

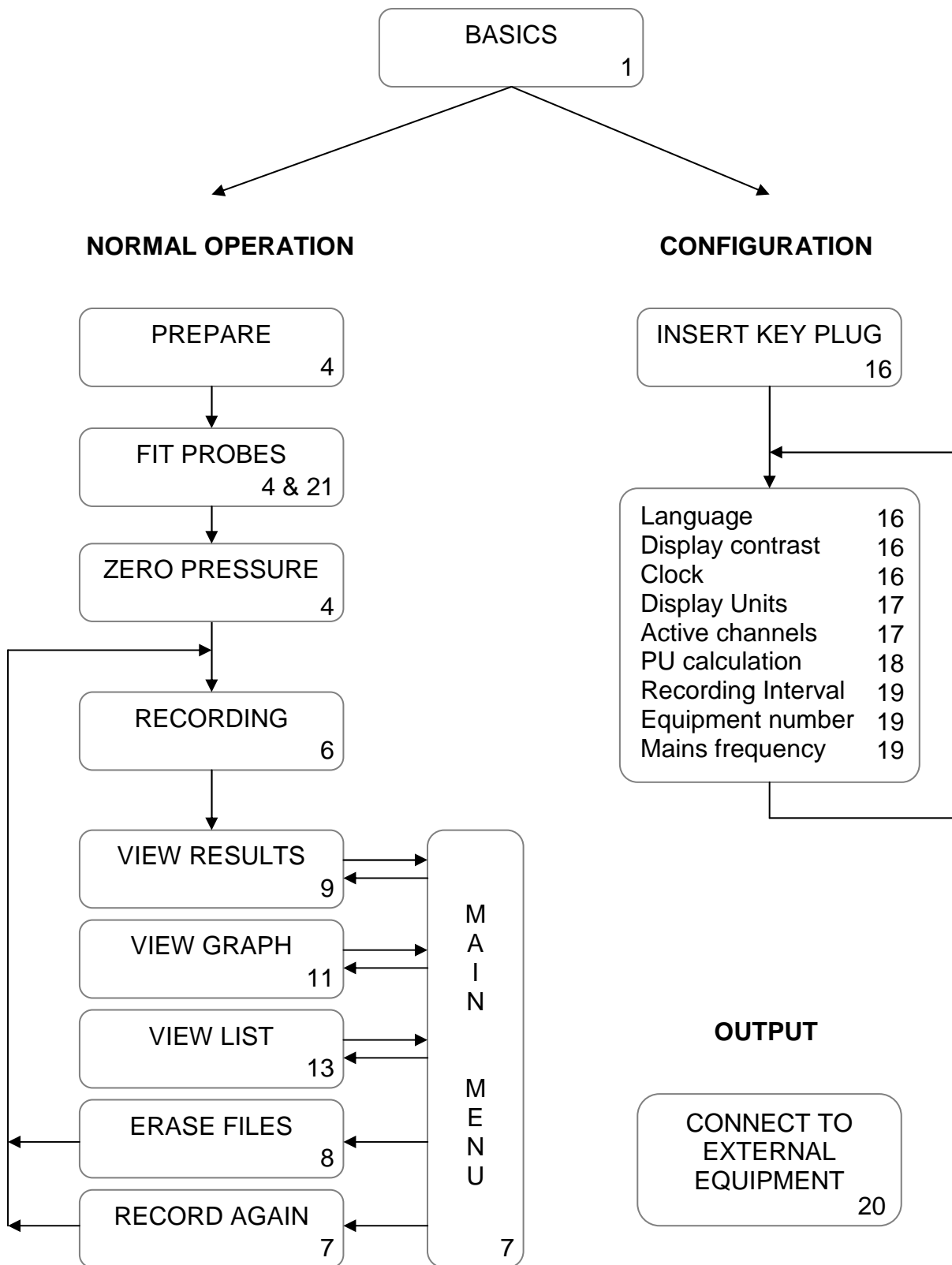
# **RPU-353**

## **PU & Pressure Monitor**

Operating manual

October 2013

# **REDPOST**



**Instrument operation related to page numbers in this manual.**

<b>Controls .....</b>	<b>1</b>	<b>Menus .....</b>	<b>15</b>
I/O (ON/OFF) switch .....	1	Moving the highlight .....	15
Indicator.....	1	Selecting an item.....	15
Display illumination .....	2	<b>Key Plug (Configuration).....</b>	<b>16</b>
Switch functions and icons .....	2	Output to other equipment .....	16
Auto power on .....	2	Language.....	16
Auto power off .....	2	Display contrast .....	16
Low battery condition.....	3	Clock.....	16
<b>Starting.....</b>	<b>4</b>	Display units .....	17
Preparing the instrument.....	4	Active channels.....	17
Pressure zero setting .....	4	PU calculation (Background).....	18
Thermometer .....	5	PU cut-off temperature .....	18
Starting the recording .....	5	PU calculation – Base.....	18
<b>Recording .....</b>	<b>6</b>	PU calculation – Z .....	18
Stopping the recording.....	6	PU calculation – Fahrenheit.....	18
Screen temperature .....	6	Recording interval.....	19
<b>Results .....</b>	<b>7</b>	Equipment number.....	19
Results displays .....	7	Mains frequency .....	19
Main menu.....	7	Leaving configuration.....	19
Calculated results.....	7	<b>Output.....</b>	<b>20</b>
Erasing a file.....	8	Stand alone operation.....	20
<b>Calculated Results .....</b>	<b>9</b>	Connection to RPC-80.....	20
Total PU achieved .....	9	Connection to PC .....	20
Unique ID number .....	9	<b>Temperature Probe.....</b>	<b>21</b>
Total recording time .....	9	Probe position .....	21
Maximum temperature .....	9	Choosing probe length.....	21
Time near max. temperature .....	9	<b>Maintenance .....</b>	<b>22</b>
Temperature at pasteuriser exit.....	10	General.....	22
PU cut-off temperature .....	10	Probe sockets .....	22
Time adding PU's .....	10	Pressure port .....	22
Maximum pressure .....	10	Probes .....	22
Time near max. pressure.....	10	Battery.....	22
Reason for stopping .....	10	<b>Frequently Asked Questions .</b>	<b>23</b>
<b>Graph.....</b>	<b>11</b>	Battery and battery charging.....	23
Cursor movement .....	11	Controls.....	25
Graph lines.....	11	Results.....	25
Off-scale records .....	12	<b>Specification .....</b>	<b>28</b>
<b>Full List .....</b>	<b>13</b>	<b>Safety and Conformity ..facing 1</b>	
Time line movement.....	13		
<b>Battery Charging .....</b>	<b>14</b>		
Battery information .....	14		
Battery temperature .....	14		

# Safety and Conformity

## Safety warning

Always follow basic safety precautions when using this equipment to reduce risk of injury. Before using the equipment, read and understand the operating instructions in this manual.

This equipment is intended to monitor the pasteurisation process in tunnel pasteurisers. It should not be used for any other purpose.

The equipment should only be connected to other equipment intended for the purpose and manufactured by Redpost Electronic Products Ltd. Suitable battery chargers are RPC-50 and RPC-80. Battery chargers from other manufacturers should not be used, they may result in danger.

The equipment may remain hot for some time after being taken from the pasteuriser. Wear protective gloves when carrying.

Always place the equipment on a level, stable surface. Do not place on shelves above eye level.



Equipment: PU & Pressure Monitor type RPU-353

Manufacturer: Redpost Electronic Products Ltd.,  
The Old Pumping Station, Toft Rd.,  
Bourn, Cambridge. CB3 7TT U.K.

Directives: 89/336/EEC "Electromagnetic compatibility"  
92/31/EEC amends above  
73/23/EEC "Electrical safety"  
93/68/EEC "CE marking"

Standards applied: EN 61000-6-3:2001 emissions  
EN 61000-6-2:2001 immunity  
EN 60825-1:1994 (as amended to 2002) LED safety

I certify that this apparatus conforms with the requirements of the above directives.

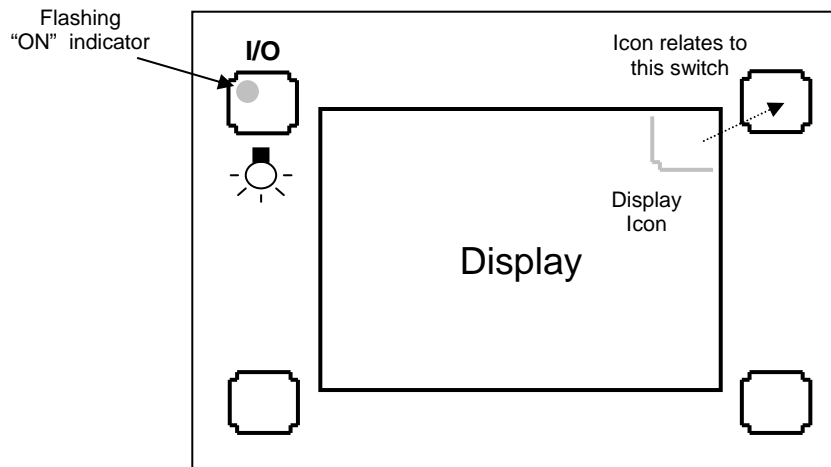
A handwritten signature in black ink that reads "Edward F. Aldred".

E.F.Aldred  
Director  
Redpost Electronic Products Ltd

Date: 29 Jan 2004



# Controls



There are four control switches arranged around the display screen. Operate the switches by touching one end of the actuator onto the glass in the marked area. Keep the actuator in position until you see a change in the display or the flashing indicator.

The two top switches are used for the main control functions. They take a few seconds to operate so that there is less chance of any accidental actions.

## I/O switch

The top left switch is the I/O (on/off) switch. Switch the instrument on by activating this switch. Switch the instrument off by activating and holding this switch for at least ten seconds. The display shows you what is happening. Remove the actuator after the instrument switches off.

If there are any recorded files they will be saved during the time the instrument is switched off.

You cannot switch the instrument off when the battery is charging from a Redpost printer/charger unit or a Redpost battery charger.

## Indicator

The small green lamp on the panel flashes once per second to show that the instrument is operating. This lamp also flashes quickly five times to acknowledge the action of either of the two top switches.

## **Display illumination**

The I/O (on/off) switch also turns on the backlight that lights up the display. When any switch is operated or there is any other activity, such as connecting a probe, the backlight will turn on. It will turn off again after a short time to save battery power. Activate the I/O switch (for about half a second) to turn on the backlight without causing any other action.

If there is very little charge in the battery then the backlight will not turn on. This saves unnecessary battery drain.

## **Switch functions and icons**

The I/O (on/off) switch always keeps the same function but for the other three switches the display will show a small “icon” to indicate the function of each switch. The icon is in the same corner as the switch it relates to. The switch icon becomes inverted (black for white) when the switch is operated. If a switch has no icon then it has no function at that time.

## **Auto power on**

The instrument will automatically switch on when it is connected to a Redpost printer/charger or a Redpost battery charger. This allows the battery charging to be controlled and the charging information to be displayed.

The I/O (on/off) switch will not turn the instrument off while it is connected to a charger but it can still be used to turn on the display backlight.

## **Auto power off**

The instrument uses several methods to reduce battery power consumption. The automatic control of the display backlight is described above.

If the instrument is idle and waiting to record a file it will automatically switch off after ten minutes. The instrument is idle if no switches are activated, no data communication is taking place and it is not connected to an active battery charger.

If the instrument is idle and displaying the results of a recorded file it will automatically switch off after twenty minutes.

**When the instrument switches off automatically any recorded files are saved.**

To resume normal operation activate the I/O (on/off) switch or connect the instrument to a Redpost battery charger.

## **Low battery condition**

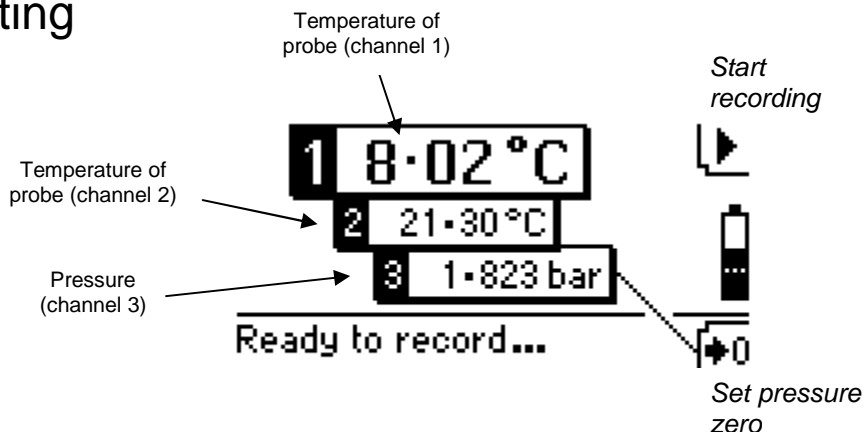
If recording is taking place when the battery charge level falls below 15% then recording will stop and the file will be saved. This ensures that recordings cannot be corrupted by low battery condition. The results screen will show the reason for stopping.

If there is less than 15% charge in the battery then the backlight cannot be switched on. This helps to ensure that the battery lasts for as long as possible. The backlight increases the battery drain by about four times.

At an even lower level of charge (below 5%) the whole instrument will turn off. Any recorded files will be saved. If you switch the instrument on again in this state it will stay on for only a few seconds. Connect the instrument to a Redpost battery charger as soon as possible.

The instrument continuously monitors its own battery use and battery charging to gauge the amount of charge that remains in the battery. If the battery voltage falls to a low level unexpectedly it may indicate that the battery is not correctly holding its charge. This can happen after several years of use. If this problem occurs the display will warn you that the battery may need to be replaced. More information can be found in the "Maintenance" section.

## Starting



## Preparing the instrument

Switch on the instrument. If there are any problems, such as insufficient charge in the battery, the display will give the information you need. Before the temperature probes are connected the location and numbering of the sockets is shown on the display.

Set up the bottle or can in the correct size holder and fit the correct length temperature probe. This process is described in the section "Temperature Probe". Connect this probe into the channel 1 socket. Channel 1 is to the right of the display. When calculating the results channel 1 is given most importance and is assumed to show the product temperature.

Select the spray probe or second container temperature probe and connect it to channel 2. Channel 2 is to the left of the display.

Both sockets must always be occupied. To run without one of the probes you can connect a dummy temperature probe. (A special plug marked with a 'T'.) You can also configure a channel to be permanently inactive: see the section "Key Plug". An inactive channel is shown by an X on the screen.

Set up the pressure measurement fitting by referring to the separate instructions for that equipment. Don't pierce the container yet. You can run without making any connection to the pressure port. To make the pressure channel inactive see the "Key Plug" section.

## Pressure zero setting

Before you connect the pressure fitting to the RPU-353 you should set the zero point of the pressure channel (channel 3). This setting should be made before each recording run and compensates for changes in atmospheric pressure. With the pressure port open to the atmosphere activate the bottom right switch (→0). After the zero has been set you can connect the pressure fitting to the port and then pierce the container to let the pressure reach the sensor. The pressure port (channel 3) is on the back edge of the instrument to the left of the display.



## **Thermometer**

When the instrument is ready to record, the temperature of the probes is shown on the display, updated every second.\* In this form the instrument can be used as a highly accurate thermometer.

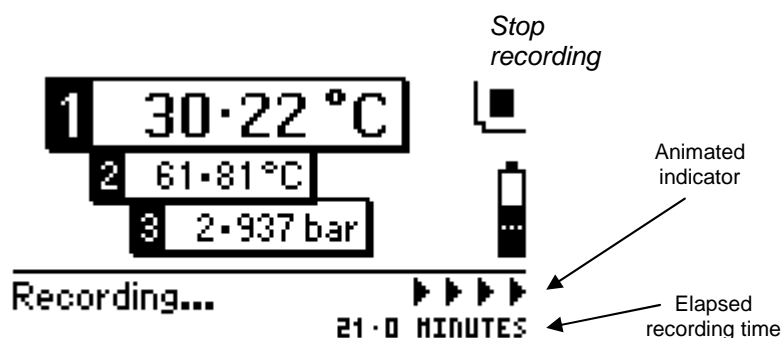
## **Starting the recording**

When you are ready to put the instrument into the pasteuriser, start recording by activating the top right switch (▶).

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\* The illustration shows the English language version in °C and bar. The text changes according to the language and units selected for the display.

# Recording



The temperature of the probes, the pressure sensor reading and the elapsed recording time are shown on the display throughout the recording run.\*

## Stopping the recording

When the instrument exits from the pasteuriser you can stop the recording by activating the top right switch (■) or by unplugging either probe. Recording will also stop after the maximum time (4 hours) or if the charge in the battery becomes too low.

As soon as recording stops the results are displayed.

You can record again without erasing the previous file. Use the top right switch to access the main menu and then select "Record Again". (See "Results" section.)

## Screen temperature

The display screen will switch off if the instrument is too hot (above 70°C). This avoids damage to the screen. Recording will continue normally under these conditions and the flashing green indicator lamp shows that the instrument is operating. Normal display operation will resume as soon as the instrument has cooled.

The instrument should never be operated at temperatures above the maximum ambient temperature shown in the specifications.

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\* The illustration shows the English language version in °C and bar. The text changes according to the language and units selected for the display.

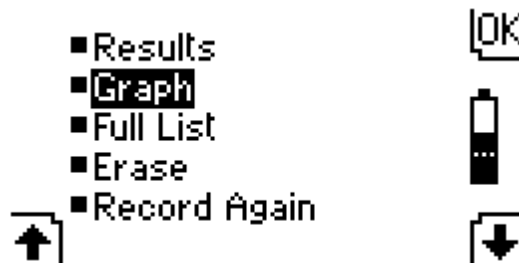
# Results

The calculated results are displayed as soon as recording stops. It is also possible to select different representations of the results.

## Results displays

There are three different results displays and they can be selected from the main menu. The right hand switch above all the results screens gives access to this menu. Later in this manual the “Menus” section explains the operation of the menus in detail.

## Main menu



- The calculated **Results** such as the total PU achieved.
- The **Graph** of the file with a movable cursor that allows you to select one record to be shown in detail.
- The **Full list** of all the records in the file in detail.
- **Erase** the recorded file(s). See more details below. You should print out important files or copy them to a PC before you erase them.
- **Record again** without erasing the previous file(s). Up to four files can be saved in the instrument at any one time. When the memory is too full to save any more files, or when the battery is being charged, this item is not shown. Files that have been printed using the RPC-80 printer/charger unit must be erased before you can record any more files.

If more than one file has been recorded you will be asked to choose the file you wish to show.

## Calculated results

The results are set out on five “pages” with up to 3 items on each page. The right hand switch below the screen (➔) is used to move to the next page and then from the final page back to the first (➔).

On the screen the channel number relating to each result is shown at the left hand side of each line as a white figure on black. Channel 1 is given most importance and is assumed to show the product temperature.

- The total PU value achieved (channel 1)
- The unique ID number of the file
- The total recording time (and optional date & time †)

† If the instrument's clock has been set then the date and time at the start of the recording is shown alternating with the total recording time. See section "Key Plug" for clock setting.

- The maximum temperature recorded (*channel 1*)
- The total time during which the temperature was within 2°C of the maximum (*channel 1*)<sup>\*</sup>
- The temperature at the exit from the pasteuriser (*channel 1*)
- The total PU value achieved (*channel 2*)
- The maximum temperature recorded (*channel 2*)
- The total time during which the temperature was within 2°C of the maximum (*channel 2*)<sup>\*</sup>
- The PU cut-off temperature (*applies to both temperature channels*)
- The total time accumulating PU's: i.e. while temperature was at or above the PU cut-off temperature (*channel 1*)
- The total time accumulating PU's (*channel 2*)
- The maximum pressure recorded (*channel 3*)
- The total time during which the recorded pressure was within 0.2 bar of the maximum (*channel 3*)<sup>\*</sup>
- The reason for stopping recording

All these results are calculated wherever possible. If the file contains any off-scale records (outside the recording range of the instrument) then some results may be invalid. A warning is shown if this is the case and some items may be shown as "unknown". Off-scale records can be caused by a faulty temperature probe.

## Erasing a file

When files are no longer required you can remove them by selecting the Erase option from the main menu. The "Menus" section explains the operation of the menu in detail.

Move the menu highlight to Erase and hold the actuator on the top right (OK) switch for ten seconds. The display shows you what is happening. All recorded files are erased together. After the files have been erased you can release the switch and the instrument will be ready to record again.

When you use the RPU-353 with the RPC-80 printer/charger unit you can erase the files, after they have been printed, by using the control panel of the RPC-80. Files that have been printed using the RPC-80 must be erased before you can record any more files.

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<sup>\*</sup> The limits for this result vary according to the display units selected.

# Calculated Results

Shows the data in the recorded file reduced to the most important details.

## **Total PU achieved**

The total number of Pasteurisation Units accumulated during the recording run. This is calculated using your chosen definition of PU and cut-off temperature. You can change the PU calculation by using the key plug. More details of the calculation are given in the “Key Plug” section under “PU calculation (Background)”.

Your packaging specification will normally set the PU definition and a target PU value for each product to ensure sufficient pasteurisation.

## **Unique ID number**

This file identity number is a combination of the instrument serial number and a running number that advances for each recording. It is therefore unique to the file.

## **Total recording time**

The total elapsed time from the moment you start recording by activating the switch until recording stops. Recording may be stopped in a variety of ways either under your control or automatically. (The reason for stopping is given as the final result.)

If the instrument’s internal clock has been set then the date and time the recording started is also shown. These extra items show alternately with the total recording time.

## **Maximum temperature**

The maximum recorded temperature.

Your packaging specification may call for a certain maximum product temperature and exceeding it could produce unacceptable flavour changes.

## **Time near maximum temperature**

The total time during which the temperature was within 2°C of the maximum. This gives an approximate value for the time the product was within the pasteuriser holding zone. The limit for this result changes to 4°F when temperature is displayed in Fahrenheit.

## **Temperature at pasteuriser exit**

The moment that the instrument leaves the pasteuriser is judged by a rise in light level from the relatively dark interior. Inspection lights inside the pasteuriser may prevent this result from being calculated. The light sensor can be seen on the front panel between the two left hand control switches, don't cover this area with tape or adhesive labels.

Your packaging specification may call for a maximum product exit temperature. If the product leaves the pasteuriser at too high a temperature the flavour may be impaired.

This result is shown for channel 1 only because that channel is assumed to show the product temperature.

## **PU cut-off temperature**

At or above this temperature PU's are accumulated. Below this temperature they are not. The cut-off temperature can be adjusted by using the key plug. More details of the cut-off and the PU calculation are given in the "Key Plug" section.

Your packaging specification may call for a particular PU cut-off temperature to ensure that pasteurising conditions are correct.

## **Time adding PU's**

The total time during which the product temperature was high enough for PU's to be achieved and added to the total. The product temperature was at or above the cut-off temperature for this length of time.

## **Maximum pressure**

The maximum recorded gauge pressure.

Your container specification will show a maximum acceptable internal pressure and exceeding it could lead to leakage or container damage.

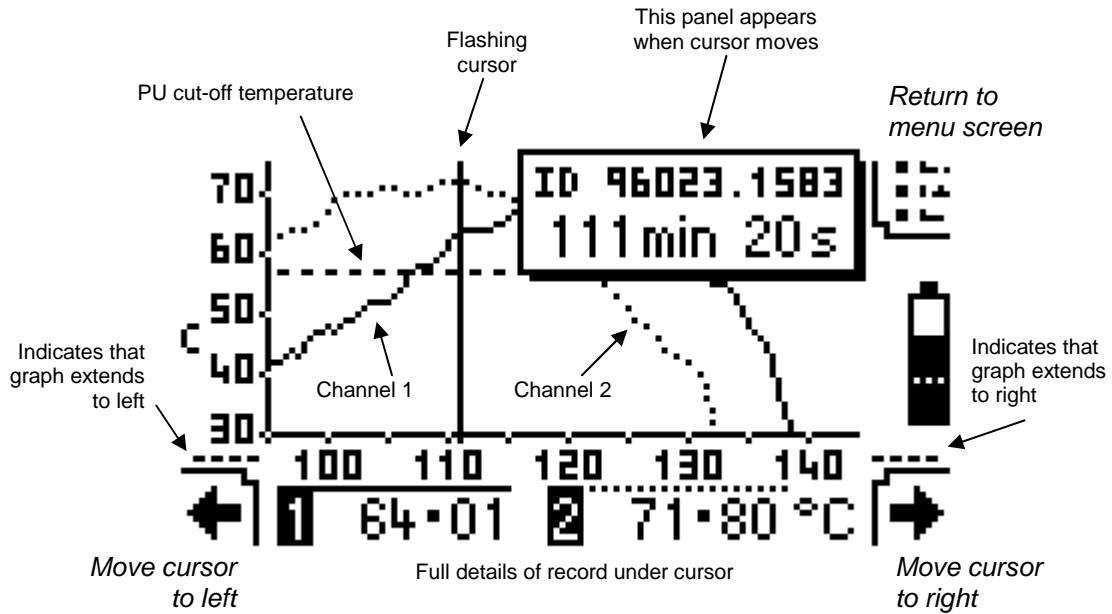
## **Time near maximum pressure**

The total time during which the gauge pressure was within 0.2 bar of the maximum. The limit for this result changes to 4 psi or 0.2 kg/cm<sup>2</sup> when pressure is displayed in alternative units.

## **Reason for stopping**

You can stop recording by activating the switch or by unplugging either probe. Recording will also stop after the maximum time (4 hours) or if the charge in the battery becomes too low.

# Graph



Shows the data in the recorded file as a graph. The temperature (in the selected display units) runs up the vertical axis and elapsed time (in minutes) runs along the horizontal.\*

## Cursor movement

The record under the cursor is shown in detail below the graph. The two switches below the screen are used to move the cursor. Moving the cursor to the right moves it towards the end of the file.

The cursor moves by one record as soon as you operate the switch. If you hold the switch for a short time then the cursor starts to move continuously, slowly at first and then faster, for as long as the switch is held. When the cursor reaches the last record in the file the switch outline becomes dim and it no longer has any effect.

Moving the cursor to the left (towards the start of the file) works in a similar way.

Whenever the cursor is moving, the elapsed time of the record under the cursor is shown in a panel at the top right of the screen. The ID number of the file is also shown here.

## Graph lines

Channel 1 shows as a solid line on the graph while channel 2 shows as a dotted line. The position of the PU cut-off temperature is shown as a dashed line. The horizontal lines above each channel in the detailed record show the style of the line for that channel.

The pressure channel (channel 3) is not shown as a line on the graph but if the pressure channel is active then the gauge pressure is shown in the detailed record

\* The illustration shows the graph in °C. The details change according to the units selected for the display.

area alternating with the temperature records.

An inactive channel is not shown on the graph and is shown with an X in the detailed record.

The vertical temperature scale adjusts automatically so that the maximum reading of the highest channel is always on the graph. A record that is below the scale leaves a gap in the graph.

If the whole graph is wider than will fit on a single screen then the cursor causes the graph to scroll from side to side so that the required portion is visible. Small dashed lines at the left or right of the time axis indicate that the graph extends further in that direction.

### **Off-scale records**

Off-scale records are too high or too low to fit within the available recording range of the instrument. The available recording range is shown in the "Specification" section. Off-scale records can be caused by a faulty probe.

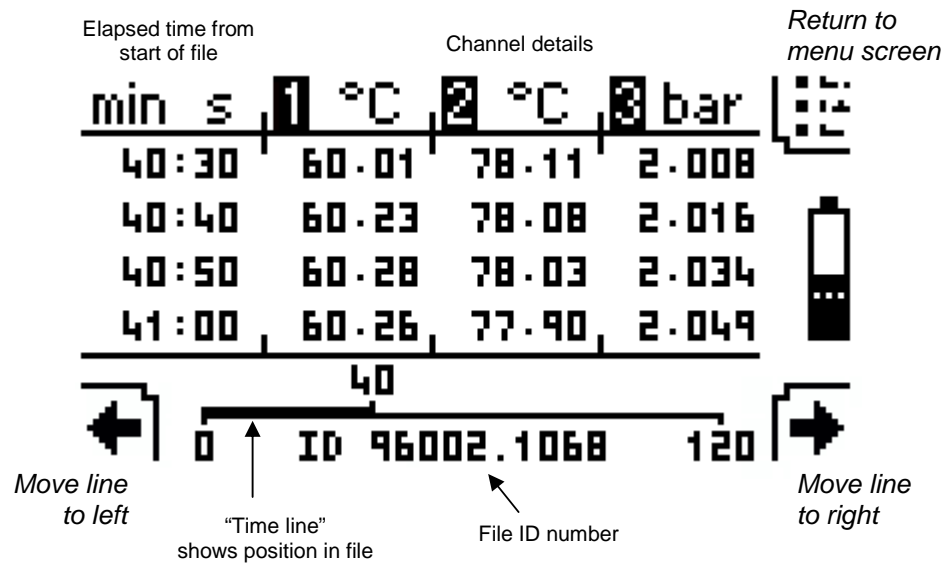
Any record that is too high or too low for the recording range does not show on the graph and leaves a gap in the graph. In the detailed record area, records above the top of the recording range show as a row of '+' signs. Similarly a row of '-' signs indicates a record that is too low for the recording range.

### **Display backlight**

You can use the top left switch at any time to turn on the display backlight.



## Full List



Shows a list of all the data in the recorded file. \*

### Time line movement

Four records from a file can be shown in detail on the screen. The "time line" shows the position of these records in relation to the whole file. The two switches below the screen are used to move the time line. Moving the line to the right shows records nearer to the end of the file.

The line moves by one record as soon as you operate the switch. If you hold the switch for a short time then the line starts to move continuously, slowly at first and then faster, for as long as the switch is held. When the line reaches the last record in the file the switch outline becomes dim and it no longer has any effect.

Moving the line to the left (towards the start of the file) works in a similar way.

The time line is not shown for very short files (under 1 minute).

An inactive channel gives a blank column with an X in the header.

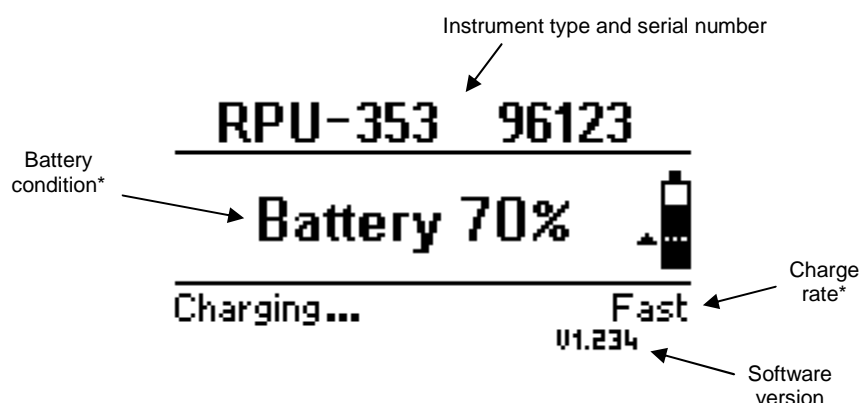
### Display backlight

You can use the top left switch at any time to turn on the display backlight.

\* The illustration shows the list in °C and bar. The details change according to the display units selected.

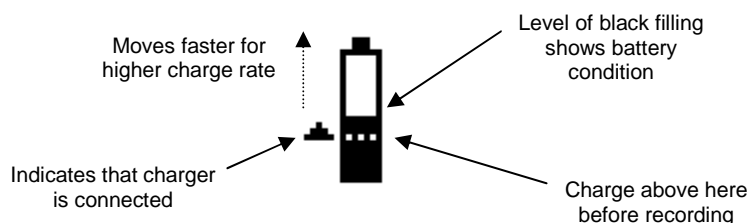
# Battery Charging

The battery in the instrument can be re-charged by the Redpost RPC-80 printer/charger or the Redpost RPC-50 battery charger. You can connect the charger to either socket. Do not leave the battery on charge continuously for more than 24 hours. If you connect to the charger before recording a file you see the complete charging information on the screen.\*



## Battery information

All the other display screens show the battery condition using just the small battery image from the complete diagram. This shows when the battery is being charged by an arrow head that moves up the battery image. The speed of movement shows the charge rate. The dotted line shows the minimum level of charge needed to start recording.



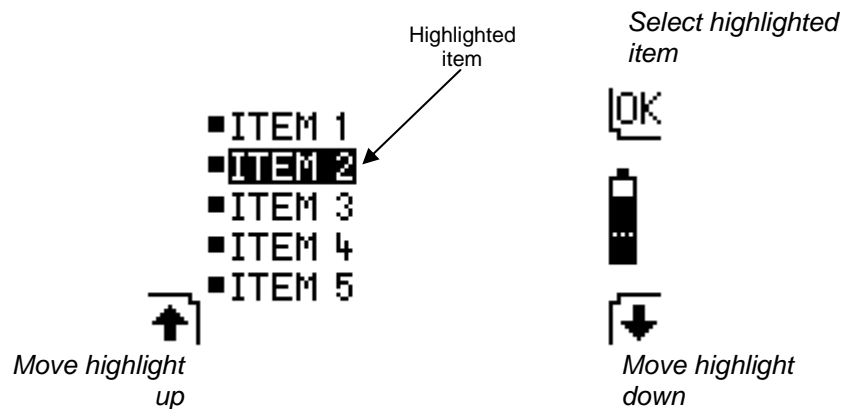
## Battery temperature

The charge rate is controlled by several factors including battery temperature. The battery will not charge if it is too hot and in that case the arrow head in the battery diagram will be stationary. Charging will resume as soon as the battery has cooled.

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\* The illustration shows the English language version. The text changes according to the language selected for the display.

# Menus



There are stages in the operation and configuration of the instrument when you need to choose an action etc. from a menu list. A menu shows all the possible choices or items in a vertical list. The method of operation is the same in every case although there can be as few as 2 and as many as 6 items in the menu list.

## Moving the highlight

The two switches below the screen are used to move the highlight over the item in the list that you wish to select.

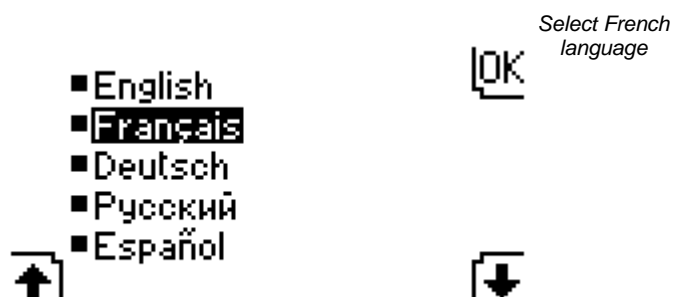
The highlight moves down by one item as soon as you operate the right hand switch. If you hold the switch for a short time then the highlight starts to move down continuously for as long as the switch is held. When the highlight reaches the bottom item the switch outline becomes dim and it no longer has any effect.

Moving the highlight up with the left switch works in a similar way.

## Selecting an item

Operate the top right (OK) switch to select the item you have highlighted.

## Example



## Key Plug (Configuration)

The key plug is a special plug marked with a 'K' which can be inserted into either probe socket and puts the instrument into configuration mode. This allows you to change the way the instrument operates. The key plug restricts access to this mode so that changes are not made unintentionally. You can use the key plug only when there are no recorded files in the instrument and it is not connected to an active battery charger.

The parameters you can change are presented on a series of screens. Each screen shows the symbol of a key at the bottom. The screen first shows you the present setting or value, if that is correct you can activate the top right (OK) switch to move to the next screen.

Activate the lower control switches if you need to change the present value. Sometimes you choose from a menu, sometimes change the value directly. When the value is correct you should always activate the top right (OK) switch.

Changes you make on a screen are only saved when you activate the OK switch for that screen.

### Output to other equipment

The settings you make with the key plug will decide how the results are shown on the display of the RPU-353.

When used with other equipment the final output device dictates all settings. Therefore when you use the RPU-353 with the RPC-80 printer/charger the settings you make on the RPC-80 and the clock in the RPC-80 will take priority when results are calculated for printing. Similarly when connecting to a PC the settings and clock in the PC take priority when results are displayed or printed by the PC.

### Language

You can select the language used for the text on the display. The decimal point symbol used for numerical output is also changed according to the language you select. English will use the point, other languages the comma.

### Display contrast

You can adjust the appearance of the display to give the best contrast. This is set during manufacture and will seldom need changing. Adjust so that the background "off" dots become just visible compared to the clear glass at the edges of the screen. Adjusting for the darkest "on" dots will not give the best contrast.

The changes you can make are intentionally kept quite small. You can however set the maximum + or - value, save it with the OK switch and then repeat the adjustment for greater changes. See "Leaving configuration" below.

### Clock

You can set the current date and time. Setting the clock in this way is optional. If recorded files are printed and then erased using the RPC-80 printer/charger then the clock settings of the RPC-80 will be automatically copied into the RPC-353. If set,

the clock will be used when results are shown on the display.

The screen first shows the present setting for the date. If you wish to make any changes then activate the lower right (+/-) switch otherwise move on by activating the OK switch.

You change the year, month and day by using the lower switches. A flashing indicator appears under the item you are changing. When the first item is correct use the top right (➔) switch to move to the next item and so on.

If you make a mistake you cannot move the cursor backwards but you can start the date entry process again as described in the next paragraph.

When you have moved past the last item the screen changes and you have the chance to make more changes by activating the (+/-) switch again. If the date is now correct you must save the changes you have made by activating the OK switch.

The screen then changes to show the present setting for the time on a 24 hour clock system. If you wish to make any changes then activate the lower right (+/-) switch otherwise move on by activating the OK switch.

You change the hours and minutes by using the lower switches in the way described above for the date. The seconds cannot be changed and will always be set to zero. You must end by saving the changes you have made by activating the OK switch.

## Display units

You can choose to display all temperatures in either Celsius (°C) or Fahrenheit (°F).

Whenever you change the temperature display units the PU calculation is also changed to the default values for those units. (See below.)

You can choose to display gauge pressures in bar, psi or kg/cm<sup>2</sup>.

## Active channels

You can make the channels active or inactive using this screen. Inactive channels do not use up any storage memory and so longer recordings can be made if required.

If you make a channel inactive in this way it will remain inactive for all recordings until you change the setting again using the key plug. To make a temperature channel temporarily inactive you can also use a dummy plug. (A special plug marked with a 'T'.) All temperature probe sockets must be occupied before you start a recording run, even for inactive channels.

If you wish to change the active state of one of the channels then activate the lower right (+/-) switch otherwise move on by activating the OK switch. On this screen a tick (✓) represents an active channel and a cross (X) an inactive one.

A flashing indicator appears under the channel you are changing. When the first channel is correct use the top right (➔) switch to move to the next. You can leave a channel as it is by moving straight to the next one.

When you have moved past the third channel position the screen changes and you have the chance to make more changes by activating the (+/-) switch again. If the channel states are now correct you must save the changes you have made by activating the OK switch.

## PU calculation (Background)

The Pasteurisation Unit (PU) is defined as relating to the sterilising effect observed when the product is held for one minute at a temperature termed the Base value. At this temperature therefore, 1 PU per minute is achieved.

Experiments on various mixtures of the common brewery biological contaminants showed that at temperatures over about 50°C there is an approximately ten-fold increase in sterilising effect for every 7°C increase in temperature. For example, if the time required to kill a population of micro-organisms at 60°C is found to be 5 minutes then if the temperature were to be increased to 67°C the time required would be only 0.5 minutes. The increase in temperature required to produce a ten-fold increase in kill rate is termed the Z value. The Z value in this case is therefore 7°C.

For beer the PU is normally defined by a Base value of 60°C and a Z value of 7°C. The same definition is often used for soft drinks and other beverages. Where there is any possibility of spore-forming bacterial contamination being present (for example in tomato juice) very much higher temperatures are required for pasteurisation. In these situations the definition of Base value 80°C and Z value 10°C is often used. Other definitions are also in use outside the brewing industry.

At product temperatures below about 50°C it is doubtful that any significant sterilising effect is achieved even though from a strictly mathematical point of view the correct PU total could still be obtained, given enough time in the pasteuriser. For this reason it is desirable to set a temperature level below which no PU's are added to the total calculated by a PU monitor. This is termed the PU cut-off temperature.

Set the PU cut-off temperature at least 5°C lower than the planned product temperature in the holding zone of the pasteuriser. Higher values will give a very conservative figure for PU achieved and will reduce the repeatability of the result because the product temperature will be changing only slowly as it crosses the cut-off temperature threshold. For beer the cut-off is not normally set below 50°C.

The next three screens allow you to adjust the PU calculation which will apply to both temperature channels.

### PU cut-off temperature

You can change the cut-off temperature in steps of 0.1°C.

### PU calculation – Base

You can select a Base value of 60, 70 or 80°C.

### PU calculation – Z

You can select a Z value of 6.94\*, 7 or 10°C.

If you set a PU definition other than the standard for beer (i.e. other than Base = 60°C and Z = 7°C) the results display will show the calculation you have chosen.

\*Note that 6.94°C is equivalent to a value of 12.5°F : often used in American text books.

### PU calculation – Fahrenheit

If you have selected to display in °F then the default PU definition will be Base = 140°F and Z = 12.5°F. The cut-off can be changed in steps of 0.1°F. You can select a Base value of 140, 160 or 180°F and a Z value of 12.5 or 18°F.

## **Recording interval**

This screen allows you to select the time interval between recordings. You can choose any value between 2 and 60 seconds. The factory setting is 10 seconds.

## **Equipment number**

This screen allows you to set your own equipment number or identification for the instrument. This can consist of up to 15 letters or numbers and will be printed with the results by the Redpost RPC-80 printer/charger. This identification may be required for ISO9000 schemes. Only upper case Roman script letters without accents can be used with numerals, space, period (.) and forward slash (/).

The screen first shows the present equipment number or a series of blank spaces if nothing has been set yet. If you wish to change or add to the equipment number then activate the lower right (+/-) switch otherwise move on by activating the OK switch.

You change the first character position of the equipment number using the lower switches. A flashing indicator appears under the character you are changing. When the first character is correct use the top right (➔) switch to move to the next character position and so on. You can leave a character blank by moving straight to the next position.

If you make a mistake you cannot move the cursor backwards but you can start the whole entry process again (see below). After entering all the characters you want you can move quickly through any remaining blank spaces by holding the top right (➔) switch for a few seconds.

When you have moved past the last character position the screen changes and you have the chance to make more changes by activating the (+/-) switch again. If the equipment number is now correct you must save the changes you have made by activating the OK switch.

## **Mains frequency**

Choose 50 or 60 Hz according to the nominal frequency of your local mains supply. This setting helps the instrument to reject interference.

After you activate the OK switch for this screen you have finished the configuration cycle.

## **Leaving configuration**

Remove the key plug if you have made all the changes you need. You can continue through another configuration cycle if you need to make more changes. You can remove the key plug at any time or switch the instrument off using the I/O (on/off) switch but remember that any changes you make on a screen are only saved when you activate the OK switch for that screen.

The configuration cycle will be interrupted if you connect the instrument to a battery charger.

# Output

The RPU-353 instrument can be used as a stand alone PU & pressure monitor or it can be connected to a variety of other equipment so that the recorded files can be permanently saved and/or printed.

## Stand alone operation

With its detailed display of calculated results, graph and full list of all records it is possible to obtain all the information about a file directly from the display of the instrument. The only other equipment required is a Redpost RPC-50 battery charger.

## Connection to RPC-80

The instrument connects to the Redpost RPC-80 printer/charger. Printed results are available and a status report for the instrument can be obtained. Connection to a PC is possible using the serial port on the RPC-80.

The settings you make on the RPC-80 will take priority over the settings in the RPU-353 when results are calculated for printing. File start time will be calculated using the clock in the RPC-80 as a reference.

When files are erased using the control button on the RPC-80 the clock settings are automatically copied into the RPU-353. This applies to RPC-80 software version 'p' or later.

## Connection to PC

It is possible to connect the instrument to a PC using the Redpost RPC-50 battery charger. The same connection is also possible using the serial port on the RPC-80. (See manuals for RPC-50 or RPC-80.)

Recorded files can also be copied and carried to a remote PC using an optional hand-held infrared data transfer unit. (Future product.)

The settings you make on the PC will take priority over the settings in the RPU-353 when results are calculated for display or printing. File start time will be calculated using the clock in the PC as a reference. The software currently offered for the PC does not alter the clock settings in the RPU-353.



# Temperature Probe

## Probe position

It is generally accepted that a slow circulation takes place in the beverage container, driven by the temperature difference between the hot container wall and the cooler body of liquid inside. This implies that the product will not be well mixed in the container during pasteurisation and so we must assume that there will be variations in the treatment received between individual contaminant cells and micro-organisms. We might try to measure the value of PU achieved for the average contaminant cell but we cannot tell which place in the container will receive the average treatment. Neither can we guarantee that some portion of the product will not receive considerably less treatment than the average, resulting in the survival of a significant number of the micro-organisms we are intending to remove.

We recommend that the tip of the temperature probe, which is its most sensitive part, should be positioned at the cold spot of the container. This is approximately 10 mm to 20 mm up from bottom of the container and exactly on the central axis. Choosing the cold spot gives the minimum result for PU achieved; in fact every contaminant cell may have been warmer than the cold spot at some time during the process, so that we can be certain that we are measuring a safe, conservative value. The recorded PU total varies very little with probe height just at the cold spot and so this position also gives the best repeatability of PU measurement.

## Choosing probe length

As a starting point, for bottles, choose a standard length temperature probe that is between 5 mm shorter and 15 mm longer than the outside height of the bottle. For cans choose one that is between 5 mm shorter and 5 mm longer than the outside height. For situations where a standard length is unsuitable, special lengths can be supplied.

Temperature probes fit into the container in a way that allows some adjustment by way of a threaded insert in the seal. This allows the tip to be positioned at the correct height above the bottom of the container and on the central axis. The adjustment is 40 mm for bottle probes and 10 mm for can probes.

For cans and small bottles the tip of the probe should be 10 mm to 15 mm from the bottom of the container. For larger bottles (over 250 mm high) the tip of the probe should be 15 mm to 20 mm from the bottom of the bottle.

# Maintenance

## General

To maintain the accuracy and reliability of the equipment we recommend that it is serviced and re-calibrated (with the probes) at regular intervals. Under light conditions of use this should be carried out at least every 1500 recording runs. When the equipment is heavily used, particularly where high pasteuriser temperatures are involved as with fruit juices, then the service and re-calibration should take place every year.

If this work is done by the manufacturers or an approved agent then the calibration and service details can be recorded in the equipment and are available via the status report.

The regular service will replace both temperature probe sockets and the battery (see below) and so ensure reliable operation.

If servicing has not been carried out by the manufacturer or an approved agent then after about a year of heavy use (or two years of light use) the desiccant within the body of the instrument should be replaced as a precaution.

## Probe sockets

The probe sockets should be lubricated after every 50 recording runs using the contact treatment grease supplied. This protects the sockets from corrosion and greatly extends their service life. A lubrication reminder is shown on the display at the correct times.

If you leave a probe or dummy plug permanently connected to one of the channels it is important to unplug it occasionally and lubricate the socket before replacing it. The lubrication reminder applies to all sockets.

If the equipment has not been returned for servicing as recommended above then after about a year of heavy use (or two years of light use) the exchange unit should be replaced as a precaution. The exchange unit includes both temperature probe sockets and the battery. Full fitting instructions are enclosed with the new part.

## Probes

The probes do not require routine maintenance. Handle them with care. When re-calibrating the equipment always re-calibrate all the probes at the same time.

## Pressure port

The pressure port should be occasionally cleaned. Remove the instrument from its frame and stand it in a tray of hot water about 25 mm deep. The water should just cover the pressure port. Never insert anything into the port or attempt to remove the pressure connector.

## Battery

Always switch the instrument off when it is not in use. If the instrument is left idle it will switch off automatically.

Do not leave the battery on charge continuously for more than 24 hours.

If the equipment has not been returned for servicing as recommended above then as the battery ages it will not hold as much charge as it did when new. The instrument can detect this and when the problem becomes severe it may give a warning on the display that the battery should be replaced. After about a year of heavy use (or two years of light use) the exchange unit should be replaced as a precaution. The exchange unit includes both temperature probe sockets and the battery. Full fitting instructions are enclosed with the new part.

If you unplug the exchange unit and then reconnect it the instrument will assume you have fitted a new battery. **Never unplug the exchange unit** unless you intend to replace it with a new one.

If you plan to store the instrument unused for more than 6 months you should first fully re-charge the battery. When the instrument is left unused, even though it is switched off, the battery gradually loses charge by a process known as "self discharge". If possible give the battery a few hours charge every 3 months during storage.

# Frequently Asked Questions

## Battery

- 1) *Sometimes the battery charge indicator doesn't move even though the instrument is connected to the charger. What's wrong?*
- 2) *When I switch the instrument on it often has less charge in it than when I switched it off. Why?*
- 3) *How long should I leave the instrument connected to the charger?*
- 4) *How long will the battery last?*
- 5) *How is battery charging controlled?*
- 6) *The display tells me that a new battery has been installed. I haven't fitted a new battery, what's going on?*
- 7) *The charge rate shown on the RPC-80 is not the same as that shown on the PU monitor. Which is correct?*

## Controls

- 10) *Which switches control the display backlight?*
- 11) *Why can't I zero the pressure channel? The message tells me that "error is too great".*

## Results

- 20) *If the product temperature is exactly equal to the cut-off temperature will any PU's be achieved?*
- 21) *The PU value displayed by the RPU-353 is not the same as that printed for the same run by the RPC-80. Why?*
- 22) *The maximum pressure value displayed by the RPU-353 is lower than that printed for the same run by the RPC-80. Why?*
- 23) *Why is the file start time shown on the display of the RPU-353 almost an hour different from the start time in the results printed by my PC?*
- 24) *Why is the exit temperature sometimes not included in the results?*
- 25) *Why doesn't the date and time of my file appear on the display of the PU monitor? It appears correctly on the printed results from my PC.*

## Battery and battery charging

- 
- 1) *Sometimes the battery charge indicator doesn't move even though the instrument is connected to the charger. What's wrong?*

Nothing's wrong. When the battery is too hot to charge more quickly the charge rate is lowered to the "trickle" charge rate which has to be set to a low level so that charging conditions are safe. If the instrument is very hot then no charging is possible. When the instrument has cooled down the charge rate will increase and refill the battery. The heat may have come from outside, for example from the pasteuriser or from inside from the process of charging the battery itself.

When the battery is full it will also stop charging although the instrument will occasionally increase the charge rate to "trickle" to make up for any gradual losses. The battery is quickly refilled and charging stops again. This cycle repeats as long as the instrument is connected to the charger. Do not leave the battery on charge continuously for more than 24 hours.

If there are no recorded files then the main battery display will show all the charging information including the reason why the battery is not charging.

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2) *When I switch the instrument on it often has less charge in it than when I switched it off. Why?*

When the instrument is switched off and left unused the battery gradually loses charge by a process known as “self discharge”. When it is next switched on the instrument estimates how much charge has been lost in this way and compensates by reducing the charge percentage.

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3) *How long should I leave the instrument connected to the charger?*

There is no need to leave the instrument on the charger after the battery shows 100% which is full charge. You should not leave the charger connected for more than 24 hours.

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4) *How long will the battery last?*

The specification shows examples of the instrument running time that can be expected from a fully charged battery.

The service life of a battery will depend on the conditions of use. Giving an exact life time is difficult. Heavy use at high pasteurising temperatures such as used for fruit juices will reduce the life. Under such conditions a battery might be expected to last for about a year. With light use and at beer pasteurising temperatures the battery might last for 2 years.

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5) *How is battery charging controlled?*

The instrument continuously monitors its own battery use and any battery charging to gauge the amount of charge that remains in the battery. This allows the percentage charge to be displayed either as a number or as the black fill level on the battery information diagram.

Whenever the charger is connected the charge rate is controlled by the instrument taking into account the state of charge and temperature of the battery and the total charging time. Charging can be fastest when the battery is empty and cool but must be slower when the battery is nearly full or is hot. The aim is to replace the charge as quickly as possible without overcharging or overheating the battery. This ensures a long service life for the battery.

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6) *The display tells me that a new battery has been installed. I haven't fitted a new battery, what's going on?*

If you unplug the exchange unit (which includes the battery) and then reconnect it the instrument will assume you have fitted a new battery. **NEVER UNPLUG THE EXCHANGE UNIT** unless you intend to replace it with a new one. See the “Maintenance” section of the operating manual.

If the battery voltage falls to a low level and then recovers it may appear as though the battery was removed and replaced by a new battery. This can happen if the battery is failing to hold its charge after a year or two of use. It might also happen if the instrument has been switched off and left unused for a long period (six months or more).

A new battery must be charged to a certain level before use and so the instrument must be connected to the charger for several hours. The instrument display gives information about this commissioning process.

In your case the instrument has wrongly sensed a battery change. You should follow the instructions on the display and charge the battery as if it were new. The internal clock settings and any saved

files will have been lost. If the same problem occurs again within a short time then the battery is beginning to fail and you should fit a new exchange unit.

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7) *The charge rate shown on the RPC-80 is not the same as that shown on the PU monitor. Which is correct?*

The RPC-80 is compatible with the RPU-353 PU & pressure monitor but it was designed for use with equipment that has a different battery type. The definitions of the charge rates are not exactly equivalent but charging will take place correctly. Refer to the display on the PU monitor for the correct charging information.

## **Controls**

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10) *Which switches control the display backlight?*

The display backlight is switched on by any of the following actions: activating any switch (even those that have no other function at the time), plugging or unplugging anything into either socket or starting any communications activity that causes a message to be displayed. The backlight will switch off again after one minute unless another action keeps it on.

If you only wish to switch on the backlight you should use the I/O (on/off) switch because then there is no chance of the switch causing any other unwanted operation (unless you hold it for more than 10 seconds!).

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11) *Why can't I zero the pressure channel? The message tells me that "error is too great".*

You should set the zero for the pressure channel before each recording run to compensate for changes in atmospheric pressure. Therefore, the pressure port must be open to the atmosphere and so you should set the zero before you connect up to the pressure fitting on the container. The pressure must be within  $\pm 0.5$  bar of standard atmospheric pressure otherwise the zero correction cannot be made.

If the port *is* open to the atmosphere and you still get the message "Can't set zero - the error is too great" then the pressure port may be blocked. This is most likely to be a problem when pasteurising soft drinks with high sugar content. Clean the port as directed in the "Maintenance" section of the operating manual. If the problem persists then there may be a fault in the pressure sensor.

## **Results**

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20) *If the product temperature is exactly equal to the cut-off temperature will any PU's be achieved?*

Yes, PU's will be achieved and added to the total. The precise definition of the PU cut-off (see "Results" section of the operating manual) is as follows: "At or above this temperature PU's are accumulated. Below this temperature they are not."

This definition also applies to the timing result displayed as "Adding PU's" but often printed as "Time above cut-off". The definition of the result has always been the same but in printed results the headings used in the past were not always so precise.

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21) *The PU value displayed by the RPU-353 is not the same as that printed for the same run by the RPC-80. Why?*

Remember that the final output device dictates all settings for PU calculation, date and time.

The RPC-80 recalculates the results from the raw data based on values you choose when setting up the RPC-80. The clock in the RPC-80 is also used as a reference for the file timing. These features make it easy to maintain a plant-wide standard for PU calculations and the date & time and to change those standards without making modifications to all the monitors. When using the RPU-353 with the RPC-80 you must be aware that different standards for PU calculation (including PU cut-off temperature) may apply to the displayed and printed results.

The same applies when connecting the PU monitor to a PC. The settings you make in the program running on the PC will take priority over the settings in the RPU-353 when results are calculated for display or printing. File start time will be calculated using the clock in the PC as a reference.

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22) *The maximum pressure value displayed by the RPU-353 is lower than that printed for the same run by the RPC-80. Why?*

The final output device dictates all settings for PU calculation, date, time, etc. and this also extends to the pressure results. The previous answer gives more details.

The RPC-80 can be set to make a correction for errors introduced by the older pressure fittings where the head space in the can is very small. These errors are very small for the more recent pressure fittings and so these corrections are not made in the RPU-353. We recommend that the head space correction in the RPC-80 is turned off. See the RPC-80 configuration manual.

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23) *Why is the file start time shown on the display of the RPU-353 almost an hour different from the start time in the results printed by my PC?*

The final output device dictates all settings for PU calculation, date and time. The previous answers give more details. In this case the clock in the PC was probably adjusted automatically for Summer Time (Daylight Saving) but you have not changed the clock in the RPC-353.

If the PU monitor is used with the RPC-80 printer/charger then the clock will be automatically updated every time files are printed out and then erased. (The software in the RPC-80 must be version 'p' or later.) This makes it easy to maintain a plant-wide standard for date & time without making modifications to all the monitors. The software used in the PC does not currently offer this facility.

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24) *Why is the exit temperature sometimes not included in the results?*

The moment that the instrument leaves the pasteuriser is judged by a rise in ambient light level from the relatively dark interior. If there are inspection lights inside the pasteuriser or if for any other reason the light level is too high inside the pasteuriser or too low outside it (where the instrument exits) then the result may not be calculated. It may be necessary to improve the lighting at the exit end of the pasteuriser particularly during night shifts.

The sensing sequence is triggered by the channel 1 temperature first rising above the PU cut-off temperature and then falling below it again before the exit from the pasteuriser. If this does not happen then the result is not calculated. (Channel 1 is assumed to read the temperature of the product.)

The light sensor can be seen on the left of the instrument's front panel between the two left hand control switches, don't cover this area with tape or adhesive labels.

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*25) Why doesn't the date and time of my file appear on the display of the PU monitor? It appears correctly on the printed results from my PC.*

The date and time when the file recording started is shown on the first page of results only if the instrument's internal clock has been set. These extra items are shown alternately with the total recording time. When the PC is used to print the results the clock in the PC is used as a reference for the file timing.

If you wish to see the file start date and time on the display then you must set up the internal clock.\* See "Key Plug" section of the operating manual. As supplied the instrument's clock is not usually set. When a new exchange unit is fitted (which includes the battery) the internal clock settings are lost.

\* If the PU monitor is used with the RPC-80 printer/charger then the clock will be automatically set or updated every time files are printed out and then erased. (The software in the RPC-80 must be version 'p' or later.) This makes it easy to maintain a plant-wide standard for date & time without making modifications to all the monitors. The software used in the PC does not currently offer this facility.

# Specification

## Technical Specification : RPU-353 PU & Pressure Monitor

### Storing data

- max No. of files : 4 \* (a file is a single recording run)
- max No. of fields : 15860 (a field is one channel record)
- recording timer setting : 4 hours \* (the maximum recording run)
- recording interval setting : 10 seconds (user can select from 2 s to 60 s)

\* Other values available to special order. Recording all 3 channels at 10 second intervals a total of 14.6 hours recording can be stored.

### Recording inputs

- |                            | temperature       | pressure                   |
|----------------------------|-------------------|----------------------------|
| - number of input channels | : 2               | : 1                        |
| - nominal range            | : -5 to +105 °C * | : -0.5 to +18.0 bar gauge* |
| - resolution               | : 0.02 °C         | : 0.002 bar                |

\* The display can show results in alternative units if required.

### Measuring accuracy - worst case, all errors, including sensors

- temperature : ± 0.25 °C (sensor in range 40 to 80 °C)  
: ± 0.4 °C (over rest of range)
- pressure (after setting zero) : ± 0.08 bar (sensor in range 0 to 8 bar gauge and 40 to 80 °C)  
: ± 0.2 bar (all other conditions)

All sensors are interchangeable within the accuracy specification

### Operating conditions - operation outside these limits may cause permanent damage

- instrument : -10 to +85 °C
- temperature sensor : -30 to +150 °C
- pressure sensor : up to +20 bar gauge

### Battery life - from a fully charged battery

- example (a) 2 maximum runs : record 4 hours, display (with backlight) 20 minutes
- example (b) 15 typical runs : record 40 minutes, display (with backlight) 5 minutes

Assumes final recording is completed within one week of the first

### Dimensions

- in frame : (Length x Width x Height)  
: 380 x 180 x 215 mm

### Weight

: 8.7 kg

Dimensions and weight are inclusive of carrying frame and a combined temperature and pressure fitting

### Materials

: Stainless steel, toughened glass and PET-P plastic.

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### Calculation of pasteurisation units (PU) can take place in the RPU-353

- accuracy : better than ± 0.001% for calculation alone \*
- range : 0 to 9999.9 PU
- resolution : 0.1 PU

\* Note that a temperature measurement error of ± 0.25 °C represents ± 8% error in PU value.

October 2013