

Hitachi Finger Vein Authentication Device

(PCT-KCC50*1/PCT-KCC90*1)

Application Notes

Rev. 2.02

June 17, 2011

Urban Planning and Development Systems, Hitachi, Ltd.

All the information contained in this document is subject to change without prior notice.

Copyright© 2009,2011 Hitachi, Ltd.

Important Notice

- 1 Verify legal regulations in each country in addition to U.S. regulations for export control, and take all necessary procedures accordingly before exporting the product. This applies to all hardware and all related software, including documents, attachments and software surrounding the hardware device.
- 2 The usage of information in this document does not allow the usage of patents, copyrights or other intellectual property owned by Hitachi or third party. Hitachi does not warrant problem arises from third party's intellectual property by using this document.
- 3 Please refer to the latest specification to design, purchase since the products or its specification may be subject to change without prior notice.
- 4 The product you have purchased has been designed and manufactured with high quality. However, avoid usage in applications that require extremely high reliability and/or where lives and/or property may be risk. Hitachi, Ltd. disclaims all liability for such uses and for any derived circumstances. That may lead to accidents if used inappropriately or in cases where a high level of reliability is required for its use or cases involving the control of space devices, aviation devices, medical devices, medical equipment to support life, nuclear equipments etc.
- 5 To use the product, maximum rating, operating voltage, installation conditions or other conditions must be within specifications described in our documents. Hitachi, Ltd. assumes no liability for problem or defects when the specifications are not kept. Please note, even if it is used under the specification, such as failsafe system is necessary for the host system to avoid accidents or problems by our product's damage or trouble.
- 6 This product is not designed against radiant rays.
- 7 Do not copy or transfer, in part or in whole, this document without prior notice and written permission from Hitachi, Ltd.
- 8 Contact Hitachi, Ltd. should you have any questions.

Table of Contents

1. INTRODUCTION.....	5
2. WARNING: HOST SYSTEM CASING DESIGN AND SET-UP LOCATIONS	5
2-1 WARNING: AN OPTICAL PART	5
2-2. WARNING: INTEGRATION.....	7
2-3 OTHER CAUTIONS.....	8
3. CAUTION FOR ENROLLMENT AND VERIFICATION	10
4. CAUTIONS: DESIGNING FEATURES.....	13
5. OPERATIONAL WARNINGS.....	17

Revision History

Rev.	Sheet No.	Description	Date	Revised by	Reviewed by	Approved by
1.00	—	New release. Based on Japanese version 1.03	July 21, 2009	Shimizu	Kisui	Kisui
2.01	5,6,8,9,13, 14,15,16,1 7	Added new type and changed for new function. Based on Japanese version 2.01.	Oct. 2, 2010	Shimizu	Horiuchi	Horiuchi
2.02	5,17	Changed Firmware version from 02-00 to 02-01 Based on Japanese version 2.02.	June 17, 2011	Shimizu	Horiuchi	Horiuchi

1. Introduction

This document provides information and warnings for you to design your system in which an integration-type finger vein authentication module (hereinafter referred to as H2E) is used.

Read this document carefully before you design your system.

PCT-KCC5001 (F/W Ver.01-00)

PCT-KCC9001 (F/W Ver.01-00)

PCT-KCC5011 (F/W Ver.01-01)

PCT-KCC9011 (F/W Ver.01-01)

PCT-KCC5021 (F/W Ver.01-02)

PCT-KCC9021 (F/W Ver.01-02)

PCT-KCC5031 (F/W Ver.02-01) *1

PCT-KCC9031 (F/W Ver.02-01) *1

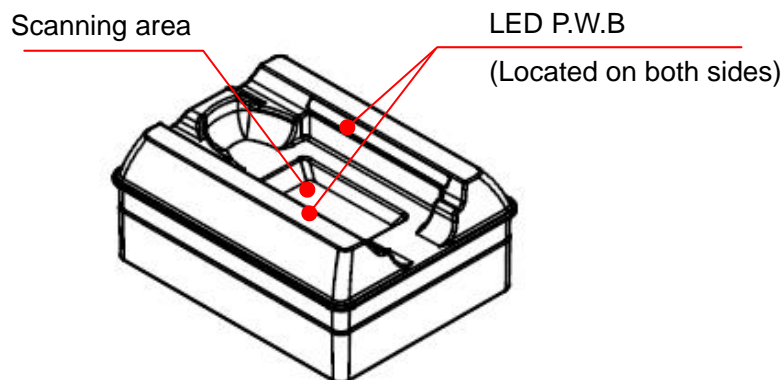
*1 The template data of PCT-KCC5031/9031 does not have compatibility with other models.

2. Warning: Host system casing design and set-up locations

When designing a casing of the device in which the H2E is integrated (hereinafter referred to as the host device) and installing the host device, be aware of the following.

2-1 Warning: an Optical Part

Because the H2E optically scans a finger vein pattern, design and install the host system so that the scanning area of the H2E will not be affected by light.



- (1) Do not install the device where it is exposed to intense light, such as under direct sun light or near a window.

If you cannot avoid installing at such places, setting “Strong light mode” for capture mode can make it easier to succeed verification. However, such as placement of a finger, individual difference or light coming into scanning area may cause verification error or false acceptance. Be sure to check if such error does not cause trouble to user’s operation before installation.

* If light goes through scanning area, error code “0Fh” may happen.

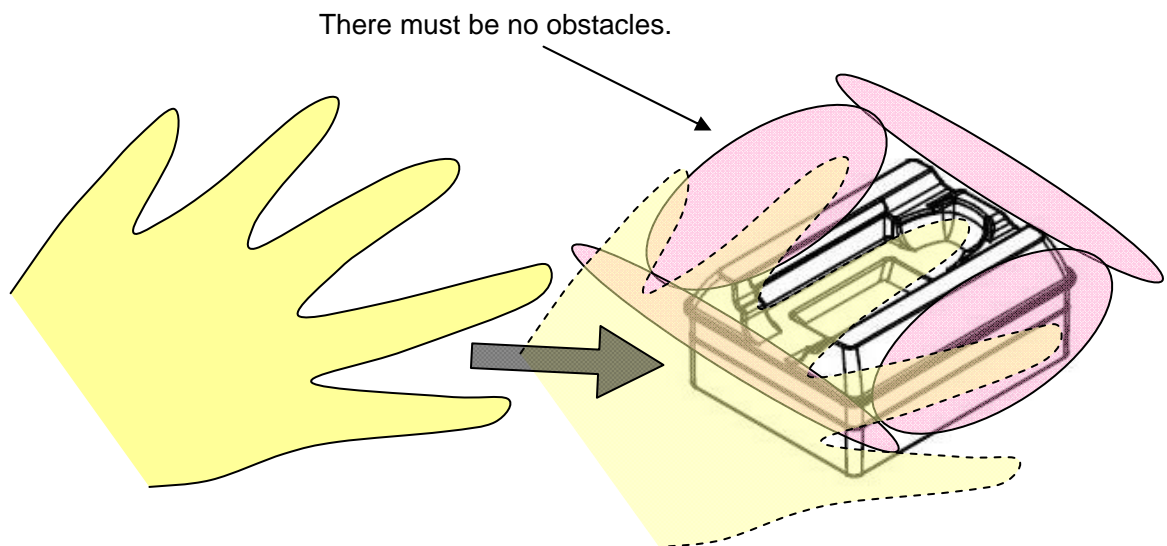
* “Strong light mode” is available only for PCT-KCC5031/9031.

- (2) When integrating a light source such as LED into the host device, design the host device so that the light from the light source will not enter the H2E’s scanning area.
- (3) Do not let the externally-irradiated light enter the H2E’s scanning area after it is reflected by the casing of the host device.
- (4) When a finger vein pattern is scanned, the near-infrared ray is emitted from the LED P.W.B. Part of the ray is reflected by the finger’s surface or the casing of the H2E. If the casing of the host device is structured to cover the H2E, the reflected ray is reflected again by the casing of the host device, and then the ray may enter the scanning area. To prevent such entry, take measures such as by designing the casing as an open device with minimum coverage possible, designing the structure in which the light will not enter the scanning area even if it is reflected, or using materials that will not cause near-infrared ray reflections.

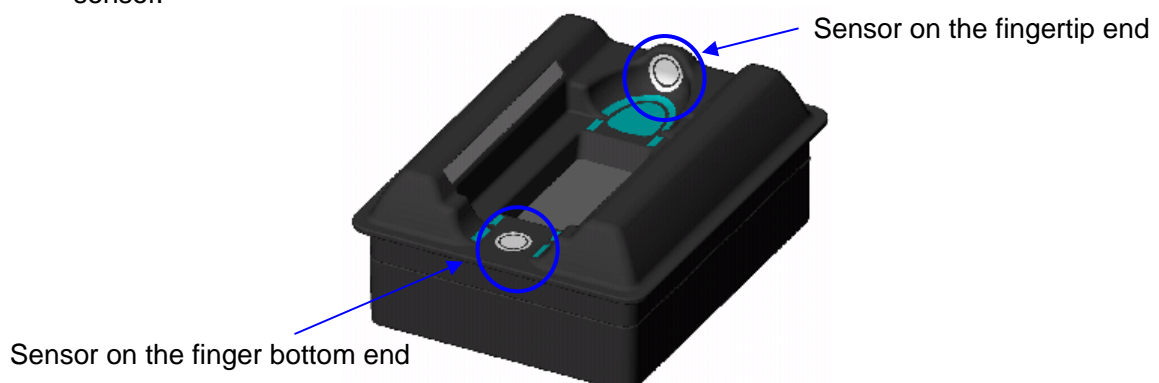
2-2. Warning: Integration

Depending on how the H2E is integrated, you cannot stably place your finger, possibly resulting in deterioration of the success rate of the verification.

- (1) Structure the host device so that you can stably place your finger on the same position each time. (For example, determine the angle of the H2E, depending on how high the H2E is to be installed.)
- (2) Allow clear space around the H2E so that you can lightly open your hand and place your finger. If other fingers contact any obstacle, you cannot stably place your scanned finger. (The other fingers should be naturally placed on both sides of the H2E.)



- (3) Allow enough room ahead of the tip of your scanned finger so that you can scan your finger even if you have long nails or artificial nails.
- (4) An embedded sensor detects placement of your finger. It is provided on each of the fingertip end and the finger bottom end of the finger plate (a total of two sensors). Design the host device so that nothing can block contact of your scanned finger to the sensor.

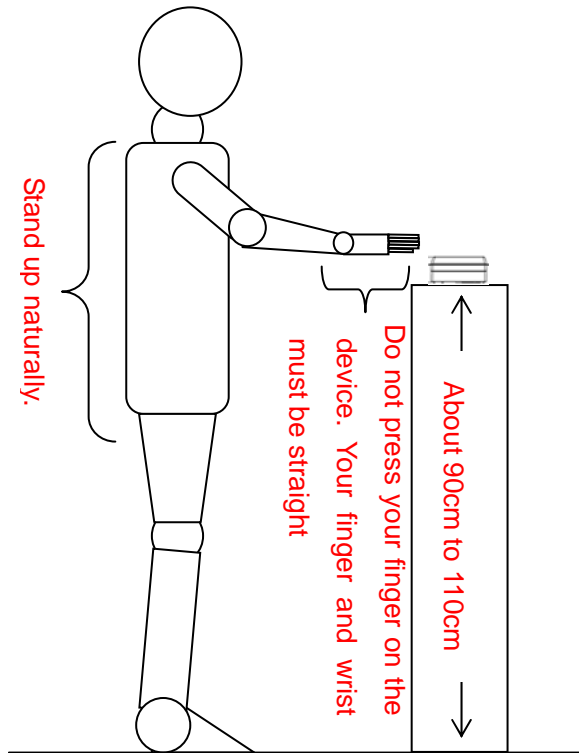


- (5) Design the host device so that it can include some components that provide information about the status of the H2E, such as a LED display, a buzzer or a display panel. Depending on your intended use, design the device so that it can display the users who are successfully verified and confirm individuals by clicking such as “Yes” or “OK” button to avoid false acceptance. (Example: time attendance machine, etc)
- (6) The H2E's waterproof performance corresponds to IEC IPX3. Waterproof the area where the H2E is integrated into the host device. (Example: packing)

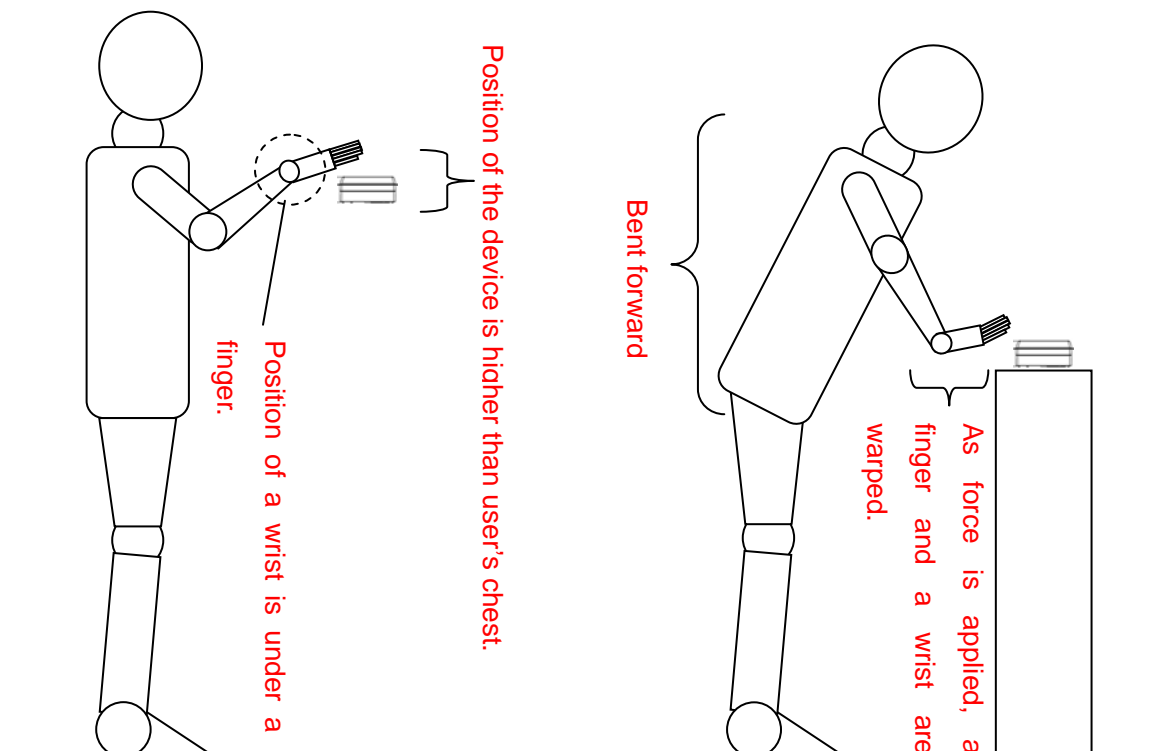
2-3 Other Cautions

- (1) Do not install the device where temperature drastically fluctuates, such as outdoor. The guaranteed range is between zero (0) degrees C and forty (40) degree C.
- (2) Do not install the device where humidity is extremely high or the device may be exposed to water (vapor) or oil (soot). The guaranteed range is between 20%Rh and 40%Rh.
- (3) Do not install the device in dusty environments. Normal office environmental usages are desirable.
- (4) Install H2E where unnatural force is not applied to finger or wrist. Installing position of H2E for enrollment and verification must be the same. Good and bad examples of the installing positions are shown as the following figure, when H2E is installed horizontally and enroll verify in a standing posture.

<Good example>

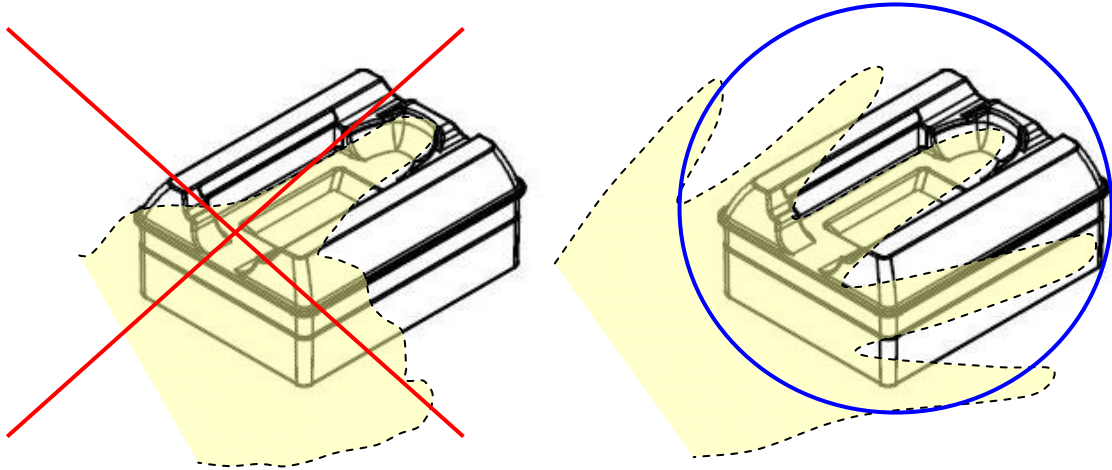


< Bad examples>



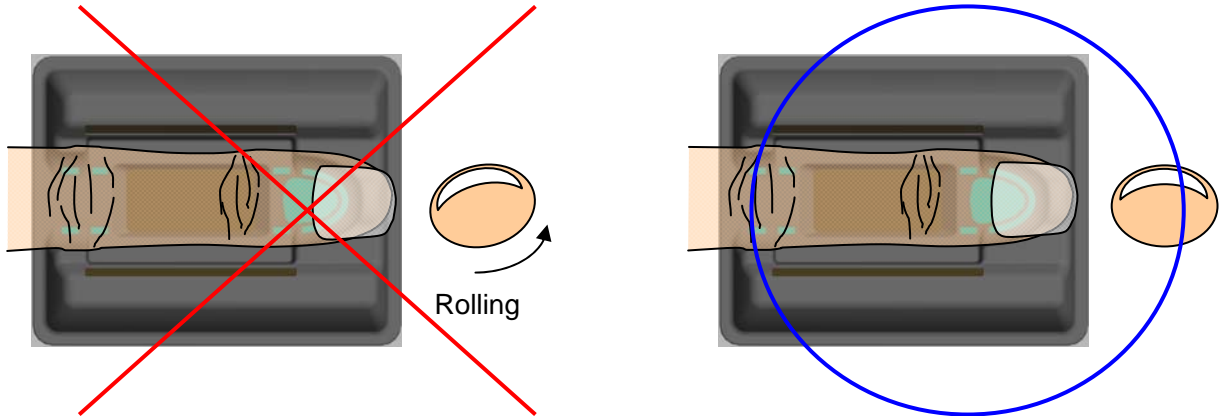
3. Caution for Enrollment and Verification

- (1) In order to stably place you finger, open your hand lightly, and then place your finger to be enrolled or verified. Enrolling or verifying with a finger holding up may deteriorate the success rate of the verification.

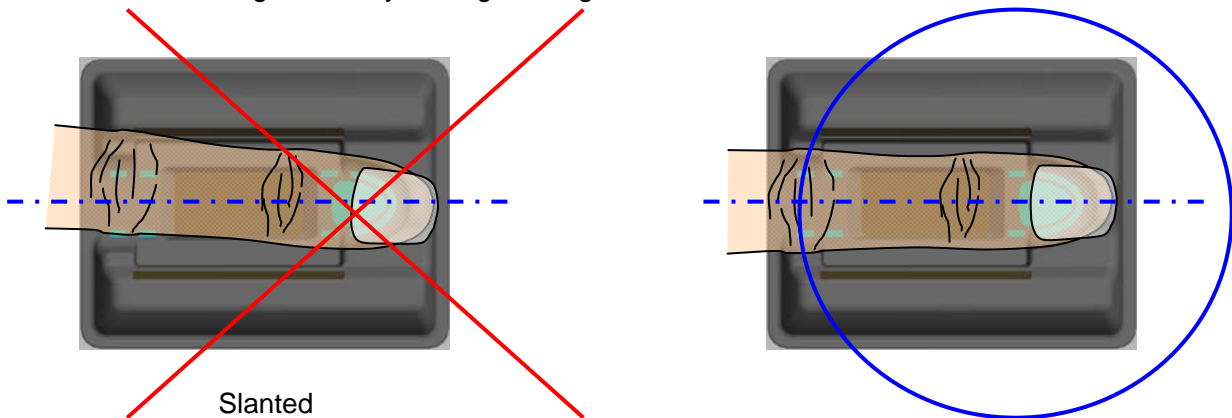


- (2) Enroll your finger with the following in mind. Depending on how you place your finger when enrolling, the success rate of the verification may deteriorate.

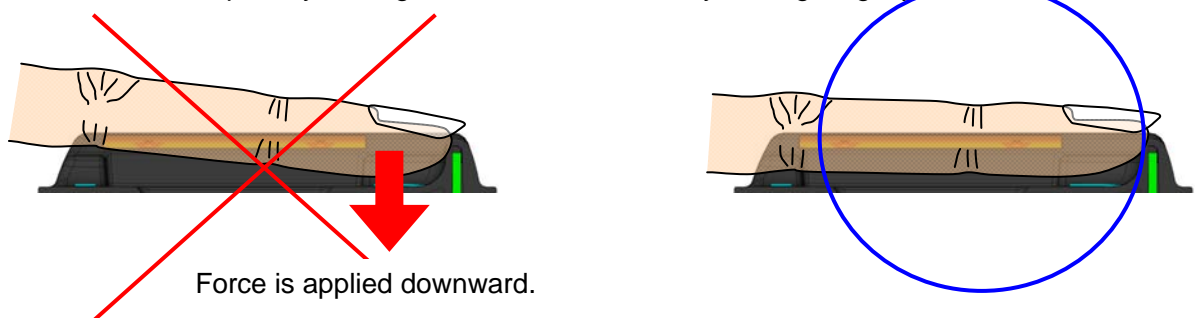
1. Place your finger straight without rolling it.



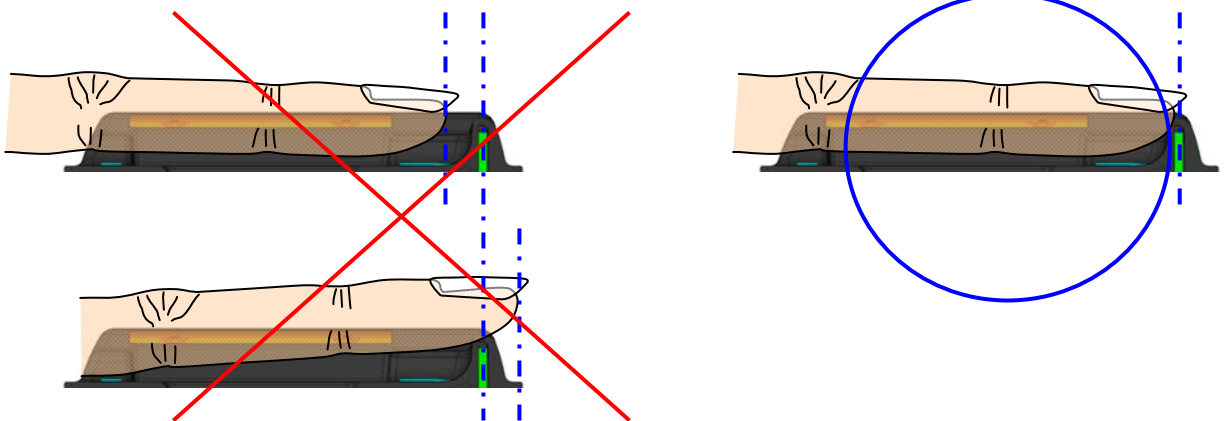
2. Align your finger with a blue finger-shaped guide. Do not rotate or slant your finger. Place your finger straight.



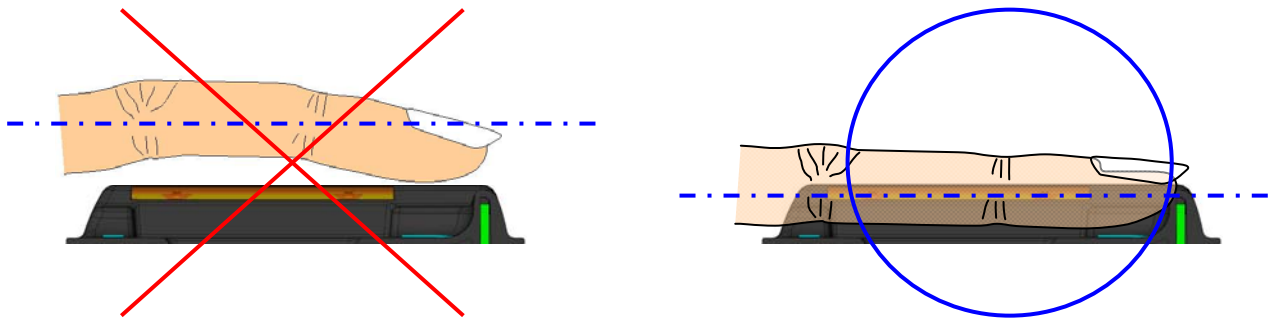
3. Do not press your finger on the device. Place your finger lightly.



4. Place your finger where your fingertip slightly comes in contact with the touch sensor on the wall of the finger plate end. (The position where you place your finger should be consistent.)



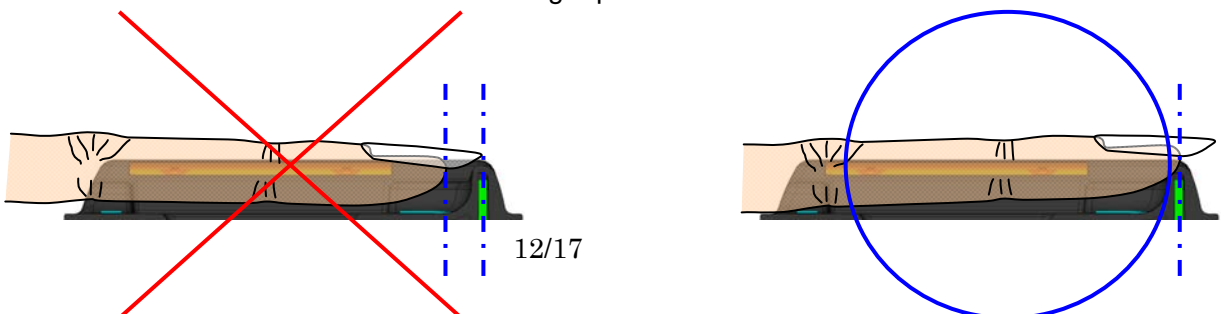
5. Place your finger so that your finger bottom will not rise. (If your finger bottom rises, the touch sensor at the bottom end may not be able to detect your finger.)



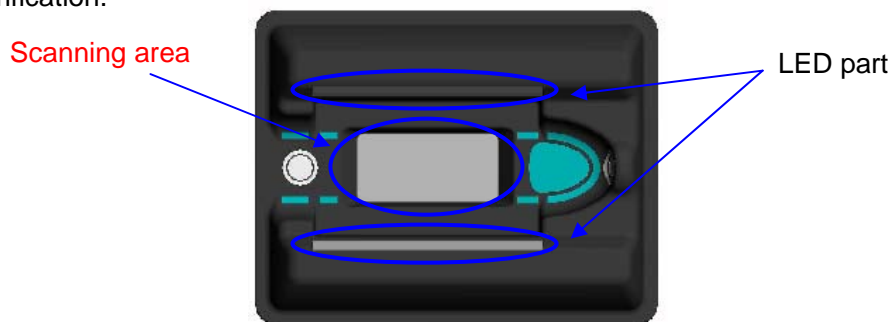
- (3) Place your finger in the same way as when you enrolled your finger. Otherwise, your finger may not be properly verified. If, for example, the finger was enrolled in a sitting posture and the user verified the finger in a standing posture, how much your finger joint bends and where your finger is placed may vary. That may result in deterioration of the success rate of the verification. Enroll your finger to the device under the same installation conditions as when verifying.

- (4) The H2E is designed to enroll and verify finger width ranging between 13mm and 25mm. Smaller or larger fingers than this range may not be properly enrolled or verified.

- (5) If your nail is long and your finger is small, your nail comes in contact with the fingertip end on the finger plate, possibly resulting in improper enrollment or verification. Place your finger where your fingertip slightly comes in contact with the touch sensor on the wall of the finger plate end.



- (6) If your finger has a cut, you have rough skin on your finger or your finger is dirty due to dust, etc, a proper vein image cannot be obtained, resulting in improper verification. Use another finger which has no cuts or rough skin, or clean your hand before verification.
- (7) Finger veins widen or narrow depending on body temperature. Therefore, if there is a considerable difference in temperature between when you enroll your finger and when you verify your finger, for example, enrolling your finger in a warm place and verifying it in a cold place, the success rate of the verification may deteriorate. Enrolling your finger at temperature similar to when your finger is verified is recommended.
- (8) Clean the scanning area and the LED part with a dry and soft cloth on a regular basis. The dirty scanning area or LED part may deteriorate the success rate of the verification.



- (9) Before using the H2E, have a training session to provide information mentioned above about enrollment and verification, and opportunity to practice. Using the H2E without providing these may deteriorate the success rate of the verification.
- (10) H2E has touch sensors at the fingertip end and finger bottom end to detect a finger. The sensors calibrate sensitivity by the specific time period. If a finger is placed for approx. 60 seconds, the calibration is executed and the sensors will not detect a finger even if a finger is actually placed. Therefore, do not keep placing a finger for long time.

4. Cautions: Designing Features

- (1) The enrolled data is saved in the flash memory built in the H2E. The flash memory has a finite number of save-and-delete cycles. Therefore, do not design your system that requires a lot of save-and-delete cycles. As frequent initialization may shorten the lifetime of the flash memory, it is recommended to delete in units of individuals or groups. (The lifetime of the flash memory is 100,000 write-and-delete cycles.)
- (2) The rated voltage of the power supply is $5V \pm 5\%$. Do not supply the voltage exceeding the

rated voltage.

- (3) Each signal for interface is 3.3V signal, except open collector pins. The maximum rating ranges from 0.3V to 3.6V. Do not apply the voltage exceeding the maximum rating.
- (4) TOUCH_OUT1 and TOUCH_OUT2 (open collector pins) have the maximum applied voltage of 24V and the maximum allowable current of 50mA (the peak value). They output a signal even when the power source in the unit is OFF (MAIN_PWR_ON ="L").
- (5) PASS_DRIVER (Open drain pin) has the maximum applied voltage of 24V and the maximum allowable current of 100mA (the peak value).
- (6) The guaranteed length of the interface cable is 200mm or shorter. Before using the cable that exceeds that length, check signal waveforms in a target device.
- (7) In order to prevent overheating or ignition of the interface cable, it is recommended that a current protective circuit should be implemented to the power supply part from the host device to the H2E.
- (8) The host device in which this product is integrated is classified into an information technology product. To ensure that the host device is not hindered by electromagnetic wave that is generated from nearby electronic devices, you need to check electro magnetic sensitivity (hereinafter referred to as EMS). To check EMS, conduct the immunity test with the H2E integrated into the host device.
The host device with H2E must comply with the EMS standards of each country it is being shipped to.
- (9) The host device in which this product is integrated is classified into an information technology product. The acceptable value and measurement method of electro magnetic interference (hereinafter referred to as EMI) that is generated from the information technology product are defined as a standard of each country (FCC for USA, CE for EU, VCCI for Japan C-Tick for Australia etc.). The host device with H2E must comply with the EMI standards of each country it is being shipped to.
- (10) If the host device cannot comply with the EMI standard value because of the integration of the H2E, it is recommended that you take measures against EMI, such as by adding an EMI filter to interface signals, or attaching a ferrite core to the interface cable. If the EMI filter is added, signal wave is affected by the EMI filter. Therefore, with the H2E integrated into the host device, check the signal wave.

(11) The lifetime of the H2E is 5 years.

In order to extend the lifetime of the H2E to that of the host device, implement functionalities to, for example, turn off the H2E when it is not used, into the host device.

(12) The enrolled data is saved in a flash memory built in the H2E. In order to prevent alterations, which are made by replacing H2Es, etc, ensure the security of the device on the host device by taking measures, such as by checking the H2E's serial number.

(13) The enrolled data saved in the flash memory is encrypted. However, it is recommended that you initialize the device before disposing of it.

(14) Verification may fail due to, for example, the way you place your finger. It is recommended that you retry verification twice (to improve the usability).

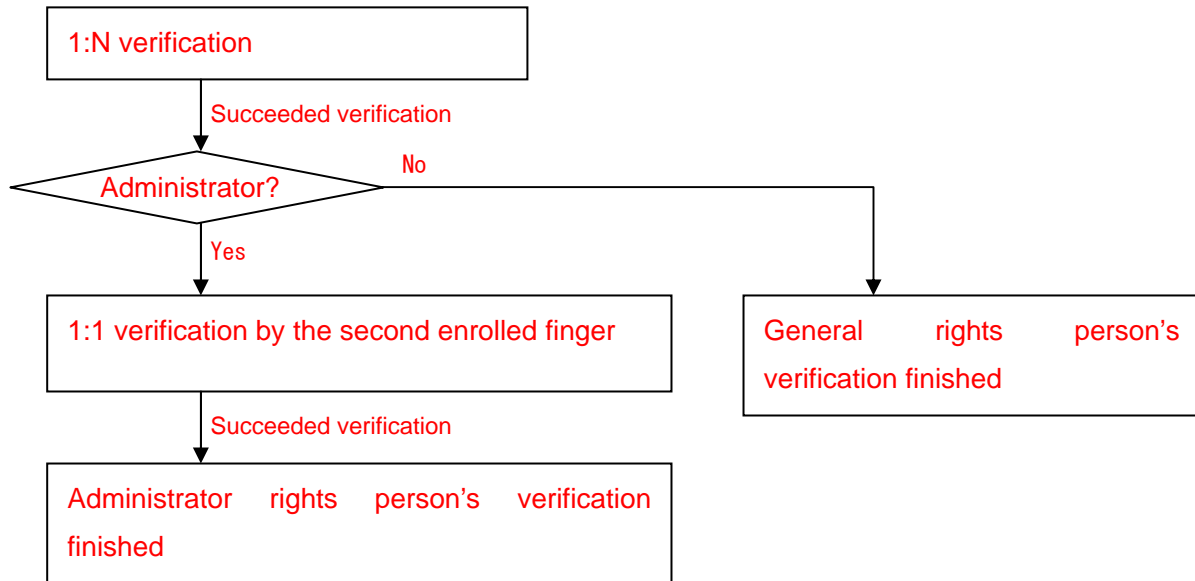
(15) Before switching between the enrollment modes, initialize the device, and then enroll fingers again. Note that if the enrollment modes are not consistent, backup and restore cannot be made. (There are two enrollment modes: two-image enrollment and three-image enrollment. The default is two-image enrollment.)

(16) Regardless of your usage purpose, 1:1 verification is recommended. Especially, for the purpose that requires a high level of the security, avoid 1:N verification. (Example: money related application such as currency settlement)

If the number "N" of 1:N verification is bigger, possibility for false acceptance becomes higher. If you must use 1:N verification, divide persons by such as department, or group to reduce N. At least N must be less than 150 for 1:N verification for enroll mode 02 or C2. Further, an administrator should be classified by verifying more than once by enrolling plural fingers to avoid false acceptance.

Reference: 1:360 verification by C2 mode takes approximately six seconds maximum.

<An example flow chart to verify twice by enrolled two fingers >



Theoretical false acceptance rate would be the following when 150 fingers are enrolled.

Administrator: 0.0000015 (150/10 billion or 1.5/100 million)

General user: 0.15% (150/100 thousand)

The above ratio is theoretical calculated value and it is not guaranteed.

(17) For unexpected events, design the host device so that it can operate with other methods other than the H2E.

(18) If an error occurs in the H2E, the internal reset automatically gets activated, and sends the response, which is stated in Section 2.2 (1) in the Serial Interface Specification document, to the host device. Therefore, if the host device receives the response in any other situation than immediately after the power is supplied, the host device should know that an error occurs in the H2E.

(19) Verification level information obtained by "Verification" command is used to lead a user to place a finger at the right position or judge re-enrollment by checking daily verification level.

- There are three verification levels, 03h means verification was succeeded with enough margins. 03h:Best, 02h: Good, 01h:Passed
- "Verification level information" is available only for PCT-KCC5031/903.

(20) Template quality information obtained by "Enroll template data" command tells quality of template data when a finger is placed. For example, practice of finger placement can be made with this information. It can be used to choose the best finger to verify by an administrator. The template quality varies depend on placement of a finger such as pressing force and stain on a finger or other condition of a finger. Thus, template quality

information is not absolute one, but general direction.

- There are five template quality levels, 05h means the template quality is the best.
- "Verification level information" is available only for PCT-KCC5031/903.

(20) The template data of PCT-KCC5031/903 is not compatible with PCT-KCC5001/PCT-KCC9001, PCT-KCC5011/PCT-KCC9011 and PCT-KCC5021/PCT-KCC9021.

Therefore H2E with firmware version 02-01 can not accept the backedup data by firmware version 01-**.

5. Operational Warnings

Be sure to design your system according to the specifications. Otherwise, the following matters may occur.

- (1) If the power supply stops when the BUSY signal is "High":

Because the H2E saves the enrolled data in the built-in flash memory, the BUSY signal is "High" while the memory is being accessed. If the power supply to the H2E is terminated when the BUSY signal is "High", or the power stops due to the MAIN_PWR_ON signal, the power supply stops while the flash memory is being accessed. This may corrupt the enrolled data in the memory. Format the flash memory and restore the enrolled data by using the backed-up data, or enroll fingers again.

- (2) If the VCC voltage does not rise within T6 (5ms at maximum):

Switching the power supply to the H2E on or off is controlled by the MAIN_PWR_ON signal, so if T1 (0ms at minimum) is satisfied, there will be no problem. However, because the power supply to the sensor is directly connected to VCC, if the VCC voltage does not rise within T6, this may result in malfunction of the sensor. Be sure to design your system to satisfy the specifications of T6.

- (3) If RESET is input within T5 (5ms at minimum):

The finger vein LSI in the H2E integrated is not properly reset, resulting in malfunction. Be sure to design your system to satisfy the specifications of T5.

- (4) If the H2E issues a new command before receiving a response for the previous command:

The H2E may not be able to receive the command issued by the host device. Design your system so that the host device must check the response from the H2E before issuing the next command.