AquaCheck Probe (BIIW) & SOLO Instruction Manual

AUG 2010

STATEMENT OF COMPLIANCY

ELECTRO-MAGNETIC COMPLIANCE

The BASIC II wireless probe, SOLO RTU, Analogue and MobiCheck versions of the AquaCheck probe have been tested and found to comply with the limits for Class A digital devices, pursuant to the requirements of the CE rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause interference to other radio communications.

Operation of the devices described in this manual also complies with part 15 of FCC as well as IC compliancy rules and regulations and are therefore subject to the following two conditions:
(1) these devices may not cause interference, and
(2) these devices must accept any interference, including interference that may cause undesired operation of the device.

EMC APPROVALS

The BASIC, Analogue and MobiCheck versions of the AquaCheck probe have been tested and found to comply with the following EMC guidelines:

IMMUNITY TESTING: IEC 61000-6-1 and IEC 61000-6-2

- ✓ Electrical Fast Transients (EFT)   - *IEC 61000-4-4*
- ✓ Electrostatic Discharge (ESD)   - *IEC 61000-4-2*
- ✓ Surges   - *IEC 61000-4-5*
- ✓ Radiated Susceptibility   - *IEC 801 –3*
- ✓ Voltage Dips and Interruptions   - *IEC 61000-4-11*
- ✓ Conducted Susceptibility   - *IEC 61000-4-6*

EMISSIONS AND HARMONICS: CISPR 11/14/15/22 IEC 61000-3-3 and IEC 61000-3-2

- ✓ Radiated Emissions
- ✓ Conducted Emissions
- ✓ Flicker
- ✓ Harmonics

FCC & IC CONFORMITY ON THE WIRELESS LOGGER, BASIC II WIRELESS PROBE AND SOLO REMOTE TRANSMISSION APPLIES WITH THE FOLLOWING CONDITIONS.

(A) **FCC ID: YFFACLOGGER; YFF-ACSOLO; YFF-ACPROBE**

FCC 15.21: Changes or modifications not expressly approved by AquaCheck will void the user's authority to operate the equipment.

FCC 15.105: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

(B) **IC ID: 8996A-ACLOGGER; 8996A-ACSOLO; 8996A-ACPROBE**: Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device. (RSS-Gen 7.1.5)

"...then anyone who leaves behind him a written manual, and likewise anyone who receives it, in the belief that such writing will be clear and certain, must be exceedingly simple-minded..."

Plato *(423-347 BC).*

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LIST OF FIGURES

1 Introduction

Capacitance based soil moisture probes have been used for irrigation scheduling purposes for the past 15 years around the world.

Global market trends have however necessitated a revised point of departure for affordable and practical irrigation scheduling technology and instruments. AquaCheck (Pty) Ltd, has recognized the shift in global trends. The AquaCheck probe was therefore specifically developed to address these needs. Its design and construction is not only flexible enough to interface with the most advanced irrigation system, but also has the ability to function as a very basic tool for entry level irrigators.

Five versions of the AquaCheck II probe are available:
  o A BASIC II wireless continuous logging version using a wireless hand-held logger for data transfer to a PC;
  o An ANALOGUE version compatible to third party analogue loggers.
  o A SDI-12 version compatible to third party SDI-12 loggers.
  o A MODBUS version compatible to third party MODBUS loggers.
  o An AquaGREEN probe (SDI-12 or MODBUS) for greenhouse and turf applications.

Capacitance sensors measure the dielectric constant of the soil by applying a voltage between two electric plates (sensor rings). The frequency measured by the rings varies with the dielectric constant, and this is used to calculate the soil moisture content of the soil. The sensors are typically positioned at various depths on a column 32mm in diameter. The current AquaCheck probe range offers six standard length options varying from 200mm to 1200mm. The 400mm typically has 4 sensors and the 1200mm offers 6 sensor depths (*see page 10 – configuration*).

The column with attached sensors is positioned in the probe shaft and is sealed with a water resistant resin. After assembly, the sensors are individually calibrated or normalized to set the default air and water counts for each sensor. The probe also takes a soil temperature reading at each depth. Each sensor has a built-in temperature variation compensation factor. Readings from each sensor are therefore corrected for possible inherent electronic temperature variations.

The probe can be set to take readings at variable time intervals but typically a reading every 30 minutes (on all 6 sensors) would allow for up to 42 days on-board storage capacity.

This manual covers the BASIC II wireless version.

1 Basic II Wireless System Components

The BASIC II wireless system consists of the following components:

A. A continuous logging soil moisture probe
B. A continuous logging RTU device
C. Hand-held wireless logger unit
D. CropGraph software
E. Accessories:
   a. Charger & Download cable
   b. Manual & Installation CD
   c. RF Utility Module
   d. Installation Kit

The AquaCheck Basic II wireless probe is also offered in a sub-surface configuration for turf and pasture applications. For this application the probe head and shaft are separate units joined by a 0.5m cable. The shaft is equipped with a hardened top cap, which if viewed from the top, looks like a standard popup sprinkler head once installed. This version of the probe is however dependent on an external communication device for power supply, data storage and/or transmission. The SOLO device mentioned herein is typical of such an external device for the sub-surface or classic versions of the AquaCheck probe.

(For more detail on the subsurface version please visit our website at www.aquacheck.co.za and browse the products section)

Figure 1: Hand-held wireless logger
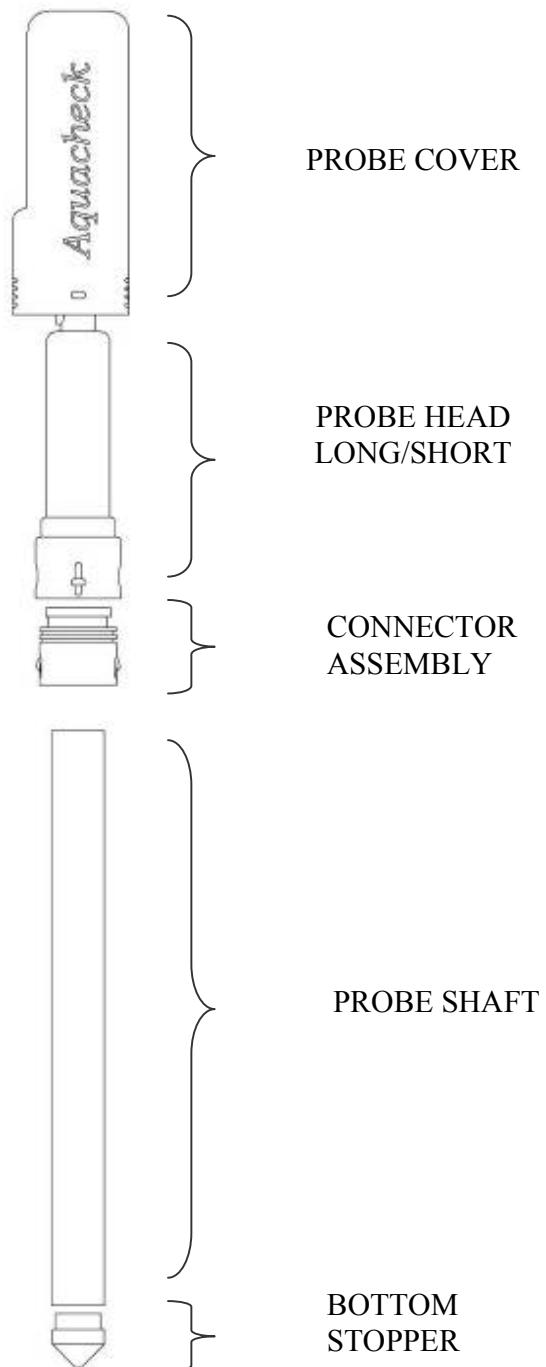
Figure 2: AquaCheck Probe

Figure 3: SOLO RTU

2 Probe construction

PROBE COVER

PROBE HEAD
LONG/SHORT

CONNECTOR
ASSEMBLY

PROBE SHAFT

BOTTOM
STOPPER

Figure 4: Probe Construction

3 General Statistics

Dimensions: 400, 600, 800, 1000, 1200mm lengths with a shaft diameter of 32mm

Weight: ±1 Kg (800mm & 6 sensors)

Protection: IP68+

Power supply: Internal 3.6V Lithium Battery (Approx 3 Years) or External 4V to 8V at 12mA active and 0.8mA standby.

Output: Digital interface (0-3V) MODBUS compatible
Analog interface (0-2,5V) (12 Bit)
6 x S-Moist. Sensors and 6 x S-Temp. sensors.

Memory: 42 days continuous, logging every half hour.

Temp. Range: 0 to 50 ^{0}C working, and -15 to 80 ^{0}C capable.

4 Sensor Configuration

The AquaCheck continuous logging probe is available in 6 standard depths or lengths:

- o   200mm length with 2 sensors at 100 and 200mm;
- o   400mm length with 4 sensors at 100, 200, 300 & 400mm;
- o   600mm length with 5 sensors at 100, 200, 300, 400 & 600mm;
- o   800mm length with 6 sensors at 100, 200, 300, 400, 600 & 800mm;
- o   1000mm length with 6 sensors at 100, 200, 400, 600, 800 & 1000mm
- o   1200mm length with 6 sensors at 200, 400, 600, 800, 1000 & 1200mm;
- o   400mm or 600mm version for pastures/turf;
- o   Soil temperature on each depth.

5 Probe Settings

Various settings on the AquaCheck BIIW probe can be changed such as ID number, date/time, logging interval, etc. A special utility tool is available from your distributor which will enable you to change these settings. For more information about the RF

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Utility Toolkit, please contact your local distributor or contact AquaCheck at
www.aquacheck.co.za
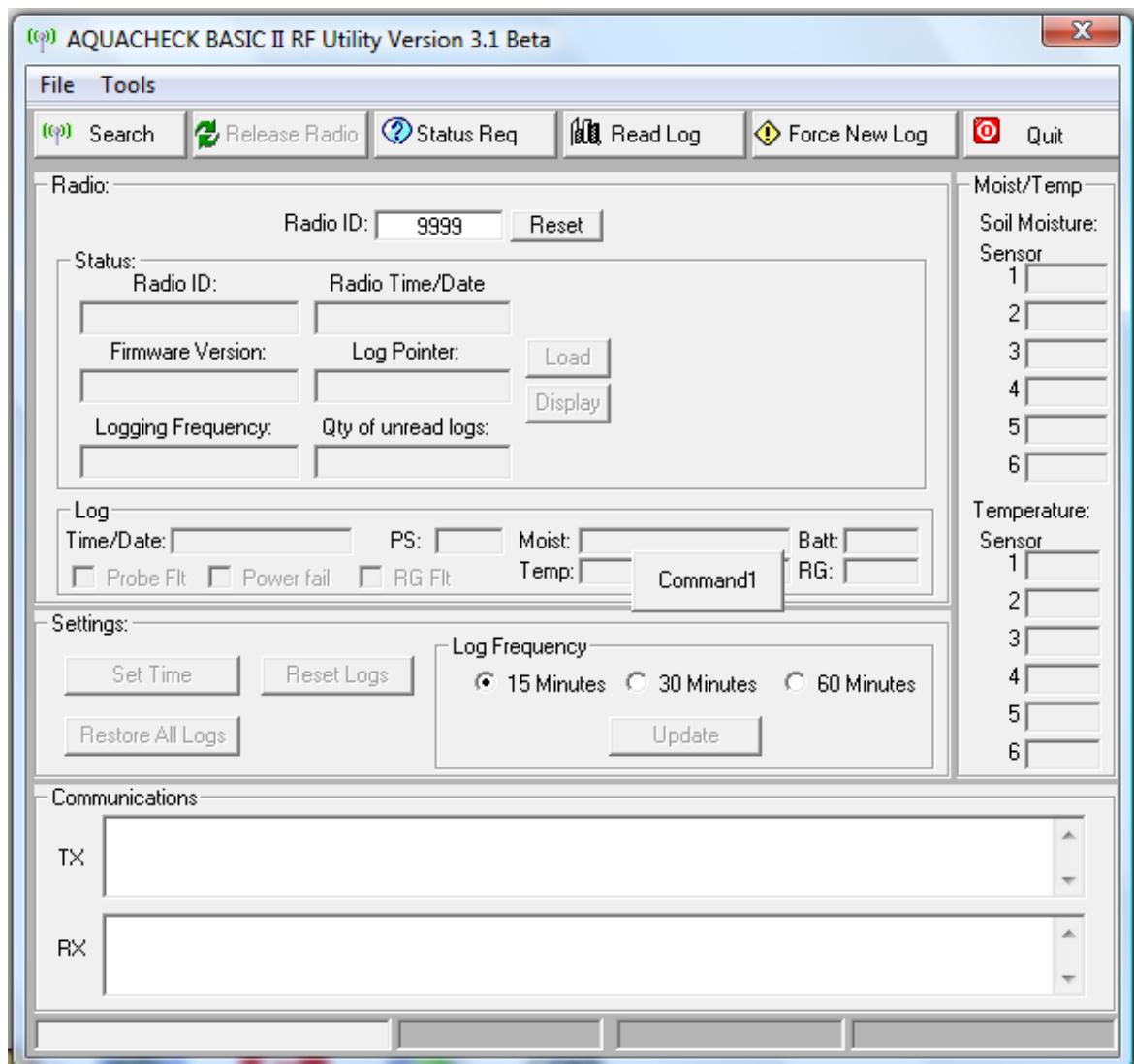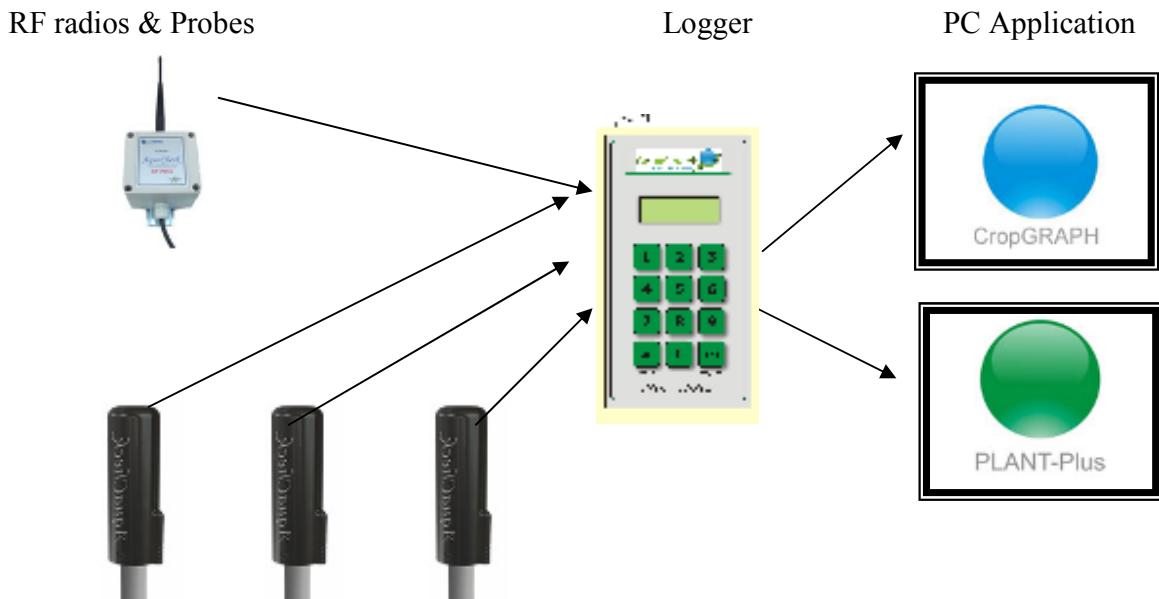
Figure 5: RF Utility Software

6 Hand-held wireless logger

6.1 Introduction

The AquaCheck Basic II data logger is a component of the AquaCheck soil moisture management system. A typical soil moisture system consists of soil moisture probes and a Data logger. The probe data (soil moisture and temperature) are relayed to

RF Hand logger via a propriety RF telemetry system. The logged data is then downloaded to a PC which processes the data for trending display via a PC application (CropGraph/Plant-Plus).

RF radios & Probes   Logger   PC Application

The hand-held wireless logger can log up to 120 probes. The logger offers a menu option which allows the user to view, edit and manage certain functions. The menu options are:

- o **Date & Time** (default)
- o **Profile Log** – normal function to collect data from the probe
- o **Single log** – log all data from a specific probe
- o **Download interval –** only applicable for the base station loggers
- o **Clear all logs** – clear data from the logger
- o **View Stats** – view how many logs are on the logger
- o **Set time & date** – change current date & time
- o **Continuous logging** –. only applicable for the base station loggers
- o **Profile setup** – populate the 120 possible profiles with probe ID's.
- o **PRO II Firmware update** – the hand logger can be used to remotely upgrade firmware on the PRO II RTU's
- o **Exit**

New firmware offering additional features on the loggers are released from time to time or as needed. There is a software utility available to upgrade your logger. Please visit the AquaCheck website to verify the latest logger firmware version for your logger at www.aquacheck.co.za and browse to the downloads section to search for the applicable files.
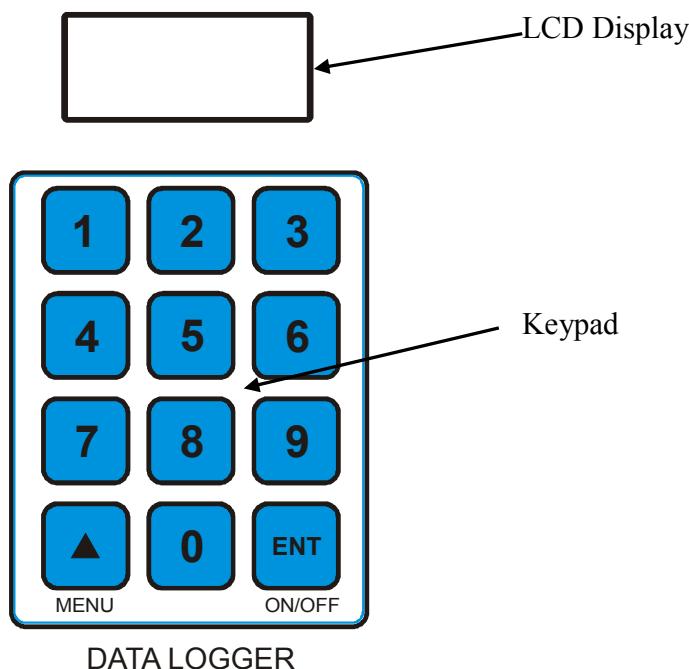
AquaCheck Basic II data logger.

The AquaCheck Basic II data logger as shown above is fitted with the following:
a.   Omni-directional internal antenna
b.   2 x 16 character Back light LCD Dot matrix display
c.   5 pin socket for charger and downloading data to a P.C.
d.   Numeric keypad
e.   Rechargeable internal battery
f.   Internal Radio to communicate with PRO II's and Basic II soil moisture probes.
g.   Databank with a capacity for 15000 logs.
h.   A mains charger, Car charger and download cable is supplied with the logger.
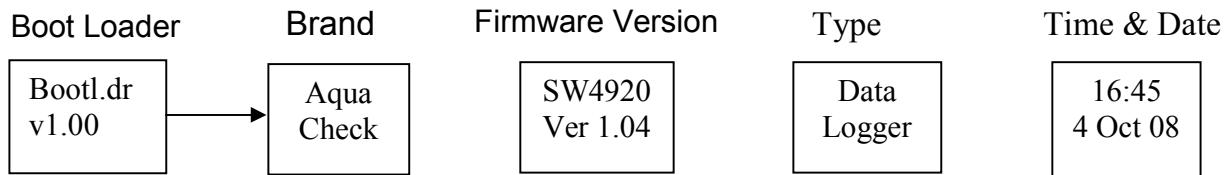
6.2 Menu Functions

The AquaCheck Basic II data logger functions are accessed via the 12-pushbutton keypad and the information is displayed on the LCD display. See below:

DATA LOGGER
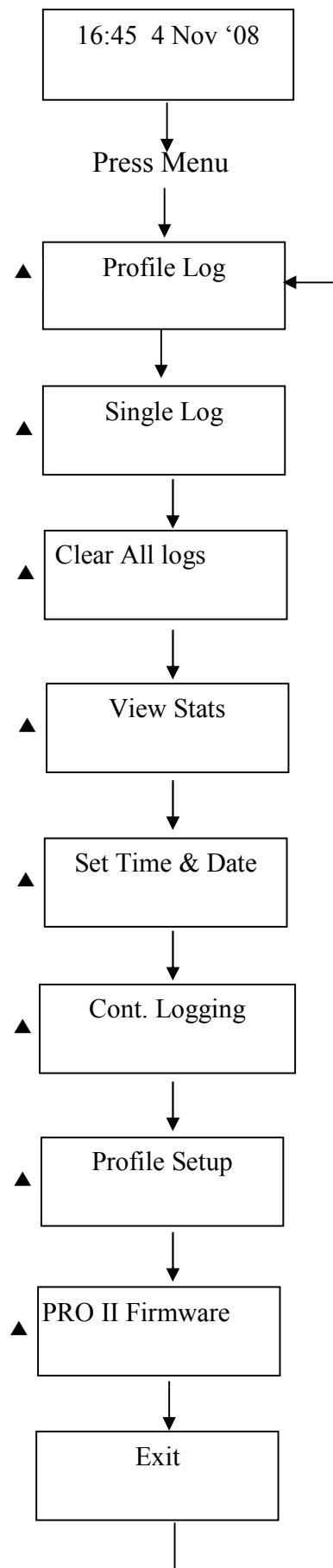
The Scroll(▲)/menu and ENT/ON/OFF pushbuttons have dual functions. The ENT pushbutton turns the logger ON and OFF, whilst during Setup, it functions as an ENTER key. Once the logger is first turned ON, only the function written below the key is operational. All the other keys are inactive.

AquaCheck

Once the logger is turned on(press the ON/OFF key) then the display turns on, displaying the following information in quick succession:

Boot Loader	Brand	Firmware Version	Type	Time & Date
Bootl.dr v1.00	Aqua Check	SW4920 Ver 1.04	Data Logger	16:45 4 Oct 08
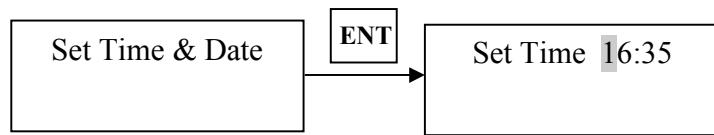
Once the time and date is displayed, press the Menu key to gain access to the logger functions. The functions can be scrolled and the menu is circular as displayed below:

```
┌─────────────────────┐
│  16:45  4 Nov '08   │
└─────────────────────┘
          │
      Press Menu
          │
          ▼
▲  ┌─────────────────┐  ◄──┐
   │   Profile Log   │     │
   └─────────────────┘     │
          │                │
          ▼                │
▲  ┌─────────────────┐     │
   │   Single Log    │     │
   └─────────────────┘     │
          │                │
          ▼                │
▲  ┌─────────────────┐     │
   │  Clear All logs │     │
   └─────────────────┘     │
          │                │
          ▼                │
▲  ┌─────────────────┐     │
   │   View Stats    │     │
   └─────────────────┘     │
          │                │
          ▼                │
▲  ┌─────────────────┐     │
   │ Set Time & Date │     │
   └─────────────────┘     │
          │                │
          ▼                │
▲  ┌─────────────────┐     │
   │  Cont. Logging  │     │
   └─────────────────┘     │
          │                │
          ▼                │
▲  ┌─────────────────┐     │
   │  Profile Setup  │     │
   └─────────────────┘     │
          │                │
          ▼                │
▲  ┌─────────────────┐     │
   │ PRO II Firmware │     │
   └─────────────────┘     │
          │                │
          ▼                │
   ┌─────────────────┐     │
   │      Exit       │─────┘
   └─────────────────┘
```

Each item on the screen flashes. Pressing the ▲/Scroll key at this time selects the next menu item.
Press ENT to execute the menu function.
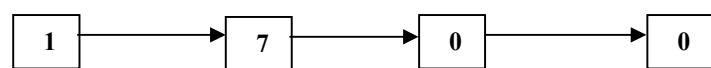
Example: To set the time and date, follow the steps below:

a. Turn on the Logger. and wait for the time and date to be displayed
b. Press the MENU/▲ key.
c. Then press the MENU/▲ key until the 'Set Time & Date' screen is displayed:

```
┌──────────────────┐   ┌─────┐   ┌──────────────────┐
│ Set Time & Date  │   │ ENT │──▶│ Set Time  16:35  │
└──────────────────┘   └─────┘   └──────────────────┘
```
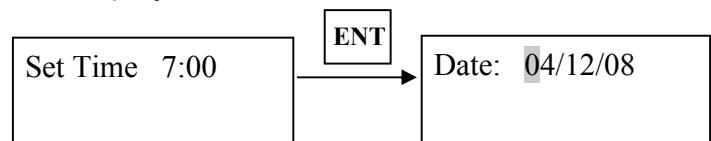
The shaded area indicates flashing.

To change the time to 17:00, now press

```
┌───┐      ┌───┐      ┌───┐      ┌───┐
│ 1 │─────▶│ 7 │─────▶│ 0 │─────▶│ 0 │
└───┘      └───┘      └───┘      └───┘
```

The display will now show:

```
┌──────────────────┐   ┌─────┐   ┌──────────────────┐
│ Set Time   7:00  │──▶│ ENT │   │ Date:  04/12/08  │
└──────────────────┘   └─────┘   └──────────────────┘
```

Using the numeric keypad, edit the date in the same manner as shown in the time setting example. Once completed, press the ENT key. The display will now show:

```
┌──────────────────┐
│ Set Time & Date  │
└──────────────────┘
```

Press the MENU/▲ key until Exit is displayed, then press Enter. Pressing Enter again will turn off the logger.

AquaCheck
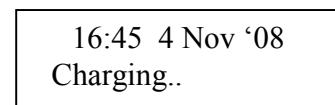
6.3 THE STEPS OF COMMISSIONING

1. Charge the logger's battery.
2. Once the probes and PRO II's are installed, record the unique ID of each one.
3. Program each ID's into a profile on the logger.
4. Set the current Time and Date on the Logger
5. Perform a profile log on all of the probes/PRO II's. This will synchronies the time and date with each device and download the unread data.

7   COMMISSIONING STEPS IN DETAIL

7.1 Charge the logger's battery.

Plug the charger into a 220V mains outlet and plug the charger's cable into the 5 way connector. After a few seconds, the display will read:

```
16:45  4 Nov '08
Charging..
```

An on-board timer is activated to time the charge cycle. Once charging is completed, the display will read: 'Charge Complete'
Unplug the charger from the logger and then from the mains. After a few seconds, the logger will turn itself off.

AquaCheck
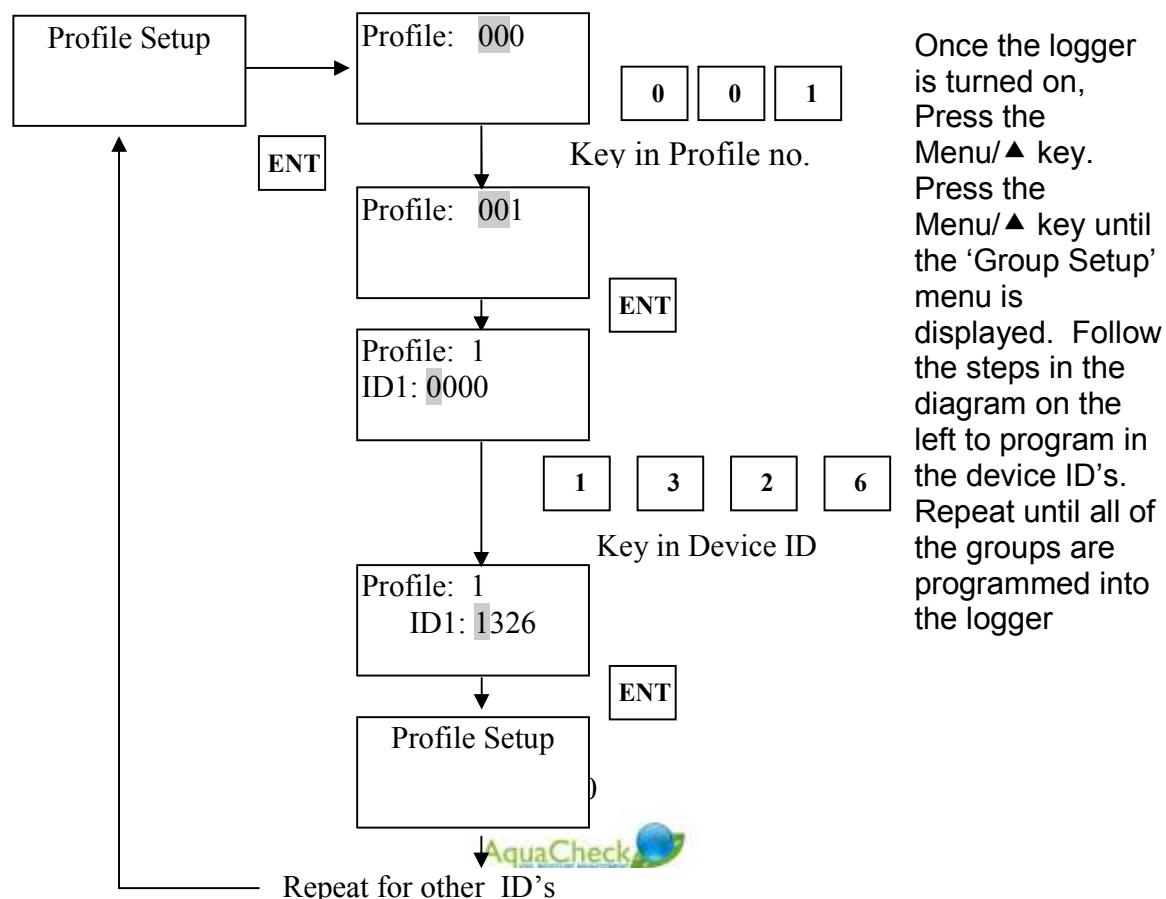
7.2 Record the unique ID of each Basic II probe PRO II.

1. Although the ID's/serial numbers are all 5 digits long, the 1st digit is always set to '5'.
2. When programming the Logger, always programme the ID's of the RF STUBS/PRO's omitting the first digit(5). For Example: With the serial Number or ID being SN:51204, when programming the ID into the Logger, program the ID as 1204 omitting the '5'.
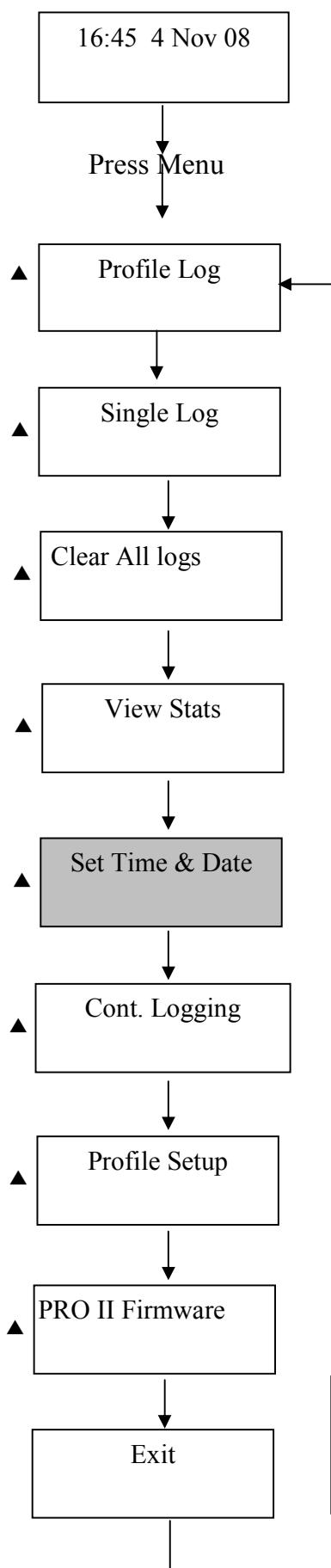
7.3 Program the ID's into the Logger

1. All of the recorded ID's of the BASIC II probes and PRO II's installed and recorded in the previous section, should be programmed into a profile, that upon downloading, the logger will automatically download all the latest data from the ID in the profile. This is called a Profile Log.
2. The Logger has a capacity for up 120 profiles.

Should one need to download all of the stored logs stored on a the BASIC II probes or PRO II, then download all the data by means of a single log. The Logger has a battery backed real time clock. During each download, the time is automatically synchronised with the BASIC II probes and PRO II's.

Profile Setup → Profile: 000

| 0 | 0 | 1 |

Key in Profile no.

ENT

Profile: 001

ENT

Profile: 1
ID1: 0000

| 1 | 3 | 2 | 6 |

Key in Device ID

Profile: 1
   ID1: 1326

ENT

Profile Setup

Repeat for other ID's

Once the logger is turned on, Press the Menu/▲ key. Press the Menu/▲ key until the 'Group Setup' menu is displayed. Follow the steps in the diagram on the left to program in the device ID's. Repeat until all of the groups are programmed into the logger

7.4 Program the current Time and Date into the Logger

16:45 4 Nov 08

Press Menu

▲ Profile Log

▲ Single Log

▲ Clear All logs

▲ View Stats

▲ Set Time & Date

▲ Cont. Logging

▲ Profile Setup

▲ PRO II Firmware

Exit
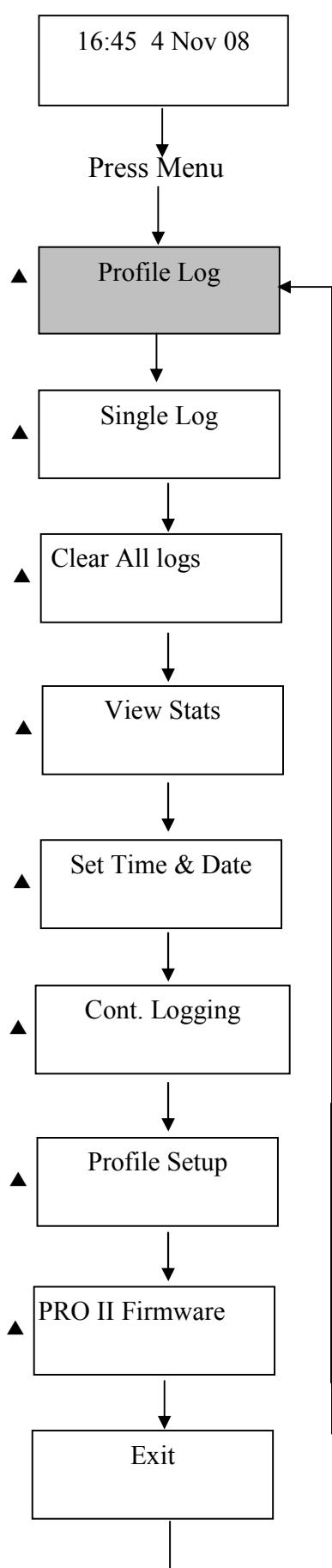
Turn on the Logger and then press the Menu/▲ key.
Press the Menu/▲ key until the 'Set Time & Date' menu
is displayed
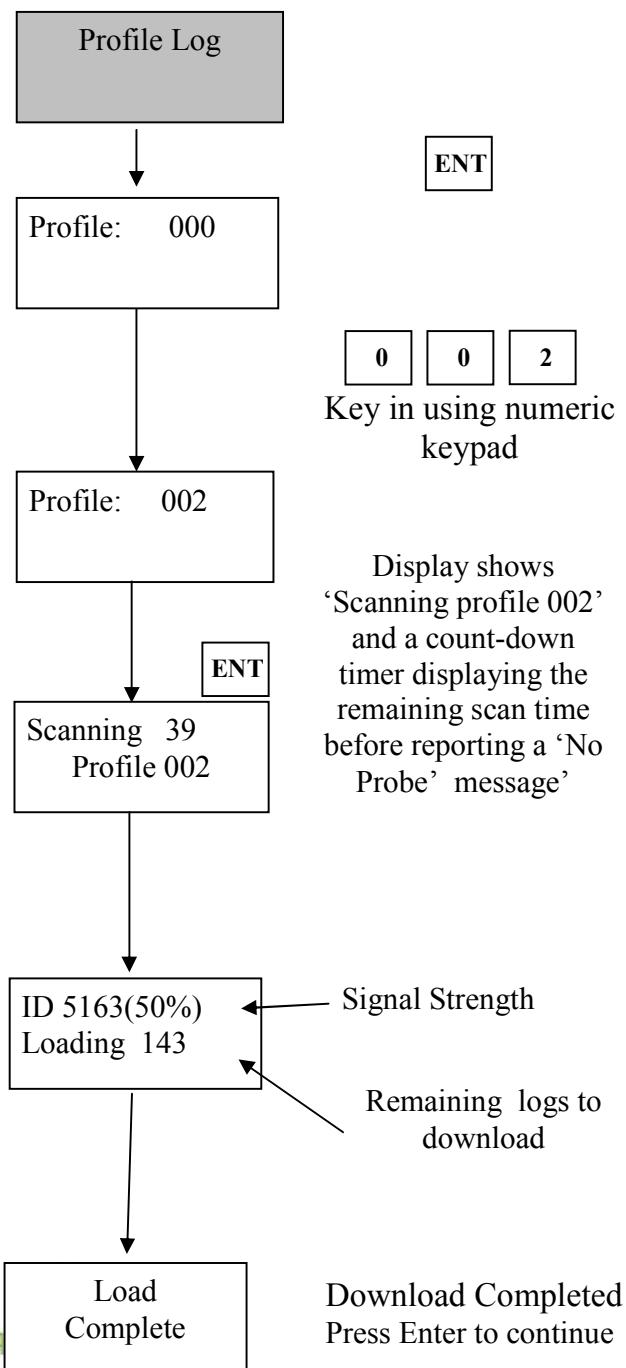
Example: To change the time from 16:35 to 17:00

ENT

Set Time & Date

Set Time: 16:35

1 7 0 0

Set Time: 7:00

Key in using
numeric keypad

ENT

Date: 01/01/07

To change Date
from 01/01/08
to
03/12/08

0 3 1 2 0 8

ENT

Date: 03/12/08

Key in using
numeric keypad

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7.5 Perform a Profile Log on all Programmed Profiles
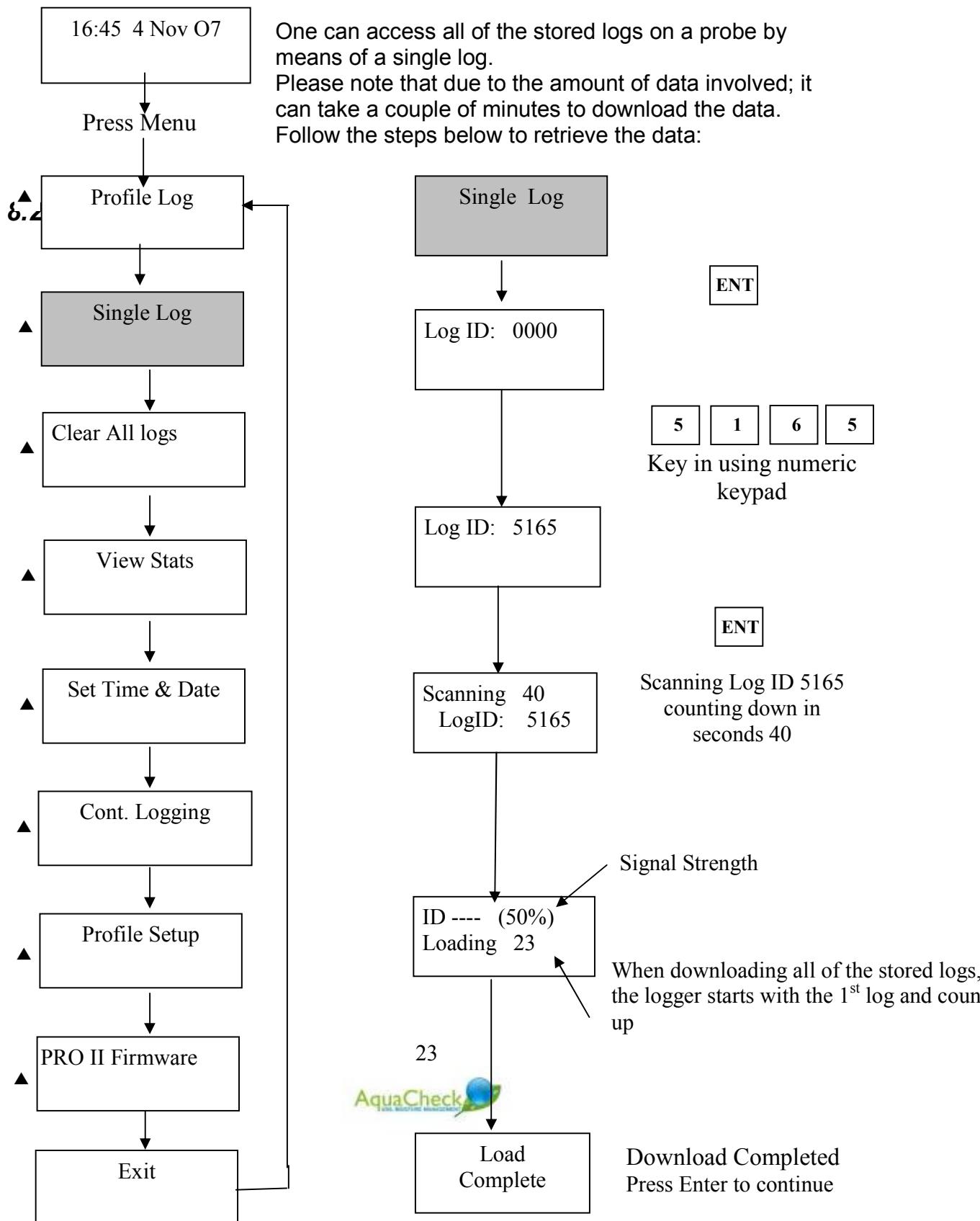
Profile logging allows one to collect the data from BASIC II probes and PRO II's in close proximity of the point of logging and only the unread data is retrieved. To do a Profile log, follow the instructions below:

```
16:45  4 Nov 08
```

Press Menu

```
Profile Log
```

```
Single Log
```

```
Clear All logs
```

```
View Stats
```

```
Set Time & Date
```

```
Cont. Logging
```

```
Profile Setup
```

```
PRO II Firmware
```

```
Exit
```

```
Profile Log
```

```
Profile:    000
```

ENT

```
0   0   2
```
Key in using numeric keypad

```
Profile:    002
```

Display shows 'Scanning profile 002' and a count-down timer displaying the remaining scan time before reporting a 'No Probe' message'

ENT

```
Scanning   39
Profile 002
```

```
ID 5163(50%)
Loading  143
```
Signal Strength

Remaining logs to download

```
Load
Complete
```
Download Completed Press Enter to continue

8   ADDITIONAL FEATURES

8.1 Single Log

One can access all of the stored logs on a probe by means of a single log.
Please note that due to the amount of data involved; it can take a couple of minutes to download the data.
Follow the steps below to retrieve the data:

16:45 4 Nov O7

Press Menu

8.2 Profile Log

Single Log

Clear All logs

View Stats

Set Time & Date

Cont. Logging

Profile Setup

PRO II Firmware

Exit

Single Log

ENT

Log ID: 0000

| 5 | 1 | 6 | 5 |

Key in using numeric keypad

Log ID: 5165

ENT

Scanning   40
  LogID: 5165

Scanning Log ID 5165 counting down in seconds 40

Signal Strength

ID ----   (50%)
Loading   23

When downloading all of the stored logs, the logger starts with the 1st log and coun up

23

Load
Complete

Download Completed
Press Enter to continue

9.2 Clear All Logs

Once all of the data is downloaded to a PC, the databank of the logger should be cleared. To clear the databank follow the instructions below:

```
┌─────────────────────┐
│  16:45  4 Nov O7    │
└─────────────────────┘
           │
           ▼
        Press Menu
```
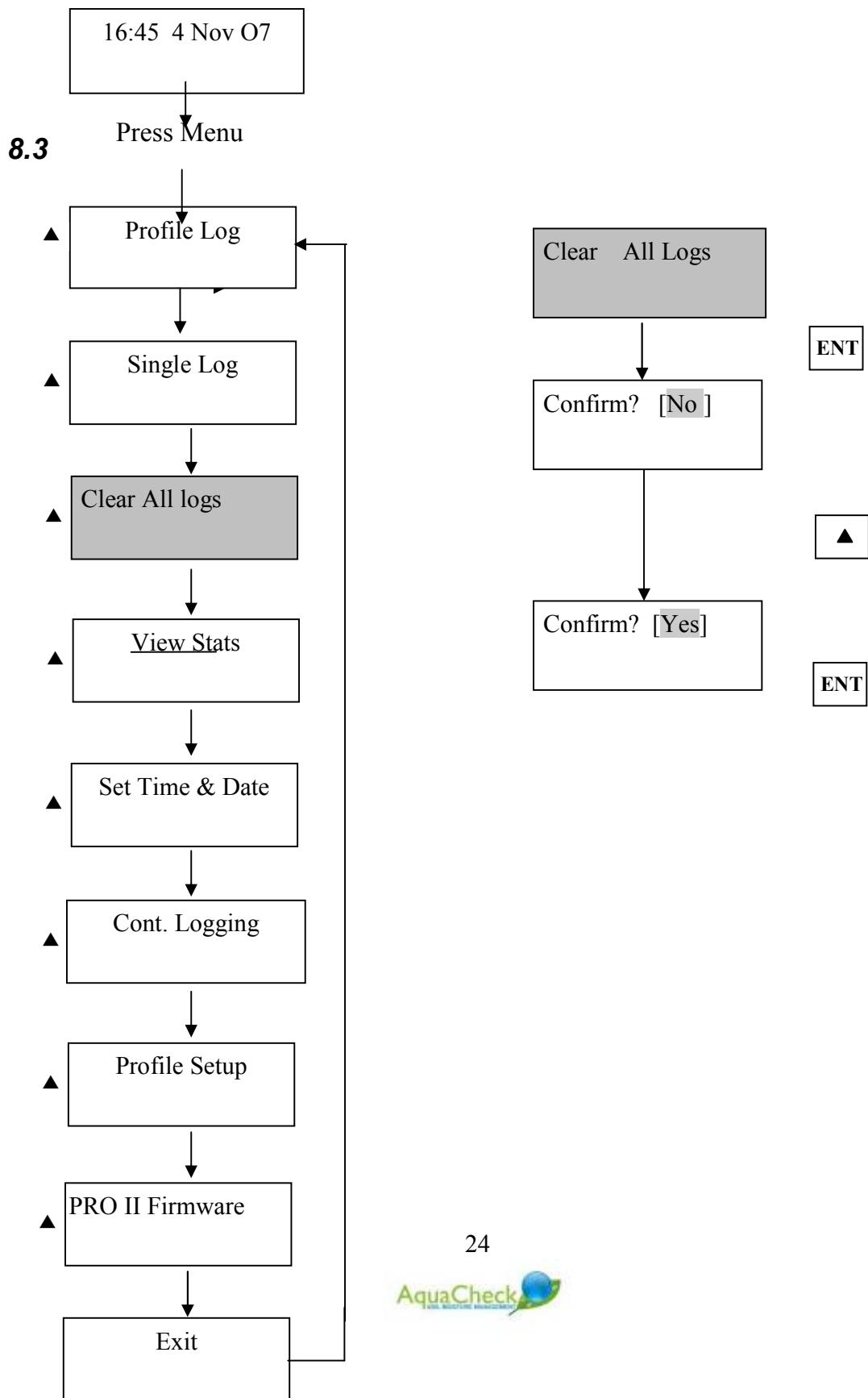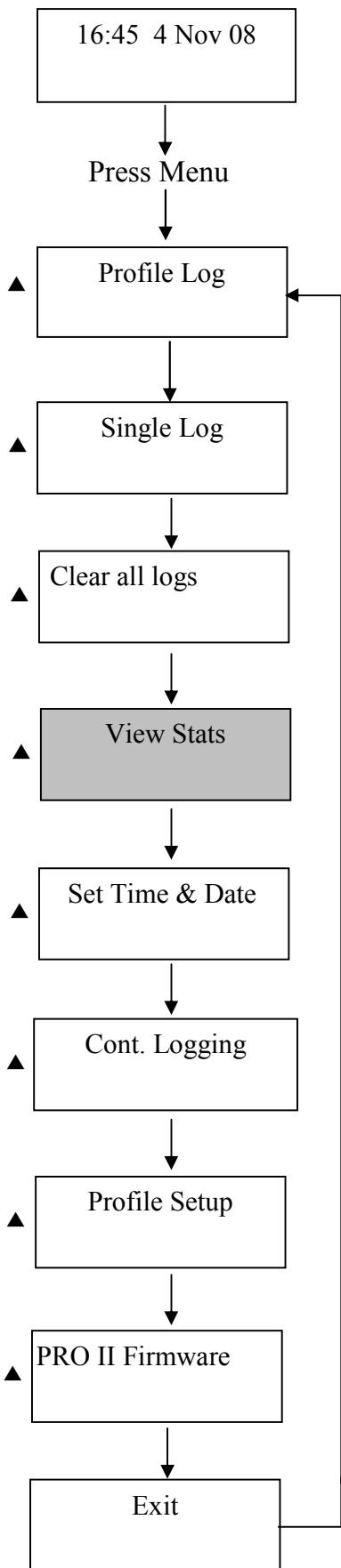
8.3

```
   ┌──────────────────┐                    ┌──────────────────────┐
▲  │   Profile Log    │◄──┐                │  Clear    All Logs   │
   └──────────────────┘   │                └──────────────────────┘
           │              │                          │            ENT
           ▼              │                          ▼
   ┌──────────────────┐   │                ┌──────────────────────┐
▲  │   Single Log     │   │                │  Confirm?   [No ]    │
   └──────────────────┘   │                └──────────────────────┘
           │              │                          │
           ▼              │                          │            ▲
   ┌──────────────────┐   │                          │
▲  │  Clear All logs  │   │                          ▼
   └──────────────────┘   │                ┌──────────────────────┐
           │              │                │  Confirm?  [Yes]     │
           ▼              │                └──────────────────────┘
   ┌──────────────────┐   │                                       ENT
▲  │   View Stats     │   │
   └──────────────────┘   │
           │              │
           ▼              │
   ┌──────────────────┐   │
▲  │  Set Time & Date │   │
   └──────────────────┘   │
           │              │
           ▼              │
   ┌──────────────────┐   │
▲  │  Cont. Logging   │   │
   └──────────────────┘   │
           │              │
           ▼              │
   ┌──────────────────┐   │
▲  │  Profile Setup   │   │
   └──────────────────┘   │
           │              │
           ▼              │
   ┌──────────────────┐   │
▲  │ PRO II Firmware  │   │
   └──────────────────┘   │
           │              │
           ▼              │
   ┌──────────────────┐   │
   │      Exit        │───┘
   └──────────────────┘
```

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9.3   View Stats

In order to keep track of the logging of data, one can view the quantity of stored logs in the logger's memory. This is a useful feature if one wants to know specifically how many logs were downloaded from a profile or ID. View the quantity of logs as follows:

16:45 4 Nov 08

Press Menu

▲ Profile Log

▲ Single Log

▲ Clear all logs

▲ View Stats

▲ Set Time & Date

▲ Cont. Logging

▲ Profile Setup

▲ PRO II Firmware

Exit

View   Stats

ENT

Total: 1095

ENT

25

AquaCheck

9 Trouble shooting

Symptom	Possible Cause	Solution
Display Dim	Battery depleted	Charge battery
After a group log, the logger displays 'No Probes'	1. Logger out of range 2. Probe ID incorrect	1. Move closer to the device. Keep the logger upright with the antenna pointing upwards to the sky when doing a log. 2. Verify the device ID
During a Profile log, Logger finds probe and starts download, afterwards, displaying 'No Reply'	1. Logger out of range or reception is poor. 2. Battery on device is marginal or flat	1. Move closer to the device. Keep the logger upright with the antenna pointing upwards to the sky when doing a log. 2. Check battery voltage on device. Voltage should be more that 3.3 volts
Logger Displays 'Profile Empty' when trying a profile log	Device ID is not programmed into group	Record device ID and program the ID into the profile.

10 Taking a reading

✋ Please note: All probes are shipped with the battery pack disconnected. To activate the probe, the probe head needs to be removed by turning it through 45^0 first and then by pulling it upwards. Make sure the battery board is properly seated and then connect the battery pack. The date/time needs to be set before a reading can be taken. In the absence of the RF Utility Toolkit, the date/time can also be set with logger using the profile log option. In this case the logger memory has to cleared immediately after the download to prevent obsolete data to be imported into the database. Browse the logger menu to the CLEAR ALL LOGS menu option and press the enter button.

To take a normal reading from a probe, the probe first needs to be added to the profile list of logger.

10.1 Adding a probe as a profile

How to:
- ✓ Go to **Profile Setup** by scrolling down the menu by pressing the menu button option on the keypad of the logger several times until you reach **Profile Setup**,
- ✓ Press Enter
- ✓ Insert profile #, i.e. 001 by using the numbers on the keypad;
- ✓ Press Enter
- ✓ Add probe ID to this profile, i.e. 5177 by using the numbers on the keypad.
- ✓ Press Enter. Profile 001 has now been populated with probe ID 5177.
- ✓ Exit

10.2 Download readings

10.2.1 Profile Log

To download the most recent readings (from the previous download) of a specific probe:

How to:
- ✓ Switch the logger on by pressing and holding the Enter button for a ½ second.
- ✓ Press menu and scroll to Profile Log

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✓ Select 001, press enter – the logger will automatically start scanning for all the probe listed in profile 001. (The probe wakes up every 15 seconds to "listen" if any logger or device is polling it.)
✓ On the logger screen (LCD) the signal strength is displayed as well as the remaining seconds. Once the logger makes a connection to the probe, the signal strength and remaining number of logs are displayed and the logger starts downloading the logs.
✓ Upon completion the logger LCD will display "Download Completed".

10.2.2 Single Log

To download all the readings from a specific probe:

How to:
✓ Browse to Single Log option by scrolling through the menu button.
✓ Select probe ID by entering the applicable probe ID i.e. 5177
✓ Press enter.
✓ Logger will start scanning for this probe.
✓ Once the logger has made a successful connection, it will start retrieving all the available data on that specific probe.
✓ All the available data from this probe will be downloaded.

11 Add-on's

The AquaCheck probe offers plug & play options for a rain gauge and or a dendrometer (PlantSense^{TM}). To add a rain gauge, the default battery pack and probe head needs to be replaced with the appropriate components. Please contact your local AquaCheck distributor or visit our website at www.aquacheck.co.za for more detail.

12 Maintenance

Very little maintenance is required when using the AquaCheck probe. The only replaceable part is the battery pack. The battery pack should last for up to 18 months under normal conditions. To replace the battery, remove the probe head and disconnect the old battery pack from the battery board. Make sure the battery board is properly seated in the 14-pin connector before connecting the new battery.

☞ Remember to set the time and date again after replacing the battery.

13 INSTALLATION OF THE PROBE

Make sure that the time & date is set on the probe before installing it. It is also recommended to remove obsolete data from the probe first. This can be done by using the RF Utility toolkit or by using the logger.

As a general rule it is strongly advisable to test the probe for integrity before installation. This can be done by first letting the probe log in open air for two hours after which it can be lowered into water up to the lower end of the connector assembly also for two hours. Air readings must be in the order of 2-4% and water readings in the order 94-98%. The probe can be reset by the hand-held logger or by using the RF Utility Toolkit.

It is important to note that the fit between the probe (or access tube in the case of the MobiCheck) and surrounding soil is of critical importance in obtaining accurate and representative soil moisture readings. Various techniques to obtain a good fit are used depending on soil type, crop type and application. A customized installation auger is available on request and can be used for all soil types. It must be noted that in extreme sandy soils a customized "hollow" tube auger usually gives better results.

13.1 Installation in sandy soils

For very sandy soils the best installation result or fit is obtained by first thoroughly wetting the profile or site. The standard hand-held auger or a specialized aluminum hollow auger is used to create a tight fit access hole. If the aluminum auger is used, it is banged or hammered into the wet sandy profile and extracted several times.

Figure 6: Drilling a hole with the hand-held auger

On each extraction, the auger is emptied into a bucket. When the desired depth is reached, the probe can be lowered into the hole to test if the appropriate depth has been achieved.

Figure 7: Collecting sand from the augured hole

Figure 8: A good fitting access tube

Figure 9: Wetting the profile

If the profile has been wetted sufficiently, the wall of the hole should remain in tacked and allow for easy access. With some installations and after the probe has been lowered into the hole, there might be a thin cavity between the probe shaft and hole wall. In this case a little bit of sand is "washed" into the cavities together with water in order to ensure a tight fit.

13.2 Using the "Slurry Technique"

The use of the slurry technique is recommended for most soil types. In extreme clayey soils and specifically for installations in centre pivots, it is however important to consider the impact of the subsequent "wetting front" when determining the readily available soil water limits.

The slurry technique for installation in most soils is recommended due to the sensitivity of capacitance based probes in general for air gaps between the access tube and soil. When the slurry method is used in the correct way, there is very little chance for air gaps forming between the access tube and soil.

Figure 10: Pouring slurry from the augured hole back into the hole

A slightly oversized hole is drilled to the desired depth using the supplied auger. It is important to keep the auger as straight as possible. Try not to "ream" the access hole. The maximum space between the access tube and augured hole wall should not be more than 2 mm.

Figure 11: Increasing the viscosity of the slurry

The excess soil from the hole is poured into a bucket and mixed with the desired amount of water to make a good slurry mix. After the hole has been drilled to the desired depth, the slurry mix is poured back into the hole. Sometime it is also beneficial if the auger is used to "enhance" the viscosity of the slurry by moving the auger several times up and down the slurry filled access hole.
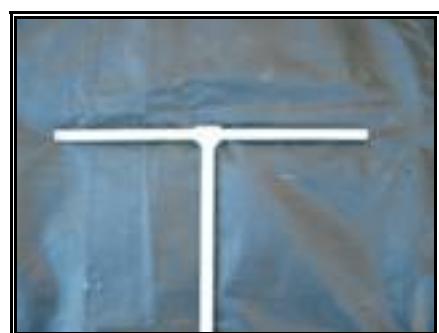
Figure 12: An installed MobiCheck access tube

The probe is inserted into the hole and as the probe is pushed down to the correct depth, the excess slurry will be forced upward and eventually be pushed out. Remove the excess slurry from the service as it may influence penetration of irrigation and rain water directly next to the probe.

Figure 13: A typical hand-auger bit

Figure 14: A typical hand-auger T-handle bar

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14 REFILL LIMITS

It is important to distinguish between the default calibration of the sensors and the setting of upper and lower readily available water limits for each probe after installation. *(This will be covered in detail in the agronomy principles section).*

Once the probe is installed, you need to calibrate the readings obtained from the probe against relative soil moisture content. In essence, a depletion curve is derived and by monitoring one or several typical wetting-drying cycles, an upper and lower "refill" limit is obtained. If the service has been requested, then this function is usually performed by a contracted agronomist.

The adjacent graphs are examples of a typical depletion cycle which has been implemented after first having recorded how the farmer was irrigating as a standard practice. The first graph shows the separate depth levels or data from sensors positioned at various depths. The second graph is the combined result of all the selected sensors for a specific probe.
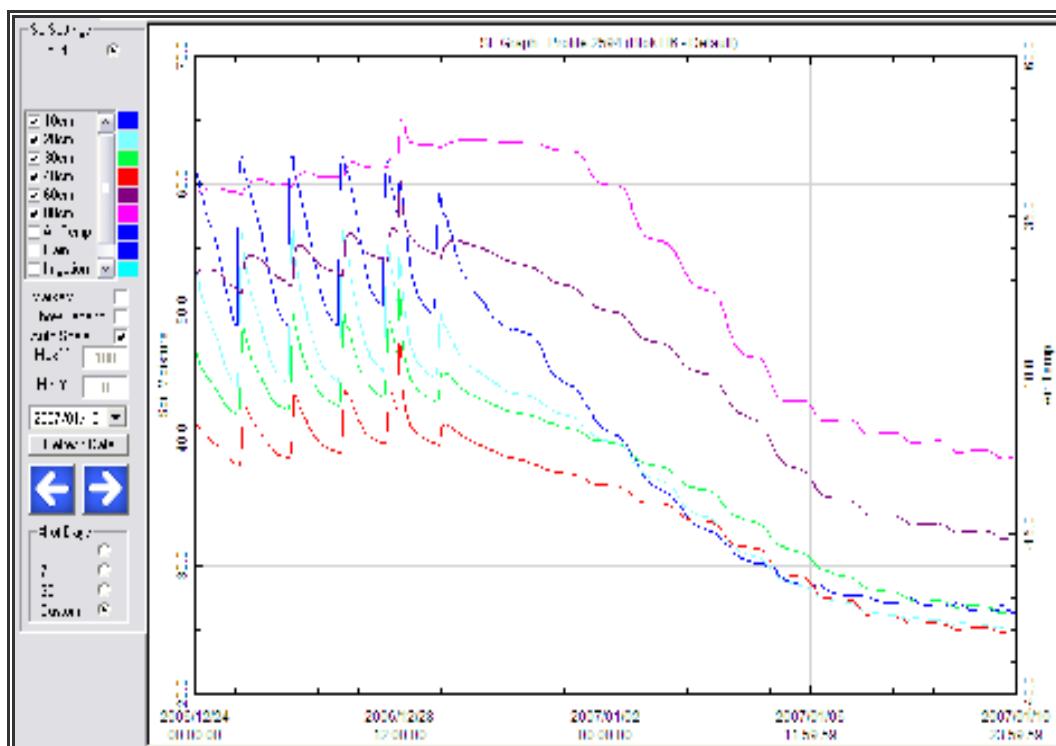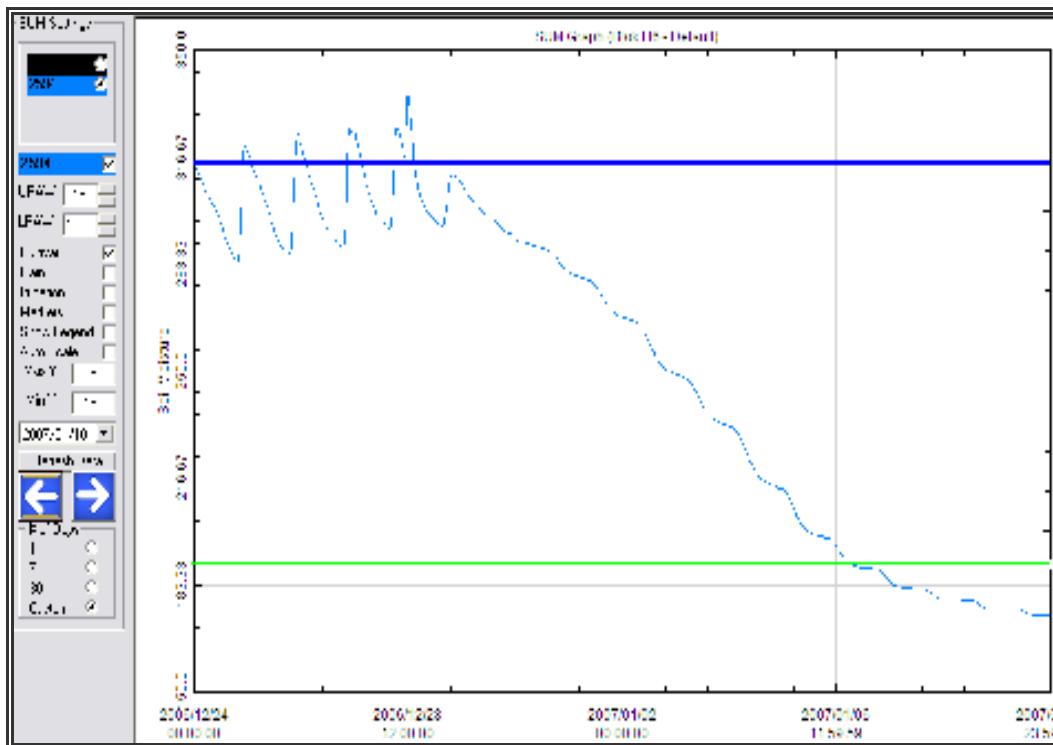
Figure 15: A typical separate level graph showing a depletion cycle

Figure 16: A typical summed graph showing a depletion cycle

On the second graph an upper refill limit and lower refill limit can be seen. These are the limits within which the grower should under normal circumstances manage his soil moisture regime.

Once installation of the probe has been completed and the profile has stabilized, the next step is to determine the upper and lower refill limits. Determining the upper and lower limits is really the key to successful and accurate irrigation scheduling techniques.

15 Getting Started

The following steps are recommended for easy setup and seamless first-time operation.

15.1 STEP 1 – Setup logger
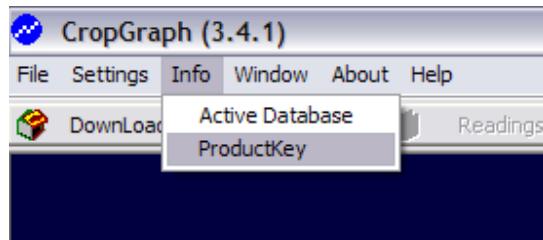
✓ Charge the logger for at least 24 hours prior to installation.
✓ Set date & time on the logger.
✓ Populate the logger with the appropriate probe ID's. heading 10.2.1

15.2 STEP 2 - Activate probe (s)

✓ Remove the Probe Cover by squeezing lightly on the opposite sides of the two locater knobs at the bottom edge of the probe cover.
✓ Turn the Probe Head 45^0 to dislocate the probe head from the two locator knobs and remove it from the connector assembly.
✓ Insert the battery board (PCB) into 14-pin connector
✓ Connect the battery pack to the terminal on the battery PCB.
✓ Carefully position the probe head over the battery pack, push towards the connector assembly so that the probe fits over the connector assembly.
✓ Make sure the o'ring set is well lubricated (only use approved lubrication as may "off the shelve" lubricants have a corrosive effect on the o'rings.
✓ Turn probe head (about 45^0) until it slots into position (with the locator knobs fitting into the locator holes).
✓ Each probe needs about 2 minutes to initiate the activation sequence.
✓ Use the RF Utility tool to confirm all the settings. (In the absence of a RF Utility Toolkit, use the profile log option on the logger menu to download all obsolete logs and to set the date time.

15.3 STEP 3 – Installing the Software

✓ Insert the supplied AquaCheck labeled mini-cd into your cd/dvd drive
✓ Run the SETUP file
✓ The CropGraph program will guide you through several installation steps
✓ Once installation is finished, go to the Info tab, click on ProductKey and complete the Software registration form.

Figure 17: ProductKey Menu

Figure 18: Software registration form

- ✓ If you are using Microsoft Outlook or Outlook express, an email with your registration form will automatically be created and added to your outbox.
- ✓ If you are using any other email program, please use the provided **Export (txt)** button and save the registration file in your preferred location. Send an email to info@aquacheck.co.za with the attached file for registration.
- ✓ Your email will be returned within 48 hours (excluding weekends) with your product unlock key. This 20-digit key needs to be filled into the open space next to the **Product Key** section.

15.4 STEP 4 – Setting up blocks

- ✓ Go to the CropGraph manual page 11 for instructions

15.5 STEP 5 – Connecting the logger to the CropGraph software

- ✓ Make sure the logger is fully charged – the LCD on the logger should display the following flashing message while still connected to main power supply: "CHARGE COMPLETE"
- ✓ Go to the CropGraph manual page 9 and follow the instructions
- ✓ Make sure the logger is connected to the CropGraph Software (PC). If a successful connection has been made, it should show **_Connected_** when the RF Download console has been activated.
- ✓ If it does not show **_Connected_** the most common reason is that the wrong com port has been selected. Make sure that the selected com port is indeed the one associated with the Serial or USB port to which the cable has been connected.
- ✓ Make sure the logger **_Date/Time_** has been synchronized with your PC. (The default value is GMT +2)

15.6 STEP 6 – Setting up groups on the logger

- ✓ Go to page 11 of this manual and follow the recommended steps.

15.7 STEP 7 – Taking the first reading

- ✓ Line probes up and identify probe serial numbers – make sure the probe numbers correspond to the probe numbers used when the blocks were created;
- ✓ Position probes in such a way that the shaft of each probe is at least 100mm away from the nearest object.
- ✓ Make sure that at least 30 minutes have passed since the probes were initiated.
- ✓ To start downloading data from the probes go to page 11 of this manual and follow the recommended steps.
- ✓ Connect the logger to the PC (and CropGraph) software.
- ✓ Make sure it says **_Connected,_** in the down load console screen after the RF download menu option has been selected.
- ✓ Initiate the download process by hitting the **Dump data** button.
- ✓ Go to page 9 of the CropGraph menu and follow the recommended steps to import data to CropGraph.

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