HITACHI PROGRAMMABLE AUTOMATION CONTROLLER



APPLICATION MANUAL (Software) (SERVICE MANUAL)



O Warranty period and coverage

The warranty period is the shorter period either 18 months from the data of manufacture or 12 months from the date of installation.

However within the warranty period, the warranty will be void if the fault is due to;

- (1) Incorrect use as directed in this manual and the application manual.
- (2) Malfunction or failure of external other devices than this unit.
- (3) Attempted repair by unauthorized personnel.
- (4) Natural disasters.

The warranty is for the PAC only, any damage caused to third party equipment by malfunction of the PAC is not covered by the warranty.

O Repair

Any investigation or repair after the warranty period cannot be covered as free of charge. Also any faults caused by above (1) to (4), will be charged for its repair (or for its investigation), even if the product is within the warranty period. In case of any contact, please ask your supplier or local Hitachi distributor. (Depending on failure part, investigation may not be possible to apply)

O Ordering parts or asking questions

When contacting us for repair, ordering parts or inquiring about other items, please have the following details ready before contacting the place of purchase.

- (1) Model
- (2) Manufacturing number (MFG.NO.)
- (3) Details of the malfunction

O Reader of this manual

This manual is described for the following person.

- Person considering the introduction of PAC
- PAC system engineer
- Person handling PAC
- Manager after installing PAC

Warning

- (1) This manual may not be reproduced in its entirety or any portion thereof without prior consent.
- (2) The content of this document may be changed without notice.
- (3) This document has been created with utmost care. However, if errors or questionable areas are found, please contact us.

Windows ® is registered trademarks of America and other registered countries of Microsoft Corp. of the United States.

CODESYS is registered trademarks of 3S-Smart Software Solutions GmbH.

EtherCAT ® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

Ethernet is registered trademarks of Fuji Xerox Co., Ltd.

EtherNet/IP is a trademark of ODVA, Inc.

PROFINET is a registered trademark of PROFIBUS Nutzerorganisation e.V. (PNO).

Company name or a product name is trademark or a registered trademark.

Safety Precautions

Read this manual and related documents thoroughly before installing, operating, performing preventive maintenance or performing inspection, and be sure to use the unit correctly. Use this product after acquiring adequate knowledge of the unit, all safety information, and all cautionary information. Also, make sure this manual enters the possession of the chief person in charge of safety maintenance.

Safety caution items are classifies as "Danger" and "Caution" in this document.



: Cases where if handled incorrectly a dangerous circumstance may be created, resulting in possible death or severe injury.



: Cases where if handled incorrectly a dangerous circumstance may be created, resulting in possible minor to medium injury to the body, or only mechanical damage

However, depending on the circumstances, items marked with



may result in major accidents.

In any case, they both contain important information, so please follow them closely.

Icons for prohibited items and required items are shown blow:

: Indicates prohibited items (items that may not be performed). For example, when open flames are prohibited, is shown.

: Indicates required items (items that must be performed). For example, when grounding must be performed, is shown.

1. About installation

- Use this product in an environment as described in the catalog and this document. If this product is used in an environment subject to high temperature, high humidity, excessive dust, corrosive gases, vibration or shock, it may result in electric shock, fire or malfunction.
- Perform installation according to this manual. If installation is not performed adequately, it may result in dropping, malfunction or an operational error in the unit.
- Do not allow foreign objects such as wire chips to enter the unit. They may become the cause of fire, malfunction or failure.

2. About wiring

REQUIRED

• Always perform grounding (FE terminal).

If grounding is not performed, there is a risk of electric shocks and malfunctions.

▲ CAUTION

- Connect power supply that meets rating. If a power supply that does not meet rating is connected, fire may be caused.
- The wiring operation should be performed by a qualified personnel. If wiring is performed incorrectly, it may result in fire, damage, or electric shock.

3. Precautions when using the unit

DANGER

- Do not touch the terminals while the power is on. There is a risk of electric shock.
- Structure the emergency stop circuit, interlock circuit, etc. outside the PAC. Damage to the equipment or accidents may occur due to failure of the PAC. However, do not interlock the unit to external load via relay drive power supply of the relay output module.

• When performing program change, forced output, RUN, STOP, etc., while the unit is running, be sure to verify safety.

Damage to the equipment or accidents may occur due to operation error.

• Supply power according to the power-up order. Damage to the equipment or accidents may occur due to malfunctions.

• Use power supply unit of EH-PS series or HX-PS series for supplying electric power.

• Do not connect DC power supply module EH-PSD / HX-PSD to a master power circuit. Supply a power to EH-PSD / HX-PSD through an appropriate isolation transformer less than up to 150VA by all means.

In the control system, recently, the connection and cooperation with the information communication system progress and information security risks including cyber attacks are growing. In a system applying this product, physical security measures mainly in the installation location and security measures in use via network are needed.

[Security risk example via the network]

- Abnormal operation, performance degradation, information leakage and data tampering by attacks from outside

- Malfunction, harm and damage occurrence due to programs and/or data tampering from outside

- It is used as an attacking step for the other systems

Hitachi Group is striving security improvement of control systems by establishing prerequisite protecting target defined for each product and equipping security protection functions under the own provision security design procedure.

In order to deal with the security risks from the outside via the network, this product is equipped with a security protection support functions for the purpose of prevention of unauthorized access. However, the security level to be determined by the control system. In addition, the assumed security risk is not fixed, it will be something to change on a daily basis.

Not only in our products, individual security protection support functions of each product configuring the system is one means to ensure the security level required for the system, it does not completely prevent the security risk growing daily.

The construction of the security level required for the control systems are responsible by the system and customer. In addition, for the maintenance of the security level will require continuous improvement measures.

In a system using this product, regardless of the presence or absence of the use of security protection support functions, trouble, accident or damages caused by unauthorized external access, Hitachi Group will not be able to bear any responsibility.

It is required for the customer side to clarify the target of the security protection of the system, following the conduct measures example to a representative, please refer to the construction and operation of the system.

-Utilization and regular review of the authentication function for the program and the data to be protected

-Utilize the security functions of the device configuring the network

-Prevention of the unspecified connection by the use of a particular function to identify connection

-Measures in the operational management, such as to lock the location of devices or limit the operator

• The screenshots of HX-CODESYS described in this manual may vary depending on its version. Check the actual screen displays on your HX-CODESYS.

4. About preventive maintenance

DANGER

• Do not connect the +, - of the battery in reverse. Also, do not charge, disassemble, heat, place in fire, or short circuit the battery.

There is a risk of explosion or fire.

• Do not disassemble or modify the unit. Electric shock, malfunction or failure may result.

• Turn off the power supply before removing or attaching module/unit. Electric shock, malfunction or failure may result.

5. About sample programs

• The sample programs described in this manual are examples of a program aimed to assist understanding how to use the corresponding function, so it does not include error handling that may be necessary for practical use. Please create the error handling etc. by the user according to the application.

Revision History

No.	Description of revision	Date of revision	Manual number
1	The first edition	2016.12	NJI-638(X)
2	Runtime update to V3.5 SP13	2020.07	NJI-638A(X)
3	Runtime update to V3.5 SP16	2022.03	NJI-638B(X)
4	Firmware update to 3.5.16.25 and 3.5.16.26	2023.02	NJI-638C(X)

Table of contents

Chapter 1 Introduction		
1.1	Installation	1-1
	1.1.1 System Requirements	1-1
	1.1.2 Installation of HX-CODESYS	1-1
	1.1.3 Installation of USB Driver	1-3
1.2	Startup	1-7

Chapte	r 2 Prog	Iramming	2-1 to 2-60
2.1	Plug D	evice (I/O Configuration)	2-1
	2.1.1	Plug Device (I/O Configuration)	2-1
	2.1.2	Scan for Devices	2-3
	2.1.3	Expansion Unit	2-4
	2.1.4	Update Devices	2-5
	2.1.5	I/O Address	2-6
2.2	I/O-Up	date	2-10
2.3	POU a	nd Task	2-13
2.4	Availab	le Characters for Variable Names	2-18
2.5	Variabl	es	2-20
	2.5.1	Data Memory	2-20
	2.5.2	Retentive Data Memory	2-21
	2.5.3	Marker Memory	2-22
	2.5.4	Numeric Literals	2-23
	2.5.5	Elementary Data Types	2-23
	2.5.6	User Defined Data Types	2-24
	2.5.7	Local Variable	2-25
	2.5.8	Global Variable	2-26
2.6	Configu	uration	2-27
2.7	Comm	unication Settings	2-29
2.8	Progra	mming	2-33
2.9	Login /	Logout	2-37
2.10	Boot A	pplication	2-40
2.11	Source	Download / Upload	2-41
2.12	Run / S	Stop / Reset / Initialize	2-43
2.13	Library		2-45
2.14	Versior	۱	2-48
	2.14.1	PLC Device	2-49
	2.14.2	Compiler	2-51
	2.14.3	Communication Devices	2-52
	2.14.4	Libraries	2-54
	2.14.5	Visualization profile	2-55
2.15	Installa	tion of Package files	2-56
2.16	Project	Archive	2-58

Chapter 3 Communication I/F in CPU

napte	r 3 Com	munication I/F in CPU	3-1 to 3-48
3.1	EtherC	AT Master	3-1
	3.1.1	Configuration	3-1
	3.1.2	Cycle of EtherCAT Task	3-3
	3.1.3	Programming	3-5
	3.1.4	Redundancy EtherCAT	3-6
	3.1.5	Wiring	3-7
3.2 Modbus-TCP / RTU / ASCII		s-TCP / RTU / ASCII	3-8
	3.2.1	Overview	3-8
	3.2.2	Modbus-TCP Master (Client)	3-9

	3.2.3	Modbus-TCP Slave (Server)
	3.2.4	Modbus-RTU / ASCII Master
	3.2.5	Modbus-RTU Slave
	3.2.6	Modbus Gateway 3-21
3.3	Genera	al Purpose Communication
	3.3.1	General Purpose Communication Over Ethernet
	3.3.2	General Purpose Communication Over Serial
3.4	Global	Network Variables
3.5	OPC U	JA Server
3.6	FTP	
	3.6.1	FTP Server
	3.6.2	FTP Server Configuration
	3.6.3	List of FTP Commands 3-31
	3.6.4	FTP Command Detail
	3.6.5	Exclusive Control of File Access
	3.6.6	SFTP Server Configuration
3.7	NTP C	lient Function
3.8	EtherN	et/IP Scanner
	3.8.1	Configuration
	3.8.2	EtherNet/IP task
3.9	PROFI	NET Controller
	3.9.1	Configuration
	3.9.2	Profinet task
3.10	Touch	Panel Communication

Chapte	er 4 Con	nmunication Modules	4-1 to 4-22
4.1	CPU L	ink Module	4-1
	4.1.1	Overview	4-1
	4.1.2	Configuration Link Parameter	4-1
	4.1.3	Declaration of Link Variable	4-3
	4.1.4	Status Monitor Library	4-5
4.2	FL-net	Interface Module	4-6
	4.2.1	Overview	4-6
	4.2.2	FL-net Parameter Configuration	4-7
	4.2.3	Cyclic Transfer	4-9
	4.2.4	Message Transmission	4-9
	4.2.5	Status Monitor Library	4-9
4.3	Profibu	us Master Module	4-11
	4.3.1	Overview	4-11
	4.3.2	Configuration of Link Parameter	4-11
4.4	Serial	Interface Module	4-13
	4.4.1	Supported Features	4-13
	4.4.2	Port Number Setting	4-13
	4.4.3	Modbus-RTU / ASCII Master	4-14
	4.4.4	General Purpose Communication	4-16
	4.4.5	LED Indication	4-17
	4.4.6	Hardware Reset and Software Reset	4-17
4.5	Device	Net Master Module	4-18
	4.5.1	Overview	4-18
	4.5.2	Configuration of Link Parameter	4-18
4.6	EtherC	CAT Slave Module	4-20
	4.6.1	Overview	4-20
	4.6.2	Operation Mode	4-20
	4.6.3	Configuration	4-20

Chapte	r 5 Debug Functions	5-1 to 5-14
5.1	Monitor	
5.2	Flow Control	5-6
5.3	Break Point	5-7
5.4	Single Cycle and Step Over / Into / Out	5-8
	5.4.1 Signal Cycle Execution	5-8
	5.4.2 Step Execution	5-8
5.5	Force Values and Write Values	5-9
5.6	Trace	5-11
5.7	Simulation	5-14

Chapter 6 Visualization

hapte	r 6 Visu	alization	6-1 to 6-36
6.1	Overvie	ew	6-1
6.2	Configu	Jration	6-2
	6.2.1	Creating Visualization	6-2
	6.2.2	Configuration	6-3
	6.2.3	Element Placing	6-5
6.3	Lamp		6-6
6.4	Switch.		6-7
6.5	Read V	/ariable Values	6-8
	6.5.1	Text-based Element	6-8
	6.5.2	Graphic Element	6-10
6.6	Write V	ariable Values	6-11
	6.6.1	Text-based Element	6-11
	6.6.2	Graphic Element	6-13
6.7	Assigni	ing a Color	6-14
	6.7.1	Toggle Color	6-14
	6.7.2	Color Variable	6-15
	6.7.3	Change Colors of Shapes as Switches/Buttons	6-16
6.8	Image.		6-17
	6.8.1	Image File	6-17
	6.8.2	Switching Image Files	6-19
6.9	Change	e Shown Visualization	6-20
6.10	Combo	Box	6-22
	6.10.1	Combo Box Integer	6-22
	6.10.2	Combo Box Array	6-23
6.11	Movem	ent/Rotating/Stretching of Shapes	6-24
6.12	Label		6-26
6.13	Dialog.		6-27
6.14	Histogr	am	6-29
6.15	Table		6-31
6.16	Check	Box	6-33
6.17	Radio E	Buttons	6-34
6.18	Spin Bo	ХХ	6-35
6.19	Executi	ion	6-36
	6.19.1	Visualization	6-36
	6.19.2	Web Visualization	6-36

Chapte	er 7 Utilit	ty Functions	7-1 to 7-28
7.1	Real T	ime Clock	
7.2	Data L	ogging	
7.3	Securit	ty Protection	7-5
7.4	Encryp	ted communication	
7.5	Recipe	e function	
	7.5.1	Add Recipe Manager	
	7.5.2	Add Recipe Definition	
	7.5.3	Configuration of Recipe Definition	
	7.5.4	Read and Write Recipe data	
	7.5.5	Read and Write Recipe data from a user program	

Appendix 1 Known Restrictions	A1-1 to A1-16
A1.1 Known Restrictions on HX-CPU 3.5.8.2x and HX-CODESYS V3.5 SP8 Patch4	A1-1
A1.2 Known Restrictions on HX-CPU 3.5.13.4x and HX-CODESYS V3.5 SP13 Patch2	A1-8
A1.3 Difference between HX-CPU 3.5.8.2x and HX-CPU 3.5.13.40 or newer	A1-13
A1.4 Known Restrictions on HX-CPU 3.5.16.2x and HX-CODESYS V3.5 SP16 Patch2	A1-14
A1.3 Difference between HX-CPU 3.5.8.2x and HX-CPU 3.5.13.40 or newer A1.4 Known Restrictions on HX-CPU 3.5.16.2x and HX-CODESYS V3.5 SP16 Patch2	A1-13 A1-14

Appendix 2 Open Source Software (OSS) List

A2-1 to A2-48

MEMO

Chapter 1 Introduction

1.1 Installation

1.1.1 System Requirements

HX-CODESYS	V3.5 SP8 Patch4	V3.5 SP13 Patch2	V3.5 SP16 Patch2
CPU	Pentium 1 G	Hz or higher	2.5 GHz or higher
Memory	1 GB c	or more	8 GB or more
Free disc space	3 GB or more	5 GB c	or more
Resolution		1024 x 768 (XGA) or higher	
Operating System	Windows® XP SP3 / Vista /	Windows® 7 SP1 or newer	Windows® 8 / 10 (32 / 64
	7 (32 / 64 bit) / 8 / 8.1 / 10		bit) or newer

1.1.2 Installation of HX-CODESYS

Before installation, shut down all other windows applications. If not, the installation may not be finished correctly.

1. The installation wizard starts up automatically by double click Setup file on HX-CODESYS installation DVD.



2. Follow the instructions





It takes about 30 minutes to 2 hours to finish installation depending on the specifications of PC.

Reference

Some part of components which are included in the old version of HX-CODESYS have been separated from the setup in order to reduce the file size since HX-CODESYS V3.5 SP16 Patch2. If you use a project file which was created by an older version of HX-CODESYS, please addionally install package files (*.package) which are placed in "Compatible" folder in the installation DVD. Please refer section 2.15 for the procedure to install a package file.



Note

The window to the right may appear during installation (depending on HX-CODESYS version). When this window appears, close this window by clicking the close button.

ile Process View Help			
ie <u>Flocess View H</u> elp			
License Events			
Patch Protection Only 128-4512942	Name: Patch Protection Only		
3S-Smart Software Solutions So 32767-18881	Serial: 128-4512942		
	Version: CmActLicense 1.19		
	Status: 🖎 License activated		
	License Update Remove License		

Note

Several <u>Microsoft components</u> are necessary to be installed for HX-CODESYS. If they are not installed in your PC, the installation of HX-CODESYS stops and a dialog appears.

Click [Install] at the dialog to extract from setup file.

HX-CODESYS V3.5 SP8 Patch 4 - InstallShield Wizard
HX-CODESYS V3.5 SP8 Patch 4 requires the following items to be installed on your computer. Click Install to begin installing these requirements.
Status Requirement
Installing Microsoft .NET Framework 3.5 SP1 Pending Microsoft Visual C++ 2013 Redistributable Package (x86) Pending Microsoft .NET Framework 4.0 Full
Installing Microsoft .NET Framework 3.5 SP1
Install

1.1.3 Installation of USB Driver

Follow the steps below to install the USB driver.

1. Plug USB cable to CPU module.



USB device port (Type: mini B)

USB cable is not included in the product. To prevent communication error by noise, prepare USB cable with ferrite core (A – mini B). 2. Popup window appears at right-bottom of screen. Click the popup window.



3. Click [Close] in this dialog (skip to search the driver in PC).

J Driver Software Installation	×
Device driver software was not successfully installed	
USB_HX Driver XNo driver found	
What can I do if my device did not install properly?	
	Close

4. Open [Device Manager], right-click on [USB_HX Driver] in [Other devices], and choose [Update Driver Software...].



Enter the below path and click [Browse] to install the USB driver.
 <Installation folder of HX-CODESYS>¥GatewayPLC¥Driver

•	Update Driver Software - USB_HX Driver
	Browse for driver software on your computer
	Search for driver software in this location:
	C:\Program Files\HX-CODESYS\GatewayPLC\Driver
	✓ Include subfolders
	Next Cancel

6. Click [Install].

↓ Update Driver Software - USB_HX Driver
Installing driver software
Windows Security
Would you like to install this device software? Name: libusb-win32 libusb-win32 devices Publisher: 3S-Smart Software Solutions GmbH
Always trust software from "3S-Smart Software Solutions GmbH".
You should only install driver software from publishers you trust. How can I decide which device software is safe to install?

Introduction

7. If the installation is finished successfully, the following dialog appears.



🚔 Device Manager	
<u>File Action View H</u> elp	
 Computer Display adapters Display adapters DVD/CD-ROM drives Human Interface Devices DE ATA/ATAPI controllers Keyboards Ibusb-win32 devices Ibusb-win32 devices Keyboards Nice and other pointing devices Monitors Network adapters Ports (COM & LPT) Processors Security Devices System devices Universal Serial Bus controllers 	

1.2 Startup

Launch HX-CODESYS, then the start page is displayed.

HX-CODESYS		
Ele Edit View Project Build Online	Debug Tools Window Help	
🎦 🚔 🗐 🗇 i 이 이 삶 🖻 🖹 🗙	(高橋)[治・()[田](양 영 → = 종)[[1 역	4≝ ≠≡ ∅ ♦ ₩
Devices 👻 🕂 🗙	Start Page 🗙	•
	A HX-CODESYS V3.5 SP8 Patch 4	
	Basic Operations	Latest News
	New Project	
	Open Project	The current news channel might not be valid or your Internet connection might be unavailable. To change the news channel, go to the
	Open Project from PLC	options dialog and select the Loadocsave Category.
	Recent Projects	
	Recent Projects	
	Close page after project load	
	Show page on startup	Y
		Last build: 😋 0 🕐 0 Precompile: 🗸 Current user: (nobody) 🧃

Click icon or choose [File]-[New Project...] to create a new project file. Then New Project dialog box appears. Choose [Standard project], enter new file name, specify location and click [OK].

New Proj	ect		×
<u>C</u> ategories	:	<u>T</u> emplates:	
Pro	raries ojects	Empty project	Standard project with Applicatio
A project co <u>N</u> ame:	untaining one device, one ap	plication, and an empty implementation for l	PLC_PRG
Location:	C:¥Users¥10149111.GLO	AL¥Documents	▼
		ОК	Cancel

Choose CPU type and programming language and click [OK].

Available languages are as follows.

- Continuous Function Chart (CFC)
- Function Block Diagram (FBD)
- Instruction List (IL)
- Ladder Logic Diagram (LD)
- Sequential Function Chart (SFC)
- Structured Text (ST)

Standard F	Project		3
	You are abou objects within - One program - A program F - A cyclic task	t to create a new standard project. This wizard will create the following n this project: mmable device as specified below PLC_PRG in the language specified below which calls PLC_PRG	
	- A reference	to the newest version of the Standard library currently installed.	
	Device:	HX-CP 1H 16 (Hitachi Industrial Equipment Systems Co., Ltd.)	
	PLC_PRG in:	Structured Text (ST)	-]
		OK Cancel	

Initial layout of the project is shown like this.

Oldbear.project * NA-CODES13	
Ele Edit View Broject Build Online Debug Tools Window Help	
图❷❸圆●○◇ǎ№ ◎ X ●\$\$ 10 / ★ \$ \$ 10 ● 10	
	-
1 PROGRAM PLC_PRG	33
2 VAR	
s all PLC topic	
Q Application	
Mutrary Manager	
🖻 🎯 Task Configuration	
S MainTask	
⊨-∭ Basic (Basic)	
- K < <u>Empty>(<empty>)</empty></u>	
- C <empty> (<empty>)</empty></empty>	
- ζ < <u>Empty</u> > (< <u>Empty</u> >)	
- C < <u>Empty>(<empty>)</empty></u>	
- ¢ <empty> (<empty>)</empty></empty>	
- Ϛ <empty> (<empty>)</empty></empty>	
- c <empty>(cempty>) Fditor</empty>	
K <empty>(<empty>)</empty></empty>	
- C <empty>(<empty>)</empty></empty>	
└ ば <empty>(<empty>)</empty></empty>	
	,
Messages - total U error(s), U warning(s), U message(s)	• 4 X
Coerror(s)	
Description Project Object Position	
Messages	
Wicesages	
Devices Devices DPUUs	
Last build O 0 0 0 Precompile: Current user: (nabady) INS In 1 Col 1	Ch 1

[Devices] and [Massages] window may not be shown at the first startup. They can be viewed with the menu [View]. If [Devices] (device tree) is behind the [POUs] tab, click [Devices] tab to show it. Double-click on POU (PLC_PRG) to open [Editor] and [Variable declaration].

Chapter 2 Programming

2.1 Plug Device (I/O Configuration)

2.1.1 Plug Device (I/O Configuration)

Right click on < Empty> slot and choose [Plug Device ...].



Choose I/O module for each slot. The next slot can be configured by clicking next empty slot without closing the Plug Device window every time.

Device: Vendor:	<all vendors=""></all>			•
Name		Vendor	Version	<u>^</u>
🖃 👔 🖪	liscellaneous			=
	16 Digital Input	Hitachi-IES	3.4.0.0	
-6	16 Digital Output	Hitachi-IES	3.4.0.0	
	32 Digital I/O	Hitachi-IES	3.5.8.20	
-6	32 Digital Input	Hitachi-IES	3.4.0.0	
	32 Digital Output	Hitachi-IES	3.4.0.0	~
🔽 Group	by category			
📃 Displa	y all versions (for expert	ts only)		
🔲 Displa	y outdated versions			
Informatio	n:			
🚹 Na Ve	ime: 8 Analog Output endor: Hitachi-IES		*	

Module name can be renamed at [Properties] in right mouse click menu.

- 16_Digital_Output (16 Digital Output)
- 😫 👘 Any_Name (16 Digital Output)

Configure I/O modules according to the list below.

8 8		
Model names	Device Names	Slot position
EH-XD8, EH-XD16, EH-XDL16,	16 Digital input	No restriction
EH-XDS16, EH-XDA16		
EH-XA16, EH-XAH16		
EH-XD32, EH-XDL32, EH-XD32E,	32 Digital input	
EH-XDL32E, EH-XD32H, EH-XD32S,		
EH-XDB32, EH-XDBL32		
EH-XD64, EH-XDL64, EH-XDB64,	64 Digital input	
EH-XDBL64		
EH-YR8B, EH-YR12, EH-YR16,	16 Digital output	
EH-YR16D		
EH-YT8, EH-YT16, EH-YTA16		
EH-YTP8, EH-YTP16, EH-YTPA16,		
EH-YTP16S		
EH-YS16		
ЕН-ҮТ32, ЕН-ҮТ32Е, ЕН-ҮТ32Н	32 Digital output	
EH-YTP32, EH-YTP32E		
EH-YT64	64 Digital output	
EH-YTP64		
EH-PT4	4 Analog input	
EH-AX44, EH-AX8V, EH-AX8H,	8 Analog input	
EH-AX8I, EH-AX8IO		
EH-AXH8M		
EH-AXG5M *1		
EH-TC8		
EH-RTD8		
EH-AY22, EH-AY2H, EH-AY4V,	8 Analog output	
EH-AY4H, EH-AY4I *2		
EH-AYH8M		
EH-AYG4M *2		
EH-CU, EH-CUE	EH-CU/E	
EH-POS *4	EH-POS/4	
EH-SIO	EH-SIO	
EH-LNK, EH-OLNK, EH-OLNKE,	EH-LNK	Only 0 to 7 slot on basic base unit *3
EH-OLNKG		
EH-RMP2	EH-LNK	
EH-RMD2	EH-LNK	
EH-FLN2, FLN3	EH-FLN2/3	
HX-ECTS	EH-LNK / HX-ECTS	
HXC-SCP	HXC-SCP	

*1 Set [8 Analog input] although this is 5-channel module.

*2 Set [8 Analog output] although this is 2 or 4-channel module.

*3 If the module is mounted on another slot than slot 0 to 7 on basic base unit, the following error message appears in CPU log.

- EH-LNK is mounted on slot *. Allowed position for EH-LNK is slot 0 to 7.
- EH-FLN2/3 is mounted on slot *. Allowed position for EH-FLN2/3 is slot 0 to 7.
- HX-ECTS is mounted on slot *. Allowed position for HX-ECTS is slot 0 to 7.
- HXC-SCP is mounted on slot *. Allowed position for HXC-SCP is slot 0 to 7.

*4 It is a discontinued product.

2.1.2 Scan for Devices

Instead of plugging I/O modules one by one, actual I/O module information can be read out from connected CPU. Right click on basic or expansion base and choose [Scan For Devices...]. Then [Scan Devices] dialog appears. Click [Copy All Devices to Project]. This function works for chosen base unit only. If you have several expansion base units, repeat [Scan For Device] for each base unit.

Devices	→ ∓ X				
= 👌 Program	-				
Device (HX-CP1H	16)				
É El DI Ciloria					
E PLC LOGIC					
= 😲 Applica	tion				
— 🎁 Libra	ry Manager	Scan Devices			
- 📄 PLC	PRG (PRG)				
E 💹 Task	Configuration	Scanned Devices			
	MaiaTask	Devicename	Devicetype		
	nali nask	16_Digital_Input	16 Digital Input		
·	a PLC_PRG	16_Digital_Output	16 Digital Output		
🖹 🔟 Basic (B 💡	Cut	EH_LNK	EH-LNK (3.5.820) 🗸		
K <er do<="" td=""><td>Cut</td><td>EH_LNK</td><td>EH-LNK (3.5.8.20) 🗸</td><td></td><td></td></er>	Cut	EH_LNK	EH-LNK (3.5.8.20) 🗸		
P	Сору	<empty></empty>	<empty></empty>		
	Death	<empty></empty>	<empty></empty>		
in ser u≞	Paste	<empty></empty>	<empty></empty>		
K <er td="" x<=""><td>Delete</td><td> <empty></empty></td><td>(Empty)</td><td></td><td></td></er>	Delete	<empty></empty>	(Empty)		
K <er an<="" td=""><td>27 17</td><td>- (Empty)</td><td><empty></empty></td><td></td><td></td></er>	27 17	- (Empty)	<empty></empty>		
L CE	Properties		<empty></empty>		
14.00	Add Object				
	Had object				
🗖 'I3> 🔎	Add Folder				
s <er< td=""><td>Scan For Devices</td><td></td><td></td><td></td><td>D.11</td></er<>	Scan For Devices				D.11
	Disable Device			Sho	
· ·	Update Device	Scan Device		Copy All Devices to Project	*

Note

- This function is available only when logout (offline). But it is necessary to login once. If you have never logged in to the target CPU, this function will not work properly.
- If there are multiple versions of the same device, the version set as the initial value differs according to the HX-CODESYS version.

V3.5 SP8 Patch4: The latest

Scan Devices						
	Scanned Devices					
	Devicename	Devicetype				
	er EH_LNK	EH-LNK (3.5.8.21) 🔽				
	- EH_SIO	EH-SIO (3.5.8.22) 🗸				
	· · · ·					

V3.5 SP13 Patch2: The oldest

So	an Devices							
	Scanned Devices							
	Devicename	Devicetype						
	er EH_LNK	EH-LNK (3.4.4.0)]					
	EH_SIO	EH-SIO (3.4.1.0)						

2.1.3 Expansion Unit

Instead of [Plug Device], choose [Add Device] to configure expansion units.

Devices	- ₽ X
Untitled74	
Device (HX-CP1H16)	
PLC Logic	Cut
🖃 🚫 Applicatic	Сору
👘 Library	Paste
	Delete
🖹 🎆 Task Ci 🔚	Properties
🖻 🕸 Ma 🏪	Add Object
🗎 🗎	Add Folder
🗏 👔 Basic (Basic)	Add Device
K <empty> (</empty>	Update Device

Select [Expansion] under Miscellaneous. HX-CPU allows to expand up to 5 expansion bases.

Set station number with ascending order from 1 to the nearest EH-IOCH2 to CPU.

Action Action	Exp opend e: or:	device 🕥 In <all vendors=""></all>	isert device 🏾 🖉) <u>P</u> lug device	⊘ <u>U</u> pda	te device	
Nar	ne		Vendor	Version			
B (Mi	iscellaneous					
		Expansion	Hitachi-IES	3.4.4.0			
±[
 ₩ G D D 	roupl	by category v all versions (f v outdated vers	or experts only))			
G D D Inform	roup l isplay isplay mation	by category r all versions (f r outdated vers	or experts only) sions)			
G G D D Inform	isplay mation Nar Ver	by category v all versions (f r outdated vers ne: ne: Expansion ndor: Hitachi-IE	ior experts only) sions		* *		

2.1.4 Update Devices

Although device (CPU) type is required to set when creating new project, it can be changed later. Right mouse click on the device and choose [Update Device]. Then [Update Device] windows appears.



Select CPU type, and click [Update Device].

Name: Device Action: O Append device O Insert device	e 🕐 Plug device 🔘 Update device							
Device:								
Vendor: <a>All vendors>	•							
Name	Vendor							
EHV-CPU1025	Hitachi-IES							
	Hitachi-IES							
	Hitachi Industrial Equipment Systems (
HX-CP1508	Hitachi Industrial Equipment Systems (
🔟 MV-x40	Hitachi-IES 💂							
· · · · · · · · · · · · · · · · · · ·	4							
Group by category Display all versions (for experts Display outdated versions	only)							
Information:								
Name: HX-CP 1H16 Vendor: Hitachi Industrial Eq	uipment Systems							
Update and try to preserve most information of Device (You can select another target node in the navigator while this window is open.)								
	Update Device Close							

Reference

The latest version is displayed in the device update window by default. Please enable "Display all versions (for experts only)" in order to be able to select a device other than the latest version.

2.1.5 I/O Address

Double click on plugged I/O module or right click and choose [Edit Object].



I/O-Bus Mapping window appears as below. Input variable name at the mapping table. These variables are used in the programming.

Digital Input 16 I/O Mapping	Channels						
	Variable	Mapping	Channel	Address	Туре	Unit	Description
Information				%IW0	WORD		
Status	- *•		Bit0	%IX0.0	BOOL		
	🍫		Bit1	%IX0.1	BOOL		
	🍫		Bit2	%IX0.2	BOOL		
			Bit3	%IX0.3	BOOL		
	🍫		Bit4	%IX0.4	BOOL		
	···· *>		Bit5	%IX0.5	BOOL		
	ᡟ		Bit6	%IX0.6	BOOL		
	ᡟ		Bit7	%IX0.7	BOOL		
	🍫		Bit8	%IX1.0	BOOL		
	🍫		Bit9	%IX1.1	BOOL		
	ᡟ		Bit10	%IX1.2	BOOL		
	🍫		Bit11	%IX1.3	BOOL		
	🍫		Bit12	%IX1.4	BOOL		
	🍫		Bit13	%IX1.5	BOOL		
	···· *>		Bit14	%IX1.6	BOOL		
	¥ø	J	Bit15	%IX1.7	BOOL		

Note

Available characters for variable names are only alphabet a to z, A to Z and number 0 to 9 and _ (underscore). The first character must not be numeric characters. Several words like BOOL, WORD, IF, FOR etc. are reserved.

Input any variable names in the field [Variable] according to your system.

🏷 Test_input_0	*	Bit0	%IX0.0	BOOL
👋 Test_input_1	**	Bit1	%IX0.1	BOOL
¥ə I 🛛		Bit2	%IX0.2	BOOL

1	16 Digital Input	~	
	_16_Digical_Input	×	

Digital Input 16 I/O Mapping	Channels							
	Variable	Mapping	Channel	Address	Туре	Unit	Description	
Information				%IW0	WORD			
Status	* Test_input_0	**	Bit0	%IX0.0	BOOL			
	🏷 Test_input_1	**	Bit1	%IX0.1	BOOL			
	ᡟ Test_input_2	**	Bit2	%IX0.2	BOOL			
	ᡟ Test_input_3	**	Bit3	%IX0.3	BOOL			
	🏷 Test_input_4	**	Bit4	%IX0.4	BOOL			
	ᡟ Test_input_5	**	Bit5	%IX0.5	BOOL			
	ᡟ Test_input_6	**	Bit6	%IX0.6	BOOL			
	🏷 Test_input_7	**	Bit7	%IX0.7	BOOL			
	ᡟ Test_input_8	**	Bit8	%IX1.0	BOOL			
	🏷 Test_input_9	*	Bit9	%IX1.1	BOOL			
	🏷 Test_input_10	**	Bit10	%IX1.2	BOOL			
	🏷 Test_input_11	**	Bit11	%IX1.3	BOOL			
	ᡟ Test_input_12	**	Bit12	%IX1.4	BOOL			
	🏷 Test_input_13	**	Bit13	%IX1.5	BOOL			
	🏷 Test_input_14	*	Bit14	%IX1.6	BOOL			
	- 🐄 Test_input_15	×.	Bit15	%IX1.7	BOOL			

If [List components immediately when typing] in the menu [Tools]-[Options]-[Smart coding] is enabled, defined variable names will be automatically listed up when it is used in all POU with assist of auto-complete.



If a variable is already used (declared) in POU or global variable list, it can be taken by clicking icon in I/O mapping window. (.... icon appears by clicking empty field.)

 Ŷ	Application.GVL.EMG_STOP	~	BitO
 ø	Application.PLC_PRG.test_out	? ø	Bit1

I/O address	ex	ample of 64 p	oints output mo	odule

Bit number	BOOL	BYTE	WORD	DWORD	LWORD	
Bit 0	%QX0.0	%QB0	%QW0	%QD0	%QL0	LSB
Bit 1	%QX0.1					
Bit 2	%QX0.2					ΙT
Bit 3	%QX0.3					
Bit 4	%QX0.4					
Bit 5	%QX0.5					
Bit 6	%QX0.6					
Bit 7	%QX0.7					
Bit 8	%QX1.0	%QB1				
Bit 9	%QX1.1					
Bit 10	%QX1.2					
Bit 11	%QX1.3					
Bit 12	%QX1.4					
Bit 13	%QX1.5					
Bit 14	%QX1.6					
Bit 15	%QX1.7					
Bit 16	%QX2.0	%QB2	%QW1			
Bit 17	%QX2.1					
Bit 18	%QX2.2					
Bit 19	%QX2.3					
Bit 20	%QX2.4					
Bit 21	%QX2.5					
Bit 22	%QX2.6					
Bit 23	%QX2.7					
Bit 24	%QX3.0	%QB3				
Bit 25	%QX3.1					
Bit 26	%QX3.2					
Bit 27	%QX3.3					
Bit 28	%QX3.4					
Bit 29	%QX3.5					
Bit 30	%QX3.6					
Bit 31	%QX3.7					
Bit 32	%QX4.0	%QB4	%QW2	%QD1		
Bit 39	%QX4.7					
Bit 40	%QX5.0	%QB5				
Bit 47	%QX5.7					
Bit 48	%QX6.0	%QB6	%QW3			
Bit 55	%QX6.7					
Bit 56	%QX7.0	%QB7				↓
						MSB
Bit 63	%QX7.7]				

The following 5 different codes access the same bit.

%QX0.0:=1; %QB0 :=1;

%QW0 :=1;

- %QD0 :=1;
- %QL0 :=1;

Note

If application program of EHV+ series is reused in HX-series and direct IEC addresses are used, although it is unusual, be noted that I/O addresses are byte-swapped. If variables are defined in I/O mapping tables, then it is no problem.

The deference of I/O address of 64 points output module between EHV+ series and HX series.

	EHV+ ser	ies IEC add	ress		HX series IEC address					
Bit	BOOL	BYTE	WORD	DWORD	LWORD	BOOL	BYTE	WORD	DWORD	LWORD
Bit 0	%QX7.0	%QB7	%QW3	%QD1	%QL0	%QX0.0	%QB0	%QW0	%QD0	%QL0
Bit 1	%QX7.1					%QX0.1				
Bit 2	%QX7.2					%QX0.2				
Bit 3	%QX7.3					%QX0.3				
Bit 4	%QX7.4					%QX0.4				
Bit 5	%QX7.5					%QX0.5				
Bit 6	%QX7.6					%QX0.6				
Bit 7	%QX7.7					%QX0.7				
Bit 8	%QX6.0	%QB6				%QX1.0	%QB1			
Bit 9	%QX6.1					%QX1.1				
Bit 10	%QX6.2					%QX1.2				
Bit 11	%QX6.3					%QX1.3				
Bit 12	%QX6.4					%QX1.4				
Bit 13	%QX6.5					%QX1.5				
Bit 14	%QX6.6					%QX1.6				
Bit 15	%QX6.7					%QX1.7				
Bit 16	%QX5.0	%QB5	%QW2			%QX2.0	%QB2	%QW1		
Bit 17	%QX5.1					%QX2.1				
Bit 18	%QX5.2					%QX2.2				
Bit 19	%QX5.3					%QX2.3				
Bit 20	%QX5.4					%QX2.4				
Bit 21	%QX5.5					%QX2.5				
Bit 22	%QX5.6					%QX2.6				
Bit 23	%QX5.7					%QX2.7				
Bit 24	%QX4.0	%QB4				%QX3.0	%QB3			
Bit 25	%QX4.1					%QX3.1				
Bit 26	%QX4.2					%QX3.2				
Bit 27	%QX4.3					%QX3.3				
Bit 28	%QX4.4					%QX3.4				
Bit 29	%QX4.5					%QX3.5				
Bit 30	%QX4.6					%QX3.6				
Bit 31	%QX4.7					%QX3.7				
Bit 32	%QX3.0	%QB3	%QW1	%QD0		%QX4.0	%QB4	%QW2	%QD1	
Bit 39	%QX3.7					%QX4.7				
Bit 40	%QX2.0	%QB2				%QX5.0	%QB5			
Bit 47	%QX2.7					%QX5.7				
Bit 48	%QX1.0	%QB1	%QW0			%QX6.0	%QB6	%QW3		
Bit 55	%QX1.7					%QX6.7]			
Bit 56	%QX0.0	%QB0]			%QX7.0	%QB7			
]			
Bit 63	%QX0.7					%QX7.7]			

2.2 I/O-Update

Input data is read at the beginning of a task and output data is written at the end of a task. I/O-update settings are configured in [PLC settings] in Device tab. Be noted that only used I/Os in program are updated, unused I/Os are not updated.

Device 🗙	
Communication Settings	Application for I/O handling: Application
Applications	PLC settings
Backup and Restore	Behaviour for outputs in Stop: Set all outputs to default
Files	Always update variables: Disabled (update only if used in a task)
Log	Edit Licenses
PLC settings	Bus cycle options Bus cycle task: www.eyendified
PLC shell	Additional settings
Users and Groups	Generate force variables for IO mapping Enable Diagnosis for devices Cham I/O mapping as accord
PLC Parameters	

Update IO while in STOP

If this option is enabled, the values of the input and output channels get updated also while the PLC program stops.

Behaviour for outputs in STOP

There are 3 options for this setting. If [Reset all outputs in STOP] setting is [Yes], that setting has priority. The specifications of this setting differ depending on the version, so refer to the notes below and the notes on the next page.

Keep current values: The current values are held. If [Update IO while is stop] is disabled, output data is not updated while PLC program stops.

Set all outputs to default: Refer to the next page for further information.

In the case of SP8, the default values resulting from the mapping will be assigned. If this setting is used, [Reset all outputs in STOP] of [Device]-[PLC Parameters] parameter must be set as [No], otherwise default value of TRUE is not valid.

In the case of SP13, if the initial value is set by user program without declaring the variable in the I/O mapping table, the initial value is used as the default value.

In the case of SP16, it is almost the same as SP13, but there are different points which are described in the notes on the next page.

Execute program: You might determine the outputs behavior by a program available within the project. Enter the name of this program here and it will be executed when the PLC gets stopped. Via button [...] the Input Assistant can be used for this purpose.

Always update variables:

If this option is activated, then for all devices of the current PLC configuration all I/O variables will get updated in each cycle of the bus cycle task. This corresponds to option [Always update variables], which can be set separately for each device in the [I/O Mapping] dialog.

The I/O update behavior when PLC program stops can be configured in [PLC Parameters] tab of [Device] editor.

Device X					
Communication Settings	Parameter	Туре	Value	Default Value	
Applications					
Backup and Restore	In International Internationa				
Files	Stop switch definition	Enumeration of BYTE	Reset warm	Reset warm	
	Reset all outputs in STOP	Enumeration of BYTE	Yes	Yes	
Log	Battery error detection	Enumeration of BYTE	Enable	Enable	
	 I/O config error detection 	Enumeration of BYTE	Enable	Enable	
PLC Settings	Program up/download by USB memory	Enumeration of BYTE	Disable	Disable	
PLC Shell					
Users and Groups					
Access Rights					
Symbol Rights					
PLC Parameters					

Stop switch definition

This parameter specifies the behavior when RUN switch is set to STOP position is specified.

Reset all outputs in STOP

This parameter specifies whether outputs for each module are reset when PLC program stops is specified. If [Reset all outputs in STOP] is [Yes] (default), all the PLC outputs including counter outputs and pulse train output of positioning module are reset because it is reset by a certain hardware signal running on the back plane bus. If default value in configured as TRUE in I/O mapping table, it is momentary reset (FALSE) at run or stop timing. If default values should be kept, set [Reset all outputs in STOP] as [No]. In this case, you must be aware the following limitation.

Note

• The actual outputs are kept even though the monitored values on HX-CODESYS are cleared, if the following configurations are selected and Reset warm or Reset cold is operated.

(1) SP8

- (a) [Update IO while in STOP] setting in [PLC Setting] window is disabled.
- (b) [Reset all outputs in STOP] setting in [PLC Parameters] window is set to No.
- (c) The assignment setting of output modules is [Map to existing variable].

(2) SP13

- (a) [Update IO while in STOP] setting in [PLC Setting] window is disabled.
- (b) [Reset all outputs in STOP] setting in [PLC Parameters] window is set to No.
- (c) [Behaviour for output in STOP] setting in [PLC Setting] window is [Keep current values] or [Execute program]. In the case of [Execute program], an additional condition (1)(c) is needed.

(3) SP16

- (a) [Update IO while in STOP] setting in [PLC Setting] window is disabled.
- (b) [Reset all outputs in STOP] setting in [PLC Parameters] window is set to No.

PLC settings	
Update IO while in stop	Actual output remains
Behaviour for outputs in Stop: Keep current values 🔹	after Reset warm / cold
test	0 1 2 3 output_0 5 6 7 8 9 10 11 12 13 14 15
	DC OUTPUT EH-YTP16

This is expected behavior. If this setting combination is required, keep in mind this mismatching and be careful to use.

Note

- If [Reset all outputs in STOP] is [Yes] (default), default value of [TRUE] in I/O mapping table is momentary reset (FALSE) at run or stop timing.
- I/O that is not used in program does not refresh. Therefore, you are not seen in TRUE when you monitored a
 mapping table in online even if the outside input that you don't use set to ON. When you want to monitor unused
 I/O, please set [Enabled1] or [Enabled2] to [Always updates variables] of the mapping table of the lower right. I/O
 is refreshed regardless of use / unused.



We recommend you to set [Yes] to [Reset all outputs in STOP] parameter when using counter or positioning modules. If [No] is set, PLC outputs without IEC address, such as counter outputs or pulse train outputs, are NOT reset when CPU stops. Also, counter module continues counting regardless of the setting of the count operation during STOP of the module.

Communication Settings	Parameter	Туре	Value	Default Value	
Applications					
Backup and Restore					
	🖤 🖗 Stop switch definition	Enumeration of BYTE	Reset warm	Reset warm	
Files	Reset all outputs in STOP	Enumeration of BYTE	Yes	Yes	
Log	Battery error detection	Enumeration of BYTE	Enable	Enable	
	I/O config error detection	Enumeration of BYTE	Enable	Enable	
PLC settings	Program up/download by USB memory	Enumeration of BYTE	Disable	Disable	
PLC shell					
Users and Groups					
PLC Parameters					

• If the settings of the counter module and CPU are conditions to continue counting while STOP, counting continues inside the counter module. Therefore, when Update IO while in STOP is disabled, the count value after restarting the operation will start from the integrated value when the CPU was stopped.

2.3 POU and Task

One application has at least one POU and one task as shown below.



POU

POU stands for Program Organization Unit and smallest unit of program. Only one programming language can be used in one POU. If you need another language, add POU by right click on [Application] and choose [Add object]-[POU] and choose language.



There are three kinds in POU, and each POU are different in how to use.

	Called by task	How to call	I/O limitation	Store data
Program (PRG)	Yes	Direct name	None	Yes
Function Block (FB)	No	Instance (copy)	None	Yes
Function (FUN)	No	Direct name	1 output only	No

Task

POU does not have information how it is executed. This information is handled by task.

Put priority, choose type of task and add or remove POU accordingly. Instead of clicking [Add Call], POU can be dragged into a task. After a project compiled, the color of POU will be changed. If POU is called by a task, it will be blue. If the POU is not called, the color will be gray.

	MainTask 🗙	
Device (HX-CP 1H16) PLC Logic Application Library Manager PLC_PRG (PRG) ← Called POU POU (PRG) ← Not called Task Configuration MainTask PLC_PRG	MainTask X Configuration Priority (031): 1 Type Cyclic Interval (e.g. t#200ms): Watchdog Cyclic Interval (e.g. t#200ms): Watchdog Enable Time (e.g. t#200ms): t Add POU Sensitivity: 1 Add POU Sensitivity: 1 Change Call	Remove POU
	Add Call X Remove Call Change Call	
	POU Comment	
	PLC_PRG	

POUs registered in a task are executed in the order from top to bottom of the task tree.

🖮 🍪 MainTask	In the case that 4 POUs are registered in MainT	ask as shown in the left figure, when MainTask is
	started in the CPU, the order of the execution is '	'POU5" → "POU1" → "POU3" → "POU4".
- 🕘 POU1	The execution order of POUs can be changed	l by clicking the "Move up" and "Move down"
POU3	buttons in the task configuration editor.	
	🕂 Add Call 🗙 Remove Call 📝 Change Call	Move Up ♦ Move Down
	POU	Comment

Note

The task type and priority can be set for each task. This makes it possible to realize complicated control by using multiple tasks, but it is necessary to design the system so that one task does not affect other tasks. Please refer to the "Notes on task design" below to design the system before creating the program, and perform thorough verification before starting operation.

Priority (0..31)

0 is the highest priority, 31 is the lowest.

Note

- Please set IEC task priority in the range of 0 to 16. Although the priority can be selected from 0 to 31, 16 to 31 are handled as the same priority inside the CPU.
- The system interruption of the CPU is executed with the priority equivalent to IEC task priority "4". Communication (including field networks such as Modbus) data reception process may affect the user program. Ethernet or serial communication data reception from an external device may delay due to a certain time task execution with a priority higher than 4.

Reference

IEC task priority setting	Priority type	Corresponding priority setting of OS
0	Highest real time priority	SCHED FIFO 54
1	Higher real time priority	SCHED FIFO 53
2		SCHED FIFO 52
3		SCHED FIFO 51
4	Real time priority	SCHED FIFO 50
5	Lower real time priority	SCHED FIFO 49
6		SCHED FIFO 48
7		SCHED FIFO 47
8		SCHED FIFO 46
9		SCHED FIFO 45
10		SCHED FIFO 44
11		SCHED FIFO 43
12		SCHED FIFO 42
13		SCHED FIFO 41
14		SCHED FIFO 40
15	Lowest real time priority	SCHED FIFO 39
16 - 31	Non-real time priority	SCHED OTHER 20

The relation of IEC task priority and the corresponding priority of OS

Туре

Choose type of the task. Inputs are read at the beginning of each task, and outputs are written at the end of the program execution.

Cyclic task

The task will be processed cyclic according to the time definition given in the field [Interval]. If actual execution time exceeds the cycle time, the next cycle does not start immediately but wait until the next fixed cycle time. For example, cycle time is set as 10 ms and 5th scan starting from 40 ms takes 12 ms, then 6th cycle starts at 60 ms as shown in the figure below.



Event task

The task will be started as soon as the variable defined in the field gets a rising edge.

Freewheeling task

The task will be processed as soon as the program is started and at the end of one run will automatically restarted in a continuous loop. There is no cycle time defined. Be noted that the priority of this task is the lowest and 3 ms of sleeping time is added at the end of each cycle for other tasks to be executed properly.

Status task

The task will be started when selected variable is TRUE.

Watchdog

When it is enabled, watchdog function is activated. If program execution time exceeds watchdog time, CPU stops program execution with [24] error code displayed at 7 segment LED.

There are two different conditions to detect watchdog error as follows.

Example: Time: #5 ms, Sensitivity: 3.

- Detect condition 1: one cycle exceeds 15 ms
- Detect condition 2: scan cycle exceeds 5 ms in 3 times consecutive

Actual cycle time of each task is monitored in Task configuration as below.

MainTask MainTask Task Configuration 🗙 🛱 EH_FLN2_3											
Properties System Events Monitor											
Task	Status	IEC-Cycle Count	Cycle Count	Last Cycle Time (µs)	Average Cycle Time (µs)	Max. Cycle Time (µs)	Min. Cycle Time (µs)	Jitter (µs)	Min. Jitter (µs)	Max. Jitter (µs)	
(E) MainTask	Valid	982	1414	13680	4285	21470	39	10000	-109	20026	

Notes on task design

Please design the time schedule when creating a program which consists of multiple tasks with different priorities. The program execution is performed in accordance with the task priority setting. For example, when the task type is set to Cyclic, if the execution cycle is the same, the task with the higher priority is executed prior. As a result, jitter may occur in the execution cycle of the task with the lower priority.


If a high-priority task is activated during execution of a low-priority task, processing of the low-priority task is interrupted and processing of the high-priority task is started.



If a high-priority task is executed for certain time, it may not be possible to secure the time for a low-priority task to operate. Note that CPU can detect a watchdog timer error and stop executing the program, if the watchdog function of a task with a low priority is enabled.

2.4 Available Characters for Variable Names

Variable name / POU name

Available characters for variable and POU names are alphabets (a to z, A to Z), numbers (0 to 9) and $_$ (underscore) only. The first character must not be a numeric character. Several words like BOOL, WORD, IF, FOR etc. are reserved.

Supported characters

Types	Supported	Remarks
Numerical	0 to 9	Not allowed to begin with numeric characters.
Alphabetical	a to z, A to Z	There is no difference of the small and capital letter.
Symbol	_	Trailing underscores are not allowed.

Examples for variable names

Allowed or not	Examples	Descriptions	
Allowed	Test_200	-	
	TEST	-	
	Test55	-	
	_Test	-	
Not allowed	2test	Starting with numeric character.	
	test_200	Trailing underscores are not allowed.	
	test-5	Minus sign is not allowed.	
	test#3	Other signs than underscore are not allowed.	
	test 3	Space is not allowed.	
	IF	Reserved word.	

If you use unicode characters, click [Project] - [Project setting], and check [Allow unicode characters for identifiers] in [Compile options].

Project Settings				—
Compile options	Compile op	otions		
Compiler warnings	- Compiler Version			
🞒 Page Setup	Eix Version:	3 5 8 40	_	
👸 Security	The version.	5.5.0.40	•	
E SFC				
Source Download	Settings			
§ Static Analysis Light	Allow unicod	de characters for identifiers		
😫 Users and Groups	Replace constants			
Uisualization	📝 Enable logg	ing in breakpoints		

Example: Japanese



Note

If Unicode characters are used improperly, warning message is displayed as follows.



Variables using multibyte characters (Japanese, Chinese, umlaut in German, etc.) cannot be used for HMI or OPC communication.

2.5 Variables

2.5.1 Data Memory

In HX-CODESYS programming, external I/O and data memory (internal registers) are handled as variable names instead of direct I/O addresses, such like [A1_switch]. If a new variable name is used, [Auto Declare] window appears. Enter an each field according to the following table. [Auto Declare] window appears if [Declare unknown variables automatically (AutoDeclare)] setting of SmartCording option in [Tools] – [Options...] menu is enabled.

	• • • •	
Auto Declare		— ———————————————————————————————————
<u>S</u> cope: VAR ▼ Object: PLC_PRG [Application] ▼	Name: A1_switch Initialization:	<u>Type:</u> INT ▼ ≥ Address:
Elags: <u>C</u> ONSTANT <u>R</u> ETAIN <u>P</u> ERSISTENT	Co <u>m</u> ment:	*
		OK Cancel

Item		Descriptions	
Scope	Scope Choose [VAR] in normal use. If global variable is used, choose [VAR_GLOBA		
		to section 2.5.8 for further information.	
Name		Variable name is defined. (available characters are described in section 2.4.)	
Туре		Data type is defined. Refer to section 2.5.5.	
Object		In case of local variable, POU name is defined.	
Initialization Initial value when program starting can be set here. If it's blank, initialization va		Initial value when program starting can be set here. If it's blank, initialization value is 0.	
Address No need to enter I/O address. EHV-CODESYS will assign to free address autor		No need to enter I/O address. EHV-CODESYS will assign to free address automatically.	
Comme	ent	Any text comment can be input.	
Flags	CONSTANT	Enter a value in the Initialization field.	
RETAIN The value is retained in nonvolatile RAM. It is not initialized by reset warm.		The value is retained in nonvolatile RAM. It is not initialized by reset warm.	
But it is initialized by reset cold or program downloading. (R		But it is initialized by reset cold or program downloading. (Refer to the section 2.12)	
	PERSISTENT The value is retained in nonvolatile RAM. It is not initialized by reset warm		
		and program downloading. (Refer to the section 2.12)	

Bit access

Any bit data in integer type data can be accessed by adding suffix dot and number (decimal 0 to 63).





2.5.2 Retentive Data Memory [RETAIN]

Activate [RETAIN] to set retain variable. The value is retained while power failure.

Auto Declare		×
<u>S</u> cope: VAR ▼	<u>N</u> ame: A1_switch	Type: INT V
Object: PLC_PRG [Application] ▼	Initialization:	<u>A</u> ddress:
Elags: <u>CONSTANT</u> <u>RETAIN</u> <u>PERSISTENT</u>	Co <u>m</u> ment:	۵ ۲
		OK Cancel

[PERSISTENT]

Add [Persistent Variables] by right mouse click menu on [Application]-[Add Object]-[Persistent Variables].

Device (HX-CP1H16)			
PLC Logic			
B 🔘 Application	1		
Cut			
Сору		Auto Doclaro	
Paste		Auto Deciare	
B B Delete		Scope: Name:	<u>Type:</u>
Refactoring +		VAR GLOBAL Count 100	INT
Basic (Basic)			
-K <empty> 🔚 Add Object 🕨</empty>	Alarm configuration	Object: <u>I</u> nitialization:	<u>A</u> ddress:
K <empty> Add Folder</empty>	Application	PersistentVars [Application] 🔻	
H EH_FLN2	A Data Canada		
K <empty:< td=""><td>Data Server</td><td>Flags: Comment:</td><td></td></empty:<>	Data Server	Flags: Comment:	
Edit Object With	CUT	CONSTANT	A
Login	External File	RETAIN	
(Company)	Global Variable List	PERSISTENT	· •
<pre><empty> (<empty>)</empty></empty></pre>	Image Pool		
<pre>4, <empty> (<empty>)</empty></empty></pre>	Interface		
<pre><cmpty> (<empty>)</empty></cmpty></pre>			
<pre>K <empty> (<empty>)</empty></empty></pre>	Network Variable List (Receiver)		OK Cancel
<pre> <empty> (<empty>)</empty></empty></pre>	Network Variable List (Sender)		
	T Persistent Variables		
	• POU		
	POU for implicit checks		
	Recipe Manager		

Activate [RETAIN] and [PERSISTENT] both and choose [VAR_GLOBAL] at [Scope] and [PersistentVars] at [Object] to set persistent variable. The value is retained while power failure. Unlike [RETAIN], it is not initialized even when reset cold or program downloading.

When it is used in POU, add prefix "PersistentVars." to variable names.

PersistentVars.Count_100;

Note

The access speed of retention / persistent memory is about 10 to 20 times slower than that of the normal volatile data memory. If high-speed processing is required, reduce the frequency of accessing the retention / persistent data memory as much as possible, such as performing calculations in the volatile data memory and writing only the results to the retention / persistent data memory.

2.5.3 Marker Memory

Normally users do not have to take care about internal address of data memory.

However if it is necessary to use I/O address consciously, such as accessing only the upper word of DWORD data, use marker memory. The address of marker memory is %M.

Auto Declare		×
<u>S</u> cope: VAR ▼	<u>N</u> ame: dwTest	Type: DWORD V
<u>O</u> bject:	Initialization:	<u>A</u> ddress:
PLC_PRG [Application]		%MD10
<u>Flags:</u>	Co <u>m</u> ment:	
CONSTANT		*
		-
		OK Cancel

For example, DWORD data dwTest, WORD data wTest_H and wTest_L are declared in the address %MD10, %MW20 and %MW21. Then high word and low word can be accessed separately with using %M addresses. The relation between each data types are same as page 2-9. Just replace "Q" with "M". The marker memory does not support RETAIN nor PERSISTENT flags.

Variable declaration

```
VAR
dwTest AT %MD10: DWORD;
wTest_L AT %MW20: WORD;
wTest_H AT %MW21: WORD;
```

END_VAR

Login display

Expression	Туре	Value	Prepared value	Address
dwTest	DWORD	16#12345678		%MD10
🔷 wTest_L	WORD	16#5678		%MW20
🔷 wTest_H	WORD	16#1234		%MW21

The max. size of marker memory is 48KB. Supported address range is shown below.

Data type	Address range		
BOOL	%MX0.0 to %MX49151.7		
BYTE	%MB0 to %MB49151		
WORD	%MW0 to %MW24575		
DWORD	%MD0 to %MD12287		
LWORD	%ML0 to %ML6143		

Note

If CPU Link module or FL-net module are used, the marker memory is used for their shared memory. Be sure use free address if the marker memory is used as general register.

2.5.4 Numeric Literals

The constant inputs in the following formats.

Types	Examples	Remarks
Binary	FALSE, TRUE, 0, 1, 2#1010_1111	Underscore is ignored
Decimal	-12 0 123_456 +986 10#1234	Underscore is ignored
Hexadecimal	16#1234, 16#FF00_F000	Underscore is ignored
Real	-12.0 0.0 0.4560 3.14159_26	Underscore is ignored
Time	T#100ms, T#5.5s	Timer (TON, etc.)
Date	DT#2012-12-31-12:34:56	RTC (Realtime clock)

2.5.5 Elementary Data Types

HX-CODESYS supports the following data types.

No.	Data types	Name	Size	Range
1	BOOL	Boolean	1	0 or 1
2	SINT	Short integer	8	-128 to 127
3	USINT	Unsigned short integer	8	0 to 255
4	BYTE	Bit string of length 8	8	0 to 255 (16#00 to 16#FF)
5	INT	Integer	16	-32,768 to 32,767
6	UINT	Unsigned integer	16	0 to 65,535
7	WORD	Bit string of length 16	16	0 to 65,535 (16#00 to 16#FFFF)
8	DINT	Double integer	32	-2,147,483,648 to 2,147,483,647
9	UDINT	Unsigned double integer	32	0 to 4,294,967,295
10	DWORD	Bit string of length 32	32	0 to 4,294,967,295 (16#00 to 16#FFFFFFFF)
11	REAL	Real numbers	32	±1.175494351 E-38 to 3.402823466E+38
12	TIME	Duration	32	0 to 4,294,967,295 ms Unit : [d]: days, [h]: hours, [m]: minutes, [s]: seconds, [ms]: milliseconds Ex. T#100S12ms, t#0.1s
13	LREAL	Long reals	64	±1.7976931348623 E+308 to 2.2250738585072 E-308
14	STRING	Variable-length single-byte character string	8× n	1 to 255 char.
15	LINT	Long integer	64	-2^{63} to 2^{63} -1
16	ULINT	Unsigned long integer	64	0 to 2 ⁶⁴ -1
17	LWORD	Bit string of length 64	64	0 to 2 ⁶⁴ -1
18	DATE	Date	32	year-month-day Ex. DATE#1996-05-06 d#1972-03-29
19	DATE_AND_TIME	Date and time of Day	32	year-month-day-hour:minute:second Ex. DATE_AND_TIME#1996-05-06-15:36:30 dt#1972-03-29-00:00:00
20	TIME_OF_DAY	Time of day	32	hour:minute:second Ex. TIME_OF_DAY#15:36:30.123 tod#00:00:00
21	LTIME	Long duration	64	Unit :[us]: microseconds, [ns]: nanoseconds Ex. LTIME#1000d15h23m12s34ms2us44ns
22	WSTRING	Variable-length double-byte character string	16× n	-

2.5.6 User Defined Data Types

HX-CODESYS supports the following data types.

No.	Name	Examples			
1	Array	ARRAY [0100] OF WORD; ARRAY [011, 022, 033] OF REAL;			
2	Subrange	WORD(04095)			
З	Enumeration	TYPE COLOR: (Red, Yellow, Green) :=Green; END_TYPE			
4	Structure	TYPE STRUCT_sample STRUCT ID : WORD; Flag : BOOL; Weight : REAL; END_STRUCT END_TYPE			

Note

A memory access violation which leads the CPU stoppage may occur, if an index exceeds the defined array area. This memory access violation can be avoided by using [Add Object] – [POU for implicit checks].



2.5.7 Local Variable

If new variable name is used in POU, [Auto Declare] window appears as below. If the field [Address] is remained as empty, this variable will be assigned in a certain memory area of CPU. [Auto Declare] window appears if [Declare unknown variables automatically (AutoDeclare)] setting of SmartCording option in [Tools] – [Options...] menu is enabled.

Auto Declare		×
<u>S</u> cope: MAR▼	<u>N</u> ame: test_input	Type: BOOL V
Object: PLC_PRG [Application]	Initialization:	<u>A</u> ddress:
Elags: CONSTANT RETAIN PERSISTENT	Co <u>m</u> ment:	A
		OK Cancel

Click [OK], this variable is registered in declaration part of POU as below.



This variable is valid only in the POU. Even if same variable name is used in another POU, [Auto Declare] window will appear and it will be assigned in another memory location and handled as different variable.

To display the [Auto Declare] window again after defining the variable, place the cursor in the variable and then select [Edit] - [Auto Declare...].

2.5.8 Global Variable

If variables need to be commonly used in all POUs, [Global Variable List] must be created by right click on Application as below.



If new variable name is used in POU, [Auto Declare] window appears as shown in local variables. Choose [VAR_GLOBAL] at [Scope] as below.

Scope:	Auto Declare						
VAR_GLOBAL VAR VAR VAR_INPUT VAR_OUTPUT VAR_IN_OUT VAR_TEMP VAR_STAT VAR_GLOBAL	Scope: VAR Object: PLC_PRG [Application] Elags: CONSTANT BETAIN PERSISTENT	Name: test_input2 Initialization: Comment:	Iype: BOOL ► > Address:				

New variable name [test_input2] is registered in GVL as below instead of POU.

Devices 👻 🕂 🗘	×	PLC_PRG 💋 GVL 🗙
Untitled69	•	<pre>1 {attribute 'qualified_only'}</pre>
E I Device (HY_CD1H15)		E 2 VAR_GLOBAL
		3 test_input2: BOOL;
PLC Logic		4 END_VAR
Application		
🧭 GVL		
📲 🎁 Library Manager		
PLC_PRG (PRG)		
🖃 🌃 Task Configuration		
🖃 😻 MainTask		
PLC_PRG		

Add a prefix "GVL." to global variable when using in POU.



2.6 Configuration

Open device window and set parameters in [PLC Parameters] tab. Please note that the parameter items differ depending on the CPU version.

Parameter		Description			
LAN/	Enable / Disable *1	Enable (default)	If you do not use the target Ethernet port, you can disable		
ETH1,		/ Disable	the cable connection.		
ETH2,	IP Address	When requesting to	change the Ethernet port related parameters, be sure to set		
ETH3	Subnet Mask	[Yes] in [Change IP	information], otherwise parameters are not downloaded. Do		
	Ethernet port Link	not forget to set bac	k to [No] after downloading.		
	speed / Duplex mode				
Default C	fateway				
Change I	P information	Yes	IP information is downloaded together with application.		
		No (default)	IP information is not downloaded when application		
			downloading.		
NTP	NTP function	Enable	Setting Use (Enable) calendar clock from NTP server or		
		/ Disable (default)	not (Disable)		
	Port number	ETH1 / ETH2	Setting port used calendar clock		
		/ ETH3			
	Logical port number	123	The number is fixed.		
	Specified by	IP address	How to specify NTP server (fixed)		
	IP address or Host name	Setting IP address o	r host name		
	Access cycle	Setting access cycle	e to NTP server (Unit: minute, default: 60 min.)		
	Timeout	Timeout is 10 s. (fix	(xed)		
FTP	FTP server	Setting parameters	regarding FTP server		
	Port number (Interface)	Refer to section 3.6			
	*2				
	Access Media				
	User Name				
-	Password		1		
SFTP*1	SFTP server	Enable	Setting whether to use the SFTP server function (Enable)		
		/ Disable (default)	or not (Disable).		
	ETH1	Enable	Together with the configuration of enabling/disabling the		
	ETH2	/ Disable (default)	SFTP server function, specify the Ethernet port used for		
	ETH3		the communication.		
	Port number	20022	The number is fixed.		
	User Name	Setting the login ID	of the SFTP server.		
	Password	Setting the login pa	ssword for the SFTP server.		
DNS	DNS Client	Enable	Setting Use (Enable) connection to DNS server or not		
		/ Disable (default)	(Disable)		
	Primary DNS server IP	Setting Primary DN	IS server IP address		
	Secondary DNS server IP	Setting Secondary I	ONS server IP address		
~ .	Domain name	Setting Domain nar			
Stop swit	ch definition	Reset warm	When Run/Stop switch is changed from Run to Stop,		
		(default)	[Reset warm] operation is performed.		
		Stop	When Run/Stop switch is changed from Run to Stop,		
D / 11		X7 (1 C 1)	[Stop] operation is performed.		
Reset all	outputs in STOP	Yes (default)	All outputs are reset by hardware signal on the backplane		
		NT	when switching to stop mode. (Refer to section 2.2)		
D. #	1.44	INO	All outputs are controlled by IEC program (software)		
Battery e	rror detection	Enable (default)	Detect battery error		
1/0 "	1.4.4		Not detect battery error		
I/U config	g error detection	Enable (default)	Detect I/O configuration error		
T' 7	*1		Not I/O configuration error		
TimeZon	e * 3	Setting time zone			

- *1: This parameter is added in CPU version 3.5.16.25.
- *2: The parameter name differs depending on the CPU version, but the functionality is the same.
- *3: CPU version 3.5.16.22 or older: The setting is applied to the ExecTime output of GetNTPStatus FB. Please set the time zone with the use of SetTimeZoneInformation FB, when using GetDateAndTime FB. CPU version 3.5.16.23 or newer: The setting is reflected in all the functions in the CPU. Along with this change, this parameter is separated from NTP setting group. Please note that the time zone setting is based on the time difference from UTC, so daylight saving time specific to the region is not reflected.

Note

- Do not set network address (host parts 0) nor broadcast address (host parts 255) and do not set illegal subnet mask such as 255.255.253.0. It is possible to set, but CPU will detect an error and message will be stored in the log.
- When using default gateway, be sure to use correct IP addresses not to duplicate network address of ETH1, 2, 3 with network address of the gateway.
- If you download a project whose device version is 3.5.16.24 or lower to a PLC whose CPU version is 3.5.16.25 or higher, Ethernet communication will be disabled because the LAN Enable/Disable setting will be disabled. Please download a project whose device version matches with the actual CPU version to your PLC.

2.7 Communication Settings

Gateway configuration

HX-CODESYS and HX-CPU are connected via the gateway (CODESYS Gateway) in the PC. The gateway automatically starts as a service when Windows starts. If the icon in the system tray at the bottom right of the screen is

in this state **Solution**, the gateway is running. In the case of **Solution**, the gateway is stopped. Click and select "Start

Gateway" to start. Also, if there is no icon in the system tray, start the gateway by the following procedure.

- Windows 8/10

List of applications > CODESYS > CODESYS Gateway V3

- Windows 7

All programs > 3S CODESYS > CODESYS Gateway V3

How to configure

Connect PC to HX-CPU with USB cable (Mini-B) or LAN cable. Either crossover cable or straight cable is available for Ethernet ports of HX-CPU. Be sure to set IP addresses of PC and HX-CPU in the same segment. If not, login with USB and change IP address of HX-CPU accordingly. The default IP addresses of HX-CPU are shown below.

Port	IP address	Subnet mask	
ETH1	192.168.0.1	255.255.255.0	
ETH2	192.168.1.1	255.255.255.0	
ETH3	192.168.2.1	255.255.255.0	

Configuration of IP address

Open Device editor and select [PLC Parameters] tab. Configure IP Address, Subnet Mask and Ethernet port Link speed / Duplex mode setting for each port. Set Default Gateway if necessary. Be sure to set "Yes" to [Change IP Information] setting after making any changes. The IP information will be updated at the subsequent login.

Device X				
Communication Settings	Parameter	Туре	Value	Default Value
	📮 🧰 LAN			
Applications	🖨 - 🧰 ETH1			
Backup and Pestore	IP Address	STRING	'192.168.0.1'	'192.168.0.1'
backup and Restore	🖤 🕸 Subnet Mask	STRING	'255.255.255.0'	'255.255.255.0'
Files	Ethernet port Link speed / Duplex mode	Enumeration of BYTE	Auto Negotia	Auto Negotia
	🗐 - 🚞 ETH2			
Log	IP Address	STRING	'192.168.1.1'	'192.168.1.1'
-	🖉 🖉 Subnet Mask	STRING	'255.255.255.0'	'255.255.255.0'
PLC Settings	Ethernet port Link speed / Duplex mode	Enumeration of BYTE	Auto Negotia	Auto Negotia
	🖨 - 🧰 ETH3			
PLC Shell	IP Address	STRING	'192.168.2.1'	'192.168.2.1'
	🖉 🖉 Subnet Mask	STRING	'255.255.255.0'	'255.255.255.0'
Users and Groups	Ethernet port Link speed / Duplex mode	Enumeration of BYTE	Auto Negotia	Auto Negotia
	Default Gateway	STRING	'0.0.0.0'	'0.0.0.0'
Access Rights	Change IP information	Enumeration of BYTE	Yes	No
Symbol Pights	🕸 - 🚞 NTP			
Symbol Rights	🖳 🔁 FTP			
IEC Objects	🗊 - 🧰 DNS			
	Stop switch definition	Enumeration of BYTE	Reset warm	Reset warm
PLC Parameters	Reset all outputs in STOP	Enumeration of BYTE	Yes	Yes
	Battery error detection	Enumeration of BYTE	Enable	Enable
PLC I/O Mapping	I/O config error detection	Enumeration of BYTE	Enable	Enable
	Program up/download by USB memory	Enumeration of BYTE	Disable	Disable
Task Deployment	🖉 TimeZone	Enumeration of BYTE	UTC	UTC

Scan network

Double click on [Device (HX-CPxxxx)] or right click and choose [Edit Object].



[Device] window will appear as below.

Device X					
Communication Settings	Scan network Gateway 👻	Device 👻			
Applications					
Backup and Restore					
Files			-	•	
Log		Gateway-1	у 🗸	[0001] (active)	
PLC settings		IP-Address: localbost		Device Name: HX-CPU	
PLC shell		Port:		Device Address:	
Users and Groups		1217		0001	
PLC Parameters				Target ID: 1070 0009	
PLC I/O Mapping				Target Type: 4096	

Choose [Communication Settings] tab and click [Scan network]. If multiple CPUs exist in the network, all the CPUs are displayed as below.

Select Device					
Select the network path to the controller:					
🖃 💑 🖕 Gateway-1	Device Name: Scan network				
HX-CPU [0001]	HX-CPU Wink				
HX-CPU [0037.A025.B002]	Device Address:				
	0001				

If you choose one of the CPU and click [Wink], RUN LED on the CPU will blink 2 times in case of STOP status or 3 times in case of RUN status.

Click [OK], then the CPU is configured as target device.



If CPU is not displayed correctly, please check the following points.

Possible cause	Action	
Bad connection of LAN cable	Check the connection of cable and the power of network switches. Check if the	
	LED of L/A at Ethernet connector is lighting in green.	
No USB driver installedInstall USB driver (refer to section 1.1.3).		
Wrong IP address	Check IP address and subnet mask of PC and CPU both. If IP address is	
	unknown, login with USB and set IP address accordingly.	
Wrong CPU type	Set right CPU type by right mouse clicking on device and choosing [Update	
	device]. If [Device]-[Filter network scans by target ID] is disabled, other types of	
	CPUs are displayed.	

Note

If both USB cable and LAN cable are connected to the same CPU, only one network detected first is displayed.

TCP/IP

The protocol of above mentioned Ethernet communication is UDP/IP. If TCP/IP is required instead of UDP/IP, enter IP address of CPU directly in the address field.

Communication Settings	Scan network Gateway 👻	Device 👻	
Applications			
Backup and Restore		•	
Files			•
Log		Gateway	192 168 0.1
PLC settings		IP-Address:	
PLC shell		Port:	
Users and Groups		1217	

If entered IP is found, information of CPU is displayed.



Rename device

After communication opened, device name of connected CPU can be changed in the menu [Device]-[Rename active device...].

Scan network Gateway 👻	De	vice -				
		Add current device to favorites		Change device	name	
		Manage favorite devices		Device name Current: I		
		Rename active device			Current: HX-CPU	
		Wink active device	New:	New:	HX-CPU	▼
		Send echo service				
	Store communication settings in project				<u>O</u> K <u>C</u> ancel	
		Confirmed online mode				
	~	Filter network scans by target ID				

2.8 Programming

Ladder programming

Basic ladder programming is shown below as a first step. Please refer to online-help of HX-CODESYS for further information about programming.



Reference

The shortcut key setting can be changed on the keyboard screen in the customization setting window ([Tools]-[Customize]).

Auto Declare		×
<u>S</u> cope: VAR ▼	<u>N</u> ame: test_input	Type: BOOL V
Object: PLC_PRG [Application]	Initialization:	<u>A</u> ddress:
Elags: OONSTANT RETAIN PERSISTENT	Co <u>m</u> ment:	Å *
		OK Cancel

If new variable name is used, [Auto Declare] window appears automatically. Edit each input field and check-boxes if necessary, and click [OK]. The variable is declared in declaration window as below.

Chapter 2	Programming

	PLC_	PRG	- X
	1	PROGRAM PLC_PRG	_
	3	test_input: BOOL;	extua
	5	END_VAR	
•			•
	Ţ	test_input	test_output

Timer (TON)

Drag TON in Function Blocks to the position to put and drop it.





Specify the name of TON (TON_0 in the figure) and set PT (preset timer value) and the variable for ET (elapsed time). PT is mandatory, but ET is optional. If ET is left as open, delete variable name. New symbol can be added to the output of TON (Q), but this output can be left as open.



If timer output is used as a contact, put suffix ".Q" to the name of TON. Elapsed time is used as suffix ".ET".

Edge detection

3 different samples with same behavior are shown for rising edge detection.



Box with EN/ENO

If EN input is TRUE, the box is executed. By right mouse clicking and choosing [Edge detection] or [Negation], the condition to execute can be changed. The ENO output has the same value as the EN input.

-()

Example 1: The box is executed while [test1] is TRUE.



Example 2: Rising edge detection

Example 3: Falling edge detection





Example 4: Negation



Example 5: Always executed (box without EN/ENO)



Execute Box

The element is a box that enables you directly enter ST code. LD language is suitable for bitwise operation and ST language is suitable for math calculation. This execute box brings advantages of ST to LD/FBD editor.





Parallel contact across multiple contacts

If you need to insert a contact in parallel to multiple contacts, choose multiple contacts with pressing [Shift] key, then choose [Insert Contact Parallel (below)] in the right mouse click menu or press [Ctrl+R] key.



Comment

Several different comments are enabled or disabled in the menu [Tools]-[Options]-[FBD, LD and IL editor].

Since symbol comment is linked to variable, if same variables are used in different location, the same symbol comment is used. Operand comment is not linked to variables. If same variables are used, different operand comments can be set.



Toggle network comment state

A network can be disabled with visible temporary. Choose [Toggle network comment state] in right mouse click menu. The color of this network will be changed and ignored. Perform the same operation to restore.



2.9 Login / Logout

Login

After programming, click or choose [Build] in Build menu. If compiling fails, error information is shown at [Description] field as follows. Double click the message to jump to the part to be corrected.

M	Messages - Total 1 error(s), 1 warning(s), 0 message(s) 👻 👎						
в	uild 🗸 🗘 uild 🗸 🗸 🗸 uild varnir	ıg(s)	0 message(s)	×			
C	Description		Project	Object	Position		
	Build started: Application: Device. Application						
	typify code						
O C0142: A local variable named 'test' is already defined in 'IoConfig_Globals_Mapping'			Untitled71	_16_Digital_Input [D			
0	C0139: The code 'test; ' has no effect. Is this the intent?		Untitled71	PLC_PRG [Device: P	Line 1, Column 1 (Impl)		
	Compile complete 1 errors, 1 warnings						

Note

If unknown message appears, it is recommended to [Clean all] in Build menu. All compile information is deleted by this operation.

When all errors are removed as below, click S or choose [Login] in Online menu to download the program to CPU.

Messages - Total 0 error(s), 0 warning(s), 0 message(s)						
Build	 O error(s) 	🖲 0 warnin	g(s)	0 message(s)	×	
Description				Project	Object	Position
Build started: Application: Device.Application						
typify code						
Compile complete 0 errors, 0 warnings						

If no application is in the CPU, this message appears. Click [Yes] to download.



If unknown version of application is in the CPU, this message appears. Click [Yes] to download.



When logging in successfully, green circle icon is displayed at [Device]. If mounted I/O modules are matched with configured ones, green icon is displayed at each I/O module also.



If any mounted I/O module is mismatched, red triangle icon is displayed at mismatched module as below.



Reference

When [Build]-[Generate code] is executed, error detection can be executed in consideration of the device-related information such as memory size in addition to program compilation performed in normal build.

Online change

Online change is a function to change application program while CPU is running without stopping program execution. When online change is performed, only changed program is downloaded to the HX-CPU.



Since running program is changed by online change operation, the machine might not work as expected, which could cause personal injury or damage. Before performing online change, check new program code carefully.

Operation of online change

To change your program in running CPU (online change), you have to logout at first. After program changing, choose [Login] again. You will have 3 options as below.

<u>O</u> nlii	ne	<u>D</u> ebug	<u>T</u> ools	<u>W</u> indow	<u>H</u> elp	
ОŞ	Lo	gin			Alt+F8	
Сğ	Lo	<u>go</u> ut			Ctrl+F8	
	Cr	eate boo	t applicat	tion		

Login with online change: Login with download: Login without any change: Only incremental program is downloaded without CPU stop. Whole the program is downloaded. CPU is forced to stop. New program is not downloaded.

HX-COD	DESYS
?	Application changed since last download. What do you want to do?
	Options
	O Login with online change.
	🔘 Login with download.
	🔘 Login without any change.
	✓ Update bootproject
	<u>O</u> K <u>C</u> ancel <u>D</u> etails

If [Clean] or [Clean all] or changing of I/O configuration, Task configuration or so on is performed before online change, online change is not possible, and download is required.

Note

Pointer variables retain their values from the last cycle. If a pointer refers to a variable whose value was changed in an online change, then the variable no longer yields the correct value. Make sure that pointer variables are reassigned in each cycle.

Logout

Choose the menu [Online]-[Logout] or click 🧖 icon to logout.

If the total number of variables in opened POU exceeds about 30,000, it takes long time to logout. If 30,000 or more variables are used in a POU, it is recommended to split it 2 or more POUs and not to open all the POUs when login.

2.10 Boot Application

The basic overview of downloading is shown as below picture. Be noted that an application (compiled user program) is downloaded to volatile RAM memory of the CPU, which means the application is lost when power is removed. If your application needs to be saved in non-volatile FLASH memory, choose [Create boot application] in Online menu while Login. When CPU is power up in the next time, the application is copied from FLASH to RAM and executed automatically if RUN/STOP switch is in RUN position. The boot application contains PLC Parameters data. However, if Change IP information setting is No or not set on the boot application, the LAN settings of PLC Parameters are transferred regardless of this setting.



*: Optional

Timing to download boot application can be configured in [Properties] of [Application] (Right click on [Application] of the project tree). The default setting is shown below.

Properties - Application [Device: PLC Logic]								
Common Information Boot application Application build options Target								
 Create implicit boot application on download Create implicit boot application on Online Change 								
Remind boot application on project close								

2.11 Source Download / Upload

Path

Source file is a file including all the information of project such as programs, variable names, comment, programming language settings and other related information. Source file is downloaded by choosing the menu [Online]-[Source download to connected device] or [File]-[Source download]. Uploading is done by choosing the menu [File]-[Source upload].

If a source file is downloaded to a CPU, it is saved as "Archive.prj" in the folder [Source]. Since executable files such as application file and boot application file are binary format, it is not possible to open as a visible program file or to reverse compile to source file. Be sure to save source files in PC or CPU, otherwise it is not possible to edit or change running program.

The Device X						
Communication Settings	Host Location: 🚢 C:\		• 🛅 🗙 🕂	Runtime Location:	Dia Source	• 🗀 🗙 🐼
Annelisettere	Name	Size	Modified 🔺	Name	Size	Modified
Applications	Dications L			t		
Backup and Restore	👔 🛊 POYOLE AIN			🚞 alarms		
	🌇 2401697			🚞 visu		
Files	🌇 Activitin			ac_persistence		
Log	🌇 o crittin F		=	🚞 _cnc		
ZTER E		_	🚞 trend			
PLC settings	🔟 star -			Archive.prj	205.43 KB (210	0,3 2016/10/07 11:00
PLC shell	🚹 🖉 esClanide Syljitain					

Downloaded timing

Downloaded timing of source file can be set in the menu [Project]-[Project Settings]-[Source Download]. The default setting is [Only on demand]. If source file is to be updated together with application, choose [Implicitly at creating bootproject, download and online change].

Project Settings		×
Project Settings Image: Compile options Image: Compiler warnings Image: Page Setup Image: Security Image: Security	Source Download Destination device <ali>devices in project> <ali>devices in project <ali>content https://www.commune.com Content https://www.commune.com Content https://www.commune.com Content https://www.commune.com </ali></ali></ali>	
	ОК	ncel

Downloaded information files

Besides boot application, source file can be saved in the CPU module, which enables you to upload original program file from PLC even if you don't have it in your PC. Some extra files can be added to source file as below. Choose according to your necessity.

Project Settings		E I	
Compile options	Source Download		
 Page Setup Security SFC Source Download Static Analysis Light Users and Groups Visualization Visualization Profile 	Destination device All devices in project> Content The project file itself is always part of the source of Use compact download Additional files Timing Implicitly at program download and online change Implicitly at creating bootproject Implicitly at creating bootproject, download and online change Only on demand	Additional files	Cancel
		OK Cancel	

Download information files

[Download information files] in [additional files setting] is not always necessary, but it is needed if you want to login without CPU stop from the PC which does not have original program file shown below as case (b) and (c).

(a) Online change from PC with source file to CPU without source file. → just Login for onlinechange

(b) Online change from PC without source file to CPU with source file and DL info. → Source upload and Login

(c) Online change from PC without source file to CPU with source file. \rightarrow Source upload and Login, then program download is required because HX-CODESYS is not able to verify if application and source files are identical. It is possible to login after downloading, but CPU must stop at that time.



2.12 Run / Stop / Reset / Initialize

Run/Stop

CPU can be started with HX-CODESYS or Run/Stop switch on the CPU module, but remote controlling with HX-CODESYS is not allowed when the Run/stop switch is in Stop position as shown below.

Switch position User operations	STOP	RUN	
Stop with HX-CODESYS	Stop (ignored)	Stop	
Run with HX-CODESYS	Stop (ignored)	Run	
Reboot PLC (Cycle power)	Stop	Run *	

* CPU starts running independent from the last status before power failure.

HX-CPU resets all the I/O at starting by hardware signal. For this reason, outputs are reset in one task cycle time at the timing from stop to run independent from PLC settings.

Reset

When CPU detects a serious error called "exception", such as watchdog error, program execution stops. If HX-CODESYS is connected, "Exception" indication blinks until this status is cleared. This exception status is cleared only by [Reset] operation. HX-CODESYS has 2 different types of [Reset] operation: [Reset warm] and [Reset cold]. All of them can initialize exception status, but behavior of CPU are different as shown below. Be noted that [Reset origin] initializes not only an exception but also your application and boot application in CPU module.

Initialize

Initializing operation is to reset not only exception status and data memory but also non-volatile memory. HX-CODESYS has two different initializing operation, [Reset origin] and [Reset origin device]. Differences are listed in the table below.

Data Operation	VAR	VAR RETAIN	VAR PERSISTENT	Application (volatile memory)	Boot application (non-volatile)	Source file (non-volatile)	WebVisu Data, Online user info.	IP address, Realtime Clock data
STOP	Х	Х	Х	Х	Х	Х	Х	Х
Reset warm	-	Х	Х	Х	Х	Х	Х	Х
Reset cold	-	-	Х	Х	Х	Х	Х	Х
Download	-	-	Х	(updated)	(updated)	(updated)	(updated)	X*1
Online Change	Х	Х	Х	(updated)	(updated)	(updated)	(updated)	Х
Reboot PLC	-	Х	Х	-	Х	Х	Х	Х
Reset origin (Initialize PLC)	-	-	-	-	-	Х	Х	Х
Reset origin device [Device]	-	-	-	-	-	-	-	Х

X = maintained, - = initialized, *1: Updated if [Change IP information] is set as YES.

Note

If downloaded application is renamed in [Device]-[File] window of HX-CODESYS, in which the application name in CPU is mismatched with HX-CODESYS, [Reset origin] and [Reset origin device] do not work properly.

Stop switch definition

Definition of stop position of run/stop switch can be configured as [Stop] or [Reset warm] in CPU configuration. Default setting is [Reset warm] since it is almost same behavior as [Stop] of existing Hitachi PLC.

Parameter	Туре	Current Value	Prepared Value
🖳 - 🚞 LAN			
🗄 🛄 NTP			
🗐 - 🧰 FTP			
Stop switch definition	Enumeration of BYTE	Reset warm	
Reset all outputs in STOP	Enumeration of BYTE	Yes	
Battery error detection	Enumeration of BYTE	Enable	
I/O config error detection	Enumeration of BYTE	Enable	
Program up/download by USB memory	Enumeration of BYTE	Disable	

Note

• The output operation when CPU stops running the user program differs depending on the PLC settings and PLC parameters settings. The behavior when the RUN switch is toggled to the stop position is described below. <<Actual output behavior>>

- In the case that Reset all outputs in STOP is Yes, all outputs turn OFF.
- In the case that Reset all outputs in STOP is No, output behavior is the follwoings.
- (1) SP8

The output status depends on the Stop switch definition setting. In the case of Reset warm, the outputs are cleared. In the case of Stop, the outputs follow the setting of Behaviour for outputs in Stop. (However, if the output module variable is mapped from a variable which is declared in a POU or a GVL, the output value is not cleared even if the Stop switch definition setting is Reset warm.)

(2) SP13

The output behavior depends on the setting of Behaviour for outputs in Stop. (If the setting is [Execute program] and the target variable is not used in the specified program, the output follows the setting of Stop switch definition. However, if the output module variable is mapped from a variable which is declared in a POU or a GVL, the output value is not cleared even if the Stop switch definition setting is Reset warm.)

(3) SP16

The output behavior depends on the Stop switch definition setting. In the case of Reset warm, the values before the program stopped are kept. In the case of Stop, the outputs follow the setting of Behaviour for outputs in Stop.

<<Monitored values>>

- If Stop switch definition is Reset warm, the monitored value turns to the initial value. (In the case of SP8, if a variable is declared on the I/O mapping table, it is cleared to zero instead of the initial value.)
- In the case that Stop switch definition setting is Stop, the monitored value depends on the setting of Behaviour for outputs in Stop. (If the setting of Behaviour for outputs in Stop is [Set all outputs to default], the behavior differs among each SP version. Refer to P2-11 for details.)
- USB communication is disconnected when RUN Switch of HX-CPU is set to STOP, if Stop switch definition setting is Reset warm and multiple PLCs are connected to a PC via USB.
- The error code 23 cannot be cleared by "Reset origin device".

2.13 Library

A library is a package including several function or function blocks. The libraries are stored in the Library repository. If you need to use libraries in your project, you must load it from the library repository by [Add library]. In case of HX-CPU, the following libraries are preloaded automatically to new project.

Devices 👻 🗸 🗶	Library Manager 🗙	
Program Device (HX-CP1H16)	🎦 Add library 🗙 🕻 elete library 🛛 🚰 Properties 🐞 Details 🛛 🐺 Placeholders 🖉 Library repository	,
PLC Logic	Name	Namespace
= 🔘 Application	🗄 🚥 🕬 3SLicense = 3SLicense, 3.5.8.0 (3S - Smart Software Solutions GmbH)	_3S_LICENSE
Library Manager	🗄 🗝 🚾 BreakpointLogging = Breakpoint Logging Functions, 3.5.5.0 (3S - Smart Software Solutions GmbH)	BPLog
PLC PRG (PRG)	🕸 🚥 CAA DTUtility = CAA DTUtil Extern, 3.5.5.0 (CAA Technical Workgroup)	DTU
Task Configuration	🗄 🗝 🚥 CAA File = CAA File, 3.5.7.0 (CAA Technical Workgroup)	FILE
🖻 🦃 MainTask	😟 🚥 CAA Types = CAA Types Extern, 3.5.5.0 (CAA Technical Workgroup)	CAA
E PLC PRG	CmpHIESErrors_HX = CmpHIESErrors_HX, 3.5.8.21 (HIES)	CmpHIESErrors_HX
G [®] Trace	CmpHIESLib_HX = CmpHIESLib_HX, 3.5.8.21 (HIES)	CmpHIESLib_HX
Basic (Basic)	i∰…•⊠ IoDrvEthernet = IoDrvEthernet, 3.5.8.20 (3S - Smart Software Solutions GmbH)	IoDrvEthernet

Libraries as shown below are loaded automatically when new project is opened.

Name of Library	Note
IoStandard	System library for I/O control
3SLincense	System library
Standard	IEC61131-3 compliant standard library
Util	PID, BCD and other utility instructions included
CAA DTUtility	RTC (realtime clock) data reading/writing
CAA File	File access library
SysCom	Serial communication library
CAA Types	Sub library for CAA File
CmpHIESLib_HX *1	HX specific instruction library
CmpHIESErrors_HX *1	HX specific error handling library

Loaded libraries automatically

*1 Use libraries with suffix "_HX". The libraries without "_HX" are for EHV+ series.

If these libraries are not found in the library manager, install libraries by choosing [Tools]-[Library Repository] and then clicking [Install].

Tool	s <u>W</u> indow <u>H</u> elp	fi Library Repository	—
Ø	Package Manager	Location: System 👻	Edit Locations
Ô	Library Repository	(C:¥ProgramData¥CODESYS¥Managed Libraries)	
	Device Repository Visualization Styles Repository License Repository License Manager Scripting ►	Installed libraries: Company: (All companies) Company: (All	Uninstall
	<u>C</u> ustomize <u>O</u> ptions	B − B = Use Cases	
			Find
		Group by category	Details
		Library Profiles	Close

Procedure to update libraries

CASE: A library which is loaded automatically

Libraries which are loaded automatically are displayed in gray color.

1. Click [Placeholders] button in Library Manager Editor.

Library Manager 🗙			
😤 Add library 🔀 Delete library 🛛 🕾 Properties 🗊 Details 🔄 Placeholders 👔 Library reposit	tory		
Name Placeholders	Namespace	Effective version	
🕮 🕬 3SLicense = 3SLicense, 3.5.12.0 (3S - Smart Software Solutions GmbH)	_3S_LICENSE	3.5.12.0	
🛱 👓 📾 BreakpointLogging = Breakpoint Logging Functions, 3.5.5.0 (3S - Smart Software Solutions GmbH)	BPLog	3.5.5.0	
🖾 👓 🚾 CAA DTUtility = CAA DTUtil Extern, 3.5.12.0 (CAA Technical Workgroup)	DTU	3.5.12.0	
🛱 - 🚾 CAA File = CAA File, 3.5.13.0 (CAA Technical Workgroup)	FILE	3.5.13.0	
🛱 🗝 🗺 CAA Types = CAA Types Extern, 3.5.13.0 (CAA Technical Workgroup)	CAA	3.5.13.0	

2. Click library cell of the target library.

Placeholders		
Name	Library	Info
CmpSysEthernet	SysEthernet, 3.5.12.0 (3S - Smart Software Solutions GmbH)	Resolved by device
CommFB	CommFB, 3.5.13.0 (3S - Smart Software Solutions GmbH)	Resolved by device
Component Manager	Component Manager, 3.5.13.0 (System)	Resolved by device
IoDrvBase	IoDrvBase, 3.5.13.0 (System)	Resolved by device
IODrvEtherCAT	IODrvEtherCAT, 3.5.13.20 (3S - Smart Software Solutions GmbH)	Resolved by subdevice
IoStandard	IoStandard, 3.5.13.0 (System)	Resolved by device
Rts Service Handler	Rts Service Handler, 3.5.5.0 (3S - Smart Software Solutions GmbH)	Resolved by device

3. Select target version in the list of the installed versions.

Placeholders

Name	Library						
CmpSysEthernet	SysEthernet, 3.5.12.0 (3S - Smart Software Solution	SysEthernet, 3.5.12.0 (3S - Smart Software Solutions GmbH)					
CommFB	CommFB, 3.5.13.0 (3S - Smart Software Solutions G	imbH)					
Component Manager	Component Manager, 3.5.13.0 (System)						
IoDrvBase	IoDrvBase, 3.5.13.0 (System)						
IODrvEtherCAT	IODrvEtherCAT, 3.5.13.20 (3S - Smart Software So	lutions GmbH)					
IoStandard	Other versions of IODrvEtherCAT	1					
Rts Service Handler	13.5.4.0	vlutions GmbH)					
Standard	3 5 14 30						
StringUtils	3.5.17.50						
SysCom	3.5.13.30						
SysCpuHandling	3.5.12.40						
SysMem	3.5.11.40						
SysSem	3.5.10.0						
SysSocket	3.5.9.50						
SysTarget	3590						
SysTime	25940	1					
SysTimeCore	3.5.0.40						
1	3600						

CASE: A library which is added manually

Libraries which are added manually are displayed in black color.

1. Click the target library in Library Manager Editor.

/ 🎁 Library Manager 🗙		
🎦 Add library 🗙 Delete library 🛛 😭 Properties 🔋 Details 🗐 Placeholders 🛛 🎁 🛚	Library repository	
Name	Namespace	Effective version
SLicense = 3SLicense, 3.5.12.0 (3S - Smart Software Solutions GmbH)	_3S_LICENSE	3.5.12.0
🛱 🚥 📾 BreakpointLogging = Breakpoint Logging Functions, 3.5.5.0 (3S - Smart Software Solu	tions GmbH) BPLog	3.5.5.0
🗄 🖙 💷 CAA DTUtility = CAA DTUtil Extern, 3.5.12.0 (CAA Technical Workgroup)	DTU	3.5.12.0
🛱 📲 CAA File = CAA File, 3.5.13.0 (CAA Technical Workgroup)	FILE	3.5.13.0
CAA Types = CAA Types Extern, 3.5.13.0 (CAA Technical Workgroup)	CAA	3.5.13.0
CmpHIESErrors_HX = CmpHIESErrors_HX, 3.5.8.21 (HIES)	CmpHIESErrors_HX	3.5.8.21 🛛 🕚
CmpHIESLib_HX = CmpHIESLib_HX, 3.5.13.40 (HIES)	CmpHIESLib_HX	3.5.13.40 🛛 🕚
IODrvEtherCAT = IODrvEtherCAT, 3.5.13.20 (3S - Smart Software Solutions GmbH)	IoDrvEthercatLib	3.5.13.20
🗓 👓 💷 IoStandard = IoStandard, 3.5.13.0 (System)	IoStandard	3.5.13.0
•ত্তি Standard = Standard, 3.5.13.0 (System)	Standard	3.5.13.0
SysCom = SysCom, 3.5.5.0 (System)	SysCom	3.5.5.0
🕮 📲 SysProcess, 3.5.7.0 (System)	SysProcess	3.5.7.0
🗄 🗤 🗤 Util = Util, 3.5.11.0 (System)	Util	3.5.11.0

2. Click Properties button.

/ 🎁	Library	Mana	ager 🗙				
🖰 Add	library	×)elete libra	ary [Prope	rties	Details
Name					Г	-VS Decen	ortion
±	3SLicen	se = 3	SLicense,	3.5.12.) (3S - Si	narts	ortware Solut
h 📼	n I			1.000		-	

3. Select target version in the list of the installed versions.

Properties - SysPr	ocess, 3.5.7.0 (System)		\times
General:		Version:	
Namespace:	SysProcess	Specific version: 3.5.7.0	·
Default library:		O Newest version alv 3.5.7.0	
an d da		3.5.2.0	-
Visibility:		3.2.0.0	
Only allow qu	ualified access to all identifiers.	3.0.2.0	1

2.14 Version

The corresponding device and library depend on the HX-CPU firmware version.

Firmware		3 5 16 23 26	3 5 16 22	3 5 13 40/41	35876	35875	35822 24	3 5 8 21
Device [Description	3.5.16.23-26	3.5.16.22	3.5.13.40/41	3.5.8.26	3.5.8.25	3.5.8.24	3.5.8.21
Hardwar	re Rev	00	00	00	00	00	00	00
Runtime		3 5 16 22	3 5 16 22	3 5 13 40	3 5 8 22	3 5 8 22	3 5 8 21	3 5 8 20
Compile	r	3 5 16 20	3 5 16 20	3 5 13 20	3 5 8 20	3 5 8 20	3 5 8 20	3 5 8 20
Visualiza	ation Profile	3 5 16 20	3 5 16 20	3 5 13 20	3 5 8 20	3 5 8 20	3 5 8 20	3 5 8 20
Device	FH-I NK	3 5 8 21	3 5 8 21	3 5 8 21	3 5 8 21	3 5 8 21	3 5 8 20	3 5 8 20
Dovios	FH-FLN2/3	3 5 8 21	3 5 8 21	3 5 8 21	3 5 8 21	3 5 8 21	3 5 8 20	3 5 8 20
	FH-SIO	3.5.8.22	3.5.8.22	3.5.8.22	3.5.8.21	-	-	-
	HXC-SCP	3.5.16.20	-	-	-	-	-	-
	HX-ECTS	3.5.16.20	-	-	-	-	-	-
	EtherCAT Master	3.5.16.20	3.5.16.20	3.5.13.20	3.5.8.40	3.5.8.40	3.5.8.40	3.5.8.40
	Ethernet Adapter	3.5.16.0	3.5.16.0	3.5.13.0	3.5.10.0	3.5.10.0	3.5.8.20	3.5.8.20
	Modbus TCP Master	3.5.16.0	3.5.16.0	3.5.13.0	3.5.8.10	3.5.8.10	3.5.8.10	3.5.8.10
	Modbus TCP Slave	3.5.16.0	3.5.16.0	3.5.12.0	3.5.7.0	3.5.7.0	3.5.7.0	3.5.7.0
	Modbus TCP Slave Device	3.5.16.0	3.5.16.0	3.5.13.0	3.5.5.0	3.5.5.0	3.5.5.0	3.5.5.0
	Modbus COM	3.5.16.0	3.5.16.0	3.5.11.20	3.4.0.0	3.4.0.0	3.4.0.0	3.4.0.0
	Modbus SIO-COM	3.5.8.20	3.5.8.20	3.5.8.20	3.5.8.20	-	-	-
	Modbus Serial Device	3.5.16.10	3.5.16.10	3.5.13.20	3.5.5.0	3.5.5.0	3.5.5.0	3.5.5.0
	Modbus Master, COM Port	3.5.16.0	3.5.16.0	3.5.13.10	3.5.8.10	3.5.8.10	3.5.8.10	3.5.8.10
	Modbus Slave, COM Port	3.5.16.0	3.5.16.0	3.5.10.30	3.5.4.0	3.5.4.0	3.5.4.0	3.5.4.0
	EtherNet/IP Scanner	3.5.16.0	3.5.16.0	-	-	_	-	-
	PN-Controller	3.5.16.50	-	-	-	_	_	_
Library	IoDrvEtherCAT	3.5.16.0	3.5.16.0	3.5.13.20	3.5.8.0	3.5.8.0	3.5.8.0	3.5.8.0
	IoDrvBase	3.5.13.0	3.5.13.0	3.5.13.0	3.5.5.0	3.5.5.0	3.5.5.0	3.5.5.0
	loDrvUtility	3.5.16.0	3.5.16.0	3.5.11.0	3.5.10.0	3.5.10.0	-	-
	ModbuTCPSlave	3.5.16.0	3.5.16.0	3.5.13.0	3.5.8.10	3.5.8.10	3.5.8.10	3.5.8.10
	IoDrvModbusBase	3.5.16.0	3.5.16.0	3.5.13.0	3.5.8.10	3.5.8.10	3.5.8.10	3.5.8.10
	IoDrvModbusTCP	3.5.16.0	3.5.16.0	3.5.13.0	3.5.8.10	3.5.8.10	3.5.8.10	3.5.8.10
	СтрАрр	3.5.15.0	3.5.15.0	3.5.13.0	3.5.8.0	3.5.8.0	3.5.8.0	3.5.8.0
	CmpEventMgr	3.5.16.0	3.5.16.0	3.5.12.0	3.5.8.0	3.5.8.0	3.5.8.0	3.5.8.0
	CmplecTask	3.5.14.0	3.5.14.0	3.5.13.0	3.5.8.0	3.5.8.0	3.5.8.0	3.5.8.0
	CmplecVarAccess	3.5.15.0	3.5.15.0	3.5.13.0	3.5.7.0	3.5.7.0	3.5.7.0	3.5.7.0
	loStandard	3.5.16.0	3.5.16.0	3.5.13.0	3.5.8.0	3.5.8.0	3.5.8.0	3.5.8.0
	SysCom	3.5.15.0	3.5.15.0	3.5.5.0	3.5.5.0	3.5.5.0	3.5.5.0	3.5.5.0
	SysSocket	3.5.15.0	3.5.15.0	3.5.13.0	3.5.8.0	3.5.8.0	3.5.8.0	3.5.8.0
	SysTimer	3.5.5.0	3.5.5.0	3.5.5.0	3.5.5.0	3.5.5.0	3.5.5.0	3.5.5.0
	SysTimerRtc	3.5.5.0	3.5.5.0	3.5.5.0	3.5.5.0	3.5.5.0	3.5.5.0	3.5.5.0
	UDP	3.5.16.0	3.5.16.0	3.5.10.0	3.5.8.0	3.5.8.0	3.5.8.0	3.5.8.0
	TCP	3.5.15.0	3.5.15.0	3.5.9.50	3.5.8.10	3.5.8.10	3.5.8.10	3.5.8.10
	FDT Manager	-	-	-	3.5.3.30	3.5.3.30	3.5.3.30	3.5.3.30
	NetVarUdp	3.5.16.0	3.5.16.0	3.5.12.0	3.5.8.0	3.5.8.0	3.5.8.0	3.5.8.0

Firmware version (Target-Version) of your CPU is monitored in communication settings of Device as below.



The followings are the procedure to change the version of each object in the HX-CODESYS project.

2.14.1 PLC Device

Select [Update Device...] in the right-click menu of PLC Device.

Devices	• 9	L X
Untitled 12		•
Device (HX-CP1H16) 그 관리 PLC Logic 고 (아주 Application	よ (唱画 (Cut Copy
Library Mai		Paste Delete
⊟ - ∰ Task Confi ⊟ - ∰ MainTa		Refactoring
Basic (Basic) ↓ <empty> ↓ <empty> ↓ <empty> ↓ <empty></empty></empty></empty></empty>		Add Object Add Folder Add Device
<pre>C <empty> C <empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></empty></pre>	ו רב	Update Device Edit Object

Activate [Display all versions (for experts only)] in Update Device window.

ama Device				
Action				
Append device Insert devi	ce O Plug device O Update device Update sam	e devices in pro	ject	
String for a full text search	Vendor <all vendors=""></all>			
Name	Vendor	Version	Description	
- EHV-CPU1051	Hitachi-IES	3.4.4.32	Hitachi-IES EHV + CPU, Memory size: 1024K	B, CoDes
- EHV-CPU1102	Hitachi-IES	3.5.4.11	11 Hitachi-IES EHV + CPU, Memory size: 2048	
HX-CP 1H16	Hitachi Industrial Equipment Systems Co., Ltd.	3.5.16.22	5.22 Hitachi-IES HX-series, High-performance	
HX-CP 1H16R	Hitachi Industrial Equipment Systems Co., Ltd.	3.5.16.22	Hitachi-IES HX-series, Redundancy type, Pr	rogram m
- M HX-CP 1508	Hitachi Industrial Equipment Systems Co., Ltd.	3.5.16.22	Hitachi-IES HX-series, Standard type, Progr	ram memo
HXC-CP 1H16 Hitachi Industrial Equipment Systems		3.5.16.22	22 Hitachi-IES HX-series, Hybrid type, Program mer	
- M HXC-CP2H16	P2H16 Hitachi Industrial Equipment Systems Co., Ltd.		Hitachi-IES HX-series, Hybrid type 2, Progra	am memor
- 🗊 MV-x20	Hitachi-IES	3.5.3.44	Hitachi-IES MICRO-EHV + 20-pt (12-in, 8-ou	ut), Memo
- MV-x40	Hitachi-IES	3.5.3.44	Hitachi-IES MICRO-EHV + 40-pt (24-in, 16-o	out), Mem
- MV-x64	Hitachi-IES	3.5.3.49	Hitachi-IES MICRO-EHV+ 64-pt (40-in, 24-o	out), Mem

All versions of the target model are displayed. Select the proper version that corresponds to the firmware version of your HX-CPU.

me Device Action) Append device () Insert device	e 🔵 Plug device 🔘 Update device 🔲 Update sam	e devices in proj	ect	
tring for a full text search	Vendor <all vendors=""></all>			
Name	Vendor	Version	Description	
EHV-CPU1102	Hitachi-IES	3.5.4.11	Hitachi-IES EHV + CPU, Memory size: 2048KB, Co	DeS
👔 HX-CP 1H 16	Hitachi Industrial Equipment Systems Co., Ltd.	3.5.8.21	Hitachi-IES HX-series, High-performance type, Pr	ogr
📶 HX-CP 1H 16	Hitachi Industrial Equipment Systems Co., Ltd.	3.5.8.22	Hitachi-IES HX-series, High-performance type, Pr	ogr
- 🔟 HX-CP 1H 16	Hitachi Industrial Equipment Systems Co., Ltd.	3.5.8.23	Hitachi-IES HX-series, High-performance type, Pr	ogr
🔟 HX-CP 1H 16	Hitachi Industrial Equipment Systems Co., Ltd.	3.5.8.24	Hitachi-IES HX-series, High-performance type, Pr	ogr
1 HX-CP 1H 16	Hitachi Industrial Equipment Systems Co., Ltd.	3.5.8.25	Hitachi-IES HX-series, High-performance type, Pr	ogr
🔟 HX-CP 1H 16	Hitachi Industrial Equipment Systems Co., Ltd.	3.5.8.26	Hitachi-IES HX-series, High-performance type, Pr	ogr
1 HX-CP 1H 16	Hitachi Industrial Equipment Systems Co., Ltd.	3.5.13.40	Hitachi-IES HX-series, High-performance type, Pr	ogr
HX-CP 1H 16	Hitachi Industrial Equipment Systems Co., Ltd.	3.5.13.41	Hitachi-IES HX-series, High-performance type, Pr	ogr
HX-CP1H16	Hitachi Industrial Equipment Systems Co., Ltd.	3.5.16.22	Hitachi-IES HX-series, High-performance type, Pr	ogr
HX-CP1H16R	Hitachi Industrial Equipment Systems Co., Ltd.	3.5.13.40	Hitachi-IES HX-series, Redundancy type, Program	n m
/				>

The version of the PLC device set in the project is shown on the information screen of the device editor.

Device 🗙	
Communication Settings	General
Applications	Name: HX-CP1H16 Vendor: Hitachi Industrial Equipment Systems Co., Ltd.
Backup and Restore	Categories: PLCs Type: 4096
Files	Version: 3.5.13.40
Log	Description: Hitachi-IES HX-series, High-performance type, Program memory: 16
PLC Settings	
PLC Shell	
Users and Groups	
Access Rights	
Symbol Rights	
IEC Objects	
PLC Parameters	
PLC I/O Mapping	
Task Deployment	
Status	
Information	

2.14.2 Compiler

Select [Project] - [Project Settings...] menu.

View	Proj	ect	Build	Online	Debug	Tools	Windo
3 0	*:::	Add	l Object				- ► P
	6	Add	l Folder				- 1
		Sca	n for Dev	ices			- i
12		Upc	late Devi	ce			- 1
ze (HX-O	ß	Edit	Object				- 1
PLC Logic		Edit	Object V	Vith			- 1
💭 Арр	R,	Onl	ine Confi	g Mode			- 1
- 🎁 L		Set	Active Ap	oplication			- 1
	i	Proj	ject Infor	mation			
<u> </u>	6	Proj	ject Settir	ngs			
		Proj	ject Envir	onment	2		

Project Settings window is displayed. Select [Complile options] from the menu on the left side of the screen and specify the compiler version which corresponds to the firmware version of your HX-CPU.

Project Settings					×
Compile options	Compile o	ptions			
Compiler warnings	- Compiler Versio	n			
Library development	Complier versio	···		_	
🚔 Page Setup	Fix version	3.5.13.20		\sim	
👸 Security		3.5.13.20		<u>^</u>	
E SFC		3.5.13.10	Ч		
SoftMotion	Settings	3.5.12.80		_	
Source Download	Allow unico	ode 3.5.12.70			

÷

2.14.3 Communication Devices

Select [Update Device...] in the right-click menu of a Communication Device (e.g. EtherCAT Master).

Basic (Basic)	_
🔟 EtherCAT_Master (EtherCAT Master	
	, Cut
E	Copy
6	🔁 Paste
>	X Delete
	Refactoring •
E	Properties
1	Add Object
6	Add Folder
	Add Device
	Insert Device
	Scan for Devices
	Disable Device
	Update Device
	ີງ Edit Object

Activate [Display all versions (for experts only)] in Update Device window.

me EtherCAT_Master				
Action				
Append device 🔿 Insert device 🔿 Plug dev	vice 💿 Update device 🗌 Update sa	me devices in pr	oject	
tring for a full text search	Vendor All vendors >			
Name	Vandar	Version	Description	
	vendor	version	Description	
Brot Ether CAT				
	3S - Smart Software Solutions GmbH	3.5.16.30	EtherCAT Master	
EtherCAT Master SoftMotion	3S - Smart Software Solutions GmbH	3.5.16.30	EtherCAT Master SoftMotion	
🗉 🕮 Ethernet Adapter				
🗉 👄 EtherNet/IP				
Chapter 2 Programming

All versions of the target communication device are displayed. Select the proper version that corresponds to the firmware version of your HX-CPU.

ma Eth	AT Master			
ne Eu	IerCAT_Master			
ction				
) Append	d device 🔘 Insert device 🔵 Pl	ug device 💿 Update device 🔲 Update sar	me devices in p	roject
tring for a	a full text search	Vendor <all vendors=""></all>		
Vana -		Vender	Version	Description
vame	-	vendor	version	Description
-	Bed Master			
	EtherCAT Master	3S - Smart Software Solutions GmbH	3.4.4.0	EtherCAT Master
	EtherCAT Master	3S - Smart Software Solutions GmbH	3.5.0.0	EtherCAT Master
	EtherCAT Master	3S - Smart Software Solutions GmbH	3.5.3.0	EtherCAT Master
	EtherCAT Master	3S - Smart Software Solutions GmbH	3.5.4.0	EtherCAT Master
	EtherCAT Master	3S - Smart Software Solutions GmbH	3.5.5.0	EtherCAT Master
	EtherCAT Master	3S - Smart Software Solutions GmbH	3.5.7.0	EtherCAT Master
	EtherCAT Master	3S - Smart Software Solutions GmbH	3.5.7.30	EtherCAT Master
	EtherCAT Master	3S - Smart Software Solutions GmbH	3.5.8.0	EtherCAT Master
	🛛 🏢 EtherCAT Master	3S - Smart Software Solutions GmbH	3.5.8.40	EtherCAT Master
	🐨 🔟 EtherCAT Master	3S - Smart Software Solutions GmbH	3.5.9.0	EtherCAT Master
	\cdots 🔟 EtherCAT Master	3S - Smart Software Solutions GmbH	3.5.9.50	EtherCAT Master
	🐨 🔟 EtherCAT Master	3S - Smart Software Solutions GmbH	3.5.10.0	EtherCAT Master
	🔤 🔟 EtherCAT Master	3S - Smart Software Solutions GmbH	3.5.11.40	EtherCAT Master
	🐨 🔟 EtherCAT Master	3S - Smart Software Solutions GmbH	3.5.12.40	EtherCAT Master
	🗹 🔟 EtherCAT Master	3S - Smart Software Solutions GmbH	3.5.13.20	EtherCAT Master
	🐨 🔟 EtherCAT Master	3S - Smart Software Solutions GmbH	3.5.13.30 h	EtherCAT Master
	💮 🚹 EtherCAT Master	3S - Smart Software Solutions GmbH	3.5.14.0	EtherCAT Master
	🖳 🔟 EtherCAT Master	3S - Smart Software Solutions GmbH	3.5.14.30	EtherCAT Master
	- 💮 EtherCAT Master	3S - Smart Software Solutions GmbH	3.5.15.30	EtherCAT Master
		3S - Smart Software Solutions GmbH	3.5.16.0	EtherCAT Master
	- 🔟 EtherCAT Master	3S - Smart Software Solutions GmbH	3.5.16.20	EtherCAT Master

The version of the communication device set in the project is shown on the information screen of the device editor.

💮 EtherCAT_Master 🗙	
General	General
	Name: EtherCAT Master
Sync Unit Assignment	Vendor: 3S - Smart Software Solutions GmbH
	Categories: Master
EtherCAT I/O Mapping	Type: 64
	ID: 0000 0001
EtherCAT IEC Objects	Version: 3.5.13.20
	Description: EtherCAT Master
Status	Configuration version: 3.5.11.0
Information	
	P

2.14.4 Libraries

Open Library Manager window and click Placeholders button.

Devices 👻 🕈 🗙	Library Manager 🗙		
- Dutitled 12	🕒 Add Library 🔀 Delete Library 🕍 Properties 🗃 Details 🔄 Placeholders 👔 Library Repo	sitory 🕕 Icon legend	ł
Device (HX-CP1H16)	Name	Namespace	Effective version
PLC Logic	Placeholders	3S LICENSE	3.5.12.0
= Q Application	BreakpointLogging = Breakpoint Logging Functions, 3.5.5.0 (3S - Smart Software Solutions GmbH)	BPLog	3.5.5.0
Library Manager	CAA Device Diagnosis = CAA Device Diagnosis, 3.5.13.0 (CAA Technical Workgroup)	DED	3.5.13.0
PLC_PRG (PRG)	🛱 🗠 📒 CAA DTUtility = CAA DTUtil Extern, 3.5.12.0 (CAA Technical Workgroup)	DTU	3.5.12.0
EtherCAT Task	CAA File = CAA File, 3.5.13.0 (CAA Technical Workgroup)	FILE	3.5.13.0
MainTask	🕸 📒 CAA Types = CAA Types Extern, 3.5.13.0 (CAA Technical Workgroup)	CAA	3.5.13.0
PLC PRG	CmpHIESErrors_HX = CmpHIESErrors_HX, 3.5.8.21 (HIES)	CmpHIESErrors_HX	3.5.8.21 0
Basic (Basic)	CmpHIESLIb_HX = CmpHIESLIb_HX, 3.5.13.40 (HIES)	CmpHIESLib_HX	3.5.13.40 🕚
EtherCAT_Master (EtherCAT Master)	IODrvEtherCAT = IODrvEtherCAT, 3.5.13.20 (3S - Smart Software Solutions GmbH)	IoDrvEthercatLib	3.5.13.20
	IoStandard = IoStandard, 3.5.13.0 (System)	IoStandard	3.5.13.0
	Standard = Standard, 3.5.13.0 (System)	Standard	3.5.13.0
	SysCom = SysCom, 3.5.5.0 (System)	SysCom	3.5.5.0
	Util = Util, 3.5.11.0 (System)	Util	3.5.11.0

Placeholders window is displayed. Select the target library which you want to change the version, and specify the version corresponding to the firmware version of your HX-CPU.



Libraries which are loaded automatically are displayed in black color. Those libraries may not be displayed in the list on Placeholders window. In that case, select the target library in Library Manager window and click Properties button.

/ 🎁	ibrary Manager 🗙		
🗄 Add	Library 🗙 Delete Library 🛛 🎦 Properties 🗊 Details 🖾 Placeholders 🖉 Library Repos	itory 🕕 Icon legend.	
Name	Properties	Namespace	Effective version
<u>ب</u>	3SLicense = 3SLicense, 3.5.12.0 (3S - Smart Software Solutions GmbH)	_3S_LICENSE	3.5.12.0
_ 🗷	BreakpointLogging = Breakpoint Logging Functions, 3.5.5.0 (3S - Smart Software Solutions GmbH)	BPLog	3.5.5.0
± [CAA Device Diagnosis = CAA Device Diagnosis, 3.5.13.0 (CAA Technical Workgroup)	DED	3.5.13.0
_ ۱	CAA DTUtility = CAA DTUtil Extern, 3.5.12.0 (CAA Technical Workgroup)	DTU	3.5.12.0
۳	CAA File = CAA File, 3.5.13.0 (CAA Technical Workgroup)	FILE	3.5.13.0
۰	CAA Timer Extern, 3.4.4.0 (CAA Technical Workgroup)	TMR	3.4.4.0
±	CAA Types = CAA Types Extern, 3.5.13.0 (CAA Technical Workgroup)	CAA	3.5.13.0
··· [CmpHIESErrors_HX = CmpHIESErrors_HX, 3.5.8.21 (HIES)	CmpHIESErrors_HX	3.5.8.21 🚺
	CmpHIESLib_HX = CmpHIESLib_HX, 3.5.13.40 (HIES)	CmpHIESLib_HX	3.5.13.40 🕕 🕚
_ ۱	IODrvEtherCAT = IODrvEtherCAT, 3.5.13.20 (3S - Smart Software Solutions GmbH)	IoDrvEthercatLib	3.5.13.20
±	IoStandard = IoStandard, 3.5.13.0 (System)	IoStandard	3.5.13.0
···· [Standard = Standard, 3.5.13.0 (System)	Standard	3.5.13.0
±	SysCom = SysCom, 3.5.5.0 (System)	SysCom	3.5.5.0
<u>ا</u> ، 🖻	Util = Util, 3.5.11.0 (System)	Util	3.5.11.0

Property window appears. Specify the version corresponding to the firmware version of your CPU.

roperties - CAA 1	imer Extern, 3.4.4.0 (CAA Technical Wo	rkgroup)	×
General:		Version:	
Namespace:	TMR	Specific version: 3.4.4.	
Default library:		Newest version alv 3.5.5. 3.5.1.	
Visibility:		3,4,4,	° 🖓

2.14.5 Visualization profile

Select [Project] – [Project Settings...].

View	Proj	ject	Build	Online	Debug	Tools	Windo
5 N	*:::	Add	l Object				- ► P
		Add	l Folder				- 1
		Sca	n for Dev	ices			- i
12		Upo	late Devi	ce			- 1
- ce (HX-C	ß	Edit	Object				- 1
PLC Logic		Edit	Object V	Vith			- 1
💭 Арр	Ľ	Onl	ine Confi	ig Mode			- 1
- 🎁 L		Set	Active A	oplication			- 1
	i	Pro	ject Infor	mation			
<u> </u>	₽	Proj	ject Settii	ngs			
		Pro	ject Envir	onment	2		

Project setting window appears. Select the visualization profile from the menu on the left side of the window and specify the version corresponding to the firmware version of your HX-CPU.

 Compile options Compiler warnings Library development Page Setup Security 	Project Settings			×	
CODESYS V3.5 SP13 Patch 3 % SFC CODESYS V3.5 SP13 SoftMotion CODESYS V3.5 SP12 Patch 6 Source Download CODESYS V3.5 SP12 Patch 5 Static Analysis Light CODESYS V3.5 SP12 Patch 4 Users and Groups CODESYS V3.5 SP12 Patch 4 Users and Groups CODESYS V3.5 SP12 Patch 4 Visualization CODESYS V3.5 SP12 Patch 1 ODESYS V3.5 SP12 Patch 1 CODESYS V3.5 SP12 Patch 1 CODESYS V3.5 SP12 Patch 1 CODESYS V3.5 SP12 Patch 1 ODESYS V3.5 SP12 Patch 1 CODESYS V3.5 SP12 Patch 1	 Compile options Compiler warnings Library development Page Setup Security SFC SoftMotion Source Download Static Analysis Light Users and Groups Visualization Visualization Profile 	Visualization Profile Visualization Profile Specificprofile	Profile CODESYS V3.5 SP13 Patch 2 CODESYS V3.5 SP13 Patch 2 CODESYS V3.5 SP13 Patch 3 CODESYS V3.5 SP13 Patch 3 CODESYS V3.5 SP12 Patch 6 CODESYS V3.5 SP12 Patch 5 CODESYS V3.5 SP12 Patch 5 CODESYS V3.5 SP12 Patch 4 CODESYS V3.5 SP12 Patch 4 CODESYS V3.5 SP12 Patch 2 CODESYS V3.5 SP12 Patch 1 CODESYS V3.5 SP12 Patch 1 CODESYS V3.5 SP12 Patch 1 CODESYS V3.5 SP11 Patch 1 CODESYS V3.5 SP11 Patch 2 CODESYS V3.5 SP11 Patch 1		

2.15 Installation of Package files

Package files (***.package) are used to install device files and/or library files at once. The following is the procedure to install a package file.

- 1. Store a target package file (***.package) to an optional folder.
- 2. Start up HX-CODESYS and select [Tools] [Package Manager...].



3. Click [Install...] button and select the target package file.

🗊 Package Manager						×
Currently installed packages: Refresh			Sor	t by: Name	~	Install
Name	Version	Installation date	Update info	License info		Uninstall
CAA Device Diagnosis Example	1.0.0.0	2019/07/10		No license required		Details
CODESYS Security Agent	1.1.0.0	2019/08/28		No license required		D GEENISM.
CODESYS SoftMotion	4.4.0.2	2018/12/04		No license required		Underse
Device Reader	1.0.0.5	2019/07/23		No license required		Updates

4. Follow the installation wizard.

Installation - License Agreement	×	Installation - Choose Setup Type	×
File Utilities [1.0.0.5] Please carefully read the license agreement below. You must accept the license agreement to continue with setup.	2	File Utilities [1.0.0.5] Please select the type of setup you would like to perform.	õ
License Agreement for the usage of a CODESYS Software or CODESYS Software Package General Terms of License (End User License Agreement) for the supplied Software. Please read this Software User Agreement carefully before using the supplied Software. Downloading or installation of the Software constitutes recognition by the customer of the conditions of this	X	 Complete setup All package components will be installed. Typical setup The most commonly used package components will be installed. Customized setup Full control over which package components are installed. 	
Agreement. ✓ I have read, understand, and accept the license agreement displayed above. Checksum: 4671D3B9B7C21962DD8C322E4308F652E6676B8E Cancel <back next=""> Finis</back>	ih.	Recommended for advanced users. Cancel < Back Next >	Finish

Installation - Progress	×	Installation - Summary	×
File Utilities [1.0.0.5] Please wait while the package is being installed.	đ	File Utilities [1.0.0.5] Installation summary	õ
Libraries LibraryProfile: Component/LibraryProfile 5/Plc Services.libraryprofile		Summary: Library (79) Successful Device description (1) Visualization style (1) File (3)	
Cancel < Back Next >	Finish	Cancel < Back Next >	Finish

5. After finishing the installation, the target package is listed in the Package Manager window. Please restart HX-CODESYS to apply the change.

The version of the package can be checked in the list.

Name	Version
CAA Device Diagnosis Example	1.0.0.0
CODESYS Security Agent	1.1.0.0

2.16 Project Archive

An archive file (*.projectarchive) contains all files contained and referenced in the currently opened project. It is very helpful for providing other engineers with all project-relevant files.

1. Select [File] – [Project Archive] – [Save/Send Archive].



2. Activate the checkbox next to each object that is to be saved in the archive and click [Save] button.



Note

In order to guarantee know-how protection, HX-CODESYS will not automatically add unprotected libraries, not available as "compiled-library", to a project archive. If you explicitly select such a library in the list of additional files, you will get an appropriate warning.

3. Select a storage location and a file name and click [Save] button.

Reference

If the program of a CPU is edited from multiple PCs, exchange the Project Arcive file containing Download information files among the PCs.

The file size varies depending on the number of the included components. When you select the Project Arcive menu, the following dialog will be displayed. If you want to reduce the file size, select only Download information files as shown below. The size of the generated archive file will be almost the same as the project file.



Open the project archive file containing Download information files in another PC. When Download information files exist, you can log in to the PLC without stopping the PLC.

Also, use the source download function as a way to avoid losing in the program running in the HX-CPU.

First, select "Implicitly at program download and online change" for Timing setting of Source Download configuration in order to always update the source file when the CPU program is changed. Enable [Use compact download] if you want to shorten the processing time.

Destination Device		
<all devices="" in="" project<="" th=""><th>Þ</th><th>``</th></all>	Þ	``
Content		
The project file itself	is always part of the source download archive	
Use compact dov	vnload	
Additional Files		
Timing		
Implicitly at progr	am download and online change	
 Implicitly at creation 	ng boot project	
 Implicitly at creation 	ng boot project, download and online change	
O Prompt at program	n download and online change	
Only on demand		

Click [Additional Files...] button and tick only Download information files. Then, you can log in to the PLC without stopping PLC even if you download the source file from the CPU.

Additional Files	(
 Download information files Library profile Referenced devices Referenced libraries SoftMotion Library Profiles Visualization Profile 	
OK Cancel	

Chapter 3 Communication I/F in CPU

3.1 EtherCAT Master

3.1.1 Configuration

Right-click on [Device] and choose [Add Device...]. [Add Device] window appears.

Click [EtherCAT Master] and [Add Device] button.





Double click [EtherCAT Master (EtherCAT Master)] to configure Ethernet port. After communication between PC and HX-CPU configured, click [Browse...] button and choose Ethernet port for EtherCAT master.

EtherCAT_Master X			
General	☑ Autoconfig Master/Slaves	Ether CAT	
Sync Unit Assignment	EtherCAT NIC Setting		
EtherCAT I/O Mapping	Destination Address (MAC) FF-FF-FF-FF-FF-FF	ast 🔲 Enable Redundancy	
Status	Source Address (MAC) 00-00-00-00-00 Browse		
Information	Select Network by MAC		
	✓ Distributed Clock		
	Cycle Time 4000 Sync Offset 20 Sync Window Monitoring		
	Sync Window 1 k		
Select Network Adapter			
MAC address Name I 00000000000 lo 00 000102030412 eth3 000102030413 eth1 000102030413 eth2 }	Description Choose Ethernet port to be used.	Be sure to use [eth EtherCAT master.	1] or [eth2] for
	ОК	Abort	

Chapter 3 Communication I/F in CPU

Right mouse click on [EtherCAT master] and choose [Add Device]. The available devices are shown in [Add Device] window. Choose slave units according to your system configuration and click [Add Device] button.



If actual slaves are physically connected, it is possible to search the devices from the network if communication between PC and HX-CPU has been already configured according to section 2.7. Right mouse click on [EtherCAT_Master (EtherCAT Master)] and choose [Scan For devices]. Click [Copy All Devices to Project] to complete.



Devices					>
Scanned Devices					
Devicename	Devicetype				
EH_IOCA	EH-IOCA(3.5.4.0) - 0				
16_Digital_Output	Y16				
16_Digital_Input	×16				
		⊟ Show Di	fference	es to Pro	iect
		Show Di	fference	es to Pro	iect

If EtherCAT Slave Information (ESI) file of the slave is not installed, right device name is not shown in the Scan Device dialog. Be sure to obtain the ESI file and install it to HX-CODESYS in advance in the menu [Tools]-[Device Repository].

3.1.2 Cycle of EtherCAT Task

The EtherCAT communication cycle is set with the EtherCAT Master cycle time. The configured cycle time is automatically reflected in the EtherCAT task cycle.

EtherCAT_Master X		
General	Autoconfig Master/Slaves	Ether CAT.
Sync Unit Assignment	EtherCAT NIC Setting	
EtherCAT Parameters	Destination Address (MAC) FF-FF-FF-FF-FF Broad	cast Enable Redundancy
EtherCAT I/O Mapping	Source Address (MAC) 00-00-00-00 Browse Network Name	•••
EtherCAT IEC Objects	Select Network by MAC O Select Network by Name	
Status	■ Distributed Clock Options	
Information	Cycle Time 4000 🖨 µs	
	Sync Offset 20 🔶 %	
	Sync Window Monitoring	
	Sync Window 1 🖕 µs	

(1) Case of SP8

When an EtherCAT master device is added to the device tree, an [EtherCAT_Master_Task] is automatically created under [MainTask]. The EtherCAT Master cycle time is reflected in [MainTask].

Project Device (HX-CP1H16) PRC Logic Application Device (HX-CP1H16)	Devices	▲ 1
Device (HX-CP1H16) PLC Logic Application PLC_PRG (PRG) PLC_PRG MainTask PLC_PRG MainTask PLC_PRG MainTask × Interval (e.g. t#200ms): 4000 yps	Project	
MainTask × iority (031): 0 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 1 0 1 1	🗏 📑 Device	: (HX-CP 1H16)
Application Ubrary Manager PLC_PRG (PRG) Solution MainTask PLC_PRG MainTask PLC_PRG MainTask X infguration iority (031): 0 Type Cyclic Interval (e.g. t#200ms): 4000 µs	🖻 🗐 PL	.C Logic
MainTask Ma	= ()	Application
MainTask MainTas		ibrary Manager
Image: Second guration Image: Second gurat		
MainTask MainTask MainTask X infiguration iority (031): 0 Type Cyclic Interval (e.g. t#200ms): 4000 µs		3 👹 Task Configuration
MainTask X MainTask X iority (031): Cype Cydic Interval (e.g. t#200ms): 4000		MainTask
MainTask X ifiguration iority (031): Cype Cydic Interval (e.g. t#200ms): 4000		一 一 同 EtherCAT Master.EtherCAT Task
MainTask × ifiguration iority (031): 0 Fype Cyclic ▼ Interval (e.g. t#200ms): 4000 µs ▼		
MainTask X ifiguration iority (031): 0 Type Cyclic Interval (e.g. t#200ms): 4000 µs		
ifiguration iority (031): 0 Гуре Cydic ▼ Interval (e.g. t#200ms): 4000 µs ▼	MainTask	X
iority (031): 0 Type Cyclic ▼ Interval (e.g. t#200ms): 4000 µs ▼		
iority (031): 0 Гуре Cyclic ▼ Interval (e.g. t#200ms): 4000 µs ▼	nguration	
iority (031): 0 Гуре Cyclic ▼ Interval (e.g. t#200ms): 4000 µs ▼		
Type Cyclic ▼ Interval (e.g. t#200ms): 4000 μs ▼	arity (0, 21.).	0
Type Cyclic ▼ Interval (e.g. t#200ms): 4000	onty (051):	•
Cyclic ▼ Interval (e.g. t#200ms): 4000	vpe	
Cyclic Interval (e.g. t#200ms): 4000		
	Lyclic	▼ Interval (e.g. t#200ms): 4000 µs ▼

(2) Case of SP13 or newer

When an EtherCAT master device is added to the device tree, an [EtherCAT_Task] is automatically created under [Task Configuration] separately from [MainTask]. The EtherCAT Master cycle time is reflected in [EtherCAT_Task].

Devices 👻 🔻	×
Untitled 18	-
🖻 🔟 Device (HX-CP 1H 16)	
⊟	
Application	
Library Manager	
PLC_PRG (PRG)	
🖃 🌃 Task Configuration	
EtherCAT_Task	
🖻 🕸 MainTask	
PLC_PRG	
😒 EtherCAT_Task 🗙	
Configuration	
Priority (0, 31):	
Туре	
	0ms

Note

The minimum Cycle time for EtherCAT master is 1 ms because a single microprocessor handles all the tasks in HX-CPU. If cycle time is too small, 25 error (Microprocessor Overload) will be detected. This cycle time depends on user program size and the number of I/O modules however, do not set a value less than 1 ms even if program size and the number of I/O modules are small.

💧 🖄 MainTa	sk 🗙		•
Configuration			
Priority (03 Type Occurrent Cyclic	1): 1	Interval (e.g. t#200ms): 1	ms 🗸

3.1.3 Programming

The mapping of slave's I/O is shown as the follow figures. Put variables in this map as same as other I/O modules. (1) Case of SP8

The mapping of slave's I/O is shown in [EtherCAT I/O Mapping] tab.

General	Channels							
	Variable	Mapping	Channel	Address	Туре	Default Value	Unit	Description
Process Data			Control	%QW0	UINT			Control
Startup Parameters	🗄 🍫		Status	%IW0	UINT			Status
	🛄 🗄 ··· 🧤		Module RES	%ID1	UDINT			Module RES
EtherCAT I/O Mapping	🗄 🍫		Module WDT	%ID2	UDINT			Module WDT
Status	i 🐐		Module FAIL	%ID3	UDINT			Module FAIL
Status	🗄 🍫		Module IDER	%ID4	UDINT			Module IDER
Information	i 🗄 🍫		FPGA Version	%IW10	UINT			FPGA Version
	- 😟 🗄 🦄		CPU Version	%IW11	UINT			CPU Version

(2) Case of SP13 or newer

The mapping of slave's I/O is shown in [Module I/O Mapping] tab in I/O module device editor.

nformation	Find		Filter Show	all		-	🕂 Ad	d FB for IO chan	ne
Indula I/O Manaina	Variable	Mapping	Channel	Address	Туре	Default Value	Unit	Description	Τ
iodule 1/o Mapping	🖬 🖓		x	%IW12	UINT			х	
	*		Bit0	%IX24.0	BOOL				
			Bit1	%IX24.1	BOOL				
	🍗		Bit2	%IX24.2	BOOL				
	🍗		Bit3	%IX24.3	BOOL				
	🍗		Bit4	%IX24.4	BOOL				
	* >		Bit5	%IX24.5	BOOL				
	🍫		Bit6	%IX24.6	BOOL				
	* >		Bit7	%IX24.7	BOOL				
	🍗		Bit8	%IX25.0	BOOL				
	* >		Bit9	%IX25.1	BOOL				
	- *		Bit10	%IX25.2	BOOL				
	···· 👋		Bit11	%IX25.3	BOOL				
	* >		Bit12	%IX25.4	BOOL				
	···· 🍫		Bit13	%IX25.5	BOOL				
	🍫		Bit14	%IX25.6	BOOL				
	· · · · · *>		Bit15	%IX25.7	BOOL				

Note

- If PLC is powered up with RUN/STOP switch in RUN position, I/O refresh of EtherCAT slaves may start approximately 1 second later than refresh of standard external I/O due to configuration process of EtherCAT master for slave units. If this delay gives impact your system operation, use xConfigFinished bit. This bit is set when configuration of EtherCAT master is finished. Sample program in ST language is shown as follows.
- Since EtherCAT communication is executed by an EtherCAT_Master task that is asynchronous with other tasks, the EtherCAT slave I/O refresh cycle is delayed up to one cycle of the basic/expansion base I/O refresh.

Sample program

Be sure to use the same instance name as EtherCAT master. Default instance of EtherCAT master is [EtherCAT Master].

IF EtherCAT_Master.xConfigFinished=FALSE THEN RETURN; END_IF; The following program in this POU is not executed while EtherCAT_Master.xConfigFinished is FALSE (OFF).

3.1.4 Redundancy EtherCAT

Redundancy EtherCAT Master is supported on SP13. This feature prevents the entire network from being down due to a communication path or slave failure. The slave devices also must support EtherCAT redundancy functionality to make this feature work properly.



[Configuration]

Specify a MAC address on [Redundancy EtherCAT NIC Setting] in the same way as general [EtherCAT NIC Setting] after enabling Redundancy.

EtherCAT_Master X		
General	Autoconfig Master/Slaves	Ether CAT
Sync Unit Assignment	EtherCAT NIC Setting	
EtherCAT Parameters	Destination Address (MAC) FF-FF-FF-FF-FF 🗹 E	Broadcast 🗹 Enable Redundancy
EtherCAT I/O Mapping	Source Address (MAC) A4-97-BB-06-A5-20 Br Network Name eth1	owse
EtherCAT IEC Objects	Select Network by MAC Select Network by Na	ime
Status	Redundancy EtherCAT NIC Setting	
Information	Destination Address (MAC) FF-FF-FF-FF-FF	Broadcast
	Source Address (MAC) A4-97-BB-06-A5-21 Br	owse
	Network Name eth2	
	Select Network by MAC O Select Network by Na	ime

[Properties]

The error can be obtained by using the following EtherCAT Master Device properties.

Property Name	Data type	Description
FirstPortActive	BOOL	TRUE, if the first port is operating.
SecondPortActive	BOOL	TRUE, if the second port is operating
NbrSlavesFirstPort	UINT	Represents the number of the connected slaves on the first port.
NbrSlavesSecondPort	UINT	Represents the number of the connected slaves on the second port.

```
Example)
```

	PLC	_PRG X
	1	PROGRAM PLC_PRG
-	2	VAR
	3	xFirstPortActive: BOOL;
	4	xSecondPortActive: BOOL;
	5	uiNbrSlavesFirstPort: UINT;
	6	uiNbrSlavesSecondPort: UINT;
	7	END_VAR
	1	<pre>xFirstPortActive := EtherCAT_Master.FirstPortActive;</pre>
	2	<pre>xSecondPortActive := EtherCAT_Master.SecondPortActive;</pre>
	3	uiNbrSlavesFirstPort := EtherCAT_Master.NbrSlavesFirstPort;
	4	uiNbrSlavesSecondPort := EtherCAT_Master.NbrSlavesSecondPort;
	5	

Note

Enable [Automatic Restart Slaves] setting when using Redundancy EtherCAT functionality. EtherCAT communication can continue even though one of the EtherCAT ring topologies gets disconnected. Please note that EtherCAT communication may halt for up to 1000 ms when re-connecting the cable.

Jan 1997 - 1997

Distributed Clock	Options
Cycle Time 4000 🛓 Sync Offset 20 🖨	µs □ Use LRW instead of LWR/LRD % □ Enable messages per task ✓ Automatic Restart Slaves
Sync Window 1	μs

3.1.5 Wiring

(1) Cable

Use category 5 or higher category of STP (Twisted pair with shield) cable.

(2) Hub (switch)

Standard hub (switch) is not allowed to use in EtherCAT network. Special switch for EtherCAT is required if branch topology is required. (Ex. Model CU1128 by Beckhoff)

Note

Please note that using various Ethernet based communication (EtherCAT master, Modbus-TCP, NVL, Gateway) at the same time will limit the communication performance.

3.2 Modbus-TCP / RTU / ASCII

3.2.1 Overview

HX-CPU supports the following function codes.

Hava			Modbu	us-TCP	Modbu	is-RTU	Modbus-ASCII
desimal	Decimal	Function code	Master	Slave	Master	Slave	Master *
uccimai			(Client)	(Server)			
0x01	01	Read Coils	Х	Х	Х	X*	Х
0x02	02	Read Discrete Inputs	Х	Х	Х	X*	Х
0x03	03	Read Holding Registers	Х	Х	Х	Х	Х
0x04	04	Read Input Registers	Х	Х	Х	Х	Х
0x05	05	Write Single Coil	Х	Х	Х	X*	Х
0x06	06	Write Single Register	Х	Х	Х	Х	Х
0x0F	15	Write Multiple Coils	Х	Х	Х	X*	Х
0x10	16	Write Multiple Registers	Х	Х	Х	Х	Х
0x17	23	Read/Write Multiple Registers	Х	Х	Х	X	Х

X: Supported, -: Not supported

* Supported on SP13

Modbus communication processing is executed by [Bus Cycle Task] specified in [PLC settings] tab of Device. Any task can be assigned for [Bus Cycle Task]. If <unspecified> is chosen, the shortest cycle task is assigned automatically.

Device X		
Communication Settings	Application for I/O handling:	Application 👻
Applications	PLC settings	
Backup and Restore	Behaviour for outputs in Stop:	Set all outputs to default
Files	Always update variables:	Disabled (update only if used in a task)
Log	Edit Licenses	
PLC settings	Bus cycle options Bus cycle task:	<unspecified></unspecified>

Note

Modbus master does not support broadcast query.



With [Add Device] window opened, click [Ethernet] in the device tree. Then available devices will be shown in the [Add Device] window. Click [Modbus TCP Master] and [Add Device].



With [Add Device] window opened, click [Modbus_TCP_Master] in the device tree. Then [Modbus TCP Slave] is shown in the [Add Device] window. Click [Modbus TCP Slave] and [Add Device] button according to your Modbus system configuration. If three slave units are used, add three times of slave devices.

Device (HX-CP1H16)	Name
Application	🖃 🖬 Fieldbusses
📲 📶 Library Manager	🖻 📲 🗰 Modbus
PLC_PRG (PRG)	
🗏 🌃 Task Configuration	Modbus TCP Slave
🖹 👹 MainTask	
PLC_PRG	
Basic (Basic)	
Ethernet (Ethernet)	
Modbus_TCP_Master (M	

Device (HX-CP1H16)	
🖹 📲 PLC Logic	
🖻 🧔 Application	
👘 Library Manager	
architecture Task Configuration	
🖃 🍪 MainTask	
PLC_PRG	
🗄 👔 Basic (Basic)	
Ethernet (Ethernet)	
Hodbus_TCP_Master (Modbus TCP Master)	
Modbus_TCP_Slave (Modbus TCP Slave))
Modbus_TCP_Slave_1 (Modbus TCP Slave)	Be sure to configure all slaves to be controlled.
Modbus_TCP_Slave_2 (Modbus TCP Slave)	J

Choose Ethernet port for Modbus-TCP. After communication between PC and HX-CPU configured, click [...] button and choose Ethernet port for Modbus-TCP.

🖬 Ethernet 🗙				
General	Interface:			
Status	Operating Sy	stem Settings		
Information	Change Operatin	g System Settings		
	IP address	192 . 168 . 10 . 1]	
	Subnet mask	255 . 255 . 255 . 0		
	Default Gateway	0.0.0.0		
			1	
Network Adapters				
Interfaces:				
Name Description IP Address				
lo 127.0.0.1				2
eth3 192.168.2.1				
eth 1 192.108.0.1				Choose Ethernet port to be used.
Bul2 132.100.1.1				J
IP address 192 . 168 . 0 . 1				
Subnet mask 255 . 255 . 255 . 0				
Default Gateway 0 . 0 . 0 . 0				
MAC-Address: A4:97:BB:06:A1:70				
			Ok Cancel	

Note

Set the IP address in [PLC Parameters] window. If you set it from Ethernet device editor, it will not work properly.

Chapter 3 Communication I/F in CPU

Function codes to be sent must be configured in each slave. Double-click a slave unit to open configuration window. Set IP address, response timeout and port number as follows. Unit-ID is required only when Modbus gateway (Ethernet to serial) device is used.

Modbus_TCP_Slave X			
General	Modbus-TCP		Monpue
Modbus Slave Channel	Slave IP Address:	192 . 168 . 0 . 1	MUDBO2
Modbus Slave Init	Unit-ID [1247]	1000	
ModbusTCPSlave Parameters	Port	502	
ModbusTCPSlave I/O Mapping			
Status			
Information			

Open [Modbus Slave Channel] tab and click [Add Channel...] to add function codes.

General	Name	Access Type	Trigger	READ Offset	Length	Error Handling	WRITE Offset	Length	Comment
Modbus Slave Channel									
10dbus Slave Init									
ModbusTCPSlave Parameters									
1odbusTCPSlave I/O Mapping									
itatus									
information									
						Add Chan	nel Del	ete	Edit

Configure each parameter as below. If the [Trigger] setting is [Rising edge], trigger variable (BOOL) will be automatically assigned in %QX address.

ModbusChannel		x
Channel	Channel 0	
Access Type	Read Holding Registers (Function Code 3)	
Trigger	Cyclic Cycle Time (ms) 100	
Comment		
READ Register		
Offset	0x0000 👻	
Length	1	
Error Handling	Keep last Value 🔻	
WRITE Register		
Offset	0x0000 👻	
Length	1	
	<u>O</u> K <u>C</u> ance	:I

General	Name	Access Type	Trigger	READ Offset	Length	Error Handling	N
Madhua Slava Channal	Channel 0	Read Holding Registers (Function Code 03)	Cyclic, t#100ms	16#0000	1	Keep last Value	
Houbus Slave Channel	Channel 1	Write Single Register (Function Code 06)	Cyclic, t#100ms				16
Modbus Slave Init	Channel 2	Write Single Coil (Function Code 05)	Cyclic, t#100ms				16
4odbusTCPSlave Parameters							
Andhun TCDClaure I/O Managina							
NodbusTCPSlave I/O Mapping							
1odbusTCPSlave I/O Mapping							
10dbusTCPSlave I/O Mapping itatus nformation							
1odbusTCPSlave I/O Mapping itatus nformation							
ModbusTCPSlave I/O Mapping Status Information							

Read and written data from/to slaves is assigned to %IW or %QW as seen in [ModbusTCPSlave I/O Mapping] tab. Read data from slave is assigned to input area (%IW) and data to be written to slave is assigned to output area (%QW).

General	Channels							
	Variable	Mapping	Channel	Address	Туре	Def	Unit	Description
odbus Slave Channel			Channel 0	%IW0	ARRAY [00] OF WORD			Read Holding Register
1odbus Slave Init	÷		Channel 1	%QW0	ARRAY [00] OF WORD			Write Single Register
	i K		Channel 2	%QB2	ARRAY [00] OF BYTE			Write Single Coil
10dbusTCPSlave I/O Mapping Status								

Note

- Modbus master works in the bus cycle task configured in [Modbus_TCP_Master]. If several channels are configured, single bus cycle can handle only either sending or receiving of one channel.
- If trigger is set as [Rising edge] and this bit is set and reset frequently, command sending and receiving may not work properly. When T1 is defined as time from starting of request command to end of response for channel 1, and T2 is defined as time from starting of request command to end of response for channel 2, do not set or reset trigger variable during T1+T2+...+Tn.
- When using the ModbusTCPSlave function block in a program, the availability of [Auto-reconnect] setting differs according to the IoDrvModbusTCP library version.

IoDrvModbusTCP library	Availability of Auto-reconnect setting
3.5.8.10	Disable
3.5.13.0	Enable

3.2.3 Modbus-TCP Slave (Server)

Right-click on [Ethernet] and choose [Add Device...]. Click [Modbus TCP Slave Device] in the [Add Device] window and [Add Device] button.



Choose Ethernet port for Modbus-TCP. After communication between PC and HX-CPU configured, click [...] button and choose Ethernet port for Modbus-TCP.

Etho	ernet 🔅	×												
General				Interface:										
Status				Oper Use Oper	rating Sy	stem Setti	ngs							
Informat	ion			🔘 Change C	Operating	g System S	iettings							
				IP address		192 . 16	8.10.	1						
				Subnet mask	k	255 . 25	55.255.	0						
				Default Gate	eway	0.0).0.	0						
											_			
Network A	dapters									×				
Interfaces:														
Name	Descrip	tion	IP Address							_				
eth3			127.0.0.1								h			
eth1			192.168.0.1								ļ	Choose Eth	arnat nort to ba	usad
eth2			192.168.1.1									Choose Eth	ernet port to be	useu.
											ľ			
IP address	s	192 . 10	58.0.1											
Subnet ma	ask	255 . 29	55 . 255 . 0											
Default Ga	ateway	0.0	0.0.0											
MAC-Add	lress:	A4:97:BI	B:06:A1:70											
								0	Ca	ncel				

Note

- · Set the IP address in [PLC Parameters] window. If you set it from Ethernet device editor, it will not work properly.
- Also other Ethernet ports than chosen one work as Modbus-TCP slave however, it is recommended to use configured Ethernet port only.
- Modbus-TCP slave can be added to eth1 to eth3 each, but there is only one Modbus map in the CPU. In this sense, do not configure 2 or more Modbus-TCP slaves. If the same port number is used in several Modbus-TCP slaves, Modbus-TCP slave gets error.
- If warm reset is performed while TCP connection is opened, it takes approximately 1 minute to open the connection again.

SP8 or SP13

Double-click [Modbus TCP Slave Device] and set parameters. Port number for Modbus-TCP is fixed as 502. Do not set other number but 502.

Mapping table will be created in [Modbus TCP Slave Device I/O Mapping] tab according to configured size for Holding Registers (%IW) and Input Registers (%QW).

ModbusTCP_Slave_Device	<		Configuration range		
General Modbus TCP Slave Device I/O Mapping Information	Configured Parameters TimeOut: Slave Port: Unit ID: Holding Registers (%IW): Input Registers (%QW):	2000 (ms) 502 (10 (10 (10 (10 (10 (10 (10 (10	Configuration Holding Registers (%IW) Input Registers (%QW) Start Addresses	V3.5 SP8 2500 2500 065535	V3.5 SP13 24096 24096 065535
	Data Model Start Addresses: Coils: Discrete Inputs: HoldingRegister: Input Register: Holding- and Input-Reg	0 x 0 x 0 x 0 x 0 x ister Data Areas overlay			

ModbusTCP_Slave_Device	×							
General	Channels							
	Variable	Mapping	Channel	Address	Туре	Default Value	Unit	Description
Modbus TCP Slave Device I/O Mapping	📮 ᡟ		Inputs	%IW0	ARRAY [01] OF WORD			Modbus Holding Registers
	🗖 🗄 🖷 🦘		Inputs[0]	%IW0	WORD			
Information	🖻 - 🍫		Inputs[1]	%IW1	WORD			
	🖻 ^K ø		Outputs	%QW0	ARRAY [01] OF WORD			Modbus Input Registers
	🕀 - ^K ø		Outputs[0]	%QW0	WORD			
	. <u> </u>		Outputs[1]	%QW1	WORD			

WORD registers and BOOL registers are physically in the same memory as below.

- Input register (WORD) and discrete input (BOOL)
- Holding register (WORD) and Coil (BOOL)

Input Register		Discrete Input Address 15 (0x000F)						Discrete Input Address 0 (0x0000)							Discrete Input		
Address	15	\int_{14}	13	12	11	10	9	8	7	6	5	4	3	2	1	\setminus_0	
0000	•															\mathbf{b}	/
0001																•	
0002																	
																11	
Holding Regist	er	С	oil								Coil						
		А	ddres	s15 (0	x000	F)					Add	ress 0	(0x0	000)			Coil
		\int					•								/	\	Address 16 (0x0010)
Address	15	/ 14	13	12	11	10	9	8	7	6	5	4	3	2	1	$\sqrt{0}$	/
0000	•															\mathbf{b}	
0001																•	
0002																	
									2	4.4							

<u>SP16</u>

Double-click [Modbus TCP Slave Device] and set parameters. Port number for Modbus-TCP is fixed as 502. Do not set other number but 502.

Mapping table will be created in [Modbus TCP Slave Device I/O Mapping] tab according to configured size for Holding Registers (%IW) and Input Registers (%QW).

ModbusTCP_Slave_Device	×		
General	Configured Parameters		Configu
Codel Coheman	U Watchdog	500 🌲 (ms)	Confid
Serial Gateway	Slave port	502 🖨 🗌 Bind to Ada	pter COIIII§
Modbus TCP Slave Device I/O Mapping	Holding Registers	10 🚖 (%IW) 🗌 V	Nriteable Holdin
Modbus TCP Slave Device IEC Objects	Input Registers	10 🗘 (%QW)	(%IW
	Discrete Bit Areas		()
Status	Coils	0 🔶 (%IX)	Input 1
Information	Discrete Inputs	0 🗘 (%QX)	(%QW
			Coils (
			Discre
	Data Model		(0/OV)
	StartAddresses		(%QA
	Coils	0	Start A
	Discrete inputs	0	
	Holding register	0	
	Input register	0	
	Holding- and input	egister data areas overlay	

Configuration range							
Configuration	V3.5 SP16						
Holding Registers	24096						
(%IW)							
Input Registers	24096						
(%QW)							
Coils (%IX)	065535						
Discrete Inputs	065535						
(%QX)							
Start Addresses	065535						

If [Discrete Bit Areas] is disabled, data area is defined same as SP13. In the case that this setting is enabled, Input register (WORD) and Discrete inputs (BOOL), Holding register (WORD) and Coils (BOOL) are defined individually.

ModbusTCP_Slave_Device	×									
General	Find		Filter Show all		- 🕂 Add F	Add FB for IO Channel → Go to Instance				
Serial Gateway	Variable	Mapping	Channel Holding Registers	Address %IW0	Type ARRAY [0., 1] OF WORD	Default Value	Unit	Description		
Modbus TCP Slave Device I/O Mapping			Holding Registers[0]	%IW0	WORD					
Modbus TCP Slave Device IEC Objects			Holding Registers[1] Input Registers	%IW1 %QW0	ARRAY [01] OF WORD					
Status	⊕ *		Input Registers[0] Input Registers[1]	%QW0 %QW1	WORD WORD					
Information	ii		Coils	%IB4	ARRAY [01] OF BYTE					
	±		Coils[1]	%IB4 %IB5	BYTE					
	- - " - " - " -" -" -" -" -" -" -" -" -" -" -" -" -"		Discrete Inputs Discrete Inputs[0]	%QB4 %QB4	ARRAY [01] OF BYTE BYTE					
			Discrete Inputs[1]	%QB5	BYTE					

Note

- "Force values" command to the holding register is not supported even if [Writable] setting is enabled.
- Default Value cannot be set for Discrete Inputs.

3.2.4 Modbus-RTU / ASCII Master

Right-click on [Device] and choose [Add Device...]. [Add Device] window appears. Click [Modbus COM] and [Add Device] button.





With [Add Device] window opened, click [Modbus_COM] in the device tree. Then available devices will be shown in the [Add Device] window. Click [Modbus Master, COM Port] and [Add Device] button.



Note

• Modbus command processing is executed in bus cycle tack, which is configured in PLC settings of Device. You can specify any existing IEC tasks. If the bus cycle task is <u specified>, task with the shortest cycle time is taken. If 24 or 25 error appears in CPU, specify longer bus cycle task.

With [Add Device] window opened, click [Modbus_Master_COM_Port] in the device tree. Then [Modbus Slave, COM Port] is shown in the [Add Device] window. Click [Modbus Slave, COM Port] and [Add Device] button according to your Modbus system configuration. If three slave units are used, add three times of [Modbus Slave, COM port].



Note

Be sure to use devices according to Modbus standard. If CPU receives illegal data format, CPU may fail operation.

Configure the serial port. Double-click [Modbus_COM (Modbus COM)] to open Modbus_COM window. This configuration must be same as slaves' configuration. COM Port number of HX-CPU is [1]. Available baud rate is from 4800 up to 115200.

Modbus_COM X								
General	Serial Port Configuration -							
Status	COM Port							
Information	Baud Rate	9600 🔻						
	Parity	EVEN -						
	Data Bits	8						
	Stop Bits	1						

Set the Bus Cycle Task in [Modbus Generic Serial Master I/O Mapping] tab. Configure the priority of the specified task by referring to the description of the priority in section 2.3.

General	IEC Objects							
	Variable	Mapping	Туре					
ModbusGenericSerialMaster I/O Mapping	···· 🖗 Modbus_Master_COM	**	IoDrvModbusComPort					
Status								
Information								
	Specify Bus Cycle Task							
	Specify Bus Cy	cle lask	(
	Specify Bus Cy	/cle Tasł	< c					
	Specity Bus Cy	cle Tasi	¢					
	Specity Bus Cy	/cle lask ~ vote lask vote lask	Ap to existing variable					

Chapter 3 Communication I/F in CPU

Function codes to be sent must be configured in each slave. Double-click a slave unit to open configuration window. Set slave address and response timeout as follows. Response timeout can be set also in slave individually. If it is set in master and slave both, the value in slave is applied. If response timeout in slave is deleted, then the value in master is applied.

	Modbus_Slave_COM_Port 🗙			
	General	Modbus-RTU/ASCII		MONDIIC
ľ	Modbus Slave Channel	Slave Address [1247]	1	MUDDUS
	Modbus Slave Init	Response Timeout [ms]	1000	
	ModbusGenericSerialSlaveI/O Mapping			

Open [Modbus Slave Channel] tab and click [Add Channel...] to add function codes.

hodbus_slave_con_port X									
General	Name	Access Type	Trigger	READ Offset	Length	Error Handling	WRITE Offset	Length	Comment
Modbus Slave Channel									
Modbus Slave Init									
ModbusGenericSerialSlaveI/O Mapping									
Status									
Information									
						Add o	Channel	Delete	Edit

Configure each parameter as below. If the [Trigger] setting is [Rising edge], trigger variable (BOOL) will be automatically assigned in %QX address.

Channel Name Access Type Read Holding Registers (Function Code 3) Trigger Cyclic Comment READ Register Offset 0x0000 Error Handling Keep last Value Offset 0x0000 URITE Register Offset 0x0000 I Length 1	ModbusChannel		x
READ Register Offset Dx0000 Length 1 Error Handling Keep last Value WRITE Register Offset 0x0000 Length 1	Channel Name Access Type Trigger Comment	Channel 0 Read Holding Registers (Function Code 3) Cyclic	
WRITE Register Offset 0x0000 Length 1	READ Register Offset Length Error Handling	0x0000	
	WRITE Register Offset Length	0x0000 v	

Modbus_Slave_COM_Port 🗙

General	Name	Access Type	Trigger	READ Offset	Length	Error Handl	WRITE Offset	Length	Comment
Modbus Slave Channel	Channel 0	Read Holding Registers (Function Code 03)	Cyclic, t#100ms	16#0000	1	Keep last Value			
Houbus Slave Channel	Channel 1	Write Single Register (Function Code 06)	Cyclic, t#100ms				16#0000	1	
Modbus Slave Init	Channel 2	Write Single Coil (Function Code 05)	Rising edge				16#0000	1	
ModbusGenericSerialSlaveI/O Mapping Status									
Information									
	1								
						Add Cha	nnel De	lete	Edit

Read and written data from/to slaves is assigned to %IW or %QW as seen in [ModbusTCPSlave I/O Mapping] tab. Read data from slave is assigned to input area (%IW) and data to be written to slave is assigned to output area (%QW). [Default Value] is written once when the status changes from RUN to STOP.

Modbus_Slave_COM_Port	×							
General	Channels							
	Variable	Mapping	Channel	Address	Туре	Default	Unit	Description
Modbus Slave Channel			Channel 0	%IW0	ARRAY [00] OF WORD			Read Holding Registers
Modbus Slave Init	*		Channel 1	%QW0	ARRAY [00] OF WORD			Write Single Register
	📃 🗄 🍢		Channel 1[0]	%QW0	WORD			03E8
ModbusGenericSerialSlaveI/O Mapping	ė *		Channel 2	%QW1	ARRAY [00] OF WORD			Write Single Register
Statue	i Kø		Channel 2[0]	%QW1	WORD			07D0
Status								
Information								

Note

- Modbus master works in the bus cycle task configured in Modbus_Master_COM_Port. If several channels are configured, single bus cycle can handle only either sending or receiving of one channel.
- If trigger is set as [Rising edge] and this bit is set and reset frequently, command sending and receiving may not work properly. When T1 is defined as time from starting of request command to end of response for channel 1, and T2 is defined as time from starting of request command to end of response for channel 2, do not set or reset trigger variable during T1+T2+...+Tn.

3.2.5 Modbus-RTU Slave

Right-click on [Modbus COM] and choose [Add Device...]. Click [Modbus Serial Device] in the [Add Device] window and [Add Device] button.

Devices 👻 🕂 🗙	
Project	Name
E- I Device (HX-CP1H16)	🖃 💮 Fieldbusses
□-III PLC Logic	
Cyplication Complete Application Complete Application	Modbus Serial Device
E 🌃 Task Configuration	🖮 📖 Modbus Serial Master
ia stransk □ ∰ pLC_PRG	Modbus Master, COM Port
🗉 🔟 Basic (Basic)	
Modbus_COM (Modbus COM)	
\int	
Modbus_COM (Modbus COM)	
Modbus_Serial_Device (Modbus Serial Device)	

Configure the serial port. Double-click [Modbus_COM (Modbus COM)] to open Modbus_COM window. This configuration must be same as master and other slaves' configuration. COM Port number of HX-CPU is [1].

/ III Modbus_COM X		
General	Serial Port Configuration	
Status	COM Port	1
To for small and	Baud Rate	9600 👻
Information	Parity	EVEN -
	Data Bits	8
	Stop Bits	1

SP8 or SP13

Double-click on [Modbus Serial Device] and set parameters same as the configuration of [Modbus TCP Slave]. Mapping table will be created in [Modbus Serial Device I/O Mapping] tab according to configured size for Holding Registers (%IW) and Input Registers (%QW).

Modbus_Serial_Device X		Configuration range		
General	Unit ID:	Configuration	V3.5 SP8	V3.5 SP13
Modbus Serial Device I/O Mapping	✓ Time Out: 2000	Holding Registers (%IW)	2500	24096
Information	Holding Registers (%IW): 10	Input Registers (%QW)	2500	24096
	Input Registers (%QW): 10	Start Addresses	0 (Fixed)	065535

Modbus_Serial_Device 🗙

General	Channels							
	Variable	Mapping	Channel	Address	Туре	Default Value	Unit	Description
Modbus Serial Device I/O Mapping	 *		Inputs	%IW0	ARRAY [09] OF WORD			Modbus Holding Registers
nformation	🗎 🖶 🍗		Inputs[0]	%IW0	WORD			
	😐 ᡟ		Inputs[1]	%IW1	WORD			
	😐 ·· 🍫		Inputs[2]	%IW2	WORD			
	1 🖷 🍫		Inputs[3]	%IW3	WORD			
	😟 🍫		Inputs[4]	%IW4	WORD			
	😐 🍫		Inputs[5]	%IW5	WORD			
			Inputs[6]	%IW6	WORD			
	😟 - 🍫		Inputs[7]	%IW7	WORD			
	😟 🍫		Inputs[8]	%IW8	WORD			
	i		Inputs[9]	%IW9	WORD			
	i		Outputs	%QW0	ARRAY [09] OF WORD			Modbus Input Registers

<u>SP16</u>

Double-click on [Modbus Serial Device] and set parameters same as the configuration of [Modbus TCP Slave]. Mapping table will be created in [Modbus Serial Device I/O Mapping] tab according to configured size for Holding Registers (%IW) and Input Registers (%QW).

Modbus_Serial_Device X			Configuration range	
General	Unit ID	1	Configuration	V3.5 SP16
Modbus Serial Device I/O Mapping	Watchdog	500	Holding Registers	24095
Modbus Serial Device IEC Objects	Holding registers	10 (%IW) Writeable	(%IW)	
Status	Input registers	10 (%QW)	Input Registers	24095
Information	Discrete Bit Areas		(%QW)	
	Coils	0 (%DX)	Coils (%IX)	065535
	Discrete Inputs	0 ÷ (%QX)		
			Discrete Inputs	065535
	StartAddresses Coils	0	(%QX)	
	Discrete inputs	0	Start Addresses	065535
	Holding register	0		
	Input register	0		

Note

Query from master must be according to Modbus standard. If unsupported function codes, illegal address, data or the number of data are sent, HX-CPU may not send back exception responce properly.

3.2.6 Modbus Gateway

This is a gateway function which converts Modbus messages from/to a Modbus TCP master device to/from Modbus-RTU slaves. This function is supported from CPU firmware version 3.5.16.22.

Add [Ethernet] and [Modbus TCP Slave Device] by referring to the contents of Section 3.2.3, and configure [Ethernet] and [Modbus TCP Slave Device] devices.

Open the [Serial Gateway] tab of [Modbus TCP Slave Device]. Enable [Serial Gateway Active] and configure the serial port settings corresponding to the slave. When using the built-in serial port of HX-CPU, COM-Port number is [1]. Available baud rate is from 4800 up to 115200.

ModbusTCP_Slave_Device 🗙			
General	Serial Gate	way Active	
Serial Gateway	Com-Port	1	•
Modbus TCP Slave Device I/O Mapping	Baud Rate	9600	\sim

Note

- The transmission format after conversion is 8 bits, even parity, 1 stop bit.
- Modbus Gateway behaves as a Modbus-TCP Slave device if the node address in the query is 0 or 255.

3.3 General Purpose Communication

General purpose communication is available in Ethernet port and serial port of HX-CPU.



3.3.1 General Purpose Communication Over Ethernet

Several function blocks are available in NetBaseService library shown in the table below. HX-CPU and EHV-CPU can connect via Ethernet by using the general purpose Ethernet communication function on the HX-CPU and ASR communication function of EHV-CPU. Available communication ports for general purpose Ethernet communication are 4000 to 4007 (8 ports). Refer CAA_NetBaseService.pdf in NetBaseServices library for further information.

Protocol	Command	Description
	TCP_Server	TCP server set-up
	TCP_Connection	TCP server connection establish
	TCP_Client	TCP client set-up
TCP/IP	TCP_Write	Write sending data
	TCP_WriteBuffer	Write buffered sending data
	TCP_Read	Read receiving data
	TCP_ReadBuffer	Read buffered receiving data
	UDP_Peer	Peer set-up
	UDP_Send	Send UDP data
UDP/IP	UDP_SendBuffer	Send buffered UDP data
	UDP_Receive	Receive UDP data
	UDP_ReceiveBuffer	Receive buffered UDP data

Note

In general, network byte order is big-endian, which is sending from higher byte, however, it is not always big-endian because it depends on data type such as WORD, DWORD, STRING. If necessary, use the following FUNCTION in SysSocket library to swap data.

- SysSockHtonl (Network byte order conversion from UDINT)
- SysSockHtons (Network byte order conversion from WORD)

Description example in ST language

test_out1 16#78563412 :=NBS.SysSocket.SysSockHtonl(test_in1 16#12345678); test_out2 16#3412 :=NBS.SysSocket.SysSockHtons(test_in2 16#1234);

3.3.2 General Purpose Communication Over Serial

Function blocks are available in SysCom library shown in the table below. Refer to Application manual (Command reference) for further information.

Commands	Function
SysComOpen	Serial port open
SysComOpen2	Serial port open / configuration
SysComClose	Serial port close
SysComSetSettings	Serial port configuration
SysComPurge	Serial port internal buffer clear
SysComRead	Receiving data (Read)
SysComWrite	Sending data (Write)

Table of SysCom library

Note

The following functions in SysCom library are not supported by HX-CPU.

- SysComGetSettings
- SysComSetTimeout

The maximum size that can be processed at one send / receive process is 4095 bytes. Execute the send / receive processing in multiple steps, when sending / receiving 4096 bytes or more.

Sample program

A sample program for serial port is shown below. It is recommended to use ST language for communication programming. When 1 is set in the variable test, then string data [02 31 32 33 0D] (STX 123 CR) in the variable message is sent out from the serial port.

Variable declaration

```
PROGRAM PLC_PRG
VAR
COM_sample: COM_Settings;
COM_sampleEX: COM_SettingsEX;
message: STRING := '123';
Result: DWORD;
Result1: DWORD;
write_out: UDINT;
test: INT;
Status: INT;
uchwyt: DWORD;
END_VAR
```

Program

```
COM sample.sPort:=COM Ports.SYS COMPORT1;
COM sample.byParity:=COM Parity.SYS NOPARITY;
COM_sample.byStopBits:=COM_Stopbits.SYS_ONESTOPBIT;
COM sample.ulBaudrate:=COM Baudrate.SYS BR 19200;
COM sample.ulBufferSize:=100;
COM sample.ulTimeout:=10;
COM sampleEX.byByteSize:=8;
CASE Status OF
0:
       uchwyt := SysComOpen(SYS COMPORT1, ADR(Result));
        IF Result = 0 THEN
               Status := Status + 1;
       END IF
1:
       Result1 := SysComSetSettings(uchwyt, ADR(COM sample), ADR(COM sampleEX));
       IF Result1 = 0 THEN
               Status := Status + 1;
       END IF
2:
       IF test = 1 THEN
               message:=CONCAT('$02', message);
               message:=CONCAT(message,'$0d');
                write_out:=SysComWrite(uchwyt,ADR(message),LEN(message),1000,ADR(Result));
                test:=0;
       END IF
END CASE
```

3.4 Global Network Variables

Any variables can be listed in global network variable list, which are sent to all other CPUs (max. 32 CPUs) in the network with broadcast address of UDP/IP. Either port ETH 1/2/3 can be used.

How to configure?

Setting steps for sender CPU and receiver CPU are shown as follows.

[CPU Sender]

Right click on [Application] of send-CPU and choose [Network Variable List (Sender)].



Network type: Choose [UDP].

Settings : Set port number and broadcast address.

Task: Choose any one task. The variables are sent at the end of a task cycle.

1202 192.168.2 255	1202	Canc
<u>192.168.2</u> ,255	255 255 255 255	
	200.200.200.200	
Broadcast	Adr.	
192 168 0	1	
192.100.0.	255.0	
K : 255.255	.255.0	
ddress in th	is case is 192.168	.0.255
	Broadcast 192.168.0. k : 255.255 ddress in th	Broadcast Adr. 192.168.0.1 k : 255.255.255.0 ddress in this case is 192.168

Note

If existing old project is reused for HX and the port number is set as other number than 1202, be sure to set 1202. The port number for network variable is fixed as 1202 in HX-CPU.

List identifier: If more than 2 global variable list is configured, set a number in ascending order.

Cyclic transmission: Since variables are sent every task cycle, set interval time as same or bigger than cycle time of configured task. If smaller time than task cycle is set, actual sending cycle is limited by task cycle.

Transmit on change: Variables are sent only if their values have changed; the Minimum gap can define a minimum time lapse between transfers.

Transmit on event: Variables are sent while specified variable is TRUE. Be noted that it is not edge detection but level detection.

Refer to online help of HX-CODESYS for further information.

After parameter settings of sender CPU are completed, create a file to export to receiver CPU by right mouse clicking and choosing [Properties]-[Link to File]. Be noted that 255 bytes or more of STRING/WSTRING variable are not available in network variables. Parameters of sender CPU can be edited in the tab [Network properties].

Note

Parameters in properties can be modified in online mode, but new information is not downloaded to CPU when changed. It is recommended to change the parameters in offline mode and then to download.

Device (HX-CP1H16)								
🖹 🗐 PLC L	ogic							
- 💮 Application				Properties - NVL [Device: PLC Logic: Application]				
		Cut		Common Link To File Access control Network variables Build				
		Copy		Eilename:				
=[🛃 Task 🔛	Delete		◯ Import before compile				
		Delete		Export before compile				
	4	Browse						
🖻 👔 Basic (Basic)		Refactoring	۲					
۲ - ۲	<empty> 📴</empty>	Properties						
۲,	<empty></empty>	Add Object	•					
κ.	<empty></empty>	Add Folder						
د ا	<empty> ຕີ</empty>	Edit Object						
- K - K	<empty></empty>	Edit Object With		OK <u>C</u> ancel <u>Apply</u>				

[CPU Receiver]

The next step is configuration for receiving CPU. Right click on [Application] of Receive-CPU and choose [Global Network Variable List...]. Be sure to check if Sender is properly set as configured list above.



Configuration is completed for both send and receive-CPU.

Note

- If any parameters of global variable list is changed, be sure to execute [Clean] or [Clean All] before login.
- If 2 or more network variable lists are configured, be sure to set another [List identifier] in ascending order.

Properties - NVL [Device: PLC Logic: Application]							
Common Link To File	Access control Netw	vork variables Build					
Network type:	UDP	✓ Settings					
Task:	MainTask	•					
List identifier:	1						

• The maximum number of the usage of NVL is 32 in sum of Sender and Receiver.

3.5 OPC UA Server

HX-CPU supports OPC UA server function. OPC UA (Unified Architecture) is the newest specification of OPC based on the technology used for Web service and this is data exchanging opened standard between each softwares does not depend on vendors, programming language, operation systems or region. Adaptable scope of OPC UA is expanding not only PLC, SCADA and HMI but also MES or ERP positioned as upper layer.

Client application established by using OPC UA standardized interface, it will be possible to reuse user software system even for different controller vendors of several equipment without a lot of modification.

HX-CPU supports the following functionalities as OPC UA server.

Table 3.1 OPC UA Server function

No.	Туре	Support
1	supported profile	Micro Embedded Device Server
2	supported information model	PLCOpen Information Model



Figure 3.1 Information Models and OPC UA Server Functionality

Several technical documentation are available from OPC Foundation who is Spread promotion group and it can be possible to get them from the following address. https://opcfoundation.org/.

(1) Configuration of HX-CPU side

Symbol configuration editor

Configure variable accessed by remotely from OPC UA client application using OPC UA server function on [Symbol Configuration] editor.

If [Symbol Configuration] is not on device tree, select [Add Object]-[Symbol Configuration] by clicking [Application].



Figure 3.2 [Symbol Configuration] editor

Configuration of Remote accessing variable

List of variable included in Application are shown at [Symbol Configuration]. Specify variable can be accessed remotely.




It is possible to change access right of variable can be accessed remotely. Access right can be changed by each click action. Default setting is read & write.



Figure 3.4 Access right of variable

*Write only is not supported

Enabling OPC UA server function

Check [Support OPC UA Features] by double clicking [Setting] tab of [Symbol Configuration]. (It is check status already when it configured during adding [Symbol Configuration].)

l		tion	×								
	📉 View 👻 🎬 Build	🕮 Build 🖺 Settings 🗸									
	Changed symbol configurat	< ! >	Include Comments in XML			r online change					
	Symbols		Include Node Flags in XML		te	Туре	Members	Comment			
	Constants Constants DoConfig_Global		Support OPC UA Features								
			Optimized Layout	-							
			Enable direct I/O Access								
	🛛 📝 < var_1	_	*	_	_	INT					

Figure 3.5 Enabling OPC UA server function

It will be possible to access specified variable from OPC UA Client Application by transferring the project to HX-CPU after above configuration and project build operation.

(2) Connecting from OPC UA

The following example shows connecting OPC UA server of HX-CPU from Client Application. Regarding to the operation, follow client application specification.

UA Server URI: opc.tcp://192.16	8.0.1
---------------------------------	-------

Figure 3.6 Connecting OPC UA server

Note

- If HX-CPU is executed reset warm while OPC UA clients monitor data of HX-CPU, OPC UA clients may need to re-configuration because monitoring data of HX-CPU is stop.
- There are cases that the port number needs to be specified in the URI depending on the client application. opc.tcp://<IP address of HX-CPU>:4840

Make sure what is object of security protecting and take countermeasure for system configuration and operation mentioned security protection as an example by user responsibility.

- Usage of certification function and regular review for program and data should be protected.
- Usage of security function for devices used in network system.
- Connecting protection with unspecified target by usage of specifying function for connecting target.
- Operation management protection by making limitation of key lock of device setting place or user limitation.

3.6 FTP

3.6.1 FTP Server

File read or write access (upload / download) of SD card or USB memory mounted on HX-CPU from PC connected Ethernet, due to built-in FTP server function of HX-CPU. Active mode is necessary for FTP client. If the CPU firmware version is older than 3.5.13.40, use the FTP client in active mode only. For 3.5.13.40 or newer, both active mode and passive mode can be used.



Figure 3.7 FTP server function

3.6.2 FTP Server Configuration

Configure several parameters related FTP server on [PLC Parameters] of [Device] Configuration window.

ommunication Settings	Parameter	Type	Type Value Default Va		Unit	Description
	🕸 - 🚞 LAN				1	
plications	🖶 - 🛄 NTP					
	🛱 - 📴 FTP					
ckup and Restore	FTP server	Enumeration of BYTE	Disable	Disable		Set enable if FTP server function is used
	Port number	Enumeration of BYTE	ETH1	ETH1		Choose port number for FTP server
es	Access Media	Enumeration of BYTE	USB memory	USB memory		Choose USB memory or SD card
	🖤 🛷 User Name	STRING	'ftpuser'	'ftpuser'		Enter user name of FTP server
a	Password	STRING	'ftpuser'	'ftpuser'		Enter password of FTP server
	Stop switch definition	Enumeration of BYTE	Reset warm	Reset warm		Stop switch definition
Csettings	Reset all outputs in STOP	Enumeration of BYTE	Yes	Yes		All outputs are reset in STOP by hardware
	Battery error detection	Enumeration of BYTE	Enable	Enable		Set disable if battery is not used
Cshell	 I/O config error detection 	Enumeration of BYTE	Enable	Enable		Set disable to ignore I/O config error in ERR LED and 7-SEG display
.e shen	Program up/download by USB memory	Enumeration of BYTE	Disable	Disable		Set enable to use the function of user program to up/download by USB memo
C Parameters						
isk deployment						
atus						
formation						

Figure 3.8 FTP server configuration

FTP server: Configure Enable when to use FTP.

Port number: Select communication port using for FTP. (ETH1/ETH2/ETH3)

Access Media: Select access target device. (USB memory/SD card)

If media is not mounted specified access target, login will not be accepted.

- **User Name:** Configure user name for login. (Byte character alphabet or number less than equal 32 characters) Small alpha character, number and _(under score bar) can be accepted, first character can't be number.
 - Default setting: ftpuser
- Password: Configure password for login. (Byte alpha character or number 4 to 32 characters) Usable character is byte character or special character. However, " [¥ \$ can't be used. Default setting: ftpuser

Number of connections: 1 connection.

Timeout: HX-CPU logout from FTP server as timeout when 5 minutes has passed while HX-CPU is in an idle state during login.

3.6.3 List of FTP Commands

Usable command list is shown in below.

Command	Function
ascii	Set file transfer mode to ASCII.
binary	Set file transfer mode to binary.
bye	Disconnect connection between server and exit client.
cd	Change working directory of server.
close	Disconnect connection between server.
delete	Delete specified file of server.
dir	Show detail list of server files and directories.
get	Transfer file of server into local host. [download]
lcd	Change local working directory.
ls	Show list of server files and directory.
mdelete	Delete multiple files of server.
mdir	Transfer detail of multiple files and directories into local file.
mget	Transfer multiple files of server into local host. [download]
mkdir	Make working directory onto server.
mls	Transfer several files in the several files and directory into local file.
mput	Transfer specified multiple local file into server. [upload]
open	Connect specified server.
prompt	Switch interactive mode. Toggling mode every sending command.
put	Transfer specified local file into server. [upload]
pwd	Display current working directory of server.
quit	(same as bye)
rename	Rename file name of server.
rmdir	Delete working directory of server.
type	Display current file transfer mode.

Table 3.2	Usable	command	list
-----------	--------	---------	------

3.6.4 FTP Command Detail

(ascii)

Format: ftp> ascii

Function: Set file transfer mode to ASCII.

[binary]

Format: ftp> binary Function: Set file transfer mode to Binary.

[bye]

Format: ftp> bye Function: Exit ftp.

[cd]

Format:ftp> cd [directory]Function:Change working directory to specified directory by [directory].
It is not possible upper directory from logged in directory.

[close]

Format: ftp> close Function: Disconnect connection between FTP server.

delete

Format: ftp> delete [file] Function: Delete specified file.

(dir)

Format:	ftp> dir (([directory]) (local file))
Function:	Display detail list of server file and directory.
	Save this list into file by specified [(local file)]

[get]

Format: ftp> get [file] ([local file]) Function: Transfer file of server to local. [download] It is possible to specify transferring local file name.

[lcd]

Format: ftp> lcd [local directory] Function: Change local working directory.

ls

Format: ftp> ls Function: List all file in current directory.

mdelete

Format: ftp> mdelete [file 1] ([file 2] ···)
Function: Delete multiple files of server.
If interactive mode set off by prompt command, all specified files can be deleted without confirmation.

(mdir)		
	Format:	ftp> mdir [file 1] ([file 2]) [local file]
	Function:	Transfer multiple files and directories to local file.
(mget)		
	Format:	ftp> mget [file 1] ([file 2] \cdots)
	Function:	Transfer multiple files of server to local host.
		If interactive mode set off by prompt command, all specified files are transferred without
		confirmation.
I 1 1	1	
L mkdir	Ъ	And while the stand
	Format:	htp> mkdir [directory]
	Function:	Make directory on server.
(mls)		
	Format:	ftp> mls [file 1] ([file 2]) [local file]
	Function:	Transfer multiple files and directory list to local file.
		1 5
(mput)		
	Format:	ftp> mput [file 1] ([file 2] \cdots)
	Function:	Transfer specified files to server.
		If interactive mode set off by prompt command, all specified files are transferred without
		confirmation.
Topen	Formati	ftn> onen [host]
	Formation	Compact comparison of a ddmass on hast name
	runction:	Connect server specified IP address of nost name.
[prom	ot]	
1 1	Format:	ftp> prompt
	Function:	Change interactive mode. Toggling mode every sending command.
[put]		
	Format:	ftp> put [local file] ([server file])
	Function:	Transfer specified file to server.
		If server file is specified, transfer file with specified file name.
[auit]		
[quit]	Format:	ftp> quit
	Function:	Fyit fin
	i unction.	Exit tip.
renam	ne	
	Format:	ftp> rename [file] [new file]
	Function:	Change file name of server.
	_	
(rmdir]	
	Format:	ftp> rmdir [directory]
	Function:	Delete directory of server.
tune		
type	Formati	ftn> type [type]
	i ormat.	rt. Abe [Abe]

Function: Display current file transfer mode. It is possible to change file transfer mode by specifying.

3.6.5 Exclusive Control of File Access

Exclusive control by POU is necessary if conflicting file access is occurred between FTP server function and POU. In that case, control the file exclusively with indicating file access status by POU.

Exclusive file ac	cess control	File access by POU				
for each	n file	Read	Write			
CTD command	Read	Not necessary	Necessary			
FTP command	Write	Necessary	Necessary			

Table 3.3 Exclusive file access control for each file

3.6.6 SFTP Server Configuration

SFTP server has been supported since CPU firmware version 3.5.16.25. Configure several parameters related SFTP server on [PLC Parameters] of [Device] Configuration window.

Price X						
Communication Settings	Parameter	Туре	Value	Default Value	Unit	Description
· · · · · · · · · · · · · · · · · · ·	E- 📴 LAN					
Applications	🖶 - 🧰 NTP					
Rackup and Restore	🗄 🛅 FTP					
backup and Restore	🖶 🚞 SFTP					
Files	SFTP server	Enumeration of BYTE	Disable	Disable		Set Enable if SFTP server function is used
	- 🗇 ETH1	Enumeration of BYTE	Disable	Disable		Set Enable if ETH1 port is used
Log	••• 🕸 ETH2	Enumeration of BYTE	Disable	Disable		Set Enable if ETH2 port is used
	• • ETH3	Enumeration of BYTE	Disable	Disable		Set Enable if ETH3 port is used
PLC Settings	Port number	STRING	'20022'	'20022'		Port number
	🖤 🖗 User Name	STRING	'sftpuser'	'sftpuser'		Enter user name of SFTP server
PLC Shell	Password	STRING	'sftpuser'	'sftpuser'		Enter password of SFTP server
Lisers and Groups	🖷 - 🚞 DNS					
Users and droups	Stop switch definition	Enumeration of BYTE	Reset warm	Reset warm		Stop switch definition
Access Rights	Reset all outputs in STOP	Enumeration of BYTE	Yes	Yes		All outputs are reset in STOP by hardware
	Battery error detection	Enumeration of BYTE	Enable	Enable		Set Disable if battery is not used
Symbol Rights	I/O config error detection	Enumeration of BYTE	Enable	Enable		Set Disable to ignore I/O config error in ERR LED and 7-SEG display
	🖙 🖗 TimeZone	Enumeration of BYTE	UTC	UTC		Time difference to UTC

Figure 3.9 SFTP server configuration

- SFTP server: Configure Enable when to use SFTP.
- **ETH1:** Configure Enable when to use ETH1 for SFTP.
- **ETH2:** Configure Enable when to use ETH2 for SFTP.
- ETH3: Configure Enable when to use ETH3 for SFTP.

Port number: Port number 20022 is used for SFTP (fixed).

User Name: Configure user name for login. (Byte character alphabet or number less than equal 32 characters) Small alpha character, number and (under score bar) can be accepted, first character can't be number. Default setting: sftpuser

Password: Configure password for login. (Byte alpha character or number 4 to 32 characters)

Usable character is byte character or special character. However, '? can't be used. Default setting: sftpuser

Make sure what is object of security protecting and take countermeasure for system configuration and operation mentioned security protection as an example by user responsibility.

- Usage of certification function and regular review for program and data should be protected.
- Usage of security function for devices used in network system.
- Connecting protection with unspecified target by usage of specifying function for connecting target.
- Operation management protection by making limitation of key lock of device setting place or user limitation.

3.7 NTP Client Function

NTP client function getting clock information from NTP (Network Time Protocol) of network is available with HX-CPU.

It is also possible to set clock information of HX-CPU Calendar Clock IC by getting clock information from NTP server. Get clock information when start RUN, it can be possible to set 1 minute to 1440 minute (24 hours) interval and to get clock information by specified cycle.



Figure 3.10 NTP Client function

Table 3.4 Specification of NTP client

Items	Specification
Communication protocol	SNTP (Simple Network Time Protocol)
Getting cycle	Start RUN timing, User configuration (00:01-24:00)
Collected clock data	Year / Month and date / Day / Hour / minute / second
	(data type: DATE_AND_TIME)
Refresh getting interval	Refresh by calendar time clock IC

It is possible to get NTP status by using dedicated function block (GetNTPstatus). ExecNormal of GetNTPstatus turn TRUE by getting clock data correctly, therefore if clock data is used in user program, use it after confirming ExecNormal of GetNTPstatus turns TRUE.

Note

If NTP client function is used, use it after setting time zone. Configuration is done by dedicated function block (SetTimeZoneInformation). Refer "System clock command" of HX Application Manual [Command reference edition] for further detail information.

Configuration Method

[Device] window appears after selecting [Edit Object] by double clicking or right clicking [Device (HX-CP...)] on Device tree. Select items of [NTP] by double clicking [PLC Parameters] tab.



Parameter	Туре	Value	Default Value	Unit	Description
🗄 🦾 LAN					
🚔 🛅 NTP					
••• 🕸 NTP function	Enumeration of BYTE	Disable	Disable		Time data is taken from NTP server and written on RTC
🖤 🖗 Port number	Enumeration of BYTE	ETH1	ETH1		Choose port number for NTP server
🖤 🖗 Logical port number	STRING	'123'	'123'		Logical port number
Specified by	Enumeration of BYTE	IP address	IP address		Choose IP address or Host name to specify NTP server
IP address or Host name	STRING	'0.0.0'	'0.0.0'		Enter IP address or Host name
🖤 🖗 Access cycle	WORD(11440)	60	60	min.	Set time to access NTP server
🖤 🖗 Timeout	BYTE(1255)	10	10	sec.	Set timeout value
🔍 🖗 TimeZone	Enumeration of BYTE	UTC	UTC		Time difference to UTC
🗄 🚞 FTP					
Stop switch definition	Enumeration of BYTE	Reset warm	Reset warm		Stop switch definition
Reset all outputs in STOP	Enumeration of BYTE	Yes	Yes		All outputs are reset in STOP by hardware
Battery error detection	Enumeration of BYTE	Enable	Enable		Set enable if battery is used
I/O config error detection	Enumeration of BYTE	Enable	Enable		Set disable to ignore I/O config error in ERR LED and 7
Program up/download by USB memory	Enumeration of BYTE	Disable	Disable		Set enable to use the function of user program to $up/d\ldots$

Table 3.5 Configuration Items of NTP client

Item name	Contents	Setting range	
NTP function	Select valid or invalid getting clock information from NTP	Disable / Enable	
	server.		
Port number	Select communication port getting clock information.	ETH1 / ETH2 / ETH3	
Logical port number	Set port number using for NTP server connection.	123	
		(Not changeable)	
Specified by	Select specifying method of NTP server.	IP address	
		(Fixed IP address)	
IP address or Host name	Specify NTP server.	XXX.XXX.XXX.XXX	
Access cycle	Set time interval of clock information.	1 to 1,440 (unit: minute)	
Timeout	Set detecting time of timeout.	10 (unit: minute (fixed))	
TimeZone	Specify time zone.	UTC-12:00 to UTC+12:00	

3.8 EtherNet/IP Scanner

The EtherNet/IP scanner (master) function is supported from CPU firmware version 3.5.16.22.

3.8.1 Configuration

Select [Add Device...] in the right-click menu of [Device]. Specify [Ethernet] in [Add Device] window and click [Add Device] button.





With [Add Device] window opened, click [Ethernet] in the device tree. Then available devices will be shown in [Add Device] window. Select a scanner device that corresponds to your CPU model in [EtherNet/IP]-[EtherNet/IP] Scanner] and click [Add Device].



Choose Ethernet port for EtherNet/IP. After communication between PC and HX-CPU configured, click [...] button and select Ethernet port for EtherNet/IP.

Ethernet X			
General	Interface:		
Status	Operating Sy	stem Settings	
Information	Change Operating	g System Settings	
	IP address	192 . 168 . 10 . 1	
	Subnet mask	255 . 255 . 255 . 0	
	Default Gateway	0.0.0.0	

Chapter 3 Communication I/F in CPU

Network A	dapters			(×	
Interfaces:	:					
Name	Description	IP Address				
lo		127.0.0.1				
eth3		192.168.2.1				
eth1		192.168.0.1			- }	Choose Ethernet port to be used.
eth2		192.168.1.1				
IP address	s 192	. 168 . 0 . 1				
Subnet ma	ask 255	.255 .255 . 0				
Default Ga	iateway 0	. 0 . 0 . 0				
MAC-Add	dress: A4:9	7:BB:06:A1:70				
				Ok Cancel		

Right click on [EtherNet/IP Scanner] and choose [Add Device]. The available devices are shown in [Add Device] window. Choose adapter device according to your system configuration and click [Add Device] button.



If actual adapter are physically connected, it is possible to search the devices from the network if communication between PC and HX-CPU has been already configured according to section 2.7. Right mouse click on [EtherNet/IP Scanner] and choose [Scan For devices]. Click [Copy All Devices to Project] to complete. If EtherNet/IP EDS file of the adapter is not installed, right device name is not shown in the Scan Device dialog. Be sure to obtain the EDS file and install it to HX-CODESYS in advance in the menu [Tools]-[Device Repository].

Note

Set the IP address in [PLC Parameters] window. If you set it from Ethernet device editor, it will not work properly.

3.8.2 EtherNet/IP task

When an EtherNet/IP Scanner is added to the project, a task [ENIPScannerIOTask] for executing I/O communication and a task [ENIPScannerServiceTask] for executing service communication are automatically generated.

		-	-	-	-
ė.,	4	Task	Con	figur	ration
	÷	ء 🍪	ENIPS	Scan	nerIOTask
			Він	X_C	P1H16_EtherNet_IP_Scanner.IOCycle
	÷	ء 🍪	ENIP:	Scan	nerServiceTask
			В	x_c	P1H16_EtherNet_IP_Scanner.ServiceCycle
	ė.	ا 🍣	4ain1	ask	
			B) P	LC_F	PRG

Configure priority, task cycle and watchdog same as a normal task configuration.

SENIPScannerIOTa 🕸	sk 🗙	•
Configuration		
Priority (031): 0 Type & Cyclic	V Interval (e.g. t#200ms) 10	ms ∨
Watchdog Enable Time (e.g. t#200ms) Sensitivity		ms \vee

3.9 PROFINET Controller

The PROFINET Controller (master) function is supported from CPU firmware version 3.5.16.23.

3.9.1 Configuration

Select [Add Device...] in the right-click menu of [Device]. Specify [Ethernet] in [Add Device] window and click [Add Device] button.





With [Add Device] window opened, click [Ethernet] in the device tree. Then available devices will be shown in [Add Device] window. Select a PN-Controller device whose Vender is "Hitachi Industrial Equipment Systems Co., Ltd." in [Profinet IO]-[Profinet IO Master] and click [Add Device].



Note

In PN-Controller device editor, there are fields "Cable length" and "MAU type". Please note that the values are not for setting but only for checking the real values.

Port Data

Port-001	Peer station/port		~	~	
	Cable length	~	MAU type		~

Choose Ethernet port for Profinet. After communication between PC and HX-CPU configured, click [...] button and select Ethernet port for Profinet.

General		Interface:			
Status		(a) Use Operating	System Settings		
Information		Change Operat	ing System Settings		
		IP address	192 . 168 . 10 . 1		
		Subnet mask	255 . 255 . 255 . 0		
		Default Gateway	0.0.0.0		
		П			
letwork Adapte Interfaces:	ers			×	
letwork Adapte Interfaces: Name Des	ers scription IP Address	I		•	
letwork Adapte Interfaces: Name Des Io	scription IP Address 127.0.0.1	п			
letwork Adapte Interfaces: Name Des Io eth3	ers scription IP Address 127.0.0.1 192.168.2.1	n			
Interfaces: Name Des Io eth3 eth1	ers scription IP Address 127.0.0.1 192.168.2.1 192.168.0.1	B			Choose Ethernet port to be used
Interfaces: Name Des lo eth3 eth1 eth2	ers scription IP Address 127.0.0.1 192.168.2.1 192.168.0.1 192.168.1.1			×	Choose Ethernet port to be used
Interfaces: Name Desi lo Desi eth3 eth1 eth2 IP address	ers scription IP Address 127.0.0.1 192.168.2.1 192.168.1.1 192.1680 192.1680 1				Choose Ethernet port to be used
Interfaces: Name Des lo Des eth3 eth1 eth2 IP address Subnet mask	ers Scription IP Address 127.0.0.1 192.168.2.1 192.168.0.1 192.168.1.1 192.168.0.1 192.168.0.1 1 255.255.255.0				Choose Ethernet port to be used
Interfaces: Name Desi lo Desi lo eth3 cith1 eth2 cith1 IP address Subnet mask Default Gatewa	ers scription IP Address 127.0.0.1 192.168.2.1 192.168.0.1 192.168.1.1 192.168.0.1 192.168.0.1 192.168.0.1 192.168.0.1 192.168.0.1 192.168.0.1 192.168.0.1 192.168.0.1 192.168.0.0 192.168.0.0 192.168.0.0 192.168.0.0 192.168.0.0 192.168.0.0 192.168.0.0 192.168.0.0 192.168.0 192				Choose Ethernet port to be used

Ok Cancel

Right click on [PN-Controller] and choose [Add Device]. The available devices are shown in [Add Device] window. Choose a slave device according to your system configuration and click [Add Device] button.



If actual slave are physically connected, it is possible to search the devices from the network if communication between PC and HX-CPU has been already configured according to section 2.7. Right mouse click on [PN-Controller] and choose [Scan For devices]. Click [Copy All Devices to Project] to complete. If Profinet GSDML file of the slave is not installed, correct device name is not shown in the Scan Device dialog. Be sure to obtain the GSDML file and install it to HX-CODESYS in advance in the menu [Tools]-[Device Repository].

When using [Scan For devices] configuration, the idnetification data of the slave device can be set in Scan Devices window. Specify Station Name, IP address, Subnet Mask, Gateway and click "Set Name and IP" button.

S	can Devices						_		Х
	Scanned Devices								
	Device name	Device type	Station Name	ID number	MAC Address	IP Address	Subnet Mask	Gatewa	v
	$-\!\!-$ The identification data is not available. Oheck the IP address.	Vendor-ID: 0x002A, Product-ID: 0x0313	pn-device	Error: A valid IP is required.	AC:64:17:50:A1:34	192.168.0.10	255.255.255.0		
	I&M Auto-IP <> Reset Blink LED Set Name and IP	Show only unnamed stations					Show differen	ces to proje	ect
	Set the r	name and IP address.							
3	Scan Device Install Missing Descriptions					Copy All Device	es to Project	Close	

3.9.2 Profinet task

When an PN-Controller is added to the project, a task [Profinet_IOTask] for executing I/O communication and a task [Profinet_CommunicationTask] for executing service communication are automatically generated.

🖻 🔢 Task Configuration
🖨 🍪 MainTask
PLC_PRG
🚊 🍪 Profinet_CommunicationTask
PN_Controller.CommCycle
Profinet_IOTask

Configure priority, task cycle and watchdog same as a normal task configuration.

🕸 Profinet_IOTask 🗙			
Configuration			
Priority (031): 1			
Cyclic V	Interval (e.g. t#200ms)	1	ms ∨
Watchdog			
Enable			
Time (e.g. t#200ms)			ms 🗸
Sensitivity			

Note

The send cycle is configured by "Send clock(ms)" and "Reduction ratio" in the slave device editor. Please note that the guaranteed minimum cycle is 4 ms.

Communication				
Send clock (ms)	1	\sim	Watchdog (ms)	12 🚔
Reduction ratio	4	\sim	VLAN ID	0
Phase	-	\sim		

Chapter 3 Communication I/F in CPU

3.10 Touch Panel Communication

This section explains how to connect with Pro-face touch panel manufactured by Schneider Electric (formerly Digital Electronics Corporation).

First, add a Symbol Configuration object in order to specify the variables to be transferred between the touch panel and HX-CPU. Right-click [Application] and select [Symbol Configuration] under [Add Object]. [Support OPC-UA features] is enabled because this object also serves as the OPC-UA server function setting. If you do not use the OPC-UA server function, disable it and then click [Add]. The communication with the touch panel works even when this setting is enabled.

			_			Add Symbol Configura	ation ×
Device	(HX-CP1H16	5)					
	C Logic						
=-0	Application	on U	C 1	1		Create a remot	te access symbol configuration.
	Diorary	a b	-				
	I PLC_P		Сору				
	⊟-s ⊗ Ma	E	Paste				
	- Ča	×	Delete			Name	
🖹 💮 Ва	usic (Basic)		Refactoring •			Symbol Configuration	
- K	<empty> <empty></empty></empty>	¢,	Properties			Include comment	ts in XML
Ľ	<empty></empty>	*	Add Object 🕨	M	Alarm Configuration	Support OPC UA	features
K	<empty></empty>	\bigcirc	Add Folder	0	Application		halidada Davias Asaliastias
-K	<empty></empty>	ſĩ	Edit Object	1	Data Sources Manager	(recommended	holder in Device Application
r,	<empty></empty>		Edit Object With	20	DUT	che to the test	sacinay arggar administray
2	<empty></empty>	C(S	Login		External File	Client Side Data Layo	but
2	<empty></empty>	~?			Global Variable List	 Compatibility La 	yout
-r	<empty></empty>	_	Delete application from device		Image Pool	Optimized Layou	ıt
Ľ	<empty></empty>			~0	Interface		
				2	Network Variable List (Receiver)		
				1	Network Variable List (Sender)		
				T	Persistent Variables		
				8	POU		
				8	POU for implicit checks		
				A	Recipe Manager		
				ø	Redundancy Configuration		
				•	Symbol Configuration		
				P	Text List K		Add Cancel

Press the build button if no symbol (variable name) is displayed.



Select the variables to be transferred with the touch panel after the variable names are displayed.

Symbol Configuration 🗙								
🕅 View 👻 🕮 Build 🛛 🛱 Settings 👻 To	ols 👻							
(!)There are 6 configured variables which a	are not referenced b	y the IEC cod	e. Reading an	d writing	to them may no	ot have the desired effec	t	
There are 6 configured IO variables whi	ch will not be updat	ed, as they're	not used in t	he project	. Fither used th	em in the IEC code, or co		
Changed symbol configuration will be trans	ferred with the next	download or	online change	n project				
Symbols	Access Rights	Maximal	Attribute	Type	Members	Comment		
Constants	Accessingnes	in a share a sh	Attribute	ype	members	connent		
IoConfig_Globals								
IoConfig_Globals_Mapping								
	*	*		BOOL		_16_Digital_Output :	7	
- 🔽 🛷 Lamp1	*	*		BOOL		_16_Digital_Output :		
🔽 🔌 Lamp2	*	*		BOOL		_16_Digital_Output :		D 11/0
🐨 📝 🔌 Sensor0	* ø	۰,		BOOL		_16_Digital_Input :	7	External I/O
🐨 📝 🔌 Sensor1	* ø	*		BOOL		_16_Digital_Input :		
🐨 📝 🔌 Sensor2	* ø	*		BOOL		_16_Digital_Input :	J	
🖻 📝 📄 PLC_PRG							Ś	
🐨 📝 🔌 EmergencyStop	*	*		BOOL				
🐨 📝 🔌 MaxLimit	*	*		INT				
	*	*		INT			5	Local variables
	*	*		BOOL				
🔽 < PB2	*	*		BOOL				
	*	*		BOOL			J	

When you log in to the CPU or execute [Build] - [Code Generation], a file "<ProjectName>.Device.Application.xml" is created in the project folder.



Next, configure the touch panel side. Start GP-Pro EX and open a new or existing project.

💕 Welcome to GP-Pro EX		×
67-7ro <mark>E</mark> X	New Create Project From Sample EZタワーライト画面サンブル。QVGA.pxx FZクワーライト画面サンブル。VGA.pxx A	
	アラーム履歴表示画面 px 発生中アラーム詳細表示画面_ブロック分け px ×	
	OK (Q) Cancel	

In Device/PLC settings, select "CoDeSys Automation Alliance" as Manufacturer and "CoDeSys V3 Ethernet" as Series as shown in the following screenshot. Please note that "CoDeSys Ethernet" in the selection of Series is different from "CoDeSys V3 Ethernet".

Then click [Communication Settings].

🎒 Welcome to GP-Pro EX			×
GP-Pro	Device/PLC Number of Dev	rices/PLCs	
	Manufactures	Device/PLC 1	
	Manufacturer	CoDeSys Automation Alliance	×
	Port	Ethernet (TCP)	
	TOR	Refer to the manual of this Device/PLC	
		Recent Device/PLC	
	<		>
	Use Syster	n Area	Device Information
	Back (Communication Settings New Logic New Screen	n Cancel

Click [Device/PLC1].

🛃 System 🗵	
Peripheral List	List of Device/PLC Management Addresses
Device/PLC1	
Manufacturer	:CoDeSys Automation Alliance
Series	:CoDeSys V3 Ethernet

Click the icon to the right of the device name (PLC1).

i System ⊠	
Device/PLC	Add Device/PLC Delete Device/PLC
Device/PLC 1	
Summary	Change Device/PLC
Manufacturer CoDeSys Automation Alliance Series CoDeSys V3 Ethemet	Port Ethemet (TCP)
Text Data Mode 2 Change	
Communication Settings	
Port No. 1024 🜩 🗸 Auto	
Timeout 10 🜲 (sec)	
Retry 0	
Wait To Send 0 (ms) Default	
Device-Specific Settings Allowable Number <u>Add Device</u> of Devices/PLCs 16	
No. Device NameSettings	Add Indirect Device
1 PLC1 Node Name (or) Address= ,Use Tcp//p=OFF,Node	IP /

Check [Use Tag Data] and click [New].

🎒 Individual Device Settings					×
PLC1					
PLC Settings					
Node Name (or) Address					
Use Tcp/lp					
IP Address	0.	0.	0.	0	
Port No.	11740			*	
Use User Management					
User					
Password					\bigcirc
Gateway Settings					
Connect via Gate	way				
IP Address	0.	0.	0.	0	
Port No.	1217			×	
Tag Data					
🗹 Use Tag Data					
					\sim
		Nev	v]	Edit
					Default
			OK (C))	Cancel

Communication I/F in CPU

Click [Import].

Tag List ag Data Name TagDa	ta01			- 0
Data type <all></all>	cope		∨ Usage <all></all>	✓ Update
Name	Data type			
Import	Export Expand All	Collepse All	Add	Edit Delete
				OK Cancel

Click [Browse] and select the "<ProjectName>.Device.Application.xml" file generated by HX-CODESYS. Click [OK] after the list of the variables is displayed as shown below.

Browse
^
^
~

Set the IP address of the HX-CPU and the setting completes.

🖇 Individual Device Settings						>
PLC1						
PLC Settings Node Name (or) Address]
IP Address	192	168.	0.	1		
Port No.	11740			*		
Use User Manageme	ent					
User Password					Ô	
Gateway Settings	iteway					
IP Address	0.	0.	0.	0		
Port No.	1217			A T		
Tag Data ☑ Use Tag Data						
TagData01					~	
		Ne	N		Edit	
					Default	
			OK ())	Cancel	

Chapter 3 Communication I/F in CPU

MEMO

Chapter 4 Communication Modules

4.1 CPU Link Module

4.1.1 Overview

CPU Link System is the network of CPU Link modules connected in loop topology. Common memory called link area is read or written by each CPU in the network. Link area in each CPU is defined as Global Variable List (GVL) with %M address and shared by all the CPUs.

GVL is added by right-clicking on [Application] shown below.



4.1.2 Configuration Link Parameter

Add [EH-LNK] device to the device tree in advance. Double-click [EH-LNK] and set [Offset address of writing area] (Writing area %MW offset address) and [Size of writing area].

EH_LNK X								
EH-LNK Parameters								Write Parameters
EH-LNK I/O Mapping	Parameter	Туре	Current Value	Prepared Value	Value	Default Value	Unit	Description
	🖉 🚸 LINK area %MW-address	WORD	0		0	0		LINK memory can be accessed by %M variables begi
Status	Offset address of writing area	WORD(01023)	0		0	0		Set the offset address of writing area [0-1023](a)
Information	Size of writing area	WORD(01024)	0		0	0		Set the size of writing area [0-1024]. Max.=1024-(a)

Note

- · Allowed range of values are shown below. HX-CODESYS does not detect error if the value is out of the range.
 - Offset address of writing area : 0 to 1023
 - Size of writing area : 0 to 1024

(Since the consistency between above two parameters cannot be checked by HX-CODESYS, invalid values, for example [offset address of writing area] is 1023 and [Size of writing area] is 1024, can be set. In that case, CPU detects an error and outputs error message in the CPU log.)

- If PLC settings are set as follows, received link data might not be correct because I/O refresh timing and link refresh timing are not synchronized when CPU is in stop mode.
 - Update IO while in stop : Disable
 - Behaviour for outputs in Stop : Execute program
- When an EH-LNK or EH-FLN2/3 device is added, LINK_FLNET_TASK and RefreshLinkData or RefreshFlnetData objects are automatically created. Do not change these object names. The default task priority is
 6. If it is set higher than 4, the receiving operation may be delayed on Ethernet or serial communication. For details, refer to section 2.3.

Configuration example

The following figure is an example of 3 CPUs. Each CPU has own writing area in the LINK area, which must not be overlapped. Writing area for a CPU is reading area for the other CPUs.



	CPU1	CPU2	CPU3
Writing area %MW-address (Write area %MW address)	0	400	700
Writing area size (Write area size)	400	300	324

In one CPU Link module is used per CPU, the address of LINK area is from %MW0 to %MW1023. Addresses when several LINK modules used are shown in the table below. The address is NOT depending on mounted slot number but the number of LINK modules.

	LINK-1	LINK-2	LINK-3	LINK-4	LINK-5	LINK-6	LINK-7	LINK-8
From	%MW0	%MW1024	%MW2048	%MW3072	%MW4096	%MW5120	%MW6144	%MW7168
То	%MW1023	%MW2047	%MW3071	%MW4095	%MW5119	%MW6143	%MW7167	%MW8191



LINK-1: %MW0 to %MW1023

LINK-2: %MW1024 to %MW2047

4.1.3 Declaration of Link Variable

If new variable is declared, [Auto Declare] dialog appears. For variables for LINK, put %MW address at address field and choose [VAR_GLOBAL] in scope field. Then this declaration will be added in GVL.

Auto Declare		—
Scope: VAR_GLOBAL ▼	<u>N</u> ame: wTest_link0	Type: WORD ▼>
Object:	Initialization:	<u>A</u> ddress:
GVL [Application]		%MW0
<u>F</u> lags:	Co <u>m</u> ment:	
		*
		*
		OK Cancel
🦓 GN		
B 1 VAR GLOBAL		
2 wTest_link0 A	r %MWO: WORD;	
3 END_VAR		

In POU, prefix "GVL." is necessary for example "GVL.wTest_link0".



If CPU Link module is not used, variables with %M addresses can be used as general registers.

Byte order

If EH/EHV-series, EHV+ series and HX series are used in one Link network, byte data is swapped because byte order and addressing rule are different in each series of CPU.

If 4-word data is stored in the link area as shown in the mapping below, BYTE, DWORD and LWORD data are seen as follows.

Link area mapping

Word address	Data
0	0x1234
1	0x5678
2	0xAABB
3	0xCCDD
4	
5	
1022	
1023	

Data format

]	EH/EHV			EHV+			HX	
			Da	ata		Da	ita		Da	ita
		Address	Binary	Dec.	Address	Binary	Dec.	Address	Binary	Dec.
Х	bit 0 of word 0	LO	0	4	%MX1.0	0	4	%MX0.0	0	4
	bit 1 of word 0	L1	0		%MX1.1	0		%MX0.1	0	
	bit 2 of word 0	L2	1		%MX1.2	1		%MX0.2	1	
	bit 3 of word 0	L3	0		%MX1.3	0		%MX0.3	0	
	bit 4 of word 0	L4	1	3	%MX1.4	1	3	%MX0.4	1	3
	bit 5 of word 0	L5	1		%MX1.5	1		%MX0.5	1	
	bit 6 of word 0	L6	0		%MX1.6	0		%MX0.6	0	
	bit 7 of word 0	L7	0		%MX1.7	0		%MX0.7	0	
	bit 8 of word 0	L8	0	2	%MX0.0	0	2	%MX1.0	0	2
	bit 9 of word 0	L9	1		%MX0.1	1		%MX1.1	1	
	bit 10 of word 0	LA	0		%MX0.2	0		%MX1.2	0	
	bit 11 of word 0	LB	0		%MX0.3	0		%MX1.3	0	
	bit 12 of word 0	LC	1	1	%MX0.4	1	1	%MX1.4	1	1
	bit 13 of word 0	LD	0		%MX0.5	0		%MX1.5	0	
	bit 14 of word 0	LE	0		%MX0.6	0		%MX1.6	0	
	bit 15 of word 0	LF	0		%MX0.7	0		%MX1.7	0	
В	Low byte of word 0	-		-	%MB1	0x	34	%MB0	0x	34
	High byte of word 0	-		-	%MB0	0x	12	%MB1	0x	12
	Low byte of word 1	-		-	%MB3	0x	78	%MB2	0x	78
	High byte of word 1	-		-	%MB2	0x	56	%MB3	0x	56
W	Word 0	WL0	0x1	234	%MW0	0x1	234	%MWO	0x1	234
	Word 1	WL1	0x5	678	%MW1	0x5	678	%MW1	0x5	678
	Word 2	WL2	0xA	ABB	%MW2	0xA	ABB	%MW2	0xA	ABB
	Word 3	WL3	0xC	CDD	%MW3	0xC0	CDD	%MW3	0xC0	CDD
D	1 st DWORD	DL0	0x567	81234	%MD0	0x123	45678	%MD0	0x567	81234
	2 nd DWORD	DL1	0xCCD	DAABB	%MD1	0xAAB	BCCDD	%MD1	0xCCDI	DAABB
L	1 st LWORD	_	-	-	%MLO	0x123456784	ABBCCDD	%MLO	0xCCDDAA	BB56781234

4.1.4 Status Monitor Library

The status information of EH-LNK can be read by special function block GetLinkInfo.

Set Link number and xEnable to TRUE, then status is read out in the STRUCT LinkInfo when xDone is TRUE.

GetLin	cInfo	
 xEnable BOOL	BOOL xDone	_
 byLinkNo BYTE	BOOL xError	_
	LinkInfo LinkInfo	_

Member name	Descr	iption	Туре	Remark
xSystemBusError	System bus error	0: No error 1: Error	BOOL	-
xLinkAreaSettingError	Link area setting error	0: No error 1: Error	BOOL	-
xLinkAreaOverlapError	Link area overlap error	0: No error 1: Error	BOOL	-
xStationNumberError	Station number error	0: No error 1: Error	BOOL	-
xCableDisconnection	Cable disconnection	0: No error 1: Error	BOOL	-
byCableDscnNumber	Cable disconnection num	ıber	BYTE	
lwLinkFlag	Link flag		LWORD	*
lwLinkStatus	Link status		LWORD	*
lwCPUStatus_RUN	Link status (RUN)		LWORD	*
lwCPUStatus_HALT	Link status (HALT)		LWORD	*
lwCPUStatus_Err	Link status (ERROR)		LWORD	*
lwErrorFlag	Error flag		LWORD	*
lwErrInfo_1	Error information (CPU-	Link error)	LWORD	*
lwErrInfo_2	Error information (Fram	ing error)	LWORD	*
lwErrInfo_3	Error information (Time	out error)	LWORD	*
byNo_of_ComErr	Error information		ARRAY [063] OF BYTE	-
wCycleTime_Max	Maximum refresh cycle tim	e (maximum value) [ms]	WORD	-
wCycleTime_Min	Minimum refresh cycle tim	e (minimum value) [ms]	WORD	-
wCycleTime_Now	Current refresh cycle time (current value) [ms]	WORD	-

Detail of LinkInfo structure

*: Each bit of 64-bit LWORD data corresponds to each station number 0 to 63. When accessing in bit units, specify the dot and bit number at the end.

Example) Link participation flag for station number No.5: lwLinkFlag.5

4.2 FL-net Interface Module

4.2.1 Overview

FL-net is open FA network based on Ethernet using shared memory accessed by multi-vendors' CPUs. A virtual shared memory called common memory is accessed by each CPU in cyclic.



Common memory 1 and Common memory 2 are defined in FL-net. HX-CPU uses %M address for the common memory same as CPU Link. The address of the Common memory 1 is same as CPU Link module.

LINK No.	LINK-1	LINK-2	LINK-3	LINK-4	LINK-5	LINK-6	LINK-7	LINK-8
Start of common 1	%MW0	%MW1024	%MW2048	%MW3072	%MW4096	%MW5120	%MW6144	%MW7168
End of common 1	%MW511	%MW1535	%MW2559	%MW3583	%MW4607	%MW5631	%MW6655	%MW7679
Un-used addresses	%MW512	%MW1536	%MW2560	%MW3584	%MW4608	%MW5632	%MW6656	%MW7680
	to							
	%MW1023	%MW2047	%MW3071	%MW4095	%MW5119	%MW6143	%MW7167	%MW8191

Since the size of common memory 1 is 512 words, only the 1st half of Link area is used for FL-net. The 2nd half cannot be used if FL-net module is used.

The address of the Common memory 2 is shown as below.

FL-net No.	FL-net 1	FL-net 2	
Start of common 2	%MW8192	%MW16384	
End of common 2	%MW16383	%MW24575	

The size of common memory 2 is 8192 words.



4.2.2 FL-net Parameter Configuration

Add FL-net module to device tree in advance. The device name is EH-FLN2/3. Double click [EH-FLN2/3] and set parameters as follows.

EH-FLN Parameters	Parameter	Туре	Value	Default Value	Unit	Des
EH-FLN I/O Mapping	P Address	STRING	'192.168.250.1'	'192.168.250.1'		IP Ac
	CmnMem-1 %MW address	WORD	0	0		Start
Status	CmnMem-1 writing area address (offset)	WORD(0511)	0	0		Start
	CmnMem-1 writing area size	WORD(0512)	0	0		Size
	CmnMem-2 %MW address	WORD	0	0		Start
	CmnMem-2 address (offset)	WORD(08191)	0	0		Start
	CmnMem-2 size	WORD(08192)	8192	8192		Size
	 CmnMem-2 writing area address (offset) 	WORD(08191)	0	0		Start
	CmnMem-2 writing area size	WORD(08192)	0	0		Size
	🖤 🖗 Token watchdog time	BYTE(1255)	50	50	ms	Toke
	Allowable min. frame interval time	BYTE(050)	0	0	100us	Allow
	Type and vendor name	Enumeration of BYTE	EH-FLN3/HITACHI-IES	EH-FLN3/HITACHI-IES		Туре
	🖤 🖗 Node name	STRING	'Node 1'	'Node 1'		Node
	🖤 🖗 Clear data in STOP (CmnMem-1)	Enumeration of BYTE	No	No		Clear
	Clear data in STOP (CmnMem-2)	Enumeration of BYTE	No	No		Clear

No.	Name	Description	Default
1	IP address	IP address of EH-FLN2/3	192.168.250.1
2	CmnMem-1 %MW address	Starting address of common memory 1 is displayed in	0
		online mode.	
3	CmnMem-1 writing area address	Set starting address (offset) of sending area of common	0
	(offset)	memory 1.	
4	CmnMem-1 writing area size	Set size of sending area of common memory1.	0
5	CmnMem-2 %MW address	Starting address of common memory 2 is displayed in	0
		online mode.	
6	CmnMem-2 address (offset)	Set starting address (offset) of common memory 2.	0
7	CmnMem-2 size	Set size of common memory 2.	8192
8	CmnMem-2 writing area address	Set starting address (offset) of sending area of common	0
	(offset)	memory 2.	
9	CmnMem-2 writing area size	Set size of sending area of common memory 2.	0
10	Token watchdog time	Set monitoring time between token receiving and	50
		sending it out the next node.	
11	Allowable min. frame interval time	Set waiting time between token receiving and sending	0
		out data frame to the next node.	
12	Type and vendor name	Choose vendor name and model name.	EH-FLN3/
		Functionality is same in both choices.	HITACHIIES
13	Node Name	Set node name within 10 characters.	Node1
14	Clear data in STOP (CmnMem-1)	Set Yes if common memory 1 is to be cleared when	No
		CPU stops.	
15	Clear data in STOP (CmnMem-2)	Set Yes if common memory 2 is to be cleared when	No
		CPU stops.	

Configuration example

Configuration example is shown in the figure below.



Note

- · Allowed range of values are shown below. HX-CODESYS does not detect error if the value is out of the range.
 - CmnMem-1 writing area address (offset): 0 to 511
 - CmnMem-1 writing area size: 0 to 512
 - CmnMem-2 address (offset): 0 to 8191
 - CmnMem-2 size: 0 to 8192
 - CmnMem-2 writing area address (offset): 0 to 8191
 - CmnMem-2 writing area size: 0 to 8192

(Since the consistency between above each pare parameters cannot be checked by HX-CODESYS, invalid values, for example [CmnMem-1 writing area address (offset)] is 511 and [CmnMem-1 writing area size] is 512, can be set. In that case, CPU detects an error and outputs error message in the CPU log.)

- If PLC settings are set as follows, received link data might not be correct because I/O refresh timing and link refresh timing are not synchronized when CPU is in stop mode.
 - Update IO while in stop : Disable
 - Behaviour for outputs in Stop : Execute program
- When an EH-LNK or EH-FLN2/3 device is added, LINK_FLNET_TASK and RefreshLinkData or RefreshFlnetData objects are automatically created. Do not change these object names.

4.2.3 Cyclic Transfer

If right configuration parameters are downloaded to FL-net module together with application program, FL-net module will automatically take part in the network and start cyclic transmission. Refer to section 4.2.5 for status of completing initialize.

Note

If PLC settings in HX-CODESYS are configured as below and receiving area is written by the executed program in stop, the data may be overwritten by FL-net refresh cycle depending on the timing of CPU stop and FL-net refresh cycle.

- Update IO while in stop : Disable
- Behaviour for outputs in Stop : Execute program

4.2.4 Message Transmission

HX-CPU does not support sending of user message transmission for FL-net module.

Responding is limited in a part of commands from another node. If unsupported command is received, timeout is detected by the command sender.

No.	Message	Command	Response
1	Byte block read	NA	NA
2	Byte block write	NA	NA
3	Word block read	NA	NA
4	Word block write	NA	NA
5	Network parameter read	NA	X *1
6	Network parameter write	NA	NA
7	RUN / STOP direction	NA	NA
8	Profile read	NA	NA
9	Communication log data read	NA	X *1
10	Communication log data clear	NA	X *1
11	Return received message	NA	X *1
12	Pass through type message	NA	NA

*1 Response message is handled by FL-net module.

4.2.5 Status Monitor Library

The status information of EH-FLN2/3 can be read by special function block GetFLInfo.

Set FL-net number and xEnable to TRUE, then status is read out in the STRUCT FLInfo when xDone is TRUE.



Detail of FLInfo structure

Member name	Description		Туре	Remark
xInitDone	Node initialization	0: Not yet 1: Done	BOOL	-
xParamError	Parameter error	0: No error 1: Error	BOOL	-
xAdrDuplicated1	Address duplication area1	0: No error 1: Error	BOOL	-
xAdrDuplicated2	Address duplication area2	0: No error 1: Error	BOOL	-
xWaitforRcv	Wait for receiving status	0: Normal	BOOL	-
		1: Error (Wait for receiving)		
xTokenWatchdogTime	Timeout of token	0: No error 1: Error	BOOL	-
xNodeDuplicated	Node number duplication	0: No error 1: Error	BOOL	-
xTokenTimeoutOwnNode	Timeout of own node token	0: No error 1: Error	BOOL	-
xTBN_CBN_BSIZE	TBN, CBN or BSIZE error	0: No error 1: Error	BOOL	-
xCableDisconnect	Disconnect Cable	0: No error 1: Error	BOOL	-
xTokenModeUnmatch	Un-match token mode	0: No error 1: Error	BOOL	-
axLinkFlag	Link Node	0: Not join 1: Join	ARRAY[1254]	-
			OF BOOL	
axRunStatus	Status flag upper layer (Run	0: STOP 1: RUN	ARRAY[1254]	-
	Status)		OF BOOL	
abErrStatus	Status flag upper layer	0: NORMAL	ARRAY[1254]	-
	(Error Status)	1: WARNING	OF BYTE	
		2: ALARM		
sMACID	MAC address		STRING (12)	Valid FLN3 only
wRefCycleAllowed	Allowed refresh cycle time [m	ns]	WORD	-
wRefCycleCurrent	Current refresh cycle time (cu	rrent value) [ms]	WORD	-
wRefCycleMax	Maximum refresh cycle time ((maximum value) [ms]	WORD	-
wRefCycleMin	Minimum refresh cycle time (minimum value) [ms]	WORD	-
wMinFrameIntvl	Minimum frame interval [x 1	00us]	WORD	-
xEthernetStatus	Ethernet status flag	0: No link 1: Link-up	BOOL	Valid FLN3 only
xLinkSpeed	Link speed flag	0: 10Mbps 1: 100Mbps	BOOL	Valid FLN3 only
xDuplexMode	Duplex mode flag	0: Half duplex	BOOL	Valid FLN3 only
		1: Full duplex		
xSDRAMError	SDRAM error	0: No error 1: Error	BOOL	-
xEEPROMError	EEPROM error	0: No error 1: Error	BOOL	-
xSystemError	System error	0: No error 1: Error	BOOL	-
xFlashError	FLASH error	0: No error 1: Error	BOOL	-
xMPUError	MPU error	0: No error 1: Error	BOOL	-
xSystemRAMError	System RAM error	0: No error 1: Error	BOOL	-
xNodeNumberError	Node number error	0: No error 1: Error	BOOL	-
xLinkAddressError	Link address error	0: No error 1: Error	BOOL	-

4.3 Profibus Master Module

4.3.1 Overview

Profibus master module EH-RMP/EH-RMP2 is available with HX-CPU. Variables for Profibus master module are declared in Global Variable List (GVL) with %M address. GVL is added by right-clicking on [Application] shown below.



4.3.2 Configuration of Link Parameter

Add [EH-LNK] device to the device tree in advance. Double-click [EH-LNK] and set [Offset address of writing area] (Writing area %MW offset address) and [Size of writing area].

Offset address of writing area

Configure start address of Link area. Set 0 (zero) for EH-RMP/EH-RMP2.

Size of writing area

EH-RMP: Set the actual size configured by Sycon.

EH-RMP2: Set 512 (as fixed value).

Note

Do not set 0 (zero) for Size of writing area. Even if no output module is used and all slaves are input module only, configure dummy value except 0. If 0 is configured, STATUS LED blinks 4 times in EH-RMP. If other value than 512 is set in EH-RMP2, STATUS LED blinks 4 times.

EH-LNK Parameters	Parameter	Туре	Value	Default Value	Uni
	👘 🖗 LINK area %MW-address	WORD	0	0	
EH-LNK I/O Mapping	Offset address of writing area	WORD(01023)	0	0	
	Size of writing area	WORD(01024)		0	
		X word (EH-RMP), :	512 word (EH-R	MP2

Address of reading area (Configuration is not needed.)

Read area is assigned automatically shown in the following table.

Word address	Bit address	Hitachi address	Description (EH-RMP)	Description (EH-RMP2)
%MW0	%MX0.0-7,1.0-7	WL0	[X] word	Write area
%MW1	%MX2.0-7,3.0-7	WL1	Write area	(512word)
%MW2	%MX4.0-7,5.0-7	WL2		
%MW[X]		WL[X]		
			Write area	
%MW255	%MX510.0-7, 511.0-7	WLFF	Possible to specify	
%MW256	%MX512.0-7, 513.0-7	WL100	Not supported by	
			EH-RMP	
%MW511	%MX1022.0-7, 1023.0-7	WL1FF	(256 word)	
%MW512	%MX1024.0-7, 1025.0-7	WL200	Read area	Read area
				(512word)
%MW767	%MX1534.0-7, 1535.0-7	WL2FF		
%MW768	%MX1536.0-7, 1537.0-7	WL300	Not supported by	
			EH-RMP	
%MW1023	%MX2046.0-7, 2047.0-7	WL3FF	(256word)	

4.4 Serial Interface Module

4.4.1 Supported Features

HX-CPU supports EH-SIO from the firmware version 3.5.8.26. Please note that supported function is different from EHV/EH series as below.

Function	HX-CPU	EHV/EH-CPU
Modbus-RTU master	X	Х
Modbus-ASCII master	X*	Х
Modbus-RTU/ASCII slave	-	Х
General purpose communication (Free protocol)	X	Х
Hi-Protocol	-	Х
Simple data link	-	Х

X =Supported, - =Not supported *: Supported on SP13

Note

The I/O definition of EH-SIO have been changed on the device file version 3.5.8.22. Please select 3.5.8.22 or newer when using EH-SIO with HX-CPU.

4.4.2 Port Number Setting

Open "EH-SIO Configuration" window and set the port number from "COM2" to "COM15" ("COM1" is reserved for CPU local port) or "None". Each COM port number must be unique. If it is duplicated, EH-SIO does not work.

Note



4.4.3 Modbus-RTU / ASCII Master

Right click on [Device] and choose [Add Device...]. [Add Device] window appears.

Click [Modbus SIO-COM] and [Add Device] button.





With [Add device] window opened, click [Modbus_SIO_COM] in the device tree. Then available devices will be shown in the [Add Device] window. Choose [Modbus Master, COM Port] and [Add Device] button



Note

- Although EH-SIO's Serial port does not support Modbus-RTU slave function, slave device (Modbus Serial Device) is shown since it is common device for other manufacturer's CODESYS based CPUs. Please do not choose this device.
- Modbus command processing is executed in bus cycle tack, which is configured in PLC settings of Device. You can specify any existing IEC tasks. If the bus cycle task is <unspecified>, task with the shortest cycle time is taken. If 24 or 25 error appears in CPU, specify longer bus cycle task.

Modbus Slave, COM Port

With [Add device] window opened, click [Modbus Master COM Port] in the device tree. Then [Modbus Slave, COM Port] is shown in the [Add Device] window. Click [Modbus Slave, COM Port] and [Add Device] button according to your Modbus system configuration. e.g. if 3 slaves are to be controlled, add 3 times of slave devices.



Double click on [Modbus_SIO_COM] or right click and choose [Edit Object], [Modbus_SIO_COM] Configuration window appears. Set the same COM port number as EH-SIO configuration window. Although baud rate and data frame format of EH-SIO are configured with dip switches on board, set same parameters as dip switches in this configuration window too.

Devices 🗸 🗘 🗙	Modbus_SIO_COM	
Unbled 18 Unbled 18 Device (HX-CP 1H16) Device (HX-CP 1H16)	Modbus Serial Port Configuration Serial Port Configuration COM Port Baud Rate Parity Data Bits Stop Bits	on Status Information
Modbus operation is same as CPU port.		Set same data as
		dip switches on board.

Note

- In higher baud rate, such as 57.6 or 115.2 kbps, if slave device responds less than 1 ms, CPU might fail to receive a query. In this case, change the baud rate to slower.
- Set a value larger than 50 ms to the response timeout setting of the slave device, when using [Modbus SIO-COM].

Modbus_Slave_COM_Port X	l		
General Modbus Slave Channel	Modbus-RTU/ASCII Slave Address [1247]	1	MODBUS
Modbus Slave Init	Response Timeout [ms]	1000	

4.4.4 General Purpose Communication

Besides Modbus Master function, EH-SIO supports general purpose communication same as CPU port. Add "SysCom" library by clicking [Add library] on Library manager. Only the difference from CPU port is COM port number. Be sure to set the same COM port number as [EH-SIO configuration] window.

Add Library		×
<u>C</u> ompany:	(All companies)	*
👓 Standa	rd Monitoring Data Server Driver System	^
👓 Standa	rd <i>System</i>	
👓 Standa	rd64 System	
👓 Symbol	icVarsBase <i>System</i>	
∘	back23 5ystem	
Image: SysCon	123 System	_
🕬 SysCon	n <i>System</i>	
👓 SysCpu	Handling System	
∘ 100 SysDir2	3 System	
👓 SysDir	System	
● SysDPV1Hilscher23 System		
Image: SysEve	nt23 <i>System</i>	
Image: SysEve	nt System	
👓 SysExc	ept System	~
<		
Group by	r category	
Details	OK Cance	:
4.4.5 LED Indication

MB and **MS** LED: When CPU has no application (user program) or wrong COM port setting or "None" assigned, LNK, MB, HP and MS LED will light up. If correct COM port setting is downloaded, all of the LED will turn off.

(Even EH-SIO works in Modbus-RTU mode, internal setting of EH-SIO is always general purpose mode. For this reason, MB and MS LED do not light.)

CDE LED: Even if correct COM port setting is downloaded, CDE LED will light up without cable connected because DR signal is expected to be high in RS-232C port.

Link mode

HARDWARE REV.04 or older	WDE Watch dog timer erro
LNK WDE MDE CDE	MDE Module error
SD1 RD1 SD2 RD2	CDE Command error
MB1 HP1 MB2 HP2	SD1/2 Sending data
MS1 MS2 422	RD1/2 Receiving data
SERIAL I/O	MB1/2 Modbus mode
HARDWARE REV.10 or newer	HP1/2 Hi-Protocol mode
	MS1/2 Modbus Master
SD1 RD1 SD2 RD2	422 1/2 RS-422 port enabled
MB1 HP1 MB2 HP2	

EH-SIO

4221 MS2

SERIAL I/O

4.4.6 Hardware Reset and Software Reset

When the reset button is pressed while communication, the communication is aborted since EH-SIO is initialized. This is hardware reset operation. Make stop and run to recover the communication.

Instead of that, SysComPurge command is able to initialize EH-SIO. This is software reset function.

Note

- · Do not use the EH-VCB02 cable for EH-SIO. Since EH-SIO does not perform data transmission while the CS signal is OFF, if a cable that the control line CS is not connected like EH-VCB02 is used, a data transmission timeout occurs and the scan time is extended by the timeout detection time.
- CDE LED may remain lighting, if EH-SIO is connected to a communication pear device after CPU starts running.
- · Do not press and hold the reset button, just after EH-SIO complete the data transmission.
- Please use EH-SIO device file version 3.5.8.22 or newer when using with HX-CPU.
- When using HX-CPU firmware version 3.5.8.26, the actual value of CPU Communication Timeout works with the default value regardless of the setting value.
- RS and ER signal of EH-SIO are automatically controlled. The control register of EH-SIO cannot be handled by user program.
- · The communication settings of EH-SIO follow the DIP switch setting on its body. Please note that no error is detected even if different setting from the DIP switch is configured by HX-CODESYS.
- · EH-SIO doesn't support divided data reception.

4.5 DeviceNet Master Module

4.5.1 Overview

DeviceNet master module EH-RMD/EH-RMD2 is available with HX-CPU. Variables for DeviceNet master module are declared in Global Variable List (GVL) with %M address. GVL is added by right-clicking on [Application] shown below.



4.5.2 Configuration of Link Parameter

Add [EH-LNK] device to the device tree in advance. Double-click [EH-LNK] and set [Offset address of writing area] (Writing area %MW offset address) and [Size of writing area].

Offset address of writing area

Configure start address of Link area. Set 0 (zero) for EH-RMD/EH-RMD2.

Size of writing area

Set 512 (as fixed value) for EH-RMD/EH-RMD2.

Note

Set 512 for Size of writing area. If any value other than 512 is configured, STATUS LED blinks 4 times on EH-RMD, MS LED blinks with red color on EH-RMD2.

	EH_LNK ×						
	EH-LNK Parameters	Parameter	Туре	Value	Default Value	Unit	Des
	Status	💮 🖗 LINK area %MW-address	WORD	0	0		LINK
		Offset address of writing area	WORD(01023)	0	0		Set
	Information	Size of writing area	WORD(01024)	512	0		Set
	Information			hà			
l							

	Word address	Bit address	Hitachi address	Description (EH-RMD2)
rea	%MW0	%MX0.0-7,1.0-7	WL0	Write area
d)				(256 word)
wor	%MW255	%MX510.0-7, 511.0-7	WLFF	
12 J	%MW256	%MX512.0-7, 513.0-7	WL100	Explicit message
(5 (5				send area (256 word)
Siz	%MW511	%MX1022.0-7, 1023.0-7	WL1FF	
	%MW512	%MX1024.0-7, 1025.0-7	WL200	Read area
				(256 word)
	%MW767	%MX1534.0-7, 1535.0-7	WL2FF	
	%MW768	%MX1536.0-7, 1537.0-7	WL300	Explicit message
				receive area
	%MW1023	%MX2046.0-7, 2047.0-7	WL3FF	(256 word)

Address of reading area (Configuration is not needed.) Read area is assigned automatically shown in the table below.

Reference

Set 512 word for Size of writing area, which is the summation of Write are and Explicit message send area. Please note that the last address of the writing area is 511 because the start address is 0.

4.6 EtherCAT Slave Module

4.6.1 Overview

By using the EtherCAT slave module (HX-ECTS), the HX-CPU can be used as an EtherCAT slave.



4.6.2 Operation Mode

HX-ECTS can be used in the modes shown in the following table. Set the mode corresponding to the required I/O size. ECTS ** mode is a mode for high-speed data transfer with the CPU module.

Mode	ECTS64 mode	ECTS256 mode	ECTS512 mode	LINK mode
Maximum I/O size	Input: 64 words	Input: 256 words	Input: 512 words	Input: 512 words
Device name	HX-ECTS64	HX-ECTS256	HX-ECTS512	EH-LNK
(I/O assign)				

4.6.3 Configuration

HX-ECTS can be used by connecting the device to the base module and setting the I/O mapping. The settings for ECTS ** mode and LINK mode are shown below.

(1) ECTS** mode

Plug the device name HX-ECTS ** and double-click the plugged device.

The I/O mapping screen is displayed. Set the I/O mapping by referring to the example below.

HX_ECT5512 X	Input data					
HX-ECTS512 I/O Mapping	Find	ind Filter Show all				From HX-ECTS to HX-CPU
HY-ECTS512 IEC Objects	Variable	Mapping	Channel	Address	Туре	
	🖽 🦄 arInputData	*		%IW0	ARRAY [0511] OF WORD	
Status	🖹 🧖 arOutputData	**		%QW0	ARRAY [0511] OF WORD	-
	[*] @		[0]	%QW0	WORD	
Information	* ø		[1]	%QW1	WORD	
	* @		[2]	%QW2	WORD	
						From HX-CPU to HX-ECTS

(2) LINK mode

Plug the device name EH-LNK and double-click the plugged device.

The EH-LNK parameters screen is displayed. Set the link parameters as shown in the figure below.

Offset address of writing area

Set start address of Link area. Set 0 (zero).

Size of writing area

Set 512 (as fixed value).

-	EH_LNK ×					
	EH-LNK Parameters	Parameter	Туре	Value	Default Value	Unit
		💮 🔷 LINK area %MW-address	WORD	0	0	
	EH-LNK IEC Objects	Offset address of writing area	WORD(01023)	0	0	
L	Status	🔍 🖗 Size of writing area	WORD(01024)	512	0	
	Status					

In LINK mode, marker memory (%M) of 1k words is used to input/output data between the HX-CPU and HX-ECTS. Table 4.1 shows the marker memory addresses corresponding to the I/O data.

	Addres	s of marker memory	Hitachi address	Description
C	Word address	Bit address		
	%MW0	%MX0.0-7, 1.0-7	WL0	Output data
sp				
WOL	%MW255	%MX510.0-7, 511.0-7	WLFF	From HX-CPU
512	%MW256	%MX512.0-7, 513.0-7	WL100	to HX-ECTS
Ş	%MW511	%MX1022.0-7, 1023.0-7	WL1FF	
	%MW512	%MX1024.0-7, 1025.0-7	WL200	Input data
ds				
wor	%MW767	%MX1534.0-7, 1535.0-7	WL2FF	From HX-ECTS
512	%MW768	%MX1536.0-7, 1537.0-7	WL300	to HX-CPU
l	%MW1023	%MX2046.0-7, 2047.0-7	WL3FF	

Table 4.1 Input / output address (case of link No. 1)

The marker memory address changes according to the link number. The marker memory addresses for each link number are shown in Table 4.2. When using HX-ECTS with links No.2 to 8, convert the marker memory address in Table 4.1 by referring to Table 4.2.

Table 4.2 Start / End of address

LINK No.	LINK-1	LINK-2	LINK-3	LINK-4	LINK-5	LINK-6	LINK-7	LINK-8
Start of address	%MW0	%MW1024	%MW2048	%MW3072	%MW4096	%MW5120	%MW6144	%MW7168
End of address	%MW1023	%MW2047	%MW3071	%MW4095	%MW5119	%MW6143	%MW7167	%MW8191

Chapter 4 Communication Modules

MEMO

Chapter 5 Debug Functions

5.1 Monitor

When login, the current value of variables can be monitored in variable definition area and editors. Variable Declaration area

Device Application.ladder_1							
Expression	Туре	Value	Prepared value	Address	Comment	D	
🛷 var1	BOOL	TRUE					
var2	BOOL	FALSE					
var3	BOOL	FALSE					
< var4	BOOL	TRUE					
E 🌵 TON_0	TON	1000					
🛷 var5	TIME	T#400ms					

Figure 5.1 Monitor value of variable

Table 5.1 Monitor value of variable

Display	Contents
TRUE	Variable is TRUE.
FALSE	Variable is FALSE.
T#400ms	Value is 400 ms.

Ladder logic diagram



Figure 5.2 Monitor ladder logic diagram

Table 5.2 Monitor ladder logic diagram

Symbol	Description
var1	Contact is TRUE.
var3	Negative contact is TRUE.
var2	Contact is FALSE.
var1	Negative contact is FALSE.
var2	Coil is ON.
var5	Coil is OFF.
T#500ms	Value is 500 ms.

Chapter 5 Debug Functions

Function Block Diagram



Figure 5.3 Monitor function block diagram

Display	Contents
TRUE	Value is ON.
FALSE	Value is OFF.
T#340ms	Value is 340 ms.

Structured text

1	TON_0 (IN	TRUE :=var1 TRUE	,		
2	PI	T#500ms	:=T#500MS,	(C)	
3	EI	T#380ms	=>var5	T#380ms	
4	Q	FALSE => var6 FALSE);		
5	var4 TRU	E :=var1 TRUE ;			
6	var3 FALS	E := var6 FALSE A	ND var2 FALSE ; RE	TURN	

Figure 5.4 Monitor structured text

Table 5.4 Monitor structured text

Display	Contents
TRUE	Value is ON.
FALSE	Value is OFF.
T#500ms	Value is 500 ms.

Change display mode

It is possible to change display for variable monitor with binary, decimal or hexadecimal. Select [Debug]-[Display mode].



Figure 5.5 Change display mode

Binary display

PLC_PRG X							
Device.Application.PLC_PRG							
Expression	Туре	Value	Prepared value	Address	Comment	N	
🖗 var1	INT	2#0000010011010010					
🖗 var2	INT	2#0001011000101110					
🔷 var3	INT	2#0001101100000000					
		A V					
1 var1 2#0000010011010010 := 1234;						*	
2 🕘 var2 2#0001011000101110 := 5678;						-	
3 🔵 var3 2#0001101100000000 := var1	2#0000010011010010 +	var2 2#0001011000101110	;			-	
4							
5							

Figure 5.6 Binary display

Decimal display

PLC_PRG X							
Device.Application.PLC_PRG							
Expression	Туре	Value	Prepared value	Address	Comment	1	
🔷 var1	INT	1234					
🕸 var2	INT	5678					
< var3	INT	6912					
1 var1 1234 := 1234; 2 var2 5678 := 5678; 3 var3 6912 := var1 1234 + var2 5678 ; 4							

Figure 5.7 Decimal display

Hexadecimal display

PLC_PRG X						•
Device.Application.PLC_PRG						
Expression	Туре	Value	Prepared value	Address	Comment	N.
🔷 var1	INT	16#04D2				
🔷 var2	INT	16#162E				
🕸 var3	INT	16#1B00				
1 var1 16#04D2 := 1234; 2 var2 16#162E := 5678; 3 var3 16#1800 := var1 16#04D2 + var2 16#162E ; 4						



Array variable monitor

It can't be display with array variable more than 1,000 if array declaration exceeds 1,000 at the default status.

pression	Type	Value	Prepared value	Address	Comment
🔷 var1	ARRAY [019999]				
<pre>war1[0]</pre>	WORD	0			
var1[1]	WORD	0			
var1[2]	WORD	0			
var1[3]	WORD	0			
var1[4]	WORD	0			
var1[5]	WORD	0			
var1[6]	WORD	0			
var1[7]	WORD	0			
🖗 var1[997]	WORD	0			
var1[998]	WORD	0			
var1[999]	WORD	0			

Figure 5.9 Array variable monitor 1

Change range of list display by double clicking [ARRAY[*..***]O..] to monitor array variable more than 1,000. List display is extended up to 20,000.



Figure 5.10 Array variable monitor 2

5.2 Flow Control

Flow control function is possible to confirm executing part of program by indicating green color on the part of execution.

Click [Debug]-[Flow Control] after login.



Figure 5.11 Enable flow control

Display only executing part colored green.



Figure 5.12 Display flow control

In the above example, there are three condition [x>100], [x<50] and [other] divided by condition of x value. Display executing part with green color in the case of [x=70] shows [other].

5.3 Break Point

Break point function is possible to stop program at the position specified stopping position of application program for debugging.

The possible break point position is the position can be changed value of variable or the position to call program after branch.

Configuration method of Break point

Show example of Break point with structured text.

Grey colored circle appears where break point can be set after login.



Figure 5.13 Break point position

After click [New Breakpoint] of [Debug] menu, property screen of Break point appears and then click [Location] tab. Specify POU to set Break point at [POU]. Specify the line to set Break point at [Position]. Check [Enable breakpoint immediately] to enable break point immediately after specifying.

Deb	ug <u>T</u> ools <u>W</u> indow <u>H</u> elp		
•	Start F5		
	Stop Shift+F8		
	Single Cycle Ctrl+F5		
1	New Breakpoint	New Breakpoint	
5	Edit Breakpoint	Condition Location Execution point settings	
	Toggle Breakpoint F9		
0	Disable Breakpoint		
•	Enable Bre <u>a</u> kpoint	POU: [PLC_PRG [Device: PLC Logic: Application]	
ÇI	Step Over F10	Position: RETURN	
ΨΞ	Step Into F8	Instance Path:	~
e_	Step Out Shift+F10		
→ 国	Run to Cursor		
\$	Set ne <u>x</u> t Statement		
⇔	Show next Statement		
	Write values Ctrl+F7		
	Eorce values F7		
	Unforce values Alt+F7		
	Flow Control		
	Core Dump		
	Display Mode	Enable breakpoint immediately OK	Cancel

Figure 5.14 Break point settings

Display red colored circle at valid Break point.

Display grey colored circle at invalid Break point.

Display yellow colored allow at the position program stopped.



5.4 Single Cycle and Step Over / Into / Out

5.4.1 Single Cycle Execution

Single cycle execution function is possible to execute only 1 cycle.

Execute only 1 cycle of program by clicking [Debug]-[Single cycle]. If there are several tasks, all tasks are executed only 1 cycle instead of task cycle.

	Deb	ug	<u>T</u> ools	Window	Help
2		Sta	art		F5
	-	St	op	Shif	t+F8
1		Sir	ngle <u>C</u> ycl	e Ctr	1+F5



Figure 5.15 Single cycle step function

5.4.2 Step Execution

There are four kinds of step execution function in HX-CODESYS. Set some Break point is needed due to Step execution function execute program after stopping temporaly.

(1) Step Into function

Step into function execute every one step of function or function block. If this function is to step into at the SUB_A (the line that will be executed next), this function move to the first line of SUB_A, stepping into the call. Click [Debug]-[Step Into] menu to execute Step in.



5

(2) Step Over function

Step over function execute function or function block at once. If this function is to step into at the SUB_A (the line that will be executed next), this function move to the next SUB_A, stepping over the call. Click [Debug]-[Step Over] to execute Step over.



Figure 5.17 Step over function

(3) Step Out function

If Step out function execute during the execution of function or function block by Step into function, execute all program of function or function block and go through original program from function or function block. Execute Step-in by clicking [Debug]-[Step Out].



Figure 5.18 Step out function

(4) Run to cursor

Run to Cursor execute program until position of cursor on the line.





5.5 Force Values and Write Values

Variable value can be forced to a certain value. In force values, the value is set every cycle. In write values, the value is set once.



Figure 5.20 Force values and Write values function



Configuration method of force function

Set write value of variable by double clicking [Prepared value] of variable declaration part.



It is possible to set value for variable similar way.

Device.Application.Force_writing					
Expression	Туре	Value	Prepared value		
🗼 var1	INT	0			
< var2	INT	0	100		

Display value with "<>" at value monitor part of editor part by setting value.

var1 0	:= var2	0 <100>		* 3;
--------	---------	---------	--	------



Configuration method of Write value function

Click [Debug]-[Write value] after setting write value of variable with similar way of Value force set function. The value is set only once when starting user program execution.

5.6 Trace

Trace function samples variable without dedicated program.

Configuration method

Create trace object

Add trace object by clicking [Add Object]-[Trace] after right clicking [Application].



Figure 5.22 Create trace object

Trace editor appears by double clicking [Trace] object.



Figure 5.23 Trace editor

Configure [Task] by clicking [Configuration]. Trace sampling cycle is defined by this task configuration. Configure other items if it is needed. It is recommended the trace task priority is configured lower due to avoid impacting the other process of user program when trace task load is heavy.

Trace Configuration			×
Trace PLC_PRG.abc	Record Settings E <u>n</u> able Trigger Trigger Variable: • Trigger <u>e</u> dge:	positive	
	<u>P</u> ost Trigger (samples): Trigger <u>L</u> evel: <u>T</u> ask:	51 100ms	
	<u>R</u> ecord condition: Co <u>m</u> ment:		
	Create persistent Rec	Re <u>s</u> olution: ms • ord <u>Ad</u> vanced	
Add variable Delete variable		OK Cancel	

Figure 5.24 Configure trace task

Configure trace variable at [Variable] by clicking [Add variable]. Configure other items if it is needed. In case of adding new variable, configure by clicking [Add variable] with similar way.

Trace Configuration	
□ Trace	Variable Settings
	Variable: •
	Graph <u>c</u> olor:
	Line type:
	Point type: Dot
	Activate minimum warning
	Critical lower limit: 0
	Warning minimum color:
	Activate maximum warning
	Critical upper limit: 0
	Warning maximum color:
	Displ <u>a</u> y Settings
<u>Add variable</u> <u>Delete variable</u>	OK Cancel

Figure 5.25 Add variable

Download trace data to HX-CPU by clicking [Trace]-[Download Trace] menu after login.



Figure 5.26 Download Trace

Display starts immediately according to the configured contents.



Figure 5.27 Trace data display

The following operation is possible after displaying trace data on [Trace] menu. Please refer online help for further detail information.

- Start/Stop of Trace data
- Customize display graph
- Access Trace data of HX-CPU
- Save/Read of Trace data

5.7 Simulation

In the simulation mode, an application can be downloaded and executed in a virtual controller in PC without PLC.

How to start simulation

Click [Online]- [Simulation]. Login and start execution.

If [Simulation] is chosen again, the simulation mode is cancelled.



Figure 5.28 Simulation debug

Chapter 6 Visualization

6.1 Overview

Visualization is to visualize I/O as lamps, switches or other elements, which enables easy monitoring and controlling application. Standard Visualization is available as one of the object in HX-CODESYS supported by all HX-series, and Web Visualization is displayed in standard web browser supported by HX-CP1H16, HX-CP1H16M and HXC-CP1H16.



Note

If a project which contains Web Visualization is transferred to an HX-CPU which doesn't support the functionality, an error is detected even though login can be performed.

6.2 Configuration

6.2.1 Creating Visualization

Create Visualization editor by right mouse click on [Application]-[Add Object]-[Visualization]. [Add Visualization] dialog appears. Click [Add] button. The name of Visualization can be changed if necessary. Then objects related Visualization are added in the device tree.



The object [Visualization] consists of editor area in the left to put elements and toolbox/property in the right.



You can add multiple visualization objects in the same way as above.

6.2.2 Configuration

Main settings in the Visualization Manager are shown as follows.



If you don't use Web Visualization or your CPU does not support Web Visualization, delete the object [WebVisu].



Web Visualization settings are shown as follows.

		Change if necessary.
		/
/	🙆 WebVisu 🗙	
	Start Visualization:	Visualization
	Name of .htm file:	webvisu
		Use as default page
	Update rate (ms):	200
	Default communication buffer size:	50000
		Show used visualizations
	Scaling options	
	○ Fixed ○ Isotropic	Anisotropic
	Use scaling options for dialogs	
	Client width:	1280
	Client height:	1024
	Presentation options	
	Antialiased drawing	
	Default text input	
	Input with:	Touchscreen \checkmark

Items	Parameters	Descriptions
Scaling options	Fixed	Fixed size of the visualization. The values used are client width and height.
	Isotropic	The size of the visualization is adapted to the dimensions of the web
		browser, retaining the proportions of the visualization.
	Anisotropic	The size of the visualization is adapted to the web browser.
	Use scaling options	Enabled: The dialogs, also for keypad and numpad, are scaled like the
	for dialogs	visualization (drawn with the same scaling factor). This is an advantage
		when a dialog was created to match the visualization because then they are
		scaled together.
	Client width	Width of the visualization (in pixels).
	Client height	Height of the visualization (in pixels).
Presentation options	Antialiased drawing	Enabled: Antialiasing is used when drawing the visualization in the web
		browser.
Default text input	Touchscreen	Text input on the WebVisu with touchscreen. The keypad or numpad dialog
		opens.
	Keyboard	Text input on the WebVisu with an ordinary keyboard or a virtual keyboard
		(on Android OS for example)

6.2.3 Element Placing

Visualization elements are found in the toolbox. Drag and drop the element into the editor.



Then property window is shown in the righthand of the screen. Assign a variable to link the lamp at the [Variable] field. If you click [...] icon, Input Assistant dialog appears to choose from existing variables. Configure other properties if necessary.



6.3 Lamp

The element [Lamp] is found in the category [Lamps/Switches/Bitmaps]. When the lined variable value is TRUE, it goes on, and when FALSE, it goes off.

B Visualization X		•	ToolBox		→ ₽
		^	Basic Con Measurement con Special controls I IP_VUM Curren Image switcher	nmon controls trols Lamp Date/time controls nt project Visu Lamp	Alarm manager s/Switches/Bitmaps ImagePoolDialogs Dialogs Favorite Dip switch
Properties	•		Position		
🍸 Filter 🔹 🛛 🔧 Sort by 👻 🤶	Sort order 🝷 🗹 <u>A</u> dvan			1522	
Property	Value		-		
Element name	GenElemInst_3				
Type of element	Lamp				
Position					
X	23				
Y	18		of the upper left c	orner	
Width	70				
Height	70				
Variable	PLC_PRG.lamp1	BOOL	variable to link		
 Image settings 					
🖃 Texts					
Tooltip		String	display as tooltip	for the eleme	ent
State variables			variable to togal	e the visibility	of the element
		TRUE	Invisible		
	Mallaur				
Image	reliow	Color Yello	ow, Red, Green,	Blue, Gray	



6.4 Switch

The elements switches are found in the category [Lamps/Switches/Bitmaps]. According to the operation on the switch, value TRUE/FALSE is written to a variable to be linked with the switch.

🕒 Visualization 🗙		•	ToolBox 👻
			Image Image <td< th=""></td<>
Properties	- Sort order 👻 Advance		
Property	Value		
Element name	ConFlowInst 5		
Type of element	Bush switch	- г	BOOL variable to link
	Fusit switch		
v	23		
× v	593	-	<u>—Image toggler</u>
Width	70	-	variable value.
Height	70	-	Image tapper
Variable		∙ ₊ ∣	The switch is on the variable value is TRUE
⊞ Image settings		-	while the mouse button is pressed.
Element behavior	Image toggler		
⊟ Texts		-	—— String display as tooltip for the element
Tooltip		.	BOOL variable to toggle the visibility of the element
State variables		TRUE: Invisible	
Invisible			
Deactivate inputs		_ ▲_	BOOL variable to toggle the operability of the clame
Background		TRUE: The element is shown as deactive	
Image	Gray		
			Color: Yellow, Red, Green, Blue, Gray



6.5 Read Variable Values

6.5.1 Text-based Element

The shapes in the category [Basic] or [Text field] in the category [Common controls] is to read variable values.

Basic Common cont	rols 🚺 Alarm manage	er Basic	Common co	ntrols	Alarm manager
Measurement controls	Lamps/Switches/Bitmap	Measure	ement controls	Lamps	s/Switches/Bitmaps
Special controls	Date/time controls	Spec	ial controls	Da	te/time controls
ImagePoolDialogs IP_	VUM 🚺 Current proje	ct ImageP	oolDialogs 🚺 Ii	P_VUM	Current project
Rectangle Round rec	tangle Ellipse	Tab	le Text	field	scrollbar
Properties	-		Exa	amples	
Y Filter ▼ V≱ Sort by ▼ Ž↓	Sort order ▼ <u>▼</u> <u>A</u> dvanced	ſ			
Property	Value		123	C)ecimal
Element name	GenElemInst_8	Γ			
Type of element	Rectangle		F01A	F	lexadecimal
Center Colors		[3.14	F	loating point
Use gradient color Gradient setting	linear, Black, White	[Temp. 25 deg	C V	ariable with text
 Element look Texts 					
Text		← String	gs to display. U	se % sig	n for a variable as
Tooltip		snown in the table below. Example: Temp, %d deg C			C
Iext properties		A line break can be inserted by [Ctrl+		by [Ctrl+Enter]	
Absolute movement Absolute movement					
Text variables					
Text variable		← Varia	ble to link		
Tooltip variable		. une			

Text	Format	Examples
%d, %i	Decimal (integer)	INT:=12; \rightarrow 12
%b	Binary (integer)	BYTE:=16#F3; \rightarrow 11110011
80	Octal (integer)	BYTE:=8#123; \rightarrow 123
۶x	Hexadecimal (32 bits or less)	WORD:=16#12AB; \rightarrow 12AB
%llx	Hexadecimal (64 bits)	WORD:=16#1111222233334444; → 1111222233334444
%u	Decimal (unsigned integer)	UINT:=1234; \rightarrow 1234
%f	Floating-point	REAL:=3.141592; \rightarrow %f \rightarrow 3.141592
	% <width>.<digit></digit></width>	\rightarrow %1.2f \rightarrow 3.14
	See the next page.	
%e, %E	Floating-point in exponential	REAL:=1000; \rightarrow %e \rightarrow 1.000000e+003
	notation of base 10	\rightarrow %E \rightarrow 1.000000E+003
%C	ASCII character	BYTE:=16#41; \rightarrow A
%S	Character string	STRING:='Hello'; \rightarrow Hello
00	Percent sign (%)	INT:=80; \rightarrow Text %d%% \rightarrow 80%

Floating point (%f)

%<alignment><minimum width>.<accuracy>f

Alignment	None	No alignment
(optional)	-	Left-aligned
	+	Right-aligned with plus/minus sign
Minimum width	Number of places to the left of the decimal point	
Accuracy	Number of places to the right of the decimal point	

Examples

Offline

%1.2f	%8.3f
%-1.2f	%-8.3f
%+1.2f	%+8.3f

Online	
1.00	1.000
1.00	1.000
+1.00	+ 1.000

With "< >" to show alignment clearly

Offline

<%1.2f>	<%8.3f>	
<%-1.2f>	<%-8.3f>	
<%+1.2f>	<%+8.3f>	

Online	
<1.00>	< 1.000>
<1.00>	<1.000 >
<+1.00>	<+ 1.000>

6.5.2 Graphic Element

The elements Bar display and meters in the category [Measurement controls] are to read variable values and to show in graphic view.



6.6 Write Variable Values

6.6.1 Text-based Element

The shapes in the category [Basic] or [Text field] in the category [Common controls] is to write variable values.

1	Droportion	_	
ļ	Properues	• •	
	🍸 Filter 🔹 🎼 Sort by 🍷 🤶	Sort order 🔻 🗹 <u>A</u> dvance	e
	Property	Value	
	Texts		
	Text	%d	 Strings to display. Use % sign for a variable as shown in section 6.5.
	Tooltip		
	Text properties ■		Example: Temp. %d deg C
			A line break can be inserted by [Ctrl + Enter].
	■ Relative movement		
	Text variables		
	Text variable	PLC_PRG.test	Variable to link (integer or floating-point)
	Tooltip variable		
	Dynamic texts		
	E Color variables Color variables		
	Inputconfiguration		
	OnDialogClosed	Configure	
	OnMouseClick	Configure	Event to write variable value
	OnMouseDown	Configure	(If the event is mouse clicking, choose OnMo

When clicking [Configure...], [Input Configuration] dialog appears. Choose [Write a variable] and click [>] icon. If you change [Input type], input value can be limited or keypad and numpad can be shown to enter values.

Input Configuration		×
OnMouseClick		
 Close Dialog Open Dialog Change the language Change shown Visualization Execute command Switch Framevisualization Write a Variable Execute ST-Code Toggle a variable File transfer 	 Write a Variable Write a Variable Input type: Default Choose variable to edit Use text output va Use another variable Initial display format: Min: Max: Dialog Title: Password field Position to open input Use global settin Centered 	t dialog: g(from Visualization manager
		OK Cancel

Input type

- Default, Text input: An input field appears.



- Text input with limits: An input field appears. The field shows the value range for the input.

Min: 1	Max: 99	
0		

- VisDialogs.Keypad: A virtual keyboard appears.

			_
- I " 7	\$ % & / (() = ?	I \ Back
@ Q W E	RTZU	1 O P 7	* ~ Clear
? A S	D F G H J	K L A F	· ESC
I > Y X	C V B N	M ; ;	Shift
イ ウ	Space		3 OK

- VisuDialogs.Numpad:

A virtual keyboard opens.

1			
7	8	9	Back
4	5	6	Clear
1	2	3	ESC
0	+/-	•	ок

- VisuDialogs.NumpadExtended

A virtual keyboard opens supporting hexadecimal values.

1					
• Dec	C Hex	<			
A	E	7	8	9	Back
в	F	4	5	6	Clear
с	Exp	1	2	3	ESC
D	F-E	0	+/-		ок

Chapter 6 Visualization

6.6.2 Graphic Element

The elements potentiometer in the category [Measurement controls] or Slider in the category [Common controls] are to write variable values and to show in graphic view.



6.7 Assigning a Color

6.7.1 Toggle Color

The color of shapes in the category [Basic] can be changed according to the status of BOOL variable. If you use a shape as an input device such as switch or button, refer to section 6.7.3.



6.7.2 Color Variable

Colors of shapes can be changed dynamically by color variables. If you use a shape as an input device such as switch or button, refer to section 6.7.3.

Properties	-	
🏹 Filter 🔹 🛛 🍪 Sort by 🔹 🧸	Sort order 🝷 🗹 <u>A</u> dvanced	← Enable [Advanced] setting.
Property	Value	_
 Text properties 		
 Absolute movement 		
 Relative movement 		
± Text variables		
± Dynamic texts		
 Font variables 		
Color variables		
Toggle color	PLC_PRG.lamp1	
Normal state		Color variable for the frame color when the
Frame color		variable value is FALSE.
Fill color	PLC_PRG.color_RB	Color variable for the fill color when the value
Alarmstate		value is FALSE.
Frame color		Color variable for the frame color when
Fill color	Fill color PLC_PRG.color_GB	the variable value is TRUE.
		Color veriable for the fill color where
 State variables 		the variable value is TRUE
Inputconfiguration		

The type of color variable is DWORD consisting of four bytes parameters as follows.

16#<TT><RR><GG><BB>

- <TT> : 00-FF // Transparency in 256 levels
- <RR> : 00-FF // Red in 256 levels
- <GG> : 00-FF // Green in 256 levels
- <BB> : 00-FF // Blue in 256 levels

Color variables value	Color	Sample
16#FFFF0000	Red	
16#FF00FF00	Green	
16#FF0000FF	Blue	
16#FFFFFF00	Yellow	
16#FFFF00FF	Magenta	
16#FF00FFFF	Cyan	
16#FFFFFFFF, 16#00*****	White	
16#FF000000	Black	
16#FF808080, 16#80000000	Gray	

If you change colors freely by a color variable independent from ON/OFF status of the variable, [Toggle color] is not necessary to define. In this case, define frame/fill colors in the normal state.

6.7.3 Change Colors of Shapes as Switches/Buttons

If you use shapes as switches or buttons with color changed, configure as follows.

Properties	-	
🏹 Filter 🔹 💕 Sort by 👻 🤶 So	ort order 🝷 🗹 <u>A</u> dvanced	
Property	Value	Start/Stop
Element name	GenElemInst_155	
Text ID	871	CharlelCharl
Type of element	Rectangle	StarvStop
± Position		
± Center		
= Colors		
Normal state		
Frame color	Black 🔶	
Fill color	Gray 🔶	——— Fill color when the variable value is FALSE
Alarmstate		
Erame color	Black 🗸	Frame color when the variable value is TRUE
Fill color	Green	——— Fill color when the variable value is TRUE
Use gradient color		
Gradient setting	linear, Black, W	
± Element look		
= Texts		
Text	Start/Stop	Strings to display
Tooltip		(Color variab
		has a priority
 Color variables 		
Toggle color	<toggle tap="" variable=""></toggle>	—— No definition
Normal state		
Frame color	+	
Fill color	POU.colortest	Fill color variable when the variable value is FALSE
Alarmstate		L Frame color veriable when the veriable value is TDUF
Frame color	+	
Fill color	+	
 Look variables 		
 State variables 		
Inputconfiguration		
OnDialogClosed	Configure	
OnMouseClick	Configure	Variable to link for [I ap] operation
OnMouseDown	Configure	Enchlad: Variable value is EALSE while the
OnMouseEnter	Configure	mouse button is pressed
OnMouseLeave	Configure	
OnMouseMove	Configure	Enabled: Variable value is TRUE again when the
OnMouseUp	Configure	mouse pointer is moved back to the element are
🗏 Тар		with pressed.
Variable	4	
Tap FALSE		Either
Tap on enter if captur	ed 🗌	
Togale		Variable to link for [Toggle] operation
Variable		
VOLIDUE		
Tooole on un if cantur	ed 🗆 🔺	Enabled: The value toggles regardless of where
Toggle on up if captur	ed 🗌 🖌	Enabled: The value toggles regardless of where the mouse pointer is when the mouse button is
6.8 Image

6.8.1 Image File

Add the object [Image Pool] by right mouse click on [Application]-[Add Object]-[Image Pool], and click [Add] button in the dialog [Add Image Pool].



Click the [...] icon at [File name] field, then [Select Image] dialog appears. Configure the link type according to the table below.

📑 ImagePool 🗙			
ID	File name	Image	Link type
Select Image	;	×	
Image File:			
What do you want to do with the Remember the link. Remember the link and em Embed into project.	e image file? Ibed into project.		
When the image file changes, th reload the file automatical prompt whether to reload do nothing.	en ly. the file.		
C	OK Cancel		

Items	Description
Remember the link	HX-CODESYS saves only the link and automatically updates any changes to an image
	file in the image pool. When saving the project as an archive, HX-CODESYS embeds
	the image file in the project archive.
Remember the link and embed	HX-CODESYS copies the image to the image pool and the link is retained.
into project	HX-CODESYS recognizes any changes to the image file and then update the image
	pool as needed. This behavior is controlled with the option below.
Embed into project	HX-CODESYS copies the image to the image pool. If the file is changed afterwards, it
	is not updated in the project.
Reload the file automatically	The image file is updated automatically without prompting.
Prompt whether to reload the file	If the image file has changed, you may be prompted if the image is updated or not.
Do nothing	HX-CODESYS does not update the image file in the image pool.

When an image file is configured, it is displayed as follows.

📄 ImagePool 🗙			
ID	File name	Image	Link type
caution	caution.jpg	Δ	Embedded

Added images are found in the category [ImagePool] in the ToolBox. Drag and drop as same as other elements.



6.8.2 Switching Image Files

Referenced images are switched according to the status of a BOOL variable. As described in the previous section, add images to [ImagePool]. The element [Image switcher] is found in the category [Lamps/Switches/Bitmaps].

🕘 Visualization 🗙			▼ ToolBox	→ ‡
	~ ▼		M M M	
			Basic Common co	ontrols Alarm manager
			Measurement controls	Lamps/Switches/Bitmaps
			Special controls	Date/time controls
			ImagePoolDialogs	P_VUM Current project
			VisuDialogs VisuUs	erManagement 🚺 Favorite
			Image switcher Lar	mp Dip switch
Properties	_	п		
		Ŧ		
Y Filter ▼ ♪> Sort by ▼ 2 ↓ Sort o	order 🔻 🕑 <u>A</u> dvanced			
Property	Value			
Element name	GenElemInst_17			
Type of element	Image switcher			
Position				
Variable			Variable to link	
Image settings				
Image on		_ -	Image if the variable va	
Image off			Image if the variable va	lue is TRUE
Image pushed			Image if the element is	clicked (optional)
Transparent				
Transparent color	Black		(If [Image off] is empty,	the image appears
Isotropic type	Isotropic		only when the variable	value is TRUE.)
Horizontal alignment	Left			
Vertical alignment	Тор		Image toggler	
Element behavior	Image toggler	Every mouse click switches the		vitches the image.
= Texts			Image tapper	Ŭ
Tooltip		The image of the [Image on]		age on] is displayed
🖃 State variables			while the mouse button is presse	
Invisible				
Deactivate inputs			If the image is used as set TRUE or variable to	read only (no operation) control.

6.9 Change Shown Visualization

The button in the category [Common controls] or the shapes in the category [Basic] is used to change shown Visualization.



If [Configure...] in the Input configuration field is clicked, [Input Configuration] dialog appears. Choose [Change shown Visualization] and click [>] icon. Then, choose the visualization to be changed in the [Assign] field by clicking the [...] icon to open [Input Assistant].



6.10 Combo Box

Combo boxes are found in the category [Common controls]. You can choose either Combo box integer or Combo box array.



6.10.1 Combo Box Integer

Add the object [TextList] by right mouse click on [Application]-[Add Object]-[Text List], and click [Add] button in the dialog. Enter strings in the [Default] field to show in the combobox. ID numbers are automatically input. If one of strings is chosen in the combobox, corresponding ID number is written to the variable.

TextList X		
ID	Default	
0	First	
1	Second	
2	Third	
3	Fourth	



Example: If 'Third' is chosen in the combobox, value 2 is written to the variable ComboVar.

ComboVar		
2	Third	-

6.10.2 Combo Box Array

Array variable of STRING data type is used instead of [TextList] in the element [Combobox array]. In case of the same sample as shown in the previous section Combobox integer, define the array variable as follows.

```
ComboText : ARRAY[0..3] OF STRING := ['First', 'Second', 'Third', 'Fourth'];
```

Properties	•
🍸 Filter 🔹 🔀 Sort by 🔹 🤶	ort order 👻 🗹 <u>A</u> dvanced
Property	Value
Position	
X	38
Y	111
Width	150
Height	30
Variable	PLC_PRG.ComboVar_A
Data array	PLC_PRG.ComboText
🖃 Columns	
😑 Column	_
[0]	
Width	150
Image column	
Image configu	
Text alignmen	Centered
Use template	
Max. array index	
Row height	20
Number visible rows	4
Scrollbar size	20

Example: If 'Fourth' is chosen in the combobox, value 3 is written to the variable ComboVar_A.

ComboVar_A



6.11 Movement/Rotating/Stretching of Shapes

Shapes can be moved, rotated or stretched by the parameters as follows. Shapes are found in the category [Basic].



Parameters for movement,	rotating and	stretching are	shown in	the table below.
--------------------------	--------------	----------------	----------	------------------

Property		Variable	Description
Position	Х	-	The x-coordinate of the upper left corner of the element
	Υ	-	The y-coordinate of the upper left corner of the element
	Width	-	The width of the element
	Height	-	The height of the element
	Angle	-	Static angle of rotation (in degrees)
Center	Х	-	The x-coordinate of the point of rotation
	Υ	-	The y-coordinate of the point of rotation
Absolute	Movement X	~	The distance to move to the right
movement	Movement Y	\checkmark	The distance to move to the down
	Rotation	\checkmark	The angle of rotation (clockwise). The midpoint of the element
			rotates at the center point. The alignment of the element remains the
			same.
	Scaling	\checkmark	The centric stretching ratio. The value 1000 returns the element to its
			original size.
	Interior rotation	\checkmark	The angle of rotation (clockwise). The midpoint of the element
			rotates at the center point. The alignment of the element remains
			rotates according to the coordinate system of the visualization.
	Use real values	-	Enabled: The properties of the absolute movement are interpreted as
			REAL values. The values are not rounded.
Relative	Movement top-left X	\checkmark	The distance to move to the right for the left edge of the element.
movement	Movement top-left Y	\checkmark	The distance to move to the down for the top edge of the element.
	Movement bottom-right X	\checkmark	The distance to move to the right for the right edge of the element.
	Movement bottom-right Y	\checkmark	The distance to move to the down for the bottom edge of the
			element.

Variable -: N/A (Fixed value) $\bullet:$ Variable can be used.



Related parameters are shown in the below figure.



*1 It is shown as left direction however, positive value is movement to the right.

*2 It is shown as upper direction however, positive value is movement to the down.

Rotation and interior rotations are shown as follows.



The center outside of the element



6.12 Label

Strings can be displayed without frame by the element [Label] in the category [Common controls].

💾 Visualization 🗙		-	ToolBox 👻 🕈	
Label			Basic Common controls Alarm manager Measurement controls Lamps/Switches/Bitmaps Special controls Date/time controls ImagePool ImagePoolDialogs IP_VUM Current project VisuDialogs Favorite	
Properties	↓ ₽			
🍸 Filter 🝷 🖹 🖏 Sort by 🍷 🧕 S	ort order 🔻 🗹 <u>A</u> dvanced			
Property	Value			
Element name	GenElemInst_7			
Type of element	Label			
⊟ Texts				
Text	Label	<	- Strings to display	
Position				
Х	24			
Y	26			
Width	150			
Height	30			
Text properties				
Horizontal alignment	Centered			
Vertical alignment	Centered			
Text format	Default			
Font	Default			
 Font color 	Fontcolor			
State variables				
Invisible				

6.13 Dialog

A dialog (small screen) can be displayed on the visualization screen.

Add a new Visualization to the device tree, right-click it, select Properties, and select Dialog in the Visualization tab. If you want to specify the screen size, enable [Use specified visualization size] and set the width and height to suitable values.

Properties - Visualization_1 [Device: PLC Logic: Application]	×
Common Build Access Control Visualization Use Visualization as	
 Visualization Dialog Numpad/Keypad/Dialog for input configuration 	
 Dialog is opaque Use automatic detected visualization size Include background image 	
 Use specified visualization size Visualization Size Width 400 Height 300 	
Internal	

Add a component (such as a button) to open the dialog in a parent visualization, set [Open Dialog] in the input configuration, and specify the name of the dialog to open (Visualization name).

Input Configuration		×
OnMouseDown		
 Close Dialog Open Dialog Change Language Change Shown Visualization Execute Command Switch Frame Visualization Write Variable Execute ST-Code Toggle Variable File Transfer 	Image: Second system Image: Second system	Open Dialog Dialog Visualization 1 ✓
		OK Cancel

On the dialog side, add a component (such as a button) that closes the dialog itself, set [Close Dialog] in the input configuration, and specify the own dialog name (Visualization name) to close.



6.14 Histogram

Bar graphs and line graphs can be displayed in [Histogram] in [Measurement Controls] category. The horizontal axis of the graph is evenly spaced. Use XYChart from [Special controls] category for scatter plots with variables on the horizontal axis.



Example

Data : ARRAY[1..5] OF INT;



6.15 Table

To display a table, select [Table] in [Common Controls] category.



Select a 1-dimensional or a 2-dimensional array for the property data array.

One-dimensional array: The table has one column.



Two-dimensional array: The index size of the first dimension determines the number of columns and the index side of the second dimension determines the number of rows.



Index size of the first dimension

Y Filter - I*\$ Sortby - \$↓ Sort order - ☑ Advanced Property Value Element name Genetimist_6 Type of element Table Data array PLC_PRG.table Sortby - \$↓ Specify data array. Maximum array index Specify data array. Columns Switch if the column is visible. © Column header Switch if the column label can be changed here. Width 40 Text algoment c Column width in pixels Image configurable. Image configurable. Width 40 Text algoment c Column width in pixels Image configurable. Image configurable. Text algoment c Image configurable. Image column beader Ø Show row header Ø Show row header Ø Show row header Ø State variables Ø Position Table selection ofor Selection for color Table selection for color Selection for color Table selection for color Selection for color Table selection f	Properties	↓ ₽	×
Property Value Element name GenEleminst_6 Type of element Table Data array PLC_PRG.table Maximum array index Specify data array. Limits the number of displayed rows. Limits the number of displayed rows. Column Switch if the column is visible. Image column Switch if the column label can be changed here. Width 40 Text alignment o Centered Use template Images can be displayed in the column. If [1] Images are used from image pool.) Width 40 Show column header Images are used from image pool.) Show column header Images are used from image pool.) Prosition State variables State variables Text tab Selection color Table selectioncolor Selection font color Table selection font color Selection	IV Filter ▼ Sort by ▼ A	order 👻 Advanced	
Element name GenEleminst_6 Type of element Table Data array PLC_PRG.table Maximum array index Specify data array. Columns Specify data array. Columns Switch if the column is visible. Image column Switch if the column label can be changed here. Width 40 Image column Image column is visible. Image column is visible. Image column is	Property	Value	
Type of element Table Data array PLC_PRG.table Maximum array index Specify data array. Column Limits the number of displayed rows. Column Switch if the column is visible. Image confurmt Switch if the column is visible. Width 40 Column header PLC_PRG.table[0,INDEX] Width 40 Text alignment o Centered Use template Images can be displayed in the column. (Images are used from image pool.) Images are used from image pool.) ** [1] Images are used from image pool.) ** [2] Images are used from image pool.) ** [3] Images are used from image pool.) ** [1] Images are used from image pool.) ** [2] Images are used from image pool.) ** [3] Images are used from image pool.) ** [7] Images are used from image pool. * [7]	Element name	GenElemInst_6	
Data array PLC_PRG.table Maximum array index Specify data array. Columns Limits the number of displayed rows. Column Switch if the column is visible. Total grament o PLC_PRG.table[0,INDEX] With 40 Text alignment o Centered With Column width in pixels Text alignment o Centered Text alignment o Centered # [1] # [2] Show column header 20 Row header 20 Show column header 20 Position 20 * Text index Tototip index Table selection color Selection Table selection font color Selection font color Table selection font color Selection color Table selection font color Selection font color Table selection font color Selection color	Type of element	 Table	
Maximum array index Columns © Columns Switch if the column is visible. © Column header PLC_PRG.table[0,INDEX] Width 40 © Column header PLC_PRG.table[0,INDEX] Width 40 © Text alignment 0 Centered Use template Images can be displayed in the column. (Images are used from image pool.) Width 40 Text alignment 0 Centered Width 20 Row header 20 Show row header 20 Bow header width 40 Strol Bar size 20 Position Text layment call * Text algrment call 20 Row header 20 Bow row thader 20 Boy row texts 20 Text laymap No need to set. * Text stat Text stat Text task Table selection color Selection Table selection font color Selection type No selection Selection type No selection font color Selection type Table selection font c	Data array	PLC_PRG.table	← Specify data array.
Columns Column Column Column Column Switch if the column is visible. The column label can be changed here. Column width in pixels The column header Show column header Show column header Solution The column header Solution The column header Solution The column header Solution The column header Solution Solution The column header Solution The column header Solution Solution The column header Solution Solution The column header Solution Solution The column header Solution Solution Solut	Maximum array index		Limits the number of displayed rows.
Column Column header PLC_PRG.table[0,INDEX] Width 40 Image column I	Columns		
Image column header PLC_PRG.table[0,INDEX] Width 40 Image configurati Column width in pixels Text alignment o Centered Use template Images can be displayed in the column. (Images are used from image pool.) * [1] Yestion * [2] Yestion Show column header Yestion Show column header Yestion Position Yestion * Text properties Yestion Dynamic texts Selection when clicking the table row. No selection, Cell selection, Row selection, Column selection, Row and column selection Selection font color Table selection font color Selection font color Table selection font color Selection font color Table selection font color Selection for color Table selection font color Selection font color Table selection font color Selection for color Table selection font color Selection for selected cells Contains the index of the Column of the selected cell. Variable for selected row Contains the index of the Row of the selected cell.	🖃 Column		Switch if the column is visible.
Column header PLC_PRG.table[0,INDEX] Width 40 Image column Column width in pixels Image column Image column Image column Image column <	= [0]		↓
Width 40 Image column Column width in pixels Text alignment o Images can be displayed in the column. Text alignment o Images can be displayed in the column. Text alignment o Images can be displayed in the column. Text alignment o Images can be displayed in the column. Text alignment o Images can be displayed in the column. Text alignment o Images can be displayed in the column. Text alignment o Images can be displayed in the column. * [1] Images can be displayed in the column. * [1] Images can be displayed in the column. * [1] Images can be displayed in the column. * [1] Images can be displayed in the column. * [1] Images can be displayed in the column. * [1] Images can be displayed in the column. * [1] Images can be displayed in the column. * [1] Images can be displayed in the column. * [1] Images can be displayed in the column. * [1] Images can be displayed in the column. * [1] Images can be displayed in the column. * [1] Images can be displayed in the column. * [1] Images can be displayed in the column. * [1] Images can be displayed in the column. * [1] Images can be displayed in the column. * [2] Images can be displayed in the column. * [2] Images can be displayed in the column. * [2] Images can be displayed in the column.	Column header	PLC_PRG.table[0,INDEX]	The column label can be changed here.
Image column Image configurati Text alignment o Use template Text alignment o Images can be displayed in the column. Use template Text alignment o Images can be displayed in the column. Images can be displayed in the column. Use template Text alignment o Image configurati Image configuration Image configuration Use template Text alignment o Images can be displayed in the column. Images can be displayed in the co	Width	40	Column width in pixels
* Image configurati Text alignment o Use template Text alignment o * [1] * [2] Show row header Show column header Ø Show column header Ø Show column header Ø Show column header Ø Stow column header Ø Stow column header Ø Text header width 40 Scroll Bar size 20 Ø Ø Text header Ø Selection oclor Table selectioncolor Selection color Table selection color Selection toper Table selection font color Selection toper Table selection font color Selection toper No selection	Image column		•
Text alignment o Centered Use template Image: stress of the selection of the selected cells. Text alignment o Image: stress of the selected cell. Text alignment o Image: stress of the selected cell. Text alignment o Image: stress of the selected cell. Text alignment o Image: stress of the selected cell. Text alignment o Image: stress of the selected cell. Show row header Image: stress of the selected cell. Show row header Image: stress of the selected cell. Strol Bar size Image: stress of the selected cell. Image: stress of the selected cell. Image: stress of the selected cell.			Images can be displayed in the column.
Use template	Text alignment o	Centered	(Images are used from image pool.)
Text alignment o * [1] * [2] Show row header Show row header Show column header Row height 20 Row header width 40 Scroll Bar size 20 Row header width 40 Scroll Bar size 20 * Position * Text properties Dynamic texts Text index Text index Tooltp index * Font variables Selection Selection color Selection font color Table selection font color Selection font color Selection font color Table selection font color Selection font color Yariable for selected cells Variable for selected colum Variable for selected colum Variable for valid column	Use template		
* [1] * [2] Show row header Show column header Show column header Row height 20 Row height 20 Row header width 40 Scrol Bar size 20 * Position * Text properties Dynamic texts Text list Text index Tooltip index * Font variables * State variables Selection Selection font color Frame around selected cells Variable for selected row Variable for selected row Variable for selected row Variable for selected row	Text alignment o		
* [2]	± [1]		
Show row header Image: Show column header Show column header Image: Show column header Row height 20 Row header width 40 Scroll Bar size 20 Position 20 Text properties 20 Dynamic texts 20 Text list 20 Text index 20 Tooltp index 20 State variables 5election State variables Selection font color Selection font color Table selection font color Selection font color Table selection font color Frame around selected cells 4 Variable for selected row 4			
Show column header Image: Column header Row height 20 Row header width 40 Scroll Bar size 20 Position 20 Position 20 Text properties 20 Dynamic texts 20 Text index 20 Text index 20 Tooltip index 20 Font variables Selection State variables Selection color Selection color Table selection font color Selection tolor Table selection font color Frame around selected cells 4 Frame around selected cells 4 Variable for selected row 4 Variable fo	Show row header		
Row height 20 Row header width 40 Scroll Bar size 20 Position	Show column header		
Row header width 40 Scroll Bar size 20 Position	Row height	20	
Scroll Bar size 20 Position	Row header width	40	
 Position Text properties Dynamic texts Dynamic texts Text list Text index Tooltip index Font variables State variables Selection Selection color Selection font color<td>Scroll Bar size</td><td>20</td><td></td>	Scroll Bar size	20	
 Text properties Dynamic texts Text list Text index Tooltip index Font variables Selection Selection Selection font color Selection type No selection, Row selection, Column selection, Column selection, Column selection, Row and column selection Frame around selected cells Variable for selected row Variable for selected row Variable for selected row 	Position		
 Dynamic texts Text list Text index Tooltip index Font variables State variables Selection Selection color Selection font color Selection font color Selection font color Selection type No selection Frame around selected cells Variable for selected column Variable for selected row Variable for selected row Variable for selected row 	Text properties		
Text list Image: State variables Font variables Selection Selection Selection color Selection font color Table selection font color Selection font color Table selection font color Selection type No selection Frame around selected cells A frame is drawn around the selected cells. Variable for selected row Contains the index of the Column of the selected cell.	Dynamic texts		
Text index Image: State variables Font variables Selection Selection Image: Selection color Selection font color Image: Table selection color Selection font color Image: Table selection font color Selection type No selection Frame around selected cells Image: Table selection font color Variable for selected column Image: Table selected cells Variable for selected row Image: Table selected cells Variable for selected row Image: Table selected cells Variable for selected row Image: Table selected cell Variable for valid column rule Image: Table selected cell	Text list		
Tooltip index Font variables State variables Selection Selection color Selection font color Selection font color Selection type No selection font color Selection type No selection Frame around selected cells Variable for selected row Variable for valid column	Text index		➢ No need to set.
 Font variables State variables Selection Selection color Selection font color Selection font color Selection type No selection font color Selection type No selection Frame around selected cells Variable for selected row Variable for selected row Variable for valid column 	Tooltip index		
 State variables Selection Selection color Selection font color Selection font color Selection type No selection font color Selection type No selection Frame around selected cells Variable for selected row Variable for selected row Variable for valid column 	 Font variables 		
 Selection Selection color Selection font color Selection font color Selection type No selection font color Selection type No selection, Cell selection, Row selection, Column selection, Column selection Selection type No selection, Cell selection, Row and column selection Column selection, Row and column selection Contains the index of the Selected cells. Contains the index of the Row of the selected cell. Contains the index of the Row of the selected cell. 	 State variables 		Selection when clicking the table row.
Selection color Tableselectioncolor Selection font color Table selection font color Selection type No selection Frame around selected cells A frame is drawn around the selected cells. Variable for selected column Contains the index of the Column of the selected cell. Variable for valid column Contains the index of the Row of the selected cell.	Selection		No selection, Cell selection, Row selection,
Selection font color Table selection font color Selection type No selection Frame around selected cells A frame is drawn around the selected cells. Variable for selected column Contains the index of the Column of the selected cell. Variable for selected row Contains the index of the Row of the selected cell. Variable for valid column Image: Contains the index of the Row of the selected cell.	Selection color	Tableselectioncolor	Column selection, Row and column selection
Selection type No selection Frame around selected cells A frame is drawn around the selected cells. Variable for selected row Contains the index of the Column of the selected cell. Variable for valid column Contains the index of the Row of the selected cell.	Selection font color	Table selection font color	
Frame around selected cells A frame is drawn around the selected cells. Variable for selected column Contains the index of the Column of the selected cell. Variable for selected row Contains the index of the Row of the selected cell. Variable for valid column Image: Contains the index of the Row of the selected cell.	Selection type	No selection	
Variable for selected column Contains the index of the Column of the selected cell. Variable for selected row Contains the index of the Row of the selected cell. Variable for valid column Contains the index of the Row of the selected cell.	Frame around selected cells	□ ◆	A frame is drawn around the selected cells.
Variable for selected row Contains the index of the Row of the selected cell.	Variable for selected column	+	Contains the index of the Column of the selected cell.
Variable for valid column	Variable for selected row	+	Contains the index of the Row of the selected cell.
	Variable for valid column	+	
Variable for valid row sel	Variable for valid row sel	4	U Variable for selected column variable contains a valid
Value.	<u> </u>		Value.

6.16 Check Box

A value can be written to a BOOL variable using [Check box] in [Common Controls] category.

Visualization ×		-	Visualization Toolbox	- ∓ X
	~ 🔻	^	🗎 🗎 🔉	
			Basic Common Controls	Alarm Manager
Checkbox			Measurement Controls	Lamps/Switches/Bitmaps
			Special Controls Date/Time Co	ontrois Current project
				i i
			Slider Spin Box	Invisible Input
			Progress Bar Check Box	Radio Buttons 🗸
				_
Properties		• म 🗙		
🐨 Filter 🝷 🞼 Sort by 🝷 🤶 Sort	order 👻 🗹 Advanced			
Property	Value			
Element name	GenElemInst_10			
Type of element	Check Box			
Position				
x	101			
Y	150			
Width	150			
Height	30			
Variable		•	Variable of type	BOOL
Frame size	From style			
🖃 Texts			Character string	(without single
Text	Checkbox	•	straight quotation	marks) for the
Tooltip			labeling the elem	ient.
Text properties				
Usage of	Default style values		1	
State variables				
Invisible				
Deactivate inputs				



6.17 Radio Buttons

You can select one from multiple options with [Radio Buttons] in [Common Controls] category. An integer value is written to the variable depending on which radio button is selected.

→ Visualization ×		•	Visualization Toolbox 🗸 🗸 🛪
	~ •	^	📺 🏢 🔼
			Basic Common Controls Alarm Manager
Radio button			Measurement Controls Lamps/Switches/Bitmaps
			Special Controls Date/Time Controls Current project
C Radio button			Favorite
		<u> </u>	
			Slider Spin Box Invisible Input
			Progress Bar Check Box Radio Buttons 🗸
Properties	→ ∓ X		
🍸 Filter 🔹 🔀 Sort by 🝷 🛃 Sort	order 👻 Advanced		
Property	Value		
Element name	GenElemInst_11		
Type of element	Radio Buttons		
E Position			
x	210		
Y	221	– Variat	ble (integer data type) that gives the index
Width	150	of the	radio button that the visualization user
Height	150	has a	ctivated.
Variable		Defini	tion of the number of list boxes displayed
Number of columns	1	in a co	olumn.
Radio Buttons order	Left to right	 Left to 	right: The radio buttons are aligned by
Frame size	From style	rows ι	until the number of columns is reached.
Row height	From style		
Text properties		Top to	b bottom: The radio buttons are aligned
Usage of	Default style values	row by	y columns until the number of columns is
State variables		reache	ed.
Invisible			
Deactivate inputs		A	
 Radio Buttons settings 		Create	e new: Clicking this button creates a
Radio Buttons	Create new	– new s	election button in the editor and lists
= Areas		an ad	ullional area in the properties editor.
□ [0]	× Delete	T 1 1	the second is an estimate the second
Text	Radio button	- The b	utton name is specified here.
Tooltip			
Line spacing	0		
. ■ [1]	× Delete		



6.18 Spin Box

The value of the variable can be increased or decreased with [Spin Box] in [Common Controls] category.





6.19 Execution

6.19.1 Visualization

In case of the standard visualization, it is automatically executed when [Login] and [Start]. Visualization works in [Simulation] mode also.

6.19.2 Web Visualization

Standard web browser is required in PC or tablet devices. HX-CODESYS is not required in the devices. (If wireless terminal is used, wireless device is required in HX-CPU) Web browser must support HTML5 (Firefox, Safari, IE9 or newer, etc.)

URL to access

http://<IP address>:8080/<Web file>

Example

http://192.168.0.1:8080/webvisu.htm

Web Visualization works only when HX-CPU is in [Start] status.

When accessed properly, Web Visualization screen appears after the waiting sign as shown below.



Chapter 7 Utility Functions

7.1 Real Time Clock

HX-CPU includes Calendar clock IC, Clock data can be used in program as system clock. Use this function by setting system clock and time zone information. Configure clock data by dedicated function block (CAA DTUtil library). Refer "System clock command" of HX Application Manual [Command reference edition] for further detail.

Command	Function
GetDateAndTime	Get system clock
SetDateAndTime	Set system clock
GetTimeZoneInformation	Get time zone information
SetTimeZoneInformation	Set time zone information

Time zone

There are two type of time zone in HX-CPU. Use Clock function by setting same information for both two time zone.

Table 7.2 List of time zone

Time zone Configure method		Target	
Time gone 1	Function block	GetTimeZoneInformation	
	(SetTimeZoneInformation)		
Time zone 2	Configuration (PLC Parameters)	GetNTPStatus	

Here is an example program to read the clock data. Use this example program by modifying according to the system specification. Configure NTP Client function invalid, if following the example program. Note that the program restarts from 2000 January 1st 00:00:00 automatically if clock data exceeds 2037 December 31st 23:59:59. Please refer Appx.1.1 for details.

Declaration part of variable.

```
PROGRAM POU
VAR
GetDateAndTime_0: DTU.GetDateAndTime;
SetDateAndTime_0: DTU.SetDateAndTime;
GET_TIME_ERROR: BOOL;
SET_TIME_ERROR: BOOL;
t1: TON;
test: BOOL;
currenttime: DATE_AND_TIME;
END_VAR
```

Program

7.2 Data Logging

HX-CPU supports USB memory and SD card as removable media and file access is possible. Here is sample program description executing data logging on removable media by using CAA File.

This sample program is 3 kinds data (time stamping, dummy data, text) logging making CSV file (File name: LoggingSample.csv) on USB memory. New data is added every 10 seconds automatically. Modify data writing timing according system usage.

Note

- SD card is available on HX-CP1H16, HX-CP1H16M, HXC-CP1H16.
- There may be a case that the frequency of the file writing execution is too high to write file properly. Please adjust the task cycle depending on the program.

	A	В	С
1			
2	DT#2016-05-17-21:25:22	1	This is Test !
3	DT#2016-05-17-21:25:32	2	This is Test !
4	DT#2016-05-17-21:25:42	3	This is Test !
5	DT#2016-05-17-21:25:52	- 4	This is Test !
6	DT#2016-05-17-21:26:02	5	This is Test !
7	DT#2016-05-17-21:26:13	6	This is Test !

PROGRAM PLC_PRG		
VAR		
USBMountSt	s :	BOOL;
SDMountSts		BOOL;
sDirSD	:	STRING :='/media/sd-mmcblk0pl'; // SD card
sDirUSB		: STRING :='/media/usb-sdal'; // USB memory
sFileName	:	CAA.FILENAME;
FileOpen		: File.Open;
FileClose	:	File.Close;
FileWrite		File.Write;
FileFlush	:	FILE.Flush;
sMedia	:	STRING;
iState	:	UINT :=1;
hfile	:	CAA.HANDLE;
sWriteLine		STRING(128);
GetRTC		DTU.GetDateAndTime;
xRDRTC		BOOL;
xReadDone	:	BOOL;
dtTemp	:	DATE_AND_TIME;
sDT		STRING;
Τ1	:	TON;
FileOpenDo	ne :	BOOL;
FileOpenEr	r :	BOOL;
FileWriteD	one :	BOOL;
FileWriteE	rr :	BOOL;
FileFlushD	one :	BOOL;
FileFlushE	rr :	BOOL;
Err		BOOL;
Exclsv	:	BOOL;
iNum		INT;
sNum		STRING;
END_VAR		

Program

```
USBMountSTS := UsbMountStatus();
IF USBMountSTS = FALSE THEN
                                                             * Enable (b) and comment out (a)
                                    (a)
  RETURN;
                                                               when logging data on SD card.
END IF
//SDMountSts := SdMountStatus();
//IF SDMountSTS = FALSE THEN
                                    (b)
      RETURN;
//END_IF
CASE iState OF
1:
      sMedia := sDirSD; // SD card
                                               (b)
      sMedia := sDirUSB; // USB memory _
                                                  (a)
      sFileName := '/LoggingSample.csv';
      sFileName := CONCAT(sMedia, sFileName);
      iState := 2;
2: // FileOpen: Mode.MWRITE
      FileOpen(xExecute:=TRUE, sFileName:=sFileName, xExclusive:=Exclsv, eFileMode:=File.MODE.MWRITE);
      IF FileOpen.xDone = TRUE THEN
             FileOpenDone := TRUE;
             Hfile := FileOpen.hFile;
             FileOpen(xExecute := FALSE);
             xRDRTC := TRUE;
             iState:= 10;
      ELSIF FileOpen.xError = TRUE THEN
             FileOpenErr := TRUE;
             FileOpen(xExecute := FALSE);
             iState := 90;
      END_IF
3: // FileOpen Mode.MAPPD
      FileOpen(xExecute:=TRUE, sFileName:=sFileName, xExclusive:=Exclsv, eFileMode:= File.MODE.MAPPD);
      IF FileOpen.xDone = TRUE THEN
             iState:=10;
             hfile:=FileOpen.hFile;
             FileOpen(xExecute:=FALSE);
             xRDRTC := TRUE;
      ELSIF FileOpen.xError=TRUE THEN
             FileOpen(xExecute:=FALSE);
             iState:=90;
      END_IF
10: // Get RTC data
      GetRTC(xExecute:=xRDRTC, xDone=>xReadDone, dtDateAndTime=>dtTemp);
       IF xReadDone=TRUE THEN
             sDT:=DT_TO_STRING (dtTemp);
             GetRTC(xExecute:=FALSE);
             iState:=11;
      END_IF
11: // Create & Combine the data
      iNum := iNum +1;
      sNum := INT_TO_STRING(iNum);
      sWriteLine := CONCAT('$r$n', sDT);
      sWriteLine := CONCAT(sWriteLine, ',');
      sWriteLine := CONCAT(sWriteLine, sNum);
      sWriteLine := CONCAT(sWriteLine, ',');
      sWriteLine := CONCAT(sWriteLine, 'This is Test ! ');
      iState:=12;
```

```
12: // FileWrite
      FileWrite(xExecute:=TRUE, hFile:=hfile,pBuffer:=ADR(sWriteLine), szSize:=INT_TO_UDINT(LEN(sWriteLine)));
      IF FileWrite.xDone = TRUE THEN
             FileWrite(xExecute:= FALSE);
             FileWriteDone:=TRUE;
             iState:=20; // To Flush
      ELSIF FileWrite.xError = TRUE THEN
             FileWriteErr:=TRUE;
             FileWrite(xExecute:= FALSE);
             iState:=90;
      END IF
      xRDRTC := FALSE;
20: // FileFlush
      FileFlush(xExecute:= TRUE, hFile:= hfile);
      IF FileFlush.xDone = TRUE THEN
             FileFlush(xExecute:= FALSE);
             FileFlushDone:=TRUE;
             iState:=30; // Close that file
      ELSIF FileWrite.xError = TRUE THEN
             FileFlushErr:=TRUE;
             FileFlush(xExecute:= FALSE);
             iState:=90;
      END_IF
30: // Close that file.
      FileClose(xExecute:= TRUE, hFile:= hfile);
      IF FileClose.xDone = TRUE THEN
             iState := 40;
             FileClose(xExecute:= FALSE);
      ELSIF FileClose.xError = TRUE THEN
            FileClose(xExecute:= FALSE);
             IState := 90;
      END IF
40: // wait 10 seconds
      T1(IN:=TRUE, PT:=T#10S);
      IF t1.Q THEN
            iState:=3;
            T1(IN:=FALSE);
      END_IF
90: // Error
      Err:= TRUE; // Error
END CASE;
```

Note

- Access files after confirming USB memory mounting status or SD card mounting status by program when access files of USB memory or SD card. SdMountStatus command and UsbMountStatus command are prepared to get mounting status.
- Don't remove USB memory or SD card during accessing file or directory. It will be cause can't access again. If
 USB memory or SD card needed to be removed during PLC is in RUN status, removing action like SD card switch
 pressing and execution of UsbUnmount command required after executing Flush/close command. It is convenient
 to execute by prepared input variable for invoking UsbUnmount command.
- It may take long time for file accessing time depends on USB memory or SD card type. It is recommended to separate file access task and general I/O access task.
- There are some possibilities to access file of USB memory or SD card not only from CAA File but also from FTP client etc at same timing. To avoid this situation, exclusive file access control is required.
- The maximum simultaneous use number of asynchronous process CAA Async Manager which is used by CAA File is 20. If the limit is exceeded, error code 5802 is detected.

7.3 Security Protection

Supporting function for Security protection protecting illegal access is available on HX-CPU to decrease the external security risk via network accessing. This supporting function can be used as one of method to keep the security level required for the system.



Figure 7.1 Supporting function for security protection via network access

Device user management

It is possible to define users who can access to HX-CPU. Only the registered user can login HX-CPU by registering name and password. This is same for Visualization or Web Visualization.

Please note that this functionality has been enabled by default since CPU firmware version 3.5.16.26.

The following dialog appears at login after registering device user. Enter the registered user name and password.



Figure 7.2 Access of HX-CPU registered device user

Add device user

(1) Firmware 3.5.8.2x

Procedure

- 1. Configure communication between PC and HX-CPU.
- 2. Login to HX-CPU.
- 3. Click [Online]-[Security]-[Add Online User].
 - Then, [Add Online User] dialog opens.

ne <u>D</u> ebug <u>T</u> ools <u>y</u>	Mindow Help			
Login	Alt+F8	📲 🦧 🗇 🖓 🖓 🖓 🖓 👘 🖬 🖓 🔶 🗮		
Logout	Ctrl+F8	斜周辺路進日時日時間		
Create boot application	n	AainTask 🖉		
Download		~ ~	Add Unline User	,
Online Cha <u>n</u> ge				
Source download to co	nnected device		Name:	hitachi
Multiple Download				
Reset warm			Password:	•••••
Reset cold				
Reset origin			Confirm password:	••••••
Simulation				Hide password
Security	· · · · · ·	Logoff current online user	Deserved share she	Detter
Operating Mode)	St Add Online User	Password strength:	Better
		S- Remove Online User		OV Cancel
		S. Change Password Online User		Calicei

4. Enter a user name and a password for the user account you want to create. And click [OK].

(2) Firmware 3.5.13.4x

Procedure

- 1. Configure communication between PC and HX-CPU.
- 2. Logout from HX-CPU.
- 3. Open [Users and Groups] tab of device. And click 🙆 (Synchronization) button.

Then, a dialog opens prompting whether the device user management should be activated.

Device X			
Communication Settings	📀 😂 🔜 Device user: Anonymous		
Applications	To get started, either connect to a device to upload its conf Users	HX-COE	DESYS ×
Backup and Restore			
Files		?	Currently, the user management is not activated on the device.
Log			Would you like to activate it now?
PLC Settings			Please note: When activating the user management you will be asked to login as 'Administrator' using the default
PLC Shell			password. Then you will be asked to enter a new password.
Users and Groups			
Access Rights			<u>Yes</u> <u>N</u> o

4. Click [Yes]. Then, [Device User Logon] dialog opens.

Device	User Logon		×
P	You are currently and password of	not authorized to perform this operation on the device. Please enter the name i an user account which has got the sufficient rights.	1
	Device Name:	Device (HXC-CP 1H16)	
	Device Address:		
	<u>U</u> ser Name:		
	Password:		
	Operation: Object:	View "Device"	
		0K Cancel	

5. Enter "Administrator"^{*1} as the user name and password.

Then, the dialog to change password for the built-in administrator account "Administrator" opens.

Password expired, please	e enter a new one!	×
Name:	Administrator	
Password:		
Confirm password:		
Password strength:	Very weak Videpassword	
	Password can be changed by user	
	Password must be changed at first login	
	OK Cancel	

*1: User name "Administrator" is a built-in administrator account.

- 6. Enter a new password for the built-in administrator account "Administrator". And click [OK].
- Click [Users]-[Add] button in [Users and Groups] tab. Then, [Add User] dialog opens.

		Add User		×
Synchronized mode: All changes are immediately downloaded to the devi	ce.	<u>N</u> ame: Default group:	Administrator	~
Users	Add mport Edit Delete	<u>P</u> assword: Confirm password: Password strength:	Very veak ✓ Hidepassword ✓ Password can be changed by user Password must be changed at first login ② /: Çancel	

8. Enter a user name and a password for the user account you want to create. And click [OK].

(3) Firmware 3.5.16.2x

Procedure

- 1. Configure communication between PC and HX-CPU.
- 2. Logout from HX-CPU.
- 3. Open [Users and Groups] tab of device. And click (Synchronization) button. Then, a dialog opens prompting whether the device user management should be activated.

Device X	
Communication Settings	📀 🖙 📄 Device user: Anonymous
Applications	To get started, either connect to a device to upload its conf
Backup and Restore	
Files	
Log	
PLC Settings	
PLC Shell	
Users and Groups	
Access Rights	

4. Click [Yes]. Then, [Add Device User] dialog opens.

HX-CODESYS		×
Currenti device. Would y Please n be aske to login	ly, the user management is not activated on the you like to activate it now? note: When activating the user management you wil d to create a new admin user. Then you will be aske as this user.	ll :d
	Yes No	
Add Device User		
<u>N</u> ame		
Default group	Administrator	~
<u>P</u> assword Con <u>f</u> irm password		
<u>P</u> assword Con <u>f</u> irm password Password strength	Very weak	
<u>P</u> assword Con <u>f</u> irm password Password strength	Very weak ☑ ☑ Hidepassword ☑ Password can be changed by user	
<u>P</u> assword Con <u>fi</u> rm password Password strength	Very weak ✓ Hidepassword ✓ Password can be changed by user Password must be changed at first login	

5. Enter a user name and a password for the user account you want to create. And click [OK].

Add Device User	×
<u>N</u> ame	admin
Default group	Administrator \checkmark
<u>P</u> assword	•••••
Confirm password	•••••
Passwordstrength	Better 🗸 Hidepassword
	Password can be changed by user
	Password must be changed at first login
	<u>O</u> K <u>C</u> ancel

Note

- When this procedure is canceled by some error or clicking [Cancel] button, there are cases in which a dialog to enter user name and password is displayed at next HX-CPU login. In this case, Device user management is enabled. Try to enter "Administrator" as the user name and password in the dialog.
- It is also possible to activate Device user management by [Online]-[Security]-[Add device user]. However, there are cases in which an error message is displayed. Please follow this procedure when activating Device user management.

Delete Device user management information

Procedure

- 1. Click [Reset origin device] after right clicking on [device] in the device tree.
 - * Caution: User program in HX-CPU is also deleted.
 - * If you are not logged in to the device yet, then a dialog opens for entering the user name and password.
- 2. Click [Online]-[Security]-[Logoff current device user].
- It will be possible to login without dialogs in the next time.

Onl	ine Debug Tools Window Help	_	
0 Ş	Login Alt+F8) • • * [] • • • • 8	¢ 🛒
Qğ	Logout Ctrl+F8		
	Create boot application		
	Download		
	Online Change		
	Source download to connected device		
	Multiple Download		
	Reset warm		
	Reset cold		
	Reset origin		
	Simulation		
	Security •	Logoff current device user	
	Operating Mode	St- Add device user	
		S Change Password Device Use	r

Reference

In the case of HX-CODESYS V3.5 SP8 Patch4, it is also possible to delete Device user management information by adding new user with name "Everyone" and empty password.

Chapter 7 Utility Functions

Note

- After adding new user with this procedure, a blank user name and password can't be used to login. Please make note the registered password without missing.
- A dialog at login appears again when the user name or password is different from registered users. When login can't be possible, confirm user name and password with a manager who registered device users.

In order to limit the risk of your password being cracked, the following things are recommended.

- 8 characters or more (Most suitable is 12 characters or more)
- Mixture capital letter and small letter
- Mixture number
- Mixture special character
- To avoid existing name or easily guessed phrase for password ("123", "abc" or "qwerty" etc)
- · Device user management information is deleted by [Reset origin device] operation.
- The following dialog appears if a wrong password is entered in a certain number of times. Then, the user cannot login and display Web Visualization for a certain period of time even if a correct password is entered. Please retry to enter a password after about 1 minute.
 - * Note that the following message doesn't appear in case of device user login from Web Visualization display.



Password protection of Project

Password protection is possible for project file.

This protection is valid when opening a stored file or source program in HX-CPU by HX-CODESYS. Open dialog of [Project]-[Project Settings]-[Security].



Figure 7.3 Configuration of Project password

Select [Password] by check on [Enable project file encryption]. Input current password, new password and new password confirming.

Project Settings	×
Compile options Compiler warnings Page Setup Security SFC Source Download Static Analysis Light Wisualization Wisualization Profile	Security Pensible project file encryption Password Dongle If this option is activated, a password is used to encrypt the content of the currently opened project file. The user must enter this password whenever this project is loaded, even if it is loaded as library reference. If you forget the encryption password, your project file will be lost it is current password: Current password: Confirm new password:
	OK Cancel

Figure 7.4 Input Project password

Then protection is enabled when opening a stored file or source program which is stored in HX-CPU.

At the time to open project or uplo	oading	In case of password is not correct
Encryption Password	×	CODESYS
Enter the password for 'testpw.pro	oject':	The password for the encrypted project 'pw' is not correct.
ОК Са	ancel	OK

Figure 7.5 Input Project password

Note

Project can't be opened if forgetting coding password. Please be careful not to forget password and manage it.

Access limitation of Visualization

It is possible to make access limitation for Visualization page or Display element.

Configure access right for each group by registering user and group belonging its user.



Figure 7.6 Visualization example with access limitation

🖃 🍵 testpw ė. Device (HX-CP1H16) 🖻 🗐 PLC Logic 🖻 🚫 Application 🎁 Library Manager 🕘 Settings 🔲 Default Hotkeys 🚇 Visualizatio 👔 😫 User management Font settings PLC_PRG (PRG) 😑 🌃 Task Configuration Create empty user management Create user management with default groups and users 🇐 MainTask ė DLC_PRG SVISU_TASK WisuElems.Visu_Prg This window is displayed when no user management data Visualization Manager **A**1 Double clicking 🧃 WebVisualization **B** Visualization 🗄 🕤 Basic (Basic)

User management of Visualization



There is no user management data as default setting. Click [Create user management with default groups and users] in order to register user management group and user.

Create empty user Create user management with default groups and users	Settings 🔲 Default Hotkey:	s 💾 Visualizations	St User management	The Font settings
	Create empty user management	Create user manage default groups an	ment with d users	

Configuration of Group and User is default setting in below. At this default setting, user belongs to Group [Admin] are configured having right of data changing.

Group name	Automatic logout	Logout time	Permission to change user	data Descript	tion	Id
🗉 🤮 Admin 🛛		1 minute(s)				1
Service		1 minute(s)				2
🗉 🤮 Operator	See Operator					3
😫 None						
Settings 🔲 Default	Hotkeys 🚇 Visualization:	1 minute(s)	Font settings			
Settings Default	: Hotkeys 🖷 Visualizations	1 minute(s)	Font settings			
Settings Default iroups Users Settings	Hotkeys Tisualizations Full name	1 minute(s) S S User management Password	Font settings	Deactivate	Description	
Settings Default roups Users Settings orgin name	Hotkeys Visualizations Full name Administrator	1 minute(s) S S User management Password ******	Font settings User group Admin	Deactivate	Description	
Settings Default roups Users bettings Ugin name Admin Service	Hotkeys Visualizations Full name Administrator Service	1 minute(s) 1 minute(s) Password ******	Font settings User group Admin Service	Deactivate	Description	

User name to password are same at default setting

Figure 7.8 User management Visualization manager

Next is explanation of Element configuration of Visualization.

Configure [Access rights] on the property window of element.



Figure 7.9 Access right configuration for element of Visualization

▲ Caution

In the control system, recently, the connection and cooperation with the information communication system progress and information security risks including cyber attacks are growing. In a system applying this product, physical security measures mainly in the installation location and security measures in use via network are needed.

[Security risk example via the network]

- Abnormal operation, performance degradation, information leakage and data tampering by attacks from outside

- Malfunction, harm and damage occurrence due to programs and/or data tampering from outside

- It is used as an attacking step for the other systems

Hitachi Group is striving security improvement of control systems by establishing prerequisite protecting target defined for each product and equipping security protection functions under the own provision security design procedure.

In order to deal with the security risks from the outside via the network, this product is equipped with a security protection support functions for the purpose of prevention of unauthorized access. However, the security level to be determined by the control system. In addition, the assumed security risk is not fixed, it will be something to change on a daily basis.

Not only in our products, individual security protection support functions of each product configuring the system is one means to ensure the security level required for the system, it does not completely prevent the security risk growing daily.

The construction of the security level required for the control systems are responsible by the system and customer. In addition, for the maintenance of the security level will require continuous improvement measures.

In a system using this product, regardless of the presence or absence of the use of security protection support functions, trouble, accident or damages caused by unauthorized external access, Hitachi Group will not be able to bear any responsibility.

It is required for the customer side to clarify the target of the security protection of the system, following the conduct measures example to a representative, please refer to the construction and operation of the system.

- -Utilization and regular review of the authentication function for the program and the data to be protected
- -Utilize the security functions of the device configuring the network
- -Prevention of the unspecified connection by the use of a particular function to identify connection
- -Measures in the operational management, such as to lock the location of devices or limit the operator

7.4 Encrypted communication

Encrypted communication is available on OPC UA server and Web Visualization from HX-CPU firmware version 3.5.16.22. This supporting function can be used as one of method to keep the security level required for the system.

Presetting

1. The correct time information must be set on the HX-CPU in order to generate a certificate within the HX-CPU.

There are 2 ways to set the time information on HX-CPU.

- By using CAA DTU library

- By using PLC Shell

The setting procedure from PLC Shell is shown as an example here. Please refer HX-CPU Application Manual Software Edition and Online Help for the setting from user program.

Open PLC Shell tab in the device editor and execute "rtc-set" command to set the time. The time information format is ISO 8601.

Ex) In case setting 3:00:00 March 31st 2021

rtc-set 2021-03-31T03:00:00

Device X	
Communication Settings	
Applications	
Backup and Restore	
Files	
Log	
PLC Settings	
PLC Sectings	
PLC Snell	
Users and Groups	
Access Rights	
Symbol Rights	
IEC Objects	
PLC Parameters	
PLC I/O Mapping	
Task Deployment	
Status	
Information	
	tr act 2021 02 21702-00-00
	Litt-Set 2021-05-51105:00:00

2. Install CODESYS Security Agent 1.2.1.0.package into HX-CODESYS.

CODESYS Security Agent 1.2.1.0.package is included in HX-CODESYS installation DVD. Also the package file can be downloaded from CODESYS Store.



Select [Tools]-[Package Manager...] menu.

	Tool	s	Window	Help		
7.	Ø	Pa	ackage Mana	ager	N	ļ
		Pa	ackage Desig	gner	γł	

Click [install...] button in Package Manager window to display the common dialog. Select CODESYS Security Agent 1.2.1.0.package.

🗊 Package Manager					×
Currently Installed Packages Refresh		Sort by	Name	~	Install
Name CODESTS Automation Server Connector CODESTS Codespy CODESTS Parkage Derigner CODESTS Sufficient Sufficient Data Sharing C-Seperate [SAMPLE_20210114]	Version 1. 12:0.0 2:5:15:0 3:5:16:0 1.5:0.0 3:5:16:22	Installation date 2020/09/25 2020/01/18 2020/09/25 2020/09/25 2021/01/27	Update info	Lic No I No I No I No I No I	Details Updates Search Updates
🕪 qodata jek (Cobestis 😰 Updaveši - E Modausšiwa	8,5,18,210 3,5,4,1	2020/52/02 2021/52/02		No l Lice	Download CODESYS Store Rating <u>CODESYS Store</u>

Follow the wizard to install the package. When the installation completes, CODESYS Security Agent will be added to Package Manager window.

Currently Installed Packages					
Refresh		Sort by	Name	\sim	Install
Name	Version	Installation date	Update info	Lio	Uninstall
💕 CODESYS Automation Server Connector	1.12.0.0	2020/00/25		No I	Details
🗊 COBERTS CodeSpy	3.5.16.0	2020/11/10		No I	
💕 CODES I'S Package Designer	3.5.15.0	2020/00/25		No I	Undates
CODESYS Security Agent	1.2.1.0	2021/03/31		No l	opuates
CODESYS SoftHoton	1.8.0.0	2020/00/25		Nol	Search Updates
I Ibachi Data Sharing C.Seperate [SAMR F: 20210114]	3.5.16.22	2021/01/27		No I	Download
🖉 opdate_HX CODESYS	3.5.13.210	2020/02/02		No I	
😥 UpdateS14 ModbusSlave	3, 5, 4, 1	2021/03/30		Lice	
					CODESYS Store
					Rating
					CODECVC Charac
3. Generate a certificate on the HX-CPU.

Create a new project with HX-CODESYS and select [View] - [Security Screen] menu.

	Vie	w	Project	Build	Online	Debug	Tools				
e	2	D	evices			Alt+0	1				
l		Ρ	OUs			Alt+1	- 1				
	\$	Ν	Iodules			Alt+2	- i				
7		Ν	lessages			Alt+3	- 1				
v		E	lement prop	oerties			- 1				
	*	Т	ToolBox								
	•	V	isualization	ToolBox			- 1				
		۷	Vatch				->				
	×	C	ross Referer	nce List			- 1				
	ς^{5}	C	all Tree				- 1				
	-	В	ookmarks				- 1				
	Ð	В	reakpoints				- 1				
-	陷	C	all Stack				- 1				
-	Ö,	Ν	lemory				- 1				
1		С	nline Chan	ge Memo	ry Reser	ve Settings	- 1				
		S	tart Page				- 1				
	Ø	S	ecurity Scre	en							
-	,≣	S	Store								

Security Screen window will be displayed. Open the Devices tab and click the refresh button.

🖓 Security Screen 🗙		
User		ţ.
Project	Refresh the list of available devices and their certificate stores.	
Devices	·	

Select Device in the left view to display the certificate in HX-CPU.

Φ	Information								
1	Device								
	Own Certificates								
	Trusted Certificates								
	Unstrusted Certificates								
	Quarantined Certificates								

In the right view, make sure the current time is within the Web Server certificate expiration range.

1	Information	Issued for	Issued by	Valid from	Valid until
×	OPC UA Server (not available)				
001	Encrypted Application (not available)				
5	Encrypted Communication	HX-CPU	HX-CPU	2021/03/31 11:09:31	2021/04/30 11:09:31
	💱 Web Server	HX-CPU	HX-CPU	2021/03/31 11:09:31	2021/04/30 11:09:31

Delete the certificate after setting the time information and turn off and on the power if the current time is not included in the expiration date of the certificate. A new certificate is automatically generated at the start up process.

Web Visualization

Create a project using Web Visualization and download it to the HX-CPU. Enter "https://<IP address of HX-CPU>/<file name>.htm" in the address bar of your web browser.

\odot	https:/	/192.168.0.1	/webvisu.htm
---------	---------	--------------	--------------

Depending on the browser settings, a security warning screen may be displayed.

ſ	0	Privad	y erro	r				×	+	0	-	-			×
	÷	\rightarrow	С	仚	N	ot :	secu	re	https://192.168.0.1/webvisu.htm	☆	¢	5	• (•	:
4	< -	⇒	C		N	ott	secu	re	Image: Autopart of the security, turn on enhanced protection	Ŷ	Q		• 0		

Select a menu to connect to HX-CPU in the detailed display.

Hide advanced	Back to safety
This server could not prove that it is 192.168.0.1 ; its security certificate is your computer's operating system. This may be caused by a misconfigura attacker intercepting your connection.	not trusted by tion or an
Proceed to 192.168.0.1 (unsafe)	

The visualization is displayed on your Web browser with the communication encrypted.

OPC UA Server

The setting procedure on OPC UA client differs depending on the client software, so check a manual of your client software. This document describes the setting procedure of UaExpert manufactured by Unified Automation as an example.

1. Creating a certificate for the CODESYS OPC UA server

Select [OPC UA Server (not available)] in the right view of Security Screen window and click 🛄 button.

1	Information	
X	Create a new certificate on the device.	
T	Encrypted Communication	ŀ
	🙀 Web Server	H
(P. Sc		

Specify the key length and validity period in Certificate Settings dialog. Please note that increasing the key length enhances security but increases processing time.

Certificate Settings		×
Key length (bit)	3072	\sim
Validity period (days)	365	
	<u>O</u> K <u>C</u> ancel	

After the OPC UA Server certificate is generated, restart the HX-CPU. The certificate is read at the startup process.

1	Information	Issued for	Issued by	•
×	💱 OPC UA Server	OPCUAServer@HX-CPU	OPCUAServer@HX-CPU	2
473	Encrypted Application (not available)			
	🙀 Encrypted Communication	HX-CPU	HX-CPU	2
	💱 Web Server	HX-CPU	HX-CPU	2

Create a project using the OPC UA server and download it to the HX-CPU.

2. Storing an OPC UA client certificate into the HX-CPU Launch UaExpert and click [Add Server] button.

		1		L			-		
🔡 U	nified	Auton	natio	n UaEx	pert	- BE	TA - c	b32a	c 16c
File	View	Sen	/er	Docui	ment	S	etting	s H	elp
	Ø	Ð	Ø	0		R		0	8
Project	t						dd Sei	ver	×
× 🃁	Proje	ect							

Enter IP address of the HX-CPU to [Endpoint Url], select [Basic256Sha256] for [Security Policy] and [Sign & Encrypt] for [Message Security Mode]. Click OK to close the dialog.

ど Add Server			?	\times
Configuration Name	HX-CP	U		
PKI Store	Default			•
Discovery Adv	/anced			
-Server Informa	tion —			
Endpoint Url		opc.tcp://192.168.2.1		
Reverse Conne	ect			
Security Settin	igs			
Security Policy	,	Basic256Sha256	•	
Message Secu Mode	rity	Sign & Encrypt	•	

Right-click on the added server and select [Connect].

Pro	ject		₽×
¥		Project	
	$\mathbf{\tilde{v}}$	D Servers	
		🔖 нх-сри	
	\sim	📁 Document 📟 Remove	
		📁 Data A 🐼 Connect 📐	
		Disconnect	

A warning will be displayed because the certificate is not registered. Click [Trust Server Certificate] button and select Continue.

	ate of	server OPOUAGerverenX-OPU	eturned an error:		
BadCertificateU	ntrust	bd			
ertificate Chain					
Name		Trust Status			
OPCUAServer@H	X-CPU	Untrusted			
ertificate Details					
Error	ok (B	adCertificatel Intrusted]			1
Subject	OK[D	accertificateontrustedj		_	al.
Common Name	OPCI	JAServer@HX-CPU			1
Organization		-			
OrganizationUnit					
Locality					
State					
Country					
DomainComponent					
lssuer					al.
Common Name	OPCI	JAServer@HX-CPU			
Organization					
OrganizationUnit					
Locality					
State					
Country					
DomainComponent					
Validity					
Valid From	木41	10:22:06 2021			
Valid To	金41	10:22:06 2022			
Info					
Serial Number	0				
Signature Algorithm	RSA-	SHA256			
Cipher Strength	RSA (3072 bit)			1
			Trust Server	Certific	cat
				2	_

In HX-CODESYS, click with button and select [Quarantined Certificates] in the left view of the Security Screen.

1	Secu	rity Screen 🗙
	Φ	Information
	-	🖻 🔟 Device
		🕅 Own Certificates
		Trusted Certificates
		Untrusted Certificates
		🕅 Quarantined Certificates

Drag [Ua Expert@...] displayed in the right view and drop it to [Trusted Certificates] in the left view.



Φ	Information	<u> </u>	Information	Issued for
-	🗏 🚹 Device	×	E.	UaExpert@GUUHE2017UR120
	Own Certificates	473		
	Trusted Certificates			
	Untrusted Certificates	æ		
	Quarantined Certificates	(E)		

In UaExpert, right-click on the server again and select [Connect].

Proj	ject		8	×
¥		Project		
	\sim	📁 Servers		
		🔖 нх-сри		
	\sim	📁 Document 📟 Remove		
		📁 Data A 🞑 Connect 📐		
		💥 Disconnect		

Select [Ignore] if a warning message is displayed.

Conn	ect Error	×	
Error 'BadCertificateHostNameInvalid' was returned during CreateSession, press 'Ignore' to suppress the error and continue connecting.			
	Ignore Abort		

OPC UA communication is executed with the communication encrypted.

Da	ita Access View				0
# 1	Server HX-CPU	Node ld NS4 String var	Display Name testvar	Value true	Datatype Boolean

7.5 Recipe function

The recipe function enables to read and write the values of the data memory in the HX-CPU at once. There are two ways to read and write data.

- Online operation from HX-CODESYS

- User program using a dedicated function block

7.5.1 Add Recipe Manager

Right-click on [Application] and select [Add Object] - [Recipe Manager...]. Click [Add] button in [Add Recipe Manager] dialog.



[Recipe Manager] is added to the device tree and the settings window opens.

🖻 👔 Device (HX-CP1H16)	A Decine Manager	
= ■ ■ PLC Logic	Storage General	
Application Application Library Manager PLC_PRG (PRG) Recipe Manager Task Configuration MainTask	Storage type Textual File path File extension .txtrecipe Separator O Tab O Semicolon O Comma	~]
	Available Columns > Selected Columns Type >> Yariable Name > Comment Minimal Value < Maximal Value < Save as Default Up	Down

No.	Item	Description
1	Storage type	Select storage type.Textual: saves the recipe in a readable format with the configured columns and delimiters.Binary: saves the recipe in a non-readable binary format. This format requires less storage space.
2	File path	Specify the file path. (Only when reading and writing from user program) When creating a folder called "Recipe" directly under the USB memory or SD card and saving the recipe file in it, specify the file path as follows. SD card: /media/sd-mmcblk0p1/Recipe/ USB memory: /media/usb-sda1/Recipe/ Folder name HX-CPU reads the file saved in this file path at the startup.
3	File extension	File extension for the recipe file. The resulting default name for recipe files is in the form <recipe>.<recipe definition="">.<file extension="">.</file></recipe></recipe>
4	Separator	Delimiters between the individual values in the saved file.
5	Available Columns Selected Columns	Defines which information is saved in which order in the recipe file.

7.5.2 Add Recipe Definition

Right-click [Recipe Manager] and select [Add Object] - [Recipe Definition]. Click the [Add] button in [Add Recipe Definition] dialog.



7.5.3 Configuration of Recipe Definition

Right-click in Recipe Definition editor and select [Add a New Recipe].

Variable		Туре	Name	Comment	Minimal Value	Maximal Value	Current Value
	¥						
	Ba	Сору					
	B	Paste					
	\times	Delete					
Insert Va		Insert Variab	le				
	-13	Add Child	Add Child				
	-13	Add Sibling					
	C.	Update Strue	ctured Variables				
	Q	Add a New F	Recipe N				
	9	Remove Rec	ipe 😽				
	-7	Load Recipe					
	E C	Save Recipe.					

Give a name to the recipe.

Recipe		×
Name	Recipe 1	
Copy from existing	<create empty=""></create>	\sim
	OK Cancel	

A new recipe column is added. You can add multiple recipes (columns).

🔍 Recij	oes 🗙						
Variable	Туре	Name	Comment	Minimal Value	Maximal Value	Current Value	Recipe1

Add the variables to read or write to [Variable] column. All the local variables in a POU can be added at once by specifying the POU name.

Variable	Туре	Name	Comment	Minimal Value	Maximal Value	Current Value	Recipe1
PLC_PRG.var1	INT						
PLC_PRG.var2	INT						
PLC_PRG.var3	INT						
PLC_PRG.var4	INT						
PLC_PRG.var5	INT						
PLC_PRG.var6	INT						
PLC_PRG.var7	INT						
PLC_PRG.var8	INT						

7.5.4 Read and Write Recipe data

Go online and right-click on a target recipe column to read or write data.

🔍 Recipes 🗙									•	Properties 👻 I
Variable	Туре	Name	Comm	Minim	Maxim	Current	Recip	e1 Recipe2	5	🏹 Filter 🔹 💕 Sort by 🔹
PLC_PRG.var1	INT					4909	1	10		Ż↓Sort order 🝷
PLC_PRG.var2	INT					9818	2	20		
PLC_PRG.var3	INT					14727	3 1	Cut		
PLC_PRG.var4	INT					19636	4 E	Сору		
PLC_PRG.var5	INT					24545	5 🛍	Paste		
PLC_PRG.var6	INT					29454	6 X	Delete		
PLC_PRG.var7	INT					-31173	7	Select All		
PLC_PRG.var8	INT					-26264	8			
								Browse		•
				_			+>	Insert Variable		
I Land Design							+	Add Child		
Load Recipe					\searrow		-10	Add Sibling		
⊨¥ Save Recipe							C	Update Structu	ured Var	iables
· · ·						\searrow				
🐄 Read Recipe								Add a New Re	cipe	
							<u> </u>	Remove Recip	e	
Read and Save Reci	pe						- (₌ -	Load Recipe		
								Save Recipe		
Write Recipe							-			
Load and Write Rec	ine						. 🖓	Read Recipe		
Ecold and write Rec	ipe						Ęø	Read and Save	Recipe	
							-	Write Recipe		
							-	A Construction of Maria		

Item	Description			
Load Recipe	Loads a recipe from a file in your PC to HX-CODESYS.			
Save Recipe	Saves the variable values of a recipe to a file in your PC.			
Read Recipe	Reads the variable values of a recipe from the HX-CPU to HX-CODESYS.			
Read and Save Recipe	Reads the variable values of a recipe from the HX-CPU and saves them to a			
	file in your PC.			
Write Recipe	Writes the values of a recipe to the variables in the HX-CPU.			
Load and Write Recipe	Loads a recipe from a file in your PC and writes the values to the variables in			
	the HX-CPU.			

The recipe data is also saved when the project file is saved.

7.5.5 Read and Write Recipe data from a user program

Recipe data can be read / written by the methods of the function block "RecipeManCommands". A brief sample program that reads recipe data from a USB memory and writes it to the PLC data memory, and reads the PLC data memory value and saves it as a recipe file on the USB is shown below.

Recipe Manager

🛛 🙀 Re	cipe Man	ager 🗙	
Storage	General		
Stora	age type	Textual	\sim
File p	oath	/media/usb-sda1/Recipe/	
File e	extension	.txtrecipe	

Recipe

🔍 Recipes 🗙									
Variable	Туре	Name	Comment	Minimal Value	Maximal Value	Current Value	Rcp1	Rcp2	
PLC_PRG.var1	INT						1	10	
PLC_PRG.var2	INT						2	20	
PLC_PRG.var3	INT						3	30	
PLC_PRG.var4	INT						4	40	
PLC_PRG.var5	INT						5	50	
PLC_PRG.var6	INT						6	60	
PLC_PRG.var7	INT						7	70	
PLC_PRG.var8	INT						8	80	

Program

/ B	POU	×
	1	PROGRAM POU
	2	VAR
	3	RecipeManCommands_0:RecipeManCommands;
	4	WR_Rcp: BOOL;
	5	RD_Rcp: BOOL;
	6	Errl: DWORD;
	7	Err2: DWORD;
	8	END_VAR
	1	Open recipe file from USB memory and Write to PLC data memory
		RecipeManCommands 0
		WR Rcp RecipeManCommands, LoadFromAndWriteRecipe
		'Recipes' — RecipeDefinitionName LoadFromAndWriteRecipe - Err1
		'Rcp1' — RecipeName
		'Rcp1.Recipes.txtrecipe' — FileName
	2	Read from PLC data memory and save as recipe file
		RecipeManCommands_0
		RD_Rcp RecipeManCommands.ReadAndSaveRecipeAs
		P EN ENO
		'Recipes' RecipeDefinitionName ReadAndSaveRecipeAs - Err2
		'Rcp1' — RecipeName
		'Rcp1.Recipes.txtrecipe' FileName

Note

When saving a decimal point value of a REAL or LREAL type variable which can contain a rounding error in a recipe file, hexadecimal number starting with "F16#" is added after the numerical value.

Example)

If a value of a REAL variable is 2.88, the following value is recorded in a recipe file.

GVL.rVar,REAL,2.88F16#2E147B0H-6

If this recipe is written back to an HX-CPU, the target variable will be set to 2.88.

On the other hand, if you create a recipe file as shown below and write it to the CPU, a rounding error will occur in the target variable and 2.87999988 will be set.

GVL.rVar,REAL,2.88

Appendix 1 Known Restrictions

Appx.1.1 Known Restrictions on HX-CPU 3.5.8.2x and HX-CODESYS V3.5 SP8 Patch4

The following restrictions has been recognized with HX-CODESYS V3.5 SP8 Patch4. These are dependent on the based software CODESYS V3.5 SP8 Patch4 from 3S-Smart Software Solutions, and will be improved later version.

[Open project]

When open project file by specifying file from saved project file, sometimes POU can not be opened.



This can be avoided and Project can be opened by [File]-[Open Project] after invoking HX-CODESYS.



[Wink]

Wink functionality doesn't work if Select Device window is opened by selecting [Open Project from PLC...] in the Start Page.

[System time]

The maximum system clock data of HX-CPU is 2038 January 19th 03:14:07. Configure and manage of clock data not to exceed maximum data due to exceeding maximum value operation may not be correct.

[Leap year]

Getting day information command DTU.GetDayOfWeek() can't get correct information on February 29th (leap year) and day information is [7].

D,	DOW1	SUNDAY	=DTU.GetDayOfWeek(dtDate:=D#2016-2-28,	peE
D,	DOW2	7	=DTU.GetDayOfWeek(dtDate:=D#2016-2-29,	peE
D,	DOW3	TUESDAY	=DTU.GetDayOfWeek(dtDate:=D#2016-3-1,	peEr
D,	DOW4	WEDNESDAY	:=DTU.GetDayOfWeek(dtDate:=D#2016-3-2,	peEr
D,	DOW5	THURSDAY	:=DTU.GetDayOfWeek(dtDate:=D#2016-3-3,	peEr
D,	DOW6	FRIDAY	=DTU.GetDayOfWeek(dtDate:=D#2016-3-4,	peEr
D,	DOW7	SATURDAY	=DTU.GetDayOfWeek(dtDate:=D#2016-3-5,	peEr
D,	DOM8	SUNDAY	:=DTU.GetDayOfWeek(dtDate:=D#2016-3-6,	peEr
D,	DOW9	MONDAY	:=DTU.GetDayOfWeek(dtDate:=D#2016-3-7,	peEr

[Application information]

It is possible to confirm PLC project and PLC project application information at login, however latest updated day and time of PLC application is forwarded 9 hours if previous download is done by [Login with download]. This is no problem on execution.

*Latest updating day is displayed correctly, when previous download done by [Login with online change].

	HA-CODES	15					
	(?) Ap	plication changed since last download. W	hat do you want to do	?			
	Op	otions					
	0	Login with online change.					
	۲	Login with download.					
		Login without any change					
	0	Login without any change.					
	V	Update bootproject					
		<u><u>o</u>ĸ</u>	<u>C</u> ancel	Det	ails		
Application	Information						
Applicati	on Information	Application Content					
		Application in the IDE:	Applica	tion in the PLC:	Diamlary 01	hanna fa	mucadad
Project	name:	Untitled25	Untitled	25	Display 9	nours ic	nwalueu
Last m	odification:	08 December 2016 08:07	08 Dece	mber 2016 17:07			
IDE ver	sion:	HX-CODESYS V3.5 SP8 Patch 4	HX-COD	ESYS V3.5 SP8 Patch 4			
Author	:						
Version	:						
Descrip	otion:		*		4	6.	

[Modbus-RTU / TCP Master]

Modbus channel offset

Don't set "0xFFFF" for ofset value of Slave Modbus channel, when using Modbus-RTU / TCP master. And don't set combination values of offset and lengths exceeding "0xFFFF" for ofset value of Slave Modbus channel.(Example Offset:0xFFFE, Length: 2)

ModbusChannel				x
Channel				_
Name	Channel 0			
Access Type	Read Coils (Function Code 1)		•	
Trigger	Cyclic	Cycle Time (ms)	100	
Comment				
READ Register				_
Offset	DxFFFF		-	
Length	1			
Error Handling	Keep last Value			
Offset			_	+
Length	1			_
			_	_
		<u>о</u> к	<u>C</u> ancel	

[Modbus-RTU / TCP Slave]

Disable of Device

Query will be sent even if Modbus-RTU / TCP slave device is disabled. Therefore, slave function block error(*) is detected due to receive timeout slave is occurred.

In case of Modbus-RTU: ModbusSlaveComPort_Diag * In case of Modbus-TCP: ModbusTCPSlave_Diag

In case of Modbus-RTU

ΙN	1odbus	Master	COM	Port ((Modbus	Master,	COM	Port)
----	--------	--------	-----	--------	---------	---------	-----	-------



Modbus_Master_COM_Port (Modbus Master, COM Port)

 Modbus_Slave_COM_Port (Modbus Slave, COM Port)

 Modbus_Slave_COM_Port_1 (Modbus Slave, COM Port)

 Modbus_Slave_COM_Port_2 (Modbus Slave, COM Port)

 Modbus_Slave_COM_Port_2 (Modbus Slave, COM Port)

In case of Modbus-TCP

Mod	dbus_TCP_Master (Modbus TCP Master)		
	Modbus_TCP_Slave (Modbus TCP Slave)		
	Modbus_TCP_Slave_1 (Modbus TCP Slave))]	Query is cant even if disable configured
	Modbus_TCP_Slave_2 (Modbus TCP Slave))Ĵ	• Query is sent even il disable configured

[Modbus-TCP Master]

- Channel configuration

[OK] button becomes inactive if specific offset address is used for slave channel registration at Modbus-TCP master. Specific offset address: 0x0001 / 0x0005 / 0x03E8

This can be avoided by pressing Enter instead of OK clicking.

<u>×</u>
Function Code 5)
Cycle Time (ms) 100
T
<u>OK</u> Cancel

Become inactive

[Modbus-TCP Slave]

- Device function code 15 (Write multiple coils)

Configure number of coil is 8 integral multiples when write data using Function code 15 (Write multiple coils) from external Modbus-TCP master and HX-CPU is used as Modbus-TCP slave. Operation is not properly if configure is not 8 integral multiples.

- Start address of Coil

Configure start address of coil is 16 integral multiples when it is not specified 0(zero) and HX-CPU is used as Modbus-TCP slave. Operation of Function code 5 (write single coil) is not properly if other value is set.

TodbustCP_Slave_Device	*		
General	Configured Parameters		
Modbus TCP Slave Device I/O Mapping	Slave Port: 502	(ms)	
Information	Unit ID:		
	Holding Registers (%IW): 10		
	Input Registers (%QW): 10		
	Data Model Start Addresses: Coils: 0 Discrete Inputs: 0 Holding Register: 0 Input Register: 0 Holding- and Input-Register Data	ata Areas overlay	 Set 16 integral multiples value

[Force values]

If CPU is stopped by RUN / STOP switch while variables are forced, the variables are automatically unforced because stop position of RUN / STOP switch is [Reset warm]. If HX-CODESYS is connected with online in this case, forced status continues to display. Choose [Debug]-[Unforce values] to release force status.



[Reset origin]

When the project included Recipe Manager is downloaded to HX-CPU, Several files about Recipe Manager are created but these files are not deleted by Reset origin. Please delete each file by [Device]-[Files] tab.

Runtime Location: 칠	1	• 🗀 🗙 🏘
Name	Size	Modified
🛅 _cnc		
河 Source		
🚞 Boot		
河 \$visu\$		
SysFileMap.cfg	2.13 KB (2	2000/01/0
R2.txtrecipe	476 bytes	2000/01/0
R1.txtrecipe	476 bytes	2000/01/0
🛃 3S.dat	104 bytes	2016/07/2
codesyscontrol	2.44 MB (2	2016/07/2
CODESYSControl.cfg	5.64 KB (5	2000/01/0

[Visualization]

[Text editor] in visualization function is not supported. Please do not use it. If you use it HX-CPU may operate incorrectly.

[Online change]

Do not make online change with changing FB body and without changing its instance. If you do that, error dialog appears. Click [Ignore] to continue.

Example: FB is replaced, but instance is not changed as follows.

In Structured Text

Before:	TRIG_(:	R	_TRIG;
After:	TRIG () :	F	TRIG;

In LD/FBD



If it is necessary to change like this, choose download (CPU stops) instead of online change. If it's not possible to stop CPU, add new instance as follows.

In Structured Text

After: TRIG_1 : F_TRIG;

In LD/FBD

TRIG_1: F_TRIG; TRIG_1 F_TRIG CLK 3'F 0

In addition to R_TRIG and F_TRIG, this restriction is applied to TON and TOF also.

Besides FB, it is applied to STRUCT too. Do not make online change with changing STRUCT name and without changing variable name of STRUCT.

Before: test_STR : STR_A;

After: test_STR : STR_B;

If it is necessary to change like this, choose download (CPU stops) instead of online change. If it's not possible to stop CPU, add new variable as follows.

Before: test_STR : STR_A;
After: test STR2 : STR B;

[Display in [Device] – [File] window]

A file or directory whose name is very long is desplayed as a 0 bytes file in [Device] – [Files] window.

test 1234567890 1234567890 1234567890 1234567890 12	0 bytes	1970/01/01
---	---------	------------

[Print of EXECUTE box]

The layout of print gets skewed if an EXECUTE box is used with LD language POU.



[Print of LD language POU]

If there is an circuit whose width is long with LD language POU, the width of other circuits gets same length and the margin gets more.

[Serial communication]

If general purpose communication on RS-485 port of CPU and EH-SIO simultaneously, execute SysComSetSettings() for RS-485 port of CPU only once at the beginning and do not execute SysComClose().

[Modbus-TCP/RTU Master]

Zero data is transmitted if address 0xFFFF is included in the target Modbus register address.

[Search in EXECUTE box]

Programs in EXECUTE boxies of LD language POU are excluded from [Search and replace] operation. In the case of the following example, count1 and count2 are not searched.

start		EXECUTE	
[] [EN		ENO-
	count1	:= count1 +	1;
	count2	:= count2 +	1;

Appendix 1 Known Restrictions

Appx.1.2 Known Restrictions on HX-CPU 3.5.13.4x and HX-CODESYS V3.5 SP13 Patch2

The following restrictions has been recognized with HX-CODESYS V3.5 SP13 Patch2. These are dependent on the based software CODESYS V3.5 SP13 Patch2 from 3S-Smart Software Solutions, and will be improved later version.

[Display in [Device] - [File] window]

A file or directory whose name is very long is desplayed as a 0 bytes file in [Device] - [Files] window.

test123456789012345678901234567890123456789012	0 bytes	1970/01/01

[Variable declaration in EXECUTE box]

If an undefined variable is used in an EXECUTE box, the following error window appears after clicking [OK] button in Auto Declare window. Please click [Continue] button to continue.

Untitled21.project* - CODESYS			
Unhandled exception has occurred in your application. If you click Continue, the application will ignore this error and attempt to continue. If you click Quit, the application will close immediately. Object reference not set to an instance of an object.			
✓ <u>D</u> etails <u>C</u> ontinue <u>Q</u> uit			

[Find in EXECUTE box]

[Find Next] doesn't work once the target is found in a EXECUTE box.

[Print of EXECUTE box]

The layout of print gets skewed if an EXECUTE box is used with LD language POU.



[Print of LD language POU]

If there is an circuit whose width is long with LD language POU, the width of other circuits gets same length and the margin gets more.

[Reset origin device]

Files <Recipename>.Recipes.txtrecipe are generated if a project which contains Recipe is downloaded to HX-CPU. Delete these files individually after executing [Reset origin device] because this operation doesn't delete these files.

2	_cnc		
	Source		
	Boot		
	\$visu\$		
3	SysFileMap.cfg	13 bytes	2016/07/14 10:12
۵	CODESYSControl.cfg	5.61 KB (5,748 bytes)	2016/07/14 10:12
1	R2.Recipes.txtrecipe	44 bytes	2016/07/14 10:10
1	R1.Recipes.txtrecipe	44 bytes	2016/07/14 10:10
3	3S.dat	95 bytes	2016/07/11 5:42
	codesyscontrol	2.44 MB (2,560,724 bytes)	2016/07/11 5:42

[Scan For Devices]

The version of devices which are detected by Scan For Devices cannot be changed in Scan Devices window. Update the target device after closing Scan Devices window if the version needs to be changed.

[Modbus-TCP Slave]

Modbus TCP slave device doesn't recover after executing reset if ModbusTCP Slave library 3.5.13.0 is used. Use the following combination of libraries for automatic recovery.

	ModbusTCP Slave		
IoDrvModbusTCPSIave	3.5.10.20	3.5.13.0	
3.5.5.0	Automatically recovered	Not recovered	
3.5.13.0	Compile error	Not recovered	

[Modbus-TCP Slave]

Be sure to set 0 to the start address of coil. There is a case that HX-CPU respond an exception response to F.C. 5 if the start address of coil is changed.

[Modbus-TCP Slave]

If the size of Holding / Input register is 4096, logging in to HX-CPU or monitoring variables may not work.

[Modbus-TCP / RTU / ASCII Master]

Zero data is transmitted if address 0xFFFF is included in the target Modbus register address.

```
Appendix 1 Known Restrictions
```

[IP address setting in Ethernet device window]

Be sure to configure IP address in PLC Parameters window. The setting of Default Gateway is cleared to 0.0.0.0 if IP address is changed in Ethernet device window.

[Simultaneous use of FTP client function blocks and general purpose communication functions]

SysComOpen() results in failure if SysComClose(), SysComOpen() are executed while FTP client function block is executed. Make a user program with caring the execution timing these function and function blocks.

[Leap year]

Getting day information command DTU.GetDayOfWeek() can't get correct information on February 29th (leap year) and day information is [7].

D.	DOW1	SUNDAY	=DTU.GetDayOfWeek(dtDate:=D#2016-2-28,	peE
D,	DOW2	7	=DTU.GetDayOfWeek(dtDate:=D#2016-2-29,	peE
Ð,	DOW3	TUESDAY	=DTU.GetDayOfWeek(dtDate:=D#2016-3-1,	peEr
D,	DOW4	WEDNESDAY	:=DTU.GetDayOfWeek(dtDate:=D#2016-3-2,	peEr
D,	DOW5	THURSDAY	:=DTU.GetDayOfWeek(dtDate:=D#2016-3-3,	peEr
D,	DOW6	FRIDAY	=DTU.GetDayOfWeek(dtDate:=D#2016-3-4,	peEr
Ð,	DOW7	SATURDAY	=DTU.GetDayOfWeek(dtDate:=D#2016-3-5,	peEr
Đ,	DOW8	SUNDAY	:=DTU.GetDayOfWeek(dtDate:=D#2016-3-6,	peEr
D,	DOW9	MONDAY	:=DTU.GetDayOfWeek(dtDate:=D#2016-3-7,	peEr

[Force values]

If CPU is stopped by RUN / STOP switch while variables are forced, the variables are automatically unforced because stop position of RUN / STOP switch is [Reset warm]. If HX-CODESYS is connected with online in this case, forced status continues to display. Choose [Debug]-[Unforce values] to release force status.



[Online change]

Do not make online change with changing FB body and without changing its instance. If you do that, error dialog appears. Click [Ignore] to continue.

Example: FB is replaced, but instance is not changed as follows.

In Structured Text

Before:	TRIG_0	:	R_TRIG;
After:	TRIG 0	:	F TRIG;

In LD/FBD



If it is necessary to change like this, choose download (CPU stops) instead of online change. If it's not possible to stop CPU, add new instance as follows.

In Structured Text

After: TRIG_1 : F_TRIG;

In LD/FBD

TRIG_1: F_TRIG; TRIG_1 F TRIG

CLK

In addition to R_TRIG and F_TRIG, this restriction is applied to TON and TOF also.

Besides FB, it is applied to STRUCT too. Do not make online change with changing STRUCT name and without changing variable name of STRUCT.

Before: test_STR : STR_A; After: test STR : STR B;

0

If it is necessary to change like this, choose download (CPU stops) instead of online change. If it's not possible to stop CPU, add new variable as follows.

Before: test_STR : STR_A;
After: test STR2 : STR B;

[Auto Declare dialog]

Auto Declare dialog doesn't appear even though a new variable is defined in a POU if the compiler version is 3.5.12.xx or older on HX-CODESYS V3.5 SP13 Patch2.

```
Appendix 1 Known Restrictions
```

[Behaviour for outputs in Stop]

The specified program is executed twice if Reset cold or Reset wram is operated, under the condition where [Exedute program] is selected on [Behaviour for outputs in Stop] setting. This doesn't happen if [Stop] is selected on [Stop switch definition] setting or stop is operated.

[EtherCAT Master]

EtherCAT slave EH-IOCA doesn't work properly if there is/are empty slot(s) between I/O modules. Please use EtherCAT Master device V3.5.8.40 in this case.

[Edge detection in LD language]

An edge detection doesn't work properly if it is used with a function or function block in a closed OR branch circuit. In this case, use the contact and edge detection function block in combination.



[Device editor of CPU]

Application failure is detected when opening [Device] editor next time, if [Access Rights] tab was displayed when closing [Device] editor.

Appx.1.3 Difference between HX-CPU 3.5.8.2x and HX-CPU 3.5.13.40 or newer

The following specifications are different between HX-CPU firmware 3.5.8.2x and 3.5.13.40 or newer.

[Behaviour for outputs in Stop]

A specified initial value is set to each I/O when executing login or reset warm, if [Execute program] is selected on [Behaviour for outputs in Stop] setting.

Compiler version	Just after login	Reset warm	RUN switch	RUN switch	Stop from
			operation *1	operation *2	HX-CODESYS*3
V3.5.13.20 or newer	Set	Set	Set	Not set	Not set
V3.5.8.40	Not set	Not set	Not set	Not set	Not set

[Initial value reflection to variables]

The behavior of the initial value reflection to variables is different in accordance with the compiler version.

Compiler version	Just after login	Reset warm	RUN switch	RUN switch	Stop from
			operation *1	operation *2	HX-CODESYS*3
V3.5.13.20 or newer	Set	Set	Set	Set	Set
V3.5.8.40	Not set	Not set	Not set	Set	Set

*1: Stop switch definition = Reset warm and toggling RUN switch RUN to STOP

*2: Stop switch definition = Stop and toggling RUN switch RUN to STOP

*3: Performing STOP operation from HX-CODESYS

Appx.1.4 Known Restrictions on HX-CPU 3.5.16.2x and HX-CODESYS V3.5 SP16 Patch2

The following restrictions has been recognized with HX-CODESYS V3.5 SP16 Patch2. These are dependent on the based software CODESYS V3.5 SP16 Patch2 from 3S-Smart Software Solutions, and will be improved later version.

[Monitor value after download]

There are cases that the monitor value in the program may not be displayed if [Reset Origin Device] is executed while logged in and then operate [Download]. In this case, please log out once and log in again.

[Parameter generation by "cert-gendhparams" command of PLC Shell]

Do not use "cert-gendhparams" command of PLC Shell. If you think that the operation has become unstable after executing the command, execute resetting the factory default settings.

[Time acquisition by "rtc-get" command of PLC Shell]

If the time data exceeds 2038/1/19 3:14:7, "rtc-get" command results in an error.

[Stop updating log information]

If the time data exceeds 2038/1/19 3:14:7, the update of log information stops.

[Adding I/O device after opening an old project]

If the compiler version is older than 3.5.9.0, the compilation error is detected in the I/O device section when building the project. Please set compiler version 3.5.9.0 or newer.

[Baud rate setting of Modbus_SIO-COM device]

When using a "Modbus COM" device older than 3.5.16.0 or a "Modbus SIO-COM" device older than 3.5.8.21, [General]-[Baud rate] fields is not displayed correctly ("38400bps" is not displayed, etc.). Please use "Modbus_COM" device version 3.5.16.0 and "Modbus_SIO-COM" device version 3.5.8.21.

[File deletion on peripheral storage]

Since the file access is managed by OS, it may delay.

[Baud rate setting of Modbus-TCP/RTU gateway function]

When using "Modbus TCP Slave device" device 3.5.16.0, "38400bps" is not displayed in the [Serial gateway]-[Baud rate] field.

[Modbus-TCP Slave]

Byte swap on bit access

Byte data swaps for bit access on Modbus-TCP Slave. For the bit access, enable [Discrete Bit Areas].

Start address of F.C.1 and 2

When using F.C.1 and 2, specify the start address as a multiple of 8. Otherwise it may return an incorrect response to the request.

Incorrect start address for F.C.23 write request

Modbus-TCP Slave device may handle incorrect start addresses for F.C.23 write requests. In this case, use device 3.5.15.0 or older.

Writable setting of hold register

When the writable setting of the hold register is enabled, writing from the program is possible, but Write / Force Value and writing by the initial value are not possible.

A1 – 14

- Initial value of discrete input

Initial values cannot be set to discrete input.

- Login when the bit register size is 65529 or more

Log in or monitor are not available if the bit register size on the Modbus-TCP slave is set 65529 or larger.

- Overlay function

Overlay function does not work on Modbus-TCP slaves. In this case, use a device of 3.5.15.0 or older.

[Modbus-RTU Slave]

The maximum register size for Modbus-RTU slaves is 4095.

[Default Values of I/O device]

When setting the default value for the IO device, define the variable name.

[Response data to F.C.6 request when using Modbus Gateway function]

When using Modbus Gateway function, incorrect response data may be sent to F.C.6 requests.

[Output after Reset Origin Device]

If "Behavior for outputs in stop" setting is "Execute program" and any value is written while CPU is stopped, the value before initialization may be output from the output module after "Reset Origin Device".

[EtherNet/IP Scanner]

The Diag message may not be updated after an EtherNet/IP slave device recoveries.

[Operations on IEC Object tab of Device Editor]

The error message may be displayed repeatedly after selecting the variable name in IEC object window of Device editor. In this case, select another item in [Device] once to stop displaying the message.

[Reset Origin Device]

If you check "Certificates" in Reset Origin Device option, 59 error may be detected. Please uncheck "Certificates" in order to avoid detecting the error.

[Trace monitor]

If you start the trace monitor again during trace monitoring, the starting point of the time axis may shift.

[Redundancy EtherCAT]

If you unplug the cable between the first slave and the second slave, incorrect value can be monitored on the received data of the second slave.

[Device-dedicated tasks]

Device-dedicated tasks automatically generated when adding devices such as EtherCAT Master, EtherNet/IP Scanner, PROFINET I/O Master will be deleted when the corresponding device is updated to a different device, for example, changing from EtherCAT Master to EtherCAT Master Softmotion. In this case, delete the device and then add the target device. A dedicated task is automatically generated.

MEMO

Appendix 2 Open Source Software (OSS) List

This product is using open source software (hereinafter OSS).

Information about OSS used for this product is as follows. After checking the contents, please use product.

[GNU GPL application software]

We are using the following open source software which is an applicable object of the version after GNU General Public License Version 1, February 1989 or later version (hereinafter GPL) according to a condition of GPL. We disclose the source code of open source software included in this product. We will supply the media to the person who hopes for copy, modify and distribute open source software. However please understand the following points in advance.

- We can not answer a question about the contents of source cord at all.
- We do not guarantee program which is made by offered source cord at all.
- When requesting a media, a cost sometimes occurs.
- Supply period of source code shall be either the period specified in the license or during the production period whichever is longer.

[GPLv2 application software package list]

base-passwd 3.5.29 busybox 1.24.1 ca-certificates 20160104 ethtool 4.2 eudev 3.1.5 glibc 2.23 iptables 1.6.0 libgpg-error 1.21 libnftnl 1.1.1 netbase 1:5.3 nftables 0.9.0 opkg-utils 0.1.8 procps 3.3.11 resolvconf 1.78 rng-tools 5 sysvinit 2.88 update-rc.d 0.7 util-linux 2.27.1 vsftpd 3.0.3

The following conditions are applied to GPLv2 application software. It's possible to refer to the following Web site.

https://www.gnu.org/licenses/gpl-2.0.html

GNU GENERAL PUBLIC LICENSE

Version 2, June 1991 Copyright (C) 1989, 1991 Free Software Foundation, Inc. 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301, USA

Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

Preamble

The licenses for most software are designed to take away your freedom to share and change it. By contrast, the GNU General Public License is intended to guarantee your freedom to share and change free software--to make sure the software is free for all its users. This General Public License applies to most of the Free Software Foundation's software and to any other program whose authors commit to using it. (Some other Free Software Foundation software is covered by the GNU Lesser General Public License instead.) You can apply it to your programs, too.

When we speak of free software, we are referring to freedom, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for this service if you wish), that you receive source code or can get it if you want it, that you can change the software or use pieces of it in new free programs; and that you know you can do these things.

To protect your rights, we need to make restrictions that forbid anyone to deny you these rights or to ask you to surrender the rights. These restrictions translate to certain responsibilities for you if you distribute copies of the software, or if you modify it.

For example, if you distribute copies of such a program, whether gratis or for a fee, you must give the recipients all the rights that you have. You must make sure that they, too, receive or can get the source code. And you must show them these terms so they know their rights.

We protect your rights with two steps: (1) copyright the software, and (2) offer you this license which gives you legal permission to copy, distribute and/or modify the software.

Also, for each author's protection and ours, we want to make certain that everyone understands that there is no warranty for this free software. If the software is modified by someone else and passed on, we want its recipients to know that what they have is not the original, so that any problems introduced by others will not reflect on the original authors' reputations.

Finally, any free program is threatened constantly by software patents. We wish to avoid the danger that redistributors of a free program will individually obtain patent licenses, in effect making the program proprietary. To prevent this, we have made it clear that any patent must be licensed for everyone's free use or not licensed at all.

The precise terms and conditions for copying, distribution and modification follow.

TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION

0. This License applies to any program or other work which contains a notice placed by the copyright holder saying it may be distributed under the terms of this General Public License. The "Program", below, refers to any such program or work, and a "work based on the Program" means either the Program or any derivative work under copyright law: that is to say, a work containing the Program or a portion of it, either verbatim or with modifications and/or translated into another language. (Hereinafter, translation is included without limitation in the term "modification".) Each licensee is addressed as "you".

Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running the Program is not restricted, and the output from the Program is covered only if its contents constitute a work based on the Program (independent of having been made by running the Program). Whether that is true depends on what the Program does.

1. You may copy and distribute verbatim copies of the Program's source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice and disclaimer of warranty; keep intact all the notices that refer to this License and to the absence of any warranty; and give any other recipients of the Program a copy of this License along with the Program.

You may charge a fee for the physical act of transferring a copy, and you may at your option offer warranty protection in exchange for a fee.

2. You may modify your copy or copies of the Program or any portion of it, thus forming a work based on the Program, and copy and distribute such modifications or work under the terms of Section 1 above, provided that you also meet all of these conditions:

a) You must cause the modified files to carry prominent notices stating that you changed the files and the date of any change. b) You must cause any work that you distribute or publish, that in whole or in part contains or is

derived from the Program or any part thereof, to be licensed as a whole at no charge to all third parties under the terms of this License. c) If the modified program normally reads commands interactively when run, you must cause it, when started running for such interactive use in the most ordinary way, to print or display an announcement including an appropriate copyright notice and a notice that there is no warranty (or else, saying that you provide a warranty) and that users may redistribute the program under these conditions, and telling the user how to view a copy of this License. (Exception: if the Program itself is interactive but does not normally print such an announcement, your work based on the Program is not required to print an announcement.)

These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Program, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Program, the distribution of the whole must be on

the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.

Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Program.

In addition, mere aggregation of another work not based on the Program with the Program (or with a work based on the Program) on a volume of a storage or distribution medium does not bring the other work under the scope of this License.

3. You may copy and distribute the Program (or a work based on it, under Section 2) in object code or executable form under the terms of Sections 1 and 2 above provided that you also do one of the following:

a) Accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange; or, b) Accompany it with a written offer, valid for at least three years, to give any third party, for a charge no more than your cost of physically performing source distribution, a complete machine-readable copy of the corresponding source code, to be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange; or, c) Accompany it with the information you received as to the offer to distribute corresponding source code. (This alternative is allowed only for noncommercial distribution and only if you received the program in object code or executable form with such an offer, in accord with Subsection b above.)

The source code for a work means the preferred form of the work for making modifications to it. For an executable work, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the executable. However, as a special exception, the source code distributed need not include anything that is normally distributed (in either source or binary form) with the major components (compiler, kernel, and so on) of the operating system on which the executable runs, unless that component itself accompanies the executable.

If distribution of executable or object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place counts as distribution of the source code, even though third parties are not compelled to copy the source along with the object code.

- 4. You may not copy, modify, sublicense, or distribute the Program except as expressly provided under this License. Any attempt otherwise to copy, modify, sublicense or distribute the Program is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.
- 5. You are not required to accept this License, since you have not signed it. However, nothing else grants you permission to modify or distribute the Program or its derivative works. These actions are prohibited by law if you do not accept this License. Therefore, by modifying or distributing the Program (or any work based on the Program), you indicate your acceptance of this License to do so, and all its terms and conditions for copying, distributing or modifying the Program or works based on it.
- 6. Each time you redistribute the Program (or any work based on the Program), the recipient automatically receives a license from the original licensor to copy, distribute or modify the Program subject to these terms and conditions. You may not impose any further restrictions on the recipients' exercise of the rights granted herein. You are not responsible for enforcing compliance by third parties to this License.
- 7. If, as a consequence of a court judgment or allegation of patent infringement or for any other reason (not limited to patent issues), conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the

conditions of this License, they do not excuse you from the conditions of this License. If you cannot distribute so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not distribute the Program at all. For example, if a patent license would not permit royalty-free redistribution of the Program by all those who receive copies directly or indirectly through you, then the only way you could satisfy both it and this License would be to refrain entirely from distribution of the Program.

If any portion of this section is held invalid or unenforceable under any particular circumstance, the balance of the section is intended to apply and the section as a whole is intended to apply in other circumstances.

It is not the purpose of this section to induce you to infringe any patents or other property right claims or to contest validity of any such claims; this section has the sole purpose of protecting the integrity of the free software distribution

system, which is implemented by public license practices. Many people have made generous contributions to the wide range of software distributed through that system in reliance on consistent application of that system; it is up to the author/donor to decide if he or she is willing to distribute software through any other system and a licensee cannot impose that choice.

This section is intended to make thoroughly clear what is believed to be a consequence of the rest of this License.

- 8. If the distribution and/or use of the Program is restricted in certain countries either by patents or by copyrighted interfaces, the original copyright holder who places the Program under this License may add an explicit geographical distribution limitation excluding those countries, so that distribution is permitted only in or among countries not thus excluded. In such case, this License incorporates the limitation as if written in the body of this License.
- 9. The Free Software Foundation may publish revised and/or new versions of the General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Program specifies a version number of this License which applies to it and "any later version", you have the option of following the terms and conditions either of that version or of any later version published by the Free Software Foundation. If the Program does not specify a version number of this License, you may choose any version ever published by the Free Software Foundation.

10. If you wish to incorporate parts of the Program into other free programs whose distribution conditions are different, write to the author to ask for permission. For software which is copyrighted by the Free Software Foundation, write to the Free Software Foundation; we sometimes make exceptions for this. Our decision will be guided by the two goals of preserving the free status of all derivatives of our free software and of promoting the sharing and reuse of software generally.

NO WARRANTY

- 11. BECAUSE THE PROGRAM IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE PROGRAM "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU. SHOULD THE PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.
- 12. IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MAY MODIFY AND/OR REDISTRIBUTE THE PROGRAM AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

END OF TERMS AND CONDITIONS

How to Apply These Terms to Your New Programs

If you develop a new program, and you want it to be of the greatest possible use to the public, the best way to achieve this is to make it free software which everyone can redistribute and change under these terms.

To do so, attach the following notices to the program. It is safest to attach them to the start of each source file to most effectively convey the exclusion of warranty; and each file should have at least the "copyright" line and a pointer to where the full notice is found.

one line to give the program's name and an idea of what it does.

Copyright (C) yyyy name of author

This program is free software; you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation; either version 2 of the License, or (at your option) any later version.

This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.

You should have received a copy of the GNU General Public License along with this program; if not, write to the Free Software Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301, USA.

Also add information on how to contact you by electronic and paper mail.

If the program is interactive, make it output a short notice like this when it starts in an interactive mode: Gnomovision version 69, Copyright (C) year name of author Gnomovision comes with ABSOLUTELY NO WARRANTY; for details type `show w'. This is free software, and you are welcome to redistribute it under certain conditions; type `show c' for details.

The hypothetical commands 'show w' and 'show c' should show the appropriate parts of the General Public License. Of course, the commands you use may be called something other than 'show w' and 'show c'; they could even be mouse-clicks or menu items--whatever suits your program.

You should also get your employer (if you work as a programmer) or your school, if any, to sign a "copyright disclaimer" for the program, if necessary. Here is a sample; alter the names: Yoyodyne, Inc., hereby disclaims all copyright interest in the program 'Gnomovision' (which makes passes at compilers) written by James Hacker.

signature of Ty Coon, 1 April 1989 Ty Coon, President of Vice

This General Public License does not permit incorporating your program into proprietary programs. If your program is a subroutine library, you may consider it more useful to permit linking proprietary applications with the library. If this is what you want to do, use the GNU Lesser General Public License instead of this License.

[GPLv3 application software package list]

bash 4.3.30 coreutils 8.25 dosfstools 3.0.28 lftp 4.6.3a libidn 1.32 librelp 1.2.16 readline 6.3 rsyslog 8.37.0

The following conditions are applied to GPLv3 application software. It's possible to refer to the following Web site.

GNU GENERAL PUBLIC LICENSE

Version 3, 29 June 2007

Copyright © 2007 Free Software Foundation, Inc. < http://fsf.org/>

Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

Preamble

The GNU General Public License is a free, copyleft license for software and other kinds of works.

The licenses for most software and other practical works are designed to take away your freedom to share and change the works. By contrast, the GNU General Public License is intended to guarantee your freedom to share and change all versions of a program--to make sure it remains free software for all its users. We, the Free Software Foundation, use the GNU General Public License for most of our software; it applies also to any other work released this way by its authors. You can apply it to your programs, too.

When we speak of free software, we are referring to freedom, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for them if you wish), that you receive source code or can get it if you want it, that you can change the software or use pieces of it in new free programs, and that you know you can do these things.

To protect your rights, we need to prevent others from denying you these rights or asking you to surrender the rights. Therefore, you have certain responsibilities if you distribute copies of the software, or if you modify it: responsibilities to respect the freedom of others.

For example, if you distribute copies of such a program, whether gratis or for a fee, you must pass on to the recipients the same freedoms that you received. You must make sure that they, too, receive or can get the source code. And you must show them these terms so they know their rights.

Developers that use the GNU GPL protect your rights with two steps: (1) assert copyright on the software, and (2) offer you this License giving you legal permission to copy, distribute and/or modify it.

For the developers' and authors' protection, the GPL clearly explains that there is no warranty for this free software. For both users' and authors' sake, the GPL requires that modified versions be marked as changed, so that their problems will not be attributed erroneously to authors of previous versions.

Some devices are designed to deny users access to install or run modified versions of the software inside them, although the manufacturer can do so. This is fundamentally incompatible with the aim of protecting users' freedom to change the software. The systematic pattern of such abuse occurs in the area of products for individuals to use, which is precisely where it is most unacceptable. Therefore, we have designed this version of the GPL to prohibit the practice for those products. If such problems arise substantially in other domains, we stand ready to extend this provision to those domains in future versions of the GPL, as needed to protect the freedom of users.

Finally, every program is threatened constantly by software patents. States should not allow patents to restrict development and use of software on general-purpose computers, but in those that do, we wish to avoid the special danger that patents applied to a free program could make it effectively proprietary. To prevent this, the GPL assures that patents cannot be used to render the program non-free.

The precise terms and conditions for copying, distribution and modification follow.

TERMS AND CONDITIONS

0. Definitions.

"This License" refers to version 3 of the GNU General Public License.

"Copyright" also means copyright-like laws that apply to other kinds of works, such as semiconductor masks.

"The Program" refers to any copyrightable work licensed under this License. Each licensee is addressed as "you". "Licensees" and "recipients" may be individuals or organizations.

To "modify" a work means to copy from or adapt all or part of the work in a fashion requiring copyright permission, other than the making of an exact copy. The resulting work is called a "modified version" of the earlier work or a work "based on" the earlier work.

A "covered work" means either the unmodified Program or a work based on the Program.

To "propagate" a work means to do anything with it that, without permission, would make you directly or secondarily liable for infringement under applicable copyright law, except executing it on a computer or modifying a private copy. Propagation includes copying, distribution (with or without modification), making available to the public, and in some countries other activities as well.

To "convey" a work means any kind of propagation that enables other parties to make or receive copies. Mere interaction with a user through a computer network, with no transfer of a copy, is not conveying.

An interactive user interface displays "Appropriate Legal Notices" to the extent that it includes a convenient and prominently visible feature that (1) displays an appropriate copyright notice, and (2) tells the user that there is no warranty for the work (except to the extent that warranties are provided), that licensees may convey the work under this License, and how to view a copy of this License. If the interface presents a list of user commands or options, such as a menu, a prominent item in the list meets this criterion.

1. Source Code.

The "source code" for a work means the preferred form of the work for making modifications to it. "Object code" means any non-source form of a work.

A "Standard Interface" means an interface that either is an official standard defined by a recognized standards body, or, in the case of interfaces specified for a particular programming language, one that is widely used among developers working in that language.

The "System Libraries" of an executable work include anything, other than the work as a whole, that (a) is included in the normal form of packaging a Major Component, but which is not part of that Major Component, and (b) serves only to enable use of the work with that Major Component, or to implement a Standard Interface for which an implementation is available to the public in source code form. A "Major Component", in this context, means a major essential component (kernel, window system, and so on) of the specific operating system (if any) on which the executable work runs, or a compiler used to produce the work, or an object code interpreter used to run it.

The "Corresponding Source" for a work in object code form means all the source code needed to generate, install, and (for an executable work) run the object code and to modify the work, including scripts to control those activities. However, it does not include the work's System Libraries, or general-purpose tools or generally available free programs which are used unmodified in performing those activities but which are not part of the work. For example, Corresponding Source includes interface definition files associated with source files for the work, and the source code for shared libraries and dynamically linked subprograms that the work is specifically designed to require, such as by intimate data communication or control flow between those subprograms and other parts of the work.

The Corresponding Source need not include anything that users can regenerate automatically from other parts of the Corresponding Source.

The Corresponding Source for a work in source code form is that same work.

2. Basic Permissions.

All rights granted under this License are granted for the term of copyright on the Program, and are irrevocable provided the stated conditions are met. This License explicitly affirms your unlimited permission to run the unmodified Program. The output from running a covered work is covered by this License only if the output, given its content, constitutes a covered work. This License acknowledges your rights of fair use or other equivalent, as provided by copyright law.

You may make, run and propagate covered works that you do not convey, without conditions so long as your license

otherwise remains in force. You may convey covered works to others for the sole purpose of having them make modifications exclusively for you, or provide you with facilities for running those works, provided that you comply with the terms of this License in conveying all material for which you do not control copyright. Those thus making or running the covered works for you must do so exclusively on your behalf, under your direction and control, on terms that prohibit them from making any copies of your copyrighted material outside their relationship with you.

Conveying under any other circumstances is permitted solely under the conditions stated below. Sublicensing is not allowed; section 10 makes it unnecessary.

3. Protecting Users' Legal Rights From Anti-Circumvention Law.

No covered work shall be deemed part of an effective technological measure under any applicable law fulfilling obligations under article 11 of the WIPO copyright treaty adopted on 20 December 1996, or similar laws prohibiting or restricting circumvention of such measures.

When you convey a covered work, you waive any legal power to forbid circumvention of technological measures to the extent such circumvention is effected by exercising rights under this License with respect to the covered work, and you disclaim any intention to limit operation or modification of the work as a means of enforcing, against the work's users, your or third parties' legal rights to forbid circumvention of technological measures.

4. Conveying Verbatim Copies.

You may convey verbatim copies of the Program's source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice; keep intact all notices stating that this License and any non-permissive terms added in accord with section 7 apply to the code; keep intact all notices of the absence of any warranty; and give all recipients a copy of this License along with the Program.

You may charge any price or no price for each copy that you convey, and you may offer support or warranty protection for a fee.

5. Conveying Modified Source Versions.

You may convey a work based on the Program, or the modifications to produce it from the Program, in the form of source code under the terms of section 4, provided that you also meet all of these conditions:

- a) The work must carry prominent notices stating that you modified it, and giving a relevant date.
- b) The work must carry prominent notices stating that it is released under this License and any conditions added under section 7. This requirement modifies the requirement in section 4 to "keep intact all notices".
- c) You must license the entire work, as a whole, under this License to anyone who comes into possession of a copy. This License will therefore apply, along with any applicable section 7 additional terms, to the whole of the work, and all its parts, regardless of how they are packaged. This License gives no permission to license the work in any other way, but it does not invalidate such permission if you have separately received it.
- d) If the work has interactive user interfaces, each must display Appropriate Legal Notices; however, if the Program has interactive interfaces that do not display Appropriate Legal Notices, your work need not make them do so.

A compilation of a covered work with other separate and independent works, which are not by their nature extensions of the covered work, and which are not combined with it such as to form a larger program, in or on a volume of a storage or distribution medium, is called an "aggregate" if the compilation and its resulting copyright are not used to limit the access or legal rights of the compilation's users beyond what the individual works permit. Inclusion of a covered work in an aggregate does not cause this License to apply to the other parts of the aggregate.

6. Conveying Non-Source Forms.

You may convey a covered work in object code form under the terms of sections 4 and 5, provided that you also convey the machine-readable Corresponding Source under the terms of this License, in one of these ways:

- a) Convey the object code in, or embodied in, a physical product (including a physical distribution medium), accompanied by the Corresponding Source fixed on a durable physical medium customarily used for software interchange.
- b) Convey the object code in, or embodied in, a physical product (including a physical distribution medium), accompanied by a written offer, valid for at least three years and valid for as long as you offer spare parts or customer support for that product model, to give anyone who possesses the object code either (1) a copy of the
Corresponding Source for all the software in the product that is covered by this License, on a durable physical medium customarily used for software interchange, for a price no more than your reasonable cost of physically performing this conveying of source, or (2) access to copy the Corresponding Source from a network server at no charge.

- c) Convey individual copies of the object code with a copy of the written offer to provide the Corresponding Source. This alternative is allowed only occasionally and noncommercially, and only if you received the object code with such an offer, in accord with subsection 6b.
- d) Convey the object code by offering access from a designated place (gratis or for a charge), and offer equivalent access to the Corresponding Source in the same way through the same place at no further charge. You need not require recipients to copy the Corresponding Source along with the object code. If the place to copy the object code is a network server, the Corresponding Source may be on a different server (operated by you or a third party) that supports equivalent copying facilities, provided you maintain clear directions next to the object code saying where to find the Corresponding Source. Regardless of what server hosts the Corresponding Source, you remain obligated to ensure that it is available for as long as needed to satisfy these requirements.
- e) Convey the object code using peer-to-peer transmission, provided you inform other peers where the object code and Corresponding Source of the work are being offered to the general public at no charge under subsection 6d.

A separable portion of the object code, whose source code is excluded from the Corresponding Source as a System Library, need not be included in conveying the object code work.

A "User Product" is either (1) a "consumer product", which means any tangible personal property which is normally used for personal, family, or household purposes, or (2) anything designed or sold for incorporation into a dwelling. In determining whether a product is a consumer product, doubtful cases shall be resolved in favor of coverage. For a particular product received by a particular user, "normally used" refers to a typical or common use of that class of product, regardless of the status of the particular user or of the way in which the particular user actually uses, or expects or is expected to use, the product. A product is a consumer product regardless of whether the product has substantial commercial, industrial or non-consumer uses, unless such uses represent the only significant mode of use of the product.

"Installation Information" for a User Product means any methods, procedures, authorization keys, or other information required to install and execute modified versions of a covered work in that User Product from a modified version of its Corresponding Source. The information must suffice to ensure that the continued functioning of the modified object code is in no case prevented or interfered with solely because modification has been made.

If you convey an object code work under this section in, or with, or specifically for use in, a User Product, and the conveying occurs as part of a transaction in which the right of possession and use of the User Product is transferred to the recipient in perpetuity or for a fixed term (regardless of how the transaction is characterized), the Corresponding

Source conveyed under this section must be accompanied by the Installation Information. But this requirement does not apply if neither you nor any third party retains the ability to install modified object code on the User Product (for example, the work has been installed in ROM).

The requirement to provide Installation Information does not include a requirement to continue to provide support service, warranty, or updates for a work that has been modified or installed by the recipient, or for the User Product in which it has been modified or installed. Access to a network may be denied when the modification itself materially and adversely affects the operation of the network or violates the rules and protocols for communication across the network.

Corresponding Source conveyed, and Installation Information provided, in accord with this section must be in a format that is publicly documented (and with an implementation available to the public in source code form), and must require no special password or key for unpacking, reading or copying.

7. Additional Terms.

"Additional permissions" are terms that supplement the terms of this License by making exceptions from one or more of its conditions. Additional permissions that are applicable to the entire Program shall be treated as though they were included in this License, to the extent that they are valid under applicable law. If additional permissions apply only to part of the Program, that part may be used separately under those permissions, but the entire Program remains governed by this License without regard to the additional permissions.

When you convey a copy of a covered work, you may at your option remove any additional permissions from that copy, or from any part of it. (Additional permissions may be written to require their own removal in certain cases when you

modify the work.) You may place additional permissions on material, added by you to a covered work, for which you have or can give appropriate copyright permission.

Notwithstanding any other provision of this License, for material you add to a covered work, you may (if authorized by the copyright holders of that material) supplement the terms of this License with terms:

- a) Disclaiming warranty or limiting liability differently from the terms of sections 15 and 16 of this License; or
- b) Requiring preservation of specified reasonable legal notices or author attributions in that material or in the Appropriate Legal Notices displayed by works containing it; or
- c) Prohibiting misrepresentation of the origin of that material, or requiring that modified versions of such material be marked in reasonable ways as different from the original version; or
- d) Limiting the use for publicity purposes of names of licensors or authors of the material; or
- e) Declining to grant rights under trademark law for use of some trade names, trademarks, or service marks; or
- f) Requiring indemnification of licensors and authors of that material by anyone who conveys the material (or modified versions of it) with contractual assumptions of liability to the recipient, for any liability that these contractual assumptions directly impose on those licensors and authors.

All other non-permissive additional terms are considered "further restrictions" within the meaning of section 10. If the Program as you received it, or any part of it, contains a notice stating that it is governed by this License along with a term that is a further restriction, you may remove that term. If a license document contains a further restriction but permits relicensing or conveying under this License, you may add to a covered work material governed by the terms of that license document, provided that the further restriction does not survive such relicensing or conveying.

If you add terms to a covered work in accord with this section, you must place, in the relevant source files, a statement of the additional terms that apply to those files, or a notice indicating where to find the applicable terms.

Additional terms, permissive or non-permissive, may be stated in the form of a separately written license, or stated as exceptions; the above requirements apply either way.

8. Termination.

You may not propagate or modify a covered work except as expressly provided under this License. Any attempt otherwise to propagate or modify it is void, and will automatically terminate your rights under this License (including any patent licenses granted under the third paragraph of section 11).

However, if you cease all violation of this License, then your license from a particular copyright holder is reinstated (a) provisionally, unless and until the copyright holder explicitly and finally terminates your license, and (b) permanently, if the copyright holder fails to notify you of the violation by some reasonable means prior to 60 days after the cessation.

Moreover, your license from a particular copyright holder is reinstated permanently if the copyright holder notifies you of the violation by some reasonable means, this is the first time you have received notice of violation of this License (for any work) from that copyright holder, and you cure the violation prior to 30 days after your receipt of the notice.

Termination of your rights under this section does not terminate the licenses of parties who have received copies or rights from you under this License. If your rights have been terminated and not permanently reinstated, you do not qualify to receive new licenses for the same material under section 10.

9. Acceptance Not Required for Having Copies.

You are not required to accept this License in order to receive or run a copy of the Program. Ancillary propagation of a covered work occurring solely as a consequence of using peer-to-peer transmission to receive a copy likewise does not require acceptance. However, nothing other than this License grants you permission to propagate or modify any covered work. These actions infringe copyright if you do not accept this License. Therefore, by modifying or propagating a covered work, you indicate your acceptance of this License to do so.

10. Automatic Licensing of Downstream Recipients.

Each time you convey a covered work, the recipient automatically receives a license from the original licensors, to run, modify and propagate that work, subject to this License. You are not responsible for enforcing compliance by third parties with this License.

An "entity transaction" is a transaction transferring control of an organization, or substantially all assets of one, or

Appendix 2	Open source	software	(OSS)) list
------------	-------------	----------	-------	--------

subdividing an organization, or merging organizations. If propagation of a covered work results from an entity transaction, each party to that transaction who receives a copy of the work also receives whatever licenses to the work the party's predecessor in interest had or could give under the previous paragraph, plus a right to possession of the Corresponding Source of the work from the predecessor in interest, if the predecessor has it or can get it with reasonable efforts.

You may not impose any further restrictions on the exercise of the rights granted or affirmed under this License. For example, you may not impose a license fee, royalty, or other charge for exercise of rights granted under this License, and you may not initiate litigation (including a cross-claim or counterclaim in a lawsuit) alleging that any patent claim is infringed by making, using, selling, offering for sale, or importing the Program or any portion of it.

11. Patents.

A "contributor" is a copyright holder who authorizes use under this License of the Program or a work on which the Program is based. The work thus licensed is called the contributor's "contributor version".

A contributor's "essential patent claims" are all patent claims owned or controlled by the contributor, whether already acquired or hereafter acquired, that would be infringed by some manner, permitted by this License, of making, using, or selling its contributor version, but do not include claims that would be infringed only as a consequence of further modification of the contributor version. For purposes of this definition, "control" includes the right to grant patent sublicenses in a manner consistent with the requirements of this License.

Each contributor grants you a non-exclusive, worldwide, royalty-free patent license under the contributor's essential patent claims, to make, use, sell, offer for sale, import and otherwise run, modify and propagate the contents of its contributor version.

In the following three paragraphs, a "patent license" is any express agreement or commitment, however denominated, not to enforce a patent (such as an express permission to practice a patent or covenant not to sue for patent infringement). To "grant" such a patent license to a party means to make such an agreement or commitment not to enforce a patent against the party.

If you convey a covered work, knowingly relying on a patent license, and the Corresponding Source of the work is not available for anyone to copy, free of charge and under the terms of this License, through a publicly available network server or other readily accessible means, then you must either (1) cause the Corresponding Source to be so available, or (2) arrange to deprive yourself of the benefit of the patent license for this particular work, or (3) arrange, in a manner consistent with the requirements of this License, to extend the patent license to downstream recipients. "Knowingly relying" means you have actual knowledge that, but for the patent license, your conveying the covered work in a

country, or your recipient's use of the covered work in a country, would infringe one or more identifiable patents in that country that you have reason to believe are valid. If, pursuant to or in connection with a single transaction or arrangement, you convey, or propagate by procuring conveyance of, a covered work, and grant a patent license to some of the parties receiving the covered work authorizing them to use, propagate, modify or convey a specific copy of the covered work, then the patent license you grant is automatically extended to all recipients of the covered work and works based on it.

A patent license is "discriminatory" if it does not include within the scope of its coverage, prohibits the exercise of, or is conditioned on the non-exercise of one or more of the rights that are specifically granted under this License. You may not convey a covered work if you are a party to an arrangement with a third party that is in the business of distributing software, under which you make payment to the third party based on the extent of your activity of conveying the work, and under which the third party grants, to any of the parties who would receive the covered work from you, a discriminatory patent license (a) in connection with copies of the covered work conveyed by you (or copies made from those copies), or (b) primarily for and in connection with specific products or compilations that contain the covered work, unless you entered into that arrangement, or that patent license was granted, prior to 28 March 2007.

Nothing in this License shall be construed as excluding or limiting any implied license or other defenses to infringement that may otherwise be available to you under applicable patent law.

12. No Surrender of Others' Freedom.

If conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot convey a covered work so as to

satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not convey it at all. For example, if you agree to terms that obligate you to collect a royalty for further conveying from those to whom you convey the Program, the only way you could satisfy both those terms and this License would be to refrain entirely from conveying the Program.

13. Use with the GNU Affero General Public License.

Notwithstanding any other provision of this License, you have permission to link or combine any covered work with a work licensed under version 3 of the GNU Affero General Public License into a single combined work, and to convey the resulting work. The terms of this License will continue to apply to the part which is the covered work, but the special requirements of the GNU Affero General Public License, section 13, concerning interaction through a network will apply to the combination as such.

14. Revised Versions of this License.

The Free Software Foundation may publish revised and/or new versions of the GNU General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Program specifies that a certain numbered version of the GNU General Public License "or any later version" applies to it, you have the option of following the terms and conditions either of that numbered version or of any later version published by the Free Software Foundation. If the Program does not specify a version number of the GNU General Public License, you may choose any version ever published by the Free Software Foundation.

If the Program specifies that a proxy can decide which future versions of the GNU General Public License can be used, that proxy's public statement of acceptance of a version permanently authorizes you to choose that version for the Program.

Later license versions may give you additional or different permissions. However, no additional obligations are imposed on any author or copyright holder as a result of your choosing to follow a later version.

15. Disclaimer of Warranty.

THERE IS NO WARRANTY FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE PROGRAM "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR

IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU. SHOULD THE PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

16. Limitation of Liability.

IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MODIFIES AND/OR CONVEYS THE PROGRAM AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

17. Interpretation of Sections 15 and 16.

If the disclaimer of warranty and limitation of liability provided above cannot be given local legal effect according to their terms, reviewing courts shall apply local law that most closely approximates an absolute waiver of all civil liability in connection with the Program, unless a warranty or assumption of liability accompanies a copy of the Program in return for a fee.

END OF TERMS AND CONDITIONS

How to Apply These Terms to Your New Programs

If you develop a new program, and you want it to be of the greatest possible use to the public, the best way to achieve this is to make it free software which everyone can redistribute and change under these terms.

To do so, attach the following notices to the program. It is safest to attach them to the start of each source file to most effectively state the exclusion of warranty; and each file should have at least the "copyright" line and a pointer to where the full notice is found.

<one line to give the program's name and a brief idea of what it does.> Copyright (C) <year> <name of author>

This program is free software: you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation, either version 3 of the License, or (at your option) any later version.

This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.

You should have received a copy of the GNU General Public License along with this program. If not, see http://www.gnu.org/licenses/>.

Also add information on how to contact you by electronic and paper mail.

If the program does terminal interaction, make it output a short notice like this when it starts in an interactive mode: <program> Copyright (C) <year> <name of author> This program comes with ABSOLUTELY NO WARRANTY; for details type `show w'. This is free software, and you are welcome to redistribute it under certain conditions; type `show c' for details.

The hypothetical commands 'show w' and 'show c' should show the appropriate parts of the General Public License. Of course, your program's commands might be different; for a GUI interface, you would use an "about box".

You should also get your employer (if you work as a programmer) or school, if any, to sign a "copyright disclaimer" for the program, if necessary. For more information on this, and how to apply and follow the GNU GPL, see http://www.gnu.org/licenses/>.

The GNU General Public License does not permit incorporating your program into proprietary programs. If your program is a subroutine library, you may consider it more useful to permit linking proprietary applications with the library. If this is what you want to do, use the GNU Lesser General Public License instead of this License. But first, please read http://www.gnu.org/philosophy/why-not-lgpl.html>.

[GNU LGPL application software]

We are using the following open source software which is an applicable object of the version after GNU LESSER General Public License Version 2.1, February 1999 or later version (hereinafter LGPL) according to a condition of LGPL. We disclose the source code of open source software included in this product. We will supply the media to the person who hopes for copy, modify and distribute open source software. However please understand the following points in advance.

- We can not answer a question about the contents of source cord at all.
- We do not guarantee program which is made by offered source cord at all.
- When requesting a media, a cost sometimes occurs.
- Supply period of source code shall be either the period specified in the license or during the production period whichever is longer.

[LGPLv2.1 application software package list]

attr 2.4.47 cracklib 2.9.5 glibc 2.23 gnutls 3.4.9 kmod 22 libestr 0.1.10 libgcrypt 1.6.5 libgpg-error 1.21 libmnl 1.0.3 procps 3.3.11 util-linux 2.27.1

The following conditions are applied to LGPLv2.1 application software. It's possible to refer to the following Web site. https://www.gnu.org/licenses/lgpl-2.1.html

GNU LESSER GENERAL PUBLIC LICENSE

Version 2.1, February 1999
Copyright (C) 1991, 1999 Free Software Foundation, Inc.
51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA
Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

[This is the first released version of the Lesser GPL. It also counts as the successor of the GNU Library Public License, version 2, hence the version number 2.1.]

Preamble

The licenses for most software are designed to take away your freedom to share and change it. By contrast, the GNU General Public Licenses are intended to guarantee your freedom to share and change free software--to make sure the software is free for all its users.

This license, the Lesser General Public License, applies to some specially designated software packages--typically libraries--of the Free Software Foundation and other authors who decide to use it. You can use it too, but we suggest you first think carefully about whether this license or the ordinary General Public License is the better strategy to use in any particular case, based on the explanations below.

When we speak of free software, we are referring to freedom of use, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for this service if you wish); that you receive source code or can get it if you want it; that you can change the software and use pieces of it in

new free programs; and that you are informed that you can do these things.

To protect your rights, we need to make restrictions that forbid distributors to deny you these rights or to ask you to surrender these rights. These restrictions translate to certain responsibilities for you if you distribute copies of the library or if you modify it.

For example, if you distribute copies of the library, whether gratis or for a fee, you must give the recipients all the rights that we gave you. You must make sure that they, too, receive or can get the source code. If you link other code with the library, you must provide complete object files to the recipients, so that they can relink them with the library after making changes to the library and recompiling it. And you must show them these terms so they know their rights.

We protect your rights with a two-step method: (1) we copyright the library, and (2) we offer you this license, which gives you legal permission to copy, distribute and/or modify the library.

To protect each distributor, we want to make it very clear that there is no warranty for the free library. Also, if the library is modified by someone else and passed on, the recipients should know that what they have is not the original version, so that the original author's reputation will not be affected by problems that might be introduced by others.

Finally, software patents pose a constant threat to the existence of any free program. We wish to make sure that a company cannot effectively restrict the users of a free program by obtaining a restrictive license from a patent holder. Therefore, we insist that any patent license obtained for a version of the library must be consistent with the full freedom of use specified in this license.

Most GNU software, including some libraries, is covered by the ordinary GNU General Public License. This license, the GNU Lesser General Public License, applies to certain designated libraries, and is quite different from the ordinary General Public License. We use this license for certain libraries in order to permit linking those libraries into non-free programs.

When a program is linked with a library, whether statically or using a shared library, the combination of the two is legally speaking a combined work, a derivative of the original library. The ordinary General Public License therefore permits such linking only if the entire combination fits its criteria of freedom. The Lesser General Public License permits more lax criteria for linking other code with the library.

We call this license the "Lesser" General Public License because it does Less to protect the user's freedom than the ordinary General Public License. It also provides other free software developers Less of an advantage over competing non-free programs. These disadvantages are the reason we use the ordinary General Public License for many libraries. However, the Lesser license provides advantages in certain special circumstances.

For example, on rare occasions, there may be a special need to encourage the widest possible use of a certain library, so that it becomes a de-facto standard. To achieve this, non-free programs must be allowed to use the library. A more frequent case is that a free library does the same job as widely used non-free libraries. In this case, there is little to gain by limiting the free library to free software only, so we use the Lesser General Public License.

In other cases, permission to use a particular library in non-free programs enables a greater number of people to use a large body of free software. For example, permission to use the GNU C Library in non-free programs enables many more people to use the whole GNU operating system, as well as its variant, the GNU/Linux operating system.

Although the Lesser General Public License is Less protective of the users' freedom, it does ensure that the user of a program that is linked with the Library has the freedom and the wherewithal to run that program using a modified version of the Library.

The precise terms and conditions for copying, distribution and modification follow. Pay close attention to the difference between a "work based on the library" and a "work that uses the library". The former contains code derived from the library, whereas the latter must be combined with the library in order to run.

TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION

0. This License Agreement applies to any software library or other program which contains a notice placed by the copyright holder or other authorized party saying it may be distributed under the terms of this Lesser General Public License (also called "this License"). Each licensee is addressed as "you".

A "library" means a collection of software functions and/or data prepared so as to be conveniently linked with application programs (which use some of those functions and data) to form executables.

The "Library", below, refers to any such software library or work which has been distributed under these terms. A "work based on the Library" means either the Library or any derivative work under copyright law: that is to say, a work containing the Library or a portion of it, either verbatim or with modifications and/or translated straightforwardly into another language. (Hereinafter, translation is included without limitation in the term "modification".)

"Source code" for a work means the preferred form of the work for making modifications to it. For a library, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the library.

Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running a program using the Library is not restricted, and output from such a program is covered only if its contents constitute a work based on the Library (independent of the use of the Library in a tool for writing it). Whether that is true depends on what the Library does and what the program that uses the Library does.

1. You may copy and distribute verbatim copies of the Library's complete source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice and disclaimer of warranty; keep intact all the notices that refer to this License and to the absence of any warranty; and distribute a copy of this License along with the Library.

You may charge a fee for the physical act of transferring a copy, and you may at your option offer warranty protection in exchange for a fee.

- 2. You may modify your copy or copies of the Library or any portion of it, thus forming a work based on the Library, and copy and distribute such modifications or work under the terms of Section 1 above, provided that you also meet all of these conditions:
- a) The modified work must itself be a software library.
- b) You must cause the files modified to carry prominent notices stating that you changed the files and the date of any change.
- c) You must cause the whole of the work to be licensed at no charge to all third parties under the terms of this License.
- d) If a facility in the modified Library refers to a function or a table of data to be supplied by an application program that uses the facility, other than as an argument passed when the facility is invoked, then you must make a good faith effort to ensure that, in the event an application does not supply such function or table, the facility still operates, and performs whatever part of its purpose remains meaningful.

(For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Library, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Library, the distribution of the whole must be on the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.

Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Library.

In addition, mere aggregation of another work not based on the Library with the Library (or with a work based on the Library) on a volume of a storage or distribution medium does not bring the other work under the scope of this License.

3. You may opt to apply the terms of the ordinary GNU General Public License instead of this License to a given copy of the Library. To do this, you must alter all the notices that refer to this License, so that they refer to the ordinary GNU General Public License, version 2, instead of to this License. (If a newer version than version 2 of the ordinary GNU General Public License has appeared, then you can specify that version instead if you wish.) Do not make any other change in these notices.

Once this change is made in a given copy, it is irreversible for that copy, so the ordinary GNU General Public License applies to all subsequent copies and derivative works made from that copy.

This option is useful when you wish to copy part of the code of the Library into a program that is not a library.

4. You may copy and distribute the Library (or a portion or derivative of it, under Section 2) in object code or executable form under the terms of Sections 1 and 2 above provided that you accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange.

If distribution of object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place satisfies the requirement to distribute the source code, even though third parties are not compelled to copy the source along with the object code.

5. A program that contains no derivative of any portion of the Library, but is designed to work with the Library by being compiled or linked with it, is called a "work that uses the Library". Such a work, in isolation, is not a derivative work of the Library, and therefore falls outside the scope of this License.

However, linking a "work that uses the Library" with the Library creates an executable that is a derivative of the Library (because it contains portions of the Library), rather than a "work that uses the library". The executable is therefore covered by this License. Section 6 states terms for distribution of such executables.

When a "work that uses the Library" uses material from a header file that is part of the Library, the object code for the work may be a derivative work of the Library even though the source code is not. Whether this is true is especially significant if the work can be linked without the Library, or if the work is itself a library. The threshold for this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

Otherwise, if the work is a derivative of the Library, you may distribute the object code for the work under the terms of Section 6. Any executables containing that work also fall under Section 6, whether or not they are linked directly with the Library itself.

6. As an exception to the Sections above, you may also combine or link a "work that uses the Library" with the Library to produce a work containing portions of the Library, and distribute that work under terms of your choice, provided that the terms permit modification of the work for the customer's own use and reverse engineering for debugging such modifications.

You must give prominent notice with each copy of the work that the Library is used in it and that the Library and its use are covered by this License. You must supply a copy of this License. If the work during execution displays copyright notices, you must include the copyright notice for the Library among them, as well as a reference directing the user to the copy of this License. Also, you must do one of these things:

- a) Accompany the work with the complete corresponding machine-readable source code for the Library including whatever changes were used in the work (which must be distributed under Sections 1 and 2 above); and, if the work is an executable linked with the Library, with the complete machine-readable "work that uses the Library", as object code and/or source code, so that the user can modify the Library and then relink to produce a modified executable containing the modified Library. (It is understood that the user who changes the contents of definitions files in the Library will not necessarily be able to recompile the application to use the modified definitions.)
- b) Use a suitable shared library mechanism for linking with the Library. A suitable mechanism is one that (1) uses at run time a copy of the library already present on the user's computer system, rather than copying library functions into the executable, and (2) will operate properly with a modified version of the library, if the user installs one, as long as the modified version is interface-compatible with the version that the work was made with.
- c) Accompany the work with a written offer, valid for at least three years, to give the same user the materials specified in Subsection 6a, above, for a charge no more than the cost of performing this distribution.
- d) If distribution of the work is made by offering access to copy from a designated place, offer equivalent access to copy the above specified materials from the same place.
- e) Verify that the user has already received a copy of these materials or that you have already sent this user a copy.

For an executable, the required form of the "work that uses the Library" must include any data and utility programs

Appendix 2 Open Source Software (OSS) List

needed for reproducing the executable from it. However, as a special exception, the materials to be distributed need not include anything that is normally distributed (in either source or binary form) with the major components (compiler, kernel, and so on) of the operating system on which the executable runs, unless that component itself accompanies the executable.

It may happen that this requirement contradicts the license restrictions of other proprietary libraries that do not normally accompany the operating system. Such a contradiction means you cannot use both them and the Library together in an executable that you distribute.

- 7. You may place library facilities that are a work based on the Library side-by-side in a single library together with other library facilities not covered by this License, and distribute such a combined library, provided that the separate distribution of the work based on the Library and of the other library facilities is otherwise permitted, and provided that you do these two things:
- a) Accompany the combined library with a copy of the same work based on the Library, uncombined with any other library facilities. This must be distributed under the terms of the Sections above.
- b) Give prominent notice with the combined library of the fact that part of it is a work based on the Library, and explaining where to find the accompanying uncombined form of the same work.
- 8. You may not copy, modify, sublicense, link with, or distribute the Library except as expressly provided under this License. Any attempt otherwise to copy, modify, sublicense, link with, or distribute the Library is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.
- 9. You are not required to accept this License, since you have not signed it. However, nothing else grants you permission to modify or distribute the Library or its derivative works. These actions are prohibited by law if you do not accept this License. Therefore, by modifying or distributing the Library (or any work based on the Library), you indicate your acceptance of this License to do so, and all its terms and conditions for copying, distributing or modifying the Library or works based on it.
- 10. Each time you redistribute the Library (or any work based on the Library), the recipient automatically receives a license from the original licensor to copy, distribute, link with or modify the Library subject to these terms and conditions. You may not impose any further restrictions on the recipients' exercise of the rights granted herein. You are not responsible for enforcing compliance by third parties with this License.
- 11. If, as a consequence of a court judgment or allegation of patent infringement or for any other reason (not limited to patent issues), conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot distribute so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not distribute the Library at all. For example, if a patent license would not permit royalty-free redistribution of the Library by all those who receive copies directly or indirectly through you, then the only way you could satisfy both it and this License would be to refrain entirely from distribution of the Library.

If any portion of this section is held invalid or unenforceable under any particular circumstance, the balance of the section is intended to apply, and the section as a whole is intended to apply in other circumstances.

It is not the purpose of this section to induce you to infringe any patents or other property right claims or to contest validity of any such claims; this section has the sole purpose of protecting the integrity of the free software distribution system which is implemented by public license practices. Many people have made generous contributions to the wide range of software distributed through that system in reliance on consistent application of that system; it is up to the author/donor to decide if he or she is willing to distribute software through any other system and a licensee cannot impose that choice.

This section is intended to make thoroughly clear what is believed to be a consequence of the rest of this License.

- 12. If the distribution and/or use of the Library is restricted in certain countries either by patents or by copyrighted interfaces, the original copyright holder who places the Library under this License may add an explicit geographical distribution limitation excluding those countries, so that distribution is permitted only in or among countries not thus excluded. In such case, this License incorporates the limitation as if written in the body of this License.
- 13. The Free Software Foundation may publish revised and/or new versions of the Lesser General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new

problems or concerns.

Each version is given a distinguishing version number. If the Library specifies a version number of this License which applies to it and "any later version", you have the option of following the terms and conditions either of that version or of any later version published by the Free Software Foundation. If the Library does not specify a license version number, you may choose any version ever published by the Free Software Foundation.

14. If you wish to incorporate parts of the Library into other free programs whose distribution conditions are incompatible with these, write to the author to ask for permission. For software which is copyrighted by the Free Software Foundation, write to the Free Software Foundation; we sometimes make exceptions for this. Our decision will be guided by the two goals of preserving the free status of all derivatives of our free software and of promoting the sharing and reuse of software generally.

NO WARRANTY

- 15. BECAUSE THE LIBRARY IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY FOR THE LIBRARY, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE LIBRARY "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE LIBRARY IS WITH YOU. SHOULD THE LIBRARY PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.
- 16. IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MAY MODIFY AND/OR REDISTRIBUTE THE LIBRARY AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE LIBRARY (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE LIBRARY TO OPERATE WITH ANY OTHER SOFTWARE), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

END OF TERMS AND CONDITIONS

How to Apply These Terms to Your New Libraries

If you develop a new library, and you want it to be of the greatest possible use to the public, we recommend making it free software that everyone can redistribute and change. You can do so by permitting redistribution under these terms (or, alternatively, under the terms of the ordinary General Public License).

To apply these terms, attach the following notices to the library. It is safest to attach them to the start of each source file to most effectively convey the exclusion of warranty; and each file should have at least the "copyright" line and a pointer to where the full notice is found.

one line to give the library's name and an idea of what it does.

Copyright (C) year name of author

This library is free software; you can redistribute it and/or modify it under the terms of the GNU Lesser General Public License as published by the Free Software Foundation; either version 2.1 of the License, or (at your option) any later version.

This library is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU Lesser General Public License for more details.

You should have received a copy of the GNU Lesser General Public License along with this library; if not, write to the Free Software Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA

Also add information on how to contact you by electronic and paper mail.

You should also get your employer (if you work as a programmer) or your school, if any, to sign a "copyright disclaimer" for the library, if necessary. Here is a sample; alter the names: Yoyodyne, Inc., hereby disclaims all copyright interest in the library 'Frob' (a library for tweaking knobs) written by James Random Hacker.

signature of Ty Coon, 1 April 1990 Ty Coon, President of Vice

That's all there is to it!

[LGPLv3 application software package list]

gmp 6.1.0 libidn 1.32 nettle 3.2 rsyslog 8.37.0

The following conditions are applied to LGPLv3 application software. It's possible to refer to the following Web site.

https://www.gnu.org/licenses/lgpl-3.0.html

GNU LESSER GENERAL PUBLIC LICENSE

Version 3, 29 June 2007

Copyright © 2007 Free Software Foundation, Inc. < http://fsf.org/>

Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

This version of the GNU Lesser General Public License incorporates the terms and conditions of version 3 of the GNU General Public License, supplemented by the additional permissions listed below.

0. Additional Definitions.

As used herein, "this License" refers to version 3 of the GNU Lesser General Public License, and the "GNU GPL" refers to version 3 of the GNU General Public License.

"The Library" refers to a covered work governed by this License, other than an Application or a Combined Work as defined below.

An "Application" is any work that makes use of an interface provided by the Library, but which is not otherwise based on the Library. Defining a subclass of a class defined by the Library is deemed a mode of using an interface provided by the Library.

A "Combined Work" is a work produced by combining or linking an Application with the Library. The particular version of the Library with which the Combined Work was made is also called the "Linked Version".

The "Minimal Corresponding Source" for a Combined Work means the Corresponding Source for the Combined Work, excluding any source code for portions of the Combined Work that, considered in isolation, are based on the Application, and not on the Linked Version.

The "Corresponding Application Code" for a Combined Work means the object code and/or source code for the Application, including any data and utility programs needed for reproducing the Combined Work from the Application, but excluding the System Libraries of the Combined Work.

1. Exception to Section 3 of the GNU GPL.

You may convey a covered work under sections 3 and 4 of this License without being bound by section 3 of the GNU GPL.

2. Conveying Modified Versions.

If you modify a copy of the Library, and, in your modifications, a facility refers to a function or data to be supplied by an Application that uses the facility (other than as an argument passed when the facility is invoked), then you may convey a copy of the modified version:

a) under this License, provided that you make a good faith effort to ensure that, in the event an Application does not

supply the function or data, the facility still operates, and performs whatever part of its purpose remains meaningful, or b) under the GNU GPL, with none of the additional permissions of this License applicable to that copy.

3. Object Code Incorporating Material from Library Header Files.

The object code form of an Application may incorporate material from a header file that is part of the Library. You may convey such object code under terms of your choice, provided that, if the incorporated material is not limited to numerical parameters, data structure layouts and accessors, or small macros, inline functions and templates (ten or fewer lines in length), you do both of the following:

- a) Give prominent notice with each copy of the object code that the Library is used in it and that the Library and its use are covered by this License.
- b) Accompany the object code with a copy of the GNU GPL and this license document.

4. Combined Works.

You may convey a Combined Work under terms of your choice that, taken together, effectively do not restrict modification of the portions of the Library contained in the Combined Work and reverse engineering for debugging such modifications, if you also do each of the following:

- a) Give prominent notice with each copy of the Combined Work that the Library is used in it and that the Library and its use are covered by this License.
- b) Accompany the Combined Work with a copy of the GNU GPL and this license document.
- c) For a Combined Work that displays copyright notices during execution, include the copyright notice for the Library among these notices, as well as a reference directing the user to the copies of the GNU GPL and this license document.
- d) Do one of the following: 0) Convey the Minimal Corresponding Source under the terms of this License, and the Corresponding Application Code in a form suitable for, and under terms that permit, the user to recombine or relink the Application with a modified version of the Linked Version to produce a modified Combined Work, in the manner specified by section 6 of the GNU GPL for conveying Corresponding Source.

 \circ 1) Use a suitable shared library mechanism for linking with the Library. A suitable mechanism is one that (a) uses at run time a copy of the Library already present on the user's computer system, and (b) will operate properly with a modified version of the Library that is interface-compatible with the Linked Version.

- e) Provide Installation Information, but only if you would otherwise be required to provide such information under section 6 of the GNU GPL, and only to the extent that such information is necessary to install and execute a modified version of the Combined Work produced by recombining or relinking the Application with a modified version of the Linked Version. (If you use option 4d0, the Installation Information must accompany the Minimal Corresponding Source and Corresponding Application Code. If you use option 4d1, you must provide the Installation Information in the manner specified by section 6 of the GNU GPL for conveying Corresponding Source.)
- 5. Combined Libraries.

You may place library facilities that are a work based on the Library side by side in a single library together with other library facilities that are not Applications and are not covered by this License, and convey such a combined library under terms of your choice, if you do both of the following:

- a) Accompany the combined library with a copy of the same work based on the Library, uncombined with any other library facilities, conveyed under the terms of this License.
- b) Give prominent notice with the combined library that part of it is a work based on the Library, and explaining where to find the accompanying uncombined form of the same work.

6. Revised Versions of the GNU Lesser General Public License.

The Free Software Foundation may publish revised and/or new versions of the GNU Lesser General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Library as you received it specifies that a certain numbered version of the GNU Lesser General Public License "or any later version" applies to it, you have the option of following the terms and conditions either of that published version or of any later version published by the Free Software Foundation. If the Library as you received it does not specify a version number of the GNU Lesser General Public License, you may choose any version of the GNU Lesser General Public License ever published by the Free Software Foundation.

If the Library as you received it specifies that a proxy can decide whether future versions of the GNU Lesser General Public License shall apply, that proxy's public statement of acceptance of any version is permanent authorization for you to choose that version for the Library.

[MPL application software]

We are using the following open source software which is an applicable object of the version after Mozilla Public License Version 2.0 or later version (hereinafter MPL) according to a condition of MPL. We disclose the source code of open source software included in this product. We will supply the media to the person who hopes for copy, modify and distribute open source software. However please understand the following points in advance.

- We can not answer a question about the contents of source cord at all.
- We do not guarantee program which is made by offered source cord at all.
- When requesting a media, a cost sometimes occurs.
- Supply period of source code shall be either the period specified in the license or during the production period whichever is longer.

[MPLv2.0 application software package list]

ca-certificates 20160104

The following conditions are applied to MPLv2.0 application software. It's possible to refer to the following Web site.

https://www.mozilla.org/en-US/MPL/2.0/

Mozilla Public License

Version 2.0

1. Definitions

1.1. "Contributor"

means each individual or legal entity that creates, contributes to the creation of, or owns Covered Software.

1.2. "Contributor Version"

means the combination of the Contributions of others (if any) used by a Contributor and that particular Contributor's Contribution.

1.3. "Contribution"

means Covered Software of a particular Contributor.

1.4. "Covered Software"

means Source Code Form to which the initial Contributor has attached the notice in Exhibit A, the Executable Form of such Source Code Form, and Modifications of such Source Code Form, in each case including portions thereof.

1.5. "Incompatible With Secondary Licenses"

means

a. that the initial Contributor has attached the notice described in Exhibit B to the Covered Software; or

b. that the Covered Software was made available under the terms of version 1.1 or earlier of the License, but not also under the terms of a Secondary License.

1.6. "Executable Form"

means any form of the work other than Source Code Form.

1.7. "Larger Work"

means a work that combines Covered Software with other material, in a separate file or files, that is not Covered Software.

1.8. "License"

means this document.

1.9. "Licensable"

means having the right to grant, to the maximum extent possible, whether at the time of the initial grant or subsequently, any and all of the rights conveyed by this License.

1.10. "Modifications"

means any of the following:

a. any file in Source Code Form that results from an addition to, deletion from, or modification of the contents of Covered Software; or

b. any new file in Source Code Form that contains any Covered Software.

1.11. "Patent Claims" of a Contributor

means any patent claim(s), including without limitation, method, process, and apparatus claims, in any patent Licensable by such Contributor that would be infringed, but for the grant of the License, by the making, using, selling, offering for sale, having made, import, or transfer of either its Contributions or its Contributor Version.

1.12. "Secondary License"

means either the GNU General Public License, Version 2.0, the GNU Lesser General Public License, Version 2.1, the GNU Affero General Public License, Version 3.0, or any later versions of those licenses.

1.13. "Source Code Form"

means the form of the work preferred for making modifications.

1.14. "You" (or "Your")

means an individual or a legal entity exercising rights under this License. For legal entities, "You" includes any entity that controls, is controlled by, or is under common control with You. For purposes of this definition, "control" means (a) the power, direct or indirect, to cause the direction or management of such entity, whether by contract or otherwise, or (b) ownership of more than fifty percent (50%) of the outstanding shares or beneficial ownership of such entity.

2. License Grants and Conditions

2.1. Grants

Each Contributor hereby grants You a world-wide, royalty-free, non-exclusive license:

a. under intellectual property rights (other than patent or trademark) Licensable by such Contributor to use, reproduce, make available, modify, display, perform, distribute, and otherwise exploit its Contributions, either on an unmodified basis, with Modifications, or as part of a Larger Work; and

b. under Patent Claims of such Contributor to make, use, sell, offer for sale, have made, import, and otherwise transfer either its Contributions or its Contributor Version.

2.2. Effective Date

The licenses granted in Section 2.1 with respect to any Contribution become effective for each Contribution on the date the Contributor first distributes such Contribution.

2.3. Limitations on Grant Scope

The licenses granted in this Section 2 are the only rights granted under this License. No additional rights or licenses will be implied from the distribution or licensing of Covered Software under this License. Notwithstanding Section 2.1(b) above, no patent license is granted by a Contributor:

a. for any code that a Contributor has removed from Covered Software; or

b. for infringements caused by: (i) Your and any other third party's modifications of Covered Software, or (ii) the combination of its Contributions with other software (except as part of its Contributor Version); or

c. under Patent Claims infringed by Covered Software in the absence of its Contributions.

This License does not grant any rights in the trademarks, service marks, or logos of any Contributor (except as may be necessary to comply with the notice requirements in Section 3.4).

2.4. Subsequent Licenses

No Contributor makes additional grants as a result of Your choice to distribute the Covered Software under a subsequent version of this License (see Section 10.2) or under the terms of a Secondary License (if permitted under the terms of Section 3.3).

2.5. Representation

Each Contributor represents that the Contributor believes its Contributions are its original creation(s) or it has sufficient rights to grant the rights to its Contributions conveyed by this License.

2.6. Fair Use

This License is not intended to limit any rights You have under applicable copyright doctrines of fair use, fair dealing, or other equivalents.

2.7. Conditions

Sections 3.1, 3.2, 3.3, and 3.4 are conditions of the licenses granted in Section 2.1.

3. Responsibilities

3.1. Distribution of Source Form

All distribution of Covered Software in Source Code Form, including any Modifications that You create or to which You contribute, must be under the terms of this License. You must inform recipients that the Source Code Form of the Covered Software is governed by the terms of this License, and how they can obtain a copy of this License. You may not attempt to alter or restrict the recipients' rights in the Source Code Form.

3.2. Distribution of Executable Form

If You distribute Covered Software in Executable Form then:

a. such Covered Software must also be made available in Source Code Form, as described in Section 3.1, and You must inform recipients of the Executable Form how they can obtain a copy of such Source Code Form by reasonable means in a timely manner, at a charge no more than the cost of distribution to the recipient; and

b. You may distribute such Executable Form under the terms of this License, or sublicense it under different terms,

provided that the license for the Executable Form does not attempt to limit or alter the recipients' rights in the Source Code Form under this License.

3.3. Distribution of a Larger Work

You may create and distribute a Larger Work under terms of Your choice, provided that You also comply with the requirements of this License for the Covered Software. If the Larger Work is a combination of Covered Software with a work governed by one or more Secondary Licenses, and the Covered Software is not Incompatible With Secondary Licenses, this License permits You to additionally distribute such Covered Software under the terms of such Secondary License(s), so that the recipient of the Larger Work may, at their option, further distribute the Covered Software under the terms of either this License or such Secondary License(s).

3.4. Notices

You may not remove or alter the substance of any license notices (including copyright notices, patent notices, disclaimers of warranty, or limitations of liability) contained within the Source Code Form of the Covered Software, except that You may alter any license notices to the extent required to remedy known factual inaccuracies.

3.5. Application of Additional Terms

You may choose to offer, and to charge a fee for, warranty, support, indemnity or liability obligations to one or more recipients of Covered Software. However, You may do so only on Your own behalf, and not on behalf of any Contributor. You must make it absolutely clear that any such warranty, support, indemnity, or liability obligation is offered by You alone, and You hereby agree to indemnify every Contributor for any liability incurred by such Contributor as a result of warranty, support, indemnity or liability terms You offer. You may include additional disclaimers of warranty and limitations of liability specific to any jurisdiction.

4. Inability to Comply Due to Statute or Regulation

If it is impossible for You to comply with any of the terms of this License with respect to some or all of the Covered Software due to statute, judicial order, or regulation then You must: (a) comply with the terms of this License to the maximum extent possible; and (b) describe the limitations and the code they affect. Such description must be placed in a text file included with all distributions of the Covered Software under this License. Except to the extent prohibited by statute or regulation, such description must be sufficiently detailed for a recipient of ordinary skill to be able to understand it.

5. Termination

5.1. The rights granted under this License will terminate automatically if You fail to comply with any of its terms. However, if You become compliant, then the rights granted under this License from a particular Contributor are reinstated (a) provisionally, unless and until such Contributor explicitly and finally terminates Your grants, and (b) on an ongoing basis, if such Contributor fails to notify You of the non-compliance by some reasonable means prior to 60 days after You have come back into compliance. Moreover, Your grants from a particular Contributor are reinstated on an ongoing basis if such Contributor notifies You of the non-compliance by some reasonable means, this is the first time You have received notice of non-compliance with this License from such Contributor, and You become compliant prior to 30 days after Your receipt of the notice.

5.2. If You initiate litigation against any entity by asserting a patent infringement claim (excluding declaratory judgment actions, counter-claims, and cross-claims) alleging that a Contributor Version directly or indirectly infringes any patent, then the rights granted to You by any and all Contributors for the Covered Software under Section 2.1 of this License shall terminate.

5.3. In the event of termination under Sections 5.1 or 5.2 above, all end user license agreements (excluding distributors and resellers) which have been validly granted by You or Your distributors under this License prior to termination shall survive termination.

6. Disclaimer of Warranty

Covered Software is provided under this License on an "as is" basis, without warranty of any kind, either expressed, implied, or statutory, including, without limitation, warranties that the Covered Software is free of defects, merchantable, fit for a particular purpose or non-infringing. The entire risk as to the quality and performance of the Covered Software is with You. Should any Covered Software prove defective in any respect, You (not any Contributor) assume the cost of any necessary servicing, repair, or correction. This disclaimer of warranty constitutes an essential part of this License. No use of any Covered Software is authorized under this License except under this disclaimer.

7. Limitation of Liability

Under no circumstances and under no legal theory, whether tort (including negligence), contract, or otherwise, shall any Contributor, or anyone who distributes Covered Software as permitted above, be liable to You for any direct, indirect, special, incidental, or consequential damages of any character including, without limitation, damages for lost profits, loss of goodwill, work stoppage, computer failure or malfunction, or any and all other commercial damages or losses, even if such party shall have been informed of the possibility of such damages. This limitation of liability shall not apply to liability for death or personal injury resulting from such party's negligence to the extent applicable law prohibits such limitation. Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so this exclusion and limitation may not apply to You.

8. Litigation

Any litigation relating to this License may be brought only in the courts of a jurisdiction where the defendant maintains its principal place of business and such litigation shall be governed by laws of that jurisdiction, without reference to its conflict-of-law provisions. Nothing in this Section shall prevent a party's ability to bring cross-claims or counter-claims.

9. Miscellaneous

This License represents the complete agreement concerning the subject matter hereof. If any provision of this License is held to be unenforceable, such provision shall be reformed only to the extent necessary to make it enforceable. Any law or regulation which provides that the language of a contract shall be construed against the drafter shall not be used to construe this License against a Contributor.

10. Versions of the License

10.1. New Versions

Mozilla Foundation is the license steward. Except as provided in Section 10.3, no one other than the license steward has the right to modify or publish new versions of this License. Each version will be given a distinguishing version number. 10.2. Effect of New Versions

You may distribute the Covered Software under the terms of the version of the License under which You originally received the Covered Software, or under the terms of any subsequent version published by the license steward. 10.3. Modified Versions

If you create software not governed by this License, and you want to create a new license for such software, you may create and use a modified version of this License if you rename the license and remove any references to the name of the license steward (except to note that such modified license differs from this License).

10.4. Distributing Source Code Form that is Incompatible With Secondary Licenses

If You choose to distribute Source Code Form that is Incompatible With Secondary Licenses under the terms of this version of the License, the notice described in Exhibit B of this License must be attached.

Exhibit A - Source Code Form License Notice

This Source Code Form is subject to the terms of the Mozilla Public License, v. 2.0. If a copy of the MPL was not distributed with this file, You can obtain one at https://mozilla.org/MPL/2.0/.

If it is not possible or desirable to put the notice in a particular file, then You may include the notice in a location (such as a LICENSE file in a relevant directory) where a recipient would be likely to look for such a notice. You may add additional accurate notices of copyright ownership.

Exhibit B - "Incompatible With Secondary Licenses" Notice

This Source Code Form is "Incompatible With Secondary Licenses", as defined by the Mozilla Public License, v. 2.0.

Appendix 2 Open source software (OSS) list

[Apache application software]

We are using the following open source software which is an applicable Apache license according to a condition of copyright holder.

[Apache v2 application software package list]

rsyslog 8.37.0

The following conditions are applied to Apache v2 application software. It's possible to refer to the following Web site.

https://www.apache.org/licenses/LICENSE-2.0

Apache License Version 2.0, January 2004 http://www.apache.org/licenses/

TERMS AND CONDITIONS FOR USE, REPRODUCTION, AND DISTRIBUTION

1. Definitions.

"License" shall mean the terms and conditions for use, reproduction, and distribution as defined by Sections 1 through 9 of this document.

"Licensor" shall mean the copyright owner or entity authorized by the copyright owner that is granting the License.

"Legal Entity" shall mean the union of the acting entity and all other entities that control, are controlled by, or are under common control with that entity. For the purposes of this definition, "control" means (i) the power, direct or indirect, to cause the direction or management of such entity, whether by contract or otherwise, or (ii) ownership of fifty percent (50%) or more of the outstanding shares, or (iii) beneficial ownership of such entity.

"You" (or "Your") shall mean an individual or Legal Entity exercising permissions granted by this License.

"Source" form shall mean the preferred form for making modifications, including but not limited to software source code, documentation source, and configuration files.

"Object" form shall mean any form resulting from mechanical transformation or translation of a Source form, including but not limited to compiled object code, generated documentation, and conversions to other media types.

"Work" shall mean the work of authorship, whether in Source or Object form, made available under the License, as indicated by a copyright notice that is included in or attached to the work (an example is provided in the Appendix below).

"Derivative Works" shall mean any work, whether in Source or Object form, that is based on (or derived from) the Work and for which the editorial revisions, annotations, elaborations, or other modifications represent, as a whole, an original work of authorship. For the purposes of this License, Derivative Works shall not include works that remain separable from, or merely link (or bind by name) to the interfaces of, the Work and Derivative Works thereof.

"Contribution" shall mean any work of authorship, including the original version of the Work and any modifications or additions to that Work or Derivative Works thereof, that is intentionally submitted to Licensor for inclusion in the Work by the copyright owner or by an individual or Legal Entity authorized to submit on behalf of the copyright owner. For the purposes of this definition, "submitted" means any form of electronic, verbal, or written communication sent to the Licensor or its representatives, including but not limited to communication on electronic mailing lists, source code control systems, and issue tracking systems that are managed by, or on behalf of, the Licensor for the purpose of discussing and improving the Work, but excluding communication that is conspicuously marked or otherwise designated in writing by the copyright owner as "Not a Contribution."

"Contributor" shall mean Licensor and any individual or Legal Entity on behalf of whom a Contribution has been received by Licensor and subsequently incorporated within the Work.

2. Grant of Copyright License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable copyright license to reproduce, prepare Derivative Works of, publicly display, publicly perform, sublicense, and distribute the Work and such Derivative Works in Source or Object form.

3. Grant of Patent License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable (except as stated in this section) patent license to make, have made, use, offer to sell, sell, import, and otherwise transfer the Work, where such license applies only to those patent claims licensable by such Contributor that are necessarily infringed by their Contribution(s) alone or by combination of their Contribution(s) with the Work to which such Contribution(s) was submitted. If You institute patent litigation against any entity (including a cross-claim or counterclaim in a lawsuit) alleging that the Work or a Contribution incorporated within the Work constitutes direct or contributory patent infringement, then any patent licenses granted to You under this License for that Work shall terminate as of the date such litigation is filed.

4. Redistribution. You may reproduce and distribute copies of the Work or Derivative Works thereof in any medium, with or without modifications, and in Source or Object form, provided that You meet the following conditions:

You must give any other recipients of the Work or Derivative Works a copy of this License; and

You must cause any modified files to carry prominent notices stating that You changed the files; and

You must retain, in the Source form of any Derivative Works that You distribute, all copyright, patent, trademark, and attribution notices from the Source form of the Work, excluding those notices that do not pertain to any part of the Derivative Works; and

If the Work includes a "NOTICE" text file as part of its distribution, then any Derivative Works that You distribute must include a readable copy of the attribution notices contained within such NOTICE file, excluding those notices that do not pertain to any part of the Derivative Works, in at least one of the following places: within a NOTICE text file distributed as part of the Derivative Works; within the Source form or documentation, if provided along with the Derivative Works; or, within a display generated by the Derivative Works, if and wherever such third-party notices normally appear. The contents of the NOTICE file are for informational purposes only and do not modify the License. You may add Your own attribution notices within Derivative Works that You distribute, alongside or as an addendum to the NOTICE text from the Work, provided that such additional attribution notices cannot be construed as modifying the License.

You may add Your own copyright statement to Your modifications and may provide additional or different license terms and conditions for use, reproduction, or distribution of Your modifications, or for any such Derivative Works as a whole, provided Your use, reproduction, and distribution of the Work otherwise complies with the conditions stated in this License.

5. Submission of Contributions. Unless You explicitly state otherwise, any Contribution intentionally submitted for inclusion in the Work by You to the Licensor shall be under the terms and conditions of this License, without any additional terms or conditions. Notwithstanding the above, nothing herein shall supersede or modify the terms of any separate license agreement you may have executed with Licensor regarding such Contributions.

6. Trademarks. This License does not grant permission to use the trade names, trademarks, service marks, or product names of the Licensor, except as required for reasonable and customary use in describing the origin of the Work and reproducing the content of the NOTICE file.

7. Disclaimer of Warranty. Unless required by applicable law or agreed to in writing, Licensor provides the Work (and each Contributor provides its Contributions) on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied, including, without limitation, any warranties or conditions of TITLE, NON-INFRINGEMENT, MERCHANTABILITY, or FITNESS FOR A PARTICULAR PURPOSE. You are solely responsible for determining the appropriateness of using or redistributing the Work and assume any risks associated with Your exercise of permissions under this License.

8. Limitation of Liability. In no event and under no legal theory, whether in tort (including negligence), contract, or otherwise, unless required by applicable law (such as deliberate and grossly negligent acts) or agreed to in writing, shall any Contributor be liable to You for damages, including any direct, indirect, special, incidental, or consequential damages of any character arising as a result of this License or out of the use or inability to use the Work (including but not limited to damages for loss of goodwill, work stoppage, computer failure or malfunction, or any and all other commercial damages or losses), even if such Contributor has been advised of the possibility of such damages.

	Appendix 2	Open source software (OSS) list
--	------------	---------------------------------

9. Accepting Warranty or Additional Liability. While redistributing the Work or Derivative Works thereof, You may choose to offer, and charge a fee for, acceptance of support, warranty, indemnity, or other liability obligations and/or rights consistent with this License. However, in accepting such obligations, You may act only on Your own behalf and on Your sole responsibility, not on behalf of any other Contributor, and only if You agree to indemnify, defend, and hold each Contributor harmless for any liability incurred by, or claims asserted against, such Contributor by reason of your accepting any such warranty or additional liability.

END OF TERMS AND CONDITIONS

[Artistic application software]

We are using the following open source software which is an applicable Artistic according to a condition of Artistic.

[Artistic application software package list]

perl 5.22.1 shadow 4.2.1

The following conditions are applied to Artistic application software. It's possible to refer to the following Web site.

https://opensource.org/licenses/Artistic-1.0

The "Artistic License"

Preamble

The intent of this document is to state the conditions under which a Package may be copied, such that the Copyright Holder maintains some semblance of artistic control over the development of the package, while giving the users of the package the right to use and distribute the Package in a more-or-less customary fashion, plus the right to make reasonable modifications.

Definitions:

"Package" refers to the collection of files distributed by the Copyright Holder, and derivatives of that collection of files created through textual modification.

"Standard Version" refers to such a Package if it has not been modified, or has been modified in accordance with the wishes of the Copyright Holder as specified below.

"Copyright Holder" is whoever is named in the copyright or copyrights for the package.

"You" is you, if you're thinking about copying or distributing this Package.

"Reasonable copying fee" is whatever you can justify on the basis of media cost, duplication charges, time of people involved, and so on. (You will not be required to justify it to the Copyright Holder, but only to the computing community at large as a market that must bear the fee.)

"Freely Available" means that no fee is charged for the item itself, though there may be fees involved in handling the item. It also means that recipients of the item may redistribute it under the same conditions they received it.

- 1. You may make and give away verbatim copies of the source form of the standard Version of this Package without restriction, provided that you duplicate all of the original copyright notices and associated disclaimers.
- 2. You may apply bug fixes, portability fixes and other modifications derived from the Public Domain or from the Copyright Holder. A Package modified in such a way shall still be considered the Standard Version.
- 3. You may otherwise modify your copy of this Package in any way, provided that you insert a prominent notice in each changed file stating how and when you changed that file, and provided that you do at least ONE of the following:
 - a) place your modifications in the Public Domain or otherwise make them freely Available, such as by posting said modifications to Usenet or an equivalent medium, or placing the modifications on a major archive site such as uunet.uu.net, or by allowing the Copyright Holder to include your modifications in the Standard Version of the Package.
 - b) use the modified Package only within your corporation or organization.

- c) rename any non-standard executables so the names do not conflict with standard executables, which must also be provided, and provide a separate manual page for each non-standard executable that clearly documents how it differs from the Standard Version.
- d) make other distribution arrangements with the Copyright Holder.
- 4. You may distribute the programs of this Package in object code or executable form, provided that you do at least ONE of the following:
 - a) distribute a Standard Version of the executables and library files, together with instructions (in the manual page or equivalent) on where to get the Standard Version.
 - b) accompany the distribution with the machine-readable source of the Package with your modifications.
 - c) give non-standard executables non-standard names, and clearly document the differences in manual pages (or equivalent), together with instructions on where to get the Standard Version.
 - d) make other distribution arrangements with the Copyright Holder.
- 5. You may charge a reasonable copying fee for any distribution of this package. You may charge any fee you choose for support of this package. You may not charge a fee for this Package itself. However, you may distribute this Package in aggregate with other (possibly commercial) programs as part of a larger (possibly commercial) software distribution provided that you do not advertise this Package as a product of your own. You may embed this Package's interpreter within an executable of yours (by linking); this shall be construed as a mere form of aggregation, provided that the complete Standard Version of the interpreter is so embedded.
- 6. The scripts and library files supplied as input to or produced as output from the programs of this Package do not automatically fall under the copyright of this Package, but belong to whoever generated them, and may be sold commercially, and may be aggregated with this Package. If such scripts or library files are aggregated with this Package via the so-called "undump" or "unexec" methods of producing a binary executable image, then distribution of such an image shall neither be construed as a distribution of this Package nor shall it fall under the restrictions of Paragraphs 3 and 4, provided that you do not represent such an executable image as a Standard Version of this Package.
- 7. C subroutines (or comparably compiled subroutines in other languages) supplied by you and linked into this Package in order to emulate subroutines and variables of the language defined by this Package shall not be considered part of this Package, but are the equivalent of input as in Paragraph 6, provided these subroutines do not change the language in any way that would cause it to fail the regression tests for the language.
- 8. Aggregation of this Package with a commercial distribution is always permitted provided that the use of this Package is embedded; that is, when no overt attempt is made to make this Package's interfaces visible to the end user of the commercial distribution. Such use shall not be construed as a distribution of this Package.
- 9. The name of the Copyright Holder may not be used to endorse or promote products derived from this software without specific prior written permission.
- 10. THIS PACKAGE IS PROVIDED "AS IS" AND WITHOUT ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTIBILITY AND FITNESS FOR A PARTICULAR PURPOSE.

The End

[BSD application software]

We are using the following open source software which is an applicable BSD according to a condition of copyright holder.

[BSD-2-Clause application software package list]

dropbear 2016.72 liblogging 1.0.5 ntp 4.2.8p8

The following conditions are applied to BSD-2-Clause application software.

Copyright (c) The Regents of the University of California. All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

- 1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- 2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.

THIS SOFTWARE IS PROVIDED BY THE REGENTS AND CONTRIBUTORS ``AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE REGENTS OR CONTRIBUTORS BE LIABLE

FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

[BSD-3-Clause application software package list]

dropbear 2016.72 libcap 2.24 libpam 1.2.1 openssh 7.1p2 tcl 8.6.4 tzdata 2016i util-linux 2.27.1

The following conditions are applied to BSD-3-Clause application software.

Copyright (c) The Regents of the University of California. All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

- 1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- 2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
- 3. Neither the name of the University nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE REGENTS AND CONTRIBUTORS ``AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE REGENTS OR CONTRIBUTORS BE LIABLE

FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

[MIT application software]

We are using the following open source software which is an applicable MIT according to a condition of copyright holder.

[MIT application software package list]

curl 7.47.1 dropbear 2016.72 expat 2.1.0 libfastjson 0.99.8 ncurses 6.0

The following conditions are applied to MIT application software. It's possible to refer to the following Web site.

https://opensource.org/licenses/MIT

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

[About glibc-2.23]

We are using the following open source software which is an applicable glibc according to a condition of copyright holder.

The following conditions and GNU GPL/GNU LGPL are applied to glibc-2.23 application software.

This file contains the copying permission notices for various files in theGNU C Library distribution that have copyright owners other than the FreeSoftware Foundation. These notices all require that a copy of the noticebe included in the accompanying documentation and be distributed with binary distributions of the code, so be sure to include this file along with any binary distributions derived from the GNU C Library.

All code incorporated from 4.4 BSD is distributed under the followinglicense:

Copyright (C) 1991 Regents of the University of California. All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

- 1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- 2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
- 3. [This condition was removed.]
- 4. Neither the name of the University nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE REGENTS AND CONTRIBUTORS ``AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE REGENTS OR CONTRIBUTORS BE LIABLE

FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

The DNS resolver code, taken from BIND 4.9.5, is copyrighted by UC Berkeley, by Digital Equipment Corporation and by Internet Software Consortium. The DEC portions are under the following license:

Portions Copyright (C) 1993 by Digital Equipment Corporation.

Permission to use, copy, modify, and distribute this software for any purpose with or without fee is hereby granted, provided that the above copyright notice and this permission notice appear in all copies, and

that the name of Digital Equipment Corporation not be used in advertising or publicity pertaining to distribution of the document or software without specific, written prior permission.

THE SOFTWARE IS PROVIDED ``AS IS" AND DIGITAL EQUIPMENT CORP. DISCLAIMS ALL WARRANTIES WITH REGARD TO THIS SOFTWARE, INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS. IN NO EVENT SHALL DIGITAL EQUIPMENT CORPORATION BE LIABLE FOR ANY SPECIAL, DIRECT, INDIRECT, OR CONSEQUENTIAL DAMAGES OR ANY DAMAGES WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS, WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR OTHER TORTIOUS ACTION, ARISING OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THIS SOFTWARE.

The ISC portions are under the following license:

Portions Copyright (c) 1996-1999 by Internet Software Consortium.

Permission to use, copy, modify, and distribute this software for any purpose with or without fee is hereby granted, provided that the above copyright notice and this permission notice appear in all copies.

THE SOFTWARE IS PROVIDED "AS IS" AND INTERNET SOFTWARE CONSORTIUM DISCLAIMS ALL WARRANTIES WITH REGARD TO THIS SOFTWARE INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS. IN NO EVENT SHALL INTERNET SOFTWARE CONSORTIUM BE LIABLE FOR ANY SPECIAL, DIRECT, INDIRECT, OR CONSEQUENTIAL DAMAGES OR ANY DAMAGES WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS, WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR OTHER TORTIOUS ACTION, ARISING OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THIS SOFTWARE.

The Sun RPC support (from rpcsrc-4.0) is covered by the following license:

Copyright (c) 2010, Oracle America, Inc.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

- * Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- * Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
- * Neither the name of the "Oracle America, Inc." nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT HOLDER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

The following CMU license covers some of the support code for Mach, derived from Mach 3.0:

Mach Operating System Copyright (C) 1991,1990,1989 Carnegie Mellon University All Rights Reserved.

Permission to use, copy, modify and distribute this software and its documentation is hereby granted, provided that both the copyright notice and this permission notice appear in all copies of the software, derivative works or modified versions, and any portions thereof, and that both notices appear in supporting documentation.

CARNEGIE MELLON ALLOWS FREE USE OF THIS SOFTWARE IN ITS ``AS IS" CONDITION. CARNEGIE MELLON DISCLAIMS ANY LIABILITY OF ANY KIND FOR ANY DAMAGES WHATSOEVER RESULTING FROM THE USE OF THIS SOFTWARE.

Carnegie Mellon requests users of this software to return to

Software Distribution Coordinator School of Computer Science Carnegie Mellon University Pittsburgh PA 15213-3890 or Software.Distribution@CS.CMU.EDU any improvements or extensions that they make and grant Carnegie Mellon the rights to redistribute these changes.

The file if_ppp.h is under the following CMU license:

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

- 1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- 2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
- 3. Neither the name of the University nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY CARNEGIE MELLON UNIVERSITY AND CONTRIBUTORS ``AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF

MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE UNIVERSITY OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR

OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

The following license covers the files from Intel's "Highly Optimized Mathematical Functions for Itanium" collection:

Intel License Agreement

Copyright (c) 2000, Intel Corporation

All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

- * Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- * Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
- * The name of Intel Corporation may not be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL INTEL OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION)

HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

The files inet/getnameinfo.c and sysdeps/posix/getaddrinfo.c are copyright (C) by Craig Metz and are distributed under the following license:

/* The Inner Net License, Version 2.00

The author(s) grant permission for redistribution and use in source and binary forms, with or without modification, of the software and documentation provided that the following conditions are met:

- 0. If you receive a version of the software that is specifically labelled as not being for redistribution (check the version message and/or README), you are not permitted to redistribute that version of the software in any way or form.
- 1. All terms of the all other applicable copyrights and licenses must be followed.
- 2. Redistributions of source code must retain the authors' copyright notice(s), this list of conditions, and the following disclaimer.
- 3. Redistributions in binary form must reproduce the authors' copyright notice(s), this list of conditions, and the following disclaimer in the documentation and/or other materials provided with the distribution.
- 4. [The copyright holder has authorized the removal of this clause.]
- 5. Neither the name(s) of the author(s) nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY ITS AUTHORS AND CONTRIBUTORS ``AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE AUTHORS OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES

(INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

If these license terms cause you a real problem, contact the author. */

The file sunrpc/des_impl.c is copyright Eric Young:

Copyright (C) 1992 Eric Young

Collected from libdes and modified for SECURE RPC by Martin Kuck 1994

This file is distributed under the terms of the GNU Lesser General Public License, version 2.1 or later - see the file COPYING.LIB for details. If you did not receive a copy of the license with this program, please see http://www.gnu.org/licenses/> to obtain a copy.

The libidn code is copyright Simon Josefsson, with portions copyright The Internet Society, Tom Tromey and Red Hat, Inc.:

Copyright (C) 2002, 2003, 2004, 2011 Simon Josefsson

This file is part of GNU Libidn.

GNU Libidn is free software; you can redistribute it and/or modify it under the terms of the GNU Lesser General Public License as published by the Free Software Foundation; either version 2.1 of the License, or (at your option) any later version.

GNU Libidn is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU Lesser General Public License for more details.

You should have received a copy of the GNU Lesser General Public License along with GNU Libidn; if not, see http://www.gnu.org/licenses/>.

The following notice applies to portions of libidn/nfkc.c:

This file contains functions from GLIB, including gutf8.c and gunidecomp.c, all licensed under LGPL and copyright hold by:

Copyright (C) 1999, 2000 Tom Tromey Copyright 2000 Red Hat, Inc.

The following applies to portions of libidn/punycode.c and libidn/punycode.h:

This file is derived from RFC 3492bis written by Adam M. Costello.

Disclaimer and license: Regarding this entire document or any portion of it (including the pseudocode and C code), the author makes no guarantees and is not responsible for any damage resultingfrom its use. The author grants irrevocable permission to anyone to use, modify, and distribute it in any way that does not diminish the rights of anyone else to use, modify, and distribute derivative works do not contain misleading author or version information. Derivative works need not be licensed under similar terms.

Copyright (C) The Internet Society (2003). All Rights Reserved.

This document and translations of it may be copied and furnished to others, and derivative works that comment on or otherwise explain it or assist in its implementation may be prepared, copied, published and distributed, in whole or in part, without restriction of any kind, provided that the above copyright notice and this paragraph are included on all such copies and derivative works. However, this document itself may not be modified in any way, such as by removing the copyright notice or references to the Internet Society or other Internet organizations, except as needed for the purpose of developing Internet standards in which case the procedures for copyrights defined in the Internet Standards process must be followed, or as required to translate it into languages other than English.

The limited permissions granted above are perpetual and will not be revoked by the Internet Society or its successors or assigns.

This document and the information contained herein is provided on an "AS IS" basis and THE INTERNET SOCIETY AND THE INTERNET ENGINEERING TASK FORCE DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY WARRANTY THAT THE USE OF THE INFORMATION HEREIN WILL NOT INFRINGE ANY RIGHTS OR ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

The file inet/rcmd.c is under a UCB copyright and the following:

Copyright (C) 1998 WIDE Project. All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

- 1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- 2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
- 3. Neither the name of the project nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE PROJECT AND CONTRIBUTORS ``AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE PROJECT OR CONTRIBUTORS BE LIABLE

FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

The file posix/runtests.c is copyright Tom Lord:

Copyright 1995 by Tom Lord

All Rights Reserved

Permission to use, copy, modify, and distribute this software and its documentation for any purpose and without fee is hereby granted, provided that the above copyright notice appear in all copies and that both that copyright notice and this permission notice appear in supporting documentation, and that the name of the copyright holder not be used in advertising or publicity pertaining to distribution of the software without specific, written prior permission.

Tom Lord DISCLAIMS ALL WARRANTIES WITH REGARD TO THIS SOFTWARE, INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS, IN NO EVENT SHALL TOM LORD BE LIABLE FOR ANY SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES OR ANY DAMAGES WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS, WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR OTHER TORTIOUS ACTION, ARISING OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THIS SOFTWARE.

The posix/rxspencer tests are copyright Henry Spencer:

Copyright 1992, 1993, 1994, 1997 Henry Spencer. All rights reserved.

This software is not subject to any license of the American Telephone and Telegraph Company or of the Regents of the University of California.

Permission is granted to anyone to use this software for any purpose on any computer system, and to alter it and redistribute it, subject to the following restrictions:

- 1. The author is not responsible for the consequences of use of this software, no matter how awful, even if they arise from flaws in it.
- 2. The origin of this software must not be misrepresented, either by explicit claim or by omission. Since few users ever read sources, credits must appear in the documentation.
- 3. Altered versions must be plainly marked as such, and must not be misrepresented as being the original software. Since few users ever read sources, credits must appear in the documentation.
- 4. This notice may not be removed or altered.

The file posix/PCRE.tests is copyright University of Cambridge:

Copyright (c) 1997-2003 University of Cambridge

Permission is granted to anyone to use this software for any purpose on any computer system, and to redistribute it freely, subject to the following restrictions:

- 1. This software is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
- The origin of this software must not be misrepresented, either by explicit claim or by omission. In practice, this means that if you use PCRE in software that you distribute to others, commercially or otherwise, you must put a sentence like this

Regular expression support is provided by the PCRE library package, which is open source software, written by Philip Hazel, and copyright by the University of Cambridge, England.

somewhere reasonably visible in your documentation and in any relevant files or online help data or similar. A reference to the ftp site for the source, that is, to

ftp://ftp.csx.cam.ac.uk/pub/software/programming/pcre/

should also be given in the documentation. However, this condition is not intended to apply to whole chains of software. If package A includes PCRE, it must acknowledge it, but if package B is software that includes package A, the condition is not imposed on package B (unless it uses PCRE independently).

- 3. Altered versions must be plainly marked as such, and must not be misrepresented as being the original software.
- 4. If PCRE is embedded in any software that is released under the GNU General Purpose Licence (GPL), or Lesser General Purpose Licence (LGPL), then the terms of that licence shall supersede any condition above with which it is incompatible.

Files from Sun fdlibm are copyright Sun Microsystems, Inc.:

Copyright (C) 1993 by Sun Microsystems, Inc. All rights reserved.

Developed at SunPro, a Sun Microsystems, Inc. business. Permission to use, copy, modify, and distribute this software is freely granted, provided that this notice is preserved.

Part of stdio-common/tst-printf.c is copyright C E Chew:

(C) Copyright C E Chew

Feel free to copy, use and distribute this software provided:

- 1. you do not pretend that you wrote it
- 2. you leave this copyright notice intact.

Various long double libm functions are copyright Stephen L. Moshier:

Copyright 2001 by Stephen L. Moshier <moshier@na-net.ornl.gov>

This library is free software; you can redistribute it and/or modify it under the terms of the GNU Lesser General Public License as published by the Free Software Foundation; either version 2.1 of the License, or (at your option) any later version.

This library is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU Lesser General Public License for more details.

You should have received a copy of the GNU Lesser General Public License along with this library; if not, see http://www.gnu.org/licenses/>. */

[About openssl-1.0.2h]

We are using the following open source software which is an applicable open ssl according to a condition of copyright holder.

The following conditions are applied to openssl-1.0.2h application software.

LICENSE ISSUES

The OpenSSL toolkit stays under a dual license, i.e. both the conditions of the OpenSSL License and the original SSLeay license apply to the toolkit. See below for the actual license texts. Actually both licenses are BSD-style Open Source licenses. In case of any license issues related to OpenSSL please contact openssl-core@openssl.org.

OpenSSL License

* Copyright (c) 1998-2016 The OpenSSL Project. All rights reserved. * Redistribution and use in source and binary forms, with or without * modification, are permitted provided that the following conditions * are met: * 1. Redistributions of source code must retain the above copyright * notice, this list of conditions and the following disclaimer. * * 2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in * the documentation and/or other materials provided with the * distribution. * 3. All advertising materials mentioning features or use of this * software must display the following acknowledgment: * "This product includes software developed by the OpenSSL Project * for use in the OpenSSL Toolkit. (http://www.openssl.org/)" * * 4. The names "OpenSSL Toolkit" and "OpenSSL Project" must not be used to * endorse or promote products derived from this software without * prior written permission. For written permission, please contact * openssl-core@openssl.org. * 5. Products derived from this software may not be called "OpenSSL" nor may "OpenSSL" appear in their names without prior written * permission of the OpenSSL Project. * * 6. Redistributions of any form whatsoever must retain the following * acknowledgment: * "This product includes software developed by the OpenSSL Project * for use in the OpenSSL Toolkit (http://www.openssl.org/)" * THIS SOFTWARE IS PROVIDED BY THE OpenSSL PROJECT ``AS IS" AND ANY * EXPRESSED OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE * IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR * PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE OpenSSL PROJECT OR

* ITS CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL,

* SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT

* NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES;

- * LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION)
- * HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT,
- * STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE)
- * ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED
- * OF THE POSSIBILITY OF SUCH DAMAGE.

* _____

*

* This product includes cryptographic software written by Eric Young

- * (eay@cryptsoft.com). This product includes software written by Tim
- * Hudson (tjh@cryptsoft.com).
- *

*/

Original SSLeay License

/* Copyright (C) 1995-1998 Eric Young (eay@cryptsoft.com)

* All rights reserved.

*

* This package is an SSL implementation written

* by Eric Young (eay@cryptsoft.com).

* The implementation was written so as to conform with Netscapes SSL.

*

* This library is free for commercial and non-commercial use as long as

* the following conditions are aheared to. The following conditions

* apply to all code found in this distribution, be it the RC4, RSA,

* lhash, DES, etc., code; not just the SSL code. The SSL documentation

* included with this distribution is covered by the same copyright terms

* except that the holder is Tim Hudson (tjh@cryptsoft.com).

*

* Copyright remains Eric Young's, and as such any Copyright notices in

* the code are not to be removed.

* If this package is used in a product, Eric Young should be given attribution

* as the author of the parts of the library used.

* This can be in the form of a textual message at program startup or

* in documentation (online or textual) provided with the package.

*

* Redistribution and use in source and binary forms, with or without

* modification, are permitted provided that the following conditions

* are met:

* 1. Redistributions of source code must retain the copyright

* notice, this list of conditions and the following disclaimer.

* 2. Redistributions in binary form must reproduce the above copyright

* notice, this list of conditions and the following disclaimer in the

* documentation and/or other materials provided with the distribution.

* 3. All advertising materials mentioning features or use of this software

* must display the following acknowledgement:

* "This product includes cryptographic software written by

* Eric Young (eay@cryptsoft.com)"

* The word 'cryptographic' can be left out if the rouines from the library

* being used are not cryptographic related :-).

* 4. If you include any Windows specific code (or a derivative thereof) from

* the apps directory (application code) you must include an acknowledgement:

* "This product includes software written by Tim Hudson (tjh@cryptsoft.com)"

*

* THIS SOFTWARE IS PROVIDED BY ERIC YOUNG ``AS IS" AND

* ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE

* IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE

* ARE DISCLAIMED. IN NO EVENT SHALL THE AUTHOR OR CONTRIBUTORS BE LIABLE

Appendix 2

- * FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL
- * DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS
- * OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION)
- * HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT
- * LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY
- * OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF
- * SUCH DAMAGE.
- *
- * The licence and distribution terms for any publically available version or
- * derivative of this code cannot be changed. i.e. this code cannot simply be
- * copied and put under another distribution licence
- * [including the GNU Public Licence.]
- */
[About libgcc-5.3.0/gcc-runtime-5.3.0]

We are using the following open source software which is an applicable libgcc and gcc-runtime according to a condition of copyright holder.

The following conditions and GNU GPL are applied to libgcc-5.3.0 and gcc-runtime-5.3.0 application software.

insert GPL v3 text here

GCC RUNTIME LIBRARY EXCEPTION Version 3.1, 31 March 2009

General information:

http://www.gnu.org/licenses/gcc-exception.html

Copyright (C) 2009 Free Software Foundation, Inc. http://fsf.org/">http://fsf.org/

Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

This GCC Runtime Library Exception ("Exception") is an additional permission under section 7 of the GNU General Public License, version 3 ("GPLv3"). It applies to a given file (the "Runtime Library") that bears a notice placed by the copyright holder of the file stating that the file is governed by GPLv3 along with this Exception.

When you use GCC to compile a program, GCC may combine portions of certain GCC header files and runtime libraries with the compiled program. The purpose of this Exception is to allow compilation of non-GPL (including proprietary) programs to use, in this way, the header files and runtime libraries covered by this Exception.

0. Definitions.

A file is an "Independent Module" if it either requires the Runtime Library for execution after a Compilation Process, or makes use of an interface provided by the Runtime Library, but is not otherwise based on the Runtime Library.

"GCC" means a version of the GNU Compiler Collection, with or without modifications, governed by version 3 (or a specified later version) of the GNU General Public License (GPL) with the option of using any subsequent versions published by the FSF.

"GPL-compatible Software" is software whose conditions of propagation, modification and use would permit combination with GCC in accord with the license of GCC.

"Target Code" refers to output from any compiler for a real or virtual target processor architecture, in executable form or suitable for input to an assembler, loader, linker and/or execution phase. Notwithstanding that, Target Code does not include data in any format that is used as a compiler intermediate representation, or used for producing a compiler intermediate representation.

The "Compilation Process" transforms code entirely represented in non-intermediate languages designed for human-written code, and/or in Java Virtual Machine byte code, into Target Code. Thus, for example, use of source code generators and preprocessors need not be considered part of the Compilation Process, since the Compilation Process can be understood as starting with the output of the generators or preprocessors.

A Compilation Process is "Eligible" if it is done using GCC, alone or with other GPL-compatible software, or if it is done without using any work based on GCC. For example, using non-GPL-compatible Software to optimize any GCC intermediate representations would not qualify as an Eligible Compilation Process.

1. Grant of Additional Permission.

You have permission to propagate a work of Target Code formed by combining the Runtime Library with Independent Modules, even if such propagation would otherwise violate the terms of GPLv3, provided that all Target Code was generated by Eligible Compilation Processes. You may then convey such a combination under terms of your choice, consistent with the licensing of the Independent Modules.

2. No Weakening of GCC Copyleft.

The availability of this Exception does not imply any general presumption that third-party software is unaffected by the copyleft requirements of the license of GCC.

[About tcl-8.6.4]

We are using the following open source software which is an applicable tcl according to a condition of copyright holder.

The following conditions and BSD are applied to tcl-8.6.4 application software.

This software is copyrighted by the Regents of the University of California, Sun Microsystems, Inc., Scriptics Corporation, ActiveState Corporation and other parties. The following terms apply to all files associated with the software unless explicitly disclaimed in individual files.

The authors hereby grant permission to use, copy, modify, distribute, and license this software and its documentation for any purpose, provided that existing copyright notices are retained in all copies and that this notice is included verbatim in any distributions. No written agreement,

license, or royalty fee is required for any of the authorized uses. Modifications to this software may be copyrighted by their authors and need not follow the licensing terms described here, provided that the new terms are clearly indicated on the first page of each file where they apply.

IN NO EVENT SHALL THE AUTHORS OR DISTRIBUTORS BE LIABLE TO ANY PARTY FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OF THIS SOFTWARE, ITS DOCUMENTATION, OR ANY DERIVATIVES THEREOF, EVEN IF THE AUTHORS HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

THE AUTHORS AND DISTRIBUTORS SPECIFICALLY DISCLAIM ANY WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT. THIS SOFTWARE IS PROVIDED ON AN "AS IS" BASIS, AND THE AUTHORS AND DISTRIBUTORS HAVE NO OBLIGATION TO PROVIDE MAINTENANCE, SUPPORT, UPDATES, ENHANCEMENTS, OR MODIFICATIONS.

GOVERNMENT USE: If you are acquiring this software on behalf of the U.S. government, the Government shall have only "Restricted Rights" in the software and related documentation as defined in the Federal Acquisition Regulations (FARs) in Clause 52.227.19 (c) (2). If you are acquiring the software on behalf of the Department of Defense, the software shall be classified as "Commercial Computer Software" and the Government shall have only "Restricted Rights" as defined in Clause

252.227-7014 (b) (3) of DFARs. Notwithstanding the foregoing, the authors grant the U.S. Government and others acting in its behalf permission to use and distribute the software in accordance with the terms specified in this license.

[About zlib-1.2.8]

We are using the following open source software which is an applicable zlib according to a condition of copyright holder.

The following conditions are applied to zlib-1.2.8 application software.

zlib License

This software is provided `as-is`, without any express or implied warranty. In no event will the authors be held liable for any damages arising from the use of this software.

Permission is granted to anyone to use this software for any purpose, including commercial applications, and to alter it and redistribute it freely, subject to the following restrictions:

- 1. The origin of this software must not be misrepresented; you must not claim that you wrote the original software. If you use this software in a product, an acknowledgment in the product documentation would be appreciated but is not required.
- 2. Altered source versions must be plainly marked as such, and must not be misrepresented as being the original software.
- 3. This notice may not be removed or altered from any source distribution.

[About tcp-wrappers-7.6]

We are using the following open source software which is an applicable tcp-wrappers according to a condition of copyright holder.

The following conditions are applied to tcp-wrappers-7.6 application software.

Copyright 1995 by Wietse Venema. All rights reserved. Some individual files may be covered by other copyrights.

This material was originally written and compiled by Wietse Venema at Eindhoven University of Technology, The Netherlands, in 1990, 1991, 1992, 1993, 1994 and 1995.

Redistribution and use in source and binary forms are permitted provided that this entire copyright notice is duplicated in all such copies.

This software is provided "as is" and without any expressed or implied warranties, including, without limitation, the implied warranties of merchantibility and fitness for any particular purpose.

We disclose the source code of open source software included in this product. We will supply the media to the person who hopes for copy, modify and distribute open source software. However please understand the following points in advance.

- We can not answer a question about the contents of source cord at all.
- We do not guarantee program which is made by offered source cord at all.
- When requesting a media, a cost sometimes occurs.
- Supply period of source code shall be either the period specified in the license or during the production period whichever is longer.