

# R-IN32M3 Module (RY9012A0)

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Industrial Ethernet Module Solution

# Outline

This document describes the start-up procedure of R-IN32M3 Module starter kit that includes the R-IN32M3 Module. The R-IN32M3 Module starter kit with the application controller Synergy<sup>™</sup> S7G2 development environment, SK-S7G2, takes care of the complex handling of several industrial Ethernet protocols (such as PROFINET, EtherNet/IP<sup>™</sup> and EtherCAT<sup>®</sup>). Example software of the SK-S7G2 is provided as source code and can thus be ported to other development platforms such as for RX MCUs. Accordingly, this R-IN32M3 Module starter kit allows the quick development of software prototypes of the industrial network communications and applications.

The software package that comes with the R-IN32M3 Module starter kit includes not only an integrated software development environment and example software but includes a Management Tool (Industrial Communication Explorer) from the company "port industrial automation GmbH") which has the protocol master function of PROFINET, EtherNet/IP and EtherCAT and can configure and monitor the R-IN32M3 Module.

The R-IN32M3 Module starter kit enables the user

- to quickly become familiar with the industrial Ethernet protocols (such as PROFINET, EtherNet/IP or EtherCAT) by use of the example applications; and
- to quickly develop applications on the industry-standard arm microcontroller of the Renesas Synergy SK-S7G2 starter kit.



## 1. R-IN32M3 Module Starter Kit

## **1.1 System Requirements**

The R-IN32M3 Module starter kit requires the following environment for the evaluation.

- Renesas Synergy SK-S7G2 starter kit rev. 3.3 or a later version
- PC
  - OS: Windows<sup>®</sup> 7/8/10
  - Memory: At least 8 GB
  - LAN ports
  - USB 2.0 ports



## 1.2 Hardware Configuration

## 1.2.1 Configuration of Adaptor board with R-IN32M3 module

The R-IN32M3 Module starter kit includes the Adaptor board with R-IN32M3 module for evaluation environment, which contains the R-IN32M3 Module. This board has Arduino<sup>™</sup> connectors and Pmod<sup>™</sup> connectors according to industry standards and enables the connection with the application controller.

The Pmod connector is mounted on the top side of this board. The male Arduino connectors are on the back side of the module board to be plugged into the sockets of the Synergy S7G2 starter kit. To connect and apply control from the SK-S7G2, the J13, J8, and J7 jumper blocks must be set as follows.

- J13: Connect the Socket pin with the iRJ45 pin
- J8: For the CS signal, select PB2
- J7: For the RST signal, select PD7

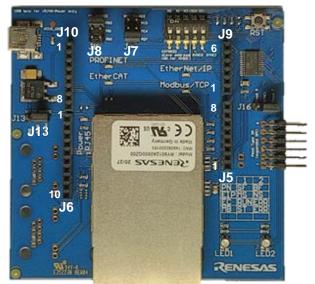


Figure 1.1 Adaptor board with R-IN32M3 module

This board has status LEDs conforming to the industrial Ethernet protocol. The lighting patterns of status LEDs differ with the communications standard.

Some examples of protocol state indicators were listed in the following table.

#### Table 1.1 Status LEDs

Industrial Ethernet	State LED1		State LED2	
Standard		Colour		Colour
PROFINET <sup>Note1</sup>	System failure	Red	Bus failure	Red
EtherNet/IP <sup>Note2</sup>	Module (MS)	Green/ Red	Network (NS)	Green/ Red
EtherCAT <sup>Note3</sup>	ESM (RUN)	Green	Error (ERR)	Red



Note1 PROFINET Diagnosis Guideline V1.4 Chapter 6.7

Note2 The CIP Networks Library Volume 2: EtherNet/IP Adaptation of CIP

Note 3 EtherCAT Indicator and Labeling ETG.1300S(R) Vx.x.x

## **1.2.2** Configuration for Using the Pmod Interfaces

The Synergy SK-S7G2 has two Pmod ports. If you will be using a Pmod interface, connect jumper J13 or J15 on the Synergy board to supply 3.3V power supply to the Pmod channel of choice of the R-IN32M3 Module.

For booting, follow the instructions in the Synergy Board Quick Start Guide Manual. Voltage supply for the Synergy SK-S7G2 is through the micro USB debug connector on the Synergy SK-S7G2. When connecting the Adaptor board with R-IN32M3 module in either mode, this board gets its power through the connectors. All operations for programming and debugging of the Synergy S7G2 are supported by this USB connection.

Note. EtherCAT function is not available for Pmod interfaces because two SYNC signals are required.

#### 1.2.3 Configuration for Using the ARDUINO Interface

The R-IN32M3 Module board and the Synergy SK-S7G2 must be plugged together by using the Arduino connection of the boards.

Voltage supply for the Synergy SK-S7G2 is through the micro USB debug connector on the Synergy SK-S7G2. When connecting the Adaptor board with R-IN32M3 module in either mode, this board gets its power through the connectors. All operations for programming and debugging of the Synergy S7G2 are supported by this USB connection.

Note. When using EtherCAT DC mode, the SYNC0 and SYNC1 signals must be assigned to the host CPU interrupt port. When combining with Synergy SK-S7G2, short the 3pin and 6pin and 4pin and 7pin of J10 on the R-IN32M3 Module board.



#### **1.3 Software Requirements**

#### 1.3.1 Integrated Software Development Environment "Renesas Synergy"

The environment for developing software for the Synergy SK-S7G2, which acts as the application controller, requires the following elements.

- Renesas e2-studio version 7.5.1 or later
- Renesas Synergy software package (SSP) version 1.7.8 or later

The e2-studio is an integrated software development environment (ISDE). The ISDE is available on the webpage of Renesas as seen in the quick start guide of the MCU board. A free Synergy license is required to use the SSP. The evaluation license is included with SSP installer, that can be downloaded after creating a Synergy account.

#### 1.3.2 GOAL and Project Files

Unpack the GOAL headers and library to a local folder. This folder contains the GOAL library and the associated headers for the Synergy required to build an application for the R-IN32M3 Module. In addition, example projects for each protocol are included to be processed via e2-studio.

The GOAL is part of the OSAL interface (API) which is used on the embedded MCU of the R-IN32M3 Module and on the application controller (AC) to control the module. In this configuration with the Renesas Synergy board and the Adaptor board with R-IN32M3 module, the S7G2 MCU on the Renesas Synergy board acts as the AC. For details, refer to the r17us0001ed\*\*\*\* User's Manual for the Software API.

#### 1.3.3 Industrial Communication Explorer (Management tool) -

The management tool called Industrial Communication Explorer (hereinafter called Management tool) is software tool which simulates a PROFINET master, an EtherNet/IP scanner as well as an EtherCAT master on a Windows PC and is a product of Renesas' partner *port industrial automation GmbH*. (https://www.port.de/).

The Management Tool is available on R-IN32M3 Module product web.

Here are some major hints for the installation of the Management tool:

The zip file with the Management tool has to be unpacked to a local folder. The resulting folder contains the executable *ICE.exe*, which can be started without an installation.

The Management Tool requires the NPF (NetGroup/Npcap Packet Filter) driver, that is installed with WinPcap/Npcap. For details, see next chapter.

Additionally, the Management Tool requires certain settings in the Windows firewall to receive data. If some software (such as antivirus) restricts the firewall of the Network to communication with the R-IN32M3 Module, allow (open) the port limitation of the Management Tool.

Open [Allow an app through Windows Firewall] from windows search with search word "through Windows Firewall".

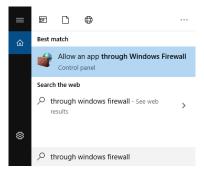


Figure 1.2 Search Windows Firewall



After the [Allowed apps] window is open, click on [Change settings] and then [Allow another app..].

- 🛧 🔐 « Windows Defender Firewal	L > Allowed apps	~ P1	Saarri	h Control Panel	
	i i moneu epps	+ 0	20010	1.50000011-0000	
A CONTRACTOR OF A CONTRACTOR OF A CONTRACTOR OF A CONTRACTOR A CONTRACTOR A CONTRACTOR A CONTRACTOR A CONTRACT	127 1222	11020	12		
low apps to communicate through			wall		
add, change, or remove allowed apps and p	orts, click Change sett	ings.			
hat are the risks of allowing an app to comm	unicate?		1	Change sett	ings
For your security, some settings are mana	ged by your system as	dministrato	He		
Allowed apps and features:					
Name	Domain	Private	Public	Group Policy	
				No	
				No	
x.	8	8	2	No	
2 e		2		No	
S	8			No	12
☑1 EXE		8	2	No	
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C - Pekid	2	8	2	No	
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Figure 1.3 Allowed Applications

Click [Browse...] and select the "ice.exe" from Industrial Communication Explorer folder. Then, click [Network types...], check all network types to be enabled ("Domain", "Private", and "Public"), and click [OK] and [Add].

Add an app	
Select the app you want to add, or click Browse to find one that is not listed, and then click OK.	Choose Network Types X
Apps: ice	Allow this app or port to communicate through Windows Firewall for the selected network type: Domain: Networks at a workplace that are attached to a domain Private: Networks at home or work where you know and trust the people and devices on the network
Path:       C:\[_R]45\[Management_Tool\[CommExplorer']       Browse         What are the risks of unblocking an app?         You can choose which network types to add this app to.	Public: Networks in public places such as airports or coffee shops
Network types Add Cancel	<u>O</u> K Cancel

Figure 1.4 Select Network Types



"ice.exe" is indicated in the list of allowed apps list. After that, click on [OK].

Allowed apps				- 0		×
	> Allowed		~ ē	Search Contr	ol	م
Allowed apps and features:						
Name	Domain	Private	Public	Group Policy	^	
Hyper-V Management Cl				No		
Hyper-V Replica HTTP				No		
Hyper-V Replica HTTPS				No		
IBM Rational Doors				Yes		
✓ ice		$\checkmark$	$\checkmark$	No		
✓ IECVarAccessBrowsingPr				No		
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			(	ОК	ance	el.

Figure 1.5 Allowed applications



#### 1.3.4 Setting the Host IP Address

This section describes device configuration, including the setting of an IP address for use in a network of devices.

Set the IP address before configuring the device. Open "Network Connection".

				Network Connections	-
View	network conne	ections		← → * ↑ 😰 « All C > N	etwork
Contro	l panel			Organize 👻	
				Ethernet Network cable unplugged Mintel(R) Ethernet Connecti	
				Ethernet 2 Unidentified network D-Link DUB-E100 USB2.0 t	o Fast E
F ()	ß []		n N	Wi-Fi Repeater-1	
etwork con	nections			Intel(R) Dual Band Wireles	-AC 82
				3 items	

Figure 1.6 View network connections

Double-click or right-click on the "Local Area Connection" icon. In the "Local Area Connection Status" window, select "Properties".

Ethernet 2 Status		×
eneral		
Connection IPv4 Connectivity:	No network access	-
IPv6 Connectivity: IPv6 Connectivity: Media State:	No network access Finabled	
Duration: Speed: Dgtails	03:14:49 100.0 Mbps	
Activity Sent	Received	-
Packets: 2.191	0	
Properties Disable	Diagnose	
	Close	

Figure 1.7 Network Status

In the "Local Area Connection Properties" window, highlight "Internet Protocol Version 4 (TCP/IPv4)" then click on the "Properties" button.



Select the radio button "Use the following IP Address" and set IP and subnet mask.

Internet Protocol Version 4 (TCP/IPv4	) Properties X											
General												
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.												
Obtain an IP address automatica	lly											
IP address:	192.168.0.1											
Subnet mask:	255.255.255.0											
Default gateway:	192.168.0.10											
Obtain DNS server address auto	matically											
• Use the following DNS server add	dresses:											
Preferred DNS server:												
Alternate DNS server:												
Ualidate settings upon exit	Ad <u>v</u> anced											
	OK Cancel											

Figure 1.8 TCP/IP configuration

Click on "OK" to finish the configuration.

#### 1.3.5 WinPcap

To use the functionality of the Management Tool, WinPcap needs to be installed. WinPcap can be found at <a href="https://www.winpcap.org">https://www.winpcap.org</a>

The Npcap also supports the Management Tool, if you have enabled "Winpcap API-compatible Mode" when installing Npcap. Npcap can be found at <a href="https://map.org/">https://map.org/</a>

#### 1.3.6 Wireshark

The Management Tool also offers a function to create a log file of all relevant parameters of the R-IN32M3 Module. For a more detailed protocol analysis, it is recommended to install the Wireshark tools. The Wireshark tools is freeware and can be downloaded at <u>https://www.wireshark.org.</u>



## 2. e2studio Project

#### 2.1 Installation

To use the sample projects with the e2studio, the e2studio and SSP must be installed.

# 2.2 Importing a Project

The example files provided by Renesas in the software for the R-IN32M3 Module starter kit can be imported into the e2-studio integrated system development environment (ISDE). In the [File] dropdown menu, use the [Import] dialog box of the e2studio to import the archive with its projects located in the unpacked project delivery into e2studio. Under [General], chose [Existing projects into workspace] when prompted for the import type. This will create new projects in the e2-studio.

🛃 Import —	
Select Create new projects from an archive file or directory.	Ľ
Select an import source:	
type filter text	
<ul> <li>✓ Events</li> <li>✓ Convert CCRX to GNURX Project</li> <li>✓ CMSIS Pack</li> <li>✓ Convert CCRX to GNURX Project</li> <li>✓ DS-5 KPIT GNUARM-RZ/NONE Project</li> <li>✓ Existing Projects into Workspace</li> <li>○ File System     <li>✓ HEW Project     <li>✓ Import KPIT GNUARM Project to GCC ARM Embedded</li> <li>□ Preferences     <li>✓ Renesas CA78KOR Project</li> <li>✓ Renesas Common Project File</li> <li>✓ C/C++</li> </li></li></li></ul>	
Image: Contract of the second seco	Cancel

Figure 2.1 e2studio Import Dialog

In the next step, the root directory of the existing archive has to be selected by using the [Browse...] button. To select the directory of the unpacked archive, make sure that all projects for importing are selected in the checkboxes, and finish importing by clicking on [Finish] as shown in the figure below. In this example, the unpacked archive files are located in the directory "C:\Renesas\\_exampleSW".



e <sup>2</sup> Import	- 0	×									
Import Projects Select a directory to sea	Select a directory to search for existing Eclipse projects.										
<ul> <li>Select root directory:</li> <li>Select archive file:</li> <li>Projects:</li> </ul>	Browse										
Image: Constraint of the system of the sy											
Options     Search for nested projects     Copy projects into workspace     Hide projects that already exist in the workspace											
Working sets	ing sets		~		₽ <b>₩</b> ect						
?	< <u>B</u> ack	<u>N</u> ext >	<u>F</u> inish	С	ancel						

Figure 2.2 e2-studio Import Project Dialog

#### 2.3 License Register

The license registration is required to use SSP. If e2-studio requests a license, register a license. The evaluation license is included in the SSP installer, that can be downloaded after creating a Synergy account.



Figure 2.3 License Request

#### 2.4 Generate Project Content

Open the "configuration.xml" file from the selected project by double clicking. The pin assignment, clock configuration, and device selection are already registered, and run [Generate Project Content].

Device Select	ion
SSP version:	
Board:	S7G2 SK
Device:	R7FS7G27H3A01CFC

Figure 2.4 Generate Project Content



# 2.5 **Project Configuration**

To use the project context menu, menu item "Build Project" to do so. As a result, binary files for the projects are generated. The "Console" log of e2-studio should look like as shown in the following screenshot.

```
🎦 Pin Conflicts 📃 Console 🔀 🛃 Debugger Console
CDT Build Console [01_pnio_simple_io]
Invoking: Cross ARM C Compiler
                                                                                                                              ^
'Invoking: Cross ARM C Compiler'
arm-none-eabi-gcc -mcpu=cortex-m4 -mthumb -mfloat-abi=hard -mfpu=fpv4-sp-d16 -00 -fmessage-leu
'Finished building: C:/Renesas/_example/goal/ext/base64/src/cencode.c'
arm-none-eabi-gcc -mcpu=cortex-m4 -mthumb -mfloat-abi=hard -mfpu=fpv4-sp-d16 -00 -fmessage-le
'Finished building: C:/Renesas/_example/goal/appl/2015013_irj45/rpc/irj45_rpc_ac.c'
'Finished building: C:/Renesas/_example/goal/appl/2015013_irj45/ac/01_pnio_simple_io/goal_app
'Finished building: C:/Renesas/_example/goal/appl/2015013_irj45/ac/01_pnio_simple_io/goal_app
'Building target: 01_pnio_simple_io.elf'
'Invoking: Cross ARM C Linker
arm-none-eabi-gcc @"01_pnio_simple_io.elf.in"
'Finished building target: 01_pnio_simple_io.elf'
'Invoking: Cross ARM GNU Create Flash Image'
arm-none-eabi-objcopy -O srec "01_pnio_simple_io.elf" "01_pnio_simple_io.srec"
'Invoking: Cross ARM GNU Print Size'
arm-none-eabi-size --format=berkeley "01_pnio_simple_io.elf"
text data bss dec hex filename
220908 3752 283176 507836 7bfbc 01_pnio_simple_io.elf
 'Finished building: 01_pnio_simple_io.srec
'Finished building: 01_pnio_simple_io.siz'
. .
10:10:23 Build Finished. 0 errors, 0 warnings. (took 40s.300ms)
```

Figure 2.5 Console Log "Build Finished"



## 2.6 **Project Debugging**

When the Build is finished without errors and warnings, the compilation is successful. The resulting binary files can be started now. Be sure that the Renesas Synergy board is connected to the workstation via USB. Then, select the [Debug As] option from the drop-down menu and choose the item [3 Renesas GDB Hardware Debugging] as shown in the figure below.

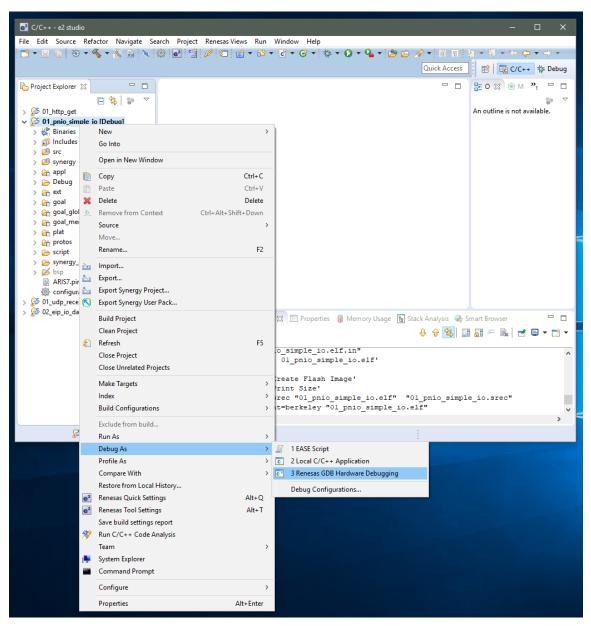


Figure 2.6 Initiate Debugging Session



In the next step, you will be prompted to select a debugging hardware. Choose "J-Link ARM" for the Renesas Synergy SK-S7G2 board. After selecting the debugging mode, it is necessary to select the chip model (R7FS7G27H).

🧧 Renesas Hardware Debugging 🛛 — 🔲 🗙	e <sup>2</sup> Renesas Hardware Debugging —	
Select Debug Hardware	No configuration exists. Please select target device:	
E1 (RX)	R7FSSD97C	^
E2 Lite (RX)	R7FS5D97E	
E20 (RX)	R7FS7G2	
EZ (RX)	R7FS7G27G	
J-Link ARM	R7FS7G27H	
Segger JLink (RX)	R7S721000	
	R7S721000_DualSPI R7S721001	
	R75721001 R75721001_DualSPI	
	R75721001_DualsP1	
	R7S721010_DualSPI	
	R7S721011	
	R7S721011_DualSPI	
	R7S721020	~
L		
OK Cancel	ОК	Cancel
UK Cancel	UK UK	Cancel

After initiating the debugging session, the "Debug perspective" is shown, where the application can be started by [Resuming] execution. This needs to be done twice since two breakpoints are automatically set at the start-up.

e²	Debug	- 01_pnio	_simple_io	_lib/synergy	/ssp/src/l	bsp/cmsis	/Device/RENESA	S/S7G	2/Source/s	tartup_S7	G2.c - e2 stu	dio			—		×
File	Edit	Source	Refactor	Navigate	Search	Project	Renesas Views	Run	Window	Help							
2	- 11		- 🔨 -	🐔 🗟 🔪	R 🕩 I	🔳 🕅	3 3 .e i		<b>ア 袋</b>	1	81 🎋 •	• •	• 💁 📲 🔊	😕 🔗 🔻	1		
2	• 🔁	- *= <	- + -> -	•	Res	ume (F8)	1						Quick Access	• I 🖻	EC/C++	参 D	ebug
			<b>F</b> :		0 - 0	و المرب ال	Teelher	-									

Figure 2.9 e2studio Toolbox



## 3. Industrial Communication Explorer (ICE)

The Management Tool -ICE- allows the development related configuration and management of the Renesas sample application. This tool is based on a UDP broadcast communication. Thus, it works independently from IP settings of the used PC and the R-IN32M3 Module.

Industrial Communication Explorer		– 🗆 X
File		
ଝ୍ଟ୍ର Network Navigator	🚾 PNIO Master 📋 Device Log 💥 ConfigMan 🥎 Firmware 🔤 EtherNet/I 😣 Exception 🤹 EtherCAT	Be Outline
	Update Settings	
Network Interfaces     D-Link DUB-E100 USB2.0 to Fast Ethernet Adap		
🕎 Intel(R) Dual Band Wireless-AC 8260 (0)	Firmware: Select FW bundle	
Juniper Networks Virtual Adapter (0) Snapshots	CC: Firmware Info: Config:	
shapshots	AC:	
	😪 Start update 🔹 Cancel update	
	(b) Messages	
	2020/09/21 07:57:48 Using JRE at C:\_RJ45\Management_Tool\iCommExplorer\jre	
	2020/09/21 07:57:48 JRE version: 11	

Figure 3.1 Industrial Communication Explorer (ICE)

This tool is organized in panels.

- The panel [Network Navigator] shows a list of available networks.
- The panel [Messages] shows the information regarding actions.
- The panel [Outline] shows the additional information relating to the selected function panel.

The following function panels are available.

Panel	Function
PNIO Master	Simple PROFINET IO master functionality
EtherNet/IP Master	Simple EtherNet/IP scanner functionality
EtherCAT Master	Simple EtherCAT master functionality
Config Manager	Access to the config manager variables
Firmware Update	Allows update the R-IN32M3 module firmware.
Device Log	Shows log messages under operation from both the
	R-IN32M3 Module and application controller.
Exception Log	Not in the scope of this manual



## 3.1 Device Detection

Connect the R-IN32M3 Module to the PC, and then execute the scan network.



Figure 3.2 Network Scan

To communicate with the R-IN32M3 Module, open the "Networks" list in [Network Navigator]. Then, chose the network interface where the R-IN32M3 Module is reachable. Select the [Scan Network] button in the toolbar.

The following dialog appears and 1 found device will be reported.

	$\times$
Scan network D-Link DUB-E100 USB2.0 to Fast Ethernet Adapter	
Running scan using local IP 192.168.0.1	
Scan complete. Found 1 device.	
OK Cancel	

Figure 3.3 Scan Network Dialog



As a result, the R-IN32M3 Module will be shown as a new device in [Network Navigator] within the scanned network.

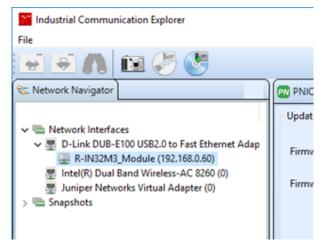


Figure 3.4 Detected R-IN32M3 Module



## 3.2 Config Manager / IP Configuration

This panel provides access to the config manager variables of the R-IN32M3 Module (volatile memory and non-volatile memory stored configuration variables).

To read a list of all variables, select the [Read configuration] button.



Figure 3.5 Read Configuration

As a result, all variables with a value are shown.

Industrial Communication Explorer									_		×
File											
💽 💌 🛝 🔝 🥐 😍											
85- Network Navigator	🔊 PNIO Master 📋	Device Log 🔀 ConfigMan 🤶	🖢 Firmware 🛛 💷 Eth	nerNet/I	🚷 Exce	eption	. 🤨	EtherCAT	🗄 Outli		
🗸 🔄 Network Interfaces	Module	Variable	Action	Туре	Temp	Read		Value ^	> = 6	GOAL_ID_I GOAL_ID_I GOAL_ID_I	ССМ
<ul> <li></li></ul>	GOAL_ID_BOOT	SIGNATURE		Generic	X	X	X	0xcb02ff6	> = 0	GOAL_ID_S	SNMP
🚆 Intel(R) Dual Band Wireless-AC 8260 (0)	GOAL_ID_BOOT	BLVERSION		String	Х	Х	X	1.4.0.0		GOAL_ID_I	
Juniper Networks Virtual Adapter (0) Snapshots	GOAL_ID_BOOT	FWVERSION		String	Х	Х	Х	1.2.0.35		GOAL_ID_I	
	GOAL_ID_BOOT	RESET_CAUSE		uint8	Х	х	Х	0x00		GOAL_ID_	
	GOAL_ID_BOOT	IMAGE_NUMBER		uint8	х	х	Х	0x01	> 🗧 GOAI		QUEUE
	GOAL_ID_BOOT	IMAGE_COUNTER		uint8	х	Х	Х	0xfb	> GOAL_ID_NE		
	GOAL_ID_CCM	SPI_TYPE		uint8		Х	х	0x01		LM	
	GOAL_ID_CCM	SPI_MODE		uint8		х	Х	0x00			
	GOAL_ID_CCM	SPI_SPEED		uint32		х	х	0x000000C			
	GOAL_ID_CCM	SPI_UNITWIDTH		uint8		Х	Х	0x00			
٢								>			
	Export Config	Import Config	🖄 Save config to fla	sh							
	▲ Messages										
	2020/09/21 07:57:48 Using JRE at C:\_RJ45\Management_Tool\iCommExplorer\jre							^			
	<ul> <li>2020/09/21 07:</li> <li>2020/09/21 08:</li> </ul>		LICP2 O to East Etht	Adapter	ing lace	م الم	102.16	9.0.1			
		12:20 Scanned D-Link DUB-E100	USB2.0 to Fast Ethernet	Adapter us	ing iocal	addres	5 192.10	6.0.1.			~

Figure 3.6 Configuration Manager

To communicate with the R-IN32M3 Module, the IP address of the R-IN32M3 Module must be within the same IP network as the IP address of the used PC. Thus, chose a valid IP address and configure the R-IN32M3 Module accordingly.



To configure an IP address, navigate to the variables of the "Module" GOAL\_ID\_NET. There it is possible to configure IP, NETMASK, and GW. Modify required values. Make sure the variable "VALID" is set to 1.

Variables modified by the user will be highlighted in yellow.

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육. Network Navigator	🔊 PNIO Master 📋	] Device Log 🔀 ConfigMana	🍫 Firmware Up 🧧	EtherNet/	/IP (	3 Except	otion Lo	g 🔹 EtherCAT I	Ma	🗄 Outline	
✓	Module	Variable	Action	Туре	Temp	Read	Write	Value	^	> GOAL_ID_BOOT	
✓	GOAL_ID_ETH	SPEED		uint32	х	x	х	0x00000019		> 🗧 GOAL_ID_DD	
R-IN32M3_Module (192.168.0.60) Intel(R) Dual Band Wireless-AC 8260	GOAL_ID_ETH	DUPLEX		uint32	х	Х	Х	b0000000x0		> GOAL_ID_SNMP > GOAL_ID_PNIO	
👮 Juniper Networks Virtual Adapter (0	GOAL_ID_ETH	PORTCNT		uint32	х	x	х	0x0000002		> GOAL_ID_HTTP	
> 📹 Snapsnots	GOAL ID NET IP IPv4 X X 192.168.0.61										
GOALJD_NET NETMASK IPv4 X X 255.255.05 → GOAL							> 🗧 GOAL_ID_QUEUI	E			
	GOAL_ID_NET	GW		IPv4		х	х	0.0.0.0		> GOAL_ID_ETH	
	GOAL_ID_NET	VALID		uint8		x	х	0x01		> 🗧 GOAL_ID_LM	
	GOAL_ID_NET	DHCP_ENABLED		uint8		Х	х	0x00			
	GOAL_ID_NET	DHCP_STATE		uint8	х	Х	х	0x00			
	GOAL_ID_NET	DNS0		IPv4		Х	Х	0.0.0.0			
Export Config     Import Config     Save config to flash											
	2020/09/21 07:57:48         Using JRE at C:\L_RU5\Management_Tool\iCommExplorer\jre           2020/09/21 07:57:48         JRE version: 11							^			
< >>	2020/09/21 08	:12:20 Scanned D-Link DUB-E100	USB2.0 to Fast Etherne	t Adapter us	sing local	addres	s 192.16	8.0.1.			

Figure 3.7 Modified Variables

Those modified variables are downloaded to the R-IN32M3 Module using the [Write configuration] button in the toolbar.

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िः. Network Navigator					

Figure 3.8 Write Configuration

When the confirmation window for changes is displayed, click "Yes". Afterwards the locally modified values are transferred to the R-IN32M3 Module, where there are only modified in RAM. Press the [Save config to flash] button to change the value of Flash installed in the R-IN32M3 Module. The changed IP settings will be applied after a reboot (Restarting Synergy board and R-IN32M3 Module).



## 3.3 Updating the R-IN32M3 Module Firmware

Under control of the Management Tool, the firmware of the R-IN32M3 Module can be updated. The firmware file will be sent to the R-IN32M3 Module via the Ethernet connection.

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සු Network Navigator	🙉 PNIO Master 📋 Device Log 💥 ConfigMana 🔗 Firmware Up 💯 EtherNet/IP 😣 Exception Log 🤹 EtherCAT Ma	🗄 Outline	
<ul> <li>✓ ■ Network Interfaces</li> <li>✓ ■ D-Link DUB-E100 USB2.0 to Fast Eth</li></ul>	Update Settings Firmware: C(\LR45\Firmware\irj45_1.2.0.35_ci1243.pfw Select FW bundle CC: Version 1.2.0-35 Firmware Info: Config: AC: @ Start update Device R-IN32M3_Module (192.168.0.61, 74:90:50:20:03:C9) Phase: Progress: Progress:		
	\delta Messages		
	2020/09/21 07:57:48 Using JRE at C:\L_RJ45\Management_Tool\iCommExplorer\jre		^
	a 2020/09/21 07:57:48 JRE version: 11		
< >	2020/09/21 08:12:20 Scanned D-Link DUB-E100 USB2.0 to Fast Ethernet Adapter using local address 192.168.0.1.		

Figure 3.9 R-IN32M3 Module Firmware Update

To check the current firmware version, select [ConfigureManager] function panel and then the [Read configuration] button (**Figure 3.5**). The value of "FWVERSION" indicates the firmware version.

Í	🔊 PNIO Master 📔	] Device Log 🔀 ConfigManager	🍫 Firmware Update	EIP EtherN	let/IP Ma	aster (	3 Except	otion Log 🔹 EtherCAT Ma
	Module	Variable	Action	Туре	Temp	Read	Write	Value
	GOAL_ID_BOOT	SIGNATURE		Generic	х	х	х	0x8caeb044924e08016cb05
	GOAL_ID_BOOT	BLVERSION		String	х	х	х	1.3.0.0
	GOAL_ID_BOOT	FWVERSION		String	Х	Х	х	2.0.0.0
	GOAL_ID_BOOT	RESET_CAUSE		uinte	×	X	X	Eirmware V
	GOAL_ID_BOOT	IMAGE_NUMBER		uint8	x	x	x	0x01
	GOAL_ID_BOOT	IMAGE_COUNTER		uint8	х	Х	х	0xea

Figure 3.10 R-IN32M3 Module Firmware version



## 4. Sample Software

## 4.1 **PROFINET** Sample Application (01\_pnio\_io\_mirror)

Start the example "01\_pnio\_io\_mirror" according to the previous description.

To establish a PROFINET communication, select the R-IN32M3 Module in [Network Navigator]. Then, select the [PNIO Master] function panel. Use [Scan device] to detect the PROFINET device.

When the "Wink" button is pressed, the detected "LED1" on the R-IN32M3 Module flashes.

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<ul> <li>Network Navigator</li> <li>Network Interfaces</li> <li>P-Link DUB-E100 USB2.0 to Fast Eth</li> <li>R-IN32M3_Module (192.168.0.61)</li> <li>Intel(R) Dual Band Wireless - AC 826C</li> <li>Juniper Networks Virtual Adapter (0</li> <li>Snapshots</li> </ul>		<u>B</u> ≝ Outline	
	Messages		
	2020/09/21 07:57:48 Using JRE at C:\I_RJ45\Management_Tool\iCommExplorer\jre		^
	2020/09/21 07:57:48 JRE version: 11		_
< >	2020/09/21 08:12:20 Scanned D-Link DUB-E100 USB2.0 to Fast Ethernet Adapter using local address 192.168.0.1.		~

Figure 4.1 PROFINET Master

To establish a cyclic PROFINET communication, select the I/O panel of the PNIO Master.

To continue, load the GSDML file provided with the sample application.

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Image: Network Navigator       Image: PNIO Master       Device Log & ConfigMana        Firm         Image: Point Network Interfaces       Image: Point Network Inter	Nware Up   EtherNet/IP  Exception Log  EtherCAT Ma  Load GSDML file  Modules:  Modules:					
a 2020/09/21 07:57:48 JRE version: 11	iii 2020/09/21 07:57:48 JRE version: 11					

Figure 4.2 PNIO Master



After that, press the [Connect] button. This button starts cyclic PROFINET communications. The example application on the application controller will mirror the output data to the input data. The I/O data can be manipulated and monitored in the I/O data table. Furthermore, once a connection is established, LED1 on the Adaptor board with R-IN32M3 module will be illuminated. Process data can be monitored and manipulated using the [IO Data] panel.

✓ O Signed8     0 /128       Output 64 bytes     Integer8       ✓ I Signed16     128/0       Input 64 bytes     Integer16	Module/Submodule	Data Type	PS/CS	Input Data	Output Data
Input 64 bytes     Integer8     0x00       V O Signed8     0 /128     0       V O Signed8     0 /128     0x00       Output 64 bytes     Integer8     0x00       V I Signed16     128/0     0x00       Input 64 bytes     Integer16     0xcafe       V O Signed16     0     128	✓ I Signed8				
<ul> <li>✓ O Signed8</li> <li>✓ O Signed8</li> <li>Ø /128</li> <li>Ø 0 0 000</li> <li>✓ I Signed16</li> <li>✓ I Signed16</li> <li>✓ I Signed16</li> <li>Ø 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</li></ul>	✓ I Signed8		128/0		
Output 64 bytes     Integer8     0x00       V I Signed16     128/0     1       Input 64 bytes     Integer16     0xcafe       V O Signed16     0 /128     1	Input 64 bytes	Integer8		0x00	
Output 64 bytes     Integer8     0x00       V I Signed16     128/0     1       Input 64 bytes     Integer16     0xcafe       V O Signed16     0 /128     1	✓ O Signed8				
<ul> <li>✓ I Signed16</li> <li>✓ I Signed16</li> <li>Input 64 bytes</li> <li>✓ O Signed16</li> <li>✓ O Signed16</li> <li>✓ O Signed16</li> <li>✓ O Signed16</li> <li>Ø /128</li> </ul>	<ul> <li>O Signed8</li> </ul>		0 /128		
✓ I Signed16         128/0           Input 64 bytes         Integer16         0xcafe           ✓ O Signed16         0 /128         0	Output 64 bytes	Integer8			0x00
Input 64 bytes Integer16 0xcafe V O Signed16 V O Signed16 0 /128	✓ I Signed16				
<ul> <li>✓ O Signed16</li> <li>✓ O Signed16</li> <li>Ø /128</li> </ul>	✓ I Signed16		128/0		
✓ O Signed16 0 /128	Input 64 bytes	Integer16		0xcafe	
	✓ O Signed16				
Output 64 bytes Integer16 0xcafe	<ul> <li>O Signed16</li> </ul>		0 /128		
	Output 64 bytes	Integer16			0xcafe

Figure 4.3 IO Data Panel



## 4.2 EtherNet/IP Sample Application (06\_eip\_io\_data\_static)

Start the example "06\_eip\_io\_data\_static " according to the previous description.

Make IP settings to establish EtherNet / IP communication with the device. You can verify the current settings using the Management tool.

Then, select the [EtherNet/IP Master] function panel. Use [Scan device] to detect the EtherNet/IP device.

Networks Network eth4 (1)  Network eth13 (0)  Network eth13 (0)  Snapshots Snapshots  Oevice Data  Encapsulation protocol version: 1 AF_INET Port: 44818 IP Address: 192.168.0.10 Vendor ID: 1105 Device Type: Generic Device Product Code: 768 Revision: 1.1 Status: Status: Status: Status: Minor Unrecoverable Fault Status: Serial Number: Product Name: Revised State: Unused	원급. Network Navigator	🔊 PNIO Master 📋 Device Log 💥	ConfigManager 🔌 Firmware Update 💯 EtherNet/IP Master
Find product of the second	✓ 🕎 Network eth4 (1)	Scan device	
Adress Familiy: AF_INET Port: 44818 IP Address: 192.168.0.10 Vendor ID: 1105 Device Type: Generic Device Product Code: 768 Revision: 1.1 X Owned Vendor X Owned Vendor X Minor Recoverable Fault X Minor Unrecoverable Fault X Major Recoverable Fault X Major Recoverable Fault X Major Recoverable Fault X Major Unrecoverable Fault	Network eth13 (0)		
Port: 44818 IP Address: 192.168.0.10 Vendor ID: 1105 Device Type: Generic Device Product Code: 768 Revision: 1.1 Xunor Qurecoverable Fault Xunor Recoverable Fault Xunor Unrecoverable Fault Xunor Unreco	> 🖷 Snapshots		
IP Address:       192.168.0.10         Vendor ID:       1105         Device Type:       Generic Device         Product Code:       768         Revision:       1.1         Xumper Address:       Configured         Xumper Address:       Xumper Address         Yumper Address:       Xumper Address         Yumper Address:       R-IN32M3_Module			
Vendor ID:       1105         Device Type:       Generic Device         Product Code:       768         Revision:       1.1         X       Owned         Vendor ID:       X         Minor Recoverable Fault       Minor Unrecoverable Fault         X       Major Unrecoverable Fault			
Perice Type:       Generic Device         Product Code:       768         Revision:       1.1         X Owned       Configured         X Minor Recoverable Fault       Minor Recoverable Fault         X Major Recoverable Fault       Major Unrecoverable Fault         X Major Unrecoverable Fault       Major Unrecoverable Fault         X Major Unrecoverable Fault       Rajor Unrecoverable Fault         Y Major Unrecoverable Fault       Rajor Unrecoverable Fault			
Product Code: 768 Revision: 1.1 X Owned Configured X Minor Recoverable Fault X Minor Unrecoverable Fault X Major Recoverable Fault X Major Unrecoverable Fault			
Revision:       1.1         Configured       Configured         Status:       Minor Recoverable Fault         Minor Unrecoverable Fault       Minor Unrecoverable Fault         Major Recoverable Fault       Major Unrecoverable Fault         Serial Number:       0x075BCD15         Product Name:       R-IN32M3_Module			
Status: Sta			
Configured  Configured  Status:  Configured  Minor Recoverable Fault  Minor Unrecoverable Fault  Major Recoverable Fault  Serial Number:  Ox075BCD15  Product Name:  R-IN32M3_Module		Revision:	1.1
Status: Minor Recoverable Fault Minor Unrecoverable Fault Major Recoverable Fault Major Unrecoverable Fault Serial Number: Product Name: R-IN32M3_Module			X Owned
Status: Minor Unrecoverable Fault Major Recoverable Fault Major Unrecoverable Fault Serial Number: Product Name: R-IN32M3_Module			✓ Configured
Minor Unrecoverable Fault     Major Recoverable Fault     Major Unrecoverable Fault     Major Unrecoverable Fault     Serial Number: 0x075BCD15     Product Name: R-IN32M3_Module		Status:	X Minor Recoverable Fault
K Major Unrecoverable Fault     Serial Number: 0x075BCD15     Product Name: R-IN32M3_Module			🗙 Minor Unrecoverable Fault
Serial Number: 0x075BCD15 Product Name: R-IN32M3_Module			💥 Major Recoverable Fault
Product Name: R-IN32M3_Module			💥 Major Unrecoverable Fault
		Serial Number:	0x075BCD15
State: Unused		Product Name:	R-IN32M3_Module
		State:	Unused

Figure 4.4 EtherNet/IP Scanner – Device Scan



To establish a cyclic EtherNet/IP communication, use the I/O panel of the EtherNet/IP scanner.

evice Commands																			
Connect																			
Connection Parameter	0->T					Con	nectio	n Paran	neter T-	>0									
Asssembly Instance ID	150					Asss	embly	Instand	e ID		100								
Assembly Data Size 32			Asssembly Data Size 32																
Run/IdleHeader							Run/l	ldleHea	der										
Packet interval in ms	10	10 Point to Point 🖌				Packet interval in ms Connection type		10 Multicast 🗸											
Connection type	Point to																		
Priority Urgent ~				Priority				Urgent ~											
Transport trigger	Cyclic	Ý																	
Timeout multiplier	2 ~																		
Config Assembly Para	meters																		
Config Assembly size	151																		
Config Assembly size 10																			
Config Assembly Data	00 00 00 00 00 00	00 00 00	00																
I/O Data O->T						1/01	Data T	->0											
00 00 00 00 00 00 00 00 00 00	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	0 00 00 0 0 00 00 0	0 00 00 00 0 00 00 00	00		00	00 0	0 00	00 0 00 0	0 00	00	- 00	00	00 0		0 00	00	00	~
																			4
Enable Run																			

Figure 4.5 EtherNet/IP Scanner Configuration

Press the [Connect] button. This button initiates a cyclic communication. Once the connection is established, both LED1 and LED2 on the Adaptor board with R-IN32M3 module will turn green. The application controller sample application mirrors the output data to the input data. Send / receive data can be operated / checked in the I / O data table.

The [I/O Data] tab is split into five different sections:

- **Connection Parameter O→T:** Scanner connection parameters Define the output assembly to connect to and define the parameters for that assembly.
- **Connection Parameter T→O:** Adapter connection parameters Define the input assembly to connect and define the parameters for that assembly
- **Config Assembly Parameters:** Parameters for the configuration assembly to use. Define parameters to be sent to the assembly for configuration
- I/O Data O→T: Data sent from the scanner to the adapter.
- **I/O Data T\rightarrowO:** Data received by the scanner from the adapter.

To close the connection, click [Disconnect].



## 4.3 EtherCAT Sample Application (09\_ecat\_slave)

To use this example, you need to update the firmware version of the R-IN32M3 Module to 2.0.0.0 or later. For the firmware update method, refer to **3.3**.

The EtherCAT simple Master provides a master implementation with the following functionality:

- test I/O data exchange with the device via EtherCAT.
- identify the device via the EtherCAT.
- read object dictionary values.
- adjust RxPDO and TxPDO mapping

Note that connection with multiple slaves is not supported.

When using the EtherCAT Simple Master, you need to set enable only "Internet Protocol Version 4 (TCP/IPv4)" on configuration of network connections. Recommend disable other drivers.

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Connect using:		
2 D-Link DUS-E	100 USB2.0 to Fast El	hemet Adapter
This connection user	the following terms	Qorfigure
		*
ō 🖣 🖬 👘		
	tocol Version 4 (TCP/I	
¢		>
lotal	Quinatal .	Properties
Description		
wide area network	rol Protocol/Internet P protocol that provides rconnected networks.	s communication
across diverse inte		

Figure 4.6 Properties of network connection



The EtherCAT master implementation always assumes, that the device is the first and only slave in the EtherCAT network. Working with more than one slave is currently not supported.

To work with the EtherCAT Master, the EtherCAT mode must be activated for the according network interface. To activate the mode, make right click on a network and click on "Enable EtherCAT" as shown in **Figure 4.7** below. This will launch the EtherCAT proxy program.

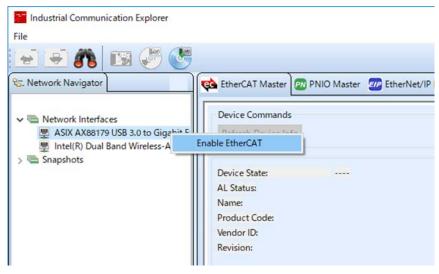


Figure 4.7 Enable EtherCAT connection



Network interfaces with the EtherCAT proxy program enabled are marked with a red font color.

In this state, you can search for EtherCAT slave devices on the network.

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5. Network Navigator	🤹 EtherCAT Mas	💯 PNIO Master 💯 EtherNet/IP M 📋 Device Log 💥 ConfigManager 🔩 Firmware Upd	Exception
✓ 🔄 Network Interfaces	Device Command	ls	
<ul> <li></li></ul>	Refresh Device I	nfo	
> Snapshots	Device State:	PREOP	
	AL Status:	No error (0x0)	
	Name:	Renesas Module	
	Product Code:	0x800	
	Vendor ID:	0x766	
	Revision:	0x1	
	And the second sec		
	Device Info Object	t Dictionary PDO Mapping I/O Data	

Figure 4.8 EtherCAT slave detect

The EtherCAT Master consists of 4 different tabs. Each function is explained below.

On the Device Info tab, you can get basic EtherCAT device information such as the device's EtherCAT State and product name.



The Object Dictionary tab allows you to read the object dictionary of your device.

5. Network Navigator	🔯 EtherCAT Mas 📴 PNIO Master 💯 EtherNet/IP M [	] Device L	og 💥 🤇	onfigMana	ger 🔧 Firmw	are Upd 🔞 E	xception Lo
Network Interfaces	Object Dictionary Commands						
🗸 🖳 ASIX AX88179 USB 3.0 to Gigabit Ethernet A	Read Object Dictionary Read value Read all object valu	es					
R-IN32M3_Module (192.168.0.100) Intel(R) Dual Band Wireless-AC 8260 #2 (0)	Object Dictionary						
n 🐚 Snapshots	Device Identity (Index 0x1000) Error Register (Index 0x1001) Manufacturer Device Name (Index 0x1008) Manufacturer Hardware Revision (Index 0x1009) Manufacturer Software Version (Index 0x1009) Seceive PDO Mapping Parameter 1 (Index 0x1600) Receive PDO Mapping Parameter 2 (Index 0x1601) Transmit PDO Mapping Parameter 2 (Index 0x1601) Transmit PDO Mapping Parameter 2 (Index 0x1600) Sync Manager Communication Type (Index 0x1c00) Sync Manager 2 PDO Assignment (Index 0x1c12) Sync Manager 3 PDO Assignment (Index 0x1c13)		Index Ox 1018	Subindex 0x0 0x1 0x2 0x3 0x4	Object Code RECORD	Data Type IDENTITY UNSIGNED8 UNSIGNED32 UNSIGNED32 UNSIGNED32 UNSIGNED32	Bit Lengt 136 8 32 32 32 32 32

Figure 4.9 EtherCAT object directory tab

Reading the object dictionary is split into phases:

- Read Object Dictionary
- : Read all the entered Object List.

- Read Value
- Read all object value
- : SDO access to selected Objects.
- : SDO access to all Objects.



The PDO Mapping tab allows to configure the mapping of the different PDOs.

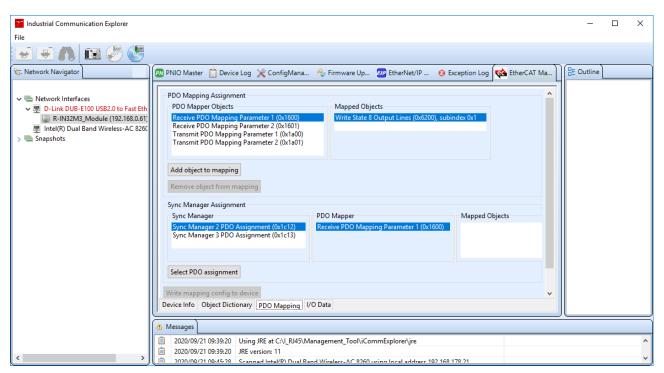


Figure 4.10 PDO mapping tab

Mappings can be assigned to the different mapping parameter objects via the "Add object to mapping" button. First select the PDO mapping object that shall be changed in the PDO Mapper Objects list and then click on the button. Mappings can be removed via the "Remove object from mapping" button.

Which mapping objects are assigned to RxPDO and TxPDOs can be selected via the "Select PDO assignment" button.

When the mapping is changed, the data is not written to the device immediately. Once the assigned mapping is changed as required, click on "Write mapping config to device". This triggers the update of the object dictionary within the device itself.



The use of the I / O Data tab allows to view process data.

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ස්ත්ර Network Navigator	🛛 💯 PNIO Master 📋 Device Log 💥 ConfigMana 😚 Firmware Up 🌌 EtherNet/IP 🥴 Exception Log 🔯 EtherCAT Ma 🛛 🗄 Outline
<ul> <li>Metwork Interfaces</li> <li>D-Link DUB-E100 USB2.0 to Fast Eth R-IN32M3_Module (192.168.0.61)</li> <li>R-IN32M3_Module (192.168.0.62)</li> <li>Snapshots</li> </ul>	Start process data exchange     Update RxPDO data       RX PDO     Write State 8 Output Lines, subindex 1       TX PDO       Read State 8 Input Lines, subindex 1
	Device Info Object Dictionary PDO Mapping I/O Data
	Messages
	2020/09/21 09:39:20 Using JRE at C:\_RV45\Management_Tool\iCommExplorer\jre
< >>	Image: Signal State State         JRE version: 11           Image: Signal State         State           Image: Signal State

Figure 4.11 I/O data tab

[I / O Data] tab

RX PDO: Data to send to the device

RXPDO: Data received from the device

The data exchange itself is started by clicking on "Start process data exchange". When changing the value of RXPDO while sending / receiving data, click [Update RxPDO data] after entering the value to update it.





Revision History		R-IN32M3 Module (RY9012A0) Quick Start Guide							
		Description							
Rev.	Date	Page	Summary						
1.00	Aug 03, 2020	-	First Edition issued						
2.00	Nov 06, 2020	4	Optimized Chapter 1.2.2						
		1, 5,15-20	Update to Industrial Communication Explorer						
		21-24	Optimized Chapter 4						
		1,3,25-30	Additional chapter for EtherCAT						
2.01	Dec 10, 2020	8-9	Add Chapter 1.3.4						
2.02	Jan 15, 2021	25	Add version and update method of FW						
		25	Add recommendation about properties of PC network connection						
2.03	Jan 29, 2021	5	Updated Synergy Software Package (SSP) version						
		20	Added how to check FW version						



#### 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 is supplied until the power reaches the level at which resetting 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  $V_{IL}$  (Max.) and  $V_{IH}$  (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  $V_{IL}$  (Max.) and  $V_{IH}$  (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

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