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Elactis
Electronics for Actuators and Integrated Systems

SOLENOID VALVE DRIVER¹

ADRV0002A with LED and Diagnostics



¹ For continuous improvement of the product values and functions may change without notice.
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Features

- Wide input voltage range
- Increased solenoid performances
- Power saving
- Limited heating
- Full protection against coil discharge
- Valve diagnostics with LED status output or status wire



Description

The ADRV0002A is a small interface electronics integrated into EN 175301-803A type connector that increases the performance of a monostable solenoid valve. It includes a power saving circuit, a wear reduction feature and extends the valve operation beyond its specifications. It turns on the valve with the necessary power and then reduces the current to the required level. The ADRV0002A automatically detects the power supply voltage and the solenoid parameters. The driver also detects errors during operation and outputs a visual error status through an LED. It comes in different finish to accommodate to all customer solutions.

Ordering description

ADRV0002ACCXXYY

CC: Cable length

CC value	00	01	05	10	20	50	99
To power supply side	Screw on cable	100mm cable	500mm cable	1m cable	2m cable	5m cable	10m cable

XX: input voltage range and diagnostics

XX value	01	02	11	12	21	22	31
Vcc min [V]	10	4.5	10	4.5	10	4.5	10
Vcc max [V]	27	12	27	12	27	12	27
LED	no	no	yellow	yellow	diagnostics	diagnostics	no
Status wire	no	no	no	no	no	no	yes

YY: Holding power

YY value	05	10	15	25	40
P hold [mW]	500	1000	1500	2500	4000

Other values available upon request

Electrical Specifications, ADRV0002ACC01YY version

Parameter		Minimum	Maximum	unit
Power Supply On	XX=01	10	27	V
	XX=02	4.5	12	
Maximum pulse current			2.5	A
Max continuous current			0.5	A
Allowed coil resistance	XX=01	8	60	Ohms
	XX=02	6	60	
Pull in time		1	150	ms
Max pull in time			150	ms
Hold power	YY=05	400	600	mW
	YY=10	900	1100	
	YY=15	1350	1650	
	YY=40	3600	4400	

Operating frequency	DC	50	Hz
Duty cycle	0	100	%
ESD protection	23 (IEC 61000-4-2 level 4)		kV
Reverse voltage protection		- 30	V
Protection against coil discharge		diode	
Operating temperature range	0	70	°C

* only if the valve is used under abnormal conditions. (the pressure is too high, valve worn out...)

If your application is out of the specifications listed above, do not hesitate to contact Elactis. We can then customize the driver to meet your most demanding needs.

Working principle

The ADRV0002A can be used with any monostable solenoid valve. For best performances it should be used with a coil rated voltage less than the power supply voltage. The ADRV0002A generates a special PWM signal which has the following characteristics:

- The inrush current is limited to the minimum necessary to activate the valve
- It has a high frequency PWM signal that generates a holding current with high power efficiency
- It has a special current regulation feature that limits the impact of the plunger. It makes the power consumption independent of the power supply and temperature. This is a significant improvement over standard power saving circuits. Using a low resistance coil it is possible to increase the magnetic force in the solenoid without decreasing the lifetime of the operator due to the additional impact energy.
- It monitors the characteristics of the solenoid. The output power is adapted to the coil automatically. In case of changing the coil type, the plug adapts the current to the new device.

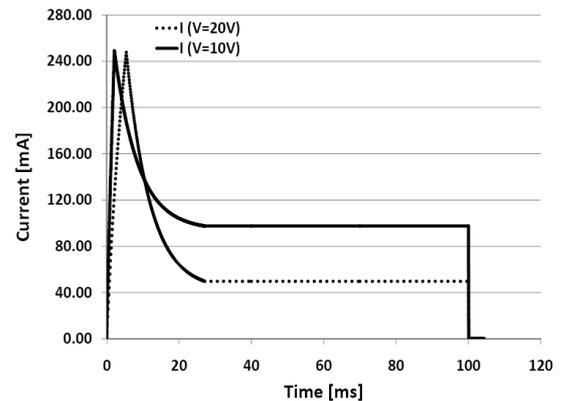


Figure 1: Typical current consumption using the ADRV0002A with a 23 Ohm solenoid with two different applied voltages for a 100 ms activation.

During operation the ADRV0002A constantly monitors the valve. There are four different statuses:

- The valve has switched and is working, the LED is always ON
- The valve is in short-circuit, the LED blinks at 4Hz
- There is no valve connected to the ADRV0002A, the LED blinks at 2 Hz
- The valve didn't switch before the maximum pull-in time, the LED blinks at 1 Hz

The plug monitors the switching only in the following cases:

- At the beginning until time-out. If it detects the switching the output will be a continuous light. If not it will blink at 1Hz.
- The plug detected absence of coil or short-cut and the coil resistance came back. In that case the electronics starts with a new detection procedure.

LED Status	Status wire	Meaning
Continuous Yellow	Vcc (high)	Valve switched on
Blinking a 0.5Hz	0 V	Valve did not turn-on within timeout
Blinking a 1Hz	0V	Valve is absent
Blinking a 2Hz	0V	Short-cut
No light	0V	No power

If there is no valve connected, or in a case of short-circuit, the power output is turned off to prevent damage to the driver. The ADRV0002A will resume normal operation as soon as a good valve is connected to it. In case of valve that did not switch within time-out, the electronics lowers the power to the hold value and the LED starts blinking.

Applications

The ADRV0002A can be used for a large variety of applications. The simplest is **heat reduction**. In applications where the coil must be powered for a long time it will heat up with the following disadvantages:

- the coil might reach temperatures beyond 60°C which creates a risk of injury
- high temperature may influence the fluid’s properties
- coil will prematurely wear out
- plastic and rubber components may deteriorate
- coil heating limits the useful external temperature range

The ADRV0002A is a high efficiency driver which will dissipate very little power in the electronics. The holding power set for the coil is in all standard configurations sufficient to maintain the valve in its active position while the heating is limited to a few °C.

The ADRV0002A allows for a **wide range of input voltages**. Therefore one can simply use a coil in any applications with supply voltages equal or higher than the rated voltage. For example using a 10V coil in a 24V application, the driver will regulate the power to accommodate for the 10V coil. It even improves the performance of the valve as the opening time will be reduced and will be more stable.

The ADRV0002A has an **integrated protection feature**. The client does not need to worry about induced reverse voltages or residual voltages on the cable. The driver closes automatically at voltages below the minimum operating voltage and eliminates the coil discharge voltage.

The ADRV0002A adapts to your power needs. In many applications the **performance of the valve** is limited by the solenoid power. You may increase the plunger stroke, the applied pressure range or the orifice size. To do this, select a lower resistance coil and use it with the driver. Warning: always consult with the valve manufacturer before exceeding the rated pressure.

The ADRV0002A is useful for **battery applications**. It limits the inrush power to the minimum and then maintains the valve in a low power mode. It also adjusts to the variations of the battery voltage.

The ADRV0002A is ideal for your **dosing** applications: whether you need to dose for a few milliseconds or for several hours the driver will make your dosing more accurate. To take full advantage of the driver, select a low resistance coil for your application. The available extra power allows your valve to open accurately and independently of external parameters. The special feature of the driver will limit the impact of the plunger on the armatures therefore you don’t need to trade off the lifetime of your valve against precision.

The ADRV0002A can **reduce wiring time** in applications requiring a large amount of valves. The bright LED’s inform the technician immediately about malfunctioning (valve missing or stuck for example). While previous use of the LED’s was to inform about the power arriving to the connector, with the integrated diagnostics it is immediately possible to detect what is wrong with the valve.

Application examples

Transportation: door locking systems. Use it to compensate for the wide operating temperature and the fluctuating power supply.

Food industry: milking system. The driver allows battery operated units work for longer period.

Inkjet industry: inlet valve for ink tank. The reduced heating prevents the ink to dry on the valve seat. It also adds extra force to open the valve against the ink’s viscosity.

Paint dosing systems: dosing the color pigments. The millisecond accuracy of the valve enables more precise dosing of the colors.

Beverage dispense: coffee machine. It enables the precise dosing of the ingredients such as sugar. The ADRV0002A can also be used to increase the working pressure range in the machine.

Irrigation systems: battery powered valves. Enhances battery lifetime.

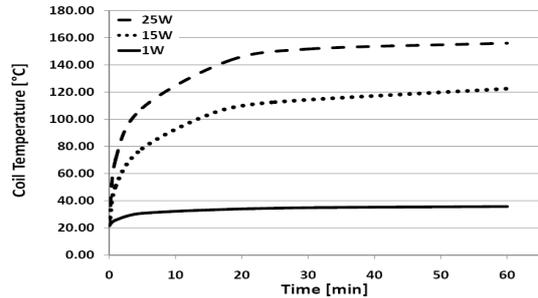


Figure 2: Temperature rise in a coil of a 32 mm solenoid valve for different power consumptions. The full line indicates that obtained with the ADRV0002A

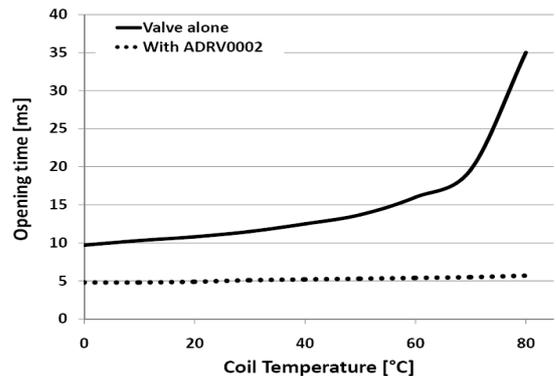


Figure 3: Response time stabilized using the ADRV0002A

Hydraulic systems: The ADRV0002A adds additional power to your valve and limits the heating of the oil. The fast current discharge accelerates the closing of the valve compared to systems protected by a diode.

Machine miniaturization: Due to reduced heating the valve needs less ventilation therefore it can be put into a smaller closed box.

Pick and Place, sorting. The ADRV002A increases the timing accuracy of the valve and it may increase significantly the lifetime of the valve therefore the product will be faster and last longer.

Recommendation for design

One of the advantages of the ADRV0002A is that it can absorb many fluctuations of electrical and environmental parameters. It is always recommended to use a coil with lower resistance than for designs without the driver. Indeed the power dissipation is limited to the amount necessary to activate the valve. A lower resistance coil at the same supply voltage will not dissipate more than a higher resistance coil. Use 10% to 50% lower resistance than without the driver.

For battery applications select a coil which will operate at a typical operational voltage 10 to 30% below the minimum of the battery voltage.

The ADRV0002A is designed especially for high frequency operations due to its special feature to enhance the closing of the solenoid or valve. Special care must be taken as during the current discharge the energy of the coil is absorbed by the electronics. The maximum magnetic power dissipation capability of the electronics is 150mW. Therefore the magnetic discharge power: $P = f \frac{LI^2}{2}$ - where f is the number of switching per second, L the inductance, I the current in the coil - should not exceed the rated power.

Mechanical drawing

EN 175301-803 type A connector (ex - DIN43650 A). The housing is black for versions without LED and transparent for others. Connector aspect and material can be subject to changes.

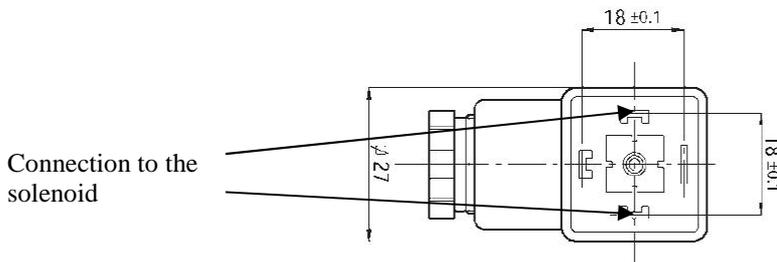
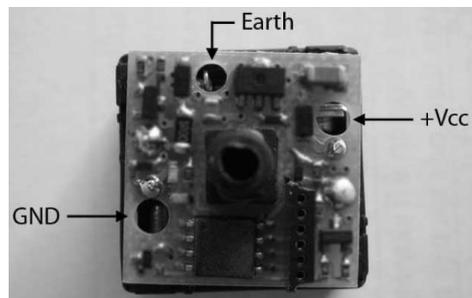
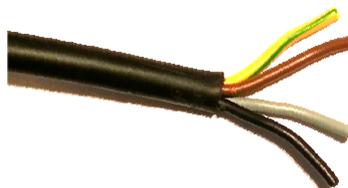


Figure 4: Drawing of the connector

Connection schematic



Field wired version



Cable version: Brown: +24V; Black: 0V; Grey: Status, Green/yellow: Earth

History records

Rev.	Change	Date
01	Creation from ADRV0002A rev. 6 with diagnostics added	24.04.09
02	Update of the specifications	08.07.09
03	Update of the specifications	01.10.09
04	Removed the "Threshold to close the valve" specification. Codification for LED added	30.11.09
05	Status wire added	29.10.13