Electro-Magnetic Compatibility (EMC)

This product complies with Council Directive 89/336/EEC when installed and used in accordance with the relevant instructions.

Service and Technical Support

PLEASE CONTACT YOUR NEAREST DISTRIBUTOR

If unknown then fax: 44 (0) 1453 733311

Our policy is one of continuous improvement and the information in this document is subject to change without notice. Check that the software reference matches that displayed by the instrument.
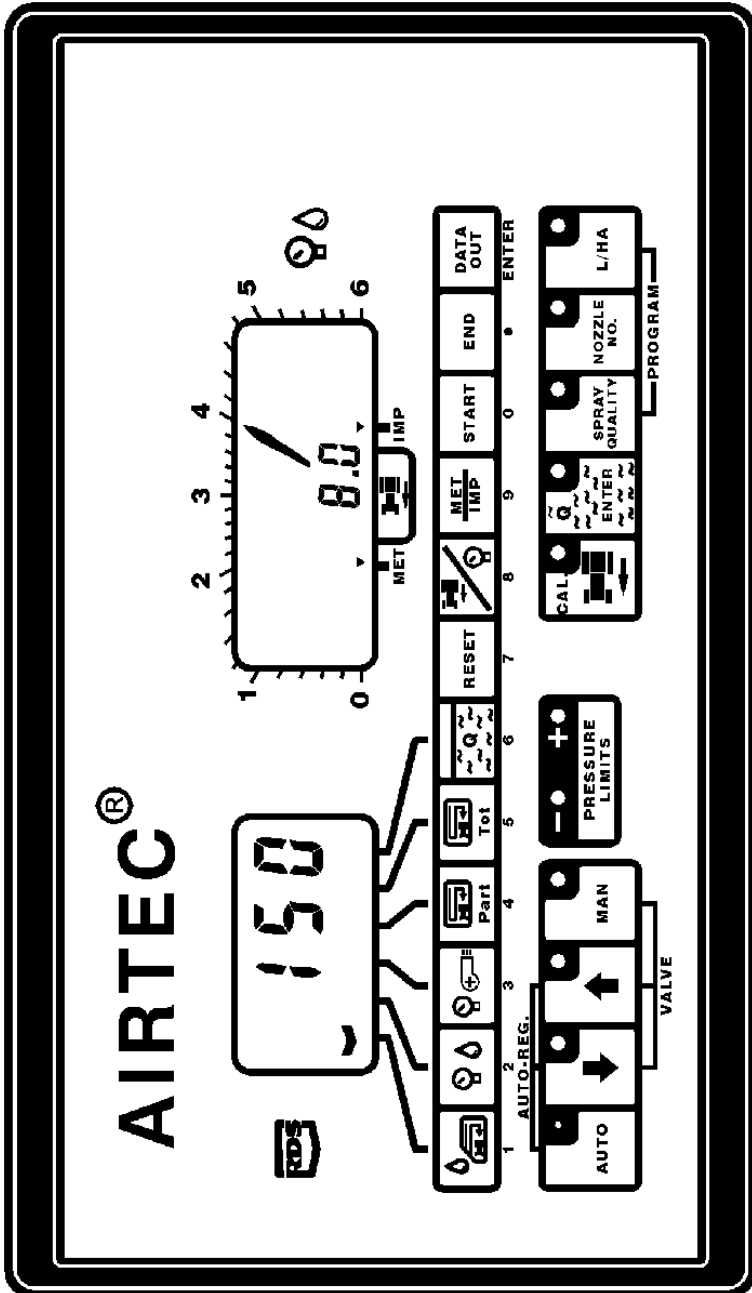
User Guide

Airtec "Magic Box"

Calibration and Operation

Software Ref: NG 308-104

Contents

Introduction

The Airtec Magic Box is a sophisticated monitoring and automatic control system developed specifically for Airtec sprayers. The Airtec Magic Box system uses a forward speed sensor, a pressure sensor in both the liquid and air systems and an interface with the sprayer control unit to provide the basic data. From this data the following information is displayed to the operator:-

Display Function		Units	
		Metric	Imperial
Instantaneous Application Rate		litres/ha	galls/acre
Liquid Pressure (Analogue & Digital Displays)		bar	psi
Air Pressure		bar	psi
Part (Trip) Area Worked		ha	acres
Total Area Worked		ha	acres
Tank Contents		litres	gallons
Forward Speed		km/hr	mph

The Airtec Magic Box is a fully automatic rate control system which regulates both the spray quality and the application rate whatever the forward speed. A "Target" Application Rate and Spray Quality is programmed in Airtec Magic Box and the system regulates to these Targets.

This Target Application Rate can be easily re-set on the Airtec Magic Box switch panel or for small areas requiring special application rates can be altered in 10% steps by a single switch operation.

The system can also be operated in manual mode and the sprayer output and Spray Quality can be altered from the Airtec Magic Box control panel.

The Airtec Magic Box will also warn the sprayer operator if the forward speed is outside acceptable limits for the spray nozzles and application rate currently being used.

As the Airtec Magic Box control system is based on the Pressure and Speed relationship, the instrument must know the nozzle output characteristic.   The flow/spray quality/air pressure and liquid pressure relationships for all four Airtec restrictor sizes are pre-programmed in the instrument memory.   The flow-pressure relationship of up to four further conventional nozzle types can be programmed into the instrument.

By simply pressing the   switch to set the nozzle type in use, the instrument is instantly set with the appropriate Target Application Rate, Target Speed, and Target Pressure for that nozzle.

The Airtec Magic Box can also be supplied with a flow sensor to install in the filling hose to monitor and automatically control the tank filling.

If appropriate sensors are installed, Airtec Magic Box can also monitor and display the speed of two rotating shafts, normally Engine Speed and PTO Speed.   The Airtec Magic Box can be programmed with alarm speeds above or below which the audible alarm will sound.

B. Normal Operation

The Airtec Magic Box is normally powered from the vehicle electrical system and is switched via the vehicle ignition key.

When the vehicle ignition is first switched on all segments of both displays will come on momentarily.

After the display test has ended the Airtec Magic Box will show the same function that was selected last time it was switched off.

Both displays will be illuminated whenever the instrument is powered.

All internal accumulated data and programmed data is stored in the instrument memory whether the instrument is connected to a power supply or not.

B.1 Metric/Imperial

Airtec Magic Box can convert any displayed or stored information between Metric and Imperial units at any time. A small chevron indicator at the bottom of the right hand display indicates which system is currently selected.

To convert from one to the other, simply press the MET/IMP switch to move the chevron between the "MET" & "IMP" indices below the display window.

B.2 Analogue Pressure Display
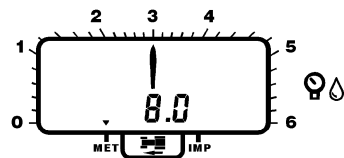
Liquid Pressure is permanently displayed on the right hand *analogue* display from 0 - 6 bar, (0 - 90 psi).

B.3 Forward Speed Display

The right-hand *digital* display (above) also shows the sprayer forward speed in km/hr or mph.

The l.e.d. in the switch is on permanently when a signal is being received from the speed sensor. The l.e.d. flashes when an internally simulated speed is displayed.

B.4   Left Hand Digital Display
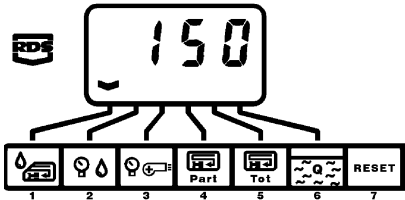
The left-hand display is selectable to show any one of ten primary functions or information on the selected function. The function selected is indicated either by the chevron at the bottom of the display or by an l.e.d. in the upper right-hand corner of the function select key or by a message on the right-hand display. To select any of the six primary functions, simply press the appropriate function select key. (All non-selected functions will continue to accumulate in the Airtec Magic Box memory).

B.4.1		Instantaneous Application Rate
B.4.2		Liquid Pressure
B.4.3		Air Pressure
B.4.4		Partial Area
B.4.5		Total Area
B.4.6		Volume Remaining In Tank

Area normally accumulates only when the implement is in work. If an automatic override switch, or sprayer control interface is connected then the area accumulation is automatically stopped and started. When the implement is out of work, the chevron indicator on the left-hand display flashes. When the implement is in work the chevron indicator is on steadily.

B. Normal Operation

B.5   Reset `RESET`

The Area and Volume registers can be reset to zero by selecting the appropriate function, then pressing and holding the `RESET` switch.

The "Volume Remaining In Tank" register will reset to the original, "Full Tank" volume.

B.6   Speed Pressure Band (Spraying "Window")
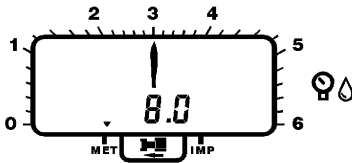
Press the switch and the right-hand displays will show the Target Pressure and Target Speed currently set.
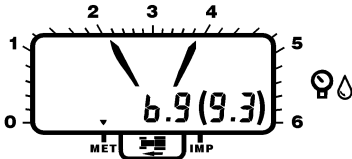
Hold this switch for 4 seconds and the display will change to show two pressure arrows indicating the "pressure limits" associated with the nozzles in use. These are the pressures at which the pressure limit l.e.d.'s will come on.

NOTE: The right-hand digital display will be alternating between two speed readings. These are the forward speeds corresponding to the upper and lower pressure limits shown on the analogue display.

The whole "window" can be moved up or down if required.

Still holding the switch, press the to reduce the pressure and speed or press the to increase the pressure and speed. Make sure that the spray pattern at the two pressure limits is still going to be correct.

8

B.7   Application Rate Controls

B.7.1   MANUAL
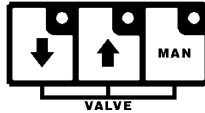
Press the [MAN] switch to select manual pressure control.

In this mode the [↓] and [↑] keys are used to manually increase or decrease either the liquid pressure or the air pressure.

When the [MAN] switch is pressed, the left-hand digital display will show either "**Air**" or "**Liq**".

Hold the [MAN] switch and the display will toggle between the two. Release the switch when the correct message is displayed before adjusting the pressure.

B.7.2 AUTO
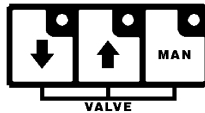
Press the [AUTO] switch to select automatic pressure control.

Automatic control will be in operation whenever the sprayer is switched on. Airtec Magic Box will monitor the forward speed of the sprayer and the spraying pressures. The flow rate will then be automatically adjusted to ensure that the application rate matches the Target Application Rate, and that the correct spray quality is maintained.

If for some reason this cannot be achieved, the left-hand display will flash "**high**" or "**lo**" as appropriate and the audible alarm will bleep.

The "**lo**" error may be caused by insufficient pump capacity or output, low or empty tank, blocked filters , incorrect jets fitted, low pump speed, too high a forward speed, etc.

The "**high**" error may be caused by the control valve being unable to dump sufficient flow back to the tank. This could be caused by over capacity of the pump, too small or too few nozzles in use, too small a control valve (1" instead of 2"), too slow a forward speed (or vehicle stationary) etc.

B. Normal Operation

The Target Application Rate can be adjusted up or down in steps of 10% of the original Target simply by pressing the [↓] or [↑] switches. The AUTO l.e.d.will flash when the Rate has been adjusted. To reset to normal, press the [AUTO] switch.

N.B. When a conventional nozzle type is selected, Auto operation will cause the air pressure control valve to open fully to cause zero air pressure.

B.8   Pressure Limits + & - [PRESSURE LIMITS]

Airtec Magic Box is programmed with a "Target Pressure" and corresponding "Target Speed" for each nozzle type and Application Rate. If the speed and therefore the pressure go outside the spraying window, one or other of the pressure limit lamps will flash and the audible alarm will sound. Automatic control is maintained outside these limits but the spray pattern and droplet size may not be acceptable.

B.9   Speed Simulation [CAL]

When there is a speed signal being received, then the [CAL] l.e.d. is on permanently. If a speed signal is being simulated, then the l.e.d. is flashing. In order to perform a calibration check on the spray nozzles with the sprayer stationary in the yard, it is possible to set a speed simulation on the Airtec Magic Box. The application rate will then be calculated and displayed corresponding to that simulated speed. This allows a nozzle test to be carried out as a cross check with the Airtec Magic Box display.

Press and hold the [CAL] key. The left-hand display will show the speed in km/hr (or m.p.h.) that will be simulated.

If that speed is correct, press the [DATA OUT ENTER] key and release both switches. The right-hand display will now show the simulated speed and the [CAL] indicator l.e.d. will flash.

If the speed displayed is not the speed you want, simply key in the speed you require using the top row of data entry keys and then press [DATA OUT ENTER].

Area will not accumulate when a simulated speed is selected.

Flow, Application Rate, and Automatic Control will operate normally.

To exit the simulated speed, press the `RESET` switch or drive the vehicle forwards when the first true speed sensor pulse will automatically stop the speed simulation.

B.10   Full Tank Volume

B.10.1 Manual Entry

The key is used to set in the volume of liquid which has been loaded into the tank.   This will normally be the full tank volume e.g. 2000 litres. Press and release the key.   The display will scroll the message "**FuLL tAnk VoL. 2000**" and the right-hand display will flash "**Ent**".

If the volume displayed is the correct volume for the full tank, press `DATA OUT ENTER` to confirm it.

If you are about to use a part tank, key in the volume of the tankful which you are about to use and then press `DATA OUT ENTER`   .

When the register is RESET it will now reset to, and will count down from, this volume.   Once the Full Tank Volume has been confirmed by pressing `DATA OUT ENTER`   , the display will scroll the message "**AlArM VoL 100**" and the right-hand display will again flash "**Ent**".

The Volume displayed now is the volume remaining in the tank at the point when the audible alarm is activated.   If this is okay, confirm it by pressing `DATA OUT ENTER` or to change the alarm volume, use the top row of keys as numerical data entry keys to key in the volume at which you want the alarm to sound and press `DATA OUT ENTER`   to confirm it

B.10.2 Automatic Entry

If a flow sensor is installed in the filling hose, the tank contents memory will be automatically altered as the tank is filled.

Press   .   The display will scroll "**Full Tank Volume xxxx**".   If the number displayed is the volume of water which you wish to end up with in the tank, press `DATA OUT ENTER`   .

B. Normal Operation

If the number displayed is wrong, use the top row of keys as numerical data entry keys to key in the volume which you want. Then press [DATA OUT / ENTER] .

The display will now scroll the message "**Volume Left In Tank xxxx**".

This is asking how much is in the tank now, normally 0000. If the volume displayed is correct, press [DATA OUT] . If the volume is wrong, key in the correct value and press [DATA OUT / ENTER] .

The display will now scroll the message "**Volume to Fill xxxx**". This is stating the volume of water which must now be added to the tank in order to end up with the correct full tank.

Once the Full Tank Volume has been confirmed by pressing [DATA OUT / ENTER] , the display will scroll the message "**ALArM VoL 100**" and the right-hand display will again flash "**Ent**".

The Volume displayed now is the volume remaining in the tank at the point when the audible alarm is activated. If this is okay, confirm it by pressing [DATA OUT / ENTER] or to change the alarm volume, use the top row of keys as numerical data entry keys to key in the volume at which you want the alarm to sound and press [DATA OUT / ENTER] to confirm it.

When the alarm volume is confirmed by pressing [DATA OUT / ENTER] the displays will now show the tank filling progress. The left-hand digital display will show the volume in the tank. The right-hand digital display will show "**FIL**" and the analogue display will show the tank contents as a percentage of the required volume. e.g. 3 = 50%, 6 = Target Volume.

As the tank is filled, the analogue display will increase up to 100% full at which point the audible alarm will sound and the valve (if installed) will close to stop the filling.

The tank filling displays can only be selected when the sprayer is switched off and is stationary.

B.11   Spray Quality

Press [SPRAY QUALITY] .   The left-hand display will show "**U.FIN**" (Very Fine), "**FIN**" (Fine), "**Med**" (Medium) or "**CoAr**" (Coarse) spray quality.

Simply press and hold the [SPRAY QUALITY] switch.   The quality messages will scroll round.

Release the [SPRAY QUALITY] switch when the correct quality is displayed.

This switch will have no effect when a conventional nozzle type is selected.

B.12   Nozzle No.

Airtec Magic Box is programmed with the flow characteristic of four Airtec restrictors and up to four conventional nozzle types. For each nozzle type, the instrument stores the Target Application Rate, Target Speed, and Target Pressure together with the full pressure - flow rate curve for that nozzle.

e.g. Lurmark Flat Fan 04 - F110 Cambridge Blue

Target Application Rate	= 240 litres/hectare
Target Speed	= 8 km/hr
Target Pressure	= 3 bar
Flow Rate at Target Pressure	= 1.60 litres/min

When changing nozzle types it is therefore a very simple procedure to reset the Airtec Magic Box for the different nozzle.

Press and hold [NOZZLE NO.].   The left-hand display will show either **28**, **35**, **40** or **50** for the four Airtec restrictors and then **A**, **b**, **C**, or **d** for four conventional nozzles. To change nozzle types, hold the switch until the appropriate letter is displayed, then release the switch.

B. Normal Operation

B.13. Target Application Rate L/HA

Press and hold L/HA to see, or to change, any of the "Target" conditions for a particular nozzle type. With the switch held, the left-hand display shows the Target Application Rate in litres/ha or galls per acre. The right-hand display shows the Target Pressure and Target Speed for that application rate.
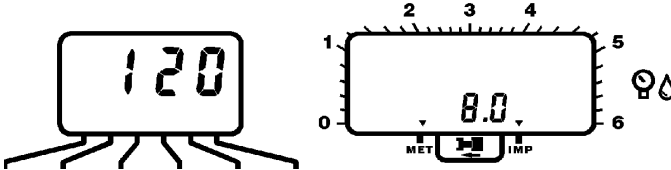
B.13.1 Changing Target Application Rate

With the L/HA switch <u>held</u>, the top row of 12 keys become re-defined as numerical data entry keys having values 1 - 9, 0, ., and ENTER as shown below each key. To change the Target Application Rate, simply key in the new rate e.g. 1, 5, 0, and press DATA OUT ENTER.

The new rate is now displayed on the left-hand display and the new target speed and pressure is shown on the right-hand display.

B.13.2 Changing Target Speed and Target Pressure

If the Target Speed or Target Pressure for the new Application Rate are inappropriate, they may be changed simply by pressing the ↓ or ↑ switches to decrease or increase the Target conditions, (still with the L/HA switch held).

B.14. Sprayer Interface Check, Engine Speed, PTO Speed, Engine Hours and Time

Airtec Magic Box can display PTO Speed, Engine Speed, Engine Hours and Time of day if the appropriate sensors are installed on the vehicle. It will also check and display the number of nozzles which are recognised as being switched on.

Press the blank key in the lower row of keys (below the no.7.) The right-hand digital display will indicate the function now being shown on the left-hand display. Initially it will show the number of nozzles recognised (**"No"**.).

Press the key again to show Pto speed ("**Pto**").

Press the key again to show Engine Speed ("**EnG**"). Press the key again to show Engine hours ("**hrS**").

Press the key again to show time of day. ("**Hr**")

The displays will stay showing the selected function until another function is selected. The time of day display will be cancelled after four seconds.

C. Programming

There are various inputs which must be programmed into the Airtec Magic Box relating to the machine and sensors installed.

This data can only be viewed or changed when the Airtec Magic Box is changed from its normal "Operating Mode" to one of its three "Programme Modes".

A front panel overlay is provided which indicates the new "programme mode" functions of each of the 12 switches at the bottom of the instrument front panel.

C.1 Entry into "Programme Modes"

C.1.1 With the Airtec Magic Box in normal Operating Mode ensure that the Metric / Imperial selection is correctly set.

C.1.2 Switch the instrument off.

C.1.3 Position the appropriate overlay card on the front panel of the instrument ensuring that it is located with its left-hand edge flush with the left-hand edge of the instrument facia, and its bottom edge located in the groove between the bezel and the front panel.

C.1.4 Press and hold the ⚹ whilst switching the instrument on.

C.1.5 The left-hand display will show "**CAL.1**", "**CAL.2**" or "**CAL 3**" and the right-hand display chevron will indicate whether Metric or Imperial mode is currently selected. This confirms that the Airtec Magic Box is now in "Programme Mode 1" "Programme Mode 2" or "Programme Mode 3".

C.1.6 The functions of the 12 lower switches have all now changed to those functions indicated by the overlay card. The left-hand display will show the value of any of these programme functions currently set in the instrument, simply by pressing the appropriate programme function switch.

C.1.7 The upper row of 12 switches have also changed to become data entry keys having, from left to right, numerical values 1 to 9, 0, decimal point and ENTER. These values are shown immediately below the normal function keys.

C.2. Data Entry Procedure

All numerical data is set by the same procedure.

C.2.1 Select the programme function to be checked, or entered, by pressing the appropriate key on the overlay.

The left-hand display will show the numerical value currently stored for that function.

C.2.2 The right-hand display will show only the Metric/Imperial chevron. Check that the appropriate mode is selected. If you wish to change the Metric/Imperial Selection you will have to revert to normal Operating Mode.

C.2.3 If the programme data is correctly set, no action is required. Simply select the next function or exit to the Operating Mode.

C.2.4 To set new numerical programme data, use the numerical entry keys which are the 12 keys in the top row. Simply key in the number to be set e.g. 2.17. As the first key is pressed, the left-hand display will flash that number and the right-hand display will flash "**Ent**". As the full number is keyed in, it appears in the left-hand display. Each key stroke is acknowledged by an audible beep.

When the number is correctly set, press [DATA OUT ENTER] to confirm the entry. The display stops flashing and the new data value is displayed on the left-hand display.

C.2.5 If an error is made in setting the data, simply enter the incorrect value and then re-programme with the correct data.

C.2.6 Some programme functions are non-numerical but allow various options to be selected. e.g. PART Width / FULL Width selection. When these functions are selected the display indicates one of the available options.

If the correct option is displayed, no action is required.

If the option is to be changed, press the function key repeatedly to toggle the display between each option. The left-hand display will now flash with the designated option and the right-hand display will flash "**Ent**". When the correct option is displayed, press [DATA OUT ENTER] to confirm its selection.

C. Programming

C.2.7   Some programme functions have a <u>secondary</u> piece of programme data which may be either numerical or an option.

To access the secondary data, press and hold the appropriate programme function key for <u>3 seconds</u>. The display will change to show the secondary data or option.

This secondary data or option is set in exactly the same way as the primary data. Once it is confirmed by pressing [DATA OUT / ENTER] the display will revert to show the primary data after a 2 second delay.
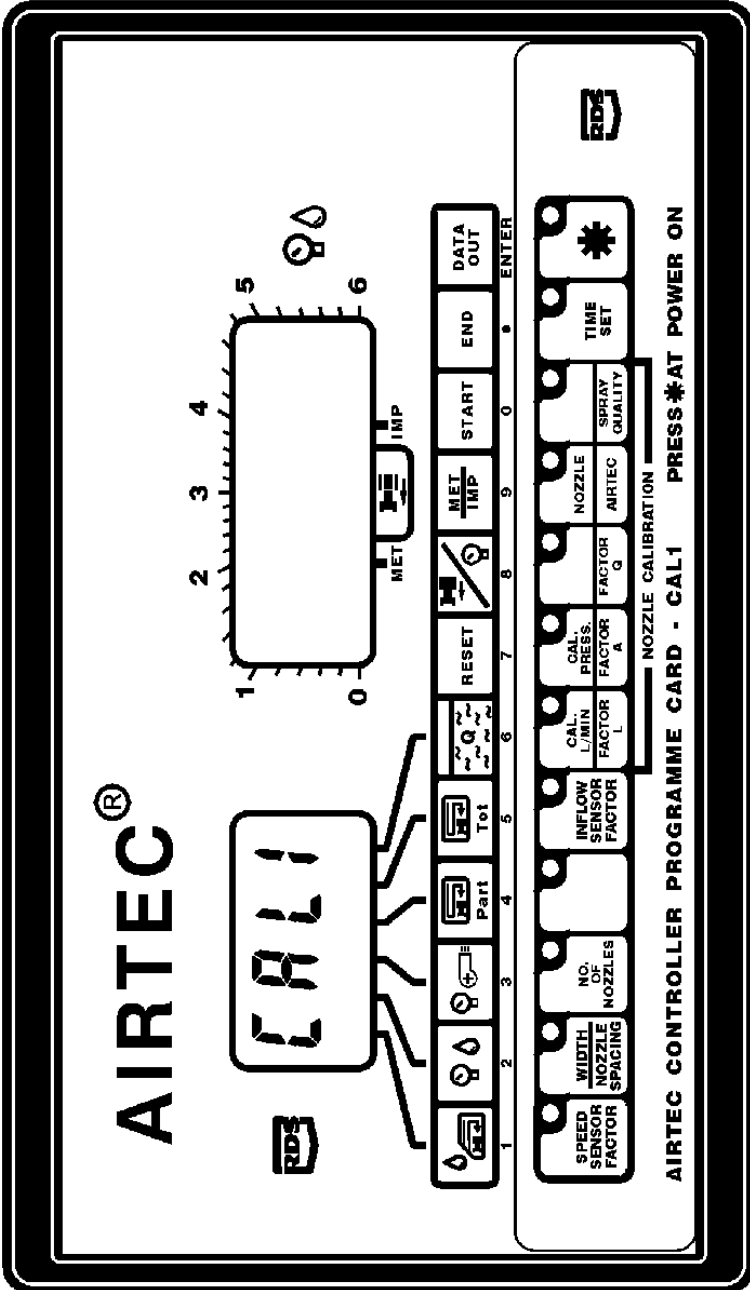
C. Programming

C.3   Programme mode 1 data

Ch.	Primary Data	Secondary Data
1	Speed Sensor Factor	
2	Nozzle Spacing / Imp. Width	Part / Full Width
3	Nozzles per Boom Section	
4	No Input on this switch	
5	Filling Flow Sensor Cal Factor	
6	Flow Rate / Airtec Factor L	
7	Cal Pressure / Airtec Factor A	
8	/ Airtec Factor Q	Nozzle Calibration
9	Nozzle Number	
10	Spray Quality	
11	Clock / Calendar Setting	
12	**Programme mode Entry/Exit**	

C.3.1 Speed Sensor Factor

The primary data to be set on this function switch is the distance the vehicle travels forwards over 2 intervals between speed sensor pulses.

This data must be determined under practical operating conditions to allow for any wheel slip, sinkage, or tyre deformation.

If a wheel sensor, operated by two magnets, is installed on a land wheel, the data to be programmed is the effective rolling circumference of the wheel. Determine this distance by driving the vehicle forwards for exactly 10 revolutions of the sensed wheel. Measure the distance travelled and divide this distance by 10 to determine the true effective wheel circumference.

The best way to establish the Speed Sensor Factor is to do an "Auto Cal" over a measured distance.

Place two markers in a field (not on a tarmac or concrete driveway) exactly 100 metres apart.

Stop the vehicle with the first marker level with some reference point on the vehicle.

If the instrument is not already in Cal_1 mode, put the Cal Mode 1 overlay in place and switch on with the [✳] switch pressed.

Select Speed Sensor Factor and **hold** the Speed Sensor Factor switch until the display shows "**AUTO**" "**CAL**".

Now drive through the 100 metre test run and stop the vehicle when the reference point is exactly on the 100 metre markm (do not reverse if you overrun the mark). As you drive through the test run, the right-hand displays will clock up the number of sensor pulses received by the instrument.

When the vehicle has covered exactly 100 metres, press [DATA OUT ENTER] . The display will flash "**End**" "**CAL**" "**AUtO**" and then will show the calculated Speed Sensor Factor.

C. Programming

C.3.2   Width / Nozzle Spacing

The primary data to be set on this function switch is always the individual nozzle spacing on a spray boom or fertiliser distributor.

Set in metres or inches.

The secondary data to be set on this function switch is the instruction "Full" or "Part" . Set "Full" width if a simple on-off override switch is installed to start and stop area accumulation. Set "Part" width if an interface lead is installed between the instrument and the sprayer switch box.

C.3.3   No. of Nozzles

The data to be set on this function switch is the number of nozzles on each boom section of the sprayer. If Full Width has been set on the Width function, the Nozzles/Section display must be programmed with the number of nozzles on the full boom e.g. 48.

If Part Width has been set on the Width function, the number of nozzles on each sprayer boom section must be set.

Switch each boom section switch on the sprayer control unit 'on' individually and programme the Airtec Magic Box with the number of nozzles on that particular section. If none or more than one boom section is recognised as being switched on, then the display will show "**1.SEC**" and no data can be entered. This will also be displayed if there is no electrical power to the sprayer control unit.

The analogue display will also indicate which boom sections are switched on. A number can only be programmed when a single arrow is displayed.

C.3.4   Inflow Sensor Factor

This is the calibration factor for the flow sensor on the filling hose.

The Calibration Factor is the number of pulses per litre (or per gallon) given by the flow sensor. This changes according to the size of the turbine assembly and may require adjustment due to the characteristics of the particular installation. The calibration factor suggested is based on clean water and will need to be adjusted when using liquids with a specific gravity significantly greater than 1.0.

Initially set as follows:

Turbine	Metric	Imperial	U.S.	
1 $^1/_2$"	165.0	749.1	624.5	
2"		100.0	454.6	378.5
3"	21.0	95.0	80.0	
4"	8.0	35.0	30.0	

Subsequent Recalibration

If the volume accumulation appears to be consistently incorrect, based on weight or measured volume, the Flow Sensor Calibration Factor can be adjusted accordingly.

Corrected Flow Sensor Factor =

$$\frac{\text{Original Flow Sensor Factor x Indicated Volume}}{\text{Actual Volume}}$$

e.g. If a 2" turbine is installed and a Flow Sensor Factor of 100 pulses per litre has been set, and the Airtec Magic Box indicated that 1900 litres have been filled whereas 2000 litres have actually been filled, then the corrected Flow Sensor Factor   is :-

$$\frac{100 \times 1900}{2000} = 95 \text{ pulses per litre}$$

C. Programming

N.B. To establish the actual volume loaded, use weight or a calibrated water meter. DO NOT BASE YOUR CALCULATIONS ON THE SPRAYER SIGHT GAUGE.

If no filling flow sensor is installed, then the Calibration Factor must be set to 0000.

C.3.5 Nozzle Calibration - Conventional Nozzles

These three input functions are used to set in the pressure-flow relationship for each of the four pre-programmed nozzles. You will need to refer to the nozzle manufacturers nozzle charts to find this information.

N.B. The nozzle performance <u>must</u> be verified by carrying out a jug test on a number of nozzles. The entire performance of the Airtec Magic Box control system relies upon the data entered at this stage.

To programme each of the nozzle types, proceed as follows:

(i) Press [NOZZLE AIRTEC]. The l.e.d. will come on. The left-hand display will show **A**, **b**, **C**, or **d**. To select a different nozzle reference, press and hold [NOZZLE AIRTEC] until the required letter is displayed.

(ii) Having selected a nozzle, press [CAL. PRESS. FACTOR A] and key in and ENTER the calibration pressure from the nozzle charts. This "Calibration Pressure" has no relevance to the Spraying Pressure it is simply a reference pressure from the nozzle calibration charts.

(iii) Now press [CAL. L/MIN FACTOR L]. Key in and ENTER the flow rate in litres per minute (or gallons per minute) for the nozzle type selected which is delivered by that nozzle when spraying at the pressure just set as the CAL. PRESSURE.

(iv) Repeat this process for as many of the nozzle types that you wish to pre-programme.

C.3.6 Nozzle Calibration - Airtec Nozzles

The Airtec nozzle calibation data is pre-programmed in the instrument. There are however three factors available to alter the nozzle performance.

Factor L - Liquid Factor

Factor A - Air Factor

Factor Q - Quality Factor

These factors should <u>not</u> be altered unless recommended by Cleanacres.

The pre-programmed factors are:

Restrictor	28	35	40	50
Liquid Factor	6.000	6.000	3.500	1.321
Air Factor	2.000	1.932	1.032	0.277
Quality Factor				
Very Fine	0.800	1.100	1.200	1.500
Fine	0.400	0.800	0.860	1.200
Medium	0.200	0.500	0.520	0.980
Coarse	0.000	0.220	0.240	0.400

C. Programming

C.3.7   Time Set

This programme function switch is used to set the clock and calendar when the Data Logging Option is installed.

Select "Time Set" function.

The left-hand display shows the time in 24 hour format and the right-hand display shows "**HrS**". Set the current time as normal, HH.MM and Enter.

The left-hand display now shows the date in UK format "date.month" and the right hand display shows "**dAt**".

Set the current date as normal DD.MM. Be sure to set all four digits using zeros where required. e.g. for 2nd March, set 0203 and ENTER.

The left-hand display now shows the year and day of the week. The right-hand display shows "**y d**". Set the year and day as YY.DD and ENTER. Monday is day 1, Sunday is day 7. e.g. on Thursday 14th March 1991 set the year and data as 9104.

C.3.8   Revert to Normal Operating Mode

Airtec Magic Box Operating Mode can be restored either by switching the power off and back on again, or by pressing and holding

Remove the programme mode overlay and store safely.

C.4   Programme mode 2 data

Ch	Primary Function
1	Liquid Air
2	Manual Pressure Decrease
3	Manual Pressure Increase
4	Pressure Displays Zero
5	Pressure Displays Gain
6	**Prog Mode 2 Entry/Exit**
7	System Response
8	Minimum Pulse Length
9	Pressure Limits
10	Minimum Pressure
11	Ha/Hrs Worked
12	Print Calibration Data
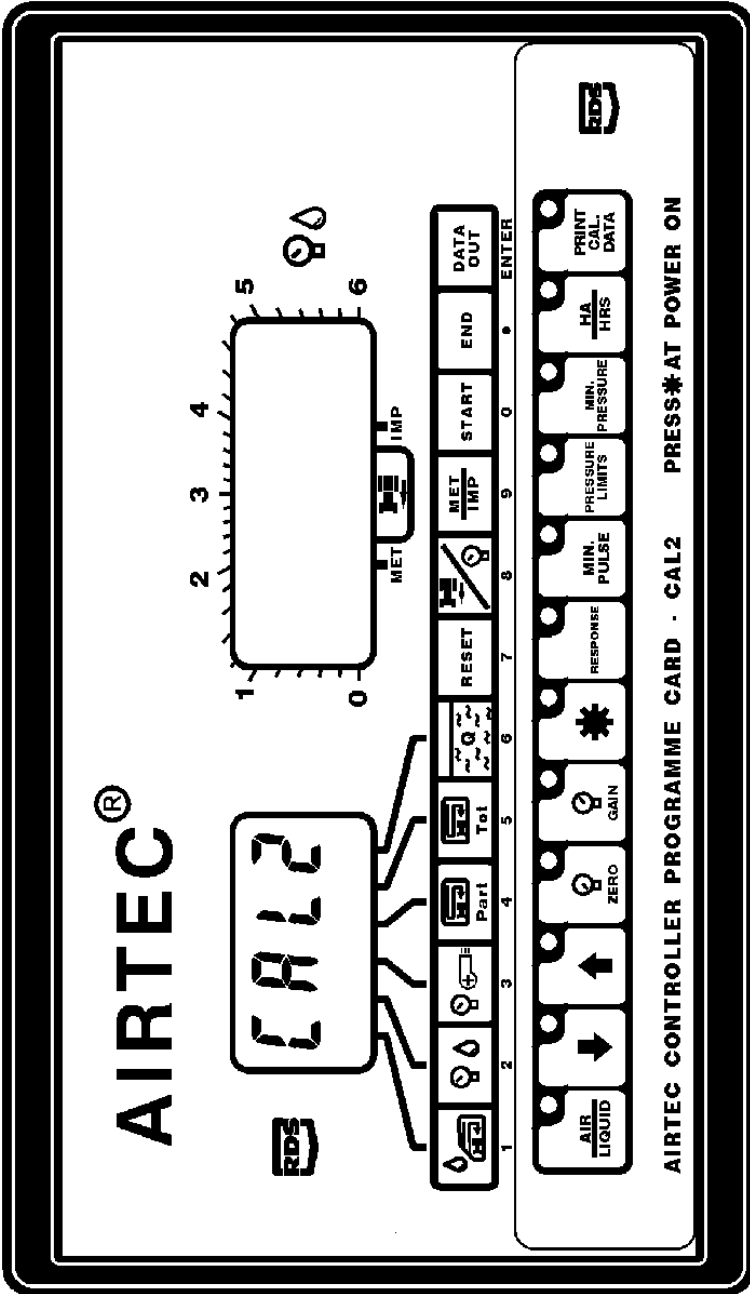
C.4.1   LIQUID/AIR

<u>All</u> of the programme data set in Programme Level 2 must be set for <u>both</u> the liquid control system <u>and</u> the air control system.

Press the switch. The left hand digital display will show either "**Li9**" (Liquid) or "**Air**" to indicate which control system is currently being set up.

Go through the following procedure and set each parameter for Liquid. Then come back to . Press and hold the switch until the display changes to show "**Air**". The "**Air**" message will be flashing and "**Ent**" will be flashing on the right hand display. Press to confirm the change.

Now go through and set each parameter for the Air control system.

C.4.2/3   Manual Pressure Decrease and Decrease
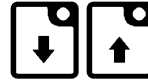
These switches have the same function in the Calibration Mode as they have in normal Manual Operating Mode. They directly drive the electrical pressure regulating valves.

C.4.4   Pressure Zero

Pressure Zero and Pressure Gain are used to calibrate the pressure sensor to the instrument. First set the zero point.

Ensure that there is no pressure in the sprayer manifold. If necessary slacken the sensor at its connection point. Press the switch. The left-hand display will flash 0.0 and the right-hand display will flash "**Ent**". Press to confirm the zero pressure reading.

C. Programming

C.4.5 **Pressure Gain**

To set the Pressure Sensor Gain (Sensor Calibration) the sprayer pump must be running. When the vehicle engine is started the Airtec Magic Box will probably revert to the normal operating mode. Switch the ignition off (leaving the engine running) and re-power the instrument with the   switch pressed to re-enter the Programme Mode.

Start the sprayer pump running and set the spray pressure on the pressure *gauge* to a typical spraying pressure using the switches to alter the spraying pressure.

N.B. The Airtec Magic Box must measure and display line pressure not manifold pressure. It is preferable to set the Pressure Gain against a pressure gauge temporarily installed on the boom line.

Alternatively set the liquid pressure the same as the liquid pressure gauge on the manifold but set the Air pressure gain to 2 psi less than the manifold air pressure. e.g. Gauge reads 18 psi, set the Pressure Gain to 16 psi.

Press the   switch. The left-hand display will show a pressure reading which may or may not be correct. Key in the actual pressure as indicated by the pressure gauge and then press   . This confirms the calibration of the instrument to the pressure gauge.

C.4.6 **System Response**

This programme function relates to the automatic control performance. The System Response can be set to any number between 0.001 and 9999.   Initially set the Liquid Response to 700 and the Air Response to 100.

If the System Response is set to a small number it will make the valve movements small and the automatic control may appear sluggish and take a long time to reach the Target Application Rate. A large number will make the valve move in large steps. This may make the Automatic Control overshoot and be unstable, hunting around the Target Application Rate.

C.4.7   Valve Minimum Pulse Length

This programme function also relates to the automatic control performance. The pulse driving the valve will become shorter in length as the application rate gets closer to the target rate. If the minimum pulse length is *too* short, there may not be any change on the flow rate.

The minimum pulse length can be set to any value between 1 and 128. Initially set the Liquid Minimum Pulse to 12 and the Air Minimum Pulse to 7.

C.4.8   Pressure Limits

For any nozzle type and application rate, the Airtec Magic Box is programmed with a Target Pressure which is the optimum spraying pressure. The control system will adjust the pressure either side of this target as the speed changes either side of the Target Speed. If the speed and therefore the pressure move too far away from the Target, the droplet size and/or spray pattern may deteriorate.

The "pressure limits" are therefore programmed to warn the sprayer operator that, although the application rate is still being controlled correctly, the system is near the end of its range.

The pressure limits will normally be set between 0.5 and 1.0 bar either side of the target.

Set and enter the pressure limits in bar or psi.

C.4.9   Minimum Pressure

Most nozzles have a diaphragm check valve or anti-drip valve which will stop the flow to the nozzle if the pressure drops to a certain level.

The Airtec Magic Box can be programmed with a MINIMUM PRESSURE which is a definite limit below which the system will not regulate.

This ensures that even at very low speeds there will always be a full spray pattern. It does mean however that there will be over application if the "Minimum pressure" is coming into effect.

The minimum pressure will normally be set between 0.5 and 1.0 bar.

Set and ENTER the minimum pressure in bar or psi.

C. Programming

C.5   Programme mode 3 data

Ch.	Primary Data	Secondary Data
1.	Prog. Data Out	
2.	Data Logging On/Off	
3.	**Prog. Mode 3 Entry / Exit**	
4.	Pulses/Engine rev	
5.	Pulses / PTO rev	PTO Channel Input
6.	Engine Speed Limit	Over/Underspeed Alarm
7.	PTO Speed Limit	Over/Underspeed Alarm
8.	Engine/Ignition Hours	
9.	-	
10.	Volume Units	
11.	Area Units	
12.	Rate Units	
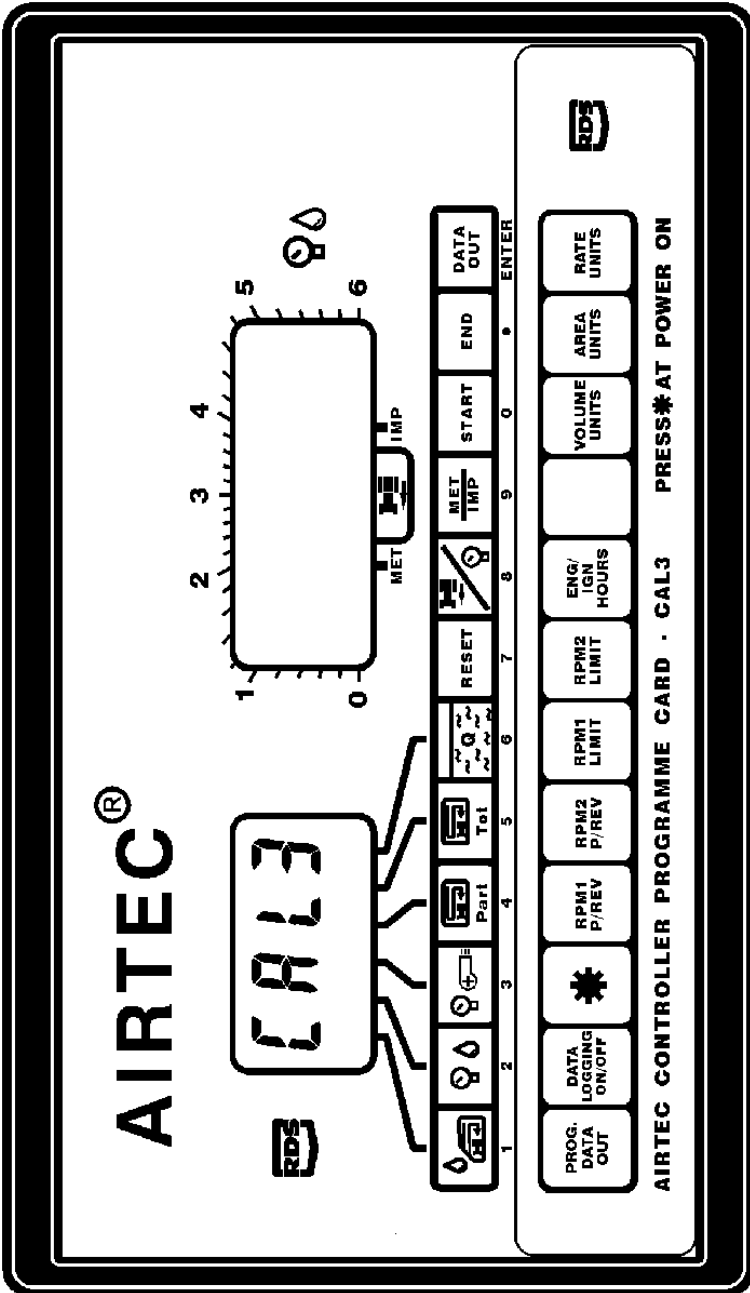
C. Programming

C.5.1 RPM1 P/REV Channel 1 Pulses per Rev.

RPM1
P/REV

The data to be set on this function switch is the number of pulses received by the engine speed sensor per revolution of the engine.

Engine speed is measured normally by an electronic pick up off the `W' terminal of the alternator. The sensor is therefore measuring alternator speed but by setting the correct factor on this channel, the display will show true engine speed.

The calibration factor must be determined by experiment and by measuring engine speed using a hand held tachometer.

(i) Initially set a calibration factor at 10.00 on this channel and Enter it.

(ii) Set Airtec Magic Box back into normal Operating Mode (by switching the ignition off and back on again.)

(iii) Run the engine at a steady speed noting the engine speed reading. Measure the true running speed of the engine using a hand held tachometer.

(iv) Set Airtec Magic Box back into "Programme Mode 2" and reset the RPM Factor by multiplying the current RPM Factor, (10.00) by the instument speed reading divided by the actual speed.

e.g. With a factor of 10.00 pulses per rev set in the instrument, say a reading of 1780 corresponds to an actual speed of 1500 r.p.m.

Correct the factor as follows:

$$\frac{10.00 \times 1780}{1500} = 11.87$$

C.5.2 RPM2 P/REV Channel 2 Pulses per Rev. `RPM2 P/REV`

The primary data to be set on this function switch is the number of pulses received by the P.T.O. speed sensor per revolution of the P.T.O. shaft.

P.T.O. speed is normally measured by a magnetic sensor operated by a single magnet in a nylon magnet ring which is fixed to the P.T.O. shaft. In this case set a figure of 1.000 pulses per rev.

P.T.O. speed can also be determined indirectly from the engine speed sensor. In this case the secondary programme data option for this channel must be set appropriately and the pulses per rev must be determined in the same manner as RPM 1 P/REV. See C.3.4

The secondary data to be set on this function switch is the option between sensors used to measure P.T.O. speed.

If P.T.O. speed is measured using its own sensor on the P.T.O. shaft, select and enter the option "**IP 2**".

If P.T.O. speed is measured indirectly by using the engine speed sensor then select and enter the option "**IP 1**".

C.5.3 RPM 1 LIMIT `RPM1 LIMIT`

The primary data to be set on this function switch is the engine alarm speed at which the audible alarm will be triggered. Set in r.p.m.

The secondary data to be set on this function switch is the option between overspeed, "**HIGH**" or underspeed, "**LO**" alarms. Select and enter the appropriate option.

C.5.4 RPM 2 LIMIT `RPM2 LIMIT`

Exactly as for RPM 1 LIMIT. See C.3.6.

C. Programming

C.5.5 **Engine Hours Sensing. Eng/Ign.** `ENG/ IGN HOURS`

When this switch is pressed, the display shows "**Eng**" or "**Ign**". If an engine speed sensor is installed, set "**Eng**" whereupon the instument will only accumulate engine hours when the engine is actually running. If no engine speed sensor is installed, set "**Ign**" whereupon the instrument will acumulate "engine" hours whenever the ignition is switched on.

C.5.6. **Revert to Operating Mode**

To exit Programme Mode 3 and revert to the Operating Mode, either switch the power off and on again or, press and hold the `✱` key for 3 seconds.

If the Data Logging Option is to be used for providing a print out or for direct data transfer to Optimix crop record computer software, refer to the separate Data Logging Handbook.

E. Programme data record

E.1 Programme Mode 1

E.1.1 Speed Sensor Factor

Tyre Size:				
Factor:				

E.1.2 **Width:** Part / Full

E.1.3 **Noz / Sec:**

1	2	3	4	5	6	7	8	9

E.1.4 **In-Flow Sensor Factor:** Pulses per litre

E.1.5 **Nozzle Calibration**

	A	b	C	d
Nozzle Manufacturer				
Type				
Cap Colour				
Cal Pressure (bar)				
Cal Flow Rate (l/min)				
Application Rate (l/ha)				

E.2   Programme Mode 2

	Liquid	Air
E.2.1 System Response:		
E.2.2 Valve Minimum Pulse Length:		
E.2.3 Pressure Limits:		
E.2.4 Minimum Pressure:		

E.3   Programme Mode 3

E.3.1   RPM 1 Pulses / Rev.:

E.3.2   RPM 2 Pulses / Rev.:   Input 1 / Input 2

E.3.3   RPM 1 Speed Limit: rpm   High / Low

E.3.4   RPM 2 Speed Limit: rpm   High / Low

E.3.5   ENG / IGN HOURS