Introduction

The ATOM Model V-850 INFANT INCUBATOR controls via microprocessor the incubator air temperature to provide an optimum, hitherto unavailable physiological environment for an infant in the incubator. It is equipped with various alarms designed for patient safety. Please make certain that the incubator has been operated properly before coming to the conclusion that the incubator is out of order. In many cases, lack of knowledge of the operating procedures is the cause of mistaking an activated alarm for a malfunction.
Table of Contents

1. Specifications of V-850 Infant Incubator ............... 4
2. Composition of V-850 Infant Incubator ................. 7
3. Block Diagram ........................................... 9
4. Wiring Diagram ........................................... 11
5. 8302A (CPU Board) Circuit Diagram ...................... 13
   8302B (Switch Board) Circuit Diagram
   8302G (Heater Board) Circuit Diagram
   8302D (Skin Temperature Probe Board) Circuit Diagram
   8302E (Sensor Block Board) Circuit Diagram
6. Description of Circuitry and Function Test I .......... 19
   6-1 Reference voltage circuit
   6-2 Over-temperature detection circuit
   6-3 A/D converter circuit
   6-4 Key input circuit
   6-5 Display unit
   6-6 Power failure detection/battery charge circuit
   6-7 Heater output/heater current detection circuit
   6-8 CPU runaway detection circuit
   6-9 Data backup with EEPROM
   6-10 DC+5V, ±12V regulator
7. Function Test 2 (Internal Test with Display) .......... 25
   7-1 Display test
   7-2 Sensor test
8. Function Test 3 (Special Internal Test with Keyboard)..................27
   8-1 Test Mode 1 (AD/Internal circulation/Others)
   8-2 Test mode 2 (Over-temperature)

9. Function Test 4 (Test with Simulator)..............................34
   9-1 Sensor open test
   9-2 Sensor short test
   9-3 36.0°C test
   9-4 Simulation test

10. Initialization of Internal Air Circulation..........................36
    10-1 Initialization

11. Over-temperature Adjustment.....................................39

12. List of Alarms.....................................................41

13. Troubleshooting...................................................45
    13-1 When power switch is turned on
    13-2 Immediately after self-diagnosis test
    13-3 Over-temperature alarm
    13-4 Internal air circulation alarm
    13-5 Incubator sensor alarm
    13-6 Others

14. Reporting of Trouble..............................................53

15. P.C. Boards (8302A)..............................................54

16. Board Components List...........................................55
1. Specifications of V-850 Infant Incubator

Electrical requirements: Customer-specified

Skin temperature/incubator temperature control mode: SC/MC system

Skin temperature setting: 34.0-38.0°C in 0.1°C steps

Skin temperature indication: 30.0-42.0°C in 0.1°C steps

Incubator temperature setting: 25.0-38.0°C in 0.1°C steps

Incubator temperature indication: 20.0-42.0°C in 0.1°C steps

Wall temperature/humidity indication: Switch-selected

Wall temperature: 20.0-42.0°C in 0.1°C steps

Humidity: 20-99% in 1% steps

Heater output: 0-Full, indicated in ten degrees

> 37°C indication: Should the incubator temperature exceed 37°C, ">37°C" indicator will light up and an audible alarm will sound.

Alarms:

Over-temperature alarm

Should the displayed value of the incubator air temperature exceed 39.0°C or should the temperature of the over-temperature sensor exceed 39.5±0.5°C, the over-temperature indicator lamp will flash, an audible alarm will sound, and the heater power will be disconnected.

Internal air circulation alarm

Should any trouble develop within the air circulation system, the appropriate indicator lamp will flash, an audible alarm will sound, and the heater power will be disconnected.
High/low temperature alarm

(MC mode of operation) Should the incubator air temperature exceed the pre-selected temperature by more than 1.5°C or drop below the set temperature by more than 3°C, the selected temperature indicator lamp will flash and an audible alarm will sound.

(SC mode of operation) Should the infant's skin temperature deviate from the pre-selected temperature by more than ±1°C, the selected temperature indicator lamp will flash and an audible alarm will sound.

Internal sensor alarm

Should any trouble develop on any of the sensors for incubator air temperature, wall temperature, humidity, over-temperature and internal air circulation, the internal sensor indicator lamp will flash and an audible alarm will sound.

Skin temperature probe alarm

Should any trouble develop on the skin temperature probe, the skin temperature probe indicator lamp will flash, an audible alarm will sound and the heater power will be disconnected.
Power failure alarm

Should power supply be interrupted due to power failure or other causes, the power failure indicator lamp will be illuminated and an audible alarm will sound.
2. Composition of V-850 Infant Incubator (temperature control)

V-850 Infant Incubator is composed of six sensors to monitor several temperatures, humidity and air flow respectively, a heater to warm up the incubator air, a fan for internal air circulation and six P.C. boards for controlling and displaying such features or parameters.

2.1 Functions of sensors

Incubator air temperature sensor

Detects the air temperature in the incubator.

Relative humidity sensor

Detects the temperature affected by evaporation heat. The sensor is covered with a wet nonwoven fabric.

Wall temperature sensor

Detects the wall temperature affected by radiation.

Over-temperature sensor

Detects an excessive rise in the incubator air temperature using an independent circuit.

Air flow sensor

Detects changes in the internal air circulation.

Skin temperature sensor

Detects the infant's skin temperature. The sensor is attached to the infant's skin.
2.2 Primary functions of boards

8302A The main board equipped with CPU, in charge of all controls.

8302B The switch board equipped both with switches for operation and with power failure alarm LED.

8302G Equipped with a heater power control relay and a current-detecting coil.

8302D Equipped with EEPROM in which data from a skin temperature thermistor are stored.

8302E Equipped both with thermistors for incubator air temperature, RH and wall temperature and with EEPROM in which sensor calibration values are stored.

2.3 Others

Power source +5V (3A), +12V (1.2A), -12V (0.3A)

Heater 260VA

Fan motor Makes the air circulate in V-850 Infant Incubator

LCD unit Displays various control data and conditions of V-850 Infant Incubator
MC unit is not equipped with S6
MC unit is not equipped with JEl

R2, R3 and Q1 will be provided when AL is operated
6. Description of Circuitry
6-1 Reference voltage input
As the unit must measure temperature very accurately, 2.5V±25mV is supplied by an IC (U12, pin2) designed to generate highly precise reference voltage. Output, in proportion to changes in temperature detected by each sensor, is generated at CH0-4.

(Test Point) * a ... 2.5V ± 25mV
* b ... 0.15V ± 5mV
* If virtual resistance (1K~2kΩ) is inserted in the sensor section, specified voltage divided by R17~20 or R23 and R27 is fed to CH0 - 4.

6-2 Over-temperature detection circuit

An over-temperature condition is detected by the following two methods:

1. When the sensor detects the incubator air temperature at or over 39.0°C, the incubator air temperature sensor judges that an over-temperature condition exists and activates the over-temperature alarm.
2. The over-temperature detection sensor, which is independent of the CPU-controlled temperature measurement circuit, activates the over-temperature alarm when the sensor detects an alarm condition at 39.5 +/- 0.5°C. In this case, both the audible and visual alarms will be automatically reset when the air temperature is felt by the sensor to have fallen by 2-3°C from the alarm temperature level.

The temperature information obtained by the over-temperature sensor is sent as voltage information to CPU via CH5.

When the over-temperature detection sensor becomes activated, the relay (K2) on the 8302C board will go OFF and the heater output will be interrupted.

Ref.) The over-temperature detection level is adjusted with VR1. Refer to 11. Over-Temperature Adjustment for procedures.

(Test Point) a ... If virtual resistance (1k~2kΩ) is inserted in the sensor section, specified voltage divided by R25, R26 and VR1 is fed to CH5.

* b ... 0.6 - 0.78V

* c ... Goes high (+5V) in over-temperature conditions (Point a < Point b).
6-3 A/D converter circuit

Temperature data inputted by each temperature sensor are switched over by 8CH multiplexer (U14) and digitally inputted to CPU via 10 bit A/D converter (U13).

The analogue voltage inputted by a sensor will vary within the range of 0.15 - 1.15V in normal conditions. Should the sensor be disconnected, 2.5V will be inputted, or should it be shorted, 0V will be inputted. (In the case of CH4, 0V for disconnection and 2.5V for short.) U15 will output 0V in case of sensor disconnection, while CPU will recognize a shorted sensor and give an alarm.
6-4 Key input circuit

When a key switch incorporated in 8302B board is pressed, 8 bit latch (U4) will input the key information to CPU via AD 0 - 7.

6-5 Display unit

Temperature information, control status and other data processed by CPU are displayed on LCD on the front panel.

6-6 Power failure detection / battery charge circuit

The unit has an internal Ni-Cd battery for an audible alarm and LED display during power failure. A power failure alarm will be given if AC power is not
supplied even though the power switch is depressed.

6-7 Heater output / heater current detection circuit
CPU outputs heater output control signals via U6 (81C55) port to control K1 (SSR) on 8302G board.
The same output is fed back to CPU by the current sensor (L1) to monitor a trouble developed on SSR, the heater, etc.

6-8 CPU runaway detection circuit
Should any trouble develop on CPU and the program be in runaway conditions, an alarm will be immediately given, and the heater power will be disconnected.

(Test Point)
* a ... During normal operation 32Hz
* b ... During normal operation +5V
   During trouble 0V
6-9 Data backup with EEPROM

When the unit is turned off, function setting backup and correction values for respective sensors will be retained.

Note) As data stored in each EEPROM on 8302A board (CPU board), 8302D board (Sensor unit board) or 8302E board (Skin temperature probe board) correspond to each instrument or sensor, sensors or EEPROM cannot be replaced.

6-10 DC +5V, ±12V regulator

The unit is provided with DC +5V, ±12V by PU1. DC +5V is used for most circuitry. Should any trouble develop on this voltage, all operation of the unit will be affected.
DC ±12V is used for LCD display backlight. Should any trouble develop on this voltage, LCD display will be darkened.

(Test Point)

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</thead>
<tbody>
<tr>
<td>AC(L)</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>-12V ± 0.6V</td>
</tr>
<tr>
<td>NC</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>+5V ± 0.15V</td>
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<tr>
<td>AC(N)</td>
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<td>2</td>
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<td>10</td>
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<td>6</td>
<td></td>
</tr>
<tr>
<td>PU 1</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+12V ± 0.6V</td>
</tr>
</tbody>
</table>
7. Function Test 2 (Internal Test with Display)

7-1 Display test

When the unit is turned on, it goes through a self-diagnostic LCD test on the display.

![LCD Display]

(Test Point)

* Neither backlight nor LCD display is on.

    \[\Rightarrow\] Check AC power switch, DC\(+12V\), +5V, and the connector.

    Faulty LCD unit

* Backlight is not illuminated.

    \[\Rightarrow\] Check DC \(+12V\).

    Faulty LCD unit.

* LCD segment is missing.

    \[\Rightarrow\] Faulty LCD unit.

* LCD display is not normal, and a power failure alarm is given.

    \[\Rightarrow\] CPU runaway. If the situation is not corrected even when the unit is started again, total malfunction is suspected.
7-2 Sensor test

Sensors are checked for malfunction while the unit is in operation.

(Test Point)

* A sensor alarm occurs and LCD displays (temperature) are all blank.
  
  \[\Rightarrow\] Defective sensor unit.
  
  Defective cable.
  
  Connector off.

* A sensor alarm occurs, and incubator air temperature, RH and wall temeprature displays go L0 or HI.
  
  \[\Rightarrow\] L0 means sensor input line disconnection;
  
  HI means short circuit.

* A sensor alarm occurs, but temperature displays are normal.
  
  \[\Rightarrow\] Either the over-temeprature sensor or the air flow sensor is disconnected or shorted.

* In SC mode, a probe alarm occurs and temeprature displays are all blank.
  
  \[\Rightarrow\] Connector is off.
  
  Defective probe.

* In SC mode, a probe alarm occurs and temperature displays indicate either L0 or H1.
  
  \[\Rightarrow\] L0 means short;
  
  H1 means disconnection.
8. Function Test 3 (Special Internal Test via Keyboard)

Special operation of the keyboard permits monitoring and checking the function of A/D converter and the condition of internal air circulation in the V-850 Infant Incubator.

Good care must be taken. An accidental misoperation may destroy the ability of the incubator to function.

8-1 Test mode 1 (A/D converter, internal air circulation, others)
*
Setting
Turn the power switch on while depressing Panel Switch 2 (📍). Hold Switch 2 until the self-diagnosis program is completed. Test Mode 1 is selected when CH.0 is indicated on the RH/wall temepature display.

* Operation
Once Test Mode 1 is selected, depress Panel Switch 4 (alarm reset switch), and the RH/wall temepature display will go through a sequence of CH.0→CH.1→CH.2→CH.3→CH.4→CH.5→CH.6.
→CH.7→OP→FA→SE→So→H7→V1→V2→Pd→CH.0→ ...  

CH.0—DH7 indicate the contents of A/D converter, OP indicates the operating temperature, Fa indicates the flow of air, SE indicates a defective sensor, So indicates a disconnected sensor, H7 indicates the temperature of the RH sensor, V1 and V2 each indicates a program version, and Pd indicates the date of programming.

Depress Panel Switch 3 (RH/wall temperature), and appropriate data will appear on the RH/wall temperature display for CH0-7, OP, FA, SE, So, H7, V1, V2 and Pd.

(Refer to the following description for details of data.)

Note: The V1.3 program does not permit displaying in any of the modes OP Pd.

* To stop the test procedure:
  Turn the power switch off and then on.

** ANALYSIS OF DATA IN TEST MODE

1. Turn the power switch on. Turn Switch 2 (↓) on. LCD Test.  
   Rh/wall temperature display
   ↓
   CH.0

2. Set Test Mode 1.

<table>
<thead>
<tr>
<th>SW4 Display 1</th>
<th>SW3 Display 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH.0</td>
<td>ON 590</td>
</tr>
<tr>
<td>ON ↓</td>
<td>←</td>
</tr>
</tbody>
</table>

* Status of skin temperature probe
  999 ... Probe disconnected
  -99 ... Probe shorted
<table>
<thead>
<tr>
<th>Channel</th>
<th>ON/OFF</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
</table>
| CH.1    | ON     | 580   | Status of incubator air temperature sensor  
|         |        |       | 999 ... Probe disconnected  
|         |        |       | -99 ... Probe shorted   |
| CH.2    | ON     | 580   | Status of wall temperature sensor  
|         |        |       | 999 ... Probe disconnected  
|         |        |       | -99 ... Probe shorted   |
| CH.3    | ON     | 580   | Status of RH sensor  
|         |        |       | 999 ... Probe disconnected  
|         |        |       | -99 ... Probe shorted   |
| CH.4    | ON     | 645   | Status of air flow sensor  
|         |        |       | -99 ... Probe disconnected  
|         |        |       | 999 ... Probe shorted   |
| CH.5    | ON     | 630   | Status of over-temperature sensor  
|         |        |       | 999 ... Probe disconnected  
|         |        |       | -99 ... Probe shorted   |
| CH.6    | ON     | 120   | Status of current sensor  
|         |        |       | -99 ... Heater output is zero.   |
| CH.7    | ON     | 0     | A/D converter ground  
|         |        |       | 0±1 : normal  
|         |        |       | others: defective interface   |
| OP      | ON     | 32.2  | Operating temperature (SC mode)  
|         |        |       | Ref. ) Refer to Section 13 for operating temperature.   |
| FA      | ON     | -40   | Status of internal air circulation  
<p>|         |        |       | -40±10 (stabilized): normal over zero: alarm conditions |
|         |        |       | (Ref.) Alarm conditions will occur frequently if internal air circulation is not initially set to be normal. Refer to Section 11 for performing initial setting of internal air circulation. |</p>
<table>
<thead>
<tr>
<th>ON</th>
<th>SE</th>
<th>ON</th>
<th>150</th>
<th>* Indicates a defective sensor.</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>... defective</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>BIT 7 6 5 4 3 2 1 0 — incubator air temperature</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>over-temperature</td>
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<td>air flow</td>
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<td>RH</td>
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<td>wall temperature</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>sensor unit off</td>
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<td></td>
<td></td>
<td>skin temperature</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>skin temperature probe off</td>
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<table>
<thead>
<tr>
<th>ON</th>
<th>So</th>
<th>ON</th>
<th>198</th>
<th>* Sensor disconnected</th>
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<tr>
<td></td>
<td>1</td>
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<td>... Disconnected</td>
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<td></td>
<td>BIT 7 6 5 4 3 2 1 0 — incubator air temperature</td>
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<td>over-temperature</td>
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<td>air flow</td>
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<td>sensor unit off</td>
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<td></td>
<td>skin temperature</td>
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<td></td>
<td></td>
<td>skin temperature probe off</td>
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<table>
<thead>
<tr>
<th>ON</th>
<th>H7</th>
<th>ON</th>
<th>365</th>
<th>* Temperature sensed by RH sensor (x10)</th>
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<thead>
<tr>
<th>ON</th>
<th>U1</th>
<th>ON</th>
<th>013</th>
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<table>
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<td>005...V17B6 (1989/5)</td>
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<table>
<thead>
<tr>
<th>ON</th>
<th>Pd</th>
<th>ON</th>
<th>704</th>
<th>* Date of programming</th>
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Note) The V1.3B program does not permit displaying in any of the modes OP~Pd.
Ref.) * The A/D converter values displayed in CH.0-3 are those of the test simulator (36.0°C) [*15. The test simulator should be calibrated correctly.]

* The values displayed in CH4 and CH5 are obtained in stabilized conditions with the incubator air temperature at 34.0 ±2°C.

* A defective or disconnected sensor is indicated decimally. Conditions of each sensor are known by converting the decimal system into the binary system.

Ex) SE (defective sensor) Displayed value D = 150 ...
    binary system (10010110)
    Content ... Skin temp probe off; wall temp sensor, air flow sensor, over-temp sensor defective.

Ex) So (disconnected sensor) Displayed value D = 198 ...
    binary system (11000110)
    Content ... Skin temp probe off; skin temp sensor, air flow sensor, over-temp sensor disconnected.

Judging from the displayed values of Se and So, the skin temp sensor must be disconnected due to the skin temp probe off. (In case of MC nothing is wrong as no skin temp sensor is attached.)
A defective wall temperature sensor must mean that the sensor input line is shorted as the sensor is not disconnected.

A defective air flow sensor and a defective over-temperature sensor both mean that the sensors are disconnected, probably their connectors on the same line are off.

Example of calculation

\[
\begin{align*}
150 - 2 &= 75 \ldots 0, \\
75 - 2 &= 37\ldots1, \\
37 - 2 &= 18\ldots1, \\
18 - 2 &= 9\ldots0, \\
9 - 2 &= 4\ldots1, \\
4 - 2 &= 2\ldots0, \\
1 - 2 &= 0\ldots1
\end{align*}
\]

Put the underlined figures together one after another beginning with the rightmost position, and you'll get 10010110.

8-2 Test Mode 2 (over-temperature test)

In this test mode, the incubator air temperature can be set to 39.5°C with MC.

* Setting

Turn the power switch on while depressing Panel Switch 1 (setting). Hold Switch 1 until the self-diagnosis program is completed.

Test Mode 2 (over-temperature test) is selected when the incubator air temperature setting reads 39.5°C.
(Test Point)

* Verify that an over-temperature alarm is given when the incubator air temperature reaches 39.5±0.5°C.

Ref.) Refer to Section 11 for adjustment.
9. Function Test 4 (Test with Simulator)

Perform simulation of the control unit with V-850 test simulator.

![Diagram of V-850 Atom Infant Incubator]

9-1 Sensor open test

Set the rotary switch of each sensor to "open" to simulate the situation where the sensor is disconnected.

(Test Point) * The heater stops.
* The value indicated by each sensor (LO) flashes.
* AD converter indicates 999 in Test Mode 1.

9-2 Sensor short test

Set the rotary switch of each sensor to "short" to simulate the situation where the sensor is shorted.

(Test Point) * The heater stops.
* The value indicated by each sensor (HI) flashes.
* AD converter indicates -99 in Test Mode 1.
9-3 36.0°C Test

Set the rotary switch of each sensor to "36.0°C" to verify that the sensor indicates 36.0°C ± 0.2°C.

Note) Test Box 1 should be calibrated correctly.

(Test Point)  * 36.0 ± 0.2
  *
  * AD converter indicates 580±15 in Test Mode 1.

9-4 Simulation test

Set the rotary switch of each sensor to simulated sensor drive to verify the operation of the control unit.
10. Initialization of Internal Air Circulation

Note) The V1.3B program does not permit "Initialization of Internal Air Circulation."

To detect any abnormalities in the internal air circulation, the conditions of internal air circulation stabilized at the reference ambient temperatures (30°C, 34°C, 37°C) are stored in the control unit. Should the fan motor stop or should any abnormality develop at the air outlet or inlet of the internal air circulation system, and internal circulation be disturbed, an alarm will occur.

Improper initialization of internal air circulation may cause abnormalities in the internal air circulation not to be detected properly.

° In such a case, it is necessary to re-initialize.

(Test Point) * Check that the unit is set properly. If the value shown of internal air circulation in Test Mode 1 is within the range of -30 to -50, the unit is set properly. However, if it is -50 or above, it is necessary to re-initialize.

10-1 Initialization Technique

Special operation of the keyboard enables you to perform initial setting of the internal air circulation system.

Utmost care should be taken as this intentional misoperation
might destroy internal functioning of the incubator.

* Preparation of setting 1.

... Set the unit (access port, mattress platform, humidity reservoir, etc) securely. Fill the humidity reservoir with water to a specified level and set the adjusting lever to high humidification.

Note) The unit, once set, cannot be reset until the initial setting of the internal circulation system is completed. Should any procedure be done on the unit in the meantime, initial setting may not be performed properly.

* Preparation of setting 2

... Turn the power switch on while depressing Panel Switch 2 (▼) and 5 (▲) simultaneously. Hold Switch 2 and 5 until the self-diagnosis program is completed.

Initial setting of internal circulation is started when the RH/wall temperature display reads FAN.

* During initial setting

... The incubator air temperature changes automatically from 30 through 34 to 37°C. Stabilized conditions of internal circulation at each temperature range are memorized.
* Setting completed

... Initial setting of internal circulation is completed when the RH/wall temperature display reads END.

The incubator air temperature will be set and controlled at 34°C thereafter.

Note) Should initial setting be interrupted, conditions before setting will be retained. Should initial setting be completed and stopped simultaneously, it cannot be said for sure that such initially set values have been accepted by the control unit. Therefore, repeat initial setting.
11. Over-temperature Adjustment

Adjust VR1 on the over-temperature detection circuit (6-2) in the same way as in 8-2 Test Mode 2 (over-temperature test).

VR1 is accessed at the sensor connector lock key section on the power switch mounting panel on the side of the power unit.

* Preparation of operation 1

... Turn VR1 fully clockwise (so that an over-temperature alarm may not be given when the incubator air temperature rises to 39.5°C).

* Preparation of operation 2

... As in 8-2 Test Mode 2, turn the power switch on while depressing Panel Switch 1 (setting), and hold Switch 1 until the self-diagnosis program is completed. Test Mode 2 (over-temperature test) is selected when the incubator air temperature setting reads 39.5°C.
* VRL adjustment
  ... When the incubator air temperature stabilizes at 39.5°C, turn VRL slowly counterclockwise until an over-temperature alarm is given.

* Verification
  ... Turn the power switch off, lower the incubator air temperature and cancel the alarm. Select Test Mode 2 again and raise the incubator air temperature toward 39.5°C to verify that an over-temperature alarm is given with the incubator air temperature at 39.5 ±0.5°C.
### List of Alarms on V-850 Infant Incubator

<table>
<thead>
<tr>
<th>Alarm Function</th>
<th>Alarm Condition</th>
<th>Delay Time</th>
<th>Heater output</th>
<th>Flashing/Intermitent Sound</th>
<th>Flashing/Continuous Sound</th>
<th>Illuminated/Continuous Sound</th>
<th>Automatic Reset</th>
<th>Manual Reset</th>
<th>15 min. Silence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Air Circulation</td>
<td>Motor has stopped, fan isn't attached, air inlet or air outlet blocked, or any other trouble has developed within the air circulation system (except during warming-up).</td>
<td>Within 15 min.</td>
<td>Off</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>When the unit has returned to normal conditions.</td>
</tr>
<tr>
<td>Over-Temperature</td>
<td>Incubator air temperature is 39.5 ± 0.5°C</td>
<td>Immediately</td>
<td>Off</td>
<td>(Incubator air temperature indicator display figure flashes.)</td>
<td>-</td>
<td>-</td>
<td>Within the range of 34.0 - 37.0°C.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Power Failure</td>
<td>Power failure, disconnected power plug, broken power cable, actuation of circuit breaker, etc.</td>
<td>Immediately</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Alarm Condition</td>
<td>Alarm Function</td>
<td>Heater Output</td>
<td>Delay Time Output</td>
<td>Flashing/Continuous Sound</td>
<td>Illuminated Continuous Sound</td>
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</tr>
<tr>
<td>Skin temperature is above pre-selected temperature by more than 1°C.</td>
<td>Pre-selected temperature will be enabled once the normal temperature range is reached. (An alarm will be given if 50 min. is exceeded before the normal temperature range is reached.)</td>
<td>off</td>
<td>Within approx. 12 seconds</td>
<td>-</td>
<td>-</td>
<td></td>
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</tr>
<tr>
<td>Skin temperature is below pre-selected temperature by more than 1°C.</td>
<td>Incubator air temperature is below pre-selected temperature by more than 1.5°C.</td>
<td>Unchanged</td>
<td>Within approx. 12 seconds</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>Incubator air temperature is over 37°C.</td>
<td>Incubator air temperature is over 37°C.</td>
<td>Unchanged</td>
<td>Within approx. 12 seconds</td>
<td>-</td>
<td>-</td>
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</tr>
</tbody>
</table>

An audible alarm will sound for 2 seconds when the indicator lamp is illuminated.
<table>
<thead>
<tr>
<th>Alarm Function</th>
<th>Alarm Condition</th>
<th>Delay Time</th>
<th>Heater Output</th>
<th>Flashing/Intermittent Sound</th>
<th>Flashing/Continuous Sound</th>
<th>Illuminated/Continuous Sound</th>
<th>Automatic Reset</th>
<th>Manual Reset</th>
<th>15 min. Silence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Sensor</td>
<td>Incubator air temp sensor</td>
<td>Immediately</td>
<td>off</td>
<td>- Defective sensor display figure and indicator flash.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>When the unit has returned to normal conditions.</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Over temp sensor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Air flow sensor</td>
<td>shorted</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RH sensor</td>
<td></td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>Wall temp sensor</td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>Incubator air temp sensor</td>
<td>Immediately</td>
<td>off</td>
<td>- Defective sensor display figure and indicator flash.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>When the unit has returned to normal conditions.</td>
<td>-</td>
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<tr>
<td></td>
<td>Over-temp sensor</td>
<td>disconnected or connector is not properly connected</td>
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<td></td>
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<tr>
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<td>RH sensor</td>
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<td></td>
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<td></td>
</tr>
<tr>
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<td>Wall temp sensor</td>
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<td></td>
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<tr>
<td>Skin temperature probe</td>
<td>Shorted</td>
<td>Immediately</td>
<td>off</td>
<td>-</td>
<td>Skin temperature display figure and indicator flash.</td>
<td>-</td>
<td>-</td>
<td>When the unit has returned to normal conditions.</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Disconnected or connector is not properly connected</td>
<td></td>
<td></td>
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<td></td>
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<td>Alarm Function</td>
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<td>Automatic Reset</td>
<td>Manual Reset</td>
<td>15 min. Silence</td>
</tr>
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<td>----------------------------</td>
<td>----------------------------</td>
<td>------------------</td>
<td>----------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Heater Disconnected</td>
<td>Heater is disconnected, relay is defective, connector is not properly connected, etc.</td>
<td>Immediately</td>
<td>off</td>
<td>Heater indicator flashes.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>When the unit has returned to normal conditions</td>
<td>-</td>
</tr>
</tbody>
</table>
13. Troubleshooting

13-1 When power switch to turned on

*1 No operation → LCD unit signal line off.
   (CPU, heater, etc. are controlled properly, but no display)
   Power isn't supplied, but no power failure detection.
   
   a. Connector in power unit is off.
   b. Check power failure detection circuit.

*2 Power failure alarm occurs → AC power isn't supplied.
   DC power isn't supplied.
   
   a. Power cord off.
   b. Connector in power unit is off.

*3 Power failure alarm occurs → CPU runaway
   LCD display abnormal
   Backlight illumination
   
   * Turn off power then on .. OK?
   a. Check power unit totally.

Diagram:

```
AC SW Heater Board SW Regulator CPU Board Power Failure Detection
       ↓                                            ↓
       LCD Unit SW Board
```
13-2 Immediately after self-diagnosis test

*1 LCD segment
   partially blank

  → Defective LCD unit
     a. Replace LCD unit.

*2 LCD backlight
   not illuminated, or dark

  → No +12V DC regulator output
     Defective LCD unit
     a. Replace SW regulator
     b. Replace LCD unit

*3 Internal sensor alarm, temperature display, abnormal

  → Trouble with A/D converter correction circuit
     Improper sensor block connection
     a. Check sensor block connection
     b. Replace power unit and sensor block

*4 Internal air circulation alarm occurs immediately

Normally, internal air circulation alarm occurs when air flow
is measured 5 - 10 minutes after power is turned on.
Over-temperature alarm

*1 Over-temperature alarm occurs though incubator air temperature display hasn't reached 39.0°C.

Temperature of over-temp sensor within inlet isn't high.

Faulty over-temp adjustment
Faulty over-temp detection circuit

a. Over-temperature adjustment (11)
b. Repair or replace CPU board (6-2)

Temperature of over-temp sensor within inlet is high

Some trouble with air circulation system in incubator

a. Check internal air circulation (8-1)
b. Check setting of unit.

* Internal air circulation alarm may occur.

Note) The following is an example in which an over-temperature alarm occurs:

Following stabilized control (a), an access port was opened for treatment or other reasons (b). The temperature at the incubator air temperature sensor dropped, and the heater output was increased to compensate for the loss. Thus only the temperature around the heater was
raised (c). When the access port was closed, excessive heat raised the incubator air temperature temporarily, the temperature at the over-temperature sensor near the heater was raised into the over-temperature detection range, and thus an alarm was given (d).
13-4 Internal air circulation alarm

*1 Internal air alarm occurs immediately after power is turned on. → See 14-2

*2 Alarm occurs → Trouble with internal air circulation.

(a) Anything to disturb internal air circulation?

(Check Point)

* Is fan motor active? Attached?
* Isn't air inlet or outlet blocked?
* Are incubator deck, hood, etc. properly installed?
* Is humidity reservoir properly installed?

*3 Alarm occurs → Trouble with internal air circulation.

(a) Isn't internal air circulation disturbed?

(Check Point)

* Sudden air flow disturbance and temperature change due to opened access ports might cause an alarm (8-1).
*4 Alarm occurs

Faulty initial setting of internal air circulation

Trouble with internal circulation measuring circuit

a. Initial setting of internal air circulation (10)
b. Replace power unit
13-5 Internal sensor alarm

*1 Internal sensor alarm occurs, and temp displays are all blank. → Status of sensor unit isn't inputted to CPU

a. Sensor unit connector disconnected.
b. Defective sensor unit. Replace.

*2 Internal sensor alarm occurs, and temp displays read LO or HI. → In case of LO, either sensor input temp is low or sensor disconnected.

In case of HI, either sensor input temp is high or sensor shorted.

a. Repair or replace sensor unit.
b. Repair or replace CPU board, and A/D converter input circuit.

*3 Internal sensor alarm occurs, and temp displays are abnormal. → A/D converter input value is normal. Trouble with temp correction.

a. Repair or replace CPU board, and A/D converter input correction circuit

Ref.) 8. Function Test 3
13-6 Others

*1 Heater output display flashes. Alarm occurs.

Specified heater output isn't supplied.

a. Heater output connector disconnected.
b. Defective heater board or defective CPU board.
c. Heater disconnected.

*2 Temp and other sensors malfunction

External factor

a. Is sensor free from spills, dust, scar, etc.? 
b. Check power unit totally.
14. Reporting of Trouble

Should any trouble develop on V-850 Infant Incubator and repair be requested or inquiry made, please report to your repair department following the example of a report form given below to help inquire into possible causes of trouble.

**Trouble Report**

<table>
<thead>
<tr>
<th>Name of Hospital</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description &amp; No. of Unit</td>
<td>No. of Power Unit</td>
</tr>
</tbody>
</table>

Details of Trouble

Factors Related to Trouble Reported

<table>
<thead>
<tr>
<th>1. Servo/Manual</th>
<th>2. Pre-selected Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Patient's Skin Temperature</td>
<td>4. Incubator Air Temperature</td>
</tr>
<tr>
<td>5. Wall Temperature</td>
<td>6. RH</td>
</tr>
</tbody>
</table>

7. Alarm

8. Values Obtained in Test Mode 1.

| 0ch | 1ch | 2ch | 3ch | 4ch | 5ch | 6ch | 7ch | CP | FA | SE | So | H7 | V1 | V2 | Fd |

Reported by
16. Board Components List

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Name &amp; Description</th>
<th>Component No</th>
</tr>
</thead>
<tbody>
<tr>
<td>C230710</td>
<td>CKT BOARD: 8302A</td>
<td></td>
</tr>
<tr>
<td>N011011</td>
<td>FIXED CARBON FILM RESISTOR</td>
<td>R-4, R-9, R-10, R-5</td>
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<tr>
<td>N015111</td>
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<td>R-2, R-3, R-1, R-11</td>
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<td>N017511</td>
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<td>R-28, R-7, R-6, R-8</td>
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<td>N011621</td>
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<td>N011251</td>
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<td>N031000</td>
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<tr>
<td>Part No.</td>
<td>Name &amp; Description</td>
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<td>CHOS IC</td>
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