Tillett and Hague Technology Guidance and Control System Brief Operators Guide

Inter-row

Disclaimer:
Considerable effort has gone into making Tillett and Hague guidance and control systems reliable under normal commercial conditions. However, it is possible that under some adverse circumstances the guidance system will be unable to operate reliably. It is the operator's responsibility to ensure that the machine is operating in a satisfactory manner. Should a fault develop, or excessive crop damage occur, operation should cease and if necessary, advice sought from your dealer or implement manufacturer.

V10.18 February 2026

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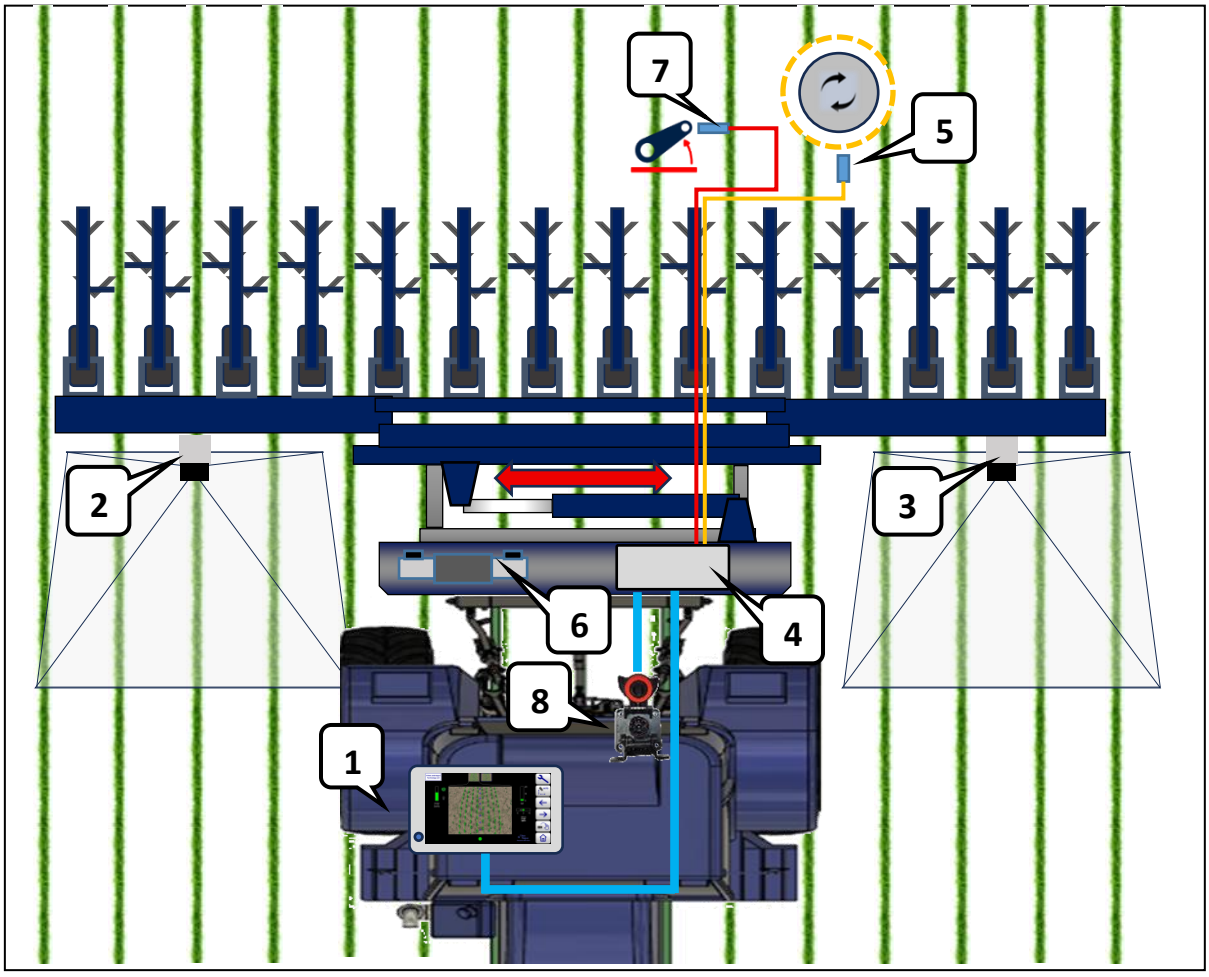
1. Product description

This vision guidance system analyses data from digital cameras to identify crop rows. Rows are tracked over successive images and their position be used to steer an implement laterally relative to those crop rows.

There are 4 main components to the system.

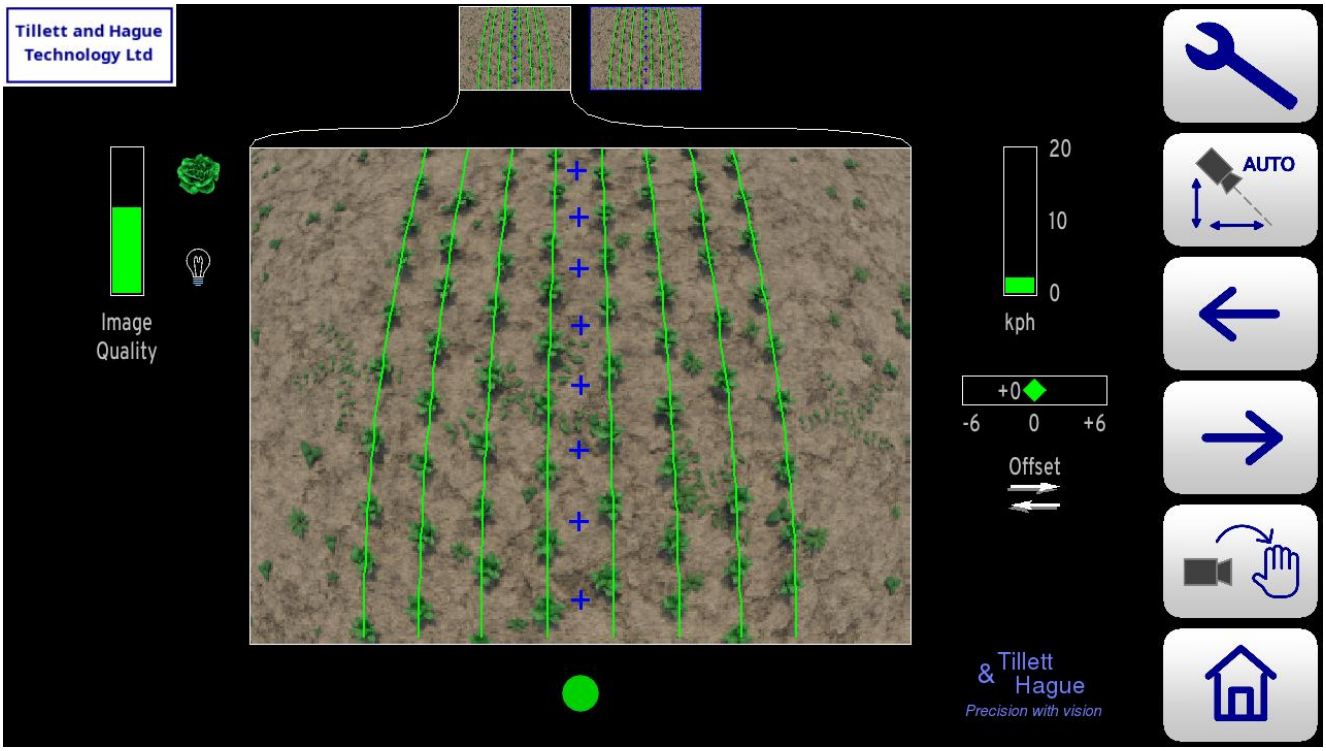
- A digital camera **(2)** or cameras **(2/3)** mounted on the implement looking ahead at a wide area of crop normally viewing several rows each.
- A cab mounted console **(1)** containing a computer to analyse camera images and find crop rows
- An implement mounted control box **(4)** housing an electronic board that controls hydraulic valves **(6)** for side shift or disc steering. That board also accepts input from position and proximity sensors **(5/7)** necessary for closed loop control.
- Some systems also have a ISOBUS connection capability **(8)** for lift and odometer inputs.



Schematic of a rear mounted inter-row guidance system with side shift

The system uses a colour camera to pick out green crop and weed from backgrounds containing soil, stones and trash. (Systems can also be configured to work in crops of other colours.) Crop plants are located within a scene by matching a template corresponding to the known planting pattern with crop plants as they appear in the camera image. That image is displayed live on the console with crop row template overlaid as green lines.

Live video display allows users to check for a good match between template and actual crop geometry, which is important for accurate row following.



Console working screen showing a typical live video image for a 2-camera interrow machine with the green template lines superimposed with 8 blue template match indication crosses up the centre of the camera view

2. Safety

1. Machines should be operated under general safety and accident prevention regulations.
2. The operator is responsible for safe operation of the machine even when automatic steering is operating.
3. The guidance system is only intended to guide agricultural implements within agricultural fields.
4. When carrying out repairs or adjustments to an implement, ensure that that the hydraulic supply is **OFF**, and hydraulic pressure is **ZERO.**
5. Never conduct maintenance work on a side shift mechanism while it is supporting the implement.
6. Side shift and steered disc mechanisms form pinch, trap and shear points. Be aware of these when carrying out maintenance.
7. Regularly check the condition of electrical cables, hydraulic hoses and fittings.
8. Do not allow other persons to ride on or work near an implement when it is in operation.
9. Ensure that the 12V supply is fused appropriately (20Amp max).
10. When routing the loom and power supply cables ensure that they do not cause a restriction or trip point in the cab.

3. Information screens

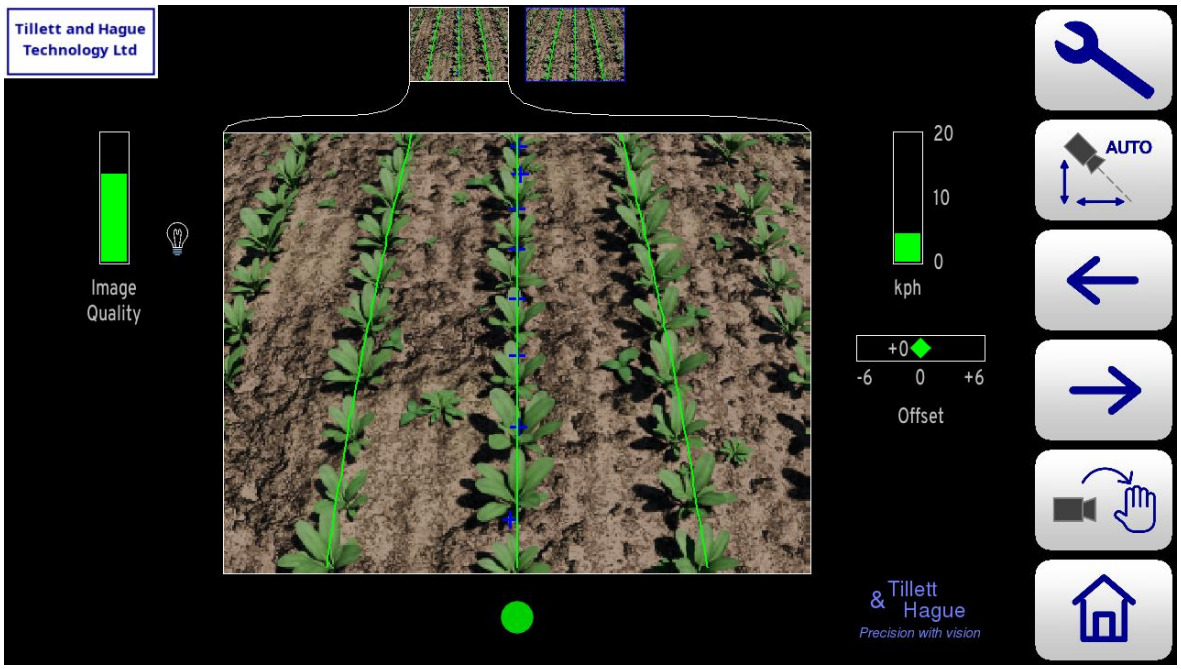
Home Screen

Switch the console on by pressing the button for a second or two until the button is illuminated. Wait for the system to “boot up”. After a few screens of PC boot up text the start up screen should appear.

From this screen you have the option to enter the Inter-row working screen (Three **green** crop rows symbol), Service Tools Menu (Spanner and screwdriver symbol) or the Configuration File Editor (Pen and paper symbol). This abbreviated version of the manual only covers the working screen. For more information consult the full reference manual.

Use the touch screen button with a 3 crop rows symbol to enter the inter-row working screen.

Working Screen

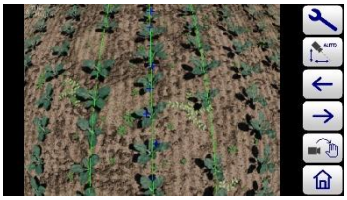


The inter-row working screen has the following features**:**

- Live video over which are superimposed two sets of markings. The first are **green** lines representing the template to which crop rows are matched. The second are a series of eight crosses arranged in the centre of the image. These represent how well the template lines up at different levels up the image.
- **Blue** crosses indicate a good match. 

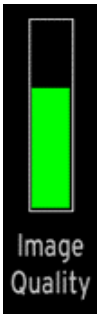
- **Yellow** and **red** crosses indicate a poor match. 

- Systems operating with multiple cameras will display live thumbnail video along the top of the display.
  - Touching thumbnails selects them for full size display.
  - Briefly touching on the main video images switches to a full screen video mode. Guidance continues in this mode, but the information symbols, speed, position indicator etc are obscured. Touching again reverts to the normal size image.

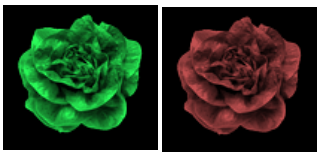


  - Pressing and holding on a camera image with a multicamera implement turns off the tracking from the selected camera displaying a large red "X" over that image. To restart guidance from the selected camera press and hold again to remove the "X".

- An image quality gauge to the left of the screen giving relative indication of likely tracking performance. The higher the green bar the better. A low bar indicates either a poor template match or poorly defined crop plants. Guidance will, under most circumstances, operate down to an indication of approximately 20% albeit at reduced accuracy.



- If a crop colour option is activated a plant symbol is shown at the top and to the right of the image quality gauge. The colour of the plant symbol indicates the current colour choice. Touching on the symbol pops up a screen that allows you to change that choice. This option is only beneficial in a small number of minority crops.



- If lights are configured a light bulb symbol is shown at the bottom right of the image quality bar. Touching the symbol turns lights on and the bulb yellow.

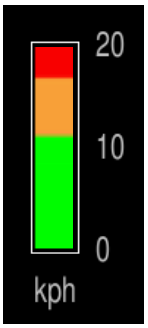
- Information symbols at the lower left of the display:
  - A warning triangle indicates poor tracking. If it is displayed with a horizontal double headed arrow lateral implement position error is estimated to exceeds 25mm.

  - If enabled the warning triangles will be accompanied by an audible warning.

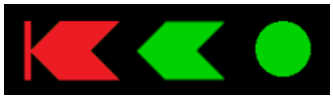
- An implement lift symbol is displayed if the lift sensor detects the implement is lifted.

- A circular red braked symbol is displayed if the implement is down but not moving.

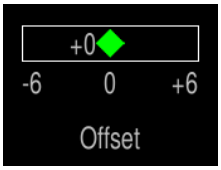
- A speed gauge on the right shows forward speed and should match tractor speed. The speed bar is normally green, an amber section indicates the machine is operating at over 75% of maximum speed and a red section indicates over speeding.



- A green dot and red/green chevrons below the image indicate side shift or slide position. A red chevron with a vertical bar indicates the limit of travel has been reached. This should not be allowed to occur for extended periods.

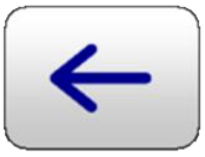


- The fine offset gauge shows the amount of left or right bias set by the user. This is used to compensate for minor lateral camera misalignment, but can also be useful on side slopes.

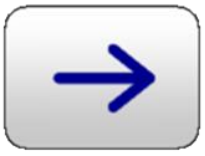


- The fine offset flip symbol, activated in the advanced setup screen, allows quick reversal of fine offset. Useful when changing direction of travel on side slopes or in crops blown by a cross wind for example.

- "Left arrow" moves fine offset left 1cm, or when in manual mode, side shifts/steers 7% of total stroke to the left.



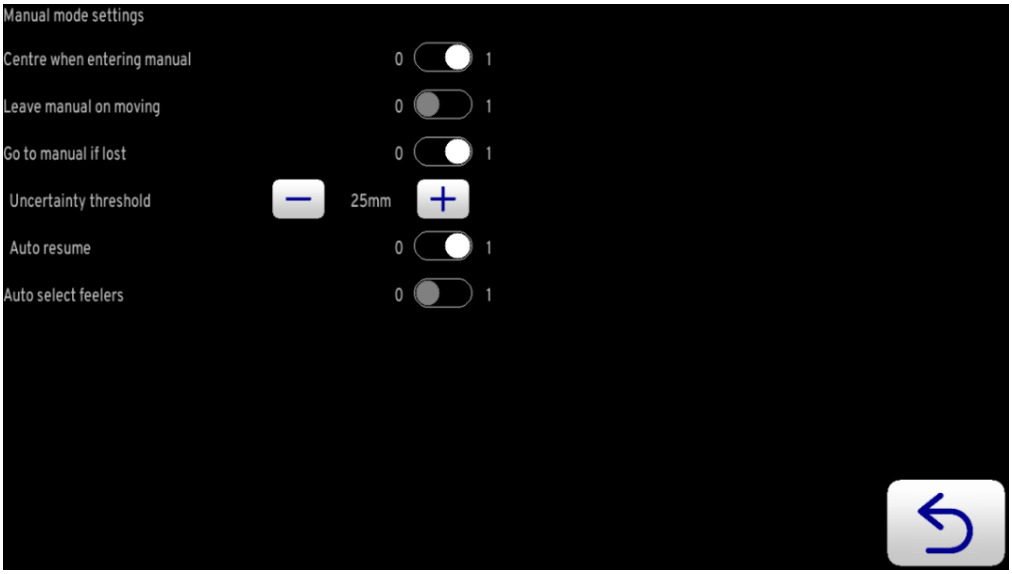
- "Right arrow" moves fine offset right 1cm, or when in manual mode, side shifts/steers 7% of total stroke to the right.
  Note
  Arrows appear thicker when in manual mode



- **Briefly** touching the button with a Camera ↷ Hand symbol enables manual mode and disables vision guidance. The fine offset adjustment arrow buttons are replaced by thicker left and right arrow buttons. The user can manually steer the side-shift or steering discs to test their function. To avoid mechanical damage these functions only operate when lifted or moving.
  .

- Manual mode can also be used to set help set camera geometry. In manual mode the green template lines are displayed as a fixed grid along with a blue centre crosshair.

- Return to vision guidance by **briefly** pressing the same button which is now labelled with a Hand ↷ Camera symbol.

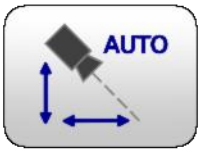


Popup manual mode settings screen

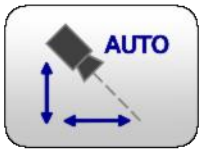
- **Touching and holding** that button pops up a manual mode settings screen enabling you to change default behaviours as described above. Options are turned on and off by touching on switch icons.
- See the reference manual for a full explanation of these options activated by touching on their toggle switches, The first two are the most likely to be required and are:
  - "Centre when entering manual" when **ON** ensures side shifts centre when entering manual mode. When **OFF** the side shift stays at its current position on entering manual mode.
  - "Leave manual mode on moving" in the default **OFF** position guidance stays in manual mode allowing you to make manual adjustments to side shift position whilst in work. Live camera video continues to be displayed so the operator can see if vision guidance is likely to be successful. If the switch is in the **ON** position guidance automatically drops into vision guidance mode when you start to move.

- For machines with a remote override manual control box the button displays a hand symbol when the box was switched on.

- For machines with mechanical guidance feelers the mode selection button cycles between manual mode, feeler and vision guidance.

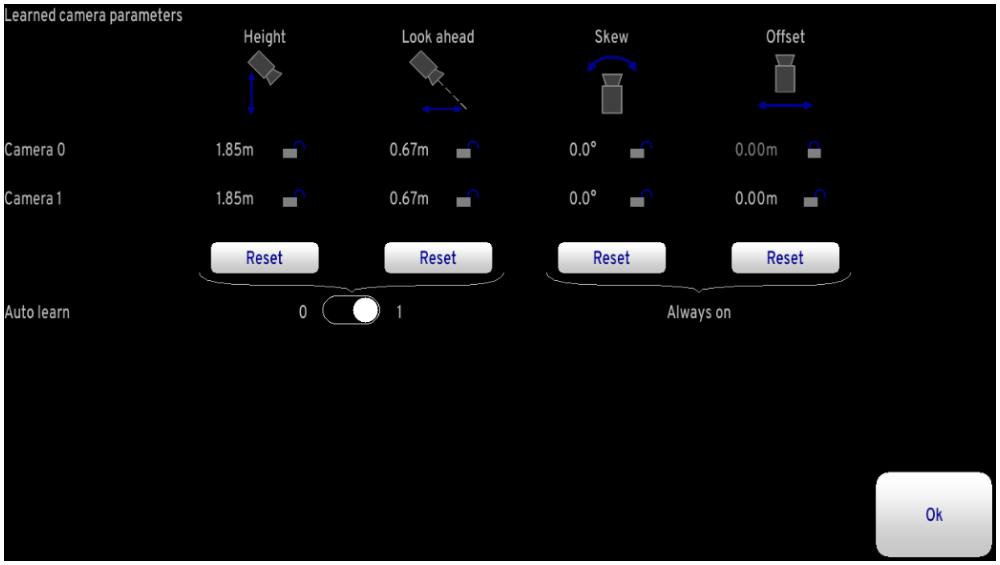


- **Briefly touching** the Auto-learn button introduces a small amount of flexibility to camera height and angle/look ahead parameters for the camera currently displaying the main image. The system automatically adjusts those parameters to give a better template fit for that camera only. Improving template fit will improve performance with respect to both accuracy and reliability.
  The auto learn function can be used whenever circumstances such as crop growth or deeper wheel ruts may have caused template match to deteriorate. It will work whilst either stationary or moving. For best results only trigger auto-learn on flat ground when crop rows are straight and clearly defined to reduce the possibility of learning from misleading scenes.



- **Touching and holding** the auto-learn button when moving has no effect, but when stationary opens a popup box displaying all four machine learned parameters. Those parameters are:
  - ***Camera height***, the height of the camera (measured from the camera lens) to ground level.
  - ***Camera lookahead***, a measure relating to camera angle to the vertical

- ***Camera skew***, a measure of camera angular misalignment in the horizontal plane.
- ***Camera offset***, the lateral error between two or more cameras fitted to the same section.



Popup learned parameters screen

For a full explanation of this page you are referred to the reference manual. It should not be required for normal operation.

Auto machine learning of camera skew and offset is compulsory for all systems, but auto-learning for camera height and lookahead estimation can be turned off using the touch toggle switch on the bottom line. Turning auto-learn off freezes parameters at their current learned values unless they are reset to configuration values. Turning auto-learn back on also resets to configuration values.

- The button with the house symbol returns you to the start-up screen.

- The button with the spanner symbol will take you to the setup screen.

Setup Screen

The setup screen allows operators to select which of the pre-loaded configurations they wish to run and adjust crop height to suit the crop conditions in the field. Settings are remembered between sessions.

Touching on the ***"Configuration"*** button allows users to select between alternative pre-programmed configurations for different crop planting geometries that require different templates. The main parameters of the chosen configuration are displayed at the bottom of the setup screen. They are:

Camera number (Note - camera numbers start at zero)

Number of rows being used for tracking and their spacing

Height - Distance vertically from camera lens to ground when in work

Look ahead – Horizontal distance along the ground from a point vertically below the camera lens to the centreline of sight (marked by cross hairs in "Manual" mode).

Ensure that an appropriate configuration file is selected before starting work. If such a configuration is not available, please ask your dealer to create one for you.

Touching on the ***"Crop Height"*** button and changing size range alters template size to compensate for the crop canopy getting closer to the camera as it grows. This avoids the need to physically adjust camera height when moving between crops of different heights. There are settings for small, medium and large crops. The definition of small, medium and large is scaled according to camera height in accordance with this table.

Camera Height	*"Small"*	*"Medium"*	*"Large"*
< 0.5m	0	5cm (2")	>10 (4")
0.5m – 1m	0	10cm (4")	>20cm (8")
>1m	<5cm (2")	15cm (6")	>30cm (12")

Advanced Settings & Diagnostics Screen

The advanced setup & diagnostics screen is accessible from the setup screen by pressing the button with the spanner ++ symbol. This screen provides test functions and displays some diagnostic information.

The top of the screen lists the implement software version, total running time and total area covered by that machine.

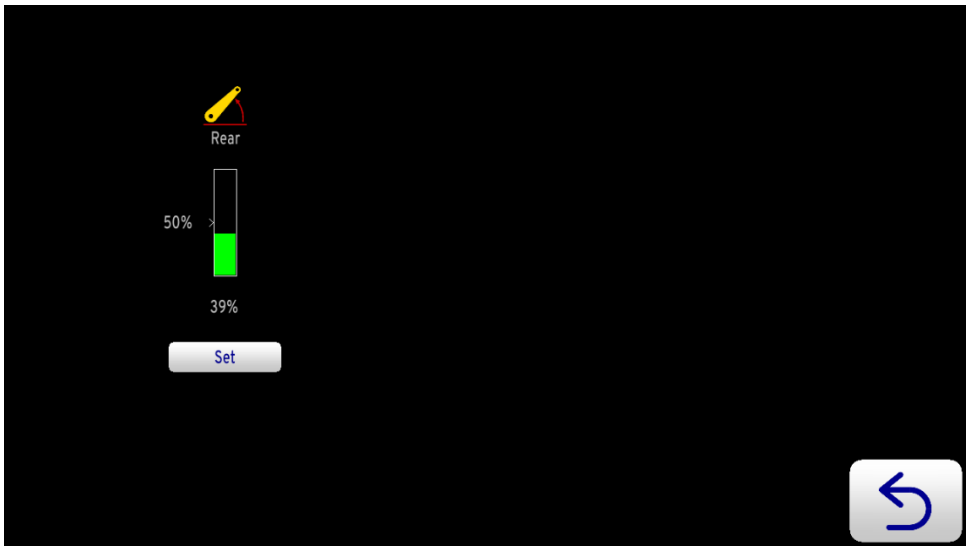
"Current Job" provides a resettable counter for elapsed time and area treated.

"Test Steering" this utility tests position sensor output, steering rate and calibrates steering direction. In the case of a successful steering test an "OK" message will be returned. If "too slow" or "too fast" messages are returned this could be due to insufficient or excessive oil flow. If a proportional steer valve is fitted, the steering test also calibrates the proportional valve flow characteristics.

Caution
Ensure steering mechanism is clear of obstructions and people before running.

"Units" toggles between metric and imperial units.

"ISOBUS Hitch Setpoint" (For ISOBUS connected systems only) this utility provides a means of adjusting the hitch transition point between in-work and out of work. The green vertical bar is a live representation of tractor hitch position read from the ISOBUS. Pressing the "Set" button changes the transition point to the current hitch position which is then displayed as a percentage of full stroke at the base of the bar.



ISOBUS popup screen for hitch position display and lift trigger point set

"ISOBUS Diagnostics" this utility allows for observation of live ISOBUS data. Useful in ensuring that connection between tractor and implement has been achieved and sensor data is available for implement operation.

The other settings listed on this screen relate to operating preferences and fault diagnostic information. Refer to your dealer or the full reference manual for explanation of these features.

4. Start-up Checks

Step 1 – Connecting the implement

Connect the implement to the tractor ensuring that the camera pole is vertical. For most situations you should ensure that there is no lateral movement in the 3-point linkage.

Mount the console in the tractor cab and connect to the implement so that the cable does not restrict cab access. Connect to the tractors fused 12V supply or the tractor's ISOBUS 12V/Communication socket.

Also connect the hydraulic hoses.

If the implement is lowered to its normal working position the "stopped" (red brake) symbol should be displayed on the working screen and the speed bar should read zero.

Step 2 – Checking Hydraulic Steering Operation

Set the tractors hydraulic control to provide a constant flow to the implement with the facility to disengage the supply immediately should a fault occur. Typically, side shifts only require about 10% of full flow.

Lift the implement clear of the ground. The side-shift or steered discs should centralise and the "stopped" symbol replaced by the "Lifted" (yellow lift arms) symbol.

Note

- Side-shift/disc travel all the way to one side on lifting the implement may indicate the hydraulic supply is connected the wrong way.
- Rapid side-shift/disc oscillations back and forth about the central position indicates that the hydraulic flow rate is too high.

From the working screen you can go into manual mode and exercise the steering using the arrow buttons.

If you have any doubts about the steering performance you can perform a steering test accessed via the Advanced Setup and Diagnostics screen:

For ON/OFF Steering Valves – Answer on screen prompts for left and right orientation as sat in the tractor looking in the direction of travel. If steering test responds with "To fast" or "To slow", hydraulic flow may require adjustment. A steering rate of between 6cm/second and 10cm/second is generally a good starting point. Flow rate is normally regulated using adjustable flow restrictors connected to the steer valve. Also ensure that flow from the tractor is not a limitation.

For Proportional Steering Valves – Run steering test utility and answer left and right orientations as per the ON/OFF valve steer test. Following this an additional full stroke movement to calibrate steering rate is performed. If the maximum steering rate cannot be achieved, hydraulic flow from the tractor may need to be increased.

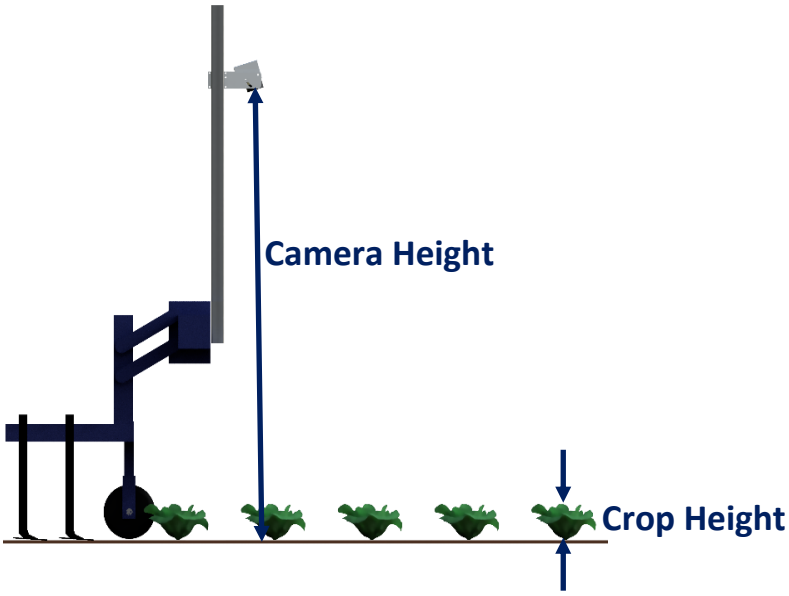
5. Getting to work in the field

Step 1 – Selecting configuration file and crop height

From the working screen press the button labelled with a spanner symbol. This switches the display to the setup screen.

If multiple configurations are loaded, select the configuration that matches your crop.

Select the most appropriate crop height setting to match actual crop height in the field.



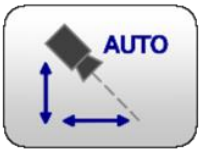
Step 2 – Checking camera height and inclination in the field

Return to the working screen and go into manual mode by touching on the Camera ↷ Hand symbol button. Set the implement down onto a typical section of crop aligned with the rows. Draw forward a few cm to ensure it has settled at its normal operating depth. If necessary, adjust the top link to level the implement keeping the camera pole vertical.

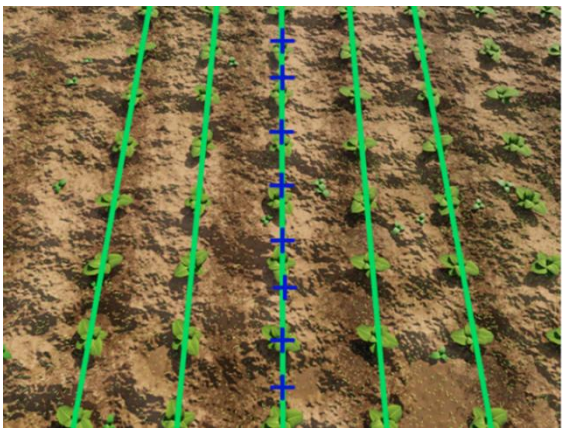
Step 3 – Check template match with crop rows

The overlaid green template lines should be parallel with and at the same spacing as the real crop rows, though they may not be exactly aligned.

Touch the same button again to start vision guidance. The overlaid green lines representing the template should lock onto the crop rows with a series of blue crosses down the centre of the image.



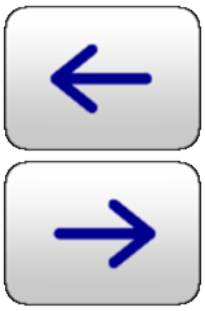
If the template lines are close to but not exactly aligned with the real crop rows you can briefly touch the Auto learn button. This should bring the template lines into a more accurate alignment with crop rows.



Step 4 – Initial running and adjusting lateral position

When you are happy you have a good template match. With the working screen in vision guidance mode and a set of blue crosses up the centre of the row pattern, set off slowly. The implement should quickly align with crop rows. It is possible that after a short distance it will have settled at a small lateral offset. Small offsets can be corrected using the fine offset facility.

Apply the required fine offset in the desired direction. Each press of an arrow key biases the steering in steps of 1cm (3/8”). Continue down the field stopping occasionally to check lateral position.



If the required fine offset exceeds the available number of steps the camera should be physically moved laterally. If fine offset is set to the left, then the camera should be moved right as viewed from behind looking forward.

It is the operator's responsibility to decide at which point the vision guidance system becomes 'lost'. If the system losses track of crop rows the operator should carefully guide the implement through to the next good reference.

Once you are confident tracking is accurate and reliable, forward speed can be increased.

6. Notes on daily operation with a correctly set up machine

- Before operation check that electrical and hydraulic connections are secure and that there are no obstructions to side shift/disc movement. Check also that any hydraulic filter indicators fitted do not show that the filter is blocked.

- On first setting the implement down in the field check for each camera that the blue crosses are present, and that template lines align with crop rows. There should be few to no yellow or red crosses.

- Proceed with caution for first few meters checking that the speed gauge matches the tractor's and that implement alignment is good. If performance is satisfactory speed can be increased.
  Note
  Soil and crop conditions may dictate maximum speeds.

- Fine offset is remembered from previous sessions and so there should not be any need to adjust this unless changes have been made to camera position.

- Setup parameters such as crop height and crop colour are remembered from last operation of selected configuration file.

- Operating on side slopes will result in some lateral error due to the tractor "crabbing" across the slope. Normally this is not significant, but in extreme cases it may be necessary to use the fine offset function to compensate. If operating in this way remember to reverse the bias when heading in the opposite direction and to return to a neutral setting when stopping work or moving to a flat area. A similar technique can be used to compensate for crop bent laterally by a cross wind. The offset flip tool can be useful in these circumstances.

- When the implement is lifted at row ends it will centralise ready for the next run.

- Vision guidance works in low light levels, but for full night operation lights are required.

- At the end of the day shut down the system by pressing the touch screen button with the power button logo and the system will shut down automatically. The power button led go out but will continue to briefly illuminate every 5 sec indicating that power is still applied via the implement. In this state the current draw is negligible.

- It is also advisable to discharge any hydraulic accumulators by reversing the tractor's hydraulic spool briefly or setting the hydraulic spool into "float" position. The implements pressure gauge indicates if this has been achieved.

7. Maintenance and Storage

Please follow the maintenance and storage instructions below in order to ensure your precision guided implement stays in first class working order.

1. Regularly check the routing of hoses and cables and protect against chaffing.

2. Although all components are designed to be shower proof, we recommend that the console is housed in a dry environment and that the implement is not exposed to wet weather for extended periods when not in use.

3. Never pressure wash any part of the guidance system.

4. Always ensure power is supplied from a supply that is appropriately fused (10 - 20 amp).

5. Always ensure the correct supply polarity is adhered to.
   BLUE = - negative, BROWN (fused side) = + positive.

For further reference materials including the full inter-row reference manual see the QR link below or go to www.thtechnology.co.uk

Tillett and Hague Technology Ltd

Delivering precision with vision