TOSHIBA
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6F8C1362

Unified Controller

nv Series

type2

Functional Manual

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Introduction

The Unified Controller nv series is a new-style integrated controller that can be applied for power control in addition to conventional electricity control and instrumentation control. In the series, "type2" is a DCS model controller that mainly executes loop control of instrumentation.

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

- Configuration of controller
  This chapter describes system configuration that mainly executes loop control, controller unit configuration, and I/O 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 fallback 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 and monitoring.
- Standard input/output
  This chapter describes the types of tag variables and their standard input/output.
- 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 Module Instruction Manual 6F8C1360
- Unified Controller nv series Ethernet(FN812) Module Operation Manual 6F8C1361
- 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 Tool 4 -Basic-Instructions 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.

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

Chapter 1
Configuration of Controller

Chapter 2
Operation of Main Unit

Chapter 1
Configuration of Controller

The Unified Controller nv series type2 is a controller with functions to be used in an instrumentation system. It can constitute an instrumentation system by connecting to the Operator Station OIS-DS for Toshiba CIE Integrated Control System CIEMAC-DS via Ethernet, or to the TC-net I/O via the TC-net I/O bus. The controller basically has redundant configuration.

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1.1 System Configuration

Fig. 1-1 shows example of the configuration of type2 Controller system.

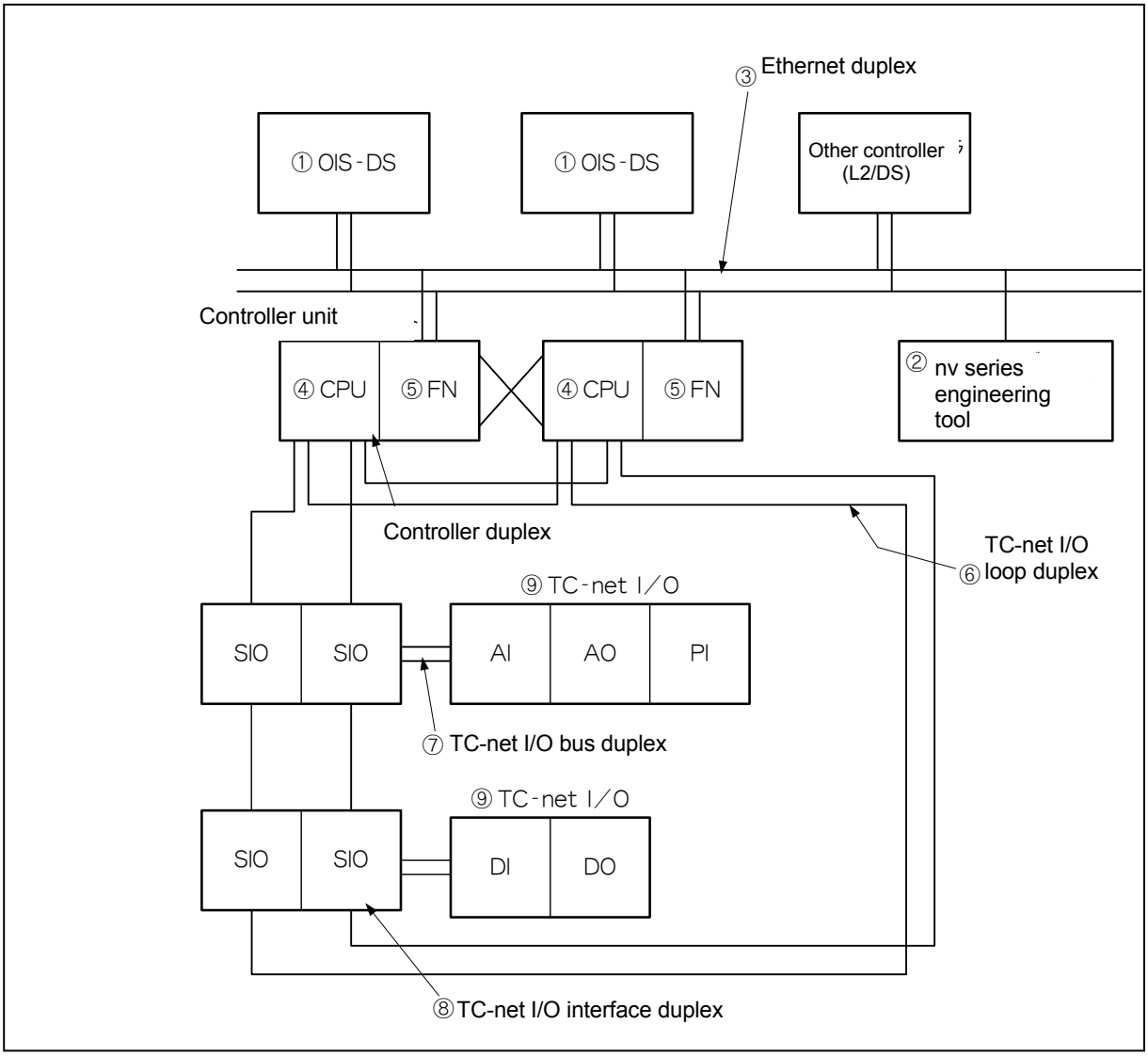

Fig. 1 Type2 controller system configuration (example)

① OIS-DS

The OIS-DS, CIEMAC's standard HMI(human interface), supports the nv series type2 controller (the standard software of the latest version is required).

② nv series nV-Tool

The Integrated Controller nV-Tool(V-Tool) supports the nv series type2 controller as an upward compatible function. Engineering and maintenance can be done in exactly the same environment as the Integrated Controller.

The Unified Controller nv series nV-Tool (nV-Tool) is common for the nv series controllers type1 and type2.

The Unified Controller nv series nV-Tool is used via the control LAN, or by connecting to the dedicated connector on the front panel of the controller module. The Unified Controller nv series nV-Tool tool must be connected to the controller module of the A system.

③ Ethernet

A control LAN is configured with duplex Ethernet (100M/1G).

For the OIS-DS, an interface module according to the Ethernet speed is required.

④ Controller unit (CPU)

The Unified Controller nv series type2 controller unit main body (CPU) forms a control station in combination with the Ethernet interface module dedicated for communication with the OIS-DS. Duplexing by station is the standard configuration.

The controller supports one system of TC-net I/O loop. To use multiple loops, an extended interface is required.

⑤ Ethernet interface module (FN)

This is the dedicated Ethernet interface module to connect the Unified Controller nv series type2 and OIS-DS.

⑥ TC-net I/O loop

This is the network to connect the unified controller unit to TC-net I/O. For the type2 controller, only duplex loop is supported.

Refer to the following Operation Manual for the details.

- Unified Controller nv series High-speed serial I/O system TC-net I/O Instruction Manual (6F8C1240)

⑦ TC-net I/O bus

This is a local bus to connect the TC-net I/O interface of the unified controller unit and TC-net I/O module. It is duplex by standard.

⑧ TC-net I/O interface

This is the interface to connect the Unified Controller nv series controller unit and TC-net I/O module. For type2, only duplexing is supported.

To support I/O of the conventional model, a TC-net I/O interface with dedicated interface functions is required.

⑨ TC-net I/O

This is the input/output module of the Unified Controller nv series.

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1.2 Controller Unit Configuration

1.2.1 Single system configuration

In single system configuration, power supply module, controller module and station bus module are implemented into base unit. I/O signals are connected to the unified controller TC-net I/O series.

● **Base unit for single system (BU816)**

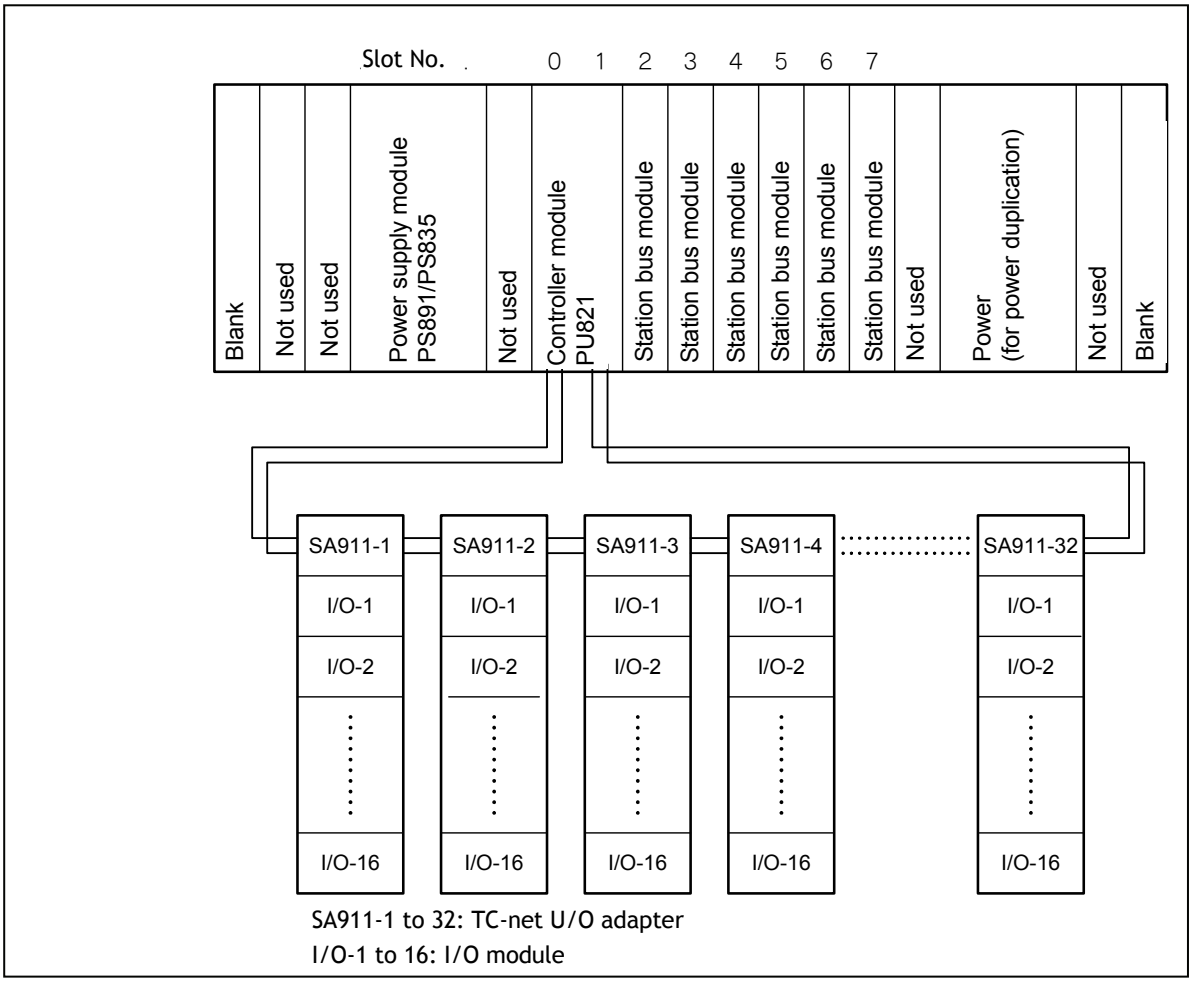


Fig. 1-2 Single configuration with single base (example)

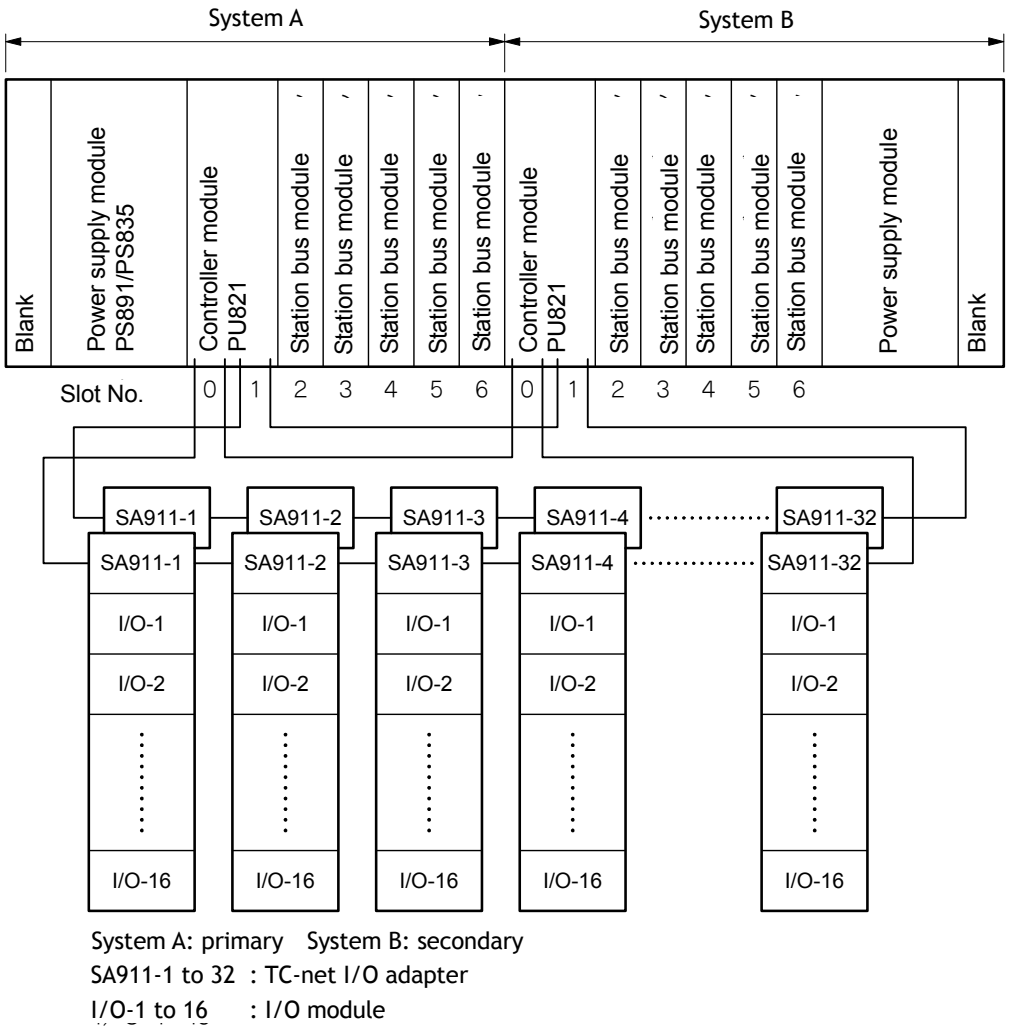
1.2.2 Duplex system configuration

The duplex system is a standby redundant system with duplexed controller unit main body.

In the duplex system, the system executing control is called online, and the system in the standby state is called standby. Also, when they are started up simultaneously, the system that starts up preferentially as online is called primary, and the system that starts up as standby is called secondary.

The duplex system has one chassis duplex configuration.

● 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. 1-3 Duplex configuration with duplex base (example)

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1.2.3 Module configuration

Table 1-1 Module type

	Slot 0/1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7
	Base unit (BU825)						
	Base unit (BU816)						
Pet-name							
Controller							
PU821	○	–	–	–	–	–	–
Station bus module (transfer module) (Note 1)							
FN812	–	○	○	○	○	○	○
Station bus module (TC-NET I/O interface module) (Note 2)							
SF8** (Note 3)	–	○	○	○	○	○	○

(Note1) Only 1 FN812 can be implemented for the transfer module.
(Note2) Up to 3 TC-NET I/O interface module can be implemented (in the future).
(Note3) *See the respective station bus module instruction for the "**" of the pet-name.

◆ **Note**

- When the duplex interface module (IF819) is implemented to the single base unit (BU816), it does not operate as a single system.
- When the duplex interface module (IF819) is not implemented to the single base unit (BU816), it does not operate as a duplex system.
- When CPU is implemented to the system A (primary side) of the duplex base unit (BU825), the system can operate as a single system. If CPU is implemented to the system B (secondary side), the system cannot operate as the single system.

1.3 I/O Configuration

1.3.1 TC-net I/O series

In the Unified Controller nv series type2, I/O is connected in the configuration with duplex TC-net I/O loop.

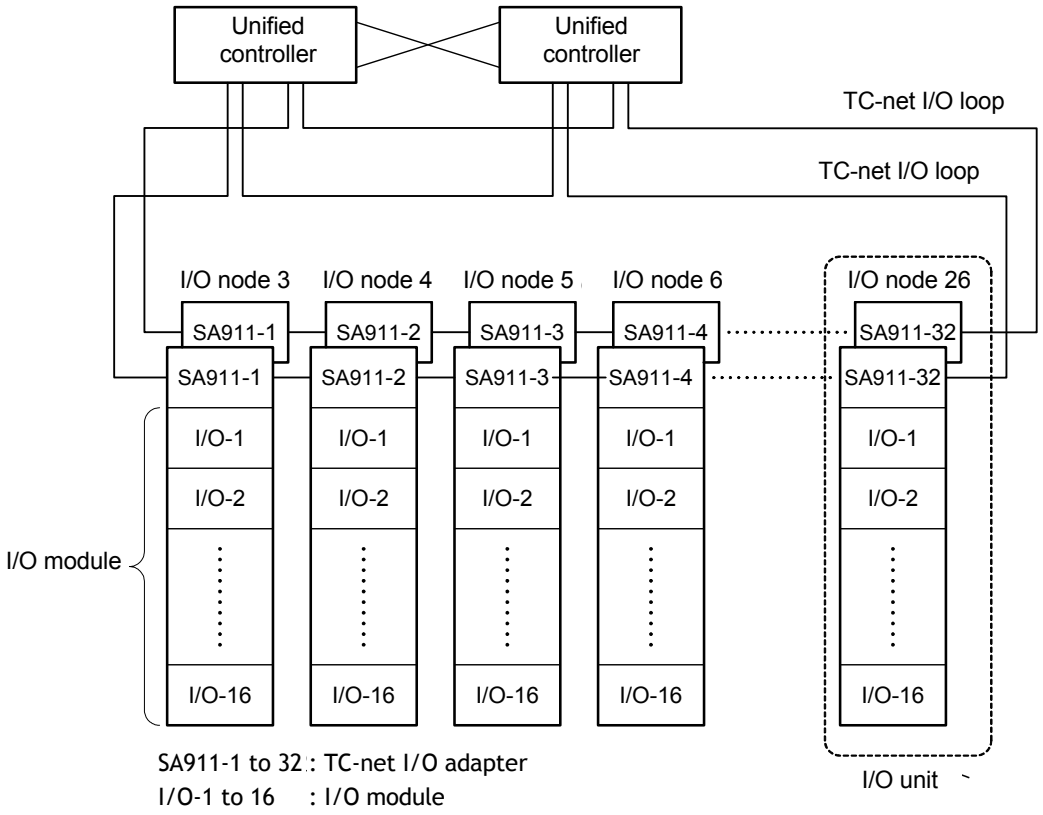

Fig. 1-4 Controller and TC-net I/O configuration (example)

As in the conventional model, the I/O modules are implemented in the slots of the I/O unit.

Each unit can be handled as a transmission node in units of the TC-net I/O interface.

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Table 1-2 TC-net I/O specification

Loop configuration	1
Nodes	max. 32 nodes (Note 1)
Node no.	3 to 34 (Note 2)
Units per one node	1
Number of implementable I/O modules per unit	max. 16
Number of implementable special I/O modules	max. 16 (Note 3)

(Note 1) TC-net I/O: 24 node, Intelligent I/O (in the future): 4 node, G3I/O (in the future): 4 node

(Note 2) TC-net I/O: 3 to 26, Intelligent I/O (in the future): 27 to 30, G3I/O (in the future): 31 to 34

(Note 3) Special modules indicate FL-net, DeviceNet, MODBUS, Ethernet, and MELSEC-net. For details, refer to "High-Speed Serial I/O System TC-net I/O Operation Manual" (6F8C1240).

1.3.2 G3 I/O series

To support G3 I/O as a conventional model, the TC-net I/O interface with the dedicated interface function is required.
The TC-net I/O interface for G3 I/O will be developed in the future.

1.3.3 Intelligent I/O module

To support intelligent I/O modules as a conventional model, the TC-net I/O interface with the dedicated interface function is required.
The TC-net I/O interface for intelligent I/O modules will be developed in the future.

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 PU821 of type1 controller.

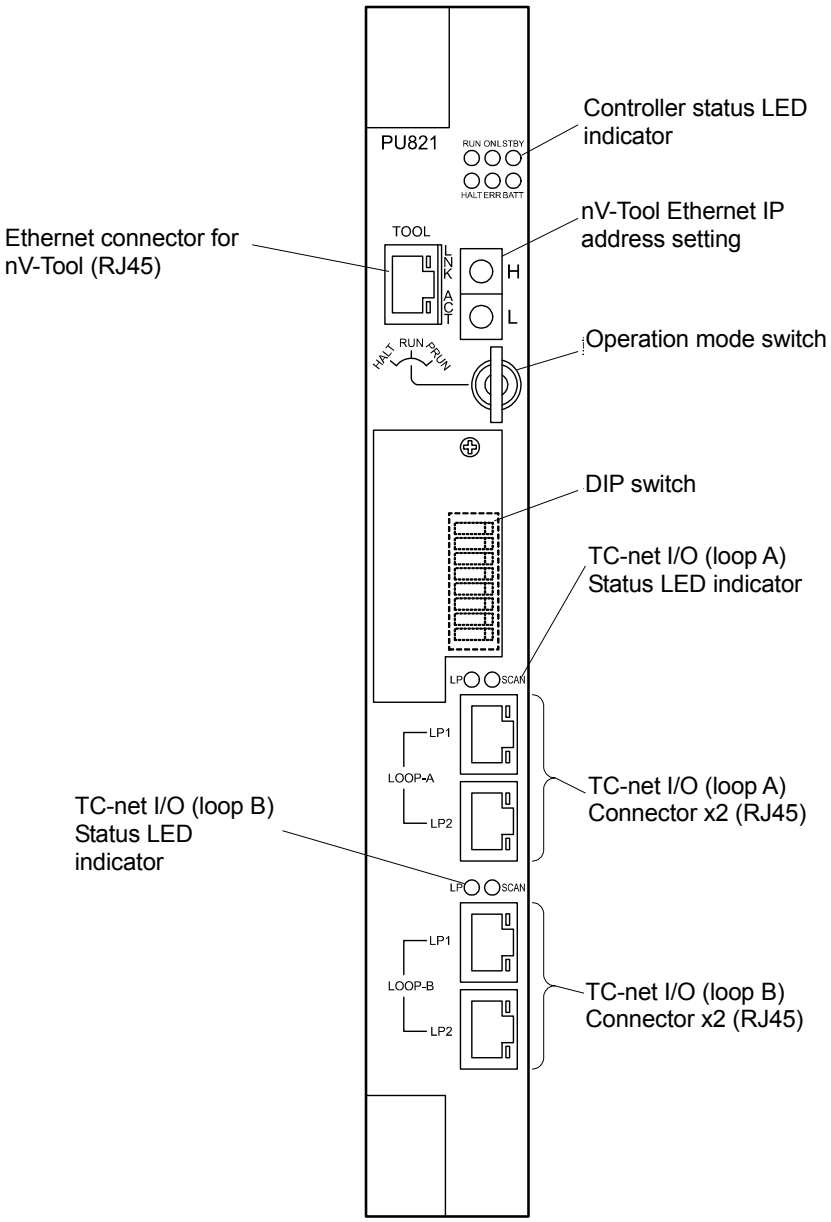

Fig. 2-1 Controller module PU821 front view

2.1 Basic Operation Flow

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

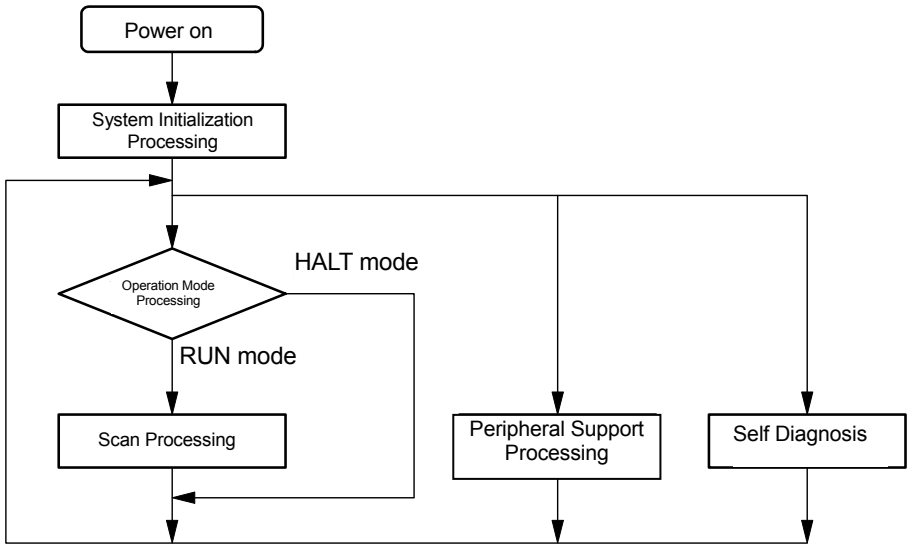

Fig. 2-2 Basic operation flow

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 OIS-DS 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 8 RAS Functions.

2.2 System Initialization Processing

After the power is turned on, the standard software in the nonvolatile memory is loaded and execution starts. The save state diagnosis and hardware diagnosis of the program-related information saved in the nonvolatile memory are executed.

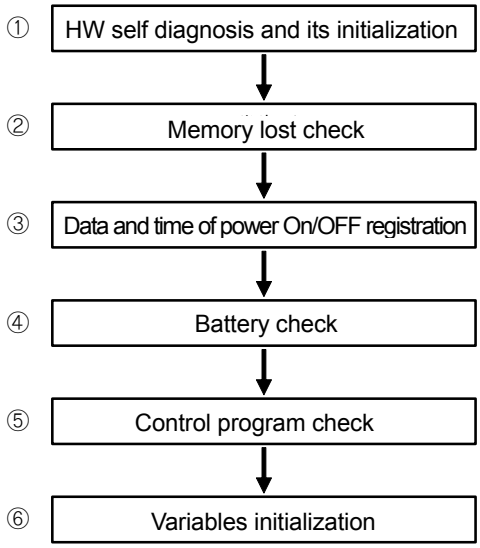

Fig. 2-3 System initialization processing flow

① Self diagnosis of hardware and its initialization

In the self diagnosis of controller hardware system ROM check, system RAM check and initialization setting are carried out.

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

It is checked whether the memory content (programs and control data) is backed up by the battery.

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.

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.

④ Battery check

Whether or not the back up battery for memory is installed 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. If the battery voltage is lower than the defined value, the message "Low voltage" is registered into the error log.

⑤ Program check

The contents of program running on the memory are checked.

⑥ Variables initialization

The time from the power off to the power on can be checked with the built-in RTC (real-time clock：in seconds), which is the power outage time.

Long interruption processing occurs if the power outage time is longer than the specified long interruption judgment time, or short interruption processing occurs otherwise.

In long interruption, all control loops of the controller tag (#LP) are set to M.

Also, in long interruption, the output holding state of the output module is checked and the current output value is read back so that control can be restarted from the current value.

In short interruption, the final output value before outage is outputted first. When the output modules complete output, control can be restarted.

For the event tasks, the task is executed once corresponding to long interruption or short interruption. If special processing for the power outage time is required, this event task can be used.

2.3 Operation Mode Processing

2.3.1 Transition condition of operation mode

To grasp the operation of the entire controller, the operation is classified into operation modes to control the operation from power on to power down.

The transition of operation modes can be checked with the event log. Also, the operation mode state can be checked on the controller state display LED on the front panel of the controller module.

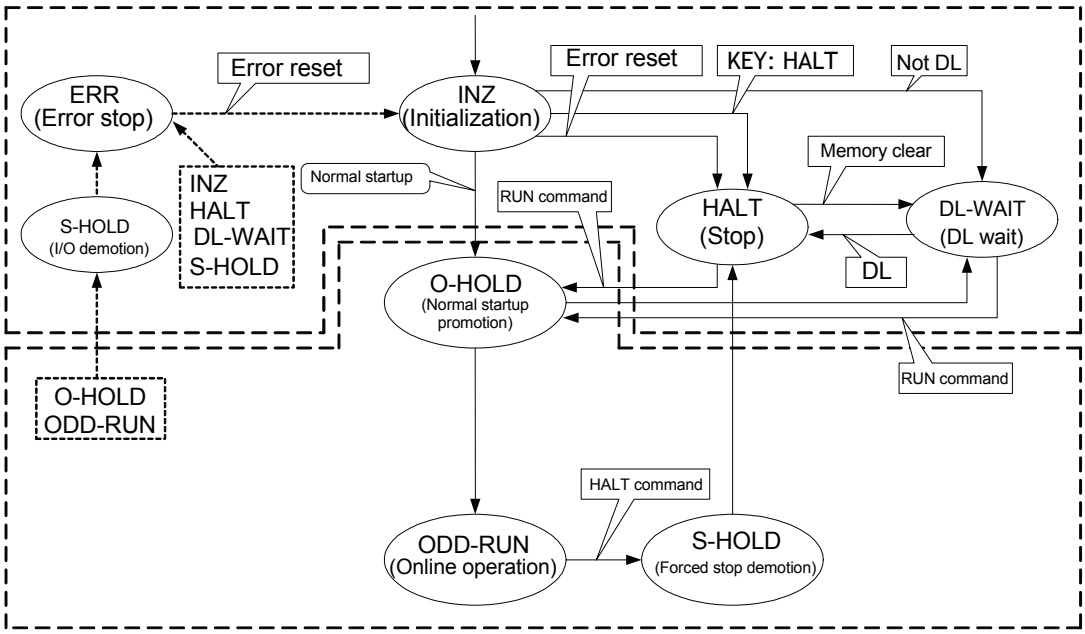

Fig. 2-4 Operation mode processing

The primary and secondary of duplex operation include the following operation modes:

- Online (Master)
  Duplexing where the standby is in a normal standby state is established and it executes control by itself.
- Standby (Slave)
  Online executes control, and it is in a normal standby state.
- Odd
  It executes control by itself, but standby is not established (single system operation).

In the controller operation mode displayed in engineering or OIS-DS, the terms such as Master above may be used in addition to Online and Standby. For the details of the display, refer to the Engineering Operation Manual and OIS-DS Operation Manual.

The mode transition can be checked in the event log. Also, the operation mode state can be checked on the controller state display LED on the front panel of the controller module.

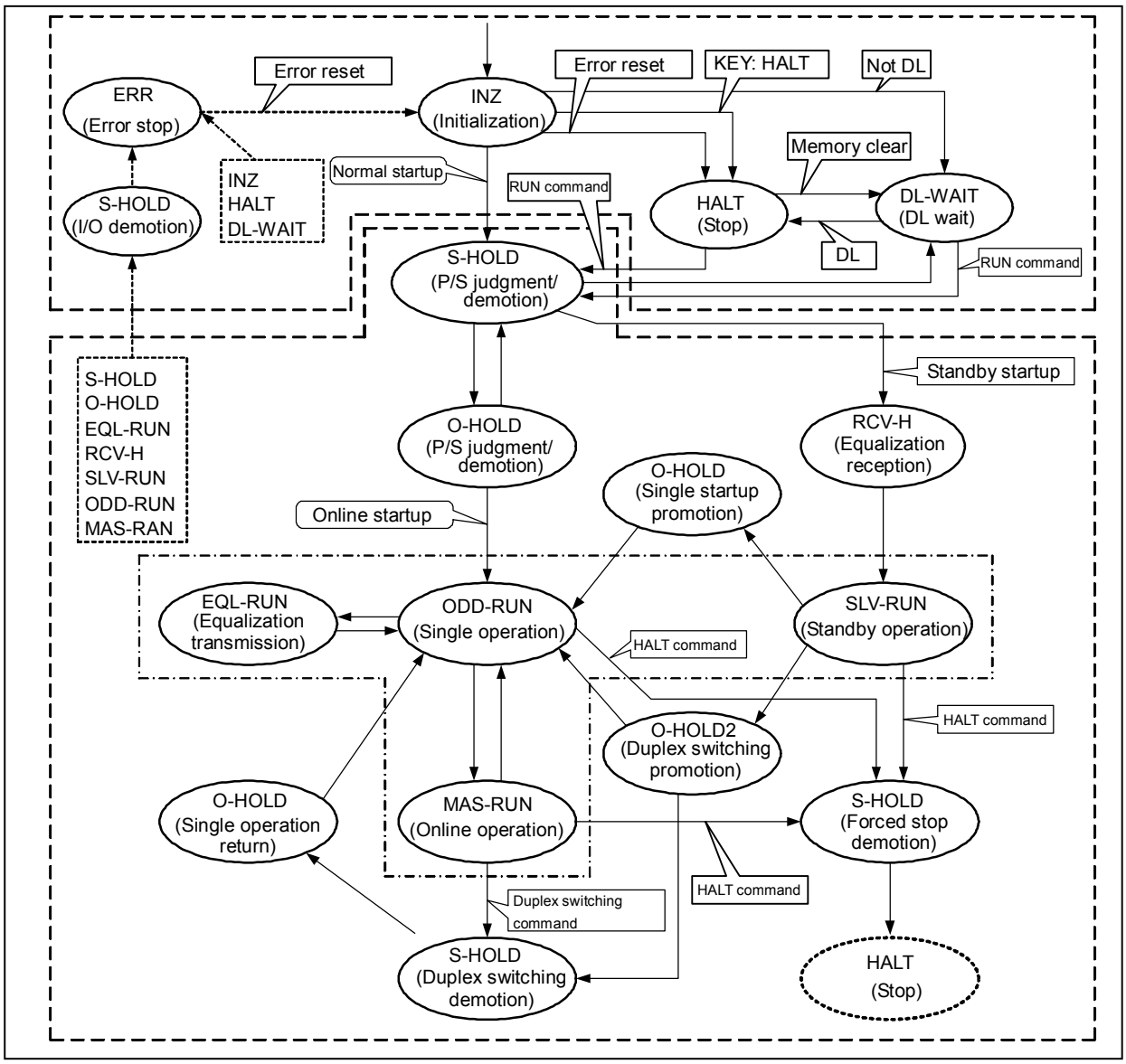

Fig. 2-5 Operation mode transition in duplex operation

2.3.2 Types and function of operation mode in single operation

In operation mode processing, memory status, operation mode switch status and operation mode change request sent from peripheral device (nV-Tool) are checked to decide the operation mode of the controller. There are three operation modes of the controller, namely RUN mode, HALT mode and ERROR mode.

The RUN mode includes RUN of single normal operation, MASTER-RUN of duplex operation, and ODD-RUN of duplex single system operation.

In the HALT mode, DL-WAIT mode of memory cleared status is provided other than the ordinary HALT.

The ERROR mode is the result of determining that the specified operation cannot be continued as a result of various types of self diagnosis.

Table 2-1 Types and function of Operation mode transition in single operation

Mode	Operation details	Remark
INZ	Initialization and self diagnosis of the controller are executed.	When the power is turned on, initialization and self diagnosis are performed. If successful, the mode automatically transits to the next operation mode.
HALT	Forced stop state	If the operation mode switch is HALT when the power is turned on, the system automatically stops in this operation mode (Note 1).
ODD-RUN	Scan control such as program execution and batch input/output are executed.	This operation mode is retained unless forced stop is selected or major failure is detected.
ERROR	Error stop state	When an error is detected in other operation modes, the system stops in this operation mode (Note 2).
DL-WAIT	Memory is cleared and waiting for download from the nV-Tool.	The system automatically transits to this mode and waits for download when memory is erased such as startup after memory clear (Note 3).
O-HOLD	Promotion processing of I/O is executed.	Input/output starts in the first operation mode upon a transition from the 1st phase to 2nd phase, and auto transition occurs to the 3rd phase.
S-HOLD	Demotion processing of I/O is executed.	Input/output is stopped, and the system transits to HALT or ERROR.

(Note 1) To reset HALT, turn the operation mode switch from HALT to RUN, or select RUN from the nV-Tool.

(Note 2) To reset ERROR, turn the operation mode switch from HALT to RUN, or request an error reset from the nV-Tool.

(Note 3) When download is complete, turn the operation mode switch from HALT to RUN, or select RUN from the nV-Tool to automatically transit to R-WAIT.

2.3.3 Operation mode and function in duplex operation

In operation mode processing, memory status, operation mode switch status and operation mode change request sent from peripheral device (nV-Tool) are checked to decide the operation mode of the controller. There are three operation modes of the controller, namely RUN mode, HALT mode and ERROR mode.

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Table 2-2 Types and function of Operation mode in duplex operation

Mode	Operation	Remark
INZ	Initialization and self diagnosis of the controller are executed.	When the power is turned on, initialization and self diagnosis are performed. If successful, the mode automatically transits to the next operation mode.
HALT	Forced outage status	If the operation mode switch is HALT when the power is turned on, the system automatically stops in this operation mode (Note 1).
ODD-RUN	Scan control such as program execution and batch input/output are executed.	Operation state with a single system due to forced stop or major failure detection of the target system.
ERROR	Error stop state	When an error is detected in other operation modes, the system stops in this operation mode (Note 2).
DL-WAIT	Memory is cleared and waiting for download from the nV-Tool.	The system automatically transits to this mode and waits for download when memory is erased such as startup after memory clear (Note 3).
EQL-RUN	Scan control such as program execution and batch input/output equalization are executed.	All information is transferred to the target system in the operation state of the operation system upon duplex startup.
RCV-H	Equalization reception is executed to start up as a standby system.	Receiving information from the target system to become a standby system.
MASTER-RUN	Scan control such as program execution, batch input/output, and tracking are executed.	Operation state in the duplex operation system.
SLAVE-RUN	Tracking and self diagnosis are executed as a standby system.	Operation state in the duplex standby system.
O-HOLD	Promotion processing of I/O is executed.	Input/output starts in the first operation mode upon a transition from the 1st phase to 2nd phase, and auto transition occurs to the 3rd phase.
S-HOLD	Demotion processing of I/O is executed.	Input/output is stopped, and the system transits to HALT or ERROR.

(Note1) To reset HALT, turn the operation mode switch from HALT to RUN, or select RUN from the nV-Tool.

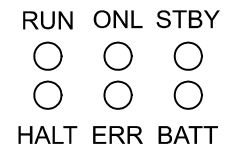
(Note 2) To reset ERROR, turn the operation mode switch from HALT to RUN, or request an error reset from the nV-Tool.

(Note 3) When download is complete, turn the operation mode switch from HALT to RUN, or select RUN from the nV-Tool to automatically transit to R-WAIT.

2.3.4 Status indication LED on front panel

Front panel of the controller module in the upper right is equipped with six controller status LED indicators which show the controller operation status. The operation mode of the controller can be determined based on the illumination or blinking of the LED.

Table 2-3 Controller status LED indicators

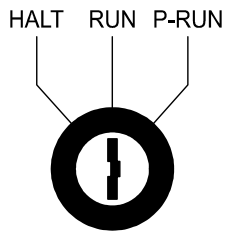
Name	Color	Meaning		LED layout
RUN	GRN	Indicates whether auto control is executed.		
		Off	No control is being executed.	
		Blink	Control is being executed, but in a special state such as simulation.	
		On	Auto control is being executed.	
ONL	GRN	Indicates it is online in the duplex system.		
		Off	Not online	
		Blink	In equalization transmission	
		On	Online in duplexing	
STBY	GRN	Indicates it is standby in the duplex system.		
		Off	Not standby	
		Blink	In equalization reception	
		On	Standby in duplexing	
HALT	GRN	Indicates it is the HALT state with awareness.		
		Off	Not HALT	
		Blink	Waiting for download after memory clear	
		On	Stopped as HALT (not an error)	
ERR	RED	Indicates error down.		
		Off	Not an error	
		Blink		
		On	Stopped as an error (an error continues)	
BATT	GRN	Indicates the battery state.		
		Off	No battery is installed, or voltage is low.	
		Blink	Charging for shutdown	
		On	Battery is normal.	

As a rule, illuminating in green indicates a normal state, and illuminating in red indicates an error state. OFF indicates they are not applicable. However, the absence of green that should exist indicates an error regardless of the presence of red.

2.3.5 Operation mode switch

The operation mode switch is used to switch the operation mode and operation state.

Table 2-4 Operation mode switch

Switch position	Operation	Operation mode SW. layout
HALT	Switching from the positions other than the HALT mode to HALT changes to the HALT mode. When the power is turned on in the HALT state, the system starts up in the HALT mode. Operation mode switching from the nV-Tool is not accepted.	
RUN	Switching from HALT to RUN changes to the RUN mode. It can be changed to the HALT mode by operation mode switching from the nV-Tool.	
P-RUN	The operation state is the same as RUN. Write of the entire program is prohibited.	

2.3.6 DIP switch

The dip switches on the front panel can be used to set or specify various functions without using the nV-Tool. The dip switches are behind the cover of the backup battery. Remove the cover to check the state or perform setting.

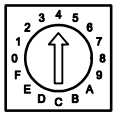
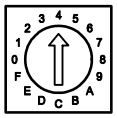
Table 2-5 DIP switch specification

Name	Function	OFF	ON	Remark	DIP switch layout
DSW-1	Memory clear	Memory clear is not performed	Memory clear is specified when both are ON	Memory clear is executed for initialization.	
DSW-2	Memory clear				
DSW-3	For manufacturer test			Reserved by manufacturer	
DSW-4	Simulation	Invalid	Valid	Specify whether to perform simulation.	
DSW-5	IP address	Class B when both are OFF	N/A	Specify the type of IP address.	
DSW-6	IP address				
DSW-7	For manufacturer test			Reserved by manufacturer	
DSW-8	For manufacturer test				

2.3.7 Ethernet IP address setting switch for nV-Tool

The Ethernet IP address setting switch for nV-Tool sets the IP address for connecting to the nV-Tool via Ethernet. The address range is fixed to "172. 16. 64.＊＊".

Table 2-6 Specification of Ethernet IP address setting switch for nv-Tool

Name	Contents	Switch layout
H	Upper digits (0 to F) of least three digits of IP address that is converted to hexadecimal.	 H
L	Lower digits (0 to F) of least three digits of IP address that is converted to hexadecimal.	 L

◇ **Remark**

- The state in which both of these switches are zero (i.e. IP address = 127.16.64.00) cannot be used.
- The address is high order digit + low order digit and can be set in the range of 1 to 254.

2.4 Scan Processing

When the controller transits to the RUN mode, the user global variables and local variables are initialized, self diagnosis (backbone module installation state check, program check, and module parameter check) is performed, and then the controller enters scan control.

In scan control, batch input/output processing and program execution processing are executed repeatedly at a fixed cycle. The fixed cycle is the scan cycle.

① Batch input processing	③ Standard input processing	② Program execution	③ Standard output processing	① Batch output processing	④ Duplex tracking processing

① Batch input/output

Input/output processing exchanges the input information used by the program and the output information generated by the program with the actual input/output devices (I/O modules). This controller performs input/output processing as managed by the system independent of the execution of the application.

The state of the external signal inputted to the input module is loaded to the input variable (%I), and the state of the output variable (%Q) is outputted to the output module. This processing is executed in a batch before program execution of the HS/MS task, so it is called batch input/output processing.

For details on the batch input/output operation, refer to "Chapter 5 I/O Input/Output."

② Program execution

The high-speed scan task and main scan task are executed at the specified scan cycle.

Each task can refer to the initialization flag, duplex switching flag, and task execution time.

The initialization flag is information obtained independently for each task. It becomes ON at the first time after the task is downloaded, and at the first time it recovers from long interruption.

The duplex switching flag becomes ON at the first time after duplex switching.

The task execution time is information obtained independently for each task. The cycle (sec) specified for the high-speed scan is obtained for the high-speed scan, and the scan cycle (sec) reflecting the sub scheduling is obtained for the main scan task.

The program is stored in the memory in the controller. The instruction words are loaded and executed one by one. Generally, the program refers to and calculates the content of the control data to update the control data. Then, the input variable (%I, input register) is used as input information, and (%Q output register) is used as output information.

③ Standard input/output

When initialization is completed successfully, normal scan task is executed.

The execution of the high-speed scan task and main scan task starts according to the priority. If sub scheduling is specified in the main scan task, it is restarted at the timing according to the grouping (phase).

In batch input, the input information of the TC-net I/O is stored from the input buffer to the input register.

In standard input processing, the indicator (#PV) information is updated using the specified input information.

The scan task is executed and required information for each task is updated. The content of the parameter tag and instrument tag is updated, but the information in the midst of execution is not outputted to I/O (as an exception, if there is any application that directly specifies output or directly accesses to the output buffer, the buffer is updated at that point, and may be sent to the output module before batch output).

In standard output processing, the output information including the output register is updated.

In batch output processing, the content of the output register is stored to the transmission buffer to the TC-net I/O output module.

④ Duplex tracking size

For the duplex standby, the application execution information and tag change information are tracked.

2.5 Duplex Operation

2.5.1 Power on start-up

When the controller starts up, the execution state is determined after necessary self diagnosis such as checking of the memory save state. If it is duplex registration, the state of the target system is mutually diagnosed, and the normal one starts up as the online. Normally, the primary side becomes the online preferentially, and the secondary starts up as the standby.

If the primary is standby and the secondary is online in the switching before power failure, the state is continued after power recovery from the power failure.

The timing is assumed so that the primary becomes online preferentially when duplexed online and standby are turned on simultaneously. When turning on the online and standby separately, turn on the standby after the online starts up completely and online operation starts.

2.5.2 Power recovery operation

For short interruption, duplex operation is restarted without executing equalization.

For long interruption, full equalization is executed before startup as the standby. During this equalization, it has not established as duplexing.

When the standby starts up during single system operation in duplexing, duplex operation is started after executing full equalization just as when power recovery is done from long interruption.

2.5.3 Target system monitoring

The target system is always mutually monitored during duplex operation.

Mutual monitoring is performed at the time of tracking regarding the data validity, the result of self diagnosis of the target, availability of tracking itself, and the implementation startup state of the target.

If it is determined as a target system error as a result of mutual diagnosis, the online enters the single system operation state. The standby is automatically promoted to the online as long as it is detected that the target system goes completely down. Otherwise, the standby is not promoted and continues its standby state.

2.5.4 I/O status monitoring

The operation state of I/O is monitored.

The error monitoring of the TC-net I/O is determined based on the communication sate by node rather than based on an error by I/O module.

Duplex switching does not occur even if an error of part of I/O is detected. The error of that part is reported, and only partial processing stop in standard input/output or access stop of that part in batch input/output occurs, and control is continued.

If one or more systems of the TC-net I/O loops become inaccessible, duplex switching occurs as it is determined as an error of the controller itself, rather than an error of the I/O system.

If all the TC-net I/O loops become inaccessible, error down occurs unconditionally. If the standby is normal, duplex switching occurs at this point.

2.5.5 Network monitoring

The communication state of Ethernet is monitored by the Ethernet module (FN).

If the Ethernet module is determined as completely abnormal, error down and duplex switching occur automatically.

If Ethernet transmission is disconnected, duplex switching occurs without error down because it cannot be determined as failure of the Ethernet module itself.

2.5.6 Download operation

When RUN of the duplex controller is performed from the state where both systems are not in the RUN state, equalization is performed from the online to standby. When the controller that does not download programs is made online first, the content of the standby is erased upon equalization.

To perform download while both systems of the duplex controller are in HALT, download to the both systems, or make the downloaded side online first.

2.6 Causes of Duplex Switching

If it is determined that control cannot be continued as a result of self diagnosis, duplex switching occurs.

2.6.1 Forced switching

Forced switching is performed when a switching instruction is sent from the nV-Tool or when the operation mode switch of the online is changed from RUN to HALT.

For forced switching, duplex switching occurs when switching is instructed and the scans under execution are fully completed. Switching occurs when the scans are completed in the original online side and batch output is completed, and the new promoted online restarts the control from batch input.

Generally, when switching occurs due to major failure or an error such as power down, duplex switching occurs when the error occurs. Therefore, it may stop in the midst of output, and control of the standby may start from the scratch.

2.6.2 Major failure of the controller

When major failure is detected in the controller, error down and duplex switching occur.

The factors of major failure include the following. Some causes error down, and others cause fallback.

- Hardware error
- I/O access error
- Program execution error

Perform appropriate setting to avoid an error by considering the installation environment, details of the program, and scan speed setting.

2.6.3 All station error of I/O

Error down and duplex switching occur when all I/O's connected to the controller becomes inaccessible.

The TC-net I/O has a duplex loop structure for high redundancy. Also, sufficient considerations have been made in terms of design such as insulated optical connection. However, it may be affected depending on the external factor.

Perform appropriate setting to avoid all station down by splitting the TC-net I/O loop into multiple systems, etc.

2.6.4 Major failure of Ethernet

Duplex switching occurs due to an error of the Ethernet module or an error of the Ethernet network system.

Perform appropriate setting so that especially the network system is not affected by the outside.

2.7 Memory Management

The Unified Controller nv series type2 has a large amount of memory and program information. Use the following functions effectively.

2.7.1 Memory clear

There are 2 types of memory clear functions; the function to initialize the entire memory of the controller, and the function to clear the downloaded information. The former memory clear is used when the controller is replaced. The latter memory clear is used to clear only the downloaded information without turning off the power.

■ Memory clear for initialization of entire memory (by switch setting)

Turn off the power of the controller. After that, turn on the dip switches 1 and 2 on the front panel. Turn on the power in this state.

When memory clear is complete, the HALT LED blinks. After memory clear is finished, turn off the dip switches 1 and 2 on the front panel, and turn on the power again.

Memory clear can be executed from the nV-Tool only when the basic program of the controller is operating normally. If the memory error state such as a parity error does not recover, memory clear by the controller switch may be required. In this case, perform memory clear forcefully by dip switch setting.

Memory clear by dip switch setting also clears the "record of operating time."

■ Memory clear for initialization of entire memory (by nV-Tool operation)

When memory clear is specified in the nV-Tool, memory clear is executed as in the setting of the dip switch above. When memory clear is complete, the system enters the download wait state. During this period, no communication such as nV-Tool transmission can be performed.

Memory clear by nV-Tool operation does not clear the "record of operating time."

■ Log clear

The system log information saved in the controller is cleared.

In the nV-Tool, select the logs to delete, and make a clear request. Only the logs of the specified type are cleared.

The event of clearing the logs is recorded in the event log.

Note

- The operation time is integrated operation time since the controller hardware was turned on for the first time, and the information is used for life diagnosis. Do not clear it unnecessarily for quality control reasons.

2.7.2 Defragmentation

Defragmentation is a function that relocates the information dispersed in the internal memory to regenerate continuous areas, just as defragmentation of general PCs.

When a program is downloaded, it is saved in the memory of the controller. When the program is deleted and free space is made, the free space is occupied first when the next program is downloaded. If this is repeated, the free space may become fragmented. This may result in a situation where download cannot be done even if the number of program steps does not reach the maximum.

Defragmentation organizes the fragmented free space to generate continuous areas to download the next program.

2.7.3 Backup/Restore

The controller has the memory backup/restore functions. They are the functions to save and restore the memory content of the controller as a memory image. The state where the program is saved can be restored rather than downloading the program again.

Backup means saving the memory content of the controller to the hard disk of the nV-Tool.

Restore means writing the memory content saved in the hard disk of the nV-Tool to the controller.

■ Backup

Set the target controller to the HALT mode.

In the nV-Tool, select Backup. In the backup processing, the progress is displayed in the bar graph. When it is complete, specify the save file name.

■ Restore

Set the target controller to the DL-WAIT mode by memory clear, etc.

In the nV-Tool, select the file to restore and execute restore. In the restore processing, the progress is displayed in the bar graph.

If restore is cancelled, the controller cannot perform normal operation. Perform memory clear again, and restart restore.

In the controller, internal initialization is executed after restore is complete or cancelled. Wait for 30 seconds or longer after completion before the next processing or operation.

2.7.4 Power OFF

When the power is turned off, the program execution at the time is stopped, and termination processing called the shutdown sequence is started. The tasks under execution may be terminated halfway.

The shutdown sequence is performed by expanding the time until the controller main unit stops from power off by supplying power equivalent to the UPS with the built-in capacitor in the power supply card.

In the shutdown sequence, program execution information, control data, and tag data are transferred to the nonvolatile memory. During this period, it is in the environment disconnected from the power supply system and network system, so it will not recover as a controller system even if the power is recovered along the way.

2.8 Tag Management

2.8.1 Tag support

The Unified Controller nv series type2 supports ONS supported by the controllers after the PCS-DS.

The types and functions of the tags are almost equivalent to the PCS-DS. The tags supported by the L1, L2, and L3 of the Integrated Controller V series are also the same.

2.8.2 Data management

The information regarding the tags is saved in the Ethernet module that is the interface with the OIS-DS for the service of ONS.

The update of input/output is executed by the standard input/output function (this function is conventionally called linearization, but this name is currently used).

The read processing of the process tags in ONS is executed and completed in the Ethernet interface. The write processing is executed in sync with the task in scan synchronization processing.

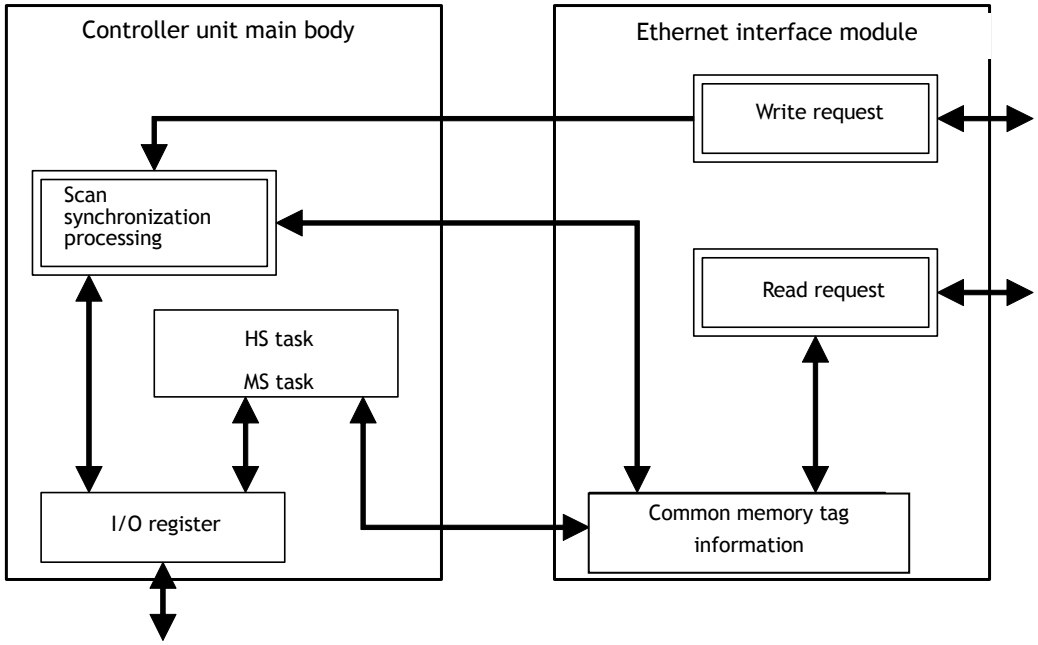


Fig. 2-6 Data flow within the controller unit

2.9 Equalization of Memory

The Unified Controller nv series consists of the standby redundant system. The standby side is waiting and not executing any program. Upon duplex switching, it must have the same state as online including the result of online control. This is called equalization of memory.

There are several types of timing and methods for memory equalization.

2.9.1 Full equalization

The entire content of the memory of online is copied before the controller starts up and starts operating as standby. This is called full equalization.

Until this equalization is complete, redundant configuration has not been established. The online side is in equalization transmission, and the standby side is in equalization reception. During this time, the operation of the online is the same as single system operation.

Full equalization is automatically executed when the power of the standby controller is turned on or when the mode changes from the HALT mode to RUN mode.

Full equalization is automatically started and cannot be requested by engineering.

2.9.2 Tracking

If the memory content changes during controller operation, it must be reflected to the standby side. The memory equalization processing for this purpose is called tracking.

Tracking is executed in sync with scan, and the content updated in the HS task and MS task is copied to the corresponding memory of the standby side.

Tracking must be completed within the specified scan cycle. If the sum of the time required for tracking and the program execution time exceeds the specified scan time, minor failure occurs as scan congestion. If the scan congestion continues for 5 scans or more, major failure occurs, resulting in duplex switching.

The following table shows the target data to be tracked automatically.

Table 2-7 Object of tracking data

EA No.	Name	Use	Transmission timing
0	Instance variable	Program's local variable (retained)	High-speed/main scan
4	User variable	Variable that the user can define	Main scan
5	Batch input/output register	IW/QW	Main scan
10	Tag instrument scan for variable (data)	PV_DATA Indicator variable LP_DATA Controller variable PB_DATA Pushbutton variable SQ_DATA Sequence operation equipment T_DATA Timer variable C_DATA Counter variable R_PARA Generic parameter (real) W_PARA Generic parameter (integer)	High-speed/main scan for PV/LP/PB. Main other.

For the following information, tracking is automatically performed upon a change from the nV-Tool or OIS-DS. Tracking can also be done by registering to the user tracking table as needed (high-speed or main scan).

The following table shows the target variables

Table 2-8 Data that can be registered in the user tracking table

EA No.	Name	Use	Transmission timing
7	Tag instrument variable (Parameter)	PV_PARA Indicator variable LP_PARA Controller variable PB_PARA Pushbutton variable SQ_PARA Sequence operation equipment P_PARA Polygonal line variable T_PARA Timer variable C_PARA Counter variable R_PARA Generic parameter (real) W_PARA Generic parameter (integer)	High-speed/main scan can be selected.
10	Tag instrument variable (data)	DW_DATA Generic register	

(Note 1) Normally, tracking of the tag instrument variable (parameter) is not required. However, when registering to the user tracking table, be careful not to exceed the maximum tracking size. If this occurs, the system goes down upon duplex startup.
The maximum size is 512KW for the main scan and 128KW for the high-speed scan.
The actual tracking size can be checked with ZD58 for the main scan and with ZD56 for the high-speed scan (refer to the list of system variables in Appendix).

2.9.3 Partial equalization

The information that is updated at an event rather than updated every scan can be equalized at the timing of the occurrence of the event using the partial equalization function.

The targets of partial equalization include parameter changes from the OIS-DS, program changes in the nV-Tool, and tag parameter changes.

Chapter 3
Tasks

Use in redundant configuration is assumed for the Unified Controller nv series type2. Duplexing involves the standby redundant system with the duplex controller unit main body.
The programs are managed by task. Each task consists of one or more programs.
The structure and language of the programs comply with IEC61131-3.
The programs are executed in the order of the specified priority and registered program (entry) number.

3.1 Task Type

Unified controller nv series has six types of tasks: two types of event tasks, 2 types of scan tasks.

Each task is executed when an event occurs or at scan time depending on the priority.

Table 3-1 Event tasks

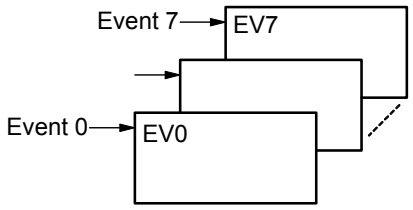
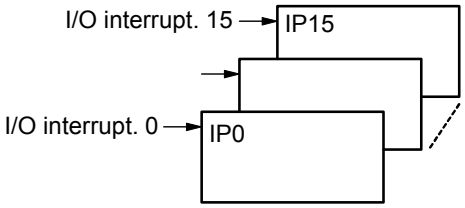
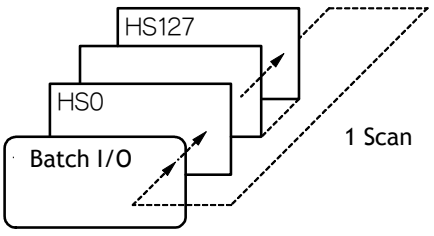
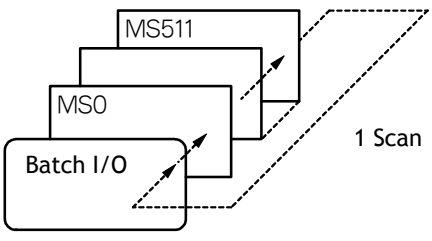
Type	Contents	No. of tasks	No. of programs	Concept
Event task (EV)	Tasks related to system status	8	1	
I/O interruption task (IP)	The task executed according to interruption request when I/O data change is detected.	16	1	

Table 3-2 Scan task

Type	Contents	No. of tasks	No. of programs	Concept
High-speed scan task (HS)	Sequence task executed regularly. Executed with intermediate priority among scan tasks.	1	128	Scan cycle: 10 to 500ms (by 10ms) 
Main scan task (MS)	Sequence task executed regularly. Executed as a scan task normally.	1 (each task)	512	Scan cycle: 100 to 1000ms (by 100ms) 

3.1.1 Event Task

There are 8 event tasks, each of which consists of one program.

Table 3-3 Types of event system tasks

Entry No.		Startup condition	Processing details
0	Initialization	Starts up at power recovery after long interruption when changing from HALT to RUN.	Necessary processing for system startup or power recovery after long interruption is executed.
1	Short interruption	Starts up at power recovery after short interruption.	Necessary processing for power recovery after short interruption is executed.
2	Error down	Starts up at error down.	Necessary processing immediately before stopping upon error down during single operation is executed.
3	Duplex switching	Starts up when changing from standby to online.	Necessary processing for initialization of duplex switching is executed.
4	I/O fallback	Starts up when I/O error is detected in batch I/O.	Processing assuming the effect of fallbacked I/O is executed.
5	Program fallback	Starts up when program fallback occurs.	Processing assuming the effect of fallbacked program is executed.
6	I/O fallback recovery	Starts up when I/O recovers to normal from fallback.	Processing assuming the effect of fallbacked I/O starting normal operation again is executed.
7	I/O node error	Starts up when a node error of the TC-net I/O is detected in batch input/output.	Processing assuming the effect of the erroneous node is executed.

Each of the event tasks has higher priority than scan system tasks, so it may be executed in interruption to the execution of the scan system tasks.

3.1.2 I/O interruption task (IP)

This is a task that starts up when interruption of the registered I/O occurs.

There are 16 interruption tasks, each of which consists of one program. When I/O interruption is registered, the program executed when the interruption occurs becomes available.

3.1.3 Scan-related task

There is one high-speed scan task with 128 programs and one main scan task with 512 programs.

The high-speed scan task has higher priority than the main scan task, so it may be executed in interruption to the execution of the main scan task.

Programs in the tasks with the same priority (high-speed scans, main scans) are executed in the order of registration (entry number), so no interruption or order change occurs. However, if sub scheduling is specified, the apparent order may change.

3.2 Task Management

3.2.1 Task execution based on priority

Control tasks follow the priorities. Tasks with higher priority are executed in preference to tasks with lower priority. This execution control is most obvious when a task with higher priority is executed when a task with lower priority is being executed.

In the example shown in the figure below, a task of the high-speed scan is executed while a task of the main scan is being executed. The task of the main scan is suspended, and the task of the high-speed scan that has higher priority is executed.

In addition, because an event in which an interruption event task with higher priority occurs while the task of the high-speed scan is being executed, the task of the high-speed scan is suspended and the interruption event task is executed.

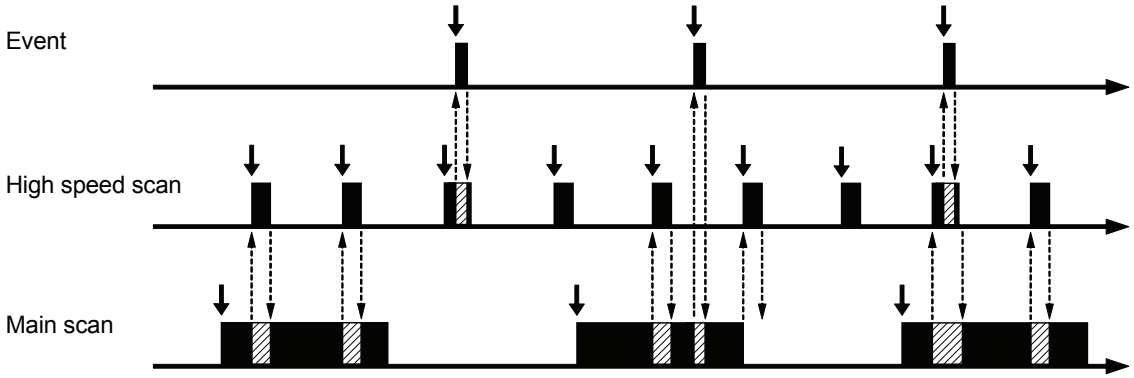


Figure 3-1 Example of task execution based on priority

3.2.2 Execution of Event

Event tasks have determined operation conditions.

The following are some example of use of each event task.

■ Event task for initialization (Entry 0)

This task is executed first when the power is turned on. Before other tasks are executed, this task can initialize the system. When the event task for initialization is complete, the tasks of the scan system are started.

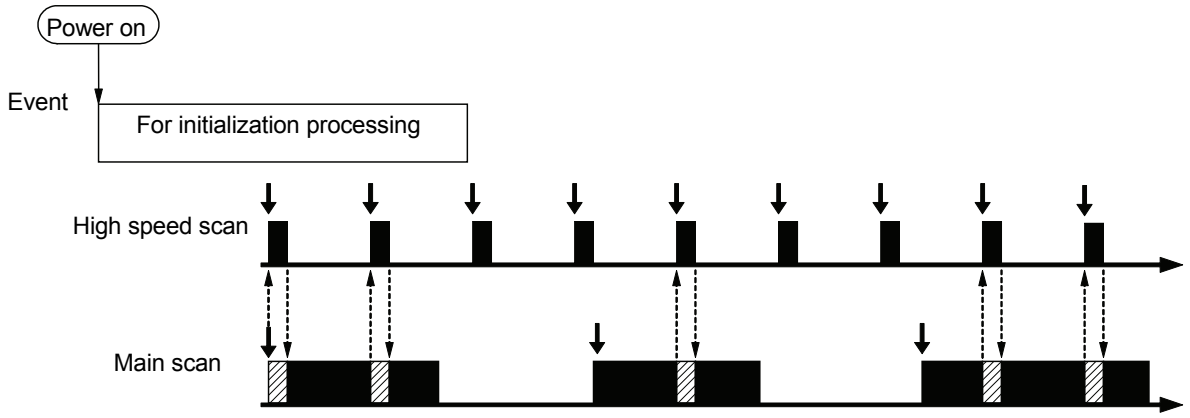


Figure 3-2 Operation example of a program for initialization

■ Event task for error down (Entry 2)

When a fatal error (major failure) is detected in self diagnosis, the execution of all tasks is stopped, and the event task for error down is executed. The tasks that are being executed and not directly related to the error are executed to the end. The tasks under execution are not suspended, but the tasks planned to be executed after that are not executed.

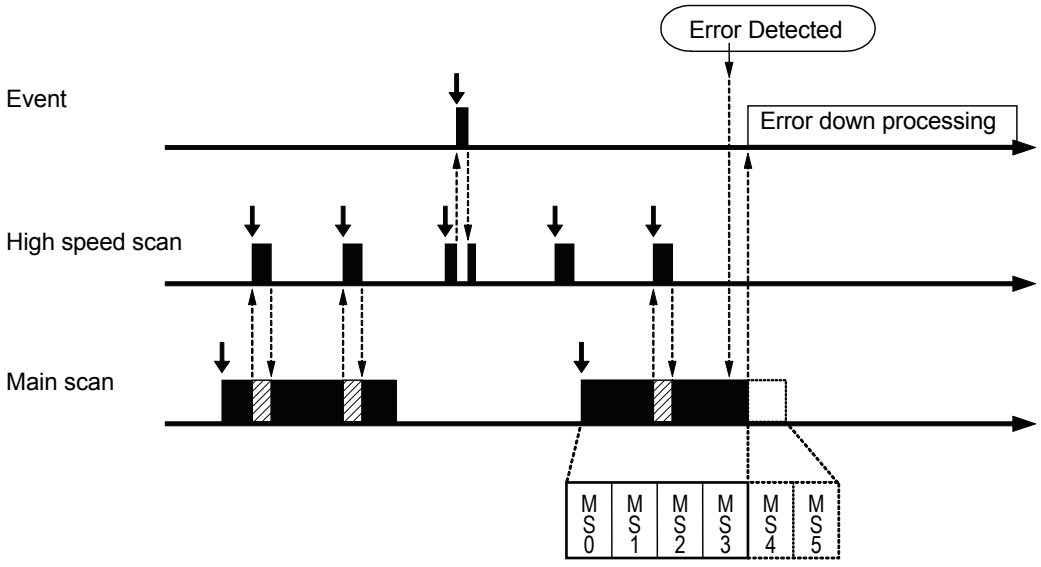


Figure 3-3 Operation example of the event task for error down

■ Event task for I/O fallback (Entry 4) /Event task for I/O fallback recovery (Entry 6)

These tasks are started up when an input/output error of I/O is detected in batch input/output and when recovery from I/O fallback is detected.

■ Control event task for program fallback (Entry 5)

Program fallback is a function that forcefully stops the program and prohibits future execution when a fatal error (e.g. detection of an illegal command) is detected during the execution of the program.

When an error is detected and the execution of the program is forcefully stopped, the event task for fallback starts up. This task can select whether to continue the execution as a controller or produce error stop.

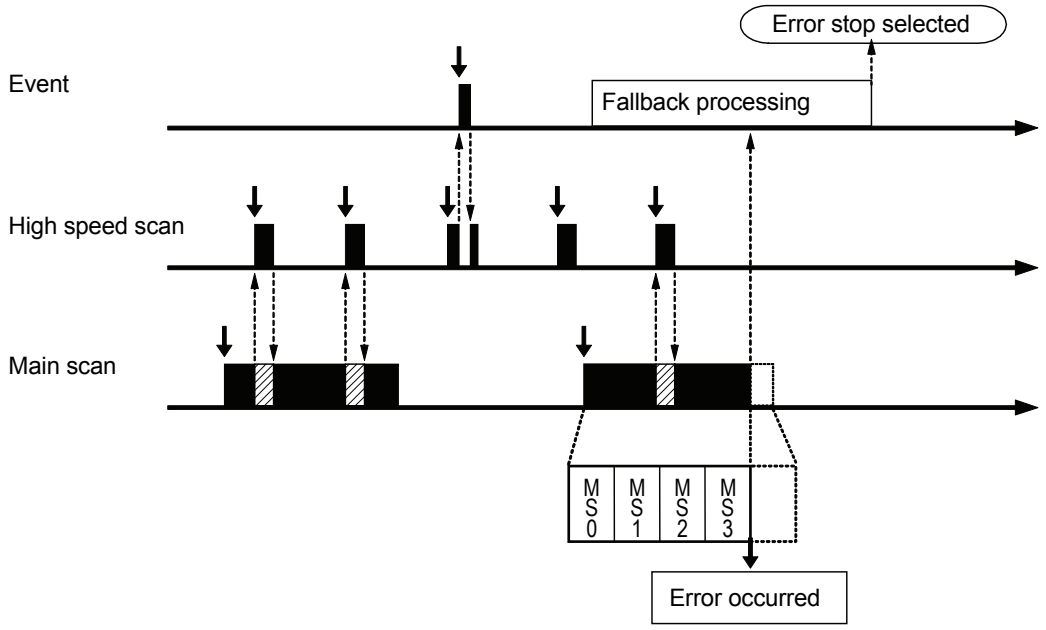


Figure 3-4 Example of selecting error stop in operation of the event task for program fallback

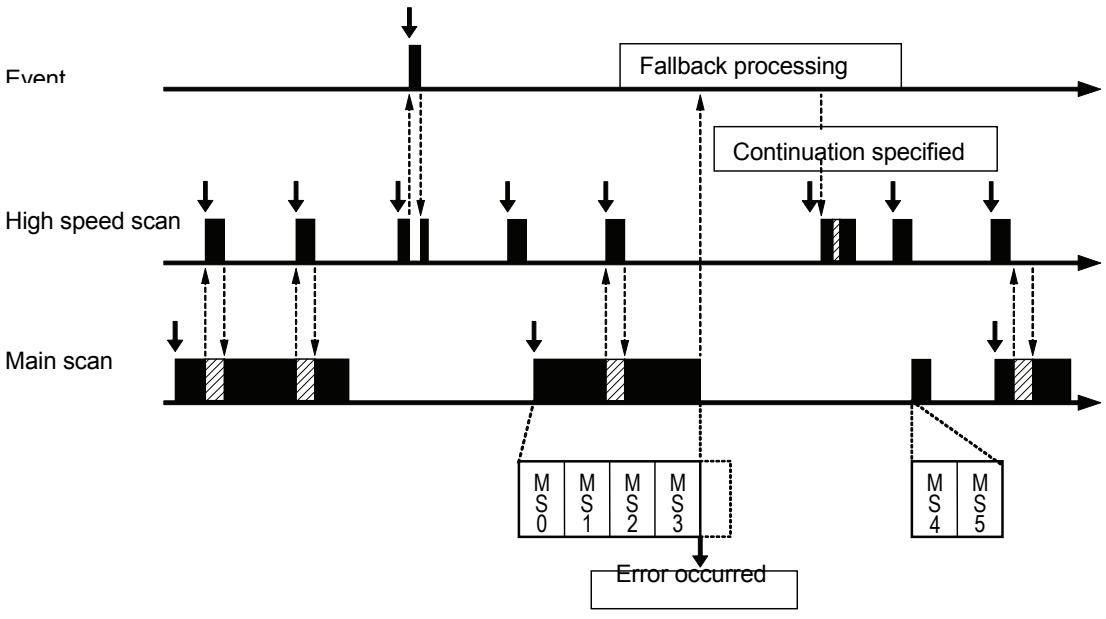


Figure 3-5 Example of selecting continuation in operation of the event task for program fallback

3.2.3 Execution of I/O interruption

To execute a program in I/O interruption, the interruption must be registered in advance. When a change in the input information is detected, the corresponding program starts up.

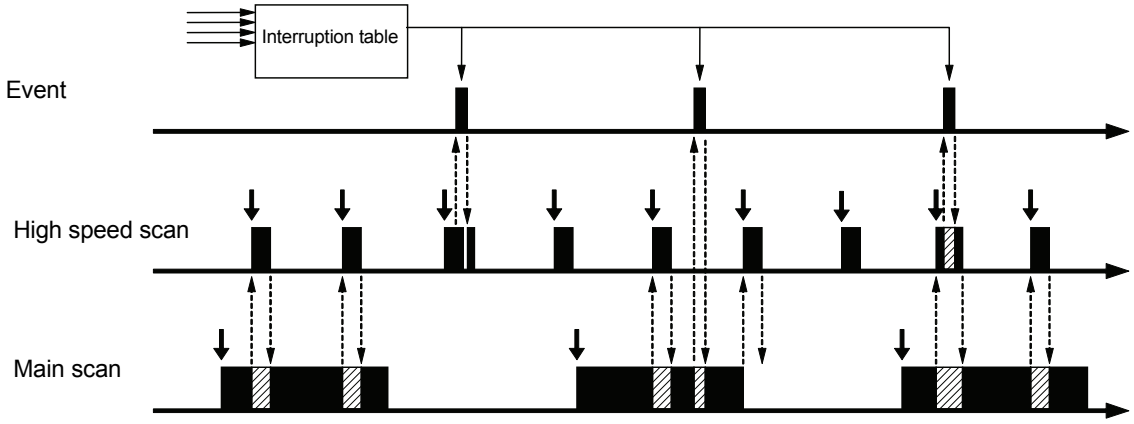


Figure 3-6 Operation example of the interruption event task

The change in the input signal detected as an interruption is saved in the system register (EA2) area as interruption status information. The I/O interruption task can refer to the status information to execute processing accordingly.

3.2.4 Execution of I/O scan

The tasks of the scan system are executed by task for the specified cycle. The registered programs are executed in the order of entry number of the tasks.

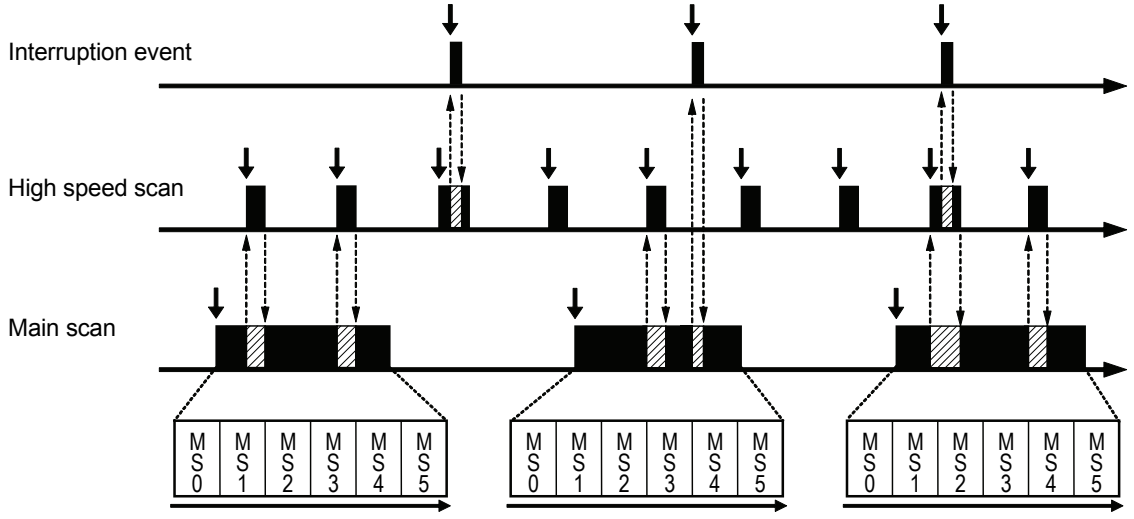


Figure 3-7 Execution example of the scan system task

3.2.5 Grouping and sub scheduling

For the scan system tasks, only one execution cycle can be registered for each of the high-speed scan (HS) and main scan (MS). When they are classified into two types, executed in high speed or in low speed, and execution in lower speed is assumed, the number of times of execution is counted by the program to perform "thinned-out execution." The controller supports automation of this "thinning-out" and management of execution timing of multiple "thinned-out" programs.

For the main scan tasks, grouping and sub scheduling can be specified.

Sub scheduling is a function that specifies the number of multiples of the specified cycle to execute the program.

Grouping divides the programs into groups. For each group, the programs are executed by shifting by one scan cycle.

This can be used to change the execution cycle and execution timing for each program.

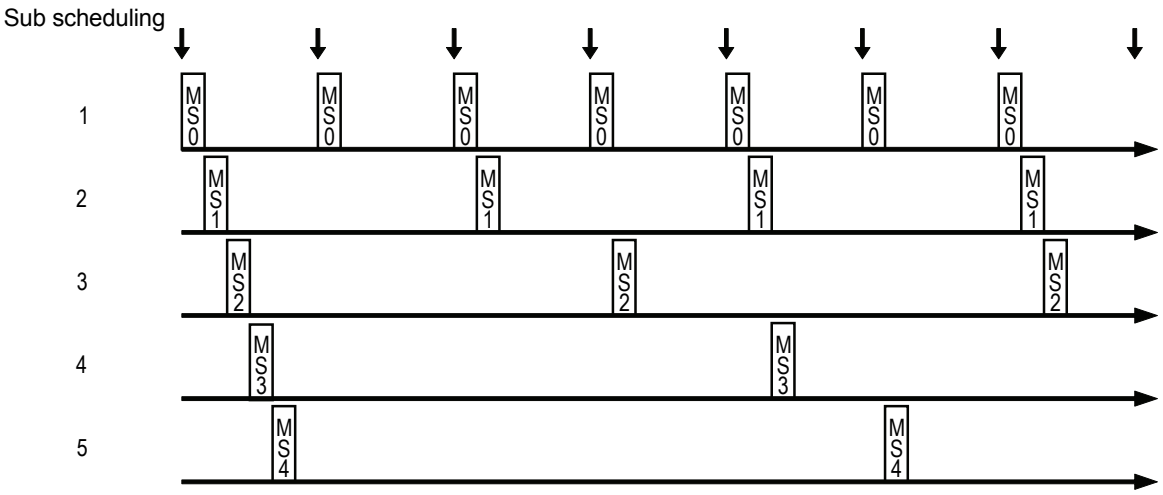


Fig. 3-8 Example of sub scheduling

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 the next figure, 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.

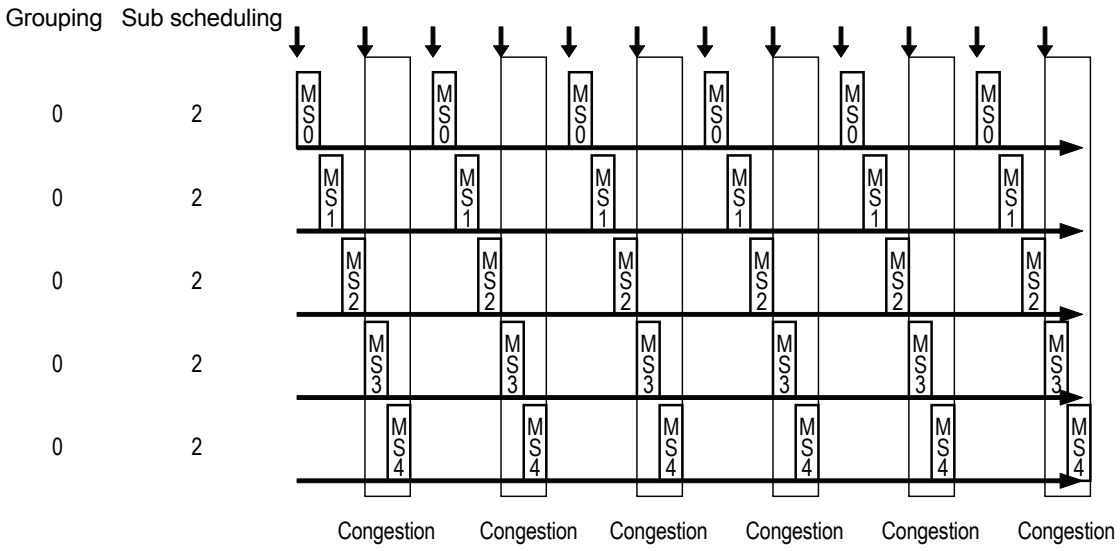


Fig. 3-9 Example of sub scheduling and grouping - 1

In the next figure, setting each program to five grouping (0 for MS0, 1 for MS1, 2 for MS2, 3 for MS3 and 4 for MS4) solves the congestion shown in the precedent example.

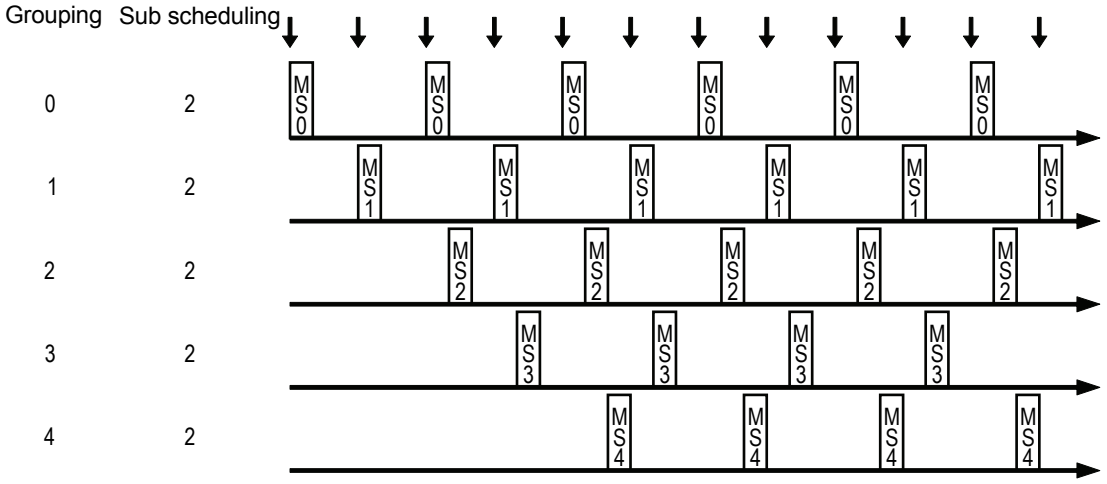


Fig. 3-10 Example of sub scheduling and grouping - 2

◆ Important

- Grouping determines timing when operation execution (RUN) starts. If the grouping setting is changed during operation execution (RUN), the change is not reflected.
- Sub scheduling determines execution timing for each scan. If sub scheduling is changed during operation execution (RUN), the change is reflected immediately. However, the phase relation with other programs is not necessarily the same as the relation when the operation execution (RUN) starts up.
- Changing the sub scheduling or grouping setting during operation execution (RUN) is not recommended.

3.2.6 Task execution error

An execution error such as failure to continue execution of a task may be detected during the execution of the task.

■ Scan congestion

The scan system task is executed repeatedly at the specified fixed cycle. If it takes too long because of too much processing, it may not be completed within the specified cycle. This state is called scan congestion.

When scan congestion is detected, it is recorded to the system log, and minor failure is generated.

If the cause of scan congestion is transient, successful recovery may be expected by catching up with the delay after a certain period of time.

Possible causes of scan congestion include the following:

- The program was too large and could not be completed within the specified time.
- An event system task was executed in interruption so that the specified time was exceeded.
- There were many interruptions inside or outside the system such as transmission processing so that the specified time was exceeded.
- The hardware response delayed and did not complete.

■ Task stall

If scan congestion is not transient and continues, continuation of processing is impossible and task stall occurs.

Task stall occurs when scan congestion continues for 3 scans. It is regarded as a case in which scan processing of 3 times is not completed after 3 times the specified scan cycle elapse.

When task stall occurs, error down of the controller occurs as major failure. In the duplex system, the system switches to the standby.

◆ Note

- Scan congestion may be transient, but congestion itself is not desirable. The scan time must be set with a margin so that congestion won't occur even with the effect of program execution due to interruptions and environment changes.
- The time required for a scan can be displayed on the nV-Tool. Refer to the time when setting the scan time.

■ Program fallback

Program fallback is a function that forcefully stops the program and prohibits future execution when a fatal error (e.g. detection of an illegal command) is detected during the execution of the program. In this case, the program fallback task (No.5) can be executed automatically in the event system task.

This task can select whether to continue the execution as a controller or produce error stop.

3.3 Batch Input/Output

3.3.1 Batch input/output

Batch input/output buffers the input before program execution to reserve input synchronism, rather than exchanging data with I/O during program execution. It also outputs after program execution to reserve output synchronism.

The batch input data retains the process state at the start of that scan, not the process state at the instant of program execution. The content will not change during program execution.

The batch output data outputs the output information determined at the end of that scan to the process, not outputting the data at the instant of program execution to the process. The information changed during program execution will not be given to the process many times.

3.3.2 Execution of I/O

Batch input/output is executed at the start of the scan. The output information created and determined in the scan task is sent to the process after waiting for the start of the next scan. The input information used for the scan task is in the state immediately before that scan.

Batch input/output is executed independently for the high-speed scan and main scan.

◆ Important

- Limit the tasks of the high-speed scan and main scan so that the corresponding batch input/output information is used.
- If batch input/output of the information inputted/outputted in the high-speed scan is performed in the main scan, update to the process becomes slower.
- If batch input/output of the information inputted/outputted in the main scan is performed in the high-speed scan, data may be outputted to the process before it is updated.

3.3.3 Input/output device

The controller connects to the TC-net I/O Series adopting the remote I/O mode as the input/output device.

The interface module to connect the intelligent I/O module (such as SAI01) will be developed separately.

3.3.4 I/O connection and I/Q register

The correspondence between the I/O modules for input/output and IQ registers that is the I/O information within the controller is called I/O connection. To refer to the data inputted/outputted in batch input/output processing from the program, refer to the IQ register.

I/O connection includes the following information:

- Type of the I/O module (connection type)
- Physical location of the I/O module (bus, unit, slot)
- Direction of input/output (input or output)
- Input/output state

The I/Q register corresponds to the I/O module by word.

I/O connection is automatically generated when the I/O module is registered. The information can be checked with the nV-Tool.

3.3.5 IQ register assignment

Batch input/output processing performs input/output of data between the I/O module and IQ register of the controller global variable based on I/O connection.

When a variable is registered to the signal of the I/O module, an IQ register is automatically assigned. The assignment range of the IQ register is pre-determined for each type of the I/O module.

Table 3-4 IQ register

I/O type	Connection type	IQ register		I/O Interruption
		Top number	Number	
Built-in	Digital input	0	1024	Allowed
	Analog input	1024	1024	Allowed
	Digital output	2048	1024	Allowed
	Analog output	3072	1024	Allowed
	Special I/O input/output	4096	4096	Allowed
	G2/G3 input	8192	2048	Allowed
	G2/G3 output	10240	1024	Allowed
	(Drive equipment input/output)	15360	1024	Allowed
Station bus	Input/output via SIF	11264	2048	Allowed
	Station global input/output	13312	1024	Not allowed
	TC-net input/output	14336	1024	Allowed

(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.

・The controller does not support the drive unit.

・For the I/O for which I/O interruption is allowed, the interruption can be used for the I/O interruption task.

3.3.6 I/O fallback

I/O fallback 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.

For the I/O fallback setting, "No fallback" or "Fallback" is specified for each I/O node in the nV-Tool registration.

3.4 Fallback

It can be specified whether to separate the erroneous part and continue operation or generate error down as an error of the entire controller when an error is detected during control execution.

The former is called fallback, and there are "task fallback" and "I/O fallback."

For the detected error, details on whether to execute fallback, and checking the log, refer to "Chapter 8 RAS Function."

3.4.1 Task fallback

When an error is detected in execution of a particular task during program execution, the task may be fallbacked.

However, error down occurs during duplex online operation and fallback occurs during duplex single system operation.

Regardless of whether the cause of the error exists in the task itself or in the external environment such as memory or I/O that is the target of the task, the task is stopped to prevent the error from continuing. The cause may include an LP error, content error of the application program, memory error, or LSI error.

This applies when the following errors are detected:

- Micro stack error
- POU not defined
- Illegal command detected
- Program boundary over
- Data boundary over
- Command not supported
- POU nest over
- Word diverting stack error
- Word merging stack error

3.4.2 I/O fallback

When an error is detected in access to a particular I/O during program execution, batch input/output execution, or periodical diagnosis of the I/O, fallback may occur not to execute the access to the I/O.

Because the TC-net I/O is used, it is I/O access with all serial transmission.

Therefore, I/O access will not become abnormal due to an error of the I/O module itself. It depends on the details caused by the transmission of the TC-net I/O.

The access may be stopped even when it is determined that the I/O module main body is erroneous rather than I/O access itself.

This applies when the following errors are detected:

- TC-net I/O loop error
- I/O error
- I/O node error

3.5 Program Management

Programs are actually downloaded in units of POUs constituting the programs. The POUs are saved in the memory in the controller.

Each of the POUs is saved in a free space corresponding to the size in the memory of the controller. This free space is generated when programs are deleted or changed and consumed when programs are downloaded.

When changes and download of programs are repeated, the use of the memory in the controller becomes fragmented. After that, download can be done if there is any free space corresponding to the unit size of the POU to download, but download fails otherwise.

As a result, there may be cases where new programs cannot be downloaded even if the number of steps of the program in the controller does not reach the maximum number (512k steps). In this case, perform defragmentation.

◇ **Remark**

- A "Writing to FROM" message may be displayed when monitoring is executed immediately after program download and monitoring fails. This occurs when the processing to back up the downloaded program takes time. Monitoring can be done successfully when it is done after a while.

Chapter 4
Variables

Variables are memory that can be referred to by the program. They are classified into different types depending on the usage.
Variable names can be defined freely. There are pre-defined (reserved) names.
The value of a variable changes only upon pre-determined initialization, storage during program execution, or write from HMI, etc.
The types and details of the variables that can be used in Unified Controller nv series type2 comply with IEC61131-3.

4.1 What is the Variable?

A variable is memory or memory area that can be referred to or changed by the program. It is a means to identify the information in the memory of the actual I/O or controller.

The nV-Tool is used to define variables.

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.

4.1.1 Types of the variable

Variables are classified into local variables and global variables according to the scope. Global variables include controller variables and network variables.

As variable names, names pre-defined by the system and names defined by the program can be used. A tag name defined as a tag with the names (atoms) of the parameters of the tag attached as extension is included in the user variable names.

■ Local variable

Local variable is a variable that can be used only by the program. It can be used as working memory in the program.

■ Controller variable

Controller variable is a variable used globally. This variable is used to exchange data between different programs.

■ Network variable

Network variable is a variable shared among stations. This variable is used to exchange data between programs on different stations.

4.1.2 Variable types

Table 4-1 shows the variable types.

Table 4-1 Variable types

Notation	Type	Bits	Effective data range
BOOL	Boolean	1	0, 1
INT	Integer	16	-32768 to 32767
DINT	Double precision integer	32	-2147483648 to 2147483647
UINT	Unsigned integer	16	0 to 65535
REAL	Real	32	-3.40282×10^{38} to 3.40282×10^{38}

TIME	Timer	32	0 to 2147483647ms(24d20h31m23s647ms)
WORD	Word	16	0000 to FFFF
DWORD	Double word	32	00000000 to FFFFFFFF

4.1.3 Variable classification

Table 4-2 shows the variable classifications.

Table 4-2 Variable classification

EA No.	Effective range	Name	Use	User definition
0	Local	Instance variable	Local variable of the program (held)(tracking)	User
1	Local	Temporary variable	Local variable of the program (not held)	User
2	Controller global	System register	Control system area (ZW)	Fixed
3	Local	Instance variable	Local variable for the program (held)(non-tracking)	User
4	Controller global	User variable	Variable that user can define	User
5	Controller global	Batch input/output register	IW/QW	Fixed
7	Controller global	Tag variable (parameter)	PV_PARA Indicator variable LP_PARA Controller variable PB_PARA Pushbutton variable SQ_PARA Sequence operation equipment P_PARA Polygonal line variable T_PARA Timer variable C_PARA Counter variable RTT_PARA DS scan parameter variable	Fixed
10	Controller global	Tag variable (data)	PV_DATA Indicator variable LP_DATA Controller variable PB_DATA Pushbutton variable SQ_DATA Sequence operation equipment T_DATA Timer variable C_DATA Counter variable R_PARA Generic parameter (real) W_PARA Generic parameter (integer) DW Data register MW Transmission register for inter-controller transmission	Fixed
9	Controller global	Inter-controller transmission	AW Reception register for inter-controller transmission	Fixed
12	Station global	Direct I/O	Direct I/O variable that can be accessed from the program	User
13	Station global	Station memory	Variable that can be accessed from the station	User
14	Controller global	TC-net I/O variable	Scan memory of the built-in TC-net I/O loop. (dedicated for direct access by standard input/output processing)	—

(Note1) "User definition" column

User : Variable name/type can be defined freely.

Fixed : Variable name/type are fixed according to the purpose of use.

— : Not available.

4.1.4 Size

The size of a variable is restricted based on the variable type.

Table 4-3 Size of variable

Variable		Size
Local variable		246KW
Global variable	User global variable	10KW
	Tag	Refer to the chapter on tags.
	System variable	Refer to the section on ZW.
	I/O variable	8KW
	Network variable	Depends on the network module specification

4.2 Initialization of the Variable

4.2.1 Initialization

Initialization of the variable can be selected from the following initializing methods. Select the 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”

4.2.2 Initialization timing

Variables are automatically initialized as needed when the controller is turned on, etc.

Each variable is initialized depending on the length of the power outage time upon power on, or when the operation mode becomes RUN.

Table 4-4 Initialization of the Variable

EA No.	Name	Initialization details			
		Short interruption startup	Long interruption startup	HALT→RUN	Duplex switching
0	Instance variable (tracking)	Continued	Continued/Zero clear (Note 2)		Continued
1	Temporary variable (Note 1)	Zero clear		Continued	
2	System register	Continued			
3	Instance variable (non tracking)	Continued	Zero clear		
4	User variable	Continued	Continued/Zero clear (Note 2)		Continued
5	Batch input/output register	Continued			
7	Tag variable (parameter)	Continued			
10	Tag variable (data)	Continued	(Note 3)		Continued
9	Inter-controller transmission	Continued			
12	Direct I/O	Continued			

13	Station memory	Continued			
14	TC-net I/O variable	Cannot be referred to from the program.			

(Note 1) The variable itself is cleared or continued. However, it is actually undefined because it is overwritten due to program execution (written and read out).

(Note 2) Cleared to zero or continued depending on the setting of the PU821 module parameter.

(Note 3) The variable itself is continued, but MV and MOD of the controller tag depend on the processing of the standard input/output. For details, refer to the chapter on the standard input/output.

4.3 Tag Variable

Variables registered as tags can be referred to as a tag type array or tag number (tag name). To refer to the parameter, the atom name is specified as extension.

The table below shows the standard tags.

Table 4-5 Types of tag variables

Tag type	Meaning	Total
PV	Indicator	1024
LP	Controller	320
PB	Pushbutton	1280
SQ	Sequence operation equipment	128
TC	Timer/counter	128
DB	Data block	256
R	Real parameter	4096
W	Integer parameter	1280
T	Timer	512
C	Counter	128
P	Polygonal line table	256
RTT	For real-time trend (OIS-DS)	512

To use a tag variable, register a tag name with the tag editor of the nV-Tool. A controller variable is automatically defined for the registered tag name. To use it in the program editor of the nV-Tool, describe the following:

If the tag name of PV is FI000,

FI000.PV

4.4 System Variable (ZW)

System variables are used by the program to exchange information with the controller. They can be referred to by the program as controller global system variables. They can be monitored to check the operation state of the controller using the nV-Tool.

A system variable has an array structure represented by word, which is also called a ZW register. It is referred to by the user program as a global variable of EA=2, system 1.

Chapter 5
I/O Input/Output

In the Unified Controller nv series type2, there are batch input/output and direct input/output as methods to execute input/output.
Batch input/output is a function that inputs/outputs data of the I/O module in a batch according to the input/output information registered in advance. Direct input/output is a function that directly inputs/outputs data of the I/O module at the timing of program execution.

5.1 I/O Execution Processing

5.1.1 Batch input/output

Batch input/output is automatically executed when the I/O module is registered.

■ Batch input/output processing and execution cycle

Batch input/output processing is divided into input processing and output processing. Input processing is executed before the program is executed, and output processing is executed after the program is executed.

Batch input/output processing is executed in synch with high-speed scan or main scan. For the execution cycle of batch input/output, the type of scan to synchronize with (high-speed scan/main scan) can be specified for each I/O module.

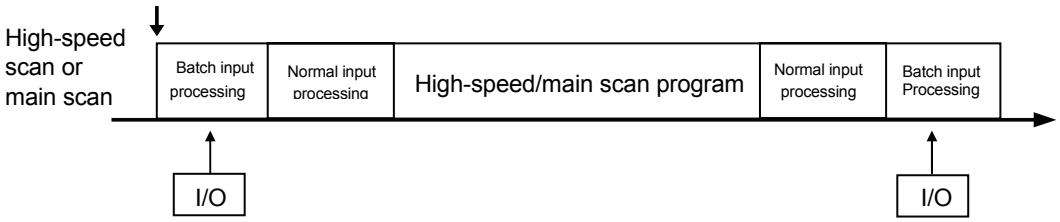


Figure 5-1 Batch input/output processing schematic diagram

■ 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 has a capacity of 8192W, and each word corresponds to the I/O module.

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.

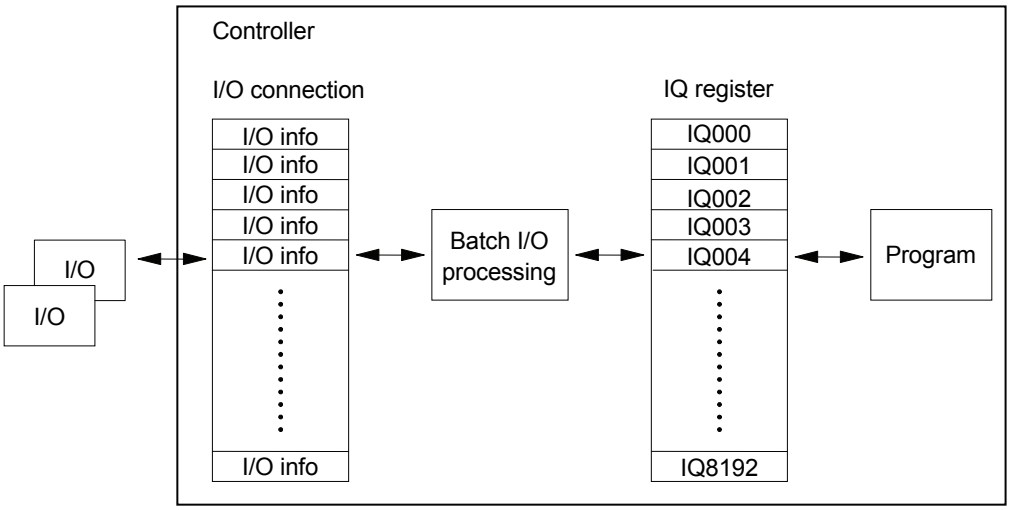


Fig 5-2 IQ register

■ 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.

Table 5-1 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
Built-in TC-net I/O	TC-net I/O digital input	0	1024	Available
	TC-net I/O analog input	1024	1024	Available
	TC-net I/O digital output	2048	1024	Available
	TC-net I/O analog output	3072	1024	Available
	TC-net I/O special input/output	4096	4096	Available
	(G3/G2 input not defined)	8192	2048	Available
	(G3/G2 output not defined)	10240	1024	Available
Station bus module	I/O input/output via SIF	11264	2048	Available
	Station global I/O	13312	1024	Unavailable
	TC-net I/O	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.

5.1.2 Direct input/output

Direct input/output directly inputs/outputs I/O modules from the instruction word of the program at the execution timing of the program without using batch input/output.

Direct input/output can directly input/output I/O module data without using batch input/output, and therefore can input/output the latest data (i.e. execute as an image).

The TC-net I/O utilizes the remote I/O format, so the output terminal cannot be accessed or operated directly.

5.1.3 I/O interruption

The change in I/O scan data is detected. It enables to execute I/O interruption event task (IP task). However, the setting of I/O status change detection needs to be connected with I/O interruption event task in advance.

For state change detection, up to 32 points can be specified.

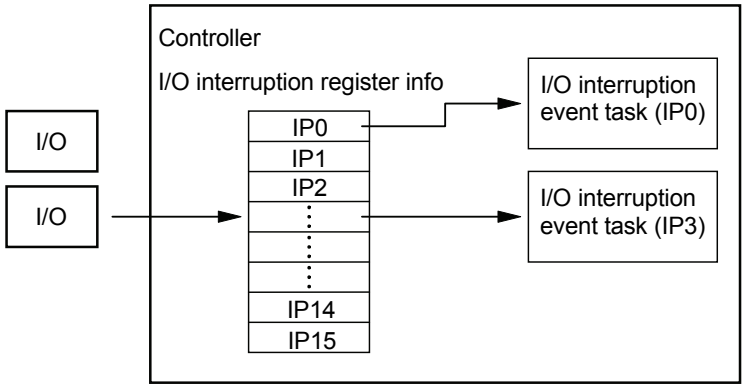


Fig 5-3 I/O interruption and I/O interruption task

5.2 I/O Execution Error

The I/O fallback function and I/O fallback recovery function are provided as error processing upon input/output of I/O modules (batch input/output processing or direct input/output processing). Both of them can intervene in error processing via the program dedicated for error processing.

5.2.1 I/O fallback

I/O fallback 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 “Fallback” or “No fallback” of I/O fallback setting for each I/O node, using nV-Tool. If an error is detected in input/output with no I/O fallback specified, error down occurs without I/O fallback.

The concept of I/O fallback at input/output to/from each I/O module is as follows

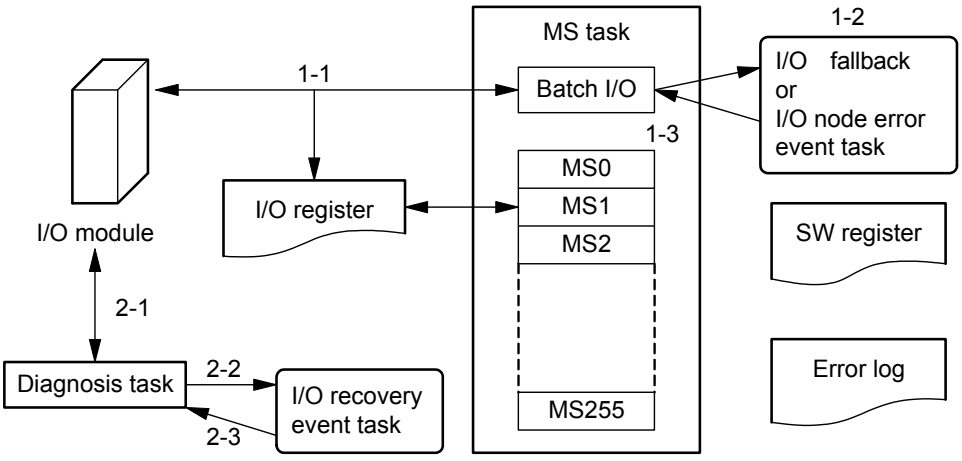


Fig. 5-4 I/O fallback

5.2.2 Fallback at batch input/output

When an error of the I/O module is detected at batch input/output, the access of the I/O is stopped by word.

The following can be identified as an error:

- Error of the I/O module itself
- Error of the TC-net I/O interface
- Error of the network system
- Error of the I/O processing system of the controller main unit

When the access is stopped upon error detection, the event task (EV4) corresponding to I/O fallback starts up.

When an error occurs in the TC-net I/O interface (node), all the I/O modules under the node cannot be accessed. In this case, the event task (EV7) corresponding to node down starts up.

5.2.3 I/O recovery

When an I/O error is detected and I/O fallback occurs, the state of the corresponding I/O is regularly diagnosed to check for recovery.

If it is determined that the I/O can be accessed again after the error is eliminated, the event task (EV6) corresponding to I/O recovery starts up.

5.2.4 Program fallback

If direct input/output is performed within a task and it is determined that the task cannot be executed due to the input/output processing itself, program fallback may occur instead of I/O fallback.

When program fallback occurs, the corresponding event task (EV5) starts up.

5.3 Error Monitoring

The error state of each component of the TC-net I/O is monitored and reported by the standard function.

When an error is detected in batch input/output or periodical diagnosis processing, it is reported as stop of input/output (I/O fallback, etc) or system tag to the OIS-DS, respectively.

For details of the errors, refer to "Chapter 9 RAS function" and the detailed explanation in "High-Speed Serial I/O System TC-net I/O Operation Manual" (6F8C1240).

5.3.1 TC-net I/O interface

The TC-net I/O interface operates as a node of the TC-net I/O loop. Therefore, its error results in inability to access to all the I/O modules under the node.

On the contrary, when only the node remains due to an error in the controller side, the I/O modules under the TC-net I/O interface node determines whether to continue or stop operation based on the instructions of the TC-net I/O interface. Continuing operation indicates holding the final output, whereas stopping operation indicates turning all outputs off (0V、0mA) by resetting the outputs.

5.3.2 TC-net I/O module

The TC-net I/O module operates by receiving the instructions from the controller via the TC-net I/O interface.

The TC-net I/O module executes self diagnosis regardless of the presence of a processor, and determines its operation based on the result.

Chapter 6
Standard Input/Output

The Unified Controller nv series type2 inherits the standard input/output that has been supported by L2 and L3 of the PCS-DS and Integrated Controller V series.

6.1 Tag Variables and Standard Input/Output Processing

The standard input/output function consists of PV processing, LP processing, PB processing, TC processing, T processing, and C processing.

Assuming general process control, the signal of an external sensor is first captured to PV processing as an initial value. After that, an engineering unit conversion of the input value is performed by PV processing, and the input value (PV) is inputted to PID processing (PID command) of the program. PID processing calculates the operation amount according to the setting value (SV) and specified control parameters and outputs the output value (MV) to LP processing. LP processing performs output processing of the output value (MV) and outputs the operation amount to external operation equipment.

The OIS has the indicator, integrator, controller, M/A operation equipment, and ratio relay tags of the analog system and the pushbutton tag of the digital system. The tag information can be displayed on the face plate and point display screen on the OIS's screen. The OIS exchanges tag information with the tag instrument variables of the controller to enable display and setting by the OIS.

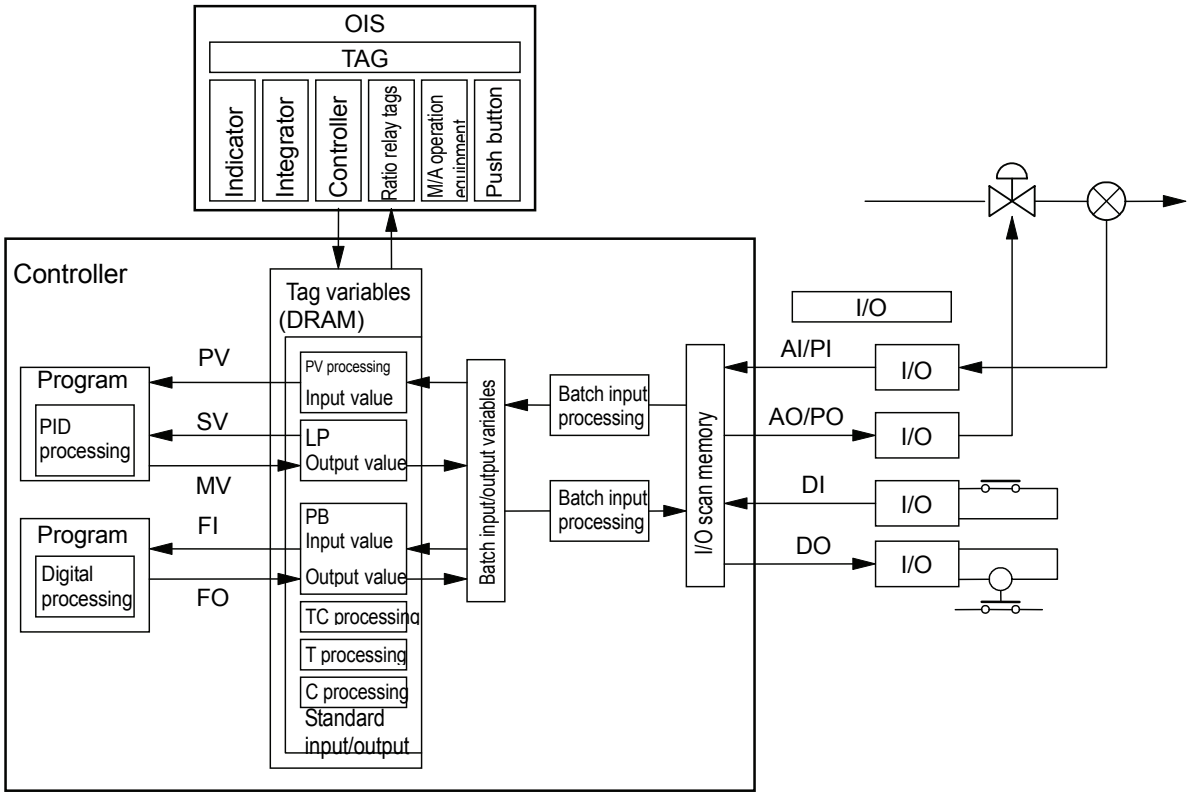


Figure 6-1 Standard input/output processing of the controller

6.2 Types of Tag Variables

The next table shows the types of the tags used in standard input/output.

Table 6-1 Types of tags

Tag instrument variable	No. of points	Update	Instrument pattern	Description
Indicator variable (PV)	1024	○	IND, AMM, PFI, TTL, WND	Instrument for analog input (instantaneous value/integration value) or pulse input (instantaneous value/integration value).
Controller variable (LP)	320	○	PID, SPI, M/A, RS, TPI, SET	Instrument for analog output or pulse output. Always used in combination with the indicator variable. (Note 1)
Pushbutton variable (PB)	1280	○	SOV, MOT, MOV, PB4, PB8, PB2	Instrument for digital input/output. Used in combination with the indicator variable as needed. (Note 1)
Sequence (SQ)	128	—	SEQ	Instrument for SFC management. Managed by the sequence dedicated command.
Timer/Counter (TC)	128	○	TIM, CNT	Instrument for the timer and counter.
Data block (DB)	256	—	DB1, DB8	
Real parameter (R)	4096	—		
Integer parameter (W)	1280	—		
Timer (T)	512	○		
Counter (C)	128	○		
Polygonal line table (P)	256	—		
DS scan parameter (RTT)	512	—		Information for real-time trend registered in the OIS.

"Update" column

○ : Updated by standard input/output processing.

— : Not updated by standard input/output processing (for application).

"Instrument pattern" column

The instrument pattern displayed on the OIS is determined based on the TYPE setting, and the corresponding standard input/output processing is performed.

(Note 1) The combination with the indicator variable must be set to the parent variable (controller or pushbutton variable) by the user.

6.3 Four Functions of Standard Input/Output

Standard input/output processing consists of 4 functions; data input/output (tag variable update), signal alarm, I/O error, and read-back. The 4 functions are executed depending on the type of the tag variable. The following table shows the relations between the tag variables (updated by standard input/output processing) and the 4 functions.

Table 6-2 Execution functions of tag variables

Tag variable	Data input/output	Signal alarm	Device error	Read-back
PV	○	○	○	—
LP	○	○	○	○
PB	○	○	○	○
TC	○	○	—	—
T	○	○	—	—
C	○	○	—	—

○: Executed, —: Not executed (no corresponding function)

■ Data input/output function

This is a basic function of standard input/output processing. PV executes data input from I/O, LP executes data output to I/O, PB executes data input/output to I/O, TC executes timer/counter time, T executes timer time, and C executes counter time. The detailed processing of each tag variable is described on the following pages.

Data input/output with I/O corresponds to 3 tag variables, PV, LP, and PB. Data input/output with the corresponding variable (address) is performed when the input point variable name (e.g. PVA) and output point variable name (e.g. MVA) are registered.

■ Signal alarm function

This function compares the result obtained by the data input/output function (e.g. PV value) and the alarm condition (e.g. PV upper limit alarm), and sets the corresponding alarm if the alarm condition is met.

A sensor error can be regarded as not an error of the I/O module (standard system side), and the input can be updated.

■ Device error function

A device error means detecting major failure (system alarm) such as transmission disconnect (module down) or ADC/read-back error in the I/O module and setting an alarm of the tag variable as an error of the module (device).

A device error corresponds to 3 tags, PV, LP, and PB. The error state of the corresponding module is read and major failure judgment is done when the hardware address (CNO to PNO) is registered. A device error is displayed as PDE (device error) in PV, MVE (MV error) in LP, and IOE (IO error) in PB. To require a safety check, MVE of LP is not automatically recovered when the error factor is eliminated, requiring a check (recovery) operation of the operator.

When a device error occurs, update of input/output is stopped in standard input/output.

When an output error (e.g. MV read-back error) occurs, auto control usually stops. However, remote operation (operation from the OIS-DS) performs output with the required output value even in this state.

■ Read-back function

For LP and PB, when control mode =M, the output read-back value from I/O is reflected to MV and F0, and made equal to the actual output value from I/O.

As in the device error function, read-back information of the module is read and read-back processing is performed when the hardware address (CNO to PNO) is registered.

◇ Remark

- Using an AO module without read-back circuit (e.g. AO928F)
  type2 assumes an AO module with read-back circuit (e.g. AO928). If it is necessary to an AO module without read-back circuit, the read-back function and device error function (read-back error detection) of standard input/output must be reset.
  To reset, register the hardware address (CNO to PNO) to ”0”. Note that this also disables the detection of module down.

6.4 Details of Data Input/Output Functions

The data input/output functions (standard input/output basic functions) for tag variables are shown below.

■ PV processing

- Analog instantaneous value conversion
  Normalization, temperature pressure correction, filtering, and engineering unit conversion are executed in the following order.

① Sensor check
When the ADC count value diverts from the normal range, the signal from the sensor/transmission equipment is regarded as disconnected. This state is a sensor error.
When no signal is inputted to the input terminal for analog input, the ADC count changes to the full count value or zero count value depending on the hardware characteristics upon the opening of the input terminal. In this case, the final converging count value and converging speed are determined by the hardware characteristics of the analog input module.
Generally, a sensor error occurs when the ADC count value becomes the full scale (4095 for 12-bit ADC) or when the input voltage is 0.7V (equivalent) or less. The former is called an upper limit error, and the latter is called a lower limit error.
Whether to execute a sensor check can be specified for upper limit check and lower limit check independently.

② Normalization
Normalization means converting the ADC count value to a percentage value.
The range of the ADC count value is determined based on the type of ADC of the input module. For 12-bit ADC, the range of the count value is 0 to 4095.
The upper limit range (CH) and lower limit range (CL) must be set after understanding the relation between the actual input effective range (voltage range or current range) and ADC count value.
Generally, the effective input range is limited within the full range of ADC, which is about−25% to 103% of the full range.
Normalization is performed according to the upper limit range (CH) and lower limit range (CL) setting of the input counter.
When the input counter is CH, PV is RH (instrument range upper limit).
When the input counter is CL, PV is RL (instrument range lower limit).

③ Temperature pressure correction
Temperature pressure correction
Square root extraction
Low-cut

④ Filtering
Current output value = [Current input value ×(1−FT)] + [Previous output value ×FT]
The digital filter is a low-pass filter with primary delay.

The coefficient FT of the digital filter can be determined using the required time constant T and scan cycle (ΔT) as shown below.
FT＝T / (T + ΔT)
Filter coefficient = 0 indicates the state where the equivalent time constant is zero and the filter does not work.
Filter coefficient = 1 indicates an infinite time constant, therefore cannot be set.
The equivalent time constant changes depending on the scan cycle, so be careful when accurate time is required.

⑤ Engineering unit conversion
The value is converted to the engineering unit value using the specified RH/RL.
The magnitude relation of RH and RL does not matter. A reverse range is also allowed.

- Pulse instantaneous value conversion
  Only input from the PI(pulse input) module is used.
  The following instantaneous value calculation is performed.
  (Instantaneous value) = (Pulse difference count)×PU×D×K×T/(Scan time)

- Analog integration value conversion
  The following integration value calculation is performed.
  (Current integration value) = [(Current instantaneous value)×D×K×(scan time) / T] + (Previous integration value)
  Integration value = 0 is retained during an integration reset.
  When the maximum integration value (MAX) is exceeded, rollover processing [(integration value －MAX)] is performed.

- Pulse integration value conversion
  Only input (16-bit endless counter of 0~65535) from the PI(pulse input) module is used.
  The following integration value calculation is performed.
  (Current integration value) = [(Pulse difference count)×PU×D×K] + (Previous integration value)
  Integration value = 0 is retained during an integration reset.
  When the maximum integration value (MAX) is exceeded, rollover processing [(integration value －MAX)] is performed.

◇ **Remark**

- The conversion accuracy of standard input/output is the single precision format and significand 24 bits, and the significant digits are equivalent to 5 to 6 digits in decimal.
- When performing integration value conversion (analog integration/pulse integration) with standard input/output, consider the significant digits. If the significant digits are not considered, a phenomenon such as the integration value not matching the field counter occurs.
- Normal integration calculation is performed in single precision. Therefore, if there is some difference between the absolute values of the integration value (up to that point) and the additional value (of that time) (about 5 digits or more in decimal as a guide), an error may be significant.

■ LP processing

- Current output conversion
  When control mode = C / A / RM, MV is converted to the output counter of the AO (analog output) module.
  The descriptions of the current direction and valve direction (direct/reverse) are according to the era of air pressure control.
  Output direction = R : AO is outputted at 4-20mA when MV is 0—100%.
  Output direction = D : AO is outputted at 20-4mA when MV is 0—100%.
  When control mode = M, MV read-back of the read-back count of the AO (analog output) module is performed.

- Pulse output conversion
  When the program sets an output request flag, the output request value is converted to the counter of the PO (pulse output) module.

◇ **Remark**

- To perform pulse output using other than standard output processing, set the bus number, unit number, slot number, and point number of the controller (parameters) to their initial values (all zero). Also, set the signal code to the calculation value.
  Setting the above stops LP processing of standard input/output, allowing the user to perform pulse output using a special output processing program.

■ PB processing

- DI input processing
  The DI of the specified DI (digital input) module is stored to FI of #PB.
  Input inverse processing is executed based on the setting.

- DO output processing
  At button operation from the OIS, set, reset, or inversion of FO is performed based on the pushbutton variable (parameter) setting.
  FO of the pushbutton variable (data) is outputted to DO of the specified DO (digital output module).
  Output inversion processing is executed based on the setting.
  This processing is performed only when control mode = A,RM.

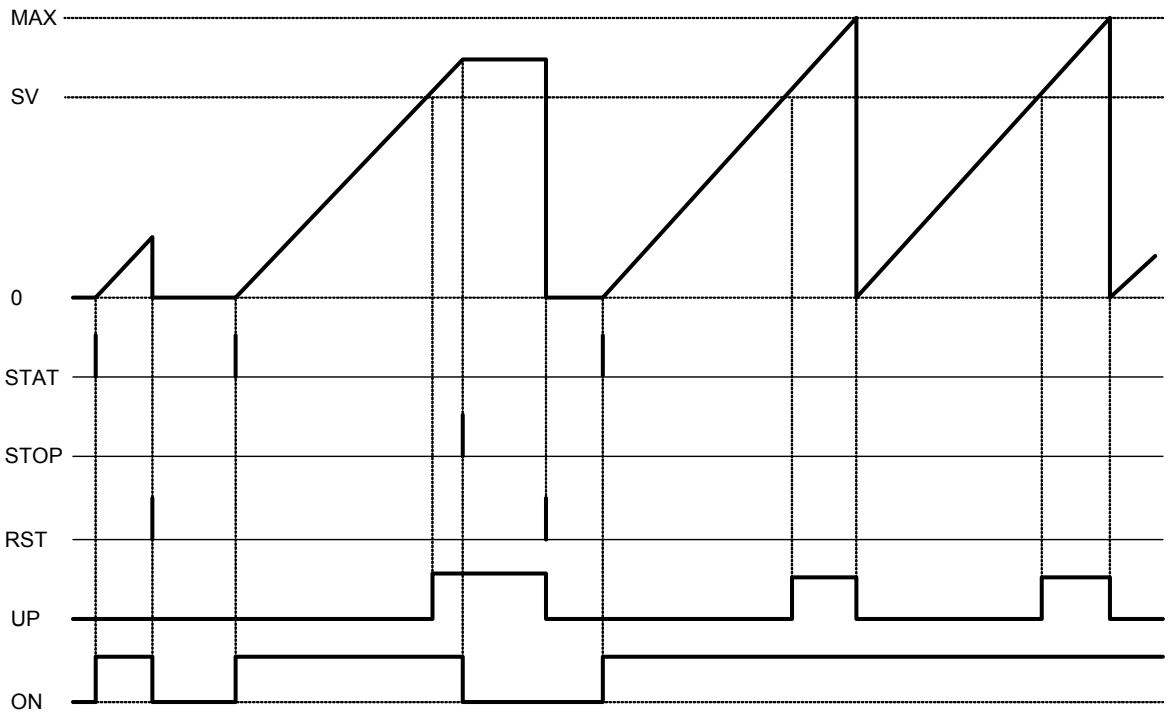
- DO read-back
  The read-back DO of the specified DO (digital output) module is stored to FO of #PB.
  This processing is performed only when control mode = M.

■ TC processing

Timer (TIM) and counter (CNT) operations are done based on the tag type (TYPE) specification.

- Timer processing

① Turns on (ON) at the start instruction (STAT), and PV addition starts.
② Different values are added to PV based on the time unit (TMEU: second, minute, hour, day).
Second: + 1 per 1 sec
Minute: + (1/60) per 1 sec
Hour: + (1/3600) per 1 sec
Day: + (1/86400) per 1 sec
③ PV addition stops at the stop instruction (STOP).
④ PV=0 at the reset instruction (RST).
⑤ Rollover processing is performed when PV exceeds the maximum value (MAX).
⑥ Preset is achieved (UP) when preset value (SV) < PV.
Addition continues up to the maximum value even preset is achieved.
[Setting other than 0 < SV; UP is OFF.]

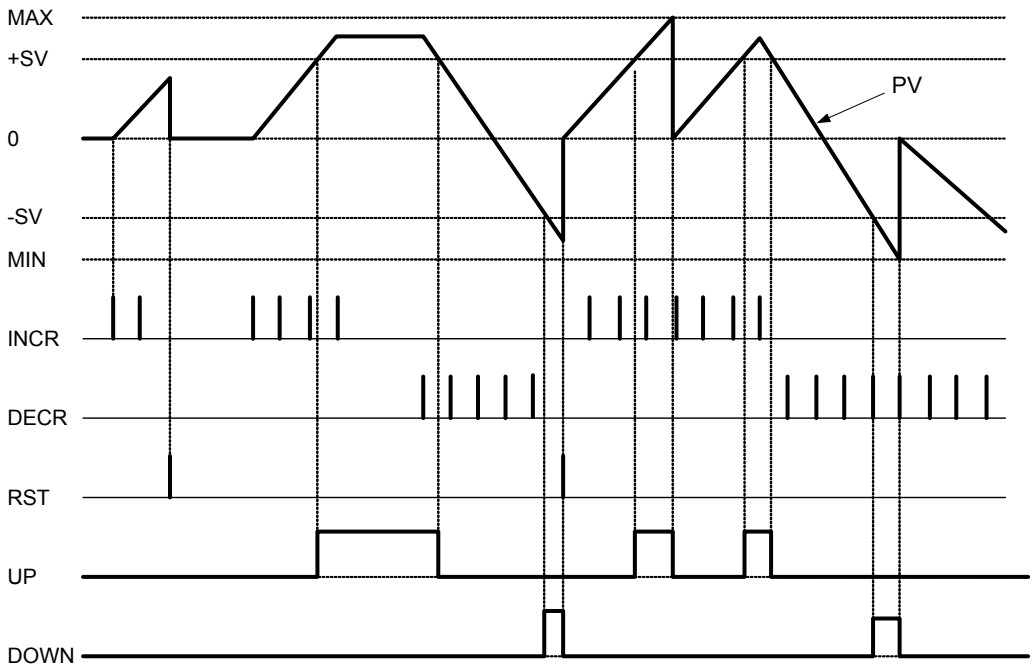


TMEU : Time unit [second (0), minute (1), hour (2), day (3)
MAX : Maximum value [0 <MAX setting]
PV : Elapsed time SV : Preset value
STAT : Start command STOP : Stop command
RST : Reset command UP : Preset value reached
ON : Counting
(NOTE) UP is OFF When SV=0.

Figure 6-2 Timer operation (TC processing)

- Counter processing

① PV increments (+1) at the increment instruction (INCR).
② PV decrements (-1) at the decrement instruction (DECR).
③ Preset is achieved (UP) when preset value (SV) ≤ PV [processing is executed only when 0 < SV]
④ Preset is achieved (DOWN) when PV ≤ SV [processing is executed only when SV < 0]
⑤ Rollover processing is performed when maximum value (MAX) < PV
⑥ Rollover processing is performed when PV < minimum value (MIN)
⑦ Reset to PV = 0 at the reset instruction (RST).



MIN	: Minimum value [Set MIN<0]	MIN	: Minimum value [Set MIN<0]
PV	: Current value	DECR	: Decrement command
SV	: Preset value [Set 0 <SV]	DOWN	: Preset value reached (DOWN)
INCR	: Increment command		
RST	: Reset command		
UP	: Preset value reached(UP)		

(NOTE) Both UP and DOWN are OFF when SV=0.

Figure 6-3 Counter operation (TC processing)

- T processing

Timer processing has 2 types of timers; 0.1 sec timer and 0.1 min timer. The first 256 of the timer variables (T[0] to T[255]) are 0.1 sec timers, and the latter 256 (T[256] to T[511]) are 0.1 min timers.

① Current value (VAL) addition starts at the start instruction (STAT).

② Different values are added to VAL based on the time unit (type of the first half or second half).

0.1 sec: + 1 per 0.1 sec

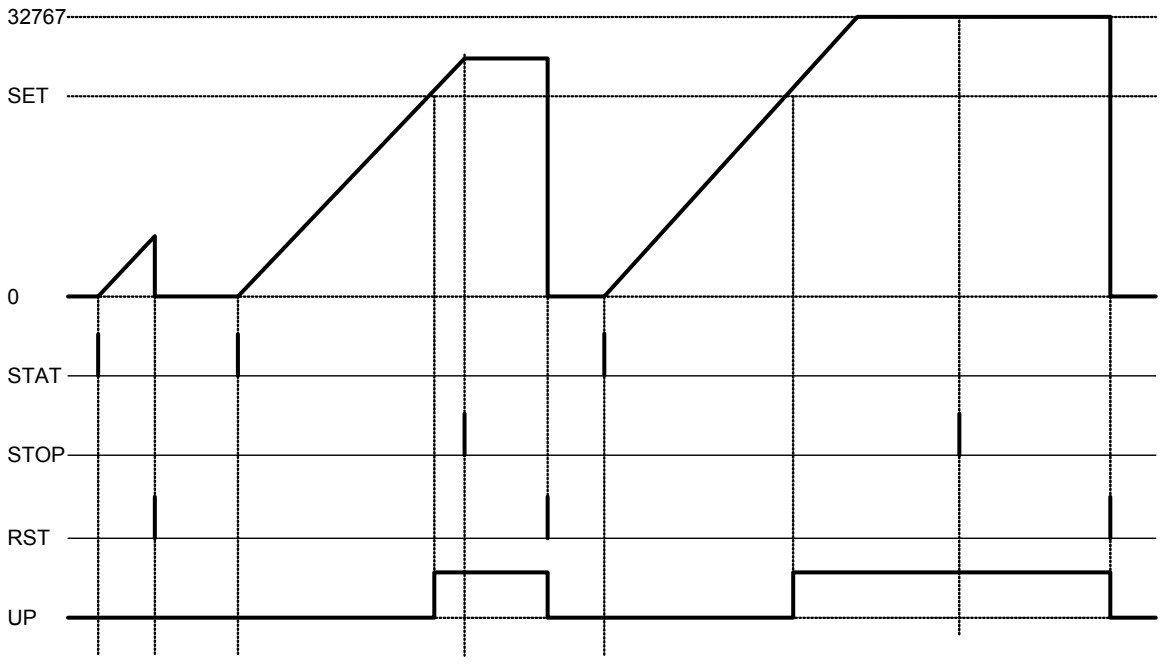
0.1 min: + 1 per 0.1 min (6 sec)

③ VAL addition stops at the stop instruction (STOP).

④ VAL = 0 at the reset instruction (RST).

⑤ Limited to 32767 when the maximum value (32767) of the integer type is reached.

⑥ Time up (UP) occurs when setting value (SET) ≤ VAL.

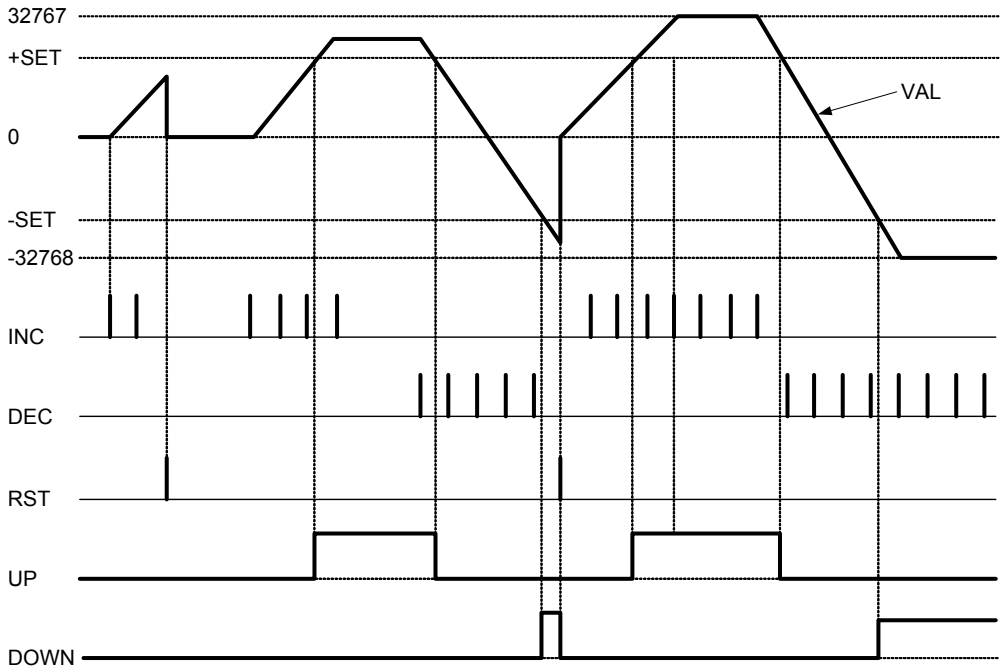


VAL : Current value
SET : Setting value
STAT : Start command
STOP : Stop command
RST : Reset command
UP : Time up

Figure 6-4 Timer operation (T processing)

- C processing

① Current value (VAL) increments (+1) at the increment instruction (INC).
② Current value (VAL) decrements (-1) at the decrement instruction (DEC).
③ Count up (UP) when setting value (SET) ≤ VAL
④ Count down (DOWN) when — setting value (SET) ≥ VAL
⑤ Limited to 32767 when the maximum value (32767) of the integer type is reached.
⑥ Limited to -32768 when the minimum value (-32768) of the integer type is reached.
⑦ Reset to VAL= 0 at the reset instruction (RST).



VAL: Current value SET: Setting value
INC: Increment command DEO: Decrement command RST: Reset command
UP : Count up (UP) DOWN: Count down (DOWN)

Figure 6-5 Counter operation (C processing)

6.5 Process Alarm

When tag registration is performed, process alarm occurrence/recovery processing is performed. The judgment of process alarms has a dead band, and the result reflects the hysteresis.

If scan off is done with an indicator, a PV value can be set from the OIS-DS. During scan off, no sensor check is performed, so the sensor error (PVI) is reset. Diagnosis of process alarms other than the sensor error is executed.

The following table shows the processing details.

Table 6-3 Process alarm processing details

Tag instrument variable	Process alarm details	
Indicator variable (PV)	DPL (PV change rate)	Alarm
	PL (PV lower limit)	Alarm
	PH (PV upper limit)	Alarm
	PRE (PV processing error)	Alarm
	PVI (sensor error)	Alarm
	PDE (device error)	Alarm
Controller variable (LP)	VPI (valve opening error)	Alarm
	DVE (deviation)	Alarm
	MVL (MV lower limit)	Alarm
	MVH (MV upper limit)	Alarm
	MVE (MV error)	Alarm
Pushbutton (PB)	IOE(DI/DO module error)	Alarm

◇ **Remark**

- When a sensor error is detected, updating of the corresponding PV data is stopped, and the last normal value remains. If data update is specified optionally, the ADC count with the sensor error can be normalized as it is and reflected to the PV value. In this case, an upper limit error or lower limit error occurs in general.
- Occurrence and recovery of the CLI (control stop) alarm of the controller is performed in the program by the user.
- The deviation error is automatically reset in the manual mode (other than the auto control mode A/C).
- The MV upper limit error and MV lower limit error are updated regardless of the control mode. Generally, if MV upper limit restriction and MV lower limit restriction are enabled in the auto control mode, the corresponding alarm occurs in the restricted (clipped) state.
- If alarm suppress is executed in the program, the following alarms other than the alarms directly linked to hardware failure are reset.
  Indicator : PDE alarm
  Controller : MVE alarm
  CLI alarm (suppress processing can be specified in the program)
  Pushbutton : IOE alarm

6.6 Sequence Tag

The sequence tags are not directly related to input/output.

The sequence tags are managed by the SFC dedicated command, and the operation results are saved to the tags.

Chapter 7
nV-Tool Support Function

To define the operation of the Unified Controller nv series type2, the nv series nV-Tool is used as an engineering environment.
The nV-Tool is a Windows application that runs on a PC, and is a common platform with the engineering of the Integrated Controller V series.

7.1 Module Parameters

The elements constituting the system are called modules. The setting items to define the operation of the modules are called module parameters.

The system components and their parameters include the parameter specifying the operation of the controller unit main body (CPU), I/O parameters managed by the controller, and parameters for connection and transmission via Ethernet.

7.1.1 Controller operation specification

Following basic operations of the controller are specified as below.

- Program fallback
  Set whether to use or not the program fallback function.
- I/O fallback
  Set whether to use or not the I/O fallback
- Global variable initialization specification
  Set whether to initialize or not the global variable at starting up in RUN mode.
- Local variable initialization specification
  Set whether to initialize or not the local variable at starting up in RUN mode.
- 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.

7.1.2 Task execution specification

The execution conditions of the task are specified.

- Scan cycle
  Specify the execution cycle of the high-speed scan tasks and main scan tasks that are executed at a fixed cycle.
  Each cycle has its available setting range and setting unit.
  Even if the scan cycle is specified, the cycle may not be retained depending on the load state of the task, resulting in execution in a slower cycle. When execution is done in a slower cycle than the specified cycle, "scan congestion" is recorded in the system log.
  If the specified cycle is too short and execution of the program for 1 scan takes longer, "scan congestion" occurs.
  Scan congestion occurs when the absolute amount of the program (the number of steps actually operation rather than apparent steps and time of individual commands) is large, standard side processing such as alarm activation takes time due to sudden state changes, or load is increased due to access to data via the transmission path such as the OIS-DS.

- Sub schedule
  Specify for main scan tasks to make the execution cycle of individual tasks integer multiples of the main scan cycle.
- Grouping
  Specify the execution phase when sub schedule is specified for main scan tasks.

7.1.3 Information on duplexing

Specify the options of duplex operation when the controller has duplex configuration.

- System alarm in duplex operation
  Specify whether to notify or not the alarm of minor failure when the secondary becomes online.
  The default is handling as minor failure.

- Auto restart
  Specify whether to restart automatically or not the system when the controller is shut down due to error down.
  The default is stopping with error down. To recover, error reset operation is required.
  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. This function is for the type3 controller.
  When RESTART is specified, system is automatically restarted when in error down, irrespective of the operation mode of other system.
- Operation with I/O status inconsistency
  The TC-net I/O adopted in the controller has duplex loop configuration, so the connection state changes automatically such as switching from loop to bus if part of the I/O is abnormal. As a result, the I/O state may be identified differently between online and standby.
  This is a function to specify whether to continue the operation of standby system or to shut down the standby system when an TC-net I/O interface that seems normal from online system but looks abnormal from standby system. This function specifies the operation in case TC-net 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.

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

  User global variable : Specify top address and size (maximum four areas) for tracking.

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

7.1.4 IP task

Set the startup condition of the IP tasks. Data change of up to 32 points (1 word each) can be detected.

- State change detection
  Specify whether to perform state change detection by 1W.
- Target I/O module
  Set the I/O module for state change detection.
- I/O word No.
  Set the word No. for state change detection.
- Detection mask (when ON)
  Set the bit for ON detection for the specified I/O module and word number (set "1" to the bit for ON detection).
- Detection mask (when OFF)
  Set the bit for OFF detection for the specified I/O module and word number (set "1" to the bit for OFF detection).
- IP task No.
  Set the number of the IP task to start up.

7.1.5 Ethernet

Set the Ethernet port for controller nV-Tool.

- IP address type
  Select "Standard."
- IP address primary
  Set "172.16.64.＊＊".
  ＊＊: Set with the Ethernet IP address setting switch for nV-Tool on the front panel of the controller.
- Subnet mask primary
  Set "255. 255. 192. 0".
- IP address secondary
  Set "172.16.64.＊＊" in the duplex system.
  ＊＊: Set with the Ethernet IP address setting switch for nV-Tool on the front panel of the secondary controller.
- Subnet mask secondary
  Set "255.255.192.0".

7.1.6 I/O loop

Set the TC-net I/O loop built into the controller main unit.

When changing the scan transmission parameters of the TC-net I/O loop from the default values, refer to, “Series High-Speed Serial I/O System TC-net I/O Operation Manual” (6F8C1240).

- I/O loop number
  Specify the number of I/O loops.
  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 TC-net 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.

7.1.7 I/O node

Set the information of the node (TC-net I/O interface, etc) connected to the TC-net I/O loop built into the controller main unit for each node.

- I/O fallback
  Set YES or NO of I/O fallback for each node.
- I/O bus healthy check time (1ms)
  Set the healthy check time of I/O bus.

7.2 Execution Status Monitor

The execution state of each task can be monitored.

7.2.1 Run time measurement

A timer that measures the execution time of tasks is built in.

Check the time required for executing all tasks and the specified scan time to allow a margin of operation.

The execution time of the high-speed scan and main scan is the time required for one scan. The margin of processing time cannot be determined just by looking at it. Conditions such as how many high-speed scans are performed for one main scan and the effect of sub scheduling must be checked at the same time.

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

7.2.2 Program monitor

nV-Tool can display the execution status (hot line display, data display) on the screen of the circuit range under program monitoring.

The ON/OFF (1/0) state of the ladder command part and the result value of the data processing command are displayed.

Up to 8 screens can be displayed simultaneously. The number of client PCs monitoring the program may vary.

The data displayed simultaneously as the program is the value upon the execution of the command rather than the data after the completion of one scan.

The program source displayed in the program monitor is the source program saved in the nV-Tool. No program source for display is saved in the controller. A ladder diagram cannot be reversely generated from the execution file (object) downloaded to the controller.

One screen per task can be monitored in the program monitor. Function blocks can be expanded simultaneously on multiple screens for one task. However, display update takes longer because the screens are displayed alternatively.

7.2.3 Data monitor

Program monitor screen of nV-Tool the statuses of devices and registers up to 32 points at maximum and displays them on the screen.

7.3 Online Maintenance

The information of the program, execution conditions, and hardware registration state can be changed while the program is being executed. This is called online maintenance, indicating changes made online.

7.3.1 I/O live insertion/removal

If a unit failure of the I/O module occurs during operation, the failing module can be replaced while the system operation is continued and the program is being executed.

The TC-net I/O module is connected via serial bus, so the module can be installed or removed without affecting other I/O modules.

7.3.2 Scan cycle

The execution cycle of the high-speed scan task and main scan task can be changed any time.

It is reflected from the next cycle after the change.

7.3.3 Program

Each task or function block can be changed or downloaded by task or by function block (by POU) any time including during execution.

■ Specification of download file

When the program is changed with the program editor of the nV-Tool, the target of download can be restricted.

- Not download the files already downloaded
  The download targets are only the files changed. This restriction shortens the download time.
- Download the files already downloaded
  The download targets are all files within the task.

■ Specification of program continuous operation

After the program is changed and downloaded during execution, it can be specified whether to continue the execution state immediately before, or restart after initialization.

- Continue to use local variables and execute
  After download, execution is restarted after copying the current values of the local variables within the task. The execution state is continued.
- Initialize local variables and execute
  After download, all the local variables within the task are cleared to zero before execution. The execution state is initialized, but the global variables are not initialized.

When the program is downloaded, the information is written to the FROM (flash memory) and saved. The FROM is a memory that can save data even during power down. While writing to the FROM, next download cannot be started. When multiple programs are downloaded successively, a message "Writing to FROM" may be displayed and download stops. In this case, retry download after a while.

7.3.4 Swap

This is a function to change the program by instruction word during execution. Replacement of instruction words, input of instruction words, and rewrite of parameter values can be done.

Individual instruction words of the program can be replaced with other instruction words that are equivalent. This is called an instruction word swap. This does not mean replacing them with totally unrelated commands.

If the inputs/parameters are not variables and direct values (immediate values), the value themselves can be rewritten to other values. This is called an immediate swap.

The variable names specified in the inputs/parameters can be rewritten to other variables. This is called a variable swap.

Following instructions can be used for swap.

Table 7-1 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

◆ Important

- Connection to the controller must be made to the Ethernet LAN-A side.

Chapter 8
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.

8.1 Hardware Diagnosis

The hardware elements constituting the controller are diagnosed.

Diagnosis can be classified in terms of when to diagnose, what to diagnose, and how to diagnose. This section describes the basic concepts of diagnosis.

8.1.1 Diagnosis at startup

When the power is turned on, initialization diagnosis for startup is performed. Specifically, the following items are diagnosed by considering the risk factors.

- Possible effect of electrical shock due to power on
- Possibility of corruption of consistency between other components with independent power supply while the power is off
- Uncertainty of normal operation of memory backup until actually observed

As a result of diagnosis, if any hardware failure or corruption of memory is found, compensation processing is performed depending on the error, and control is not restarted as a rule.

8.1.2 Fixed cycle diagnosis

Each component is monitored assuming failure that occurs during normal execution. Considering the fact that everything cannot be seen at the same time and that the effect to slow down the control operation of the controller should be reduced, diagnosis is actually performed at specific fixed cycles.

When an error is detected including appropriate retries, the error is reported, and control is stopped if it is major failure and the system is switched to standby.

Fixed cycle diagnosis includes the processing that refers to the result of the self diagnosis of each component and checks the result. Although it is a multi-processor system, there is no path to report the diagnosis result with direct interruption because it uses serial transmission, so checking is done at fixed cycles.

8.1.3 Diagnosis during execution

Genuine operation of the controller, rather than diagnosis processing executed with the direct purpose of diagnosis, may involve diagnosis information.

In batch input/output, the self diagnosis information of the input/output device is referred to at the execution of input/output simultaneously to diagnose the state of the input/output device itself along with the data.

In the tracking processing that equalizes the memory of the duplexing partner (standby seen from online), the validity of the transfer information itself and transfer mechanism can be diagnosed by attaching the diagnosis information to the memory to be transferred.

The memory of the controller has the ECC function, so the validity of the memory is diagnosed and compensated simultaneously every time the memory is access

8.2 Software Diagnosis

For the programs such as the main scan task, syntax diagnosis has been completed when it is created and compiled with the nV-Tool, so the static validity is guaranteed. However, elements such as dynamic validity or interference with other programs cannot be checked until it is operated actually as the validity under the execution environment.

Software diagnosis diagnoses the validity while the program is executed.

8.2.1 Program structure monitoring

The program and POU structure constituting the task can be monitored by executing the task.

The structure of the program is generally diagnosed by the editor and compiler of nV-Tool in advance, and a program with faulty details or inconsistency cannot be downloaded. However, a boundary error, nesting error, or stack error may be detected only during execution, so sufficient care should be taken regarding the details of the program.

If only a specific task can be determined as erroneous, task fallback occurs in which only the execution of the task is stopped.

8.2.2 Execution time monitoring

The HS task and MS task executed at fixed cycles are assumed to be completed at the specified scan cycle. If it is not completed at the specified cycle, it is determined that "scan congestion" occurred in each scan.

Scan congestion alone is not major failure because it may occur due to startup of an event task, change in the execution condition within the task, and temporary increase of load due to external factors such as Ethernet.

If scan congestion continues for 5 times the main scan in succession, error down occurs as a major failure state.

One of the possible causes for continued scan congestion is that time over 5 scans is required to recover the scan time exceeded due to temporary load increase because the load of each scan task is constantly heavy. For this reason, set a scan cycle with a sufficient margin.

The fluctuating range of scan time is affected by the details of the program and external environment, so there is no certain criterion regarding how much margin (percentage or milliseconds) is required.

An extreme example of a program that is not completed within the specified scan time is a program that repeats processing in an infinite loop. Sufficient care must be taken in programs where processing varies depending on the execution condition using the syntax commands.

8.3 System Tag

8.3.1 Error information

A system tag is information that indicates whether the state of the controller and related hardware is normal or abnormal. It is equivalent to the conventional system alarm and device alarm.

The result of the detection with the RAS function is reflected to the system tag.

The state and change of the state tag is reported to the OIS-DS, and can be displayed on the OIS-DS's screen. The operation and intervention from the OIS-DS for the alarm state and controller state are executed by writing an atom of the corresponding system tag.

Error information includes the following:

- Duplex state (in backup, in single system operation)
- Ethernet transmission state (FN812 operation state, node state)
- TC-net IO transmission state (ring state, bus state, duplex state)
- SIO operation state (operation mode, duplex state)
- IO operation state (IO module state)

8.3.2 System information

A system tag includes information that indicates the system state itself that is not necessarily abnormal.

Information indicating a simple state includes the following:

- Operation mode (whether in control or stopped, or in equalization)
- Version (list of firmware and hardware versions)

8.4 System Log

For a change in the operation state of the controller, instruction to the controller via Ethernet, and error detection via self diagnosis, the date/time and details are recorded in the system log.

Regularly read the log information to check even if the system seems to operate normally so that measures can be taken before any critical error occurs.

8.4.1 Error log

Errors detected via self diagnosis are recorded.

There are different levels of errors; major failure, minor failure, and cautions.

Recorded major failure indicates the cause of duplex switching or error down, so the information is important for the analysis.

Minor failure and cautions do not affect the operation of the controller when they occur. However, they may indicate the effect of a critical problem, or the effect from and toward the future power failure.

8.4.2 Event log

It is a record indicating that the operation of the controller changed.

It includes information such as power down, program download, clock setting change, and duplex switching.

In the duplex system, it includes important information to estimate the operation and diagnosis result of online and standby by comparing their events.

8.4.3 Transmission log

The operation state of the network is recorded.

It includes especially the diagnosis information of FN, which is the Ethernet interface module.

In the OIS-DS, it includes important information to indicate the operation state of the network such as many retry recoveries only in the Ethernet transmission system even if it is apparently normal and the controller has no particular error.

8.4.4 Intervention log

Writes from the OIS-DS to the tag of the controller are recorded.

When the tags are displayed on the point screen of the OIS-DS and remote operation is performed, the targets and setting details are recorded.

For other than the OIS-DS, the history of operations via the network is recorded.

8.4.5 Cautions on system log

Each item in the system log has the maximum number of items to be recorded.

Each time an event or error occurs, the old record is erased and the latest record is made. When many events occur (such as changes in operation, recovery from an error, operation from the nV-Tool or HMI), important information may be erased. Check the log regularly not to miss important information.

8.5 FN812 System Log

The system log is also saved in the Ethernet module FN812 as in the controller module PU821. The information related to Ethernet transmission is recorded in the transmission log of PU821, but more detailed information, operation record of the FN812 alone, or information not provided from FN812 to PU821 can be recorded only in the FN812 side.

To analyze system operation, it may be effective to collect the log of the FN812 along with the log of the PU821 for analysis and review. When collecting the log, make sure to collect information regarding both.

8.6 Trouble Shooting

8.6.1 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.

8.6.2 Error indication LED on the front panel

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 8-1.

Table 8-1 List of LED indication and error content

RUN/ERR LED	Error content	Countermeasure
RUN/ERR LED blinks every time	CPU operation error	If the status does not change even if the controller power is turned on again, replace the CPU module.
ERR LED blinks once→ RUN/ERR LED blinks once repeatedly	Boot area error	
ERR LED blinks twice→ RUN/ERR LED blinks once repeatedly	OS program RAM error	
ERR LED blinks 3 times→ RUN/ERR LED blinks once repeatedly	OS work RAM error	
ERR LED blinks 4 times→ RUN/ERR LED blinks once repeatedly	FROM ID error	
ERR LED blinks 5 times→ RUN/ERR LED blinks once repeatedly	OS program BCC error	
ERR LED illuminates	Error down	Check the error detail with the nV-Tool.

8.7 List of Diagnosis Items

■ Initialization diagnosis

The diagnosis items upon system initialization processing (when power is on) are as follows.

Table 8-2 Check Items at System Initialization Processing (Power ON) (1)

Diagnosis item and its contents	Operation when error is detected	Countermeasure
・Communication controller check 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-sales service section.
・Timer controller check Check whether the timer controller has been successfully initialized or not.		
・LP check Check whether the LP (sequence arithmetic processor) has been successfully initialized or not.		
・Station bus memory check Check whether the station bus has been successfully initialized or not.		
・ECC circuit check Check the validity of ECC circuit of each area.		
・LP transfer check Check whether data transfer by LP has been successfully completed.		
・Memory data loss Write a fixed value at certain fixed address, and check whether the value can be read.		If it is left without battery, perform memory clear and download the program. For other cases, replace the CPU module and restart the system. Or contact our after-sales service section.
・Program memory BCC check Check the validity of the program with BCC.		Replace the CPU module, and restart the system. Or contact our after-sales service section.
・Memory check Perform a read-back check of the memory of each area.		
・Battery state error Check for the absence of the battery or low voltage of the CPU.	It is regarded as minor failure and operation is continued.	Install or replace the battery.
・Fan stop detected Check whether fan unit operates normally or not.		Check the periphery of the fan and take measures.

Table 8-2 Check Items at System Initialization Processing (Power ON) (2)

Diagnosis item and its contents	Operation when error is detected	Countermeasure
・Calendar error Check the validity of the read data (date and time) from the calendar LSI.	It is regarded as minor failure and operation is continued.	Perform clock setting with the nV-Tool.
・Flash ROM write warning Check whether the number of write to the flash ROM exceeded 99000.		Flash ROM write error may occur with high possibility from now on. Replace the CPU module.
・Power supply module temperature error Check for a temperature error of the power supply module.		Replace the Power module and restart the system. Or contact our after-sales service section.
・Power supply module output stop Check whether the power supply module is operating normally.		

■ Diagnostic Items at Start-up in RUN mode

The diagnosis items upon RUN startup are as shown in the table below.

Table 8-3 Diagnostic Items at Start-up in RUN mode

Diagnosis item and its contents	Operation when error is detected	Countermeasure
・Controller unit configuration Check whether the CPU module configuration implemented to the controller unit is the same as the nV-Tool registration.	Error registration is carried out and the system is shut down as Error Down.	Match the module configuration registration state and the implementation state of the controller unit.
・Scan cycle setting Check whether the scan cycle of the scan tasks SS/HS/MS is within the range.		Load the system data such as the program from the nV-Tool and restart the system. Or contact our after-sales service section.
・Logic table error Check whether module parameters are normally registered or not.		Check the module parameter with the nV-Tool, and perform re-loading.
・Instance table logic error Check whether instance table is normally registered or not.		Load the system data such as the program from the nV-Tool and restart the system. Or contact our after-sales service section.
・User program validity Check whether the program of the MS task has been registered or not.		Load the system data in which MS task is registered from the nV-Tool, and restart the system.

■ Initialization diagnosis

The diagnosis items during scan execution are as shown in the table below.

Table 8-4 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-sales service section.
・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).		
・Batch input/output PCI timeout error Check whether a timeout error of the station module occurred at batch input/output.	Error registration is carried out. The system continues its operation as minor failure if retry result is normal. If retry result is error, fallback 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.		
・Batch input/output PCI parity error Check whether a parity error of the station module occurred at batch input/output.		
・Direct input/output PCI parity error Check whether a parity error of the station module occurred at direct input/output.		
・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 fallback depending of the program fallback specification.	
・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.	
・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.		

Table 8-4 Diagnostic Items while Scan Execution (2)

Diagnosis item and its contents	Operation when error is detected	Countermeasure
・nV-Tool source download error Check the validity of FROM write at download of the nV-Tool source.	It is regarded as minor failure and operation is continued.	Replace the CPU module and restart the system. Or contact our after-sales service section.
・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.	Replace the transmission module, CPU module, or base, and perform restart.
・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 path of the TC-net. Or check if the controller on the TC-net network is in the RUN state.
・Synchronous trend collection start error Check whether synchronous trend can start or not.		Check the setting information of the nV-Tool. Or perform clock setting from the nV-Tool.
・Synchronous trend setting file error Check whether synchronous trend can start or not.		Check the setting information of the nV-Tool. Or contact our after-sales service section.
・MS task execution/stop setting error Check whether the MS task is set to execution.	Error registration is carried out and the system is shut down as Error Down.	Set the MS task to execute, and download the setting information from the nV-Tool again.
・I/O scan cycle/talker block setting error Check the setting of the I/O scan cycle/talker block upon RUN startup.		Check the setting values of I/O scan cycle and talker block.
・RIO task entry error Check whether the RIO task entry are can be reserved.	It is regarded as Caution required and the system continues its operation.	Organize the program, and download the program again.
・POU not defined Check for non-registered POU.	Error registration is carried out and program fallback or error down is carried out depending on the specification of program fallback.	Perform batch compilation with the nV-Tool, and perform batch download.
・Illegal command detected Check whether LP(sequence operation processor) is an illegal command.		Check the user task, and perform re-loading.
・Program boundary over detected Check whether LP (sequence operation processor) is within the program range.		Download the POU (program/ function/function block).
・Data boundary over detected Check whether LP (sequence operation processor) is within the control data range.		Wrong index modifier in the program. Check the task, and perform re-loading.

Table 8-4 Diagnostic Items while Scan Execution (3)

Diagnosis item and its contents	Operation when error is detected	Countermeasure
・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.
・Non-supported command detected Check for commands not supported by LP(sequence operation processor).	Error registration is carried out and program fallback or error down is carried out depending on the specification of program fallback.	Check the control task, and perform re-loading.
・POU nesting over Check the validity of POU calling.		Change the nesting of POU calling less than 6 stages.
・Word division stack pointer error detected Check the overflow/underflow of word division stack pointer.		After survey of task, carry out re-loading.
・Word joint stack pointer error detected Check the overflow/underflow of word joint stack pointer.		
・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.
・System stack pointer error Check the validly of system stack pointer.		Replace the CPU module and restart the system. Or, contact our after-sales service section.
・Fallback program mode specification down Carry out error down according to user specification.		The cause of program fallback or I/O fallback is recorded at the same time. Take the necessary measure referring to the log.
・Fallback program recursive call Check whether the I/O fallback factor was due to I/O fallback task, or the program fallback factor was due to program fallback task.		

■ Periodical diagnosis

The items diagnosed always at fixed cycles regardless of the operation state such as the state in which control is being executed (RUN) are as follows.

Table 8-5 Normal Diagnosis Items (1)

Diagnosis item and its contents	Operation when error is detected	Countermeasure
・Communication controller check 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-sales service section.
・Timer controller check Check whether the timer controller operates normally or not.		If it is turned OFF during equalization, the memory content may left incomplete, and a BCC error occurs when the power is on next time. If there is any disconnection during equalization when checking the log, perform memory clear and restart the system.
・LP check Check whether LP (sequence arithmetic processor) operates normally or not.		
・PCI check Check whether station bus operates normally or not.		
・Station bus memory check Check the station bus memory by carrying out read-back.		
・Program memory BCC check Check the validity of program using BCC.		
・Control data memory check Perform a read-back check of the control data memory.		
・TC-net I/O loop check Check whether the TC-net I/O is in the loop state.	Error registration is carried out. System is shut down as error down or continues running with I/O fallback depending on the specification of I/O fallback.	Check the connection state of the I/O loop cable.
・TC-net I/O interface error Check the validity of the TC-net I/O interface module.	It is regarded as minor failure and operation is continued.	Replace the TC-net I/O interface module and restart the system. Or contact our after-sales service section.
・I/O error 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 fallback depending on the specification of I/O fallback.	Replace the CPU module and restart the system. Or, contact our after-sales service section.
・I/O error Check the validity of each I/O module.	Error registration is carried out. System is shut down as error down or continues running with node fallback depending on the specification of node fallback.	Check the connection state of the I/O loop cable. Or contact our after-sales service section.
・Battery state error Check for the absence of the battery or low voltage of the CPU.	It is regarded as minor failure and operation is continued.	Remove the battery.

Table 8-5 Normal Diagnosis Items (2)

Diagnosis item and its contents	Operation when error is detected	Countermeasure
・Cooling fan stop detected Check whether fan unit operates normally or not.	It is regarded as minor failure and operation is continued.	Check the periphery of the fan and take measures.
・Calendar error Check the effectiveness of data (date, time) read from the calendar LSI.		Perform clock setting with the nV-Tool.
・Power supply module temperature error Check for a temperature error of the power supply module.		Replace the power supply module and restart the system. Or contact our after-sales service section.
・Power supply module output stop Check whether the power supply module is operating normally.		
・Watchdog timer error Check for runaway of the system with the watchdog timer.	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-sales service section.

■ Duplex Diagnosis

The diagnosis items regarding duplex operation are as shown in the table below.

Table 8-6 Diagnosis items of duplex system configuration (1)

Diagnosis item and its contents	Operation when error is detected		Countermeasure
	Online	Standby	
・Tracking reception error Standby controller detected the tracking reception error.	ODD RUN mode	Error down	Check the connection state of the extended interface module, tracking transmission/monitoring cable, and carry out 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.			

Table 8-6 Diagnosis items of duplex system configuration (2)

Diagnosis item and its contents	Operation when error is detected		Countermeasure
	Online	Standby	
・Other system CPU module error Other system CPU module error was detected.	ODD RUN mode	Error down	Eliminate the error of the target system CPU module, and carry out re-execution.
・Tracking bus diagnosis signal error The tracking bus diagnosis signal error was detected.			Check the power unit, base unit and cables of other system and carry out re-execution.
・Duplex other system check signal error Duplex other system check signal error was detected.	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 implementation state of the CPU module, extended interface module, and base and carry out 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 extended interface module and carry out 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.	Single run operation mode		

Table 8-6 Diagnosis items of duplex system configuration (2)

Diagnosis item and its contents	Operation when error is detected		Countermeasure
	Online	Standby	
・Equalization sending complete timeout Equalization sending (online) controller detected the equalization sending timeout.	Single run operation mode	Error Down	Replace the CPU module or base module and restart the system.
・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 area 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 area is exceeding the allowable range.			Set the size of local variable of each task not to exceed the specified area.
・Scan transmission check Check whether scan transmission is being performed.		Error Down	Check the connection state of the I/O loop cable.
・Transmission module transmission error Check the validity of the transmission module.	Single run operation mode		Replace the transmission module, CPU module, or base, and perform restart.

Appendix A
Function Specification and its Details

A.1 Function Specifications

Table A.1-1 Controller module PU821 function specification (1)

Item			Contents
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	High-speed scan (HS)	10 to 500ms/10ms units 1 task/128 program
		Main scan (MS)	100 to 10000ms/100msunits 1 task/512 program
	Input/output method	Batch I/O	Allowed
		Direct I/O	Allowed
Interruption	Interruption	Event (EV)	8 task
		Interruption (IP)	16 task
	Interruption detection performance		20μs × n intrupt. + 100μs or less n: Detected number of status change
Program size			512 kstep
			1990POU (Note)
Control data size	Local variables/User global variables		256KW
	IQ register		16KW
	System register (ZW)		8KW
	Data register (DW)		64KW
I/O	Built-in	Number of nodes	32
		Max. No. of units	32
		Max. No. of slots	512(32 units × 16 slots)
	Extension (SIF connection)	Number of SIF	3
		Number of nodes	96
		Max. No. of units	96
		Max. No. of slots	1536(96 units × 16 slots)
	Batch input/output update time	Built-in	1μs/W or less
		Extension	2μs/W or less
	Direct input/output update time	Built-in	1μs/W or less
		Extension	2μs/W or less
Programming language			LD/FBD/SFC/ST
Duplex	Tracking time		2ms/KW
	Duplex switching time		500ms or less
Execution speed	Bit	Contact	0.02μs(provisional value)(Note 1)
		Coil	0.06μs(provisional value)(Note 1)

Table A.1-1 Controller module PU821 function specification (2)

Item			Contents
Execution speed	Integer	Transfer	0.02μs(provisional value) (Note 1)
		Addition/Subtraction	0.02μs(provisional value) (Note 1)
		Multiplication	0.06μs(provisional value) (Note 1)
		Division	0.48μs(provisional value) (Note 1)
	floating point	Transfer	0.12μs(provisional value) (Note 1)
		Addition/Subtraction	0.06μs(provisional value) (Note 1)
		Multiplication	0.12μs(provisional value) (Note 1)
		Division	0.54μs(provisional value) (Note 1)
Transmission port	nV-Tool connection (direct connection)		Built-in Ethernet
	nV-Tool connection (network)		via FN812
	Socket communication (instruction word)		via FN812
	Synchronous trend		via FN812
Supported network	Station bus module		OIS-DS connection, TC-net
	TC-net I/O bus module		Ethernet, FL-net, MODBUS (Profibus-DP, DeviceNet, MELSEC-net)
RAS	Diagnosis		Power fail check, battery 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
Process tag	Indicator		#PV 1024 tags
	Controller		#LP 320 tags
	Digital instrument		#PB 1280 tags
	Sequence		#SQ 64 tags

(Note 1) The instruction word execution speed indicates the basic command using LP.

A.2 List of System Variables

■ General information (read only)

zw	Usage		F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
0000	Calendar date (local time)	Year									× 10				× 1			
		Month									× 10				× 1			
		Day									× 10				× 1			
		Hour									× 10				× 1			
		Minute									× 10				× 1			
		Second									× 10				× 1			
0008	Ethernet IP address setting switch for nV-Tool										7	6	5	4	3	2	1	0
			<7 to 4>Upper setting value : 0 to F <3 to 0>Lower setting value : 0 to F															
0009	Operation mode key switch															2	1	0
			<0> HALT <1> RUN <2> P-RUN															
0010	Front panel dip switch										7	6	5	4	3	2	1	0
			<0> 0: Normal mode <1> <2> <3> <4> <5> <6> <7>								<0> 1: Maintenance mode <1> All memory clear <2> Test pro startup <3> <4> Debugger startup <5> <6> <7> E2ROM formatting							
0011	Duplex primary/secondary specification																	0
			0: Primary 1: Secondary															

■ Operation information (read only)

zw	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
0020	Operation mode	Own phase															
0021		Target phase															
0022																	
0023	Error information	0	1												TMP	FAN	BAT
		BAT: Battery error FAN: Fan error TMP: Temperature error (Note) F/E is fixed for contact force.															
0024	Partial equalization information	Number of times of partial equalization (maximum value)															
0025		Number of times of partial equalization (current value)															
0030	Post-command execution error status (common among all tasks)																
		<0> CF(carry flag): Used in commands with carry <1> ERF(error flag): OR of the error below															
0031	Detailed information of the above					11	10	9	8								
		<8> Division error: ON when an error occurs in the division command <9> BCD data error: ON when an error occurs in the BCD command <10> Table operation error: ON when an error occurs in table operation (ON when it is out of the tag range in the tag-related commands) <11> Encode error: ON when an error occurs in the encode command															
0032	Post-command execution error status (by task)	Post-command execution error status occurred in the task of priority 0(EV)															
0033		(Same configuration as ZW30, 31)															
0034		Post-command execution error status occurred in the task of priority 1(IP)															
0035		(Same configuration as ZW30, 31)															
0036		Post-command execution error status occurred in the task of priority 2(HS)															
0037		(Same configuration as ZW30, 31)															
0038		Post-command execution error status occurred in the task of priority 3(MS)															
0039		(Same configuration as ZW30, 31)															
0045	Execution cycle	High-speed scan cycle/setting value (ms)															
0046		Execution cycle of the task of the high-speed or main scan under execution (floating point value)															
0047		Scan cycle × Sub schedule value (ms)															
0048	Congestion information	High-speed scan congestion information (0: Normal 1: In congestion 2: Recovery)															
0049		Congestion count															
0050		Main scan congestion information (0: Normal 1: In congestion 2: Recovery)															
0051		Congestion count															
0052	Task initialization information	F	E	D													
		<F> Initialization sign(with long interruption startup or DL) <E> Duplex switching sign <D> RUN startup sign															
0055																	
0056	Tracking amount display	High-speed scan tracking amount(W)															
0057																	
0058		Main scan tracking amount(W)															
0059																	

A

■ Task information (read only)

zw	Usage		F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
0060	Task enable information	EV									7	6	5	4	3	2	1	0
0061	1: Enable	IP	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0062	0: Disable	HS	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	(or not registered)		31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
			~															
0069			127	126	125	124	123	122	121	120	119	118	117	116	115	114	113	112
0070		MS	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
			31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
			47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
			~															
			495	494	493	492	491	490	489	488	487	486	485	484	483	482	481	480
0101			511	510	509	508	507	506	505	504	503	502	501	500	499	498	497	496
0102	Reserved																	
0103	Reserved																	
0104	Task DL information	EV									7	6	5	4	3	2	1	0
0105	1: DL done	IP	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0106	0: DL not done	HS	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
			31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
			~															
0113			127	126	125	124	123	122	121	120	119	118	117	116	115	114	113	112
0114		MS	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
			31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
			47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
			~															
0145			495	494	493	492	491	490	489	488	487	486	485	484	483	482	481	480
			511	510	509	508	507	506	505	504	503	502	501	500	499	498	497	496
0146	Reserved																	
0147	Reserved																	
0148	Task fallback information	EV									7	6	5	4	3	2	1	0
0149	1: Fallback	IP	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0150	0: No fallback	HS	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
			31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
			~															
0157			127	126	125	124	123	122	121	120	119	118	117	116	115	114	113	112
0158		MS	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
			31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
			47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
			~															
			495	494	493	492	491	490	489	488	487	486	485	484	483	482	481	480
0189			511	510	509	508	507	506	505	504	503	502	501	500	499	498	497	496
0190	Reserved																	
0191	Reserved																	

A

■ Task fallback information

zw	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
0192	Task fallback factor	Program error code number 8 : Illegal command detected 9 : Address boundary error (program execution range exceeded) 10 : Boundary error (data access address range exceeded) 11 : Stack error 12 :POU error 13 :POU nest over 15 : Non-supported command detected															
0193	Task fallback error information	Task type number (0: EV, 2: IP, 3: HS, 4: MS)															
0194		Task entry number (0 to 511)															
0195	Reserved																
0196	Fallback error down specification (user registration)	0: Task fallback implemented Other than 0: Error down (Note) Error down setting is valid in single operation or unit operation in duplex. If an error that is a task fallback factor in duplex online occurs, error down occurs and the system switches to duplex.															
0197	Reserved																

■ interruption status information【Reserved: For future use】

zw	Usage		Interruption status															
			F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
0198	IP00	New																
		Current																
		Old																
0201	IP01	New																
		Current																
		Old																
0204	IP02	New																
		Current																
		Old																
0207	IP03	New																
		Current																
		Old																
0210	IP04	New																
		Current																
		Old																
0213	IP05	New																
		Current																
		Old																
0216	IP06	New																
		Current																
		Old																
0219	IP07	New																
		Current																
		Old																
0222	IP08	New																
		Current																
		Old																
0225	IP09	New																
		Current																
		Old																
0228	IP10	New																
		Current																
		Old																
0231	IP11	New																
		Current																
		Old																
0234	IP12	New																
		Current																
		Old																
0237	IP13	New																
		Current																
		Old																
0240	IP14	New																
		Current																
		Old																
0243	IP15	New																
		Current																
		Old																

■ I/O fallback information

zw	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
0300	I/O fallback occurrence factor	<0> I/O error occurred 1: Yes, 0: No															
		<1> I/O node error occurred 1: Yes, 0: No															
		<2> I/O multiple page error occurred 1: Yes, 0: No															
		<3> I/O node multiple page error occurred 1: Yes, 0: No															
0301	I/O fallback occurrence information	Main slot number (0 to 7)															
0302		Node number (0 to 255)															
0303		Unit number (0 to 7)															
0304		Slot number (0 to 255)															
0305	I/O node fallback occurrence information	Main slot number (0 to 7)															
0306		Node number (0 to 255)															
0307	Fallback error down specification (user registration)	0: I/O fallback implemented Other than 0: Error down															
0308	Reserved																
0309	Reserved																
0310	I/O fallback recovery factor													3	2	1	0
		<0> I/O error recovery 1: Yes, 0: No															
		<1> I/O node error recovery 1: Yes, 0: No															
		<2> I/O multiple page error recovery 1: Yes, 0: No															
		<3> I/O node multiple page error recovery 1: Yes, 0: No															
0311	I/O fallback recovery information	Main slot number (0 to 7)															
0312		Node number (0 to 255)															
0313		Unit number (0 to 7)															
0314		Slot number (0 to 255)															
0315	I/O node fallback recovery information	Main slot number (0 to 7)															
0316		Node number (0 to 255)															
0317	Reserved																
0318	Reserved																
0319	Reserved																

■ G3 I/O fallback information【Reserved: For future use】

zw	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
	I/O fallback request	Slot (1: Fallback specification)															
0320							10	9	8	7	6	5	4	3	2	1	0
0321	Node 27 connection Unit 1						10	9	8	7	6	5	4	3	2	1	0
0322	Node 27 connection Unit 2						10	9	8	7	6	5	4	3	2	1	0
0323	Node 27 connection Unit 3						10	9	8	7	6	5	4	3	2	1	0
0324	Node 27 connection Unit 4						10	9	8	7	6	5	4	3	2	1	0
0325	Node 27 connection Unit 5						10	9	8	7	6	5	4	3	2	1	0
0326	Node 27 connection Unit 6						10	9	8	7	6	5	4	3	2	1	0
0327	Node 27 connection Unit 7						10	9	8	7	6	5	4	3	2	1	0
0328	Node 28 connection Unit 1						10	9	8	7	6	5	4	3	2	1	0
0329	Node 28 connection Unit 2						10	9	8	7	6	5	4	3	2	1	0
0330	Node 28 connection Unit 3						10	9	8	7	6	5	4	3	2	1	0
0331	Node 28 connection Unit 4						10	9	8	7	6	5	4	3	2	1	0
0332	Node 28 connection Unit 5						10	9	8	7	6	5	4	3	2	1	0
0333	Node 28 connection Unit 6						10	9	8	7	6	5	4	3	2	1	0
0334	Node 28 connection Unit 7						10	9	8	7	6	5	4	3	2	1	0
0335	Node 29 connection Unit 1						10	9	8	7	6	5	4	3	2	1	0
0336	Node 29 connection Unit 2						10	9	8	7	6	5	4	3	2	1	0
0337	Node 29 connection Unit 3						10	9	8	7	6	5	4	3	2	1	0
0338	Node 29 connection Unit 4						10	9	8	7	6	5	4	3	2	1	0
0339	Node 29 connection Unit 5						10	9	8	7	6	5	4	3	2	1	0
0340	Node 29 connection Unit 6						10	9	8	7	6	5	4	3	2	1	0
0341	Node 29 connection Unit 7						10	9	8	7	6	5	4	3	2	1	0
0342	Node 30 connection Unit 1						10	9	8	7	6	5	4	3	2	1	0
0343	Node 30 connection Unit 2						10	9	8	7	6	5	4	3	2	1	0
0344	Node 30 connection Unit 3						10	9	8	7	6	5	4	3	2	1	0
0345	Node 30 connection Unit 4						10	9	8	7	6	5	4	3	2	1	0
0346	Node 30 connection Unit 5						10	9	8	7	6	5	4	3	2	1	0
0347	Node 30 connection Unit 6						10	9	8	7	6	5	4	3	2	1	0
0348	Node 30 connection Unit 7						10	9	8	7	6	5	4	3	2	1	0

zw	Usage		F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
	I/O return request		Slot (1: Return specification)															
0349								10	9	8	7	6	5	4	3	2	1	0
0350	Node 27 connection	Unit 1						10	9	8	7	6	5	4	3	2	1	0
0351	Node 27 connection	Unit 2						10	9	8	7	6	5	4	3	2	1	0
0352	Node 27 connection	Unit 3						10	9	8	7	6	5	4	3	2	1	0
0353	Node 27 connection	Unit 4						10	9	8	7	6	5	4	3	2	1	0
0354	Node 27 connection	Unit 5						10	9	8	7	6	5	4	3	2	1	0
0355	Node 27 connection	Unit 6						10	9	8	7	6	5	4	3	2	1	0
0356	Node 27 connection	Unit 7						10	9	8	7	6	5	4	3	2	1	0
0357	Node 28 connection	Unit 1						10	9	8	7	6	5	4	3	2	1	0
0358	Node 28 connection	Unit 2						10	9	8	7	6	5	4	3	2	1	0
0359	Node 28 connection	Unit 3						10	9	8	7	6	5	4	3	2	1	0
0360	Node 28 connection	Unit 4						10	9	8	7	6	5	4	3	2	1	0
0361	Node 28 connection	Unit 5						10	9	8	7	6	5	4	3	2	1	0
0362	Node 28 connection	Unit 6						10	9	8	7	6	5	4	3	2	1	0
0363	Node 28 connection	Unit 7						10	9	8	7	6	5	4	3	2	1	0
0364	Node 29 connection	Unit 1						10	9	8	7	6	5	4	3	2	1	0
0365	Node 29 connection	Unit 2						10	9	8	7	6	5	4	3	2	1	0
0366	Node 29 connection	Unit 3						10	9	8	7	6	5	4	3	2	1	0
0367	Node 29 connection	Unit 4						10	9	8	7	6	5	4	3	2	1	0
0368	Node 29 connection	Unit 5						10	9	8	7	6	5	4	3	2	1	0
0369	Node 29 connection	Unit 6						10	9	8	7	6	5	4	3	2	1	0
0370	Node 29 connection	Unit 7						10	9	8	7	6	5	4	3	2	1	0
0371	Node 30 connection	Unit 1						10	9	8	7	6	5	4	3	2	1	0
0372	Node 30 connection	Unit 2						10	9	8	7	6	5	4	3	2	1	0
0373	Node 30 connection	Unit 3						10	9	8	7	6	5	4	3	2	1	0
0374	Node 30 connection	Unit 4						10	9	8	7	6	5	4	3	2	1	0
0375	Node 30 connection	Unit 5						10	9	8	7	6	5	4	3	2	1	0
0376	Node 30 connection	Unit 6						10	9	8	7	6	5	4	3	2	1	0
0377	Node 30 connection	Unit 7						10	9	8	7	6	5	4	3	2	1	0

zw	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
	I/O module fallback information	Slot (1: In fallback)															
0378							10	9	8	7	6	5	4	3	2	1	0
0379	Node 27 connection Unit 1						10	9	8	7	6	5	4	3	2	1	0
0380	Node 27 connection Unit 2						10	9	8	7	6	5	4	3	2	1	0
0381	Node 27 connection Unit 3						10	9	8	7	6	5	4	3	2	1	0
0382	Node 27 connection Unit 4						10	9	8	7	6	5	4	3	2	1	0
0383	Node 27 connection Unit 5						10	9	8	7	6	5	4	3	2	1	0
0384	Node 27 connection Unit 6						10	9	8	7	6	5	4	3	2	1	0
0385	Node 27 connection Unit 7						10	9	8	7	6	5	4	3	2	1	0
0386	Node 28 connection Unit 1						10	9	8	7	6	5	4	3	2	1	0
0387	Node 28 connection Unit 2						10	9	8	7	6	5	4	3	2	1	0
0388	Node 28 connection Unit 3						10	9	8	7	6	5	4	3	2	1	0
0389	Node 28 connection Unit 4						10	9	8	7	6	5	4	3	2	1	0
0390	Node 28 connection Unit 5						10	9	8	7	6	5	4	3	2	1	0
0391	Node 28 connection Unit 6						10	9	8	7	6	5	4	3	2	1	0
0392	Node 28 connection Unit 7						10	9	8	7	6	5	4	3	2	1	0
0393	Node 29 connection Unit 1						10	9	8	7	6	5	4	3	2	1	0
0394	Node 29 connection Unit 2						10	9	8	7	6	5	4	3	2	1	0
0395	Node 29 connection Unit 3						10	9	8	7	6	5	4	3	2	1	0
0396	Node 29 connection Unit 4						10	9	8	7	6	5	4	3	2	1	0
0397	Node 29 connection Unit 5						10	9	8	7	6	5	4	3	2	1	0
0398	Node 29 connection Unit 6						10	9	8	7	6	5	4	3	2	1	0
0399	Node 29 connection Unit 7						10	9	8	7	6	5	4	3	2	1	0
0400	Node 30 connection Unit 1						10	9	8	7	6	5	4	3	2	1	0
0401	Node 30 connection Unit 2						10	9	8	7	6	5	4	3	2	1	0
0402	Node 30 connection Unit 3						10	9	8	7	6	5	4	3	2	1	0
0403	Node 30 connection Unit 4						10	9	8	7	6	5	4	3	2	1	0
0404	Node 30 connection Unit 5						10	9	8	7	6	5	4	3	2	1	0
0405	Node 30 connection Unit 6						10	9	8	7	6	5	4	3	2	1	0
0406	Node 30 connection Unit 7						10	9	8	7	6	5	4	3	2	1	0

■ Error information map (read only)【Reserved: For future use】

zw	Usage			F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
0500	Latest error code			Major category															
0501				Medium category															
0502				Minor category															
	Major failure error map			Minor category															
0510	Major category 0【Hard】	Medium category 0【CPU-related】	00H																0
			03H	3F															
0514		Medium category 1【Memory-related】	00H																0
			03H	3F															
0518		Medium category 2【TC-net I/O-related (Loop 0)】	00H																0
			03H	3F															
0522		Medium category 3【TC-net I/O-related (Loop 1)】	00H																0
			03H	3F															
0526		Medium category 4【TC-net I/O-related (Loop 2)】	00H																0
			03H	3F															
0530		Medium category 5【TC-net I/O-related (Loop 3)】	00H																0
			03H	3F															
0534		Medium category 6【I/O fallback-related (Loop 0)】	00H																0
			03H	3F															
0538		Medium category 7【I/O fallback-related (Loop 1)】	00H																0
			03H	3F															
0542		Medium category 8【I/O fallback-related (Loop 2)】	00H																0
			03H	3F															
0546		Medium category 9【I/O fallback-related (Loop 3)】	00H																0
			03H	3F															
:		:																	
0558		Medium category 12【Transmission-related】	00H																0
			03H	3F															
:		:																	
0566		Medium category 14【Other】	00H																0
			03H	3F															
0570		Medium category 15【Duplex-related】	00H																0
			03H	3F															

A

zw	Usage			F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
0574	Major category 0【Soft】	Medium category 0【Setting registration-related】	00H																0
			03H	3F															
0578		Medium category 1【Program-related】	00H																0
			03H	3F															
0582		Medium category 2【Program fallback-related】	00H																0
			03H	3F															
:		:																	
0610		Medium category 14【Other】	00H																0
			03H	3F															
0634		Medium category 15	00H																0
			03H	3F															
	Minor failure error map			Minor category															
0638	Major category 0【Hard】	Medium category 0【CPU-related】	00H																0
			03H	3F															
0642		Medium category 1【Memory-related】	00H																0
			03H	3F															
0646		Medium category 2【TC-net I/O-related (Loop 0)】	00H																0
			03H	3F															
0650		Medium category 3【TC-net I/O-related (Loop 1)】	00H																0
			03H	3F															
0654		Medium category 4【TC-net I/O-related (Loop 2)】	00H																0
			03H	3F															
0658		Medium category 5【TC-net I/O-related (Loop 3)】	00H																0
			03H	3F															
0662		Medium category 6【I/O fallback-related (Loop 0)】	00H																0
			03H	3F															
0666		Medium category 7【I/O fallback-related (Loop 1)】	00H																0
			03H	3F															

A

zw	Usage			F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
0670	Major category 0【Hard】	Medium category 8 【I/O fallback-related (Loop 2)】	00H																0
			03H	3F															
0674		Medium category 9 【I/O fallback-related (Loop 3)】	00H																0
			03H	3F															
:		:																	
0686		Medium category 12 【Transmission-related】	00H																0
			03H	3F															
:		:																	
0694		Medium category 14 【Other】	00H																0
			03H	3F															
0698		Medium category 15 【Duplex-related】	00H																0
			03H	3F															
0702	Major category 1【Soft】	Medium category 0 【Setting registration-related】	00H																0
			03H	3F															
0706		Medium category 1 【program-related】	00H																0
			03H	3F															
0710		Medium category 2 【Program fallback-related】	00H																0
			03H	3F															
:		:																	
0758		Medium category 14 【Other】	00H																0
			03H	3F															
0762		Medium category 15	00H																0
			03H	3F															

■ G3 parallel I/O diagnosis information (read only)【Reserved: For future use】

zw	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
	I/O bus error information (major failure)	Unit (1 to 7)															
1000	Node 27 connection I/O bus									7	6	5	4	3	2	1	0
1001	Node 28 connection I/O bus									7	6	5	4	3	2	1	0
1002	Node 29 connection I/O bus									7	6	5	4	3	2	1	0
1003	Node 30 connection I/O bus									7	6	5	4	3	2	1	0
	I/O module error (minor failure)	Slot (0 to 10)															
1010							10	9	8	7	6	5	4	3	2	1	0
1011	Node 27 connection Unit 1						10	9	8	7	6	5	4	3	2	1	0
1012	Node 27 connection Unit 2						10	9	8	7	6	5	4	3	2	1	0
1013	Node 27 connection Unit 3						10	9	8	7	6	5	4	3	2	1	0
1014	Node 27 connection Unit 4						10	9	8	7	6	5	4	3	2	1	0
1015	Node 27 connection Unit 5						10	9	8	7	6	5	4	3	2	1	0
1016	Node 27 connection Unit 6						10	9	8	7	6	5	4	3	2	1	0
1017	Node 27 connection Unit 7						10	9	8	7	6	5	4	3	2	1	0
1018	Node 28 connection Unit 1						10	9	8	7	6	5	4	3	2	1	0
1019	Node 28 connection Unit 2						10	9	8	7	6	5	4	3	2	1	0
1020	Node 28 connection Unit 3						10	9	8	7	6	5	4	3	2	1	0
1021	Node 28 connection Unit 4						10	9	8	7	6	5	4	3	2	1	0
1022	Node 28 connection Unit 5						10	9	8	7	6	5	4	3	2	1	0
1023	Node 28 connection Unit 6						10	9	8	7	6	5	4	3	2	1	0
1024	Node 28 connection Unit 7						10	9	8	7	6	5	4	3	2	1	0
1025	Node 29 connection Unit 1						10	9	8	7	6	5	4	3	2	1	0
1026	Node 29 connection Unit 2						10	9	8	7	6	5	4	3	2	1	0
1027	Node 29 connection Unit 3						10	9	8	7	6	5	4	3	2	1	0
1028	Node 29 connection Unit 4						10	9	8	7	6	5	4	3	2	1	0
1029	Node 29 connection Unit 5						10	9	8	7	6	5	4	3	2	1	0
1030	Node 29 connection Unit 6						10	9	8	7	6	5	4	3	2	1	0
1031	Node 29 connection Unit 7						10	9	8	7	6	5	4	3	2	1	0
1032	Node 30 connection Unit 1						10	9	8	7	6	5	4	3	2	1	0
1033	Node 30 connection Unit 2						10	9	8	7	6	5	4	3	2	1	0
1034	Node 30 connection Unit 3						10	9	8	7	6	5	4	3	2	1	0
1035	Node 30 connection Unit 4						10	9	8	7	6	5	4	3	2	1	0
1036	Node 30 connection Unit 5						10	9	8	7	6	5	4	3	2	1	0
1037	Node 30 connection Unit 6						10	9	8	7	6	5	4	3	2	1	0
1038	Node 30 connection Unit 7						10	9	8	7	6	5	4	3	2	1	0

zw	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
	I/O no-response parity error (major failure)	Slot (0 to 10)															
1040							10	9	8	7	6	5	4	3	2	1	0
1041	Node 27 connection Unit 1						10	9	8	7	6	5	4	3	2	1	0
1042	Node 27 connection Unit 2						10	9	8	7	6	5	4	3	2	1	0
1043	Node 27 connection Unit 3						10	9	8	7	6	5	4	3	2	1	0
1044	Node 27 connection Unit 4						10	9	8	7	6	5	4	3	2	1	0
1045	Node 27 connection Unit 5						10	9	8	7	6	5	4	3	2	1	0
1046	Node 27 connection Unit 6						10	9	8	7	6	5	4	3	2	1	0
1047	Node 27 connection Unit 7						10	9	8	7	6	5	4	3	2	1	0
1048	Node 28 connection Unit 1						10	9	8	7	6	5	4	3	2	1	0
1049	Node 28 connection Unit 2						10	9	8	7	6	5	4	3	2	1	0
1050	Node 28 connection Unit 3						10	9	8	7	6	5	4	3	2	1	0
1051	Node 28 connection Unit 4						10	9	8	7	6	5	4	3	2	1	0
1052	Node 28 connection Unit 5						10	9	8	7	6	5	4	3	2	1	0
1053	Node 28 connection Unit 6						10	9	8	7	6	5	4	3	2	1	0
1054	Node 28 connection Unit 7						10	9	8	7	6	5	4	3	2	1	0
1055	Node 29 connection Unit 1						10	9	8	7	6	5	4	3	2	1	0
1056	Node 29 connection Unit 2						10	9	8	7	6	5	4	3	2	1	0
1057	Node 29 connection Unit 3						10	9	8	7	6	5	4	3	2	1	0
1058	Node 29 connection Unit 4						10	9	8	7	6	5	4	3	2	1	0
1059	Node 29 connection Unit 5						10	9	8	7	6	5	4	3	2	1	0
1060	Node 29 connection Unit 6						10	9	8	7	6	5	4	3	2	1	0
1061	Node 29 connection Unit 7						10	9	8	7	6	5	4	3	2	1	0
1062	Node 30 connection Unit 1						10	9	8	7	6	5	4	3	2	1	0
1063	Node 30 connection Unit 2						10	9	8	7	6	5	4	3	2	1	0
1064	Node 30 connection Unit 3						10	9	8	7	6	5	4	3	2	1	0
1065	Node 30 connection Unit 4						10	9	8	7	6	5	4	3	2	1	0
1066	Node 30 connection Unit 5						10	9	8	7	6	5	4	3	2	1	0
1067	Node 30 connection Unit 6						10	9	8	7	6	5	4	3	2	1	0
1068	Node 30 connection Unit 7						10	9	8	7	6	5	4	3	2	1	0

■ G3 parallel I/O online map (read only)【Reserved: For future use】

zw	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
1100	T-S20 NO-1 station	Station status															
1101	T-S20 NO-2 station	<0> Test mode (1: In execution)															
1102	T-S20 NO-3 station	<1>															
1103	T-S20 NO-4 station	<2>															
1104	T-S20 NO-5 station	<3>															
1105	T-S20 NO-6 station	<4> Parent station / child station (1: Parent station)															
1106	T-S20 NO-7 station	<5> Scan transmission prohibition / allowance(1: Prohibited)															
1107	T-S20 NO-8 station	<6>															
1108	T-S20 NO-9 station	<7>															
1109	T-S20 NO-10 station	<8>															
1110	T-S20 NO-11 station	<9>															
1111	T-S20 NO-12 station	<10>															
1112	T-S20 NO-13 station	<11>															
1113	T-S20 NO-14 station	<12> Online															
1114	T-S20 NO-15 station	<13> Standby															
1115	T-S20 NO-16 station	<14> Offline															
1116	T-S20 NO-17 station	<15> Down															
1117	T-S20 NO-18 station																
1118	T-S20 NO-19 station																
1119	T-S20 NO-20 station																
1120	T-S20 NO-21 station																
1121	T-S20 NO-22 station																
1122	T-S20 NO-23 station																
1123	T-S20 NO-24 station																
1124	T-S20 NO-25 station																
1125	T-S20 NO-26 station																
1126	T-S20 NO-27 station																
1127	T-S20 NO-28 station																
1128	T-S20 NO-29 station																
1129	T-S20 NO-30 station																
1130	T-S20 NO-31 station																

A

zw	Usage	Station number (1 to 64)															
		F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
1140	T-S20 CH1 online map	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
		32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
		48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33
		64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49
1144	T-S20 CH2 online map	Same as above															
1148	T-S20 CH3 online map	Same as above															
1152	T-S20 CH4 online map	Same as above															
1156	T-S20 CH5 online map	Same as above															
1160	T-S20 CH6 online map	Same as above															
1164	T-S20 CH7 online map	Same as above															
1168	T-S20 CH8 online map	Same as above															
1172	T-S20 CH9 online map	Same as above															
1176	T-S20 CH10 online map	Same as above															
1180	T-S20 CH11 online map	Same as above															
1184	T-S20 CH12 online map	Same as above															
1188	T-S20 CH13 online map	Same as above															
1192	T-S20 CH14 online map	Same as above															
1196	T-S20 CH15 online map	Same as above															
1200	T-S20 CH16 online map	Same as above															
1204	T-S20 CH17 online map	Same as above															
1208	T-S20 CH18 online map	Same as above															
1212	T-S20 CH19 online map	Same as above															
1216	T-S20 CH20 online map	Same as above															
1220	T-S20 CH21 online map	Same as above															
1224	T-S20 CH22 online map	Same as above															
1228	T-S20 CH23 online map	Same as above															

zw	Usage	Station number (1 to 64)															
		F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
1232	T-S20 CH24 online map	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
		32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
		48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33
		64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49
1236	T-S20 CH25 online map	Same as above															
1240	T-S20 CH26 online map	Same as above															
1244	T-S20 CH27 online map	Same as above															
1248	T-S20 CH28 online map	Same as above															
1252	T-S20 CH29 online map	Same as above															
1256	T-S20 CH30 online map	Same as above															
1260	T-S20 CH31 online map	Same as above															
1264	T-S20 CH32 online map	Same as above															

A

■ F10 status map (read only)【Reserved: For future use】

zw	Usage		F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
1270	CH1	Command																
1271		Status																
1272	CH2	Command																
1273		Status																
1274	CH3	Command																
1275		Status																
1276	CH4	Command																
1277		Status																
1278	CH5	Command																
1279		Status																
1280	CH6	Command																
1281		Status																
1282	CH7	Command																
1283		Status																
1284	CH8	Command																
1285		Status																

Command

0: Communication operation state

1: Output prohibition operation complete flag

2: Reconfiguration flag

4: Scan transmission error flag

8: Communication stop request

9: Output prohibition request

Status

0: Communication operation state
(0: MS's communication startup request 1: Stop request)

1: Scan transmission state
(0: Scan transmission stopped 1: In operation)

4: MS state (0: Normal 1: Major failure)

5: MS operation state (0: Normal 1: Under test)

6: MS/RS selection(0: MS1: RS)

8: Block transmission control information
(0: Not supported 1: Supported)

9: Computer link transmission control information
(0: Not supported 1: Supported)

■ User system alarm failure bit area (user registration)

zw	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
1300	a00g00									Major failure (ALIT)							
1301										Minor failure (ALIT)							
1303	a00g01									Major failure (ALIT)							
1304										Minor failure (ALIT)							
:	:	:															
1362	a00g1F									Major failure (ALIT)							
1363										Minor failure (ALIT)							
1364	a01g00									Major failure (ALIT)							
1365										Minor failure (ALIT)							
1366	a01g01									Major failure (ALIT)							
1367										Minor failure (ALIT)							
:	:	:															
1426	a01g1F									Major failure (ALIT)							
1427										Minor failure (ALIT)							

A

■ User system alarm mask bit area (user registration)

zw	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
1500	EXST																
1501												a01	a00				
		21 bit: a 00 user system alarm(0: No 1: Yes)															
		22 bit: a 01 user system alarm(0: No 1: Yes)															
1502	a00.EXST	g0F	g0E	g0D	g0C	g0B	g0A	g09	g08	g07	g06	g05	g04	g03	g02	g01	g00
1503		g1F	g1E	g1D	g1C	g1B	g1A	g19	g18	g17	g16	g15	g14	g13	g12	g11	g10
		0 to 31 bit : User system alarm of g00 to g1F of a00(0: No 1: Yes)															
1504	a00g00.EXST									d07	d06	d05	d04	d03	d02	d01	d00
1505										d0F	d0E	d0D	d0C	d0B	d0A	d09	d08
		0 to 7 bit: Device 00 to 07 of g00(major failure)															
		16 to 23 bit: Device 08 to 0F of g00(minor failure)															
1506	a00g01.EXST									d07	d06	d05	d04	d03	d02	d01	d00
1507										d0F	d0E	d0D	d0C	d0B	d0A	d09	d08
		0 to 7 bit: Device 00 to 07 of g01(major failure)															
		16 to 23 bit: Device 08 to 0F of g01(minor failure)															
:	:	:															
1566	a00g1F.EXST									d07	d06	d05	d04	d03	d02	d01	d00
1567										d0F	d0E	d0D	d0C	d0B	d0A	d09	d08
		0 to 7 bit: Device 00 to 07 of g1F(major failure)															
		16 to 23 bit: Device 08 to 0F of g1F(minor failure)															
1568	a01.EXST	g0F	g0E	g0D	g0C	g0B	g0A	g09	g08	g07	g06	g05	g04	g03	g02	g01	g00
1569		g1F	g1E	g1D	g1C	g1B	g1A	g19	g18	g17	g16	g15	g14	g13	g12	g11	g10
		0 to 31 bit: User system alarm of g00 to g1F of a01(0: No 1: Yes)															
1570	a01g00.EXST									d07	d06	d05	d04	d03	d02	d01	d00
1571										d0F	d0E	d0D	d0C	d0B	d0A	d09	d08
		0 to 7 bit: Device 00 to 07 of g00(major failure)															
		16 to 23 bit: Device 08 to 0F of g00(minor failure)															
1572	a01g01.EXST									d07	d06	d05	d04	d03	d02	d01	d00
1573										d0F	d0E	d0D	d0C	d0B	d0A	d09	d08
		0 to 7 bit: Device 00 to 07 of g01(major failure)															
		16 to 23 bit: Device 08 to 0F of g01(minor failure)															
:	:	:															
1632	a01g1F.EXST									d07	d06	d05	d04	d03	d02	d01	d00
1633										d0F	d0E	d0D	d0C	d0B	d0A	d09	d08
		0 to 7 bit: Device 00 to 07 of g1F(major failure)															
		16 to 23 bit: Device 08 to 0F of g1F(minor failure)															

A

■ Inter-controller transmission bit map area

zw	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
1700	Inter-controller transmission diagnosis registration map																1
1701	0 bit : Controller number 1																
1702	:																
1703	63 bit: Controller number 64 1: Diagnosed 0: Not diagnosed	64															
1704	Inter-controller transmission diagnosis healthy map																1
1705	0 bit: Controller number 1																
1706	:																
1707	63 bit: Controller number 64 1: Healthy 0: Unhealthy	64															

ZW1700 to 1702(Registered by the user)

■ OIS, SVR transmission bit map

zw	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
1708	OIS, SVR transmission diagnosis registration map 1: Diagnosed, 0: Not diagnosed														OIS1	SVR2	SVR1
1709		EWS8							EWS1	OIS22							
1710	Reserved	0 bit: SVR1, 1 bit: SVR2															
1711		2 bit: OIS1 to 23 bit: OIS22, 24 bit: EWS1 to 31 bit: EWS8															
1712	OIS, SVR transmission healthy map 1: Healthy, 0: Unhealthy														OIS1	SVR2	SVR1
1713		EWS8							EWS1	OIS22							
1714	Reserved	0 bit: SVR1, 1 bit: SVR2															
1715		2 bit: OIS1 to 23 bit: OIS22, 24 bit: EWS1 to 31 bit: EWS8															
1716	Controller number display	Own system controller (0, 1 to 64)															

ZW1708 to 1709(Registered by the user)

■ Data block with strobe (#DB) data change flag【Reserved: For future use】

256 words from ZW1840 to ZW2095 are used.

zw	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
1840	#DB1 Change																
		0 bit: ON when #DB1 is changed from OIS (Reset is done by the application)															
1841	#DB2 Change																
		0 bit: ON when #DB2 is changed from OIS (Reset is done by the application)															
:	:	:															
2095	#DB256 Change																
		0 bit: ON when #DB256 is changed from OIS (Reset is done by the application)															

A

■ MELSECNET10information【Reserved: For future use】

< Station status >

zw	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2100	No.1 station status	Station state						S	R	NET10 state				IF mode			
2101	No.2 station status																

- Bit 0 to 3: I/F mode
  0 : F/W of GMF313 may not be operating.
  1 : Normal mode
  2 : Host DPRAM test mode 1
  3 : Host DPRAM test mode 2
  4 : Host DPRAM test mode 3
  5 : Base local mode
  6 to 14 : F/W of GMF313 may not be operating.
  15: Built-in hardware error of GMF313
- Bit 4 to 7: NET10 state
  0 : Host DPRAM test mode or F/W of GMF313 may not be operating.
  1 : NET10 being initialized
  2 : Reading parameter
  3 : NET10 normal mode
  4 to 14 : F/W of GMF313 may not be operating.
  15: NET10 error(health check error)
- Bit 8 : DPRAM
  0: Updating 1: Stopped
- Bit 9 : Cyclic transmission
  0: Updating 1: Stopped
- Bit 10, 11: Reserved
- Bit 12 to 14: for future expansion

A

< Online map >

ZW	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2116	No.1 Bandpass																B
2117	No.1 Online map	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
2118		32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
2119		48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33
2120		64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49
2121	No.2 Bandpass																B
2122	No.2 Online map	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
2123		32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
2124		48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33
2125		64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49

B: 0 Normal 1: Abnormal

Online map: 0 Normal 1: Abnormal

■ TC-net I/O loop alarm detailed information【Reserved: For future use】

ZW	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2200	Loop 0 A system alarm information																
		0 bit: No connection target (major failure) 1 bit: Bus state (major failure) 8 bit: Bus state (minor failure)															
2201	Loop 0 B system alarm information																
		0 bit: No connection target (major failure) 1 bit: Bus state (major failure 8 bit: Bus state (minor failure)															
2202	Loop 1 A system alarm information																
		0 bit: No connection target (major failure) 1 bit: Bus state (major failure) 8 bit: Bus state (minor failure)															
2203	Loop 1 B system alarm information																
		0 bit: No connection target (major failure) 1 bit: Bus state (major failure) 8 bit: Bus state (minor failure)															
2204	Loop 2 A system alarm information																
		0 bit: No connection target (major failure) 1 bit: Bus state (major failure) 8 bit: Bus state (minor failure)															
2205	Loop 2 B system alarm information																
		0 bit: No connection target (major failure) 1 bit: Bus state (major failure) 8 bit: Bus state (minor failure)															
2206	Loop 3 A system alarm information																
		0 bit: No connection target (major failure) 1 bit: Bus state (major failure) 8 bit: Bus state (minor failure)															
2207	Loop 3 B system alarm information																
		0 bit: No connection target (major failure) 1 bit: Bus state (major failure) 8 bit: Bus state (minor failure)															

A

■ TC-net I/O interface major failure representative alarm【Reserved: For future use】

ZW	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2208	Loop 0 A system major failure representative alarm	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2209		34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Normal 1: Major failure)															
2210	Loop 0 B system major failure representative alarm	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2211		34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Normal 1: Major failure)															
2212	Loop 1 A system major failure representative alarm	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2213		34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Normal 1: Major failure)															
2214	Loop 1 B system major failure representative alarm	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2215		34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Normal 1: Major failure)															
2216	Loop 2 A system major failure representative alarm	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2217		34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Normal 1: Major failure)															
2218	Loop 2 B system major failure representative alarm	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2219		34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Normal 1: Major failure)															
2220	Loop 3 A system major failure representative alarm	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2221		34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Normal 1: Major failure)															
2222	Loop 3 B system major failure representative alarm	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2223		34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Normal 1: Major failure)															

■ TC-net I/O interface minor failure representative alarm【Reserved: For future use】

ZW	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2224	Loop 0 A system	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2225	minor failure representative alarm	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Normal 1: Minor failure)															
2226	Loop 0 B system	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2227	minor failure representative alarm	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Normal 1: Minor failure)															
2228	Loop 1 A system	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2229	minor failure representative alarm	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Normal 1: Minor failure)															
2230	Loop 1 B system	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2231	minor failure representative alarm	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Normal 1: Minor failure)															
2232	Loop 2 A system	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2233	minor failure representative alarm	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Normal 1: Minor failure)															
2234	Loop 2 B system	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2235	minor failure representative alarm	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Normal 1: Minor failure)															
2236	Loop 3 A system	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2237	minor failure representative alarm	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Normal 1: Minor failure)															
2238	Loop 3 B system	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2239	minor failure representative alarm	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Normal 1: Minor failure)															

■ TC-net I/O interface in-ring map【Reserved: For future use】

ZW	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2240	Loop 0 A system	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2241	In-ring map	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Error or no S I/O registration 1: In-ring)															
2242	Loop 0 B system	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2243	In-ring map	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Error or no S I/O registration 1: In-ring)															
2244	Loop 1 A system	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2245	In-ring map	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Error or no S I/O registration 1: In-ring)															
2246	Loop 1 B system	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2247	In-ring map	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Error or no S I/O registration 1: In-ring)															
2248	Loop 2 A system	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2249	In-ring map	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Error or no S I/O registration 1: In-ring)															
2250	Loop 2 B system	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2251	In-ring map	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Error or no S I/O registration 1: In-ring)															
2252	Loop 3 A system	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2253	In-ring map	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Error or no S I/O registration 1: In-ring)															
2254	Loop 3 B system	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
2255	representative alarm	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		0 to 31 bit: S I/O node number (0: Error or no S I/O registration 1: in-ring)															

A

■ Built-in TC-net I/O (Loop 0) I/O major failure representative alarm 【Reserved: For future use】

ZW	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2256	Node 3 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2257	Node 4 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2258	Node 5 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2259	Node 6 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2260	Node 7 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2261	Node 8 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2262	Node 9 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2263	Node 10 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2264	Node 11 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2265	Node 12 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2266	Node 13 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2267	Node 14 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2268	Node 15 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2269	Node 16 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2270	Node 17 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2271	Node 18 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2272	Node 19 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2273	Node 20 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2274	Node 21 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2275	Node 22 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2276	Node 23 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2277	Node 24 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															

A

ZW	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2278	Node 25 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2279	Node 26 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2280 : 2283	Node 27 : Node 30	Not used; dedicated for G3 parallel I/O															
2284 : 2287	Node 31 : Node 34	Not used; dedicated for intelligent serial I/O															

■ Built-in TC-net I/O (Loop 0) I/O minor failure representative alarm 【Reserved: For future use】

ZW	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2288	Node 3 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2289	Node 4 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2290	Node 5 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2291	Node 6 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2292	Node 7 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2293	Node 8 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2294	Node 9 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2295	Node 10 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2296	Node 11 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2297	Node 12 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2298	Node 13 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2299	Node 14 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2300	Node 15 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2301	Node 16 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2302	Node 17 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															

ZW	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2303	Node 18	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2304	Node 19	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2305	Node 20	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2306	Node 21	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2307	Node 22	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2308	Node 23	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2309	Node 24	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2310	Node 25	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2311	Node 26	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2312 : 2315	Node 27 : Node 30	Not used; dedicated for G3 parallel I/O															
2316 : 2319	Node 31 : Node 34	Not used; dedicated for intelligent serial I/O															

A

■ SIF-1(Loop 1) I/O major failure representative alarm【Reserved: For future use】

ZW	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2320	Node 3	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2321	Node 4	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2322	Node 5	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2323	Node 6	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2324	Node 7	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2325	Node 8	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2326	Node 9	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2327	Node 10	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															

ZW	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2328	Node 11	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2329	Node 12	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2330	Node 13	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2331	Node 14	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2332	Node 15	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2333	Node 16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2334	Node 17	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2335	Node 18	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2336	Node 19	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2337	Node 20	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2338	Node 21	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2339	Node 22	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2340	Node 23	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2341	Node 24	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2342	Node 25	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2343	Node 26	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2344 : 2347	Node 27 : Node 30	Not used; dedicated for G3 parallel I/O															
2348 : 2351	Node 31 : Node 34	Not used; dedicated for intelligent serial I/O															

A

■ SIF-1(Loop 1) I/O minor failure representative alarm【Reserved: For future use】

ZW	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2352	Node 3 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2353	Node 4 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2354	Node 5 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2355	Node 6 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2356	Node 7 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2357	Node 8 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2358	Node 9 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2359	Node 10 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2360	Node 11 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2361	Node 12 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2362	Node 13 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2363	Node 14 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2364	Node 15 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2365	Node 16 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2366	Node 17 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2367	Node 18 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2368	Node 19 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2369	Node 20 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2370	Node 21 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2371	Node 22 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2372	Node 23 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2373	Node 24 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															

ZW	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2374	Node 25 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2375	Node 26 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2376 : 2379	Node 27 : Node 30	Not used; dedicated for G3 parallel I/O															
2380 : 2383	Node 31 : Node 34	Not used; dedicated for intelligent serial I/O															

■ SIF-2(Loop 2) I/O major failure representative alarm【Reserved: For future use】

ZW	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2384	Node 3 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2385	Node 4 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2386	Node 5 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2387	Node 6 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2388	Node 7 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2389	Node 8 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2390	Node 9 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2391	Node 10 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2392	Node 11 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2393	Node 12 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2394	Node 13 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2395	Node 14 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2396	Node 15 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2397	Node 16 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															

ZW	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2398	Node 17 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2399	Node 18 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2400	Node 19 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2401	Node 20 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2402	Node 21 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2403	Node 22 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2404	Node 23 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2405	Node 24 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2406	Node 25 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2407	Node 26 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2408 : 2411	Node 27 : Node 30	Not used; dedicated for G3 parallel I/O															
2412 : 2415	Node 31 : Node 34	Not used; dedicated for intelligent serial I/O															

A

■ SIF-2(Loop 2) I/O minor failure representative alarm【Reserved: For future use】

ZW	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2416	Node 3 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2417	Node 4 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2418	Node 5 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2419	Node 6 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2420	Node 7 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2421	Node 8 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2422	Node 9 I/O minor failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															

ZW	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2423	Node 10	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2424	Node 11	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2425	Node 12	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2426	Node 13	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2427	Node 14	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2428	Node 15	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2429	Node 16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2430	Node 17	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2431	Node 18	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2432	Node 19	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2433	Node 20	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2434	Node 21	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2435	Node 22	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2436	Node 23	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2437	Node 24	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2438	Node 25	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2439	Node 26	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2440 : 2443	Node 27 : Node 30	Not used; dedicated for G3 parallel I/O															
2444 : 2447	Node 31 : Node 34	Not used; dedicated for intelligent serial I/O															

■ SIF-3(Loop 3) I/O major failure representative alarm【Reserved: For future use】

ZW	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2448	Node 3 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2449	Node 4 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2450	Node 5 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2451	Node 6 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2452	Node 7 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2453	Node 8 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2454	Node 9 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2455	Node 10 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2456	Node 11 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2457	Node 12 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2458	Node 13 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2459	Node 14 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2460	Node 15 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2461	Node 16 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2462	Node 17 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2463	Node 18 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2464	Node 19 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2465	Node 20 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2466	Node 21 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2467	Node 22 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2468	Node 23 I/O major failure representative alarm	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															

ZW	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2469	Node 24	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2470	Node 25	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2471	Node 26	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O major failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Major failure)															
2472 : 2475	Node 27 : Node 30	Not used; dedicated for G3 parallel I/O															
2476 : 2479	Node 31 : Node 34	Not used; dedicated for intelligent serial I/O															

■ SIF-3(Loop 3) I/O minor failure representative alarm【Reserved: For future use】

ZW	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2480	Node 3	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2481	Node 4	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2482	Node 5	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2483	Node 6	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2484	Node 7	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2485	Node 8	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2486	Node 9	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2487	Node 10	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2488	Node 11	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2489	Node 12	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2490	Node 13	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2491	Node 14	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															

ZW	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2492	Node 15	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2493	Node 16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2494	Node 17	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2495	Node 18	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2496	Node 19	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2497	Node 20	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2498	Node 21	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2499	Node 22	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2500	Node 23	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2501	Node 24	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2502	Node 25	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2503	Node 26	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	I/O minor failure representative alarm	0 to 15 bit: I/O slot number (0: Normal 1: Minor failure)															
2504 : 2507	Node 27 : Node 30	Not used; dedicated for G3 parallel I/O															
2508 : 2511	Node 31 : Node 34	Not used; dedicated for intelligent serial I/O															

■ Other areas by application

ZW	Usage	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
4096 6143	Work area for GP (2KW)																
6144 8191	Reserved																

A.3 List of Module Parameters

Table A.3-1 List of module parameters (1)

Item	Contents	Setting value
Program fallback	Specify whether to transition to ERROR mode or to separate the program with error and to continue operation (fallback) when any error occurs in program execution.	NO: Error down YES: Continues fallback operation
I/O fallback	Specify whether to transition to ERROR mode or to stop inputting/outputting the I/O module with error and to continue operation (fallback) when any error occurs in batch input/output.	NO: Error down YES: Continues fallback 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
DC short interruption	Set the short interruption time.	0: Long interruption 1 to 30(Unit: 1s)
HS task scan cycle	Specify the execution cycle of the high-speed scan task (HS).	0: Stop 10 to 5000(Unit: 10ms)
MS task scan cycle	Specify the execution cycle of the main scan task (MS).	0: Stop 100 to 10000(Unit: 100ms)
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 a TC-net I/O that seems normal from online system but looks abnormal from standby system. This function specifies the operation in case TC-net I/O loop seems abnormal by four or more points.	Continue execution/Error down
State change detection	Specify whether to perform state change detection by word.	Yes: Perform state change detection No: Do not perform state change detection
Target I/O module	Select the I/O module performing state change detection.	Registered I/O module
I/O word No.	Set the word No. for state change detection.	Detection word No.
Detection mask (when ON)	Set the bit in which ON detection is performed in process data of 1 word set in Target I/O module and I/O word No.	Set "1" to the bit for ON detection.
Detection mask (when OFF)	Set the bit in which OFF detection is performed in process data of 1 word set in Target I/O module and I/O word No.	Set "1" to the bit for OFF detection.

Table A.3-1 List of module parameters (2)

Item	Contents	Setting value
IP task No.	Set the IP task to start up when change detection is performed.	0 to 15
Difference between the GMT and local time	Specify the difference between the Greenwich Time and local time in hours. In Japan, specify "+9"(default value).	+12 to -12
Correction unit system		SI: Yard/pound:
Scan synchronous processing in OIS tag write	Specify whether or not to synchronize the data write to the controller in tag information change from the OIS with main scan.	Yes: Perform synchronous processing No: Do not perform synchronous processing
DO read-back processing in M mode	Specify whether to store the read-back value from the DO module to FO in the M mode.	Yes: Perform DO read-back processing No: Do not perform DO read-back processing
Controller number	Set a unique value in the system to operate as the CIEMAC-DS system.	1 to 32
DS scan	Specify whether or not to allow DS scan execution.	Allowed / Prohibited
Inter-controller transmission	Specify whether or not to allow inter-controller transmission.	Allowed / Prohibited
IP address type	Set the type of the IP address.	Class B
IP address	Specify the IP address of the controllers of primary/secondary side. In "**", set the rotary switch setting value of the front panel of the primary side/secondary side controllers. If the system in single configuration, specify the primary side controller only.	172.16.64.**
Subnet mask	Specify the subnet mask of the primary/secondary controller. If the system in single configuration, specify the primary side controller only.	255.255.192.0
I/O loop number	Set the number of I/O loops.	1: Single configuration 2: Duplex configuration
I/O loop high speed scan cycle	Set the high-speed scan cycle of TC-net 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 TC-net I/O loop.	10 to 1000 (unit in 1 ms)
I/O loop mid speed scan cycle	Set the mid-speed scan cycle of TC-net 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 TC-net I/O loop.	10 to 1000 (unit in 1 ms)
I/O fallback	Set whether carry out the I/O fallback for the unit of node or not.	NO: No fallback YES: Fallback
I/O bus healthy check time	Set the I/O bus healthy check time.	1 to 1024 (unit in 1 ms)

Appendix B
Precautions on Use and Restrictions

This chapter describes the precautions on use, changes, and restrictions for the Unified Controller nv series type2, focusing on differences from the PCS-DS and Integrated Controller V series.

B.1 Restrictions on Use

■ General

It operates as a control LAN provided with the connection to the OIS-DS. Therefore, the FN module must be implemented.

To retain memory in case of power down, shutdown processing is performed. To achieve this, the power supply for shutdown (large-capacity capacitor) is installed in the power supply module. If this shutdown power supply is not fully charged, the memory content may be lost in case of power down and control cannot be continued upon power recovery. The charge state can be checked with a battery error.

■ I/O

It is designed assuming the TC-net I/O module is used. The TC-net I/O module realizes online maintenance functions such as installation/removal online as in the conventional serial I/O (such as intelligent I/O modules). However, maintenance and diagnosis functions equivalent to the conventional I/O may not be present, such that many I/O modules do not have any CPU.

As conventional serial I/O, intelligent I/O modules will be supported in the future.

The TC-net I/O is serial I/O rather than parallel I/O. Therefore, when accessing I/O directly (direct input/output), the data is not the content of the I/O module, and the transmission buffer of the TC-net I/O loop is accessed.

The TC-net I/O is made redundant with the duplex loop structure. The loop itself is duplex, and even if part of it is disconnected, the remaining part constitutes a bus structure. As a result, the connection state of the I/O may seem different between online and standby. Check with the display on the OIS-DS and nV-Tool.

■ Process tag

The supported process tags are equivalent to the PCS-DS and Integrated Controller V series L2/DS. However, the total number of indicator tags (#PV) is increased from 768 to 1024, controller tags from 256 to 320, and #PB from 1024 to 1280.

For standard input/output for #PV, options have been added to the behaviors upon a sensor error. In conventional operation, the final value of PV is continued when a sensor error is detected. Now it can be selected whether to update the PV value using the ADC count value in case of a sensor error.

■ System register (ZW)

The configuration of the system register (ZW) is equivalent to the PCS-DS and Integrated Controller V series L2/DS. However, the register numbers may be shifted because the hardware configuration is different significantly. When using conventional applications, check with the register number table.

■ Instruction word

The execution of instruction words is performed by LP specifically developed for the Unified Controller nv series. The execution speed of LP is higher than the processer installed to S3 of the Integrated Controller V series.

Basic commands are executed by LP, so they are executed faster than the Integrated Controller L Series.

For instruction words, instrumentation dedicated commands are added. The entire instruction words are equivalent to that of the Integrated Controller L Series.

The instrumentation commands are executed by the management processor (SH). Therefore, the execution time of instrumentation commands may be slower than the basic commands of other LP.

■ Engineering

The new design environment is the Unified Controller nv series nV-Tool, which is upward compatible with the common design environment of the Integrated Controller V series, V-Tool.

The types and numbers of tasks are according to L3 of the Integrated Controller V series. However, SS (ultra high-speed scan) tasks and BG (background) tasks are not implemented.

The total number of operating POU is 2048, but only up to 1990 can actually be registered in the control program. The remaining is dedicated for the special functions such as synchro-trend.

■ Self diagnosis

The self diagnosis function has been changed according to the new hardware configuration. The mechanism may be different from the diagnosis of the conventional controller.

For memory diagnosis, ECC is adopted instead of the conventional parity diagnosis.

■ Network

For Ethernet connection, the dedicated interface module (FN812) to connect to the OIS-DS is used. The Ethernet module (EN) for type 1 cannot be used alone. The FN812 and EN can be implemented simultaneously. However, the computer link protocol of EN cannot be used.

B.2 Application Registration in Duplexing

B.2.1 Identification of duplexing

Normally, the control program does not have to be aware that the controller is duplexed.

The registration information and execution result of the control program are equalized in every scan when they are changed or executed.

The results of operations or changes from the outside such as OIS-DS are automatically reported to the standby side and equalized, so the operation can be inherited.

B.2.2 Parameter changes

When parameters are changed in the control program, the information in the standby side may need to be matched.

To equalize the parameter information changed in the control program to the standby side automatically using the partial equalization function, the dedicated instruction word must be used in parameter change. Perform partial equalization in the following order:

① Store it with the dedicated save command.

② Save the parameter type and information of the change target to the buffer.

③ After the scan is complete, transfer it during normal tracking.

If parameter changes occur frequently and partial equalization is executed many times in the control program as a result, the execution speed is decreased due to heavy load both in the execution of the instruction words and partial tracking.

A control program that calculates and updates parameter values at each scan is not recommended because partial tracking is executed at each scan. Designing a program that performs calculation before using the parameter may reduce useless load because partial tracking is not necessary.

B.2.3 Event tasks in switching

When duplex switching occurs, the event task (EV3) starts up.

If common processing is required rather than measures for individual control programs or control targets, describe it within this event task.

B.2.4 Identification of switching

When duplex switching occurs in the controller, the flag indicating switching is set for 1 scan in the first scan after the switching. The control program can monitor this flag to identify the presence of switching occurred.

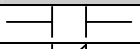
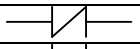
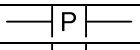
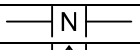
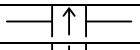
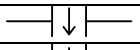
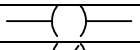
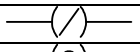
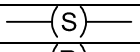
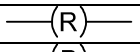
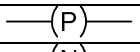
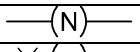
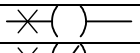
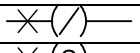
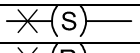
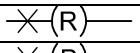
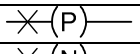
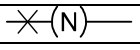
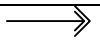
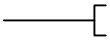
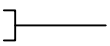
The controller is designed to shorten the time required for duplex switching as much as possible for seamless switching operation. However, it may be impossible to determine if the controller state is completely normal immediately before switching depending on the effect of failure causing the switching. Monitor the switching flag with the control program, and take appropriate measures when switching is identified for important control targets.

Some of the causes that require some processing in switching include a delay for the time required for switching and an unexpected operation of the controller immediately before switching.

B

Appendix C
Run Time of Instruction Word

■ List of instruction word execution

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
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	
Master control set	MCS	1		0.02	
Master control reset	MCR	1		0.02	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
Counter					
Up counter	CTU	1		0.44	
Down counter	CTD	1		0.64	
Up/Down counter	CTUD	1		0.44	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
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	
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	

C

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
Immediate value load	LD	1	Boolean	0.02	
		1	Integer	0.02	
		2	Double precision	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	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	
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	

C

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
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	
	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	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
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	—	
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	—	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
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	—	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
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	—	
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

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
Smaller than	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	—	
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

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
Maximum value	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	—	
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

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
Minimum value	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	—	
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	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
Upper/lower limit	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	—	
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	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
Multiplexer	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	
	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	
	DINT_TO_UINT	1	EN/ENO not used	0.08	
			EN/ENO used	0.20	

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Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
Integer→ Integer conversion	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	
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	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
Integer→ Elapsed time conversion	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	
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	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
BCD→ Integer conversion	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	
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	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
Time data conversion	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
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)	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	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
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	
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-type2	
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	
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

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nV-type2	
Add	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	
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	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
Increment	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	—	
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	—	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
Subtract time data	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	—	
	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	
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	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
Decode	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
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	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
Get I/O module status	GET_IO_STS	1	EN/ENO not used	2.24	
			EN/ENO used	2.32	
Request I/O fallback	IOFB_REQ	1	EN/ENO not used	1.54	
			EN/ENO used	1.62	
Request I/O fallback 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	
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

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
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	
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	1		0.88	
User definition	—	1		1.70+0.04×N	N: No. of inputs
User definition	—	1		1.64+0.04×N	N: No. of inputs
User definition	—	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	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
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	—	
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	0.64	
ELSE (IF syntax)	ELSE	1	Condition established	0.14	
			Condition not	0.68	
ELSEIF	ELSEIF	1	Condition established	0.14	
			Condition not	0.68	
END_IF	END_IF	1		0.02	
CASE	CASE	1		0.12	
:	:	1	Condition established	0.22	
			Condition not	0.62	
. .	. .	1	Condition established	0.30	
			Condition not	0.68	
: ,	: ,	1	Condition established	0.22	
			Condition not	0.64	

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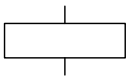
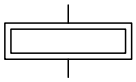
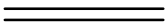
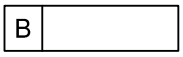
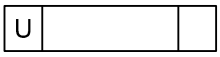
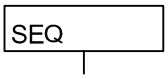
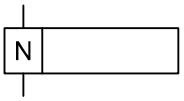
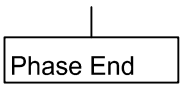
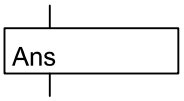
Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
. . ,	. . ,	1	Condition established	0.32	
			Condition not	0.74	
ELSE (CASE syntax)	ELSE	1	Condition established	0.14	
			Condition not	0.68	
END_CASE	END_CASE	1		0.02	
FOR_DO	FOR_DO	1	Loop condition	0.24	
			Loop condition 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	0.12	
			WHILE condition not	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	0.12	
			REPEAT condition	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	—	
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		—	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
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	—	
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	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
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	
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	

Instruction word	Symbol	No. of steps	Run time		Remark
			Condition	nv-type2	
Action			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.

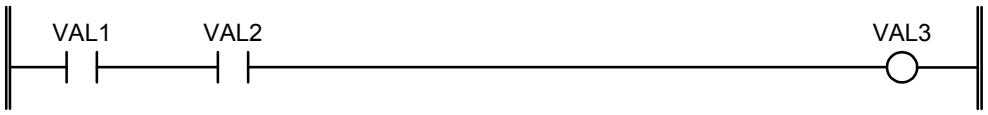
Unit [μs]

	nv-type2		
	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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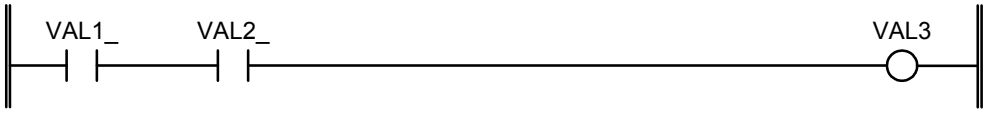
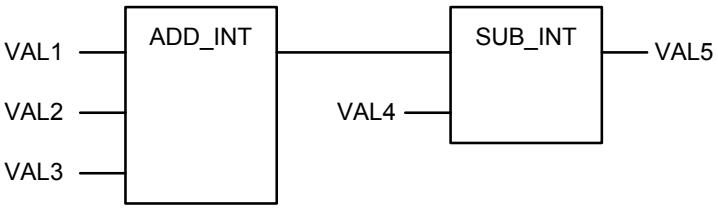
<Ex. 2> Calculation example of LD circuit run time
(Case when VAL1_is an I/O variable (direct I/O), VAL2_is a station variable (direct I/O) and VAL3 is a local variable)



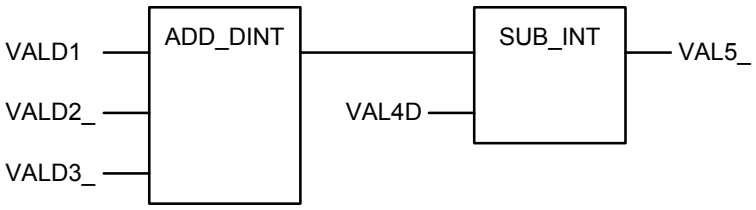
	a contact	(VAL1_)	2.00 to 2.50	(I/O variable (direct I/O))
	a contact	(VAL2_)	2.50	(Station variable (direct I/O))
+)	Coil	(VAL3)	0.06	(Local variable)
	Total		4.56 to 5.06	

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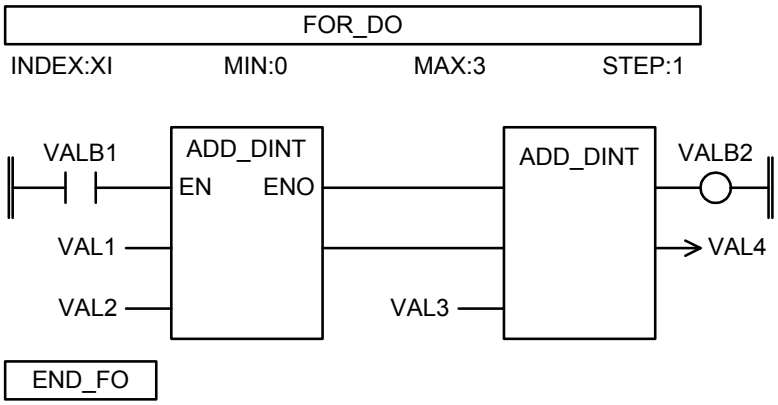
<Ex. 5> Calculation example of run time of LD circuit mixed with FBD circuit
(Case when all variables are local variables)



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 type2 Functional Manual

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