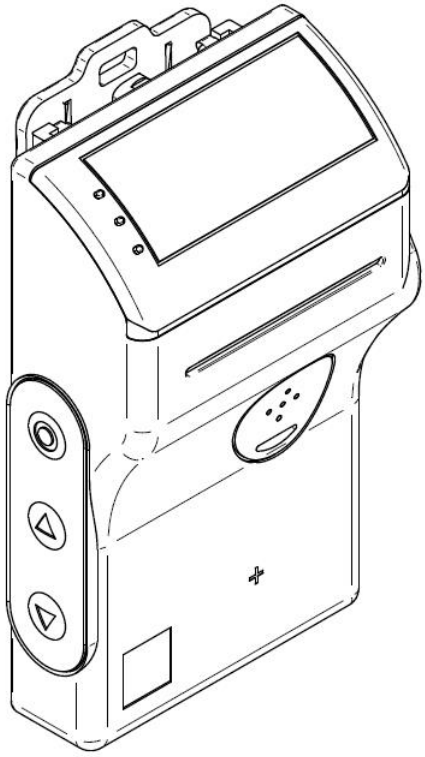
User's Manual

Electronic Personal Dosimeter
NRF50



Introduction

This User’s Manual explains the operation of the Electronic Personal Dosimeter NRF50. It provides descriptions of parts, functions and operational instructions for optimal use. Please make sure that you read this manual carefully before operation.

In the event of product malfunction, contact Fuji Electric representative immediately.

Handling Precaution

Please read the following handling precautions to ensure that you use the NRF50 Electronic Personal Dosimeter safely and avoid injury/damages. Please read this User's Manual carefully to understand all the precautions before using theNRF50 Electronic Personal Dosimeter.

	Precautions for Use
⚠Attention	・ The Dosimeter is a precision instrument. Do not drop it or subject it to impact. ・ Keep the Dosimeter in a plastic bag for protection when use in an environment where chemical fumes, splashes/steam, full of dust and wastes are present. ・ Handle the Dosimeter with clean, dry hands. If becomes tainted, clean it with dry cloth. ・ Do not place the Dosimeter and metal objects in the same pocket. It may cause the Dosimeter breaking. ・ Avoid use where high frequency noise. Pay attention when use near the following devices: 1. Mobile phone 2. Local wireless phone such as Personal Handyphone System (PHS) 3. High power transceiver 4. Microwave oven 5. Radar 6. Welding machine 7. Any other spark discharging or high intensity radio wave emitting devices Especially keep the Dosimeter at least 5cm away from any mobile/ wireless phones ・ When the battery level is critically low, read the displayed value within 10 minutes. ・ Use AA alkaline battery only. During replacement, align the battery polarities correctly. ・ Prior to disposal of the used battery, protect exposed terminals with insulating tape to prevent shorting that may cause possible heating, rupture, or burning. Otherwise, injury or fire may result. ・ Do not throw the Dosimeter or battery into a fire. Do not disassemble them. ・ Keep a certain distance between the buzzer and ears to avoid the injury. (Buzzer makes the sound over 90dB at 30 cm distance) ・ Do not use the Dosimeter as a survey meter. ・ If a hard impact is made on the Dosimeter, it is possible that there is a crack on the Dosimeter. In this case, deteriorations to the capabilities in a waterproof and a resistance of radio wave may happen.

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1. Overview

The Electronic Personal Dosimeter NRF50 (hereinafter referred to as NRF50) is designed to provide measurement of personal dose equivalent of external exposure to radiations (hereinafter referred to as dose).
NRF50 indicates accumulated dose or dose rate. When measured dose (rate) value exceeds preset dose (rate) alarm threshold, NRF50 will activate audible alarm and flashes LED.

By using the Dosimeter Configuration Tool and a PC, it is able to write PC-edited setting values to NRF50 and read measurement trend data from the NRF50 via communication with the device.

If it’s worn tightly to the body, energy characteristic of the NRF50 enables direct reading of personal dose equivalent Hp(10).

2. Contents

2.1 Standard product package

(1) NRF50 1 pcs

(2) Accessory

- Battery (AA alkaline battery) 2 pcs

2.2 Model

NRF50

3. Precautions

⚠Attention

3.1 Operational conditions

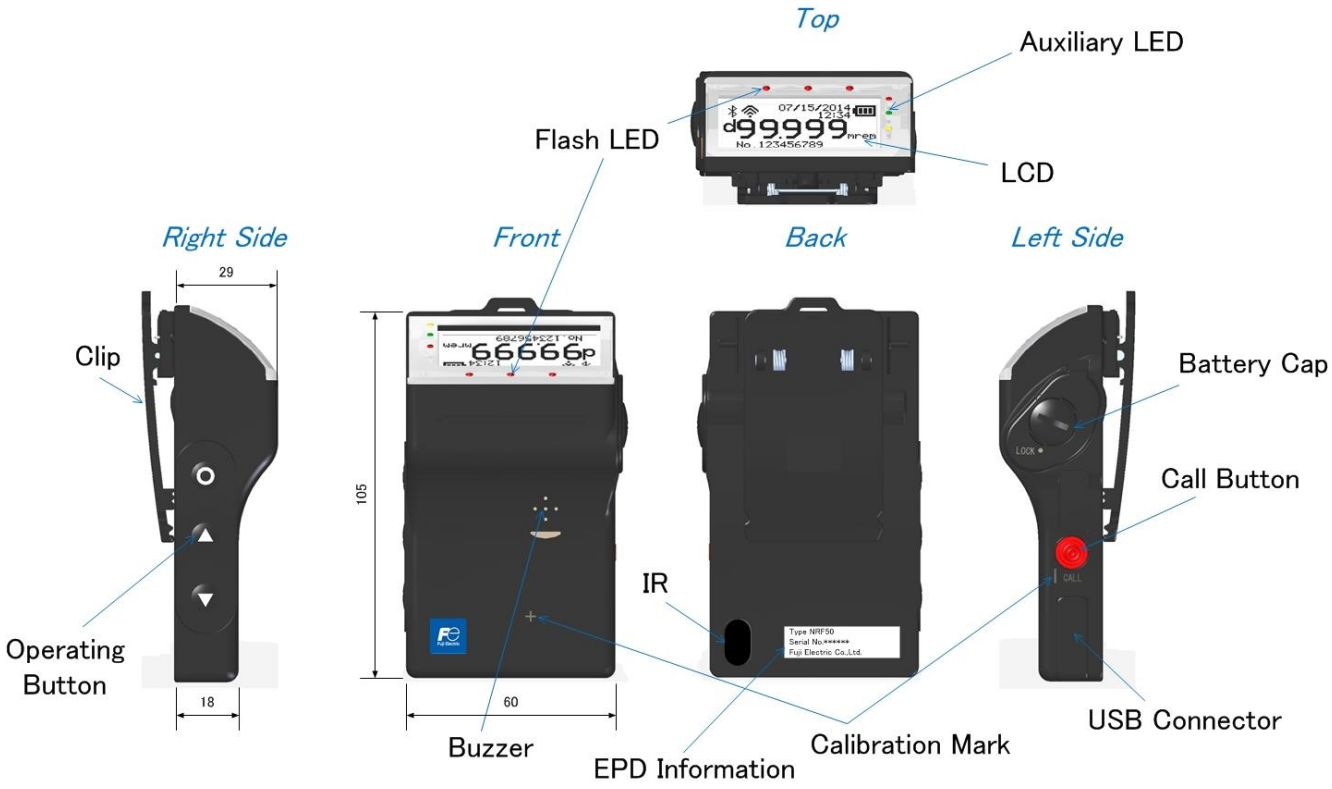
Item	Conditions
Temperature range	-10 °C to +50 °C
Relative humidity	95 % or less (No condensation)
Storage temperature	-25 °C to +50 °C

3.2 Other requirements

(1) See User's Manual of "Dosimeter Configuration Tool" for information on parameter writing and data reading via the device and a PC.
(2) Try turn OFF & ON the NRF50 if you encounter technical problems. See the "Troubleshooting Table" if the problem is not recovered.
(3) Accumulated dose cannot be reset if the power-on-reset setting of NRF50 is "OFF". In this case, please reset the accumulated dose through theDosimeter Configuration Tool.

4. Description of Parts and Functions

4.1 Part names



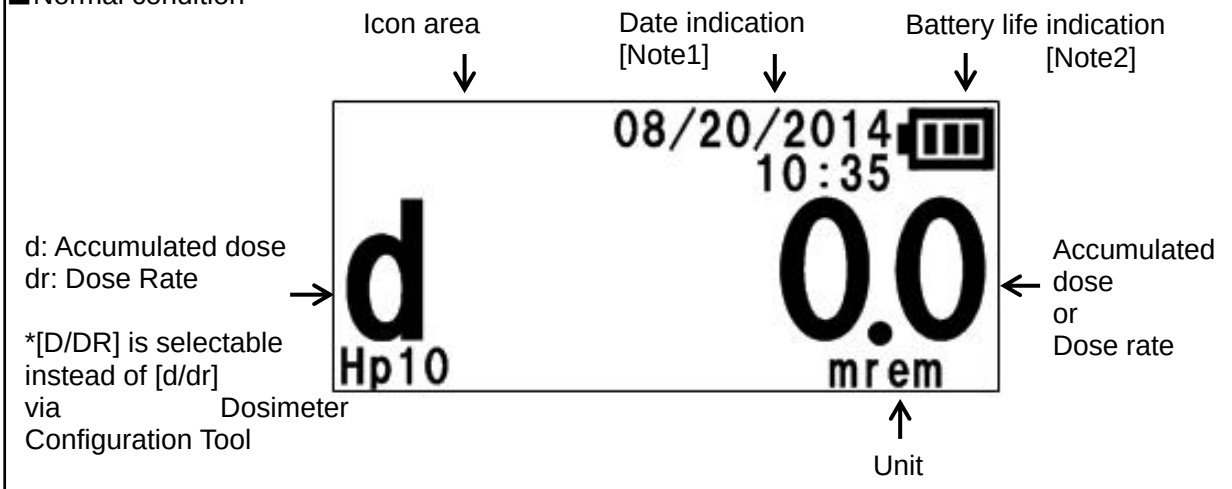
Functions

1. Buzzer	: It sounds when NRF5 starts its operation, alarm and monitoring sound is generated.
2. Flash LED	: Red LED on top of LCD flashes during alarm generation.
3. Auxiliary LED	: Green LED flashes along to monitoring sound. Red LED flashes along to alarm. Yellow LED flashes along to preliminary warning alarm.
4. LCD	: Liquid Crystal Display Indicator.
5. Battery Cap	: Cap of battery compartment.
6. Operating Button	: Switch indication screen. Also, some operation parameters such as alarm threshold can be changed by these buttons.
7. Calibration Mark	: Shows location of calibration reference point. (Sensor position)
8. USB Connector	: For power supply or communication by connecting USB cable.
9. Infrared window	: For communication with infrared communication device.
10. Call Button	: Emergency alarm button. Press for more than 3 seconds to generate warning sound and indication. If user does not use this emergency alarm, the function can be made void by the Dosimeter Configuration Tool.
11. EPD Information	: For indicating model and serial number of the NRF50.
12. Clip	: To fix the NRF50 on the chest pocket or on the waist belt.

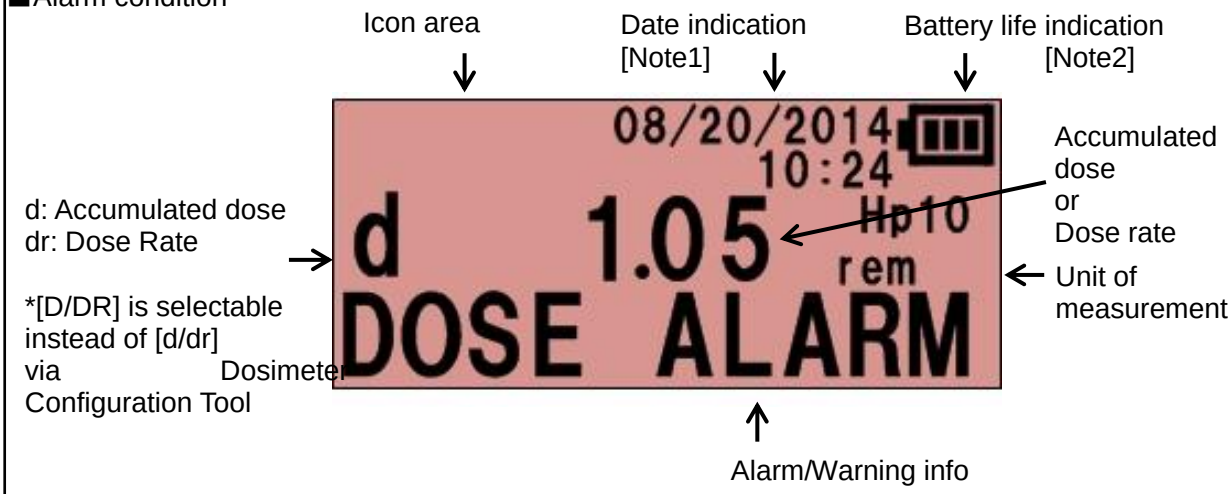
4.2 Display function

LCD Indication

■Normal condition

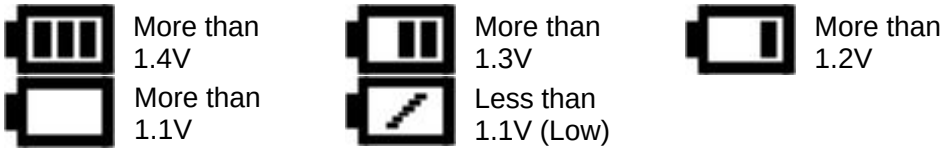


■Alarm condition



Note1: During normal operation, ":" for time indication flashes.

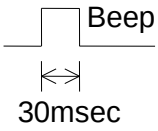
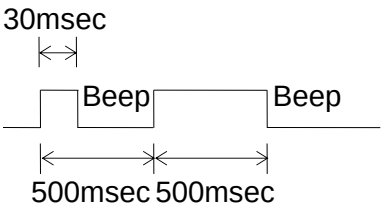
Note2: Battery life indicates remaining voltage as follows.



4.3 Buzzer function

4.3.1 Audible signal

Audible signals sound under the following circumstances:

Circumstance	Audible signal sounds when	Beep pattern
Turn ON/OFF	NRF50 is turned on	
	NRF50 is turned off	No sound
Contact to Dosimeter Configuration Tool	Communication starts	No sound
Data transmission	Successful completion of data transmission	No sound
	Setting values of NRF50 are changed using a Dosimeter Configuration Tool	
	Data transmission failed	No sound

4.3.2 Audible alarms

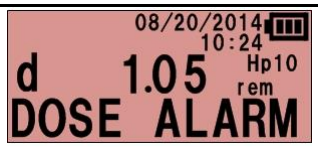
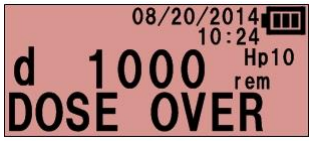
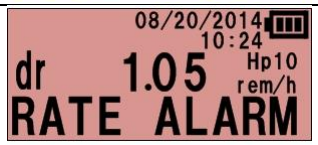
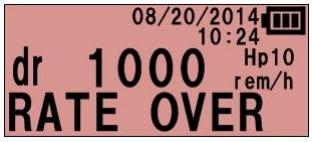
Alarm activation and beep pattern are configurable by user with Dosimeter Configuration Tool. When multiple alarms happen, alarm pattern is determined by alarm priority.

Alarm priorities are as follows:

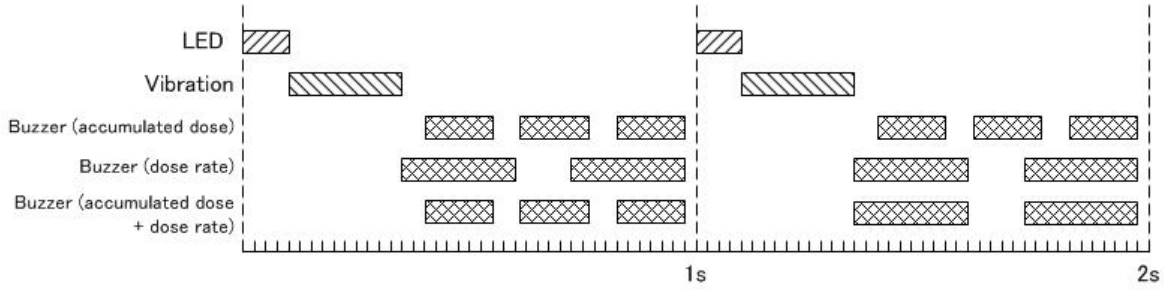
Priority	Alarm	Remarks
1	Memory error	Breakdown
2	RTC error	Breakdown
3	Emergency alarm	
4	Detector optical check error	
5	Accumulated dose overload	
6	Dose rate overload	
7	Time alarm	
8	Accumulated dose alarm	
9	Dose rate alarm	
10	Accumulated dose warning	
11	Dose rate warning	
12	Low battery voltage	
13	Calibration due expiration	
14	Communication error (radio, BT, USB)	Component failure

Initial setting value of alarm activations and beep patterns are as follows:

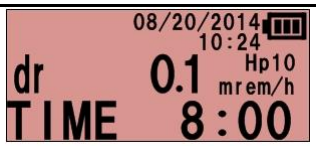
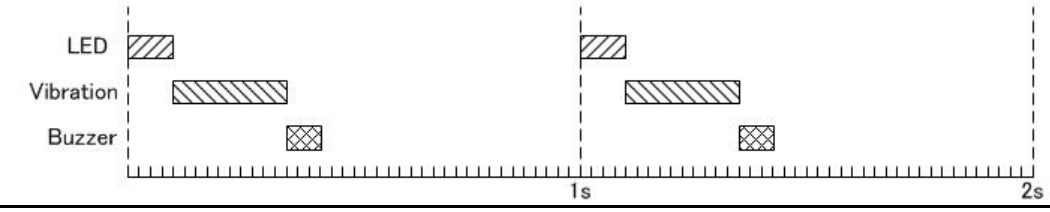
(1) Dose (rate) alarm

Alarm type	LCD indication	Buzzer	Vibration	LED/Backlight
Accumulated dose alarm	 When overload 	Sounds 3 times per 1 second	Vibrates 1 time per 1 second	Flashes 1 time per 1 second Alarm: Flash LED + Auxiliary LED (RED) Warning: Auxiliary LED (YELLOW) RED/YELLOW backlight flashes 1 time per 1 second
Accumulated dose warning				
Dose rate alarm	 When overload 	Sounds 2 times per 1 second (Long beep)		
Dose rate warning				

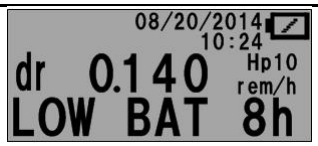
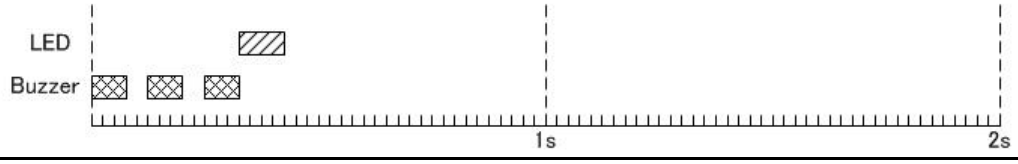
Alarm pattern



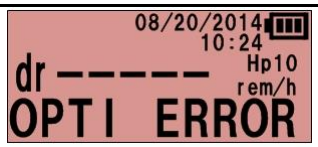
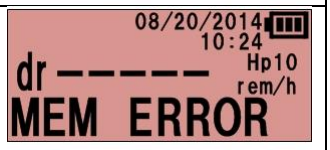
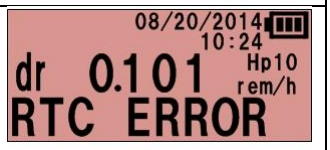
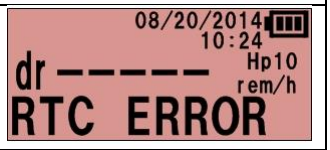
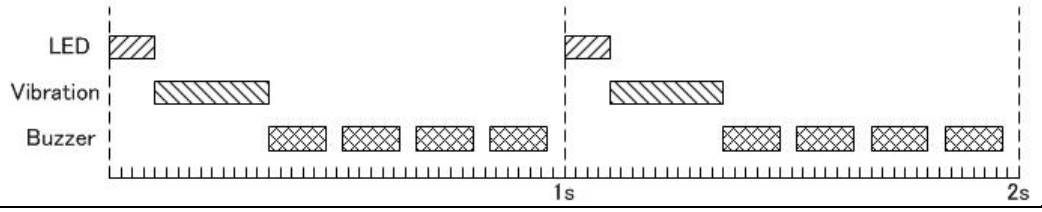
(2) Operation time alarm

Alarm type	LCD indication	Buzzer	Vibration	LED/Backlight
Time alarm	 *Indication (HH:MM) is operating time (increasing)	Sounds 1 time per 1 second (Short sound)	Vibrates 1 time per 10 seconds	Flashes 1 time per 10 seconds Flash LED + Auxiliary LED (RED) RED backlight flashes 1 time per 1 second
Alarm pattern 				

(3) Low battery voltage

Alarm type	LCD indication	Buzzer	Vibration	LED/Backlight
Low battery voltage	 *Count down remaining operation time to turn off	Sounds 3 times per 10 minutes (Short sound)	No vibration	Flashes 1 time per 10 seconds Auxiliary LED (RED) No backlight
Alarm pattern 				

(4) Indication of abnormality

Alarm type	LCD indication	Buzzer	Vibration	LED/Backlight
Detector optical check error		Sounds 4 times per 1 second	Vibrates 1 time per 1 second	Flashes 1 time per 1 second Flash LED + Auxiliary LED (RED) RED backlight flashes 1 time per 1 second
Memory error				
Memory error (When measurement stops)				
RTC error				
RTC error (When measurement stops)				
Emergency alarm				
Alarm pattern 				

(5) Calibration due expiration and communication error

Alarm type	LCD indication	Buzzer	Vibration	LED/Backlight
Calibration due expiration		No buzzer	No vibration	No LED Yellow backlight flashes 1 time per 1 second
Radio communication error (Detected component failure when turning on)				
Bluetooth error (Detected component failure when turning on)				
USB error (Detected component failure when turning on)				

4.3.3 Monitoring Sound

Buzzer sounds 1 time for a short period, if accumulated dose reaches a preset value of dose interval for monitoring sound. Monitoring sound interval can be chosen from 6 types, “OFF”, “10 mrem”, “1 mrem”, “0.1 mrem”, “0.02 mrem” and “0.01 mrem”. Please see User’s Manual of “Dosimeter Configuration Tool” for details.

5. Parts Replacement

5.1 Battery replacement

Follow these steps to replace the batteries:

(1) Press and hold “◎” button to turn NRF50 off.

(2) Open the cap of battery compartment using a coin or coin driver.

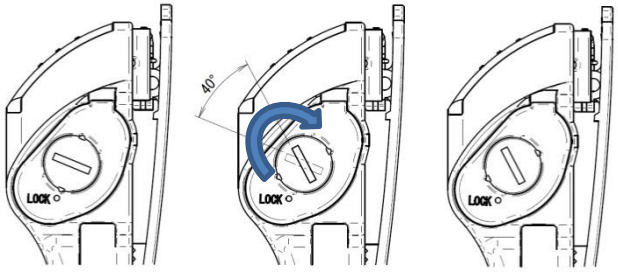
(3) Replace the batteries.

Insert new ones properly in the compartment with care to check the directions “+” and “-“.

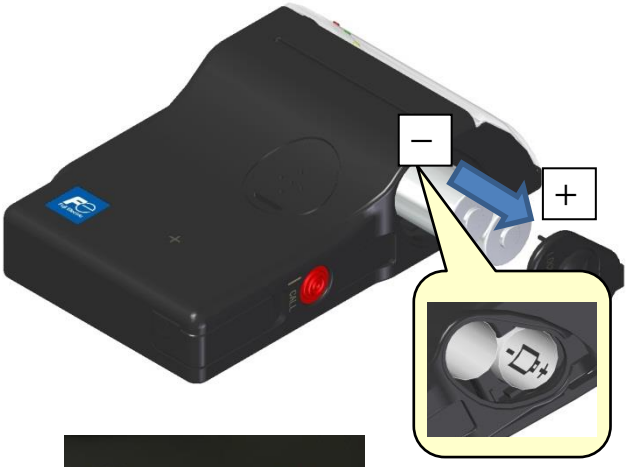
(Both batteries are positioned in the same direction)

(4) Close the cap and tighten with a coin or coin driver.

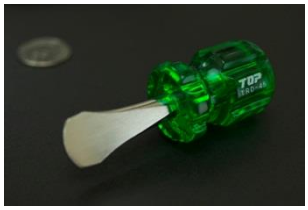
* NRF50 can be operated even by one battery.



Close　　Use a coin to open　　Open



Battery polarity sign



Coin driver

⚠ Attention	1. When replacing batteries, make sure to turn off NRF50. 2. During replacement, align the battery polarity correctly. 3. Use only AA Alkaline battery.

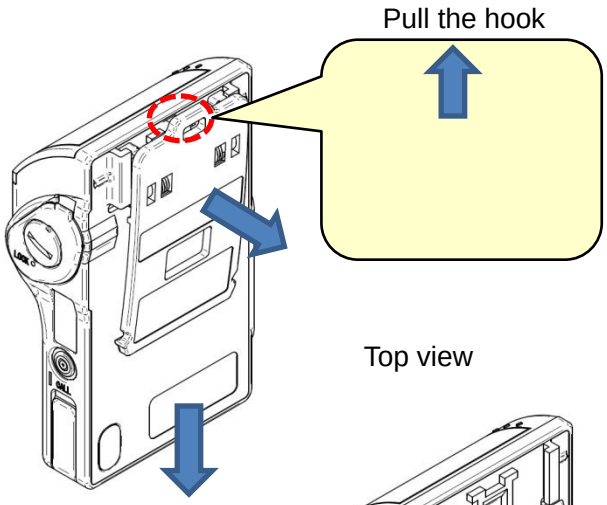
5.2 Clip replacement

Follow these steps to replace the clip:

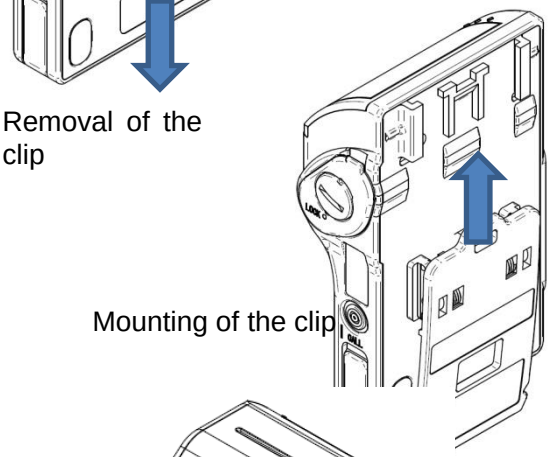
Removal of the clip

(1) Pull the clip hook

(2) Pull the clip down keeping the clip hook away from the dosimeter.



Top view



Removal of the clip

Mounting of the clip

(1) Push the clip up until the clip hook closely inserted to the disimter

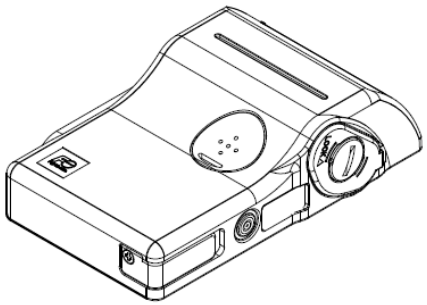
Mounting of the clip

5.3 USB connector cap replacement

Removal of the USB connector cap

(1) Open the USB connector cap.

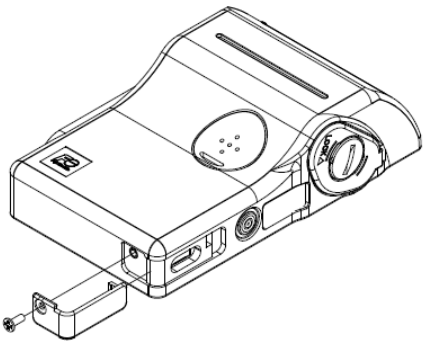
(2) Turn a screw down with a Phillips-head screwdriver and take off the USB connector cap.



The way of put on the USB connector cap

(1) Put on the USB connector cap and turn a screw up with a Phillips-head

(2) Close the USB connector cap.

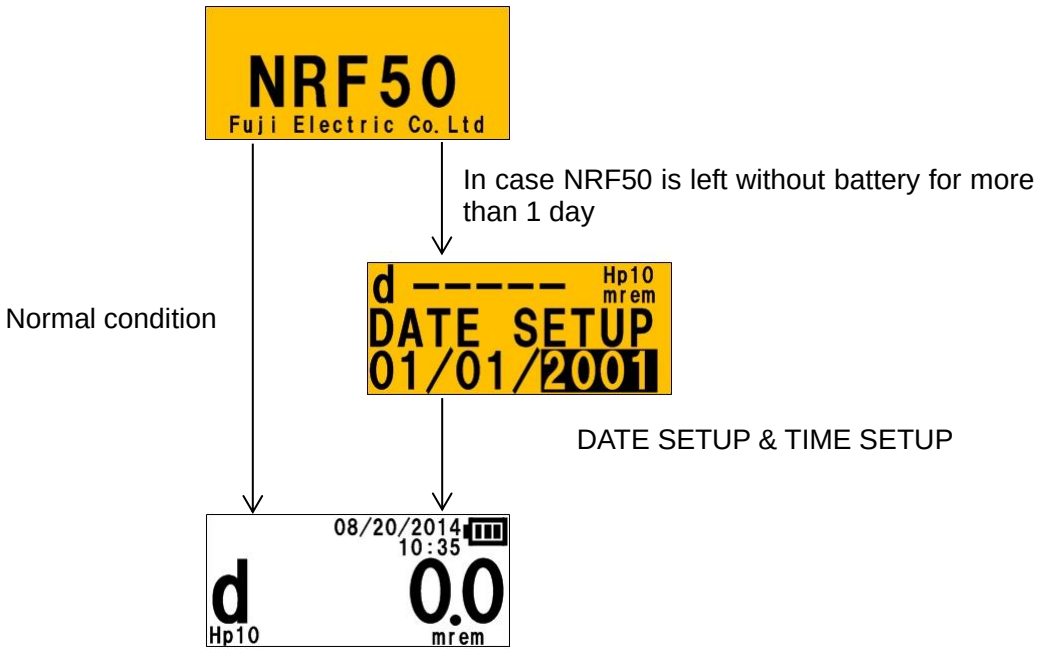


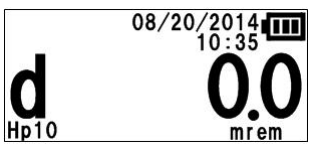
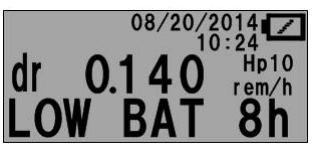
6. Operational Instruction

6.1 When starting to use

(1) Press and hold “◎” button for more than 3 seconds to start the NRF50.

Confirm the power is ON (Backlight and LED check, one time short beep sound) and LCD displays an initial screen.



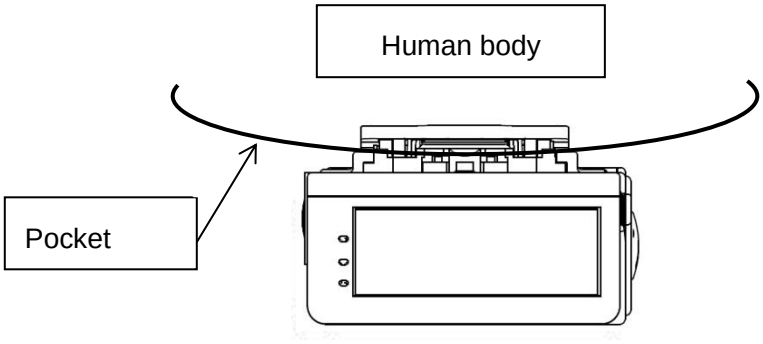
Check items	Confirmation method	
Audible signal (1 beep)	Short beep sound is generated when dosimeter is turned on.	
Indicated dose value	0.0 mrem or 0.0 mrem/h (Accumulated dose may not be 0.0 mrem if the power-on-reset setting of NRF50 is “OFF”.)	
LCD	〔Normal display〕  When accumulated dose is 0.0 mrem	〔Example of abnormal display〕  When generating alarm for low battery

(2) White backlight turns on by pressing any of “◎”, “△” or “▽” button.

Display of accumulated dose (rem) and dose rate (rem/h) can be switched by pushing the button of “△” or “▽”. “◎” button can also switch the display to other screens.

Please see section 6.2 in details for screen change methods by “◎” button.

(3) Put NRF50 in the chest pocket as shown below.

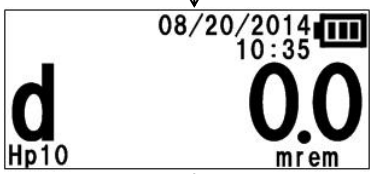
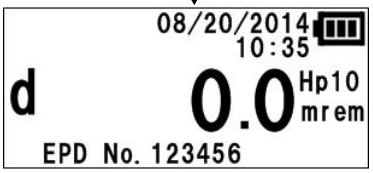
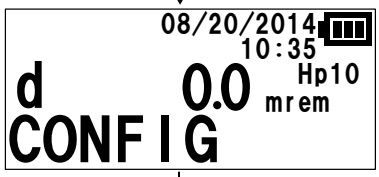
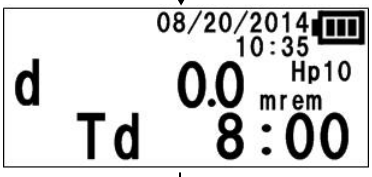


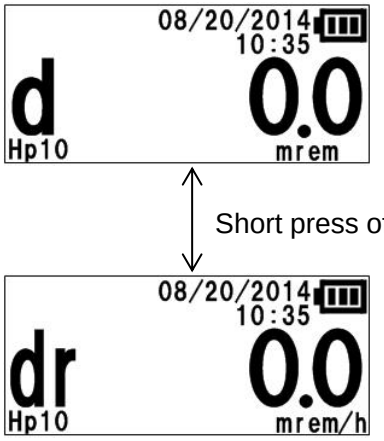
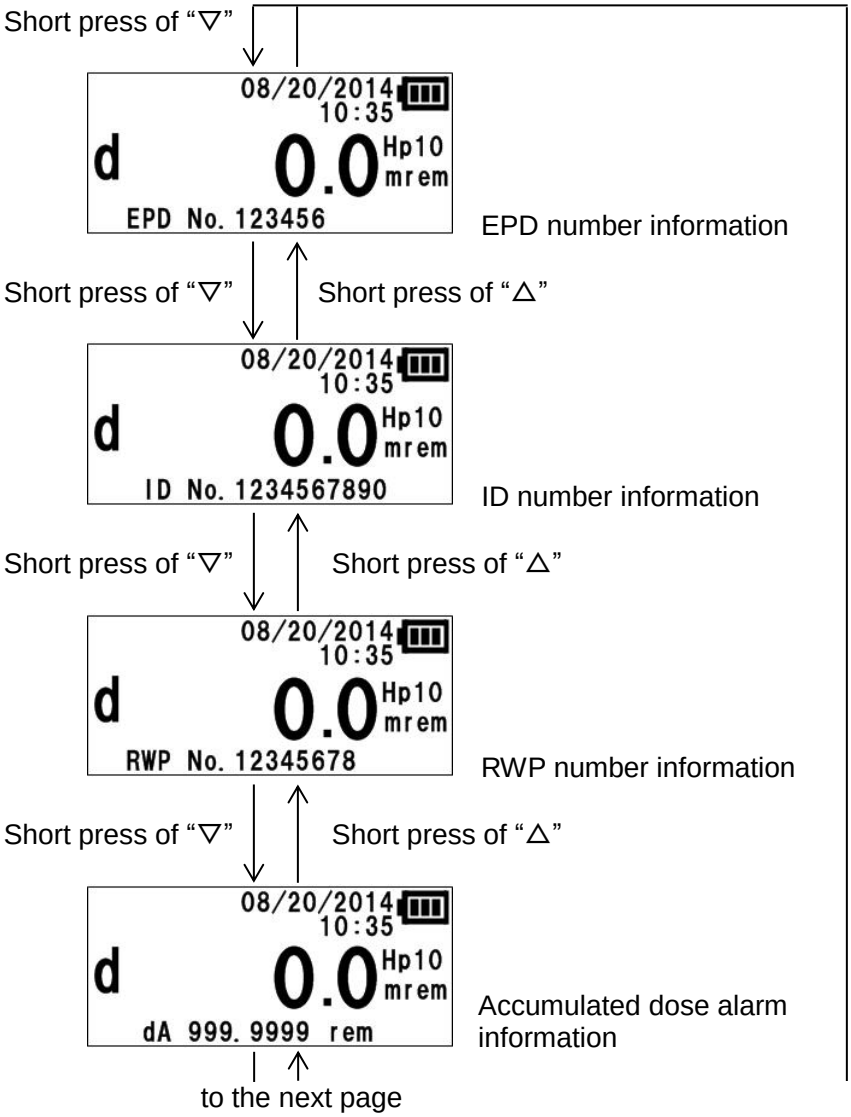
※Direction of NRF50:

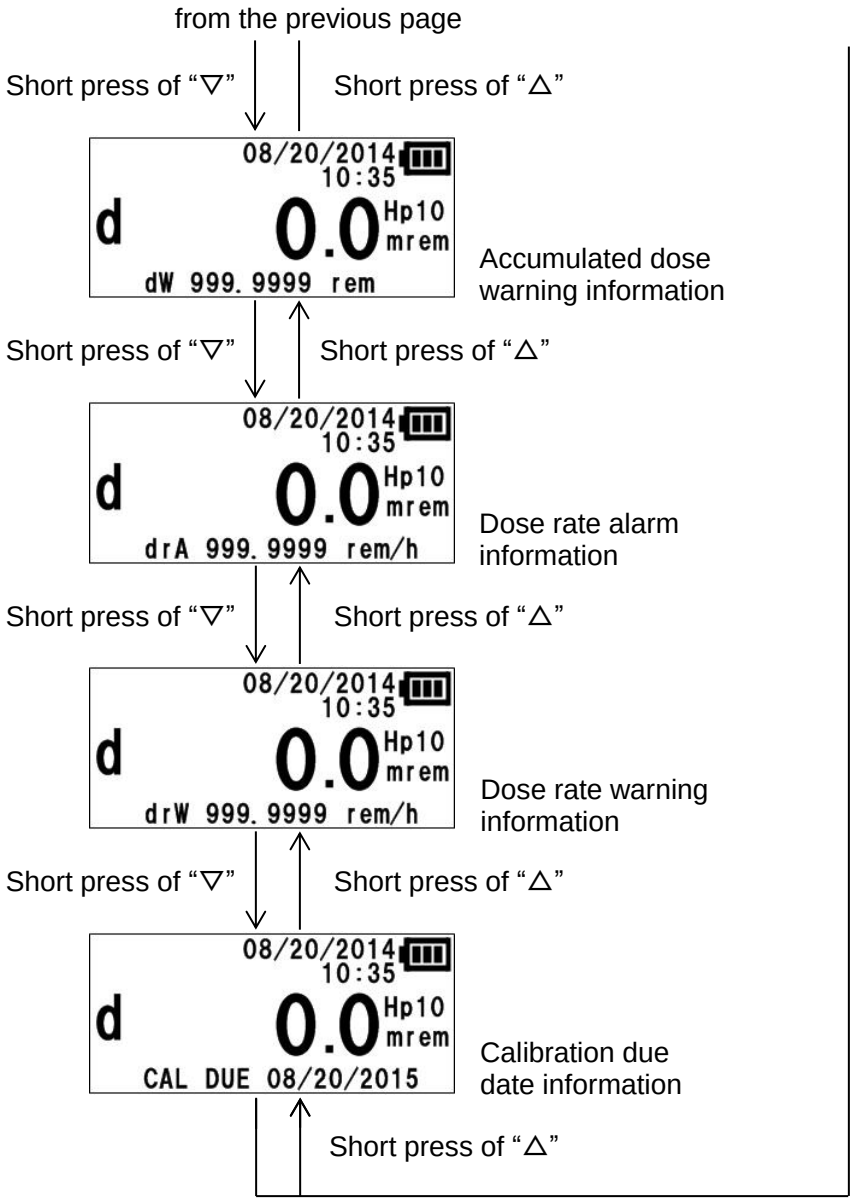
As EPD is viewed from wearer, operation button and auxiliary LED must be positioned so that they are in the right side from wearer’s point of view, and buzzer faces outward.

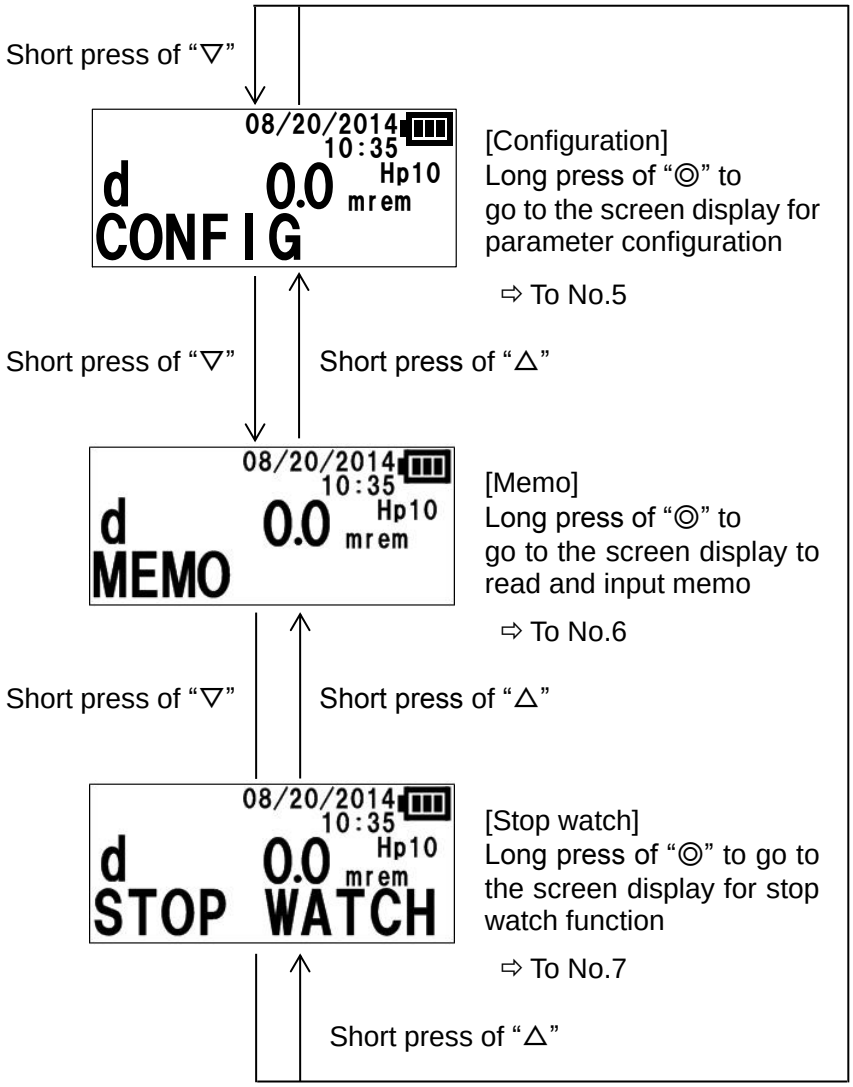
6.2 During use (Normal operation)

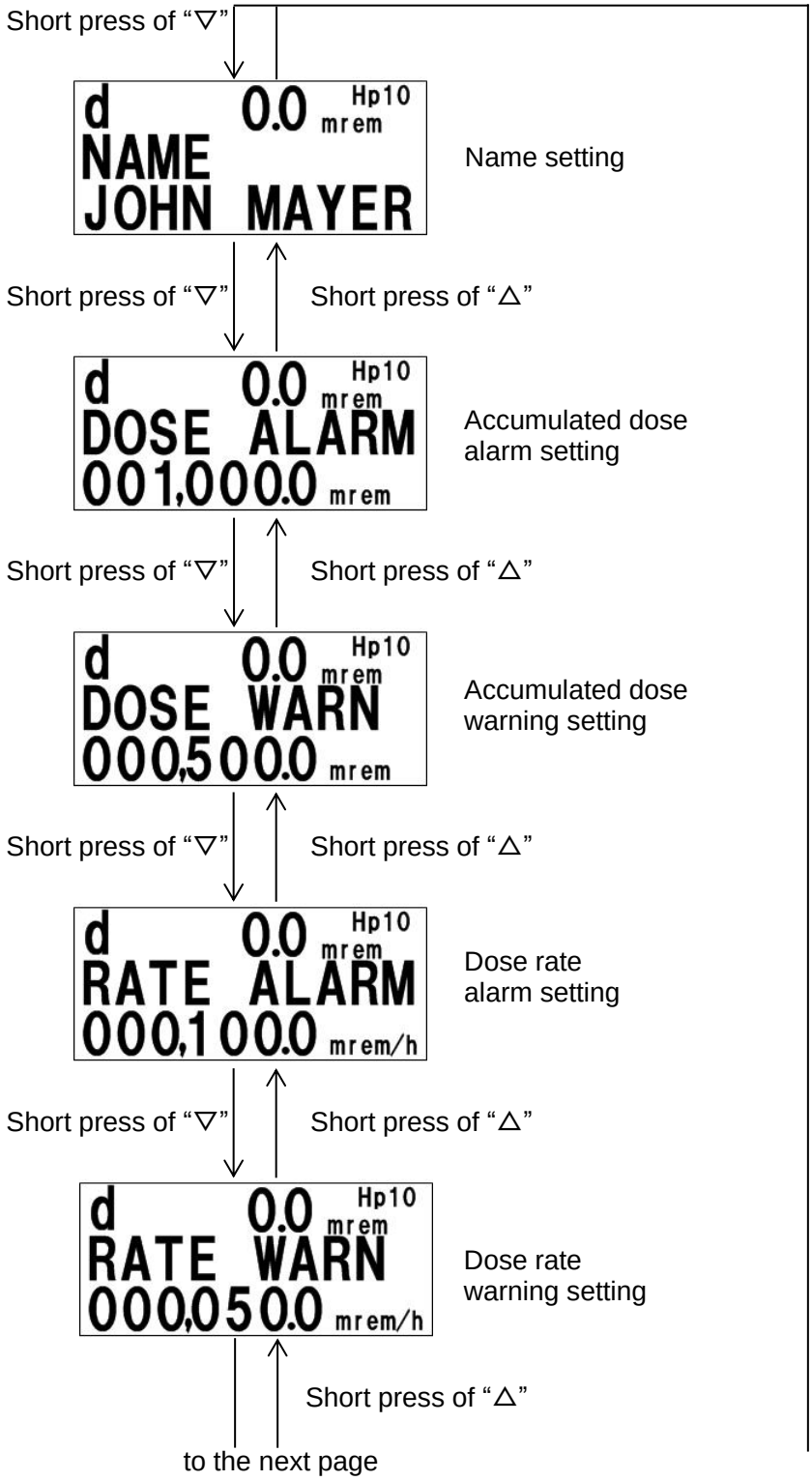
LCD display change flow by operation of button
*If either of the operation buttons was pressed when LCD backlight is turned off, LCD backlight would be turned on. Then, LCD display will be changed as the following table shows.

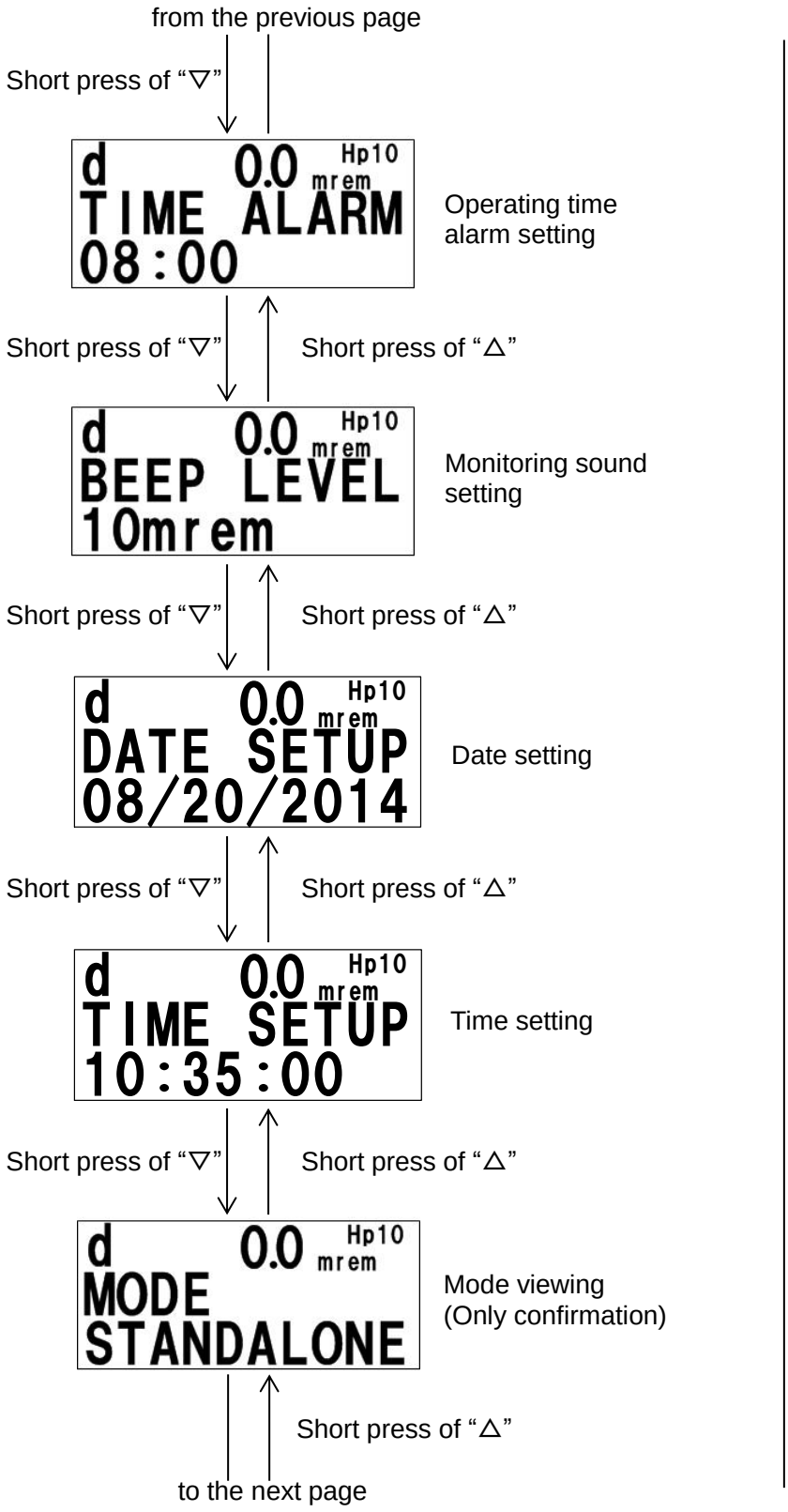
No.	Display	Remarks
1	[Basic display] ⇨ To No.2  [Information display] Short press of "◎" ⇨ To No.3  [Configuration/Accessory display] Short press of "◎" ⇨ To No.4  [Operating time display] Short press of "◎" ⇨ To No.8  Short pressing of "◎"	Power turns off by long press of "◎" button. (In Basic display or Information display) Indication is changed by short press of "△" or "▽" button in each display. See the following pages for detailed flow.

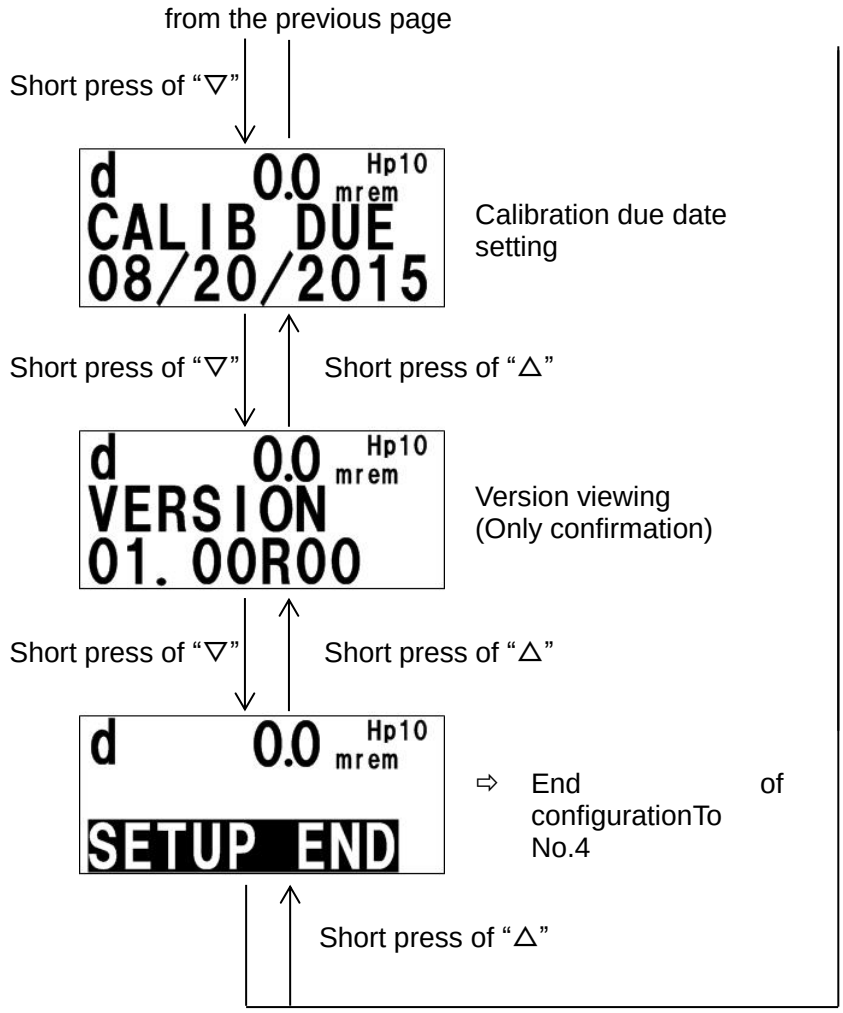
No.	Display	Remarks
2	[Basic display] Switching  	Power turns off by long press of “◎” button.
3	[Information display] Switching  	Power turns off by long press of “◎” button. Each indication can be selected to show/hide via Dosimeter Configuration Tool.

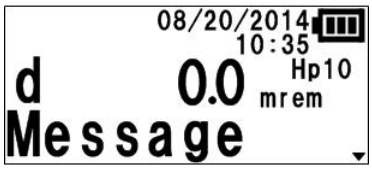
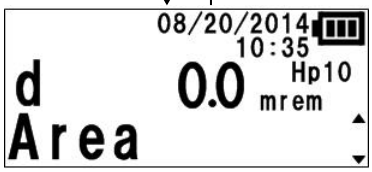
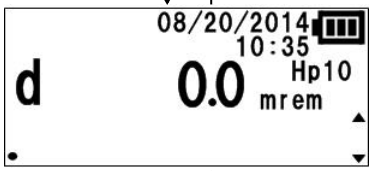
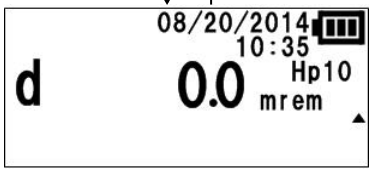
No.	Display	Remarks
3	[Informationdisplay] Switching (continued)  	Power turns off by long press of "◎" button. Each indication can be selected to show/hide via Dosimeter Configuration Tool.

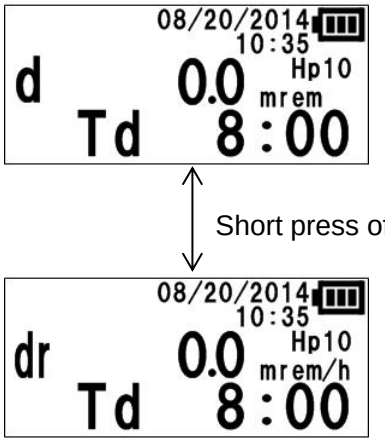
No.	Display	Remarks
4	[Configuration/Accessory display] Switching  	Long press of "◎" to go to each screen display.

No.	Display	Remarks
5	[Parameter configuration display] Switching  	Short press of "◎" to change a displayed parameter. (Yellow backlight turns on) Long press of "◎" to confirm the parameter change. Name can be entered with 10 characters from A to Z. Alarm value can be set with numbers of 0 to 9.

No.	Display	Remarks
5	[Parameter configuration display] Switching (continued)  	Short press of "◎" to change a displayed parameter. (Yellow backlight turns on) Long press of "◎" to confirm the parameter change. Alarm setting, date and time setting can be set with numbers 0 to 9. Monitoring sound can be selected from "10 mrem", "1 mrem", "0.1 mrem", "0.02 mrem", "0.01 mrem" and "OFF".

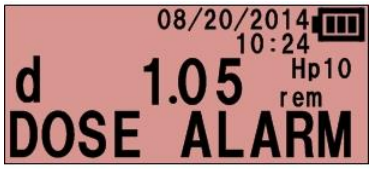
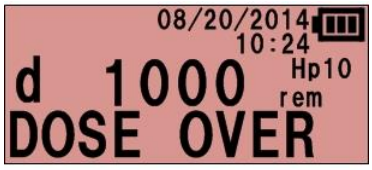
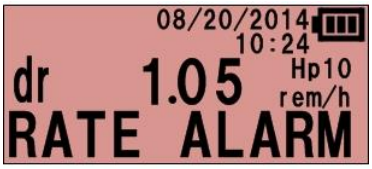
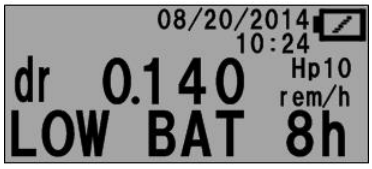
No.	Display	Remarks
5	[Parameter configuration display] Switching (continued)  	Short press of “◎” to change a displayed parameter.. (Yellow backlight turns on) Long press of “◎” to confirm the parameter change. Calibration due date setting can be set with numbers 0 to 9. Return to Configuration display by short press of ”◎”.

No.	Display	Remarks
6	[Memorandum]  Memo display (1st to 10th characters) Short press of “▽” Short press of “△”  Memo display (11th to 20th characters) Short press of “▽” Short press of “△”  Memo display (21st to 30th characters) Short press of “▽” Short press of “△”  Memo display (31st to 32nd characters)	Return to Configuration/Accessory display by long press of “◎”.

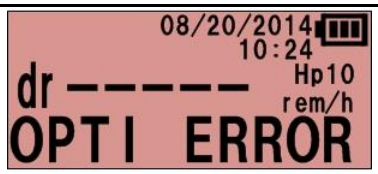
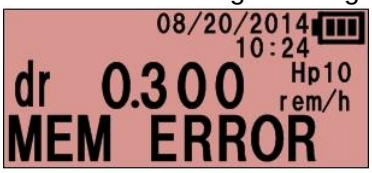
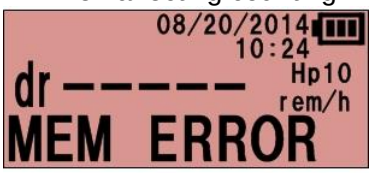
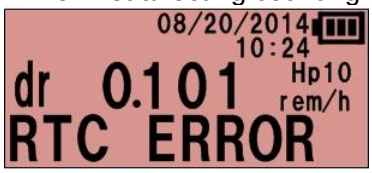
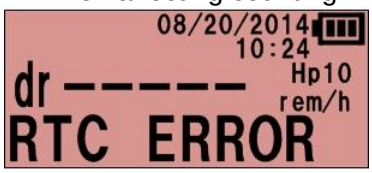
No.	Display	Remarks
7	[Stop watch] Stop watch display [Start]/[Stop] : Short press of "△" when white backlight turns on [Clear] : Short press of "◎" when the stop watch does not run and white backlight turns on	Return to Configuration/Accessory display by long press of "◎". (It is possible even when time counting up)
8	[Operating time display] Switching  Indication of accumulated dose and operating time (Td : time remaining, Decreasing from operating time alarm value) Indication of dose rate and operating time (Td : time remaining, decreasing from operating time alarm value) [Ti : time increasing from beginning of the operation] is selectable instead of [Td] via Dosimeter Configuration Tool.	Power cannot turn off by long press of "◎" button. Return to Basic display by short press of "◎" button.

6.3 During use (When alarm is generated)

LCD display when some alarms are generated
*See Chapter 4 for operation of buzzer, vibration and LED/Backlight during alarm generation.

No	Item	Display	Remarks
1	Accumulated dose alarm/warning	Alarm  Overload  Warning 	Warning alarm is generated when exceeding dose warning set value. Alarm is generated when exceeding dose alarm set value. Also, display is changed when overload happens.
2	Dose rate alarm/warning	Alarm  Overload Warning 	Warning alarm is generated when exceeding dose rate warning set value. Alarm is generated when exceeding dose rate alarm set value. Also, display is changed when overload happens. Alarm is canceled when dose rate reaches down at 80% of warning/alarm value or less.
3	Operation time alarm		When exceeding operating time alarm set value, time alarm is generated.
4	Low battery voltage		Low battery voltage alarm is generated when battery voltage reaches less than 1.1V. Remaining operational hours is displayed with numbers 1 to 9 h, then power OFF after 1 hour.

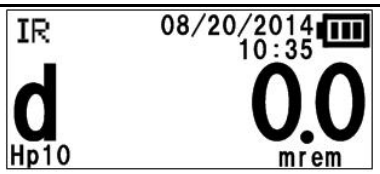
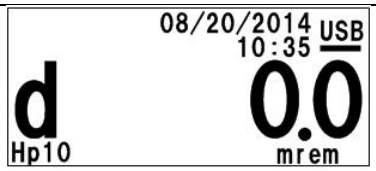
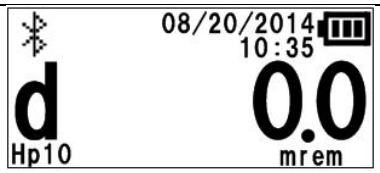
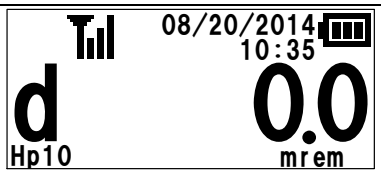
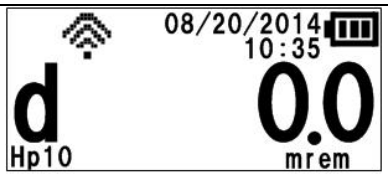
⚠ Attention	1. Replace the battery promptly when generating low battery voltage alarm. 2. Buzzer,LED,Backlight,Vibrator and other function may not work after low battery voltage alarm is activated.

No	Item	Display	Remarks
5	Detector optical check error		When detector failure is detected by internal LED optical pulse check, detector optical check error alarm is generated.
6	Memory error	When not affecting counting  When affecting counting 	When memory failure occurs during data backup, memory error alarm is generated. When the failure does not affect counting function, operation continues. When the failure affects counting function, operation stops and the dose (rate) value would be lost.
7	RTC error	When not affecting counting  When affecting counting 	RTC error alarm is generated, when Real Time Clock (RTC) IC error is detected. When the error does not affect counting function, operation continues. When the error affects counting function, operation stops and the dose (rate) value would be lost.
8	Emergency alarm		Emergency alarm is generated, when “call” button is pressed for more than 3 seconds.
9	Calibration due expiration		Expiration alarm is generated when calibration due date is passed.

*Communication error may be generated only right after the NRF50 turns on.

6.4 During use (When communicating)

LCD display during communication

No	Item	Display	Remarks
1	Infrared communication		“IR” is displayed on the upper left of screen during infrared communication.
2	USB communication		“USB” is displayed at battery life position during USB connection and communication.
3	Bluetooth communication		“Bluetooth mark” is displayed on the upper left of screen during Bluetooth communication.
4	900MHz wireless telemetry (900MHz radio type only)		“Radio telemetry mark” is displayed on the upper left of screen during communication with 900MHz wireless telemetry.
5	Wi-Fi telemetry (Wi-Fi type only)		“Wi-Fi telemetry mark” is displayed on the upper left of screen during communication with Wi-Fi telemetry.

6.5 After use

Turn OFF by long press of “◎” on basic display or information display.

7. Care and Maintenance

Check the NRF50 as specified below to ensure quality of the product performance.

7.1 Daily check and maintenance items

No	Check items	Procedures	Check point
1	Appearance	Check the NRF50 visually. When to check；Before use and after battery replacement Check purpose；Check if there is no abnormality with the case and battery cap.	No signs of crack, damages or breakage on the case. No signs of gap between case and battery cap.
2	Indication error/ calibration	To confirm the indication error within 10% to the reference dose equivalent using Cs-137. When to check: 1 year or less Check purpose: To ensure a valid dose measurement by dosimeter	If indication error is greater than 10%, please configure calibration factor correctly. If the error is unusually large, please contact Fuji Electric representative.

7.2 Consumable supplies

Please Contact Fuji Electric representative for the following consumables.

No	Parts name	Replace criterion	Drawing number	remarks column
1	Battery cap	2 years	TQ403907C1	
2	USB connector cap	2 years	TQ504089C1	
3	Clip	When clip is broken	TQ403901C1	

8. Specification

8.1 General Specification

Model : NRF50
Detector : Silicon semi-conductor
Radiation type : γ(X) rays (30 keV to 7.0 MeV)
Dose display range: 0.1 mrem to 1000 rem, 0.1 mrem/h to 1000 rem/h
Effective measurement range: 2.0 mrem to 1000 rem, 0.05 mrem/h to 1000 rem/h (accumulated dose)
10.0 mrem/h to 1000 rem/h (dose rate)
Rated range : Gmha (category for IEC61526)
60 keV to 6 MeV, 10.0 mrem to 1000 rem, 0.05 mrem/h to 1000 rem/h
Indication error : Within ±10 % (Cs-137, 2.0 mrem to 1000 rem)
Within ±30 % (Cs-137, 10.0 mrem/h to 100.0 mrem/h)
Within ±20 % (Cs-137, 100.0 mrem/h to 1000 rem/h)
Energy characteristic : Within ±20 %（Cs-137, 50 keV ～ 6 MeV）
Direction characteristic : Within ±20 %（Cs-137, Vert. and horz. to ±75°）
Within ±50 %（Am-241, Vert. and horz. to ±75°）
Energy and direction response: Relative response 0.71 to 1.67 (60 keV to 6 MeV, 0° to 60°)
Temperature characteristic: -13 % to +18 % (20 °C, -10°C to +40°C)

Temperature test result
Left for 4 hours in each temperatures. Evaluated by amount of change in the last 30 minutes.

Reference (20°C)		-10°C			50°C		
variation	(mrem)	variation	(mrem)	result	variation	(mrem)	result
	1.004		1.032	2.79%		0.932	-7.17%

Dimensions : approx. 105 mm(H) × 60 mm(W) × 29/18 mm(D) (excluding protrusion)
Weight : approx. 170 g (2 Batteries), approx. 100 g (Battery excluded)
Battery : AA alkaline battery (x 2)
Continuous operating time: more than 2500 hours (under normal temperature, no alarms, new battery)
Reference standards: IEC61526 Ed3.0(2010), ANSI N42.20(2003)
USB interface : USB2.0, micro-B（Use with power supply and communication）*NRF5 does not have a function to charge batteries.
Recommended USB cable・・・CW-117MC（Core wave）or equivalent
* It may not work when use except for recommended USB cable

8.2 Storage data

1. List of storage data (Updated value is stored in EEPROM every 1 minute)

・EPD number
・Current time
・Current accumulated dose
・Current dose rate
・Operating time
・Alarm setting values (Accumulated dose, Dose rate : 2 for each)
・Time alarm setting value
・Calibration factor
・Error flag
・Condition flag
・Other setting parameter values

2. Trend data storage

Following data is stored at preset interval of trend data. (max. 4000)

・Measurement date and time
・Accumulated dose
・Maximum dose rate

9. Appendix

9.1 Trouble shooting table

Error Indication	Possible Cause	Suggested Solution
“OPTI ERROR”	(1) Sensor unit malfunction (2) CPU malfunction	(1),(2) Contact Fuji Electric representative.
“MEM ERROR”	(1) EEPROM malfunction (2) CPU malfunction	(1),(2) Contact Fuji Electric representative.
“RTC ERROR”	(1) RTC malfunction (2) CPU malfunction	(1),(2) Contact Fuji Electric representative.
“COMM ERR”	(1) Radio module malfunction	(1) Contact Fuji Electric representative.
“BT ERROR”	(1) Bluetooth module malfunction	(1) Contact Fuji Electric representative.
“USB ERROR”	(1) CPU malfunction	(1) Contact Fuji Electric representative.

When returning the item to Fuji Electric representative, please provide with precise details of problems.

Note : This table is applied only to the malfunctions that occurs during or after proper use, handling and storage.

Symptom	Possible Cause	Suggested Solution
No indications on LCD	(1) Defective battery connection (2) Mode switch malfunction (3) LCD malfunction (4) CPU malfunction	(1) Check battery polarity and there is no exogenous material. (2) - (4) Contact Fuji Electric representative.
Characters on LCD are garbled.	(1) LCD malfunction (2) CPU malfunction	(1),(2) Contact Fuji Electric representative.
Backlight does not light when pressing a mode switch.	(1) Mode switch malfunction (2) LCD malfunction (3) CPU malfunction	(1) - (3) Contact Fuji Electric representative.
Dose error ・Dose accumulation does not work ・Displayed dose is high ・Displayed dose is low	(1) LCD malfunction (2) Sensor unit malfunction (3) CPU malfunction (4) Calibration factor trouble	(1) - (3) Contact Fuji Electric representative. (4) Check calibration factor. Contact Fuji Electric representative for calibration method.
Buzzer does not sound	(If display operation is correct) (1) Attached Exogenous material (2) Set frequency failure (3) Buzzer lead wire is broken (4) CPU malfunction	(1) Check if there is no dust. If it is not improved after removing a dust, contact Fuji Electric representative. (2) - (4) Contact Fuji Electric representative.
Vibration does not work	(1) Vibration malfunction (2) CPU malfunction	(1),(2) Contact Fuji Electric representative.

Symptom	Possible Cause	Suggested Solution
LED does not light	(1) LED unit malfunction (2) CPU malfunction	(1),(2) Contact Fuji Electric representative.
Operational hour is short Battery voltage alarm is always displayed	(1) End of the battery's life (2) Increase the current consumption (3) CPU malfunction (4) Failure of voltage decline detection	(1) Replace with a new battery. See "5.1". (2) Check the proper contacts in the battery compartment and there is no exogenous material in the battery case. If trouble continues, contact Fuji Electric representative. (3),(4) Contact Fuji Electric representative.
IR communication is unable	(1) Communication distance is too far (2) Communication port is dirty. (3) CPU malfunction (4) Malfunction of dosimeter configuration software (PC)	(1) Set the distance between communication port of NRF50 and the Dosimeter Configuration Tool within 5cm. Also confirm that these windows are face to face. (2) Clean the communication part with soft cloth. Check if there is no exogenous material. If trouble continues, contact Fuji Electric representative. (3) Contact Fuji Electric representative. (4) Refer to the instruction manual of Dosimeter Configuration Tool to check if software operation is proper.
USB communication does not work	(1) Cable malfunction (2) Connector malfunction (3) CPU malfunction	(1) Check conduction to confirm there is no problem with the cable. (2),(3) Contact Fuji Electric representative.
Bluetooth communication does not work	(1) Module malfunction (2) CPU malfunction (3) Abnormal pairing setting	(1),(2) Contact Fuji Electric representative. (3) Confirm a pairing works correctly
Telemetry communication does not work	(1) Module malfunction (2) CPU malfunction	(1),(2) Contact Fuji Electric representative.
Crack, breakage, damage on the case	(1) Breakage due to drops, etc.	(1) Contact Fuji Electric representative.

9.2 Disposal

Please follow the local raw and regulation for disposal of the product.

NRF50 uses a hazardous substance shown below.

Dispose of hazardous substances by referring to the information below.

Hazardous substances

Hazardous substances	Point of use	How to dispose
Trivalent chromate	Screw for USB connector caps	Turn a screw down with Phillips-head screwdriver and take off the USB connector cap.（Following 5.3） Dispose the screw by following local regulation, rule and procedures.

NRF50 includes recyclable parts.

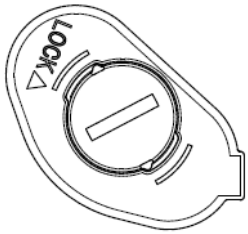
Recycle the recyclable parts for efficient use of resources and environmental protection if it's appropriate at the location of product disposal..

Dispose of other parts as industrial waste.

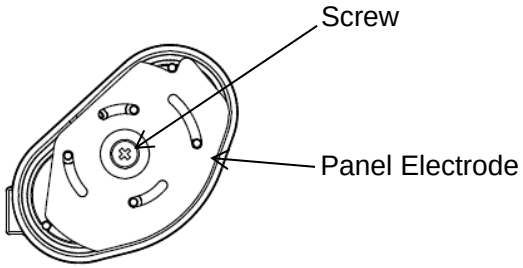
Recyclable Parts

No.	Name	Quantity	Substance	Surface treatmen	How to dispose
1	Screw	1	SUS	—	Turn a screw down with Phillips-head screwdriver.
2	Plate Electrode	1	SUS	Gold plate	Panel electrode can be removed when the screw is removed.

Battery caps



Front surface



Reverse side

9.3 Calibration

This section describes the calibration procedures for NRF50.

Expose NRF50 to the gamma-ray sources such as ^{137}Cs and ^{60}Co.

A dose should be measured by placing the source at a certain distance (calibration distance) from reference point of NRF50 so that true value of the dose is traceable to the National Standard.

(1) Determination of a reference dose value (R_0)

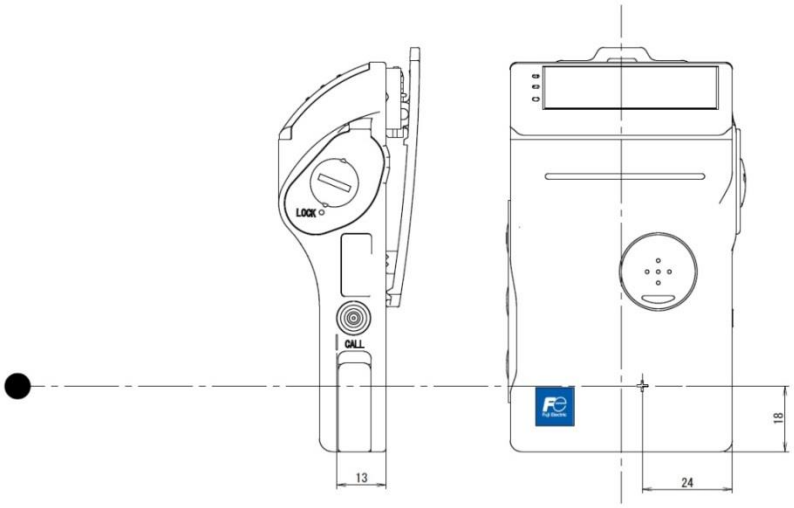
- Determine a reference dose value (R_0) by the following method:

a. Calculate R_0 from the reference source activity, the distance between the reference source and reference point of NRF50 (calibration distance) and irradiation time.

b. Or the dose rate value at the reference point may be simply well-known by field calibration/characterization. In this case, reference dose value (R_0) can be calculated by the known dose rate value and irradiation time.

(2) Dose value (R_1) measurement

- Place the source such as ^{137}Cs and ^{60}Co at the calibration distance from reference point of NRF50.
- Take the dose reading (R_1) after irradiation which gives enough statistical stability.



Example of Geometrical Conditions

(3) Calculation of the calibration factor

- Compare the reference dose (R_0) and the dose reading (R_1). If there is an unacceptable difference between R_0 and R_1, change the calibration factor.

In general, the calibration factor (C_1) is calculated by the following formula:

$$C_1 = C_0 \times R_0/R_1$$

C_0: Original Calibration Factor

(4) Setup of the calibration factor

- To change the calibration factor, perform the following procedures:

a. After the irradiation, connect NRF50 with the Dosimeter Configuration tool and run configu ration software.

b. Click on “Calibration”, enter the calculated calibration factor (C_1) to the new value of gamma-ray calibration factor.

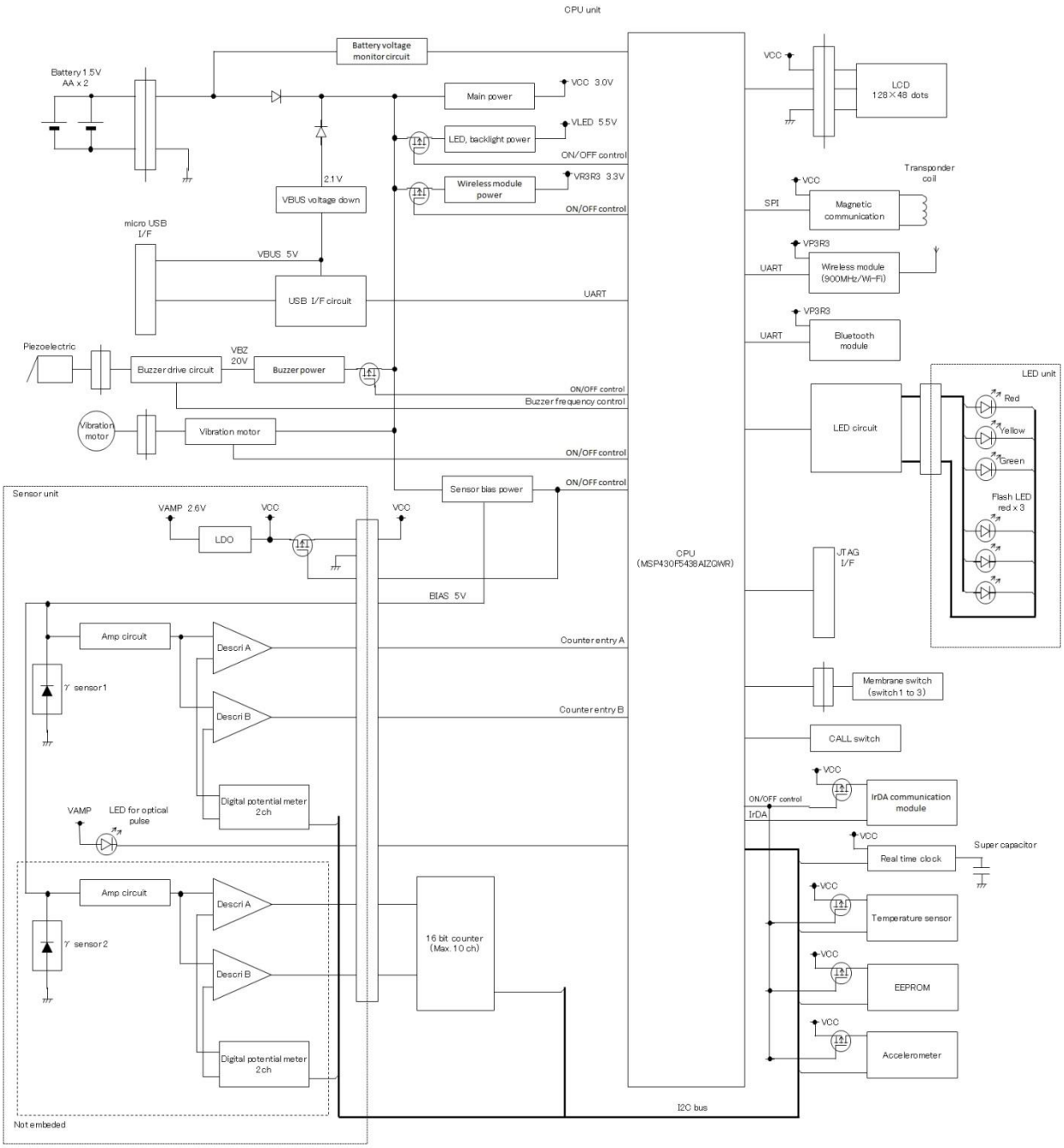
c. Press the “Write” button.

d. Confirm the current value is set to the new value.

*Also, the calibration due date should be changed at the time of calibration.

See User’s Manual of “Dosimeter Configuration Toolfor detail procedures.

9.4 Block diagram



★ Your Comment ★

Dear customers,

Any comments/ requests/ suggestions regarding our instruction manual? Please feel free to contact us by filling out this form and give to our sales representative.

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