

## RZ/N2L Group

**Application Note** 

R01AN6796EJ0110 Rev.1.10 Aug 7, 2023

RZ/N2L Industrial Network SOM Kit Application Note: EtherCAT CiA402 Slave Software

## Introduction

This document explains Sample Program setup procedures for EtherCAT<sup>®</sup> slave functionalities with the adapted EtherCAT Stack Code for Renesas RZ/N2L platform. This describes steps to confirm slave behavior and stack features using TwinCAT<sup>®</sup>Master Configuration tool.

## **Target Device**

RZ/N2L

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## 1. Overview

This document describes how to run EtherCAT on the RZ/N2L Group. Run the standalone variant using only one core.

EtherCAT(Ethernet for Control Automation Technology) is an Ethernet based fieldbus system, developed by Beckhoff Automation. Development of EtherCAT was to apply Ethernet for automation applications (e.g., for motion control, I/O, sensors) requiring short data update times with low communication jitter and reduced hardware costs.

Tool to generate EtherCAT Slave Stack Code (SSC Tool) is available to the ETG members free of charge. This can be downloaded from the ETG website. SSC tool can be used to generate customized stack, device description files (ESI) and individual source code documentation to suit the developer's own needs.

This document describes the procedure for testing the EtherCAT slave function using EtherCAT stack code compatible with the Renesas RZ/N2L platform. Scope of the documentation is limited to explaining how to use the SSC tool for EtherCAT slave stack code generation and testing its behavior against TwinCAT masters and test applications.

## 1.1 Abbreviations/Definitions

#### Table 1. Abbreviations/Definitions

Index	Abbreviations /Definitions	Description
1	CoE	CAN application protocol over EtherCAT
2	EEPROM	Electrically Erasable Programmable Read-Only Memory
3	ESC	EtherCAT Slave Controller
4	ESI	EtherCAT Slave Information
5	FoE	File Access Over EtherCAT
6	12C	Inter-Integrated Circuit
7	MB	Mail Box
8	PDO	Process Data Object
9	SSC	Slave Stack Code
10	EoE	Ethernet Over EtherCAT

## 1.2 Reference

Technical information about EtherCAT is available via ETG member site, and information about RZ/N2L is available via Renesas.

#### Table 2. Technical Inputs

Index	Technical Inputs
1	r01uh0955ejxxxx-rzn2l.pdf (RZ/N2L User's Manual: Hardware)
2	r01an6434ejxxxx-rzt2-rzn2-fsp-getting-started.pdf (Getting started with Flexible Software Package)
3	r12ut0020edxxxx-rzn2l-som-kit-hw.pdf (RZ/N2L Industrial Network SOM Kit Use's Manual)



## 2. Features

EtherCAT slave stack code generated by SSC Tool provides the functionality of EtherCAT slave controller.

Includes the following features :

- ESM (EtherCAT State Machine)
- Mailbox protocols:
  - CoE (CAN application protocol over EtherCAT)
- Synchronization Modes:
  - Free Run
  - Sync Manager Synchronization
  - DC Synchronization
- CiA402 Drive Profile:
  - csp Mode
  - csv Mode



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



## 3. Project Setup

## 3.1 Requirements

#### Table 3. Requirements

Manadan	Description				
vender	Description				
Renesas Electronics	RZ/N2L Industrial Network SOM Kit				
IAR Systems	<ul> <li>Embedded Workbench® for ARM Version 9.30.1</li> </ul>				
	Please apply patch				
	(EWARM_Patch_for_RZN2L)				
	which is available in http://www.renesas.com/rzn2l.				
	Regarding how to apply the patch, please read the				
	readme file in patch file.				
Renesas Electronics	<ul> <li>e<sup>2</sup> studio 2023-04</li> </ul>				
	<ul> <li>FSP Smart Configurator 2023-04</li> </ul>				
	<ul> <li>RZ/N2L Flexible Software Package (FSP) v1.2.0</li> </ul>				
	Please download from the link below.				
	https://github.com/renesas/rzn-fsp/releases/tag/v1.2.0				
IAR Systems	I-jet				
SEGGER	Hardware: J-Link				
	Software: J-Link Commander V7.82f *1				
Beckhoff Automation	Slave Stack Code (SSC) Tool Version 5.13				
Beckhoff Automation	TwinCAT3				
	IAR Systems Renesas Electronics IAR Systems SEGGER Beckhoff Automation				

\*1: J-Link Commander is used for erasing flash memory.

J-Link Commander is included in "J-Link Software and Documentation Pack" on the following site. <u>https://www.segger.com/downloads/jlink/</u>



## 3.2 Hardware

This document describes the major hardware. Refer to RZ/N2L Industrial Network SOM Kit user's manual and schematic for more board details.



Figure 3-1 RZ/N2L Industrial Network SOM Kit

## 3.3 Note about Ethernet PHY driver using FSP

This SOM Kit has VSC8531 that is not compatible with FSP as PHY chip. Therefore, we have modified the PHY driver for VSC8531. For details, see "Appendix: FSP Configuration for VSC8531".



## 3.4 Setup the Board

Setting the board for running sample program is shown below.

1. Connect the I-jet to J2 or the USB cable to J5 for J-link OB on Carrier board.



Figure 3-2 Setup the SOM Kit

- 2. Power is supplied by connecting USB Micro-B cable to the USB connector "J5) of the Carrier board.
- 3. Connect Ethernet Cable to the Ethernet Connector "ETH0".



## 3.5 Generating the Slave Stack Code

SSC Tool is used for generating the slave stack code.

Note). Replace the folder name in the following description according to the tool to be used.

1. Start the SSC Tool from the Window Start menu.

		EtherCAT Slave Stack Code Tool $ \wedge $
	2	EEPROM Programmer
	)	EtherCAT Development Docume
SS	C C	SSC Tool

#### 2. Select File > Open.

350	EtherCAT	Slave* - Slav	ve Stack	Code Tool			
Fil	e Proje	ect Tool	Help				
E 🗋	New	Ctrl+N		Slave Settings			
<b>1</b>	Open	Ctrl+O		SSC Version	5.12		
	Save	Ctrl+S		Config File Vers	ion1.4.0.0		
	Save A		hine	File name		D	
			-	aceapplic		Ac	
	Exit			aoeapplh			
	Mailbox		_	applInterfac	eh	Ec	
l I	· · · · · · ·			· ·			

#### 1. Select the following file,

## "common\ecat\_CiA402\SSCconfig\ RZN2 EtherCAT CiA402.esp"

select SSC Configurator Project File		×	
$\leftarrow$ $\rightarrow$ $\checkmark$ $\uparrow$ $\blacksquare$ $\ll$ ecat_CiA $\rightarrow$ SS	SCconfig v ව SS	SCconfigの検索	,c
整理 ▼ 新しいフォルダー			?
r01an5926ej0090-rzt2m-eth ^	名前 ^	種類	更新日
RZT2M_EtherCAT_RSK_be	RZT2 EtherCAT CiA402.esp	ESP ファイル	2022/0
common			
ecat_CiA402			
ESI			
Patch			
SSCconfig 🗸 🗸	C		>
ファイル名( <u>N</u> ): RZT2	EtherCAT CiA402.esp 🗸 E	therCAT Slave Project (*.esp)	$\sim$
	E	開く( <u>O</u> ) キャンセノ	ŀ



- EtherCAT Slave\* Slave Stack Code Tool × File Project Tool Help Slave Project Navigation Slave Settings ⊡- EtherCAT Slave SlaveInformation Generic SSC Version 5.12 Config File Version1.4.0.0 Generic:
   Hardware
   EtherCAT State Machine
   Synchronisation
   Application
   L\_ProcessData
   Mailbox File name Description Version AGE ADS 5.11 aoeapplh applInterface h EcatAppl EtherCAT application 5.12 Compiler bootmode.c ESM EtherCAT State Machine 5.12 5.11 bootmodeh bootloaderapp1.c Bootloader Bootloader Sample 5.12 bootloaderapp1h 5.12 CiA402appl CiA402 Sample Application cia402appl.c 5.12 cia402app1h 5.12 CoE CAN Application Profile over EtherCAT 5.12 coeappl.c coeapplh 5.12 e Add File(s) Reload File Conflicts 👥 Info 🔥 Warning 🔞 Error New project created
- 2. After clicking the [OK] button, the following window opens.

3. Select Project > Create new Slave Files.

EtherCAT Slave* - Slave Stack Code Tool
File       Project       Tool       Help         Slave Project Update       Project Update       gs         Image: Find Setting       Ctrl+F       Version1.4.0.0         Image: Find Setting       Complex       aoeapplc         Image: Find Setting       Application       aoeapplc         Image: Find Setting       Application       aoeapplc         Image: Find Setting       Soceapplc       applInterface h         Image: Find Setting       Compiler       bootmode c



4. Click the [Start] button to start creating the EtherCAT Slave Stack Code.

Project File	C:¥RZT2_esc_	dual_WS1_RSK_beta3¥CPU1¥rz¥fsp¥src¥r_ecat¥utilities¥ssc_config¥RZT2 EtherCA	
	Source Folder	C#RZT2_esc_dual_WS1_RSK_beta3¥CPU1¥rz¥fsp¥src¥r_ecat¥utilities¥ssc_config¥]	Change
	ESI File	C#RZT2_esc_dual_WS1_RSK_beta8#CPU1#rz#fsp#src#r_ecat#utilities#ssc_config#	Change
	Doc Folder	C:¥RZT2_esc_dual_WS1_RSK_beta3¥CPU1¥rz¥fsp¥src¥r_ecat¥utilities¥ssc_config	Change
Progress			

 When a message "New file created successfully" appears, the creation processing is completed, and the source files are located in the following folder. "common\ecat\_CiA402\SSCconfig\Src"

File ZT2_esc_dual_WS1_RSK_beta3¥CPU1¥rz¥f	#src¥r_ecat¥utilities¥ssc_config¥R	RZT2 EtherCAT.esp	
Source Folder C:¥RZT2_esc_dual_WS1_R	_beta3¥CPU1¥rz¥fsp¥src¥r_ecat¥ut	tilities¥ssc_config¥ Chan	ge
ESI File C:¥RZT2_esc_dual_WS1_R	_ _beta3¥CPU1¥rz¥fsp¥src¥r_ecat¥ut	tilities¥ssc_config¥ Chan	je
Doc Folder C:¥RZT2 esc dual WS1 RS	beta3¥CPU1¥rz¥fsp¥src¥r ecat¥ut	tilities¥ssc config Chan	ge
<pre>Interface.h" : new file written uppl.c" : new file written appl.c" : new file written create Files Finish croe.c" : new file writ croe.c" : new file written box.c" : new file written box.c" : new file written lef.c" : new file written lef.c" : new file written etr.c" : new file written ierv.c" : new file written ierv.ch : new file written</pre>	reated successfully .	CPU1\rz\fsp\src\r_ecat	:

Note), If an error occurs during generation, uncheck "Create device description" in [Tool]-> [Option]-> [Create Files] of the SSC tool.



6. Right-click on the apply\_patch.bat file and select [Run as an administrator] → [Yes] The patch file contains modifications to make the SSC source file suitable for the RZ/N2L.

[ewarm] *"common\ecat\_CiA402\Patch\apply\_patch\_ewarm.bat"* 

[e2studio]

"common\ecat\_CiA402\Patch\apply\_patch\_e2studio.bat"

Move SSC Src tolder	
1_dir(s) moved.	
Patching process start	
patching file Src/cia402appl.c	
patching file Src/cia402appl.h	
patching file Src/ecatcoe.h	
patching file Src/mailbox.h	
patching file Src/sdoserv.h	
Patching process end	
Move patced Src folder	
1 dir(s) moved.	
Press any key to continue	

After execution of the patch, the modified source file is stored in the following folder.

[ewarm]

"project\rzn2I\_som\ecat\_CiA402\ewarm\src\ethercat\ beckhoff"

[e2studio] "project\rzn2l\_som\ecat\_CiA402\e2studio\src\ethercat\ beckhoff"

Note) If the patch command is not installed on your PC, you will need to install ver. 2.5.9 or a later version of GNU patch.

If it is already installed, skip this step.

Download the patch command (currently ver. 2.5.9) from the following Web page and store "patch.exe" in a folder on a path that makes the file executable from the command prompt. <u>http://gnuwin32.sourceforge.net/packages/patch.htm</u>



## 4. Setting up a TwinCAT3

#### 4.1 Copying the ESI Files

Before starting TwinCAT, copy the ESI files that are included in the release folder to TwinCAT destination "\TwinCAT\3.x\Config\IO\EtherCAT"

ESI file for current release available at,

"common\ecat\_CiA402\ESI\ Renesas EtherCAT RZN2 CiA402.xml"

## 4.2 Add Driver

Add the Ether driver for TwinCAT. (First time only)

From the start menu, select [TwinCAT3]  $\rightarrow$  [Show Realtime Ethernet Compatible Devise].

Select the connected Ether port from the communication ports and install it.





## 5. Running the sample application

#### 5.1 Setting sample code for EWARM

Build the sample code and load it into RAM using IAR Embedded Workbench.

Note). Please install FSP Smart Configurator in advance.

Refer to the latest getting started guide.( R01an6434ejxxxx-rzt2-rzn2.pdf) Replace the project name in the figure with the project name of this sample project.

#### 1. Open the sample project. "project\rzn2l\_som\ ecat\_CiA402\ewarm \RZN2L\_SOM\_ESC\_CiA402.eww"



#### 2. Open the "RZ Smart Configurator"

File Edit View Project I-jet	Тос	ls Window Help	
i 🗅 🗅 🔛 🕋 🔚 🕹 🛍 🕻	Φ	Options	
Workspace 🔻 🗣 🗄		Filename Extensions	
Debug		Configure Viewers	
Files 🍳		Configure Custom Argument Variables	
🗆 🌒 RZN2L_esc_RSK 🗸	10	Configure Tools	
⊢⊞ i Flex Software ⊢⊞ SSC		IAR Project Converter	
buildinfo.ipcf		RZ Smart Configurator	

#### 3. Generate the code with "Generate Project Content".

tacks Configuration					Generate Project Conte
Threads 🚯 New Thread 🚯 Remove 📄	HAL/Common Stacks			New Stack >	🗄 Extend Stack > 🔊 Remov
<ul> <li>✓ Set and the set of the set o</li></ul>	g_ioport I/O Port Driver on r_ioport	<ul> <li>g_ethercat_ssc_port0 Ethenet</li> <li>g_ether_phy0 Ethernet</li> <li>Driver on r_ether_phy0</li> <li>g_ether_selector0</li> <li>Ethernet Driver on r_ether_selector</li> <li>1</li> </ul>	g_ether_phy1 Ethernet Driver on r_ether_phy     g_ether_selector1 Ethernet Driver on r_ether_selector     g	Add Ethernet PHY Driver ch2	<ul> <li>g_timer0 Timer Driver on r_cmt</li> <li>(1)</li> </ul>

4. Select the "Rebuild All" item from the "Project" menu to rebuild the project.



i 🗅 🗋 🔛 🕋 i		Add Files	🚽 < Q, > 🤹 🖽 < 📮 > 🕢 👂 📗 🌒
Workspace		Add Group	
Debug	<b>[</b> ]	Import File List	
Files		Add Project Connection Edit Configurations	<pre>" encoding="UTF-8" standalone="yes"?&gt; ion version="1.8" name="Flex Software"&gt;</pre>
□ ■ RZN2L_es	×	Remove	)7G084M08
- ⊕ i Build 0	0	Create New Project	)J DIR\$/rzn/arm/CMSIS 5/CMSIS/Core R/Include
Gener		Add Existing Project	)_DIR\$/rzn/fsp/inc )J_DIR\$/rzn/fsp/inc/api
⊢ <b>Ģ</b> ∎ssc	۰	Options Alt+F7	<pre>&gt;J_DIR\$/rzn/fsp/inc/instances</pre>
-⊞ i beckh		Version Control System	<pre>J_DIR\$/rzn/fsp/src/rm_ethercat_ssc_port J_DIR\$/rzn_cfg/fsp_cfg</pre>
buildinfo.	0	Make F7	J_DIR\$/rzn_cfg/fsp_cfg/bsp J_DIR\$/rzn_gen
		Compile Ctrl+F7	]]_DIR\$/src
	9	Rebuild All	:h>
	0	Clean	J_DIR\$/rzn/arm/CMSIS_5/CMSIS/Core_R/Include J_DIR\$/rzn/fsp/inc
	•	Batch build F8	]_DIR\$/rzn/fsp/inc/api ]_DIR\$/rzn/fsp/inc/instances
		Clean Browse Information	<pre>J_DIR\$/rzn/fsp/src/rm_ethercat_ssc_port</pre>

- 5. Press the "RESET" switch of the RZ/N2L Industrial Network SOM Kit.
- 6. After connecting the board and I-jet, click the Download and Debug button on the Project toolbar.

	oject I-jet Tools Window Help	_
it t 🗅 🗳 🗗 🕻	Add Files	🚽 🤇 🔾 🔉 🤹 KE 🔇 🏮 🖉 🖷
Workspace	Add Group	
Debug 🛃	Import File List	
Files	Add Project Connection	<pre>" encoding="UTF-8" standaLone="yes"?&gt;</pre>
Piles □ ● RZN2L_es	Edit Configurations	ion version="1.8" name="Flex Software">
	Remove	)7G084M08
-⊞ ■ Comp( ℃		]]_DIR\$/rzn/arm/CMSIS_5/CMSIS/Core_R/Include
📔 🖵 🖬 Progra 🎽	Add Existing Project	)J_DIR\$/rzn/fsp/inc )J DIR\$/rzn/fsp/inc/api
	Options Alt+F7	<pre>JJ_DIR\$/rzn/fsp/inc/instances</pre>
-⊞ i beckhi   -⊞ i renesa	Version Control System	<pre>J_DIR\$/rzn/fsp/src/rm_ethercat_ssc_port J_DIR\$/rzn_cfg/fsp_cfg</pre>
i 🖳 🗋 buildinfo.i 👩	Make Fi	J_DIR\$/rzn_cfg/fsp_cfg/bsp J] DIR\$/rzn_gen
	Compile Ctrl+F7	DTD# (asset (asth)
	Rebuild All	:h>
₫	Clean	<pre>J_DIR\$/rzn/arm/CMSIS_5/CMSIS/Core_R/Include J DIR\$/rzn/fsp/inc</pre>
•	Batch build F8	<pre>J_DIR\$/rzn/fsp/inc/api J_DIR\$/rzn/fsp/inc/api</pre>
	Clean Browse Information	]]_DIR\$/rzn/fsp/inc/instances ]]_DIR\$/rzn/fsp/src/rm_ethercat_ssc_port
	C-STAT Static Analysis	<pre>J_DIR\$/rzn_cfg/fsp_cfg ) DIR\$/rzn_cfg/fsp_cfg/bsp</pre>
8	Stop Build Ctrl+Break	- Darkpy Sile () putchy
	Download and Debug Ctrl+E	
	Debug without Downloading	<pre>true J_DIR\$/script/fsp_ram_execution.icf</pre>



7. Press the "Resume" button for the project. Program will run.

File Edit View Project	Deb	oug Disassembly I-jet Tools Wind	ow Help
: 🎦 🖻 🖬 🔚 🛛 🕹		Go F5	• <
Workspace	0	Break	
Debug	1	Reset	
Files	8	Stop Debugging Ctrl+Shift+D	e file -
□ ● RZN2L_esc_RSK	A	Step Over F10	) <b>id</b> ) {
│	7	Step Into F11	();
🛛 🗕 🖅 🖬 Components	г•	Step Out Shift+F11	
📙 🗖 🖬 Generated Dat	×i.	Next Statement	
│ │ └─⊞	۰I	Run to Cursor	
🔰 🛏 🖬 beckhoff	m	Autostep	
L — E interestas	۰	Set Next Statement	
buildinfo.ipcf □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □		C++ Exceptions	
		Memory	
		Refresh	
		Logging	
II			-



## 5.2 Setting sample code for GCC

#### 5.2.1 Erasing the flash memory

First, erase the flash memory by following the steps below. This step can be skipped after erasing the flash memory.

Open the J-Link Commander.



Figure 5-1 Open J-Link Commander



First, type "connect" to establish a target connection and press enter.

Next, specify the connection conditions as follows.

- Device> (Default = press enter)
- TIF>S
- Speed> (Default = press enter)

After that, confirm the message "Cortex-R52 identified." Is displayed.

	🔜 J-Link Commander V7.82f	_	Х
	SEGGER J-Link Commander V7.82f (Compiled Dec 8 2022 09:40:05) DLL version V7.82f, compiled Dec 8 2022 09:38:33		^
	Connecting to J-Link via USBO.K. Firmware: J-Link OB-S124 compiled Sep 1 2022 15:38:25 Hardware version: V1.00 J-Link uptime (since boot): Od OOh O6m O5s S/N: 831650215 VTref=3.300V		
$\rightarrow$	Type "connect" to establish a target connection, '?' for help J-Link>connect Please specify device / core. <default>: R9A07G084M08 Type '?' for selection dialog Device&gt; Please specify target interface: J) JTAG (Default) S) SWD</default>		
$\rightarrow$	s) smu T) cJTAG TIF>S Specify target interface speed [kHz]. <default>: 4000 kHz Speed&gt;</default>		
			~

Figure 5-2 Connection conditions (1/2)



Figure 5-3 Connection conditions (2/2)



Use the commands below to enable flash erase and erase the flash memory.

- >exec EnableEraseAllFlashBanks

- >Erase 0x6000000, 0x60100000

After that, confirm the message "Erasing done." Is displayed.

#### Enter "q" to exit J-Link Commander.



#### Figure 5-4 Erase flash memory (1/2)



Figure 5-5 Erase flash memory (2/2)



#### 5.2.2 Setting sample code for GCC

Build the sample code and load it into RAM using Renesas Electronics e<sup>2</sup> studio.

Note). Please install e2studio and adapt the FSP\_Packs\_v1.0.0 in advance. Refer to the latest getting started guide.( R01an6434ejxxxx- rzt2-rzn2.pdf)

Replace the project name in the figure with the project name of this sample project

Import the sample project. After the program is started, by selecting [File] → [Import] → [Existing Projects into Workspace]. Check the "select root directory" and select "project\rzn2l\_som\ecat\_CiA402\e2studio" folder → [Finish].

💽 Import			
Import Projects			
Select a directory to sea	rch for existing Eclipse projects.		
Select root directory:	C:¥Users¥a5000352¥Desktop¥RZN2L_EtherCAT_RSK_rev0100_rc1	~	Browse
O Select archive file:		×	Browse
Projects:			
	:¥Users¥a5000352¥Desktop¥RZN2L_EtherCAT_RSK_rev0100_rc1¥project¥rzn2l		Select All
RZN2L_esc_RSK (C	C:¥Users¥a5000352¥Desktop¥RZN2L_EtherCAT_RSK_rev0100_rc1¥project¥rzn2l	I_rsk_rzn2l¥ecat_IO¥e2studio)	Deselect All

#### 2. Open "cofiguration.xml" in the "RZN2L\_SOM\_ESC\_CiA402" project



3. Generate the code with "Generate Project Content".

Threads 💿 New Thread 🖻 Remove 😑	HAL/Common Stacks	New	Stack > 🚔 Extend Stack > 🖗	Remo
<ul> <li>HAL/Common</li> <li>g_ioport I/O Port Driver on r_ioport</li> <li>g_ethercat_ssc_port0 EtherCAT SSC Port</li> </ul>	<ul> <li>g_ioport I/O Port Driver on r_ioport</li> </ul>	∉ g_ethercat_ssc_port0 Ethe	erCAT SSC Port	A
		g_ether_phy0 Ethernet     Driver on r_ether_phy	g_ether_phy1 Ethernet     Driver on r_ether_phy	Pr Ad
Cobjects New Object > Remove		<ul> <li>g_ether_selector0</li> <li>Ethernet Driver on</li> <li>r_ether_selector</li> <li>①</li> </ul>	<ul> <li>g_ether_selector1</li> <li>Ethernet Driver on</li> <li>r_ether_selector</li> <li>①</li> </ul>	



4. Select and build the "RZN2L\_SOM\_ESC\_CiA402" project.



- 5. Press the "RESET" switch of the RZ/N2L Industrial Network SOM Kit.
- Connect J-Link to the SOM Kit, start debugging in the following procedure. In [Project Explorer] view, right click the node of project to be debugged and select [Debug As] → [Debug Configurations].

Project Explorer × ✓ Solution RZN2L_esc_RSK (i > Solution Solution National Solution		Image: Second	DSV1_ESD Configu	"at	
> 🐸 rzn		Show In	Alt+Shift+W >		HAL/Common Stacks
> 😂 rzn_gen > 🕵 src > 🗁 Debug > 🗁 rzn_cfg > 🗁 script	1 1 1 1 1	Copy Paste Delete Source Move	Ctrl+C Ctrl+V Delete >	er o th	
💮 configuration.x		Rename	F2	Ŀ	g_ether_phy0 Ether
RZN2L_esc_RSI RZN2L_esc_RSI		Import Export Renesas FSP Export	>	>	G_enter_phycettern     Driver on r_ether_ph
	Ł	Build Project Clean Project Refresh Close Project Close Unrelated Project	F5		
		Build Targets Index	>	u	upts Event Links Stacks Components
		Build Configurations	>	1	ィー 🏶 スマート・ブラウザー 💷 スマート・マニュアル 🎋 Debug
	0	Run As	>	K]	K]
	蓉	Debug As	>	C	1 GDB OpenOCD Hardware Debugging (DSF)
		Team Compare With Restore from Local History	>	C	<ul> <li>2 GDB Simulator Debugging (RH850)</li> <li>3 Local C/C++ Application</li> <li>4 Renesas GDB Hardware Debugging</li> </ul>
		MISRA-C	>	C	5 Renesas Simulator Debugging (RX, RL78)
	8	C/C++ Project Settings Renesas C/C++ Project Settings	Ctrl+Alt+P >	a	Debug Configurations at-beckelev "R7N2Lesc RSK elf"



[Renesas DBG Hardware Debugging]  $\rightarrow$  [RZN2L\_SOM\_ESC\_CiA402 Debug\_Flat] item, then press [Debug]

reate, manage, and run configurations	
<ul> <li>P P P P P P P P P P P P P P P P P P P</li></ul>	Name:       RZN2L_esc_RSK Debug_Flat         Main       > Debugger       > Startup         Project:       RZN2L_esc_RSK       Browse         C/C++ Application:       Debug/RZN2L_esc_RSK.elf       Browse         Variables       Search Project       Browse         Build (if required) before launching       Search Project       Browse
Remote Java Application	Build Configuration:     Use Active       O Enable auto build     O Disable auto build
Renesas Simulator Debugging (RX, RL78)	Use workspace settings <u>Configure Workspace Settings</u> Revert Apply

#### Following dialog will appear, so switch to the debug screen.

Con	firm Perspective Switch X
2	This kind of launch is configured to open the Debug perspective when it suspends. This Debug perspective supports application debugging by providing views for displaying the debug stack, variables and breakpoints. Switch to this perspective?
Rem	Switch No



7. Before running the loaded program, change the CPSR register of CR52 general register on Registers tabs.

Change the register value from "0x200001fa" to "**0x200001da**". If the CPSR register value has not changed, program will stop at Default\_Handler () at run time.

Name	Value
✓ ∰ General Registers	
1911 rO	0x1
1818 r1	0x80281a10
1811 r2	0xa500
388 r3	0x80281300
1919 r4	0xbb92caf
888 r5	0x1e58a574
Itti r6	0x0
1888 r7	0x0
1888 r8	0x0
1818 r9	0x0
## r10	0x0
3888 r11	0x0
1818 r12	0xe51ff004
1918 sp	0x101fe8
and Ir	0x10006d
Itti pc	0x102000
1811 cpsr	0x200001da

8. Press the "Resume" button for the project. Program will stop at hal\_entry (). Press the "Resume" button again. Program is running.



## 6. Connecting to TwinCAT3

Start TwinCAT3 by using the procedure described below, From the start menu, select [Beckhoff]  $\rightarrow$  [TwinCAT3]  $\rightarrow$  [TwinCAT XAE].

After the program is started, by selecting [File]  $\rightarrow$  [New]  $\rightarrow$  [Project], create a new project of the TwinCAT XAE Project type. The subsequent procedure is described below.

## 6.1 Scanning I/O Devices

1. (Scan for devices): Under solution explorer -> I/O -> Devices, select 'Scan' as in Figure below



2. (Selecting port): The EtherCAT port will be displayed as below. Select and press OK.

Solution Ex	· ·	- 🗆 ×	_
	xpiorer		
	lution Explorer (Ctrl+;)	- م	
	tion 'TwinCAT_gECATSlave' (1 project winCAT_gECATSlave SVSTEM MOTION PLC SAFETY C++ VO C++ VO Devices Devices 2 (EtherCAT) Mappings	)	
1	new I/O devices found		×
J	⊠Device 2 (EtherCAT) [Ethernet (Twi	nCAT-Intel PCI Ethernet Adapter (G	igab) OK Cancel Select All Unselect All

Note). This will list EtherCAT master if a valid slave is present in the network.



3. (Activate slave): The slave is listed in the boxes, in our case "Renesas EtherCAT" in box1 shown in figure below. Press activate free run.





## 6.2 Updating EEPROM Data

If the data of another application has already been written to the EEPROM, replace the data. The following shows the procedure for replacing the data on the EEPROM:

- 1. Double-click [Box 1] to display a panel on the right side of the window.
- 2. Select the [EtherCAT] tab.
- 3. Click the [Advanced Setting] button.
- 4. Select [ESC Access]  $\rightarrow$  [EEPROM]  $\rightarrow$  [Hex Editor].
- 5. Select [Download from List] → Select ESI File "common\ecat\_CiA402\ESI\Renesas EtherCAT RZN2 CiA402.xml"
- 6. Select "Renesas EtherCAT RZ/N2 Cia402 2port" or "Renesas EtherCAT RZ/N2 CiA402 3port"
- 7. OK and Download.

General EtherCAT D	C Process Data Startup CoE - Online Online
Туре:	Renesas EtherCAT RZ/T2
Producty Newsion:	2048 / 256
Auto Inc Addr:	0 2
EtherCAT Addr:	1001  Advanced Settings
Identification Value:	0
Previous Port:	Master ~
Advanced Settings	×
General	Hex Editor
Timeout Settings Identification	0000 80 0E 44 EE 10 00 00 00 00 00 00 00 00 00 00 CB 00D
FMMU / SM	0020 00 00 00 00 00 00 00 00 00 00 00 00
Init Commands ⊕- Mailbox	0040 00 00 00 00 00 00 00 00 00 00 00 00
Distributed Clock	060 00 00 00 00 00 00 00 00 00 00 00 00
ESC Access	0070 00 00 00 00 00 00 00 00 00 00 00 00
E <sup>2</sup> PROM	0090 FF
- Enhanced Link De	00A0 FF
Smart View	00C0 FF
- Hex Editor	00E0 FF
Memory	OOFO FE FF
4	
4	
	5
	Download Read from File
	Upload Write to File
< >	opicad write to rite 6

#### Figure 6.1: EEPROM update

**Option A** - Create ESI binary file from ESI XML and download.



- 1. SSC Tool  $\rightarrow$  [Tool]  $\rightarrow$  [EEPROM Programmer].
- 2. [FILE]  $\rightarrow$  [OPEN]  $\rightarrow$ Browse and select the ESI file.
- 3. [FILE]  $\rightarrow$  [Save AS]  $\rightarrow$  Select type as binary.
- 4. A binary file will be generated in the specified folder.
- 5. [Read from File] Select the ESI binary file  $\rightarrow$  [Download].
- 6. Confirm the write status using [Upload] option.

After the data is replaced, restart the RZ/N2L (by turning it off and on, or resetting it) so that the new data is applied to the microcomputer. Execute [Restart TwinCAT System].



## 6.3 CiA402 Drive Profile check

In this chapter, check the operation of the CiA402 drive profile.

#### 6.3.1 Rescanning the Device

- 1. Press the [Restart TwinCAT (Config Mode)] button.
- 2. In the [Restart TwinCAT System in Config Mode] dialog box, click on [OK].
- 3. In the [Load I/O Devices] dialog box, click on [Yes].
- In the [Active Free Run] dialog box, click on [Yes]. This will be OK if "Box 1" in the System Manager tree has turned to "Box 1 (RZ/N2 EtherCAT CiA402)".

Note). When scanning the device, the CiA402's ESI is used, so the axis configuration settings are displayed. Select [NC-Configuration]

EtherCAT drive(s) added		×
Append linked axis to:	NC - Configuration     CNC - Configuration	OK Cancel

#### 6.3.2 Checking the Operation Mode

- (1) If double-click on [Box 1] in the System Manager tree, panel will be displayed on the right side of the screen.
- (2) Select the [Online] tab and check that "Current Status" has turned to "OP".
- (3) In the System Manager tree, expand + on the left side of "Box 1".

#### 6.3.3 CiA402 State Transition

To check the operation in csp and csv modes, the state must be changed to "Operation Enabled" in both modes.

Change the state by setting a value in the "Control Word" object and check the state by confirming the value of the "Status Word" object.

(1) Select "Inputs" → "Status Word" in the Solution Explorer tree and then select the [Flags] tab on the right-side panel. value will then be displayed.

Change the display mode from [Dec] to [Hex]

Solution Explorer 🔹 🖣 🗙	TwinCAT Project4 😕 🗙
· ○ ○ 🏠 🛱 -   <sup>*</sup> ⊙ - ₱   🖋 🗕	Variable Flags Online
Search Solution Explorer (Ctrl+:)	
🚔 Image	Display Scaling: (none) ~
<ul> <li>Image-Info</li> <li>SyncUnits</li> <li>Inputs</li> <li>Outputs</li> <li>InfoData</li> </ul>	Display Mode: Dec Vec Fault Correction Method: Hex Both
<ul> <li>Renesas EtherCAT RZ/T2 CiA402 2port)</li> <li>Rodule 1 (csp - axis)</li> <li>Inputs</li> </ul>	
≥ = Inputs ≥ Error Code	
<ul> <li>Status Word</li> <li>ActualPosition</li> </ul>	



	X TwinCAT Project4 🕫 X
🛱 •   <sup>7</sup> © • @   🗲 💻	Variable Flags Online
ion Explorer (Ctrl+:)	) -
/0	Value: 0
E Devices	New Value: Eorce Release Write
🗮 Device 5 (EtherCAT)	New Value: Force Release Write
茸 Image	Comment: object 0x6040:0
茸 Image-Info	
SyncUnits	Set Value Dialog X
Inputs	Dec: 128 OK
Outputs	
InfoData	Hex: 0x0080 Cancel
<ul> <li>Renesas EtherCAT RZ/T2 CiA402 2port)</li> </ul>	Float
<ul> <li>Module 1 (csp - axis)</li> </ul>	
A 🛄 Inputs	
👻 Error Code 👻 Status Word	Bool: 0 1 HexEdit 0-
ActualPosition	Binary: 80 00 2
<ul> <li>Actual Position</li> <li>Actual Velocity</li> </ul>	Bit Size: 01 08 16 032 64 0?
<ul> <li>Actual Velocity</li> <li>Actual Torque</li> </ul>	
Touch Probe Status	
Touch Probe Position 1 Positive Value	
Touch Probe Position 2 Positive Value	Error List
😕 Following Error Actual Value	Entire Solution - 😵 0 Errors 🔥 0 Warnings 🚺 0 Messages   Clear   B
🔁 Digital Inputs	
	<sup>14</sup> Description
Control Word	
Max Torque	

(2) Check the operation of the profile. Initialize the control word by setting it to 128 (Dec).

(3) Select "Outputs" → "Control Word" in the System Manager tree and then select the [Online] tab on the right-side panel. value will then be displayed.

Click on [Write] and set values from [7] to [15] in that order.

} 🗄 -   ™ - ₩ 💻	Variable Flags	Online
		on the
1/0	Value:	7
<ul> <li>Devices</li> <li>Device 5 (EtherCAT)</li> <li>Image</li> </ul>	New Value:	Force Release Write
<ul> <li>Image-Info</li> <li>SyncUnits</li> </ul>	Comment:	Set Value Dialog ×
Inputs		Dec: 15 OK
Outputs     InfoData		Hex: 🗡 Dx000F Cancel
<ul> <li>InfoData</li> <li>Rox 1 (Renesas EtherCAT RZ/T2 CiA402 2port)</li> <li>Rodule 1 (csp - axis)</li> </ul>		Float
Inputs		Bool: 0 1 Hex Edit
<ul> <li>Error Code</li> <li>Status Word</li> </ul>		
<ul> <li>Status word</li> <li>ActualPosition</li> </ul>		
<ul> <li>Actual Velocity</li> </ul>		Bit Size: 01 08
<ul> <li>Actual Torque</li> <li>Touch Probe Status</li> <li>Touch Probe Position 1 Positive Value</li> </ul>		
Touch Probe Position 2 Positive Value	Error List	
🔁 Following Error Actual Value	Entire Solution	🗸 😣 0 Errors 🔒 🔥 0 Warnings 🚺 0 Messages 🛛 Clear
Digital Inputs	" Descrip	
Control Word		
Max Torque		



(4) Select "Inputs" → "Status Word" in the System Manager tree and then select the [Online] tab on the right-side panel. value will then be displayed.

If the value is [0x1237], the state is "Operation Enabled". Proceed to the next step. If the value is [0x1208], the state is "Fault" for some reason. Set "Control Word" to [128] once and return to step (1).

Explorer	<b>∓ ∓ ×</b> • ۹	Variable Flags Online
<ul> <li>I/O</li> <li><sup>™</sup> Devices</li> <li><sup>™</sup> Device 5 (EtherCAT)</li> <li><sup>™</sup> Image</li> </ul>	*	Value: 0x1237 New Value: Force Release Write
<ul> <li>Image-Info</li> <li>SyncUnits</li> <li>Inputs</li> <li>Outputs</li> <li>InfoData</li> <li>Box 1 (Renesas EtherCAT RZ/T2 CiA402 2port)</li> <li>CiA402 2port)</li> </ul>		object 0x6041:0
<ul> <li>Inputs</li> <li>Error Code</li> <li>Status Word</li> <li>ActualPosition</li> <li>Actual Velocity</li> </ul>		
<ul> <li>Actual Torque</li> <li>Touch Probe Status</li> <li>Touch Probe Position 1 Positive Valu</li> <li>Touch Probe Position 2 Positive Valu</li> </ul>		Error List



#### 6.3.4 csp Mode

Check that "Module 1" is displayed as "Module 1 (csp-axis)".

 Select "Outputs" → "Target Position" in the System Manager tree and then select the [Online] tab on the right-side panel. A value will then be displayed.

Click on [Write] and set a desired value. As an example, set [100000] here.

Solution Explorer
Solution Explorer Search Solution Explorer (Ctrl+:) MOTION PLC SAFETY C++ Device 4 (EtherCAT) Image Info Solution Solution Device 4 (EtherCAT) Image Info Solution Device 4 (EtherCAT) Image Image Info Solution Solution Device 4 (EtherCAT) Image Image Info Solution Device 4 (EtherCAT) Image Image Info Solution Sol

(2) Select "Inputs" → "Actual Position" in the System Manager tree and then select the [Online] tab on the right-side panel. A value will then be displayed.





#### 6.3.5 csv Mode

Г

Change the operation mode

- (1) In the System Manager tree, select "Box 1 (RZ/N2 EtherCAT CiA402)" and then select the [Slots] tab on the right-side panel.
- (2) If select "Axis 1" under "Slot" in the left frame of the tabbed page, modules which can be added will be displayed in the right frame of the page, so add "csv-axis".

G	ieneral	EtherCAT	DC	Process Data	Slots	Startup	CoE - Onl	ine Online			
	Slot				Modu	le	3	Module	Moduleld	Description	
		Axis 0			csp - a	axis	<	Csv,csp - axis	0x00119800	dynamic switchbewteen csp	
1		Axis 1						Csp - axis		Axis only supports csp	
							x	💦 csv - axis	0x00319800	Axis only supports csv	2
							<i></i>				

- (3) Check that "Module 2 (csv-axis)" has been added in the System Manager tree.
- (4) Execute "Reload Devices" to reflect the configuration.
- (5) Follow the procedure described in section 4.7 to change the state to "Operation Enabled".
- (6) Select "Outputs" → "Target Velocity" in the System Manager tree and then select the [Online] tab on the right-side panel. A value will then be displayed.
   Click on [Write] and set a desired value. As an example, set [100000] here.

) 🕜   ĩo - 🖻   🖊 🗕	Variable Flags Online
Solution Explorer (Ctrl+:)	₽ - 2           Value:         100000
AMOTION	New Value: Force Release Write
<ul> <li>SAFETY</li> <li>Subject C++</li> <li>I/O</li> </ul>	Comment: object 0x60FF:0
▲ <sup>de</sup> <sub>La</sub> Devices ▲ ➡ Device 3 (EtherCAT)	3
tage ↓ Image-Info	Set Value Dialog X
<ul> <li></li></ul>	Dec: 100000 OK
<ul> <li>InfoData</li> <li>Renesas EtherCAT RZ/T2 CiA402 2port)</li> </ul>	Hex: 0x000186A0 Cancel
<ul> <li>Module 1 (csp - axis)</li> <li>Module 2 (csv - axis)</li> </ul>	Pioat [.401/2362e40
✓ Inputs ✓ Error Code ✓ Status Word	Boot         0         1         Hex Edit           Binary:         A0 86 01 00         4         4
🔁 ActualPosition 🔁 Actual Velocity	Bit Size: 01 08 016 0 32 64 0?
<ul> <li>Actual Torque</li> <li>Touch Probe Status</li> </ul>	
10 Touch Probe Position 1 Positive Value 12 Touch Probe Position 2 Positive Value 13 Digital Inputs	
▲ Gutyuts Control Word	
➡ Max Torque ➡ Velocity Offset	
Torque Offset	Error List
Positive Torque Limit Value Vegative Torque Limit Value Populative Torque Limit Value	▼     ♥ 0 Errors     .1 0 Warnings     ● 0 Messages     Clear       Description     F. Line
1 Target Velocity	



(7) Select "Inputs" → "Actual Velocity" in the System Manager tree and then select the [Online] tab on the right-side panel. A value will then be displayed.

Check that the value set in "Target Velocity" allows incrementation up to [100000].





## 7. CiA402 Drive Profile

The CiA402 drive profile is a device profile for driving motors and motion control and mainly defines functional operations for servo drives, sine-wave inverters and stepping motor controllers. In this profile, the multiple operation modes and corresponding parameters are defined as an object dictionary. Also, Finite State Automaton (FSA) to define the internal and external behavior in every state is included. When changing the state, the result after transition is reflected in the status word object that shows the current state by specifying the state through the control word object. The control word and various command values (such as speed) are assigned to TxPDO, and the status word and various real values (such as position) are assigned to TxPDO. Please see the contents of the CiA402 standard for more details.



Figure 7-1 CiA402 Communication Flow

## 7.1 **Operation Modes**

In the application note, the following modes are supported from among the operation modes defined in the CiA402 standard.

Operation Mode	Support
Profile position mode	No
Velocity mode (frequency converter)	No
Profile velocity mode	No
Profile torque mode	No
Homing mode	No
Interpolated position mode	No
Cyclic synchronous position mode	Yes
Cyclic synchronous velocity mode	Yes
Cyclic synchronous torque mode	No
Cyclic synchronous torque mode with commutation angle	No
Manufacturer specific mode	No

Table 7-1 List of Supported Operation Modes



## 7.2 State Transition

In this application note, the following is supported as FSA defined in the CiA402 standard.



Figure 7-2 CiA402 State Transition Diagram

## 7.3 **Object Dictionary**

The following is the list of the object dictionaries supported in this application note.

Table 7-2	List of Supported Object Dictionaries	3
-----------	---------------------------------------	---

Operation Mode	OBJECT Name	INDEX	Category	Access	Data Type	PDO Mapping
	Position actual value	0x6064	Mandatory	ro	INT32	Yes
	Following error window	0x6065	Optional	rw	UINT32	No
	Velocity actual value	0x606C	Conditional	ro	INT32	Yes
	Max torque	0x6072	Optional	rw	UINT16	Yes
	Torque actual value	0x6077	Conditional	ro	INT16	Yes
Cyclic synchronous position mode	Target position	0x607A	Optional	rw	INT32	Yes
+ Overlie over shore over	Software position limit	0x607D	Optional	c,rw	INT32	No
Cyclic synchronous velocity mode	Position offset	0x60B0	Optional	rw	INT32	Yes
	Velocity offset	0x60B1	Optional	rw	INT32	Yes
	Torque offset	0x60B2	Optional	rw	INT16	Yes
	Following error actual value	0x60F4	Optional	ro	INT32	Yes
	Target velocity	0x60FF	Conditional	rw	INT32	Yes



## RZ/N2L Group RZ/N2L Industrial Network SOM Kit Application Note: EtherCAT CiA402 Slave Software

Function Group	OBJECT Name	INDEX	Category	Access	Data Type	PDO Mapping
Torgue Limiting	Positive torque limit value	0x60E0	Conditional	rw	UINT16	Yes
	Negative torque limit value	0x60E1	Conditional	rw	UINT16	Yes
Homing	Home Offset	0x607C	Optional	rw	INT32	No
Homing	Homing speeds	0x6099	Conditional	c,rw	UINT32	No
	Touch probe function	0x60B8	Optional	rw	UINT16	Yes
Touch Probe	Touch probe status	0x60B9	Optional	ro	UINT16	Yes
TOUCHFIDDE	Touch probe pos 1 pos value	0x60BA	Optional	ro	INT32	Yes
	Touch probe pos 2 pos value	0x60BC	Optional	ro	INT32	Yes
Gear ratio	Gear ratio	0x6091	Optional	c,rw	UINT32	No
Other object	OBJECT Name	INDEX	Category	Access	Data Type	PDO Mapping
	Error code	0x603F	Optional	ro	UINT16	Yes
	Controlword	0x6040	Mandatory	rw	UINT16	Yes
	Statusword	0x6041	Mandatory	ro	UINT16	Yes
	Quick stop option code	0x605A	Optional	rw	INT16	No
	Shutdown option code	0x605B	Optional	rw	INT16	No
Controlling the power drive system	Disable operation option code	0x605C	Optional	rw	INT16	No
unve system	Halt option code	0x605D	Optional	rw	INT16	No
	Fault reaction option code	0x605E	Optional	rw	INT16	No
	Modes of operation	0x6060	Optional	rw	INT8	Yes
	Modes of operation disp	0x6061	Optional	ro	INT8	Yes
	Supported drive modes	0x6502	Mandatory	ro	INT32	No
General object	Motor type	0x6402	Optional	rw	INT16	No
	Position demand value	0x6062	Optional	ro	INT32	No
Position control function	Position actual internal value	0x6063	Optional	ro	INT32	No
	Position window	0x6067	Optional	rw	UINT32	No
Optional application	Digital inputs	0x60FD	Optional	ro	UINT32	Yes
FE	Digital outputs	0x60FE	Optional	c,rw	UINT32	No,Yes



## 7.4 Implementing the Motor Control Program

According to the CiA402 standard from the list of CiA402 protocol stack I/F functions in Table 7-3, implement the motor control application. Each function links the number of each state transition of CiA402 FSA shown in Figure 7-2 and the corresponding function is called in case of state transition. In each function, describe the processing that calls the motor control program or the relevant processing of the main CPU.

CiA402 State	eTransition1					
	Description					
[	This function is used when state transition 1 has occurred.					
	Describe the operation in the case of the state transition.					
	Usage					
	#include "cia402appl.h"					
I F	Parameters TCiA402Axis *pCiA402Axis					
	Return Value					
	0 Normal end					
	1 Error					
	Remark Remark					
	In the case of error occurrence during processing, exit the function by setting					
	the appropriate values for each object in accordance with the CiA402 standard.					
	If 1 is set to return value, state transition does not occur.					
CiA402_State	eTransition2					
	Description					
	This function is used when state transition 2 has occurred.					
	Describe the operation in the case of the state transition.					
	Usage					
	#include "cia402appl.h"					
	Parameters					
	TCiA402Axis *pCiA402Axis					
	Return Value					
	0 Normal end					
	1 Error					
	Remark					
	In the case of error occurrence during processing, exit the function by setting					
	the appropriate values for each object in accordance with the CiA402 standard.					
	If 1 is set to return value, state transition does not occur.					

Table 7-3 List of CiA402 Protocol Stack I/F Functions



CiA402_Sta	ateTransition3
_	Description
	This function is used when state transition 3 has occurred.
	Describe the operation in the case of the state transition.
	Usage
	#include "cia402appl.h"
	Parameters
	TCiA402Axis *pCiA402Axis
	Return Value
	0 Normal end
	1 Error
	Remark
	In the case of error occurrence during processing, exit the function by setting
	the appropriate values for each object in accordance with the CiA402 standard.
	If 1 is set to return value, state transition does not occur.
CiA 402 St	ateTransition4
CIA+02_51	
	Description This function is used when state transition 4 has occurred.
	Describe the operation in the case of the state transition.
	Usage
	#include "cia402appl.h"
	Parameters
	TCiA402Axis *pCiA402Axis
	Return Value
	0 Normal end
	1 Error
	Remark
	In the case of error occurrence during processing, exit the function by setting
	the appropriate values for each object in accordance with the CiA402 standard.
	If 1 is set to return value, state transition does not occur.
CiA402 Sta	ateTransition5
_	Description
	This function is used when state transition 5 has occurred.
	Describe the operation in the case of the state transition.
	Describe the operation in the case of the state transition.
	Usage
	#include "cia402appl.h"
	Parameters
	TCiA402Axis *pCiA402Axis
	Return Value
	0 Normal end
	· · · · · · · · · · · · · · · · · · ·
	1 Error
	Remark
	In the case of error occurrence during processing, exit the function by setting
	the appropriate values for each object in accordance with the CiA402 standard.
	If 1 is set to return value, state transition does not occur.



CiA402_St	ateTransition6
	Description
	This function is used when state transition 6 has occurred.
	Describe the operation in the case of the state transition.
	1
	Usage
	#include "cia402appl.h"
	Parameters
	TCiA402Axis *pCiA402Axis
	Return Value
	0 Normal end
	1 Error
	Remark
	In the case of error occurrence during processing, exit the function by setting
	the appropriate values for each object in accordance with the CiA402 standard.
	If 1 is set to return value, state transition does not occur.
CiA402 St	ateTransition7
	Description
	This function is used when state transition 7 has occurred.
	Describe the operation in the case of the state transition.
	Usage
	#include "cia402appl.h"
	Parameters
	TCiA402Axis *pCiA402Axis
	Return Value
	0 Normal end
	1 Error
	Remark
	In the case of error occurrence during processing, exit the function by setting
	the appropriate values for each object in accordance with the CiA402 standard.
	If 1 is set to return value, state transition does not occur.
CiA402 St	ateTransition8
	Description
	This function is used when state transition 8 has occurred.
	Describe the operation in the case of the state transition.
	Describe the operation in the case of the state transition.
	Usage
	#include "cia402appl.h"
	Parameters
	TCiA402Axis *pCiA402Axis
	Return Value
	0 Normal end
	1 Error
	Remark
	In the case of error occurrence during processing, exit the function by setting
	the appropriate values for each object in accordance with the CiA402 standard.
	If 1 is set to return value, state transition does not occur.
	If 1 is set to return value, state transition does not occur.



CiA402_Sta	teTransition9
	Description
	This function is used when state transition 9 has occurred.
	Describe the operation in the case of the state transition.
	Usage
	#include "cia402appl.h"
	Parameters
	TCiA402Axis *pCiA402Axis
	Return Value
	0 Normal end
	1 Error
	Remark
	In the case of error occurrence during processing, exit the function by setting
	the appropriate values for each object in accordance with the CiA402 standard.
C: 1 102 Sta	If 1 is set to return value, state transition does not occur. teTransition10
CIA402_Sta	Description
	This function is used when state transition 10 has occurred.
	Describe the operation in the case of the state transition.
	Usage
	#include "cia402appl.h"
	Parameters
	TCiA402Axis *pCiA402Axis
	Return Value
	0 Normal end
	1 Error
	Remark
	In the case of error occurrence during processing, exit the function by setting
	the appropriate values for each object in accordance with the CiA402 standard.
	If 1 is set to return value, state transition does not occur.
CiA402 Sta	teTransition11
_	Description
	This function is used when state transition 11 has occurred.
	Describe the operation in the case of the state transition.
	Usage
	#include "cia402appl.h"
	Parameters
	TCiA402Axis *pCiA402Axis
	Return Value
	0 Normal end
	1 Error
	Remark
	In the case of error occurrence during processing, exit the function by setting
	the appropriate values for each object in accordance with the CiA 402 standard.
	If 1 is set to return value, state transition does not occur.



CiA402 Sta	ateTransition12
	Description
	This function is used when state transition 12 has occurred.
	Describe the operation in the case of the state transition.
	Describe the operation in the case of the state transition.
	Usage
	#include "cia402appl.h"
	Parameters
	TCiA402Axis *pCiA402Axis
	Return Value
	0 Normal end
	1 Error
	Remark
	In the case of error occurrence during processing, exit the function by setting
	the appropriate values for each object in accordance with the CiA402 standard.
	If 1 is set to return value, state transition does not occur.
CiA402_Lo	
	Description
	This function is used when state transition 13 has occurred.
	-
	Describe the operation in the case of the state transition.
	Usage
	#include "cia402appl.h"
	Parameters
	UINT16 ErrorCode
	Return Value
	None
	Remark
	If the error corresponding to state transition 13 occurs,
	call this function after processing required and saving data at error location.
CiA402 Sta	ateTransition14
_	Description
	This function is used when state transition 14 has occurred.
	Describe the operation in the case of the state transition.
	Describe the operation in the case of the state transition.
	Usage
	#include "cia402appl.h"
	Parameters
	TCiA402Axis *pCiA402Axis
	Return Value
	0 Normal end
	• • • • • • • • • • • • • • • • • • • •
	1 Error
	Remark
	In the case of error occurrence during processing, exit the function by setting
	the appropriate values for each object in accordance with the CiA402 standard.
	If 1 is set to return value, state transition does not occur.



CiA402_Sta	teTransition15
_	Description
	This function is used when state transition 15 has occurred.
	Describe the operation in the case of the state transition.
	Usage
	#include "cia402app1.h"
	Parameters
	TCiA402Axis *pCiA402Axis
	Return Value
	0 Normal end
	1 Error
	Remark
	In the case of error occurrence during processing, exit the function by setting
	the appropriate values for each object in accordance with the CiA402 standard.
	If 1 is set to return value, state transition does not occur.
CiA402_Sta	teTransition16
_	Description
	This function is used when state transition 16 has occurred.
	Describe the operation in the case of the state transition.
	Describe the operation in the case of the state transition.
	Usage
	#include "cia402app1.h"
	Parameters
	TCiA402Axis *pCiA402Axis
	Return Value
	0 Normal end
	1 Error
	Remark
	In the case of error occurrence during processing, exit the function by setting
	the appropriate values for each object in accordance with the CiA402 standard.
	If 1 is set to return value, state transition does not occur.
APPL MO	FOR MotionControl Main
-	Description
	Implement the motion control code when the state of CiA402 FSA is
	"Operation enabled". Describe the process for each mode of operation.
	Usage
	#include "cia402app1.h"
	Parameters
	TCiA402Axis *pCiA402Axis
	Return Value
	0 Normal end
	1 Error
	Remark
	At the initial state, this function is described in "main.c" and
	calls "CiA402_DummyMotionControl" function for reference.



## 8. Appendix: FSP Configuration for VSC8531

RZ/N2L Industrial Network SOM Kit has VSC8531 as PHY chip. If reconfiguring by latest FSP, FSP configuration and source code needs to change from default.

(1) Regenerate source files by lates FSP

Remove the following four folders. After that, open the project according to section 5.

- When using e2studio, \project\rzn2l\_som\ecat\_CiA402\e2studio
- When using EWARM, \project\rzn2I\_som\ecat\_CiA402\ewarm



Figure 8-1 Remove folder generated by FSP

(2) Change ethernet driver configuration for VSC8531

Configure g\_ether\_phy0 Ethernet Driver on r\_ether\_phy for VSC8531 as shown in Figure 8-2. Configuration value for VSC8531 shows in Table 8-1.



Figure 8-2 Ethernet Driver Configuration for VSC8531 (e.g. ETH0)

Table 8-1 FSP Configuration	Value for VSC8531
-----------------------------	-------------------

Items	Default value	Config value for VSC8531	
		ETH0	ETH1
PHY-LSI Address	0	0	1
Select PHY	Default	VSC8541	VSC8541



(3) Add initialization code for VSC8531

The following code for VSC8531 initialization should be added to "ether\_phy\_targets\_initialize\_vsc8541" function in rzn/fsp/src/r\_ether\_phy/r\_ether\_phy.c.

The inclusion of "board\_som.h" is also required for code activation.

#include "board\_som.h" ~~ Omission ~~ void ether\_phy\_targets\_initialize\_vsc8541 (ether\_phy\_instance\_ctrl\_t \* p\_instance\_ctrl) { ~~ Omission ~~ /\* LED Behavior \*/ reg = ether\_phy\_read(p\_instance\_ctrl, ETHER\_PHY\_REG\_LED\_BEHAVIOR); reg &= ~(1U << ETHER\_PHY\_REG\_LED0\_FEATURE\_DISABLE\_OFFSET);</pre> reg |= 1U << ETHER\_PHY\_REG\_LED1\_FEATURE\_DISABLE\_OFFSET;</pre> ether\_phy\_write(p\_instance\_ctrl, ETHER\_PHY\_REG\_LED\_BEHAVIOR, reg); #if defined(BOARD\_RZN2L\_SOM\_KIT) /\* for VSC8531 \* /\* select extended page 2 register \*/ ether\_phy\_write(p\_instance\_ctrl, ETHER\_PHY\_REG\_EXTEND\_GPI0\_PAGE, 0x02); /\* read WoL and MAC Interface Control \*/ reg = ether\_phy\_read(p\_instance\_ctrl, 0x1b); /\* set control to slow \*/ reg &= 0xFF9F; ether\_phy\_write(p\_instance\_ctrl, 0x1b, reg); /\* Configure RX\_CLK delay and TX\_CLK delay to 2.0ns \*/ ether\_phy\_write(p\_instance\_ctrl, ETHER\_PHY\_REG\_EXPAGE2\_RGMII\_CTRL, 0x0044); /\* select extended page 0 register \*/ ether\_phy\_write(p\_instance\_ctrl, ETHER\_PHY\_REG\_EXTEND\_GPI0\_PAGE, 0x00); #endif } /\* End of function ether\_phy\_targets\_initialize() \*/



## **Revision History**

			Description	
Rev.	Date	Page	Summary	
1.00	Feb 6, 2023	-	First edition issued	
1.10	Aug 7.2023	-	Support RZ/N2L FSP v1.2.0	



# General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

#### 1. Precaution against Electrostatic Discharge (ESD)

A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.

2. Processing at power-on

The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power is supplied until the power reaches the level at which reseting is specified.

3. Input of signal during power-off state

Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.

4. Handling of unused pins

Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.

5. Clock signals

After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.

#### 6. Voltage application waveform at input pin Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V<sub>IL</sub> (Max.) and V<sub>IH</sub> (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V<sub>IL</sub> (Max.) and V<sub>IH</sub> (Min.).

7. Prohibition of access to reserved addresses

Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.

8. Differences between products

Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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