Premium Control Products Designed and Manufactured for Industry

Installation and Operations Manual

JS101 Four Axis Joystick Controller

Electro-Hydraulic Control

doc. p/n JS101M1B

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General Description

The JS101 is a four axis programmable joystick controller with an integral electro-hydraulic valve driver. The joystick mechanism utilizes a non-contacting, *non-inductive,* solid state, fixed field magnetic flux sensor technology. The JS101 can drive up to four electro-proportional 4-way valves. These can be pulse width modulated coils or solenoid coils, with momentary or latching control.

The joystick is configured with the hand lever traveling in a full circular pattern creating a standard X and Y controller. The lever position in combination with two push buttons allows the user to independently select each of the four axes. A small handheld program editing tool connects to the controller via a connector in the hand lever giving the installer a quick and easy method to make valve drive settings. The installer can select different coil types, adjust PWM frequency, increase or decrease the hand lever deadband, pre-set an axis for safe or live action, separate or combine lever positions to act with exclusive or crossing logic, inhibit over travel with external limit switches and many other options.

The hand lever and electronic drive circuitry are fully enclosed in a single compact metal box with no internal adjustments or fuses. The JS101 mounts through a 2” diameter clearance hole and can be readily adapted to any cab configuration. The wiring interface is accomplished with a sixteen-pin twist lock connector mounting out the bottom of the controller. Cable assemblies and mounting brackets are available through your dealer.

General Specification:

- Operating voltage: 10-32 VDC mobile vehicle electrical systems
- Coil drive Outputs: 100 ma to 2500 ma, PWM (current controlled) or solenoid (full voltage)
- Hand lever: Full range circular, spring return to center, T-handle w/ (2) push-buttons, right thumb
- Lever force: 1 lb. force for full travel. The absolute maximum force is 50 lbs. [(1)]
- External inputs: Two digital inputs for reading current sourcing proximity sensors, relays, psi sw., etc.
- Alarm: Audible alarm (beeper), confirms functions and faults to the operator
- Wiring interface: AMP CPC twist-lock connector, (16) pin, gold pins
- Enclosure: 3.5" x 5" x 3" anodized aluminum enclosure, stainless fasteners
- Calibration: RD203 handheld via DIN connector access through the T-handle
- Options: Four low power outputs; for controlling relays, spreader control interface, axis expansion interface, remote displays, etc.

[(1)] Note; The JS101 is not warrantied against damage to the hand lever mechanism. Use caution to prevent hand lever forces beyond the 50lb.rating.

Accessories

JS101C1	Standard four axis cable, 16 pin CPC plug, split loom, with 15 ft vehicle leads. Includes common valve coil ground lead, color coded wires. see dwg. no. JS101W1 for pin outs and connection reference
RD203	Handheld program editing tool with five digit display, four pushbuttons and cable. It connects directly to the T-handle via a 6 pin DIN plug.
JS100H5	Universal mounting bracket, allows left or right side mounting, basic L shape with predrilled mounting holes and gold zinc plating. Includes captive fasteners for easy assembly.

About this manual ....

This manual attempts to provide the required information to properly apply, install, program and operate the JS101 joystick controller. This manual is focused toward the snow/plow and spreader truck applications. For users who are applying this device into other uses such as roadside mowers, cranes, industrial pick-n-place machines, lifts, etc. the reader is asked to look beyond the industry terms used. The JS101 is a flexible controller able to be adapted to a wide variety of applications.

The factory can provide custom software to create new features that will solve special application needs. Please contact your dealer for information regarding special factory programming options.

Basic Operation

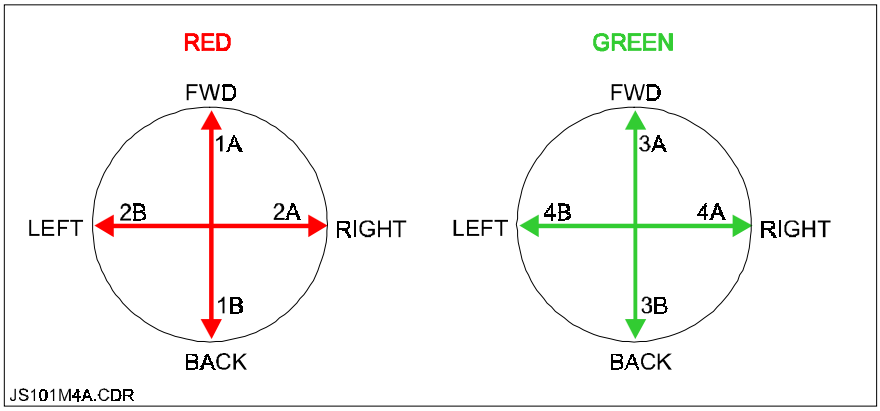
The JS101 joystick controller provides three basic attributes for the operator. The first and most important is the hand lever. The operator uses the **hand lever** to precisely control the hydraulic flow for each of four functions. Small movements of the hand lever will give the operator very fine flow control.

The second attribute is the two **pushbuttons** located on the left end of the T-handle. These pushbuttons are located for the operator's right thumb to press and hold when moving the hand lever. The red pushbutton corresponds to axes one and two. The green pushbutton corresponds to axes three and four. The corresponding pushbutton is pressed and held for that axis group to be active.

The third attribute is a **beeper** which produces audible chirps for the operator to use as confirmations to specific actions. Since there are no lamps to indicate that power is on, the JS101 will beep two short chirps each time the unit is powered up. A single beep is made whenever an axis is enabled by a pushbutton. Refer to the main body of this manual for descriptions of the other beeper uses.

Because the JS101 provides different modes of operation and unique ways in which each axis is enabled and used, the installer must inform the operator which axes are live verses safe and which are exclusive verses crossing. The process of setting up the JS101 and configuring each of the axes, modes, coils, trims, ramps, shape, etc. may appear complicated at first glance. Remember the operator's view of the final result is much simpler.

This diagram depicts the basic hand lever positions with the red and green pushbutton association to the axis assignments. The directions fwd/back, left/right apply to the joystick hand lever movements. Each of the eight valve drive outputs, 1A/1B, 2A/2B, 3A/3B, 4A/4B are referenced.



Features and Definitions

The JS101 joystick controller offers numerous operational features not available from other joystick designs. The JS101 gives users a semi-custom platform for implementing multi-axis open loop electro-hydraulic control. Following is a list of terms, definitions and features to help explain how to best program and utilize the JS101.

Axis

In the field of motion control the term axis defines each complete motion. example; a snow plow requires two axes of control, one axis is for the plow up/down motion and the other axis is for the plow left/right motion. The JS101 is a four axis controller with four valve output pairs. Each output pair corresponds to a bi-directional hydraulic function, ie., up/down, left/right, in/out, etc.

Hand Lever

The hand lever (often referred to as the joystick) travels freely in a 2 inch circle. The lever is spring loaded so it automatically returns to the center position when the operator releases the T-handle. The JS101 is a right hand device with the operator's right thumb used to press and hold the red or green pushbutton. Each pushbutton is used to provide a safe (or dead man) action. The Safe mode is used to prevent accidental operation.

Proportional vs. bang-bang

Proportional control refers to the electro-hydraulic flow control valves that use pulse width modulation as a means to regulate the valve spool position. Bang-bang refers to the standard solenoid [on-off] valves. Although a proportional flow control valve can be made to function as a solenoid valve the reverse is not true.

The JS101 controller lets the user select the type of valve that will be used on each axis, proportional or solenoid. The latching function is a special feature of the solenoid valve. The JS101 can latch (hold) the coil drive active after the joystick is released. A second move of the hand lever will unlatch the solenoid coil. This feature is useful for a variety of pin and release functions commonly found on mobile industrial vehicles.

PWM frequency

The PWM (pulse width modulation) frequency is established by the valve manufacturer. The JS101 uses one frequency for all eight proportional valve coils. In most cases lowering the PWM frequency by 10% to 20% below the manufacture's spec. will produce a slightly more responsive valve. Solenoid coils receive full voltage and do not use PWM control.

Ramp

The ramp feature applies a small slope control to the proportional output drive. The ramp helps dampen sudden hand lever movements to create a smoother control. The ramp is the same for both increases and decreases in output. The ramp time across the full range of the hand lever motion is approx. 2 seconds.

Deadband

The deadband is a small circular area in the center of the overall hand lever range. When the hand lever is within the deadband area there is no valve drive output. As the hand lever is positioned just beyond the deadband area the valve drive output becomes active. The deadband is adjusted depending on how sensitive the response needs to be for a given application (operator's preference). The deadband only applies to the proportional valve coils. Solenoid valve coils are not energized at the deadband point, but are instead energized when the hand lever pushed past 50% of full travel.

When an axis is defined as both live and exclusive the deadband alone is used to determine which axis will be activated. At the point where the hand lever crosses beyond the deadband, the controller determines which quadrant the lever is in and selects the axis accordingly.

Exclusive vs. crossing

An axis pair is defined as exclusive by restricting one axis to being active at a time. By making an axis pair exclusive the user can more easily isolate the up/down from the left/right movements. By contrast the crossing feature allows both axes to be activated at the same time. The crossing feature is used when the application requires combined motion, such up and out or down and left.

Safe vs. live

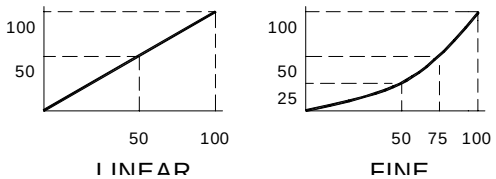
An axis is defined as safe when it requires the operator to push and hold the associated pushbutton to control the axis. An axis is live when the operator only has to move the hand lever to activate the valve drive. Because the JS101 uses one hand lever to implement four axes of control the installer is restricted from simultaneously assigning axis one and three (or two and four) to be live.

> *Note: each JS101 is shipped from the factory with all four axes preset for **SAFE** control. It's the responsibility of the installer to determine the appropriateness of using **LIVE** control. The operator must be made aware of the added risk to safety when using the **LIVE** control mode.*

An important note: Use caution when assigning a live axis on top of a safe axis. Consider how axis one is on top of axis three. The following example explains: If the Red axis 1A/1B is live and the Green axis 3A/3B is safe there can be a problem when the operator may intend to move 3B but not push the green PB before moving the lever. The 1B axis will activate when the hand lever is first pulled back and then axis 3B becomes active when the green PB is pressed.

Shape

The shape feature refers to the curve that relates the hand lever position to the valve drive output. In the linear mode the output is directly equal (linear) to the hand lever position. The fine mode provides a slope to the output such that a 50% hand lever movement produces a 25% output. The fine mode allows the operator to more easily control low speed movements.



Valve Trim

Most electro-hydraulic proportional valves operate at voltages less than the full voltage of the system. In a 12vdc system a typical valve spool will begin to crack open and flow a minimum GPM at 3 volts with the maximum flow at 9 volts. The JS101 allows the installer to individually set the min. and max. drive for each valve coil. The installer can make these adjustments through some easy trial and error checks.

Output Disable

The JS101 has two dedicated limit switch inputs used to inhibit movement of an axis, typically used to prevent a hydraulic cylinder from bottoming out or other machinery damage due to over travel. Each of the two limit switch inputs can be assigned to any of the eight valve coils allowing the installer to inhibit the motion of a single axis direction or an entire grouping of directions using positive or negative logic. The limit switch inputs cannot be assigned to any the auxiliary axes.

Pass / Blast

The JS101 uses one of the low power outputs for sending a Pass / Blast command code. Pass is a spreader mode where the granular material is turned off so the vehicle can pass of be passed. Blast is a spreader mode where the granular material is delivered at the maximum rate. This feature is enabled through menu **Pb.** The Pass/Blast is a live function and does not require the operator to press a pushbutton. This function toggles, example; select position 2 (left – right), by moving the lever left the Pass is latched on, a second lever move to the left will latch Pass off, the Blast operates the same by moving the lever to the right.

Installation

Mechanical

The JS101 is designed for mounting inside the operators' cab. The JS101 enclosure is sealed against dirt, dust and some water spray but it's not recommended for outside use. The joystick should be mounted in a location that best affords the operator convenient access to the hand lever and pushbuttons. The controller with its compact design was intended to mount next to the drivers' right leg for easy reach. Mounting the joystick bracket to the seat base will allow the seat to move with the seat keeping the operators hand at a consistent position.

A basic mounting bracket is available through your dealer, ref. part no. **JS100H5**. The L-shaped bracket can be mounted to either side of the joystick controller. It includes pre-punched holes with captive fasteners and is zinc plated so no painting is required. Important**, DO NOT** drill any holes into the JS101 enclosure. **DO NOT** disassemble the joystick controller. This unit is **factory sealed**. If the seal is broken the warranty is void. There are no field serviceable parts within the unit.

Special note: *The hand lever is a light-touch mechanism so as to reduce strain on the operator's hand and wrist. The normal operating force required to move the hand lever to its full position is 1 lb. The hand lever mechanism is rated for an absolute maximum force of 50 lbs. Forces greater than 50 lbs. will bend the shaft. If this occurs the hand lever will appear loose and flop around without returning to its center position. Over force is considered a misuse and is not warrantied by the manufacturer. Please instruct the operator to use care and never apply forces greater than what is required to properly move the hand lever.*

Mounting considerations:

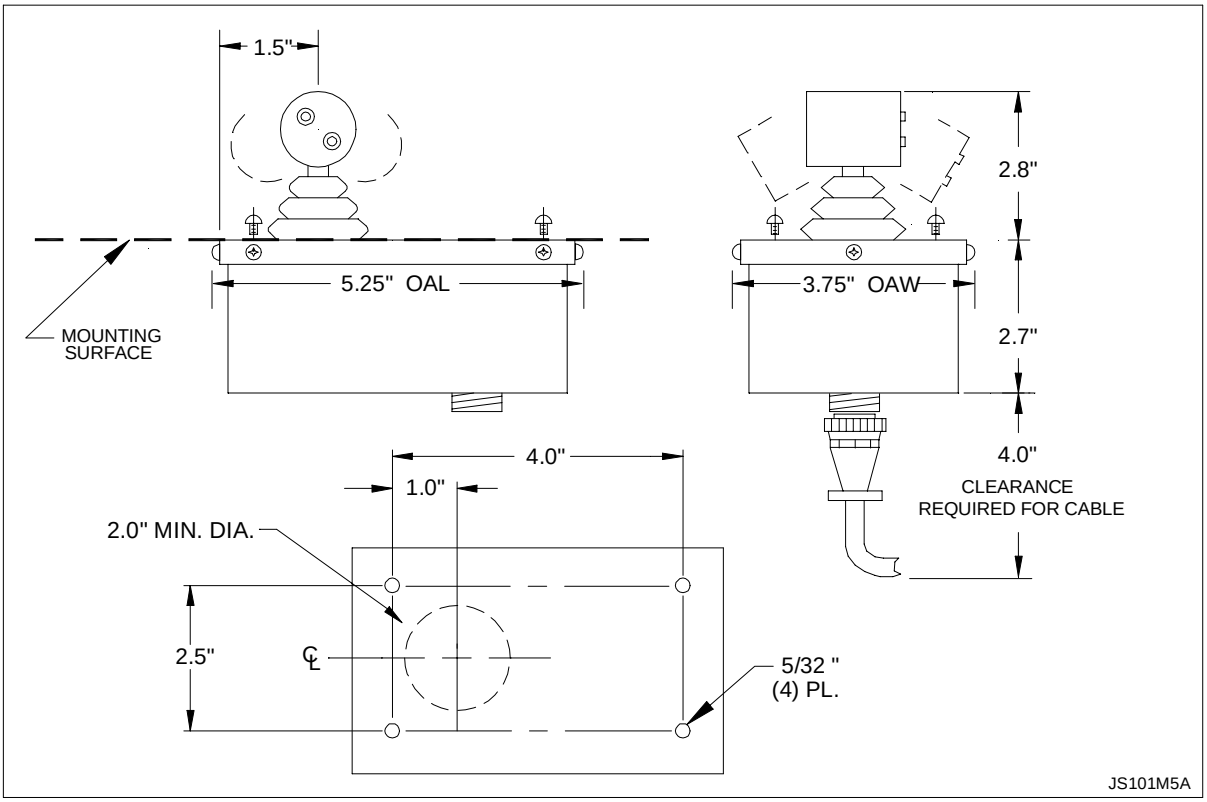
a. Think through the overall mounting task before starting and carefully locate the joystick position for the operator and the required cable routing.
b. Create a firm (stiff) mount. The joystick mounting bracket should not be allowed to vibrate.
c. Discourage the operators from pulling on the joystick handle as a means to lift or position themselves in the cab. The joystick handle is rated for 50lbs. absolute maximum force. Exceeding the 50lb. force will bend the joystick shaft.
d. Ensure the cable harness has enough free play to move as the seat moves. Route the cable to avoid exposure to any sharp or rough edges. Strain relieve the harness along its path to prevent unwanted vibration or abrasion. Make sure the cable cannot exert damaging forces to the connector located on the bottom of the JS101.
e. Make sure the joystick can be easily removed for service. The fasteners should have clear access for wrenches and the cable must be easy to disconnect. When using either the JS100H5 or the JS1ARA1 optional mounting assemblies, the installer must ensure the joystick can rotate 90 deg. so that the hand lever can pass down and through the oval opening for easy removal.

Electrical

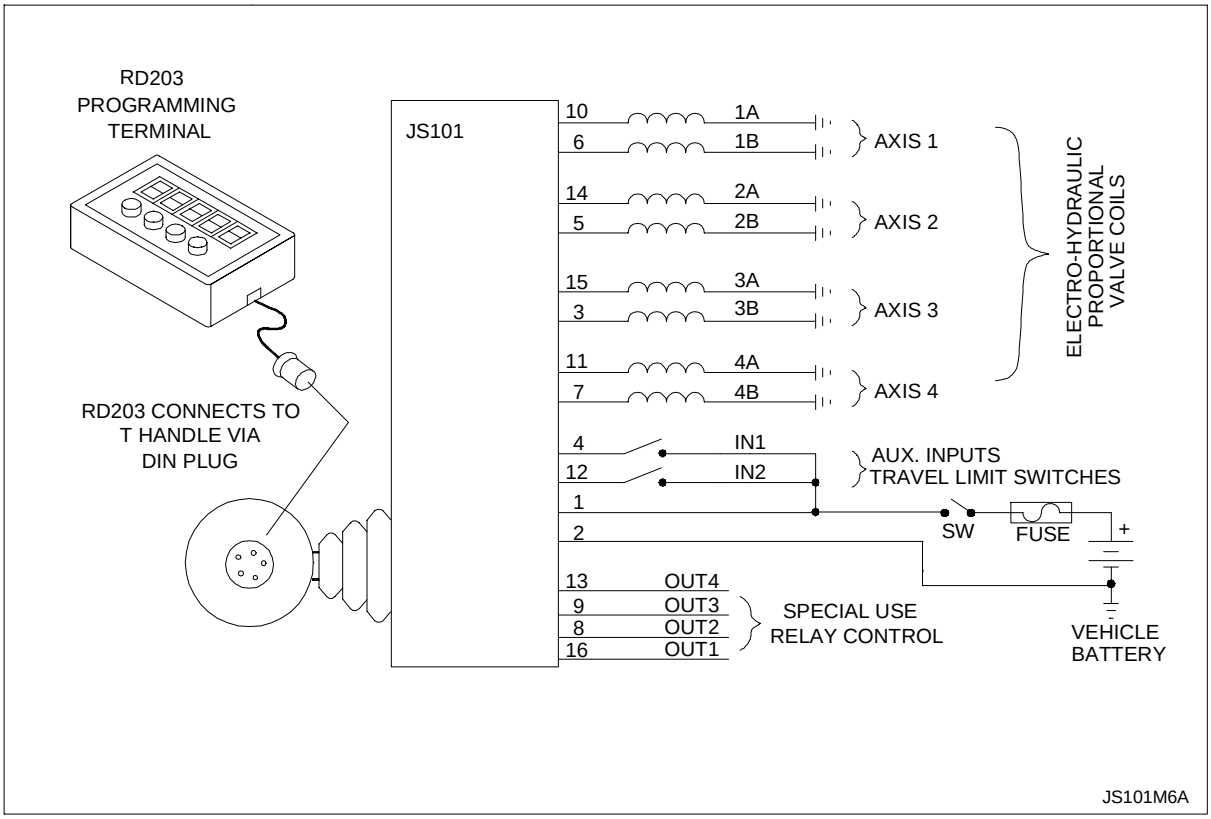
Connect the power lead (Red) to a switched branch circuit fused at no more than 10 amps. The maximum power requirement of the joystick controller is 7.5 amps. The power and ground leads are 18 gauge wire (rate for 15 amps). **DO NOT** connect the power lead directly to the vehicle battery. A disconnect switch must be employed to ensure the operator can readily remove power from the electro-hydraulic functions. Note; the standby current is approx. 100ma and without a disconnect switch the JS101 can drain a vehicle battery in less than one week.

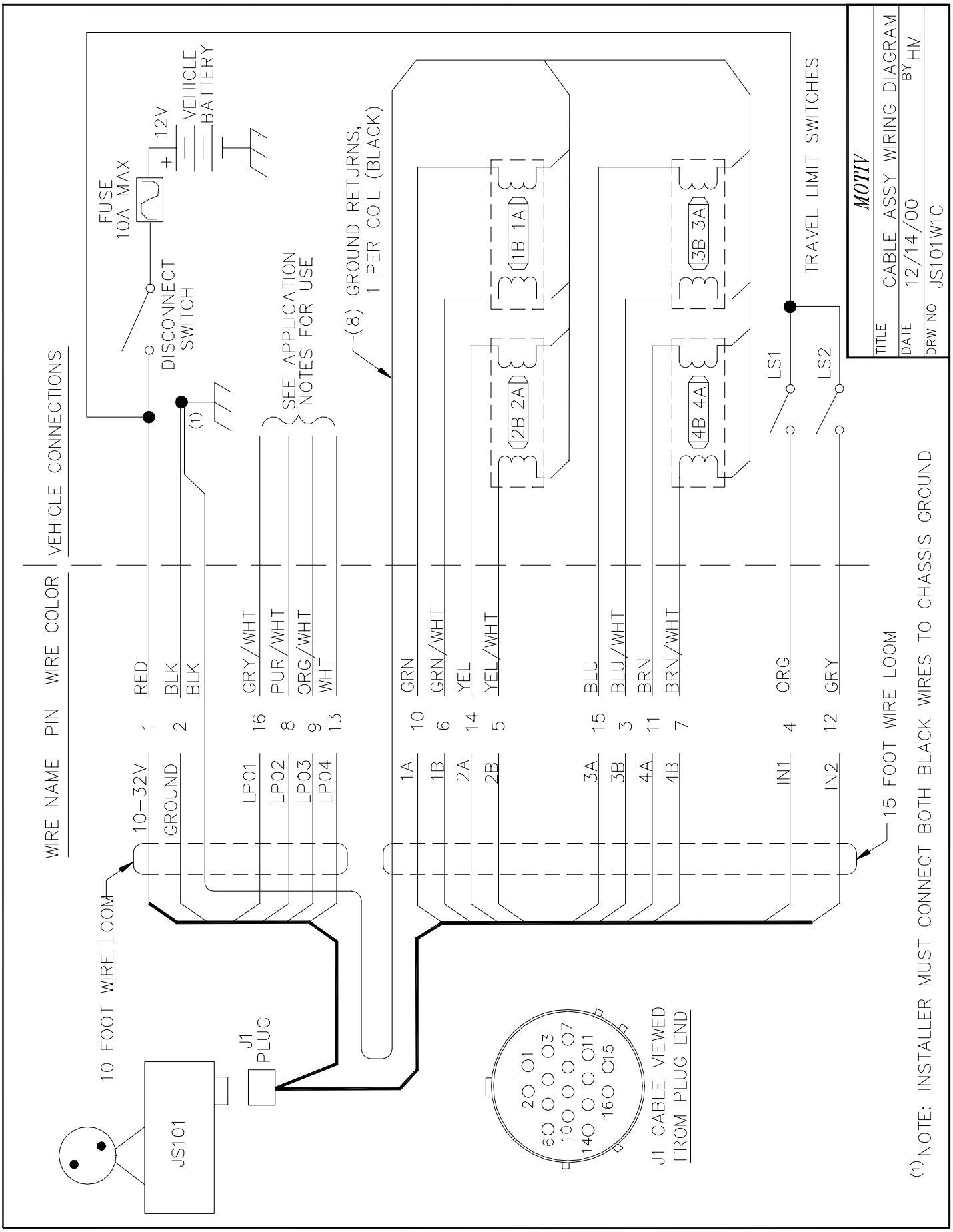
The valve leads are supplied as eight pairs of wires. Each valve connection includes an individual ground lead (black). The cable assembly does not include any valve connectors. The installer must obtain the correct connectors from the valve manufacturer. The valve leads are 20 gauge wire (rated for 8 amps). The best performance is achieved when all connections are soldered. Crimp type connections can be used. **DO NOT** use twist type connections. Properly prepare and seal all connections for weather tight use. It's recommended to use a non-hardening silicon grease for coating and packing all terminations, pins, crimps and connector housings.

MECHANICAL DIMENSIONS



ELECTRICAL DIAGRAM

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GROUND 2 BLK BLK
LP01 16 GRY/WHT
LP02 8 PUR/WHT
LP03 9 ORG/WHT
LP04 13 WHT
1A 10 GRN
1B 6 GRN/WHT
2A 14 YEL
2B 5 YEL/WHT
3A 15 BLU
3B 3 BLU/WHT
4A 11 BRN
4B 7 BRN/WHT
IN1 4 ORG
IN2 12 GRY
FUSE 10A MAX
12V
VEHICLE BATTERY
DISCONNECT SWITCH
SEE APPLICATION NOTES FOR USE
(8) GROUND RETURNS, 1 PER COIL (BLACK)
1B 1A
2B 2A
3B 3A
4B 4A
TRAVEL LIMIT SWITCHES
LS1
LS2
10 FOOT WIRE LOOM
15 FOOT WIRE LOOM
J1 PLUG
JS101
J1 CABLE VIEWED FROM PLUG END
(1) NOTE: INSTALLER MUST CONNECT BOTH BLACK WIRES TO CHASSIS GROUND

Programmable Settings

The installer can order the JS101 from the dealer pre-set for a specific application. However, there are a number of adjustments that are best determined in the field. These program settings can be made in the field using the RD203 hand held program editing tool. The task for the installer is to establish the correct setting for each feature listed in the following chart.

Handheld program editing tool, RD302. The handheld unit has four pushbuttons (keys) and a five digit numeric display. The handheld unit connects to a dedicated communication port on the JS101. The Shift key changes the display between the descriptive label and the stored data that corresponds to that label. Start by using the Inc and Dec keys to scroll thru the available labels, see chart below. With the label you want to edit showing on the display, press and hold the shift key to now view the current setting. To edit this value continue to hold the Shift key and use the Inc and Dec keys to change the data selection for that label. When you have completed your adjustment press the save key (confirmation beep) and then release the shift key. You can now use the hand lever to immediately test your new setting without unplugging the handheld. Important note; you MUST press the save key in order for your selection to be used.

Program settings

Label	Definition	Data, Range	Note
JS101	Checksum	x x x x	Checksum identifies the software version. xxxx = 4 digit hexadecimal value
JS-Lr	Verify lever position (left – right)	0-100	Full left = 0, full right = 100, 50 = center end limits of 0 and 100 may not be fully reached due to small errors in the component mechanics
JS-Ud	Verify lever position (forward - back)	0-100	Full down = 0, full up = 100, 50 = center end limits of 0 and 100 may not be fully reached due to small errors in the component mechanics
db	Handle position deadband	2 – 15	Percent of lever travel from center required to begin minimum output.
SHAPE	Output linearity setting	LinE - FinE	Line = output is linear to lever position Fine = output is finely controlled for small lever positions
PF	PWM Frequency (Hz)	50 - 180	Value is displayed in Hertz. resolution 5 hz. PWM freq. is established by valve manuf.
rP	Ramp enable	OFF - on	
Pb	Pass/Blast enable	OFF 1 2	1 = Position 1 and 2 = Position 2 cannot be same lever position as a live axis
b-SEC	Blast timer	0-30	off delay timer adj. 0 - 10 seconds alternate timer adjust for live axis one or three
rLb-A	Auxiliary axis selection	n/a	not available
CHEC	I/O test functions	Off	LPO = low power output, LS = limit switch input, rl-In = MA switch input, Pb = joystick PB

Axis assignments and control modes

The hand lever is divided into four positions of control. Each lever position represents an axis along with a corresponding pushbutton to operate each bi-directional output driver pair.

Position (axis) one	= Red PB fwd/back	= coils 1A (fwd) and 1B (back)
Position (axis) two	= Red PB right/left	= coils 2A (right) and 2B (left)
Position (axis) three	= Green PB fwd/back	= coils 3A (fwd) and 3B (back)
Position (axis) four	= Green PB right/left	= coils 4A (right) and 4B (left)

refer to hand lever diagram in the section 'Basic Operation'

In the following section each natural axis pair (fwd/back and left/right) by association to the colored pushbutton can be defined as crossing or exclusive. Crossing is used when the joystick is required to give combined control, such as up/down **and** left/right. Exclusive is used to isolate the axes so that you will only get up/down **or** left/right.

In addition each axis by association to the hand lever position can be defined as **safe** or **live**. Safe is a deadman type control where the operator must hold the corresponding pushbutton (red or green) for the entire time the axis is to be active. Any time the PB is released the output stops. The live control option gives the operator direct control by simply moving the hand lever without pressing a pushbutton.

*Note; each JS101 is shipped from the factory set up for **SAFE** control mode. It's the responsibility of the installer to determine the appropriateness of using **LIVE** control. There is an obvious risk to safety when using the LIVE control mode and both the installer and operator should be aware of the risk.*

Program settings

Label	Definition	Data, Range	Note
r-Pb	red PB	CrS - E	**Cr**o**s**sing allows both axes 1 and 2 to be active at a time **E**xclusive allows one axis, 1 or 2 to be active at a time
g-Pb	green PB	CrS - E	**Cr**o**s**sing allows both axes 3 and 4 to be active at a time **E**xclusive allows one axis, 3 or 4 to be active at a time
1-POS	lever control	SAFE LIvE	requires red PB to activate coils 1A and 1B requires lever fwd/back to activate coils 1A and 1B
2-POS	lever control	SAFE LIvE	requires red PB to activate coils 2A and 2B requires lever right/left to activate coils 2A and 2B
3-POS	lever control	SAFE LIvE	requires green PB to activate coils 3A and 3B requires lever fwd/back to activate coils 3A and 3B
4-POS	lever control	SAFE LIvE	requires green PB to activate coils 4A and 4B requires lever right/left to activate coils 4A and 4B

Coil types

Each axis has two coils labeled A and B. Each axis can have a different coil type. If an axis is not assigned to be used set the coil type to OFF. If the solenoid coil is selected the output is not pulse width modulated. Instead the solenoid output is set to full vehicle voltage. The solenoid output is active when the hand lever is positioned past the 50% point.

When a coil pair is set up for solenoid control, the installer can further select the solenoid coil to be driven in a momentary or latched mode. In momentary mode the solenoid is on for only as long as the hand lever is moved. In the latched mode the solenoid output is turned on and held (latched) on. Releasing the hand lever leaves the latch on. By moving the hand lever a second time but in the opposite direction the active coil is now latched off.

Program settings

Label	Definition	Data, Range	Note
1coIL	Coil type axis 1	OFF SOL ProP SOL-L	OFF = Coil never energized SOL = Solenoid Coil (momentary) ProP = Proportional Coil SOL-L = Solenoid Coil (latching)
2coIL	Coil type axis 2	OFF SOL ProP SOL-L	OFF = Coil never energized SOL = Solenoid Coil (momentary) ProP = Proportional Coil SOL-L = Solenoid Coil (latching)
3coIL	Coil type axis 3	OFF SOL ProP SOL-L	OFF = Coil never energized SOL = Solenoid Coil (momentary) ProP = Proportional Coil SOL-L = Solenoid Coil (latching)
4coIL	Coil type axis 4	OFF SOL ProP SOL-L	OFF = Coil never energized SOL = Solenoid Coil (momentary) ProP = Proportional Coil SOL-L = Solenoid Coil (latching)

Output Disable

The JS101 has two inputs that can be assigned to disable outputs. This is typically used when it's necessary to limit the travel of a hydraulic cylinder, such as the dump body's hoist-up limit switch. Each input allows positive or negative logic. Two inputs can be assigned to disable the same coil (logical OR). Also two or more outputs can be disabled by a single input.

Program settings

Label	Definition	Data, Range	Note
1A-od	axis 1	nonE	coil output 1A is not disabled
	lever fwd	1 – on	input 1 = +12vdc 1A disabled
		1 – oFF	input 1 = 0 vdc 1A disabled
		2 – on	input 2 = +12vdc 1A disabled
		2 - oFF	input 2 = 0 vdc 1A disabled
1B-od	axis 1	nonE	coil output 1B is not disabled
	lever back	1 – on	input 1 = +12vdc 1B disabled
		1 – oFF	input 1 = 0 vdc 1B disabled
		2 – on	input 2 = +12vdc 1B disabled
		2 - oFF	input 2 = 0 vdc 1B disabled
2A-od	axis 2	nonE	coil output 2A is not disabled
	lever right	1 – on	input 1 = +12vdc 2A disabled
		1 – oFF	input 1 = 0 vdc 2A disabled
		2 – on	input 2 = +12vdc 2A disabled
		2 - oFF	input 2 = 0 vdc 2A disabled
2B-od	axis 2	nonE	coil output 2B is not disabled
	lever left	1 – on	input 1 = +12vdc 2B disabled
		1 – oFF	input 1 = 0 vdc 2B disabled
		2 – on	input 2 = +12vdc 2B disabled
		2 - oFF	input 2 = 0 vdc 2B disabled
3A-od	axis 3	nonE	coil output 3A is not disabled
	lever fwd	1 – on	input 1 = +12vdc 3A disabled
		1 – oFF	input 1 = 0 vdc 3A disabled
		2 – on	input 2 = +12vdc 3A disabled
		2 - oFF	input 2 = 0 vdc 3A disabled
3B-od	axis 3	nonE	coil output 3B is not disabled
	lever back	1 – on	input 1 = +12vdc = 3B disabled
		1 – oFF	input 1 = 0 vdc = 3B disabled
		2 – on	input 2 = +12vdc = 3B disabled
		2 - oFF	input 2 = 0 vdc = 3B disabled
4A-od	axis 4	nonE	coil output 4A is not disabled
	lever right	1 – on	input 1 = +12vdc 4A disabled
		1 – oFF	input 1 = 0 vdc 4A disabled
		2 – on	input 2 = +12vdc 4A disabled
		2 - oFF	input 2 = 0 vdc 4A disabled
4B-od	axis 4	nonE	coil output 4B is not disabled
	lever left	1 – on	input 1 = +12vdc 4B disabled
		1 – oFF	input 1 = 0 vdc 4B disabled
		2 – on	input 2 = +12vdc 4B disabled
		2 - oFF	input 2 = 0 vdc 4B disabled

Valve coil trims

For optimal performance each output coil pair using proportional (PWM) control requires the installer to correctly setup the minimum drive current and the maximum drive current. The basic **theory** is as follows; as the hand lever crosses over the deadband point the valve drive output jumps from off to the minimum trim setting. And as the hand lever reaches its full travel the valve drive will correspondingly be at its maximum trim setting.

To help with making these trim settings, the **displays** are set up to read out in percent of full voltage drive. This makes is easy to calculate fractional changes. Which ever a valve coil trim is displayed on the RD203 the hand lever is active. After you save a setting you can test your result by moving the hand lever (press the appropriate PB, red or green). Once you find a good setting it's easy to apply that same valve trim to other coils. For example, the settings for plow left are very likely to be the same for plow right given the cylinder size and flows are equal.

Setting the **minimum** valve trim is simply a matter of finding the correct drive signal to just make the cylinder move (creep). The human eye is very adept at determining just where something begins to move. The display for each of the valve trims uses a decimal point for indicating when the hand lever has crossed the deadband point. The decimal point will help you hold the lever at that turn-on point so you can more easily confirm the creep speed for the cylinders minimum trim.

It's more difficult to determine the correct **maximum** trim settings. It's hard for the human eye to gauge changes at the higher speeds. Not to mention that a cylinder soon runs out of stroke at the higher speeds. Some installers may think that simply setting the maximum trim to the 100% will ensure the maximum flow is reached. The problem with this approach is that now the useful range of the hand lever will be crammed into a smaller distance, which limits the operators' ability to achieve the fine feathering that is generally desired with a proportional control. Also, some proportional coils can overheat if operated at voltages higher than the maximum flow rating.

The best approach to finding a good **maximum** trim setting is to start at a low setting and work up to higher settings. Often a lower setting is acceptable because the full flow of the valve is too large. Example; if the min trim is 28% try a max trim of 40%. If more speed is needed try 50% and so on until the max trim is just high enough to achieve your desired speed.

Program settings

Label	Definition	Data, Range	Factory setting
4b-H	Max. coil drive	20.0 - 99.0	75.0 %
4b-L	Min. coil drive	1.0 - 80.0	25.0 %
4A-H	Max. coil drive	20.0 - 99.0	75.0 %
4A-L	Min. coil drive	1.0 - 80.0	25.0 %
3b-H	Max. coil drive	20.0 - 99.0	75.0 %
3b-L	Min. coil drive	1.0 - 80.0	25.0 %
3A-H	Max. coil drive	20.0 - 99.0	75.0 %
3A-L	Min. coil drive	1.0 - 80.0	25.0 %
2b-H	Max. coil drive	20.0 - 99.0	75.0 %
2b-L	Min. coil drive	1.0 - 80.0	25.0 %
2A-H	Max. coil drive	20.0 - 99.0	75.0 %
2A-L	Min. coil drive	1.0 - 80.0	25.0 %
1b-H	Max. coil drive	20.0 - 99.0	75.0 %
1b-L	Min. coil drive	1.0 - 80.0	25.0 %
1A-H	Max. coil drive	20.0 - 99.0	75.0 %
1A-L	Min. coil drive	1.0 - 80.0	25.0 %

Troubleshooting problems

The JS101 is designed with no internal serviceable parts. The unit is factory sealed. If any problems occur, please contact your dealer to have the unit returned to the factory for service.

The JS101 requires a handheld programming unit, RD203. It's primary use is to setup the various internal parameters for proper operation, but it also offers the installer features to assist in solving problems.

The most successful tools used to solve most electro-hydraulic problems are; knowledge of the electro-hydraulic system, how the vehicle is wired, how the hydraulics are plumbed, where connections are located, having complete as-built wiring diagrams, a multi-meter volts-ohms-amps, RD203 handheld programmer, JS1T1 tester, a willingness to read and the ability to apply a logical approach to troubleshooting.

Rule one — A problem must be repeatable through some specific action(s) in order to be solvable. The first goal to troubleshooting is to find a way to make the problem occur (or repeat).

Rule two — Systematic division is used to narrow the problem down to its cause. Divide and conquer. example; if up/down does not work but left/right does work, then swap the valve coil connections. If the problem moves to the opposite function the fault is in the controller or cable, if the problem stays with the original function the fault is with the valve.

Power problems

The JS101 will operate on voltages from 10 to 32 vdc. The JS101 gives a short double beep when the power is applied. If there is an intermittent power condition the double beep will sound each time the power is interrupted. Intermittent power problems are usually caused by poor wiring, bad wire crimps, broken or cracked connections, corroded fuse clips, etc.

If you think there is an intermittent power problem the actual task of finding where the fault resides may be difficult. Sometimes wiggling a connector or wire termination can cause the problem to re-occur. Sometimes hanging a volt meter on the power lead while the vehicle allows the observer to locate some coincidence with other actions.

Valve drive problems

The JS101 has four output pairs. If you suspect a failed output, swap that coil lead to the opposite side of that valve or to another valve altogether. Now, if the new valve connection works properly the original valve likely has a bad coil or spool. If however, the new valve connection also doesn't work the fault is with either the controller or the cable harness. To eliminate the wiring harness you will need to use you multi-meter to measure the impedance of the valve coil circuit. Remove the 16 pin plug from the bottom of the JS101 and measure the ohms between the specific two pins that correspond to your suspected circuit. Refer to the cable diagram for the correct pins. Always compare the impedance between different valve coils of the same type.

Use care when connecting your multi-meter to the plug end of the cable. The individual sockets can be easily damaged by inserting the meter test leads. Test leads can spread the socket and reducing the grip force down to a point where you will experience intermittent connection problems. It’s best to only touch the meter leads to the ends of the individual sockets while taking your readings. DO NOT insert test leads into connector sockets.

Typically, the valve coil resistance will measure from 3 to 12 ohms for 12 volt systems and twice that for 24 volt systems. Coil resistance is lower when cold and higher when hot and can change by 2 to 3 ohms after warming up. The cabling can add form 1 to 3 ohms to your reading. The power ratings for most proportional coils are between 10 and 20 watts.

Hand lever considerations

The hand lever (aka joystick) must operate smoothly in all directions. It should return to center when released and there should be no sticky points where the handle appears to hang up or stop. The pushbuttons should have a short clean snap. The pushbutton force is firm and should always return when released. The T-handle should be tight and not swivel when you try to rotate it. The boot should be clean and not have any tears or holes. The connector for the RD203 should be clean and free of any debris. The RD203 plug should proceed all the way into the receptacle without hanging up or jamming. To insert the plug it helps to genitally rotate the plug until the pins lines up, the plug has a key tab.

Handheld / Test modes

The RD203 has several menus where you can test and verify the inputs and outputs of the controller.

Label	Definition	Data, Range	Factory setting
CHEC	**test mode**	To select the five test menus shown below, press and hold the shift key and use the inc/dec keys. Each test has specific instructions.	
		OFF- This is the default screen. No test is selected. This screen is automatically displayed when the hand held is removed, changed to a new label or the power is cycled. This prevents the operator from leaving the JS101 in test mode.	
		LPO- Test the four low power outputs Hold shift key, push lever fwd LPO-1 = on Hold shift key, push lever right LPO-2 = on Hold shift key, push lever back LPO-3 = on Hold shift key, push lever left LPO-4 = on	
		LS-- Test the two limit switch inputs, IN1 and IN2 Hold the shift key, activate LS1, read LS-01 Hold the shift key, activate LS2, read LS-02 Hold the shift key, activate both LS1&2, read LS-12	
		rl - In not available	
		Pb - In Test the hand lever's red and green push buttons release the shift key, display CHEC press the red PB, display CHEC **r** press the green PB, display CHEC **g** note, the pushbuttons interfere with the handheld display so this test requires you to release the shift key to observe the results. Likewise, you must release the PB being tested to see the **r** or **g** show as the right most digit	