

# Operations Manual

## **DS201**

EL Front Panel Version

## **DS209**

Steel Panel with Map Lights

DS201M1G

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INSTALLATION RECORD

This form should be filled out during the installation of the DS201. It will prove to be an invaluable asset for the maintenance personnel. For multiple truck installations, copy this form and record the calibration settings for each truck.

Installation date \_\_\_\_\_  
 Truck number \_\_\_\_\_  
 Type of spreader \_\_\_\_\_  
 Gate opening \_\_\_\_\_  
 DS201 serial number \_\_\_\_\_  
 DS201 FW & CS \_\_\_\_\_

Calibration Settings:

Ground speed sensor type,	VRM or Hall or LV
Conveyor shaft sensor type,	_____ pulses/rev.
MPH calib. (hex = 1)	_____ counts/mile
Conveyor calib. (hex = 2)	_____ lb/K pulse
Conveyor valve min. (hex = 4)	_____ %
Conveyor valve max. (hex = 4)	_____ %
Max conveyor speed (hex = 4)	_____ pul/sec (hz)
Spinner valve min. (hex = 5)	_____ %
Spinner valve min. (hex = 5)	_____ %
Run mode options (hex = 6)	_____
Blast timer (hex = 8)	_____ sec.
Max. Feed Rate (hex = 9)	_____ lbs/mile
Gear box ratio (hex = A)	_____ 1:1= spot mode
Product ratio (hex = B)	_____
Valve monitor (hex = C)	_____ . _____
Truck number (hex = D)	_____
Liquid calib. (hex = E)	_____ lb/min
PWM frequency (hex = F)	_____ hertz

## General Description

The DS201 is a digital spreader control designed for use by highway salt and sand spreading equipment. It regulates the shaft speed of the conveyor (or auger) motor in direct response to the vehicle's ground speed (mph). By using the ground speed to proportionally regulate the conveyor speed, the DS201 can create a spread rate which is calibrated in units of "*pounds per mile*". The DS201 achieves a smooth and accurate control of the hydraulic valves using electronic pulse width modulation.

The DS201 features a large digital display to give the operator an accurate readout of the "*pounds per mile*" being spread. The display is a valuable tool for observing the spread rate both in Manual and Automatic modes. In addition, the display will alert the operator to any sensor or valve problems and aids the shop personnel when calibrating the spreader system.

The terms "convey" and "auger" are interchangeable and refer to the method by which the material is dispensed from the vehicle. This manual uses the general term "conveyor". For those vehicles using screw type augers, the reader will have to fill in with the word "auger".

## Manual and Automatic control

The DS201 will operate as a *manual* controller, allowing the operator direct flow control of both hydraulic functions, independent of the vehicle speed. *Manual* mode is useful for those special situations where ground speed control is either impractical or not available because of problems with a sensor. It's important to note that *Manual* mode will result in the costly waste of material.

The DS201 offers excellent material control as a ground speed controller, often referred to as *automatic* control. For automatic control the DS201 uses electrical pulses from the vehicle's transmission to calculate MPH. As the vehicle speed increases, so will the conveyor speed. Likewise, as the vehicle speed decreases the conveyor speed will also decrease. The goal of the automatic mode is to achieve a constant spreading rate. *Automatic* control has proven to be a very effective method for cost savings of spreading material.

*Ground speed control formula:*

$$\text{lbs/mile} = \frac{\text{lbs/hour}}{\text{miles/hour}}$$

The *automatic* mode improves the spreading operation by turning off the spinner and conveyor when the vehicle stops and restarting both of these functions when the vehicle begins moving again. The installer has the option to allow the spinner to remain on when the vehicle stops.

## Open Loop conveyor control

Open loop control is the simplest approach to ground speed regulation. The DS201 controls the conveyor motor by assuming that a 50% conveyor output is reached by driving the valve with a 50% signal. The digitally controlled valve trims produce a linear output. In reality, any given hydraulic valve is not perfectly linear. Some consideration should be given to the non-linear valve response by plotting the valve drive voltage versus the conveyor RPM.

For most applications open loop can be used and therefore illuminate the need to install or maintain the conveyor shaft speed sensor required for closed loop. The installer should be aware that there are some inaccuracies with open loop control. Field tests have shown the open loop control to have acceptable errors of approximately 12%.

## Closed Loop Conveyor Control

For the most accurate spreading available the DS201 offers a closed loop control. Here the conveyor is outfitted with a pulse counter (sensor) so the actual shaft speed (RPM) can be verified by the DS201. In all other ways closed loop works the same as open loop. Closed loop is more accurate and it solves problems with valve and motor non-linearity. Closed loop especially improves the accuracy at lower feed rates. From field tests, closed loop control is approximately +/- 5% compared to +/- 12% for open loop.

## Spinner

The spinner motor function is referred to as the "*spread width*". The operator sets the spinner RPM to establish the desired lane coverage. The operator can experiment with various settings to achieve one lane or two lane coverage. The spinner can be optionally set up to shut down when the vehicle comes to a stop or remain running. Unlike the conveyor, the vehicle's spinner is operating in open loop. Therefore, the operator may need to keep it fine tuned.

## DS201 Features List

- \_ Manual or automatic mode, with zero speed (mph) shut off.
- \_ Open loop or closed loop spread rate control.
- \_ Calculate and record accumulated pounds delivered for two granular products.
- \_ Senses hydraulic stall conditions and conveyor shaft sensor failures.
- \_ Automatically shows (ground speed) sensor output and sensor failures.
- \_ Function as an electronic speedometer for ground speed calibration.
- \_ Automatically cross calibrate from closed to open loop with sensor failures.
- \_ Adjustable Blast duration timer.
- \_ Select Blast output to equal max application rate or max valve trim.
- \_ Adjustable maximum feed rate limit.
- \_ Lock-out spinner shut-off at zero MPH.
- \_ Lock-out manual mode or allow both auto and manual mode.
- \_ Spot spreading feature turns conveyor on/off from remote operator switch.
- \_ Skip spreading feature to time cycle the conveyor on and off.
- \_ Adjustable PWM frequency, to accommodate any proportional valve.
- \_ Digitally adjustable minimum and maximum valve trims.
- \_ Valve monitor, short and open in the valve circuits, alerts operator
- \_ Operates with two granular product densities, [normal and alternate].
- \_ Compensates MPH calculations for vehicles using 2 speed rearends.
- \_ Field printer records the spreading activity; product type, distance, average vehicle speed, time, date, granular weight, and calibration settings.
- \_ Select truck no. to assist tracking printer outputs within a large fleet.
- \_ Metric or English format for storing and printing data. [DL107]
- \_ Internal real time clock to track days, months, years, time AM/PM

## OPERATION

In this section each of the features used by the operator are listed and explained. The discussion covers each of the controls found on the front panel. Refer to the back of the manual for a sketch of the front panel or unpack the DS201 and use it to follow along.

### Power on/off switch

The power on/off switch is in the upper left corner of the panel. When the power is on, the display will be active and never blank. If the display is completely blank there is an internal problem with the DS201, such as a blown fuse. The power switch controls the 12 volt power for the DS201 control box, the valves, and the sensors.

The four digit display flashes the *software FW* number (*firmware*) for the first 1/2 second after the power switch is turned on. Use this number when discussing detailed issues with your dealer. After the firmware number the control moves directly to what-ever mode has been selected.

Each DS201 is equipped with two other identification numbers, the checksum and serial number. To obtain these, press and hold the Blast PB and then turn on the power switch. The DS201 will first flash a special four digit number on the display. This is referred to as the CS (checksum). It's a unique number specific to the program shipped from the factory. Immediately following the checksum number is the serial number. The FW CS and s/n numbers will be required when discussing a problem with your dealer. Always have them ready.

**DO NOT USE THE POWER SWITCH TO SPOT SPREAD.** The DS201 is not designed to be turned on and off rapidly. There is a 2 second delay upon power up which the computer uses to initialize. In addition, the power switch will receive a large discharge spark from the valve coils if you turn off the DS201 with the valves on. Spot spreading should only be accomplished by using the aux. switch connected to input (pin 5). See section on spot spreading.

The DS201 is equipped with an automatic reset latch. If the computer should ever malfunction, due to a power spike or some other cause, the display should display four zeros (0000). The operator can clear the error by turning the power off, waiting 10 seconds and then turning the power on again. If the DS201 repeatedly fails this reset test report the malfunction to your dealer.

## Display

The display shows numeric values between 0 to 9999. Listed below are most of the displays you will encounter. The display primarily shows the feed rate in lbs. per mile

<u>Display</u>	<u>Explanation</u>
0	Feed rate knob full CCW (conveyor off)
20	Auto mode, minimum feed rate, vehicle moving
9999 x x x x	Manual mode, conveyor turning, vehicle is not moving. Auto mode, all digits flashing, vehicle is not moving (x) denotes any number from 0 to 9999.
x x . x x	Auto mode, decimal point flashing means conveyor is off because either the spot or skip mode is active. (x) denotes any number from 0 to 9999.
- - - -	( 4 dashes ) Blast is active, timer on.

## Error codes

0000 (4 zeros )	Computer error, (DS201 requires power cycle reset)
1... 11...111 (marching one's)	Stalled conveyor or bad conveyor sensor, Press Blast PB to clear error switches to open loop
2... 22...222 (marching two's)	Spinner valve failure, press Blast PB to clear
3... 33...333	Conveyor valve failure, press Blast PB to clear (marching three's)
5...55...555	Error codes beyond 4's are not defined at this time.(marching five's) Refer to added supplements.



## Mode Switch

The mode selection is a 3 position toggle switch located in the bottom center of the front panel. There are two modes: Manual and Automatic. The center position is used to display accumulated lbs. When first powered up, if the mode switch is centered, the DS201 assumes the Automatic mode.

When the mode switch is moved from Manual to the center position the mode stays in Manual but the display changes from manual feed rate (lbs/mile) to accumulated lbs. Likewise, if the mode switch is moved from Auto to the centered position the mode will stay in Auto and the display will change to accumulated lbs. Therefore, whenever the mode switch is centered the operational mode retains where the switch came from. To actually change the mode, the switch must be moved all the way from Manual to Auto or visa versa.

## Manual mode

Placing the mode switch down puts the DS201 control into the Manual mode. The Manual mode does not require either the ground speed input sensor or the conveyor RPM input sensor to operate. In Manual mode the conveyor and spinner will only respond to the position of the control knobs.

Manual mode gives the operator complete and direct digital control over the hydraulic valves. The display will continue to show the lbs. per mile being spread as long as both pulse signal inputs are present. It is important to note that because there is no ground speed control the displayed feed rate will change as the mph changes. The display will show a 0 when the conveyor (spreader) is off. If the conveyor remains on when the vehicle is stopped, the display will read 9999.

Manual mode is useful for testing the basic valve drive and is always available for backup operation should either sensor fail. Remember Manual mode does not conserve spreading material and should only be used when required. And manual mode will not automatically shut off the valves when the vehicle comes to a stop.

There is an option for the installer to set up the DS201 without a Manual mode (auto mode only). In this case if the operator needs to dump the remaining material from the vehicle, use the following procedure: with the vehicle not moving (zero MPH), set the mode switch to manual and press the Blast push-button. The conveyor will stay on until the Blast PB is pressed a second time.

## Automatic mode

Placing the mode switch to the upper position puts the DS201 into the Automatic mode. Automatic mode is intended to be the primary mode for spreading. The operator is able to keep his/her eye on the road while the DS201 maintains a constant feed rate. The full Automatic range is from 20 lbs./mile up to 3000 lbs./mile. There is a programmable upper limit, adjustable from 100 lb/mi up to 3000 lb/mi. See programming section, maximum feed rate.

The pulses from the transmission sensor create the ground speed control. While the vehicle is stopped (0 MPH) the display will flash the desired feed rate. Once the vehicle starts moving the display stops flashing and the desired feed rate is displayed steady (non-blinking). The conveyor shaft rpm will automatically increase in direct relation to the vehicle speed, keeping the feed rate constant. The spinner will always turn on to its preset level and then turn off again when the vehicle stops.

If the combination of vehicle speed and desired feed rate becomes too large, the conveyor will reach its maximum speed and the DS201 will display only the feed rate that is being delivered. The operator is notified of this *conveyor overrun* by a sudden decrease in lbs/mile readout. During the conveyor overrun the displayed feed rate will decrease (numbers scroll down) below the set point level. When the vehicle slows down to a speed where the conveyor can keep up, the display will scroll back up to the desired feed rate and level off for normal operation.

This scroll up and down that occurs with conveyor overrun is often misunderstood. After careful review, in most cases the conveyor overrun is a direct result to the conveyor calibration error. Review conveyor calibration.

Accumulated lbs.

*What is accumulated lbs.?* It is a special feature where by the DS201 calculates the accumulation by weight of the material as it's being spread. The accumulation is always taking place, whether in Manual, Auto or Blast modes. There are actually two internal accumulators, one for each product. The displayed value is in 100's of lbs. So that a reading of 40 will be a weight of 4000 lbs. The operator can let the accumulation continue until a total weight of 999,900 lbs. is reached. After which the accumulator rolls over and begins again at zero. The accumulated lbs. value is retained even when the power is removed.

When the mode switch is centered the display shows the accumulated lbs. based on which position the product switch is in. Recall the mode remains whatever the last position of the mode switch was. This allows the operator to choose either mode, Manual or Automatic, and still be able to view the accumulated lbs.

Since there is a separate accumulator for each product, as you view the accumulated lbs. the value will change when you switch between the two product types, normal and alternate.

#### *Clearing the accumulated lbs.*

If the operator wants to *clear* the accumulated lbs. first set the product switch to the product type you wish to clear (normal or alternate). The product switch always directs which accumulator will be cleared. Turn the power switch off, wait at least 10 sec. then, while holding down the Blast button, turn the power on. To clear both product accumulators you must keep the DS201 powered up for at least 25 seconds after clearing the first accumulator. After the 25 second wait period, simply change the product switch and repeat the same steps.

The product accumulations are calculated by continuously multiplying the feed rate (lbs/minute) by the current mph. If the conveyor is not correctly calibrated or if the conveyor turns without feeding material, then the accumulated value will be incorrect. If the error is too great the operator should have the system re-calibrated.

## Blast (unloading the hopper)

The Blast button is an orange colored push-button located in the lower left corner of the panel. Blast is used whenever the operator wants to instantly dump 100% of the conveyor's capacity. The Blast feature will operate any time it is pressed, regardless of the mode switch or the vehicle speed.

The Blast button can be programmed to function with a time duration. Typically, Blast is used to give a full conveyor output when the spreading truck is passing through an intersection or school zone. The timer begins when the Blast button is released. If you only want the preset time, then just hold the Blast switch down for a quick moment, then release it. The Blast function will stay on until the timer times out.

If the operator wants to end the Blast cycle he/she can, at any time, press the Blast switch momentarily and the Blast timer will turn off. The display will show - - - - (4 dashes) whenever Blast is active. If the Blast duration timer is set for 0 seconds, Blast will operate as a momentary function.

The run mode configuration of the DS201 allows for the Blast output to be set to either the valves maximum trim setting or the feed rate maximum lbs/mile setting. The specific spreading policy for your area will dictate which of these methods should be used. Refer to the programming section on Run mode configuration, Hex=6.

To unload the spreader in auto only mode, stop the vehicle, select manual mode, press the Blast button. The Blast button will toggle, push-on / push-off to unload the spreader, but only while the vehicle is stopped.

## Feed Rate

The feed rate knob is located in the upper right hand corner of the panel. In the Manual mode the feed rate knob will directly set the flow output of the hydraulic conveyor circuit. In Automatic mode the feed rate knob is used to set the desired feed rate in lbs/mile. As the feed rate knob is adjusted the results are directly seen on the display. In Auto mode the display always rounds off the number to the nearest 10 lbs./mile. The full CCW position of the knob will always turn the conveyor off, regardless of the vehicle speed, mode switch or minimum valve trim setting.

## Spot Spreading

Spot spreading allows the operator to instantly turn on and off the conveyor output. A remote push on - push off foot switch or toggle type dash switch is typically used by the operator. Connect the switch contacts between pin 5 and ground. When the spot switch is turned on [pin 5 grounded] the DS201 will instantly turn off the conveyor output. When the remote switch contacts open [pin 5 ungrounded] the conveyor will instantly come up to the required speed that meets the lbs/mile set on the display.

Many operators will attempt spot spreading by using the power switch to turn the spreader on and off. It is not a good practice to turn the DS201 computer on and off as frequently as the spot spreading is normally done. The DS201 uses a built in power-on delay for checking the internal memory. For these reasons it is always recommended to use the external switch for spot spreading. Refer to the programming section for details.

## Skip Spreading Not Recommended

Skip spreading uses a timer to turn the conveyor on and off at a fixed interval. The operator uses a foot or panel switch to signal the DS201 to turn the skip mode on. The skip timer can be set up to 30 seconds. Example; if the skip timer were set to 5 seconds, the spreader would run for 5 seconds on and 5 seconds off. This cycle will repeat as long as the input switch is active.

## Spread Width

The spread width knob is located in the lower right hand corner of the panel. It is used to set the spinner RPM. The full CCW position of the knob will always turn the spinner off, regardless of the vehicle speed, mode switch or minimum valve trim setting. With a little practice, the operator can easily determine the various settings for the spread width knob to achieve the desired spread widths. The spread width knob provides the operator with a very fine control of the spinner speed. To achieve the best spinner control the minimum and maximum spinner valve trims must be set correctly.

In the programming section there is an option that allows the spinner to operate in two different modes. The first is to automatically turn on and off with the vehicle motion. The second is to remain on all the time, regardless of vehicle speed. Refer to Run mode configuration for selection of this option.

## Product Switch

The product switch is located just below the power switch. It allows the operator to choose between two different product types, such as sand or salt. The product switch modifies the calibration ratio for both the material spread rate and accumulated lbs.

By changing the product switch, the operator will see no change to the displayed lbs/mile rate. However, the speed of the conveyor will change so that the selected material will be spread at the displayed rate.

When the DS201 is fitted with a liquid option the product switch has a 3rd position (centered) for selecting the liquid product. The left side of the display also includes (3) status lamps to aid the operator.

## Error codes

The DS201 can detect several system failures. Each of these is presented to the operator through a series of special error codes. Each code is shown on the display as four digits, 1111 or 2222 or 3333, etc.

0000	Computer fault, requires reset
1111	Conveyor sensor, no output, press Blast PB for open loop mode
2222	Spinner valve, open or short circuit, see valve monitor
3333	Conveyor valve, open or short circuit, see valve monitor

## FP100 *Field Printer Option*

The DS201 has an optional RS232 communications port for use with a Field Printer. The printer allows the equipment supervisor to extract the spreading history from the DS201. This option gives product accumulation totals, average speeds, peak speeds, calibrations, date, time, weights, and distances traveled. Please contact your dealer for supplemental information on the Field Printer.

In addition to a field printer option the DS2 will communicate to a PC or Laptop computer using a standard RS232C interface. For details please refer to the supplement section at the end of this manual.

## PROGRAMMING

Programming the DS201 is accomplished using an internal selector switch and the front panel controls. The term "programming" may be misleading since the installer is only adjusting a numeric value to several preset variables within the computer's memory. An optional DL107 handheld programming tool is available through your dealer.

Use a small Phillips screwdriver to open the front panel access door and a small standard flat tipped screwdriver used to rotate the selector (hex) switch and trim pots.

Each item to be programmed is selected by rotating a sixteen position switch. As a matter of short hand this manual will refer the selector switch and it's position as [ Hex = # ]. ie., selector position three would be shown as [ Hex=3]

When you have completed the programming of the DS201, each of the numerical values should be written down in the front cover of this manual for future reference.

### Programming Panel

The programming access panel is located on the right side of the front panel between the feed rate and the spread width knobs. Loosen [approx. three turns] the upper right and lower left screws. The small square door will now hinge out and to the right. Through the opening you will see (4) small trim pots and the sixteen position (hex) switch. On newer versions a small lamp shines on the hex switch for better viewing.

The variable you are entering may have a value between 10 and 600, the input can only give you 256 numbers. This works out to be every 2.3 numbers which, when rounded into whole numbers the display resolution will be in increments of 3. It's just a simple matter for you to use the number nearest to your desired value. The error created by this method is less than 0.5%.

The conveyor and MPH calibrations have a wide range of possible program values. In order to accommodate this the spread width knob will have to select more numbers than it's normal one turn can reach. At the end of it's full CW or CCW turning point the display will change by increments of 100. When you are within the correct range by 100 turn the knob back to the center and fine tune in the exact value.

When you are finished making your program adjustments, put the hex switch back to the run mode, hex = 0. Close the small programming access panel back and tighten the two Phillips screws.

Programming Guide (HEX switch)

<i>Position</i>	<i>Function</i>	<i>Page</i>
0	Run mode.	--
1	Calibrating MPH, transmission sensor.	24
2	Feed rate calibration lbs/minute for open loop, lbs/1000 pulses servo (1) lbs/10000 pulses servo (2)	25-27
3	Actual MPH readout	24
4	Conveyor valve trim, min. and max. display shows % valve drive.	22-23
5	Spinner valve trim, min. and max. display shows % valve drive.	22-23
6	Run mode configuration [Blast] [Liquid] [Operator] [Servo]	18-21
7	Closed loop feed rate dump Displays accumulated pulses dumped	27
8	Blast duration timer 0 to 30 sec.	28
9	Maximum feed rate. 100 lbs/mi. to 3000 lbs/mi.	28
A	2 Speed gear box ratio 5:1 to 1/5:1 1:1 = Spot spreading mode	28-29
B	Product sw ratio 5:1 to 1/5:1	29
C	Valve monitor low = short, high = open 2222 = spinner, 3333 = conveyor	30
D	Truck number (printer option) 0 to 250	31
E	not used	
F	PWM frequency adjustment 30 hz to 270 hz.	22



## Programming Outline

The following outline is given in a sequence most commonly used for setting up the DS201 spreader control system. The first four items marked with an (\*) are required and must be completed in order for the DS201 to be tested. The remaining items are options and if not used should be left at the factory setting.

### Step

1. \* Run mode options, open or closed loop, auto/man, spot, etc. Hex = 6
2. \* Set up the proportional valves. Hex = F, 4, 5 and C.
3. \* Calibrate the transmission sensor. Hex = 1 and/or 3.
4. \* Calibrate the conveyor sensor. Hex = 2 and 7.
5. Set Blast duration timer. Hex = 8.
6. Set the maximum feed rate. Hex = 9.
7. Set the Product ratio. Hex = B.
8. Set the two speed gear box ratio, spot or skip timer. Hex = A.
9. Set the truck ID number, (printer option) Hex = D.
10. Hex = E Not Used

Do a quick test *first*.

*Let's save some time.*

You should first verify that the sensors, valves, cables and overall hydraulic system are functioning. Refer to the installation procedure, read through the section on Quick test and perform these tests prior to starting any of the following programming tasks. The quick test is designed to confirm that the overall system is wired correctly. The DS201 comes from the factory pre-programmed so that all the necessary functions should perform well enough to verify the sensors and valves.

>>> READ AND UNDERSTAND THIS SECTION <<<

Making a change to any program variable is accomplished by using the following

*save routine (SR)*. The only exception to this procedure is the valve trim adjustments.

- > Set the hex sw to the desired position and view the current value on the display.
- > Press and hold the Blast push-button.
- > Turn the Spread Width knob until the display reflects your new value.
- > Release the Blast PB to save the variable into the memory.

Throughout the programming section, anytime it is required that you modify or save a program variable, the manual will refer to the (SR) procedure described above.

When setting the run mode configuration (Hex = 6) the Feed Rate knob is used to select one of the four digits. (the blinking digit is the selected one)

To modify the valve trims use the associated trim pot located under the programming panel door. These trim pots are live adjustments and do not require that you hold the Blast PB. You can view the valve trim settings by using Hex=4 (conveyor) and Hex=5 (spinner). The valve trim settings are displayed as a percentage.

## STEP ONE     Setting up the Run Modes

There are *four parts* to this section. Each part corresponds to a digit on the display. Set the selector switch to position 6 [ hex = 6 ]. As shown below each (digit) on the display has a defined meaning. At the end of this section are some examples that will help confirm your understanding or lack there of.

left digit			right digit
( <i>Blast</i> )	( <i>Liquid</i> )	( <i>Operator</i> )	( <i>Servo</i> )

To set up each of the run mode options, start with part one (Servo) and proceed through to part four (Blast).

### *Part One     Choosing the type of servo*

The servo digit selects what type of servo your conveyor is going to use. Open loop assumes that the conveyor has no feedback sensor. Closed loop assumes the conveyor has a rotary pulse generator. The choice between lbs/1000 pulses and lbs/10000 pulses is determined after the pulse dump is performed. Refer to the pulse dump section for details. Open loop uses a lbs/minute dimension and closed loop uses lbs/pulse dimension.

> Decide open or closed loop.

For open loop set the servo digit = 0

For closed loop (low pulses) set the servo digit = 1

For closed loop (high pulses) set the servo digit = 2

(note; during the conveyor calibration an actual material dump is made to determine the weight of material verses the pulses. First use servo = 1 and if the measurement is less than 150 lbs per 1000 pulse, the servo digit will need to be reset to 2.

lbs/min (open loop)	servo digit = 0
lbs/1000 pulse (closed loop)	servo digit = 1
lbs/10,000 pulses (closed loop )	servo digit = 2

*Program*                    Blast    Liquid    Operator    Servo

Turn the Feed Rate knob to select the far right digit (blinking). Press and hold the Blast PB, adjust the Spread Width knob to change current value, release the Blast PB to save your choice.

STEP ONE Setting up the Run Modes *continued*

*Part Two Choosing the operator modes*

The operator digit lets you select between several operator related features. The three options are as follows:

auto/man or auto only    spot or skip mode    spinner shut-off auto or manual

- > Decide if you want to lock out manual operation for the operator.
- > Decide how the remote switch input is to be used;  
(choose one) two speed gearbox, spot spreading or skip spreading.
- > Decide if you want the spinner to auto shut-off at zero MPH

To implement the decisions use the chart below. Select the line number that completely describes your group of options. The number at the far left of the chart is the number you will program into the operator digit.

operator digit	Mode sw front panel	spreading method	spinner method
0	auto & man	spot	auto
1	auto only	spot	auto
2	auto & man	skip	auto
3	auto only	skip	auto
4	auto & man	spot	manual
5	auto only	spot	manual
6	auto & man	skip	manual
7	auto only	skip	manual

Each of the operator options will also effect the value programmed into hex = A. Refer to the section for Hex = A for programming.

<u>option</u>	<u>hex =A value</u>
spot	1.00
skip	timer = 1 thru 30 seconds
two speed rearend	ratio = .20 thru 5.00

*Program*                    Blast    Liquid    Operator    Servo

Turn the Feed Rate knob to select the second digit from the right (blinking). Press and hold the Blast PB, adjust the Spread Width knob to change current value, release the Blast PB to save your choice.

STEP ONE    Setting up the Run Modes *continued*

*Part Three    Choosing the liquid options*

The liquid digit offers three choices. If your system is not equipped with the liquid option you should leave the liquid digit set to (0). If you are using the LC201 liquid pump control to drive a variable volume liquid pump set the liquid digit to (1). If you are constructing your own version of a liquid system and it has only a fixed output level the digit to (2). If you are using a large volume hydraulic/ liquid pump for anti-icing use (3).

- > Decide how the liquid option will be used.
  - (0) for no liquid
  - (1) for variable liquid pumps
  - (2) fixed volume liquid pumps
  - (3) anti-icing, large volume hyd/liquid pump

*Program*                    Blast    Liquid    Operator    Servo

Turn the Feed Rate knob to select the second digit from the left (blinking). Press and hold the Blast PB, adjust the Spread Width knob to change current value, release the Blast PB to save your choice.

*Part Four    Choosing the Blast operation*

The Blast digit allows you to choose what level the conveyor output will servo to when the Blast PB is used. The Blast PB will drive the conveyor output to its full 100% level (max valve trim) by setting the Blast digit to (0). If a more restrictive approach is desired, you can set the Blast output equal to the maximum feed rate setting established with the with hex = 9. For the Blast to equal the maximum feed rate set this digit to (1).

- > Decide how the Blast will function.
  - (0) for Blast = maximum valve trim
  - (1) for Blast = maximum feed rate

*Program*                    Blast    Liquid    Operator    Servo

Turn the Feed Rate knob to select the far left digit (blinking). Press and hold the Blast PB, adjust the Spread Width knob to change current value, release the Blast PB to save your choice.

STEP ONE     Setting up the Run Modes *by example*

Below are some examples for some typical Run mode configurations. Follow through each of them in order to confirm your understanding of the task.

*Run Mode (examples)*

*example one*

To obtain the run mode for: closed loop, auto mode only, fixed liquid output, Blast = max rate, spot spreading and the spinner using auto shut-off; the run mode display should read as follows:

left digit (1) (2) (1) (1) right digit

*example two*

To obtain the run mode for: closed loop, auto & man modes, variable liquid output, Blast = max trim, spot spreading and the spinner using auto shut-off; the run mode display should read as follows:

left digit (0) (1) (0) (1) right digit

*example three*

To obtain the run mode for: closed loop w/ less than 150 lbs/1000 pulses, auto mode only, no liquid output, Blast = max rate, spot spreading and the spinner using manual shut-off; the run mode display should read as follows:

left digit (1) (0) (5) (2) right digit

*example four*

To obtain the run mode for: open loop, auto mode only, no liquid output, Blast = max trim, spot spreading and the spinner using auto shut-off; the run mode display should read as follows:

left digit (0) (0) (1) (0) right digit

## STEP TWO Setting up the proportional valves

### PWM frequency ( hex = F )

Check the valve specifications supplied by the valve manufacturer for the correct frequency. The PWM frequency comes from the factory set-up for 180 hz.

Select Hex = F. The display will show PWM frequency in cycles per second [hertz]. The range between 30 and 270. Use the (SR) method to set this variable.

### Valve Adjustment ( general information )

Adjusting the proportional valve is basically the same for either the conveyor or the spinner valve. The goal is to set the DS201's proportional output voltage for the beginning and ending point of hydraulic flow. The valve drive voltage that just begins hydraulic flow is known as the minimum trim. The valve drive voltage that establishes the maximum flow rate is the maximum trim.

Located behind the programming access panel are (4) trim pots. The top (2) are for trimming the conveyor valve and the bottom (2) are for the spinner valve.

Hex = 4, The display shows the % of valve drive for the conveyor valve.

Hex = 5 The display shows the % of valve drive for the spinner valve.

The hydraulics must be active and up to normal operating temperature (120 deg. F) with the engine set to 1000 RPM. You must be able to view the motor rotations for both the conveyor and spinner. If necessary use a helper to tell you when the shafts are turning.

On some systems you may notice hydraulic interaction between the spinner and conveyor. Always make the valve trim adjustments with the opposite valve turned off. After you have adjusted the valve trims, return to hex = 0 and with the mode switch in manual turn on both the feed rate and spread width motors. Watch the RPM of one while changing the other. If the two valve functions interact, consult your hydraulic dealer. The DS201 does not have any electrical interaction between the two valve drives, provided you use two independent conductors for each.

### Conveyor Valve Trim ( hex = 4 )

When setting up a closed loop conveyor, the shaft pulse counter becomes a useful tool for observing the speed of the conveyor. By pressing the Blast PB at Hex = 4 the display will show the pulses per second from the sensor. Observe this number while adjusting the conveyor max. trim. Set the max. valve trim to the lowest value where any further increase in the trim pot will give no increase in display. This is the point where the conveyor has reached its fastest RPM. Release the Blast switch and the display will return to the % of valve drive.

The DS201 is designed to cross calibrate from a closed loop system over to an open loop system in the event of a conveyor sensor failure. To cross calibrate the DS201 must have the correct maximum conveyor speed set. The procedure described below in step 2 automatically calculates and sets the max. conveyor speed into memory.

1. Set hex = 4 and the feed rate knob to its minimum position (full CCW). With a small flat-tipped screwdriver slowly adjust the conveyor minimum trim (upper left pot) so that the conveyor shaft is just rotating (very slowly).

Note: Step 2 is required for the DS201 to cross calibrate correctly.

2. Next turn the feed rate knob up to its maximum position (full CW). Adjust the maximum trim (upper right trim pot) so that the conveyor shaft just reaches its highest speed. Press the Blast PB and the display will show you the sensor pulse rate. Observe the pulse rate to adjust the conveyor speed to the peak value. Release the Blast PB to store the maximum conveyor speed into memory.

To test the valve trim move the feed rate knob from its minimum setting to the maximum setting and the conveyor speed should go from lowest RPM to its maximum RPM.

### Spinner valve trim ( hex = 5 )

1. The spinner valve adjustment is nearly the same as the conveyor adjustment. First set hex = 5 and set the spread width knob fully CCW. Next, adjust the spinner minimum trim pot (lower left) so that the spinner shaft is just beginning to rotate, slowest RPM.

2. Since spinners usually rotate much too fast remember to adjust the spinner maximum to a speed which typifies your maximum needs (for most applications this is 2 lanes in width). Set the lane width knob to full CW. Adjust the maximum trim pot (lower right) for the desired top speed for the spinner.



### STEP THREE MPH Calibration ( hex = 1 and 3 )

The MPH calibration for the DS201 is simply a matter of matching the vehicle's dash board speedometer to the DS201's internal speedometer.

Jack up the rearend of the truck ( Think safety!! Use axle stands and tire blocks ). Select hex = 3 to view MPH. Select a gear and set the throttle for a dashboard speed of 20 MPH. On the DS201 press and hold the Blast switch while slowly turning the spread width knob. Match the DS201's display to the dashboard MPH. Release the Blast switch to save the calibration into memory.

If you have several trucks, each with the same transmission, rear end and tire size this calibration can be directly entered into the other DS201's. Using the DS201 that was calibrated first, read the counts/mile from hex = 1. On each of the target DS201's enter in the same counts/mile value. Set Hex=1 and use the normal (SR) procedure.

Note: the [display X 100] = the actual counts/mile.

To test the MPH calibration, set hex = 3, run the engine speed up and down. Compare the DS201's displayed MPH with the vehicle dashboard speedometer. They should track each other. The DS201's MPH should = zero when the vehicle is at rest and move up from zero as the vehicle begins moving (1 MPH). If the DS201's display is erratic or does not start and stop at zero MPH you may have a sensor interface problem. Refer to the Installation section on ground speed sensors.

Note: The accuracy of the MPH calibration is no better than the accuracy of the dashboard speedometer. Any inherent error will effect the printer (option) since the data logging bases its distance as the time integration of speed.

#### STEP FOUR Feed Rate Calibration (general)

The conveyor calibration is the key to overall accuracy of the spreader control. The purpose of this test is to determine the rate at which the conveyor can dispense the granular material. If it's an open loop system you need to determine the *lbs./minute*. If it is a closed loop system you need to determine the *lbs./1000 pulses*.

In the following tests it's recommended that you perform the measurements with as much accuracy as possible. If the product is sand, salt or a combination, try to run the tests with the actual material so that the real density is used. ie., if the sand is normally wet, then run your test with the wet sand. Or if it's a sand/salt mixture then run the tests using the correct sand/salt ratio. As with the MPH calibration the overall accuracy of the spreader system can be no better than the results of this test.

When weighing the product it is best to use a vehicle scale which you can drive the entire truck onto. An alternate method is to dump the material onto a tarp and then shovel the material into a bucket. Weigh one full bucket on a bathroom scale and multiply the total number of buckets by the weight of the first bucket.

STEP FOUR Feed Rate Calibration *continued*

*Gate opening ?*

Many spreaders offer variable gate openings. These gate openings were originally the only way to regulate the amount of material. The DS201 will eliminate the need to change the gate settings. Ideally you should choose a gate setting which will produce your highest required feed rate at the highest spreading speed.

$$\frac{\text{lbs / mile} \times \text{MPH}}{60} = \text{lb/minute}$$

*Practice example:*

Given your maximum spreading speed is 35 MPH and your maximum desired feed rate at that speed is 800 lb/mile; put 35 and 800 into the above formula and the result is 467 lbs/minute. Therefore you need a gate setting that will give you at least  
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7 lb/min. In practice you would probably use a setting for 500 lb/min.

Preset a gate opening to approximately 50%, perform a timed dump with the feed rate at 100% for 5 to 10 minutes. Weight the amount of material dumped and divide the weight (pounds) by the dump time (minutes) to get lbs/minute.

From the 50% gate opening you started with, readjust the gate to achieve the 500 lbs/minute (for this example). Re-test the new gate opening to confirm you can achieve the required feed rate for maximum speed at maximum rate.

## Time Dump for Open Loop Conveyors ( hex = 2 )

Now that you have read and understand the gate example shown above you are ready to calibrate your conveyor for open loop. The following procedure restates the same test, except with a bit more detail.

With the truck bed full of the *normal* product make note of the total vehicle weight, put the DS201 into the Manual mode, set the conveyor output to 100% and set your gate to your first try (best guess) opening. Measure the duration of the dump. It's very important that you watch the conveyor as it feeds to ensure the material does not bridge up, jam or develop a void. You want to have a constant and even dump at 100% feed rate. If you can dispense at least half the truck during this test, you will have better results. It will also help to keep the bed tilted on tailgate units so the material continues to flow into the auger. Weight the truck before and after, take the difference and divide by the total time to calculate the lbs/minute.

If the gate opening produced an adequate amount of material you can program the setting. Set hex = 2 and use the (SR) procedure. You should have already set the run mode configuration servo digit to 0.

STEP FOUR Feed Rate Calibration *continued*

Pulse Dump for Closed Loop Conveyors ( hex = 2 and 7 )

Closed loop systems require that you determine the lbs. dumped per 1000 pulses of the conveyor sensor. The DS201 has a pulse dump feature that lets you observe the accumulation of pulses from the conveyor sensor as you are making the test dump. Set hex = 7, press and hold the Blast PB. The display will count down from 2, 1, 0 and then start the conveyor turning. The conveyor will run at the selected feed rate.

As the dump is proceeding the display will show the accumulation of pulses from the conveyor sensor. If you are making a very long pulse dump you must keep count how many times the display counter rolls over. Each rollover is 10,000 pulses. You can vary the speed of the conveyor during the test with the feed rate knob. By varying the feed rate you will more accurately approximate the normal action of a conveyor. Try to average 50%.

Begin pulse dump with the DS201 set to SERVO 1. Then determine if the calibration rate is greater than or less than 150.

Weigh the truck both before and after the dump is completed. Take the difference between the two as the lbs. dumped and divide by the total pulses. Take the lb/pulse and multiply by 1000.

$$\frac{\text{lbs dumped}}{\text{total pulses}} \times 1000 = \text{calibration rate}$$

If the calibration rate is greater than 150 use servo range (1) and program hex = 2 with the calibration rate as is. If the calibration rate is less than 150 use servo range (2) and program hex =2 with the calibration rate x 10.

Example #1: Given that you have dumped 8400 lbs. in 6350 pulses. The calibration rate is { [8400 / 6350] x 1000 } = 1323. The result is above 150 you can use servo range (1) and program 1323 into hex = 2 as the feed rate calibration.

Example #2: Given that your test dump was for 1200 lbs. in 9500 pulses. The calibration rate is { [1200 / 9500] x 1000 } = 126. The result is below 150 and you must use servo range (2) and program [126 x 10 = 1260] into the hex = 2 as the feed rate calibration.

Use the (SR) procedure. Remember to change the run mode config. to the correct servo (1) or (2) as shown in the above examples.

#### STEP FIVE Blast Duration Timer ( hex = 8 )

The blast timer is adjustable from 0 to 30 seconds. Set hex = 8 and view the time delay (in seconds) on the display. To change the duration timer, use the (SR) procedure. The DS201 is factory shipped with 0 seconds for the duration time.

#### STEP SIX Maximum Feed Rate ( hex = 9 )

The DS201 will allow you to fix a maximum feed rate. The maximum feed rate only applies to the Auto mode. The full range for Auto mode is from 40 #/mile up to 3000 #/mile. The maximum feed rate can be set from 100 lbs/mile in 100 pound increments up to 3000 lbs/mile. Set hex = 9 and use the (SR) procedure to change it.

#### STEP SEVEN Two Speed Rearend, Spot or Skip mode ( hex = A )

This option requires an electrically dry contact switch input on pin 5 to signal the DS201 of the rearend ratio change. Since other options use this same electrical input the installer can define which option is being used by the value entered into Hex=A.

For Spot mode a 1.00 must be entered into Hex = A

For Skip mode a timer value of 1-30 seconds must be entered into Hex = A.

For the two speed rearend option a ratio between .20 and 5.00 must be entered into Hex = A. the following section describes how to set up your two speed rearend ratio.

Note: Pin 5 of the connector is also reserved for a spot spreading switch input. Only one of these options can be used: either the two speed gear box or the spot spread, but not both. Refer to the section on spot spreading.

#### Two speed rear end

This section is for vehicles that will be spreading with two speed rear ends. The DS201 provides an electrical input and ratio multiplier to achieve the required MPH conversion. This is a three part procedure.

The gear ratio rule: When (pin 5) is electrically open (+12vdc) the DS201 leaves the MPH as calibrated. If (pin 5) is electrically grounded (0vdc) the DS201 divides the MPH signal by the program ratio.

Part Two *Calculate the correct ratio.*

The DS201 can accept ratios from 5:1 to .1:1. This allows you to invert your logic so that either the low or a high signal will change the ratio. The ratio rule can be best explained with the following examples;

*Gear box example 1;*

Given: DS201 MPH was calibrated in low range.

Given: Gear box high range is 1.3 : 1

Therefore: The switch input must be open in low range.

1 divided by 1.3 = .77 (program ratio = .77)

*Gear box example 2;*

Given: DS201 MPH was calibrated in high range.

Given: Gear box high range is 1.3 : 1

Therefore: The switch input must be grounded in low range.

1.3 divided by 1 = 1.3 (program ratio is 1.3)

Part Three *Program the correct ratio into the DS201 memory.*

Set hex = A, use the (SR) procedure. To test this feature, set hex = 3, drive the truck around while changing the gear box range switch and confirm the correct change in the calculated (displayed) MPH. Note, spot spreading requires that the gearbox ratio be set to 1:1.

STEP EIGHT Product Switch ( hex = B )

The Product switch allows the operator to select between two types of material. It's located on the front panel between the Power and Blast switches. There are two product choices, normal and alternate. With the liquid option the DS201 uses a three position product switch, with liquid in the center.

In the normal product position the operator will have a feed rate equal to that established by the conveyor calibration. When switched to the alternate product the DS201 uses a ratio based on the difference between the two product densities.

Example: If the normal material is sand and weighs 110 lbs. per cu. ft. and a alternate material is a sand/salt mix weighing 80 lbs. per cu. ft. Then the ratio of alternate / normal =  $80 / 110 = 0.73$ . This is the product ratio.

To program in the product ratio set hex = B. Use the (SR) procedure.

The product ratio is factory set to 1.00 and therefore the front panel product switch will have no effect when used. The total range is 5.00 to 0.20. Since the product ratio can be above 1 or below 1, you are free to choose either material to be normal or alternate.

## STEP NINE Valve Monitor (hex = C)

In the shop the DS201 offers the maintenance technician some extra assistance. The hex = C is used to display the electrical status for each valve circuit. Refer to the back section of this manual for the diagram that shows the front panel display and various knob settings for using this feature.

The DS201 determines an open when the circuit resistance is much higher than normal. A short is determined when the circuit resistance is lower than normal. Usually only one of the spreading valves is bad and the other valve coil can be used as a comparison.

Note: during this test the valves are being electrically driven and regulated by the DS201. And if the hydraulic pump is active the technician is warned to use care when working with live hydraulics. Valves coils can be tested without the hydraulics active. Remember cold valve coils will read lower in resistance.

To change the valve monitor settings select hex = C hold the Blast PB and use the appropriate knob (conveyor or spinner) to select the valve monitor. Release the Blast PB to save your choice.

The spread width knob is used to set the spinner valve and the feed rate knob is used for the conveyor valve. The left two digits reflect the spinner valve and the right two digits are for the conveyor valve. Two dashes indicate the monitor will ignore open circuits and blank digits indicate the valve monitor is off. Regular numbers (4 to 90) means the monitor is on. The actual number is a relative indication of the circuit impedance. Very low numbers (4 or 5) indicate a short circuit. Very high numbers (90 to 99 ) indicate an open circuit. A normal valve will read between 15 and 60.

The purpose of the valve monitor is to assist in trouble shooting a bad valve circuit. The feature is not required and if it give you too many problems you can turn it off by setting the display to blank digits. If no spinner function is used make sure you set the spinner monitor to dashes or blanks. Some valves will tend to read very high and can erroneously trip off as an open circuit. You can program these valves with dashes so that short circuits will still be protected.

In the normal spreader operation the DS201 will present two different error codes to the display. Error codes 2222 indicate a spinner circuit fault and 3333 indicate a conveyor circuit fault. Pressing the Blast switch will clear the errors. However, if the problem still exists the error code will re-appear.



## STEP TEN Truck Number (hex = D)

The truck number is used by the field printer. Each DS201 can be programmed with a different truck number. The range of numbers is from 0 to 250. The truck number is stored internally in the DS201 memory. The truck number can be printed out using the DS201 Field Printer. This scheme allows a group of spreader vehicles to be uniquely identified so that the data retrieved can be organized by individual truck.

To set the truck number use hex = D and the (SR) routine.

## PROGRAMMING COMPLETE

At this point you have completed the programming for the DS201. Return the hex switch to position zero [hex=0]. The DS201 is ready for operation. If this is the first system you have set up you may want to perform some test to determine the overall accuracy of your spreader control.

A simple way to test the system is to fill the vehicle with material and weight the truck. From the material yard block up the rear wheels and run the vehicle at about 20 MPH with the feed rate set at a typical level for your use. First zero the accumulated lbs. and then after the truck has dumped about 75% re-weigh and compare the actual material dumped to the accumulated lbs. stored by the DS201. Your error can be corrected by either changing the MPH calibration or the conveyor calibration. If the MPH of the DS201 compares fairly well with the dash board speedometer the more likely change should be made to the conveyor calibration. If the actual dump is greater than the internal accumulator then increase the conveyor calib. Likewise, if the actual is less than the accumulator then decrease the conveyor calib. Remember it's all a simple matter of ratios.

## INSTALLATION

The installation should only be attempted by a qualified truck equipment dealer. Please read through these instructions and guidelines. Not every installation is the same and it's impossible for this manual to give the installer a nut by nut and wire by wire list to follow. Read the installation section first and then make a plan before starting.

### Mechanical Considerations

The DS201 must be mounted inside the cab of the truck. Mount the DS201 in a location so the driver can easily reach the control knobs and switches. The viewing angle and orientation should complement the digital display. The operator needs to glance at the display while driving so the display should be aligned for proper viewing and be easy to read.

In a pedestal style mount, where the console is located between the cab seats, often there are several hand levers for controlling the plow and hoist. Make sure there isn't a conflict between these levers and the spreader control.

In the retrofit applications some installers will mount the spreader control to the dashboard. The DS201 is made for flange mounting and requires a mounting bracket for dashboard mounting. Please refer to the mounting bracket sketch in the back of this manual.

## Electrical Considerations

### Power Input

The DS201 will operate on standard vehicle power, 9vdc to 16vdc. The DS201 is internally protected with an 8 amp fuse. The DS201 is protected against accidental reverse power. In the event of a polarity reversal while the DS201 power switch is on the internal 8 Amp fuse will blow.

The display on the DS201 is intended to be on whenever the power switch is on. In this way the display serves as a power indicator. If the display is blank check the 12 volt power input or the fuse.

### Valve connection

The DS201 will work with most any proportional hydraulic valve. In most cases the cable harness supplied with the DS201 is already outfitted with the proper connector to match up to the valve. If this is not the case, correct cable ends are available from your dealer. If you desire to connect the ends yourself, please understand the following requirements:

The connection **MUST** be weather tight. If you fail to make the proper weather tight seal it's likely salt corrosion and water will destroy the connection.

Label the connections so that it will be clear to the maintenance people which wire goes to which valve. Route the wires correctly along the frame and back into the cab. Allow for the necessary turns, sweeps and pulls so that the cable is not stretched too tight. Clip or tie-wrap the cable all along the path. If there is any excess cable, it should be coiled up inside the cab, in the console or under the dash, but not outside.

If the cables supplied to you are not long enough, be very careful with how you lengthen them. It is best to cut the cable out near the end by the connector, because if it is a shielded wire you won't be affecting the shield nearly as much as if you cut the cable in the middle. Solder your connection and use heat shrink tubing over each of the wires individually and then again over the whole group. Prior to shrinking the last piece apply some RTV (silicone) sealant to the wire and shrink over the wet RTV. After the sealant cures it will give you a much better weather tight seal. Please read the EMI/RFI section for tips on how to prevent or reduce electrical noise.

Refer to the back of this manual for the valve wiring diagram.

## Conveyor Sensor Connection

The DS201 uses a 3 wire hall effect sensor for the conveyor shaft pickup. They have 3 wires and can be hooked up wrong. Usually, but not always, the wire colors will be the clue to the hook-up. Red is the 12 v. power, white is the signal and black is ground.

Conveyor sensors can require the connector be close to the sensor, since during the off season the spreader box may be removed. Conveyor sensors are usually located near open gears, chains, rocks and sand. Route the cable along a protected path . Use tie-wraps or cable clips to keep the cable out of the way from moving objects.

The DS201 is factory set to directly accept the hall effect pickup for the conveyor sensor.

## Ground Speed Sensor

The DS201 has an internally mounted dip switch with four levers which needs to be changed depending on the type of ground speed sensor used. Refer to the dip switch Selection Guide in the back of this manual. The dip switches are located behind a plastic plug located on the left side of the DS201. Remove the plug and set the dip switch levers with a small screw driver.

Hall Sink. On older trucks the standard speedometer cable is outfitted with a square cable adapter to generate the ground speed pulses. The electronic output is a Hall effect signal. This is a 0 - 12v square wave signal.

VRM. On newer trucks using the electronic speedometers the ground speed pick up will be a VRM. VRM (variable reluctance magneto) is the standard speed sensor on newer trucks. The VRM is a simple two wire device, which when placed very close to the teeth of a moving gear will produce an AC signal (zero crossing). The frequency of the AC signal are used to determine the vehicle speed.

VRM's are not polarity sensitive and you are free to wire them up in either direction. However, the new electronic speedometers ground one side of the VRM sensor and the DS201 also does the same. If the dashboard speedometer stops working after the DS201 is connected to the VRM, the grounds are likely crossed and you will need to reverse the connections between the DS201 and the VRM.

The DS201 provides a 3000 ohm input for the VRM. On the back of the DS201 printed circuit board is a trim pot used to adjust the sensitivity. This is factory set for 300mv and should only be re-adjusted if recommended by your dealer.

Low voltage. On the newer computerized transmissions a special signal is used by the manufacturers. The DS201 has a third choice for these computerized systems which uses a low voltage interface. The DS201 will trigger on a 3 volt signal.

Test. To test how well the ground speed sensor is working, put the DS201 in the mph mode set hex = 3, and observe the display (mph). As you move the truck speed up and down, the display should follow along smoothly. It should also turn completely off (mph = 0) when the vehicle is stopped. If the display is jumpy and the right hand digit looks like an eight all the time, the signal may be too noisy and will likely cause problems with the automatic spreading functions.

## Quick Test

The following procedure is a *quick test* used for checking out the basic spreader system. At this point we are assuming all the cables and wires are connected, and the hydraulic system is complete. The DS201 is shipped from the factory with run mode set for closed loop and the trims set for 25% and 75%. These basic settings should work just fine for the quick test.

## Quick Valve Test

Activate the hydraulic system and let it warm up. Check for leaks. Next, place the DS201 into Manual mode with the feed rate and spread width knobs set to their full CCW (off) position. Turn the power switch on. Individually turn each knob on, first the feed rate (conveyor) and then spread width (spinner). Run them up through their full range and observe how the hydraulic motors function.

1. Do the hydraulic motors turn the proper direction?
2. Does the conveyor & spinner motor speeds span from dead stop to full speed?
3. Are there any hydraulic leaks?

## Quick ground speed check

To test the ground speed sensor you need to take the truck for a quick spin around the driveway or jack and block the rearend off the ground. With the mode switch in Auto and the truck tires not moving the display will blink, confirming the DS201 is not receiving transmission pulses. Put the truck into gear and get the tires moving (approx 10 mph). If the display goes from flashing to non-flashing then the ground speed signal is being received and the sensor is assumed OK for now.

## Quick conveyor sensor test

Do this next test only for closed loop systems (if there is no conveyor shaft sensor, skip this next test).

To test the conveyor sensor put the mode switch to Manual with the feed rate set up about 40%. Check to make sure the conveyor shaft is rotating. If the conveyor pulses are NOT being received then the decimal point on the display will light up. If the conveyor sensor is OK the decimal point will not be present.

## Electrical Noise And Radio Interference EMI/RFI

The problems with electrical interference (EMI/RFI) can not be overstated and should not be underestimated. There are no absolutes in the area of EMI/RFI, but there are some guidelines.

The DS201 spreader control system is concerned with two types of noise. The first is when the DS201 is a victim of the regular electrical noise of truck system. This electrical noise can be associated with the ignition, alternator, voltage regulator, relay, the two-way communication radio, etc. The DS201 has internal power input transient (spike) suppressers and a common mode filter for this type of noise. If the operation of any other electrical device on the vehicle causes the DS201 to malfunction, contact your dealer for special assistance.

The second type of electrical noise is where the DS201 is causing a problem with the communication (two-way) radio. The best way to determine if there is a problem is to perform a radio check. (please refer to the next section)

## Radio Check

Set the radio on the most commonly used channel and adjust the squelch right to the point where the radio is about to come on. With no activity on that channel, turn on the DS201. If you here some strange *star wars* like sounds coming from the two-watt radio, you have a problem. Try all the channels, always adjusting the squelch to the edge of sensitivity. Turn the spreader on and off for each channel. Make a list of every frequency for which you hear interference.

If you need help get someone familiar with radios to work with you. The main objective is to solve the radio noise problem, before you release the truck into service.

## What can be done about RFI?

If you have a radio interference problem the following section may help you to review the installation and perhaps you can find a fix. Please report any problems to your dealer. There are several fixes which can be prescribed, including special filters.

The installation is the primary area of concern. The need to ground the equipment is very important. Each unit has two spot faced terminal connections on the back of the box for the installer to use for making a solid connection to ground. Each DS201 is shipped with a grounding strap.

Spot facing all grounding connections is a MUST. Connect one end of the ground strap to the back of the DS201 and the other end to a spot faced point on the truck. It's best to pick the nearest steel item. In most cases the cab console is a good choice. The console should be welded to the truck body.

A final solution may be to have the factory install a special radio filter kit in the DS201. Contact the dealer for recommended filter kits.



## TROUBLESHOOTING

This troubleshooting guide assumes that the vehicle and DS201 were at one time completely checked out and working correctly. These tips indicate possible causes only if the system was at one time correct.

1. Turning the power on but the display remains blank:

- > Is the internal fuse OK? (replace with 8 amp fast blow 5mm x 20mm)
- > Are the power leads disconnected or reversed ?
- > Is the 9 pin connector hooked up ?

2. One valve works but the other doesn't:

- > Reverse the valve connections and if the other valve fails then the cable or the DS201 is at fault. If the same valve fails then the valve is at fault. Refer to section on valve monitor

3. There are no hydraulic functions in the Auto mode but Manual mode is OK:

- > Does the display stop flashing when the vehicle is moving?  
If not, you probably have a bad transmission sensor.

4. In Auto mode; marching ones on the display;  
conveyor is failed but spinner runs fine:

- > Check your closed loop conveyor sensor. Or you may have an conveyor stall.

5. You have marching ones on the display in both Manual and Auto modes.

- > This is an open loop stall condition, check the pressure sw.

6. The valve coil is suspect.

- > Check for open or short circuit. Normal coil resistance's is from 3 to 15 ohms or compare it to a good coil.

- > Directly drive the valve coil with 12 volts and see if the hydraulic circuit functions. Some coils will not survive with a direct 12 volts so don't leave it connected for long but it is OK to do a quick test.

7. The sensor is suspect.

- > Do a sensor load test. Refer to the back of this manual for the correct sensor load test procedure.

## SERVICE

### Rear panel removal

The rear panel of the DS201 may need to be removed if:

- > the fuse requires replacing
- > the VRM trim pot needs adjustment
- > the program chip (EPROM) is to be changed for an upgraded

When removing the back panel always remove the connector screws first and then the three panel screws. The 9-pin connector is directly soldered to the circuit board and will not pull away with the back panel.

### Replacing the DS201

Prior to removing the faulty DS201, verify its programmed variables by using the selector switch. Write down each setting. If you have a printer, use menu 5 to print out the calibration list. Fill in the installation record in the front of this manual. When installing the replacement DS201 you will need to re-enter each of the variables. This procedure should take ten minutes.

### For Repairs

Ditco Inc.  
106 E. Titus St  
Kent, WA 98032  
253 854 1002  
[ditco@qwest.net](mailto:ditco@qwest.net)

## Supplemental

### RS232 Comm Port

The DS2 is equipped with a RS232C comm. port. Using a PC or Laptop with a RS232 comm port you can download the accumulated totals and calibration settings from the DS2. Normally this comm. port connection is used by a field printer, ref. p/n FP100. The DS2 will send a the PC the same data and format as it would to a printer.

Set your PC up with a terminal emulator, Microsoft Hyper-terminal works good  
Comm port number (your choice)

Properties      Baud rate is    2400  
                  start bit, none    **N**  
                  8 data bits,        **8**  
                  stop bit,one      **1**  
                  flow control, none (don't care)

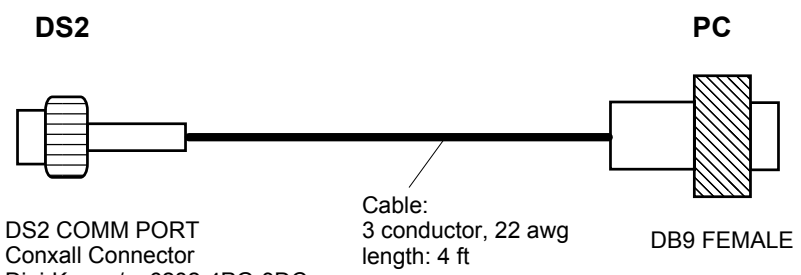
### Comm. port Commands

From your terminal emulator you send the following:

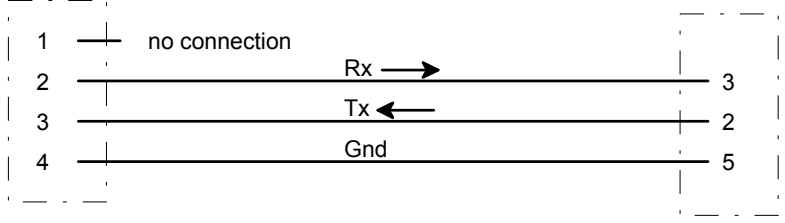
<u>          </u>	<u>ASCII Command</u>	<u>Description</u>
1.	<Ctrl> Q command to start)	Puts the DS2 into printer mode (must use this receive opening page w/ list printer commands
2	0 1 <Ctrl> T	receive Recent Totals
3.	0 2 <Ctrl> T	Receive Annual totals
4.	0 3 <Ctrl> T	Clear Recent Totals
5.	0 4 <Ctrl> T	Clear Annual totals
6.	0 5 <Ctrl> T	receive all calibration info
7.	0 6 <Ctrl> T	receive all Totals and calib. info

Note; alternate to using the 01 thru 06 <Ctrl> T commands you can select the number 1-6 using the Lane Width Knob, press blast to transmit.

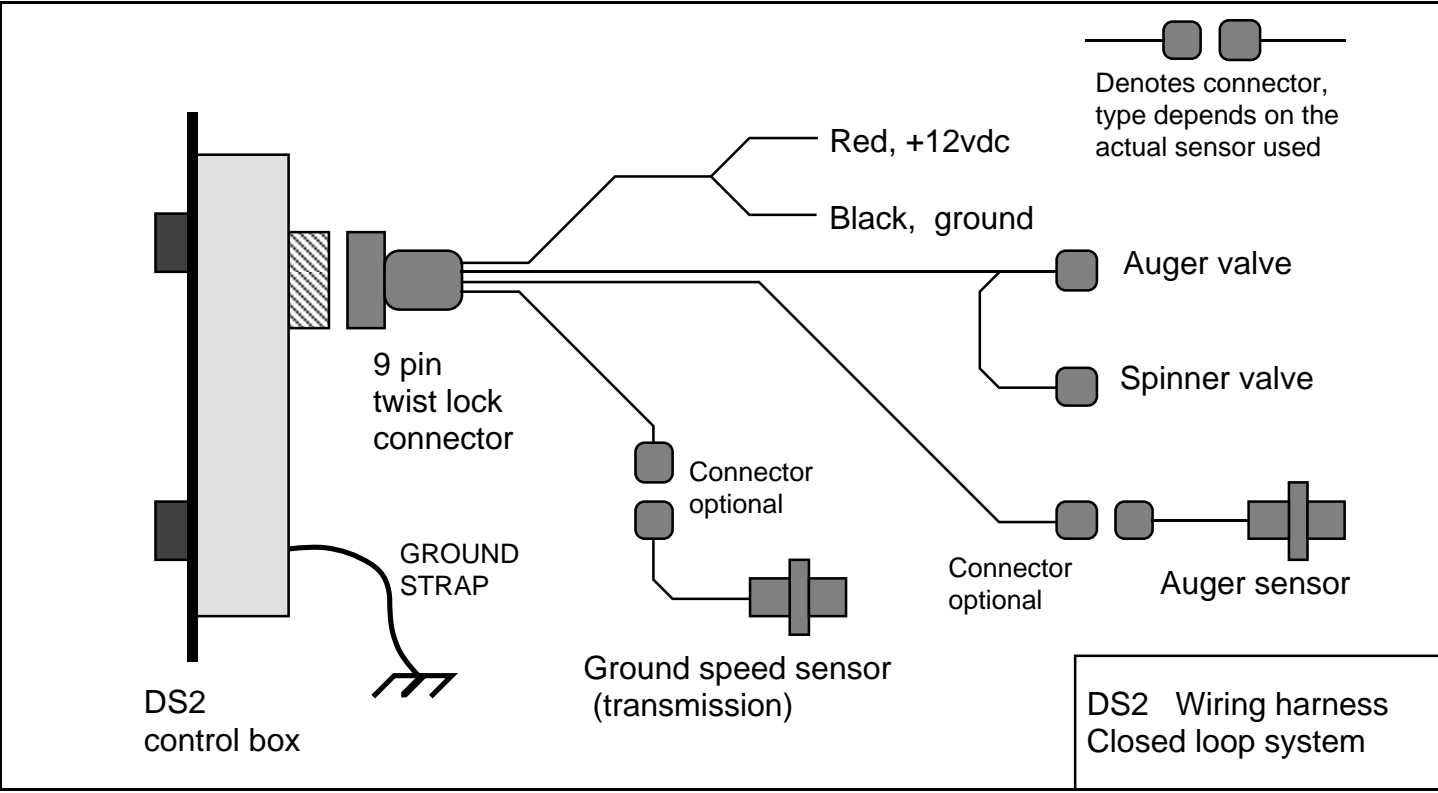
### DS2 to PC cable. (shown below)



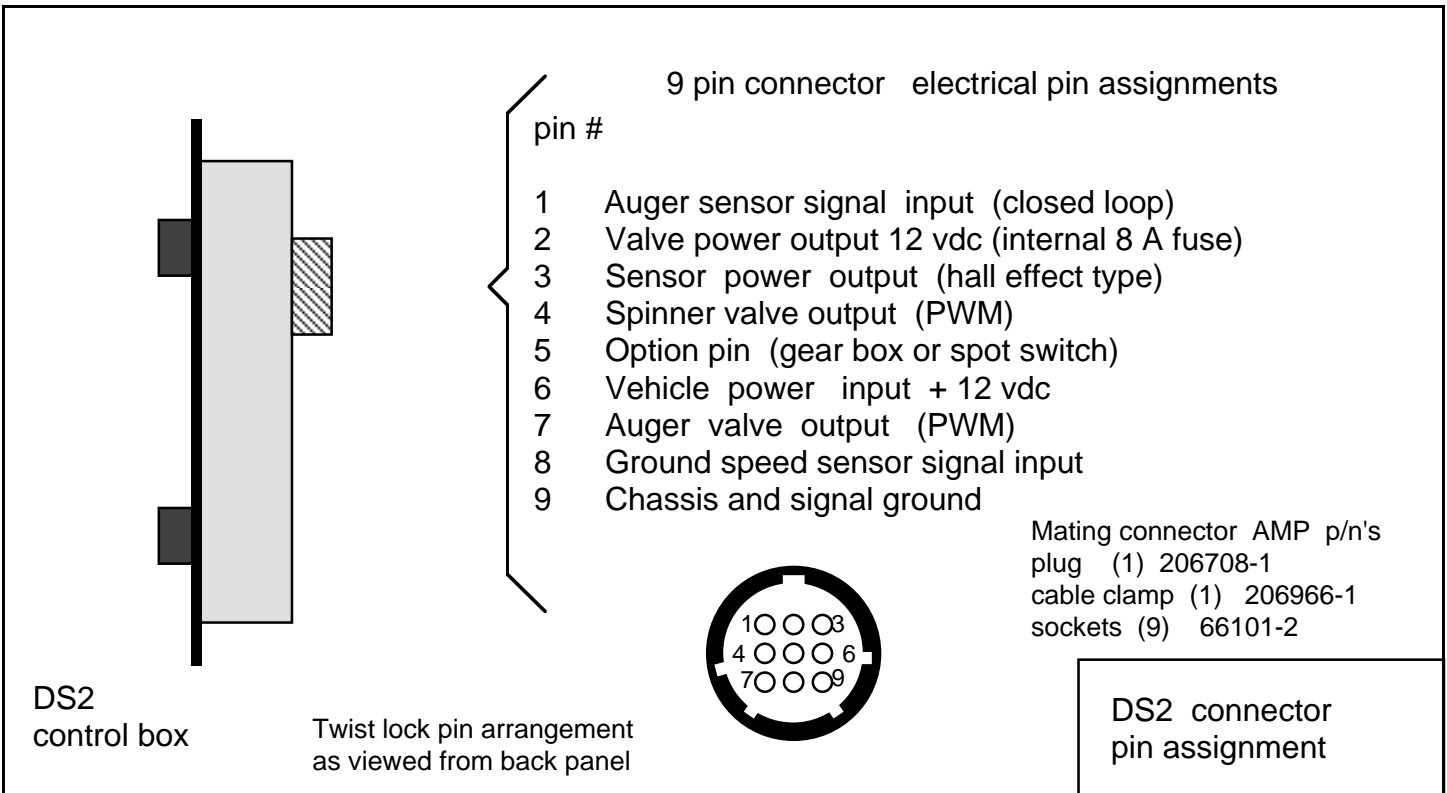
DS2 COMM PORT  
Conxall Connector  
Digi-Key p/n 6282-4PG-3DC  
1-800-344-4539



DS200M1Y



DS200M3Y



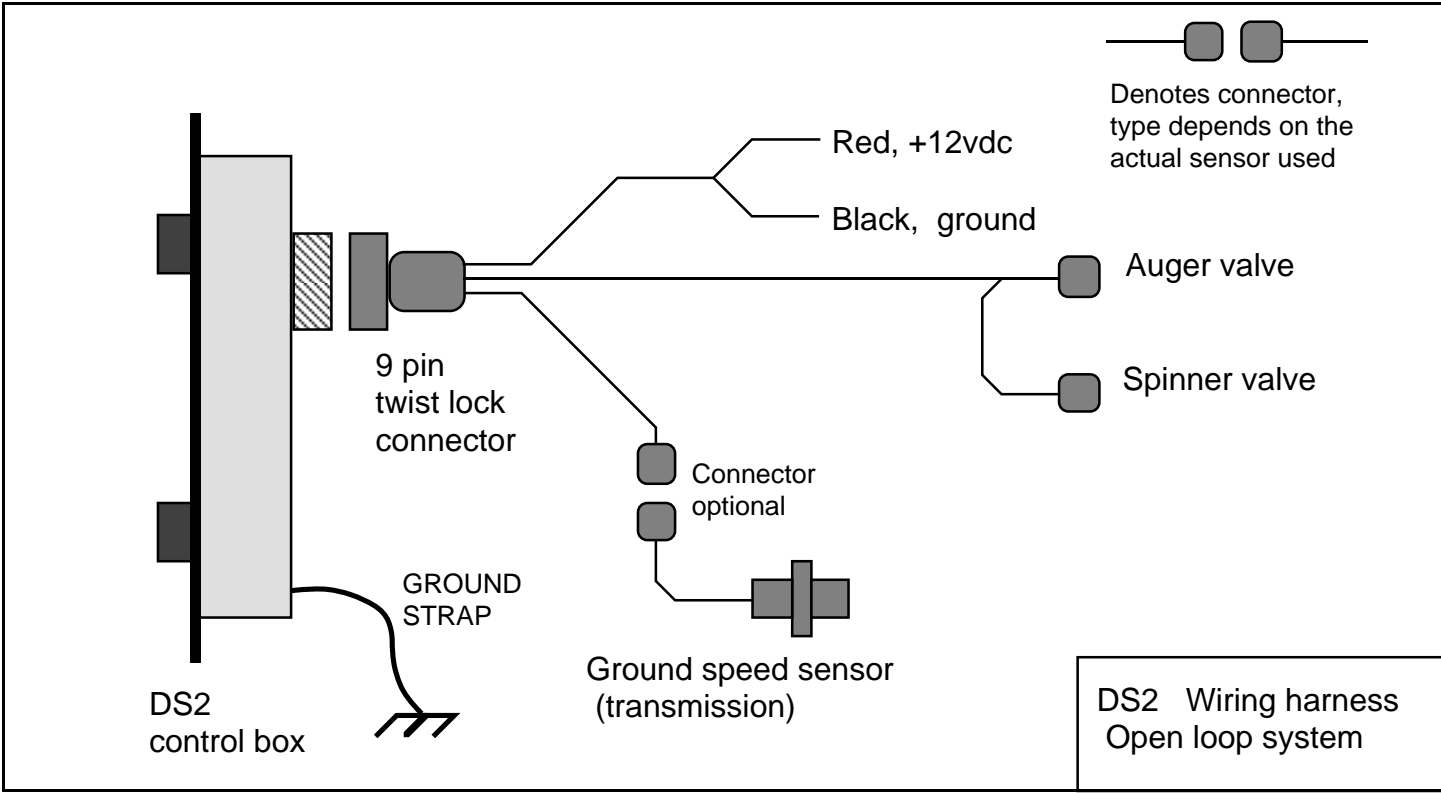
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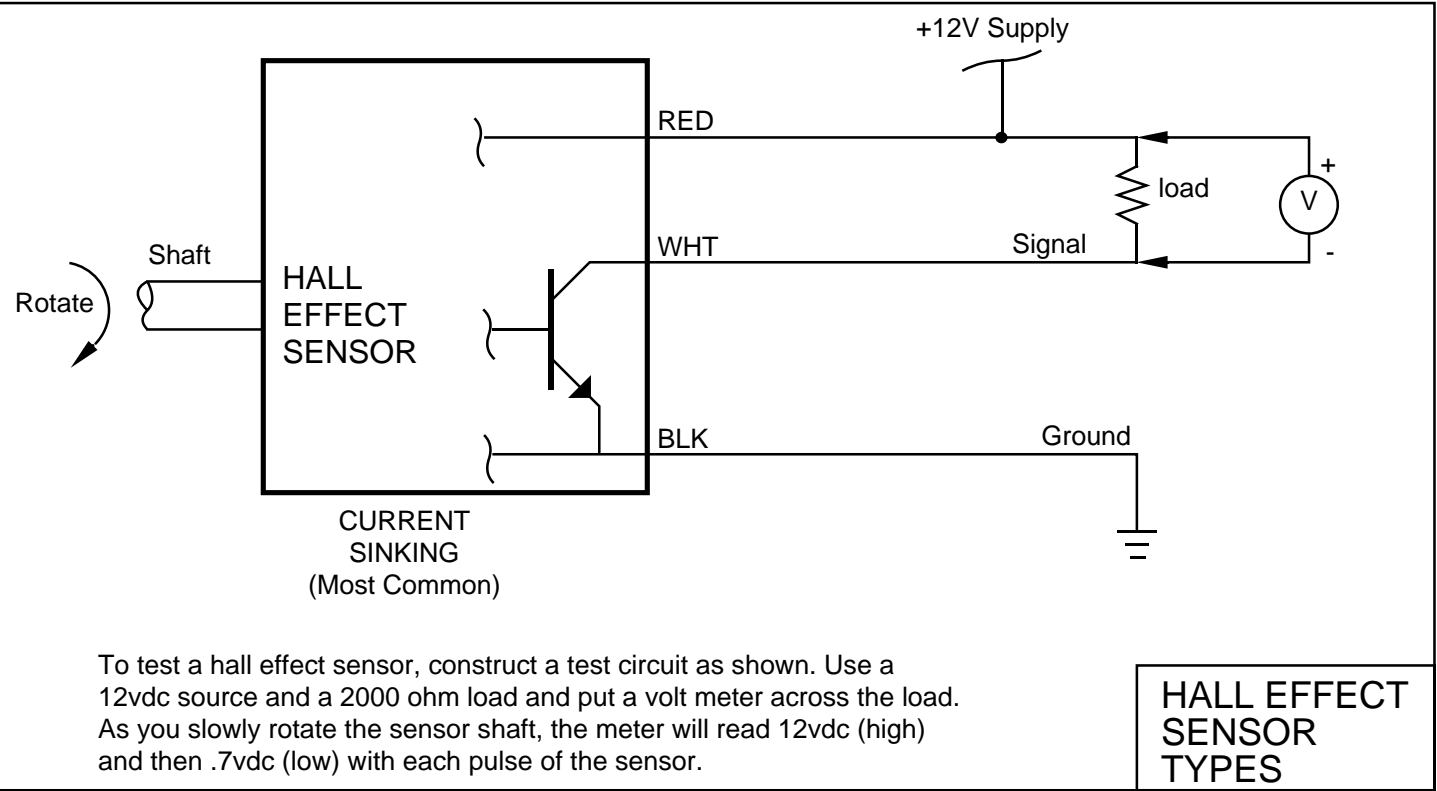
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DS200M2Y

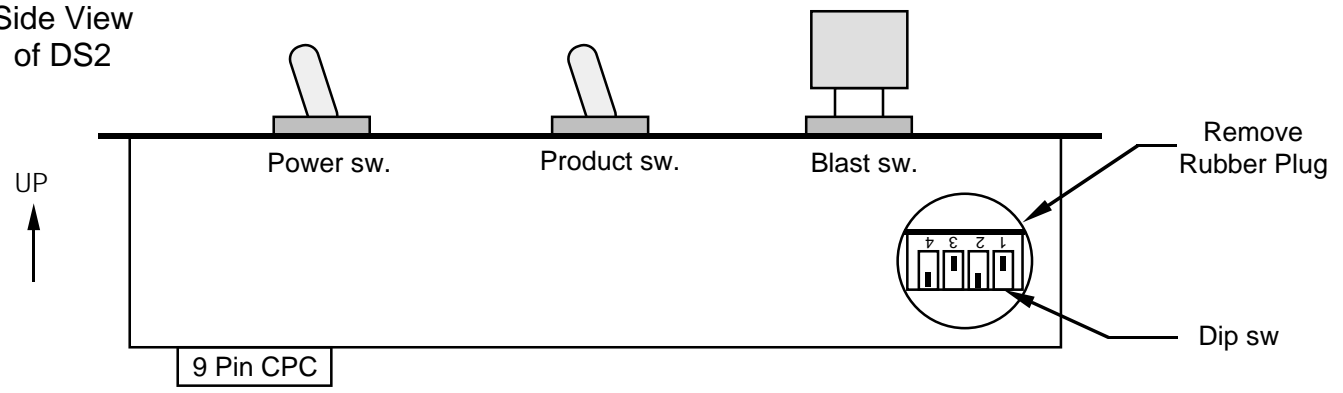




DS200M4Y

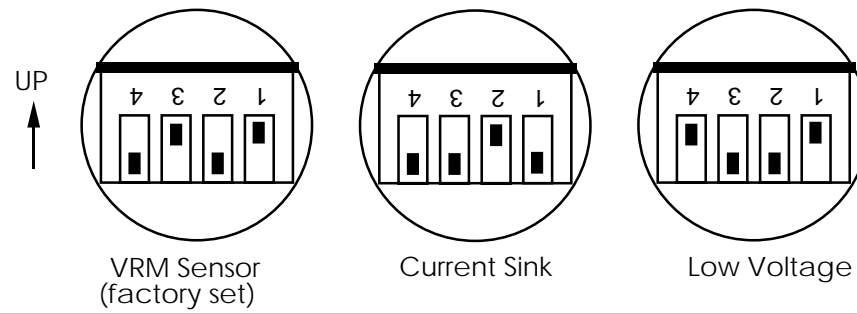


Side View of DS2



Ground speed sensor selection

1. Remove small plug from side of DS2
2. Use small screwdriver to select DIP SW levers
3. Replace Plug

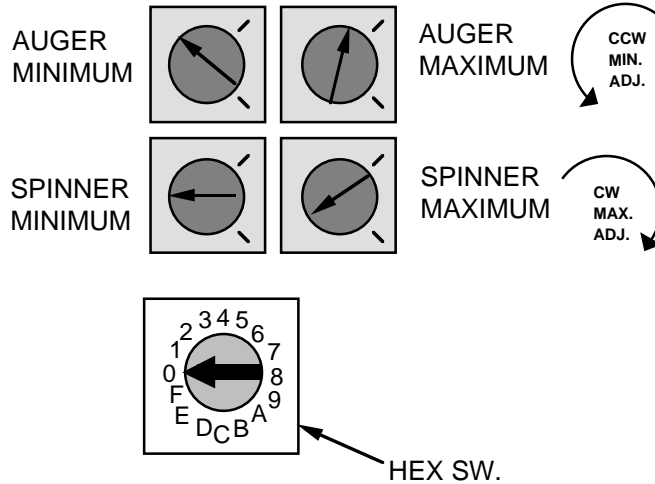


DIP SW GUIDE  
DS2

DS200M5Y

## DS2 PROGRAM SWITCH PANEL

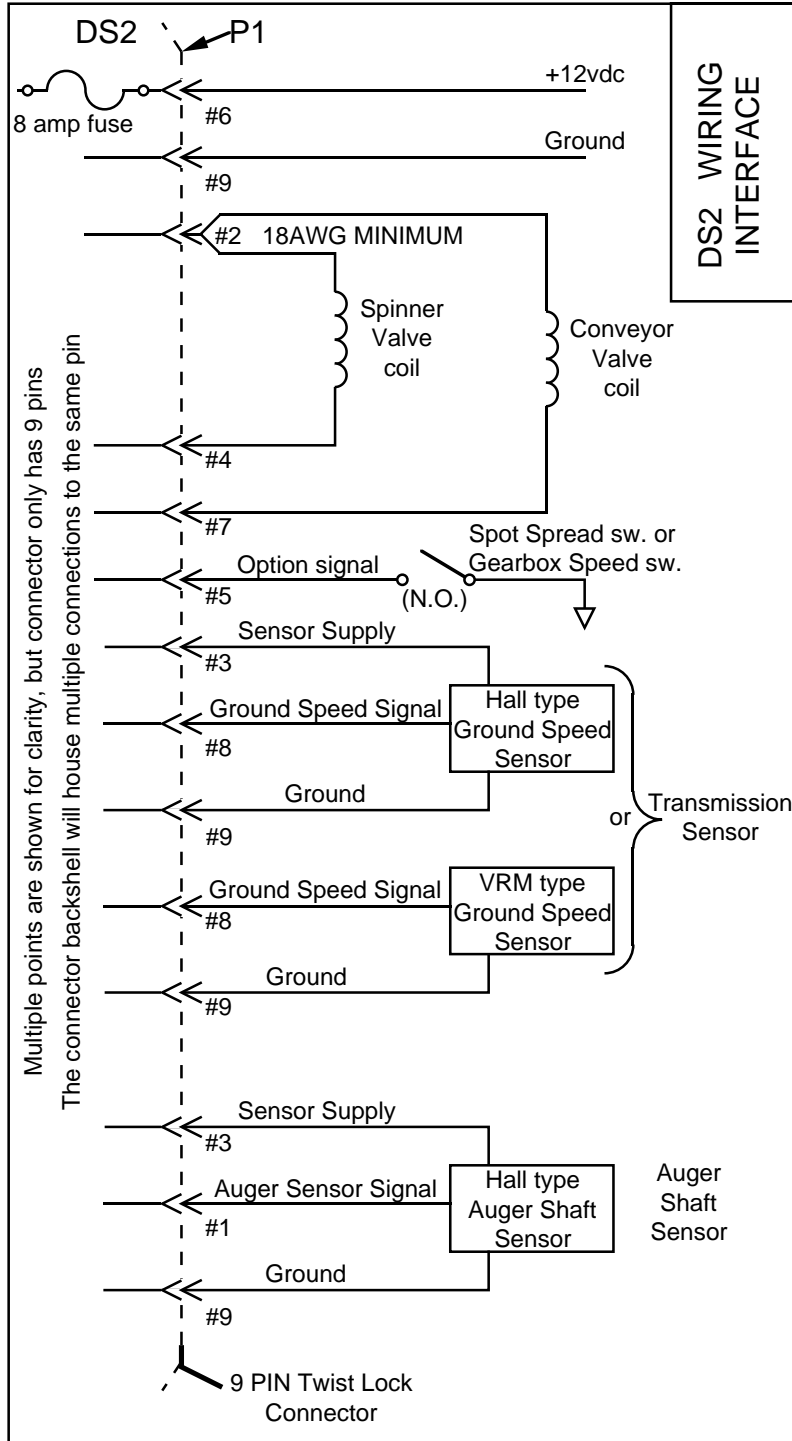
### HEX SWITCH GUIDE



#### HEX SW POSITION

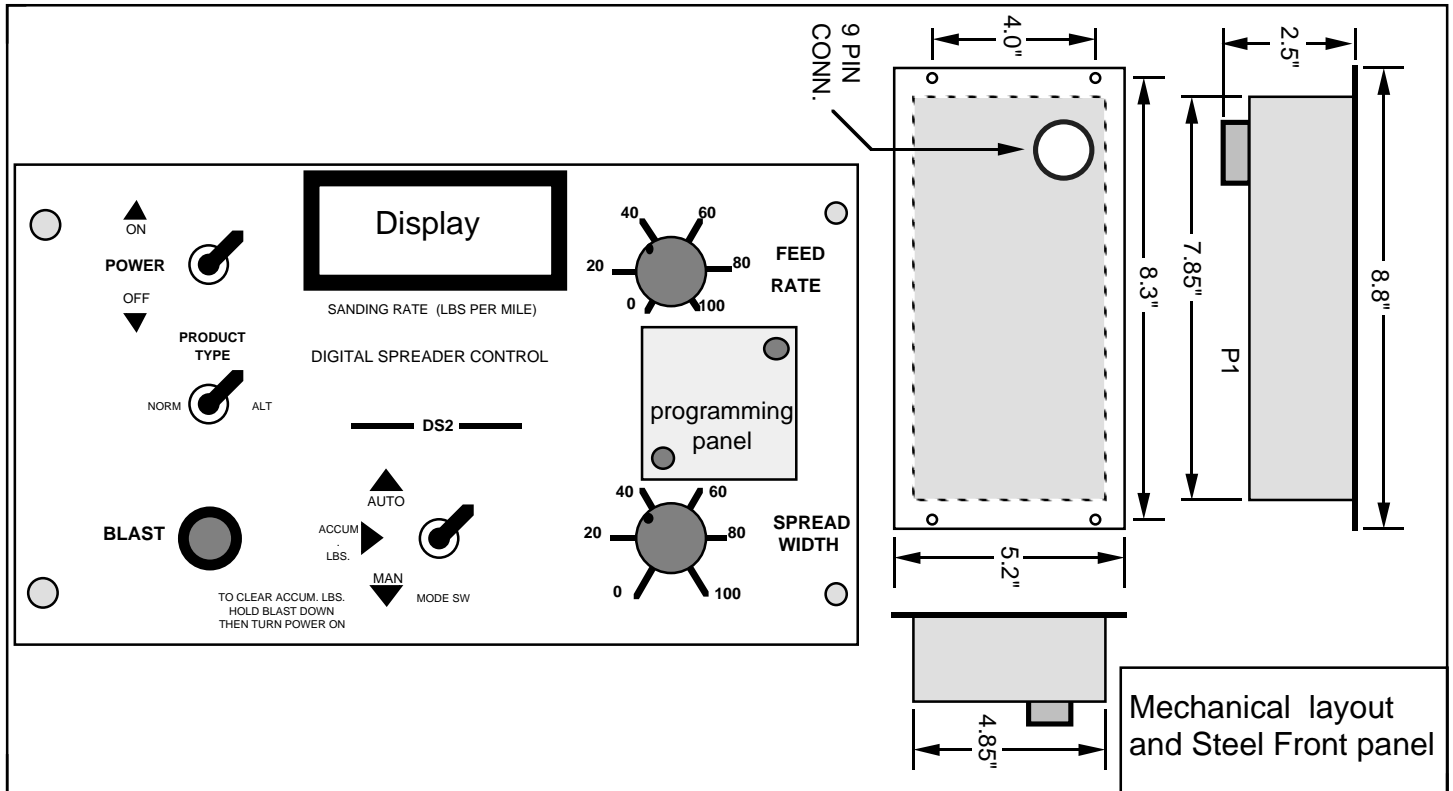
- 0 RUN MODE
- \* 1 COUNTS PER MILE CALIB.
- \* 2 AUGER CALIB. LBS/MIN OR LBS/1000 PULSES
- \* 3 MPH DISPLAY
- 4 AUGER VALVE TRIM DISPLAY
- 5 SPINNER VALVE TRIM DISPLAY
- \* 6 RUN MODE OPTIONS
- 7 AUGER PULSE DUMP
- \* 8 BLAST DURATION TIMER 0 TO 30 SEC.
- \* 9 MAX. FEED RATE
- \* A GEAR BOX RATIO
- \* B PROD. SW RATIO
- \* C VALVE MONITOR
- \* D TRUCK #
- \* E LIQUID CALIBRATION
- \* F PWM FREQ. ADJ. 30 HZ. THRU 285 HZ.

\* Note (\*) identifies settings which are programmable. Hold down the Blast switch and turn the spread width knob until the display shows the desired value. Releasing the blast switch will then save the value into memory.

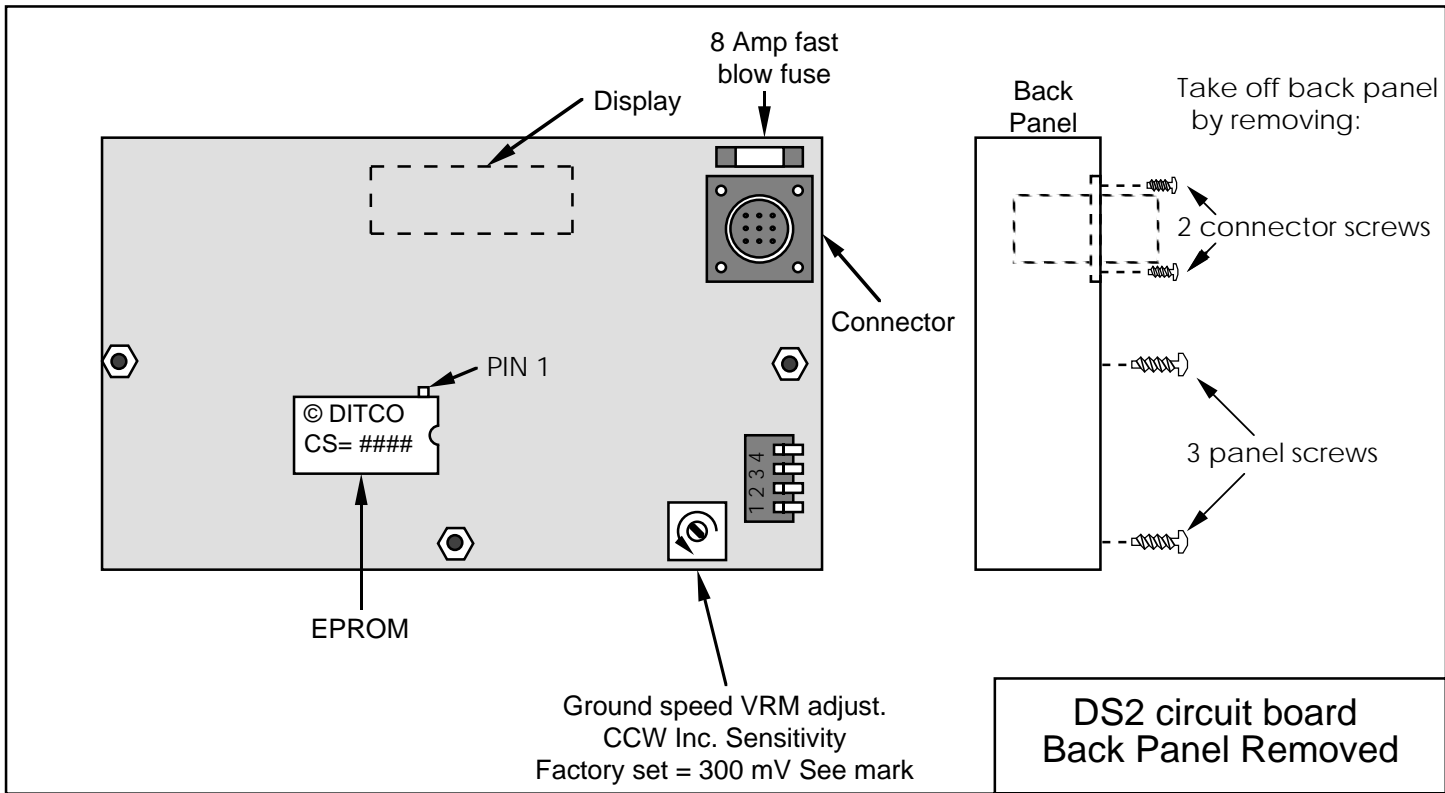


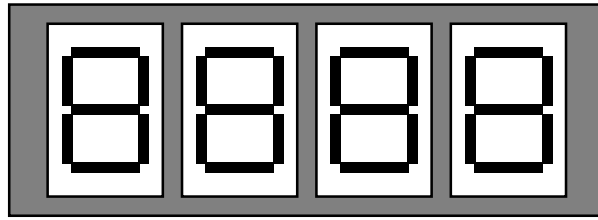
DS200M8Y

DS200M9Y



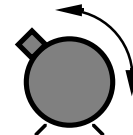
DS200M10Y





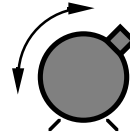
BLAST      LIQUID      MODE      SERVO

TURNING THE FEED RATE KNOB  
SELECTS THE DIGIT TO BE CHANGED.  
-- BLINKS WHEN SELECTED.



FEED RATE

HOLDING THE BLAST BUTTON WHILE  
TURNING THE SPREAD WIDTH KNOB  
CHANGES THE SELECTED DIGIT.  
--USE THE CHART SHOWN BELOW.



SPREAD WIDTH

#### RUN MODE CONFIGURATION CHART

USE HEX=6

BLAST

- 0 = MAX TRIM
- 1 = MAX RATE

LIQUID

- 0 = OFF
- 1 = VARIABLE, Low Volume
- 2 = FIXED
- 3 = Hyd, High Volume

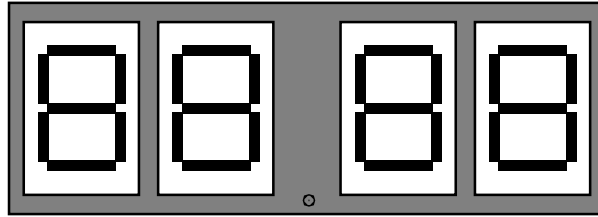
MODE

- 0 = MANUAL/AUTO
- 1 = AUTO ONLY

SERVO

- 0 = OPEN LOOP
- 1 = CLOSED LOOP LOW
- 2 = CLOSED LOOP HIGH (/10)

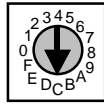
DS200M13Y



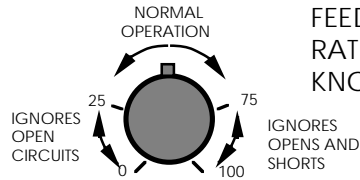
SPINNER

AUGER

-- = Ignore Open Circuits  
Blank = Monitor Off  
xx = Normal Operation



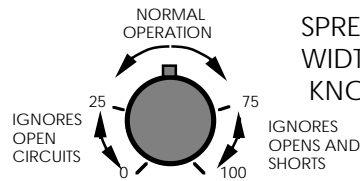
HEX SW = C



FEED  
RATE  
KNOB



BLAST  
BUTTON



SPREAD  
WIDTH  
KNOB

DS200M15Y

