



HE-VA Auto-Controller MAC8000i Applicator Controller

Operation
and
Product Calibration

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Electromagnetic Compatibility (EMC)



This product complies with Council Directive 2004/108/EEC when installed and used in accordance with the relevant instructions.

IMPORTANT, READ THIS BEFORE USING THE MAC8000i

The *MAC8000i* installation is a part of the Precision Farming System ("the System"). It is very important that you follow the described calibration procedures before operating the *PS8000i* instrument. Calibration and operation of the *MAC8000i* must be in accordance with these instructions. Use of the System is subject to the following disclaimer;

1. So far as is legally permissible HE-VA ApS, or its distributors, shall not be liable, whatever the cause, for any increased costs, loss of profits, business, contracts, income, or anticipate savings or for any special, indirect or inconsequential damage whatsoever (death or personal injury excluded).
2. The capabilities and functions of the Precision Farming System ("the System") are limited as set out in the specification of the System, details of which are contained in the Help files and product literature and which must be read before using the System.
3. Without prejudice to the generality of the above it is hereby acknowledged that the System is not designed nor intended to a) originate variable treatment plans or b) achieve or avoid any application rate outside application parameters, which in both cases shall be the responsibility of the operator.
4. The standard terms and conditions of HE-VA ApS, a copy of which is available on request, apply to the supply and operation of this System.

Service and Technical Support

PLEASE CONTACT YOUR NEAREST HE-VA dealer.
If unknown then contact HE-VA ApS for further information



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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.

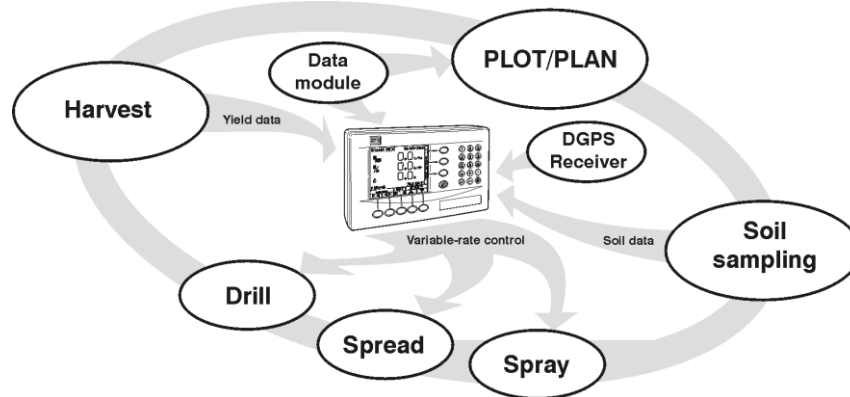
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1. Overview

1.1 The HE-VA Precision Farming System

The HE-VA MAC8000i head unit is a fully DGPS compatible, multi-function cab computer for a wide range of applications (figure 1).

Figure 1



1.2 Installation and Inter-operability with other systems

The *MAC8000i* control system comprises several component kits. This modular approach means that a suitable control system can be specified for a very wide range of implements. When re-configured with the appropriate control software, the head unit can be simply transferred between different implements.

The *MAC8000i* can also output variable-rate instructions to other control systems including Vicon, Bogballe and Amatron systems, as well as acting on variable-rate instructions received from Fieldstar, Soyl Opti, Agrocom ACT, JD Greenstar, Raven and Hydro-N Sensor systems.

1.3 Control Software

Your *MAC8000i* instrument is pre-loaded with "MAC 8000i" control software only.

With the purchase of a "secondary software module" - an electronic chip loaded into the back of the instrument, the Pro-Series can be instantly switched to perform another function e.g. from a Sprayer Controller to a Data Logger for route navigation and soil mapping tasks. This is done from "Instrument Select" in the "USER OPTIONS" menu.

There are software modules for yield monitoring/mapping, route/soil mapping, variable-rate sprayer control, variable-rate belt spreader control, variable-rate disc spreader control, and variable-rate seed drilling.

For information on connecting and configuring PF *hardware* e.g. the Secondary Software Module, DGPS Receiver, cables etc, and data transfer to your PC, please refer to the "Data Logging and Transfer" manual.

1.4 Control System

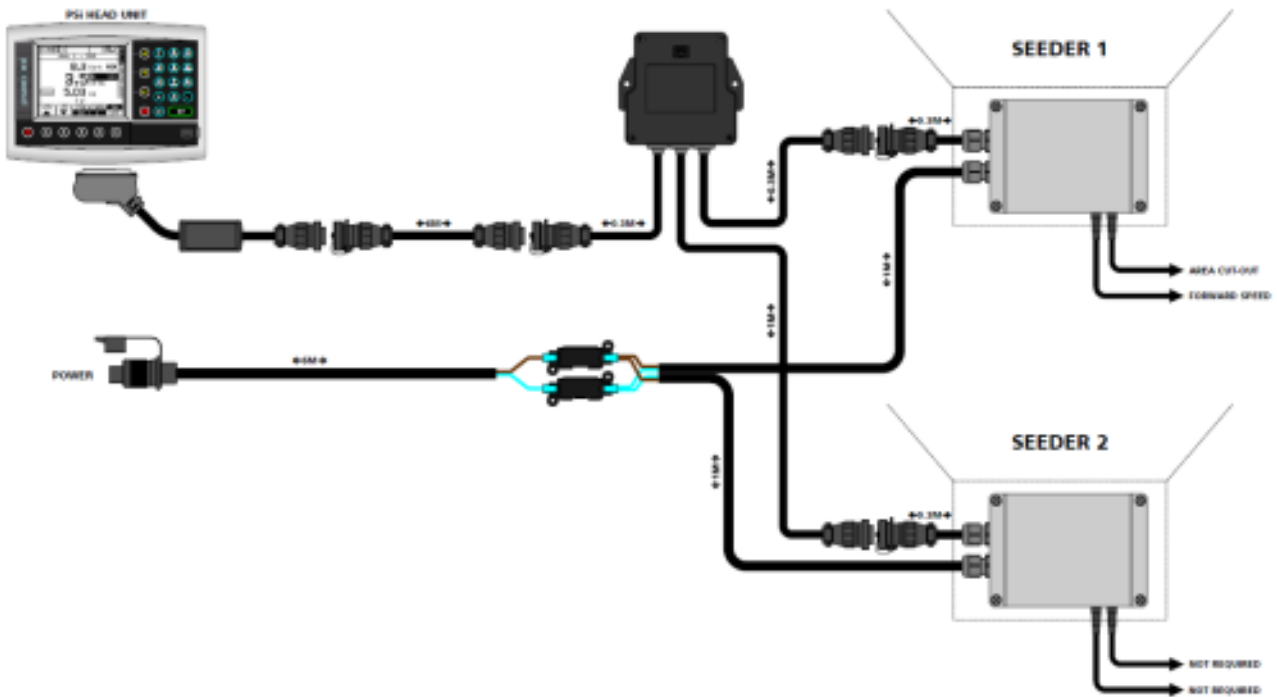
Closed loop control

The *MAC8000i* is a multi channel controller, operating a control system comprising of either a motor encoder, a flow sensor or pressure sensor, and one of several types of control valve or PWM output to enable closed loop control.

Proportional control

Also, forward speed measurement enables full *proportional* control, i.e. to maintain a set application rate irrespective of forward speed (within limits).

The forward speed sensor may be fitted either to the tractor or to the implement. It may be either a simple magnetic sensor measuring wheel or propshaft rotation, or a radar sensor. Speed measurement via a GPS VTG message is also an option.



System configuration

The *MAC8000i* can be configured to accurately control an applicator, via a range of settings made in the calibration menu on initial installation. These settings are normally made by a technician, and should not need to be adjusted during normal operation.

During normal operation, the operator needs only to set/calibrate the system for the product being applied and the metering rolls fitted. The operator can also 'fine-tune' the product calibration to account for variations in field conditions. These calibration procedures are described in this manual.

1.5 Control Modes

1.5.1 Automatic Control Mode

This gives fully automatic application rate control. Motor Speed is automatically regulated as forward speed varies, to ensure that the actual application rate constantly matches a preset target rate. The application rate can be manually nudged up and down from the target rate as required for spot application in specific areas. Programmable alarms warn of high and low application rates.

Field data ("job summaries") can be logged and are stored in the instrument memory. Up to 75 summaries can be stored. If you have a GPS receiver connected, as well as creating a job summary, you can also log the vehicle route and application data to a "dynamic log" file on the SD memory card. The job summary data is also appended to this file, which can be viewed using PC-based Precision Farming software programs.

1.5.2 VRT (Variable-rate treatment) Control Mode

This enables the system to be controlled via treatment instructions prepared using PC-based Precision Farming software programs, in conjunction with DGPS position data. To enable fully automatic variable-rate treatment for Precision Farming applications, the *MAC8000i* requires a suitable DGPS receiver and suitably formatted SD memory, card to implement treatment plans generated using PC-based Precision Farming software programs.

A work record file is automatically created on the SD card to log data confirming the actual treatment. The job summary data is also appended to this file, which can be viewed using PC-based Precision Farming software programs. Please refer to the "Data Logging and Transfer" manual Pt No. S/DC/500-10-573 for details of DGPS installation, setup and data transfer with the PC.

1.6 The Head Unit Keypad

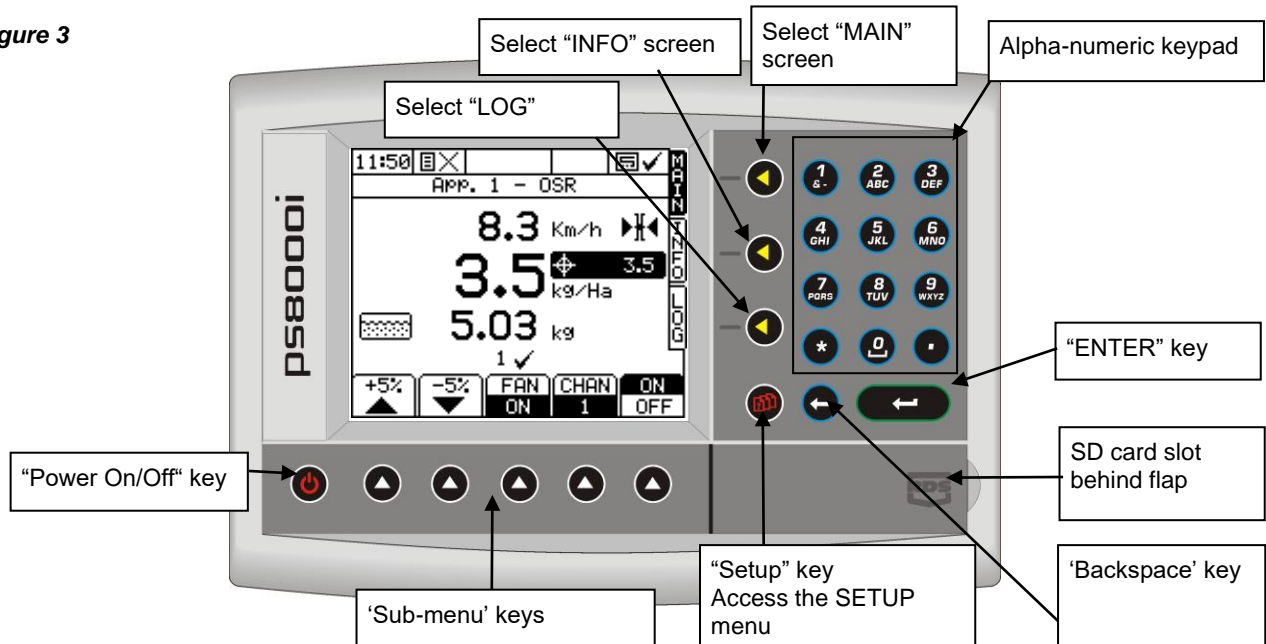
1.6.1 Menu keys

All instrument functions are accessed via the menu keys adjacent to the LCD display.


The four menu keys to the right of the screen (figure 3) access the primary screen pages (those viewed during normal operation). There are three primary screens, MAIN, INFO and LOG for normal operating functions, and a SETUP screen for calibration functions.

The five sub-menu keys below the screen control the various display functions and settings for each of the primary screen pages. Text or icons are displayed adjacent to the sub-menu keys to denote their function.

Figure 3





1.6.2 Startup


Press the  key. The startup screen, which shows the software version, will display for about 8 seconds then the MAIN screen is displayed.


1.6.3 Data Entry

Alpha-numeric values are entered via the right-hand keypad. You must press the key from 2 to 5 times to select the required letter. (Some keys have additional special characters not shown on the key legend).

The  key will either toggle between lower and upper case characters, or when preceding a numerical entry, sets a MINUS value.

The  key will toggle between 0 and a SPACE.

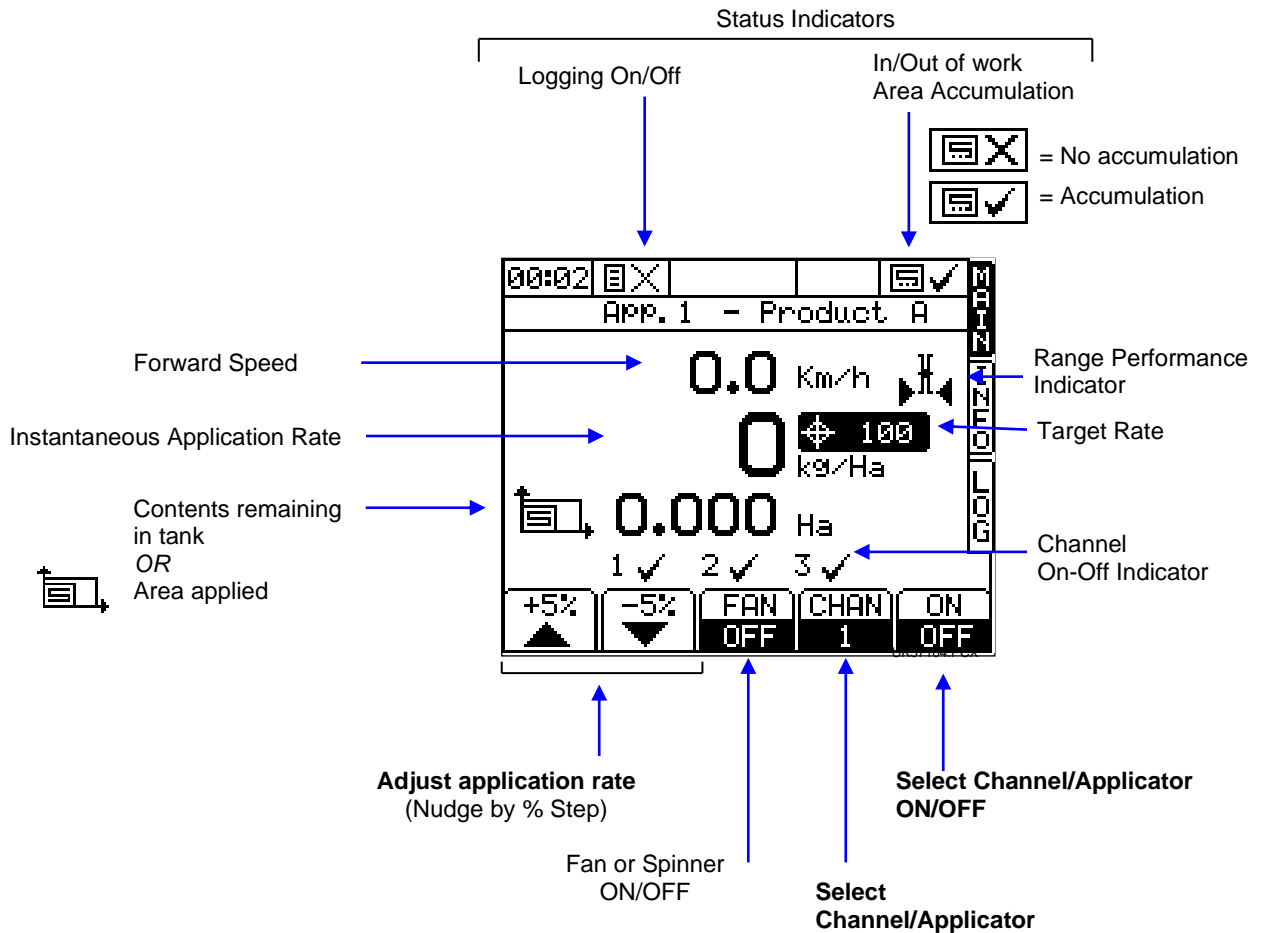
The  key will BACKSPACE the screen cursor if you need to re-enter a character.

The  key is the ENTER key and is normally pressed to confirm the data entry into memory.

1.7 The MAIN screen page

The instrument will always default to the MAIN screen on startup. The MAIN screen displays the following information.

Figure 4

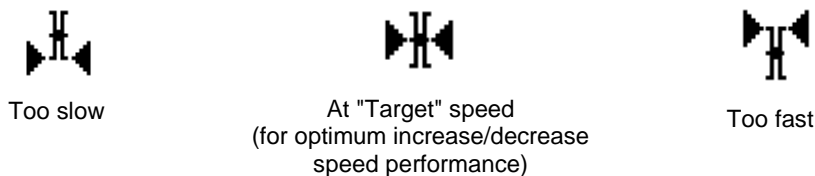


1.7.1 Target Rate Indicator

The target rate is displayed by the graphic. If the application rate has been adjusted above or below the target rate, then the target rate will be flashing.

1.7.2 Range performance Indicator

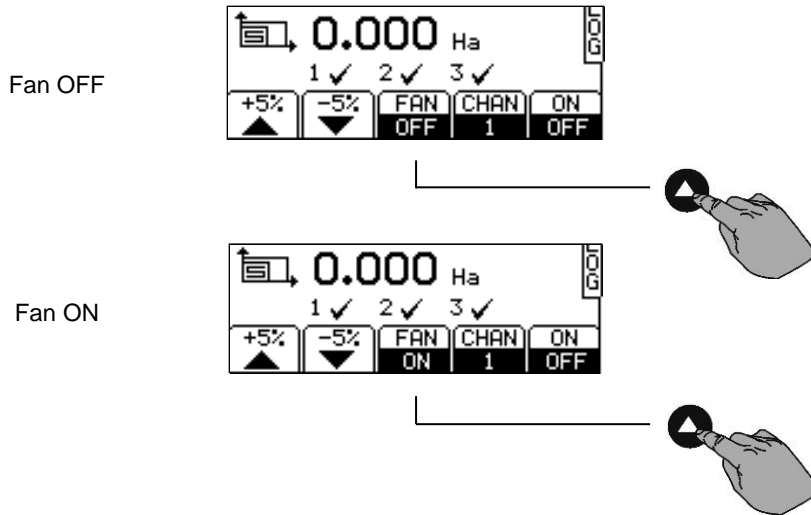
The Range performance Indicator shows what percentage of the output the system is currently applying at. The "Target Speed" is at the middle of the speed range.



For optimum performance and range you should maintain your forward speed as close to the "target" speed as possible.

1.7.3 MAIN Screen Display Options

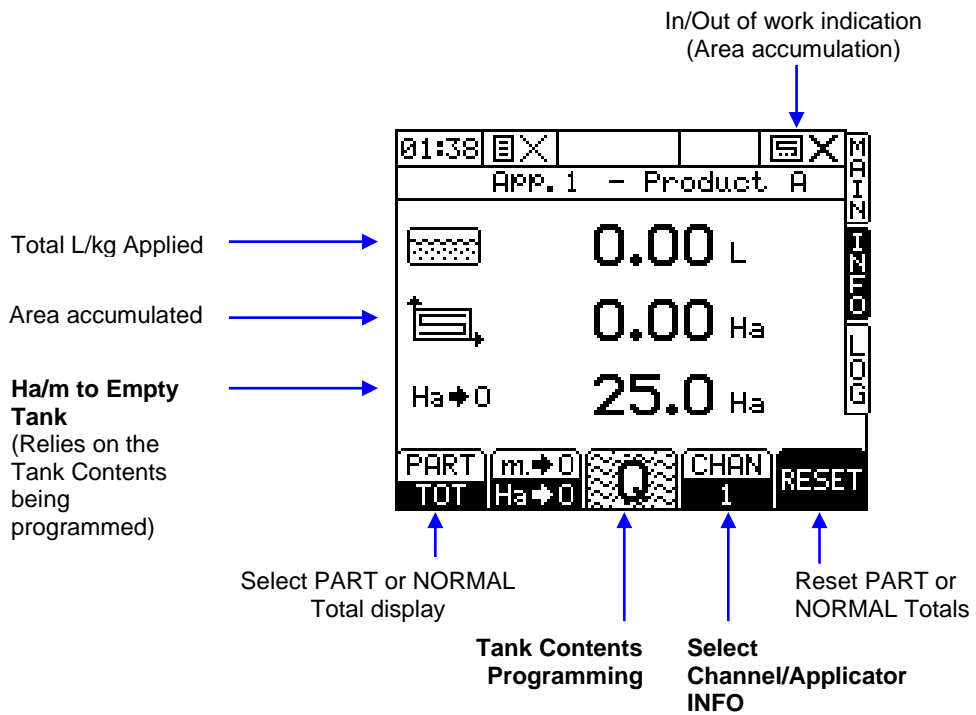
Depending upon the setup, you can switch the distribution output (Electric Fan, Spinner, Hydraulic Fan) On and Off using the on screen buttons.



1.8 The INFO screen page

Additional work measurement functions are displayed on this page.

Figure 6 The INFO screen





1.9 The LOG screen page




This page controls data logging (Field Summary data), and P.F. functions, and data transfer (e.g. printing a job summary).

Figure 7 The LOG screen

Data Card Status:

-  = Insert data card
-  = Logging

GPS Status:

-  = No position
-  = position/ no diff.
-  = position / full diff.

Select GPS Status screen

Select and review / clear / print summary data for stored jobs

Start / End logging

Please refer to the "Data Logging and Transfer" manual for further information.

1.10 The SETUP screen page


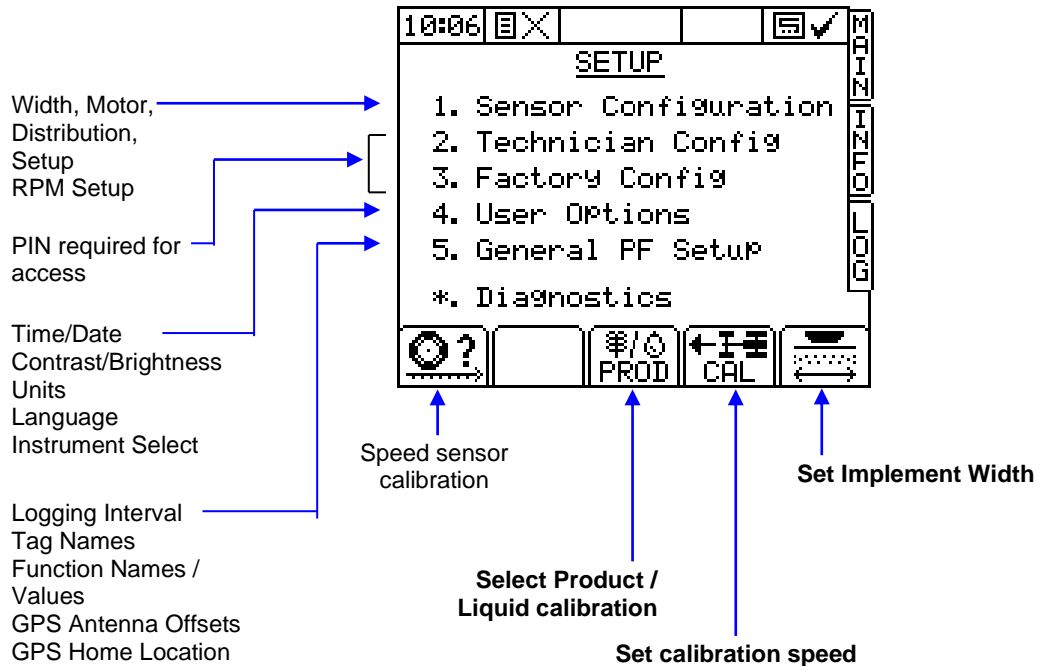
The  key selects the SETUP menu for calibration factors and calibration settings specific to particular products being applied and applicators.

Figure 8 The SETUP screen



You should not need to enter menus 1, 2 and 3 in normal use. These settings are generally made only on initial installation. Menus 2 and 3 can be protected with a personalised PIN number to prevent unauthorized access. Calibration settings that need to be changed during normal use are shown on figure 8.

1.11 Units

Information can be displayed in Metric or Imperial units by selecting the desired option via the SETUP menu.

| Function | Units | |
|--|----------------------|--------------|
| | Metric | UK Imperial |
| Forward Speed | km/h | miles/h |
| Application rate | litres/ha | gallons/acre |
| | kg/ha | lbs/acre |
| | tonnes/ha | tons/acre |
| | seeds/m ² | seeds/acre |
| Part/Total Area | hectares | acres |
| Tank volume/ Part/Total volume applied | Litres | Gallons |
| | kg | lbs |

1.12 Forward Speed Sensor

1.12.1 Select Sensor Option


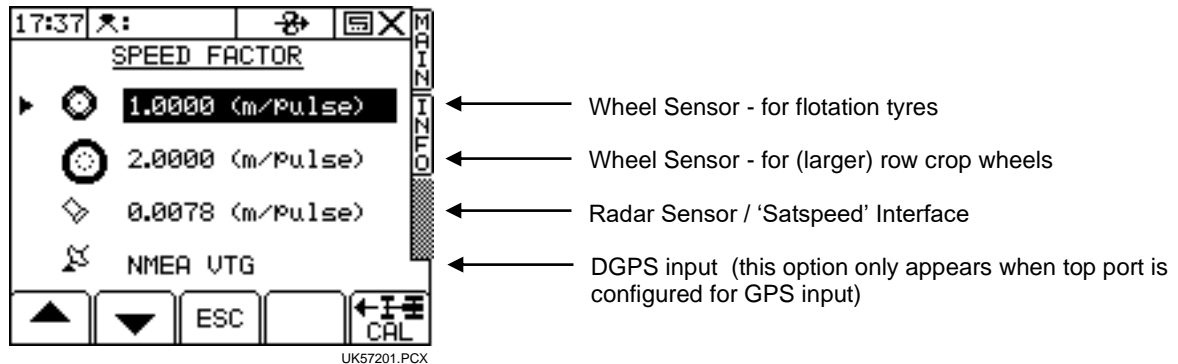

- From the SETUP screen, press  to select the "SPEED FACTOR" screen (fig. 1b).

Figure 1b



- Move the arrow cursor to select the option and press  to confirm.


1.12.2 Wheel sensor calibration – 'Autocal'


If the tractor has a standard wheel sensor and magnets installed, you can programme the instrument with two speed sensor factors - for flotation tyres and for row crop wheels. Remember to select the appropriate factor after changing wheels.

The Speed Sensor Factor ("SSF") is the distance travelled forward from the forward speed sensor. This could be calculated based on the nominal tyre diameter or rolling distance and then entered manually (ref. section 1.1.3), however this does not take into account wheel slip, compaction, or tyre deformation under practical operating conditions.

The best method is to do an "Auto Cal".

Mark a set distance of 100 metres (or 100 yards depending on the units set on the instrument) by suitable means. The surface should be representative of the average field conditions (i.e. not a paved surface). Position the vehicle with the first marker level with a suitable reference point on the vehicle.

With the appropriate sensor option highlighted on the "SPEED FACTOR" page, press ENTER, then select "Auto Cal". Press  and then follow the screen instructions.

Stop the vehicle when the second marker lines up with the pre-determined reference point on the vehicle and press  to end the "Auto Cal" procedure. The Speed Sensor Factor is automatically re-calculated and stored in memory.

NOTE: If you overrun the marker, do not simply reverse - repeat the "Auto Cal" procedure from the beginning.

1.12.3 Wheel sensor calibration - manually calculating the Forward Speed Factor

The smaller the speed sensor factor the better the speed update will be. Aim for a factor less than 2.000 m (78.78").

NOTE: Perform the following calculations in inches or metres depending on whether the instrument is set for Imperial or Metric units. If you calculate the factor using any other unit of measurement e.g. feet or centimetres, the forward speed display will be incorrect.

- If a single magnet is installed (as with a standard Propshaft Sensor kit)**, the distance travelled for each turn of the prop shaft must be determined. To determine this distance, drive the vehicle forwards for exactly **10** revolutions of the prop shaft. Measure this distance (in inches or metres) and divide by **10**, to find the Speed Sensor Factor.
- If 2 magnets are installed (as with a standard Wheel Sensor kit)**, the distance is 1/2 the effective rolling circumference of the wheel. To determine this circumference, drive the vehicle forward in field conditions (with the implement attached if applicable), for exactly **10** revolutions of the sensed wheel. Measure this distance (in inches or metres) and divide by **20** to find the Speed Sensor Factor.
- If 4 wheel magnets are installed**, the distance is 1/4 the effective rolling circumference of the wheel. To determine this circumference, drive the vehicle forward in field conditions (with the implement attached if applicable), for exactly **10** revolutions of the sensed wheel. Measure this distance (metres) and divide by **40** to find the Speed Sensor Factor.

Carry out this test whenever soil conditions or wheel sizes change.

If the calibration factor works out at over 2.000 m (78.78 inches), consider fitting additional magnets. Extra magnets are recommended if the vehicle has large diameter wheels or is slow-moving. In extreme circumstances you can find that the speed keeps going to zero as it times out before the next pulse arrives.

Number of magnets required

The table gives the number of magnets required to enable a speed update of approximately 1 Hz or greater on the display.

| Tyre diameter | Typical speed in normal operation: | | |
|---------------|------------------------------------|------------------------------|----------------------------|
| | up to 5mph (8km/h) | 6 to 9 mph (9 to 15 km/h) | 10mph (16 km/h) or over |
| 12" (0.3m) | 1 | 1 | 1 |
| 24" (0.6m) | 1 | 1 | 1 |
| 36" (0.9m) | 2 | 2 | 1 |
| 48" (1.2m) | 4 | 2 | 2 |
| 60" (1.5m) | 4 | 4 | 2 |
| 72" (1.8m) | 4 | 4 | 2 |

Example Calculation

A vehicle is fitted with a single magnet mounted on the propshaft. The measured distance for 10 rotations of the sensed wheel is 47'-6".

1. Convert the distance to inches :- $(47' \times 12") + 6" = 570"$
2. Divide by 10 (magnet pulses) to give the calibration factor:- $570" / 10 = \underline{57.0}$
3. Programme the factor '057.0' as described overleaf.

1.12.4 Radar Sensor / SatSpeed


If a Radar sensor is installed at the correct angle of $45 \pm 1^\circ$, the Speed Sensor Factor is **0.0078** m (or **0.312** inches). It is still recommended to do an 'Autocal' since the sensor may not be mounted exactly at 45° .

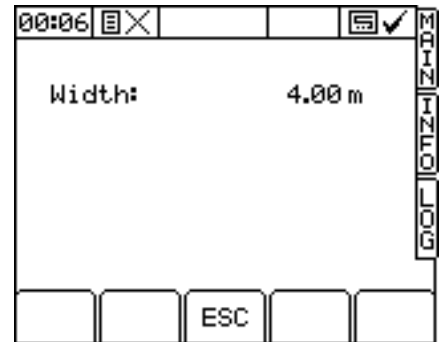
1.12.5 NMEA VTG Input

No calibration is necessary. The GPS must be enabled in the PF Setup in order to use the NMEA VTG option for forward speed.

1.13 Width Configuration

1.13.1 Programming implement width

Press the  button on the main SETUP page
Enter the width of the implement in metres.



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1.14 GPS Configuration

1.14.1 To enable the GPS to be used

From the main SETUP menu, select option 5 GENERAL PF SETUP




Select 6. Ports Setup → using the arrow keys below the screen, set the TOP PORT to 'GPS Only'.

If using a GPS 16, select 5. GPS Baudrate and ensure that the baud rate is set to 9600. If a different GPS is being used then this speed must be established prior to configuration.

If the GPS is communicating correctly then a tick will be shown in the top header bar.



GPS Status:

-  = No position
-  = position/ no diff.
-  = position / full diff.

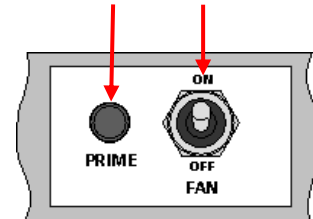
2. Operation

2.1 Product Calibration

Ensure the feed roll setup is appropriate for the intended seed type, application rate and forward speed range for application.

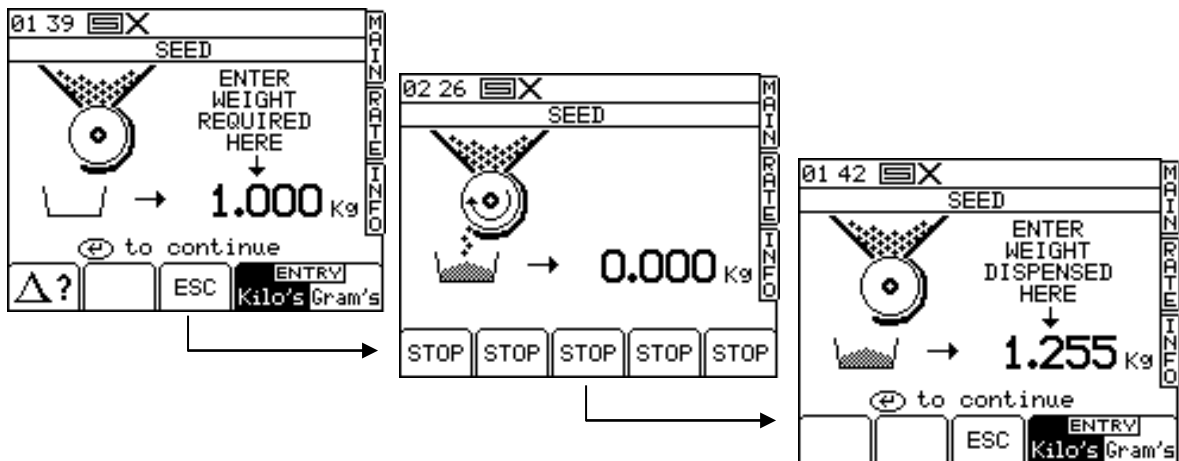
Switch the 'FAN' switch to the off position on the junction box. This enables the product calibration function.

Place a container under the seed outlet of the metering unit then press and hold the PRIME button to dispense the product.

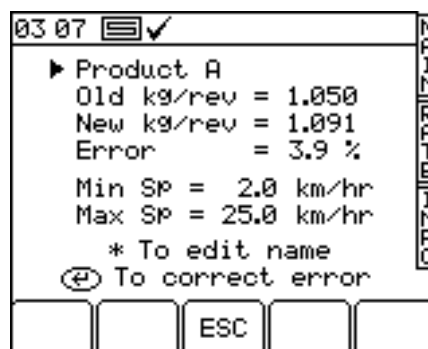


The instrument automatically switches to the calibration mode, and the display will count up the theoretical weight (in grams or kg) of product based on the calibration factor currently stored in memory.

Once you have dispensed sufficient product, release the priming switch and weigh the product metered out. The theoretical weight will be displayed on the screen. Weigh the contents of the container, and then enter the *ACTUAL* weight dispensed and press ENTER to confirm.



Press ENTER again for the instrument to re-calculate and display the new calibration factor in kg/rev, the error %, and the maximum forward speed that is permissible based on the application rate set for the product.



Press ENTER again to confirm and store the new calibration factor, or press ESC to return to the SETUP menu screen.

If using more than one channel and a product name is also required then this can be entered by pressing the * key and using the Alphanumeric keypad to enter the product name.

2.2 Dual Product Machine Calibration

2.2.1 Calibrating for two Products or Applicators

The same routine as in 2.1 must also be carried out for the second or third applicator, even if the same product is being applied.

After calibrating the instrument will display a minimum and maximum forward speed that it can achieve the programmed target rate at. Alarms will be shown on the MAIN page if the forward speed is outside of these targets, for either channel.

2.2.2 Editing a product name after calibration

The default product descriptions are 'Product A', 'Product B' and 'Product C'.

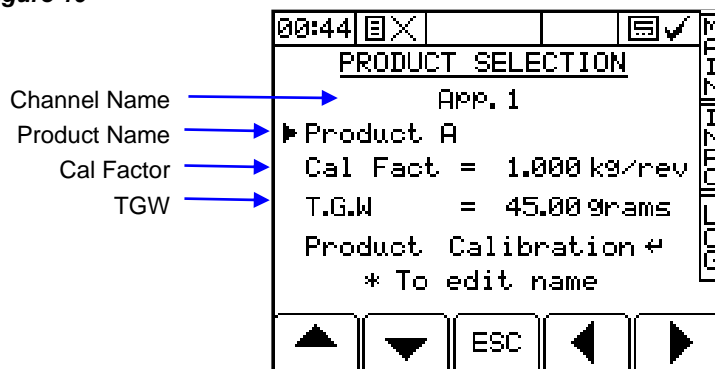
From the 'PRODUCT SELECTION' screen, press the  key to select the 'PRODUCT NAMES' screen (fig. 14b).

Select the product name using the arrow keys, and edit the name using the alpha-numeric keypad.

2.2.3 Product Page

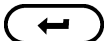
- From the 'main SETUP MENU, select the Product page 

Figure 10





2.3 Automatic Rate Control


2.3.1 Setting the Target Rate


From the "MAIN" screen simply key-in the desired target rate and press .

2.3.2 Overriding the Target Rate

- Press   to override the target rate.

The preset target rate can be overridden in $\pm 5\%$ steps while working.

While overridden, the target rate indicator  will flash.

- Press  to return to the target rate.

The instrument will automatically alarm if the application rate cannot be maintained within a specified % of the target rate (the % band is programmed via the 'Alarm Setup' screen in the Setup MENU).

When the alarm threshold is reached, the instrument beeps, and an alarm screen displays the message "UNDER APPLICATION" (e.g if the forward speed is too high), or "OVER APPLICATION" (e.g. if the forward speed is too low).

Pressing any of the lower 'OK' keys will cancel the alarm screen and return to the 'MAIN' operating screen.

2.4 Hopper Contents


The PS8000i automatically calculates the quantity of product remaining in the hopper. The calculation is based on the full hopper volume programmed via the "INFO" screen. You can also programme an alarm threshold so that the instrument will warn you when the hopper volume is getting low.

When the alarm threshold is reached (e.g. 5 kg), the instrument beeps, and an alarm screen displays the message '**HOPPER LOW**'. Press any of the lower 'OK' keys to cancel the alarm screen and return to the 'MAIN' operating screen.

The screen will change to show the alarm screen and the message '**HOPPER EMPTY**' once the hopper contents register reaches zero.

These alarms can also be triggered by using a hopper level sensor installed in the base of the hopper, this method however will have no effect on the Ha→ 0 reading on the INFO page.

2.4.1 Hopper fill

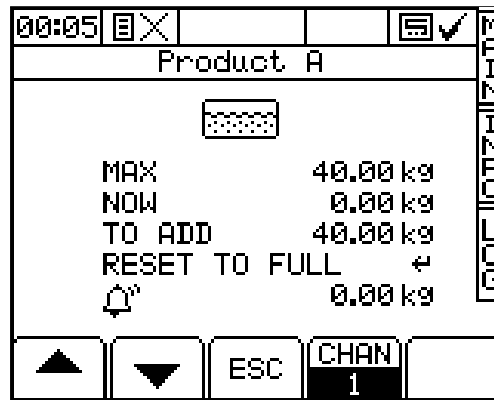
1. Refill the hopper to the desired level.
2. Select the "INFO" screen and press  to access the HOPPER FILL screen (fig. 16). The screen will display,

"MAX" - the full hopper contents


"NOW" - the contents remaining in the hopper

"TO ADD" - contents to replenish

Figure 16 Hopper fill screen



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1. If refilling the tank to capacity, then select '**RESET TO FULL**' and press ENTER.
2. Confirm that "**MAX**" corresponds to the quantity in the tank. Adjust as necessary.
3. If partly filling the tank, select '**NOW**' and enter the part volume in the tank, then press ENTER.
4. Confirm the alarm volume () is OK (typically the quantity needed to seed a single bout). Adjust as necessary.

2.5 Part / Total Accumulation and RPM display

You can record the area and volume sprayed for a particular job using the "PART" Total function. In addition the area and volume will be recorded to the "TOTAL" memory register.

Select the "INFO" screen to display the accumulated totals and the RPM display.



Select 'PART' to display the Part Area and Part Volume accumulation,




Select "TOTAL" to display the Total Area and Total Volume accumulation.

2.5.1 Reset Totals

Select the "PART" or "TOTAL" display.

Press the **RESET** key.

Press  to zero the totals or press **ESC** to return to the "INFO" screen.

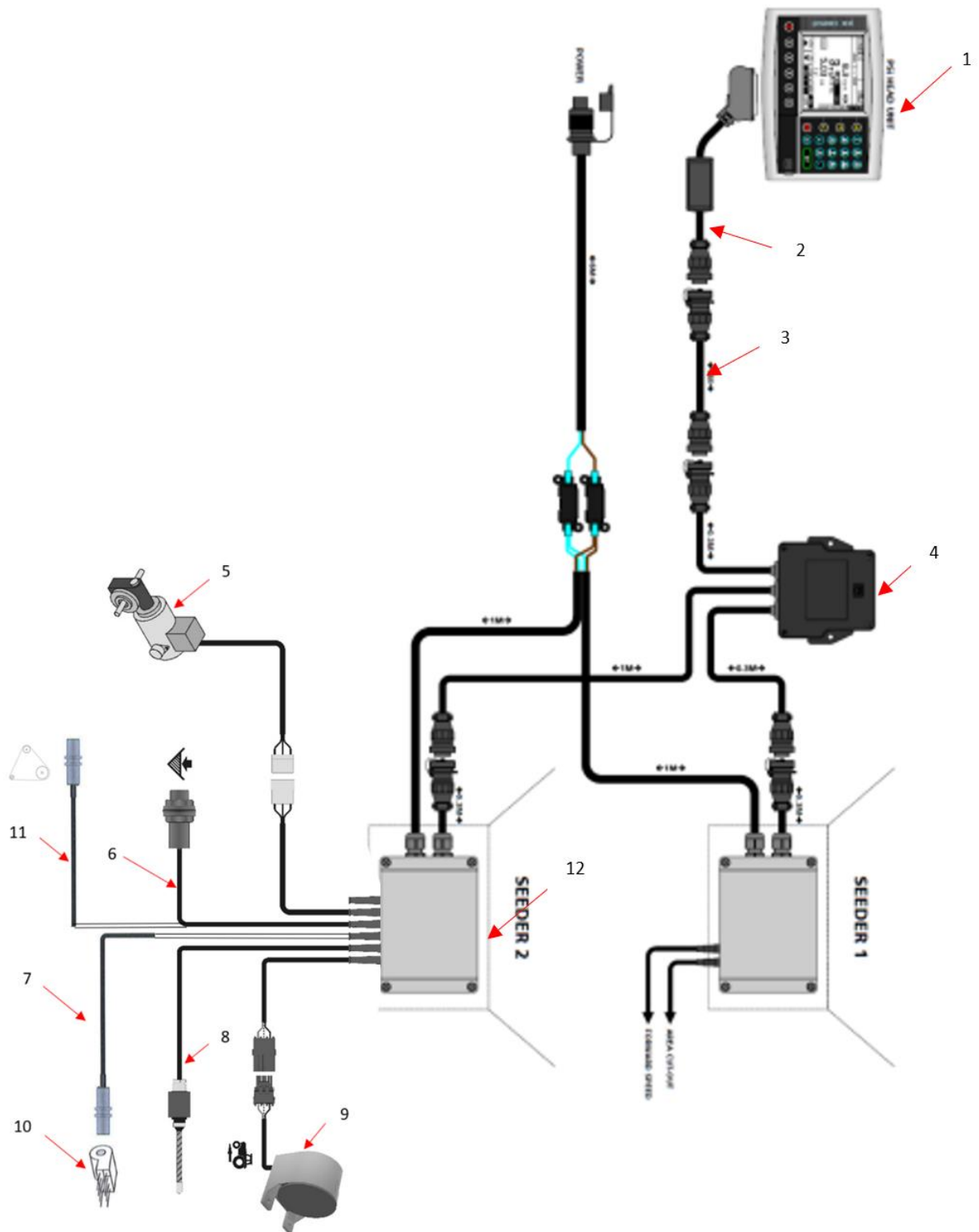
2.6 Alarms

There are a number of alarms, most being programmable by the operator. Note that setting alarm limits to zero will disable that alarm function.

Press any of the lower 'OK' keys to cancel an alarm and return to the MAIN screen. The Channel that the alarm is applicable to will be shown at the top of the page.

| | | |
|---|---|--|
| Application Rate | 'UNDER APPLICATION' 'OVER APPLICATION' | This alarm is based on % variance from the target rate. It therefore alerts the operator to speed up or slow down until the alarm condition is cancelled. The limits can be set by the operator on the 'Alarms Setup' screen in the SETUP menu. The default limits are $\pm 20\%$ of the target rate. |
| The following alarms can also be configured if so desired, but would normally be overridden by the application rate alarm if set (except for RPM alarm). The limits must be set in respect of flow sensor capacity / spray performance. | | |
| Forward Speed | 'FORWARD SPEED LOW' 'FORWARD SPEED HIGH' | These will be defined by the product calibration factor, the application rate and the width of the machine. These will be shown after a product calibration. |
| Fan Alarms <i>(When using electric fans)</i> | 'FAN OFF' 'FAN FAIL' | 'FAN OFF' will be shown if the machine is in work and has a forward speed but the fans have not been enabled/switched on. This could be either by not switching on screen or by the toggle switch on the junction box. 'FAN FAIL' will be shown if the fans stop while in work. This could be due to a connection issue or fan failure. |
| RPM | 'RPM LOW' 'RPM HIGH' | If using spinners or hydraulic fans. The limits can be set by the operator on the 'RPM Setup' screen in the SETUP menu. |

3. Spare part list



| Pos. | Item no. | Designation |
|------|-----------|---|
| 1 | 0520549 | Monitor |
| 2 | 0520560 | Monitorcable L=2600 (new model) |
| | 0520570 | Monitorcable L=2100 (old model) |
| 3 | 0520496 | Extension cable 4m |
| | 0520477 | Extension cable 6m |
| | 0520497 | Extension cable 9m |
| 4 | 0520582 | Junction box |
| 5 | 0520474 | Motor |
| 6 | 332052778 | Sensor f/tank capacity |
| 7 | 0520305 | Fan sensor |
| 8 | 0520464 | Switch RDS |
| 9 | 0520462 | Radar |
| 10 | | Fan (hydr) Spare part numbers is in Multi-seeder spare parts book |
| 11 | 332052777 | Sensor f/metering roller |
| 12 | 0520489 | Junction box |
| 12a | 0520491 | PCB for 0520489 |

