

## RX231 Group

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## Human Machine Interface Solution Kit R0K5RX231D000BR

### Overview

This document is the user's manual for the Human Machine Interface Solution Kit (R0K5RX231D000BR). R0K5RX231D000BR (also referred to as the HMI Solution Kit herein) uses the Renesas Electronics Corporation RX231 32-bit microcontroller and Smart Analog IC. The HMI Solution Kit board serves as a demo and evaluation system for USB, LCD, touch key, voice record & playback, and motion detection functions and low-power operations.

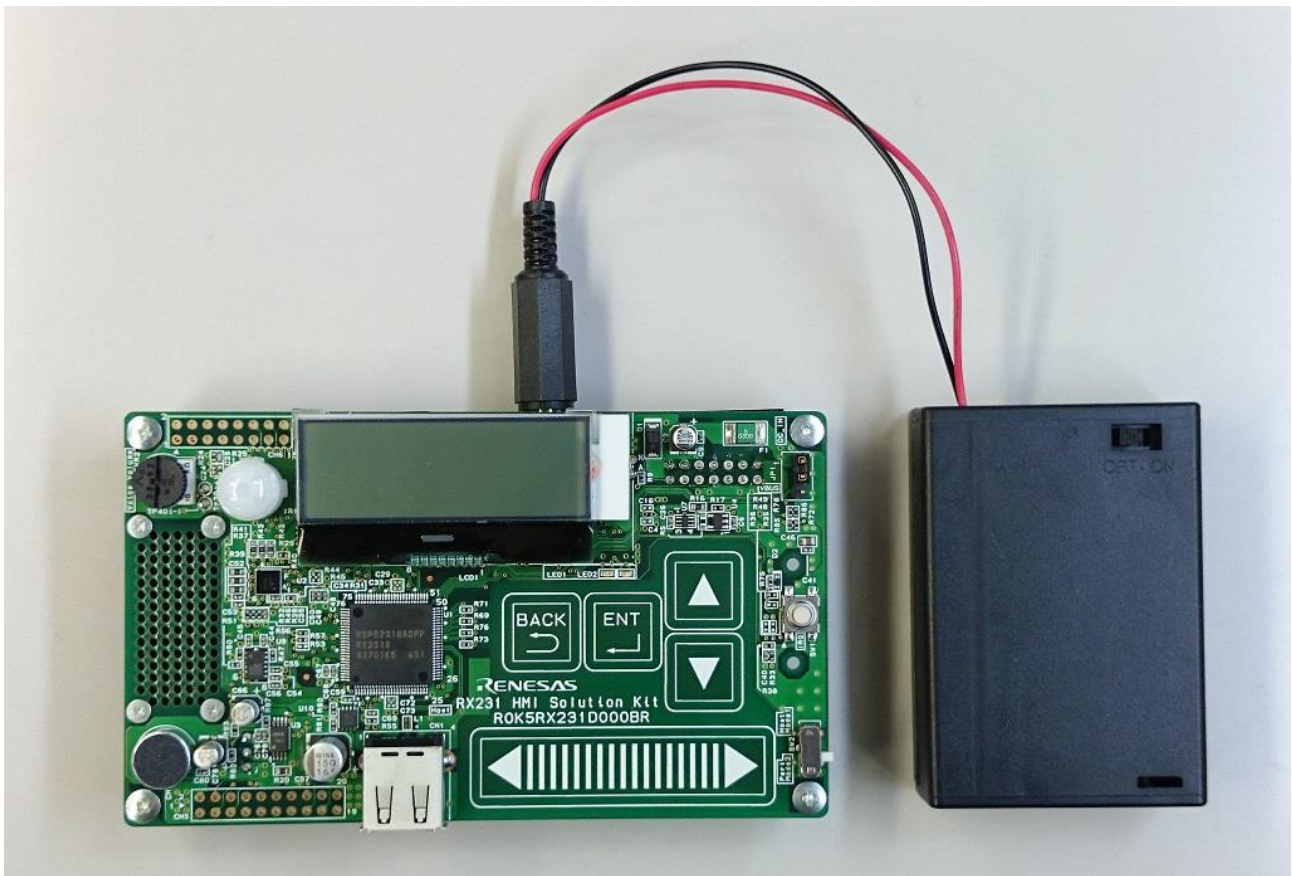
#### (1) Demo applications

Demo programs are preloaded before shipment; the R0K5RX231D000BR is ready for immediate use.

- Low-power demo: power-saving example of device using wake-up upon motion detection
- Voice record & playback demo: voice memo and pre-set sound replay based on MCU software

#### (2) Evaluation Applications

- Software development using Kit system hardware
- Function expansions to MCU or Smart Analog IC using connectors CN3, CN5 and CN6
- Sensor mediation through Workbench6: Integrated Development Environment for Renesas Capacitive Touch
- Debugging via E1 emulator. Programming in USB boot mode.



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## Introduction

Thank you for purchasing the Renesas Electronics Corporation RX231 Human Machine Interface Solution Kit (R0K5RX231D000BR).

Before using this kit, check the contents of the package as listed in the “Package Contents” section in the release notes included with the product.

If you have any questions about this produce, contact Renesas Electronics Corporation, Renesas System Designs, or a licensed distributor.

## Related Manuals and Application Notes

Refer to the manuals and application notes listed below as needed when using this product.

RX231 User’s Manual: Hardware (R01UH0496EJ)

<http://www.renesas.com/products/mpumcu/rx/rx200/index.jsp>

Renesas USB MCU USB Basic Mini Firmware (R01AN 2166EJ)

[http://www.renesas.com/products/tools/middleware\\_and\\_drivers/c\\_driver/usb\\_driver/app\\_notes.jsp](http://www.renesas.com/products/tools/middleware_and_drivers/c_driver/usb_driver/app_notes.jsp)

## 1. Important Notes

Read this document carefully before using this product.

What this product is:

The term “this product” as used in this document refers to the following product manufactured by Renesas Electronics Corporation. The term “this product” does not include the customer’s user systems or host machines.

- a) RX231 Human Machine Interface Solution Kit (R0K5RX231D000BR)

### Intended uses:

This product is a demo plus evaluation board product for demonstrating the features of the Renesas Electronics Corporation RX231 32-bit microcontroller.

This product should only be used for these purposes.

### Intended users:

This product should only be used by persons who have read and understood this document. A basic knowledge of electrical circuits, logic circuits, and microcontrollers is required to use this product.

### When using this product:

- (1) Renesas assumes no responsibility for the results of customer development projects using this product.
- (2) Renesas will, in response to defects or problems found in this produce, either suggest workarounds or repair said defects, either for a fee or without charge. However, in no case will Renesas guarantee the suggested workaround or repair.
- (3) When this product is used in Japan, it is not subject to laws concerning electrical safety or electromagnetic interference.
- (4) Renesas cannot foresee all possible conditions or usages that have hidden dangers. Therefore, the warnings in this document and the warnings attached as labels to the product do not cover all cases. The customer must take responsibility for using this product safely.
- (5) This product has not been approved under UL, or any other, safety standards, nor under IEC or other similar standards. Therefore, if this product is transported outside Japan, the user must be fully aware of this point.
- (6) This product may not be included in a user end product for mass production.
- (7) If a problem occurs in a device included in this product, Renesas will not replace it with product in which the device problem has been resolved.
- (8) Operation with all connected USB devices is not guaranteed.
- (9) The application notes and sample programs provided with this product are all provided for reference purposes only. Their operation is not guaranteed. These should only be used as reference materials when the customer is developing their own software.

**Usage restrictions:**

This product may only be used for verifying the functions of the RX231 microcontroller.

Thus it may not be embedded in a customer's end product for mass production. Furthermore, this product may not be used for the following development purposes.

1. Transportation or mobile applications
2. Medical applications (equipment on which a human life depends)
3. Aerospace applications
4. Nuclear power control applications
5. Submarine repeater/relay applications

Customers who are considering these types of application should contact Renesas Electronics Corporation, Renesas System Design, or a licensed distributor.

**Product modifications:**

Renesas has a policy of continually improving this product. Therefore the specifications, design, and documentation of this product are subject to change without notice.

**Rights:**

1. Renesas will accept no responsibility for any damage, or any infringement of patent or any other rights, arising from the use of any information included in this document, or the use of this product or these circuits.
2. This document does not grant the user any license for patent rights or any other rights belonging to Renesas or any third party.
3. All rights concerning this document and this product (R0K5RX231D000BR) remain the property of Renesas Electronics Corporation.

**Figures:**

Parts of the figures in this document may differ from the actual product.

**Guarantee:**

Renesas will replace this product without charge if any defect is found within one month of purchase. In all other cases, this product is provided "as is" and no repair, analysis, etc. are supported.

## 2. Safety Items

### 2.1. Definitions of Symbols

A variety of symbols are used in this document and on the product itself to prevent in advance danger to you the user or any third parties and to prevent in advance damage to any physical property.

This section, Safety Items, presents these symbols and their meanings. It also presents safety notes to assure that this produce is used safely and correctly.

This product should only be used after fully understanding the material presented in this section.



Warning items indicate things that, if not avoided, could lead to death or serious injury.



Caution items indicate both latent dangers that can lead to minor or moderately severe injury and latent dangers that can lead to property damage if not avoided.

In addition to the above two markings, the following are displayed at the same time if appropriate.

**[Important]** Indicates a point that can lead to equipment failure or malfunction if incorrectly set when setting up this product.

A triangular mark  $\triangle$  indicates a warning or caution.

Example:



The  $\odot$  mark indicates something that is forbidden.

Example:



## 2.2. Warnings

### Warning

#### Battery related warnings:

##### Warnings:

Do not use or place batteries near an open flame or fire, near a stove, or in any other high-temperature location. Also, do not disassemble, modify, or directly solder to batteries. These can lead to leakage of battery fluids, internal heat generation, rupture, or ignition of batteries.

When connecting batteries to this product, do not use unreasonable force if it is difficult to connect the battery. Always check the battery polarity before connecting. This can lead to leakage of battery fluids, internal heat generation, rupture, or ignition of the battery.

Do not apply flames or other heat sources to batteries. Batteries may explode if heated. Do not hammer, nail, or step on batteries. Batteries may explode if mechanical force or shock is applied.

Do not connect a battery's plus (+) and minus (-) terminals together with a wire or any object made of metal. Do not transport or store batteries along with metal objects. These can lead to leakage of battery fluids, internal heat generation, rupture, or ignition of the battery.

If any battery fluids leak out of the battery and get on your skin or clothes, immediately wash the battery fluids away completely with water. Battery fluids can cause skin burns and other harm. If any battery fluid gets in your eyes, it can cause blindness. In the event that battery fluids get in your eyes, wash your eyes with water thoroughly and seek medical attention immediately.

Do not allow water or other fluids to get onto a battery. This can cause battery heating, the risk of electrical shock, or failure of the battery. Keep this in mind when considering battery usage location and handling.

If a battery leaks or emits an unusual odor, immediately remove it from the vicinity of any flame or spark. A flame or spark may ignite the leaked battery fluid and cause a fire or rupture of the battery.

#### Handling related warnings:

Do not disassemble or modify this product. Renesas does not guarantee this product if it has been disassembled or modified.

The power supply for this product can be selected to be either the USB bus or a DC jack. A jumper is used to select the power supply. Always check the jumper position before connecting a power source. An incorrect jumper position can lead to leakage of battery fluids, internal heat generation, rupture, or ignition of battery or damage to this evaluation board itself or any USB connected equipment.



This product does not include any battery charging functionality.

If, during either use or storage of this product, any abnormality in the product itself (including abnormal odors, heating, color changes, or shape changes to the product itself) are observed, disconnect the USB cable and power supply cable immediately.

When such an abnormality occurs, it may result in heating, rupture, or ignition of the battery. Therefore, do not continue using this product. Contact either Renesas Electronics Corporation, Renesas System Design, or a licensed distributor.

#### Installation:



Do not install this equipment in a location that has a high humidity or where water or other fluids could get on it. This equipment may be damaged if water or other fluids could get on it.

#### Ambient temperature:



The upper limit for the ambient temperature under which this product may be used is 35°C. This maximum rated ambient temperature must not be exceeded.

## 2.3. Cautions

### **Caution**

#### Handling:

This product must be handled carefully. Do not drop, knock over, or apply any strong mechanical shocks to this product.

Do not touch this product's connectors or component pins with bare hands. Internal components may be damaged by electrostatic discharge.

When connecting or disconnecting cables from this product, hold the parts of the cable intended to be grasped (such as the plugs) and avoid putting stress on the cable. Do not pull on this product when it is connected to a communications cable or user system connection cable. Stress on the cable can result in internal disconnections in the cable. When connecting a cable to a connector, be careful not to insert the plug in the reverse orientation. Reverse insertion can result in damage to this product itself or to connected equipment.

The power supply for this product can be selected from two options (the provided battery box or the USB cable). The jumper J1 (on the back side of the circuit board) is used to select the power supply. Always check the jumper position before connecting a power source. An incorrect jumper position can result in damage to this product or the PC connected over the USB cable.

Do not handle this product with wet hands. This can lead to failure of the product.



#### Transport methods:

When transporting this product, use the product's packing box and cushioning materials and ship it with precision equipment handling. If the product's packing is insufficient, it may be damaged during shipping.

If it must be transported by some other method, pack it carefully as precision equipment.

When packing this product, always use the antistatic pouch included with this product.

If some other pouch is used, damage to the product may be caused by electrostatic discharge.



#### Abnormal operation:

If operation of this product becomes abnormal due to interference from, for example, external noise, apply the following procedure.

1. Turn off the power.
2. Wait 10 seconds and then turn the power back on.



#### Disposal:

When disposing of this product, handle it as industrial waste according to all applicable laws.

To dispose of batteries, follow the instructions of the local government that collects batteries for disposal or recycling.



#### European Union regulatory notices:

The WEEE (Waste Electrical and Electronic Equipment) regulations put responsibilities on producers for the collection and recycling or disposal of electrical and electronic waste. Return of WEEE under these regulations is applicable in the European Union only. This equipment

(including all accessories) is not intended for household use. After use the equipment cannot be disposed of as household waste, and the WEEE must be treated, recycled and disposed of in an environmentally sound manner.

Renesas Electronics Europe GmbH can take back end of life equipment, register for this service at "<http://www.renesas.eu/weee>".





### 3. Specifications

Hardware specifications for R0K5RX231D000BR are shown in Table 3.1 and the functions realized by the product using the MCU software included in this product are described in general in Table 3.2.

**Table 3.1 Hardware Specifications**

Item	Description		Remarks
Catalog number	R0K5RX231D000BR		
Power supply	[1]DC jack (J1) Center plus	a. Battery box (three AA batteries) b. AC adapter (sold separately) *1	Select [1] or [2] using JP1 jumper. Refer to 5.1.1 for details.
	[2]USB micro-B (CN2)	c. USB bus-powered	
Input voltage	3.5V-5.5V		
Current drain	Max: 300mA		
Dimensions	Main unit: 120 x 70x27mm, Battery box: 70 x 48 x 20mm		
Environmental conditions	Operating: 10 to 35°C, storage: -10 to 50°C		No condensation
Microcontroller	R5F52318ADFP(ROM:512KB, RAM:64KB, 100LQFP)		RX231
Smart Analog IC	RAA7301013CBG		SAIC101
Flash memory	MX25L6433FM2I-08G (64Mbit)		SPI communication
Standard interface	USB Standard-A (CN1)		Refer to Note 2, Note 4
	USB micro-B 8 CN2)		Refer to Note 4
Evaluation interface	CN3: for wireless module evaluation (24 5602 024 000 829 H+) CN5,CN6: for function expansion (2.54mm pitch through-hole)		Refer to Note 2
Debugging interface	E1 connector (CN4)		Refer to section 5.3
Sensors	Pyroelectric infrared sensor		Detected by SAIC101
	Acceleration sensor		Detected by MCU
Display	LCD displays: 1 (16 characters x 2 lines)		I2C communication
	LED displays: 2, (LED1 - green, LED2 - orange)		
Key input	Cap touch (4 buttons, 1 slider)		
	Mechanical push button (interrupt : SW1, reset: SW3) Mechanical slide (mode switch: SW2, USB boot: SW4)		
Voice record/playback (S/W encoding/decoding)	Playback	1.2 W power amp (TS49901ST) Circuit board mounted speaker or earphone jack (J3, φ3.5mm, monaural)	Refer to Note 3
	Recording	Capacitor microphone, Op-amp (HA1630D06TEL-E)	
Music playback	16-bit audio DAC ((PCM1774RGPT) 40mW+40mW headphone output (J2, φ3.5mm, stereo)		Refer to Note 2
Current measurement	Current measurement of Board power supply (3.2V)		
Oscillation device	Oscillator: 16 MHz, 32.768kHz; oscillation (module) 11.2896MHz		

Note 1: When using an AC adapter, make sure it meets the following specifications:

Plug shape: external diameter 5.5mm, internal diameter 2.1mm

Electrical specifications: 5V±5%, 0.5A or higher, Center plus

Modifying the software (especially values corresponding to the USB host) will change current consumption as well. Make sure current specification meets all requirements.

Note 2: Not supported by the standard software included in this product. The user must provide the appropriate software to use this function.

Note 3: The volume adjustment knobs VR1 and VR2 reduce volume when turned to the left and increase volume when turned to the right. Turning this knob beyond its normal range of operation will cause damage to the product. Do not use excessive force when using.

Note 4: Don't connect USB cable to CN1 and CN2 at the same time. This can lead to failure of the product.

**Table 3.2 Function Outline (Software Version: V1.00)**

Item	Description	Remarks
Startup modes (select from three types)	1) Normal mode Demo applications can be used on the HMI Solution Kit as is. Connect the board to the user PC with a USB connection to employ Workbench6 (Integrated Development Environment for Renesas Capacitive Touch) (Note 1).	Select the operating mode at startup. Refer to section 5.1.2
	2) Storage mode The on-board flash memory can be used as a USB memory when the board and user PC are connected with a USB connection.	
	3) USB boot mode MCU's can be reprogrammed using the Renesas FLASH Programmer when the board and PC are connected using a USB connection. (Note 2)	
Startup mode descriptions		Refer to section 5.2
1) Normal mode		Refer to section 5.2.1
Low-power demo	Low-power operations demonstration using a motion detection sensor (pyroelectric infrared sensor, acceleration sensor) •Normal operating state: all board internal power supplies are set to ON. If motion is not detected for the set period, the mode goes to low-power 1 state. •Low-power 1 state: LCD display back lighting turns off. If motion is not detected for another set period, the mode goes to low-power 2. Returns to normal operating mode when motion is detected. •Low-power 2 state: Suppresses power consumption for some of the embedded circuits to a level even lower than low-power 1 state. Press SW1 to return to normal operating mode.	Refer to section 5.2.1.1  LCD indicates consumption current of board's internal power supply (3.2V). Use SW2 to enable/disable motion detection function of pyroelectric infrared sensor.
Voice recording demo	a. Voice playback Plays back voice data stored in MCU memory before product shipment. (Note 3).	Refer to section 5.2.1.2
	b. Voice record/playback Records up to 10 seconds of voice with on-board microphone, and plays back recorded voice. Recorded data is stored in flash memory.	Refer to section 5.2.1.2
System controls	a. Time setting	Refer to section 5.2.1.3
	b. Software version confirmation	Refer to section 5.2.1.4
	c. Low-power state transition time selection	Refer to section 5.2.1.5
	d. Pedometer	Refer to section 5.2.1.6
	e. Touch key adjustments	Refer to section 5.2.1.7
2) Storage mode	*Same as "Startup modes" above.	Refer to section 5.2.2
3) USB boot mode	*Same as "Startup modes" above.	Refer to section 5.2.3

Note 1: Refer to Renesas website for details on Workbench6 (Integrated Development Environment for Renesas Capacitive Touch).

[http://renesas.com/applications/key\\_technology/human\\_interface/touch\\_sensor\\_system\\_2gen/child/technology\\_child.jsp](http://renesas.com/applications/key_technology/human_interface/touch_sensor_system_2gen/child/technology_child.jsp)

Note 2: Refer to Renesas website for details on Renesas FLASH Programmer.

[http://www.renesas.com/products/tools/flash\\_prom\\_programming/rfp/index.jsp](http://www.renesas.com/products/tools/flash_prom_programming/rfp/index.jsp)

Note 3: Renesas Electronics Corporation holds all rights to the voice data provided with this product. Use of this voice data anywhere else is strictly prohibited.

### 4. Part Names

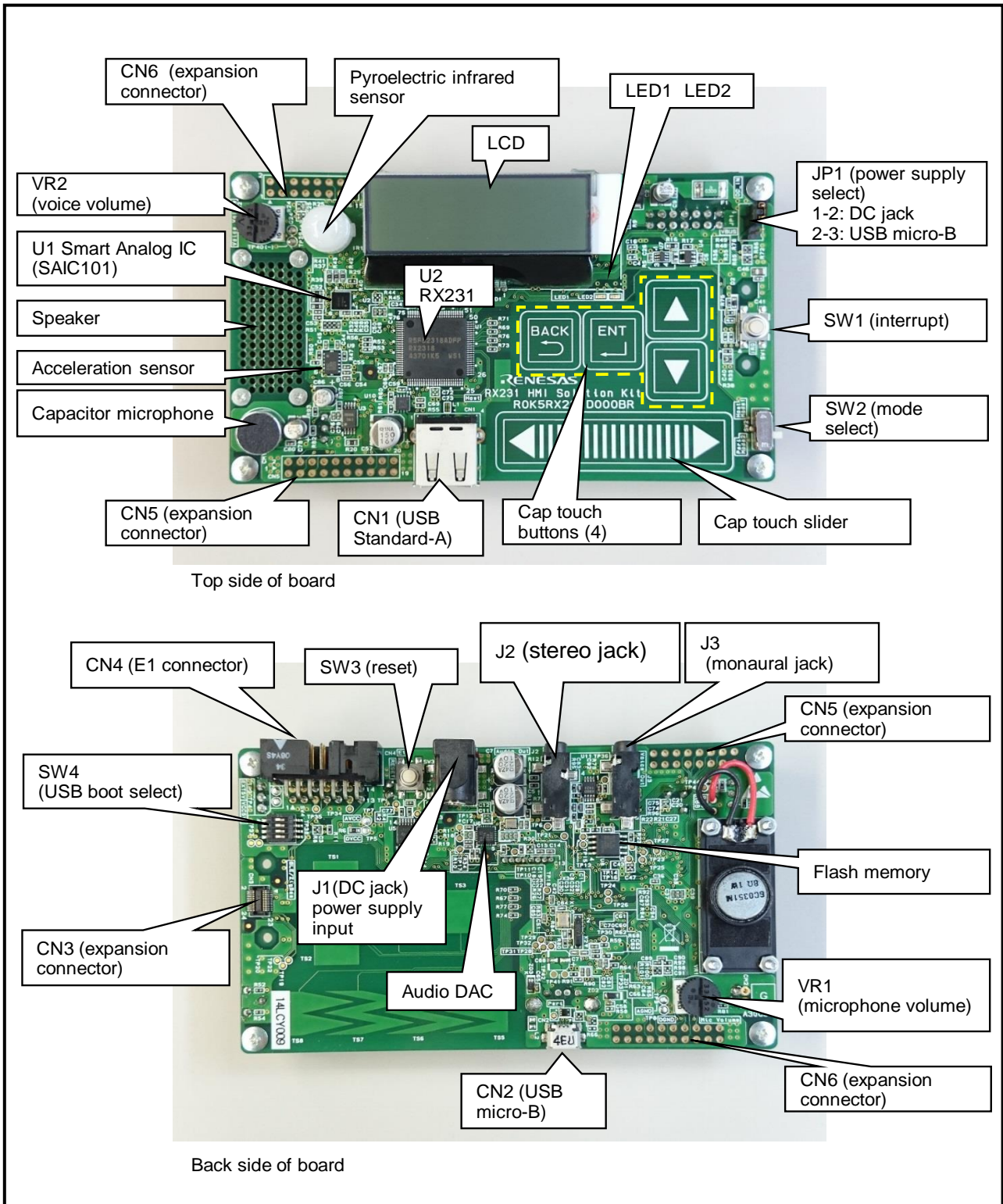


Figure 4.1 Circuit Board Part Names

## 4.1. RX231 and Expansion Connector Pin Assignments

The HMI Solution kit is equipped with expansion connectors (CN3, CN5, and CN6) for function expansion and user evaluation.

### 4.1.1. RX231 Pin Assignments

**Table 4.1 RX231 Pin Assignments**

Pin No.	Pin Name (Note 1)	Pin No.	Pin Name (Note 1)	Pin No.	Pin Name (Note 1)	Pin No.	Pin Name (Note 1)
1	VREFH	26	CN5:7	51	PC1	76	CN6:7
2	DA0	27	Test PAD	52	PC0	77	CN6:8
3	VREFL	28	Test PAD	53	SMOSI9	78	CN6:9
4	MTIOC3C	29	Test PAD	54	SMISO9	79	Test PAD
5	VCL	30	USB0_VBUS	55	SCK9	80	Unused pin (Note 2)
6	VBATT	31	Test PAD	56	PB4	81	IRQ5
7	MD/FINE	32	USB0_OVRCURA	57	PB3	82	Test PAD
8	XCIN	33	P13	58	PB2	83	CN5:6
9	XCOUT	34	CN5:3	59	SSDA6	84	PD2
10	RES#	35	VCC_USB	60	VCC	85	IRQ1
11	XTAL	36	USB_DM	61	SSCL6	86	IRQ0
12	VSS	37	USB_DP	62	VSS	87	AN007
13	EXTAL	38	VSS_USB	63	PA7	88	AN006
14	VCC	39	TS15	64	SSIWS0	89	AN005
15	UPSEL	40	TS16	65	PA5	90	AN004
16	CN5:5	41	TS17	66	SSITXD0	91	AN003
17	CN5:4	42	TS18	67	PA3	92	CN5:16
18	USB0_VBUSEN	43	TS19	68	PA2	93	CN5:15
19	CN5:12	44	TS20	69	SSISCK0	94	VREFL0
20	CN5:10	45	UB	70	CN6:10	95	AN000
21	CN5:13	46	TS22	71	CN6:6	96	VREFH0
22	CN5:14	47	TS23	72	CN6:5	97	AVCC0
23	CN5:11	48	TSCAP	73	CN6:4	98	Test PAD
24	CN5:9	49	CN3:10(TXD5)	74	CN6:3	99	AVSS0
25	CN5:8	50	CN3:12(RXD5)	75	AUDIO_MCLK	100	DA1

Note 1: Pin names indicated here are specific to this product.

Refer to the RX231 hardware manual for explanation of the RX231 pin functions.

Note 2: In product's default state, the open pin can be wired as CN3:16 by mounting a resistor.

### 4.1.2. Expansion Connector CN3

The CN3 connector is manufactured by Kyosera (type number: 24 5602 024 000 829 H+).

**Table 4.2 CN3 Pin Assignments**

Pin No	Connection Destination	Remarks	Pin No	Connection Destination	Remarks
1	DGND	Digital GND	2	DVCC	Digital power supply (3.2V)
3	—		4	—	
5	—		6	—	
7	RESET	Board reset	8	—	
9	—		10	U1:49	
11	—		12	U1:50	
13	—		14	—	
15	—		16	—	When R48 is mounted: U1:80 (Note 1)
17	—		18	—	
19	—		20	—	Test PAD
21	DGND		22	—	
23	—		24	DVCC	Digital power supply (3.2V)

“—” indicates the pin is not connected.

Note 1: Mount a 0Ω resistor as noted in the comments to connect to signal U1.

### 4.1.3. Expansion Connectors CN5 and CN6

CN5 and CN6 are 2.54mm-pitch, double-row through-hole connectors.

**Table 4.3 CN5 Pin Assignments**

Pin No	Connection Destination	Remarks	Pin No	Connection Destination	Remarks
1	DVCC	Digital power supply (3.2V)	2	DGND	Digital GND
3	U1:34		4	U1:17	
5	U1:16		6	U1:83	
7	U1:26		8	U1:25	
9	U1:24		10	U1:20	
11	U1:23		12	U1:19	
13	U1:21		14	U1:22	
15	U1:93		16	U1:92	
17	—	When R53 is mounted: U1:91 (Note 1)	18	—	
19	—		20	—	

“—” indicates the pin is not connected.

Note 1: Mount a 0Ω resistor as noted in the comments to connect to signal U1.

**Table 4.4 CN6 Pin Assignments**

Pin No	Connection Destination	Remarks	Pin No	Connection Destination	Remarks
1	DVCC	Digital power supply (3.2V)	2	DGND	Digital GND
3	U1:74		4	U1:73	
5	U1:72		6	U1:71	
7	U1:76		8	U1:77	
9	U1:78		10	U1:70	
11	U2:D6	AIN2P-R37-GND (Note 1)	12	U2:C6	AIN2N-R39-GND (Note 1)
13	U2:F4	AIN3P-R40-GND (Note 1)	14	U2:E5	AIN3N-R41-GND (Note 1)
15	U2:F3	ANI4P-R42-GND (Note 1)	16	U2:E4	AIN4N-R43-GND (Note 1)

“—” indicates the pin is not connected.

Note 1: Connected to GND through a 0Ω resistor before shipment (process pin when not in use).

When using this pin, remove resistor as noted in remarks.

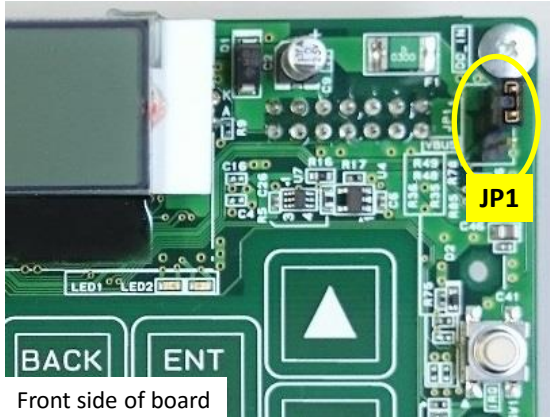
## 5. Operating Procedures

### 5.1. Power Supply at Startup

Make sure you implement the following settings before supplying power to the board.

- (1) Select input power supply: DC jack or USB bus power
- (2) Select startup mode: normal mode, storage mode, or USB boot mode

#### 5.1.1. Select Power Supply Input



Power input through DC jack:  
 (battery box or AC adapter)  
 Short connection between 1 and 2.

JP1

1	●
2	●
3	●

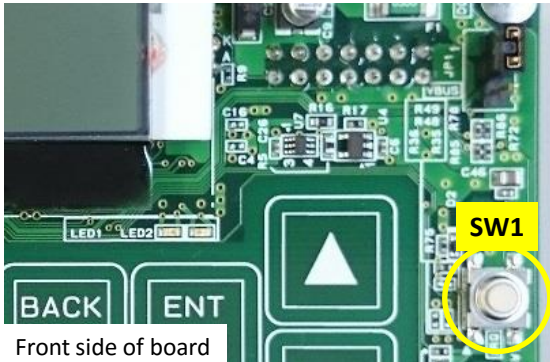
Power input from USB micro-B:  
 (supplied from USB host)  
 Short connection between 2 and 3.

JP1

1	●
2	●
3	●

Figure 5.1 Power Supply Input Selection (JP1)

#### 5.1.2. Select Startup Mode



Normal mode:  
 Set upper 3 bits of SW4 to OFF,  
 then supply power to board.

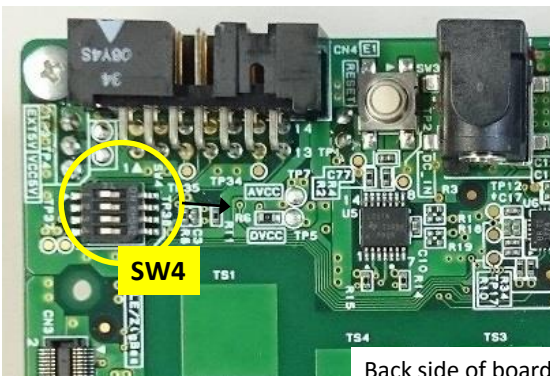
SW4

OFF	ON
■	□
■	□
■	□
□	□

Storage mode:  
 Set upper 3 bits of SW4 to OFF,  
 then supply power to board  
 while pressing down SW1.

SW4

OFF	ON
■	□
■	□
■	□
□	□



USB boot mode:  
 Set upper 3 bits of SW4 to ON,  
 then supply power to board.

SW4

OFF	ON
□	■
□	■
□	■
□	□

\*The setting of SW4 lower 1st bit is not related to start-up mode.

Figure 5.2 Startup Mode Selection (SW1, SW4)

### 5.1.3. Startup Procedure

After setting the power supply as described in section 5.1.1 Select Input Power Supply above, start up the board with the following procedure. Select the operating mode for the power supply startup according to the description in section 5.1.2 Select Startup Mode, above.

#### (1) Battery box or AC adapter power supply (JP1: short pins 1-2)

- Battery box

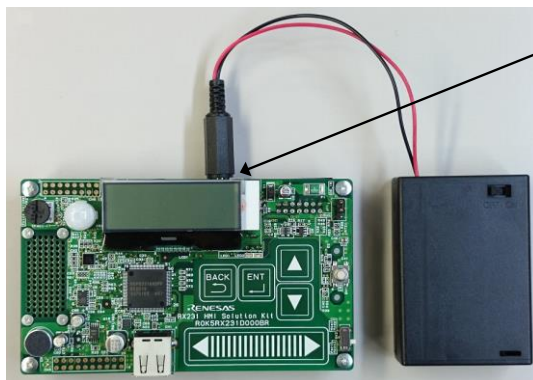
Place three AA batteries in the battery box.

Insert the battery box plug into the DC jack (J1) on the back side of the board. Set the battery box switch to ON to turn on the board.

- AC adapter

The user will need to supply an AC adapter as this kit does include one (Refer to section 3. Specifications).

Insert the AC adapter plug into the DC jack (J1) on the back of the board and the board will immediately turn on.



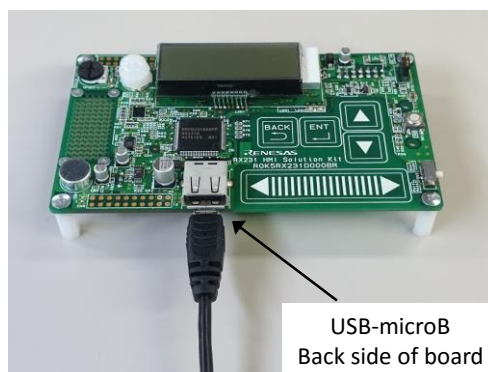
DC jack (J1) on back of board  
Connect the battery box (included in kit) or AC adaptor (not included).  
\*The kit does not include batteries and must be provided by the user.

**Figure 5.3 Battery Box or AC Adaptor Connection**

#### (2) USB Host Device Bus Power Supply (JP1: short pin 2-3)

A USB cable is not included in the kit and must be provided by the user. This board is equipped with a micro-B connector. Insert the cable to the connector, located on the back side of the board. Note: the USB Standard-A connector located on the top side of the board cannot be used for power supply.

Make sure you have the appropriate connector to fit the USB host device that serves as the power supply source. Connect the USB cable between the USB host device and the board to start up the board.



USB-microB  
Back side of board



USB host device example: computer

**Figure 5.4 USB Cable Connection**



### 5.2. Demo Operations

The HMI Solution Kit supports three startup modes (normal mode/storage mode/USB boot mode), as described in Table 3.2.

This section describes how to operate the HMI Solution Kit in either normal or storage mode using the MCU software (V1.00) that comes standard with the kit.

To use the product in USB boot mode, refer to the Renesas FLASH Programmer explanation on the Renesas website. [http://www.renesas.com/products/tools/flash\\_prom\\_programming/rfp/index.jsp](http://www.renesas.com/products/tools/flash_prom_programming/rfp/index.jsp)

#### 5.2.1. Normal Mode Operations

The following describes operations when the board is started up in the normal mode. Refer to section 5.1.2 for instructions on how to start up the board.

An outline of operations is provided in Figure 5.5, followed by detailed explanations for Demo 1: ECO, Demo 2: SOUND, and OTHER.

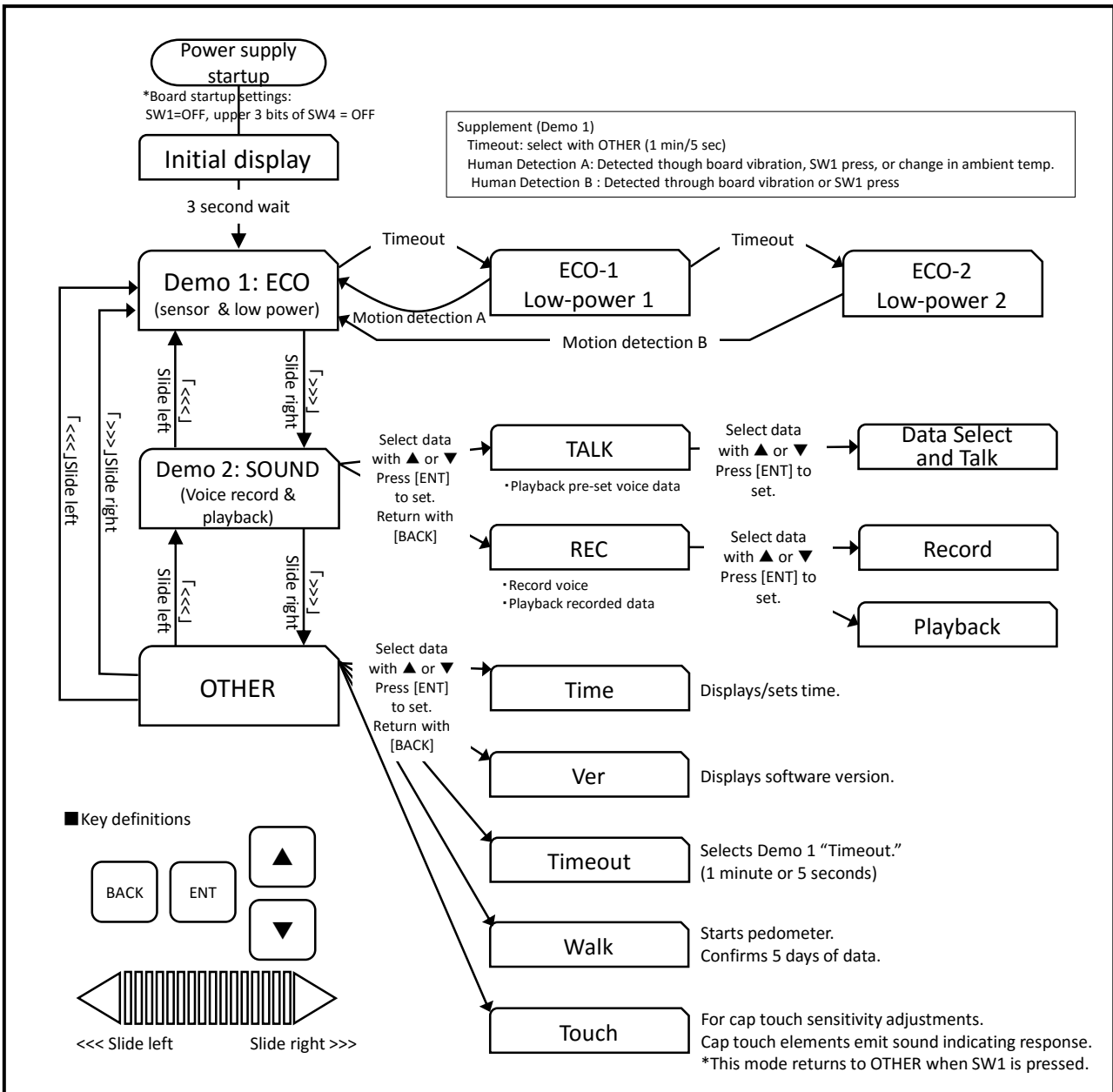


Figure 5.5 Outline of Operations in Normal Mode

5.2.1.1. Low-power demo: Demo1 (ECO)

Demo 1: ECO starts automatically 3 seconds after the board is started up in normal mode. This function demonstrates the device’s transition to low-power operations triggered by the motion sensor. When motion is not detected for a set period (1 minute or 5 seconds), the function stops and the device goes to low-power state (second level).

The pyroelectric infrared sensor used for motion detection senses change within the infrared detection range. Therefore, the device will not transition to the low-power state if a person is located nearby. To disable detection based on the pyroelectric infrared sensor, set SW2 to “Mode2” and use appropriately.

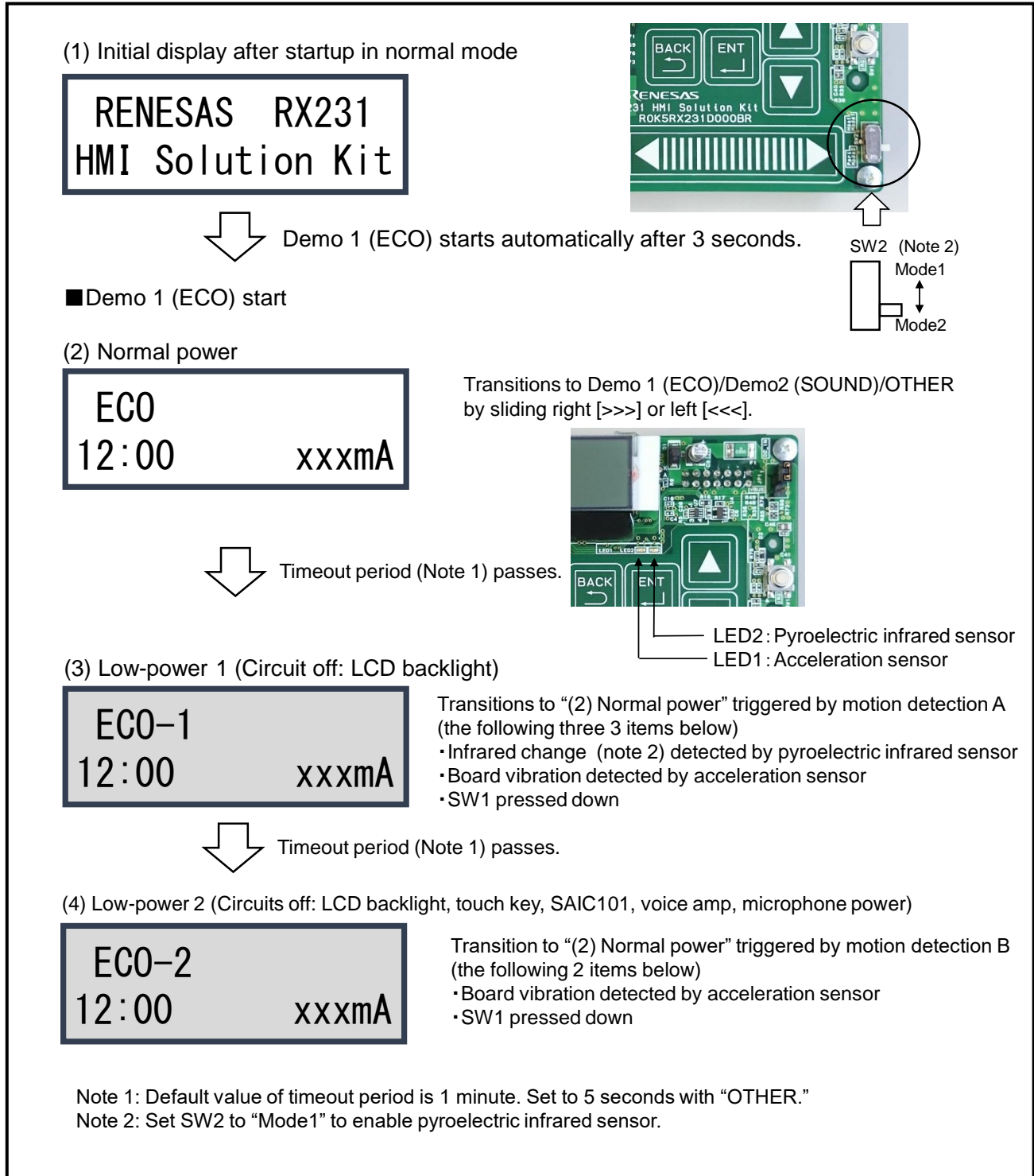


Figure 5.6 Demo 1: ECO in Normal Mode

**5.2.1.2. Playback of preset voice data, Voice record & playback demo: Demo2 (SOUND)**

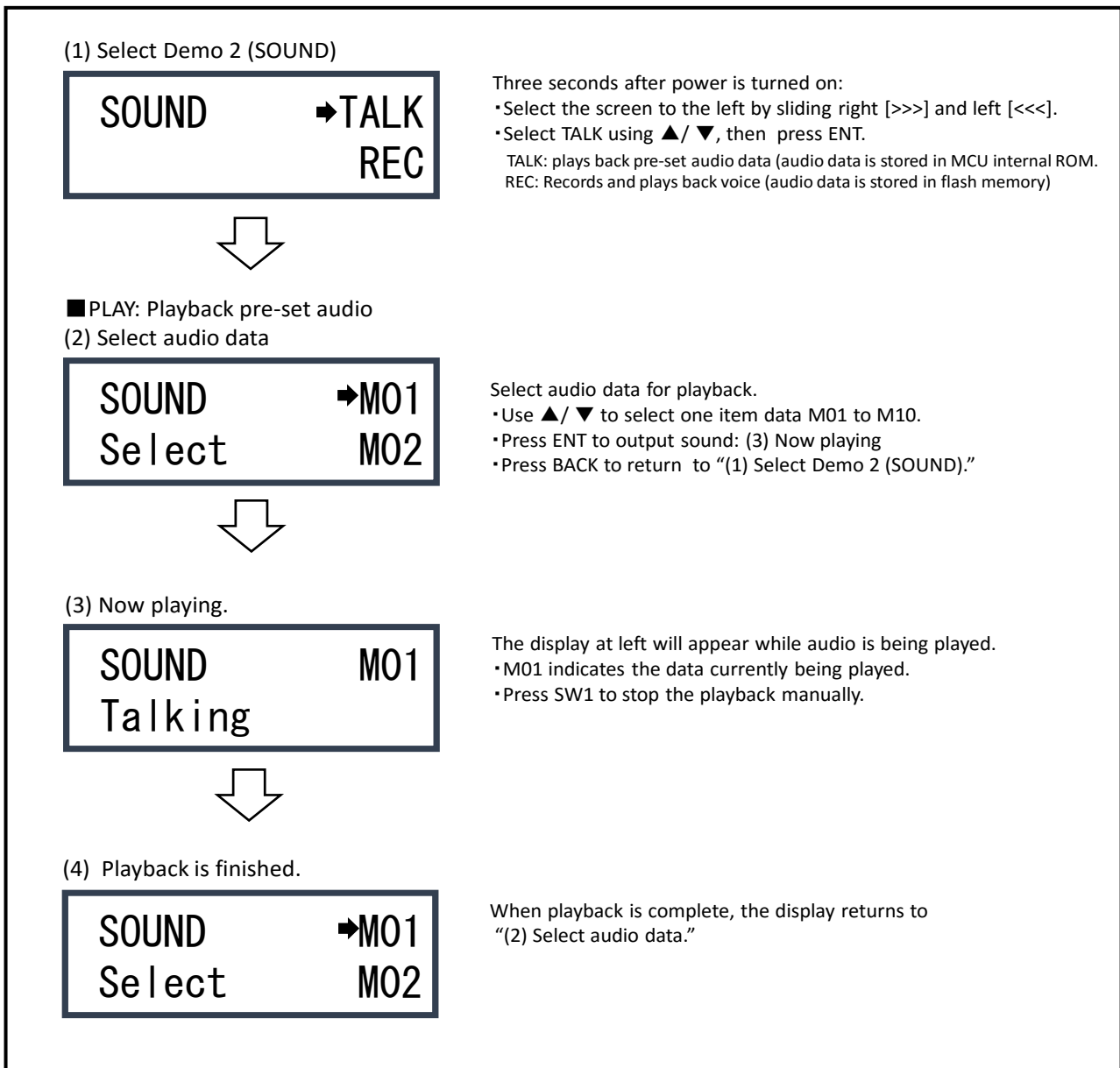
To run “Demo 2: SOUND,” startup the board in normal mode. After “Demo 1: ECO” starts, use the slider and slide right [>>>] or left [<<<] to transition to the desired demo. This demo confirms two voice functions, as follows.

(1) Playback of preset voice recording: Plays back voice data stored in MCU’s internal memory before product shipment.

(2) Voice record & playback: Records voice with on-board microphone and plays back recorded sound. The board allows up to two recordings, 10 seconds each. Recorded data is stored in the flash memory.

\*(1) and (2) above are realized using Renesas’ proprietary ADPCM Codec Software, available on the Renesas website: [http://www.renesas.com/products/tools/middleware\\_and\\_drivers/tiny\\_soft/adpcm/m3s\\_s2\\_tiny/index.jsp](http://www.renesas.com/products/tools/middleware_and_drivers/tiny_soft/adpcm/m3s_s2_tiny/index.jsp)

At the time of product shipment, the RX231 software (V1.00) supported the following voice data formats:  
 Preset voice data channel: monaural, sampling frequency: 16kHz; quantization bit: 16-bit, encoding bit length: 4 bits  
 Voice recording channel: monaural, sample frequency: 8kHz; quantization bit: 16-bit, encoding bit length: 4 bits



**Figure 5.7 Demo 2: SOUND “TALK (playback pre-set data)” in Normal Mode**

**Table 5.1 Pre-set Phrases (voice data)**

Display No.	Phrase (Japanese)	Remarks (English)
M01	いらっしゃいませ。	Welcome.
M02	ルネサスブースにようこそ。	Welcome to the Renesas booth.
M03	係員を呼んでください。	Please call the person in charge.
M04	指示に従い操作してください。	Please follow the instructions.
M05	扉が開いています。	The door is open.
M06	おつりが出ます。	Your change will be issued.
M07	雨が降ってきました。	It has started to rain.
M08	お湯が沸きました。	The hot water is ready.
M09	ご利用ありがとうございます。	Thank you.
M10	またお越しください。	Please come again.

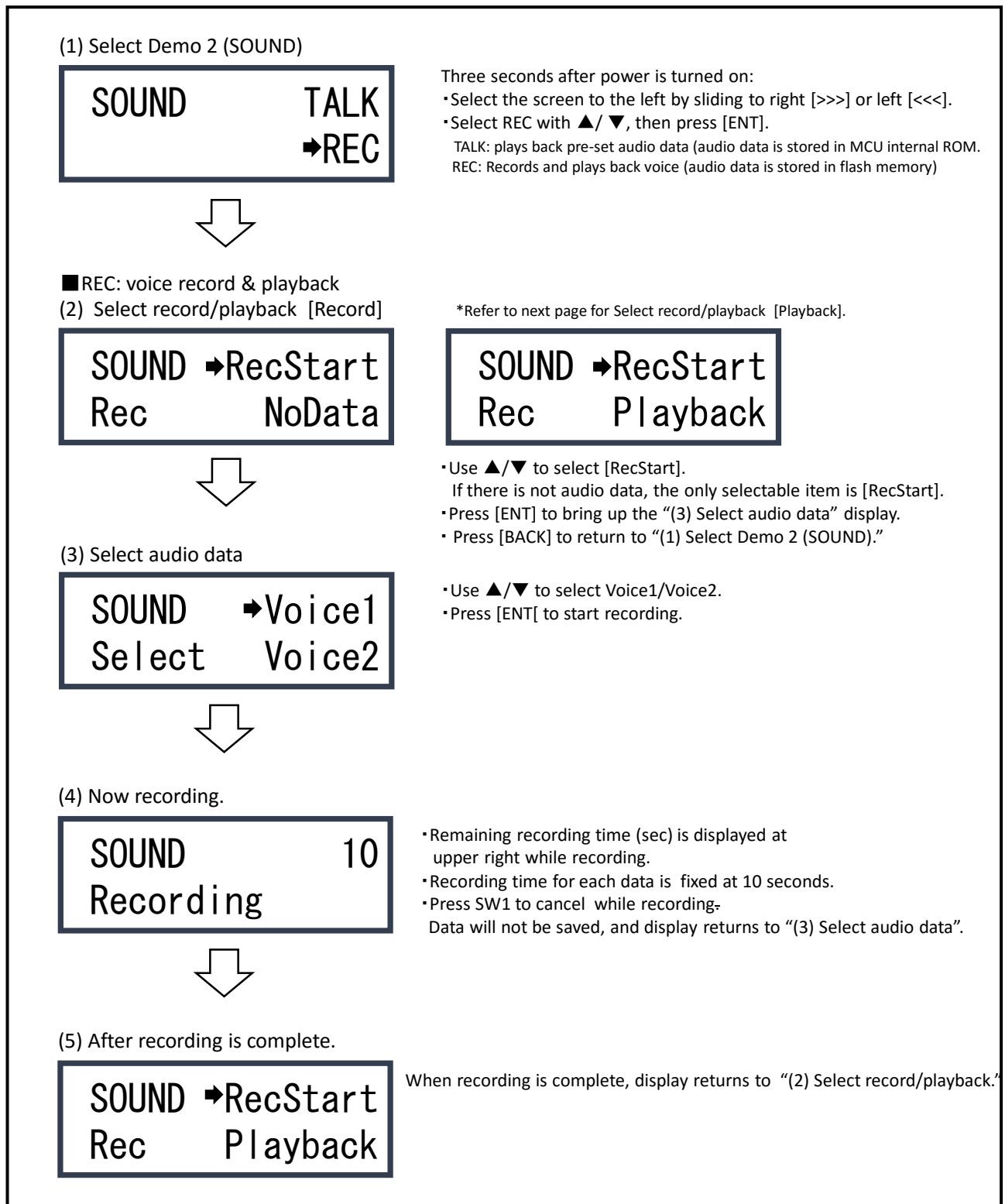


Figure 5.8 Demo 2: SOUND "REC: record & playback voice" (record) in Normal Mode

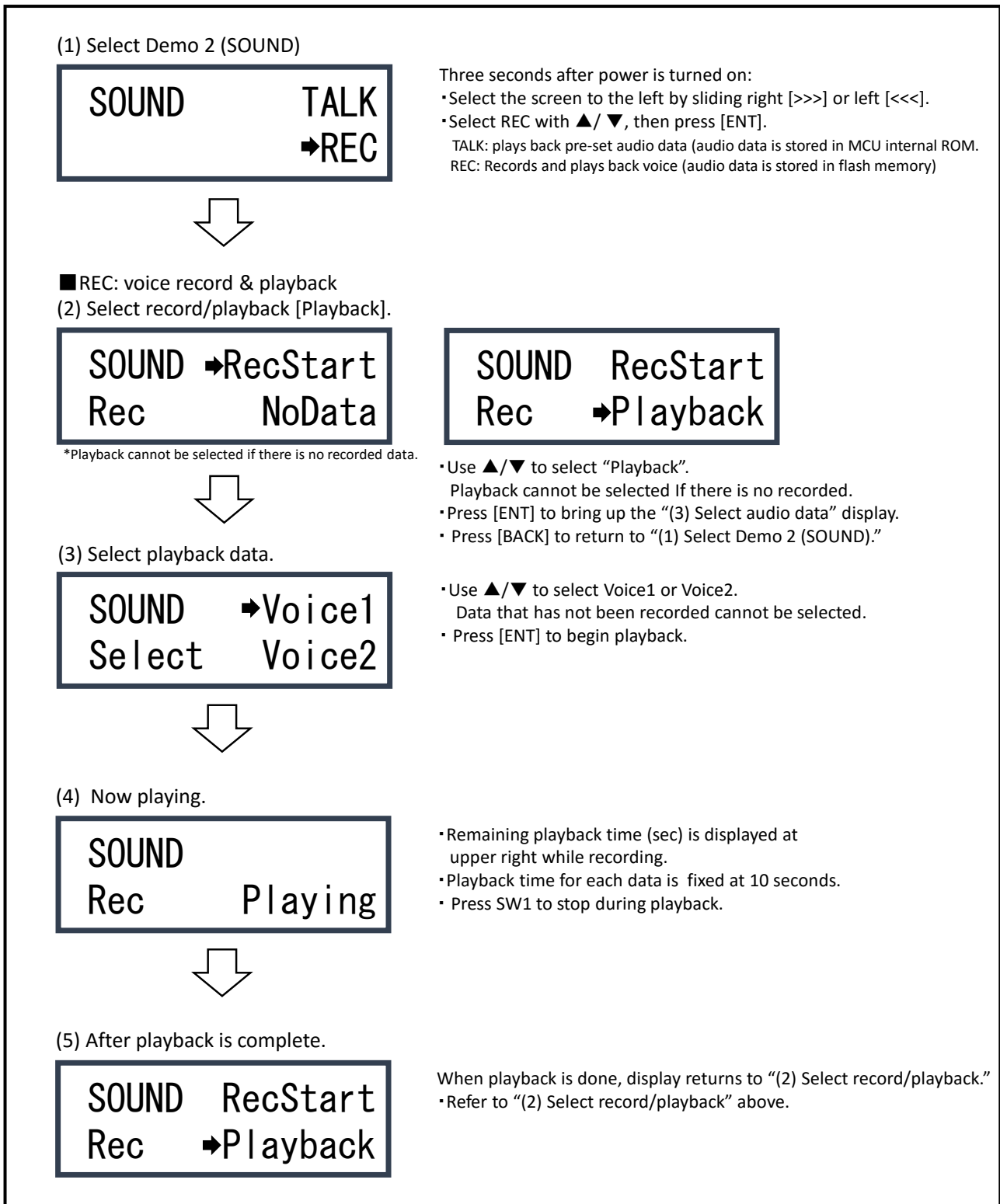


Figure 5.9 Demo 2: SOUND "REC: record & playback voice" (playback) in Normal Mode

5.2.1.3. Normal Mode: OTHER (Time setting)

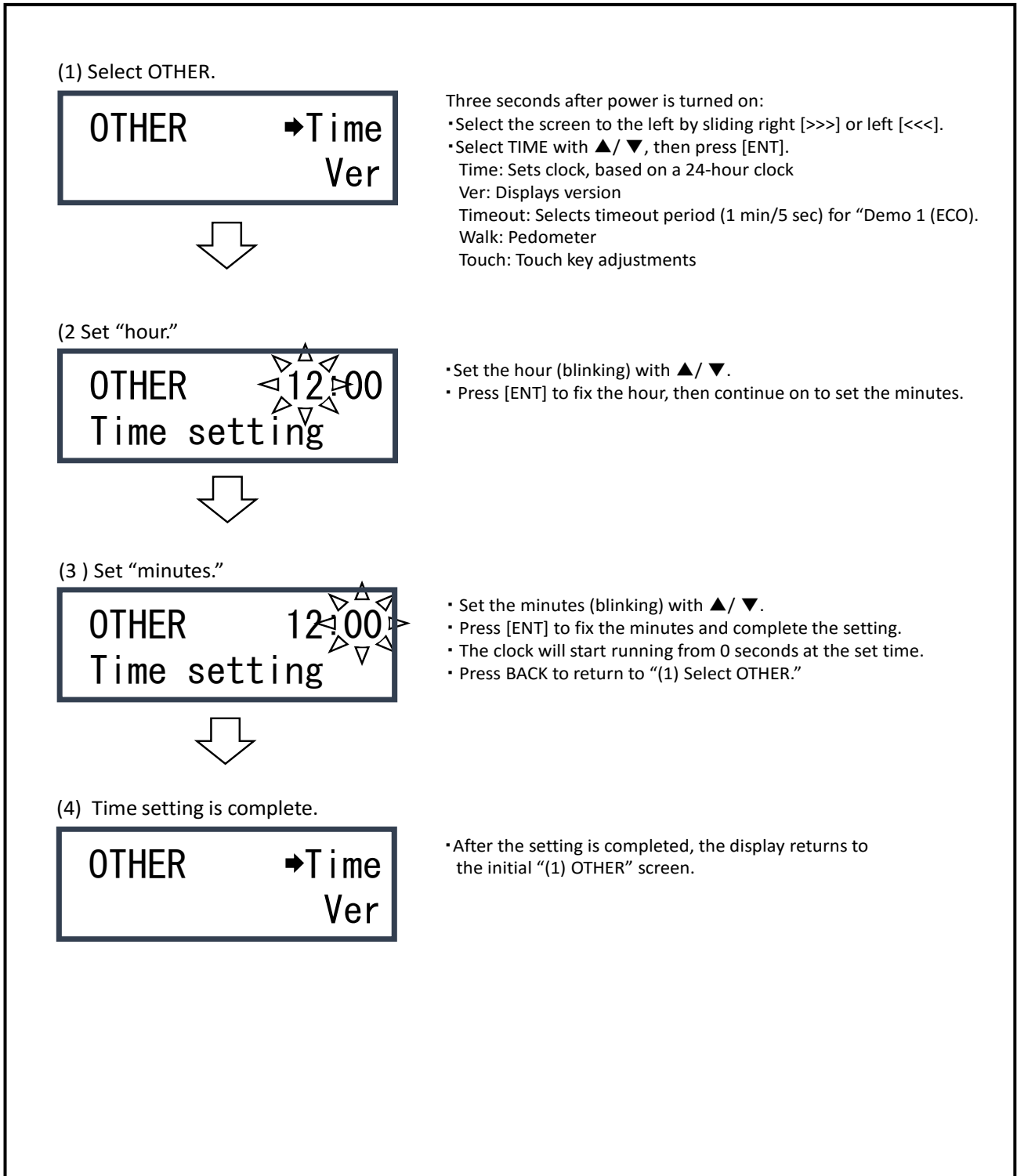


Figure 5.10 OTHER (time setting) in Normal Mode

5.2.1.4. Normal Mode: OTHER (Version Display)

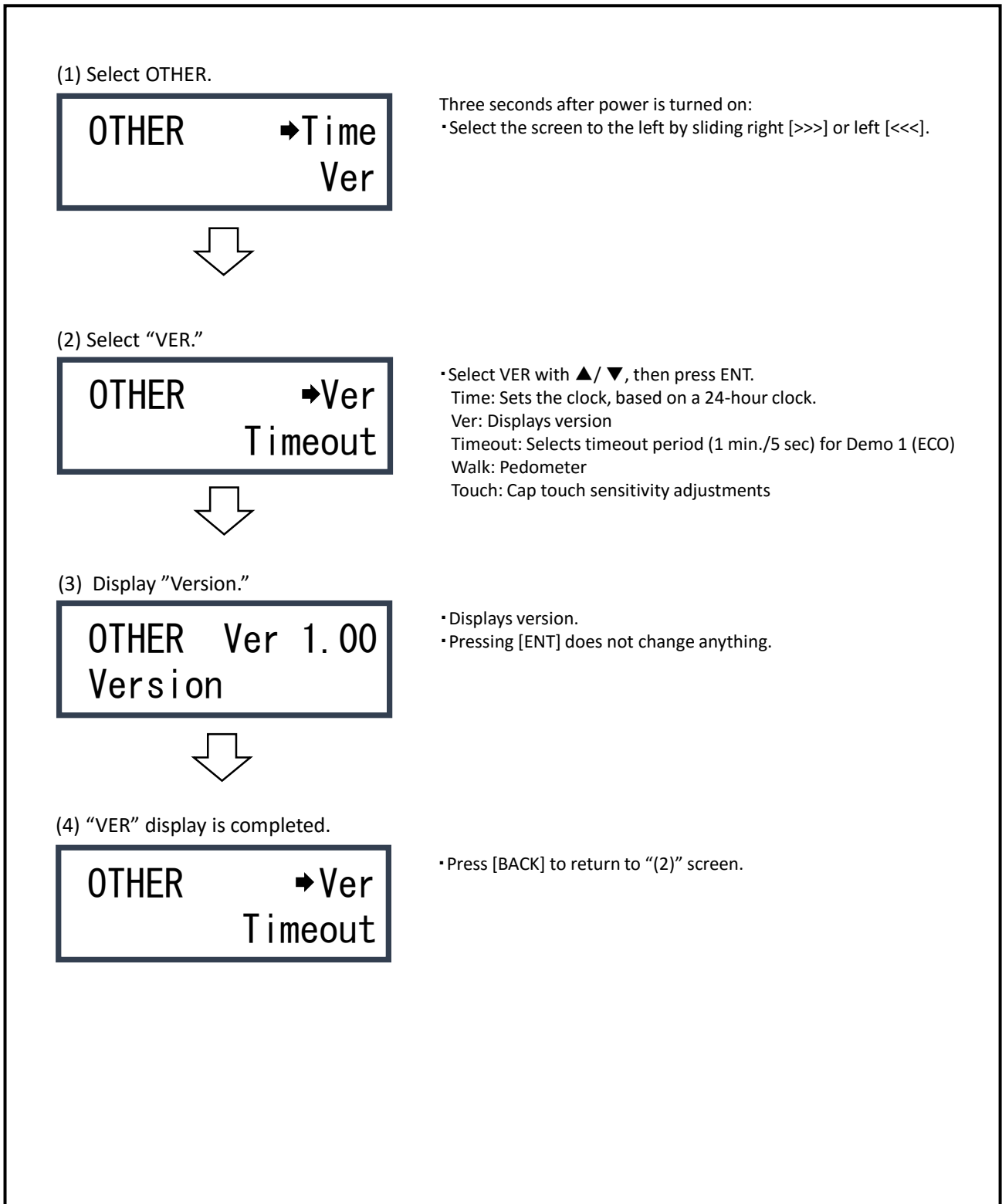


Figure 5.11 Normal Mode: OTHER (Version Display)



5.2.1.5. Normal Mode: OTHER (Timeout period selection)

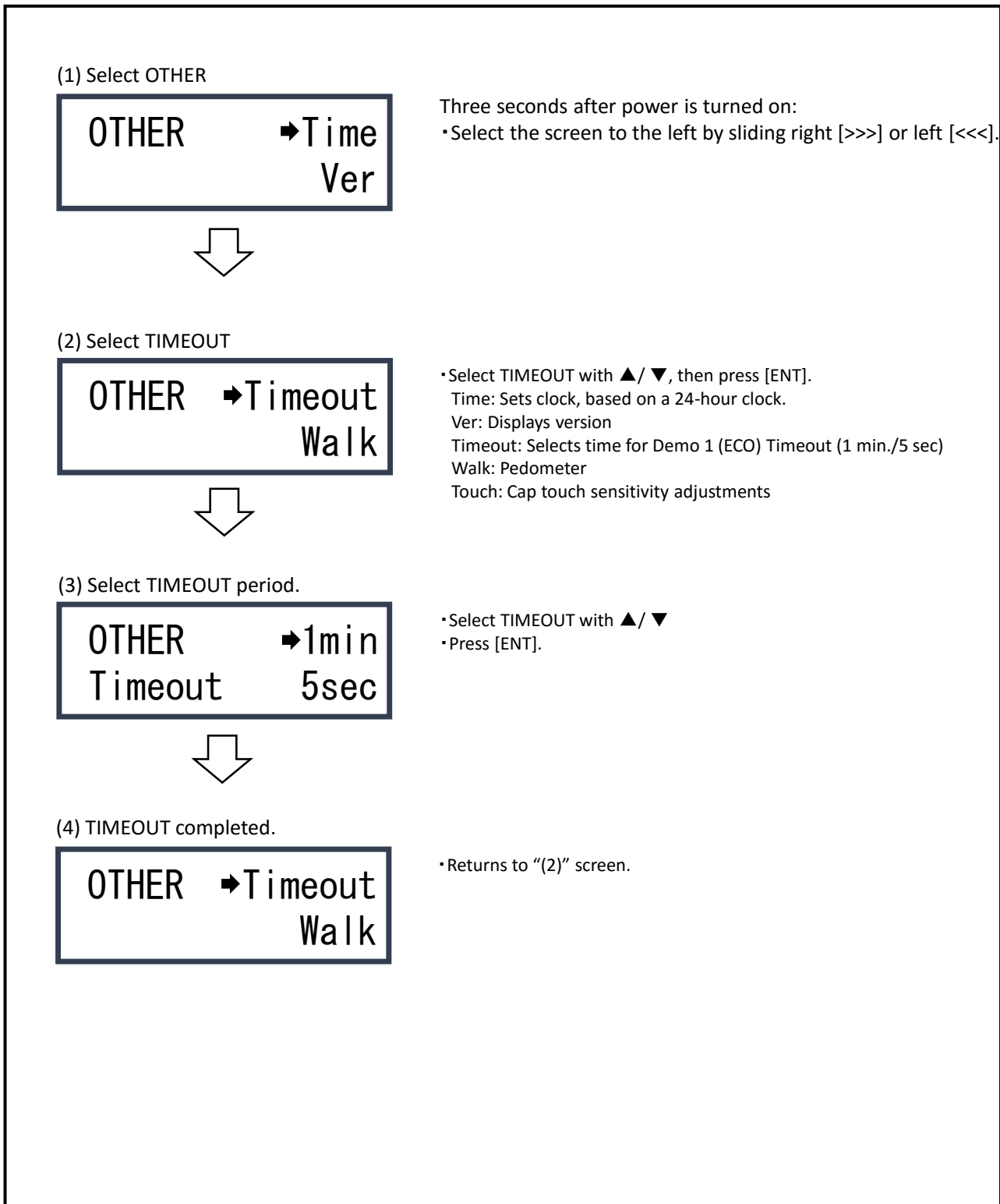


Figure 5.12 OTHER (Timeout period selection) in Normal Mode

5.2.1.6. Normal Mode: OTHER (Pedometer)

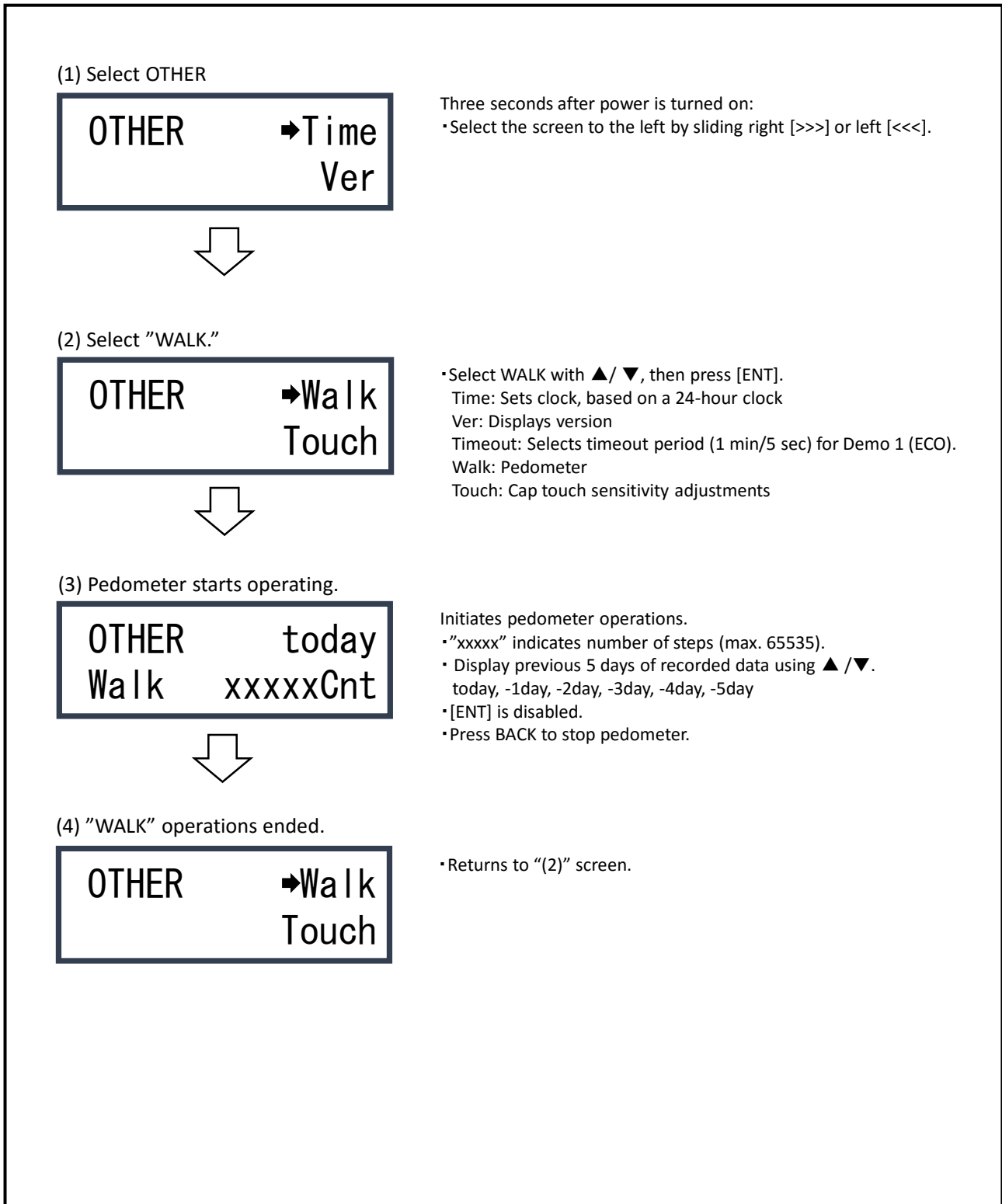


Figure 5.13 OTHER (Pedometer) in Normal Mode

5.2.1.7. Normal Mode: OTHER (Cap Touch Adjustments)

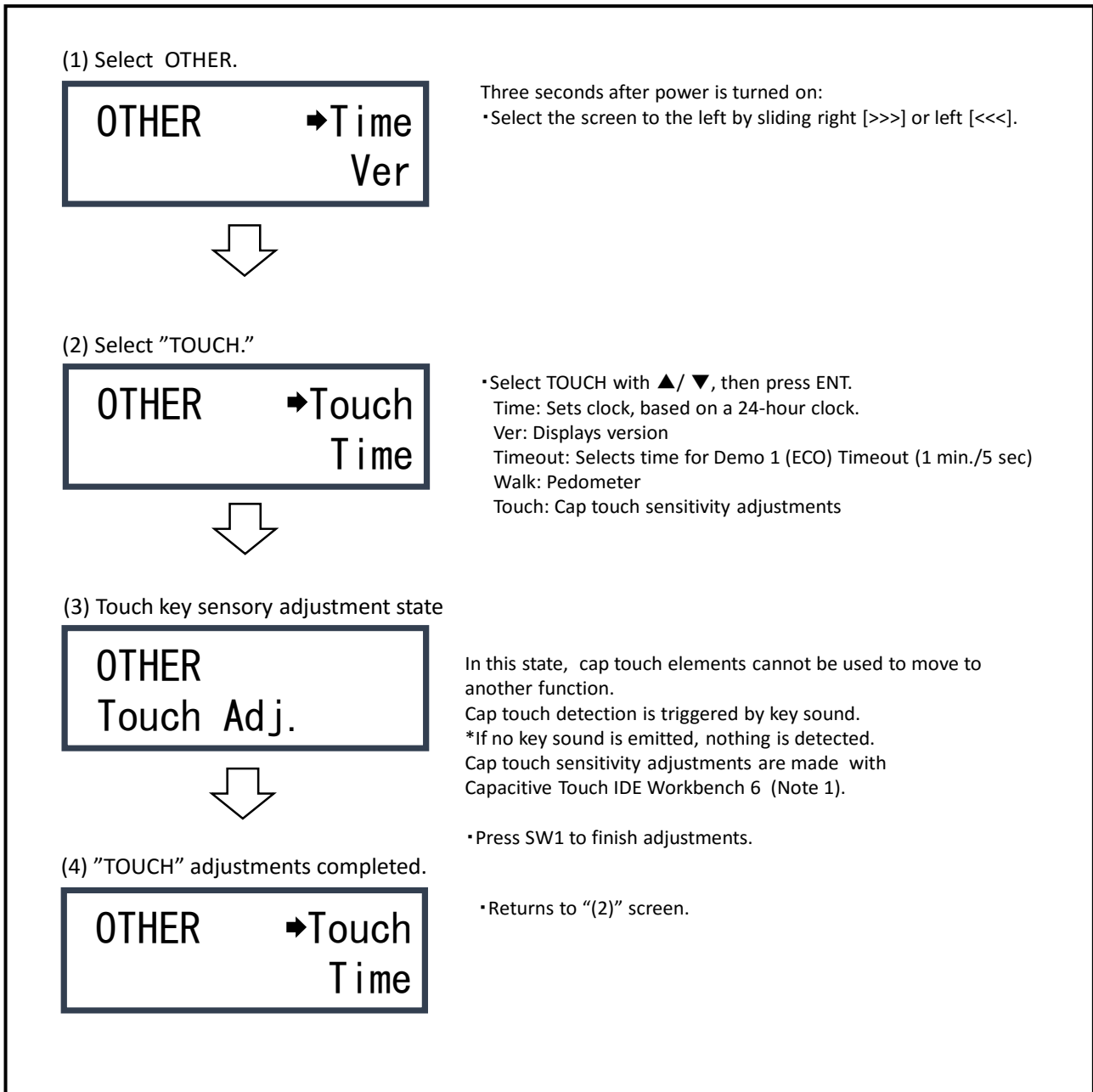


Figure 5.14 OTHER (cap touch adjustments) in Normal Mode

Note 1. Refer to the Renesas website for details on Workbench6(Integrated Development Environment for Renesas Capacitive Touch).

[http://renesas.com/applications/key\\_technology/human\\_interface/touch\\_sensor\\_system\\_2gen/child/technology\\_child.jsp](http://renesas.com/applications/key_technology/human_interface/touch_sensor_system_2gen/child/technology_child.jsp)

### 5.2.1.8. Preparations of using Workbench6 (Connection with PC)

Refer to the Renesas website for details on Workbench6(Integrated Development Environment for Renesas Capacitive Touch).

[http://renesas.com/applications/key\\_technology/human\\_interface/touch\\_sensor\\_system\\_2gen/child/technology\\_child.jsp](http://renesas.com/applications/key_technology/human_interface/touch_sensor_system_2gen/child/technology_child.jsp)

#### ■ USB cable connection

Connect the Kit board and host PC with a USB cable .

The USB-microB connector is located the back side of the board.

A power supply is chosen in SW1. (USB or DC-Jack)

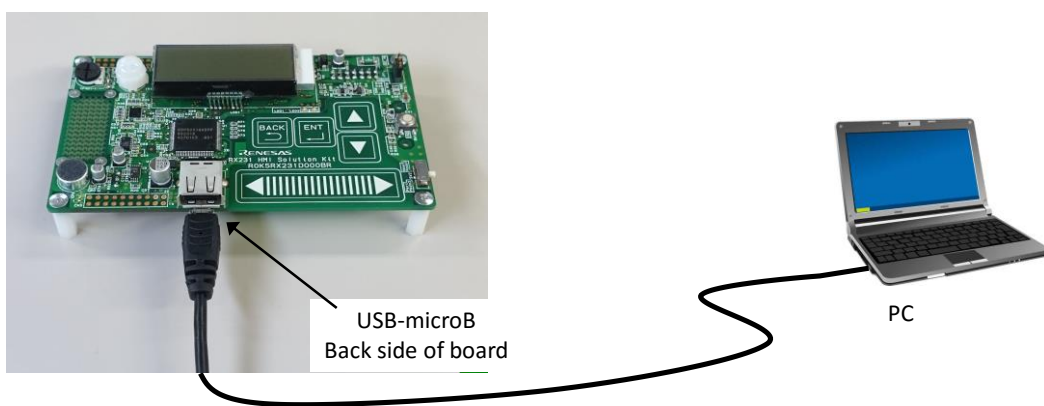
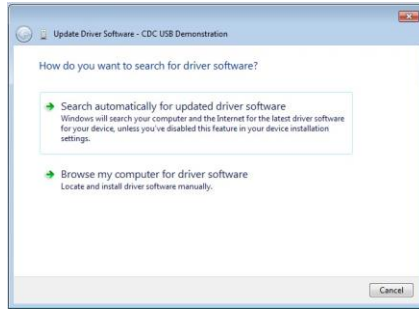


Figure 5.15 Connection of USB cable with PC

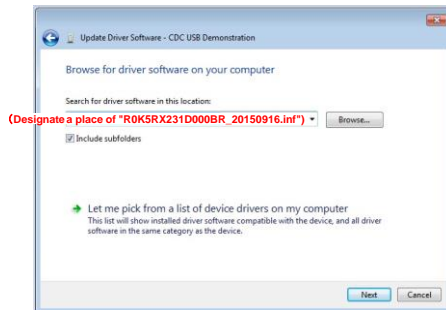
5.2.1.9. Preparations of using Workbench6 (USB driver Installation)

1. Follow the procedure below when Windows asks for driver installation. (This example uses Windows 7.)



Installation method specification dialogue.

2. Specify "R0K5RX231D000BR\_20150916.inf" location.



3. A warning dialogue will appear; ignore and press "Continue".



4. When completion dialogue appears, driver installation is complete.

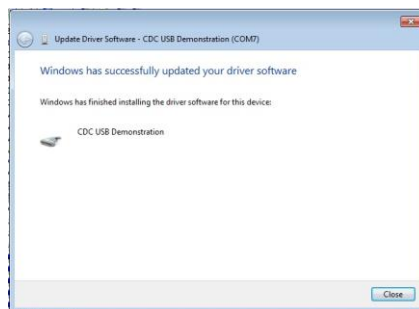


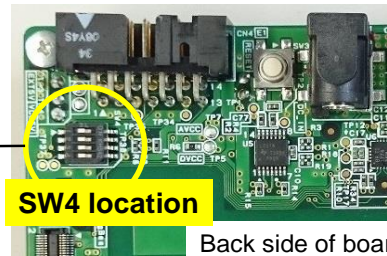
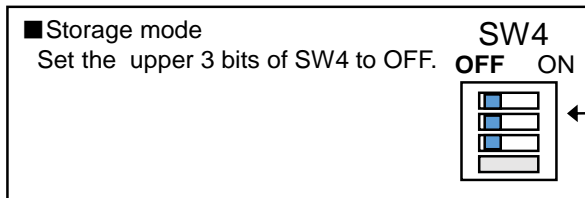
Figure 5.16 USB Driver Installation

### 5.2.2. Storage Mode Operations

This section describes how to use the HMI Solution Kit in storage mode. For instructions on how to start up the board in storage mode, Refer to section 5.1.2.

#### (1) Startup in storage mode

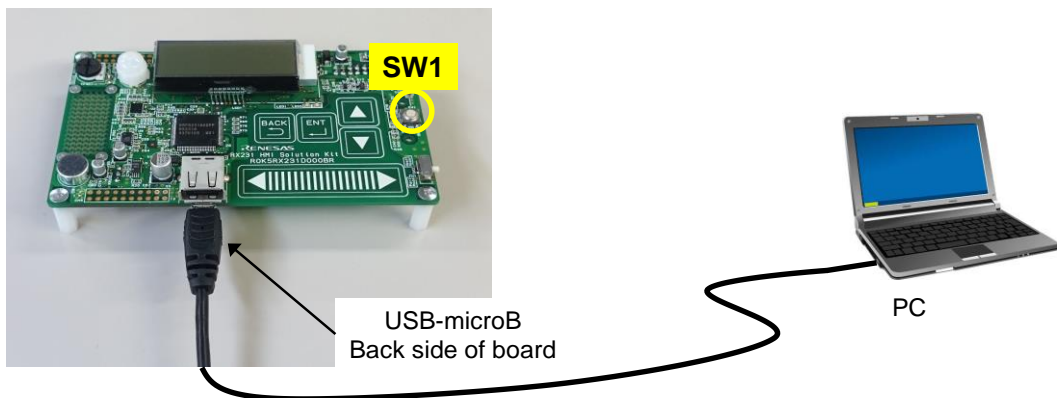
Set SW4 to the following and then supply power to the board.



\*The setting of the lowest SW4 bit is not related to the startup mode.

Turn on power while pressing SW1 down. Release SW1 after the screen in (2) below appears.

\*For USB bus-power, connect the USB cable while pressing SW1 down.



#### (2) LCD display during storage mode



- The board is recognized by the PC as a USB memory.
- This memory can't write and erase from PC.
  - The board's on-board serial flash is used as memory.
  - Recorded audio data is stored in the flash memory (Note 1).
  - LED1 (green) blinks when a file is accessed.

\*Note 1. The extension for audio data is "dat".

Audio data is to convert it to a wav file by Renesas ADPCM change tool, and it can be played on the PC.

**Figure 5.17 Storage Mode Operations**

### 5.2.3. USB Boot Mode Operations

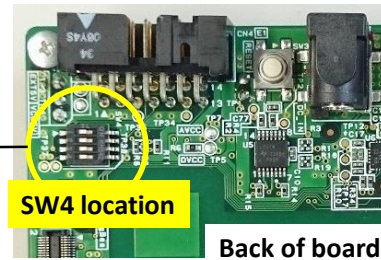
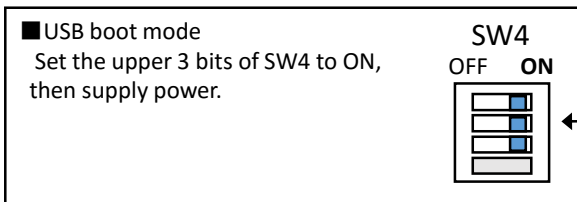
This section describes how to use the HMI Solution Kit in USB boot mode. For instructions on how to start up the board, Refer to section 5.1.2.

USB boot mode is an MCU function that enables a program to be downloaded via a USB cable. The Kit board is equipped with a switch for starting up operations in USB boot mode. You will need a Renesas FLASH Programmer to use this mode. Visit the Renesas website for more details.

[http://www.renesas.com/products/tools/flash\\_prom\\_programming/rfp/index.jsp](http://www.renesas.com/products/tools/flash_prom_programming/rfp/index.jsp)

**(1) Startup in USB boot mode**

Set SW4 as shown below and then supply power to the board.



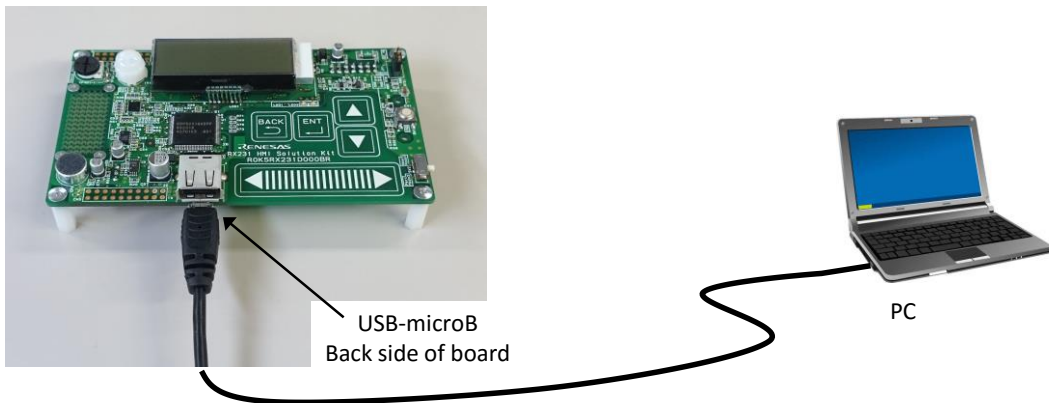
\*The setting of the lowest SW4 bit is not related to the startup mode.

**(2) USB cable connection**

Connect the Kit board and host PC with a USB cable .

The USB-microB connector is located the back side of the board.

A power supply is chosen in SW1. (USB or DC-Jack)



**Figure 5.18 Operations in USB Boot Mode**

### 5.3. E1 Connection

Connect the E1 Emulator to rewrite or debug RX231 programs.

- (1) Make sure the board's power is turned off.
- (2) Connect the E1 cable to CN4 on the board.  
Confirm the location of the polarizing key first to avoid mis-insertion.

Refer to the usage manuals included with E1 and the development environment for instructions on how to use E1. When supplying power from E1, turn off the board's power supply (DC jack or USB). The safest way is to cut off power input from both the DC jack and USB bus is by removing JP1.

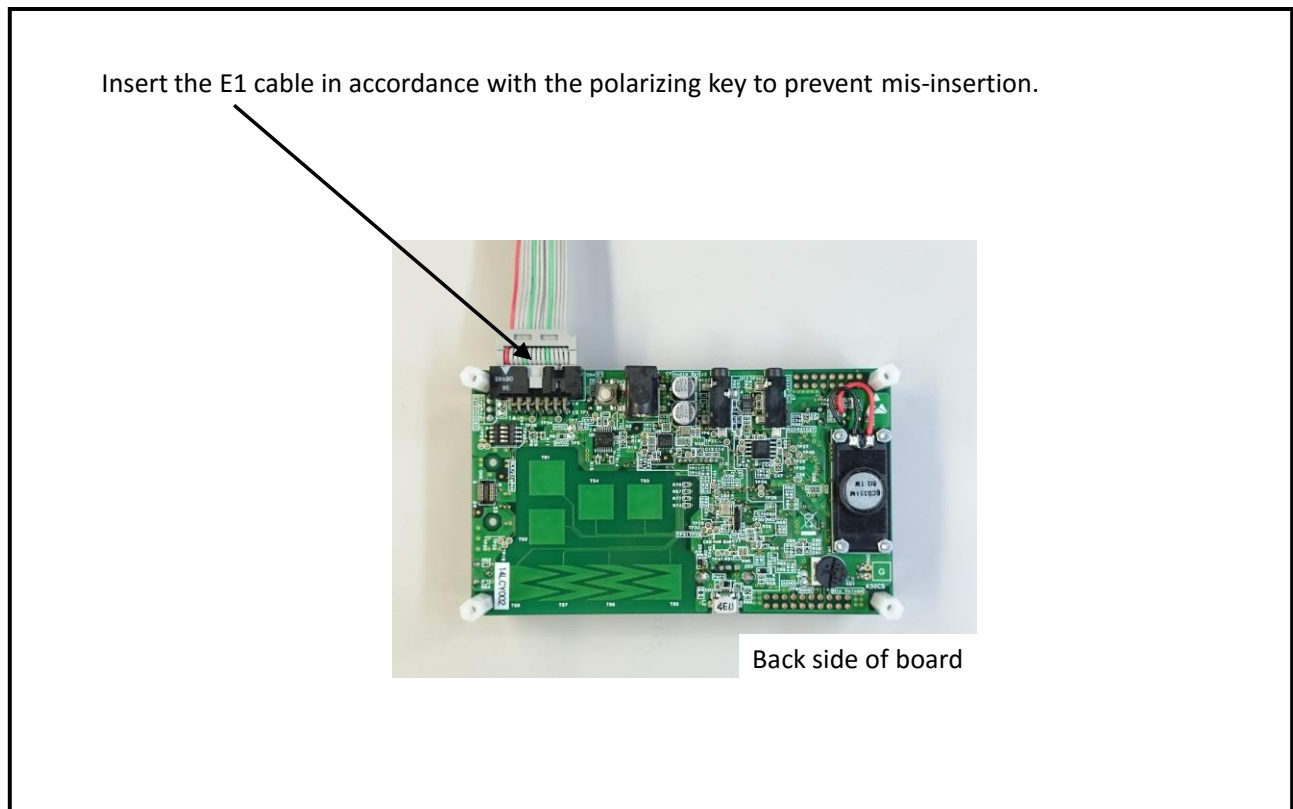


Figure 5.19 E1 Connection Diagram



### 6. Notes when using J3 (monaural jack)

The common electric potential of the voice output (J3) of this board is 1.6V.

When using J3, please don't connect the speaker which "a common electrode of J3" and "GND of this board" is shorted. Otherwise, this board will break down by an over-current.

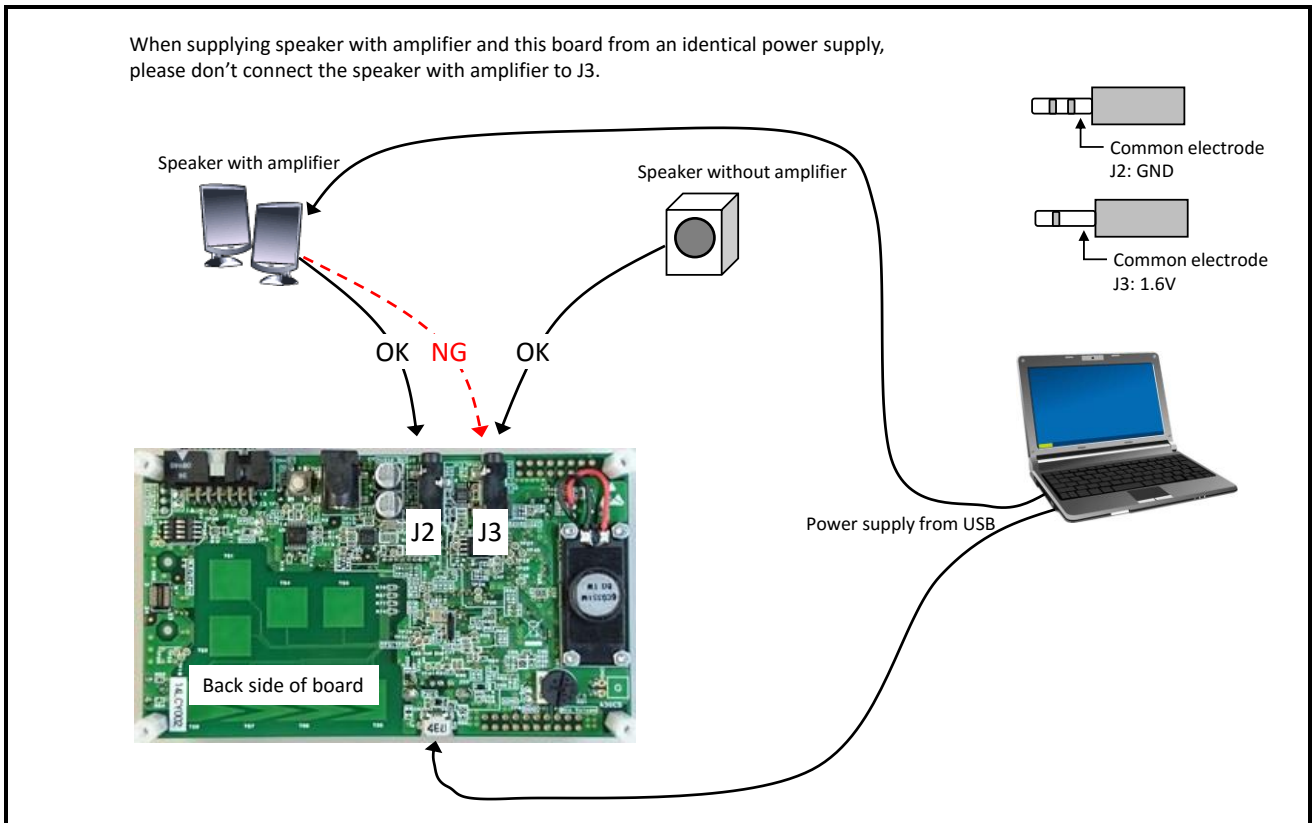


Figure 6.1 Use example of J3

## 7. Circuit Diagram

Refer to appendix 1.

## 8. Component Layout Diagram

Refer to appendix 2.

## 9. Parts List

Refer to appendix 3.

## Website and Support

Renesas Electronics Website

<http://www.renesas.com/>

USB Device Website

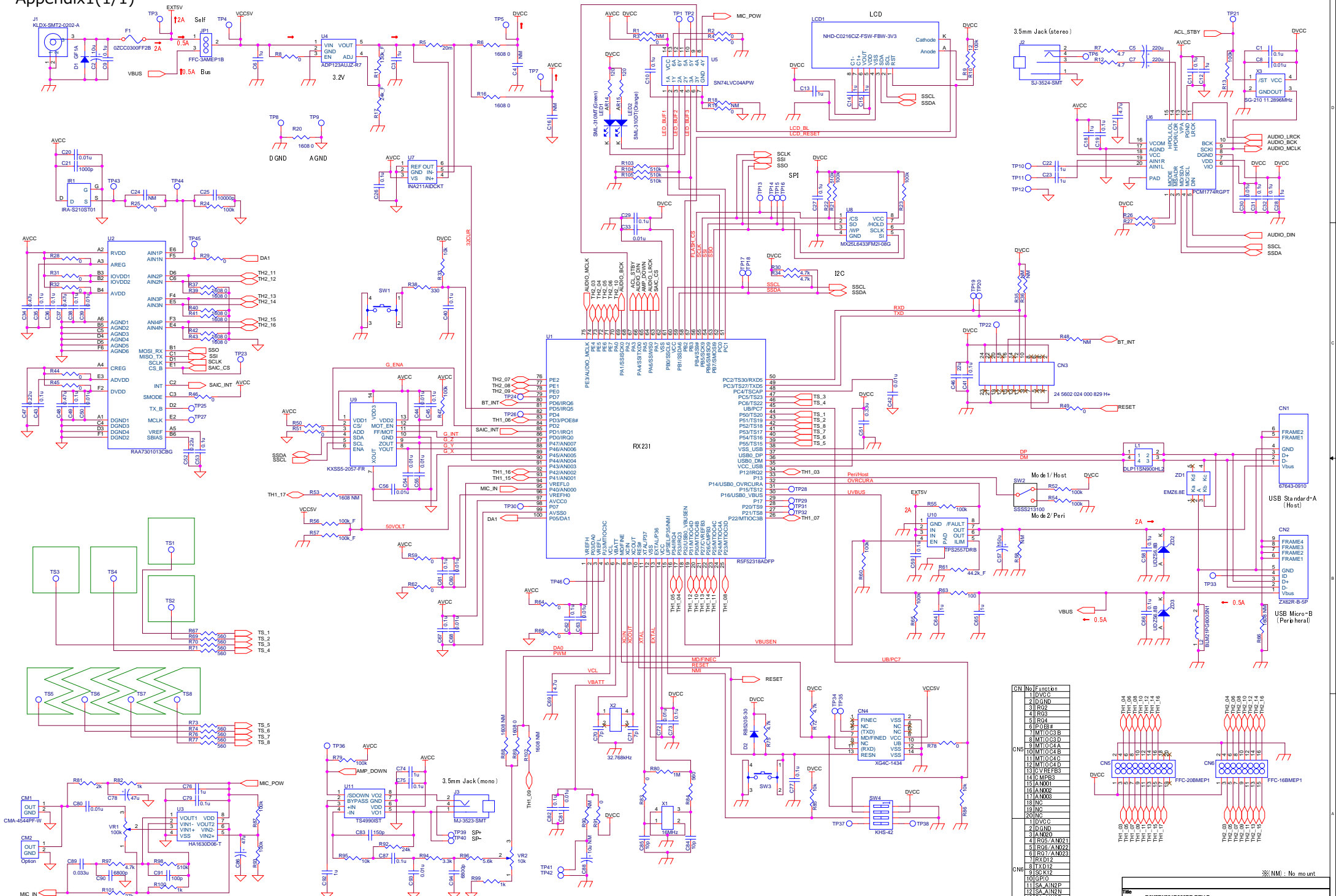
[http://www.renesas.com/applications/key\\_technology/connectivity/usb/index.jsp](http://www.renesas.com/applications/key_technology/connectivity/usb/index.jsp)

Inquiries

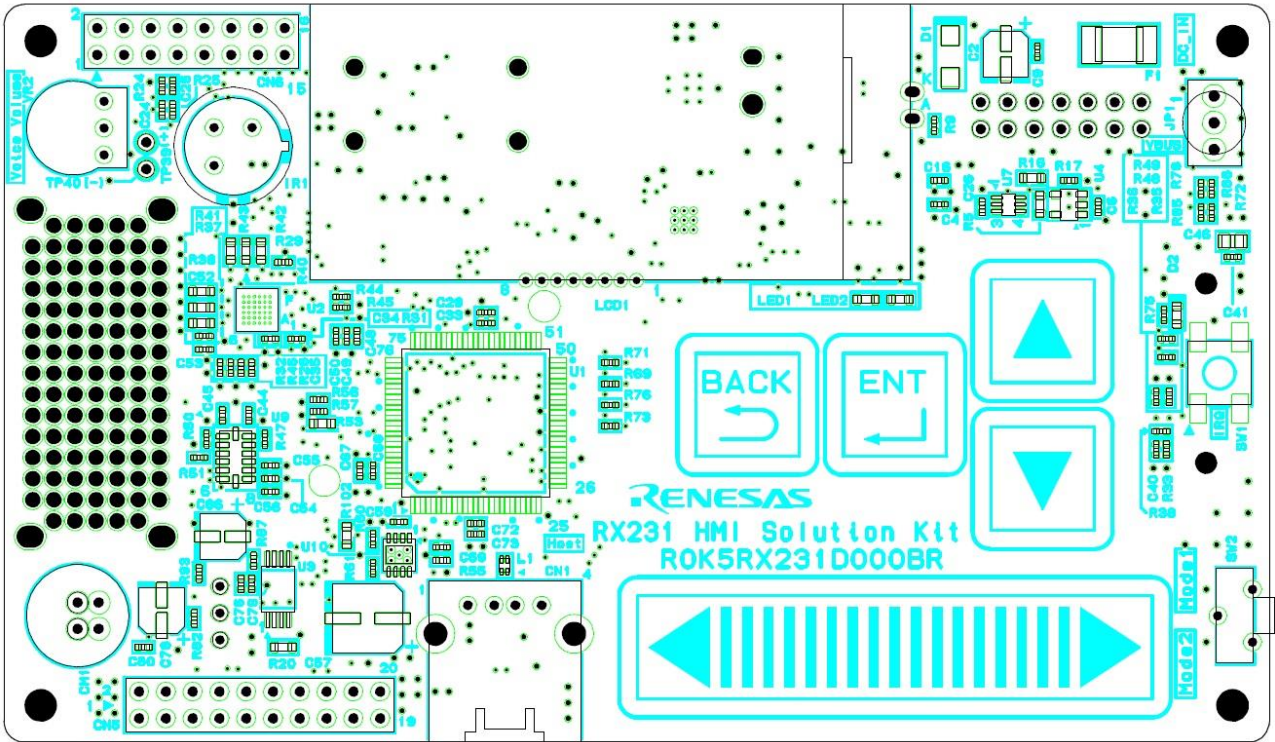
<http://www.renesas.com/contact/>

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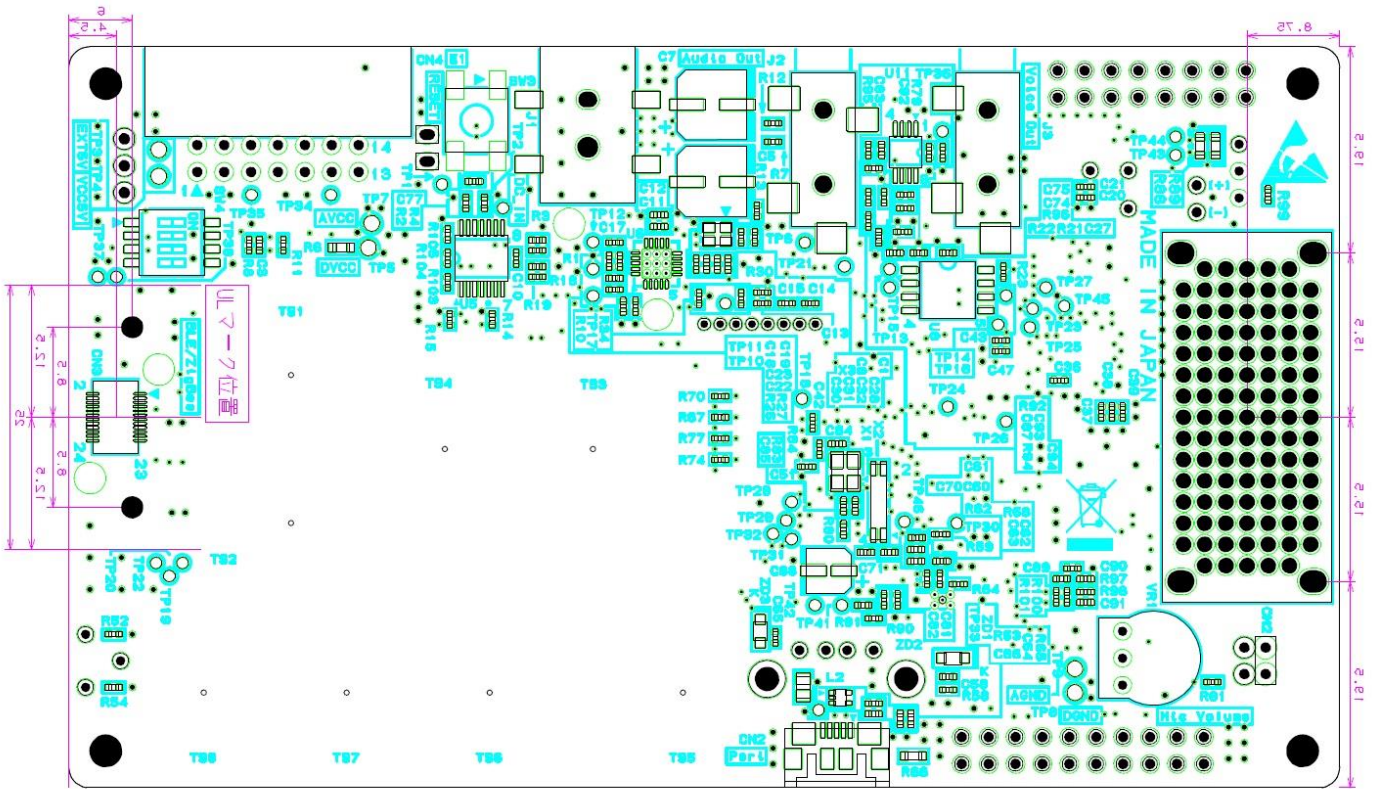
# Appendix1(1/1)



CN No	Function
CN1	1:DVCC
CN1	2:GND
CN1	3:R02
CN1	4:TP02
CN1	5:GND
CN1	6:PD0B#
CN1	7:INTIOCS D
CN1	8:INTIOCS B
CN1	9:INTIOCS D
CN1	10:INTIOCS D
CN1	11:INTIOCS D
CN1	12:INTIOCS D
CN1	13:INTIOCS D
CN1	14:INTIOCS D
CN1	15:INTIOCS D
CN1	16:INTIOCS D
CN1	17:INTIOCS D
CN1	18:INTIOCS D
CN1	19:INTIOCS D
CN1	20:INTIOCS D
CN1	21:INTIOCS D
CN1	22:INTIOCS D
CN1	23:INTIOCS D
CN1	24:INTIOCS D
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CN1	27:INTIOCS D
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CN1	89:INTIOCS D
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CN1	91:INTIOCS D
CN1	92:INTIOCS D
CN1	93:INTIOCS D
CN1	94:INTIOCS D
CN1	95:INTIOCS D
CN1	96:INTIOCS D
CN1	97:INTIOCS D
CN1	98:INTIOCS D
CN1	99:INTIOCS D
CN1	100:INTIOCS D



<b>ROK5RX231 D000BR</b>
TOP-SILK
TOP-RESIST



<b>ROK5RX231 D000BR</b>
BOT-SILK
BOT-RESIST

## Parts List of R0K5RX231D000BR Board

No	Component Name		Component Specification			Qty/set	—	Remarks
	Type	Symbol on Board	Product Number (Specification)	Manufacture	Mount/Unmount			
1	Microphone	CM1	CMA-4544PF-W	CUI	Mount	1		
2	USB Standard A	CN1	67643-0910	Molex	Mount	1		
3	USB Micro B	CN2	ZX62R-B-5P	Hirose	Mount	1		
4	Connector	CN3	24 5602 024 000 829 H+	KYOCERA	Mount	1		
5	Connector	CN4	24 5602 624 000 829 H+	Connetor	Mount	1		
6	Ceramic Capacitor	C1,C9,C10,C11,C19, C26,C27,C29,C31,C32, C35,C36,C38,C40,C41, C43,C45,C49,C53,C58, C59,C61,C62,C66,C67, C73,C75,C77,C79,C82, C87	GRM155R71C104KA88D	Murata	Mount	31		0.1u
7	Electrolytic Capcitor	C2	EMVA250ADA100MD55G	NIPPON CHEMI-CON	Mount	1		10u,25V
8	Ceramic Capacitor	C3,C6,C12,C13,C14, C15,C18,C22,C23,C28, C64,C65,C74,C76,C92	GRM155R61A105KE15D	Murata	Mount	15		1u
9	Electrolytic Capcitor	C5,C7	EMVA100ADA221MF80G	NIPPON CHEMI-CON	Mount	2		220u,10V
10	Ceramic Capacitor	C8,C20,C30,C33,C39, C42,C44,C50,C54,C55, C56,C60,C63,C68,C72, C80,C81,C93	GRM155B11E103KA01D	Murata	Mount	18		0.01u
11	Ceramic Capacitor	C17,C69	GRM155R60J475ME47D	Murata	Mount	2		4.7u
12	Ceramic Capacitor	C21	GRM1555C1H102JA01D	Murata	Mount	1		1000p
13	Ceramic Capacitor	C25	GRM155B11E103KA01D	Murata	Mount	1		10000p
14	Ceramic Capacitor	C34,C37,C48	GRM155R61A474KE15D	Murata	Mount	3		0.47u
15	Ceramic Capacitor	C46	C2012X5R1A226M125AB	TDK	Mount	1		22u
16	Ceramic Capacitor	C47,C52	GRM155R71C224KA12D	Murata	Mount	2		0.22u
17	Ceramic Capacitor	C51	GRM155R61A334KE15D	Murata	Mount	1		0.33u
18	Electrolytic Capcitor	C57	EMVA160ADA151MF80G	NIPPON CHEMI-CON	Mount	1		150u,16V
19	Ceramic Capacitor	C70,C71	GRM1555C1H7R0BA01D	Murata	Mount	2		7p
20	Electrolytic Capcitor	C78,C86	EMVA6R3ADA470MD55G	NIPPON CHEMI-CON	Mount	2		47u,6.3V
21	Ceramic Capacitor	C83	GRM1555C1H151JA01D	Murata	Mount	1		150p
22	Ceramic Capacitor	C84,C85	GRM1555C1H100RA01D	Murata	Mount	2		10p
23	Ceramic Capacitor	C89	GRM155B31E333KA87D	Murata	Mount	1		0.033u
24	Ceramic Capacitor	C90,C94	GRM155R11E682KA01	Murata	Mount	2		6800p
25	Ceramic Capacitor	C91	GRM1552C1H101JZ01D	Murata	Mount	1		100p

No	Component Name		Component Specification			Qty/set	—	Remarks
	Type	Symbol on Board	Product Number (Specification)	Manufacture	Mount/Unmount			
26	Diode	D1	GF1A-E3/67A	Vishay	Mount	1		
27	Diode	D2	RB520S-30	Rohm	Mount	1		
28	Polyswitch	F1	OZCC0300FF2B	Bel Fuse	Mount	1		
29	Pyroelectric infrared sensor	IR1	IRA-S210ST01	Murata	Mount	1		
30	Jumper	JP1	FFC-3AMEP1B	HTK	Mount	1		
31	DC Jack	J1	KLDX-SMT2-0202-ATR	Kycon	Mount	1		
32	AUDIO JACK	J2	SJ-3524-SMT	CUI	Mount	1		3.5mm STEREO
33	AUDIO JACK	J3	MJ-3523-SMT	CUI	Mount	1		3.5mm MONO
34	LCDモジュール	LCD1	NHD-C0216CiZ-FSW-FBW-3V3	NewHaven Display	Mount	1		
35	LED	LED1	SML-310MT	Rohm	Mount	1		Green
36	LED	LED2	SML-310DT	Rohm	Mount	1		Orange
37	Chip Resistor	R2,R3,R4,R8,R19, R25,R26,R27,R28,R29, R31,R32,R44,R45,R46, R49,R50,R51,R59,R62, R64,R68,R78,R83,R91	MCR01MRTJ000	Rohm	Mount	25		1005 0
38	Shunt Resistor	R5	UCR03EWPFSR020	Rohm	Mount	1		20mΩ
39	Chip Resistor	R6,R16,R20,R37,R39, R40,R41,R42,R43,R89	MCR03MRTJ000	Rohm	Mount	10		1608 0
40	Chip Resistor	R7,R12	MCR01MRTJ4R7	Rohm	Mount	2		4.7
41	Chip Resistor	R9	MCR01MRTJ120	Rohm	Mount	1		12
42	Chip Resistor	R10,R13,R21,R23,R24, R47,R52,R54,R55,R60, R65,R79,R87,R93	MCR01MRTJ104	Rohm	Mount	14		100k
43	Chip Resistor	R11	MCR01MRTF1303	Rohm	Mount	1		130k F
44	Chip Resistor	R14,R15	MCR01MRTF1200	Rohm	Mount	2		120
45	Chip Resistor	R17	MCR01MRTF2402	Rohm	Mount	1		24k F
46	Chip Resistor	R22,R98,R103,R104,R105	MCR01MRTJ514	Rohm	Mount	5		510k
47	Chip Resistor	R30,R34,R72,R75,R97	MCR01MRTJ472	Rohm	Mount	5		4.7k
48	Chip Resistor	R33,R85,R86,R95	MCR01MRTJ103	Rohm	Mount	4		10k
49	Chip Resistor	R38	MCR01MRTJ331	Rohm	Mount	1		330
50	Chip Resistor	R56,R57	MCR01MRTF1003	Rohm	Mount	2		100k F
51	Chip Resistor	R61	ERJ-2RKF44422X	Panasonic	Mount	1		44.2k F
52	Chip Resistor	R63	MCR01MRTJ101	Rohm	Mount	1		100
53	Chip Resistor	R67,R69,R70,R71,R73, R74,R76,R77,R84	MCR01MRTJ561	Rohm	Mount	9		560
54	Chip Resistor	R80	MCR01MRTJ105	Rohm	Mount	1		1M
55	Chip Resistor	R81	MCR01MRTJ202	Rohm	Mount	1		2k
56	Chip Resistor	R82,R99,R100	MCR01MRTJ102	Rohm	Mount	3		1k
57	Chip Resistor	R92	MCR01MRTJ243	Rohm	Mount	1		24k
58	Chip Resistor	R94	MCR01MRTJ332	Rohm	Mount	1		3.3k

No	Component Name		Component Specification			Qty/set	—	Remarks
	Type	Symbol on Board	Product Number (Specification)	Manufacture	Mount/Unmount			
59	Chip Resistor	R96	MCR01MRTJ562	Rohm	Mount	1		5.6k
60	Chip Resistor	R101	MCR01MRTJ273	Rohm	Mount	1		27k
61	Tactile Switch	SW1,SW3	B3SN-3012	Omron	Mount	2		
62	Slide Switch	SW2	SSSS213100	ALPS	Mount	1		
63	DIP Switch	SW4	KHS-42	Otax	Mount	1		
64	RX231 MCU	U1	R5F52318ADFP	Renesas	Mount	1		
65	Smart Analog IC	U2	RAA7301013CBG RAA7301014CBG	Renesas	Mount	1		
66	Op Amp	U3	HA1630D06-T	Renesas	Mount	1		
67	Linear Regulator	U4	ADP123AUJZ-R7	ADI	Mount	1		
68	Logic IC	U5	SN74LVC04APW	TI	Mount	1		
69	Audio DAC	U6	PCM1774RGPT	TI	Mount	1		
70	Current-Shunt Monitor	U7	INA211AIDCKT	TI	Mount	1		
71	Flash Memory	U8	MX25L6433FM2I-08G	Macronix	Mount	1		
72	Accelerometer	U9	KXSS5-2057-FR	Kionix	Mount	1		
73	Current Switch IC	U10	TPS2557DRB	TI	Mount	1		
74	Audio Power Amp	U11	TS4990IST	STMicro	Mount	1		
75	Variable Resistor	VR1	3352T-1-104LF	Bourns	Mount	1		100k
76	Variable Resistor	VR2	3352T-1-103LF	Bourns	Mount	1		10k
77	Crystal Unit	X1	FA-238 16MHz	EPSON	Mount	1		16MHz,10pF,±50ppm
78	Crystal Unit	X2	MC-146	EPSON	Mount	1		32.768kHz, 7pF,±20ppm
79	Crystal Oscillator	X3	SG-210STF 11.2896ML	EPSON	Mount	1		11.2896MHz ±50ppm
80	Zener Diode	ZD1	EMZ6.8ET2R	Rohm	Mount	1		
81	Zener Diode	ZD2,ZD3	UDZSTE-176.8B	Rohm	Mount	2		
82	Microphone	CM2	—	—	Unmount	0		
83	Connector	CN5	FFC-20BMEP1B	HTK	Unmount	0		20pin (10×2)
84	Connector	CN6	FFC-16BMEP1B	HTK	Unmount	0		16pin (8×2)
85	Ceramic Capacitor	C4,C16,C24	—	Murata	Unmount	0		1005
86	Electrolytic Capcitor	C88	EMVA250ADA100MD55G	NIPPON CHEMI-CON	Unmount	0		
87	Common Mode Filter	L1	DLP11SN900HL2	Murata	Unmount	0		
88	Chip Ferrite Beads	L2	BLM21PG600SN1	Murata	Unmount	0		
89	Chip Resistor	R1,R18,R35,R36,R48, R58,R90	—	—	Unmount	0		1005
90	Chip Resistor	R53,R66,R88,R102	—	—	Unmount	0		1608



No	Component Name		Component Specification			Qty/set	—	Remarks
	Type	Symbol on Board	Product Number (Specification)	Manufacture	Mount/Unmount			
91	TP	TP1,TP2,TP6,TP10,TP11, TP12,TP13,TP14,TP15,TP16, TP17,TP18,TP19,TP20,TP21, TP22,TP23,TP24,TP25,TP26, TP27,TP28,TP29,TP30,TP31, TP32,TP33,TP34,TP35,TP36, TP37,TP38,TP39,TP40,TP41, TP42,TP43,TP44,TP45,TP46	—	—	Unmount	—	—	Pad $\Phi$ 1.0mm
92	TP	TP3,TP4,TP5,TP7,TP8, TP9,	—	—	Unmount	—	—	Pad $\Phi$ 1.5mm
93	Touch PAD	TS1,TS2,TS3,TS4,TS5, TS6,TS7,TS8	—	—	Unmount	—	—	Capacitive Touch
94	PCB	—	ROK5RX231D000BR	SANYO KOGYO	—	1	—	

## Revision Record

Rev.	Date	Description	
		Page	Summary
1.00	2015.08.05	-	First edition issued
1.01	2015.12.04	33	Added section 6
1.02	2016.12.01	33	Change section 6

## 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. 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 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. Unused pins should be handled as described under Handling of Unused Pins in the manual.

### 2. Processing at Power-on

The state of the product is undefined at the moment 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 moment 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 moment 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 moment when power is supplied until the power reaches the level at which resetting has been specified.

### 3. Prohibition of Access to Reserved Addresses

Access to reserved addresses is prohibited.

- The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

### 4. Clock Signals

After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has 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. Moreover, 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.

### 5. Differences between Products

Before changing from one product to another, i.e. to a product with a different part number, confirm that the change will not lead to problems.

- The characteristics of Microprocessing unit or Microcontroller unit products in the same group but having a different part number may differ in terms of the 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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