Fertilizer Spreader Control Operations Manual m/n DS203

General Operation version date 4-19-99

1. The spreader control uses a ground speed input in conjunction with auger feedback to regulate the application rate. The auger shaft auger speed is servo controlled in a closed loop mode. The controller calculates and displays the application rate in lbs. per acre. in addition to an accumulated acre counter.

2. The front panel controls allow the operator to select:
   > Power switch
   > Auto or Manual mode.
   > Application Rate, 0 to 1000 lbs/acre fertilizer, 0 to 8000 lbs/acre lime
   > Spread Width selector five position, first and last positions are adjustable
   (10' - 40'), 50, 60, 70, (75' - 100') feet.
   > Material selector, Lime or Fertilizer.
   > Material density, front panel adjustable from 30 to 120 lb/cuft.
   > Digital display of lbs/acre, Accumulated acres, view auger RPM and % of hydraulic valve drive.

3. The Power switch controls all of the power to the spreader control system, valve drive, auger sensor and the ground speed sensor.

4. The Calibrate push-button (PB) is used in conjunction with the application knob to set the material density and other internal calibration values.

   To set the material density the operator must press and hold the calibrate PB. The display will show the density presently selected in lbs/cuft. To change the density, turn the application knob till the display shows the new density, release the calibrate PB and the new value is automatically stored into the memory.

   The calibrate PB is also used to clear the accumulated acres from the memory. To clear the accumulated acres, turn the power on with the calibrate PB held down for 5 seconds. This will automatically reset the internal acre counter to zero. Note, the actual number of accumulated acres is automatically retained by the memory even when the power is turned off.

   In the event of an auger sensor failure, an audio alarm will sound to alert the operator. Pressing the calibrate PB will clear the audio alarm. The actual auger failure will auto clear once the sensor is repaired.

5. The auto/accum/manual switch is the mode selection used to select between the auto and manual .

   The mode switch in the up position selects the automatic mode which controls the auger speed in relation to the ground speed and will give the operator a true lbs/acre output. The auger automatically starts and stops in conjunction with the vehicle starting and stopping. The display shows lbs/acre.

   The mode switch in the down position selects the manual mode which can be used when ever either the ground speed sensor or the auger speed sensor should fail. In the manual mode the auger hydraulic valve is directly controlled by the application rate knob. The display shows the lbs/acre, but remember, there is no ground speed modulation. Therefore the application rate will change with the vehicle speed. Manual mode will give an auger output even when the vehicle is stopped.

   The mode switch in the center position is used for viewing the accumulated acres. When the operator centers the mode switch the operation stays in what ever mode the position of the switch came from. ie., if the mode switch is in the auto mode and the switch is centered the mode stays auto but the display changes to show accumulated acres.

6. The spread width knob is set by the operator to the actual spread width. If this selection is not correct the lbs/acre rate and the accumulated acres will be incorrect.

7. The application rate knob is the primary way information is entered into the control unit. In normal operation this knob is used to enter three operational variables.

   a. Lbs/arce set point for automatic mode
   b. The auger valve drive for manual mode.
   c. Material density in lbs/cuft for lime and fertilizer product.

   When the application knob is set to zero, by turning it all the way left (full CCW position), this will set the auger valve drive to zero full off, regardless of vehicle speed or the mode.

   The application knob is also used to set other internal parameters when calibrating the system.

8. The material switch is used to select between the two products, lime or fertilizer. Since the gate opening for the auger is different between lime and fertilizer it is imperative the operator change the material switch setting corresponding to each gate opening change. The spreader control uses a separate internal auger calibration constant (lbs/rev)for each gate opening.

9. The spreader control uses the four digit LED display to inform the operator of all the operational parameters.

   When the power is on the display will always show something. The display is therefore the basic power-on indication. Under normal operation the display is not ever blank.

   The display will blink the lbs/acre to inform the operator when there is no ground speed signal being received and will blink when the vehicle is stopped allowing the application rate to be set prior to moving. As the vehicle begins to move the display should stop blinking and lock on to a steady value to indicate the ground speed signal is ok.

   In auto mode the four decimal points are used to indicate that the auger sensor pulses are not being received. If the auger sensor fails the controller will first ramp the valve drive up to 100% and still if no pulses are received the display will then show the four decimal points along with a best guess of the auger RPM. The application rate knob automatically switches over to a manual type control and the operator can directly set the auger RPM. It is important to note that the RPM value displayed when the auger pulses fail is an approximate value based on the open loop valve drive.

   If the auger pulse signal should fail while in the manual mode, the display is used to show the operator the actual percentage of valve drive. This display is specifically recognizable since there is a - (dash) on either side of the percentage number. ie., -12- means 12% and -45- means 45%, etc.

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Calibration and program adjustments

1. The program adjustments are made with the use of two trim pots and a selector switch located under the program door. This door is located on the front panel just above the spread width selector switch. Loosen the two screws and swing the program door out and to the right. Inside the access door you will observe the two trim pots located on top and the hex sw on the bottom.

2. Each of the program variables is adjusted by selecting the corresponding position on the 16 position (Hex) switch. The zero position is the run mode and the switch must be returned to this position after any changes are completed. Use the correct sized screwdriver when making these adjustments. The Hex switch and trim pots use a standard flat tipped screwdriver with a 7/64" wide tip.

   Each of the variables selected by the Hex sw. will be viewed on the display. The auger min and max valve trims are set by using the two trim pots, located just above the Hex switch. All of the remaining variables are set by a method to be refereed to as (EE).

   The **(EE) method** of setting and saving a program variable is as follows: First select the correct Hex switch position, next press and hold the calibrate PB while adjusting the application knob until the display matches the desired value. Release the calibrate PB and the value is automatically saved into memory. The following chart is a complete list of program settings, the Hex sw position and the ranges for each.

Hex switch position	**Variable name**	**Adjustment Range**	**Factory setting**
0	Run mode	0 to 1000 lb/acre	n/a
1	auger trim	1% - 99%	26% min, 70% max
2	PWM freq	20hz-250hz	100 hz
3	View MPH	0 - 25.5 mph	n/a
4	Cts/mile (display x 100)	8000 -207000	17400 (174)
5	Small gate (fertilizer) [cuft/100pul]	.200 - .799	.360 **
6	Large gate lime) [cuft/100pul]	.800 - 1.299	1.07 **
7	Pulse dump	0 - 9999	Press PB to begin count
8	Auger sensor [pul/rev]	50 - 150	100
9	View Auger [RPM]	0 - 200	Press & hold PB [5 sec]
A	Max auger speed (Proportional gain)	1 - 255	100 hz
B	Ramp speed (Integral gain)	1 - 255	50 slow - fast
C	Minimum spread width	10 - 40 ft	40 ft
D	Maximum spread width	75 - 100 ft	80 ft
E	display test	8.8.8.8.	n/a
F	alt run mode	view dynamic lbs/acre output, for test only	

** Note, the factory settings for the small gate and large gate calibrations (item 5 and 6) assume a 100 pul per rev feedback sensor is being used. The chart (below) is for selecting the correct calibrations when using sensors with other pulse rates.

(material)	50 PPR	60 PPR	**100 PPR**	120 PPR
Fertilizer	.720	.576	**.360 ****	.288
Lime	2.140	1.712	**1.07 ****	.856

3. Hex sw = 2 is for setting the PWM (pulse width modulated) frequency. The specified PWM freq. is established by the valve manufacture. Use Hex sw = 2 and the (EE) method to adjust this variable.

4. Hex sw = 1 is used to set the auger valve trims. Make sure the hydraulic system is warmed up to normal temperature. Set the idle up so there is sufficient hydraulic flow. Set the Hex sw = 1, turn the application knob full CCW = 0 and adjust the auger min trim pot. to a point where the auger shaft is just turning (very slow). Make note of the number on the display, it is the % of auger drive required to just bring the valve on.

   Next turn the application knob to full CW = 100% and adjust the auger max trim to a point where the auger shaft is just reaching its full speed. There is a tendency to set the max trim too high. You can use a handheld tachometer to make this setting or you can place the Hex sw = 9 and view the auger RPM. Adjust the max trim pot. till the RPM on the display reaches its highest point. Put the hex sw = 1 and you can see the actual valve drive (%) required to achieve max flow.

5. Hex sw = 3 is for calibrating the MPH. The simplest method to calibrate the spreader control is to match it to the dashboard speedometer. This can be done with Hex sw = 3 press and hold the calib. PB. Turn the application knob to make the DS203 MPH display match dashboard speedometer while the vehicle is traveling approx. 15 MPH.

   Hex sw = 4 is an alternate method of speed calibration which uses a calculation based on the number of pulses per mile. Specific to the three ground speed sensors; the Trak-Star speed sensor m/n 00325 has a fixed output of 5.028 hertz per MPH; the Dickey-Jon m/n 456401910 which uses 44.21 hertz per MPH; and the AM Sensors m/n MSM30000 which also uses 44.21 hertz per MPH.

   The Trak-Star speed sensor m/n 00325 will be used as an example, the other sensors are calibrated in a similar fashion. The sensor has a fixed output of 5.028 hertz per mile per hour. [sensor output x 3600 = pulses per mile] therefore 5.028 x 3600 = 18100 pulses per mile. The spreader control displays pulses per mile / 100 = 181. Field tests have a more accurate setting is 174,000 cts/mile.

   You can confirm the MPH calibration by using the acre counter. Set the spread width to 80 ft and one acre is accumulated every 544.5 ft traveled. One mile traveled will therefore equal to 9.7 acres. Clear the acre counter and then drive the vehicle at a constant speed of approx. 15 mph at exactly 1 mile the acre counter should read 9.7 acres. If the acre counter reads too high at the one mile mark you will need to go to hex position 4 and enter a larger number and retest.

6. Hex sw = 7 is the pulse dump used to calibrate the auger output in cuft/100 pulses. The application knob is used to control the auger speed during the dump. The calibrate PB is used to energize the valve. The auger pulses received will be accumulated and displayed. By dumping a measured volume of material and dividing by the number of auger pulses you can determine the cuft/100 pulses for both of the gate settings used for lime and fertilizer.

7. Use Hex sw = 5 to enter the auger calibration for the small gate setting (fertilizer). The number ranges from .200 - .799. Use the (EE)

8. Use Hex sw = 6 to enter the auger calibration for the large gate setting (lime). The number ranges from .800 - 1.299. Use the (EE)

9. Hex sw = 8 is used to enter in the pulse per revolution (ppr) of the auger sensor. The range is from 50 ppr to 150 ppr. Use the (EE) method.

10. Hex sw = 9 is used to view the auger shaft RPM based on the PPR value entered into Hex = 8 (above). The application knob will allow you to vary the auger shaft speed while viewing the RPM. In the event of a failed auger sensor the control will automatically calculate and display the approx RPM based on the % of valve drive. **To set the failed auger feature, press and hold the calibrate PB for at least 5 seconds**. The auger will drive up to the max trim drive while the control samples the RPM. After 5 seconds release the PB and the calibration is saved.

11. Hex sw = A is the proportional gain used to adjust the valve drive for lbs/acre set point. [[Max RPM] x]pul/rev][/ 60 sec/min = max auger speed in hertz. Use hex = 9 to view the maximum RPM and then calculate the corresponding maximum speed in hertz and enter that number into the hex = A. Use the (EE) method.

12. Hex sw = B is the integral error gain used to adjust the stability for lbs/acre set point. This adjustment affects the ramp rate that the valve drive is allowed to change by. The range is from 1 (slowest) to 255 (fastest). Trial and error proves to be the best way to set this variable. Start with a fast setting and work down until the overshoot in auger speed is minimized. If you adjust the error gain too fast the auger shaft will be overly responsive and oscillate above and below the desired speed. If you make the error gain too large the auger shaft speed will be steady but very sluggish in response and it will take too long to find the correct speed. Use the (EE) method.

13. Hex sw = C sets the minimum spread width. Use the (EE) method.

14. Hex sw = D sets the maximum spread width. Use the (EE) method.

15. Hex sw = E is not used at this time and will only test the display by turning on all of the LED segments and decimal points.

16. Hex sw = F is an alternate run mode used to observe the actual auger feedback as it relates to lbs/acre. The display will be dynamic and show any deviations from setpoint. It is useful for checking the loop gains and ground speed effects.

Wiring connections