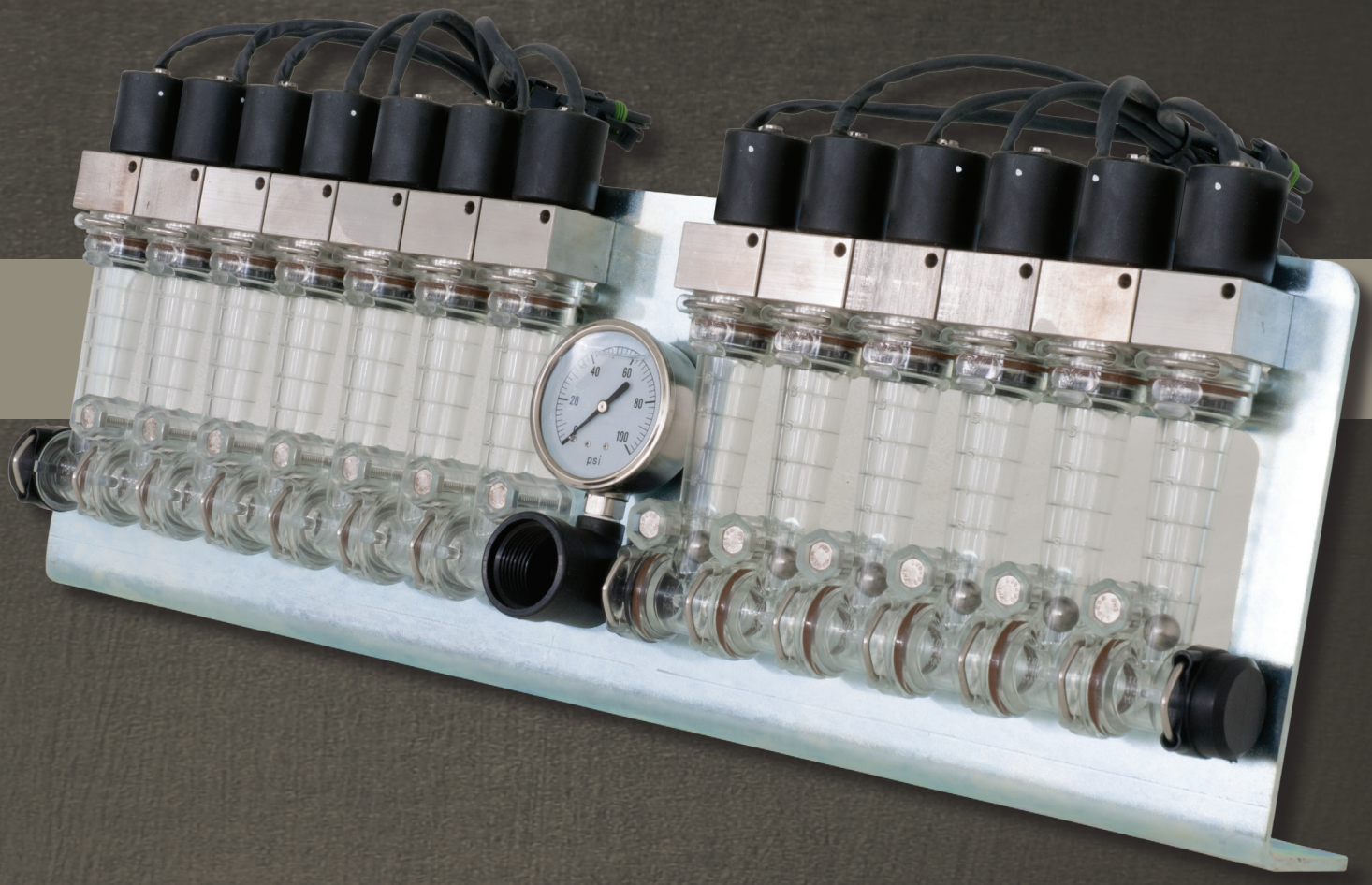
CAPSTAN
SINCE 1893 AG SYSTEMS, INC.
APPLICATION SYSTEMS FOR PROFESSIONALS

Instant Variable Rate for Liquid Fertilizer

N-Ject® LF
Product Manual



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N-JECT® LF PRODUCT MANUAL • PART NUMBER: 625156-001 (10.8.2013)

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101 N. Kansas Ave.
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INTRODUCTION

This Owners manual is intended to assist operators and service technicians in the operation, installation, maintenance and trouble shooting of the N-Ject® LF System. Some of the following steps should only be performed by trained service personnel.

If a problem arises that can not be corrected with the information in this manual, please contact you local Dealer for service and technical assistance.

Dealer : _____
Contacts: _____
Phone: _____
Address: _____
City/State/Zip: _____

Factory Service / Repairs
Capstan Ag Systems, Inc.
Topeka, KS 66603
Phone: (785) 232-4477
Fax: (785) 232-7799
Hours: 8:00 am –4:30 pm

SAFETY INFORMATION

The Safety Alert Symbol is used through this manual to mean **ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED!**

WARNING! - Wear proper personal protective equipment (PPE). PPE includes, but is not limited to, goggles, gloves, long sleeve.

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OPERATION

The operation of the N-Ject® LF is very simple and easy. The N-Ject® LF system is turned on and off with the rate controller. The rate controller and the N-Ject® LF should be turned off whenever you are starting the tractor. Turn on the Rate Controller. Make sure the boom switches are in the off position. Verify the rate settings in the rate controller, adjust if necessary. Turn on the solution pump and set the pressure to 40 psi. using the tractor hydraulics adjustment. The system is set and ready to apply product. To begin applying product, turn on the boom switches and the master switch on the rate controller.

The rate controller uses the speed signal, the boom widths and the target rate to calculate a target flow rate. It measures the flow rate with the flow meter and compares the actual to target rate. Then using the servo signal, it tells the N-Ject® LF to increase flow, decrease flow or hold steady. If it tells the N-Ject® LF to increase the flow, the N-Ject® LF increases the duty cycle of the PWM signal to the pulsing valves, which are pulsing at 3 hz. or 3 times per second. This allows more flow through the valve during each pulse, thus increasing flow. If the rate controller tells the N-Ject® LF less flow, the duty cycle is shortened, reducing flow through the valve during each pulse cycle, thus reducing flow. If the rate controller sends no signal the N-Ject® LF holds the duty cycle and the flow remains constant.

S***tart Up Operation:***

1. Start the tractor with the Rate Controller in the Off position.
2. Turn on the Rate Controller.
3. Verify rates and settings in the Rate Controller.
4. Engage the pump and set the pressure.
5. Turn on the boom switches and/or master to apply product.
6. Using the master switch the product can be turned on or off as desired.

Shut Down Procedure:

1. Shut off the boom switches and master switch.
2. Turn off the pump.
3. Turn off the Rate Controller.
4. Shut off tractor.

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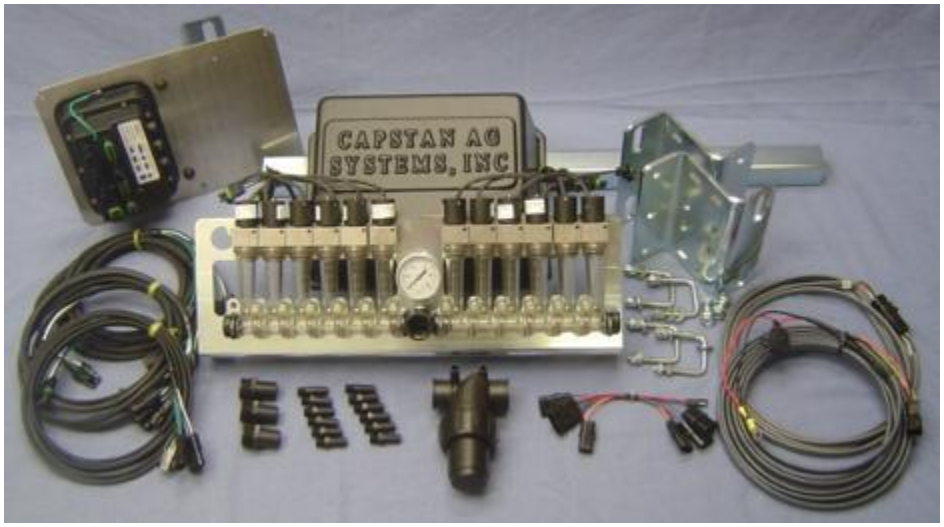
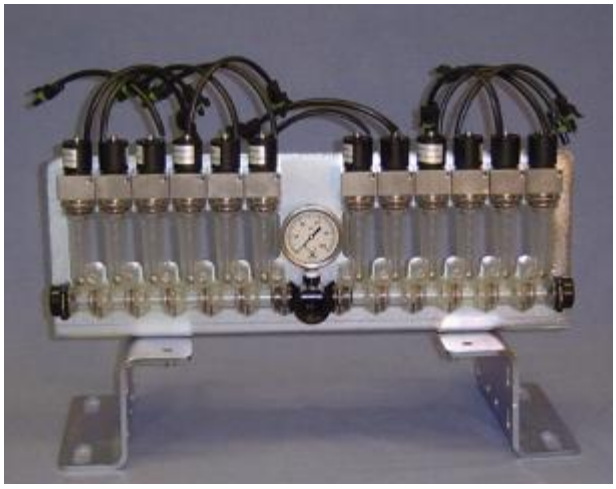
INSTALLATION AND SET UP

The first step in the installation is to identify all the parts and to find an appropriate location for each one. When you unpack your system you will find flow manifold(s), mounting brackets, an electronics enclosure, wiring harnesses and a strainer. The picture below includes all supplied components for a 3 section, 12 row N-Ject® LF system.



Flow Manifold(s)

Using the mounting brackets and u-bolts (not included), locate the flow manifold on the front of the tool bar near the center or just to the right of center. It should be easy to see from the cab of the tractor. A standoff is supplied to raise the flow manifold above the tool bar 24 inches. Secure the manifold with the necessary hardware.



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Electronics Enclosure
The electronics enclosure has a mounting bracket attached to the bottom that can be easily mounted to the tool bar (u-bolts not included). Mount the enclosure in an easily accessed location with the opening out of the enclosure away from tires, which can throw mud.

Wiring Harness
Locate the Power harness. It is a gray cable with a square four pin connector on one end with a fuse holder and ring terminals on the other. It needs to be connected at the battery to 12Volts, the fused (30 amp) ring terminal (orange or red) connects to Positive (+12V) the other (black) to Negative (gnd). Make sure that you are connecting to 12 Volts, some tractors may use two, 6 volt batteries. Verify the voltage with a voltmeter. Reversing the wires will cause damage to the Commander Module and is not covered by warranty. Route the cable under the cab and back to the hitch point of the tractor.

Locate the power harness extension. This harness allows for disconnect at the hitch point. The tractor end will have a male square four pin connector. Connect this end to the Power harness at the hitch point of the tractor. Route the cable from the hitch point to the master module. The module end will have female square four pin connector.

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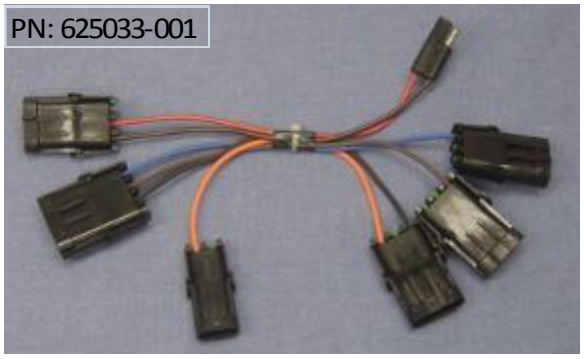
Locate the Ag Leader/Raven/John Deere adapter. This harness is used to connect the modules to the rate controller servo, flowmeter, and section shutoff connectors.



Additional sections

The parts pictured to the right are required to divide the toolbar into three additional sections. These parts include a slave module, power harness and extension, Ag Leader/Raven/JD adapter, slave adapter, and section harnesses.

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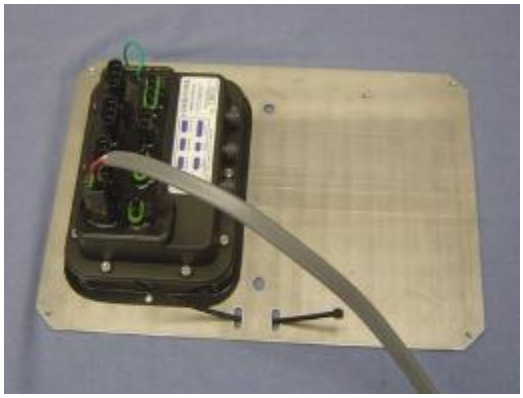
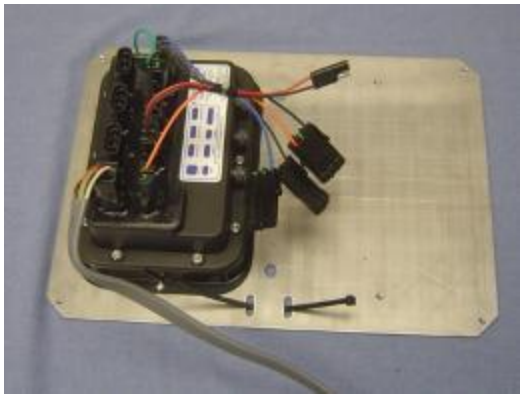
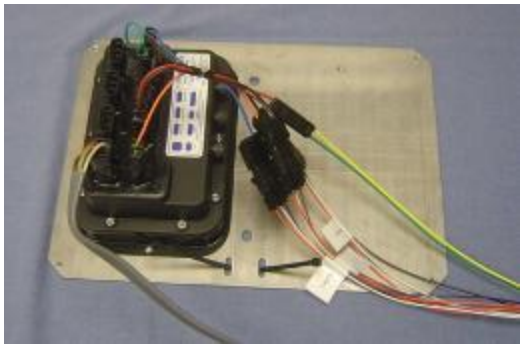
Route the rate controller and power harness across the toolbar so that it will be easy to secure. Remove the hood from the enclosure. The connectors are labeled on the decal. Connect the power harness to the Commander Master Module connector labeled **POWER**.



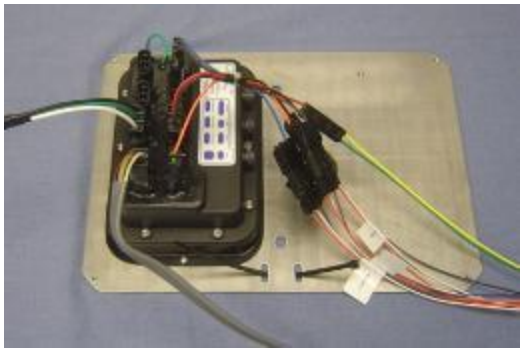
Connect the Ag Leader/Raven/JD adapter to the **SERVO**, **SHUTOFF**, and **CAB POWER** connections on the master module



Connect the rate controller harness to the servo and section connections on the Ag Leader/Raven/JD adapter.
Section 1—Black
Section 2—Brown
Section 3—Blue



Connect the section harnesses to the **SECTION** connectors on the master module. Route the section harnesses to the manifold.



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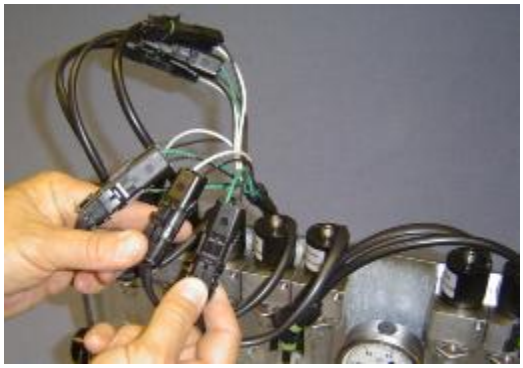
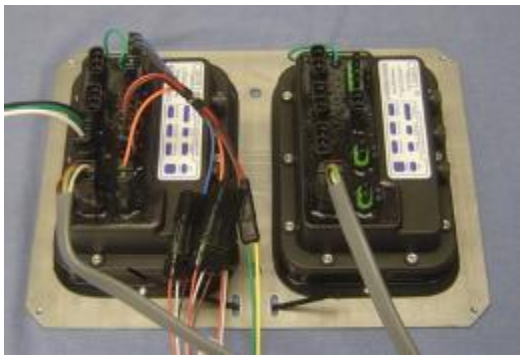
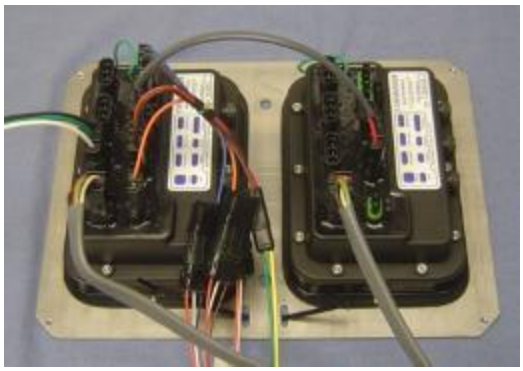
Connect the section harnesses to the valves that are plumbed to the section. Alternate the connections to the valves, white and green across the manifold. Place dust plugs in any unused connectors at the manifold



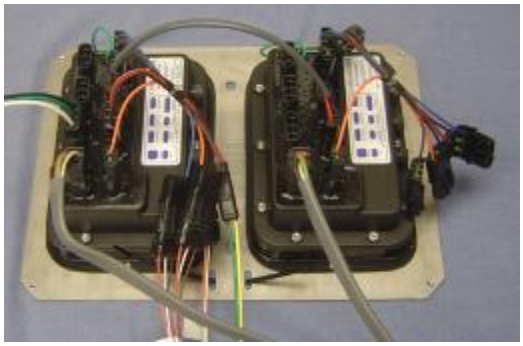
Additional sections
If you are dividing the toolbar into three additional sections you must add a Commander Slave Module and the associated wiring. Route the additional power harness across the toolbar so that it will be easy to secure. Connect the power harness to the **POWER** connection on the slave module



Connect the slave jumper between the **SLAVE OUT** connection on the master module and the **SLAVE IN** connection on the slave module.



Connect the additional Ag Leader/Raven/ JD adapter to the **SHUTOFF**, and **CAB POWER** connections on the master module. The servo connection on this harness will not be used.



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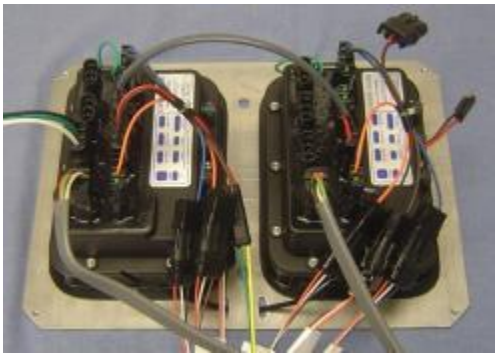
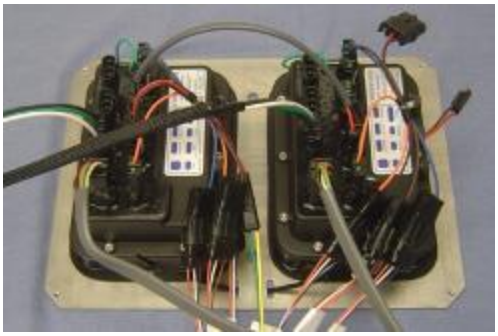
Connect the rate controller harness to the section connections on the Ag Leader/ Raven/JD adapter. The servo connection on the second adapter will not be used
Section 4—Black
Section 5—Brown
Section 6—Blue



Connect the section harnesses to the **SECTION** connectors on the slave module. Route the section harnesses to the manifold. Then connect the section harnesses to the valves that are plumbed to the section. Alternate the connections to the valves, white and green across the manifold. Place dust plugs in any unused connectors at the manifold



Plumbing

Installing the plumbing system may be the most challenging because of the many variations. Basically you have a tank or tanks, centrifugal pump, bypass valve, strainer and flow meter. Capstan recommends the following: Mount the tanks per tank manufacturer making sure to place shut off valves in the tank outlets. Connect the tank(s) to the pump using suction type hose that is the same size or larger than the pump inlet. On the pump outlet, install a tee fitting. One leg of the tee is plumbed with a manual bypass valve or adjustable pressure relief valve that is plumbed back to the tank. The remaining leg of the tee is plumbed with a 1" hose to the 1" strainer, to the flow meter and then to the manifold. If your system requires more than 13 valves you will have multiple manifolds. In this case it may be desired to place a large strainer between the tee and the flow meter. After the flow meter another tee will be required to divide the flow between the manifolds. The supplied 80 mesh strainers should be plumbed between the tee and each manifold. If you are using a pump other than a hydraulic driven centrifugal, contact your dealer or the factory.

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The strainer is a very important part of the system. The strainer provided has an 80 mesh screen. It collects contamination before it reaches the flow meter and pulsing valves. Contamination in either of these can shorten the life of the system or cause the valves to stick. Make sure the strainer is installed with the flow in the right direction (pump to the manifold) and easy to access for cleaning and so fertilizer will not drip on other components during cleaning. Then clean the strainer on a regular basis.

Follow the manufacturers' recommendation on the flow meter. For single manifold systems we recommend mounting the flow meter in the length of hose running up to the manifold as shown. For multiple manifold systems the flow meter should be mounted between the pump and the line tee. Connect the flow meter to the rate controller.

The pulsing valves are ported with a ¼" fpt for a hose barb. Using at least 3/8", but preferably ½" hose, connect the valves to the knives or coulters and secure with hose clamps. 1/2" hose barbs are supplied with the manifold. Make sure there is enough slack in the hose for folding and other moving joints. Secure the hoses to the tool bar.

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RATE CONTROLLER SETTINGS

Raven 440/460
Valve Type – C-STD
Valve Cal - 63

Setting the valve type is standard step in the initial set up for the controller. Follow the instructions in the Raven manual for initial calibration.

Raven 4400/4600
Valve Type – C-STD
Valve Cal - 63

Setting the valve type is standard step in the initial set up for the controller. Follow the instructions in the Raven manual for initial calibration.

Ag Leader Insight with Direct Command
Control Valve - Inline Servo
Valve Response 1 – 100%
Valve Response 2 – 40%
Response Threshold - 3

Refer to the Ag Leader manual or quick reference sheets for setting the Control Valve and Response settings.

John Deere GS2
Control Valve Type - standard
Control Valve Calibration - 2563

Refer to the John Deere manual or quick reference sheets for setting the Control Valve and Response settings.

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SYSTEM TESTS

Dry Test

You are now ready to test the system. The dry test will test the electronics to make sure the rate controller and the N-Ject® LF are operating correctly together. With the tractor off, but the key turned on, turn on the rate controller and place the rate controller in the manual mode.

Turn on the section switches and the master switch on the rate controller. The valves should begin to pulse. Hold the Inc/Dec switch (or touch screen button) on the rate controller in the INC position. The valves should lock open, (stop pulsing) after about three seconds. Now hold the Inc/Dec switch in the Dec position and hold. The valves should begin pulsing again. After 6 seconds, the valves should then lock closed (stop pulsing). If the valves lock open and lock closed, the system is working correctly and you are ready to proceed with the liquid and pressure. If the system doesn't respond correctly, check all the wiring connections and then refer to the troubleshooting section.

Liquid Test

It is recommended to test the system with water prior to using fertilizer.

Open the supply valves on tank(s). With the rate controller and the N-Ject® LF in the OFF position, start the tractor. Turn on the rate controller and place it in Man mode. Turn on the section switches and the master switch. The valves should begin pulsing. This helps to purge air out of the system and allows the pump prime easier. Engage the liquid pump. Once the pump has primed and purged the air, turn off the master boom switch and adjust the liquid pressure to about 40 psi. Set a target speed in the rate controller using the self test feature. Turn on the master switch on the rate controller. If the self test mode will not hold the speed, disconnect the rate controller speed input.

Place the rate controller in Auto mode (Rate 1 or Rate 2). The rate controller should adjust the duty cycle of the pulsing valves and lock in on the target rate. Change the self test speed to verify operation at the lower speeds. Test with rate changes to match your planned variable rates. If the system has trouble hitting the high rates, increase your pressure or slow down the speed. If the system has trouble hitting the low rates, lower your pressure or speed up.

You are now ready to go to the field! It is always a good idea to verify speed calibration, your accuracy in the field is only as good as your calibration values.

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SPECIAL APPLICATION CONCERNS

Nitrogen Fertilizers
When the N-Ject® LF system is used with Nitrogen fertilizers the slight variation in rate due to the valves pulsing at 3 Hz is normally eliminated by the mobility of nitrogen in the soil. It will move to fill in the gaps.

Phosphorous Fertilizers
Some fertilizers such as phosphorous do not move readily in the soil. When using products that are not mobile in the soil it may be desirable to change the system to a 10 Hz pulse rate to eliminate any affect from the pulsation.

Offset Shanks
Offset shanks can increase the affect of pulsation. If the shanks are offset to alternate front and back, and the pulsing valves are wired to alternate the front shanks will all pulse together and the back shanks will all pulse together. At 6mph the toolbar travels approximately 2.9ft in 1/3 second. If the speed and offset distance are matched up like 6mph and 2.9 ft the effect is that the pulses from the shanks will be in line in the soil instead of offset. In this case it may be desirable to change the system to a 10 Hz pulse rate to eliminate any affect from pulsation.

Low Rates
The N-Ject® LF system can apply a wide range of rates without the use of orifices, however if the system is only to be used at low rates a half rate orifice may be used in the flow indicator. This orifice will allow finer control at low rates, but will limit the maximum rate of the system.

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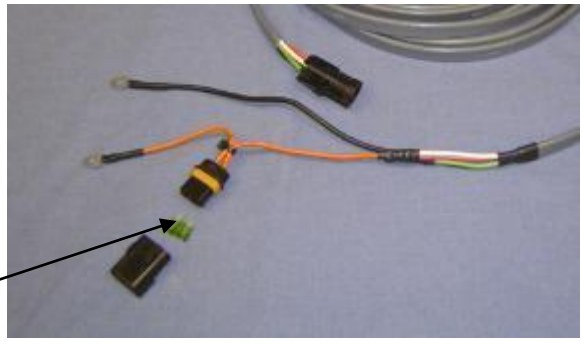
TROUBLESHOOTING

Valves will not pulse: Verify the section and master switches are turned on. Check for a blown **30 amp** fuse at the battery connection. Place the rate controller in Man and use the Inc/Dec switch check that the valves are not locked open or closed.



Section will not come on: Check section fuses in the front edge of the module. These are **10 amp** buss fuses. A blown fuse is a sign of a shorted wire or a shorted coil on one or more of the valves. Ohm the coils out to verify they are reading correctly. Check wire harness between the module and the valves for damage or bare spots that could short to the frame. After the bad coil or damaged harness has been fixed or replaced insert a new 10 amp buss fuse.

Failed Coil: Check the coil with an Ohm Meter. Set meter for Ohms (Ω) and verify the lead placement in the meter. Measure the resistance across the coil. The meter should read 12 Ohms or close to that. A 0 Ohm reading indicates a shorted coil which might have blown the 10A section fuse in the module. A higher reading or an open load reading (OL) indicates a broken wire in the coil. Either reading indicates a failed coil and the coil should be replaced.

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Single valve will not pulse: The plunger is lodged with debris or the coil has failed. Check the coil with an ohm meter. The meter should read approximately 12 ohms. Remove coil assembly be careful no to loose the o-ring that seals the coil and the valve body. Check that the poppet is moving freely. Check valve seat for contamination.

Single valve will not shut off: There is contamination in the valve that prevents the poppet from closing completely. Disassemble the valve and remove the contamination. Repeated contamination is a sign of a damaged strainer or improperly sized screen. 80 Mesh is required.

Cannot hit target rate: The pressure may be too low or the speed too high for the target rates. Verify that you are within the range of the system. When the valves lock open and are no longer pulsing, you have reached the maximum flow. Check for a plugged strainer. Slower speeds or additional pressure is needed. Do not exceed 100 psi.

Rate will not lock on: Check the settings in the rate controller. See page 13 for rate controller settings. Also check that display smoothing is on.

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MAINTENANCE

Always flush the system with clean water after each use. Tank cleaners may be used as necessary to prevent buildup and sticking in the valves.

Winter the system with RV antifreeze after cleaning for winter storage.

Avoid high pressure spray when cleaning the tool bar, high pressure forces contamination and corrosion into cracks and crevices, just where you don't want it. Use low pressure to dilute and remove the corrosive chemicals from the system. Then you can follow up with the higher pressure. Avoid high pressure on the valves and wiring connectors.

If the tractor is to be jump started or welded on, always remove the fuse near the battery to protect the system electronics.

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WARRANTY

Capstan Ag Systems, Inc., the Seller, warrants to the Ultimate Purchaser/User, its products to be free from defects in material and workmanship in normal use and service for a period of one year from date of purchase. The Owner Registration Form must be completed by the Purchaser or Reseller and returned to the Seller.

Purchaser, by acceptance of Seller's product, assumes all risk and liability of the consequences of any use or misuse by Purchaser, its' employees or others.

The Seller's obligation under this warranty shall be limited to the repairing or replacing at the Seller's option, the component which the Seller's inspection discloses to be defective, free of charge, return freight paid by Seller, provided the Purchaser: (i) Notifies Seller of defect within thirty (30) days of failure; (ii) Returns the defective component to Seller, freight prepaid; (iii) Completed the Owner Registration Form and returned it to Capstan; and (iv) Establishes that the product has been properly installed, maintained and operated in accordance with Seller's instructions or instructions contained in its operations or maintenance manuals and within the limits of normal usage.

All replacement components furnished under this warranty, but shipped before the failed component is returned for evaluation, will be invoiced in the usual manner and warranty adjustments will be made after the component claimed to be defective has been returned to and inspected and deemed defective by the Seller at Seller's factory.

Upon determining that a component has failed under warranty, the repaired component or replacement component, furnished under this warranty, will be shipped at the Seller's expense, to the Purchaser's location. Seller will credit the Purchaser an amount equal to the incoming freight paid by the Purchaser. Seller shall not be responsible for installation costs. (For all international transactions, Buyer shall be responsible for all customs and brokerage fees.)

If the component does not prove to be defective, the Purchaser shall be liable for all freight, inspection and handling costs. In no event will any claim for labor or incidental or consequential damages be allowed for removing or replacing a defective product. Warranty will be denied on any component which has been subject to misuse, abuse, accidents, or alterations, or to improper or negligent use, maintenance, storage or transportation and handling.

The liability of the Seller under this warranty, or for any loss or damage to the components whether the claim is based on contract or negligence, shall not in any case exceed the purchase price of the components and upon the expiration of the warranty period all such liability shall terminate. The foregoing shall constitute the exclusivity remedy of the Purchaser and the exclusive liability of the Seller.

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The terms of this warranty do not in any way extend to any product which was not manufactured by the Seller or an affiliate of Seller.

This warranty shall be void, and Seller shall not be liable for any breach of warranty, if the component(s) shall have been repaired or altered by persons other than the Seller, unless expressly authorized by Seller in writing.

The foregoing warranty is exclusive and is in lieu of all other warranties expressed or implied. All implied warranties of merchantability and fitness for a particular purpose are hereby disclaimed by Seller and are excluded from this agreement. Seller shall not be liable for any incidental or consequential damages resulting from any breach of warranty.

Limitation of Liability – Purchaser's exclusive remedy for breach of warranty shall be repair or replacement of defective component(s): Provided, if the component(s) are incapable of being repaired or replaced, Purchaser's exclusive remedy shall be credit issued, but such credit shall not exceed the purchase price of the components.

Any claim for breach of Seller's warranty must be in writing addressed to Seller and must set forth the alleged defect in sufficient detail to permit its easy identification by Seller. All breach of warranty claims must be made within thirty (30) days after expiration of the warranty period which is applicable to the defective product. The applicable time periods are set forth in the above warranty term. Any breach of warranty claim not timely made will not be honored by the Seller and will be of no force and effect.

On any claim of any kind, including negligence, Seller's liability for any loss or damage arising out of, or from the design, manufacture, sale, delivery, resale, installation, technical direction of installation, inspection, repair, operation of use of any products shall in no case (except as provided in the terms of the Patent Indemnity) exceed the purchase price allocable to the components.

In no event, whether as a result of breach of contract or warranty or alleged negligence, shall Seller be liable for incidental or consequential damages, including, but not limited to: personal injury, loss of profits or revenue, loss of use of equipment or any associated equipment, cost of capital, cost of substitute equipment, facilities or services, downtime costs, environmental damage, crop losses, or claims of customers of Purchasers for such damages.

Patent Indemnity - Seller retains for itself any and all property rights in and to all designs, inventions and improvements pertaining to any products and to all patents, trademarks, copyrights and related industrial property rights arising out of work done in connection therewith. Purchaser expressly agrees that it will not assert any rights to property rights retained herein by Seller.

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REPAIRS AND WARRANTY EVALUATIONS

Any component that needs to be repaired or evaluated for warranty has to be authorized before return. Contact the Factory (785-232-4477) to get a Return Goods Authorization (RGA #). This helps to track the part coming into the factory for repair or replacement.

Before returning any component to the factory, clean the component as well as possible to remove any dirt or chemical residue. Components received at the factory that are not clean, will be returned and warranty denied.

After receiving your RGA#, package the part, making sure to include the RGA#, your name, your address and phone number and description of problems or failure. Then ship to:

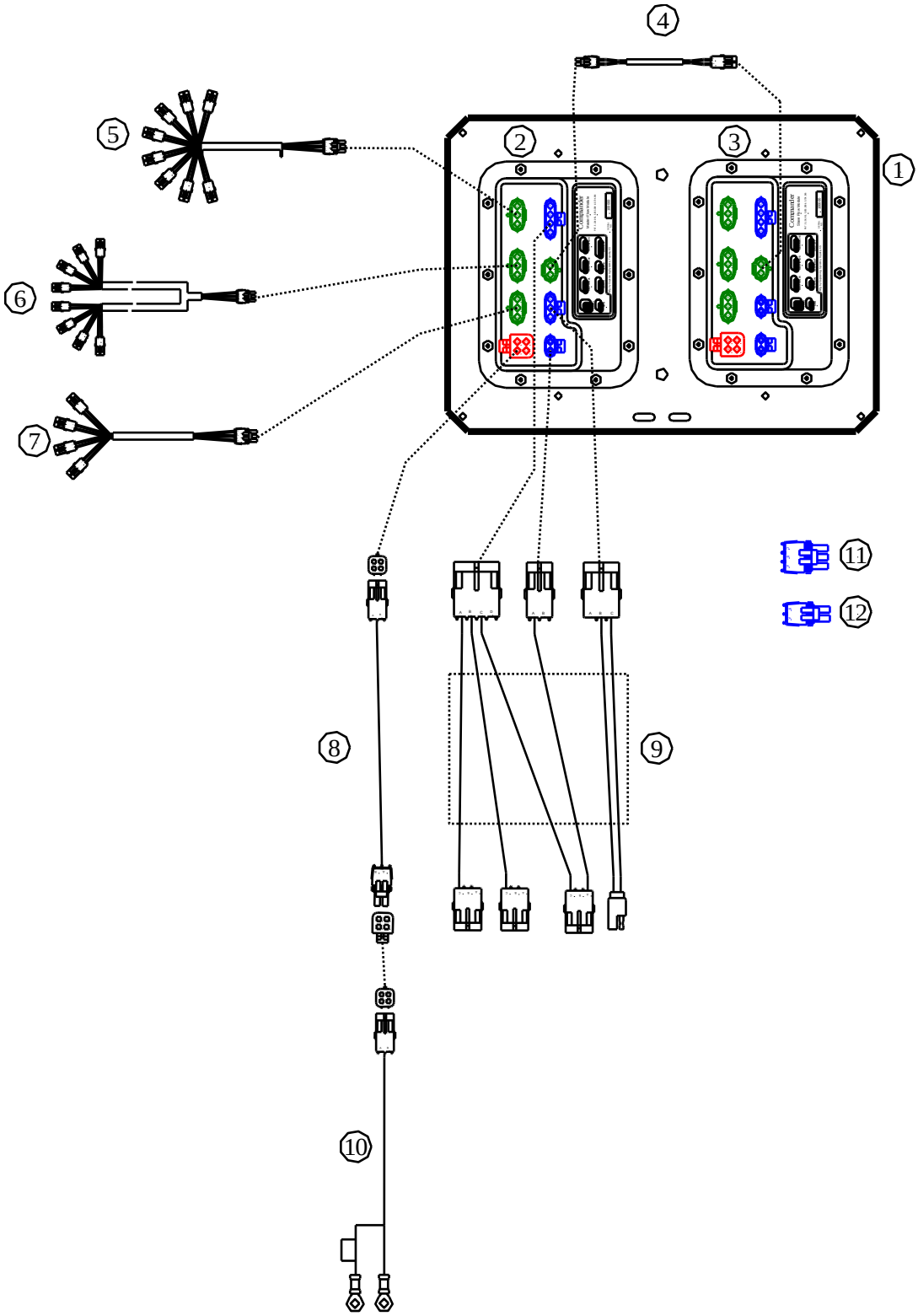
Capstan Ag Systems, Inc.
Attn: Warranty/Repair
101 North Kansas Ave.
Topeka, KS 66603

Phone: (785) 232-4477
Fax: (785) 232-7799
Hours: 8:00 am – 4:30 pm CST

Upon receipt of the component in question, the component will be evaluated for

warranty or repaired and returned.

ELECTRICAL PARTS



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Item #	Description	Part #
1	Enclosure Assy., 2-Module	116400-001
2	Commander Master Module	116150-011
3	Commander Slave Module	116149-012
4	Harness - slave interconnect	116200-003
5	LF – 8 Valve Harness -10’	625032-001
6	LF – 4+4 Valve Harness – 10’	625035-001
7	LF - 4 Valve Harness- 10'	625038-001
8	Extension, Sq 4 cond x 10', 12 ga	117501-004
9	Adapter - Ag Leader,Raven,John Deere	625033-001
10	Power Cable, Sq 4 cond x 25', 12ga	117501-001
11	Plug, 3-Pin Tower	116200-046
12	Plug, 2-Pin Tower	116200-045

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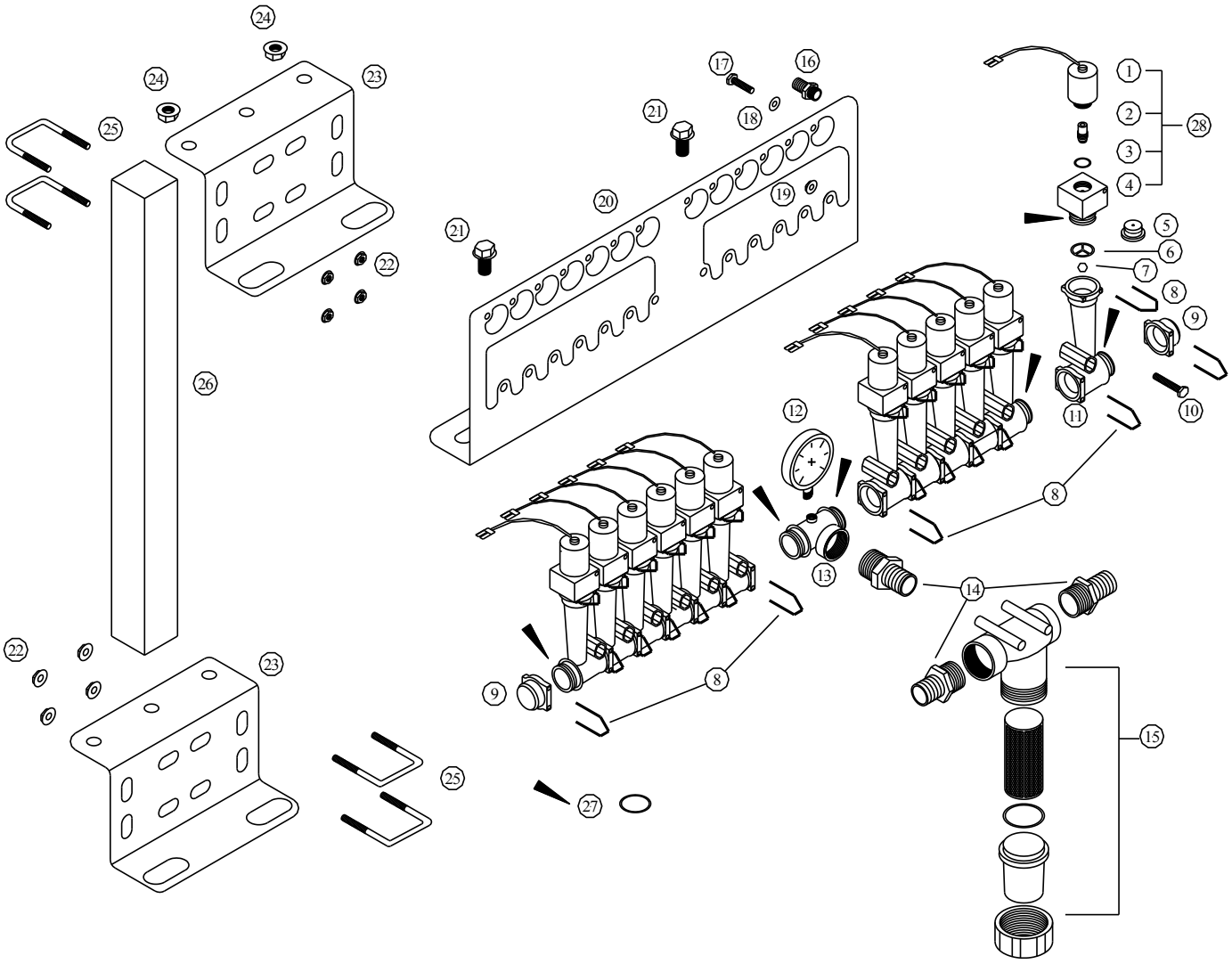
PLUMBING PARTS



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Item #	Description	Part #
1	Coil Assy., 12 watt, Overmolded	625147-011
2	Plunger Assy., PFE, For 5/32” LF Valve	716009-111
3	O-Ring, -015, Viton, Inside Valve	715022-204
4	Valve Body, 5/32” Orifice, Square LF	625010-011
5	Orifice w O-ring, Ø3/32”, For ½ Flow Rows	625014-006
6	Ball Retainer	625014-005
7	Indicator Ball, ½” Stainless	625014-007
8	Clip, for Indicator & End Cap	625014-003
9	End Cap w/o Clip	625016-002
10	Bolt, Indicator Mounting, ¼”-20 x 1-3/4”	625026-001
11	Indicator Body, w/o clips, w/o O-ring	625014-002
12	Pressure Gauge, 100psi, Stainless, Liquid Filled	620163-001
13	Tee, For Indicator, w/o O-Rings, 1”FNPT	625015-002
14	Nipple, 1”MNPT x 1”HB, Nylon	625023-001
15	Strainer Assy, 80mesh, 1”NPT	625021-001
16	Outlet Barb Fitting, ¼”MNPT x ½”HB, Nylon	625024-001
17	Bolt, Valve Mounting, ¼”-20 x ¾”	625025-001
18	Flat Washer, Valve Mounting, ¼”	625028-001
19	Flange Nut, Indicator Mounting, ¼”-20	625027-001
20	Bracket, Indicator/Valve Mounting	625011-001
21	Flange Bolt, Manifold Bracket, ½”-13 x 2”	620113-001
22	Flange nut, u-bolt	620138-001
23	Mounting Bracket, Enclosure, Z-Shaped	620135-001
24	Flange Nut, Manifold Bracket, ½”-13	620114-001
25	U-bolt, 3/8"	710100-524
26	Riser Tube, 36”	625030-001
27	O-Ring, Viton, For Indicator, Tee & Valve	625014-004
28	Valve Assy, PFE	625013-002

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COMMANDER FLOW MODULE

Dip Switch	1	2	3	4	5	6	7	8
	Mode	Freq.	Min. DC	Display	Not Used	Not Used	Servo	Resistor
ON	Master	3 Hz	10%	Off			PWM	Enable
OFF	Slave	10 HZ	0%	On			Bipolar	Disable

Rotary Switch – Response Time

Position	0	1	2	3	4	5	6
Response	1 sec	2 sec	3 sec	4 sec	6 sec	8 sec	10 sec

Default Settings	**DS#1**	**DS#2**	**DS#3**	**DS#4**	**DS#5**	**DS#6**	**DS#7**	**DS#8**	**Rotary Switch**
CNH Master	ON	OFF	ON	OFF	OFF	OFF	OFF	ON	Position 3
CNH Slave	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	Position 3
N-Ject/LF	ON	ON	OFF	OFF	OFF	OFF	OFF	ON	Position 4

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