

KeyWrap Service Operation Manual

Rev1.10

[Revision history]

Rev.	Date of issue	Details of revisions	
		Page	Description
1.00	2017.12.28	-	First edition
1.01	2018.10.17	9 to 10, 14 to 17	Images were exchanged.
1.02	2018.11.19	15, 27 to 30	A product selection screen and a description of debug environment were added.
1.03	2018.11.28	1 to 27	Correction associated with disclosure of the official version
1.04	2018.12.07	1 to 27	"Customer's key encryption system" was revised to "KeyWrap service".
1.05	2019.02.19	15	"Renesas Synergy" was added to the product selection screen.
1.06	2019.03.28	15 to 16	A description that the PGP key is provided in the export-format was added.
1.07	2020.03.13	From 27	Procedures of download and installation of GPG and generation of a PGP key pair were added.
1.08	2020.08.31	16 to 17	A PGP key exchange window was replaced, and a description was added.
1.09	2021.02.15	2, 4, 6, 8, 14 to 25, 27 to 35, 36 to 37	Removed Author, Reviewer and Approver from Revision history. "General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products" and "Notice" were added. "7. Encryption service" was revised to "7. KeyWrap Service". Images were exchanged.
1.10	2022.04.01	17	Specify the types of keys that can be used in the items on the PGP key exchange.

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1. Introduction

This manual describes how to use the KeyWrap service that Renesas Electronics Corporation (hereinafter, simply Renesas) provides.

2. Types of tools and functions

The KeyWrap service provides the following functions.

Table 2-1 Descriptions of individual functions

Function name	Function	System platform
User registration	This is for registering a customer account with an e-mail address as the ID.	Web application
Resetting a password	If you are unable to log in because you have forgotten your password, this can be used to change the password.	Web application
PGP key exchange	This is for exchanging your PGP public key and Renesas's PGP public key.	Web application
Encryption service for evaluation	The Key2 (customer's key) generated by Renesas will be encrypted by "HRK ¹ " (the embedded key of the chip) and sent to you.	Web application Note) Some of products are not supported.
Encryption service for products	The Key2 (customer's key) you have generated will be encrypted by "HRK" (the embedded key of the chip) and sent to you.	Web application
Changing your password	This is for changing your password.	Web application

3. Recommended environment

The recommended environment for this system is shown below.

OS

Windows 10 or later

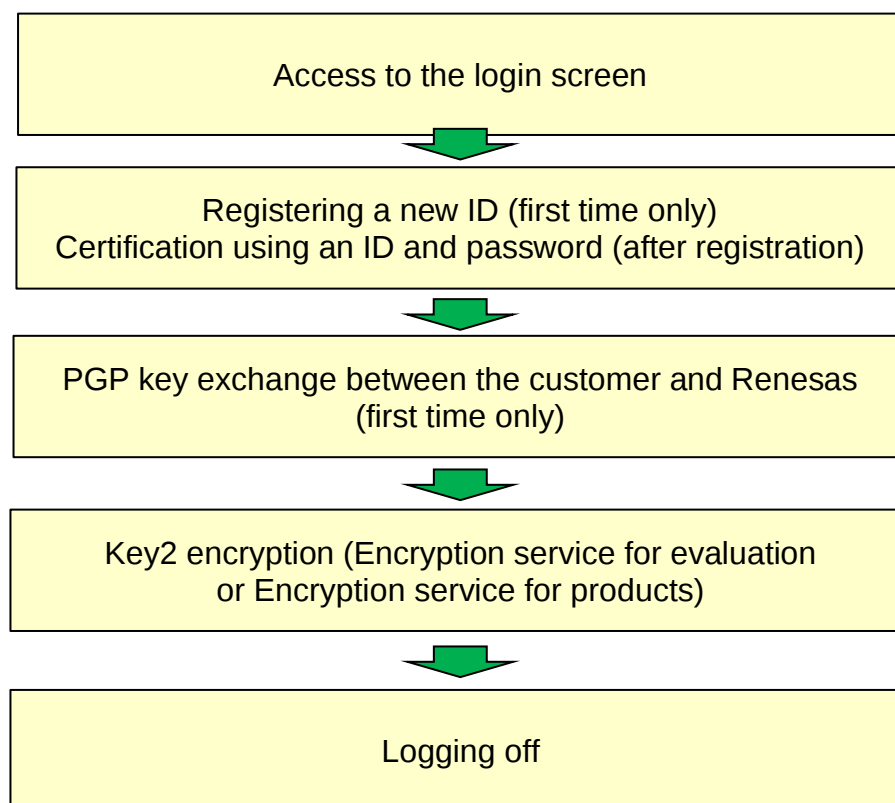
Browser

Internet Explorer 11 (not using Enterprise Mode), Google Chrome, Firefox, Microsoft Edge

¹ Hidden Root Key

4. Workflow

An overview of the workflow in using this system is shown below.



5. Access to this system

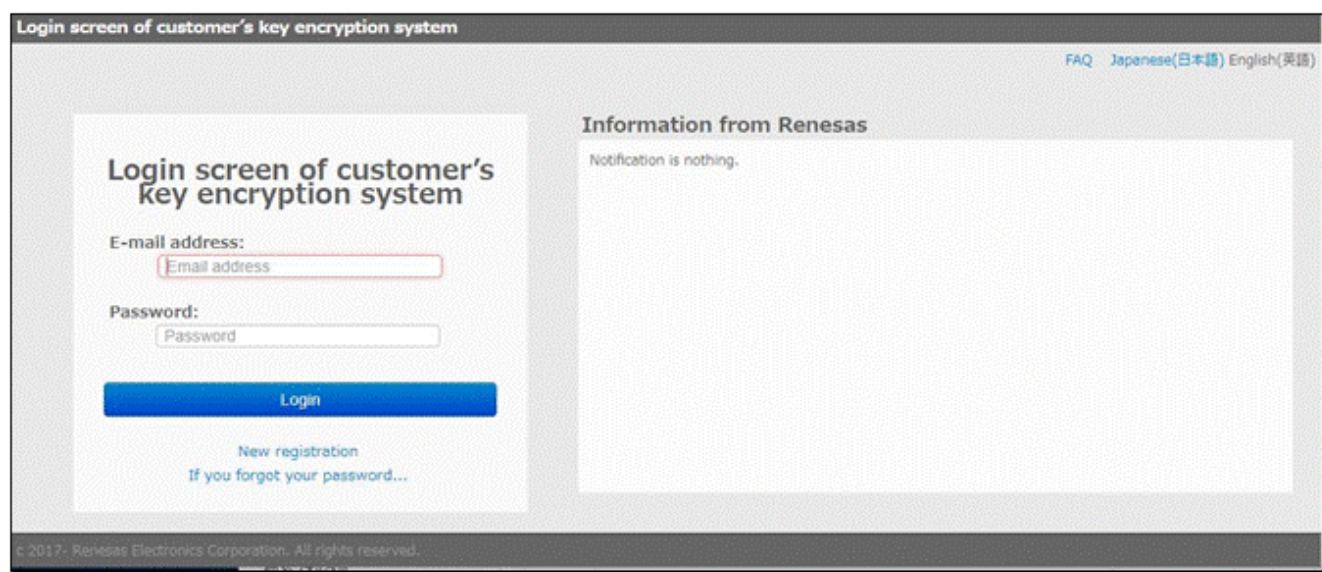
Access the following URL through a Web browser to use this system.

<https://d1m.renesas.com/keywrap/>

* Internet Explorer 11 cannot be used with this system if it is in Enterprise Mode or set for the compatibility view. Cancel Enterprise Mode and compatibility view, or use Microsoft Edge.

6. Login screen

Access the URL specified in section 5 “Access to this system”, to view the login screen, which is shown below.



The screenshot displays the login interface for the 'customer's key encryption system'. The page has a dark header bar with the title 'Login screen of customer's key encryption system' on the left and navigation links 'FAQ', 'Japanese(日本語)', and 'English(英語)' on the right. The main content area is divided into two columns. The left column contains the login form with the title 'Login screen of customer's Key encryption system', followed by 'E-mail address:' with a text input field, 'Password:' with a text input field, a blue 'Login' button, and links for 'New registration' and 'If you forgot your password...'. The right column is titled 'Information from Renesas' and contains the text 'Notification is nothing.'. The footer of the page shows the copyright notice '© 2017: Renesas Electronics Corporation. All rights reserved.'.

Figure 6-1 Login screen

6-1. New registration

6-1-1. Registering an e-mail address

User registration is required for logging-in to this system.

Click on “New registration” in the login screen to display the following screen for entering e-mail address.

The e-mail address entered on this screen will be used as an ID for subsequently logging in to this system. Accordingly, note that the e-mail address you enter at this stage must be correct. After entering the e-mail address, click on the “Send mail” button. The system will then send confirmation mail from Renesas to the registered e-mail address.

If you have not received the e-mail, check whether e-mail from the @renesas.com domain can be received correctly, and whether the e-mail address you entered was correct. After confirming the e-mail address, enter the same e-mail address and related information (customer information) on the new registration screen opened from the link stated in the confirmation e-mail as described in sections 6-1-2 and 6-1-3. The ID will then be formally registered with the system (formal registration).

The formal registration must be done within three hours of sending of the confirmation mail. Attempting formal registration more than three hours after the confirmation mail will show that this is no longer available. In such a situation, note that you will need to restart the registration from entry of the e-mail address on the new registration screen.

Figure 6-2 New registration

6-1-2. Contents of the confirmation mail

After you have registered the e-mail address, confirmation mail with the subject line “[KeyWrap service] registration confirmation mail” will be sent to the registered e-mail address. The e-mail (as shown below) will include a URL for registering customer information. Confirm the contents of the mail and click on the URL to open the registration screen (for customer information).

Dear customer,

Thank you for registering with the customer's key encryption service.
To start using this service, you need to click on the following URL to register your information.

<http://dlm.renesas.com/keywrap/?menu=reg%2Fregist%2Ffixed%2F¶m=id%3D10A0HJq7SQI%2FhCLowAEq1khCZMq%252BKEAYC1rxPohqWT0%253D>

• Notes
Please register your information within three hours of receiving this e-mail.
The URL expires after the three hours, after which you will need to start the registration process anew.

Please delete this email if you were not aware that you were going to receive it.

* This email was sent from a send-only address.
Please understand that there will be no response, even if you reply to this address.
* If you have forgotten your password, reset your password via the link “If you have forgotten your password ...” on the login page of this system.

Thank you.

Renesas Electronics Corporation

Figure 6-3 Contents of the confirmation mail

6-1-3. Registering customer information

Clicking on the URL in the confirmation mail will open the registration screen (for customer information) shown below.

Enter your name, company name, password, and re-enter the password in the row for that purpose, and click on the “Next (confirmation)” button. After the confirmation screen is displayed, click on the “Registration” button to complete the user registration.

The name row accepts up to 100 double-byte characters or 200 single-byte characters, and the e-mail address row accepts up to 100 single-byte characters. The password shall consist of 8 to 32 alphanumeric characters and may include the symbols “!” and “@”.

The screenshot shows a web form titled "New registration" in a dark header bar. In the top right corner of the header, there are links for "Japanese(日本語)" and "English(英語)". The main content area has a light gray background and contains the following text: "Your information will be registered. Enter all of the following items. The password is from 8 to 32 characters, which must be single-byte, and may include the symbols “!” “@”." Below this text are five input fields: "E-mail address :" with the value "user07@renepat.co.jp", "Name :", "Company Name :", "Password :", and "Re-enter your password :". Each field is a white rectangle with a thin gray border. Below the input fields is a button labeled "Next (confirmation)". At the bottom of the page, in a dark footer bar, is the text "© 2017- Renesas Electronics Corporation. All rights reserved."

Figure 6-4 New registration screen (for customer information)

Once you have successfully registered the customer information, the following screen will open. Click on the “Start service” button to start using this KeyWrap service.



New registration

[Japanese\(日本語\)](#) [English\(英語\)](#)

Registered

E-mail address : user07@renepat.co.jp

Name : John Renesas

Company Name : Renesas Electronics

Start service

© 2017- Renesas Electronics Corporation. All rights reserved.

Figure 6-5 Completion of new registration

6-2. Resetting the password

6-2-1. Requesting a reset of the password

If you forget your password and thus are unable to log in to the KeyWrap service, the password can be reset to enable logging in again.

Click on the “If you forget your password...” link on the login screen. The following screen will open. Enter the registered e-mail address and click on the “Send mail” button. E-mail with the subject line “[KeyWrap service] resetting a password” will be sent to the e-mail address you have entered to inform you of the URL for resetting your password for this system.

If you have not received the e-mail, check whether e-mail from the @renesas.com domain can be received correctly, and whether the e-mail address you entered was correct. After confirming the e-mail address, enter it on the “Initialize password” screen again.

You must reset the password within three hours of sending of the confirmation mail. Attempting formal registration more than three hours after the confirmation mail will show that this is no longer available. In such a situation, note that you will need to restart the registration from entry of the e-mail address on the “Initialize password” screen.



The screenshot shows a web browser window with the title "Initialize password". In the top right corner, there are links for "Japanese(日本語)" and "English(英語)". The main content area contains the following text: "Please enter the e-mail address for which you want to reset the password." followed by "We will send you e-mail to inform you how to reset your password." Below this is a text input field labeled "E-mail address :". At the bottom of the form are two buttons: "Send mail" and "Return". The footer of the page reads "© 2017- Renesas Electronics Corporation. All rights reserved."

Figure 6-6 “Initialize password” screen (to issue a request for sending e-mail)

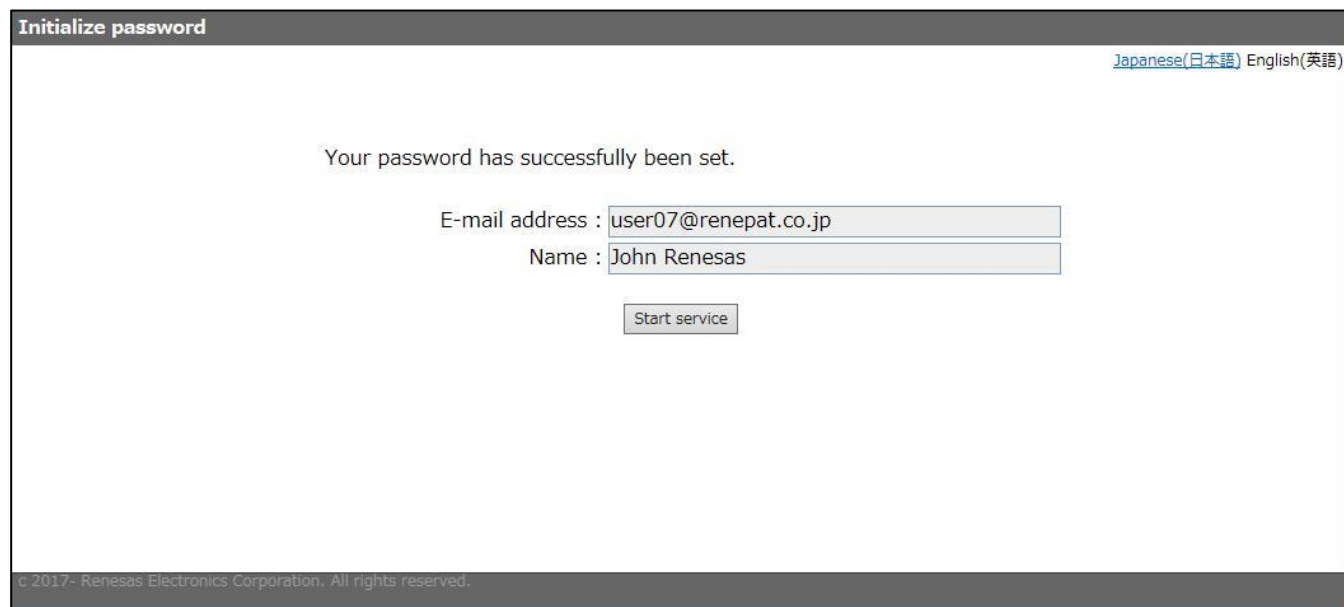
6-2-2. How to reset your password

Clicking on the URL stated in the e-mail sent by the KeyWrap service produces the “Initialize password” screen for resetting your password that is shown below.

The password shall consist of 8 to 32 alphanumeric characters and may include the symbols “!” and “@”.

Figure 6-7 “Initialize password” screen (for entering a new password)

Once you have successfully reset your password, the following screen will open. Click on the “Start service” button to start using this KeyWrap service. Use the new password for authentication when you subsequently log in.



The screenshot shows a web interface titled "Initialize password" in a dark header bar. In the top right corner of the page, there are links for "Japanese(日本語)" and "English(英語)". The main content area displays the message "Your password has successfully been set." Below this, there are two input fields: "E-mail address : user07@renepat.co.jp" and "Name : John Renesas". A "Start service" button is positioned below the name field. At the bottom of the page, a footer bar contains the text "© 2017- Renesas Electronics Corporation. All rights reserved."

Figure 6-8 Completion of password initialization

7. KeyWrap Service

7-1. Agreement

When logging in to the KeyWrap service, the following terms of agreement are displayed. After you have confirmed the terms of agreement, click on the “I agree” or “I disagree” button. If you click on the latter, the display will return to the login screen.

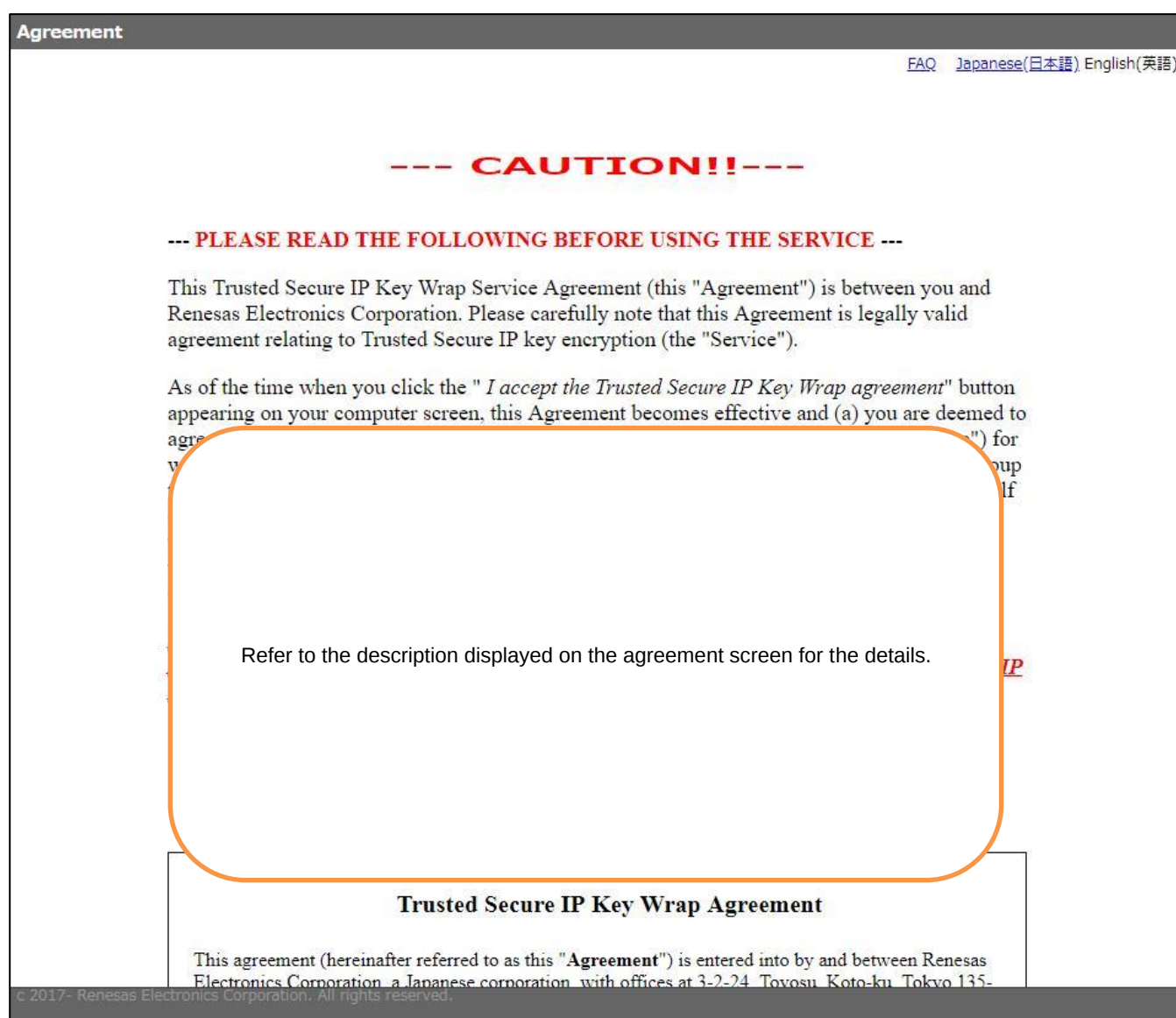


Figure 7-1 “Agreement” screen

7-2. Product selection

Clicking on the “I agree.” button on the agreement screen will open the product selection screen shown below.

After you have selected the required product category (series), the KeyWrap service screen will be displayed.

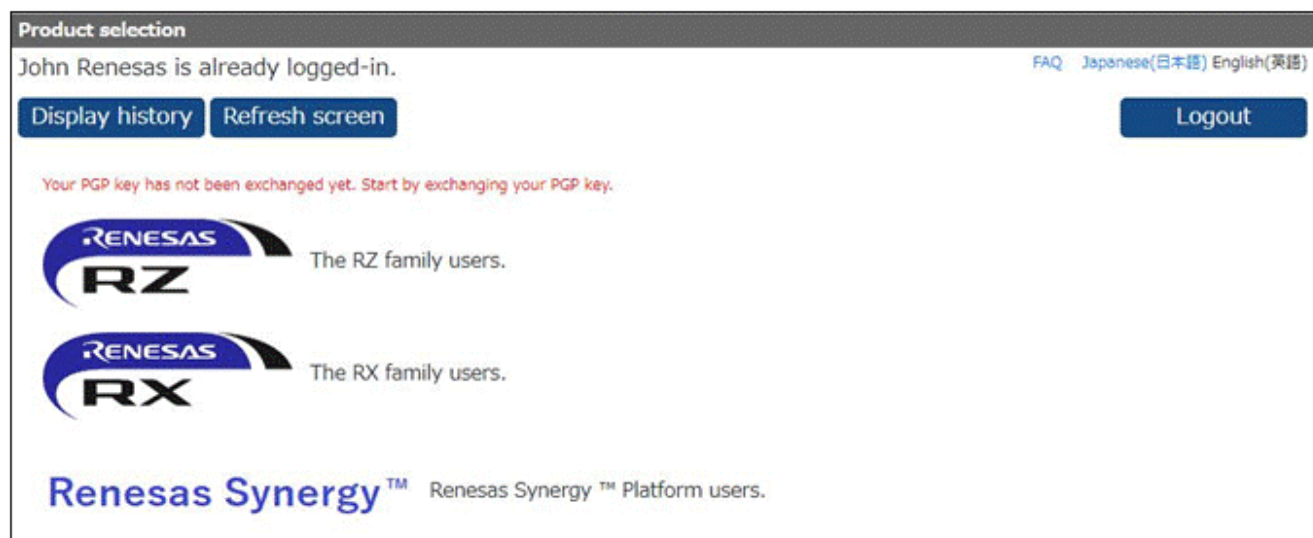


Figure 7-2 Product selection screen

The functions corresponding to each of the buttons on the KeyWrap service screen are as follows.

Table 7-1 Functions of buttons (product category selection screen)

Name of button	Function
Display history	This displays a table of the history of data encryption processing.
Refresh screen	This refreshes the screen.
Logout	This is for logging out of the system. To use the system again, log in to the system from the login screen again.
Product category (series)	This is for displaying the KeyWrap service screen for the product category (series) you have selected.
FAQ	This displays Q&As as a summary of frequently asked questions.

7-3. KeyWrap service screen

Clicking on the “I agree.” button on the agreement screen will open the KeyWrap service screen shown below.

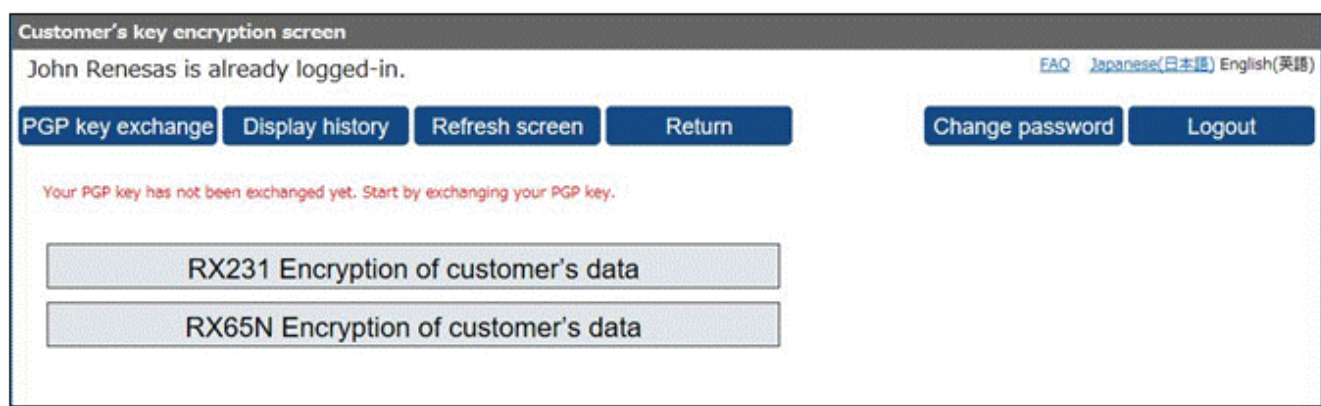


Figure 7-3 KeyWrap service screen

The functions corresponding to each of the buttons on the KeyWrap service screen are as follows.

Table 7-2 Functions of buttons

Name of button	Function
PGP key exchange	This is for exchanging your PGP public key (export-format) and Renesas's PGP public key (export-format). Unless the PGP keys are exchanged, the data encryption processing for the given product will not be available. If the term of validity of the keys has expired, the keys can be updated by using this function again.
Display history	This displays a table of the history of data encryption processing.
Refresh screen	This refreshes the screen.
Return	This causes the display to return to the product selection screen.
Change password	This is for changing your password.
Logout	This is for logging out of the system. To use the system again, log in to the system from the login screen again.
(Respective product name) customer's data encryption	This initiates the customer's key encryption for the given product.
FAQ	This displays Q&As as a summary of frequently asked questions.

7-4. PGP key exchange

7-4-1. Message displayed when the PGP keys have not been exchanged

Unless the PGP keys have been exchanged, encrypted data cannot be sent back to you, so the encryption processing is not available. In such situations, the message in red letters below is displayed.

To exchange the PGP keys, generate a customer's PGP public key in advance, then click on the "PGP key exchange" button on the KeyWrap service screen.

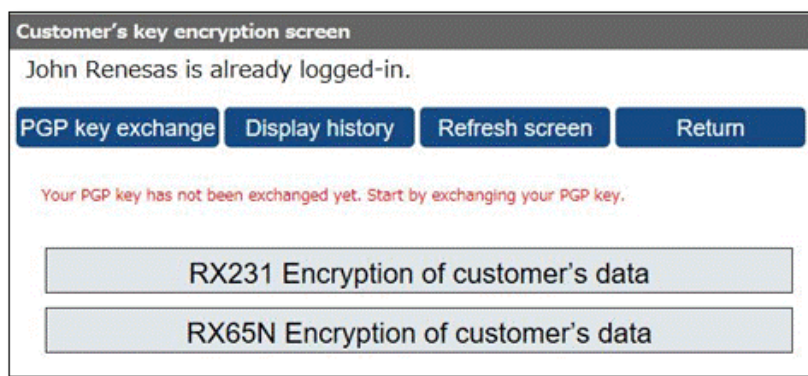


Figure 7-4 Message displayed when the PGP keys have not been exchanged

7-4-2. PGP key exchange screen

Generate a customer's PGP key pair in advance. Only RSA key can be used in KeyWrap system. (RSA-4096 keys are recommended.)

Clicking on the "PGP key exchange" button on the KeyWrap service screen opens the PGP key exchange screen shown below.

Click on the "Reference" button to select the PGP public key from among the key pairs generated by the customer. After you have selected the key, click on the "PGP key exchange" button to execute the PGP key exchange.

To check the authenticity of the Renesas PGP public key obtained through the PGP key exchange, output the fingerprint of the Renesas PGP public key obtained through your own tool and confirm that it matches the fingerprint information on this screen.

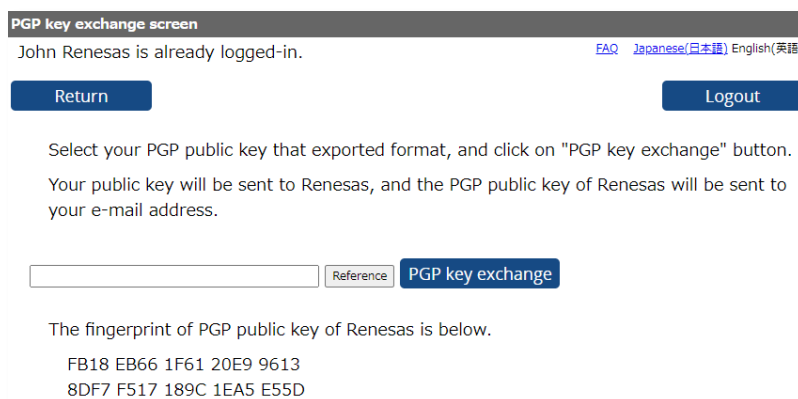


Figure 7-5 PGP key exchange screen

7-4-3. Cases where the PGP public key is registered normally

If the PGP key selected on the PGP key exchange screen is registered normally, e-mail as shown below will be sent with the subject line "[KeyWrap service] PGP key transmission". Renesas's PGP public key will be attached to the e-mail. Store the key with care. Renesas's PGP public key is essential to encryption processing for products.

* The PGP public key can be registered any number of times. If the key is registered multiple times, the latest PGP public key that has been registered normally is used in encryption. Accordingly, note that all other PGP public keys registered before that are discarded.

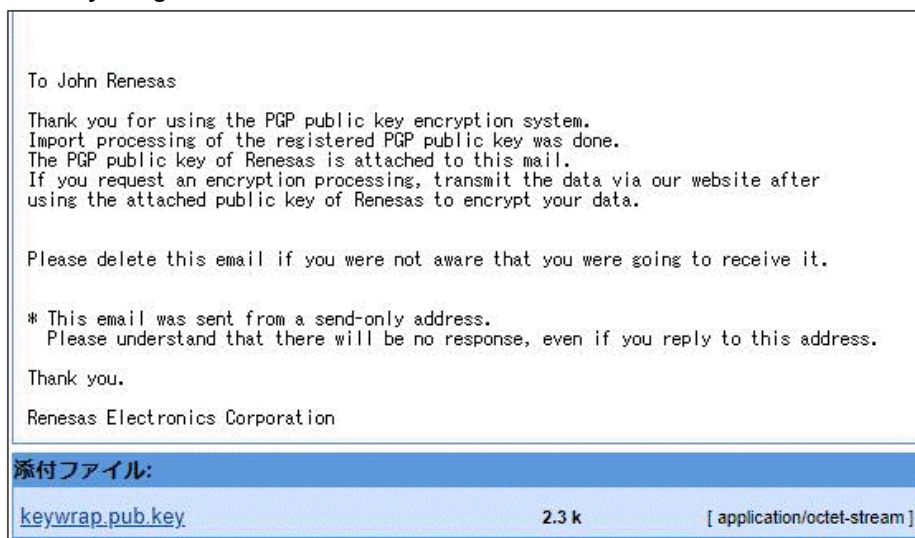


Figure 7-6 PGP key exchange mail

Once the customer's PGP public key is correctly registered with the server of Renesas, the message urging the exchange of the PGP public keys is no longer displayed, as shown below.

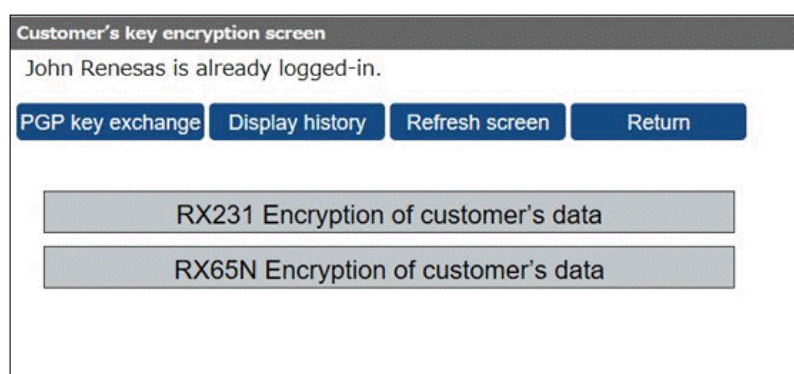


Figure 7-7 KeyWrap service screen (after PGP key exchange)

7-4-4. Cases where the PGP public key is not registered normally

If the registration of the customer's PGP key selected on the PGP key exchange screen does not proceed normally, e-mail as shown below will be sent with the subject line "[KeyWrap service] PGP key import error". Review the registered customer's PGP public key.

To John Renesas

Thank you for using the PGP public key encryption system.
Import processing for the PGP public key that you registered failed.
Please confirm your PGP public key, and then re-register it.

Please delete this email if you were not aware that you were going to receive it.

* This email was sent from a send-only address.
Please understand that there will be no response, even if you reply to this address.

Thank you.

Renesas Electronics Corporation

Figure 7-8 PGP key exchange error mail

7-5. History screen

Clicking on the "Display history" button on the KeyWrap service screen opens a display of the history of your KeyWrap service processing as shown below.

History					
John Renesas is already logged-in.					
FAQ Japanese(日本語) English(英語)					
Refresh screen		Return		Logout	
Date and time of reception	Product name	Processing mode	State	Date and time of completion	
2018/11/21 10:55:25	RX65N	Products	Sended	2018/11/21 10:55:46	
2018/11/21 10:55:08	RX231	Products	Sended	2018/11/21 10:55:45	

Figure 7-9 History screen

7-6. Changing your password

Clicking on the “Change password” button on the KeyWrap service screen opens the “Change password” screen shown below. To change your password, enter the previous password, the new password to be used after the change, and re-enter the latter (for confirmation) in the given row. The password shall consist of 8 to 32 alphanumeric characters and may include the symbols “!” and “@”.

Change password

John Renesas is already logged-in. [FAQ](#) [Japanese\(日本語\)](#) [English\(英語\)](#)

[Register](#) [Return](#) [Logout](#)

The password is from 8 to 32 single-byte alphanumeric characters, and may also include the symbols “!” and/or “@”.

E-mail address :

Previous password :

Password after change :

Re-enter your new password :

Figure 7-10 “Change password” screen

7-7. Customer's data encryption for individual products

Clicking on each of the data encryption buttons for the RZ family, RX family, RE family and RA family opens the encryption processing screen for the respective products.



Figure 7-11 Encryption screen for the respective products (RZ/G)

7-7-1. Applying for the encryption service for evaluation

Selecting the encryption service for evaluation on the encryption service screen for a given product starts processing to encrypt the Key2 (customer's key) generated by Renesas by HRK and then send it to you. After a certain period of time, e-mail as shown below will be sent with the subject line "Your [product name] KeyWrap service data is attached to this mail." The attached file will have been encrypted with your PGP public key. Therefore, use your PGP secret key to decrypt the attached file after having downloaded it.

The Key2 (customer's key) file before encryption and the Key2 (customer's key) file after encryption with HRK are attached to the e-mail and have file names in the following respective formats.

Key2 (customer's key) file before HRK encryption: [Product name]_yyyymmddhhmmss.key.pgp

Key2 (customer's key) file after HRK encryption: [Product name]_yyyymmddhhmmss_enc.key.pgp

Examples:

Key2 (customer's key) file before HRK encryption: RZ-G_20171201073050.key.pgp

Key2 (customer's key) file after HRK encryption: RZ-G_20171201073050_enc.key.pgp

The encryption service for evaluation is not available for continuous use. Select further processing after an interval of at least 10 seconds has elapsed.

7-7-2. Applying for the encryption service for products

Selecting the encryption service for products on the encryption service screen for a given product opens the screen of the encryption service for products shown below.

Use the public key of Renesas to encrypt the Key2 (customer's key) you have generated in advance, and select the file you have thus encrypted from the Reference button on this screen. After you have selected the file, click on the "Settle" button. The encryption service for products then starts.

The following limitations apply to the files that can be registered with the encryption service for products.

- The files shall have been encrypted by PGP.
- The extension of the file name shall be .pgp.
- The file shall be no larger than 200 KB after PGP encryption.

RX231 Encryption service for products

John Renesas is already logged-in. [FAQ](#) [Japanese\(日本語\)](#) [English\(英語\)](#)

[Return to the menu](#) [Return](#) [Logout](#)

Use our PGP public key to encrypt Key2 that you have made as the customer key.

Specify the file for encryption by using the browse button, and click on the OK button.
Example: xxxxx.pgp, etc.

[Reference](#) [Settle](#)

Figure 7-12 Encryption service for products

7-7-3. Cases of successful encryption for a product

If the encryption for a product was successful, e-mail as shown below will be sent with the subject line “Your [product name] KeyWrap service data is attached to this mail.” and have the encrypted data file as an attachment. The attached file is encrypted with your PGP public key. A file name of the following form is used for transmission of the file.

Customer's attachment file: xxxx.pgp

File attached to the reply: xxxx_enc.key.pgp

The xxxx part is the name of the file you have sent with the file name extension removed.

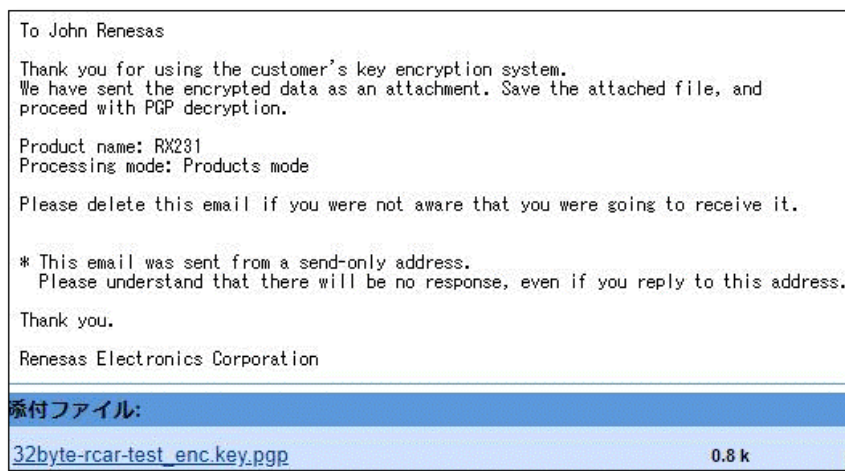


Figure 7-13 Mail for notification of the result of encryption

7-7-4. Cases of failure in encryption for a product

(1) Failure of PGP decryption

If decryption of the file you have sent to Renesas by using Renesas's secret key does not proceed normally, e-mail as shown below will be sent with the subject line “[KeyWrap service] PGP key decryption error”.

Confirm that the key that you used for PGP encryption was actually the key received in the PGP key exchange.

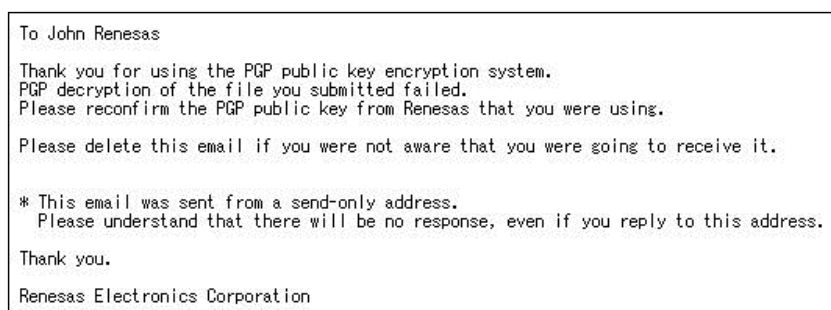


Figure 7-14 Mail for notification of failure of PGP decryption

(2) Other errors

If the file you attached is not conformant with the limitations on format which Renesas has assumed, e-mail as shown below and with the subject line “[KeyWrap service] encryption error” will be sent.

Confirm that you created the file for sending to Renesas according to the right procedures.

To John Renesas

Thank you for using the PGP public key encryption system.
Correct processing of the encryption processing data you registered was not possible.
Please confirm the encryption processing data that you created.

Specifically, confirm that the data satisfy the following conditions.

- If you aren't using the tools we provide, confirm that the file format is correct.
- Confirm that the data are MSB first.

Please delete this email if you were not aware that you were going to receive it.

* This email was sent from a send-only address.
Please understand that there will be no response, even if you reply to this address.

Thank you.

Renesas Electronics Corporation

Figure 7-15 Mail for notification of an encryption error

7-8. FAQ

Clicking on the FAQ link displays a pop-up FAQ screen that includes frequently asked questions and is shown below.

On the FAQ screen, the questions are listed with the first few words of the answer below each. Clicking on (A) produces a full display of the given answer.

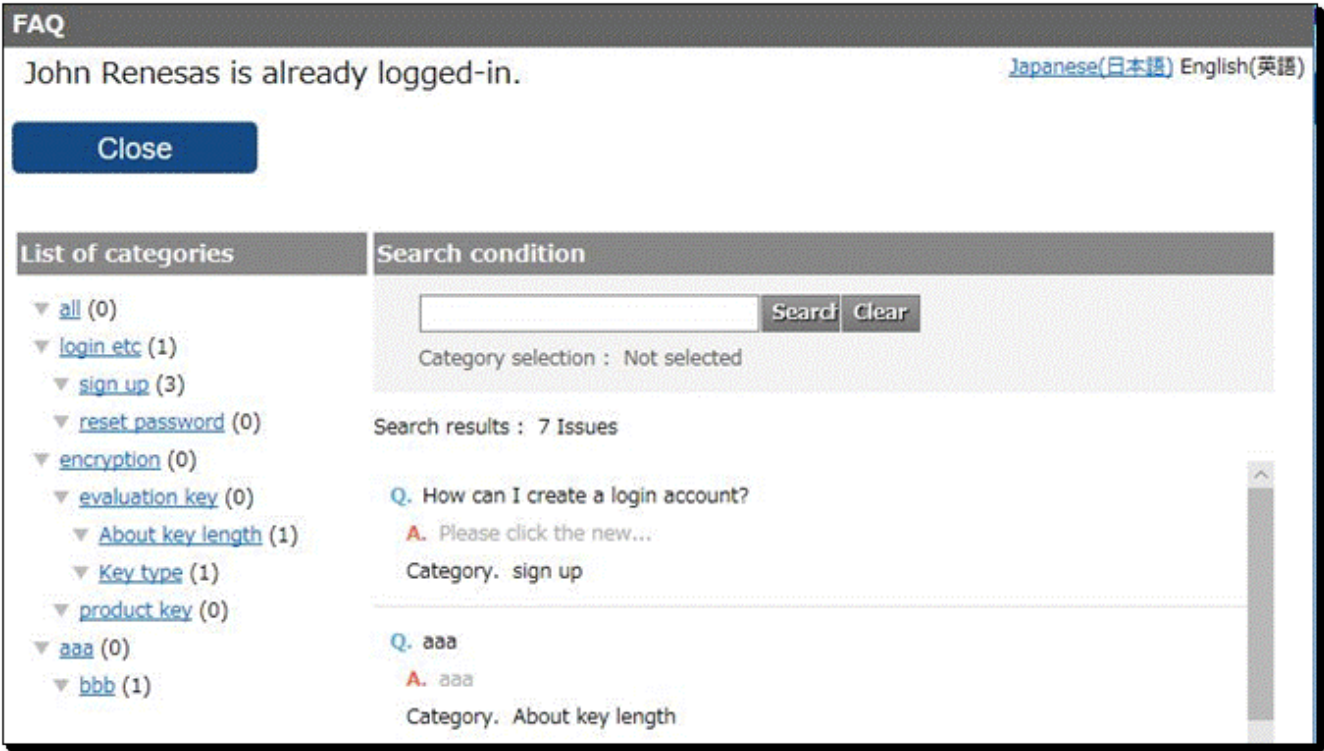


Figure 7-16 FAQ

7-8-1. Searching the FAQs

You can search for FAQs by clicking on the links for categories in the list of categories, or by entering a search string in the text field and clicking on the search button in the search condition pane. Refer to the following table for the search methods. The search conditions are cleared by clicking on the clear button, after which all of the items are again displayed.

Table 7-3 Search methods

Search item	Search method
Category	FAQs are narrowed down to the items belonging to the selected category.
Text field of search condition	The results are narrowed down to those FAQs that include the text string entered in the text field in the question or answer.

8. Annex

8-1. Annex A: Installation of GPG, and setting methods for the keys (Windows)

8-1-1. Obtaining GPG

Access the following site from which you can download GnuPG for Windows.

<https://www.gpg4win.org/>

Click on [Download] button.

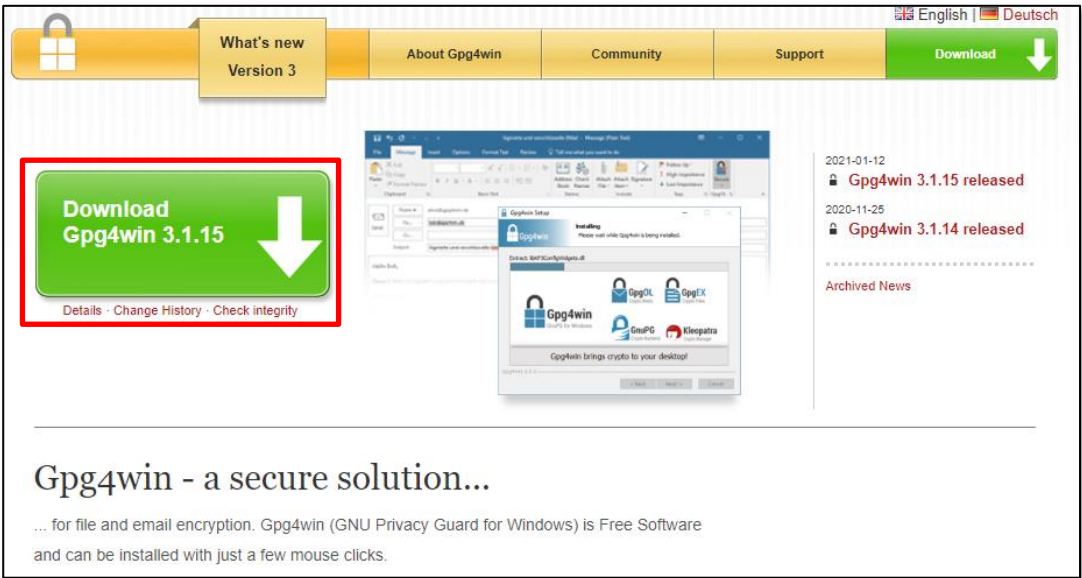


Figure 8-1

Select \$0 unless you wish to donate, and click on [Download] button to download the installation file.

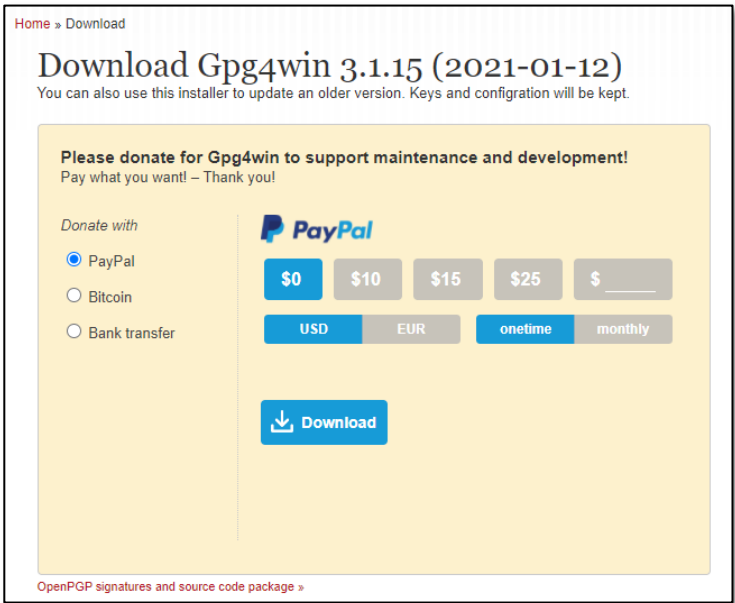


Figure 8-2

8-1-2. Installation of Gpg4win

Execute the installation file obtained in section 8-1-1 to start installation. When the installation starts, click on [Next] button on the setup screen shown in Figure 9-3.



Figure 8-3

On the next screen (a figure below), also select [Next]. Kleopatra is a tool for managing key pairs using GUI. For managing the key pairs mentioned below, be sure to enter a check mark for Kleopatra and install it. (Do not remove the check mark.)

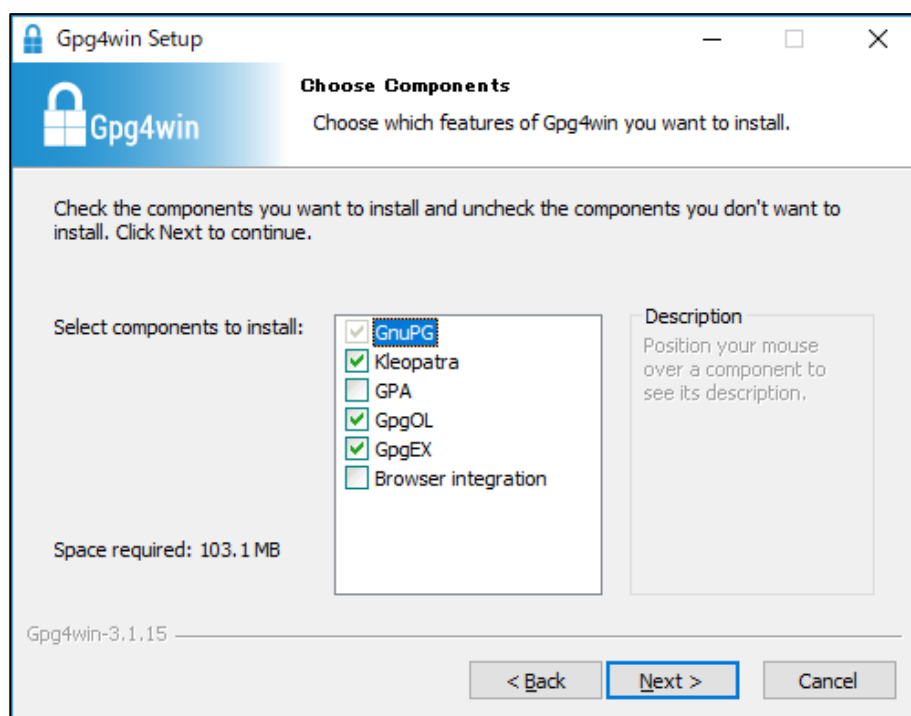


Figure 8-4

Confirm the destination folder of installation, then click on [Install] button to start installation. (See the figure below.)

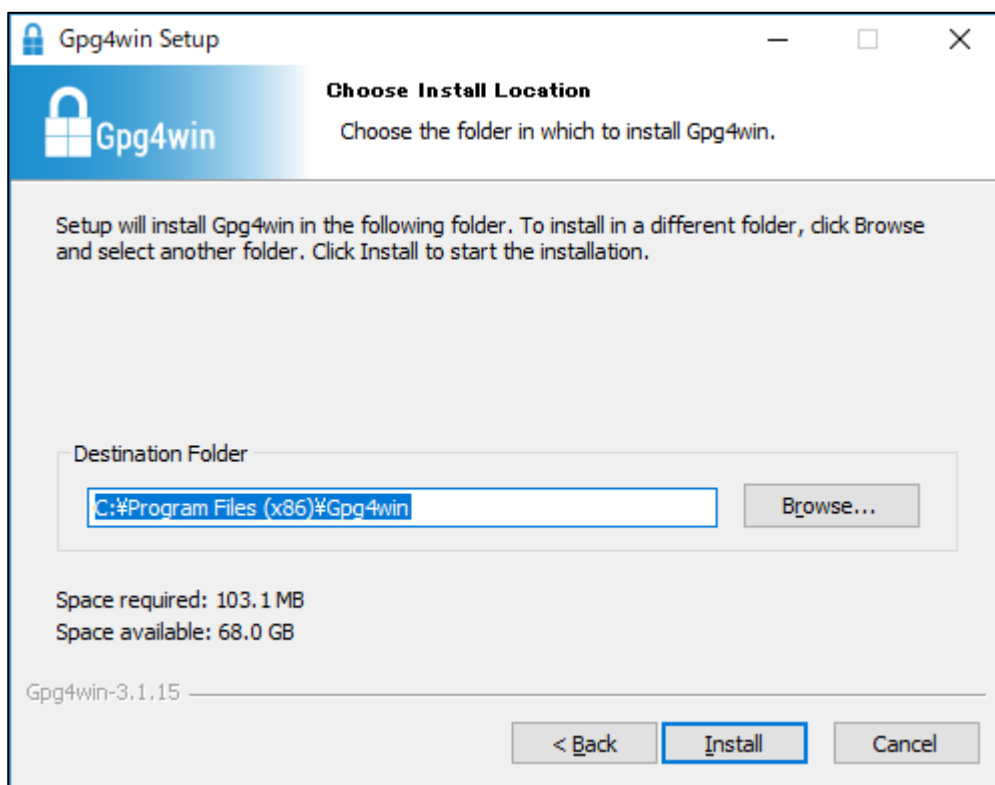


Figure 8-5

On the screen after completion of installation, also select [Next]. (See the figure below.)



Figure 8-6

On the screen below, click on [Finish]. If [Run Kleopatra] is checked, Kleopatra runs simultaneously.



Figure 8-7

8-1-3. Creating a secret key

If Kleopatra starts after installation, leave it as it is. If it does not start, double click on the icon on the desktop. Otherwise, click on the start button (Windows button) and select Kleopatra from the list of applications to start it. Kleopatra is a GUI tool for managing key pairs.

When Kleopatra is started for the first time, the following window is displayed. To create a key pair, select [New Key Pair].



Figure 8-8

When creation of a key pair starts, entering a name of key pair and e-mail address is required. 2048-bit RSA is the target by default. If you need other options, click on the [Detail setting] button. Type of keys or date of expiry can also be modified. Use RSA for KeyWrap service.

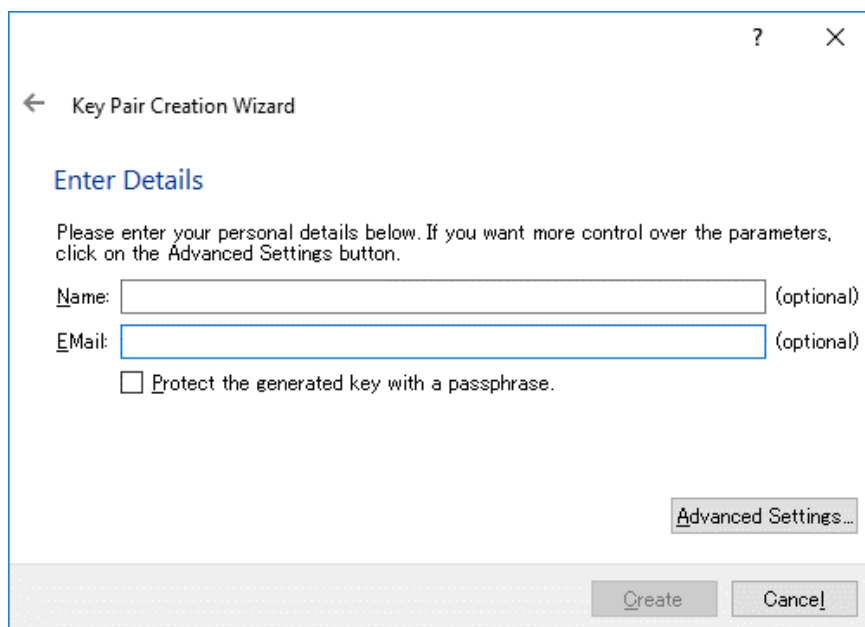


Figure 8-9

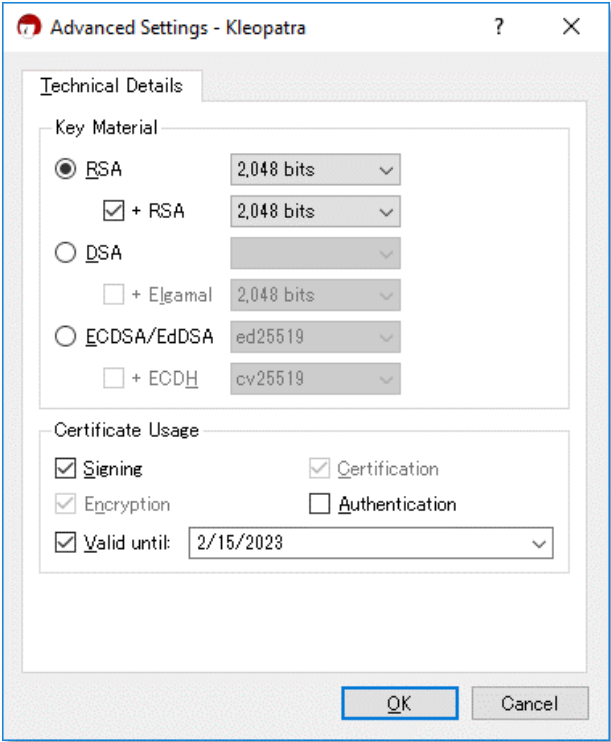


Figure 8-10

When creation of key starts, a passphrase is required. So, enter the passphrase. Note that you must not forget your passphrase.

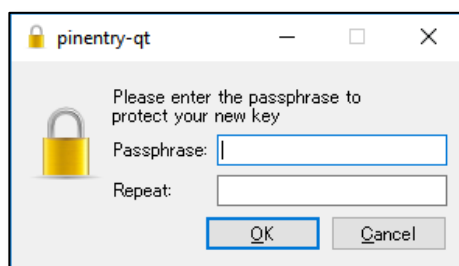


Figure 8-11

If the passphrase is not secure enough, a popup dialog will be displayed for confirmation. To change the passphrase, select [Enter a new passphrase] button. To use the passphrase as is, select [I use it as is] button.

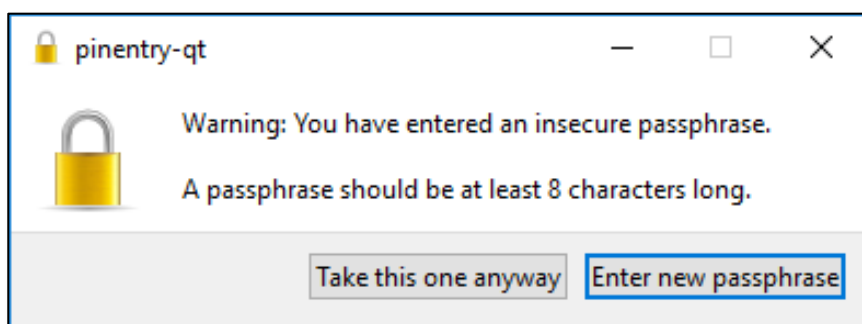


Figure 8-12

Wait for a while until the creation completes. Then the following screen will be displayed. Click on [Complete] button to close the screen.

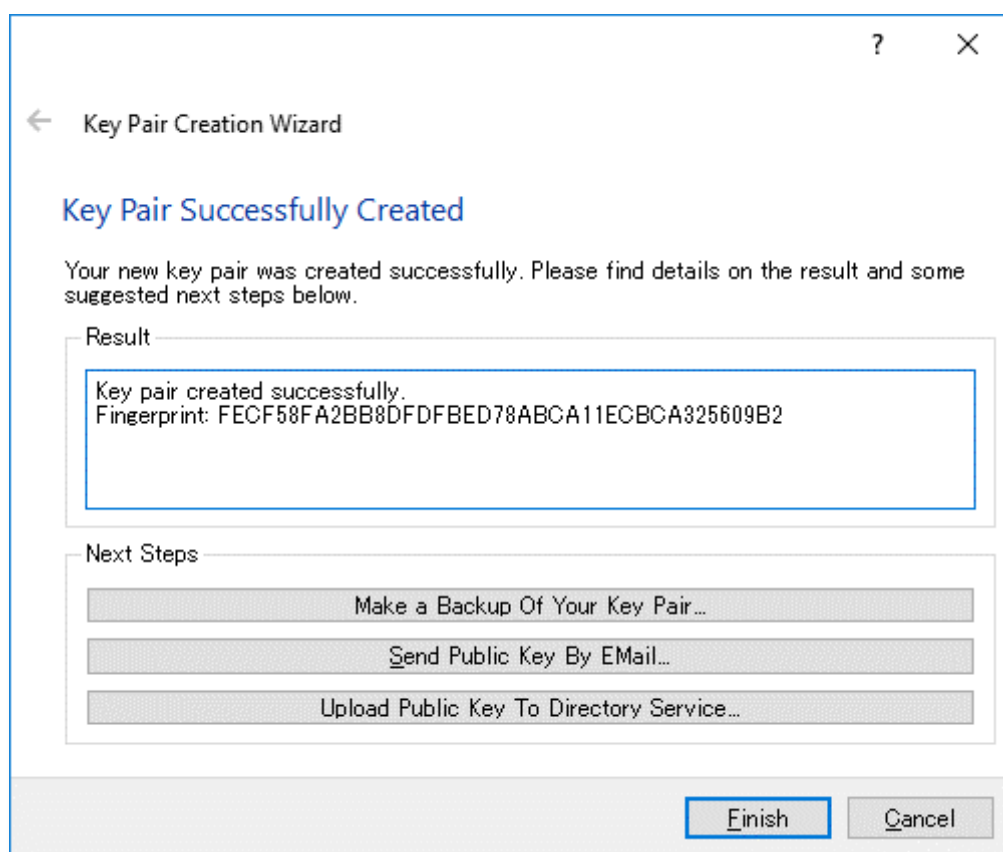


Figure 8-13

If the key is created successfully, the created key is displayed on the key list screen of Kleopatra.

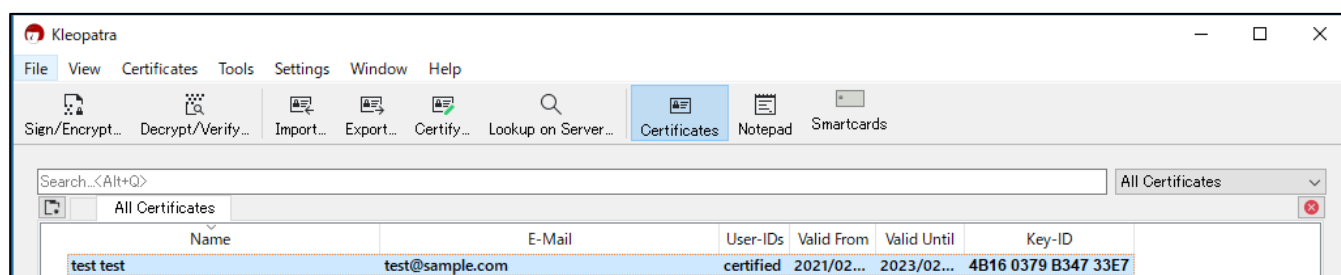


Figure 8-14

8-1-4. Exporting public key

For exporting a public key, select the target key and click on [Export] icon above. When the exporting completes, a file dialog appears. Then, select the folder and enter the file name to save the file. When the export of the file completes, the public key is stored in the specified folder.

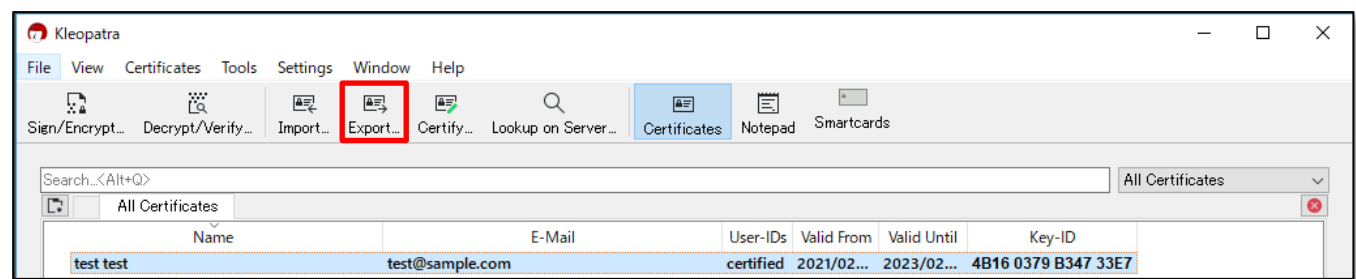


Figure 8-15

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 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.

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