Description: The Dual Solenoid Multifunction Valve Driver provides accurate control of hydraulic proportional and directional valves used in mobile equipment and industrial processes. This multifunctional design will support inputs from a joystick potentiometer with or without center tap, a standard potentiometer or commonly available control signals such as 0 to 5 Volts, 0 to +/-5 Volts, 0 to 10 Volts, 0 to +/-10 Volts, 0 to 20 mA, 0 to +/-20 mA or 1K potentiometer. The power supply connection is conditioned to withstand the harsh environment found in vehicular power systems. Maximum current output is 2 Amps, 1 Amp, 300 mA or 100 mA. A high-low range input provides reduced output for limited operation. The driver is potted and packaged in a metal base. It holds an IP65 rating. Flat tab style or screw terminal connections are provided.

Features:
- High efficiency PWM with superimposed dither
- High-speed power up permits the entire electronics package to be powered from safety interlock trigger switches or joystick mounted micro switches, when safety is of primary concern
- High low range input provides reduced output for limited operation (i.e. training or operation in tight spaces)
- Pump enable output active only when the joystick is active
- Suitable for harsh environments (IP65 protection rating)
- Electronic overload protection
- Static and surge protection built in
- EMI/RFI resistant
- Current sensing circuit maintains output current regardless of changes in input voltage and coil resistance
- Adjustable electronic joystick deadband jump
- Adjustable minimum current (0 to rated Amps) and maximum current (0 to rated Amps)
- Maximum current outputs include 2 A, 1 A, 300 mA, 100 mA or other values on request
- Adjustable asymmetrical ramps (0.01 to 5 Seconds) with symmetrical ramps user selectable
- Center null to accommodate joystick or potentiometer centering errors
- Master/slave option permits only one axis to operate at a time
Application:

The Dual Solenoid Driver controls a variety of hydraulic valve combinations including:

- **Application A**: Dual Solenoid 4 Port Proportional Valve
- **Application B**: Dual Solenoid 3 Port Proportional Valve
- **Application C**: Dual Solenoid 3 Port Proportional Valve
- **Application D**: Dual Solenoid 2 Port Proportional Valve
- **Application E**: Dual Solenoid Multifunction Valve Driver
- **Application F1**: Single Solenoid 2 Port Proportional Flow Control Valve
- **Application F2**: Single Solenoid 2 Port Proportional Flow Control Valve
- **Application G**: Dual Solenoid Multifunction Valve Driver
- **Application H**: Dual Solenoid Multifunction Valve Driver

Diagram:

- ![Diagram](image-url)
**Dither:** Dither can be superimposed over a command signal to cause a small vibration or barely detectable oscillation of the servo valve spool. This reduces friction effects causing hysteresis and increases the linearity of the valve. The generation of acoustical noise is also significantly reduced. These are the effects that low frequency PWM is meant to cause. This design uses high frequency PWM with superimposed dither with the advantage that amplitude and frequency are user adjustable to suit the application.

**Joystick Deadband:** Deadband is the zone of the joystick or threshold of the control signal where no action is generated by joystick movement or control signal application. Deadband jump will be provided inherently by the safety microswitches if they are installed on the customer’s joystick. In this case, the electronic deadband would normally be disabled. If the microswitches are not installed, the same effect can be produced with an electronic threshold. This feature can be enabled or disabled using onboard DIP switch 2. The value of the deadband is factory set and can be specified to suit the application.

**Joystick Center Null:** Center Null will be provided inherently by the safety microswitches on the customer’s joystick, if installed. If the safety microswitches are not installed, the same effect can be provided by external connections to the input side of the solenoid driver. If the joystick potentiometer is connected to +5 V Reference, its midpoint terminal should be connected to +2.5 V Reference. This ensures that the mechanical and electrical centers of the joystick are consistent with each other.
Multiple outputs are available to support a variety of hydraulic circuits as described on page 2. The diagram below shows the outputs from the Dual Solenoid Multifunction Valve Driver as a reflection of the movement of a remote joystick. The electronic joystick deadband (Setting 5 on Switch 2) was selected.

**Dual Solenoid Multifunction Valve Driver**
(7 outputs/axis - single axis portrayed)

**OUTPUT SIGNALS SHOWN AS JOYSTICK MOVEMENT**
-45 degrees 0 degrees +45 degrees
+/-7.5 degrees electronic joystick deadband (other values available)

**NOTE:**
Deadband is selected in these examples.
A = Solenoid A
B = Solenoid B

- **p** = proportional output;
  0-2 Amps DC proportional to joystick
- **d** = digital (on/off) output;
  2 Amps DC - on/off, at system voltage when joystick is engaged

**ABp** = To create the ABp signal to drive a single solenoid, externally short the SAL and SBL terminals. Connect the solenoid to SBL and either SAH or SBH.

**ABd** = pump enable; Ad or Bd are ON;
2 Amps DC - on/off, at system voltage when joystick is engaged

**Cd** = latching output (digital)
Function:

Refer to the Connections, Input Settings and Adjustments section on page 9 for the layout of the terminals, user selectable settings and adjustments.

To create the ABp signal to drive a single solenoid, externally short the SAL and SBL terminals. Connect the solenoid to SBL and either SAH or SBH. (Note: SAH and SBH are internally connected.)

Refer to the diagram on page 5 for a definition of the output signals as a function of joystick motion.

Maximum Output Current: Maximum output current is limited to 2.5 Amps (min. current setting + max. current setting ≤ 2.5 A).

Disable Input: DO NOT USE THE DISABLE INPUT FOR SAFETY CONTROL. A separate external normally open switch on the input power is the best solution as illustrated on page 6.

This function disables the input command. To activate the disable input terminal, tie the disable terminal to +10V or +Vps. The controller will operate in the following manner.

1. If the output to either Solenoid A or Solenoid B is ON and the disable input is activated, the output to Solenoid A or B will remain ON. While the disable input is activated, if either Solenoid A or B is commanded OFF and then commanded ON, the output to either Solenoid will remain OFF.

2. If the output to either Solenoid A or Solenoid B is OFF and the disable input is activated, the output to Solenoid A or B will remain OFF. While the disable input is activated, if either Solenoid A or B is commanded ON, the Solenoid will remain OFF. If then, the disable input is removed, the output to the Solenoid will turn ON.

Master/Slave: In a multi-axis system it is sometimes desirable to prevent more than one axis from operating at a time. By connecting the master/slave links together in parallel, using the Disable terminal, operation will be limited to the first axis to be engaged. In other words, the upstream joystick will have priority.

Multiple-axis: The Dual Solenoid Driver is designed to accept the output from a single axis of a joystick. For multi-axis applications, where more than one axis operates at a time, use one Dual Solenoid Driver per axis.

Cd output: The Cd output is useful for forward/reverse or up/down applications. If the joystick is pushed forward past its deadband, the unit will remain in forward mode unless the joystick is pulled into reverse past the joystick’s deadband of -7.5 degrees.

A

INPUT

DEADBAND

B

Cd

ABd

The Cd signal output turns on when the input signal reaches the -7.5 degree deadband setpoint. It remains on until the input signal reaches the -7.5 degree deadband setpoint (opposite direction).

Returning the input signal to the +7.5 degree deadband setpoint after the Cd output goes off, restarts the cycle.

An ABd (pump enable) output signal is shown as a comparison.
**Technical Specifications:**
All specifications typical at nominal input voltage and 25°C unless otherwise specified.

### General Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operating conditions</strong></td>
<td>-40 to +85 degrees C (-40 to 185°F)</td>
</tr>
<tr>
<td><strong>Storage temperature</strong></td>
<td>-50 to +125 degrees C (-58 to 257°F)</td>
</tr>
<tr>
<td><strong>Protection</strong></td>
<td>Potted (encapsulated)</td>
</tr>
<tr>
<td><strong>IP65 rating</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>1.40 lbs. (0.64 kg) (DSDA-SMB-TB-01)</td>
</tr>
<tr>
<td><strong>Electrical connection</strong></td>
<td>DSDA-SMB-TB-01, DSDA-SMB-1K-TB, DSDA-SMB-TB-01-300MA, DSDA-SMB-TB-01-100MA:</td>
</tr>
<tr>
<td></td>
<td>22 flat tabs</td>
</tr>
<tr>
<td></td>
<td>Mates with 0.25 inch female tab connector, supplied by customer</td>
</tr>
<tr>
<td></td>
<td>(Keystone P/N: 4470) and accepts 16-20 AWG wire</td>
</tr>
<tr>
<td></td>
<td>DSDA-SMB-SC-01, DSDA-SMB-SC-MT-1A, DSDA-SMB-1K-SC:</td>
</tr>
<tr>
<td></td>
<td>22 pluggable polyamide screw terminals</td>
</tr>
<tr>
<td></td>
<td>Matting female vertical plug connectors provided that accepts 16-20 AWG wire</td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td>Potted unit packaged in a metal base</td>
</tr>
<tr>
<td></td>
<td>3.87 x 5.37 x 1.17 inches or 98.4 x 136.5 x 29.74 mm (W x L x H)</td>
</tr>
<tr>
<td></td>
<td>(Contact manufacturer for application-specific requirements.)</td>
</tr>
</tbody>
</table>

Dimensions: inches [mm]
## Input Specifications
For proper operation, match the power supply voltage with rating of coil. Operating the driver with a supply voltage lower than the valve’s rated voltage may result in reduced maximum current output.

<table>
<thead>
<tr>
<th>Operating voltage (power supply requirement)</th>
<th>9 to 32 VDC power supply range (24 VDC nominal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reverse polarity protection</td>
<td></td>
</tr>
<tr>
<td><em>Total current draw will be the sum of the currents drawn by all connected equipment plus 25 mA.</em></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control input signal options - voltage</th>
<th>0 to 5 Volts (2.5 V = 0, +/-2.5 V), 0 to 10 Volts (5 V = 0, +/-5 V), 0 to +/-10 Volts (0 V = 0, +/-10 V) (user selectable by DIP Switch 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Other signal inputs are available (contact manufacturer).</em></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control input signal options - current</th>
<th>0 to 20 mA (10 mA = 0, +/-10 mA), 0 to +/-20 mA (0 mA = 0, +/-20 mA) (user selectable by DIP Switch 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Other signal inputs are available (contact manufacturer).</em></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Joystick potentiometer input</th>
<th>The potentiometer connection provides a 5.0 VDC bias voltage as well as a 2.5 VDC center-tap driving voltage. A remote joystick potentiometer with or without center tap may be used. A 10K potentiometer is recommended. The unit accepts potentiometers from 2.5K-50K Ohms as well as a 1K potentiometer (only in Models: DSDA-SMB-1K-TB and DSDA-SMB-1K-SC).</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Low range input (Imax/2)</th>
<th>This input, when active, will provide a 50% reduction in output current slope. It is used to increase the resolution of operation for limited operation such as when training new operators or during operation in tight quarters. It is activated by applying power (+9-32VDC) to the Imax/2 tab and if not used, it may be left unconnected.</th>
</tr>
</thead>
</table>

| Input resistance | Voltage mode: 500K Ohms Current mode: 250 Ohms |

## Output Specifications
All outputs are capable of operating a solenoid or relay rated to correspond with the maximum current output rating of the controller. Each output can withstand an indefinite short circuit to power or ground. Each output is protected from over-voltage with a re-circulating diode. The solenoid coils and on/off valves should have no polarity or protection diodes for proper operation of the device. The maximum current output of the driver should not exceed the current rating of the solenoid coil.

| Range of maximum output current | DSDA-SMB-TB-01, DSDA-SMB-SC-01, DSDA-SMB-1K-TB, DSDA-SMB-1K-SC: 2000 mA  
DSDA-SMB-SC-MT-1A: 1000 mA  
DSDA-SMB-TB-01-300MA: 300 mA  
DSDA-SMB-TB-01-100MA: 100 mA  
Other output versions are available on request.  
*For 2 Amp versions, maximum output current is limited to 2.5 A (min. current setting + max. current setting ≤2.5 A).* |
|--------------------------------|--------------------------------------------------------------------------------------------------|

| Solenoid resistance selection (nominal) | Nominal resistance of solenoid coil should comply with:  
Rcoil ≤ (Vpower supply - 1.5 V)/l-max |
|----------------------------------------|--------------------------------------------------------------------------------------------------|

<table>
<thead>
<tr>
<th>Minimum current setting (Sol A and B)</th>
<th>0 to rated Amps (adjustable)</th>
</tr>
</thead>
</table>

| Maximum current setting (Solenoid A and B) | 0 to rated Amps (adjustable)  
The maximum current is offset by the minimum current setting. |
|-------------------------------------------|-----------------------------|

<table>
<thead>
<tr>
<th>Current ramp time - up and down (Solenoid A and B)</th>
<th>0.01 - 5 seconds (symmetrical or non-symmetrical*) (*select with DIP Switch 2)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Dither amplitude</th>
<th>0 to 10% of maximum current (adjustable)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Dither waveform</th>
<th>Triangular</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Current dither frequency</th>
<th>70 to 350 Hz ±10% of full scale (adjustable)</th>
</tr>
</thead>
</table>
Connections, Input Settings and Adjustments

The Metal Box will accommodate up to ¼ inch mounting screws (not supplied). Maximum current output rating shown below is 2 Amps. Refer to unit part number for other available output ratings.

**POWER INPUT**

**CONTROL INPUTS**

- SGND
- IN
- DISABLE
- IMAX2
- SGND
- +10 V REF.
- +2.5 V REF.
- +5 V REF.

**DIP Switch 1**

- ON
- +/-10 V
- +/-5 V or +/-20 mA
- 0-10 V
- 0-5 V or 0-20 mA
- 5
- 0

Voltage

The setting shown is 0-10 VDC input. SET UP:

- All settings on SW1 should be in the OFF position.
- Select current or voltage input with setting 5.
- ON is current (I) and OFF is voltage (V).
- Switch to ON position, the appropriate setting for input signal range (settings 1, 2, 3 or 4).

**DIP Switch 2**

- 0-5 OFF
- Electronic Joystick
- Deadband

Symmetrical Ramps
Solenoid A: 1-ON 2-OFF
Solenoid B: 3-ON 4-OFF

Non-symmetrical Ramps
Solenoid A: 1-OFF 2-ON
Solenoid B: 3-OFF 4-ON

5-0 OFF
5-ON

The settings shown are symmetrical up and down ramps for Solenoids A and B. Electronic deadband is selected for the joystick input or control signal.

**PROPORTIONAL OUTPUTS**

- SAH (SOLENOID Ap High)
- SAL (SOLENOID Ap Low)
- SBH (SOLENOID Bp High)
- SBL (SOLENOID Bp Low)

**DIGITAL OUTPUTS**

- Ad + DIGITAL OUTPUT
- Ad - DIGITAL OUTPUT
- Bd + DIGITAL OUTPUT
- Bd - DIGITAL OUTPUT
- Ab & PUMP ENABLE OUTPUT
- Ab & PUMP ENABLE OUTPUT
- Cd + LATCING OUTPUT
- Cd - LATCING OUTPUT

**ADJUSTMENTS**

**I-MIN-A**

- PROPORTIONAL
- CW = increase
- 0 to 2.0 Amps

**I-MAX-A**

- PROPORTIONAL
- CW = increase
- 0 to 2.0 Amps

**I-MIN-B**

- PROPORTIONAL
- CW = increase
- 0 to 2.0 Amps

**I-MAX-B**

- PROPORTIONAL
- CW = increase
- 0 to 2.0 Amps

**A-UP RAMP**

- CW = increase
- 0.01 to 5 seconds

**B-UP RAMP**

- CW = increase
- 0.01 to 5 seconds

**A-DOWN RAMP**

- CW = increase
- 0.01 to 5 seconds

**B-DOWN RAMP**

- CW = increase
- 0.01 to 5 seconds

**DITHER LEVEL**

- CW = increase
- 0 to 10% of rated I-max

**DITHER FREQUENCY**

- CW = increase
- 70 to 350 Hz
Adjustments to the single turn potentiometers are made using a flat head or Philips screwdriver.
For P/N: DSDA-SMB-SC-MT-1A, minimum and maximum current adjustments are 20 turn pots.

<table>
<thead>
<tr>
<th>Settings/Adjustments</th>
<th>Range of Adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input signals</td>
<td>Select the appropriate current or voltage signal (DIP switch 1).</td>
</tr>
<tr>
<td>Minimum Current Setting ($I_{\text{min}}$) for Solenoid A</td>
<td>0 to 2000 mA* (CW = increase)</td>
</tr>
<tr>
<td>Maximum Current Setting ($I_{\text{max}}$) for Solenoid A</td>
<td>0 to 2000 mA* (CW = increase)</td>
</tr>
<tr>
<td>Minimum Current Setting ($I_{\text{min}}$) for Solenoid B</td>
<td>0 to 2000 mA* (CW = increase)</td>
</tr>
<tr>
<td>Maximum Current Setting ($I_{\text{max}}$) for Solenoid B</td>
<td>0 to 2000 mA* (CW = increase)</td>
</tr>
<tr>
<td>$I_{\text{max}}$/2 Full speed (unconnected)</td>
<td>Half-speed (activated by applying 9-32 VDC through an external switch supplied by customer)</td>
</tr>
<tr>
<td>Symmetrical/non-symmetrical ramps</td>
<td>Symmetrical/non-symmetrical (user selected by DIP switch 2)</td>
</tr>
<tr>
<td>Rising Ramp Time for Solenoid A</td>
<td>0.01 to 5 seconds (CW = increase; CCW = decrease)**</td>
</tr>
<tr>
<td>Falling Ramp Time for Solenoid A</td>
<td>0.01 to 5 seconds (CW = increase; CCW = decrease)**</td>
</tr>
<tr>
<td>Rising Ramp Time for Solenoid B</td>
<td>0.01 to 5 seconds (CW = increase; CCW = decrease)**</td>
</tr>
<tr>
<td>Falling Ramp Time for Solenoid B</td>
<td>0.01 to 5 seconds (CW = increase; CCW = decrease)**</td>
</tr>
<tr>
<td>Dither Amplitude</td>
<td>0 to 10% of rated maximum current (CW = increase; CCW = decrease)</td>
</tr>
<tr>
<td>Dither Frequency</td>
<td>70 to 350 Hz (±10%) (CW = increase; CCW = decrease)</td>
</tr>
<tr>
<td>Deadband Jump</td>
<td>+/- 7.5 degrees (user selected by DIP Switch 2)</td>
</tr>
</tbody>
</table>

- Maximum output current range is limited to 2.5 A (min. current setting + max. current setting < 2.5 A).
- If symmetrical ramps are selected, the rising ramp trim pot for each solenoid should be used to set the ramp time and the falling ramp trim pot of each solenoid is disabled.
- CW = clockwise, CCW = counterclockwise

Ordering Part Number: PACKAGED – POTTED IN METAL BASE

- 2A output, with tabs: DSDA-SMB-TB-01
- 2A output, with screw terminals: DSDA-SMB-SC-01
- 2A output, 1K pot input, with tabs: DSDA-SMB-1K-TB
- 2A output, 1K pot input, with screw terminals: DSDA-SMB-1K-SC
- 300 mA output, with tabs: DSDA-SMB-TB-01-300MA
- 100 mA output, with tabs: DSDA-SMB-TB-01-100MA
- 1A output, with screw terminals, 20 turn trimpots for min. and max. current adjustments: DSDA-SMB-SC-MT-1A
- 60V clamping, with screw terminals: DSDA-SMB-SC-60V

Specify electronic joystick deadband if other than +/-7.5 degrees.

Specifications are indicative and subject to change. Actual performance will vary depending on the application and operating conditions. Users should satisfy themselves that the product is suitable for use in the intended application. All our products carry a limited warranty against defects in material and workmanship. Please refer to our Warranty, Application Approvals/Limitations and Return Materials Process as described on www.axiomatic.com/service.html.