

LA701

Liquid Sprayer Control

Operation and Installation Manual



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General Description

The LA701 uses advanced digital control technology to regulate the application rate for highway sprayer vehicles equipped with liquid dispensing systems. The LA701 regulates a single liquid delivery pump output (GPM) in direct proportion to the vehicle's ground speed (MPH) to create a constant spray rate, measured in gallons per lane mile. The operator can set the application rate directly in gallons per lane mile and select any of three lanes: left, center and/or right. The LA701 uses a vacuum fluorescent display for an outstanding presentation of all operational factors, such as MPH, Gal/lane mi., GPM, and selected lanes.

Manual vs. Automatic Control

The LA701 can operate as a **manual** controller independent of vehicle speed allowing the user direct control of both the pump output and lane selection. Manual mode is useful for testing the individual system components and special situations where ground speed control is either impractical or not available because of problems with a sensor. It's important to note that normal spraying operations should not use manual mode because it will result in an unregulated output and a costly waste of material.

The LA701's primary function is to provide ground speed control, also referred to as **automatic** control. Automatic mode uses the electronic pulses from the vehicle's transmission to calculate MPH. The operator establishes an application set point in gallons per mile. As the vehicle speed increases the LA701 will correspondingly increase the pump speed. Likewise, as the vehicle speed decreases, the pump speed will also decrease. The goal of the automatic control is to achieve a consistent and repeatable spraying policy. Using the automatic mode will improve the safety of the spraying operation by turning off the main pump and lane booms when the vehicle stops and restarting these functions when the vehicle begins to move again.

LA701 Features

- Automatic spray rate control to achieve a desired application in gallons per lane mile
- Automatic ground speed shut off when MPH = 0
- Manual spray control with direct operation of the pump output and lane selection
- Calculate, record and display accumulated gallons delivered
- Continuously display the vehicle speed (MPH), pump output (GPM) and delivery rate (GPLM)
- Control up to three lanes with up to three output flow levels per lane
- Supervisors choice to disable manual mode and restrict operation to auto mode only
- Low liquid alarm to protect the pump, uses a tank mounted low level float switch
- Choice of ground speed sensor types (VRM, Hall effect, Wheel, AC or DC coupled)
- Ground speed sensor calibration and pump flow sensor calibration
- Electro-hydraulic proportional valve control, PWM current mode servo, adjustable PWM freq.
- Digitally adjustable minimum and maximum electro-hydraulic valve drive
- Digitally adjustable boom minimum and maximum flows
- Tank filling feature with full-tank shut-off
- Field printer option; accumulated gallons dispensed, total sprayed miles, date/time, calib., etc.
- Real time clock with day, date and time for data logging trip information
- Failed fuse detection
- Senses failed GPM sensor, failed pump valve circuit, failed boom valve relay circuit

Operation

For basic operation in automatic mode use the following four steps:

- 1) Turn the power switch on and select the automatic mode
- 2) Use the rate knob to select the desired spray rate, viewed as GPLM (gal. per lane mile)
- 3) Push lane switch(s) upward to select the required lanes: left, center and/or right.
- 4) Begin driving the vehicle. The application rate or lane selection can be changed on the fly.

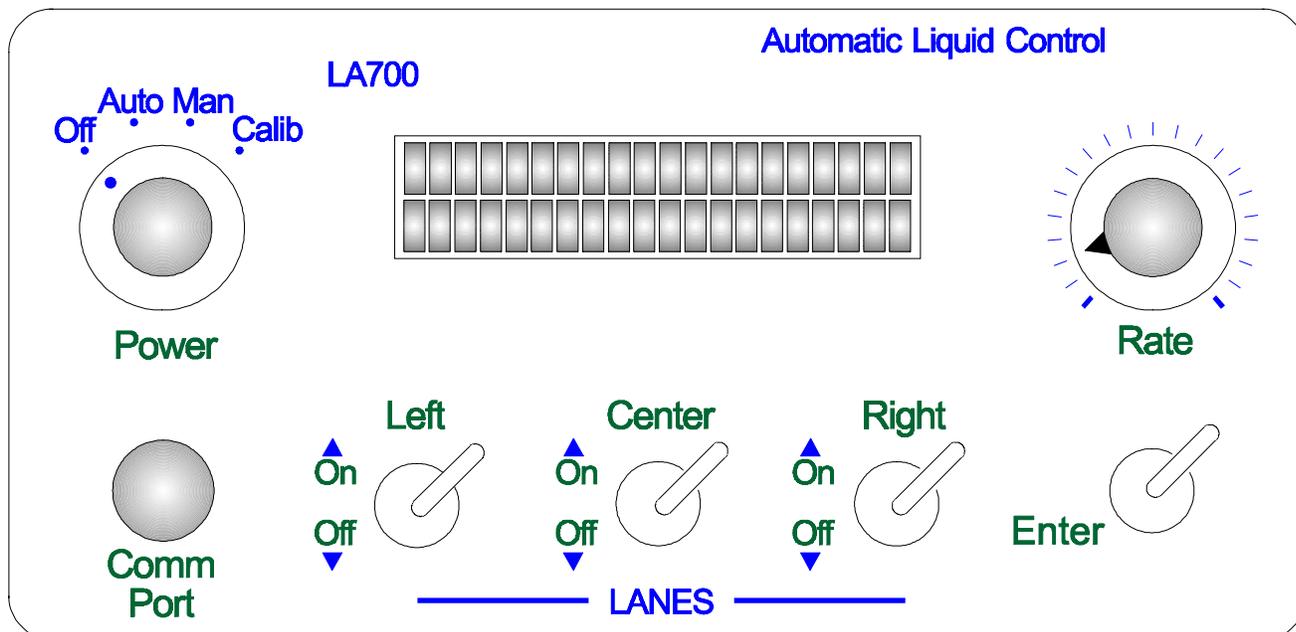
The LA701 will automatically choose the correct boom per lane to achieve the correct flow based on the GPLM rate. The spray will start and stop with the vehicle movement and the GPM output will automatically re-adjust based on the current vehicle speed.

For Manual operation use these three steps:

- 1) Turn the power switch on and select the manual mode.
- 2) Use the lane switch(s) to select the desired lane(s). The display will indicate your boom selection for each lane, see the superscript; (1), (2), (3) adjacent to the lane indicator. (1) is for low flow, (2) is for high flow and (3) is for combined flow (low plus high).
- 3) Use the rate knob to dial in the desired liquid output. The display shows the GPM and when the vehicle is moving the LA701 will continually re-calculate the resulting GPLM.

In manual mode the liquid output will go active as soon as a selection is made. The operator must remember to turn the liquid output off. [rate knob fully CCW or push down the lane switch(s)] The manual mode does not require the MPH or flow sensor to operate. In manual mode the displayed GPLM will vary with vehicle speed.

Front panel layout and operation



Power switch (and mode selection)

The main power switch has four positions: Off, Auto, Man, Calib. The main power switch is used to shut down all of the sprayer functions. In the off position, all power is removed from the valves and sensors. The automatic and manual selections are used to choose the mode of operation. The calibration selection allows you to view/edit the calibrations, print, clear the data memory and to fill the liquid tank.

Special note: The flow for each boom is selected by the LA7 via a control relay within each motorized ball valve. When the LA7's power is turned off each relay de-energizes and the ball valves will automatically close. This feature will only work correctly if the motor power for each ball valve routes from a source outside the LA7. Usually this power will come through the vehicles key switch. If so it is important that the operator remember to turn the LA7 off before the key switch on

Lane switches (left, center, right)

During the initial setup the installer establishes which lanes are available. To activate a lane (boom) press the associated lane switch [up]. Likewise, to turn a lane off press the lane switch [down]. The LA701 displays your lane selections under the title **Lanes** on the main run menu. The display also shows a small subscript next to each lane indicator. This subscript informs the operator of the current lane selection. A subscript of (1) is a low flow selection, (2) is a high flow selection and (3) is for a maximum flow selection where both sets of boom nozzles are on. In manual mode a lane selection will immediately turn on the boom valve. In auto mode the boom valve will turn on as the vehicle begins to move. The subscripts (1,2,3) will advance and decrement automatically.

Rate knob

In auto mode the rate knob is used to dial in the desired application rate (GPLM). In manual mode the rate knob sets the GPM output of the liquid pump. In addition, the rate knob is used to select various menus for programming and printing and to edit the numeric value of the individual program parameters. See the programming section for more information.

The Enter switch is used by the operator to view the accumulated gallons dispensed. When pressed it toggles the MPH field off and replaces it with **Accum** (gallons) field. The Enter switch is also used to edit and save data in the programming functions. See the programming section for more information.

Fault Alarms

A "Low Liquid" alarm informs the operator that the liquid tank is very near empty. If the LA7 is operating in auto mode the pump is immediately shut off to prevent pump damage. This alarm displays in auto mode whenever the low liquid float switch goes active for 3 seconds. The operator can switch to manual mode to work around the low tank condition, but this is only recommended for cases where an attentive operator needs perform a controlled test. The "Low Liquid" message will alternately blink when in manual mode to continually remind the operator to resolve the low liquid condition before liquid pump is damaged. The LA7 will automatically clear this alarm when the low tank switch rises up to a safe level. It's possible this alarm will come and go as road conditions change (road-crown or hills).

A "Flow Sensor Failure" alarms in auto mode whenever the LA7 has stopped receiving pulses from the flow sensor. There is about a 3-5 second delay. After which the pump is automatically shut off. The operator is instructed by the display to switch to manual mode. The LA7 will operate in manual mode without a flow sensor. This allows the operator to proceed with spraying until the sensor can be repaired. To clear this alarm the LA7 power switch must be cycled off and back on. If the condition is again determined to exist the alarm will repeat.

A "Pump Valve Failed" message shows when an electrical fault occurs in the pump valve circuit. Since the system cannot operate without a pump, the system is automatically shut down and the operator is required to return the vehicle for maintenance.

A "Ball Valve Failed" "Valve: ## Disable" message will alarm the operator if an over current condition occurs in one of the six ball valve relay circuits. Each valve is numbered as follows:

##	<u>name</u>
1	right low flow
2	right high flow
3	center low flow
4	center high flow
5	left low flow
6	left high flow

The failed valve is disabled and will not be used again during that run. Normal operation continues but the operator will not have a pump output if the failed ball valve is selected. If the power to the LA7 is cycled this alarm will be reset.

An "Internal Fuse Blown" message shows when the internal 5 amp fuse has blown. This alarm cannot be reset and requires the operator to return the vehicle for maintenance. The liquid pump and the boom valves will not operate with the internal fuse blown.

A "Watch Dog Error" message appears to inform the operator that an internal computer problem has occurred. Cycling the power off then on again may reset the problem. The operator should inform maintenance if this alarm occurs.

Printing

Locate the printer port in the lower left corner of the front panel. Remove the dust cap to reveal the 4 pin connector. With the power turned off, connect the field printer. Switch the power on and the printer will be automatically "print ready". Switch the power switch over to the calib. position. Use the rate knob to select " Print Reports". Press the Enter switch and release to access the printer menus. Use the Rate knob to select one of the print menus (see below). With your selection blinking, press Enter to print.

P1 Trip Truck Calib
P2 **Clear totals:** Trip Truck

After all printing is complete, turn the power switch off and disconnect the printer.

Tank Filling

The LA701 can assist the operator with filling the liquid tank. Select calib. and turn the rate knob CW until the "Fill Tank" field blinks. Press Enter display to the tank filling menu.

Pump Tank ↓ Gals.
off ----- 0

To fill tank:

- The display starts off showing "Rate CCW"
- So first turn the rate knob full CCW. This starts the filling sequence. *ready to start*
- Next adjust the rate knob upward to begin the pumping, view the pump output as xx%
- Again, you can turn the rate knob full CCW to stop the pump at any time
- Press enter to reset the gallon counter at any time
- The status of the two internal float switches is shown next to the Tank field as:
 - ↓ (dn arrow) = low tank switch is active
 - ↑ (up arrow) = high tank switch is active

When the high tank float switch is up (active) the pump is automatically turned off to prevent overfilling.

Pump Tank Gals.
xx% Filling accum gal

This display indicates normal filling.
No arrow shows neither tank switch is active.

Pump Tank ↑ Gals.
off Full accum gal

This display indicates tank is full.
Tank shows high tank switch active.

Programming

Programming the LA701 requires the installer to adjust several internal parameters in order for the spraying equipment to be calibrated and accurate. The LA701 is shipped with preset adjustments to make it easy to confirm operation of the hydraulic valves, electrical wiring, sensors and liquid components. Refer to the section on installation and initial setup on how to check out the spray system.

The rate knob is used to select the menu. Turning the rate knob to the right will increase to the next menu. Likewise, turning the rate knob to the left will move back to the previous menu. The middle range of the rate knob is used to select between different fields within any given menu. The selected field always blinks to confirm your position in the menu.

To change the value of a parameter, press and hold the enter switch. Use the rate knob to modify the displayed value. Release the enter switch to save the new value. Note: some of the menus allow you to operate the boom valves and liquid pump in order to verify the liquid spray output. In these cases a lane switch is used to make the output active.

To access the programming menus, requires you use a password. Without the password the operator can view but not change the program settings, View Mode Only.

Enter password

The password range is from 0 to 999. The initial factory password is "0".

To enter a password:

- turn the Power switch to Calib., (full CW)
- turn the Rate knob (full CCW) and the "Calib menu" will blink,
- press and hold Enter switch,
- turn the Rate knob until the correct password shows on the display,
- release the Enter switch and the display will jump menu no. 1

You can change the password using menu [12]. If you lose your password you can call your dealer for the backdoor code. If you do not enter a password the LA701 will go to a view-only mode that allows you to scroll through the various menus but you're unable to make any changes.

Menu 1 **MPH Sensor Type** Factory setting [World]

hold enter switch, adjust rate knob to select VRM, World, or Hall.
release enter switch to save your selection.

Menu 2 **Lane selection** Factory setting [Y Y Y]

use rate knob to select a lane: L-left, C-center, R-right (blinking = selected)
hold enter switch to choose yes or no (no = lane is removed and not used)
release the enter switch to save the choice
repeat the sequence for each lane

Menu 3 **Pulses per mile calibration** Factory setting [30000]

... three methods to calibrate MPH

... use method 1) if you already know the pulses/mile range: 5000 - 150,000
Hold enter and adjust the rate knob to directly set pulses/mile release the enter sw to save the value

... use method 2) to count the sensor pulses generated over a known distance
The LA7 has a pulse accumulator for the MPH sensor. This pulse accum. is reset when you select menu 3, pulses = zero. As you drive the pulse accum. will increment. Stop the vehicle at your desired distance, 1/4 mi, 1/2 mi, 1 mi. etc. and record the pulses. Calculate the pulse / mile (pulses/distance) remember 5280 ft = 1mile. Use step 1) to directly enter your calculated value

... use method 3) to match the LA7 MPH with the vehicle speedometer.
At a fixed speed (20 MPH is best) hold enter and adjust rate knob until the displayed MPH equals the dashboard MPH. Release enter to save the calibration. The LA7 has assisted you in calculating the pulses / mile. You can now use the pul/mi from menu 3 to directly calibrate other identical vehicles using a LA7.

Menu 4 **Pulses per gallon** Factory setting [71.3]

- 1) use a lane sw to select left, center or right with a boom flow of 1, 2 or 3.
as soon as the lane is selected the boom and pump will go active
- 2) use the rate knob to control the pump output. rate = CCW = off
- 3) press/release enter to reset the flow counter, turn rate knob CW to start pump.
during the dump view accum. pulses and accum. gallons delivered
- 4) end the dump by pressing the lane switch off (sw down) or rate = CCW
- 5) measure the dumped liquid and calculate: [pul/gal = total pulses/total gals.]
- 6) enter pul/gal (flashing) hold enter sw and adjust rate knob to set pul/gal value
or match gal (displayed) to the actual dump range; 20.0 to 240.0 pul/gal
[note, Raven flow sensors list the calib. no. as 710 which is to be interpreted as 71.0 pulse per gallon

Menu 5 **PWM freq.** Factory setting [130]

PWM freq. range (35 to 200 hertz)

- 1) hold enter switch, adjust rate knob to select the PWM frequency
- 2) release enter switch to save your selection

Menu 6 **Pump valve minimum trim adjustment** Factory setting [400]

- 1) select any number of booms and flow levels using the lane switches.
selecting the lane will start the pump output. (ma. value stops flashing).
- 2) adjust rate knob to set desired minimum nozzle flow, min valve drive (ma).
view GPM for reference and observe the actual nozzle flow.
- 3) press/release enter to save the current min valve trim and stop the pump.
note: switching the lane off will end the valve trim and resume old setting.

To directly set the valve minimum (ma) without pump output:

- > hold the enter sw (ma. flashing) and adjust rate knob to set minimum (ma)
- > release enter sw to save

Menu 7 **Pump valve maximum trim adjustment** Factory setting [1500]

- 1) select any number of booms and flow levels using the lane switches.
selecting the lane will start the pump output. (ma. value stops flashing)
- 2) adjust rate knob to set desired maximum nozzle flow, max valve drive (ma).
view GPM for reference and observe the actual nozzle flow.
- 3) press/release to save the current max valve trim and stop the pump.
note: switching the lane off will end the valve trim and resume old setting.

To directly set the valve maximum (ma) without running the pump:
> hold the enter sw (ma. flashing) and adjust rate knob to set maximum (ma)
> release enter sw to save

Menu 8 **Low flow nozzle range setting** Factory setting [5/30]

- (do this step twice, first for min then for [max])
- 1) use rate knob to select min [max] flow (blinking = selected)
 - 2) use lane switches to choose left, center or right. (low flow nozzle only)
selecting the lane will start the pump output. (value stops flashing)
 - 3) use rate knob to adjust pump output. recall, rate=ccw=pump off.
view GPM for reference, verify nozzle flow.
 - 4) press/release the enter sw to save the min [max] flow setting and stop the pump.
note: switching the lane off will stop the pump and resume old flow setting.

To directly set the min [max] flow without running the pump:
> select min [max] with the rate knob (blinking = selected)
> hold the enter sw (flow flashing) and adjust rate knob to set min [max] flow
> [rate = ccw will set the low flow boom = off]
> release enter sw to save

Menu 9 **High flow nozzle range setting** Factory setting [25/50]

- (do this step twice, first for min then for [max])
- 1) use rate knob to select min [max] flow (blinking = selected)
 - 2) use lane switches to choose left, center or right. (high flow nozzle only)
selecting the lane will start the pump output. (value stops flashing)
 - 3) use rate knob to adjust pump output. recall, rate=ccw=pump off.
view GPM for reference, verify nozzle flow.
 - 4) press/release the enter sw to save the min [max] flow setting and stop the pump.
note: switching the lane off will stop the pump and resume old flow setting.

To directly set the min [max] flow without running the pump:
> select min [max] with the rate knob (blinking = selected)
> hold the enter sw (flow flashing) and adjust rate knob to set min [max] flow
> [rate = ccw will set the high flow boom = off]
> release enter sw to save

Installation

The complete installation for the LA701 consists of the mechanical mounting, electrical connections, system check out and programming/calibration. The mechanical mounting uses a simple U-bracket which is removed from the LA701 via the two wing knobs on either side of the unit. **Do not** use alternate fasteners, since the internal circuit board could be damaged by longer screws. The U-bracket should be fastened to a stable, solid surface. Place the unit at no more than arm's length from the operator. Position the faceplate toward the operator for direct viewing and also allow sufficient rear panel clearance for the cable connectors. Avoid placing the control unit where it will be exposed to water or high heat.

The electrical connections are located on the rear panel via two 9-pin twist lock connectors. The pin outs for these are listed in the following table. If special cables have been supplied by your dealer, refer to those cable drawings for details which may differ from the basic ones provided in this publication.

As shown in the wiring diagram the motorized rotary ball valves used to control each lane and nozzle group require a separate power supply path, around the LA7. This insures the ball valves have the power to close when the LA7 is turned off

Connector pin out definitions for the LA701, via two rear panel connectors

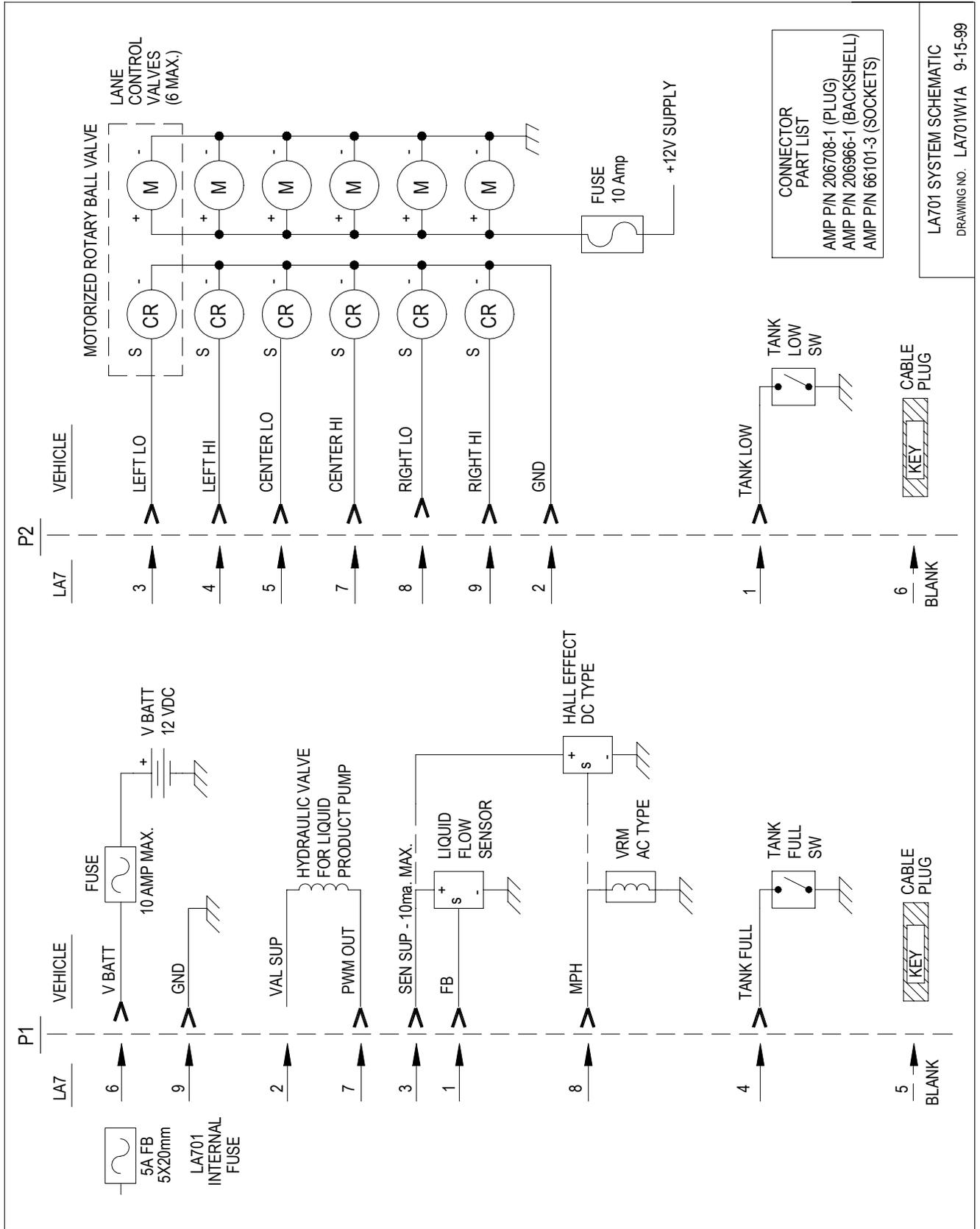
J1/P1 9 pin receptacle with pin 5 keyed

Pin	Function	Type
1	GPM Sensor	open collector input, edge sensing, 12vdc, 10 ma
2	Valve Supply	fused 12vdc supply, 3 amp
3	Sensor Supply	fused 12vdc supply, 500ma max
4	Tank full switch	active low = tank full = contact closed, 12vdc, 10ma
5	-- blank/plug --	Key P1, cable plug end is keyed at pin 5
6	Main power supply	12vdc (+) power
7	Pump Control	PWM output, lowside mosfet switch, 2.5 amp max
8	MPH Input	selectable AC or DC type signal
9	Ground	vehicle ground

J2/P2 9 pin receptacle with pin 6 keyed

Pin	Function	Type
1	Low Liquid switch	active low = tank low = contact closed, 12vdc, 10ma
2	Boom Valve Return	common ground for all boom control relay signals
3	Left lane Low flow	sourcing output, 12vdc, 60ma
4	Left lane High flow	sourcing output, 12vdc, 60ma
5	Center lane Low flow	sourcing output, 12vdc, 60ma
6	-- blank/plug --	Key P2, cable plug end is keyed at pin 6
7	Center lane High flow	sourcing output, 12vdc, 60ma
8	Right lane Low flow	sourcing output, 12vdc, 60ma
9	Right lane High flow	sourcing output, 12vdc, 60ma

Refer to LA701W1A system schematic on the following page.



Quick Checkout Procedure

Purpose: To give a quick check list of procedures to verify the liquid control system is ready to calibrate.

Setting up a new installation for the LA7 liquid control system is comprised of two parts. The first is the hardware check out to prove the system components are operational. The second part is to calibrate and setup the computer control parameters. For the calibration phase its recommended you use the operational manual.

The LA701 comes from the factory preset with calibration values that should make it possible to checkout the liquid system's basic operation. This check out procedure includes steps to verify the spray system's hydraulic and liquid plumbing issues are leak free and the pump is turning in the correct direction. The following steps are in a sequence based on a typical installation. You may vary the sequence as needed.

Step # 1 Visual verification the all system connections are correct.
* Refer to the system layout drawing to locate each device and verify the following:

1. Hydraulic pump and flow control valve hoses are correctly plumbed
2. Liquid pump, tank and boom hoses are correctly plumbed
3. Electrical connections are complete:
 - ◆ main power is active and cables are connected to the LA7
 - ◆ proportional hydraulic valve cable connections
 - ◆ liquid flow sensor cable connections
 - ◆ boom control valves cable connections
 - ◆ low level tank float switch is connected
 - ◆ MPH sensor

Step # 2 Utilize the LA7 as a diagnostic tool to verify all functions are operational

Power: At the LA7 front panel, turn on the main power switch to manual mode. The display will verify the LA7 has powered up. If certain wiring errors exist the LA7 may display an alarm right away. Remember to use manual mode for checking the basic inputs and outputs within the system.

MPH: Drive the vehicle or use jacks to freely drive the wheels. Observe the MPH value on the display. The MPH number will probably not match the dashboard speedometer reading, but, you should observe that the displayed MPH value goes to zero when the vehicle stops and when driving the MPH number should climb and fall smoothly in proportion to the speedometer. If the MPH value displayed on the LA7 screen stays at zero you may need to enter the program mode and change the sensor type.

Refer to the programming manual, menu 1. Factory setting for the MPH sensor is "world" type. If this doesn't work try VRM and re-test. Next, try Hall and re-test. If you are unable to receive and display a valid MPH value proceed on with the remaining check out and consult with your dealer.

The LA7 can receive spurious pulses and interpret them as a MPH signal. This is evident when you stop the drive line (MPH=0) and the displayed MPH value on the LA7 continues to show a value other than zero. A direct way to test for this is to operate the pump valve in manual mode. You should not run the liquid pump dry, so leave the hydraulics turned off. Switch on a valid lane selection, (left, center or right) and turn the rate knob up to mid position. The valve is now active and if the displayed MPH value goes from zero to some number you have an interference problem. Reported this to your dealer. The remedies for this problem are: improve the grounding, provide cable shielding or use an alternate connecting for the MPH signal.

Pump: Fill the liquid tank with a test liquid (water is a good choice) and from manual mode turn on the center lane switch and turn up the rate knob. Immediately check that the liquid product pump is rotating in the correct direction.

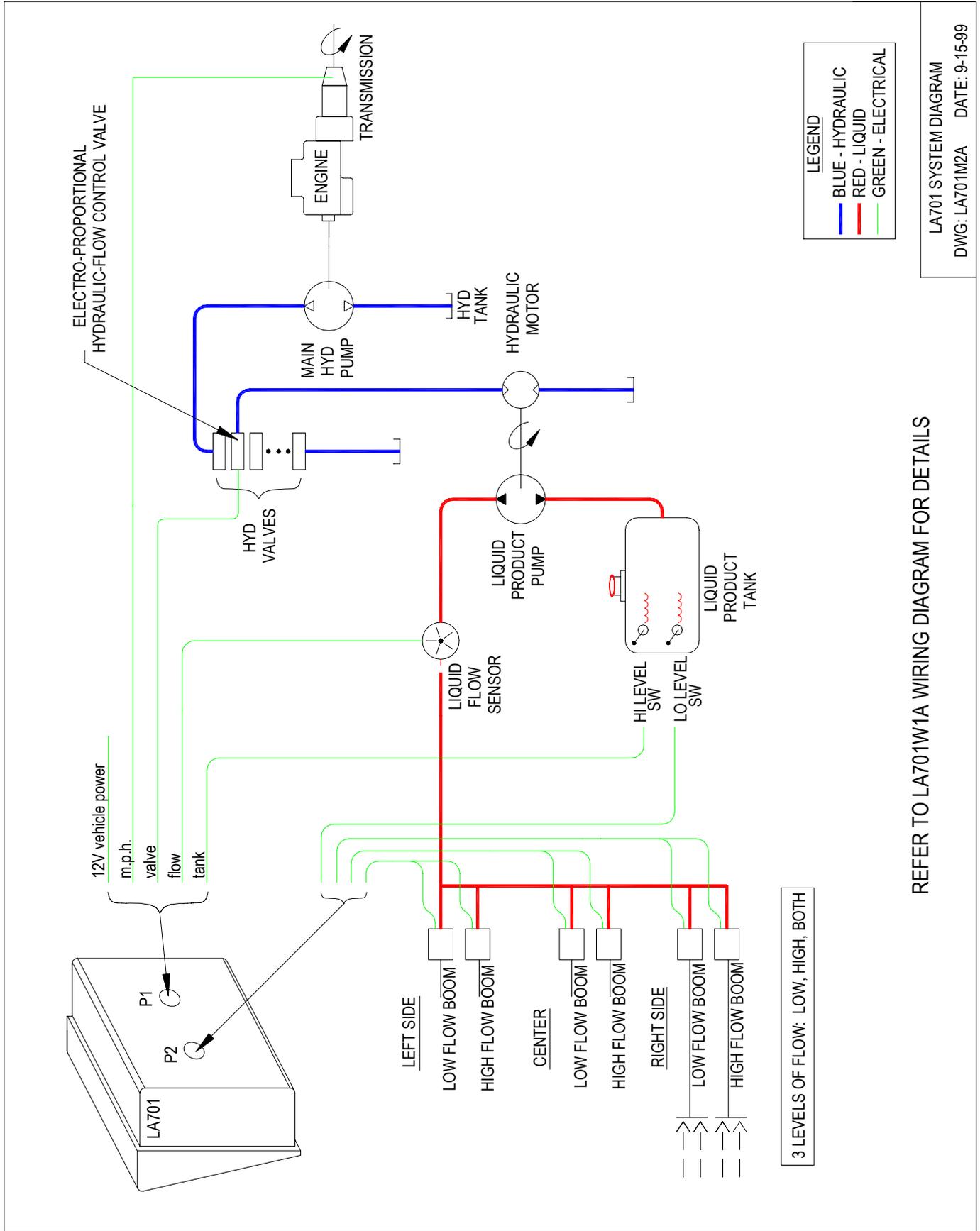
NOTE: the liquid pump is easily damaged by reversal or by running dry.

Valve: Check for leaks and then verify that manual adjustments to the rate knob correspond to proportional changes in the liquid volume at the spray nozzles.

Lanes: Use the procedure above to verify each spray lane nozzle group is operational by selecting each lane one at a time. Note, the first time you press the lane switch up you energize the low flow nozzles and a second push up will bring on the high flow group. Likewise, pushing the lane switch down will first drop the high flow and the low flow.

GPM: To verify the GPM sensor observe the display in manual mode. The GPM value should increase and decrease with the rate knob. Again, the value may seem incorrect and will be calibrated for accuracy later.

Low tank switch: The low tank float switch has closed contacts when the liquid level is normal. If you disconnect the cable connection at the float switch you can verify the LA7 reads the low tank condition. The LA7 will display a low tank error.



LEGEND

Blue line	HYDRAULIC
Red line	LIQUID
Green line	ELECTRICAL

3 LEVELS OF FLOW: LOW, HIGH, BOTH

REFER TO LA701W1A WIRING DIAGRAM FOR DETAILS

LA701 SYSTEM DIAGRAM

DWG: LA701M2A DATE: 9-15-99