

## Trio Application Control System – Instruction Sheet

P/N 7580708\_01



**CAUTION** – The procedures detailed within this guide should only be performed by trained Nordson personnel or by persons cleared to do so by Nordson. Incorrect adjustment can result in equipment damage or even personal injury.

### OVERVIEW

The TRIO application system is designed to provide no part no spray gun triggering control for up to 8 groups of guns in up to 8 zones of vertical part detection.

Depending on the model ordered, it can also control up to 2 axes, or up to 4 axes.

The 2 axis version can be configured via the user interface to control 2 reciprocators, 2 Z-axis, or 1 reciprocator and 1 Z-axis.

The 4 axis version can be configured via the user interface to control 4 reciprocators, 4 Z-axis, or 2 reciprocators and 2 Z-axis.

A horizontal beam array system can also be added to provide automatic part width profiling which enables the Z-axis to maintain a pre-set gun to part distance at all times regardless of part width.

A 4" touch sensitive screen is used for all interactions between the operator and the machine. In addition, the control panel is fitted with an Emergency Stop push-button, a Reset push-button and a lamp indicating when the emergency stop relay is de-energised.

These instructions describe in detail, the operation required to control the system via the operator interface.

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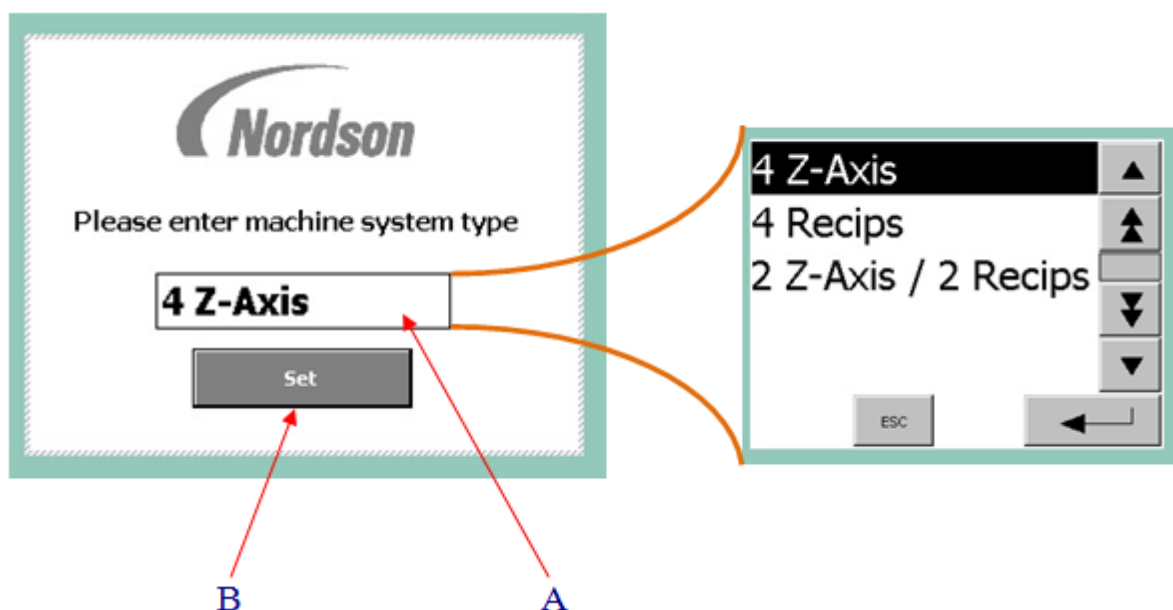
## **START-UP**

### **Start-up sequence:**

1. Ensure that the system is safe to start.
2. Power-up the control panel via the isolator located on the front of the panel door.
3. Ensure the emergency stop buttons are pulled out.
4. Press the Control Reset push-button on the control panel.
5. The safety circuits will now energise, the movers will drive to their back / top limits to zero, and after a short delay, the main screen will be displayed on the operator panel.

## **INITIAL START SCREEN**

When the unit is powered for the first time, the system type entry screen will be displayed as shown below. The type and number of movers must be entered into the system before it will allow any control function to take place.

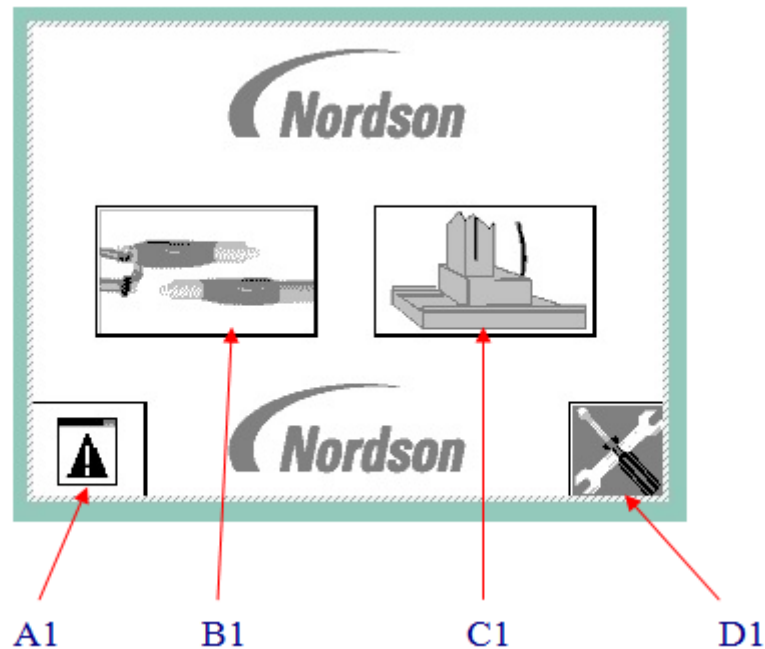


Pressing the window keyed as **A** above, will display a selection list as shown above right. Select the system type required by touching the option in the list, followed by the enter key.

Then press the Set button keyed as **B** above.

The system will then display the start screen for the relevant mover control selected as detailed below.

## **START SCREEN**



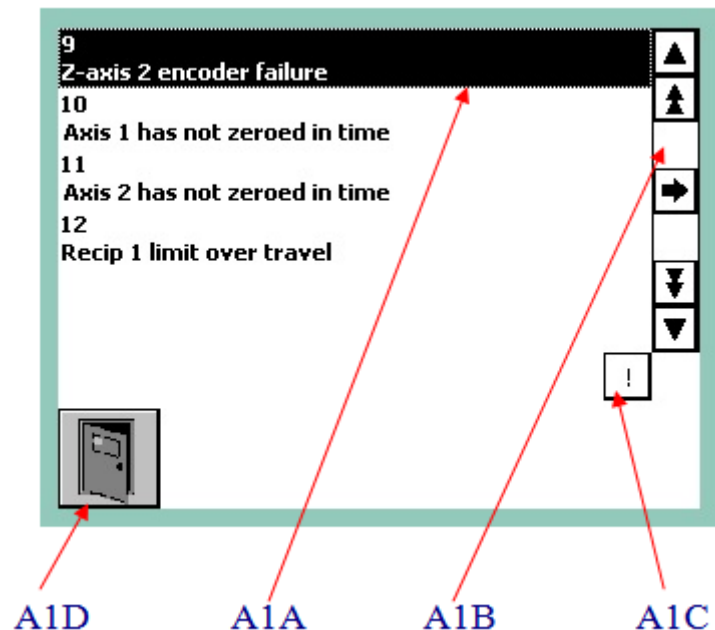
All dimensions that need to be entered, are in millimetres and all time values in seconds unless otherwise stated.

The buttons available from this screen are keyed above and described below:-

**A1 – alarm list** - All faults are logged within an alarm list.

Pressing this button will display the alarm log containing a brief description of any current faults.

## ALARM LIST SCREEN



**A1A – Alarm message** – This field displays the current alarm description along with a unique identifier number. This identifier number will be needed by Nordson personnel if technical support is required for a problem.

**A1B – Scroll bar** – Use the scroll bar to navigate up and down the alarm list. Press the single arrow to jump one message at a time. Press the double arrows to jump one page at a time.

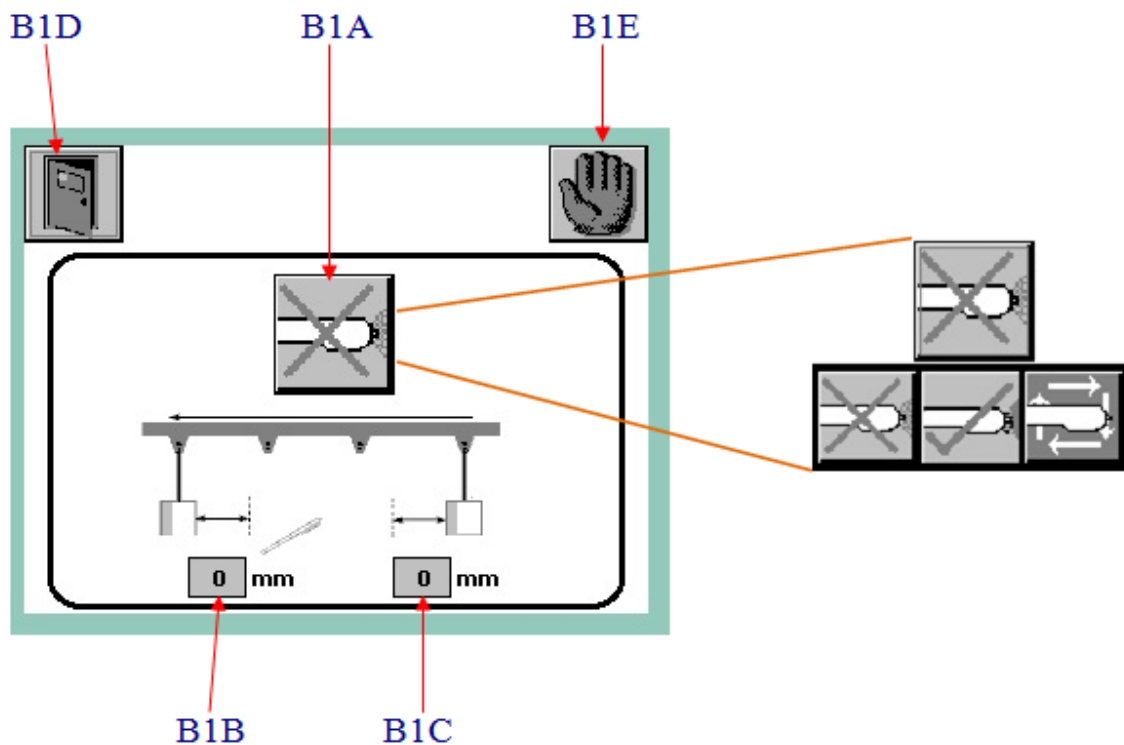
**A1C– Acknowledge** – Press this button to acknowledge an alarm. If the alarm has cleared, then after this button is pressed, the message will disappear from the list. If it is still active, the message will remain and automatically disappear after it has cleared.

**A1D– Exit** – This button exits the alarm log and returns to the previous screen.

## GUN CONTROL SCREENS

**B1 – Gun control** – Press this button to display the automatic gun trigger control screen as detailed below.

### Automatic gun trigger screen



**B1A – guns auto / manual / off** – This button sets the state of the gun trigger control between auto, all on, or off. In auto mode, the guns only trigger when product is in front of them and the conveyor is running. In all on mode, all the guns will trigger all of the time. In off mode, the guns will never trigger.

To set a mode, press this button and a horizontal list of 3 buttons will appear below it. Press the left button as shown above right, to select off mode. Press the middle button to select all on mode. Press the right button to select auto mode. After a button is pressed, the list will automatically disappear again and the button will display the mode selected.

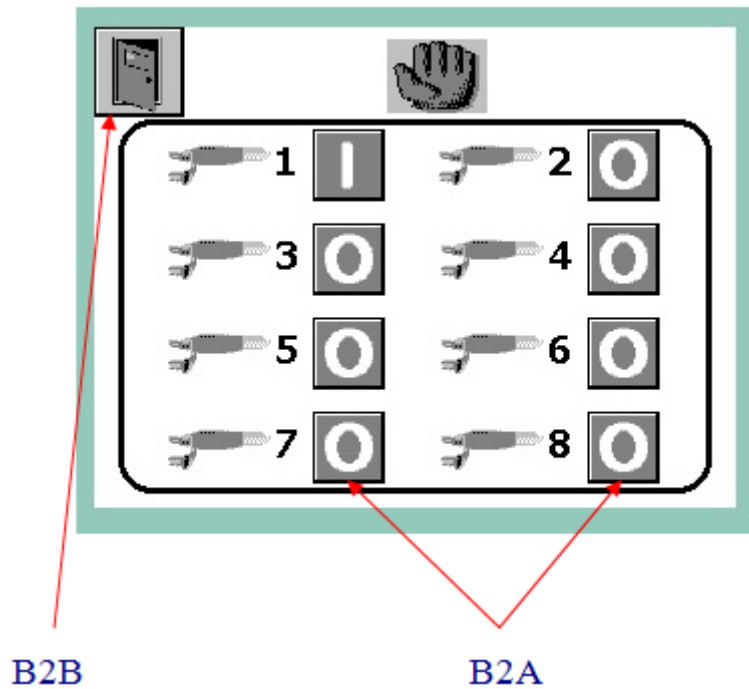
**B1B– after spray** – This entry shows how many millimetres after the product has passed the gun before it will switch off. Touch the value and a keypad will appear to adjust it.

**B1C– before spray** – This entry sets how many millimetres before the product arrives at the gun that it will trigger on. Touch the value and a keypad will appear to adjust it.

**B1D– Exit** – This button exits the screen and returns to the start screen.

**B1E– Individual gun control** – This button displays the individual gun control screen as shown below. It allows each gun to be independently triggered on. This can be used for maintenance or fan pattern set up purposes as an example.

### Individual gun control screen



**B2A – gun trigger control** – This button triggers an individual gun on or off. Each subsequent press of this button toggles the trigger state between on and off. A 'O' indicates the gun is off. A 'I' indicates the gun is triggered on.

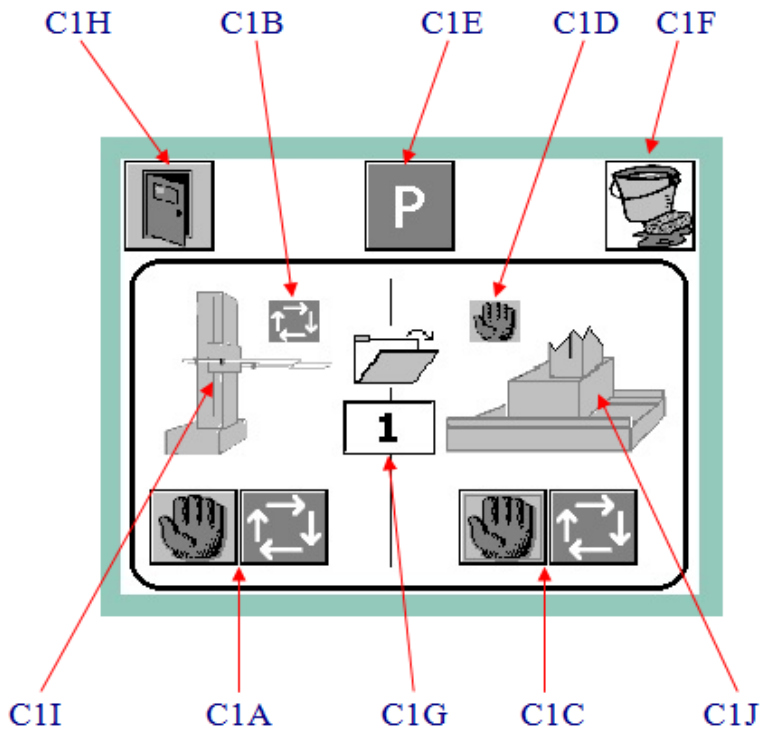
**B2B– Exit** – This button exits the screen and returns to the auto gun control screen.

## MOVER CONTROL SCREENS

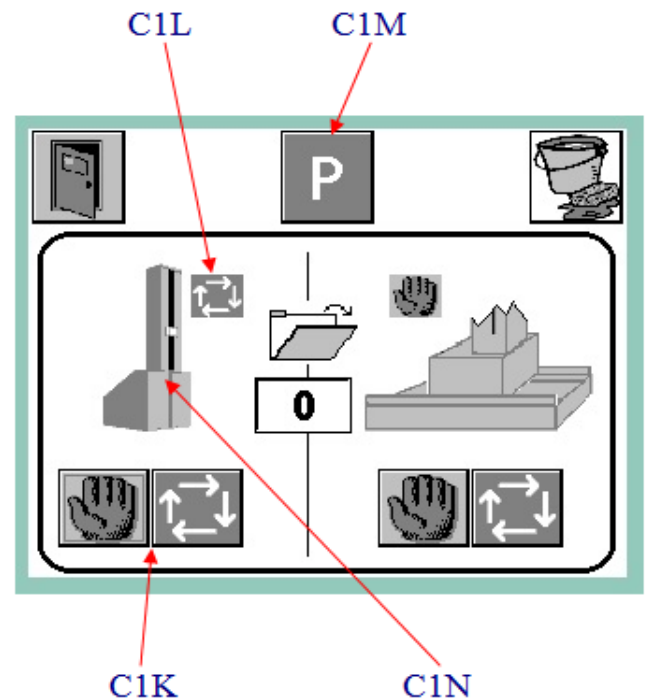
By pressing the button keyed as **C1** located on the start screen, the system will display the main mover control screen as shown below:-

### Main mover control screen

#### *Reciprocator version*



#### *Oscillator version*



**C1A– Recip manual / auto selectors** – These buttons change the reciprocator mode between auto and manual control. These are global buttons and apply the mode selected to all reciprocators in the system. In auto mode (selected by pressing the button with 4 arrows in a circle on it), the reciprocator runs between a preset top and bottom limit at a preset speed. In manual mode (selected by pressing the button with the symbol of a hand on it), the reciprocators will not move unless jogged via the manual move buttons located on the individual reciprocator control screens detailed in a later section of this manual.

**C1B – Global mode display** – This icon displays the current mode of the reciprocators. If displaying the auto symbol (denoted by 4 arrows in a circle), all reciprocators in the system are set to auto mode. If displaying the manual symbol (denoted by the symbol of a hand), all reciprocators in the system are set to manual mode. If there is no symbol displayed at all, then there is a mix of modes between the reciprocators.



**C1C– Z-axis manual / auto selectors** – These buttons change the Z-axis mode between auto and manual control. These are global buttons and apply the mode selected to all Z-axis in the system. In auto mode (selected by pressing the button with 4 arrows in a circle on it), the Z-axis profiles around any product that enters the booth maintaining a fixed distance from the work. In manual mode (selected by pressing the button with the symbol of a hand on it), the Z-axis will not move unless jogged via the manual move buttons located on the individual Z-axis control screens detailed in a later section of this manual.

**C1D – Global mode display** – This icon displays the current mode of the Z-axis. If displaying the auto symbol (denoted by 4 arrows in a circle), all Z-axis in the system are set to auto mode. . If displaying the manual symbol (denoted by the symbol of a hand), all Z-axis in the system are set to manual mode. If there is no symbol displayed at all, then there is a mix of modes between the Z-axis.

**C1E - park** – This button stops the reciprocators and Z-axis if running and moves them to their pre set park positions. It will also stop the guns if they are spraying in automatic mode. The button will flash on and off when the system is in park.

**C1F – External gun clean** – This button initiates the external gun clean sequence. When initiated, the reciprocators are sent to their park positions and the Z-axis are sent fully into the booth. The external gun blow-off solenoids are actuated and the Z-axis are then withdrawn to their back limits at a slow speed to clean the guns of powder. The movers will then stay at this position until the operator presses the park release button (**C1E**).

**C1G – Program selection** – This data entry selects the program to be run for both the reciprocators and Z-axis. There are 256 programs available in which are stored various top turn, bottom turn and speeds for the reciprocators as well as before move, after move and gun to part distances for the Z-axis. These parameters will be described in more detail in a following section of this manual.

**C1K – Oscillator manual / auto selectors** – These buttons change the oscillator mode between auto and manual control. These are global buttons and apply the mode selected to all oscillators in the system. In auto mode (selected by pressing the button with 4 arrows in a circle on it), the oscillators run when the booth is running and stop when the booth is switched off. In manual mode (selected by pressing the button with the symbol of a hand on it), the oscillators will not run unless switched on via the manual run button located on the individual oscillator control screen detailed in a later section of this manual.

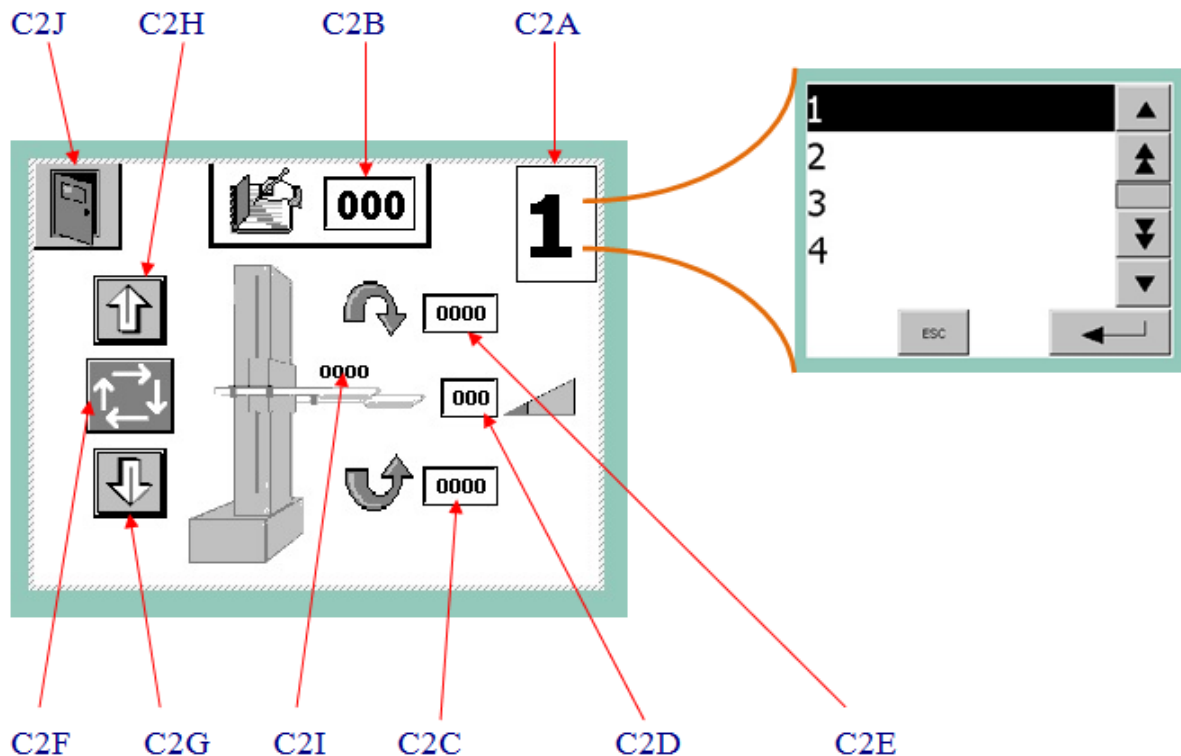
**C1L – Global mode display** – This icon displays the current mode of the oscillators. If displaying the auto symbol (denoted by 4 arrows in a circle), all oscillators in the system are set to auto mode. If displaying the manual symbol (denoted by the symbol of a hand), all oscillators in the system are set to manual mode. If there is no symbol displayed at all, then there is a mix of modes between the oscillators.

**C1M - *park*** – This button stops the oscillators and Z-axis if running and moves them to their pre set park positions. It will also stop the guns if they are spraying in automatic mode. The button will flash on and off when the system is in park.

**C1H – *Exit*** – This button exits the screen and returns to the start screen.

**C1I – Individual recip screen** – This button displays the individual reciprocator control screen as shown below.

### Individual reciprocator control screen



**C2A – Reciprocator selection** – This Field shows the reciprocator number that the displayed data relates to. It also acts as the reciprocator data to display selector. Touch the number to reveal a list of reciprocator numbers as shown above right. Select the reciprocator number of interest and press the enter key. The screen will now display all data related to that reciprocator.

**C2B – Program number to edit** – This Field displays the program number into which all displayed data is stored. Any changes in values within this screen are automatically stored within the program number displayed. Touch the number to change which programs' data is displayed and therefore editable.

**C2C – bottom turn** – This field adjusts the point at which the reciprocator will turn around and travel up. This point is measured in millimetres from the top of the gun slot.

**C2D – speed** – This field adjusts the speed at which the reciprocator will traverse in metres per minute.

**C2E – top turn** – This field adjusts the point at which the reciprocator will turn around and travel down. This point is measured in millimetres from the top of the gun slot.

**C2F – *auto / manual selector*** – This button toggles between reciprocator auto and manual control. In auto mode (selected when the button displays 4 arrows in a circle on it), the reciprocator runs between a preset top and bottom limit at a preset speed. In manual mode (selected when the button displays a symbol of a hand on it), the reciprocators will not move unless jogged via the manual move buttons.

**C2G – *Manual recip down*** – This button will only be visible if manual mode is selected. When pressed, it will drive the reciprocator down as long as the lower software limit is not exceeded. Press and hold the button to drive, release the button to stop the reciprocator.

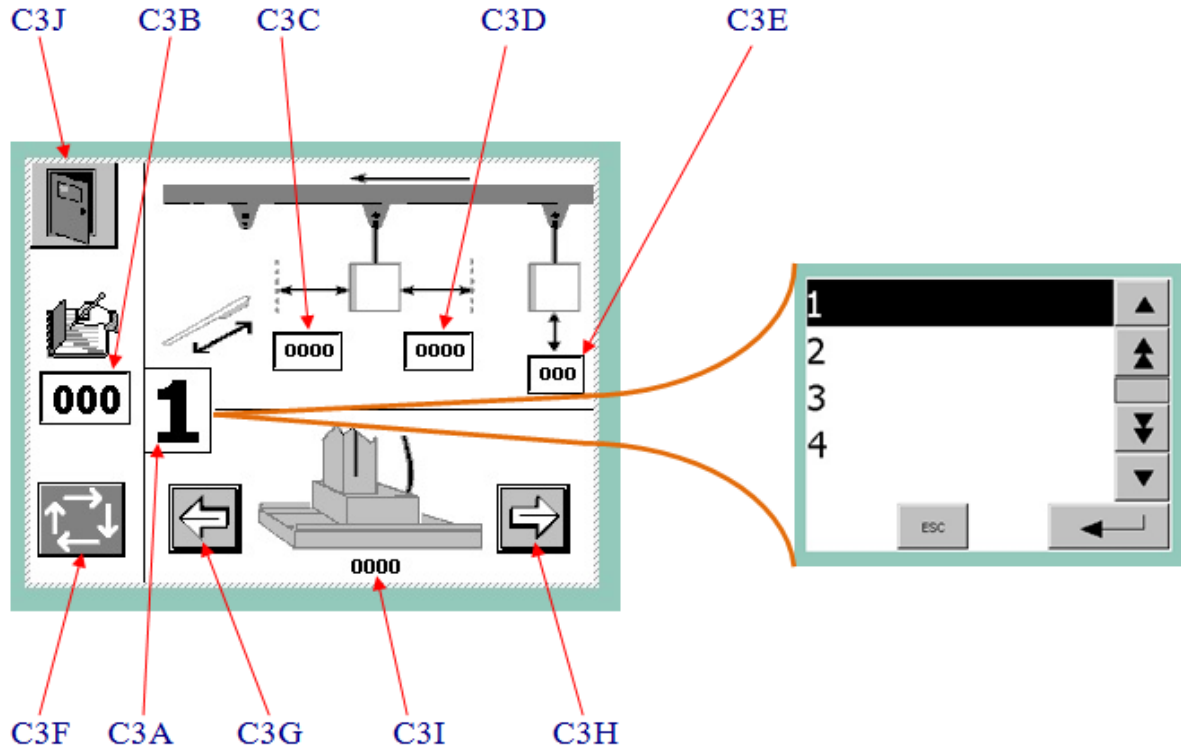
**C2H – *Manual recip up*** – This button will only be visible if manual mode is selected. When pressed, it will drive the reciprocator up as long as the upper software limit is not exceeded. Press and hold the button to drive, release the button to stop the reciprocator.

**C2I – *Current reciprocator position*** – This field displays the current reciprocator position. This value is referenced as the distance down from the top of the booth auto slot.

**C2J – *Exit*** – This button exits the screen and returns to the main mover control screen.

## Individual Z-axis control screen

**C1J – Individual Z-axis screen** – This button displays the individual Z-axis control screen as shown below.



**C3A – Z-axis selection** – This Field shows the Z-axis number that the displayed data relates to. It also acts as the Z-axis data to display selector. Touch the number to reveal a list of Z-axis numbers as shown above right. Select the Z-axis number of interest and press the enter key. The screen will now display all data related to that Z-axis.

**C3B – Program number to edit** – This Field displays the program number into which all displayed data is stored. Any change in values within this screen are automatically stored within the program number displayed. Touch the number to change which programs' data is displayed and therefore editable.

**C3C – Before move distance** – This data entry adjusts the distance before the part arrives, at which the Z-axis will withdraw back from the part.

**C3D – After move distance** – This data entry adjusts the distance after the part has passed, before the Z-axis will return to its wait position.

**C3E – Gun to part distance** – This data entry sets the distance the gun will position itself away from the product regardless of the product size.

**C3F – Auto / manual selector** – This button toggles between Z-axis auto and manual control. In auto mode (selected when the button displays 4 arrows in a circle on it), the Z-axis will profile the work maintaining a preset gun to part distance.

In manual mode (selected when the button displays a symbol of a hand on it), the Z-axis will not move unless jogged via the manual move buttons.

**C3G – Manual Z-axis forwards** – This button will only be visible if manual mode is selected. When pressed, it will drive the Z-axis forwards as long as the forward software limit is not exceeded. Press and hold the button to drive, release the button to stop the Z-axis.

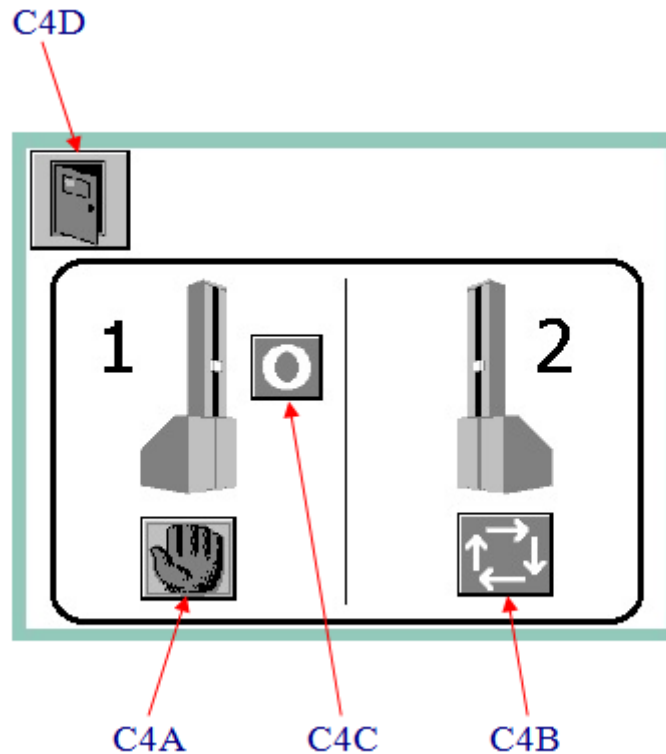
**C3H – Manual Z-axis reverse** – This button will only be visible if manual mode is selected. When pressed, it will drive the Z-axis backwards as long as the back software limit is not exceeded. Press and hold the button to drive, release the button to stop the Z-axis.

**C3I – Current Z-axis position** – This field displays the current gun tip position in relation to the conveyor centre line.

**C3J – Exit** – This button exits the screen and returns to the main mover control screen.

## **Individual oscillator control screen**

**C1N– Individual oscillator screen** – This button displays the individual oscillator control screen as shown below.



**C4A – Auto / manual selector** – This button toggles between oscillator 1 auto and manual control. In auto mode (selected when the button displays 4 arrows in a circle on it), the oscillator will run when the booth is running and stop when the booth is switched off. In manual mode (selected by pressing the button with the symbol of a hand on it), the oscillators will not run unless switched on via the manual run button **C4C**.

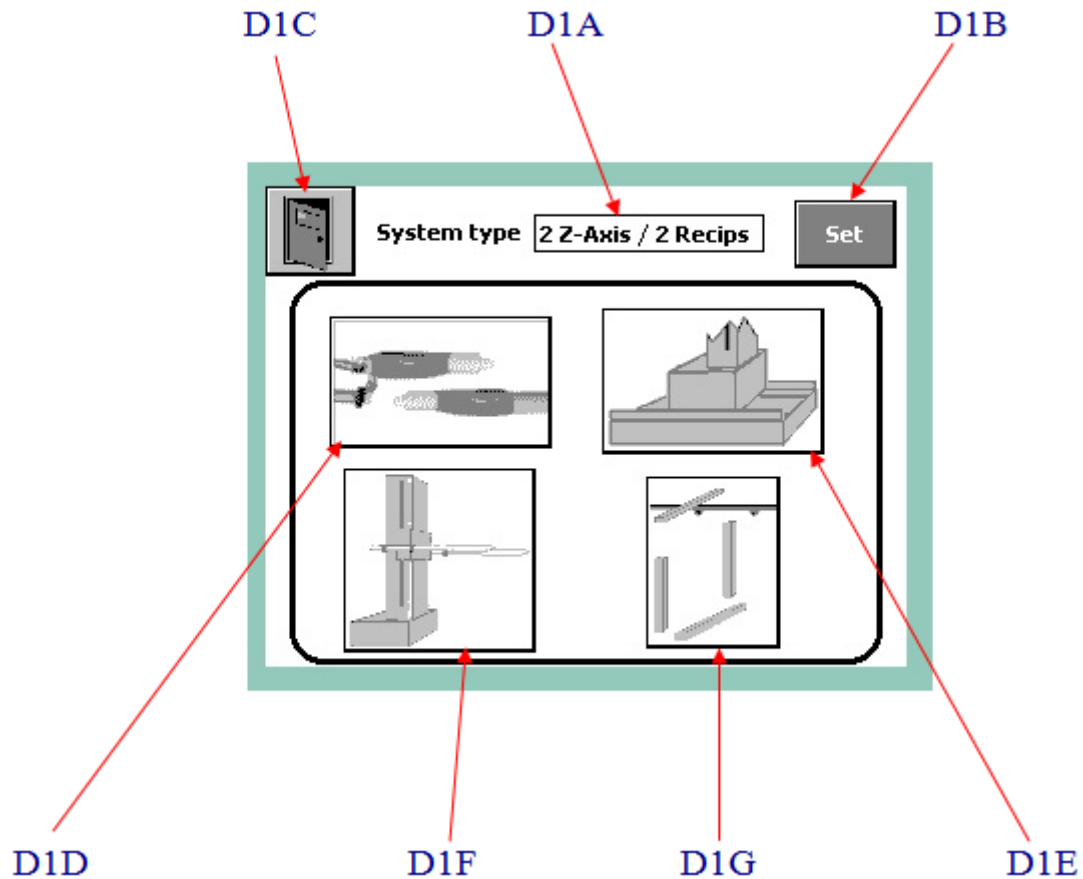
**C4B – Auto / manual selector** – This button performs the same function as **C4A**, but for oscillator 2.

**C4C – manual run** – This button manually switches the oscillator on or off. It will only be visible if manual mode has been selected. Each subsequent press of this button will toggle the oscillator between running and stopped.

**C4D – Exit** – This button exits the screen and returns to the main mover control screen.

## CONFIGURATION SCREEN

By pressing the button keyed as **D1** located on the start screen, the system will display the configuration selection screen as shown below.



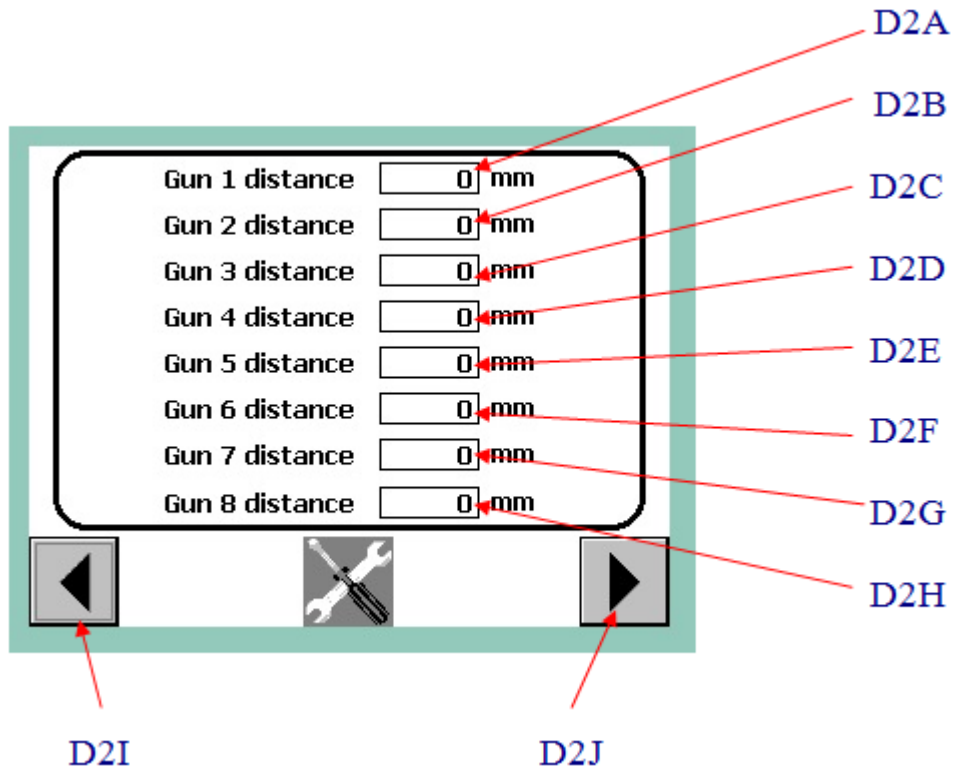
**D1A – System type selection** – This entry is used in conjunction with **D1B** to change the type and number of movers assigned to the system. This is the same process as detailed in the Initial start screen section at the beginning of this manual, but it allows system type changes to be made at any time. Press **D1A** to reveal a drop-down selection list. Select the system type required as detailed at the beginning of this manual. Then press the set button **D1B** to confirm the selection. The system will then display the start screen for the relevant mover control selected.

**D1C – Exit** – This button exits the screen and returns to the start screen.



## Gun configuration screens

**D1D – Gun configuration** – Press this button to access the gun configuration screens as detailed below.

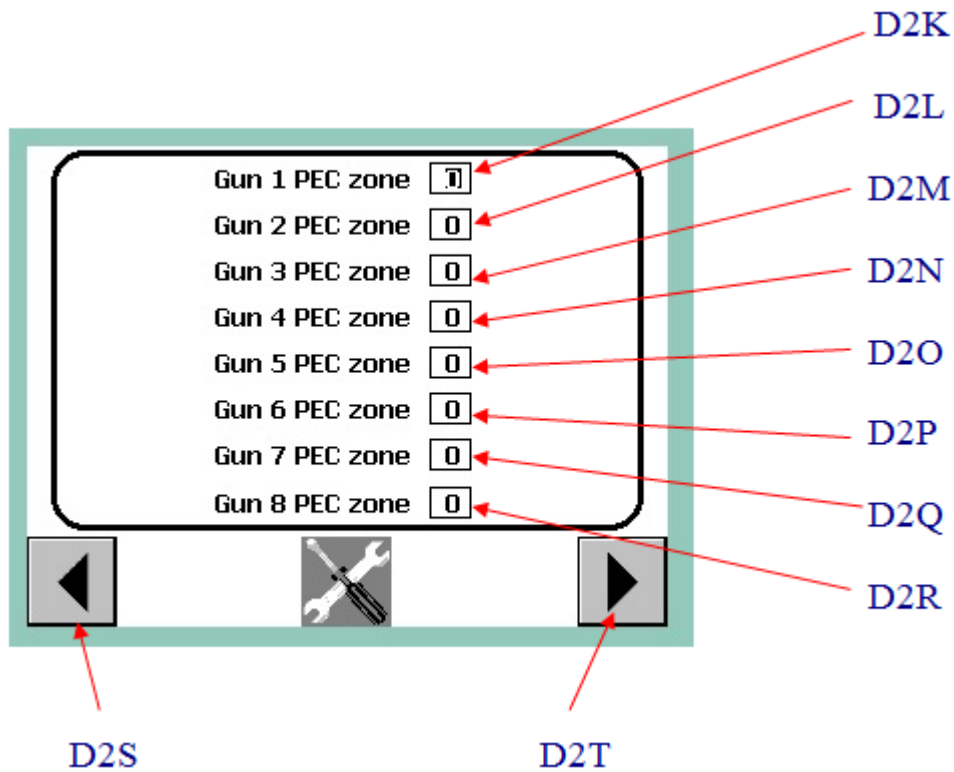


**D2A – Horizontal distance** – This value sets the distance between the photocell stand and gun 1 in millimetres.

**D2B to D2H – Horizontal distances** – These values set the distances between the photocell stand and guns 2 – 8 respectively in millimetres.

**D2I – Previous screen** – This button exits the screen and returns to the configuration selection screen.

**D2J – Next screen** – This button displays the next gun configuration screen as shown below-



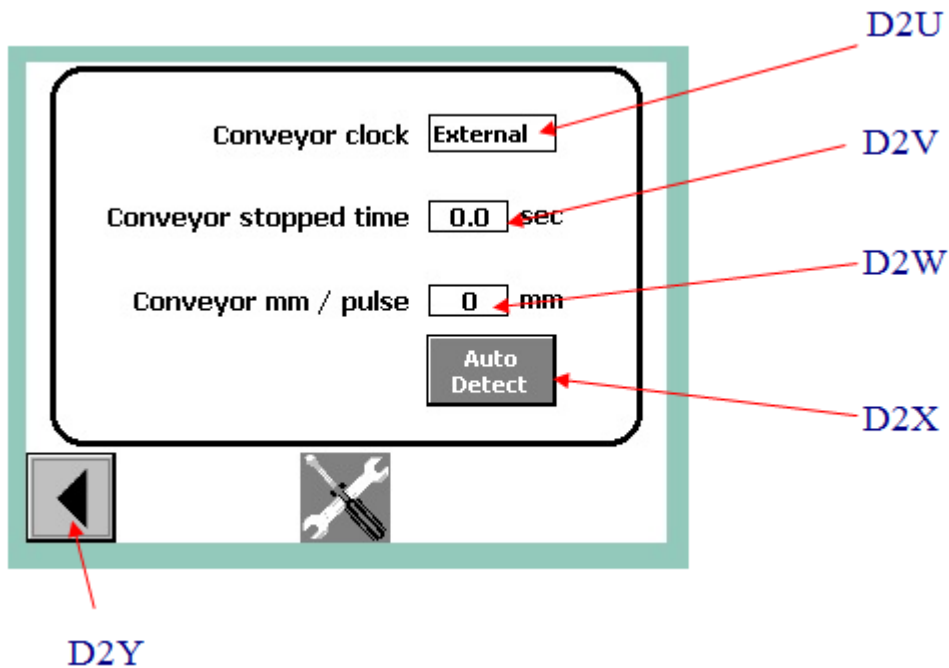
**D2K– Gun zone assignment** – This entry assigns one of the 8 photocell inputs available to gun 1. For example, if gun 1 photocell zone is set to 3, then only parts detected by photocell 3 will be sprayed by gun 1.

**D2L to D2R – Gun zone assignments** – These entries assign one of the 8 photocell inputs available to guns 2 – 8 respectively.

NOTE – One zone can be assigned to multiple guns if necessary.

**D2S – Previous screen** – This button returns to the previous gun configuration screen.

**D2T – Next screen** – This button displays the next gun configuration screen as shown below-



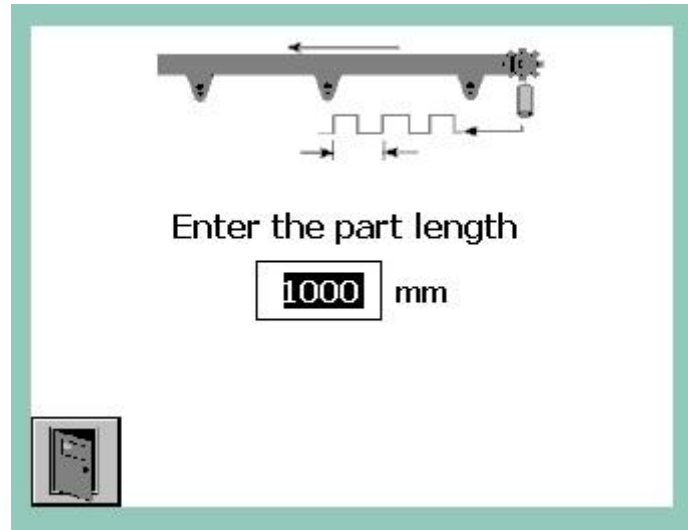
**D2U – Conveyor clock** – This entry selects whether an external conveyor clock signal (encoder) will be implemented or an internally generated clock pulse for part tracking. If an internally generated clock pulse is selected, the system will use the automatic resolution detection method (described below) to assign the number of millimetres of conveyor travel to each internal pulse. This method can also be used in conjunction with a conveyor running input from the customer to stop the internal conveyor clock pulse whenever the conveyor is stopped.

**D2V – Conveyor stopped timeout** – This entry sets the number of seconds that a conveyor pulse has **not** been received for, before the system determines that the conveyor is stopped. When the conveyor is seen as stopped, the controller will automatically turn off the guns. It will automatically restart them again when the conveyor restarts.

**D2W – Conveyor mm / pulse** – If external clock mode has been selected and the amount of millimetres conveyor travel per pulse is known, this can be entered into this screen. However, it is also possible to use the system to automatically detect this value for you as detailed below.

**D2Y– Previous screen** – This button returns to the previous gun configuration screen.

**D2X– Conveyor pulse auto detect** – Press this button to start the automatic pulse length detect option as shown below. The system requires the operator to hang a flat square panel on the conveyor of a known width. When requested, the part must be run through the photocell stand. The system will then take the entered width of the part and the number of conveyor pulses sampled during the part detection and automatically calculate the conveyor travel per pulse.



This entry requires the width of the sample part to be entered in millimetres.

A message will then appear on the screen requesting that the part be hung on the conveyor. After the part has been hung, it must be driven through the photocell stand. Once the part passes through the photocell stand, a pulse length detection complete message will be displayed for 5 seconds before the screen will automatically return to main start screen.

NOTE- The process can be cancelled at any time by pressing the exit button in the bottom left hand corner of the screen.

## **Z-axis configuration screens**

**D1E – Z-axis configuration** – Press this button located on the configuration selection screen, to access the Z-axis configuration screens as detailed below.

The screenshot shows a configuration screen with the following fields and buttons:

- D3A** points to the input field for "Z-axis 1 encoder pulses / mm" (value: 1).
- D3B** points to the input field for "Z-axis 1 distance to first gun" (value: 0).
- D3C** points to the input field for "Z-axis 1 first to last gun distance" (value: 0).
- D3D** points to the input field for "Z-Axis 1 centre line to gun tip" (value: 0).
- D3E** points to the input field for "Z-Axis 1 on right side of booth?" (value: No).
- D3F** points to the input field for "Colour change auto mode?" (value: No).
- D3G** points to the left arrow button.
- D3H** points to the right arrow button.

**D3A – Encoder resolution** – This entry sets the number of pulses the Z-axis position encoder returns for every millimetre of carriage movement.

**NOTE** – when a Z-axis is attached to the system for the first time, a routine to teach the system the length of the Z-axis base is must be performed. This routine must also be performed if either the front or reverse limit switch positions are changed. This routine can be performed as often as necessary. If this routine is not carried out, then the gun to centre line dimension will not be correct the next time the system is powered up.

To perform the routine, select manual mode and drive the Z-axis forwards until it stops on the front limit switch. After a short delay, drive the Z-axis back until it stops on the reverse limit switch. This whole procedure needs to be completed within 60 seconds. Once the Z-axis reaches the reverse limit, the distance travelled is automatically stored and the process is complete. If the sequence is not completed within 60 seconds, wait 1 minute and repeat the process again from the beginning.

**D3B – Z-axis to 1<sup>st</sup> gun distance** – This entry sets the distance in millimetres from the beam array stand to the first gun mounted on the Z-axis.

**D3C – 1<sup>st</sup> to last gun distance** – This entry sets the distance in millimetres from the first gun mounted on the Z-axis, to its last gun.

**D3D – Z-axis centre line to gun tip distance** – This entry sets the distance in millimetres from the centre line of the booth to the gun tip when the Z-axis is driven fully forwards onto the front limit switch.

**D3E – Z-axis on right side of booth?** – This entry sets whether the Z-axis is on the left side of the booth or the right side. This determines whether the Z-axis will respond to parts detected on the right side of the booth or the left.

**D3F – Colour change auto mode?** – This entry selects whether the system will run a manual clean sequence or an automatic one.

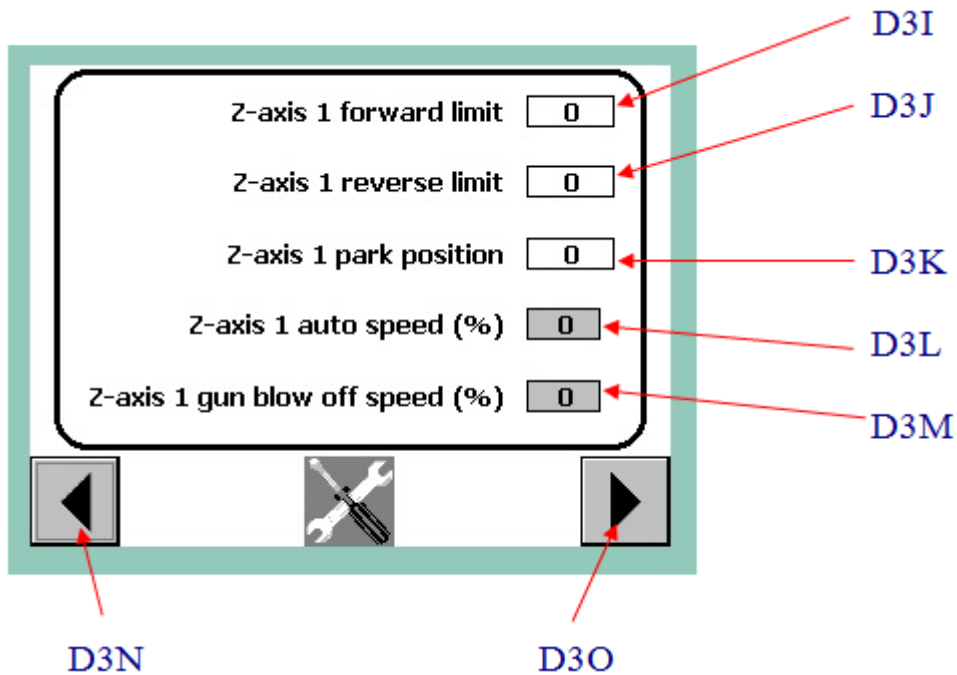
In manual mode, the Z-axis performs the external gun blow off sequence as described earlier in this manual (detailed at key **C1F**).

In auto mode, the system handshakes with the feed centre to perform a complete colour change sequence including internal gun purge. The sequence is as follows-

1. The feed centre requests a colour change and the reciprocators / Z-axis move to their park positions and stop.
2. The system sends a signal to the feed centre indicating that the guns are at their purge positions and that the internal gun purge can be performed.
3. Upon completion of the internal gun purge, the feed centre sends a signal indicating the fact after which the Z-axis are moved fully in, the external gun blow offs are energised and the Z-axis are withdrawn at slow speed to their back limit positions. The external gun blow offs are then de-energised.
4. The movers remain in this position until the operator has completed the colour change and presses the park release button (keyed as **C1E**)

**D3G– Previous screen** – This button exits the screen and returns to the configuration selection screen.

**D3H– Next screen** – This button displays the next gun configuration screen as shown below.



**D3I – Z-axis forward limit** – This entry sets the ultimate position that the mover can move in to. The dimension is set as distance from booth centre line to gun tip.

**D3J – Z-axis reverse limit** – This entry sets the ultimate position that the mover can move out to. The dimension is set as distance from booth centre line to gun tip.

**D3K – Z-axis park position** – This entry sets the position the Z-axis will go to if park is selected. It is also the position used when the guns are internally purged during an auto colour change sequence. The dimension is set as distance from booth centre line to gun tip.

**D3L - Automatic Z-axis speed** – This entry sets the speed at which the Z-axis will traverse during normal production mode. The value is entered as a percentage of maximum speed.

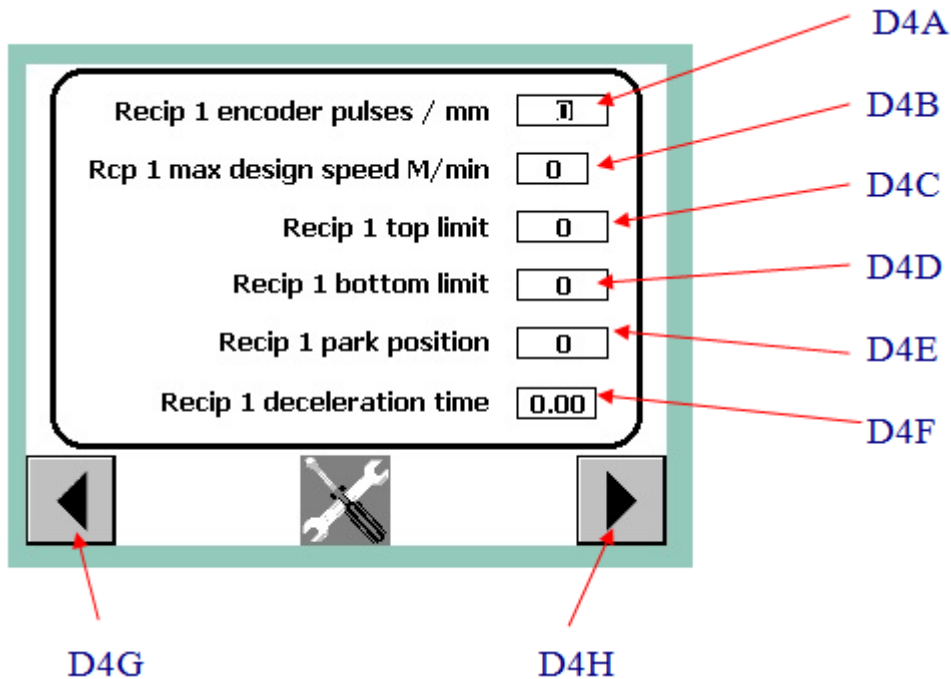
**D3M - Clean Z-axis speed** – This entry sets the speed at which the Z-axis will travel out during the external gun blow off phase of the cleaning cycle. The value is entered as a percentage of maximum speed.

**D3N – Previous screen** – This button returns to the previous Z-axis configuration screen.

**D3O– Next screen** – This button displays the next Z-axis movers configuration screen. All entries for each Z-axis configuration screen are the same and in the same order as detailed above for Z-axis 1.

## **Reciprocator configuration screens**

**D1F – Reciprocator configuration** – Press this button located on the configuration selection screen, to access the reciprocator configuration screens as detailed below.



**D4A – Encoder resolution** – This entry sets the number of pulses the reciprocator position encoder returns for every millimetre of carriage movement.

**D4B – Maximum design speed** – This entry sets the maximum design speed of the reciprocator in metres / minute. This value can be found on the type plate of the reciprocator column itself.

**D4C – Top limit** – This field adjusts the maximum position that the reciprocator can move up to in millimetres. This dimension is measured down from the top of the gun slot.

**D4D – Bottom limit** – This field adjusts the lowest position that the reciprocator can move down to in millimetres. This dimension is measured down from the top of the gun slot.

**D4E – park position** – This field adjusts the park position of the reciprocators in millimetres. This dimension is measured down from the top of the gun slot.

**D4F– Deceleration time** – This field sets the deceleration time that has been configured in the inverter drive unit. This value can be found at parameter P1121 in the Micromaster inverter unit.

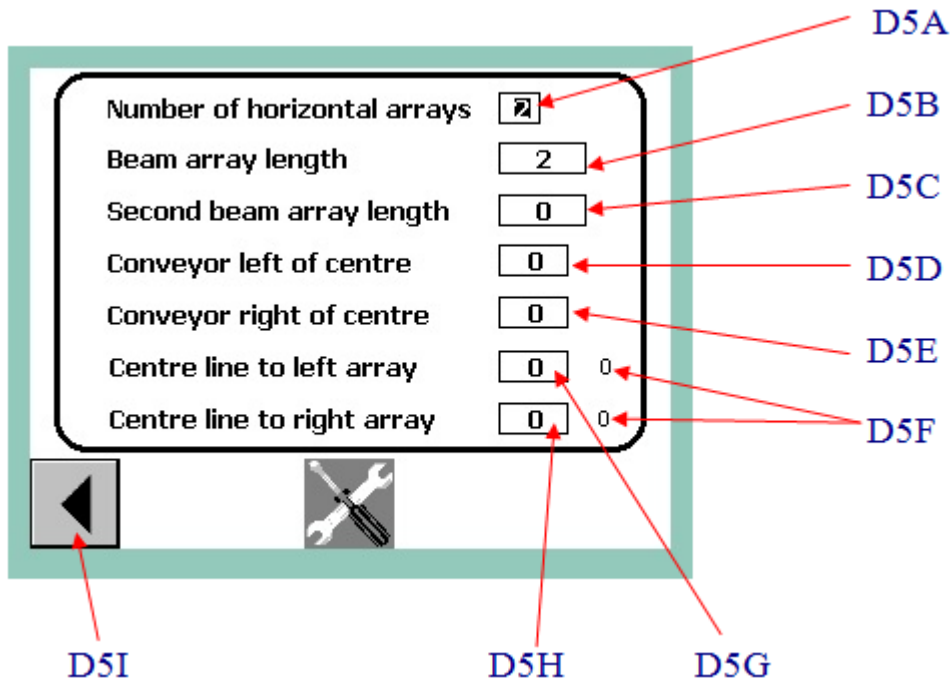
**D4G– Previous screen** – This button exits the screen and returns to the configuration selection screen.



**D4H– *Next screen*** – This button displays the next reciprocator movers configuration screen. All entries for each reciprocator configuration screen are the same and in the same order as detailed above for reciprocator 1.

## Beam array configuration screen

**D1G– Beam array configuration** – Press this button located on the configuration selection screen, to access the beam array configuration screens as detailed below.



**D5A – No. of horizontal arrays** – This entry sets whether there is one beam array across the top of the conveyor or whether there are 2 beam arrays slung under the conveyor left and right of centre.

**D5B – Beam array length** – This entry sets the length of the beam array in millimetres. If two beam arrays have been selected, then this is the length of the first left hand beam array.

**D5C – Second beam array length** – This entry sets the length of the second right hand beam array in millimetres. If only one beam array has been selected, this entry is not visible.

**D5D – Conveyor left of centre** – This entry sets the width of conveyor track from centre line to the left that is blocking the beam array detection. If two beam arrays have been selected, this entry is not visible.

**D5E – Conveyor right of centre** – This entry sets the width of conveyor track from centre line to the right that is blocking the beam array detection. If two beam arrays have been selected, this entry is not visible.

**D5F – Current part dimension** – These values display the actual left hand and right hand width dimensions of any product currently in the beam array. These dimensions are measured in millimetres from centre line to the products far left hand edge or right hand edge.

**D5G – Centre line to left array** – This entry sets the distance from the booth centre line to the start (inner edge) of the left hand beam array in millimetres. If one beam array has been selected, this entry is not visible.

**D5H – Centre line to right array** – This entry sets the distance from the booth centre line to the start (inner edge) of the right hand beam array in millimetres. If one beam array has been selected, this entry is not visible.

**D5I– Previous screen** – This button exits the screen and returns to the configuration selection screen.

## **ALARM LIST DEFINITIONS**

Any system fault that occurs will display an alarm message. The list of possible alarm messages are detailed below.

**Emergency Stop relay de-energised** – Displayed when an emergency stop button has been pressed.

Ensure all emergency stop buttons are released and press the control reset button.

**Z-axis inverter drive fault** – Displayed when the inverter drive is powered, but doesn't report back that it is healthy and ready to run.

**Z-axis front limit over travel** – Displayed when the Z-axis has travelled beyond the pre-configured ultimate front safety limit.

**Z-axis back limit over travel** – Displayed when the Z-axis has travelled beyond the pre-configured ultimate back safety limit.

**Z-axis encoder failure** – Displayed when the Z-axis is commanded to drive and the current position value is not changing. This is either due to the fact the position encoder has failed, or that the Z-axis is mechanically jammed and not able to move.

**Axis has not zeroed** – When power is first applied to the system, the reciprocator or Z-axis must go to a known datum point and zero its position counter. This alarm will be displayed if it has not reached this datum point within 60 seconds of being commanded to do so.

**Reciprocator limit over travel** – Displayed when the reciprocator has travelled above or below the pre-configured ultimate software safety limits.

**Reciprocator crossed turn around limits** – Displayed when the top turn and bottom turn dimensions have been reversed. As an example, the top turn could be set to 150mm and the bottom turn 1600mm. If the operator sets the top turn to 1600mm and the bottom turn to 150mm by mistake, then the reciprocator will be disabled and this alarm message will be displayed.

**Reciprocator inverter drive fault** – Displayed when the inverter drive is powered, but doesn't report back that it is healthy and ready to run.

**Reciprocator encoder failure** – Displayed when the reciprocator is commanded to drive and the current position value is not changing. This is either due to the fact the position encoder has failed, or that the reciprocator is mechanically jammed and not able to move.

