring up to 8 screens at maximum and display the contents (hot line display, data display) on the screen.

This displays the data at the time when the command is executed, not the data after completion of one scan. So it is useful also for program debugging.

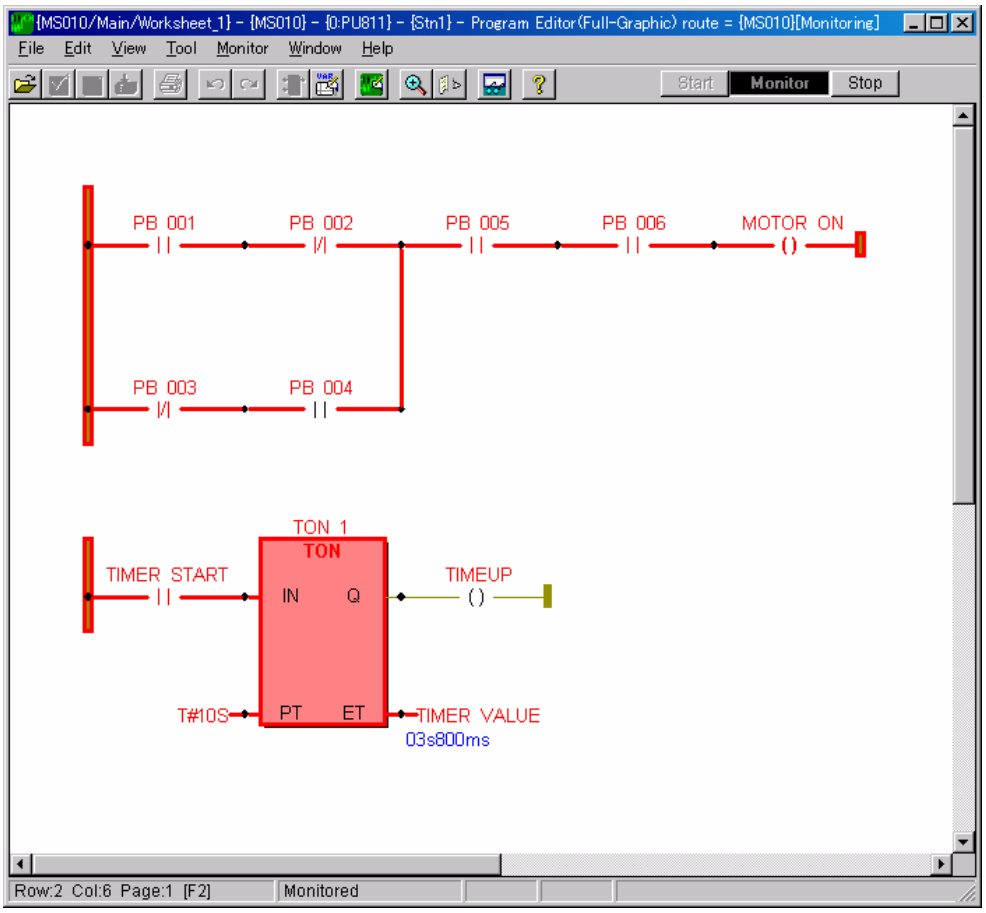


Fig. 5-6 Program monitor

5.3.3 Data value monitor

Program monitor screen of nV-Tool collects the statuses of devices and registers up to 32 points at maximum and displays them on the screen. Select from menu, “Display” > “Data monitor” during program monitoring and the data value monitor shown in Fig. 5-7 is displayed.

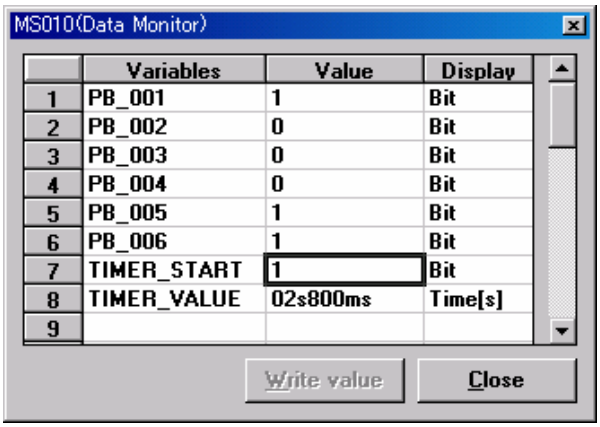


Fig. 5-7 Data value monitor

5.4 Online Change

Online change is a function to change the configuration information and program of the controller during online operation (RUN).

Online change function includes the following:

- Task scan cycle change
- Online program change function
- Instruction word swap function
- Contacts and coils forced operation function
- I/O connection online change function

5.4.1 Task scan cycle change

This is a function to change the task scan cycles of main scan task (MS), high speed scan task (HS), super speed scan task (SS), during the online operation (RUN) of the system.

The change can be made from the nV-Tool, Module parameters screen in the following operation procedure.

1 Select “Module” or “Tool and module”.

2 Change task scan cycle and click WRITE button.

3 Confirmation message is displayed. Follow the instruction.

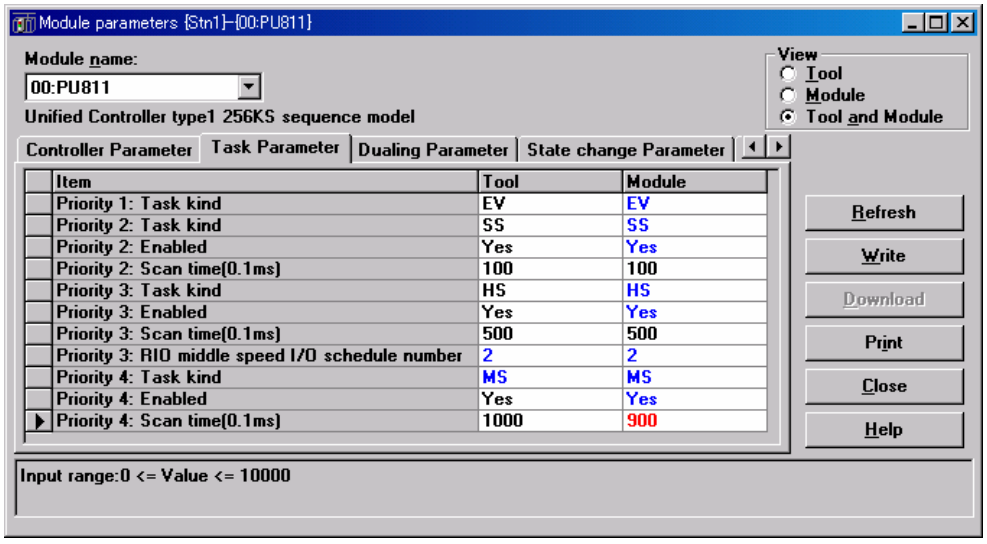


Fig. 5-10 Task scan cycle change screen

◇ **Supplementary**

- When reducing the present task scan setting to smaller value, scan congestion may occur depending on the setting value. When changing the task scan cycle, change the setting, taking into consideration fully the task execution time in the tab appearing “Module parameters” > “Data”
- Set the value larger than 80 % of the present task scan cycle setting. Setting the value 80 % or less of the present setting value is not allowed.

5.4.2 Online program change

When any change is made to the program during online operation (RUN), this function downloads only the changed program from nV-Tool to the controller, and the program in the controller is changed while the online operation is continued.

When downloading the program to the controller, two parameters can be specified in the download screen displayed at downloading. Select appropriate parameter.

■ Specification of download file

You can select two modes for downloading: the mode “Not download the files already downloaded” (i.e. download object is the files that are changed) and the mode “Download the files already downloaded” (i.e. download object is all files in the task).

■ Specification of program continuous operation

You can select two modes for continuous operation: the mode “Initialize local variables and execute” (i.e. after download, all local variables are cleared to zero and the program is executed) and the mode “Continue to use local variables and execute” (i.e. after download, the present value of the local variables in the task is copied and the program is executed).

If the former is selected, program continuity is not guaranteed. When the latter is selected, the system can operate continuing the status before program change.

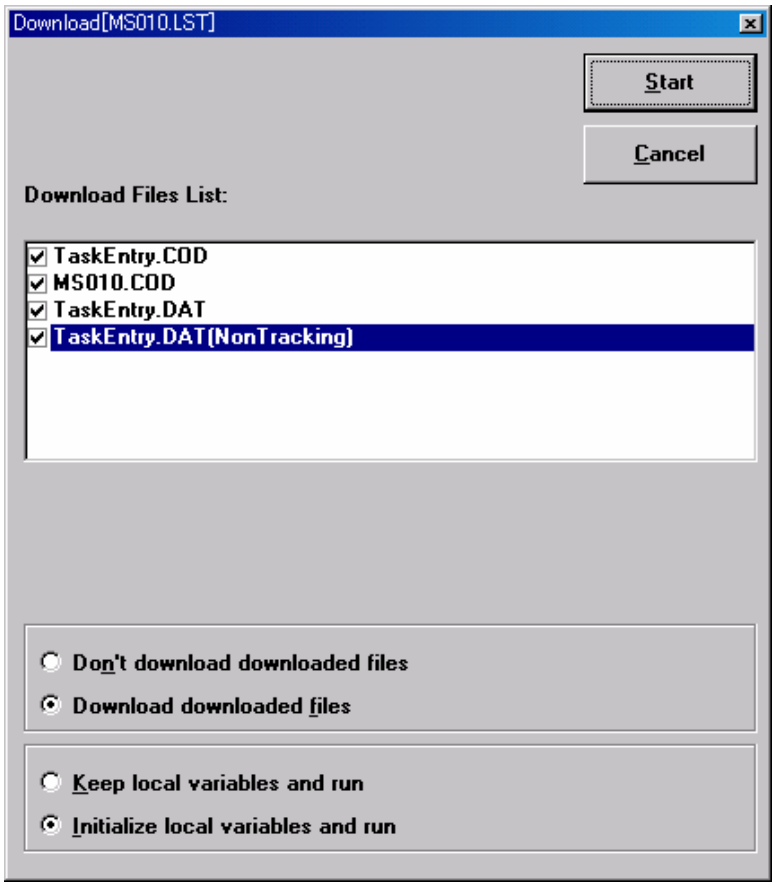


Fig. 5-11 Program DL screen

◇ Supplementary

- You can select “Continue to use local variable and execute” only when local variable is added.

5.4.3 Instruction word swap

This is a function to overwrite the instruction words and immediate values, monitoring the program with the program editor of nV-Tool during online operation (RUN).

Select from program editor “Tool” > “Instruction swap”. To swap the instruction word, move the cursor to the item to change, change it with the instruction swap menu and execute “Write”.

Following instructions can be used for instruction work swap.

Table 5-7 List of instruction word swap

Group	Instruction word that can be swapped	Immediate value swap	Variable swap
Contact	a-contact, b-contact	—	Available
Coil	Coil, reverse coil, set coil, reset coil	—	Available
Gate	a-contact gate b-contact gate	—	Available
Load	—	Available	Available
Store/Set	—	—	Available

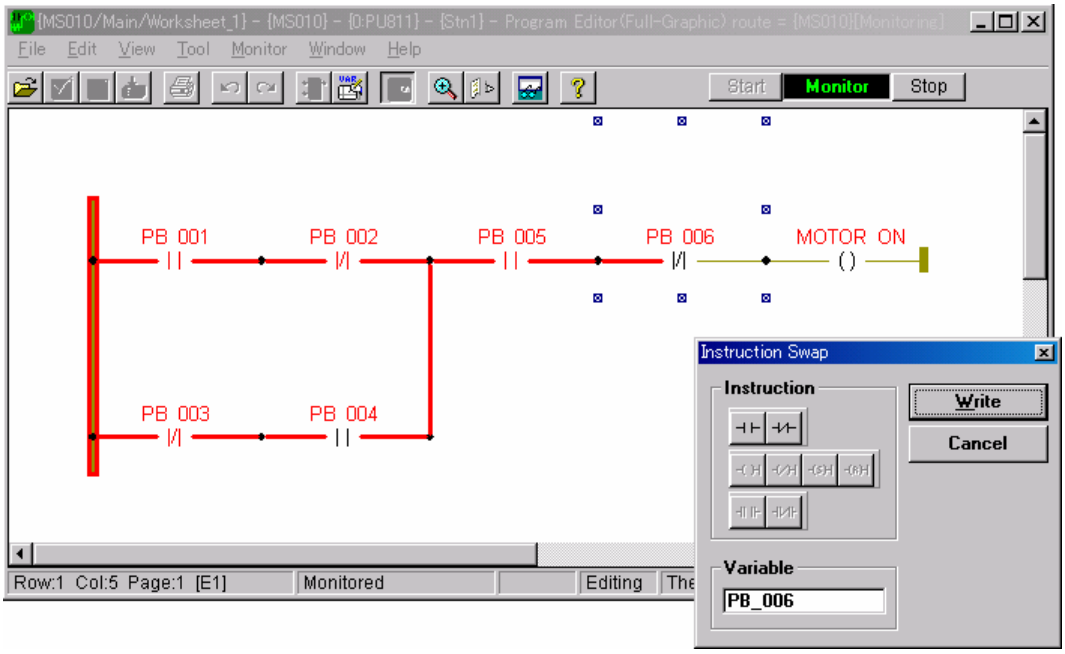


Fig. 5-12 Instruction word swap screen

5.4.4 Contacts and coils forced operating function

This is a function to perform forced operation of contacts (forced holding of setting value) and forced operation of coils (forced holding of output result) from the program editor of nV-Tool.

Select from program editor “Tool” - “Contact/ Coil Force”. To execute the forced operation of contacts and coils, move the cursor to the item to force, change it with “Contact/ Coil Force” and execute “Write”.

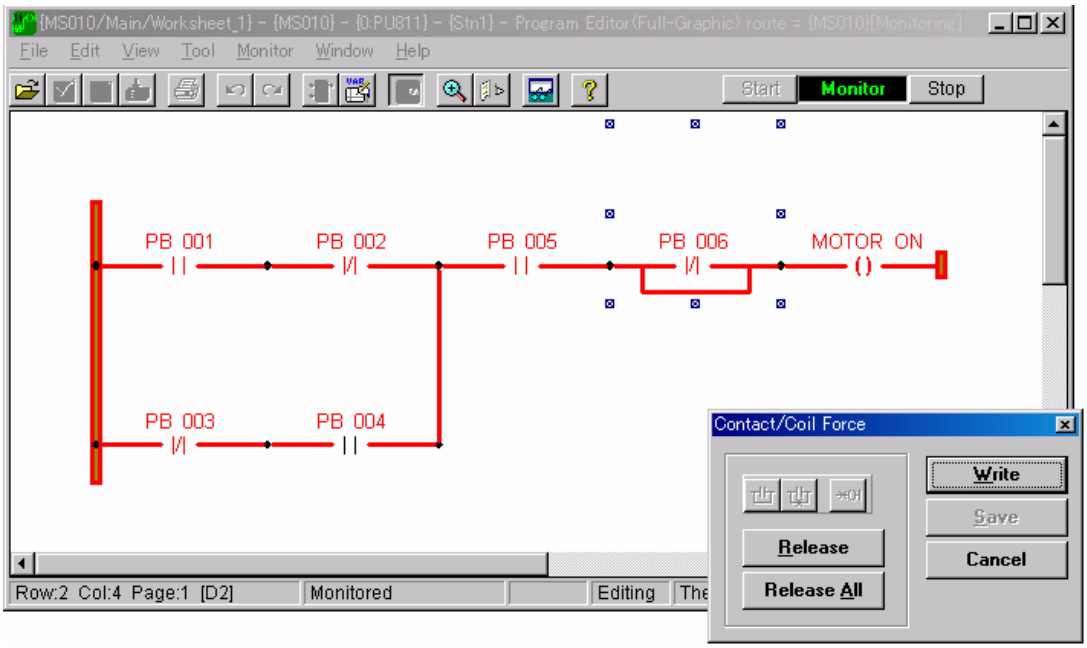


Fig. 5-13 Forced operation of contacts and coils screen

5.4.5 Online addition of I/O connection (Under development)

This function downloads the batch specification of input/output (I/O connection) of system global variables and station global variables during online operation (RUN). This is used when executing the batch input/output of variables added later without HALT (suspended status) of the controller in operation.

Chapter 6
RAS Function

RAS means Reliability, Availability and Serviceability. All functions equipped to the unified controller nv series to heighten the reliability and serviceability of the system that utilizes the unified controller nv series are called as RAS function as a generic term.

6.1 Self Diagnosis

This section describes the contents of the items that are carried out to check the health of the controller by the controller itself to prevent malfunctions from occurring, such as self diagnosis, timing of the diagnosis and the operation when error is detected.

When performing the system design, fully review the safety (fail safe) of the system operation when the controller detected any error and the back up of the system operation.

The meaning of the word used in the following description is as below:

- Error registration: To save the contents of error and its occurrence time into error log.
- Error down: To turn OFF all outputs and transition to ERR mode
- Caution: To register information to the error registration, special register (S register) and continue the operation.

■ Diagnostic Items at System Initialization Processing (Power ON)

Table 6-1 Check Items at System Initialization Processing (Power ON) (1)

Diagnosis item and its contents	Operation when error is detected	Countermeasure
• Communication controller error Check whether the communication controller has been successfully initialized or not.	Error registration is carried out and the system is started up in ERR mode.	Replace the CPU module and restart the system. Or, contact our after-sale service section.
• Timer controller error Check whether the timer controller has been successfully initialized or not.		
• LP (Language Processor) error Check whether the LP (Language Processor) has been successfully initialized or not.		
Station bus memory check error Check whether the station bus has been successfully initialized or not.		
• LP diagnosis error Check whether LP is enabled to run normally or not during HALT.		
• ECC circuit check error Check the validity of ECC circuit of each area.		
• LP (Language Processor) transfer error Check whether data transfer by LP (Language Processor) has been successful or not.		

Table 6-1 Check Items at System Initialization Processing (Power ON) (2)

Diagnosis item and its contents	Operation when error is detected	Countermeasure
• Data loss check error Write a fixed value into a certain fixed address and check whether the value has been read correctly or not.	Error registration is carried out and the system is started up in ERR mode.	Download the system data such as program from tool and restart the system
• User program memory BCC check error Check the validity of user program with BCC		Replace the CPU module and restart the system. Or, contact our after-sale service section.
• Memory check error Carry out read-back check of the memory in each area.		
• Built-in Ethernet initializing error Check whether built-in Ethernet is initialized normally or not.		Check IP address setting. If still unable to solve the problem, replace the CPU module and restart the system. Or, contact our after-sale service section.
• Low battery error (CPU) Check the battery voltage of CPU.	It is regarded as minor failure and operation is continued.	Remove the battery.
• Battery uninstalled (CPU) Check whether battery for CPU is installed or not.		Install the battery.
• Cooling fan stop detected Check whether fan unit operates normally or not.		Survey around the fan unit and take necessary measures.
• Calendar error Check the effectiveness of data (date, time) read from the calendar LSI.		Carry out time setting from nV-Tool.
• Flash ROM overwrite warning Check whether overwrite times to Flash ROM exceeds 99,000 times or not.		Flash ROM write error may occur with high possibility from now on. Replace the CPU module.
• Power module error detection When using duplex power module, check that both Power modules operate normally or not.		Replace the Power module and restart the system. Or contact our after-sale service section.
• PCI arbitration module error detection Check whether PCI arbitration module operates normally or not.	Error registration is carried out and the system is started up in ERR mode.	Replace the PCI arbitration module, base unit or CPU module and restart the system. Or, contact our after-sale service section.

■ Diagnostic Items at Start-up in RUN mode

Table 6-2 Diagnostic Items at Start-up in RUN mode (1)

Diagnosis item and its contents	Operation when error is detected	Countermeasure
• I/O node down Check whether any node down I/O exists or not.	Error registration is carried out and the system continues operation.	Check the cable connection status. If no problem is observed to the cable connection, contact our after-sale service section.
• Basic unit configuration registration error Check whether or not the CPU module configuration installed in the basic unit is the same as that registered to nV-Tool.	Error registration is carried out and the system is shut down as Error Down.	Match the registered configuration status and the actual installation status of the basic unit. When registering RIO task, TC-net registration is required.
• Scan cycle setting value error Check whether the scan cycle of each scan (SS/HS/MS) is within the specification range or not.		Check the scan cycle setting value. If no problem is observed, down load the system data such as program from nV-Tool and restart the system. Or contact our after-sale service section.
• Logic table (module parameter) error Check whether module parameters are normally registered or not.		After survey of logic table (module parameter) with nV-Tool, carry out reloading
• Instance table logic error Check whether instance table is normally registered or not.		Carry out memory clear and re-download the setting information from nV-Tool. If still error occurs contact our after-sales service section.
• Synchronous trend collection start error Check whether synchronous trend can start or not.	It is regarded as minor failure and operation is continued.	When setting time from nV-Tool, or checking the synchronous trend of nV-Tool and start download and re-synchronous trend.
• Synchronus trend setting file error Check whether synchronous trend can start or not.		Check the synchronous trend setting of nV-Tool, download and restart re-synchronous trend. If the trouble still remains by downloading synchronous trend, replace CPU module or EN module. Or contact our after-sale service section.
• MS task execution/stop setting error Check whether MS task is set to execute or not.	Error registration is carried out and the system is shut down as Error Down.	Set the MS task to execute. Download the setting information using nV-Tool.
• I/O scan cycle, Talker block setting value error Check the setting of I/O scan cycle and Talker block at start-up in RUN mode.		Check the setting value of I/O scan cycle and Talker block. If no problem is observed, reload the system data such as program and restart the system. Or contact our after-sale service section.

Table 6-2 Diagnostic Items at Start-up in RUN mode (2)

Diagnosis item and its contents	Operation when error is detected	Countermeasure
• User program error Check whether the program registration exists or not.	Error registration is carried out and the system is shut down as Error Down.	If the program is not registered to the corresponding task, register the program and carry out reloading. When the program is already registered to the corresponding task load the program from nV-Tool and restart the system.

■ Diagnostic Items while Scan Execution

Table 6-3 Diagnostic Items while Scan Execution (1)

Diagnosis item and its contents	Operation when error is detected	Countermeasure
• Illegal intern interruption (detected by CPU) Check the validity of OS.	Error registration is carried out and the system is shut down as Error Down.	Replace the CPU module and restart the system. Or, contact our after-sale service section.
• Watch dog timer error Check whether watch dog error was detected or not.		
• Illegal access to memory space Check no illegal access to memory space.		
• Illegal LP interruption (detected by CPU) Check whether no illegal interruption from LP (Language Processor).		
• Station bus access error Check whether the error occurs by station bus access or not.	It is regarded as minor failure and operation is continued.	
• Direct I/O PCI and other error detected Check whether or not any error other than time out error of station module occurs when carrying out direct I/O.	Error registration is carried out. The system continues its operation as minor failure if retry result is normal. If retry result is error, degeneracy or Error Down is carried out.	
• Direct I/O PCI time out error detected Check whether or not time out error of station module occurs when carrying out direct I/O.		
• Micro stack error Check whether over or empty of micro stack occurs or not.	Error registration is carried out. The system shuts down as Error Down or continues its operation with program degeneracy depending of the program degeneracy specification.	
• Watch dog error detected by LP Check whether LP detected watch dog timer error or not.	Error registration is carried out and the system is shut down as Error Down.	

Table 6-3 Diagnostic Items while Scan Execution (2)

Diagnosis item and its contents	Operation when error is detected	Countermeasure
• ECC uncorrectable error Check whether or not uncorrectable error occurs in ECC of each area.	Error registration is carried out and the system is shut down as Error Down.	Replace the CPU module and restart the system. Or, contact our after-sale service section.
• Device access error Check whether or not any error occurs at access to each area.		
• Access time out Check whether or not the time out occurs at tracking I/F or LP transfer access.		
• Station bus access error Check whether or not any error occurs by station bus access.		
• Tool source download error Check the validity of FROM writing at downloading the tool source.	It is regarded as minor failure and operation is continued.	
• I/O scan start/stop request error Check the validity of I/O scan start/stop request.	Error registration is carried out and the system is shut down as Error Down.	
• Transmission module error Check the validity of transmission module.	It is regarded as minor failure and operation is continued.	Check the transmission module registration status and its installation. If no problem is observed, replace the transmission module and restart the system. Or contact our after-sale service section.
• Flash ROM overwrite warning Check whether overwrite times to Flash ROM exceeds 99,000 times or not.		Flash ROM write error may occur with high possibility from now on. Replace the CPU module.
• TC-net scan block unhealthy detected Check whether or not the TC-net scan block unhealthy occurs at batch input/output.	It is regarded as Caution required and the system continues its operation.	Check the transmission line of TC-net. Or, check whether the controller on the TC-net network is in RUN status or not.
• Synchronous trend collection start error Check whether synchronous trend can start or not.	It is regarded as minor failure and operation is continued.	When setting time from nV-Tool, or checking the synchronous trend of nV-Tool and start download and re-synchronous trend.
• Synchronus trend setting file error Check whether synchronous trend can start or not.		Check the synchronous trend setting of nV-Tool, download and restart re-synchronous trend. If the trouble still remains by downloading synchronous trend, replace CPU module or EN module. Or contact our after-sale service section.

Table 6-3 Diagnostic Items while Scan Execution (3)

Diagnosis item and its contents	Operation when error is detected	Countermeasure
• Task entry error Check whether task entry area is secured or not.	It is regarded as Caution required and the system continues its operation.	Check the size of a program. Cut down programs and then download the user program again.
• POU undefined Check whether unregistered POU exists or not.	Error registration is carried out and program degeneracy or error down is carried out depending on the specification of program degeneracy.	Carry out batch download after batch compilation using nV-Tool.
• User task illegal command detected LP (Language Processor) checks the illegal command.		After survey of user task, carry out reloading.
• User task area over detected LP (Language Processor) checks the user program area.		Download POU (Program/Function/Function Block)
• User task data area over detected LP (Language Processor) checks the area of user data area.		Index modification error in the user program.
• Scan congestion detected Check whether scan execution is within the set scan cycle or not.	It is regarded as minor failure and operation is continued.	Prolong the scan cycle or reduce the program size of the scan task.
• Scan time error detected Check whether scan time exceeds the specified value or not.	Error registration is carried out and the system is shut down as Error Down.	Reduce the program size. If still unable to solve the problem with smaller size program, LP failure is considered. Replace the CPU module and restart the system.
• Unsupported user task command detected LP (Language Processor) checks the unsupported command.	Error registration is carried out and program degeneracy or error down is carried out depending on the specification of program degeneracy.	After survey of user task, carry out reloading.
• POU nesting over Check the validity of POU calling.		Change the nesting of POU calling less than 6 stages.
• Word division stack point error detected Check the overflow/underflow of word division stack pointer.		After survey of user task, carry out reloading.
• Word joint stack pointer error detected Check the overflow/underflow of word joint stack pointer.		After survey of user task, carry out reloading.
• Run time error Check whether task run time exceeds the value of run time monitor value or not.	Error registration is carried out and the system is shut down as Error Down.	Reduce the program size. If still unable to solve the problem with smaller size program, LP failure is considered. Replace the CPU module and restart the system.

Table 6-3 Diagnostic Items while Scan Execution (4)

Diagnosis item and its contents	Operation when error is detected	Countermeasure
• System stack pointer error Check the validly of system stack pointer.	Error registration is carried out and the system is shut down as Error Down.	Replace the CPU module and restart the system. Or, contact our after-sale service section.
• Degeneracy program mode specification down Carry out error down according to user specification.		The cause of program degeneracy or I/O degeneracy is recorded at the same time. Take the necessary measure referring to the log.
• Degeneracy program recursive call Check whether the I/O degeneracy factor was due to I/O degeneracy task, or the program degeneracy factor was due to program degeneracy task.		

■ Normal Diagnosis Items (executed regularly irrespective of operation mode)

Table 6-4 Normal Diagnosis Items (1)

Diagnosis item and its contents	Operation when error is detected	Countermeasure
• Communication controller error Check whether the communication controller operates normally or not.	Error registration is carried out and the system is shut down as Error Down.	Replace the CPU module and restart the system. Or, contact our after-sale service section.
• Timer controller error Check whether the timer controller operates normally or not.		
• LP (language processor) error Check whether LP (Language Processor) operates normally or not.		
• PCI error Check whether station bus operates normally or not.		
• Station bus memory check error Check the station bus memory by carrying out read-back.		
• User program memory BCC check error Check the validity of user program using BCC.		
• Memory check error (for user data execution) Check the user data memory by read-back check.		
• SDRAM data check error Check the validity of SDRAM (firmware area).		

Table 6-4 Normal Diagnosis Items (2)

Diagnosis item and its contents	Operation when error is detected	Countermeasure
• SDRAM read/write check error Check the SDRAM (work area) by read-back.	Error registration is carried out and the system is shut down as Error Down.	Replace the CPU module and restart the system. Or, contact our after-sale service section.
• I/O loop error Check whether I/O is in loop status or not.	Error registration is carried out. System is shut down as error down or continues running with I/O degeneracy depending on the specification of I/O degeneracy.	Check the cable connection status.
• Controller scan transmission error Check whether or not the I/O of both systems are unable to perform scan transmission in SLAVE-RUN.	Error registration is carried out and the system continues operation.	Check the cable connection status.
• SI0 error detected Check the validity of SI0 module.	Error registration is carried out. System is shut down as error down or continues running with node degeneracy depending on the specification of node degeneracy.	Replace the SI0 module. Or, contact our after-sale service section.
• I/O error detected Check the validity of each I/O module.	Error registration is carried out. System is shut down as error down or continues running with I/O degeneracy depending on the specification of I/O degeneracy.	Replace the I/O module. Or, contact our after-sale service section.
• I/O node down Check the validity of I/O node.	Error registration is carried out. System is shut down as error down or continues running with node degeneracy depending on the specification of node degeneracy.	Check the cable connection status. If no problem is observed to the cable connection, contact our after-sale service section.
• SI0 duplexing error detected Check the validity of SI0 duplex mode.	It is regarded as Caution required and the system continues its operation.	Replace the SI0 module. Or, contact our after-sale service section.
• Transmission error of transmission module. Check whether the transmission module is healthy or unhealthy.	Error registration is carried out and the system is shut down as Error Down.	The controller stops only in duplex operation. Replace the transmission module or the stopped system and restart the system. If the error still continues, replace the CPU module and restart the system. Even if the error is not restored, replace the base unit and restart the system.
• Low battery error (CPU) Check the battery voltage of CPU.	It is regarded as minor failure and operation is continued.	Remove the battery.
• Battery uninstalled (CPU) Check whether battery for CPU is installed or not.		Install the battery.
• Cooling fan stop detected Check whether fan unit operates normally or not.		Survey around the fan unit and take necessary measures.

Table 6-4 Normal Diagnosis Items (3)

Diagnosis item and its contents	Operation when error is detected	Countermeasure
• Calendar error Check the effectiveness of data (date, time) read from the calendar LSI.	It is regarded as minor failure and operation is continued.	Carry out time setting from nV-Tool.
• Power module error detected Check whether the power module operates normally or not.		Replace the Power module and restart the system. Or, contact our after-sale service section.
• Self diagnosis congestion error Check whether the congestion occurs caused by self diagnosis processing or not.	Error registration is carried out and the system is shut down as Error Down.	Replace the CPU module and restart the system. Or, contact our after-sale service section.

■ Duplex Diagnosis Items

Table 6-5 Diagnosis items of duplex system configuration (1)

Diagnosis item and its contents	Operation when error is detected		Countermeasure
	Online controller	Standby controller	
• Tracking reception error Standby controller detected the tracking reception error.	ODD RUN mode	Error down	Check the installation status of CPU module, extended interface module and base unit. Then carry out the re-execution.
• Equalization reception error Equalization receiving controller detected the equalization reception error.			
• Partial equalization reception error Partial equalization receiving controller detected the partial equalization reception error.			
• Equalization reception complete timeout Equalization receiving controller detected the equalization reception timeout error.			
• Tracking reception complete timeout Tracking receiving controller detected the tracking reception timeout error.			
• Other system CPU module error Other system CPU module error was detected.			Solve the CPU module of other system and carry out re-execution.
• Other system power OFF or tracking bus error Tracking bus diagnosis signal error was detected.			Check the power unit, base unit and cables of other system and carry out re-execution.

Table 6-5 Diagnosis items of duplex system configuration (2)

Diagnosis item and its contents	Operation when error is detected		Countermeasure
	Online controller	Standby controller	
• Duplex other system check signal error Duplex other system check signal error was detected.	ODD RUN mode	Error down	Check the power unit, base unit and cables of other system and carry out reexecution.
	When the status change from HALT to RUN is requested, both systems are shut down as error down.		
• Control right signal error Control right signal error was detected.	ODD RUN mode	Error down	
• Primary/secondary switch setting error Mode change switch setting error of the extended interface module was detected.	Error down		Set the system so that primary setting and secondary setting do not conflict in both systems, and carry out re-execution.
• Duplex software status error Duplex software status error was detected.	ODD RUN mode		Check the installation status of CPU module, extended interface module and base unit. Then carry out the re-execution.
• Duplex hardware status error Duplex hardware status error was detected.			
• Duplex module error Error down of the extended interface module was detected.			Check the installation status of CPU module, extended interface module and base unit. Then carry out the re-execution.
• Other system duplex module error Other system extended interface module error down was detected.			
• Tracking sending error Online controller detected the tracking sending error.			Replace the CPU module or base module and restart the system.
• Equalization sending error Equalization sending (online) controller detected the equalization sending error.			
• Partial equalization sending error Partial equalization sending (online) controller detected the partial equalization sending error.			
• Equalization sending complete timeout Equalization sending (online) controller detected the equalization sending timeout.			

Table 6-5 Diagnosis items of duplex system configuration (3)

Diagnosis item and its contents	Operation when error is detected		Countermeasure
	Online controller	Standby controller	
• Tracking sending congestion When the tracking data sent at previous scan is not received, tracking sending congestion occurs. In this case, the tracking is not sent for this time.	Continues running	Continues running	Prolong the scan cycle or reduce the tracking size of the scan task.
• Tracking area specification error Tracking are is specified exceeding the allowable range.			Set the size of the user global variable of each task or D register size not to exceed the specified area.
• Tracking sending size error Tracking are is specified exceeding the allowable range.			Set the size of local variable of each task not to exceed the specified area.
• Other system tracking reception congestion Check whether tracking processing by the standby system is in congestion or not.	—		Prolong the scan cycle or reduce the tracking size of the scan task.
• Stop due to ODD RUN mode of other system Check whether the CPU module of the other system in ODD RUN or not.	ODD RUN mode	Error Down	Check the error of the other system. Take the necessary measures corresponding to the error.

6.2 Event Log / Error Log Registration

The time of power ON/OFF and the status of mode transition are recorded in the event log. Or, when an error was detected in self diagnosis of the controller the error contents and the time of occurrence are registered in the table of the error log. These two logs can register the events up to 128 events at maximum. When a new content is registered the contents registered before are put back in the order. If the registered contents exceed 128 events the oldest event is discarded.

When the log events of which contents are the same occur consecutively, the event detected at the first and the last are registered. The time to detect, events that occurred between these two events is indicated in the column of consecutive times at the right of the log screen.

Event log and error log are displayed together in the nV-Tool system log. Fig. 6-1 shows the system log screen.

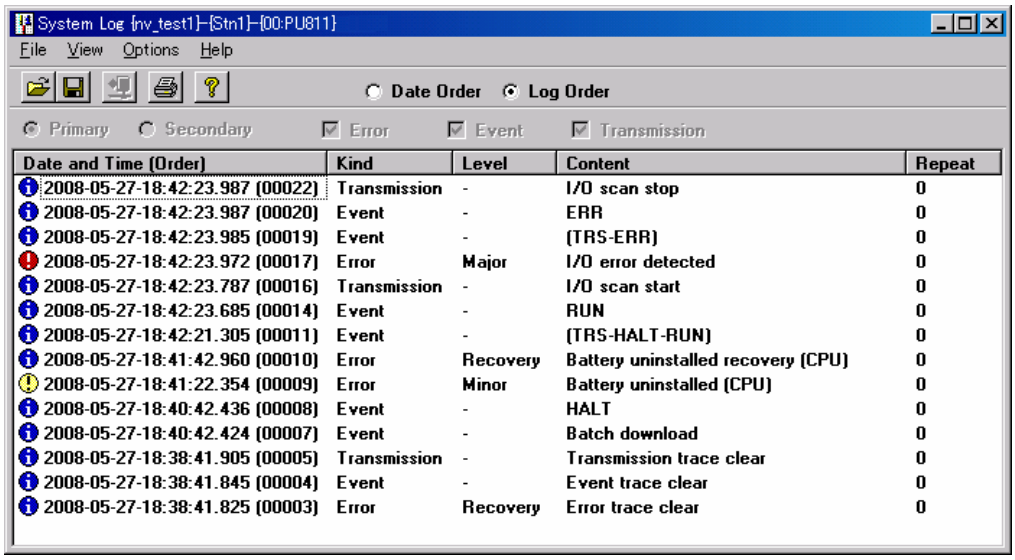


Fig. 6-1 System log screen

Above system log screen says that “I/O error detected” occurred. If you want to check the detail information of the error, double click the error log to check (“I/O error detected” in this case) to display the detailed window for the log in the table. Refer to 6.4.4 Check by error log for the details.

6.3 Memory Protect

When the mode switch is set to P-RUN, the system becomes memory protect status.

If any operation is instructed from nV-Tool to the system in memory protect status, no operation is executed and caution message appears on the nV-Tool screen.

Following operations are prohibited in memory protect status.

- Memory clear
- Download
- Program editing (including online change)
- Restore
- Defrag

Using memory protect function prevents program from damage due to erroneous operation of the programmer.

6.4 Trouble Shooting

6.4.1 When an error occurs

When the controller detected an error by its self diagnosis, the error message (and incident information) is registered to error log table. If the error content belongs to one of those unable to continue operation, all outputs are turned OFF and stops the operation (error down).

Error log table can save error messages and occurrence time of the latest events up to 128 events and display then on nV-Tool.

Other than the error log the following pieces of information are registered in the log table and can be displayed on the nV-Tool.

- Event log: Power ON/OFF and mode control
- Transmission log: Information on transmission such as Ethernet

Also the connection status and operation status of the modules registered by nV-Tool (controller, station bus module, I/O module) can be checked.

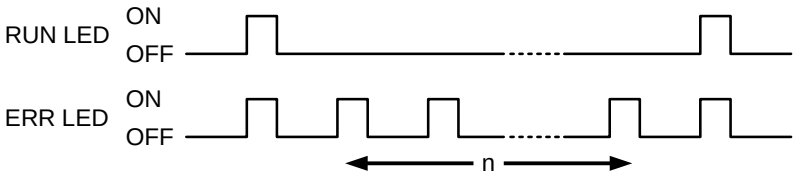
6.4.2 Error indication LED

When the RUN/ERR LED on the front panel of the controller stops in the status described in the following table, an error occurs in the controller. The content of the error can be checked using RUN/ERR LED indication. Take the necessary measures in accordance with Table 6-6.

Table 6-6 List of LED indication and error content

ERR LED blinking times between RUN/ ERR LED blinking at the same time (Note)	Error content	Countermeasure
0	CPU operation error	If the status does not change even if the controller power is turned on again, replace the CPU module.
1	Boot area error	
2	OS program RAM error	
3	OS work RAM error	
4	FROM ID error	
5	OS program BCC error	
Only ERR LED blinks	Internal Ethernet initializing error	
ERR LED lights continuously	Error down	Check the error status referring to 6.4.3 and later.

(Note) ERR LED blinking times between RUN/ERR LED blinking at the same time means “n” of the following figure.



6.4.3 Error check at error down

When the ERR LED on the front panel of the controller lights continuously, the controller main unit is in error down status. In this case connect nV-Tool and display the error log or module status to check the error contents.

6.4.4 Check by error log

The operation procedure to display the error log is described below. This is written supposing a case when an error occurs to the external power unit of the I/O module during its operation.

1. **Connect the controller and the nV-Tool with Ethernet cable.**
2. **Start up the nV-Tool.**
3. **Specify the system or the station you want to display from the product tree of the nV-Tool.**

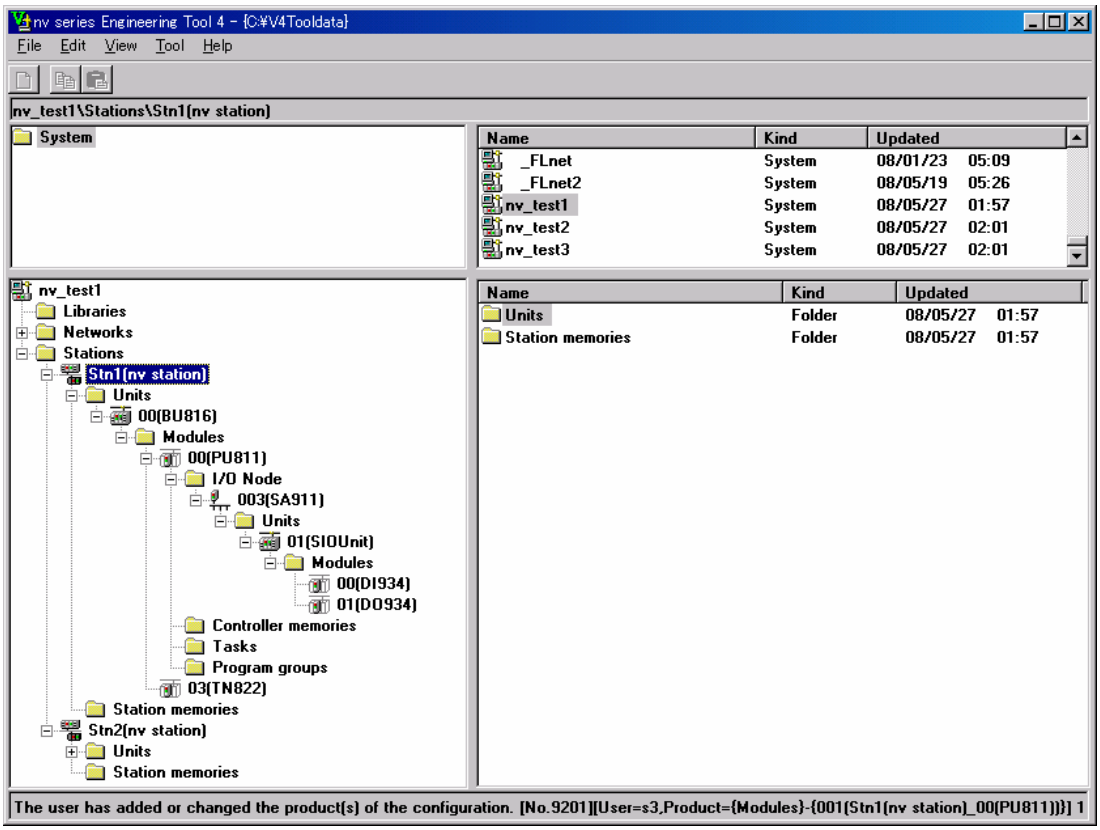


Fig. 6-2 Product tree

4 Execute from the menu of nV-Tool product tree ＜File＞＜System view＞ to start [System View].

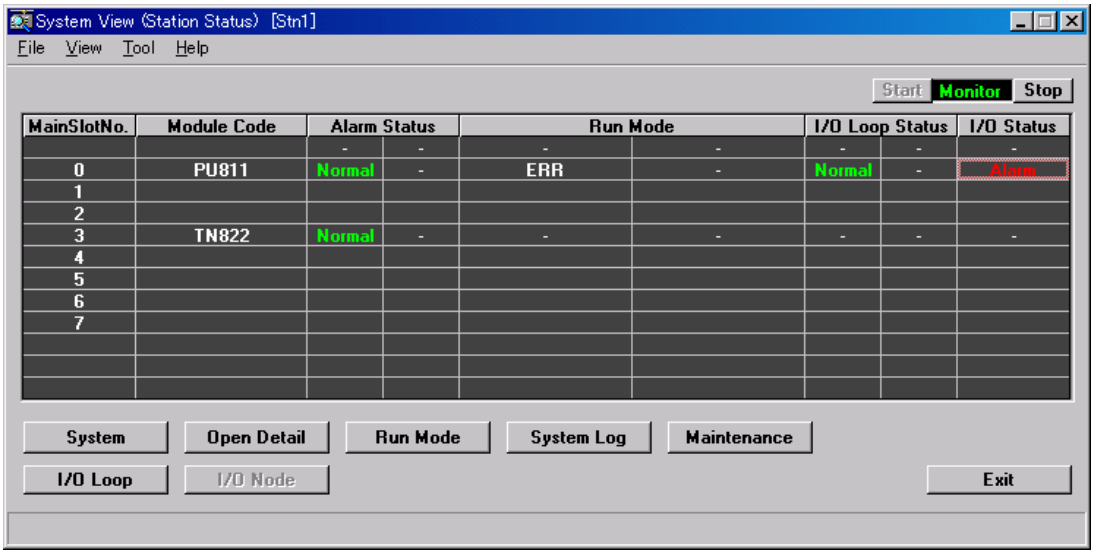


Fig. 6-3 System view

5 Select the corresponding controller main slot No. displayed in [System review] and execute from the menu ＜nV-Tool＞ ＜System log＞.

[System log] is displayed.

The error log, event log and transmission log are displayed in [System log].

Log update: When displaying the latest log, click <Log read out> icon, or execute from the menu <File> <Log read out>.

Specify log to display: When displaying only the specified log, specify the check box of the log above the [System log].

Specify controller: For duplex configuration controller, specify the controller by checking the check box of [Primary] [Secondary] above the [System log].

Saving log information: The log information displayed on the screen can be saved with CSV format from the menu <File> <Save file>.

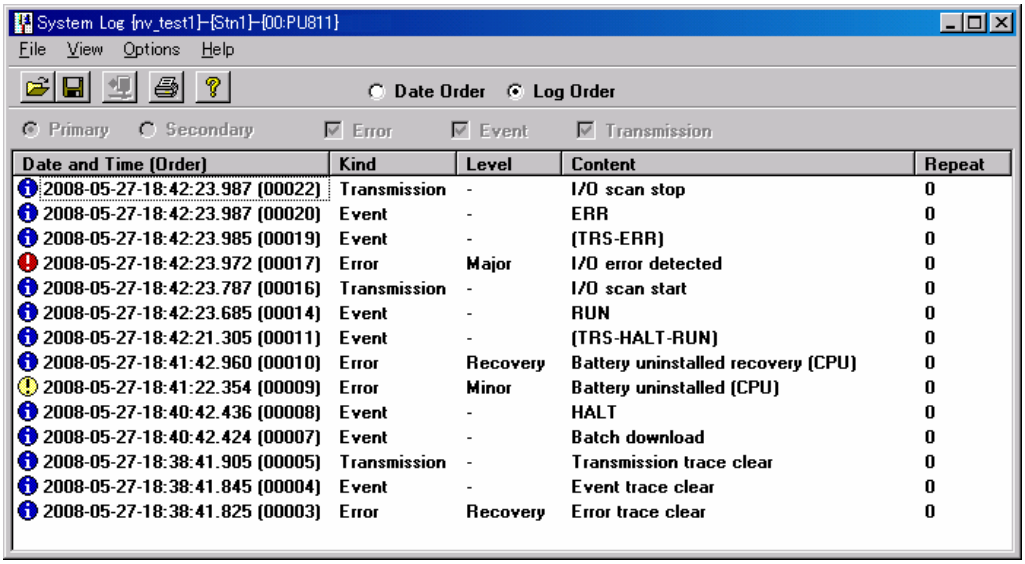


Fig. 6-4 System log

6

6 From the error log shown in Fig. 6-4, check that the "I/O error detected" occurs.

If you want to check the detailed contents of the log, double click the displayed log, or execute from the menu <Display><Detail>.
The [Detailed log] is displayed.

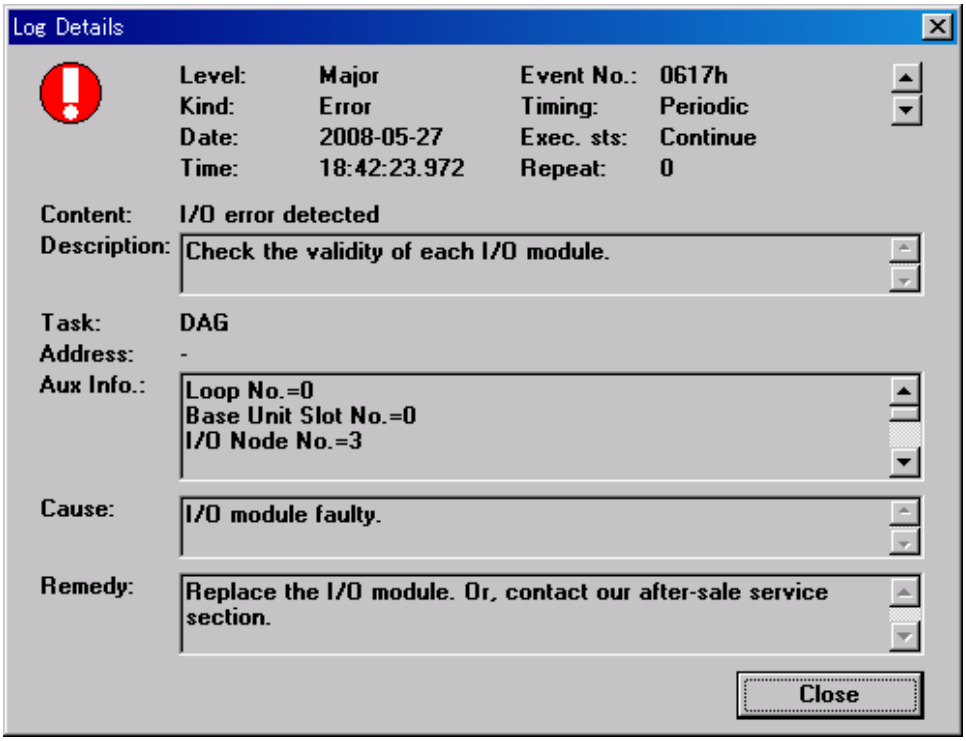


Fig. 6-5 Detailed error log

7 Check “Cause”, “Countermeasure” in [Detailed log].

Take the necessary measures in accordance with these pieces of detailed information.
When an error occurred while program execution, carry out the operation such as program correction.
However, these operations are not accepted in error down status. In that case the system needs to be carried out “Error Reset” from nV-Tool.
The operation procedure of “Error Reset” is described below.

8 Start up from the menu of nV-Tool product tree <File><System View>.

9 Select the slot No. of the controller you want to carry out error reset and select from the menu <Tool> <Set RUN Mode>.

[Set Run Mode] is displayed.

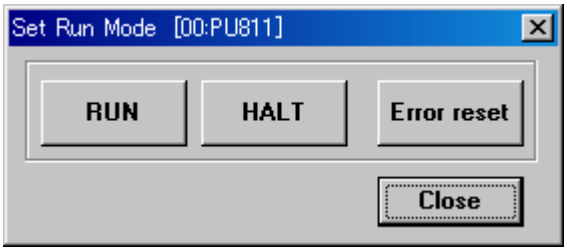


Fig. 6-6 Operation mode setting

10 Click “Error Reset”.

Check screen is displayed. Select “YES” here. Then the error reset is completed and the controller becomes HALT mode. Perform program correction in this status.

11 Then start up the system in RUN mode again.

Set the operation mode switch of the controller to HALT and then switch to RUN. Or, execute RUN command from the nV-Tool [Operation Mode Setting].

◇ **Supplementary**

- Error log is registered also in calendar log, however the date and time are displayed as “＊＊＊＊＊－＊＊＊＊＊”.
- When “Transmission service error” is displayed in [Log read out], the nV-Tool and the controller main unit are not yet updated. Check the selected contents of the system and the station and connection status of the connecting cables. If no problem is observed, communication circuit error of the controller main unit or of nV-Tool can be possible.

6.4.5 Check by module status

Operation procedure to check the status of each module is described below. This is written supposing a case when an error occurs to the external power unit of the I/O module during its operation.

1 **Connect the controller and the nV-Tool with Ethernet cable.**

2 **Start up the nV-Tool.**

3 **Specify the system or the station you want to display from the product tree of the nV-Tool.**

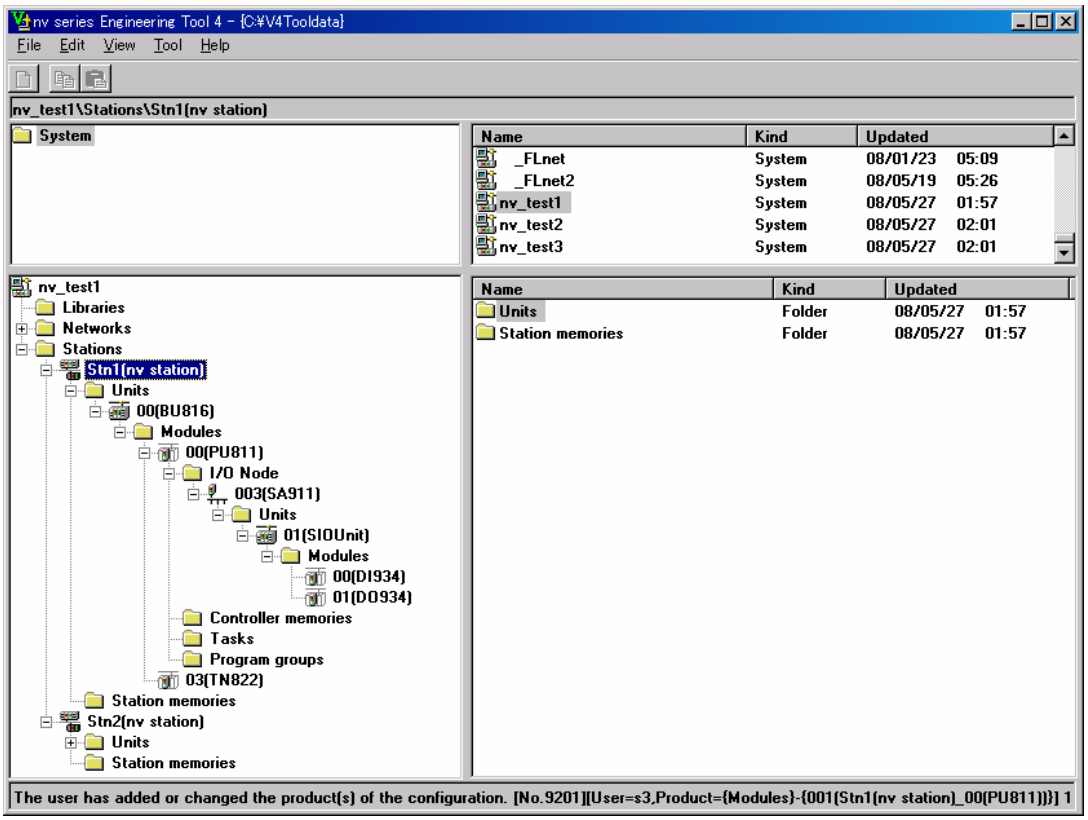


Fig. 6-7 Product tree

4 **Execute from the menu of nV-Tool product tree ＜File＞ ＜System review＞ to start [System View].**

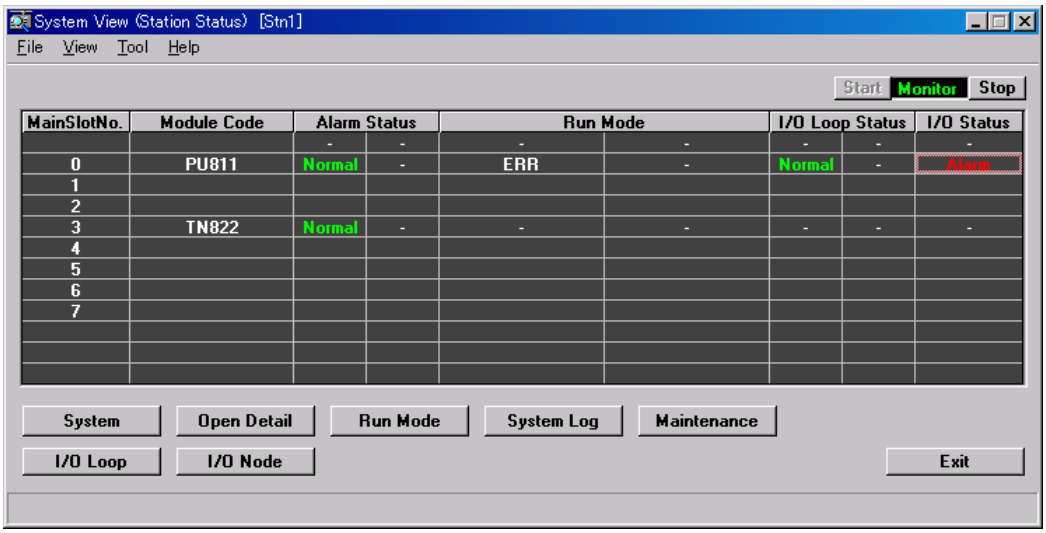


Fig. 6-8 System view

5 Check the alarm status, program degeneracy status, operation mode, I/O loop status and I/O status of the controller from [System view].

In the case of duplex configuration, each status of both primary and secondary is displayed in this order.
From Fig. 6-8 above it is checked that I/O status is in error.

6 Check the detailed contents of I/O status.

Select the main slot No. of the corresponding controller in [System view]. Click the [I/O node status] button or double click the cell of [I/O status] of the corresponding controller. Then [I/O node status] is displayed.
From Fig. 6-9 above it is checked that I/O status of the I/O node No.3 is in error.

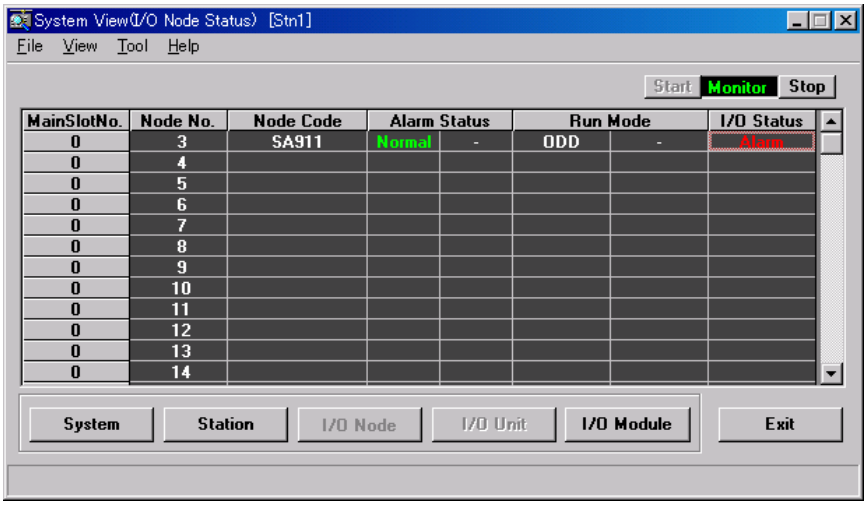


Fig. 6-9 I/O node status

7 Check the detailed contents of I/O status.

Select the corresponding I/O node No. in [I/O node status]. Click the [I/O module status] button or double click the cell of [I/O status] of the corresponding I/O node No. Then [I/O module status] is displayed.
From Fig. 6-10 above it is checked that I/O module (DO934) of the I/O node No.3, slot No.1 is in error.

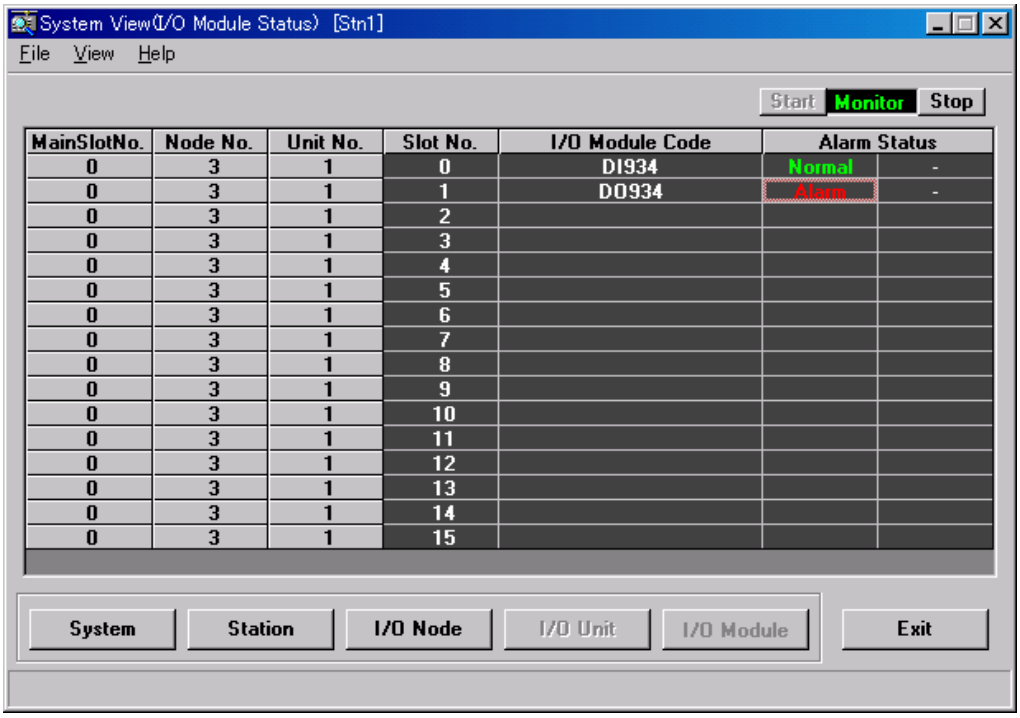


Fig. 6-10 I/O module status

8 Check the detailed alarm of the I/O module.

Select the corresponding slot No. of the [I/O module status]. Execute the menu <Display><I/O module detail alarm>, or double click the cell of [Alarm status] of the corresponding slot No. Then [I/O module detail alarm] is displayed.
From Fig. 6-11 above it is checked that ST1 (alarm specific to I/O module) occurs in I/O module (DO934) of I/O node No.3, slot No.1. ST1 of DO934 module means external power error.
Refer to the instruction manual of each I/O module for ST0 to ST3 (alarm specific to I/O module).

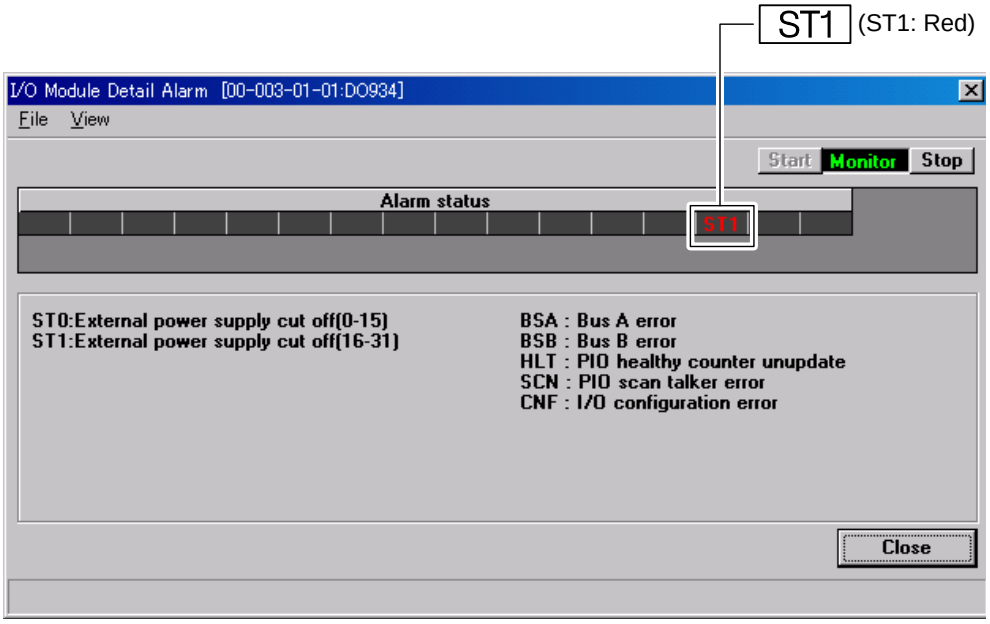


Fig. 6-11 I/O module detailed alarm

6.4.6 Minor failure

There may be a case when a minor failure (such as battery error or calendar error) occurs in the controller even if no ERR LED on the front panel of the controller is lighting. In this case also, you can check the error contents using nV-Tool in the similar manner to the case of error down.

The operation procedure to display the error log is the same as those described in 6.4.3 Error check at error down. However no execution of error reset from nV-Tool is needed as the operation is still continued.

Appendix A
Function Specification and its Details

A.1 List of Function Specifications

The functions of unified controller nv series type 1 controller are listed in Table A.1-1.

Table A.1-1 List of function specifications (1)

Item				Contents
				Controller module PU811
Control method				Stored program/cyclic scan
Processor	Control processor			General-purpose processor
	Language processor (LP)			Dedicated LSI
	I/O processor			Dedicated LSI
Execution method	Scan method	SS task	Fixed time scan	0.5 to 500 ms (by 0.1 ms unit)
		HS task		0.5 to 500 ms (by 0.1 ms unit)
		RIO task		0.5 to 500 ms (by 0.1 ms unit)
		MS scan		0.5 to 1000 ms (by 0.1 ms unit)
	Task switching time			60 μs
	Input/output		Batch I/O	Equipped
			Direct I/O	Equipped
Interruption	IP task			16 lines
	Interruption detection performance			20 μs × n intrupt. + 100 μs or less n: Detected number of status change
Program size *				256 kstep
User data size	Local variables/User global variables			256 kword
	IQ register			16 kword
	Special register (S register)			1 kword
	Data register (D register)			8 kword
I/O	Built-in I/O		Number of nodes	32
			Max. No. of units	32 (32 nodes × 1 unit)
			Max. No. of slots	512 (32 units × 16 I/O modules)
	G3 I/O (Note 1)		Number of nodes	4
			Max. No. of units	28 (4 nodes × 7 units)
			Max. No. of slots	308 (28 units × 11 I/O modules)
	Batch I/O		I/O updating time	1 μs/word or less
			Station bus updating time	2 μs/word or less
	Direct I/O		I/O updating time	1 μs/word or less
			Station bus updating time	2 μs/word or less

* This means the capacity of program saving memory, but not the allowable maximum steps of the user program. The user program and the control information for its operation are included in this program saving memory.

Table A.1-1 List of function specifications (2)

Item			Contents
			Controller module PU811
Programming language			LD, FBD, SFC, ST
Duplex function	Tracking time		2 ms/kw
	Duplex switching time		50 ms or less
Execution speed	Bit	Contact	0.02 μs
		Coil	0.06 μs
	Integer	Transfer	0.02 μs
		Addition/Subtraction	0.02 μs
		Multiplication	0.06 μs
		Division	0.48 μs
	Floating	Addition	0.12 μs
		Subtraction	0.06 μs
		Multiplication	0.12 μs
		Division	0.54 μs
Transmission port	nV-Tool connection		Directly connected to the controller
	nV-Tool connection (network)		Via Ethernet module of station bus
	Socket communication (instruction word)		Via Ethernet module of station bus
	Computer link		
	Synchronous trend		
Supported network	Station bus module		Ethernet, TC-net100, Profibus (Note 1)
	High speed serial TC-net I/O bus module		MODBUS、FL-net, Ethernet (Note 1), DeviceNet (Note 1)
	G3 I/O bus module (Note 1)		DeviceNet, FL-net, Profibus, TOSLINE-S20/TOSLINE-S20LP, TOSLINE-F10/TOSLINE-F10M
RAS function	Diagnosis		Power fail check, parity check, LP function check, I/O processer function check, illegal instruction detection, WDT, system ROM BCC check, peripheral LSI check, ECC check of all memories, station bus access parity check and time out, I/O status check.
	Monitoring		System status display (incl. I/O status display), trace (error, event, transmission), program run time measurement, program execution congestion detection
	Debug/maintenance		Online status display, backup/restore function, defrag, online maintenance function, simulation function

(Note 1) Under development

A.2 Special Register (S register)

Special registers (S registers) are listed below.

Table A.2-1 List of special registers (S registers)

Address	Name	Function
SW[0 to 10]	Station configuration	—
SW[11 to 13]	Switch setting status	—
SW[14 to 15]	Operation mode	—
SW[16 to 22]	Date and time	—
SW[23]	Timing relay	—
SW[24 to 33]	Instruction word execution status	—
SW[64 to 95]	nV-Tool setting information	—
SW[96]	Communication flag	—
SW[230 to 231]	Interlock group status	—
SW[240 to 255]	Computer linkage status	—
SW[256 to 265]	Representative alarm information	—
SW[266 to 299]	Duplex information	—
SW[300 to 332]	Program degeneracy-related information	—
SW[340 to 356]	I/O degeneracy-related information	—
SW[360 to 671]	I/O degeneracy-related detailed information	—

Table A.2-2 Station configuration

Address	Name	Function
SW[0]	CPU ID (CPU type code)	0510H
SW[1]	CPU sub ID	1: type1
SW[2]	Installation slot position	0 to 7
SW[3]	Slot 0 installation type code	—
SW[4]	Slot 1 installation type code	
SW[5]	Slot 2 installation type code	
SW[6]	Slot 3 installation type code	
SW[7]	Slot 4 installation type code	
SW[8]	Slot 5 installation type code	
SW[9]	Slot 6 installation type code	
SW[10]	Slot 7 installation type code	

Table A.2-3 Switch setting status

Address	Name	Function
SW[11]	Mode change key switch status	1: HALT, 2:RUN, 4: P-RUN
SW[12]	IP address rotary switch status	0 to 255
SW[13]	DIP switch status	0 bit: Switch 1 status
		1 bit: Switch 2 status
		2 bit: Switch 3 status
		3 bit: Switch 4 status
		4 bit: Switch 5 status
		5 bit: Switch 6 status
		6 bit: Switch 7 status
		7 bit: Switch 8 status
		(0:OFF/1:ON)

Table A.2-4 Operation mode

Address	Name	Function
SW[14]	Operation mode	Refer to 2.3.8 Mode display, Table 2-12 mode value
SW[15]	Operation mode (for compatibility to conventional type)	0: Initializing 1: HALT 2: RUN 3: – 4: – 6: ERROR

Table A.2-5 Date and time

Address	Name	Function
SW[16]	Calendar data (year)	Lower 2 digit in BC (07, 08·····)
SW[17]	Calendar data (month)	Month (01 to 12)
SW[18]	Calendar data (day)	Day (01 to 31)
SW[19]	Calendar data (hour)	Hour (00 to 23)
SW[20]	Calendar data (minute)	Minute (00 to 59)
SW[21]	Calendar data (second)	Second (00 to 59)
SW[22]	Calendar data (day of week)	Day of week (Sun: 00, Mon: 01, … , Fri: 05, Sat: 06

(Note) Date and time is saved with BCD code to lower 8 bits.

Table A.2-6 Timing relay

Address	Name	Function
S[23].B[0]	Timing relay 0.1S	0.05 sec OFF/0.05 sec ON (Cycle 0.1 sec)
S[23].B[1]	Timing relay 0.2S	0.1 sec OFF/0.1 sec ON (Cycle 0.2 sec)
S[23].B[2]	Timing relay 0.4S	0.2 sec OFF/0.2 sec ON (Cycle 0.4 sec)
S[23].B[3]	Timing relay 0.8S	0.4 sec OFF/0.4 sec ON (Cycle 0.8 sec)
S[23].B[4]	Timing relay 1.0S	0.5 sec OFF/0.5 sec ON (Cycle 1.0 sec)
S[23].B[5]	Timing relay 2.0S	1.0 sec OFF/1.0 sec ON (Cycle 2.0 sec)
S[23].B[6]	Timing relay 4.0S	2.0 sec OFF/2.0 sec ON (Cycle 4.0 sec)
S[23].B[7]	Timing relay 8.0S	4.0 sec OFF/4.0 sec ON (Cycle 8.0 sec)
S[23].B[8]	—	
S[23].B[9]	—	
S[23].B[10]	—	
S[23].B[11]	—	
S[23].B[12]	—	
S[23].B[13]	—	
S[23].B[14]	Normally ON	
S[23].B[15]	Normally OFF	

A

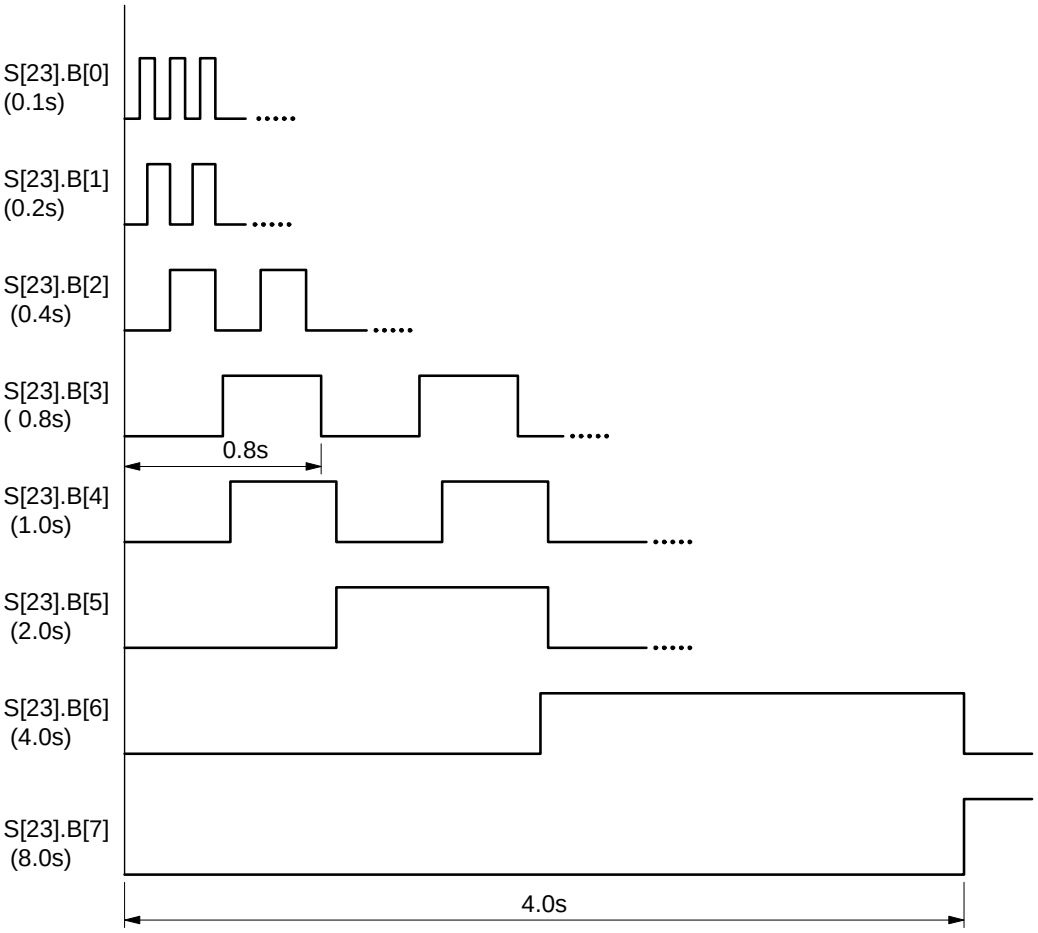


Fig. A-1 Timing relay

Table A.2-7 Instruction word execution error status (Common for all tasks: Compatible to integrated controller)

Address	Name	Function
S[24].B[0]	CF (Carry flag)	Used for the instruction with carry
S[24].B[1]	ERF (Error flag)	
S[24].B[2]	—	
S[24].B[3]	—	
S[24].B[4]	—	
S[24].B[5]	—	
S[24].B[6]	—	
S[24].B[7]	—	
S[24].B[8]	—	
S[24].B[9]	—	
S[24].B[10]	—	
S[24].B[11]	—	
S[24].B[12]	—	
S[24].B[13]	—	
S[24].B[14]	—	
S[24].B[15]	—	
S[25].B[0]	—	
S[25].B[1]	—	
S[25].B[2]	—	
S[25].B[3]	—	
S[25].B[4]	—	
S[25].B[5]	—	
S[25].B[6]	—	
S[25].B[7]	—	
S[25].B[8]	Division error	ON when division error occurred
S[25].B[9]	BCD data error	ON when data error was detected in BCD coded instruction
S[25].B[10]	Table operation error	ON when error occurred in table operation instruction
S[25].B[11]	Encode error	ON when error occurred in encode instruction
S[25].B[12]	—	
S[25].B[13]	—	
S[25].B[14]	—	
S[25].B[15]	ASC data conversion error	ON when error occurred in ASC code using instruction

Table A.2-8 Instruction word execution error status (for each task)

Address	Name	Function
SW[26]	Instruction word execution error occurred at priority 0 task	Priority 0: EV or IP Same configuration for SW[24] and SW[25]
SW[27]		
SW[28]	Instruction word execution error occurred at priority 1 task	Priority 1: SS or IP Same configuration for SW[24] and SW[25]
SW[29]		
SW[30]	Instruction word execution error occurred at priority 2 task	Priority 2: HS Same configuration for SW [24] and SW [25]
SW[31]		
SW[32]	Instruction word execution error occurred at priority 3 task	Priority 3: MS Same configuration for SW [24] and SW [25]
SW[33]		

Table A.2-9 nV-Tool setting information

Address	Name	Function
SW[64]	SS task scan cycle setting value	
SW[65]	HS, RI0 task scan cycle setting value	
SW[66]	MS task scan cycle setting value	
SW[67]	Reserved	
SW[95]	Reserved	

Table A.2-10 Notification flag

Address	Name	Function
S[96].B[0]	Time change notification flag	Set when time is changed
S[96].B[1]	—	
S[96].B[2]	—	
S[96].B[3]	—	
S[96].B[4]	—	
S[96].B[5]	—	
S[96].B[6]	—	
S[96].B[7]	—	
S[96].B[8]	—	
S[96].B[9]	—	
S[96].B[10]	—	
S[96].B[11]	—	
S[96].B[12]	—	
S[96].B[13]	—	
S[96].B[14]	—	
S[96].B[15]	—	

Table A.2-11 Interlock group status

Address	Name	Function
SW [230]	Interlock group status	S[230].B[0]: Group 1 : S[231].B[15]: Group 32 0: Interlock not established 1: Interlock established
SW [231]		

Table A.2-12 Computer link status (Ethernet connection)

Address	Name	Function
SW[240]	No.1 computer link status information	Status information 0 to 3 bit: Slot No. 4 to 8 bit: Reserved 9 bit: Computer link task Operating/halt (1/0) 10 bit: Error/normal (1/0) 11 bit: Computer link allowed/prohibited (1/0) 12 to 15 bit: EN8＊＊(7) Set port number Port number: Computer/PC link recv. port Port number + 1: Computer link send port Port number + 2: Reserved Error classification 0: Other 1: en_soket 2: en_bind 3: en_sendto 4: en_select 5: en_recvfrom 6: en_close Error code Return value from API
SW[241]	Setting port number	
SW[242]	Error category	
SW[243]	Error code	
SW[244]	No.2 computer link status information	
SW[245]	Setting port number	
SW[246]	Error category	
SW[247]	Error code	
SW[248]	No.3 computer link status information	
SW[249]	Setting port number	
SW[250]	Error category	
SW[251]	Error code	
SW[252]	No.4 computer link status information	
SW[253]	Setting port number	
SW[254]	Error category	
SW[255]	Error code	

Table A.2-13 Representative alarms

Address	Name	Major/minor failure	Address
S[256].B[0]	Hardware major failure (own controller)	Major	OR of S[257].B[0] to B[15]
S[256].B[1]	Hardware minor failure (own controller)	Minor	OR of S[258].B[0] to B[15]
S[256].B[2]	Software major failure (own controller)	Major	OR of S[259].B[0] to B[15]
S[256].B[3]	Software minor failure (own controller)	Minor	OR of S[260].B[0] to B[15]
S[256].B[4]	—	—	—
S[256].B[5]	—	—	—
S[256].B[6]	—	—	—
S[256].B[7]	—	—	—
S[256].B[8]	—	—	—
S[256].B[9]	—	—	—
S[256].B[10]	—	—	—
S[256].B[11]	—	—	—
S[256].B[12]	—	—	—
S[256].B[13]	—	—	—
S[256].B[14]	—	—	—
S[256].B[15]	—	—	—

Table A.2-14 Mid scale classified alarms (Hardware major failure)

Address	Name	Major/minor failure	Function
S[257].B[0]	CPU related matter	Major	PCI error (time out, parity)
S[257].B[1]	Memory related matter	Major	ECC uncorrectable error
S[257].B[2]	I/O loop 0	Major	I/O SW[360] to SW[361] major failure
S[257].B[3]	—	—	—
S[257].B[4]	—	—	—
S[257].B[5]	—	—	—
S[257].B[6]	I/O error loop 0	Major	I/O OR of SW[368] to SW[371] OR of SW[416] to SW[447] Node not in-ling exists
S[257].B[7]	—	—	—
S[257].B[8]	—	—	—
S[257].B[9]	—	—	—
S[257].B[10]	—	—	—
S[257].B[11]	—	—	—
S[257].B[2]	—	—	—
S[257].B[3]	—	—	—
S[257].B[14]	—	—	—
S[257].B[15]	Duplex related matter	Major	OR of S[272].B[0] to B[15]

Table A.2-15 Mid scale classified alarms (Hardware minor failure)

Address	Name	Major/minor failure	Function
S[258].B[0]	Reserved	—	—
S[258].B[1]	Reserved	—	—
S[258].B[2]	I/O loop 0	Minor	I/O Minor failure of SW[360] to SW[361]
S[258].B[3]	—	—	—
S[258].B[4]	—	—	—
S[258].B[5]	—	—	—
S[258].B[6]	I/O error loop 0	Minor	I/O OR of SW[384] to SW[387] and SW[448] to SW[479]
S[258].B[7]	—	—	—
S[258].B[8]	—	—	—
S[258].B[9]	—	—	—
S[258].B[10]	—	—	—
S[258].B[11]	I/O degeneracy related matter	Minor	In case of I/O degeneracy
S[258].B[12]	Transmission related matter	Minor	OR of S[263].B[0] to B[15]
S[258].B[13]	—	—	—
S[258].B[14]	Other hardware related matter	Minor	OR of S[261].B[0] to B[15]
S[258].B[15]	Duplex related matter	Minor	OR of S[276].B[0] to B[15]

Table A.2-16 Mid scale classified alarms (Software major failure)

Address	Name	Major/minor failure	Function
S[259].B[0]	Setting and registration related matter	Major	nV-Tool setting information error
S[259].B[1]	User task related matter	Major	Task scan run time error
S[259]. B [2]	Reserved	—	—
S[259].B[3]	—	—	—
S[259].B[4]	—	—	—
S[259].B[5]	—	—	—
S[259].B[6]	—	—	—
S[259].B[7]	—	—	—
S[259].B[8]	—	—	—
S[259].B[9]	—	—	—
S[259].B[10]	—	—	—
S[259].B[11]	—	—	—
S[259].B[12]	—	—	—
S[259].B[13]	—	—	—
S[259].B[14]	Reserved	—	—
S[259].B[15]	—	—	—

Table A.2-17 Mid scale classified alarms (Software minor failure)

Address	Name	Major/minor failure	Function
S[260].B[0]	Reserved	—	—
S[260].B[1]	User task related matter	Minor	OR of S[262].B[0] to B[15]
S[260].B[2]	Task degeneracy related matter	Minor	OR of SW[300] to SW[326]
S[260].B[3]	—	—	—
S[260].B[4]	—	—	—
S[260].B[5]	—	—	—
S[260].B[6]	—	—	—
S[260]. B [7]	—	—	—
S[260]. B [8]	—	—	—
S[260]. B [9]	—	—	—
S[260].B[10]	—	—	—
S[260].B[11]	—	—	—
S[260].B[12]	—	—	—
S[260].B[13]	—	—	—
S[260].B[14]	Reserved	—	—
S[260].B[15]	—	—	—

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Table A.2-18 Hardware minor alarms details

Address	Name	Major/minor failure	Function
S[261].B[0]	Battery uninstalled	Minor	—
S[261].B[1]	Battery voltage error	Minor	—
S[261].B[2]	—	—	—
S[261].B[3]	Calendar error	Minor	—
S[261].B[4]	Fan stopped	Minor	—
S[261].B[5]	System A power failure	Minor	—
S[261].B[6]	System B power failure	Minor	—
S[261].B[7]	—	—	—
S[261].B[8]	FROM overwriting times alarm	Minor	—
S[261].B[9]	—	—	—
S[261].B[10]	—	—	—
S[261].B[11]	—	—	—
S[261].B[12]	—	—	—
S[261].B[13]	—	—	—
S[261].B[14]	—	—	—
S[261].B[15]	—	—	—

Table A.2-19 Software minor alarms details

Address	Name	Major/minor failure	Function
S[262].B[0]	SS task scan congestion	Minor	—
S[262].B[1]	HS task or RIO task scan congestion	Minor	—
S[262].B[2]	MS task scan congestion	Minor	—
S[262].B[3]	—	—	—
S[262].B[4]	—	—	—
S[262].B[5]	—	—	—
S[262].B[6]	—	—	—
S[262].B[7]	—	—	—
S[262].B[8]	—	—	—
S[262].B[9]	—	—	—
S[262].B[10]	—	—	—
S[262].B[11]	—	—	—
S[262].B[12]	—	—	—
S[262].B[13]	—	—	—
S[262].B[14]	—	—	—
S[262].B[15]	—	—	—

Table A.2-20 Transmission module error details

Address	Name	Major/minor failure	Function
S[263].B[0]	Reserved	—	—
S[263].B[1]	Reserved	—	—
S[263].B[2]	Slot 2 transmission module error	Minor	—
S[263].B[3]	Slot 3 transmission module error	Minor	—
S[263].B[4]	Slot 4 transmission module error	Minor	—
S[263].B[5]	Slot 5 transmission module error	Minor	—
S[263].B[6]	Slot 6 transmission module error	Minor	—
S[263].B[7]	Slot 7 transmission module error	Minor	—
S[263].B[8]	Reserved	—	—
S[263].B[9]	Reserved	—	—
S[263].B[10]	Reserved	—	—
S[263].B[11]	Reserved	—	—
S[263].B[12]	Reserved	—	—
S[263].B[13]	Reserved	—	—
S[263].B[14]	Reserved	—	—
S[263].B[15]	Reserved	—	—

Table A.2-21 Duplex tracking size

Address	Name	Function
SW[266] SW[267]	SS task tracking size (unit in word)	—
SW[268] SW[269]	HS task tracking size (unit in word)	—
SW[270] SW[271]	MS task tracking size (unit in word)	—

Table A.2-22 Duplex related major failure

Address	Name	Major/minor failure	Function
S[272].B[0]	Tracking reception error	Major	Detected by standby side
S[272].B[1]	Equalization reception error	Major	Detected by standby side
S[272].B[2]	Partial equalization reception error	Major	Detected by standby side
S[272].B[3]	Stop due to ODD-RUN of other system	Major	Detected by standby side
S[272].B[4]	Equalization reception complete time out	Major	Detected by standby side
S[272].B[5]	Tracking reception complete time out	Major	Detected by standby side
S[272].B[6]	Other system CPU module error	Major	—
S[272].B[7]	Tracking bus diagnosis signal error	Major	—
S[272].B[8]	Duplex other system check signal error	Major	—
S[272].B[9]	Duplex control right signal error	Major	—
S[272].B[10]	Primary/secondary switch setting error	Major	—
S[272].B[11]	Duplex software status error	Major	—
S[272].B[12]	Duplex hardware status error	Major	—
S[272].B[13]	(Reserved)	—	—
S[272].B[14]	(Reserved)	—	—
S[272].B[15]	(Reserved)	—	—

Table A.2-23 Duplex related minor failure

Address	Name	Major/minor failure	Function
S[276].B[0]	Tracking sending error	Minor	Detected by online side
S[276].B[1]	Equalization sending error	Minor	Detected by online side
S[276].B[2]	Partial equalization sending error	Minor	Detected by online side
S[276].B[3]	(Reserved)	—	—
S[276].B[4]	Equalization sending complete time out	Minor	Detected by online side
S[276].B[5]	(Reserved)	—	—
S[276].B[6]	(Reserved)	—	—
S[276].B[7]	(Reserved)	—	—
S[276].B[8]	Secondary system online operation	Minor	Detected by standby side
S[276].B[9]	SS task tracking sending congestion	Minor	Detected by online side
S[276].B[10]	HS task tracking sending congestion	Minor	Detected by online side
S[276].B[11]	MS task tracking sending congestion	Minor	Detected by online side
S[276].B[12]	Other system tracking reception congestion	Minor	Detected by online side
S[276].B[13]-S[276].B[15]	(Reserved)	—	—

Table A.2-24 Duplex related information

Address	Name	Major/minor failure	Function
S[278].B[0]	Information on the own system primary/secondary switch	—	1: Primary 0: Secondary
S[278].B[1]	(Reserved)	—	—
S[278].B[2]	(Reserved)	—	—
S[278].B[3]	(Reserved)	—	—
S[278].B[4]-S[278].B[15]	(Reserved)	—	—

Table A.2-25 Duplex other system information

Address	Name	Major/minor failure	Function
S[280].B[0]-S[280].B[7]	Other system duplex phase (mode)	—	—
S[280].B[8]-S[280].B[10]	Other system healthy counter	—	—
S[280].B[11]	Mode change switch status of other system extended interface module	—	1: Primary 0: Secondary
S[280].B[12]-S[280].B[15]	(Reserved)	—	—
S[281].B[0]-S[281].B[15]	(Reserved)	—	—
S[282].B[0]	Battery uninstalled	—	—
S[282].B[1]	Battery voltage error	—	—
S[282].B[2]	—	—	—
S[282].B[3]	—	—	—
S[282].B[4]	Fan stopped	—	—
S[282].B[5]	—	—	—
S[282].B[6]	—	—	—
S[282].B[7]-	—	—	—
S[282].B[8]	FROM overwriting times alarm	—	—
S[282].B[9]-S[282].B[15]	(Reserved)	—	—
SW[283]	(Reserved)	—	—
SW[284]	Other system transmission counter in Slot 2 to 7	—	The transmission counter counts up by receiving a communication test text at least once in 10 seconds. When the communication test text is not received for 10 seconds, the counter is cleared to zero.
SW[285]	Reserved		
SW[286]	Other system transmission counter (Slot 2)	—	
SW[287]	Other system transmission counter (Slot 3)	—	
SW[288]	Other system transmission counter (Slot 4)	—	
SW[289]	Other system transmission counter (Slot 5)	—	
SW[290]	Other system transmission counter (Slot 6)	—	
SW[291]	Other system transmission counter (Slot 7)	—	

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Table A.2-26 Program degeneracy information

Address	Name	Function
SW[300]	Event program (EV0-7)	Program degeneracy information 0 bit: Status of program n 1 bit: Status of program n + 1 2 bit: Status of program n + 2 3 bit: Status of program n + 3 4 bit: Status of program n + 4 5 bit: Status of program n + 5 6 bit: Status of program n + 6 7 bit: Status of program n + 7 8 bit: Status of program n + 8 9 bit: Status of program n + 9 10 bit: Status of program n + 10 11 bit: Status of program n + 11 12 bit: Status of program n + 12 13 bit: Status of program n + 13 14 bit: Status of program n + 14 15 bit: Status of program n + 15 Program degeneracy status 0: normal 1: in degeneracy
SW[301]	Super speed scan program (SS0)	
SW[302]	I/O interruption program (IP0-15)	
SW[303]	High speed scan program (HS0-15)	
SW[304]	High speed scan program (HS16-31)	
SW[305]	High speed scan program (HS32-47)	
SW[306]	High speed scan program (HS48-63)	
SW[307]	High speed scan program (HS64-79)	
SW[308]	High speed scan program (HS80-95)	
SW[309]	High speed scan program (HS96-111)	
SW[310]	High speed scan program (HS112-127)	
SW[311]	Main scan program (MS0-15)	
SW[312]	Main scan program (MS16-31)	
SW[313]	Main scan program (MS32-47)	
SW[314]	Main scan program (MS48-63)	
SW[315]	Main scan program (MS64-79)	
SW[316]	Main scan program (MS80-95)	
SW[317]	Main scan program (MS96-111)	
SW[318]	Main scan program (MS112-127)	
SW[319]	Main scan program (MS128-143)	
SW[320]	Main scan program (MS144-159)	
SW[321]	Main scan program (MS160-175)	
SW[322]	Main scan program (MS176-191)	
SW[323]	Main scan program (MS192-207)	
SW[324]	Main scan program (MS208-223)	
SW[325]	Main scan program (MS224-239)	
SW[326]	Main scan program (MS240-255)	
SW[327]	—	
SW[328]	Program degeneracy factor	1 to : Program error code (Note 1)
SW[329]	Program type of program degeneracy	0: EV 1: SS 2: IP 3: HS 4: : MS
SW[330]	Program entry No. of program degeneracy	0 to 255
SW[331]	Reserved	—
SW[332]	Specify operation selection	0: Program degeneracy Other than 0: Error down

(Note 1) Program error code
- 8: Illegal instruction detected
- 9: Address boundary error (Program execution area exceeded)
- 10: Boundary error (Data access address area exceeded)
- 11: Stack error
- 12: POU not registered
- 13: POU nesting over
- 14: Station bus access error
- 15: Unsupported instruction detected

Table A.2-27 I/O degeneracy information

Address	Name	Function
S[340].B[0]	I/O degeneracy factor - I/O error/no error	1: Error, 0: No error
S[340].B[1]	I/O degeneracy factor - I/O node error/no error	1: Error, 0: No error
S[340].B[2]	I/O degeneracy factor - I/O plural errors/no error	1: Plural errors, 0: No plural errors
S[340].B[3]	I/O degeneracy factor -I/O node plural errors/no error	1: Plural errors, 0: No plural errors
S[340].B[4] to S[340].B[15]	Reserved	—
SW[341]	I/O degeneracy information - 1 (Main Slot No.)	Main slot No.(0 to 7)
SW[342]	I/O degeneracy information - 2 (Node No.)	Node No. (0 to 255)
SW[343]	I/O degeneracy information - 3 (Unit No.)	Unit No. (0 to 7)
SW[344]	I/O degeneracy information - 4 (Slot No.)	Slot No. (0 to 255)
SW[345]	I/O node degeneracy information - 1 (Main slot No.)	Main slot No. (0 to 7)
SW[346]	I/O node degeneracy information - 2 (Node No.)	Node No. (0 to 255)
SW[347]	Operation selection specification	0: I/O degeneracy Other than 0: Error down

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Table A.2-28 I/O degeneracy recovery information

Address	Name	Function
S[350].B[0]	I/O degeneracy recovery factor - I/O recovery/no recovery	1: I/O recovery exists, 0: Not exist
S[350].B[1]	I/O degeneracy recovery factor - I/O node recovery/no recovery	1: I/O node recovery exists, 0: Not exist
S[350].B[2]	I/O degeneracy recovery factor - I/O plural recoveries exist/not exist	1: Plural recoveries exist, 0: Not exist
S[350].B[3]	I/O degeneracy recovery factor - I/O node plural recoveries exist/not exist	1: Plural recoveries exist, 0: Not exist
S[350].B[4] to S[350].B[15]	Reserved	—
SW[351]	I/O degeneracy recovery information – 1 (Main slot No.)	Main slot No. (0 to 7)
SW[352]	I/O degeneracy recovery information – 2 (Node No.)	Node No. (0 to 255)
SW[353]	I/O degeneracy recovery information – 3 (Unit No.)	Main unit No. (0 to 7)
SW[354]	I/O degeneracy recovery information – 4 (Slot No.)	Slot No. (0 to 255)
SW[355]	I/O node degeneracy recovery information – 1 (Main slot No.)	Main slot No. (0 to 7)
SW[356]	I/O node degeneracy recovery information – 2 (Node No.)	Node No. (0 to 255)

Table A.2-29 I/O loop alarm detailed information

Address	Name	Function
SW[360]	Loop 0 System A alarm information	0 bit: No counter part (Major failure) 1 bit: Bus status (Major failure) 2 bit: Reserved : 8 bit: Reserved 9 bit: Bus status (Minor failure) 10-15: Reserved
SW[361]	System B alarm information	
SW[362]	—	
SW[363]	—	
SW[364]	—	
SW[365]	—	
SW[366]	—	
SW[367]	—	

Table A.2-30 SIO major failure representative alarms

Address	Name	Function
SW[368]	Loop 0 System A SIO representative alarm information	0 bit: SA911-3 1 bit: SA911-4 2 bit: SA911-5 : : 30 bit: SA911-33 31 bit: SA911-34 1: Failure 0: Normal
SW[369]		
SW[370]	Loop 0 System B SIO representative alarm information	
SW[371]		
SW[372]	—	
SW[373]	—	
SW[374]	—	
SW[375]	—	
SW[376]	—	
SW[377]	—	
SW[378]	—	
SW[379]	—	
SW[380]	—	
SW[381]	—	
SW[382]	—	
SW[383]	—	

Table A.2-31 SIO Minor failure representative alarms

Address	Name	Function
SW[384]	Loop 0 System A SIO representative alarm information	0 bit : SA911-3 1 bit : SA911-4 2 bit : SA911-5 : : 30 bit : SA911-33 31 bit : SA911-34 1: Failure 0: Normal
SW[385]		
SW[386]	Loop 0 System B SIO representative alarm information	
SW[387]		
SW[388]	—	
SW[389]	—	
SW[390]	—	
SW[391]	—	
SW[392]	—	
SW[393]	—	
SW[394]	—	
SW[395]	—	
SW[396]	—	
SW[397]	—	
SW[398]	—	
SW[399]	—	

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Table A.2-32 SA911 inling map

Address	Name	Function
SW[400]	Loop 0 System A SIO representative alarm information	0 bit : SA911-3 1 bit : SA911-4 2 bit : SA911-5 : : 30 bit : SA911-33 31 bit : SA911-34 1: Inling 0: Failure or no SIO registration
SW[401]		
SW[402]	Loop 0 System B SIO representative alarm information	
SW[403]		
SW[404]	—	
SW[405]	—	
SW[406]	—	
SW[407]	—	
SW[408]	—	
SW[409]	—	
SW[410]	—	
SW[411]	—	
SW[412]	—	
SW[413]	—	
SW[414]	—	
SW[415]	—	

Table A.2-33 I/O representative major failure alarms

Address	Name	Function
SW[416]	SA911-3 I/O representative alarm	0 bit : Slot 0 1 bit : Slot 1 2 bit : Slot 2 : : 14 bit : Slot 14 15 bit : Slot 15 1: Failure 0: Normal
SW[417]	SA911-4 I/O representative alarm	
SW[418]	SA911-5 I/O representative alarm	
—	—	
—	—	
—	—	
—	—	
—	—	
—	—	
—	—	
SW[446]	SA911-33 I/O representative alarm	
SW[447]	SA911-34 I/O representative alarm	

Table A.2-34 I/O representative minor failure alarms

Address	Name	Function
SW[448]	SA911-3 I/O representative alarm	0 bit : Slot 0 1 bit : Slot 1 2 bit : Slot 2 : : 14 bit : Slot 14 15 bit : Slot 15 1: Failure 0: Normal
SW[449]	SA911-4 I/O representative alarm	
SW[450]	SA911-5 I/O representative alarm	
—	—	
—	—	
—	—	
—	—	
—	—	
—	—	
SW[478]	SA911-33 I/O representative alarm	
SW[479]	SA911-34 I/O representative alarm	

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A.3 List of Module Parameters

Module parameters are listed in Table A.3-1. These parameters are set with "type 1 controller module parameter setting" of nV-Tool. (See Fig. 5-1.)

Table A.3-1 List of module parameters (to specify controller operation)

Item	Contents	Setting value
Program degeneracy	Specify whether to transition to ERROR mode or to separate the program with error and to continue operation (degeneracy) when any error occurs in program execution.	NO: Error down YES: Continues degeneracy operation
I/O degeneracy	Specify whether to transition to ERROR mode or to stop inputting/outputting the I/O module with error and to continue operation (degeneracy) when any error occurs in I/O module.	NO: Error down YES: Continues degeneracy operation
Initialization of global variables	Set whether to initialize global variables at starting up in RUN mode or not to initialize.	NO: Not initialize YES: Initialize
Initialization of local variables	Set whether to initialize local variables at starting up in RUN mode or not to initialize.	NO: Not initialize YES: Initialize
Output of time setting by program to log	Set whether to register the time change by program into event log or not to register.	YES: Register to log NO: Not register

Table A.3-2 List of module parameters (Task execution specification)

Item	Contents	Setting value
Priority 1 Task type	Set the task type to be allocated to task priority 1.	EV/IP
Priority 2 Task type	Set the task type to be allocated to task priority 2.	SS/IP
Priority 2 Execution setting	Set whether to execute the super speed scan task (SS) or not when SS is set to the task type of task priority 2.	Stop/Execute
Priority 2 Scan cycle	Specify the execution cycle of the super speed scan tack (SS) when the SS is set to the task type of priority 2.	0: Stop 5 to 5000 (unit in 0.1 ms)
Priority 3 Task type	Set the task type to be allocated to task priority 3.	HS/RIO
Priority 3 Execution setting	Set whether to execute the high speed scan task (HS) or to execute the Remote I/O task (RIO) that is set to the task type of task priority 3.	Stop/Execute
Priority 3 Scan cycle	Specify the execution cycle of the high speed scan task (HS) or the remote I/O task (RIO) that is set to the task type of task priority 3.	0: Stop 5 to 5000 (unit in 0.1 ms)
Priority 3 RIO mid speed I/O division number	Specify the RIO mid speed I/O division number when the remote I/O task (RIO) is set to the task type or task priority 3.	2 to 64
Priority 4 Task type	Set the task type to be allocated to task priority 4.	MS
Priority 4 Execution setting	Set whether or not to execute the main scan task (MS) set to task type of priority 4.	Stop/Execute
Priority 4 Scan cycle	Specify the execution cycle of the main scan task (MS) set to task type of priority 4.	0: Stop 5 to 10000 (unit in 0.1 ms)

Table A.3-3 List of Module parameters (Duplex information) (1)

Item	Contents	Setting value
System alarm in duplex operation	Specify whether to notify an alarm as a minor failure or not when the secondary becomes online in duplex system configuration.	Normal: Notifies an alarm as a minor failure Special: Not regard as a failure
Auto restart	Specify whether to restart the system automatically or not when the controller makes error down.	No restart: Stop Restart only standby system: Restarts the standby system only Restart: Restarts the system
Operation at I/O status inconsistency	This is a function to specify whether to continue the operation of standby system or to shut down the standby system when an SIO that seems normal from online system but looks abnormal from standby system. This function specifies the operation in case I/O loop seems abnormal by four or more points.	Continue execution/Error down
MS synchronization Tracking area specification of user global variables	Specify the tracking area of the user global variables of tracking object in main scan task (MS) synchronization.	All: Tracking is carried out to all areas 1 to 4: Tracking is carried out for 1 to 4 areas (max.) None: No tracking
MS synchronization Tracking area specification of D register	Specify the tracking area of the D register of tracking object in main scan task (MS) synchronization.	All: Tracking is carried out to all areas None: No tracking Size: Specify the size
MS synchronization Head of the user variables of tracking object	Specify the head address of the user global variables of tracking object in main scan task (MS) synchronization.	0 to 262143 (Word addressing)
MS synchronization Size of the user variables of tracking object	Specify the size of the user global variables of tracking object in main scan task (MS) synchronization.	0 to 32768 (Word size)
MS synchronization Head of the D register of tracking object	Specify the head address of the D register of tracking object in main scan task (MS) synchronization.	0 to 8191 (Word addressing)
MS synchronization Size of the D register of tracking object	Specify the size of the D register of tracking object in main scan task (MS) synchronization.	0 to 8192 (Word size)
HS synchronization Head of the user variables of tracking object	Specify the head address of the user global variables of tracking object in high speed scan task (HS) synchronization.	0 to 262143 (Word addressing)
HS synchronization Size of the user variables of tracking object	Specify the size of the user global variables of tracking object in high speed scan task (HS) synchronization.	0 to 32768 (Word size)
HS synchronization Head of the D register of tracking object	Specify the head address of the D register of tracking object in high speed scan task (HS) synchronization.	0 to 8191 (Word addressing)

Table A.3-3 List of Module parameters (Duplex information) (2)

Item	Contents	Setting value
HS synchronization Size of the D register of tracking object	Specify the size of the D register of tracking object in high speed scan task (HS) synchronization.	0 to 8192 (Word size)
SS synchronization Head of the user global variables of tracking object	Specify the head address of the user global variables of tracking object in super speed scan task (SS) synchronization.	0 to 262143 (Word addressing)
SS synchronization Size of the user global variables of tracking object	Specify the size of the user global variables of tracking object in super speed scan task (SS) synchronization.	0 to 32768 (Word size)
SS synchronization Head of the D register of tracking object	Specify the head address of the D register of tracking object in super speed scan task (SS) synchronization.	0 to 8191 (Word addressing)
SS synchronization Size of the D register of tracking object	Specify the size of the D register of tracking object in super speed scan task (SS) synchronization.	0 to 8192 (Word size)

A

Table A.3-4 List of Module parameters (Status change notification)

Item	Contents	Setting value
Status change detection	Specify whether to detect the status change in the unit of 1W or not	YES: Detects status change NO: Not detect status change
Objective I/O module	Select the I/O module of the detection object of status change.	Registered I/O module
I/O word No.	Specify the word no. of the detection object of status change.	Detection work No.
Detection mask (when ON)	Set which bit in 1 word process data that is set by I/O module and I/O word No. is detected for its change to ON.	
Detection mask (when OFF)	Set which bit in 1 word process data that is set by I/O module and I/O word No. is detected for its change to OFF.	Set “1” to the bit to detect the change to OFF
IP task No.	Set which IP task is started up when status change is detected.	0 to 15

Table A.3-5 List of Module parameters (Other)

Item	Contents	Setting value
Computer link Ethernet Slot No.	Specify which Ethernet card is connected with installation slot no. as maximum four Ethernet cards can be installed.	2 to 7
Computer link UDP port No.	Specified the UDP port No. for computer link.	1024 to 65535

Table A.3-6 List of Module parameters (Ethernet)

Item	Contents	Setting value
IP address	Specify the IP address of the controllers of primary/secondary side. Set the "**" with the setting value of Ethernet I/P address setting switch on the front panel of the primary/secondary controller. If the system in single configuration, specify the primary side controller only.	Class B 172.16.64. ** Class C 192.168.0. **
Subnet mask	Specify the subnet mask of the primary/secondary controller. If the system in single configuration, specify the primary side controller only.	Class B 255.255.192.0 Class C 255.255.255.0

Table A.3-7 List of Module parameters (I/O loop)

Item	Contents	Setting value
I/O loop number	Set the number of I/O loops.	Single configuration: 1 Duplex configuration: 2
I/O loop high speed scan cycle	Set the high speed scan cycle of I/O loop.	1 to 100 (unit in 0.1 ms)
I/O loop high speed healthy check time	Set the high speed scan healthy check time of I/O loop.	10 to 1000 (unit in 1 ms)
I/O loop mid speed scan cycle	Set the mid speed scan cycle of I/O loop.	10 to 1000 (unit in 1 ms)
I/O loop mid speed healthy check time	Set the mid speed scan healthy check time of I/O loop.	10 to 1000 (unit in 1 ms)

Table A.3-8 List of Module parameters (I/O node)

Item	Contents	Setting value
I/O degeneracy	Set whether carry out the I/O degeneracy for the unit of node or not.	NO: No degeneracy YES: Degeneracy
I/O bus healthy check time	Set the I/O bus healthy check time.	1 to 1024 (unit in 1 ms)

A

Appendix B
Computer Link

B.1 What is Computer Link?

Computer link is a function to bridge between the host computer (including display) and the controller for data exchange using dedicated communication protocol.

■ What is available by computer link

- Read-out of controller status
- Read-out of controller register/device data
- Write-in of register/device data to controller
- Read-out of calendar and time data of controller
- Write-in of calendar and time data to controller

◇ **Supplementary**

- Unified controller nv series supports a part of the functions of our PROSEC-T series computer link (functions described above).

■ Communicating procedure

Controller is always in waiting status for the request from host computer. It responds to the request from the host.

■ Connection

Ethernet connection

B.2 Ethernet Connection

■ Operation flow

1 Set the parameters of the controller.

Perform the setting in the following procedure.

- Set the computer link setting (Ethernet connection) of the module parameter using nV-Tool.
  Refer to 5.1 Module Parameters for the details.

◇ Supplementary

- Set the computer link setting to the controller while it is in RUN mode. To start up the computer link, turn on the system in RUN mode.

2 Set the parameters of the host computer.

Set the transmission parameters in accordance with the specification of the host computer in use.

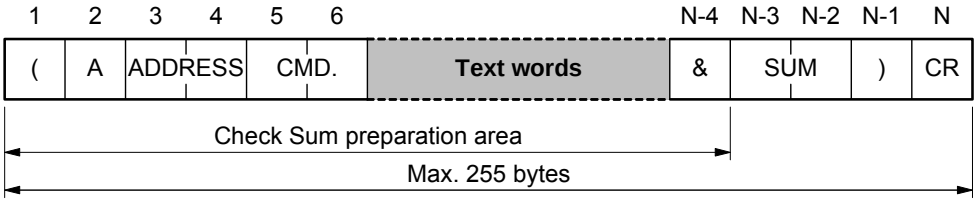
3 Connect the controller and the host computer.

Refer to the separate manual “Unified controller nv series Ethernet (EN811) module Instruction Manual (6E8C5128)”.

The computer link connection is established by the above operation.

B.3 Transmission Format

Computer link uses following transmission format for communication.



Contents of the text and its size

- (: Top code (H28) 1 byte
- A: Format identification code (H41) 1 byte
- ADDRESS: Station No. 2 bytes
  This data is meaningless, however, be sure to set this data.
- CMD. : Command 2 bytes
- Text words: Data section
- &: Check sum discrimination code (H26) 1 byte
- SUM: Check sum 2 bytes
  JIS8 code of the lower digit of the sum from the top code to the check sum discrimination code
-) : Final code (H29) 1 byte
- CR: Carriage return code (H0D) 1 byte

(H**) is an expression of JIS8 code in hexadecimal of the upper 4 bits + lower 4 bits. Refer to B.7 JIS8 Code Table.

◇ Supplementary

- Maximum text length (N) is 255 bytes.
- Check sum of the data sent from the host computer can be omitted. In this case delete the check sum discrimination code and check sun.

B.4 Transmission Rules

Following transmission rules are applied to the computer link function.

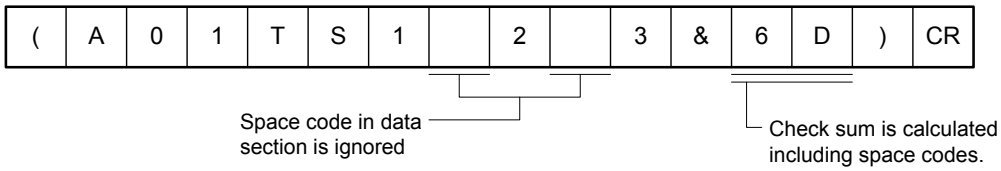
■ Controller is always in waiting status

The controller is always in waiting status to receive the request command from the host computer.

There is no case when the controller carries out transmission independently.

■ Space code (H20) is ignored

When any space code (H20) is included in the data section sent from the host computer, it is regarded. However, the check sum calculation is made including the space code.



Ex.)

Transmission text (A01TS1__2__3&6D)

Return text (A01TS123&2D)

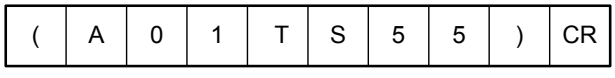
Text contents are the same for above two texts, but the space is ignored. So their check sums are different.

■ Check sum of the transmission text can be omitted

The transmission data from the host computer can be sent without check sum.

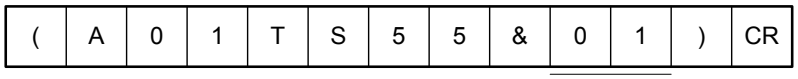
■ Check sum is attached to the return text

Transmission text



(A01TS55) CR

Return text



(A01TS55&01) CR

Check sum is always attached to the return text.

■ JIS8 code is used

All transmission and reception data use JIS8 code (including 8-bit ASCII code).

■ Received data before "(" is ignored

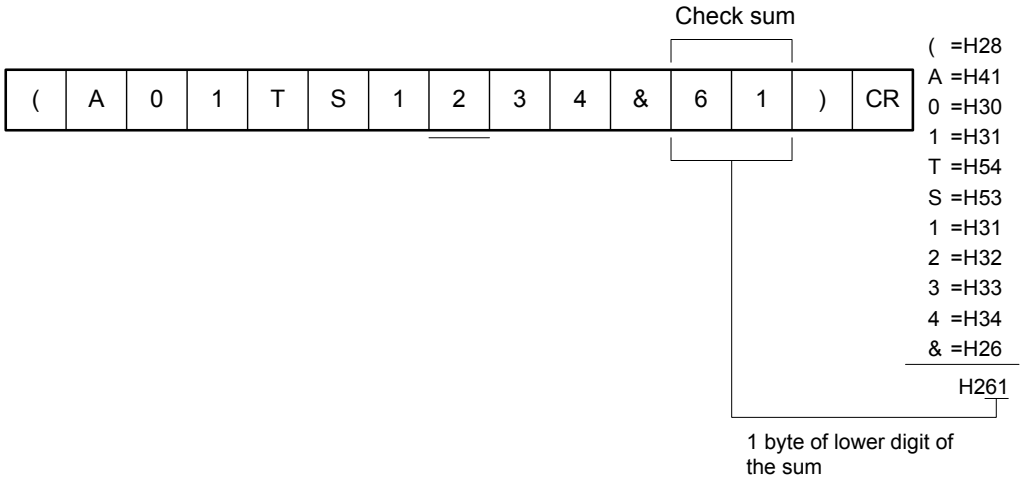
The controller ignores all data received before "(" (H28) was received.

■ Reception is completed with ")"CR

Only when ")" CR (the combination of ")" and CR) is received, the reception is regarded as completed. If any one of ")" and CR alone is received, it is regarded as transmission error.

■ Preparation procedure of check sum

Check sum is a 1-byte JIS8 code of the lower digit of the sum from the top code "(" to the check sum discrimination code "&".



B

B.5 List of Commands

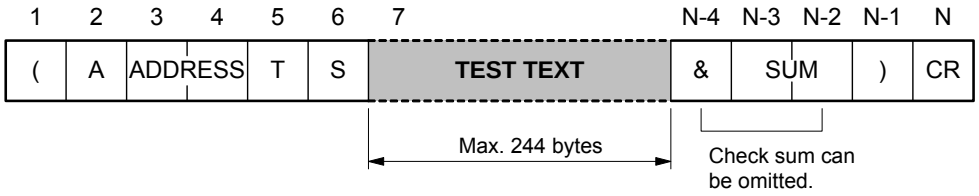
Following commands are available for the controller.

Command code	Function name	Contents	Remark
TS	Test text	Performs turn-around test of the data prepared by user in the computer link.	
ST	PC status read-out	Reads out the controller main unit status.	
DR	Register/device read-out	Reads out data from register/device.	
DW	Register/device write-in	Write in data to register/device.	
RT	Calendar/Clock read-out	Reads out data from calendar/clock.	
WT	Calendar/Clock write-in	Set the data to calendar/clock.	
CE	Computer link error	Displays the computer link error.	Response only
EE	PC main unit error	Displays the error processing of the controller main unit.	Response only

■ Test text《TS》

Communication test is carried out between the controller and the host computer.

Transmission text



Return text

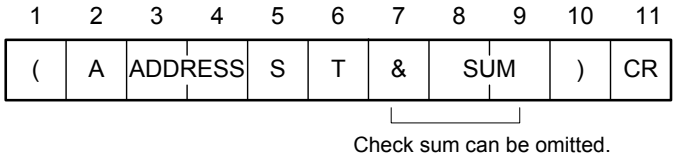
- Function
  When the communication is executed successfully, the data same as the transmission data is returned.
  If any error occurs, <CE> or <EE> command is returned.
  The maximum size of the test data is 244 bytes.

- Ex. 1
  Transmission text: (A01TS123456789&74)
  Return text: (A01TS123456789&74)
  JIS8 code is available for the test data.
  However, "(", ")" and "&" cannot be used.
- Ex. 2
  Transmission text: (A01TS 12345&16)
  Return text: (A01TS 12345&96)
  The space _ in the test data is ignored.

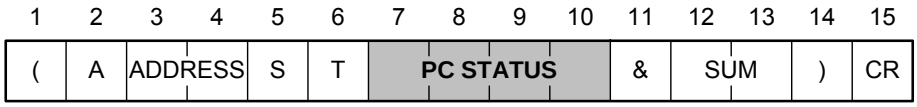
■ PC status read-out《ST》

The operation status of the controller is read out.

Transmission text



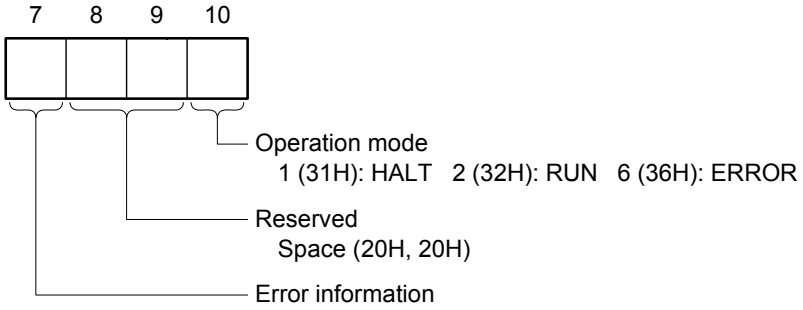
Return text



(When error occurred, <CE> or <EE> is returned.)

● Function

The operation status of the controller (operation mode/error cause at error occurrence) is read out and displayed.



Error information	Software error		Hardware error	
	Minor failure	Major failure	Minor failure	Major failure
0	—	—	—	—
1	—	—	—	●
2	—	—	●	—
3	—	—	●	●
4	—	●	—	—
5	—	●	—	●
6	—	●	●	—
7	—	●	●	●
8	●	—	—	—
9	●	—	—	●
A	●	—	●	–
B	●	—	●	●
C	●	●	—	—
D	●	●	—	●
E	●	●	●	—
F	●	●	●	●

In this table the information of S register S[256].B[0] to S[256].B[3] is expressed with a character.

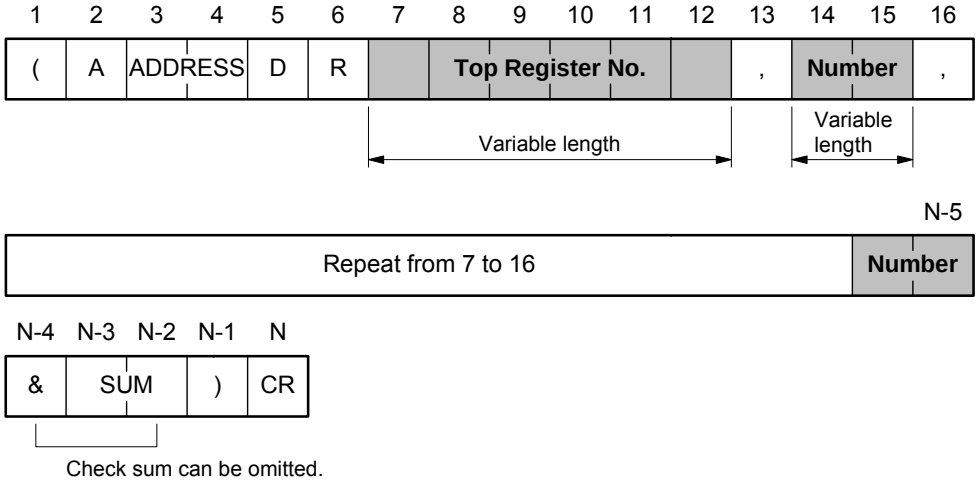
Refer to Appendix A2 Special register (S register)

0 means normal, and other than 0 means any error.

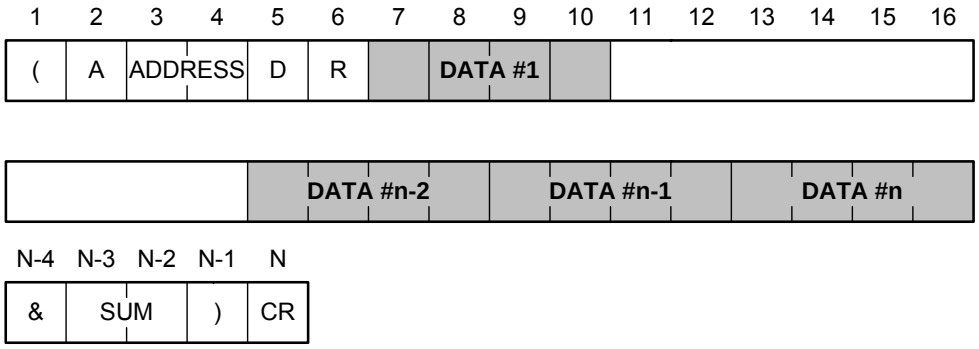
■ Read-out of register/device《DR》

Data in the register/device can be read out.

Transmission text



Return text



(When any error occurs, <CE> or <EE> is returned.)

● Function

- The register/device data of the specified number from the specified top register/device number are read out.
- The registers/devices of different type can be read out in combination at a time.
- The number of registers/devices that can be read out at a time is maximum 32.
- Zeros of the register/device No. can be omitted as R9 for R0009. Zero in their number can be omitted also if the number is one digit as 8 for 08.
- When the number is 1, number specification can be omitted.
- Separate the register number and the number with a "," (comma).
- The returned data is displayed in the unit of 4 bytes in the specified order.
- The register data that can be displayed is expressed in hexadecimal of 16 bits. Device data 0001 means ON, and 0000 means OFF, respectively.

◇ **Supplementary**

- The types of device/register that can be requested by DR command are listed below.

	Device						Register							
	S	R	X	Y	I	Q	SW	RW	D	XW	YW	IW	QW	F
Controller	○	○	○	○	○	○	○	○	○	○	○	○	○	○

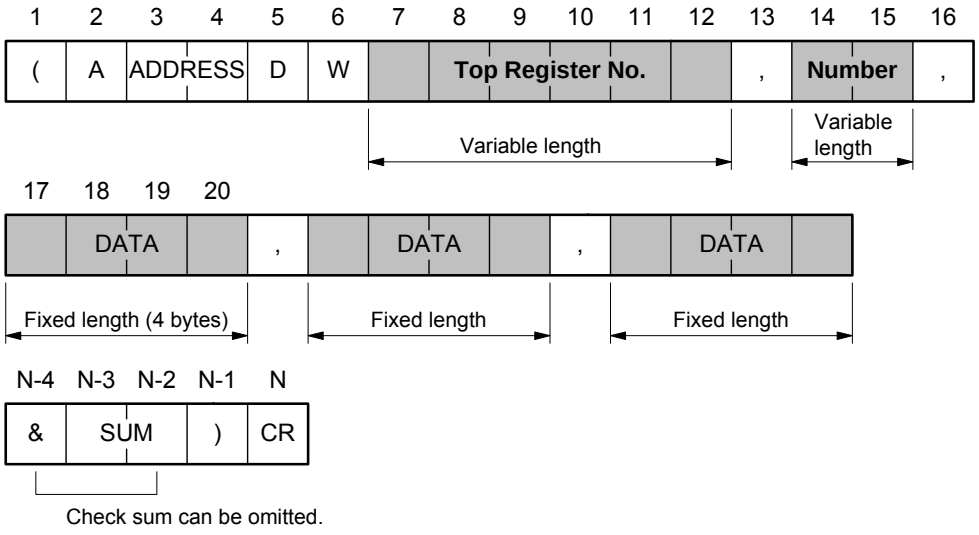
○: Reading enabled

- The maximum text length (N) of DR command is 255 bytes.
- Refer to B.6 Expressions by Controller and by Computer Link for the relation between device/register by controller and that by computer link.

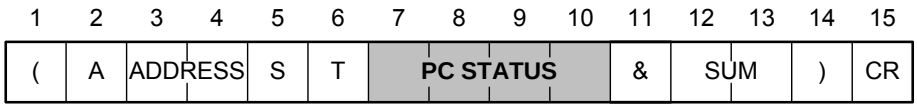
■ Write-in to register/device《DW》

Data is written in to the register/device.

Transmission text



Return text



(When any error occurs, <CE> or <EE> is returned.)

● Function

- The register/device data of the specified number from the specified top register/device number are written in.
- The registers/devices of different type can be written in combination at a time.
- The number of registers/devices that can be written in at a time is maximum 32.

- The data that can be written in is expressed in hexadecimal of 4 bits. Device data ON is specified with 0001, and OFF by 0000, respectively.
- Zeros of the register/device No. can be omitted as R9 for R0009.
- Separate the register/device number, the number of the register/device and the data with a "," (comma).
- If the data was written in successfully the controller status is returned.

◇ **Supplementary**

- The types of device/register that can be requested by DW command are listed below.

	Device						Register							
	S	R	X	Y	I	Q	SW	RW	D	XW	YW	IW	QW	F
Controller	○	○	○	○	○	○	○	○	○	○	○	○	○	○

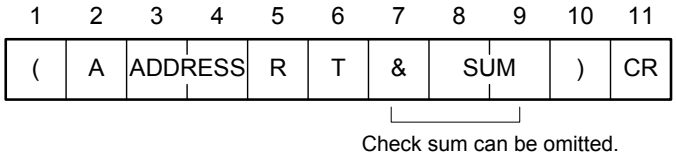
○: Writing enabled

- The maximum text length (N) of DW command is 255 bytes.
- Refer to B.6 Expressions by Controller and by Computer Link for the relation between device/register by controller and that by computer link.

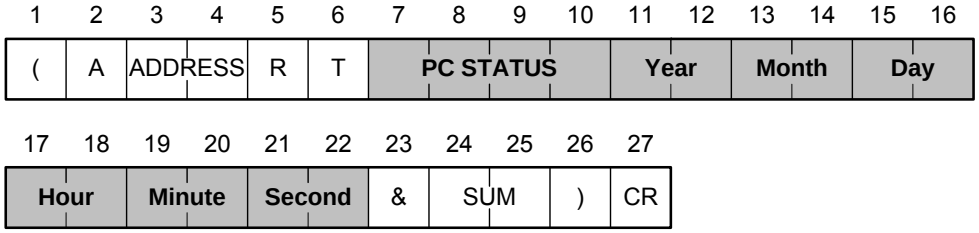
■ Calendar clock read out《RT》

Data set to the calendar and the clock built in the controller are read out.

Transmission text



Return text



(When any error occurs, <CE> or <EE> is returned.)

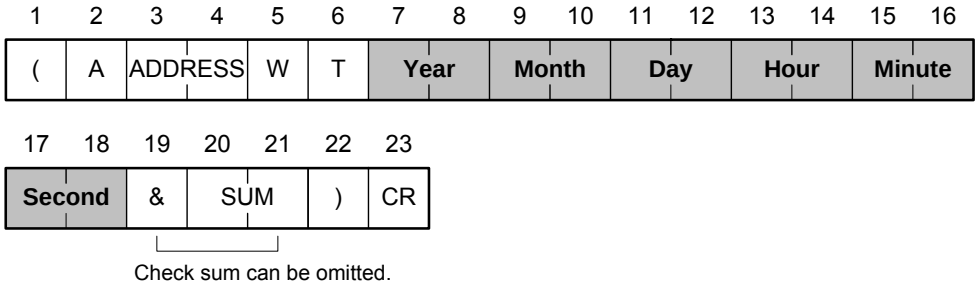
● Function

The data set to the built in calendar and the built in clock of the controller are read out. All these data are displayed in 2 digits decimal numbers.

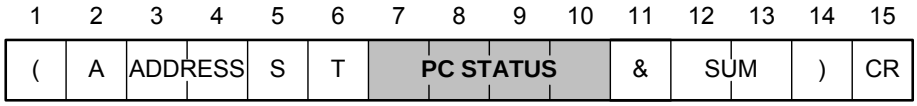
■ Calendar clock write-in《WT》

Data is written in to the calendar and the clock of the controller.

Transmission text



Return text



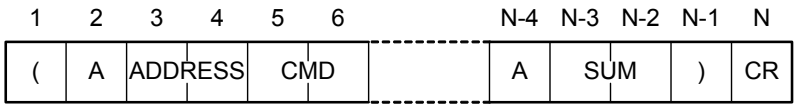
(When any error occurs, <CE> or <EE> is returned.)

- Function
  The sent data of year, month, day, hour, minute and second are written in to the built in calendar and the built in clock of the controller.
  All data are specified in 2 digits of decimal number. When the data is specified in one digit (the case when the sum of all data is within 12 digits), and when the upper limit of the data is exceeded, an error is notified.
  When the data is written in successfully, PC status is returned.

■ Computer link error《CE》

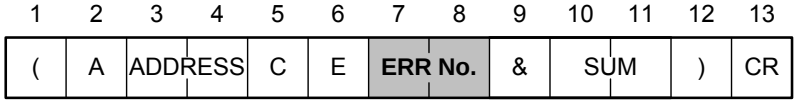
The contents of the format check error of the computer link is displayed.

Transmission text



The objects of this check are all transmission texts.

Return text



● Function

When any error is observed at the format check of the transmission text, the error number is displayed.

Computer link error number (ERR No.)

	Content	Meaning
01	Command error	No corresponding command exists
02	Format error	Transmission format does not coincide.
03	Check sum error	Check sum does not coincide.

● Ex. 1

Transmission data : (A01SS&96)

Return data : (A01CE01&D9)

Command error : No corresponding command (SS)

● Ex. 2

Transmission data : (A01DRRW100, 2YW100, 3&BE)

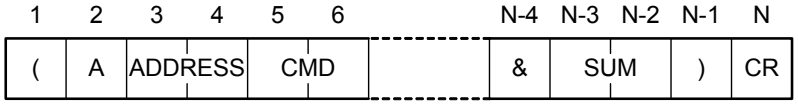
Return data : (A01CE02&DA)

Transmission format error : No separation comma between register number and the number in the read-out of register 〈DR〉.

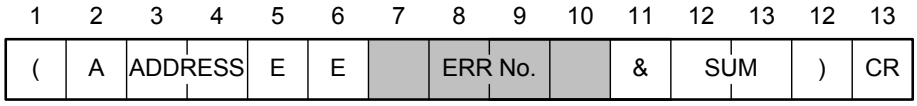
■ PC main unit error《EE》

Controller main unit error occurred during computer link is displayed.

Transmission text



Return text



● Function

The computer main unit error occurred during computer link is displayed in 4 digits decimal number.

Refer to the next section “Error status” for the error number and its contents.

● Error status

7	8	9	10
○	○	○	○

	Content	Meaning
0052	Transmission format error	Transmission format does not coincide.
0115	Register No./size error	Register No. outside the range was specified.

B.6 Expressions by Controller and by Computer Link

The unified controller nv series provides the variables characteristic to the controller (S, D registers) of which variable structure, its name and logical address have been defined in advance for the compatibility with the conventional products.

When making an access to the system using the computer link, the functions same as that of the conventional products can be realized by describing the program to set the data to the variables characteristic to the controller using application program.

Following table lists the controller variables that can be specified by the register/device read out command (DR) and the register/device write-in command (DW) among the commands of computer link and the variable expressions specified by the computer link text.

Variable			Effective size	Expression by the controller	Expression by the computer link
System register	Device	S	0～1023F	S[nnnn].B[m]	Snnnnm
	Register	SW	0～1023	SW[nnnn]	SWnnnn
Data register	Device	D	0～8191F	D[nnnn].B[m]	Rnnnnm
	Register	DW	0～8191	DW[nnnn]	RWnnnn/Dnnnn
I/O variable	Device		0～9999F	%IXnnnn.m/ %QXnnnn.m/ Variable name	Xnnnnm/Innnnm Ynnnnm/Qnnnnm
	Register		0～9999	%Iwnnnn/ %QWnnnn/ Variable name	XWnnnn/IWnnnn Ywnnnn/QWnnnn

◆ **Note**

- The size of I/O variables that can be used by the controller is 16,384 words. However, the computer link has a restriction. When the computer link uses the I/O variable, use the variable within the range of 0 to 9999 words.

Table B-2 Register/device corresponding table between the controller and the computer link

Device S	Register SW
S[000].B[0]	SW[0]
S[000].B[1]	
S[000].B[2]	
:	
:	
S[000].B[15]	
S[001].B[0]	SW[1]
S[001].B[1]	
:	
S[001].B[15]	
:	:
:	:
S[1023].B[0]	SW[1023]
S[1023].B[1]	
:	
S[1023].B[15]	

Device S	Register SW
S0000	SW0
S0001	
S0002	
:	
:	
S000F	
S0010	SW1
S0011	
:	
S001F	
:	:
:	:
S10230	SW1023
S10231	
S1023F	

Expression by controller	
Device D	Register DW
D[000]. B[0]	DW[0]
D[000]. B[1]	
D[000]. B[2]	
:	
:	
D[000]. B[15]	
D[001]. B[0]	DW[1]
D[001]. B[1]	
:	
D[001]. B[15]	
:	
:	
D[8191]. B[0]	DW[8191]
D[8191]. B[1]	
:	
D[8191]. B[15]	

Expression by computer link		
Device R	Register	
	RW	D
R0000	RW0	D0
R0001		
R0002		
:		
:		
R000F		
R0010	RW1	D1
R0011		
:		
R001F		
:	:	:
:	:	:
R81910	RW8191	D8191
R81911		
:		
R8191F		

B

B.7 JIS8 Code Table

Upper 4 bits →

←Lower 4 bits	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	NUL	DLE	(SP)	0	@	P	'	p				－	タ	ミ		
1	SOH	DC1	!	1	A	Q	a	q				ア	チ	ム		
2	STX	DC2	“	2	B	R	b	r			「	イ	ツ	メ		
3	ETX	DC3	#	3	C	S	c	s			」	ウ	テ	モ		
4	EOT	DC4	$	4	D	T	d	t			、	エ	ト	ヤ		
5	ENQ	NAK	%	5	E	U	e	u			・	オ	ナ	ユ		
6	ACK	SYN	&	6	F	V	f	v			ヲ	カ	ニ	ヨ		
7	BEL	ETB	‘	7	G	W	g	w	Not defined		ァ	キ	ヌ	ラ	Not defined	
8	BS	CAN	(	8	H	X	h	x			ィ	ク	ネ	リ		
9	HT	EM	)	9	I	Y	I	y			ゥ	ケ	ノ	ル		
A	LF	SUM	*	:	J	Z	j	z			ェ	コ	ハ	レ		
B	VT	ESC	+	;	K	[	k	{			ォ	サ	ヒ	ロ		
C	FF	FS	,	<	L	¥	l	|			ャ	シ	フ	ワ		
D	CR	GS	-	=	M	]	m	}			ュ	ス	ヘ	ン		
E	SO	RS	.	>	N	^	n	~			ョ	セ	ホ	゛		
F	SI	US	/	?	O	_	o				ッ	ソ	マ	゜		

B

Appendix C
Precautions on Design of Duplex System

This Appendix describes the precautions on preparation of user program.

C.1 Scan Time

Set the scan time to the value of the scan time set to single operation added with the tracking time.

The tracking time is 2 ms per tracking data 1 kword (KW). However, when the tracking data is less then 1 kw, the data is regarded as 1 kword (KW) for the calculation.

① Tracking data 1 KW or less ··2 ms

② Tracking data 1 KW or more 2 ms/KW
The contents of 2 ms/KW is the sum of the following (A) and (B).

(A) until the online side completes sending the tracking data

(B) until the standby side completes receiving the tracking data

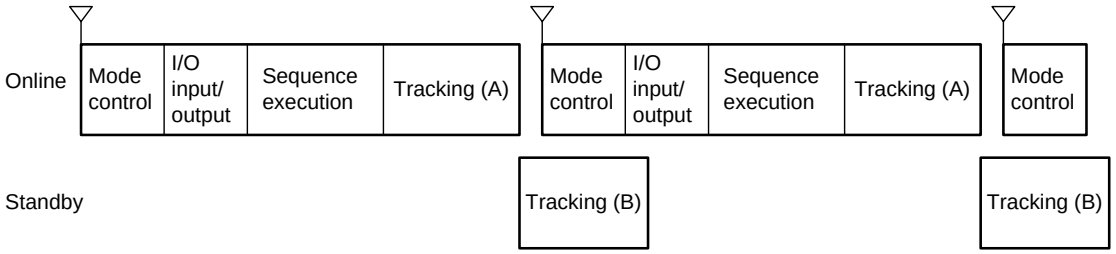


Fig. C.1-1 Tracking time

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The data size of each tracking data and the tasks sending the data are listed in the Table C.1-1.

The data sent synchronized with each task of SS/HS/MS are the data user declared and information of the system management information.

The size of tracking data (number of words) can be checked with the value displayed in the special register (S register) in duplex operation.

Table C.1-1 Types of tracking data

Name	Send task	Display of sent data size (in Word)
Local variable of SS task	SS task	S register SW[266] SW[267]
D register (for tool designation)		
User controller global variable (for tool designation)		
(Management information)		
Local variable of HS task	HS task	S register SW[268] SW[269]
D register (for tool designation)		
User controller global variable (for tool designation)		
(Management information)		
Local variable of MS task	MS task	S register SW[270] SW[271]
D register (for tool designation)		
User controller global variable (for tool designation)		
(Management information)		

(Note 1) Local variable includes the variables used by the function block.
When executing two or more tasks at a same time, set the scan time with the tracking time of each task added with the tracking time of all tasks.

■ Design procedure of scan time

1. Calculate the transferred tracking data size transferred synchronized with each task from the transmission data size displayed in Table C.1-1. Then calculate the tracking time of each task by multiplying the tracking performance and data size.

Table C.1-2 Tracking transmission time of each synchronized task

Each task	Transmission data size	(A)+(B)
SS task synchronized transmission data size	16 KW	32 ms
HS task synchronized transmission data size	24 KW	48 ms
MS task synchronized transmission data size	43 KW	86 ms

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2. Calculate the scan time of duplex operation by adding the tracking time of each synchronized task calculated using Table C.1-2 to the scan time set to single operation.

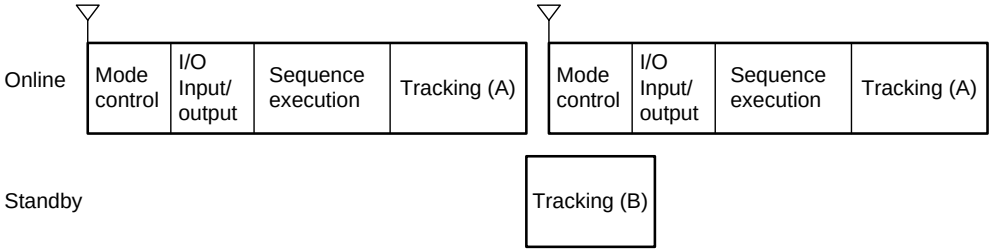

Fig. C.1-2 Scan time of duplex operation

When two or more tasks are executed, add the execution time of the upper priority task to the one scan time of the task of lower priority.

In Fig. C.1-3, add HS task program execution time (I/O input/output time + sequence execution time) and the double of the tracking time to the scan cycle of MS task.

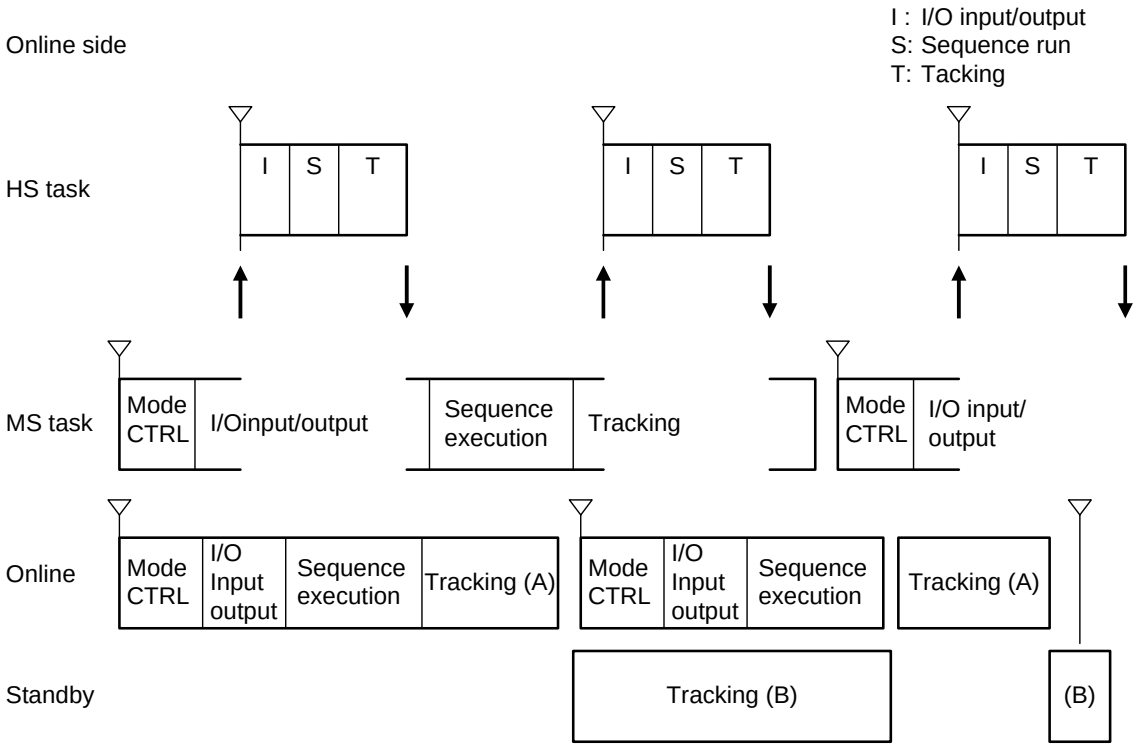

Fig. C.1-3 Tracking at executing two or more tasks

3. Add a margin of 10 ms to the scan cycle calculated at above 2, considering the partial equalization time when changing the online.

Note

- Scan-related task is a task to perform the processing basic to the system. It is not preferable that the task execution is always in scan congestion or in tracking congestion. Set the scan cycle to the value with a margin not to make congestion.
- You can decrease the tracking size by registering the variables not requiring tracking as the Non Tracking variable.

C.2 Full Equalization Time

Full equalization time is decided by the size of transmission.
Therefore,

Full equalization time (ms) = ((Steps of user program × 2 ÷ 1024)
+ (Words of the user global variable ÷ 1024)
+ 256 (=controller setting information)) × 2
ms/KW
+ 360 ms

Ex.) Let user program steps be 60 ksteps, user global variable size be 5 kW, the equalization time is given as below.

(60×1024×2/1024) + (5×1024/1024)+256)×2+360 =
(120+5+256)×2+360
= 1122ms

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C.3 Duplex Switching Time

Duplex switching time is a period from the time when the cause to switch the duplex status occurred to the time when the switched system becomes enabled to start the scan control.

The duplex switching time is composed of the three items as indicated in Fig. C.3-4.

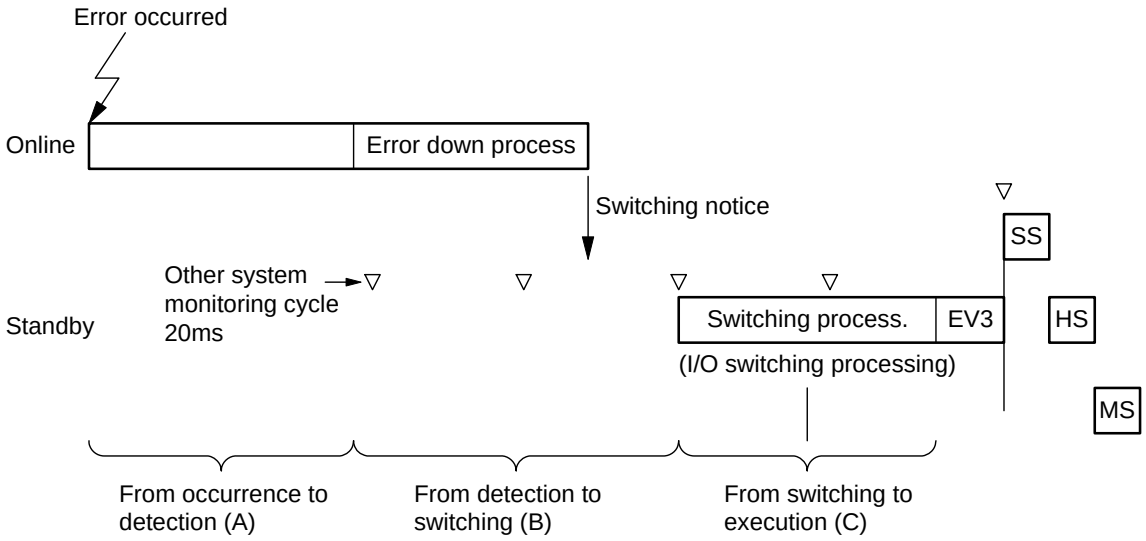


Fig. C.3-4 Explanation of switching duplex operation

(A) Time from error occurrence to its detection
Program execution error is recognized as an error immediately when the error occurs. However WDT error takes 350 ms.

(B) Time from error detection to system switching
This is a time for the online system to recognize the error and the standby system to recognize the single operation. In this period the error down processing, error processing notification processing to the standby system and the error sensing processing by the standby system. Since the monitoring cycle of error sensing processing by the standby system is 20 ms, time difference of 0 to 20 ms occurs for switching the system to the same error.

(C) Time from system switching to execution of user program
This is a time for the standby system to recognize the switching, carry out switching processing (I/O switching processing, data initialization) and to start to execute the user program (event task 3 is carried out at first). After execution of event task 3, the scan control of each task is started.

Each time becomes as shown in Table C.3-1.

Table C.3-1 Duplexing switching time

Duplex switching time = Time from error occurrence to its detection (A) + Time from error detection to switching (B) + Time from switching to execution of user program (C)		
Time from error occurrence to its detection (A)	Program execution error, ECC error	Within 1 ms
	WDT time out	350ms
Time from error detection to switching (B)	Max. 50ms	
Time from switching to execution of user program (C)		

(Note 1) After (C) use program execution, the event task 3 is executed and each task starts its execution.
Time (C) does not include the execution time of event task 3.

(Ex.) The time from the occurrence of data boundary error during execution with MS task scan cycle 200 ms to the resume of control by MS task is given as below at maximum, supposing that Event task 3 and SS/HS task are not registered.
(A) + (B) + (C) = 1 + 50ms = 51ms

C.4 I/O

Be careful about the following items when carrying out switching duplex operation.

■ I/O input/output

General I/O module has continuity before and after the switching. However I/O stops its operation during the switching duplex operation. If the program that increments regularly is used, the increment is not carried out during the switching duplex operation.

■ Status change notification

The status change notification function that can be specified by module parameter of PU811 may not detect the change during switching duplex operation. When using the signal important for the system, do not use the status change notification function.

C.5 Degeneracy Function

■ Program degeneracy

When an execution error is detected while executing the program, the program with an error is isolated and other programs continue execution. This is called as program degeneracy.

When a similar error occurs in the duplex system, the system is shut down due to error down without carrying out program degeneracy even if the program degeneracy is instructed, and the system is switched to the standby side and continues to execute all tasks. If another error occurs to the switched system and program degeneracy is instructed, the program with the error is isolated and the system enters into program degeneracy operation.

◆ Note

- It is recommended to set program degeneracy for the duplex system.

■ I/O degeneracy

When an I/O error is detected while executing the program, the I/O with an error is isolated and other I/Os continue execution. This is called as I/O degeneracy.

In duplex system when an I/O error is detected for the I/O instructed as I/O degeneracy, the system carries out I/O degeneracy and continues the operation. The reason to continue operation is that the I/O access route is redundant. In other words, since TC-net I/O loop is constructed as dual loop, I/O can be accessed normally even if three failures occur in the I/O access route at the same time.

If an I/O error is detected for the single system and I/O degeneracy is not instructed, the system makes error down.

If an I/O error is detected to the I/O not instructed degeneracy in the duplex system, the switching of duplex operation is generated and if another error is detected further to the switched system, the both systems make error down.

◆ Note

- It is recommended to set I/O degeneracy for the duplex system.
  Instruct I/O degeneracy for each node.
  Assign separate node to the I/O that needs to stop the system when error occurs and the I/O that allows the system to continue operation by I/O degeneracy.

C.6 Event Task 3

When online side is down during duplex operation and control of the system is switched to standby side, event task 3 is executed at first. Describe the initialization processing necessary for duplex switching into event task 3.

C.7 Station Bus Transmission Module (Ethernet module/TC-net module)

Since the different hardware is used for the station bus transmission module of duplex system of the unified controller, they are controlled individually.

The control of the station bus transmission module (such as socket generation) is carried out by communication function block command (USEND_T/URCV_T). So the application programs that use the communication function block command need to be initialized when duplex switching is carried out to become the program to operate from the initial status (open processing of socket) again.

■ Outline of the processing carried out at duplex switching

- The switching of the system from standby to online by event task 3 (EV3) for switching duplex operation is detected.
- The program using communication function block initializes the local variables in the communication function block when switching duplex operation is carried out. Write a program so that the system operates from the initial status (open processing of socket) again to initialize the information. Refer to Instruction Words Description (6E8C4826) for the details.

◇ **Supplementary**

- When the system is switched from online to standby, the sockets requested by communication function block are all closed automatically.

C.8 Precautions on Switching Duplex TC-net Module

When connecting the unified controller duplex system to the information/control network TC-net 100, be careful about the following restrictions.

■ Basic configuration

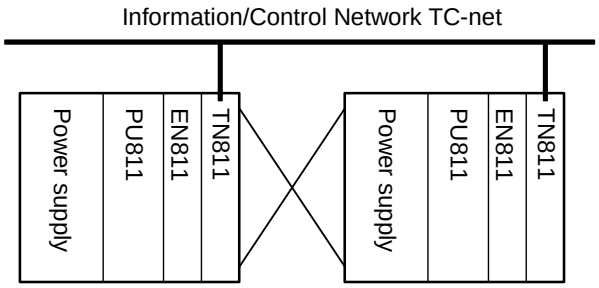


Fig. C.8-1 Configuration of duplex system

- TC-net station address must be set to different address for primary and secondary.
- Set the same setting to the logical setting such as scan cycle and scan address for primary and secondary.
- Online side and standby side are in scan transmission start and scan transmission stop status respectively.

■ Restriction by type1 controller

1. When the type1 controller becomes error status, the duplex operation switching is activated and TC-net scan transmission is taken over from the online to the standby.
2. When TC-net module has any error, or when cable breakage occurs, carry out switching duplex operation from online side to standby side by user program.

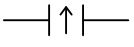
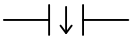
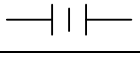
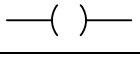
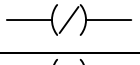
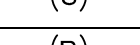
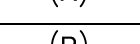
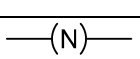
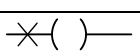
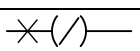
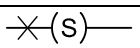
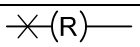
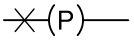
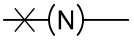
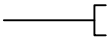
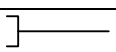
   Refer to the following instruction manuals for the diagnosis of TC-net.

   - TC-net 100 Module Instruction Manual (6F8C1360) Chapter 7 Application Interface

C

Appendix D
Run time of Instruction Word

■ List of instruction word execution

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Contact/Coil					
a contact		1		0.02	
b contact		1		0.02	
Rise contact		2		0.06	
Fall contact		2		0.10	
Rise edge detection		1		0.12	
Fall edge detection		1		0.12	
Inverter		1		0.02	
Coil		1		0.06	
Inverted coil		1		0.06	
Set coil		1		0.06	
Reset coil		1		0.06	
Rise coil		2		0.12	
Fall coil		2		0.12	
Forced coil		1		0.02	
Forced inverted coil		1		0.02	
Forced set coil		1		0.02	
Forced reset coil		1		0.02	
Forced rise coil		2		0.06	
Forced fall coil		2		0.06	
Execution control					
Jump control set	JCS	1		0.64	
Jump control reset	JCR	1		0.02	
Jump		1		0.72	
Label	LABEL	1		0.02	
Conditional execution start instruction		1		0.64	
Conditional execution end instruction		1		0.02	

D

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Master control set	MCS	1		0.02	
Master control reset	MCR	1		0.02	
Counter					
Up counter	CTU	1		0.44	
Down counter	CTD	1		0.64	
Up/Down counter	CTUD	1		0.44	
Timer					
On-delay timer (0.1 ms)	TON_100us	2		0.46	
On-delay timer (1 ms)	TON	1		0.42	
On-delay timer (10 ms)	TON_10ms	2		0.46	
On-delay timer (100 ms)	TON_100ms	2		0.46	
On-delay timer (0.1 min)	TONM_P	2		0.46	
Off-delay timer (0.1 ms)	TOF_100us	2		0.52	
Off-delay timer (1 ms)	TOF	1		0.44	
Off-delay timer (10 ms)	TOF_10ms	2		0.52	
Off-delay timer (100 ms)	TOF_100ms	2		0.52	
Off-delay timer (0.1 min)	TOFM_P	2		0.52	
Pulse timer (0.1 ms)	TP_100us	2		0.50	
Pulse timer (1 ms)	TP	1		0.46	
Pulse timer (10 ms)	TP_10ms	2		0.50	
Pulse timer (100 ms)	TP_100ms	2		0.50	
Single shot (100 ms)	SS_P	2		0.44	
Single shot (0.1 min)	SSM_P	2		0.44	
Real time clock	RTC	2		—	
Real time clock	RTC_N	2	When changing time	30.74	
			When reading time	6.36	
On/Off-delay timer	DEL_L	2		—	
Flip-flop					
Set priority flip-flop	SR	2		0.40	
Reset priority flip-flop	RS	2		0.32	
Semaphore	SEMA	2		0.42	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Transfer					
Load	LD	1	Boolean	0.02	
			Integer	0.02	
			Double precision integer	0.04	
			Unsigned integer	0.02	
			Real	0.04	
			Duration	0.04	
			Date	0.04	
			Time	0.04	
			Date and time	0.48	
			Variable length character string	—	
			16-length bit string	0.02	
			32-length bit string	0.04	
			Index register	0.02	
Immediate value load	LD	1	Boolean	0.02	
		1	Integer	0.02	
		2	Double precision integer	0.04	
		1	Unsigned integer	0.02	
		2	Real	0.04	
		2	Duration	0.04	
		2	Date	0.04	
		2	Time	0.04	
		1	16-length bit string	0.02	
		2	32-length bit string	0.04	
Store	ST	1	Boolean	0.06	
			Integer	0.02	
			Double precision integer	0.04	
			Unsigned integer	0.02	
			Real	0.04	
			Duration	0.04	
			Date	0.04	
			Time	0.04	
			Date and time	0.48	
			Variable length character string	—	
			16-length bit string	0.02	
			32-length bit string	0.04	
			Index register	0.10	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Set store	SET	1	Boolean	0.06	
			Integer	0.14	
			Double precision integer	0.16	
			Unsigned integer	0.14	
			Real	0.16	
			Duration	0.16	
			Date	0.16	
			Time	0.16	
			Date and time	0.48	
			Variable length character string	—	
			16-length bit string	0.14	
			32-length bit string	0.16	
			Index register	0.22	
a contact gate		1		0.16	
b contact gate		1		0.16	
Data transfer	MOVE_INT	1	EN/ENO not used	0.02	
			EN/ENO used	0.18	
	MOVE_DINT	1	EN/ENO not used	0.02	
			EN/ENO used	0.18	
	MOVE_UINT	1	EN/ENO not used	0.02	
			EN/ENO used	0.18	
	MOVE_REAL	1	EN/ENO not used	0.02	
			EN/ENO used	0.18	
	MOVE_WORD	1	EN/ENO not used	0.02	
			EN/ENO used	0.18	
	MOVE_DWORD	1	EN/ENO not used	0.02	
			EN/ENO used	0.18	
	MOVE_TIME	1	EN/ENO not used	0.02	
			EN/ENO used	0.18	
	MOVE_TOD	1	EN/ENO not used	0.02	
			EN/ENO used	0.18	
	MOVE_DATE	1	EN/ENO not used	0.02	
			EN/ENO used	0.18	
	MOVE_DT	1	EN/ENO not used	3.66	
			EN/ENO used	3.82	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Data transfer	MOVE_STRING	1	EN/ENO not used	—	
			EN/ENO used	—	
Table transfer	TMOV	1	EN/ENO not used	3.12+0.06×N	N: No. of words
			EN/ENO used	3.34+0.06×N	N: No. of words
Data exchange	XCHG_INT	2		0.16	
	XCHG_DINT	2		0.20	
	XCHG_UINT	2		0.16	
	XCHG_REAL	2		0.20	
	XCHG_WORD	2		0.16	
	XCHG_DWORD	2		0.20	
	XCHG_TIME	2		0.20	
	XCHG_TOD	2		0.20	
	XCHG_DATE	2		0.20	
Table initialization	TINZ_INT	1	EN/ENO not used	1.90+0.02×N	N: No. of words
			EN/ENO used	2.04+0.02×N	N: No. of words
	TINZ_DINT	1	EN/ENO not used	1.90+0.04×N	N: No. of words
			EN/ENO used	2.04+0.04×N	N: No. of words
	TINZ_UINT	1	EN/ENO not used	1.90+0.02×N	N: No. of words
			EN/ENO used	2.04+0.02×N	N: No. of words
	TINZ_REAL	1	EN/ENO not used	1.90+0.04×N	N: No. of words
			EN/ENO used	2.04+0.04*N	N: No. of words
	TINZ_WORD	1	EN/ENO not used	1.90+0.02×N	N: No. of words
			EN/ENO used	2.04+0.02×N	N: No. of words
	TINZ_DWORD	1	EN/ENO not used	1.90+0.04×N	N: No. of words
			EN/ENO used	2.04+0.04×N	N: No. of words
	TINZ_TIME	1	EN/ENO not used	1.90+0.04×N	N: No. of words
			EN/ENO used	2.04+0.04×N	N: No. of words
	TINZ_TOD	1	EN/ENO not used	1.90+0.04×N	N: No. of words
			EN/ENO used	2.04+0.04×N	N: No. of words
	TINZ_DATE	1	EN/ENO not used	1.90+0.04×N	N: No. of words
			EN/ENO used	2.04+0.04×N	N: No. of words
	TINZ_DT	1	EN/ENO not used	—	
			EN/ENO used	—	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Comparison					
Larger than	GT_INT	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	GT_DINT	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	GT_UINT	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	GT_REAL	1	EN/ENO not used	0.16+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.30+0.06×(N-1)	N: No. of inputs
	GT_WORD	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	GT_DWORD	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	GT_TIME	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	GT_TOD	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	GT_DATE	1	EN/ENO not used	—	
			EN/ENO used	—	
	GT_DT	1	EN/ENO not used	—	
			EN/ENO used	—	
Larger than or equal	GE_INT	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	GE_DINT	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	GE_UINT	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	GE_REAL	1	EN/ENO not used	0.16+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.30+0.06×(N-1)	N: No. of inputs
	GE_WORD	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	GE_DWORD	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	GE_TIME	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	GE_TOD	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	GE_DATE	1	EN/ENO not used	—	
			EN/ENO used	—	
	GE_DT	1	EN/ENO not used	—	
			EN/ENO used	—	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Equal	EQ_INT	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	EQ_DINT	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	EQ_UINT	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	EQ_REAL	1	EN/ENO not used	0.16+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.30+0.06×(N-1)	N: No. of inputs
	EQ_WORD	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	EQ_DWORD	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	EQ_TIME	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	EQ_TOD	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	EQ_DATE	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	EQ_DT	1	EN/ENO not used	—	
			EN/ENO used	—	
Smaller than or equal	LE_INT	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	LE_DINT	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	LE_UINT	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	LE_REAL	1	EN/ENO not used	0.16+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.30+0.06×(N-1)	N: No. of inputs
	LE_WORD	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	LE_DWORD	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	LE_TIME	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	LE_TOD	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	LE_DATE	1	EN/ENO not used	—	
			EN/ENO used	—	
	LE_DT	1	EN/ENO not used	—	
			EN/ENO used	—	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Smaller than	LT_INT	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	LT_DINT	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	LT_UINT	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	LT_REAL	1	EN/ENO not used	0.16+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.30+0.06×(N-1)	N: No. of inputs
	LT_WORD	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	LT_DWORD	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	LT_TIME	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	LT_TOD	1	EN/ENO not used	0.12+0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.24+0.06×(N-1)	N: No. of inputs
	LT_DATE	1	EN/ENO not used	—	
			EN/ENO used	—	
	LT_DT	1	EN/ENO not used	—	
			EN/ENO used	—	
Not equal	NE_INT	1	EN/ENO not used	0.06	
			EN/ENO used	0.20	
	NE_DINT	1	EN/ENO not used	0.06	
			EN/ENO used	0.20	
	NE_UINT	1	EN/ENO not used	0.06	
			EN/ENO used	0.20	
	NE_REAL	1	EN/ENO not used	0.06	
			EN/ENO used	0.26	
	NE_WORD	1	EN/ENO not used	0.06	
			EN/ENO used	0.20	
	NE_DWORD	1	EN/ENO not used	0.06	
			EN/ENO used	0.20	
	NE_TIME	1	EN/ENO not used	0.06	
			EN/ENO used	0.20	
	NE_TOD	1	EN/ENO not used	0.06	
			EN/ENO used	0.20	
	NE_DATE	1	EN/ENO not used	0.06	
			EN/ENO used	0.20	
	NE_DT	1	EN/ENO not used	—	
			EN/ENO used	—	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Hysteresis comparison	GT_L	2		—	
	GE_L	2		—	
	LT_L	2		—	
	LE_L	2		—	
Selection					
Maximum value	MAX_INT	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.16+0.02×N	N: No. of inputs
	MAX_DINT	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.16+0.02×N	N: No. of inputs
	MAX_UINT	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.16+0.02×N	N: No. of inputs
	MAX_REAL	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.26+0.14×(N-1)	N: No. of inputs
	MAX_WORD	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.16+0.02×N	N: No. of inputs
	MAX_DWORD	1	EN/ENO not used	0.16+0.14×(N-1)	N: No. of inputs
			EN/ENO used	0.36+0.14×(N-1)	N: No. of inputs
	MAX_TIME	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.16+0.02×N	N: No. of inputs
	MAX_TOD	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.16+0.02×N	N: No. of inputs
	MAX_DATE	1	EN/ENO not used	—	
			EN/ENO used	—	
	MAX_DT	1	EN/ENO not used	—	
			EN/ENO used	—	
Table maximum value	MAXL_INT	1	EN/ENO not used	1.90+0.18×N	N: No. of inputs
			EN/ENO used	2.02+0.18×N	N: No. of inputs
	MAXL_DINT	1	EN/ENO not used	1.96+0.20×N	N: No. of inputs
			EN/ENO used	2.08+0.20×N	N: No. of inputs
	MAXL_UINT	1	EN/ENO not used	1.90+0.18×N	N: No. of inputs
			EN/ENO used	2.02+0.18×N	N: No. of inputs
	MAXL_REAL	1	EN/ENO not used	1.98+0.20×N	N: No. of inputs
			EN/ENO used	2.10+0.20×N	N: No. of inputs
	MAXL_TIME	1	EN/ENO not used	1.96+0.20×N	N: No. of inputs
			EN/ENO used	2.08+0.20×N	N: No. of inputs
	MAXL_TOD	1	EN/ENO not used	1.96+0.20×N	N: No. of inputs
			EN/ENO used	2.08+0.20×N	N: No. of inputs
	MAXL_DATE	1	EN/ENO not used	—	
			EN/ENO used	—	
	MAXL_DT	1	EN/ENO not used	—	
			EN/ENO used	—	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Minimum value	MIN_INT	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.16+0.02×N	N: No. of inputs
	MIN_DINT	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.16+0.02×N	N: No. of inputs
	MIN_UINT	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.16+0.02×N	N: No. of inputs
	MIN_REAL	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.26+0.14×(N-1)	N: No. of inputs
	MIN_WORD	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.16+0.02×N	N: No. of inputs
	MIN_DWORD	1	EN/ENO not used	0.16+0.14×(N-1)	N: No. of inputs
			EN/ENO used	0.36+0.14×N-1)	N: No. of inputs
	MIN_TIME	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.16+0.02×N	N: No. of inputs
	MIN_TOD	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.16+0.02×N	N: No. of inputs
	MIN_DATE	1	EN/ENO not used	—	
			EN/ENO used	—	
	MIN_DT	1	EN/ENO not used	—	
			EN/ENO used	—	
Table minimum value	MINL_INT	1	EN/ENO not used	1.90+0.18×N	N: No. of words
			EN/ENO used	2.02+0.18×N	N: No. of words
	MINL_DINT	1	EN/ENO not used	1.96+0.20×N	N: No. of words
			EN/ENO used	2.08+0.20×N	N: No. of words
	MINL_UINT	1	EN/ENO not used	1.90+0.18×N	N: No. of words
			EN/ENO used	2.02+0.18×N	N: No. of words
	MINL_REAL	1	EN/ENO not used	1.98+0.20×N	N: No. of words
			EN/ENO used	2.10+0.20×N	N: No. of words
	MINL_TIME	1	EN/ENO not used	1.96+0.20×N	N: No. of words
			EN/ENO used	2.08+0.20×N	N: No. of words
	MINL_TOD	1	EN/ENO not used	1.96+0.20×N	N: No. of words
			EN/ENO used	2.08+0.20×N	N: No. of words
	MINL_DATE	1	EN/ENO not used	—	
			EN/ENO used	—	
	MINL_DT	1	EN/ENO not used	—	
			EN/ENO used	—	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Average value	AVE_INT	1	EN/ENO not used	0.56+0.02×(N-1)	N: No. of words
			EN/ENO used	0.68+0.02×(N-1)	N: No. of words
	AVE_DINT	1	EN/ENO not used	1.24+0.34×N-1)	N: No. of words
			EN/ENO used	1.32+0.34×N-1)	N: No. of words
	AVE_UINT	1	EN/ENO not used	0.56+0.02×(N-1)	N: No. of words
			EN/ENO used	0.68+0.02×(N-1)	N: No. of words
	AVE_REAL	1	EN/ENO not used	0.62+0.08×(N-1)	N: No. of words
			EN/ENO used	0.74+0.08×(N-1)	N: No. of words
	AVE_TIME	1	EN/ENO not used	1.24+0.34×(N-1)	N: No. of words
			EN/ENO used	1.32+0.34×(N-1)	N: No. of words
Table average value	AVEL_INT	1	EN/ENO not used	2.14+0.06×N	N: No. of words
			EN/ENO used	2.26+0.06×N	N: No. of words
	AVEL_DINT	1	EN/ENO not used	2.90+0.36×N	N: No. of words
			EN/ENO used	3.02+0.36×N	N: No. of words
	AVEL_UINT	1	EN/ENO not used	2.14+0.06×N	N: No. of words
			EN/ENO used	2.26+0.06×N	N: No. of words
	AVEL_REAL	1	EN/ENO not used	2.16+0.12×N	N: No. of words
			EN/ENO used	2.28+0.12×N	N: No. of words
	AVEL_TIME	1	EN/ENO not used	2.90+0.36×N	N: No. of words
			EN/ENO used	3.02+0.36×N	N: No. of words
Upper/lower limit	LIMIT_INT	1	EN/ENO not used	0.04	
			EN/ENO used	0.24	
	LIMIT_DINT	1	EN/ENO not used	0.04	
			EN/ENO used	0.24	
	LIMIT_UINT	1	EN/ENO not used	0.04	
			EN/ENO used	0.24	
	LIMIT_REAL	1	EN/ENO not used	0.22	
			EN/ENO used	0.34	
	LIMIT_WORD	1	EN/ENO not used	0.04	
			EN/ENO used	0.24	
	LIMIT_DWORD	1	EN/ENO not used	0.40	
			EN/ENO used	0.52	
	LIMIT_TIME	1	EN/ENO not used	0.04	
			EN/ENO used	0.24	
	LIMIT_TOD	1	EN/ENO not used	0.04	
			EN/ENO used	0.24	
	LIMIT_DATE	1	EN/ENO not used	—	
			EN/ENO used	—	
	LIMIT_DT	1	EN/ENO not used	—	
			EN/ENO used	—	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Selector	SEL_BOOL	1	EN/ENO not used	0.26	
			EN/ENO used	0.38	
	SEL_INT	1	EN/ENO not used	0.26	
			EN/ENO used	0.34	
	SEL_DINT	1	EN/ENO not used	0.26	
			EN/ENO used	0.34	
	SEL_UINT	1	EN/ENO not used	0.26	
			EN/ENO used	0.34	
	SEL_REAL	1	EN/ENO not used	0.26	
			EN/ENO used	0.34	
	SEL_WORD	1	EN/ENO not used	0.26	
			EN/ENO used	0.34	
	SEL_DWORD	1	EN/ENO not used	0.26	
			EN/ENO used	0.34	
	SEL_TIME	1	EN/ENO not used	0.26	
			EN/ENO used	0.34	
	SEL_TOD	1	EN/ENO not used	0.26	
			EN/ENO used	0.34	
	SEL_DATE	1	EN/ENO not used	0.26	
			EN/ENO used	0.34	
	SEL_DT	1	EN/ENO not used	—	
			EN/ENO used	—	
Multiplexer	MUX_BOOL	1	EN/ENO not used	0.46	
			EN/ENO used	0.60	
	MUX_INT	1	EN/ENO not used	0.66	
			EN/ENO used	0.76	
	MUX_DINT	1	EN/ENO not used	0.66	
			EN/ENO used	0.76	
	MUX_UINT	1	EN/ENO not used	0.66	
			EN/ENO used	0.76	
	MUX_WORD	1	EN/ENO not used	0.66	
			EN/ENO used	0.76	
	MUX_DWORD	1	EN/ENO not used	0.66	
			EN/ENO used	0.76	
	MUX_REAL	1	EN/ENO not used	0.66	
			EN/ENO used	0.76	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Multiplexer	MUX_TIME	1	EN/ENO not used	0.66	
			EN/ENO used	0.76	
	MUX_TOD	1	EN/ENO not used	0.66	
			EN/ENO used	0.76	
	MUX_DATE	1	EN/ENO not used	0.66	
			EN/ENO used	0.76	
	MUX_DT	1	EN/ENO not used	—	
			EN/ENO used	—	
Table multiplexer	MPX_INT	1	EN/ENO not used	1.90	
			EN/ENO used	2.02	
	MPX_DINT	1	EN/ENO not used	1.98	
			EN/ENO used	2.10	
	MPX_UINT	1	EN/ENO not used	2.00	
			EN/ENO used	2.12	
	MPX_WORD	1	EN/ENO not used	2.00	
			EN/ENO used	2.12	
	MPX_DWORD	1	EN/ENO not used	1.98	
			EN/ENO used	2.10	
	MPX_REAL	1	EN/ENO not used	1.98	
			EN/ENO used	2.10	
	MPX_TIME	1	EN/ENO not used	1.98	
			EN/ENO used	2.10	
	MPX_TOD	1	EN/ENO not used	1.98	
			EN/ENO used	2.10	
	MPX_DATE	1	EN/ENO not used	1.98	
			EN/ENO used	2.10	
	MPX_DT	1	EN/ENO not used	—	
			EN/ENO used	—	
Type conversion					
Integer→ Integer conversion	INT_TO_DINT	1	EN/ENO not used	0.02	
			EN/ENO used	0.18	
	INT_TO_UINT	1	EN/ENO not used	0.08	
			EN/ENO used	0.20	
	DINT_TO_INT	1	EN/ENO not used	0.02	
			EN/ENO used	0.16	

D

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
nteger→ Integer conversion	DINT_TO_UINT	1	EN/ENO not used	0.08	
			EN/ENO used	0.20	
	UINT_TO_INT	1	EN/ENO not used	0.02	
			EN/ENO used	0.20	
	UINT_TO_DINT	1	EN/ENO not used	0.02	
			EN/ENO used	0.18	
Integer→ Real conversion	INT_TO_REAL	1	EN/ENO not used	0.04	
			EN/ENO used	0.22	
	DINT_TO_REAL	1	EN/ENO not used	0.04	
			EN/ENO used	0.22	
	UINT_TO_REAL	1	EN/ENO not used	0.04	
			EN/ENO used	0.22	
Integer→ Bit string conversion	INT_TO_WORD	1	EN/ENO not used	0.02	
			EN/ENO used	0.20	
	INT_TO_DWORD	1	EN/ENO not used	0.06	
			EN/ENO used	0.18	
	DINT_TO_WORD	1	EN/ENO not used	0.10	
			EN/ENO used	0.22	
	DINT_TO_DWORD	1	EN/ENO not used	0.06	
			EN/ENO used	0.18	
	UINT_TO_WORD	1	EN/ENO not used	0.06	
			EN/ENO used	0.18	
	UINT_TO_DWORD	1	EN/ENO not used	0.06	
			EN/ENO used	0.18	
Integer→ BCD conversion	INT_TO_BCD_WORD	1	EN/ENO not used	0.98	
			EN/ENO used	1.10	
	INT_TO_BCD_DWORD	1	EN/ENO not used	0.98	
			EN/ENO used	1.10	
	DINT_TO_BCD_WORD	1	EN/ENO not used	0.98	
			EN/ENO used	1.10	
	DINT_TO_BCD_DWORD	1	EN/ENO not used	0.98	
			EN/ENO used	1.10	
	UINT_TO_BCD_WORD	1	EN/ENO not used	0.96	
			EN/ENO used	1.08	
	UINT_TO_BCD_DWORD	1	EN/ENO not used	0.98	
			EN/ENO used	1.10	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Integer→ Elapsed time conversion	INT_TO_TIME	1	EN/ENO not used	0.02	
			EN/ENO used	0.18	
	DINT_TO_TIME	1	EN/ENO not used	0.02	
			EN/ENO used	0.18	
	UINT_TO_TIME	1	EN/ENO not used	0.02	
			EN/ENO used	0.18	
Real→ Integer conversion	REAL_TO_INT	1	EN/ENO not used	0.06	
			EN/ENO used	0.26	
	REAL_TO_DINT	1	EN/ENO not used	0.04	
			EN/ENO used	0.24	
	REAL_TO_UINT	1	EN/ENO not used	0.22	
			EN/ENO used	0.34	
Real → BCD conversion	REAL_TO_BCD_WORD	1	EN/ENO not used	1.12	
			EN/ENO used	1.24	
	REAL_TO_BCD_DWORD	1	EN/ENO not used	1.12	
			EN/ENO used	1.24	
Real → Elapsed time conversion	REAL_TO_TIME	1	EN/ENO not used	0.04	
			EN/ENO used	0.24	
Bit string → Integer conversion	WORD_TO_INT	1	EN/ENO not used	0.02	
			EN/ENO used	0.38	
	WORD_TO_DINT	1	EN/ENO not used	0.02	
			EN/ENO used	0.38	
	WORD_TO_UINT	1	EN/ENO not used	0.06	
			EN/ENO used	0.18	
	DWORD_TO_INT	1	EN/ENO not used	0.02	
			EN/ENO used	0.20	
	DWORD_TO_DINT	1	EN/ENO not used	0.06	
			EN/ENO used	0.18	
	DWORD_TO_UINT	1	EN/ENO not used	0.02	
			EN/ENO used	0.20	
Bit string → Bit string conversion	WORD_TO_DWORD	1	EN/ENO not used	0.02	
			EN/ENO used	0.18	
	DWORD_TO_WORD	1	EN/ENO not used	0.02	
			EN/ENO used	0.20	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
BCD→ Integer conversion	WORD_BCD_TO_INT	1	EN/ENO not used	1.00	
			EN/ENO used	1.12	
	WORD_BCD_TO_DINT	1	EN/ENO not used	1.00	
			EN/ENO used	1.12	
	WORD_BCD_TO_UINT	1	EN/ENO not used	1.00	
			EN/ENO used	1.12	
	DWORD_BCD_TO_INT	1	EN/ENO not used	1.16	
			EN/ENO used	1.28	
	DWORD_BCD_TO_DINT	1	EN/ENO not used	0.98	
			EN/ENO used	1.12	
	DWORD_BCD_TO_UINT	1	EN/ENO not used	1.16	
			EN/ENO used	1.28	
BCD→ Real conversion	WORD_BCD_TO_REAL	1	EN/ENO not used	1.12	
			EN/ENO used	1.24	
	DWORD_BCD_TO_REAL	1	EN/ENO not used	1.12	
			EN/ENO used	1.24	
BCD→ Elapsed time conversion	WORD_BCD_TO_TIME	1	EN/ENO not used	1.00	
			EN/ENO used	1.12	
	DWORD_BCD_TO_TIME	1	EN/ENO not used	0.98	
			EN/ENO used	1.12	
Elapsed time→ Integer conversion	TIME_TO_INT	1	EN/ENO not used	0.02	
			EN/ENO used	0.20	
	TIME_TO_DINT	1	EN/ENO not used	0.02	
			EN/ENO used	0.18	
	TIME_TO_UINT	1	EN/ENO not used	0.08	
			EN/ENO used	0.20	
Elapsed time→ Real conversion	TIME_TO_REAL	1	EN/ENO not used	0.04	
			EN/ENO used	0.22	
Elapsed time→ BCD conversion	TIME_TO_BCD_WORD	1	EN/ENO not used	0.98	
			EN/ENO used	1.10	
	TIME_TO_BCD_DWORD	1	EN/ENO not used	0.98	
			EN/ENO used	1.10	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Truncation	TRUNC_INT	1	EN/ENO not used	0.06	
			EN/ENO used	0.26	
	TRUNC_DINT	1	EN/ENO not used	0.04	
			EN/ENO used	0.24	
	TRUNC_UINT	1	EN/ENO not used	0.06	
			EN/ENO used	0.26	
Sign inversion	NEG_INT	1	EN/ENO not used	0.02	
			EN/ENO used	0.20	
	NEG_DINT	1	EN/ENO not used	0.02	
			EN/ENO used	0.20	
	NEG_REAL	1	EN/ENO not used	0.02	
			EN/ENO used	0.20	
DEG→ RAD conversion	DEG_TO_RAD	1	EN/ENO not used	0.24	
			EN/ENO used	0.36	
RAD→ DEG conversion	RAD_TO_DEG	1	EN/ENO not used	0.24	
			EN/ENO used	0.36	
BIN conversion	BIN_INT_P	1	EN/ENO not used	1.82	
			EN/ENO used	1.94	
	BIN_DINT_P	1	EN/ENO not used	2.48	
			EN/ENO used	2.60	
Time data conversion	DT_TO_TOD	1	EN/ENO not used	1.96	
			EN/ENO used	2.08	
	DT_TO_DATE	1	EN/ENO not used	1.94	
			EN/ENO used	2.06	
Time data connection	CONCAT_D_TOD	1	EN/ENO not used	2.00	
			EN/ENO used	2.18	
ASCII→ HEX conversion	ATOH_T	1	EN/ENO not used	4.14+1.18×N	N: No. of words
			EN/ENO used	4.30+1.18+N	N: No. of words
HEX→ ASCII conversion	HTOA_T	1	EN/ENO not used	3.42+1.04×N	N: No. of words
			EN/ENO used	3.58+1.04×N	N: No. of words
ASCII→ Real conversion	ASC_TO_REAL	1	EN/ENO not used	—	
			EN/ENO used	—	
Real→ ASCII conversion	REAL_TO_ASC	1	EN/ENO not used	—	
			EN/ENO used	—	
ASCII (decimal)→ Double precision integer conversion	ASCDEC_TO_DINT	1	EN/ENO not used	2.28+1.34×N	N: Table size
			EN/ENO used	2.40+1.34×N	N: Table size

D

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
ASCII (Hexadecimal) →Double precision integer conversion	ASCHEX_TO_DINT	1	EN/ENO not used	1.96+1.38×N	N: Table size
			EN/ENO used	2.08+1.38×N	N: Table size
Double precision integer→ASCII (Decimal) conversion	DINT_TO_ASCDEC	1	EN/ENO not used	2.86+0.72×N	N: Table size
			EN/ENO used	3.02+0.72×N	N: Table size
Double precision integer→ASCII (Hexadecimal) conversion	DINT_TO_ASCHEX	1	EN/ENO not used	4.78+0.10×N	N: Table size
			EN/ENO used	5.00+0.10×N	N: Table size
Array→ String conversion	ARRAY_TO_STRING	1	EN/ENO not used	—	
			EN/ENO used	—	
String→ Array conversion	STRING_TO_ARRAY	1	EN/ENO not used	—	
			EN/ENO used	—	
Tag No. conversion	TO_INDEX	1	EN/ENO not used	—	
			EN/ENO used	—	
Numerical function					
Square root	SQRT	1	EN/ENO not used	0.54	
			EN/ENO used	0.66	
Exponential	EXP	1	EN/ENO not used	2.72	
			EN/ENO used	2.84	
Common logarithm	LOG	1	EN/ENO not used	4.62	
			EN/ENO used	4.74	
Natural logarithm	LN	1	EN/ENO not used	4.52	
			EN/ENO used	4.64	
Absolute value	ABS_INT	1	EN/ENO not used	0.02	
			EN/ENO used	0.20	
	ABS_DINT	1	EN/ENO not used	0.02	
			EN/ENO used	0.20	
	ABS_REAL	1	EN/ENO not used	0.02	
			EN/ENO used	0.20	
Sine	SIN	1	EN/ENO not used	2.64	
			EN/ENO used	2.76	
Cosine	COS	1	EN/ENO not used	2.64	
			EN/ENO used	2.76	
Tangent	TAN	1	EN/ENO not used	3.32	
			EN/ENO used	3.44	
Inverse sine	ASIN	1	EN/ENO not used	2.86	
			EN/ENO used	2.98	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Inverse cosine	ACOS	1	EN/ENO not used	3.06	
			EN/ENO used	3.18	
Inverse tangent	ATAN	1	EN/ENO not used	3.06	
			EN/ENO used	3.18	
Logical operation					
AND	AND_BOOL	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.14+0.02× (N-1)	N: No. of inputs
	AND_WORD	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.18+0.02×(N-1)	N: No. of inputs
	AND_DWORD	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.18+0.02×(N-1)	N: No. of inputs
Table AND	TAND	1	EN/ENO not used	4.90+0.28×N	N: Table size
			EN/ENO used	5.06+0.28×N	N: Table size
OR	OR_BOOL	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.14+0.02×(N-1)	N: No. of inputs
	OR_WORD	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.18+0.02×(N-1)	N: No. of inputs
	OR_DWORD	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.18+0.02×(N-1)	N: No. of inputs
Table OR	TOR	1	EN/ENO not used	4.90+0.28×N	N: Table size
			EN/ENO used	5.06+0.28×N	N: Table size
NOT	NOT_BOOL	1	EN/ENO not used	0.02	
			EN/ENO used	0.16	
	NOT_WORD	1	EN/ENO not used	0.02	
			EN/ENO used	0.20	
	NOT_DWORD	1	EN/ENO not used	0.02	
			EN/ENO used	0.20	
Table NOT	TNOT	1	EN/ENO not used	3.12+0.08×N	N: Table size
			EN/ENO used	3.36+0.08×N	N: Table size
Exclusive OR	XOR_BOOL	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.14+0.02×(N-1)	N: No. of inputs
	XOR_WORD	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.18+0.02×(N-1)	N: No. of inputs
	XOR_DWORD	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.18+0.02×(N-1)	N: No. of inputs

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Table exclusive OR	TXOR	1	EN/ENO not used	4.90+0.28×N	N: Table size
			EN/ENO used	5.06+0.28×N	N: Table size
Table negative exclusive OR	TXNR	1	EN/ENO not used	4.90+0.28×N	N: Table size
			EN/ENO used	5.06+0.28×N	N: Table size
Test	TEST_WORD	1	EN/ENO not used	0.06	
			EN/ENO used	0.20	
	TEST_DWORD	1	EN/ENO not used	0.06	
			EN/ENO used	0.20	
Bit operation					
Bit right shift	SHR_WORD	1	EN/ENO not used	0.80	
			EN/ENO used	0.92	
	SHR_DWORD	1	EN/ENO not used	0.84	
			EN/ENO used	0.96	
Bit left shift	SHL_WORD	1	EN/ENO not used	0.86	
			EN/ENO used	0.98	
	SHL_DWORD	1	EN/ENO not used	0.86	
			EN/ENO used	0.98	
Bit right rotate	ROR_WORD	1	EN/ENO not used	0.84	
			EN/ENO used	0.96	
	ROR_DWORD	1	EN/ENO not used	0.84	
			EN/ENO used	0.96	
Bit left rotate	ROL_WORD	1	EN/ENO not used	0.90	
			EN/ENO used	1.02	
	ROL_DWORD	1	EN/ENO not used	0.90	
			EN/ENO used	1.02	
Arithmetic shift	SFA_WORD_P	1	EN/ENO not used	0.28	
			EN/ENO used	0.40	
	SFA_DWORD_P	1	EN/ENO not used	0.28	
			EN/ENO used	0.40	
Logical shift	SFL_WORD_P	1	EN/ENO not used	0.28	
			EN/ENO used	0.40	
	SFL_DWORD_P	1	EN/ENO not used	0.28	
			EN/ENO used	0.40	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Arithmetic operation					
Add	ADD_INT	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.18+0.02×(N-1)	N: No. of inputs
	ADD_DINT	1	EN/ENO not used	0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.18+0.02×(N-1)	N: No. of inputs
	ADD_UINT	1	EN/ENO not used	0.02+0.02×(N-1)	N: No. of inputs
			EN/ENO used	0.20+0.02×(N-1)	N: No. of inputs
	ADD_REAL	1	EN/ENO not used	0.04+0.08×(N-1)	N: No. of inputs
			EN/ENO used	0.18+0.08×(N-1)	N: No. of inputs
Add with carry	ADC_INT	1	EN/ENO not used	1.40	
			EN/ENO used	1.58	
	ADC_DINT	1	EN/ENO not used	1.28	
			EN/ENO used	1.46	
Subtract	SUB_INT	1	EN/ENO not used	0.02	
			EN/ENO used	0.20	
	SUB_DINT	1	EN/ENO not used	0.02	
			EN/ENO used	0.20	
	SUB_UINT	1	EN/ENO not used	0.22	
			EN/ENO used	0.34	
	SUB_REAL	1	EN/ENO not used	0.06	
			EN/ENO used	0.24	
Subtract with carry	SBB_INT	1	EN/ENO not used	1.40	
			EN/ENO used	1.58	
	SBB_DINT	1	EN/ENO not used	1.28	
			EN/ENO used	1.46	
Multiply	MUL_INT	1	EN/ENO not used	0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.28+0.06×(N-1)	N: No. of inputs
	MUL_DINT	1	EN/ENO not used	0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.28+0.06×(N-1)	N: No. of inputs
	MUL_UINT	1	EN/ENO not used	0.06×(N-1)	N: No. of inputs
			EN/ENO used	0.28+0.06×(N-1)	N: No. of inputs
	MUL_REAL	1	EN/ENO not used	0.04+0.08×(N-1)	N: No. of inputs
			EN/ENO used	0.28+0.08×(N-1)	N: No. of inputs
	MUL_INT_DINT	1	EN/ENO not used	0.04	
			EN/ENO used	0.22	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Divide	DIV_INT	1	EN/ENO not used	0.48	
			EN/ENO used	0.60	
	DIV_DINT	1	EN/ENO not used	0.64	
			EN/ENO used	0.76	
	DIV_UINT	1	EN/ENO not used	0.74	
			EN/ENO used	0.86	
	DIV_REAL	1	EN/ENO not used	0.54	
			EN/ENO used	0.64	
Remainder	MOD_INT	1	EN/ENO not used	0.48	
			EN/ENO used	0.60	
	MOD_DINT	1	EN/ENO not used	0.64	
			EN/ENO used	0.76	
	MOD_UINT	1	EN/ENO not used	0.58	
			EN/ENO used	0.70	
Increment	INC_INT	1	EN/ENO not used	2.56	
			EN/ENO used	2.68	
	INC_DINT	1	EN/ENO not used	2.58	
			EN/ENO used	2.70	
	INC_UINT	1	EN/ENO not used	—	
			EN/ENO used	—	
	INC_REAL	1	EN/ENO not used	—	
			EN/ENO used	—	
	INC_TIME	1	EN/ENO not used	—	
			EN/ENO used	—	
Decrement	DEC_INT	1	EN/ENO not used	2.56	
			EN/ENO used	2.68	
	DEC_DINT	1	EN/ENO not used	2.58	
			EN/ENO used	2.70	
	DEC_UINT	1	EN/ENO not used	—	
			EN/ENO used	—	
	DEC_REAL	1	EN/ENO not used	—	
			EN/ENO used	—	
	DEC_TIME	1	EN/ENO not used	—	
			EN/ENO used	—	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Exponent	EXPT_INT	1	EN/ENO not used	1.60	
			EN/ENO used	1.72	
	EXPT_DINT	1	EN/ENO not used	1.60	
			EN/ENO used	1.72	
	EXPT_UINT	1	EN/ENO not used	1.60	
			EN/ENO used	1.72	
	EXPT_REAL	1	EN/ENO not used	2.22	
			EN/ENO used	2.34	
Add time data	ADD_T_T	1	EN/ENO not used	—	
			EN/ENO used	—	
	ADD_TOD_T	1	EN/ENO not used	—	
			EN/ENO used	—	
	ADD_DT_T	1	EN/ENO not used	—	
			EN/ENO used	—	
	ADD_D_INT	1	EN/ENO not used	—	
			EN/ENO used	—	
	ADD_D_DINT	1	EN/ENO not used	—	
			EN/ENO used	—	
	ADD_D_UINT	1	EN/ENO not used	—	
			EN/ENO used	—	
Subtract time data	SUB_T_T	1	EN/ENO not used	—	
			EN/ENO used	—	
	SUB_D_D	1	EN/ENO not used	—	
			EN/ENO used	—	
	SUB_TOD_T	1	EN/ENO not used	—	
			EN/ENO used	—	
	SUB_TOD_TOD	1	EN/ENO not used	—	
			EN/ENO used	—	
	SUB_DT_T	1	EN/ENO not used	—	
			EN/ENO used	—	
	SUB_DT_DT	1	EN/ENO not used	—	
			EN/ENO used	—	
	SUB_D_D_INT	1	EN/ENO not used	—	
			EN/ENO used	—	
	SUB_D_D_DINT	1	EN/ENO not used	—	
			EN/ENO used	—	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Subtract time data	SUB_D_D_UINT	1	EN/ENO not used	—	
			EN/ENO used	—	
	SUB_D_INT	1	EN/ENO not used	—	
			EN/ENO used	—	
	SUB_D_DINT	1	EN/ENO not used	—	
			EN/ENO used	—	
	SUB_D_UINT	1	EN/ENO not used	—	
			EN/ENO used	—	
Multiply time data	MUL_T_INT	1	EN/ENO not used	—	
			EN/ENO used	—	
	MUL_T_DINT	1	EN/ENO not used	—	
			EN/ENO used	—	
	MUL_T_UINT	1	EN/ENO not used	—	
			EN/ENO used	—	
Divide time data	DIV_T_INT	1	EN/ENO not used	—	
			EN/ENO used	—	
	DIV_T_DINT	1	EN/ENO not used	—	
			EN/ENO used	—	
	DIV_T_UINT	1	EN/ENO not used	—	
			EN/ENO used	—	
Data processing					
Set carry	SETC	1		0.64	
Reset carry	RSTC	1		0.64	
Encode	ENC_WORD_INT	1	EN/ENO not used	0.36	
			EN/ENO used	0.48	
	ENC_WORD_DINT	1	EN/ENO not used	0.36	
			EN/ENO used	0.48	
	ENC_DWORD_INT	1	EN/ENO not used	0.36	
			EN/ENO used	0.48	
	ENC_DWORD_DINT	1	EN/ENO not used	0.36	
			EN/ENO used	0.48	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Data processing					
Decode	DEC_INT_WORD	1	EN/ENO not used	2.54	
			EN/ENO used	2.66	
	DEC_INT_DWORD	1	EN/ENO not used	2.66	
			EN/ENO used	2.78	
	DEC_DINT_WORD	1	EN/ENO not used	2.54	
			EN/ENO used	2.66	
	DEC_DINT_DWORD	1	EN/ENO not used	2.66	
			EN/ENO used	2.78	
Bit counter	BC_WORD	1	EN/ENO not used	1.18	
			EN/ENO used	1.30	
	BC_DWORD	1	EN/ENO not used	2.14	
			EN/ENO used	2.26	
Table bit set	TSET_INT	1	EN/ENO not used	3.24	
			EN/ENO used	3.38	
	TSET_DINT	1	EN/ENO not used	3.24	
			EN/ENO used	3.38	
	TSET_WORD	1	EN/ENO not used	3.24	
			EN/ENO used	3.38	
	TSET_DWORD	1	EN/ENO not used	3.24	
			EN/ENO used	3.38	
Table bit reset	TRST_INT	1	EN/ENO not used	3.24	
			EN/ENO used	3.38	
	TRST_DINT	1	EN/ENO not used	3.24	
			EN/ENO used	3.38	
	TRST_WORD	1	EN/ENO not used	3.24	
			EN/ENO used	3.38	
	TRST_DWORD	1	EN/ENO not used	3.24	
			EN/ENO used	3.38	
Input/output					
Special module data input	MREAD	1		—	
Special module data output	MWRITE	1		—	
Special module data input	MREAD_N	2			N: No. of words
Special module data output	MWRITE_N	2			N: No. of words

D

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
ASC module character string data input	ASCREAD	1		—	
ASC module character string data output	ASCWRITE	1		—	
Get status change detection	GET_IP_INF	1	EN/ENO not used	1.88	
			EN/ENO used	2.04	
Direct input/output	IO_T	1	EN/ENO not used	—	N: No. of words
			EN/ENO used	—	N: No. of words
Get I/O node status	GET_SIO_STS	1	EN/ENO not used	2.42	
			EN/ENO used	2.50	
Get I/O module status	GET_IO_STS	1	EN/ENO not used	2.24	
			EN/ENO used	2.32	
Request I/O degeneracy	IOFB_REQ	1	EN/ENO not used	1.54	
			EN/ENO used	1.62	
Request I/O degeneracy recovery	IORC_REQ	1	EN/ENO not used	1.54	
			EN/ENO used	1.62	
Process function					
Dead band	DB_INT	1	EN/ENO not used	0.32	
			EN/ENO used	0.44	
	DB_DINT	1	EN/ENO not used	0.40	
			EN/ENO used	0.52	
	DB_REAL	1	EN/ENO not used	0.38	
			EN/ENO used	0.50	
Differential	DIF2	2	Initialization	1.92	
			Ordinary	1.90	
Integral	INTG	2	Initialization	0.64	
			Ordinary	1.38	
Super 2 degree of freedom PID	PID2	2	Initialization	10.56	
			Ordinary	10.34	
MV operation	MVS	2	MV operation	3.08	
			Tracking	2.78	
MV fixed value registration	MVF	1	EN/ENO not used	3.40	
			EN/ENO used	3.52	

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Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Polygonal line	PLN_INT	1	EN/ENO not used	4.62+0.98×N	N: No. of referred points
			EN/ENO used	4.74+0.98×N	N: No. of referred points
	PLN_REAL	1	EN/ENO not used	3.38+1.30×N	N: No. of referred points
			EN/ENO used	3.50+1.30×N	N: No. of referred points
	PLN_REAL2	1	EN/ENO not used	3.04+0.40×N	N: No. of referred points
			EN/ENO used	3.24+0.40×N	N: No. of referred points
Inverse polygonal line	ILNL_INT	1	EN/ENO not used	4.48+1.32×N	N: No. of referred points
			EN/ENO used	4.60+1.32×N	N: No. of referred points
	ILNL_REAL	1	EN/ENO not used	2.96+1.68×N	N: No. of referred points
			EN/ENO used	3.08+1.68×N	N: No. of referred points
	ILNL_REAL2	1	EN/ENO not used	2.60+0.78×N	N: No. of referred points
			EN/ENO used	2.84+0.78×N	N: No. of referred points
Dead time	DT	1	EN/ENO not used	4.62+0.04×N	N: No. of words
			EN/ENO used	4.96+0.04×N	N: No. of words
Moving average (high speed)	MAV	1	EN/ENO not used	6.12	
			EN/ENO used	6.42	
Moving average (low speed)	MAV_N	1	EN/ENO not used	7.24+0.32×N	N: No. of samples
			EN/ENO used	7.50+0.32×N	N: No. of samples
Rate of change limit	DLM_INT	2	E=0	0.54	
			E=1	0.76	
	DLM_DINT	2	E=0	0.60	
			E=1	1.04	
	DLM_REAL	2	E=0	0.62	
			E=1	0.92	
Phase lag/lead	LAG2	2	E=0	2.36	
			E=1	2.34	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Industrial unit conversion	UNT	1	EN/ENO not used	2.66	
			EN/ENO used	2.78	
% conversion	PCT	1	EN/ENO not used	2.74	
			EN/ENO used	2.86	
Quality successive PID	PID3	2	Initialization	12.62	
			Execute	17.20	
Accumulate with reset	RSM_L	2		—	
Program control					
Functional return	RETURN	1		0.88	
Functional block return	RETURN	1		0.88	
User definition function call <Boolean>	—	1		1.70+0.04×N	N: No. of inputs
User definition function call <Other than Boolean>	—	1		1.64+0.04×N	N: No. of inputs
User definition function block call	—	2		1.58+0.04×N	N: No. of inputs
Program call	—	3	MS task	5.26+0.04×N	N: No. of inputs
			Other than MS task	3.40+0.04×N	
Enable program execution	EN_P	1	EN/ENO not used	4.06	
			EN/ENO used	4.18	
Disable program execution	DIS_P	1	EN/ENO not used	4.10	
			EN/ENO used	4.22	
Start event program	START_P	1	EN/ENO not used	2.32	
			EN/ENO used	2.46	
Enable interrupt	EI_T	1	EN/ENO not used	0.20	
			EN/ENO used	0.32	
Disable interrupt	DI_T	1	EN/ENO not used	0.20	
			EN/ENO used	0.32	
Character processing					
Character string length	LEN	1	EN/ENO not used	—	
			EN/ENO used	—	
Character string left extract	LEFT	1	EN/ENO not used	—	
			EN/ENO used	—	
Character string right extract	RIGHT	1	EN/ENO not used	—	
			EN/ENO used	—	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Character string extract	MID	1	EN/ENO not used	—	
			EN/ENO used	—	
Character string connect	CONCAT	1	EN/ENO not used	—	
			EN/ENO used	—	
Character string insert	INSERT	1	EN/ENO not used	—	
			EN/ENO used	—	
Character string delete	DELETE	1	EN/ENO not used	—	
			EN/ENO used	—	
Character string replace	REPLACE	1	EN/ENO not used	—	
			EN/ENO used	—	
Character string find	FIND	1	EN/ENO not used	—	
			EN/ENO used	—	
Character string define	DEF_STRING	1	EN/ENO not used	—	
			EN/ENO used	—	
Control syntax					
IF	IF	1		0.02	
THEN	THEN	1	Condition established	0.12	
			Condition not established	0.64	
ELSE (IF syntax)	ELSE	1	Condition established	0.14	
			Condition not established	0.68	
ELSEIF	ELSEIF	1	Condition established	0.14	
			Condition not established	0.68	
END_IF	END_IF	1		0.02	
CASE	CASE	1		0.12	
:	:	1	Condition established	0.22	
			Condition not established	0.62	
. .	. .	1	Condition established	0.30	
			Condition not established	0.68	
: ,	: ,	1	Condition established	0.22	
			Condition not established	0.64	
. . ,	. . ,	1	Condition established	0.32	
			Condition not established	0.74	

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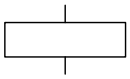
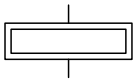
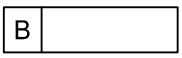
Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
ELSE (CASE syntax)	ELSE	1	Condition established	0.14	
			Condition not established	0.68	
END_CASE	END_CASE	1		0.02	
FOR_DO	FOR_DO	1	Loop condition established	0.24	
			Loop condition not established	0.84	
EXIT (FOR syntax)	EXIT	1		0.56	
END_FOR	END_FOR	1		0.82	
WHILE	WHILE	1		0.02	
DO	DO	1	WHILE condition established	0.12	
			WHILE condition not established	0.64	
EXIT (WHILE syntax)	EXIT	1		0.56	
END_WHILE	END_WHILE	1		0.58	
REPEAT	REPEAT	1		0.02	
UNTIL	UNTIL	1		0.02	
EXIT (REPEAT syntax)	EXIT	1		0.56	
END_REPERT	END_REPERT	1	REPEAT condition not established	0.12	
			REPEAT condition established	0.66	
Communication					
Socket comm. send	USEND_T	2		—	
Socket comm. sent	USEND_N	2			
Socket comm. receive	URCV_T	2		—	
Socket comm. receive	URCV_N	2			
Comm. FB(XMIT_T)	XMIT_T	2		—	
Comm. FB(XMIT_N)	XMIT_N	2			
Duplex operation control					
Duplex system Online/Standby switch	DUPLEX_CHG	1			
Duplex system Own system down	DUPLEX_DOWN	1			
Partial equalization (Variable designated)	EQUALIZE_VAR	1	EN/ENO not used	—	
			EN/ENO used	—	
Partial equalization (Address designated)	EQUALIZE_ADDR	1	EN/ENO not used	—	
			EN/ENO used	—	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Process control					
Current output PID	PID_P	2		—	
Current output sample PI	SPI_P	2		—	
Pulse output	PIDP_P	2		—	
Pulse output sample PI	SPIP_P	2		—	
Feed forward	FFD_P	2		—	
Double cross limit	DCL_P	2		—	
Tag operation					
Controller mode change	CMLP_P	1	EN/ENO not used	—	
			EN/ENO used	—	
Push button mode change	CMPB_P	1	EN/ENO not used	—	
			EN/ENO used	—	
Sequence mode change	CMSQ_P	1	EN/ENO not used	—	
			EN/ENO used	—	
Set SV	SSV_P	1	EN/ENO not used	—	
			EN/ENO used	—	
Reset SV	RSV_P	1	EN/ENO not used	—	
			EN/ENO used	—	
Set MV	SMV_P	1	EN/ENO not used	—	
			EN/ENO used	—	
Reset MV	RMV_P	1	EN/ENO not used	—	
			EN/ENO used	—	
Shut CV	SCV_P	1	EN/ENO not used	—	
			EN/ENO used	—	
Push button ON	PB_P	1	EN/ENO not used	—	
			EN/ENO used	—	
Push button lock	LB_P	1	EN/ENO not used	—	
			EN/ENO used	—	
Action timer	ACT_P	1	EN/ENO not used	—	
			EN/ENO used	—	
Action counter	ACC_P	1	EN/ENO not used	—	
			EN/ENO used	—	
Own step jump	SJ_P	1	EN/ENO not used	—	
			EN/ENO used	—	
Reset jump	RJ_P	1	EN/ENO not used	—	
			EN/ENO used	—	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
RAS					
Cyclic trace	DATALOG_C	2		1.02	
Diagnosis of condition not established	DIAG_D	2		6.40+1.00×N	
Get calendar data	GET_CLND	1		0.2	
				0.30	
SFC					
Step		1		0.38	
Initial step		2	Initialization	0.60+0.06×N	N: No. of steps
			Ordinary	0.42	
Transition		2		0.62	
Selection branch		2	Branch	0.60×N	N: No. of branches
			Join	0.60×N	N: No. of joints
Parallel branch		2	Branch	0.56+0.24×N	N: No. of branches
			Join	0.38+0.40×N	N: No. of joints
Link		2			N: No. of steps
Action (Boolean)		3	N or not specified	0.86	
			R	0.88	
			S	0.94	
			L	1.20	
			D	1.22	
			P	0.96	
			P1	0.94	
			P0	0.86	
			SD	1.26	
			DS	1.36	
			SL	1.34	
			NH	0.82	
			SH	0.92	
			LH	1.34	
			DH	1.36	

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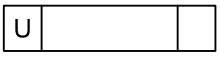
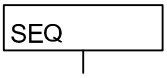
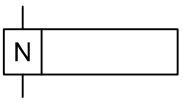
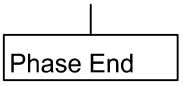
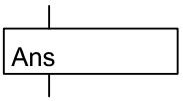
Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type1	
Action (User definition)		3/5	N or not specified	2.70	
			R	2.72	
			S	2.78	
			L	3.04	
			D	3.06	
			P	2.80	
			P1	2.78	
			P0	2.70	
			SD	3.10	
			DS	3.20	
			SL	3.18	
			NH	2.66	
			SH	23.18.76	
			LH	3.2	
			DH	0	
Sequence		2		—	
Phase step		5		—	
Phase end		1		—	
Answer step		3		—	

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■ Instruction run time for operand type

The instruction run time increases according to the type of operand. Add the value listed in the following table when calculating the instruction run time.

The list of instruction run time indicates the run time of local variable.

However the added value described in Object 3 increases according to the access frequency of station bus. So it must be referred as a guideline.

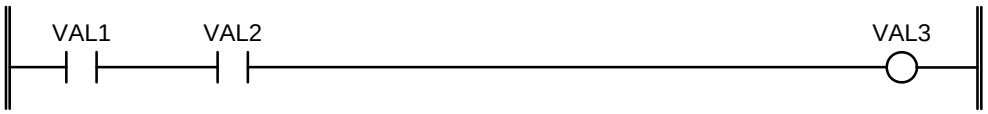
Unit [μs]

	nv-type1		
	Object 1	**Object 2**	**Object 3**
	Local variable Controller variable I/O variable (batch I/O) Network variable (batch I/O))	I/O variable (direct I/O) Network variable [I/O] (direct I/O)	Station variable (direct I/O) Network variable [Station module] (direct I/O)
Contact	As per List of instruction run time	2.0 to 2.5	2.5
Coil			
LD (1 word data length)			
LD (2 words data length)			
ST/SET (1 word data length)			
ST/SET (2 words data length)			

■ Calculation example of run time

The instruction run time can be calculated by adding the run times of described instruction words. Following shows a calculation example.

<Ex. 1> Calculation example of LD circuit run time
(Case when VAL1, VAL2, VAL3 are local variables)



	a contact	(VAL1)	0.02	(Local variable)
	a contact	(VAL2)	0.02	(Local variable)
+)	Coil	(VAL3)	0.06	(Local variable)
	Total		0.10	

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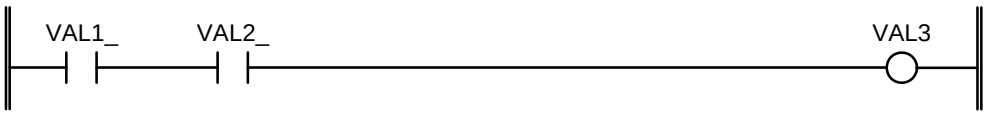
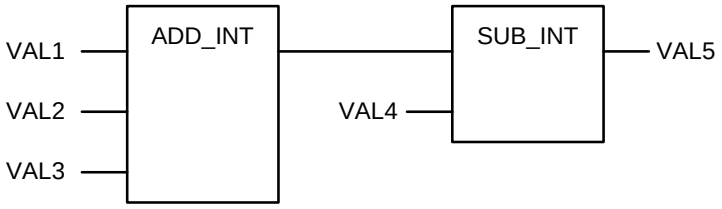
<Ex. 2> Calculation example of LD circuit run time
(Case when VAL1_is an I/O variable (direct I/O), VAL2_is a station variable (direct I/O) and VAL3 is a local variable)



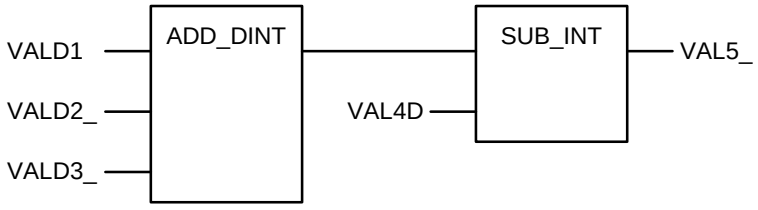
	a contact (VAL1_)	2.00 to 2.50	(I/O variable (direct I/O))
	a contact (VAL2_)	2.50	(Station variable (direct I/O))
+)	Coil (VAL3)	0.06	(Local variable)
	Total	4.56 to 5.06	

<Ex. 3> Calculation example of FBD circuit run time
(Case when VAL1～VAL5 are local variables)



	LD(VAL1 to 4)	0.02*4	(Local variable)
	ADD_INT	0.02*(N-1)	N = 3
	SUB_INT	0.02	
+)	ST(VAL5)	0.02	(Local variable)
	Total	0.16	

<Ex. 4> Calculation example of FBD circuit run time
(Case when VALD1 and VALD4 are local variables, VALD2_ is an I/O variable (direct I/O), and VALD3_, and VALD5_ is a station variable)



	LD(VALD1, 4)	0.04 × 2	(Local variable)
	LD(VALD2_)	0.04 + (2.00 to 2.50)	(I/O variable (direct I/O))
	LD(VALD3_)	0.04 + 2.50	(Station variable (direct I/O))
	ADD_INT	0.02 × (N-1)	N = 3
	SUB_INT	0.02	
+)	ST(VALD5_)	0.04 + 2.50	(Station variable (direct I/O))
	Total	7.26 to 7.76	

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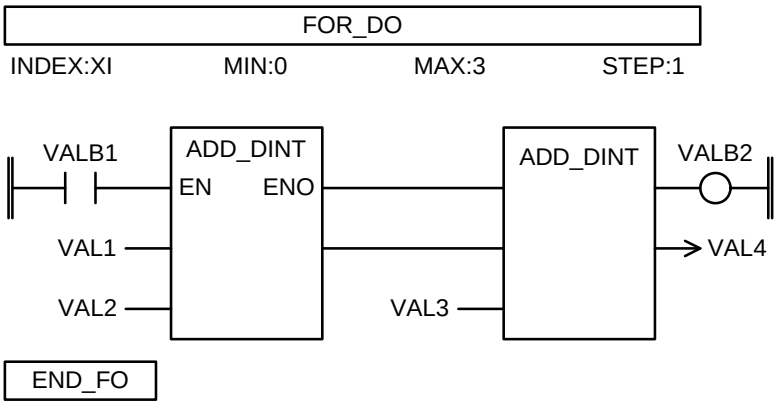
<Ex. 5> Calculation example of run time of LD circuit mixed with FBD circuit
(Case when all variables are local variables)



Repetition for 4 times	LD(MIN, MAX, STEP)	0.04*3	(Immediate value)
	LD(VAL1, VAL2, VAL3)	0.02*3	(Local variable)
	SET(VAL4)	0.14	(Local variable)
	ADD_INT	0.18 + 0.02* (N-1)	N = 2
	SUB_INT	0.20	
	a contact	0.02	(Local variable)
	Coil	0.06	(Local variable)
	END_FOR	0.82	
	FOR_DO (Condition established)	0.24	
+)	FOR_DO (Condition not established)	0.84	
	Total	8.28	

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Unified Controller nv series type1 Functional Manual

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