

RX72M Group

Application Note

R01AN4778EJ0100 Rev.1.00 Aug. 2, 2019

Introduction

This is a quick start guide to running OPC UA (Micro / Nano) Server communications on the RX72M communications board for evaluating industrial networks.

Target Device

RX72M Group

Sample Program

This sample program uses the evaluation version of the OPC UA stack produced by one of our partners, Another-ware Corporation. The stack's major communications specifications are as follows.

- Communications protocol: Compliant with OPC UA Specifications Release 1.03
- Transfer protocol : UA-Binary
- Security policy : None

For purchase of the official version of the stack and the specifications of the sample program, contact Another-ware Corporation.

Another Ware Co., Ltd.: https://www.another-ware.co.jp/

[Restrictions]

The evaluation version of the OPC UA stack consists of library files which were built with the functional limitations as listed below. This version is only made available for purposes of evaluation.

• The evaluation stack automatically stops running after 90 minutes. Re-starting the program requires resetting the device.

Please note that the evaluation stack cannot be used in commercial products. Purchasing the official version of the OPC UA stack is required if it is to be used in a commercial product.



Contents

1. Op	perating Environment
2. Se	etting up and Connecting the Evaluation Board4
2.1 S	Setting up the Board
2.2 S	Selecting the Power Source
3. Ins	stalling the e ² studio6
	nstalling the CC-RX Compiler V3.01.00
	low to check the registered Compiler6
4. Co	onnections8
5. Im	porting a Sample Project to the e ² studio9
6. Pro	ogramming and Debugging10
7. Ap	opendix12
7.1 V	/erifying Operation of the Sample Program12
7.1.1	Configuration of Connections
7.1.2 I	Evaluation procedure
7.1.2.1	Connection with the Communication Board13
7.1.2.2	Setting up the IP address of PC 13
7.1.2.3	Starting OPC UA Client
7.1.2.4	Reading out the data and Writing data of OPC UA Server17
7.2 S	Setting IP address and port number19
7.3 In	nstalling OPC UA Client
7.3.1 I	Downloading of dataFEED OPC UA Client
7.3.2	Installing dataFEED OPC UA Client



1. Operating Environment

The sample program covered in this manual runs in the environment below.

Table 1.1 Operating Environment

Item	Description
Board	RX72M communications board
	TS-TCS07298 from Tessera Technology
CPU	RX CPU (RXv3)
Operating frequency	CPU clock (CPUCLK): 240 MHz
Operating voltage	3.3 V
Operating modes	Single chip mode
Device requirements	R5F572MNDDBD
	Code flash memory
	Capacity: 4 Mbytes
	ROM cache: 8 Kbytes
	Data flash memory
	Capacity: 32 Kbytes
	RAM/extended RAM
	Capacity: 512 Kbytes / 512 Kbytes
Communications protocol	OPC UA (UA-Binary)
Integrated development environment	e ² studio (V7.5.0 or later) with the CC-RX compiler (V3.01.00)
Emulator (ICE)	Renesas E2 Lite



2. Setting up and Connecting the Evaluation Board

For detailed information on the board, refer to the RX72M Group Communications Board Hardware Manual.

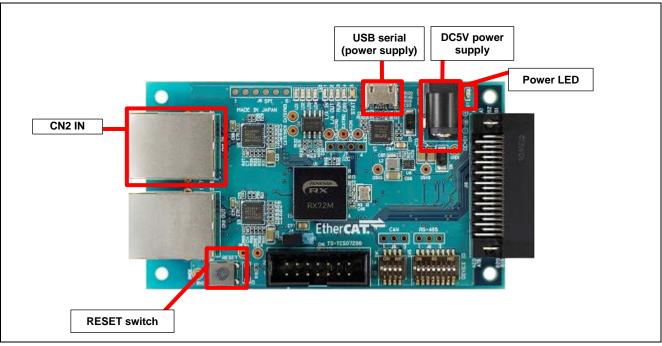


Figure 2.1 Configuration of the RX72M Communications Board



2.1 Setting up the Board

Before supplying power to the board, set up jumpers and connect the cables. In addition, make settings for the JTAG configuration mode. This mode is normally used with a short circuit between jumper pins 2 and 3.

For the detailed locations of the related parts, refer to the RX72M Communications Board Hardware Manual.

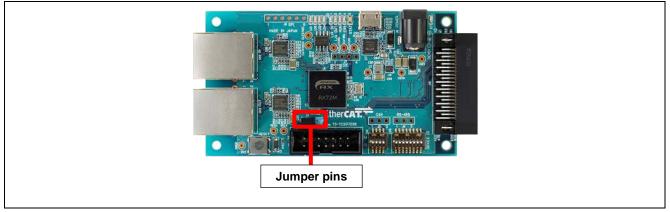


Figure 2.2 Setting up Jumper Pins

2.2 Selecting the Power Source

Power to the RX72M can be supplied from a 5-V DC power source or through the USB port. Use whichever is suitable for the configuration of your operating environment.



3. Installing the e² studio

Download the e² studio for RX72M (V7.5.0 or later) from the Web site below.

https://www.renesas.com/e2studio_download

3.1 Installing the CC-RX Compiler V3.01.00

The compiler selection dialog box appears while installing the e² studio. Click [Renesas CCRX v3.01.00] and select [Next]. CC-RX V3.01.00 Compiler for RX72M will be installed with the e² studio.

🙀 Renesas CC-RX Compilers		* ^
□ Renesas CCRX v3.00.00 v3.00.00 Renesas C/C++ Compiler Package f ダウンロード・サイズ: 22.5 MB Requires: • Renesas Tool License Manage ☑ Renesas CCRX v3.01.00 Renesas C/C++ Compiler Package f ダウンロード・サイズ: 21.4 MB Requires: • Renesas Tool License Manage	er - 2.2.1 for RX Family v3.01.00	
🙀 GCC for Renesas RX (Registration I	Required)	*
GCC for Renesas RX 4.8.4.201803 GCC for Renesas RX 4.8.4.201803 ダウンロード・サイズ: 72.8 MB	4.8.4.201803	
GCC for Renesas RX 4.8.4.201801	4.8.4.201801	

To start the e² studio, execute "e2studio.exe" in the following installation folder.

e2_studio_rx72m\eclipse

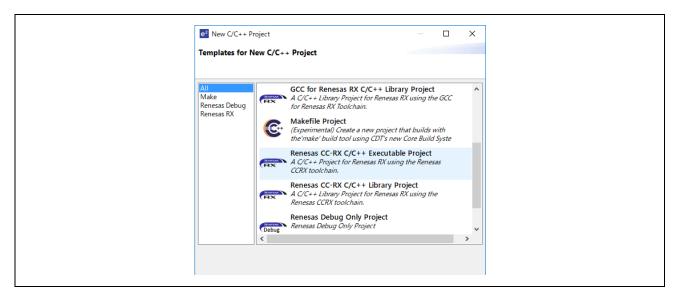
3.2 How to check the registered Compiler

- (1) Start the e² studio.
- (2) Select [File] \rightarrow [New] \rightarrow [C/C++Project] \rightarrow [Next].

e ² New Project	_	×
Select a wizard Create a new C or C++ project		Ź
Wizards: type filter text > General → C/C++ C/C++ Makefile Project with Existing Code > General → Java > General		



(3) In the [Templates for New C/C++ Project] dialog box, select [Renesas RX] → [Renesas CC-RX C/C++ Executable Project] → [Next].



- (4) In the [New Renesas CC-RX C/C++ Executable Project] dialog box, enter a desired project name and select [Next].
- (5) In the [Select toolchain, device & debug settings] dialog box, select [Manage Toolchains...] under [Toolchain Settings].
- (6) In the [Renesas Toolchain Management] dialog box, the registration was successful if "v3.01.00" has been added under "Renesas CCRX".

on startup	
ins are installed	
Installation Path	
C:¥Renesas¥RX¥3_1_0¥	
C:¥Program Files (x86)¥Renesas¥RX¥2_8_0¥	
ain	
	ins are installed Installation Path C:¥Renesas¥RX¥3_1_0¥ C:¥Program Files (x86)¥Renesas¥RX¥2_8_0¥



4. Connections

- (1) Connect the LAN cable to the "CN2 IN" side.
 - Refer to "7.1.1 Connection Configuration" for connection configuration.
- (2) Connect the E2 Emulator Lite to the JTAG connector on the communications board with the user interface cable.
- (3) Connect the E2 Emulator Lite to a USB port of the PC you are using. The "ACT" LED on the E2 Emulator Lite starts to blink.
- (4) The "Found new hardware" wizard appears. Follow the procedure described below to install the driver. Installation on a PC running Windows[™] 7, 8, or 8.1 requires logging in with a user name that has administrator rights.

Windows[™] 7/8/8.1: A notice appears on the Windows taskbar when the installation is finished.

Windows[™] 10: A button for device configuration appears on the Windows taskbar and installation is automatic.

(5) Supply power to the communications board from a 5-V DC power source or through the USB port.



5. Importing a Sample Project to the e² studio

(1) Extract the archived sample project and store it in any folder.

(2) Select [File] \rightarrow [Import].

(3) In the [Select] dialog box, select [General] → [Existing Projects into Workspace] and select [Next].

e² Import —	
Select Create new projects from an archive file or directory.	Ľ
Select an import wizard:	
type filter text	
 General Archive File Existing Projects into Workspace File System HEW Project Preferences Projects from Folder or Archive Rename & Import Existing C/C++ Project into Workspace Renesas CCRX project conversion to Renesas GCC RX Renesas CS+ Project for CA78K0R/CA78K0 Renesas CS+ Project for CC-RX and CC-RL C/C++ 	

- (4) In the [Import Projects] dialog box, check the "Select archive file:" button, then select [Browse...].
- (5) Select the "opcuaserver_RX72M" folder of the sample project stored in any folder in (1), and select [Open].

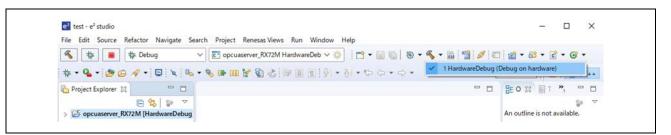
e ² Import	-		×
Import Projects Select a directory to search for existing Ecli	pse projects.		7
Select root directory:	¥opcuaserver_RX72M 🗸	B <u>r</u> owse	
O Select <u>a</u> rchive file: <u>P</u> rojects:	any folder	Browse	
opcuaserver_RX72M (¥opcuaserve	Select All	
		Deselect A	II
		Refresh	

Check "RX72M_DnetSlave(RX72M_DnetSlave/)" under the "Projects" label and select [Next]. The project will be imported into the workspace.



6. Programming and Debugging

(1) Select the "opcuaserver_RX72M" project in the Project Explorer view. Select the arrow next to the build button (hammer icon) and select [HardwareDebug] from the drop-down menu.



(2) e² studio will build the project. After the build is completed, select the arrow next to the debug button (bug icon). You can start debugging by selecting [Debug Configurations...].

e ² ws - e ² studio)		
File Edit Sour	ce Refactor N	Vavigat	te Se
%	📕 🐐 Debug		
🎄 🕶 🤷 🕶 🙋) 🗁 🛷 👻 🛯) (v	i 0,
(no launch	history)		
Debug As		>	$\overline{}$
Debug Con	figurations	:	oug]
Organize Fa	avorites		
			· · ·

(3) Select the file " opcuaserver_RX72M HardwareDebug" and download the program to the target device. Click on the [Debug] button to start debugging.

opcuaserver_RX72M Ha
O Enable auto build
O Disable auto build

(4) If a firewall warning is displayed for "e2-server-gdb.exe", check the checkbox for [Private networks, such as my home or work network] and select [Allow access].



- (5) The User Account Control (UAC) dialog box may appear. Enter the administrator's password and select [Yes].
- (6) If the Confirm Perspective Switch dialog box appears prompting you to switch the perspective, check the checkbox for [Remember my decision] and select [Yes].
- (7) The green "ACT" LED on the E2 Lite debugger will be continuously lit.

After downloading the code, select the [Resume] button to run the code. The code will break at the address where the main function starts. Select the [Resume] button again to continue to run the code.



7. Appendix

7.1 Verifying Operation of the Sample Program

Operation of the sample program can be verified as follows.

7.1.1 Configuration of Connections

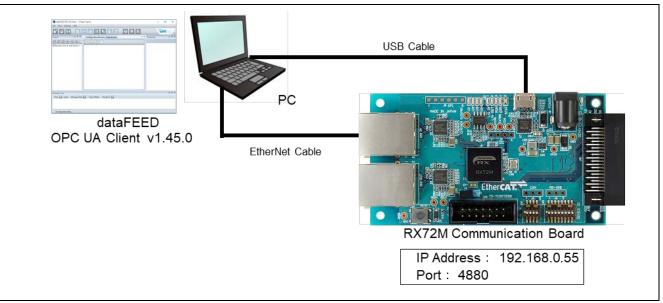


Figure 7.1 Configuration of Connections

Table 7.1 Lis	st of Devices
---------------	---------------

ltem	Description
OPC UA Server device	RX72M communications board (with this sample program already written to it)
	TS-TCS02796 from Tessera Technology
PC software	dataFEED OPC UA Client (Softing)



7.1.2 Evaluation procedure

7.1.2.1 Connection with the Communication Board

Connect the communication board and PC, [refer to 7.1.1 System Configuration] Power is supplied from communication board when PC and the USB serial of the communication board are connected.

7.1.2.2 Setting up the IP address of PC

(1) Set the IP address of PC. Open "Network Settings".



Windows10 : Control panel->Network and Sharing Center->Change adapter settings

(2) Select local area connection and select properties.

	🎴 ローカル エリア接続の	状態		×	
	全般				
	接続				
	IPv4 接続:		+	インターネット	
	IPv6 接続: メディアの状態:		ネットワー	-ク アクセスなし 有効	
	期間:			01:50:37	
	速度:			100.0 Mbps	
	[]][[]][[]][[]][[]][[]][[]][[]][[]][[]				L
	動作状況				
properties		送信 ——	. —	受信	L
	1771×	5,296,360		13,628,682	
	פּילט (P) 😵	無効にする(D)	診断(G)		L
				閉じる(C)]



(3) Select "Internet Protocol Version 4(TCP/IPv4) and click on the [Properties] button.

Internet Protocol Version 4(TCP/IPv4)	□ ーカル エリア接続のプロパティ ネットワーク 共有 接続の方法: ※ Realtek PCIe GBE Family Controller 構成(C) この接続は次の項目を使用します(0): ※ ● Microsoft ネットワーク用ファイルとプリンター共有 → TwinCAT Ethernet Protocol for All Network Adapters → インターネット プロトコル バージョン 6 (TCP/IPv6) ※ → インターネット プロトコル バージョン 4 (TCP/IPv4) → Link-Layer Topology Discovery Mapper I/O Driver
	 < □□ インストール(N)< 前序(U) プロパティ(R) 説明 伝送制御プロトコル/インターネット プロトコル。相互接続されたさまざまな ネットワーク間の通信を提供する、既定のワイド エリア ネットワーク プロトコ ルです。 OK キャンセル

(4) Select the IP address and subnet mask in the area indicated by the red frame in the figure below.

IP address setting example

: 192.168.0.xx : 255.255.255.0

Subnet mask setting example

と般	7/13根今付 TD 設定た白新的に取得することが7
まます。サポートされていない場合は、 てください。	ている場合は、IP 設定を自動的に取得することがで ネットワーク管理者に適切な IP 設定を問い合わせ
◎ IP アドレスを自動的に取得する	(0)
─◎ 〉次の IP アドレスを使う(S): ─	
IP アドレス(1):	· · ·
サブネット マスク(U):	
デフォルト ゲートウェイ(D):	· · ·
DNS サーバーのアドレスを自動	的に取得する(B)
● 次の DNS サーバーのアドレスを	使う(E):
優先 DNS サーバー(P):	
代替 DNS サーバー(A):	
■終了時に設定を検証する(L)	■詳細設定(V)

The setting up is complete.



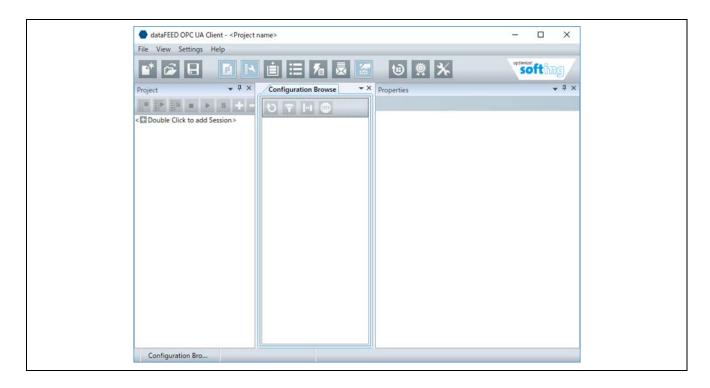
7.1.2.3 Starting OPC UA Client

(1) From the Windows start up menu, start up the dataFEED.



For information on install of dataFEED OPC UA Client refer to [Installation of 7.3 OPC UA Client].

(2) Click on the upper left, [Double click to added session].





(3) Session Connect screen is displayed, enter the following information and click on OK.

- Session Name : Any session name (ex : dataFEED OPC UA Client 1)
- Endpoint URL : Endpoint O URL (ex : opc.tcp://192.168.0.55:4880/Renesas/MicroUaServer)
- Security Mode: None
- Security Policy: None
- Message Encoding: Binary

Session Connect		×
Eliteration Eliteration Eliteration Eliteration	Session Properties	-
Remote Manual	Session Name:	dataFEED OPC UA Client 1
Recent	 Endpoint Informat Endpoint Url: 	opc.tcp://192.168.0.55:4880/Renesas/MicroUa
	Security Mode:	None *
	Security Policy:	None *
	Message Encoding:	Binary ~
	 Authentication Set 	tings
	User Identity:	Anonymous *
	User Name: Password:	
	Advanced Endpoir	t Information
	Application Name:	
	Application Type:	
	Application Uri: Product Uri:	
	Transport Profile Uri:	
	Server Capabilities:	
	Validate Connection	OK Cancel
L	(mode comection)	on pecareer

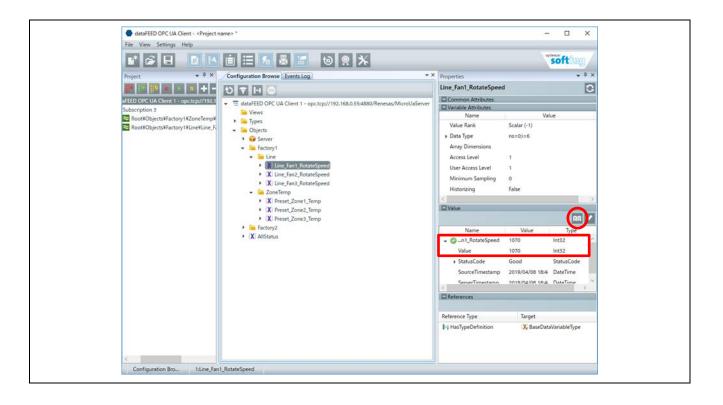
(3) Check whether the text at the bottom of the window has been [Active]. The connection with the OPC UA Server is complete.

File View Settings Help		
🖬 🕞 🖯 📘 🖪	: = 5 5 5 9 9 ×	softing
Project • # ×	Configuration Browse Events Log	• X Properties • 9
)		
dataFEED OPC UA Client 1 - opc.tcpi	🔹 🐨 dataFEED OPC UA Client 1 - opc.tcp://192.168.0.53/4880/Renesas/MicroUaServer	Session Properties
	ing Vens ▶ Griggen ▶ Colorado	Session Name: dataFEED DFC UAI Client 1 Session Idi Authenticidori Anzymous Imrecut (md) Locales Check Domain Check Domain Application Name MicroUsineer Endpoint Une Security Node: None Security Node: None Message Encoding: Binary
		D Authentication Settings
		User Identity: Anonymous
	Message Log	- 9
	Time 🖬 Level Message Tent 🖬 Tiace Masks Thread Id 🖬	
C	dataFEED OPC UA Client 1, Active	



7.1.2.4 Reading out the data and Writing data of OPC UA Server

- (1) Method of reading data
- ① Open the Configuration Browse tab and select the browse name of the data want to read. (ex.Line_Fan1_RotasSpeed)
- 2 The data sent from the OPC UA Server is displayed in the Value window at the lower right of the screen.
- ③ The data is updated each time you click on the notepad icon at the bottom right of the Value window.





(2) Method of writing data

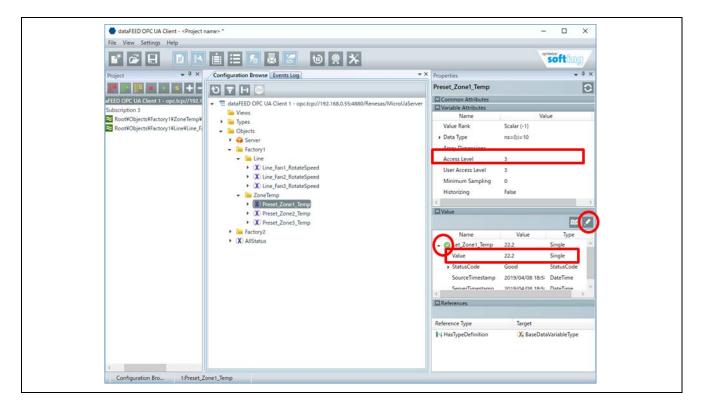
- ① Open the [Configuration Brows tab]and select the browse name. (ex.Preset_Zone1_Temp)
- 2 Check the [Access Level] displayed on Variable Attributes is [3].

[Access Level]

1 : only reading out / can be read out and written

(Change of Access Level can be configured by constructing the address area.)

- ③ It is written when pressing the Enter key or selecting the pencil mark at the upper right of the Value window.
- ④ Check that the value written in "Value" is displayed and *** is displayed.





7.2 Setting IP address and port number

To change the IP address and port number of the communication board, change [APPLICATION/AppServer/appserver_ip_address.h] in this sample proglam.

- If want to change the IP address.
- ① Enter the IP address in NETCONFIG_IP_ADDRESS as a string.
- 2 Enter the IP address in hexadecimal in NETCONFIG_IP_ADDRESS.

Ex.) If IP address is "192.168.0.32"

#define NETCONFIG_IP_ADDRESS "192.168.0.32" #define NETCONFIG_IP_ADDRESS_BIN 0xC0A80020

■ If want to change the Subnet Mask

① Enter Subnet Mask as a string in NETCONFIG_NET_MASK.

2 Enter Subnet Mask in hexadecimal in NETCONFIG_NET_MASK.

Ex.) If Subnet Mask is "255.255.255.0"

#define NETCONFIG_NETMASK	"255.255.255.0"
#define NETCONFIG_NETMASK_BIN	0xFFFFFF00

- If want to change the Port number
- ③ Enter the port number in decimal in NETCONFIG_PORT_NUMBER.

Ex.) If Port number is 4840

#define NETCONFIG_PORT_NUMBER 4840

23 /* 24 /* DEFINE		*/
25 //*===================================	~192.168.0.55~↔ 0xC0A80037	/* 192.168.0.55 */↔
28 C 29 #define NETCONFIG_NETMASK 30 #define NETCONFIG_NETMASK_BIN	"255.255.255.0" 0xFFFFFF00	/* Net Mask */↔ /* 255.255.0.0 */↔
31 [32 #define NETCONFIG_GATEWAY_BIN 33 년	0x0000000	/* 0.0.0.0 */↔
34 #define NETCONFIG_PORT_NUMBER 35 #define NEICONFIG MACADDRESS	4880 { Ux74, Ux90, Ux50	/* Port Number */↔ , UxUU, UxD9, UxA6 }↔
36 ↔ 37 #endif // APPSERVER_IPADDRESS_H_ ↔		



7.3 Installing OPC UA Client

7.3.1 Downloading of dataFEED OPC UA Client

You need to register an account when downloading dataFEED OPC UA Client of Softing. Register an account from the following URL and downloading.

Softing : <u>https://company.softing.com/en/startpage.html</u>

7.3.2 Installing dataFEED OPC UA Client

① Start the installer (InstallDataFFEDOpcUaClientxxx.exe), Clic on [Next>](xxx: Version)

dataFEED OPC UA Client 1.45	- InstallShield Wizard	×
softing	Welcome to the InstallShield Wizard for dataFEED OPC UA Client 1.45	
0 1 1 0 0 1 0 1 0 0 1 1 0 1 0 1 1 0 1 0 0 1 1 1 1 Industrial	The InstallShield(R) Wizard will allow you to modify, repair, or remove dataFEED OPC UA Client 1.45. To continue, dick Nex	vr xt.
	< Back Next > Cancel	

② Select [I accept the terms in the license agreement] and click on the [Nexst>] button.

corresponding program documentation. (Hereinafter referred to as "SOFTWARE".) SOFTING points out that it is not possible, at the state of the art, to produce computer programs with high complexity which work free of errors in all applications and combinations.	=	en you ("LICENSEE") and Softing Industrial ter program stored on a data carrier and the	LICENSE AGREEMENT FOR SOFTWARE PRODU 1 SUBJECT MATTER OF AGREEMENT SUBJECT MATTER OF AGREEMENT between Automation GmbH ("SOFTING") is the computer
2 PROPERTY RIGHTS, RIGHTS OF USE With the purchase of the product the LICENSEE acquires only property of the medium on which the SOFTWARE is stored. As soon as we have received the full payment of the invoice, SOFTING grants the non-exclusive right to use the SOFTWARE only on a single computer and only at one	*	the state of the art, to produce computer program in all applications and combinations. EE acquires only property of the medium on white ve received the full payment of the invoice, SOFT TWARE only on a single computer and only at o	SOFTING points out that it is not possible, at th with high complexity which work free of errors in 2 PROPERTY RIGHTS, RIGHTS OF USE With the purchase of the product the LICENSEE the SOFTWARE is stored. As soon as we have grants the non-exclusive right to use the SOFTV
I accept the terms in the license agreement Print		t Pri	I accept the terms in the license agreement



③ Click on the [Install] and start the installation.

dataFEED OPC UA Client 1.45 - InstallShield Wizard	×	
Ready to Repair the Program	optimizel	
The wizard is ready to begin installation.	a dubg	
Click Install to begin the installation.		
If you want to review or change any of your installation settings, c exit the wizard.	ick Back. Click Cancel to	
InstallShield		
< Back Ins	tall Cancel	
	tall Cancel	

④ When the installation is complete, the view results screen is displayed and click on the [Finish].

劇 dataFEED OPC UA Client 1.45 -	InstallShield Wizard	×
014 00 01	The InstallShield Wizard has successfully installed dataFEED DPC UA Client 1.45. Click Finish to exit the wizard.	
0 1 1 1 0 0 0 1 1 Industrial		
	< gack Einish Cancel	

⑤ A shortcut of 「dataFEED OPC UA Client」 is created on the desktop. dataFFED of installation is completed.





Website and Support

Renesas Electronics Website http://www.renesas.com/

Inquiries http://www.renesas.com/contact/

All other logos and trademarks are the property of the respective trademark owners.



Revision History

		Description	
Rev.	Date	Page	Summary
1.00	Aug. 2, 2019	—	First edition issued

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

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.

• Arm[®] and Cortex[®] are registered trademarks of Arm Limited (or its subsidiaries) in the EU and/or elsewhere. All rights reserved.

- · Ethernet is a registered trademark of Fuji Xerox Co., Ltd.
- · IEEE is a registered trademark of the Institute of Electrical and Electronics Engineers Inc
- · TRON is an acronym for "The Real-time Operation system Nucleus.
- · ITRON is an acronym for "Industrial TRON.
- μ ITRON is an acronym for "Micro Industrial TRON.
- · TRON, ITRON, and μ ITRON do not refer to any specific product or products.
- · OPC and OPC UA are registered trademark and patented technology, licensed by OPC Foundation.
- Additionally all product names and service names in this document are a trademark or a registered trademark which belongs to the respective owners. a trademark or a registered trademark which belongs to the respective owners.

Notice

- Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
- Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
- 3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
- 4. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
- Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The intended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.
 "Standard": Computers: office equipment: computers: office equip
 - "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.

"High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.

Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user's manual or other Renesas Electronics document.

- 6. When using Renesas Electronics products, refer to the latest product information (data sheets, user's manuals, application notes, "General Notes for Handling and Using Semiconductor Devices" in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
- 7. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
- 8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
- 9. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
- It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
- This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
 Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.
- (Note1) "Renease Electronics" as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.
- (Note2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev.4.0-1 November 2017)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu, Koto-ku, Tokyo 135-0061, Japan www.renesas.com

Contact information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit: www.renesas.com/contact/.

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.