JR TECHNOLOGY LIMITED

M50 Moisture Monitor Handset User Guide (Radome Display)

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1 Introduction

The M50 is a modular moisture measurement system, designed for use in environments ranging from hand-held measurements to industrial monitoring and control. It can be used to measure the moisture content in any non-conducting material.

The M50 Handset is one component in the M50 system. It is a battery-powered unit that allows the M50 probe to be used in portable applications. The handset is shown below, connected an M50-P-A probe.

Two versions of Handset user interface are available. This document describes Handset part number M50-PHP-R, as shown in the figure below, which displays a Go/No-go indication designed for testing radomes. The alternative user interface shows the moisture content as a percentage of the material's dry weight.

Figure 1: M50 handset and probe.

1.1 Handset Features

The handset's firmware can be customised for different applications, but this unit's primary features include:

- Moisture level displayed in a graphical format, divided into 'good', 'poor' and 'fail' categories.

- Three preset density values are programmed into the handset (sandwich, foam and solid), for quick selection by the user when working with different composite materials.

- Data logging function to store readings in the handset for download to a PC.

- USB interface to allow handset configuration from a computer, download of log data, and recharging unit's batteries.

- Rechargeable batteries giving up to 20 hours continuous usage from a full charge.

- Batteries can be recharged by plugging the handset into a USB interface or a mains-powered USB charger.

- The unit is designed to have a IP65 ingress protection rating[1].

1.2 Packing List

The following items are shipped with the standard M50 handset system:

- Handset (fitted with rechargeable batteries).
- Docking station for recharging the batteries and communicating with a PC.
- M50 probe, fitted with cable and handle for connection to handset.
- Mains powered USB charger.
- USB cable to connect the docking station to the mains charger or a computer.
- Software installation disk for PC software to configure the handset.
- Protective rubber boot for handset (optional item).
- Carry case for handset (optional item).

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1 Design goal – not yet formally tested.

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1.3   Setting up the Handset and Probe

First connect the probe to the handset. The connector on the probe's cable fits to the screw connector on the top of the handset. It is keyed and will only fit one way. Screw the connector in until it is finger-tight. Do not use any tools to tighten the connector.

To set up the docking station for battery charging, connect the USB socket on the rear of the docking station either to a USB mains charger or to a computer's USB port. Then the batteries can be charged simply by placing the handset in its docking station, The batteries may only be partially charged when the unit ships, and could take up to ten hours to fully charge.

1.4   Replacing The Batteries

The unit ships with 3 NiMH 'AA' rechargeable batteries with nominal capacity of 2850mAh. If the batteries need to be replaced in the future (they are accessible from the underside of the handset), it is important to replace them with equivalent NiMH batteries.

The handset is configured to charge the batteries when docked in the docking station, with a charging current appropriate to these high-capacity NiMH cells. It is important that the correct rechargeable cells be fitted. Under no circumstances fit anything other than NiMH batteries.

⚠	**Only fit the correct high capacity NiMH batteries.**

![JR Technology Limited logo]

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2   Handset Controls

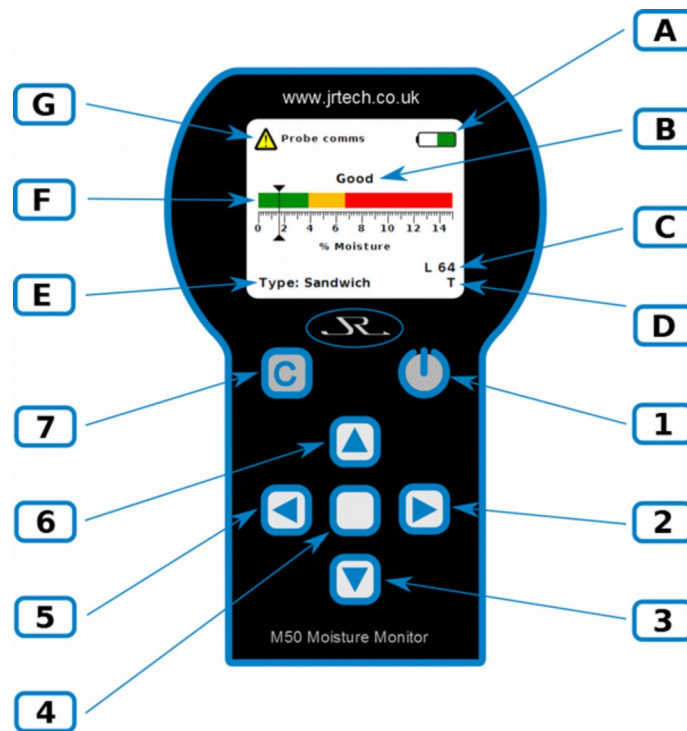The figure below shows the handset's screen indicators and keypad controls.

Figure 2: Handset's Indications and Control Keys

2.1   Screen Indicators

The indicators labelled A to F in the above figure have the following meanings.

2.1.1   Indicator A – Battery Level Indicator

The battery indication shows the charge remaining in the batteries. Normally the display is green, but when the charge drops below about 25% the colour changes to orange.

The unit is recharged by placing it in the docking station, which can be plugged into a mains-powered USB charger or into a computer's USB port. In either case the unit will draw power over the USB connection to charge the batteries. When the battery is charging the indicator shows an animated display in a loop where the battery level rises from zero to fully charged.

When the handset is connected to an external power source it will beep to confirm that it has external power. If the unit is switched off when it is docked then it will turn on the LCD at low intensity to provide an indication of the battery charging status. If the unit is removed from the dock it will beep again and switch off.

2.1.2 Indicator B – Condition Summary

The handset shows a summary of the condition of the material currently being sensed by the probe. If the moisture content is below 2.9% it is flagged as 'good', between 2.9% and 5.0% it is flagged as 'poor', and above 5.0% it is 'fail'.

2.1.3 Indicator C – Number of Data Log Points Available

The handset allows up to 64 data points to be logged in its memory for downloading to a computer over the USB interface. This item shows the number of data log points that remain unused in the handset.

2.1.4 Indicator D – Auto Switch Off Timer

The handset provides a feature to automatically switch off the handset after a period of inactivity. When this feature is enabled a **T** symbol is shown on the screen. When the feature is disabled (the factory default) there is no symbol present in this location.

2.1.5 Indicator E – Density Setting

The handset contains three preset configurations of material density, and this indicator displays which preset is in use. The factory default provides settings for sandwich, foam and solid composite materials.

2.1.6 Indicator F – Bar Graph

This provides a graphical indication of the moisture content of the sample under test. The numbers and scale underneath the bar graph show the moisture reading as the percent moisture content by weight of the sample under test. It is calculated using the following formula:

$$Percent\ Moisture = \frac{Weight_{moist} - Weight_{Dry}}{Weight_{Dry}} \times 100$$

The moisture reading depends on the dry weight of the material, which is configured in the handset by selecting one of the presets (Section 3.2 describes how to do this).

2.1.7 Indicator G – Error Status

In normal operation the top left of the screen is blank. In the event of an error condition this space is used to report the problem. In Figure 2 above the warning means that the handset cannot communication with the probe (e.g. because it is disconnected).

2.2   Keypad Controls

The buttons on the keypad labelled 1 to 7 in the above figure have the following functions.

2.2.1   Button 1 – Power key

This key is used to switch the handset on and off. Press this key once to switch on the handset. At start-up a splash screen is displayed showing the unit's part number and serial number, while a power-on self-test is performed. Once the start-up tests have completed, this key can be pressed again to switch the unit off.

The unit supports an automatic power-down facility, set via a configuration menu (see Section 3.1). This is provided to minimise battery usage in the event the unit is accidentally left switched on. The factory default is for the unit to remain switched on indefinitely.

2.2.2   Button 2 – Right Arrow Key

This key is used to scroll through the preset density settings. Each time the key is pressed the next available preset is selected. When the handset reaches the end of the list of presets it will then return to the first preset in the list.

When navigating menus this key is used to activate the next sub-menu in the menu hierarchy.

2.2.3   Button 3 – Down Arrow Key

In the normal display mode this key is used for one-touch data logging. Each time the key is pressed the current moisture measurement and handset configuration is logged in memory. Up to 64 such data points can be recorded in the handset. This data can be downloaded to a PC and stored to disk, and the log is also cleared under control of the PC interface. See Section 4.2.2 for details.

When navigating menus this key is used to scroll through the menu items in the active menu. When the last item in a menu is active, pressing this key again scrolls around to the first item in the menu.

2.2.4 Button 4 – Menu Key

This key is used to enter and exit the system configuration menu. When the key is pressed the screen is redrawn showing just the battery level indication and the top-level menus, as shown below. In the diagram the top-level menu is active. The bar graph to the right is the sub-menu for the *Backlight* menu item, and is currently inactive (it is greyed out).
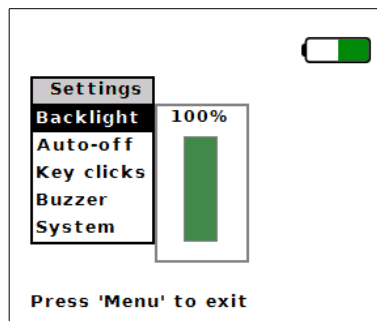

Figure 3: Top-level Menu

The four arrow keys on the keypad can then be used to navigate through the menus and configure the handset. Pressing the **Menu** key at any time when the menus are displayed will return to the main display screen.

The top-level menu has sub-menus to control or view the following:

- LCD backlight brightness
- Automatic switch-off of the instrument
- Settings for the handset key-clicks and buzzer
- System version information

The highlighted menu item in the active menu can be changed using the **Up-Arrow** and **Down-Arrow** keys. The **Right-Arrow** key is used to activate the sub-menu of the highlighted item in the active menu. The **Left-Arrow** key is used to deactivate the current menu and return to its parent menu.

2.2.5 Button 5 – Left Arrow Key

This key is used to scroll through the preset density settings. Each time the key is pressed the previous preset is selected. When the handset reaches the beginning of the list of presets it will then scroll around to the last preset in the list.

When navigating menus this key is used to deactivate the current menu and reactivate its parent menu.

2.2.6 Button 6 – Up Arrow Key

When navigating menus this key is used to scroll through the menu items in the active menu. When the first item in a menu is active, pressing this key again scrolls around to the last item in the menu.

2.2.7 Button 7 – Unused Key

This key is unused in this version of the handset GUI.

3 Operating The Handset

The following sections describe how to use the handset.

3.1 Switching the Handset On, and Auto Switch-Off

To switch on the handset, press the power key once. The unit will switch on and run its self-tests before showing the main display screen. The unit is switched off by pressing the power key again.

3.1.1 Auto Switch-Off

To configure the auto switch-off timer, press the **Menu** key to enter the system configuration menu. Then use the **Down-Arrow** key to navigate to the *Auto-off* menu item. This will bring up a sub-menu (deactivated initially) with several options for the auto-off time, as shown below.
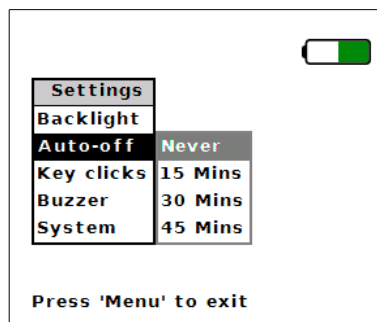

Figure 4: Auto-off Menu Item Selected.

The factory default setting of the is timer is *Never*, so that is the item highlighted in the sub-menu (albeit greyed out because the menu is inactive). To activate the sub-menu, press the **Right-Arrow** key once. The top-level menu will be deactivated and the sub-menu activated, as shown below.
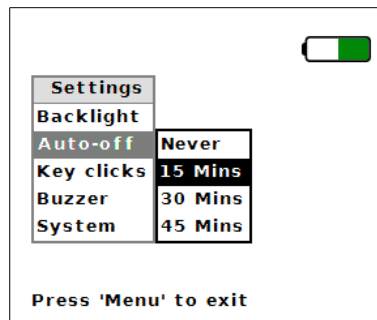

Figure 5: Auto-off Sub-Menu Activated.

Once the sub menu is activated, use the **Up-Arrow** and **Down-Arrow** keys to select the auto-off feature as desired. The options are:

1. Never switch the unit off automatically (the default)

2. Switch off after 15 minutes of inactivity

3. Switch off after 30 minutes of inactivity

4. Switch off after 45 minutes of inactivity

Inactivity is defined as the situation where no key has been pressed and the readout from the handset has not changed by more than 0.1% moisture reading. If a key is pressed, or if the moisture reading changes by more than this threshold, then the auto-off timer is reset.

After the desired auto-off setting has been selected, press the **Menu** key to return to the main display screen, or press the **Left-Arrow** key to re-activate the top-level menu in order to modify other features of the handset configuration.

3.2 Using Presets to Configure the Material Density

This section describes how to select a preset to quickly switch between different material density settings. The handset has three presets which can be selected by the user. The factory default contains settings for sandwich, foam and solid composite materials.

To select a preset, press the **Right-Arrow** or **Left-Arrow** key. The **Right-Arrow** key switches to the next preset in the list. The probe is immediately configured to use the density of the preset chosen. If the **Right-Arrow** key is pressed when the current preset is at the end of the list then it automatically rolls over to the first preset. Similarly, the **Left-Arrow** key can be used to switch to the previous preset in the list. If the current preset is the first in the list then it scrolls round to the last in the list.

The currently selected preset is shown on the bottom left of the display (display indication E in Figure 2).

3.3 Logging Data Points

The handset allows up to 64 data points to be logged in its memory for downloading to a computer over the USB interface. Each data point contains the following information:

- a time-stamp

- the preset in use when the data point was logged

- the probe's density setting

- the moisture level as reported on the handset.

The time-stamp is taken from the Handset's real-time clock. This clock is configured via the USB computer interface (see Section 4.2.3 for details on how to set the real-time clock). The moisture level stored in the logged data point is that shown on the display when the log was taken.

The number of log points available for use are shown on the bottom right of the display next to the 'L' symbol – display indication C in Figure 2. Initially this will read 64, since no data points are stored in the handset when it ships from the factory.

To store a data point, just press the **Down-Arrow** key once. This stores the current moisture measurement, and the number of available data points will decrement to show that a point has been taken.

The data log points cannot be cleared or viewed from the handset itself. This is only possible via the USB computer interface (see section 4.2.2 for details of how to read and clear the data log).

3.4   Setting the LCD Backlight Intensity

From the main display screen of the handset, press the **Menu** key once to enter into the system configuration menu. The *Backlight* menu item will be highlighted as it is the first item in the menu, and to the right its sub-menu (a bar graph) is displayed showing the LCD backlight intensity, on a percentage scale of 0 to 100%. This is shown below.
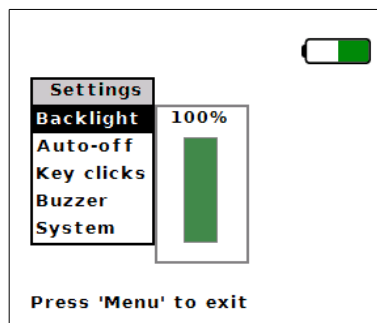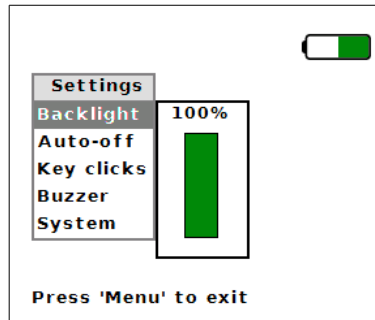
Figure 6: Top-Level Menu with LCD Backlight Item Highlighted.

This sub-menu is is not active when the main menu is first displayed. Activate the bar graph by pressing the **Right-Arrow** key on the handset. The *Backlight* menu item in the top-level menu will be greyed out, and the bar graph's display will be highlighted, as shown below.

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Figure 7: Backlight Sub-Menu Activated.

Once the bar graph is activated the **Up-Arrow** and **Down-Arrow** keys can be used to increase and decrease the backlight intensity respectively. To make large changes, hold the key down and after a brief delay the key action will auto-repeat to avoid having to press the key multiple times.

The changes made to the LCD brightness are actioned immediately,. So if the **Down-Arrow** key is held pressed the brightness will continually reduce until the key is released.

Once the desired brightness has been chosen, just press the **Menu** key again to dismiss the menus and return to the main display. Alternatively, press the **Left-Arrow** key to deactivate the brightness bar graph and reactivate the top level menu., Once the top-level menu has been reactivated, the **Up-Arrow** and **Down-Arrow** keys can be used to navigate to different items to modify other parts of the configuration.

3.5   Setting the Buzzer Controls

The Handset can be configured to output a tone with a pitch that increases with the moisture content being measured. This gives an audio indication of the moisture level in the material under test.

To configure the audio output, press the **Menu** key to enter the system configuration menu. Then use the **Down-Arrow** key to navigate to the *Buzzer* menu item. This will bring up a sub-menu (deactivated initially), as shown below.
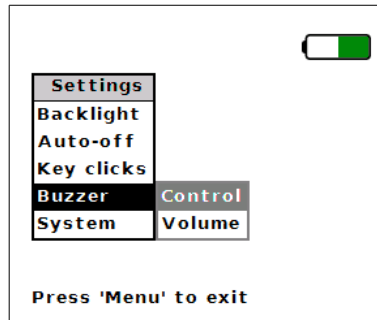
Figure 8: Buzzer Menu.

Then press the **Right-Arrow** key once to activate the sub-menu, after which the Handset will appear as shown below.
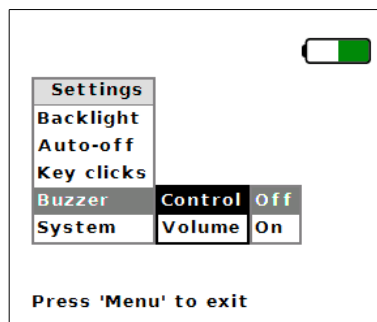

Figure 9: Buzzer menu, when activated.

To switch the buzzer on or off, press the **Right-Arrow** key once more to activate the Control sub-menu. The lowest level menu will then be activated, as shown below. Then use the **Up-Arrow** and **Down-Arrow** keys to enable or disable the buzzer.
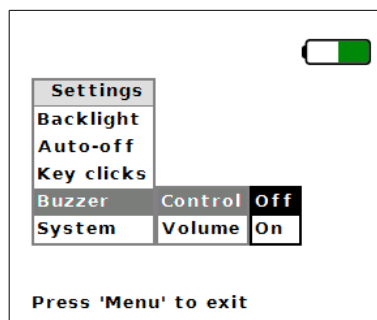

Figure 10: Buzzer Control sub-menu.

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The loudness of the buzzer can be set by entering the buzzer's *Volume* sub-menu. From the menu state shown in Figure 9, press the **Down-Arrow** key to select the *Volume* sub-menu and then press the **Right-Arrow** key to activate it. The screen will appear as shown below.
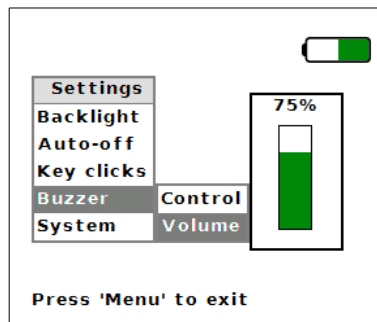

Figure 11: Buzzer's Volume control menu.

Once the bar graph is activated the **Up-Arrow** and **Down-Arrow** keys can be used to increase or decrease the buzzer's volume. These keys can be held down if required to modify the setting without having to press the key multiple times. This change to the buzzer's loudness is actioned immediately, there is no confirmation dialogue required before the change is made (but note that the buzzer is always disabled while using the menus).

3.6 Configuring Key Clicks

The Handset can be configured to generate an audible click each time a button is pressed. To configure this, press the **Menu** key to enter the system configuration menu. Then use the **Down-Arrow** key to navigate to the *Key clicks* menu item. This will bring up a sub-menu (deactivated initially), as shown below.
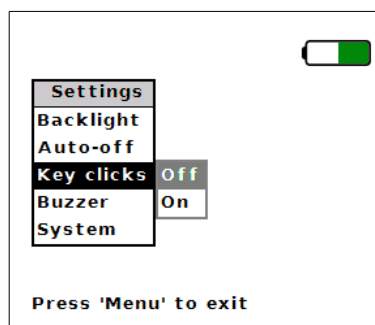

Figure 12: Key clicks Menu

Activate the sub-menu by pressing the **Right-Arrow** key on the handset. Then use the **Up-Arrow** and **Down-Arrow** keys to choose whether key clicks are enabled or disabled.

3.7 Viewing the System Version

The last item in the top-level menu reports the software version installed in the Handset. To view this information, press the **Menu** key once from the main display screen of the handset to enter into the system configuration menu. Then navigate to the *System* sub-menu. This menu item simply displays version numbers – it is not possible to modify anything.
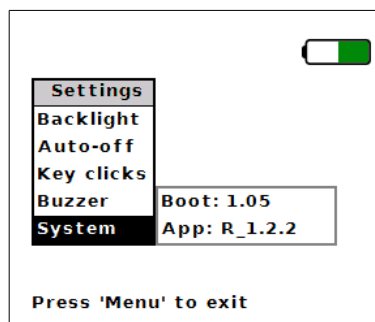

Figure 13: System Menu.

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4   Configuring the Handset From a Computer

The Handset can be connected to a computer via a USB interface, and this provides a data connection that is used to configure the handset and manage logged data.

4.1   Installing the Software

The software is installed by double-clicking on the file called M50HandsetConfig.msi. This installs the software onto the computer, and it can be run either via the Windows Start menu or by double-clicking on the shortcut placed onto the desktop.

4.1.1   Installing USB Device Drivers in MS Windows

When the handset is first plugged into a PC, the computer should find and install the USB drivers automatically if the computer is connected to the Internet. For reference, the required software is FTDI's "virtual COM port (VCP)" driver for their FT232BL devices. Drivers are available for free download from their website http://www.ftdichip.com.

Once the USB driver is installed the Handset will appear to be connected on a Windows COM port. The way to find out which COM port has been assigned to the probe is to go to the Control Panel menu, then Administrative Tools, and open "Computer Management". Click on "Device Manager" in the left-hand pane of the window that opens, then scroll down to "Ports (COM & LPT)" in the right-hand pane. One of the items in this list will say something like "USB Serial Port (COM3)". In this example the probe would be connected on COM3.

4.2 Running the Software

When the software starts it first asks for the serial port on which the Handset is connected (see Figure 14). Select the Handset's serial port from the drop-down selection and press OK. The software will download the Handset's preset configuration data and log and populate the main program window.
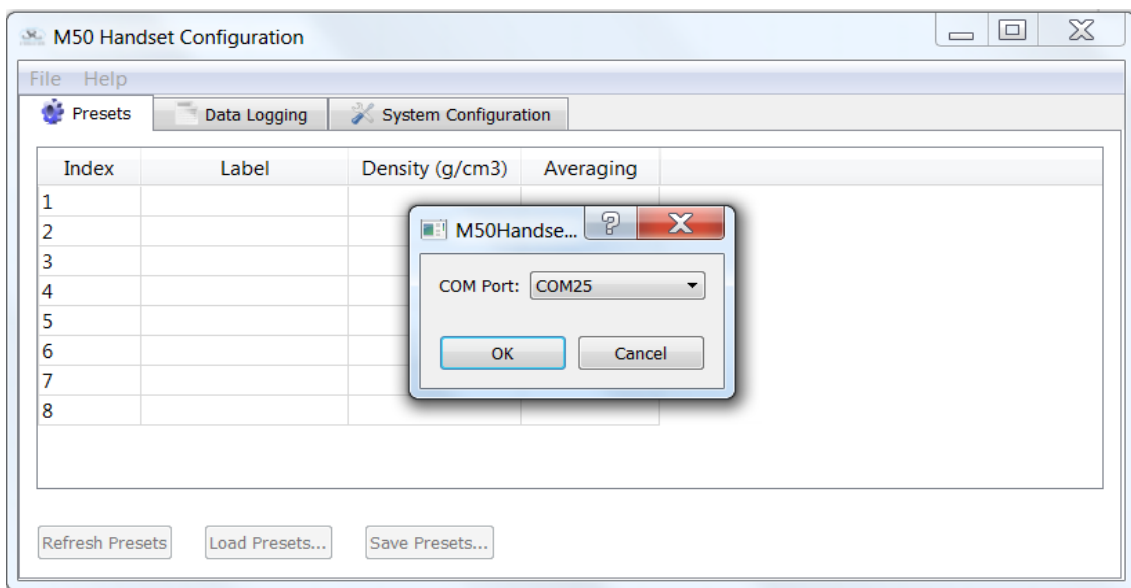

Figure 14: Startup Screen of the PC Software.

There are three tabs on the top of the program's main window, to control different aspects of the handset:

Presets	This tab shows the Handset's preset configuration data. The presets can be loaded, saved, and edited.
Data Logging	This tab shows data points logged in the handset. The log can be saved to disk and the handset's contents cleared.
System Configuration	This tab shows the Handset and Probe product codes, serial numbers and version numbers.

4.2.1 Configuring Presets

Select the Presets page by clicking on the top button on the left hand side of the main window. The figure below shows the screen with factory-default preset data.
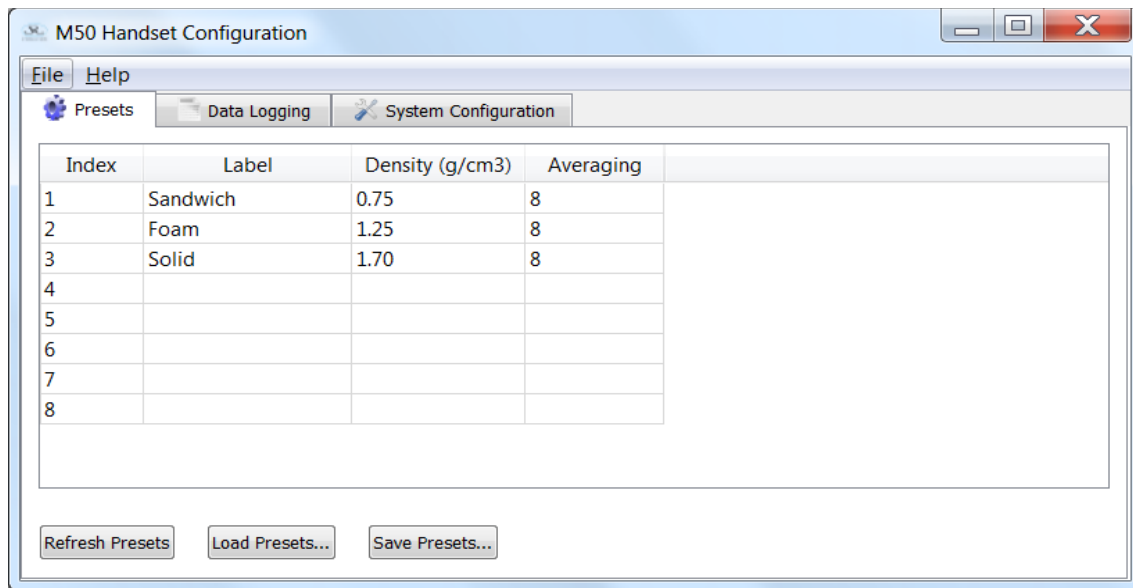

Figure 15: Preset Management Window.

The program loads the preset configuration data from the handset when it starts, but this data can be updated manually by pressing the **Refresh Presets** button on this page.

The preset configuration currently displayed in this window can be saved to disk by pressing the **Save Presets...** button. The data is saved in a file which has a `.PRS` suffix.

The **Load Presets...** button allows a previously saved `PRS` file to be reloaded into the Handset. When a `PRS` file is loaded, the new preset configuration is written to the handset, and then the handset's configuration is re-read back into the program. This ensures that the data displayed in the program always matches that stored in the handset.

4.2.1.1 Editing Presets

A single preset can be edited by double-clicking on a cell in the table. The data in the cell can then be edited, as shown below. When the Enter key is pressed or the mouse is clicked elsewhere on the screen the updated preset is written to the handset.
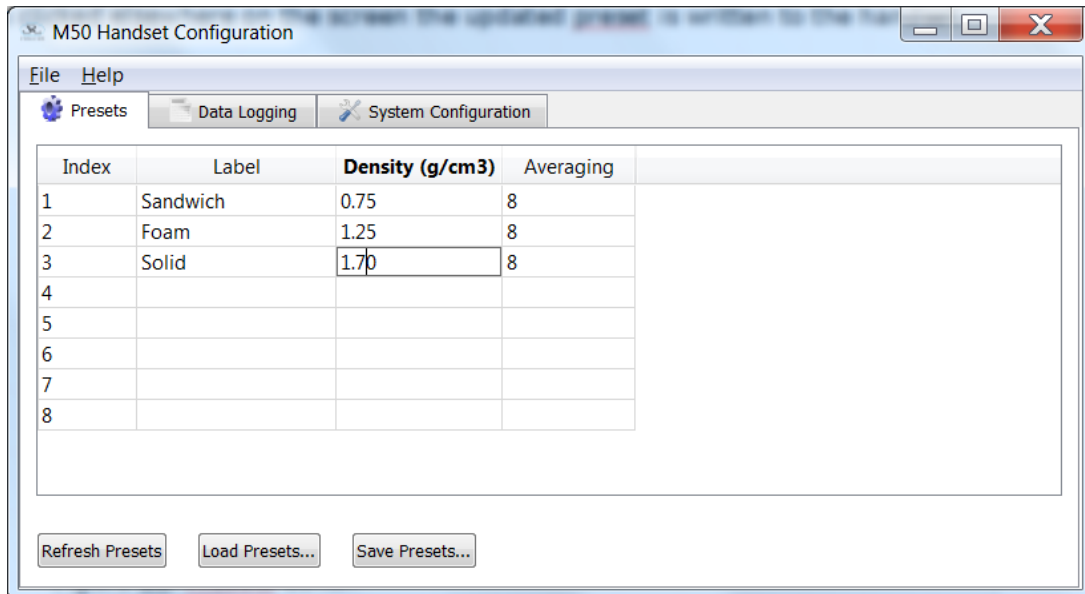

Figure 16: Presets Editor.

4.2.2 Managing Logged Data

View the data logged in the handset by selecting the Data Logging tab from the top of the program window. The table in the window will then show all the logged data. An empty log window is shown in Figure 17 below. Each log point contains the following information:

Index   A numerical index from 1 to 64

Time   The time at which the data point was logged, from the handset's real-time clock.

Preset   The number of the preset in use when the data was logged. A value of zero means that there was no preset in use.

Density   The density setting in use when the data point was logged.

Averaging   The averaging setting in use when the data point was logged.

Moisture   The moisture value as displayed on the handset's screen (i.e. the zero-offset is incorporated into this value)

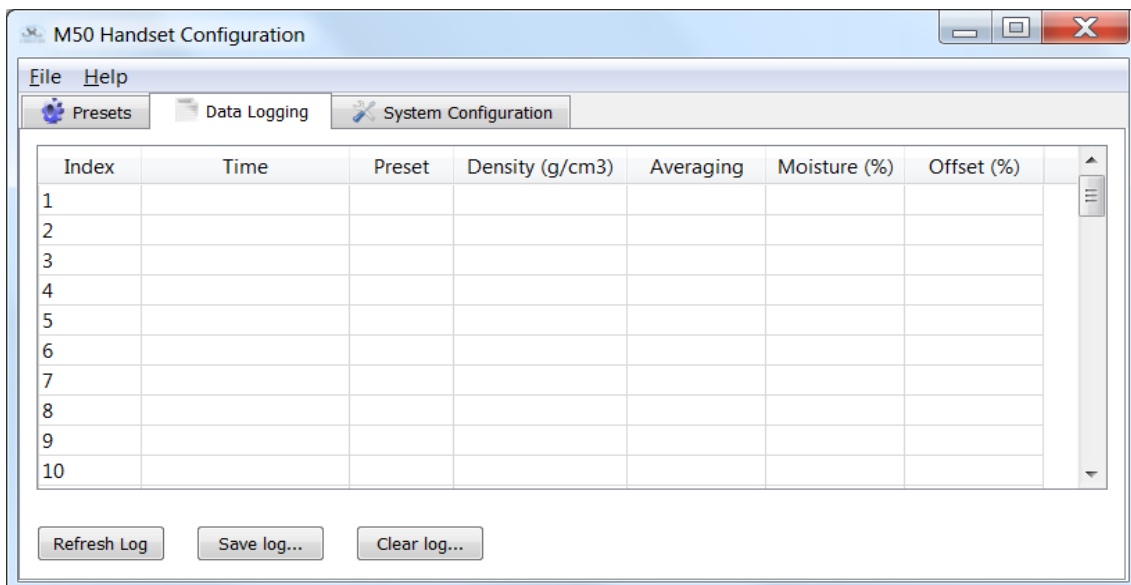Offset   The zero-offset in use when the data point was logged.

Figure 17: Data Logging Window, With Empty Log Table.

The log is downloaded to the PC when the software first connects to the handset, but it can be manually updated by pressing the **Refresh Log** button. The **Save Log...** button allows the log to be saved to disk as a CSV file. The **Clear Log...** button clears the log from the handset and also from the table displayed in the program.

4.2.3 System Configuration

The System Configuration tab is shown in Figure 18 below. At the top of the screen the handset and probe product codes, serial numbers, and firmware version numbers are displayed. Below this the program displays the setting of the real-time clock in the handset. This screen is also used to update the handset's firmware.
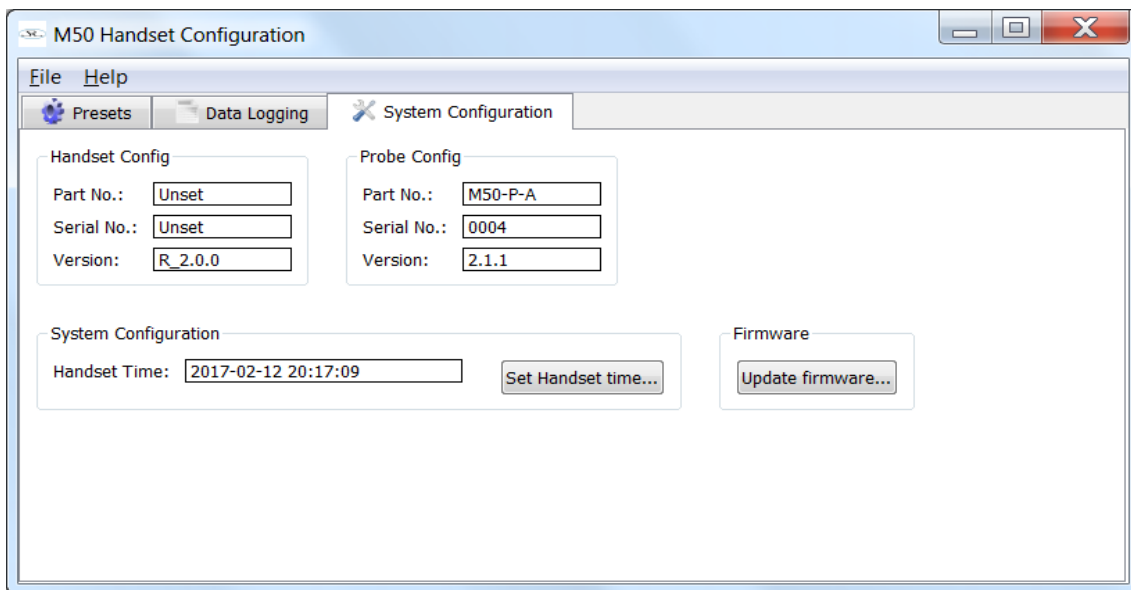

Figure 18: System Configuration Page.

To update the handset's real-time clock, click on the **Set Handset Time...** button. This opens a dialogue box for setting the time. The default setting in this dialogue is the PC's current time. So it is sufficient just to press the OK button to set the handset's time to match that of the PC.

The handset's real-time clock will maintain its setting when the instrument is switched off. The time will be lost when the handset's batteries run down or are removed.
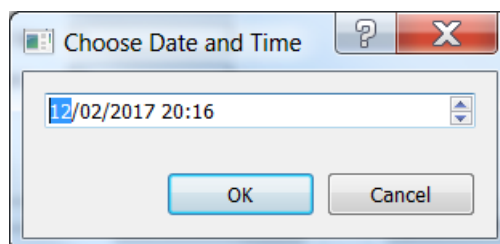

Figure 19: Handset Time Setting Dialogue Box.

5 Error Messages

The top left of the LCD display is reserved for error messages. When the display is working properly, this area will be blank. The following error messages may be displayed:

Error message	Description
⚠ Probe comms	The handset is unable to communicate with the probe (e.g. the probe has been disconnected)

6 Revisions

Date	Revision	Description
2013-12-17	1.1	First version of manual for Radome display.
2017-02-12	1.2	Update for new version of PC control software.

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