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Elactis
Electronics for Actuators and Integrated Systems

HIGH POWER SOLENOID DRIVER[1]

ADRV1012K

Preliminary

[1] This datasheet is a preliminary description. Values and functions may change without notice.

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released on: 01/02/2010

Features

- Controlled pull-in and hold power to solenoid
- Fast turn-off
- Wide input voltage range from 20V to 120V
- High power capability with up to 25A pull-in current
- Up to 2A hold current
- 2 wires or external input operation
- Programmable parameters
- Solenoid diagnostics with LED and status output

Description

The ADRV1012K is a sophisticated driver for solenoids and solenoid valves. It controls the pull-in and hold phases by pre-setting the appropriate voltages and currents. The power seen by the solenoid is independent of the power supply, temperature or other influences. Furthermore, the power consumption is limited to the strict minimum even in the pull-in phase and reduced to the hold current as soon as the plunger has moved. Therefore the same coil can be used over the full power supply voltage range with identical behavior in all conditions.
The ADRV1012K is designed for the most demanding power applications. The 25A pull-in and 2A hold capability with up to 120V supply voltage will switch even the biggest solenoids or valves.

Ordering description

ADRV1012K*XXYY*

XX: input voltage range

XX value	**01**	**02**
Vcc min [V]	20	38
Vcc max [V]	60	125

YY: command voltage range

XX value	**01**	**02**
Vcc min [V]	10	38
Vcc max [V]	60	125

Electrical Specifications, ADRV1012KXX *version*

Parameter			**Minimum**	**Maximum**	**unit**
Power Supply On	XX=01		20	60	V
	XX=02		38	125	
Maximum pulse current (<150 ms)				25	A
Hold current			0.3	2	A
Pull in time				Auto-detect	ms
Pull-in current amplitude for detection			0.7		A
Max pull in time[1]				1000	ms
Start-up time				150	ms
Response time to enable				2	ms
Enable voltage	ON	YY=01	10	60	V
		YY=02	20	125	
	OFF		0	1.5	
Status	Error		Low impedance		
	No error		High impedance		
Status current				20	mA
Reverse voltage protection				- 150	V
Protection against coil discharge				diode	
Operating temperature range			10	70	°C [2]

[1] Only if the solenoid is used under abnormal conditions. (pressure is too high, solenoid worn out…)
[2] A custom version can go down to -40°C

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 ADRV1012K manages the current in a monostable solenoid. After the enable pin is set, a pre-determined pull-in voltage ($V_{pull-in}$) is put on the coil. Once the solenoid has switched the output is regulated to a pre-set current (I_{hold}). This value is kept until the Enable is set to 0. The pull-in voltage and hold current are factory programmed to customer request. It is also possible to change these values with an external programming kit. During operation the ADRV1012K constantly monitors the solenoid. The status is reported on an opto-coupled current output alarm pin. This output can drive for example a 20mA relay. An LED helps visualize the output state. The meaning of the status is summarized in the table below:

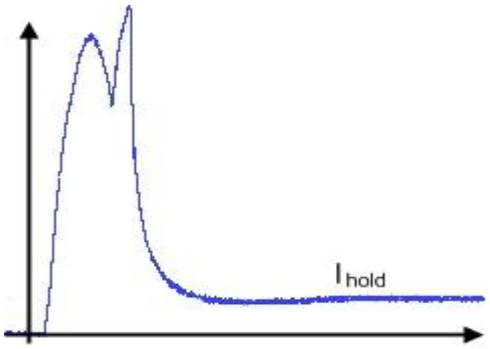


Figure 1: Typical current pattern using the ADRV1012K

LED Status and output	Meaning
Continuous Green / Status high	Solenoid driver is operating correctly
LED turned off / Status low	Solenoid did not turn-on within timeout or Coil is not present or Voltage is too low
LED turned off / Status low; Coil switched OFF	Short-cut

Applications

The driver is particularly well adapted:

- To reduce the switching time (ON and OFF)
- To enable the usage of the same solenoid or valve at different voltage ranges
- To save energy and reduce heating.
- To reduce the coil size.

Reducing switching time is very important in accurate sorting and dosing applications. Large coils producing big forces can be energized very fast if they are chosen to be very low resistance and combined with the ADRV1012K. The driver will limit the current taken out of the power supply and reduce to the minimum the power consumption and heating. During the turn-off, it contains a special feature allowing a faster switching than without the driver.

The driver can be used over a wide variety of voltages. As it supports big currents and voltages, it can be used with a low voltage coil in applications ranging from 24V to 110VDC. We recommend using a 24V coil and setting the Pull-in voltage to the rated value. The driver and the same solenoid will operate with exactly the same characteristics (opening time, closing time, forces and power consumption) over the full operating voltage range (i.e. 38V to 125V)

The driver can deliver 20A during the pull-in phase at up to 110VDC nominal voltages. This means that solenoids up to 2KW can be driven by the board. The power saving is very well optimized. Due to the current regulated output, the power can be reduced close to the minimum value before the solenoid turns-off. Temperature and voltage changes are compensated by the driver. The power is also limited during the pull in phase on one side by the Pull-in voltage and on the other by the automatic plunger detection. The first ensures that even with changing power supply voltages the pull-in current will not change. This enables savings on the power requirements of the power supply. The switching detection saves on the current as it will never rise to the nominal value. Heating is therefore minimized both during the pull-in and the hold phase. This is very important for high frequency operations.

Smaller coils can be used saving significant weight and copper. Coils that otherwise would overheat can be used in combination with the driver. Its optimized power saving and high current capability allows the use of much smaller solenoids than before to develop the same forces.

Recommendation for design

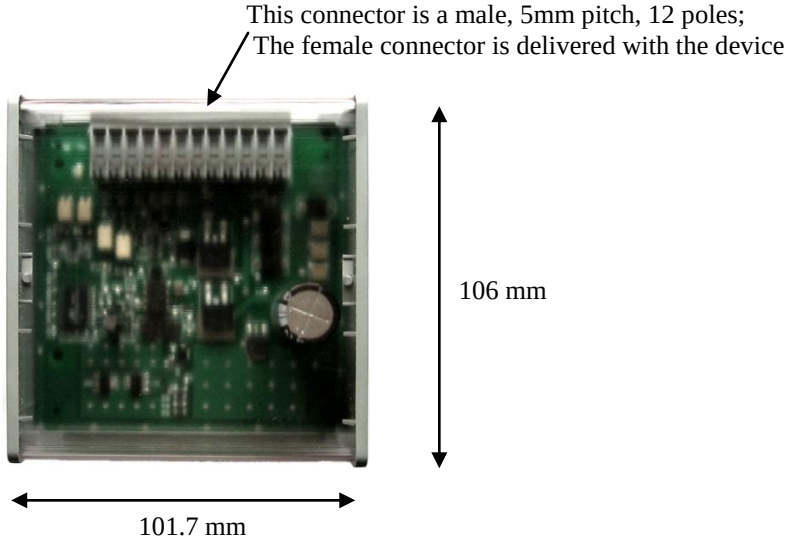
The driver is a high frequency PWM signal generator. Care has to be taken to minimize electromagnetic emissions. The driver must be put as close as possible to your coil and with twisted wires. Power supply cables should also be kept as short as possible and be twisted.
The total magnetic power seen by the circuit should be kept smaller than **300mW**. To compute this power, the hold current (which is the current at the moment of the switch-off), the coil inductance and the frequency of switching must be known. The following formula is then used:

$$P_{mag} = \frac{1}{2} L I^2 \cdot f$$

For instance, if we have a coil with a 50mH inductance, 2A hold, the max switching frequency will be:

$$f_{\max} = \frac{2 \cdot P_{mag\,\max}}{L I^2} = \frac{2 \cdot 0.3}{50 \cdot 10^{-3} \cdot 2^2} = 3Hz$$

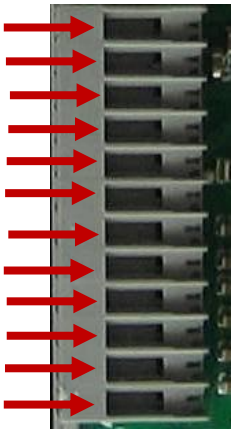
Mechanical drawing



The device can be directly put on a horizontal plane, or on a DIN rail (there are fixing feet for mounting on DIN 35 rails on the bottom of the enclosure)

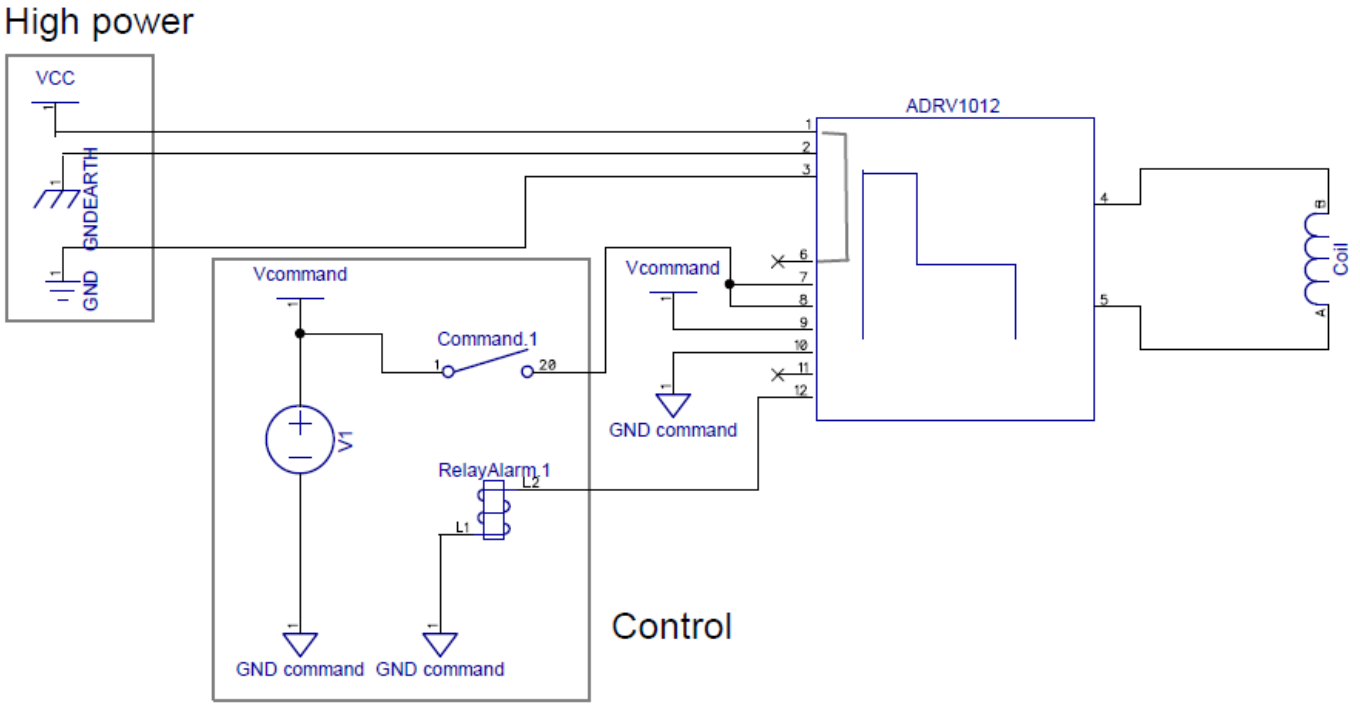
Wiring

1)	Vsupply
2)	Earth
3)	GND
4)	Coil
5)	Coil+
6)	Supply out
7)	Connect to pin 8*
8)	Enable
9)	Supply for Status
10)	GND for Enable
11)	NC
12)	Status



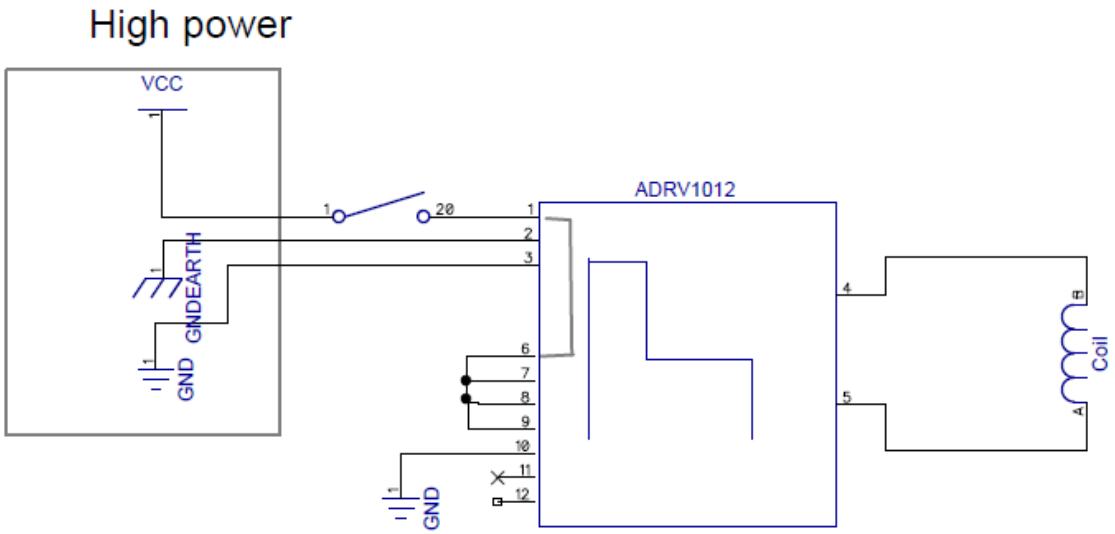
*: This pin 7 has to be connected to pin 8 to operate the solenoid; this is done directly on the female connector
V supply and GND must be connected to your power supply.
The Earth pin has to be fixed to your grounding connection for operation above 48V.
Coil – and Coil + are the outputs to the solenoid coil.
V supply out is an auxiliary output which is internally connected to V supply. It can be used to replace the power supply for the Enable and Output pins. In that case there is no galvanic isolation.
Supply for Status must be connected to the power supply of the command (for example the 24V of the PLC or to Vsupply Out)

External trigger



The driver can be driven by an external source such as a PLC or a relay. Switching the Enable (Pin 8) will switch the solenoid on or off. The output can be connected to an alarm.
In case if the Enable is activated using the same power supply, Supply for Status (Pin 9) can be connected to Power supply out (Pin 6).

Two wire operation



To use the device in two wire mode (ON/OFF by switching on or off the power supply) connect as described on the schematics above. This mode is only recommended for slow operation as there is a 150ms delay to start the ADRV1012K driver.

RS232 interface

An optional RS232 interface can be used to program various parameters by the user. These parameters are the following:

- Pull-in voltage
- Hold current

History records

Rev.	Change	Date
01	Creation	22.07.09
02	Update	28.07.09
03	Include wiring	29.07.09
04	Update	18.09.09
05	Update of the pin7 connections	28.10.09
06	Update of the "Pull-in current amplitude for detection" and added command voltage in the ordering description	01.02.10