



INIX0500200A D

Spike and Hold Driver Instructions For IECX0501350A and IECX0501500A

Part numbers supported by this document:

IECX0501350A ——— Adjustable Range Spike & Hold Driver: 0.1 – 5.0ms (Preset 0.30ms)

IECX0501500A ——— Adjustable Range Spike & Hold Driver: 1 - 100ms (Preset 50ms)

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Introduction

The Lee Company has designed the IECX0501350A and IECX0501500A Spike & Hold Drivers to assist in producing precise dispensed volumes and reduced power consumption with Lee solenoid valves. This driver is fully assembled and requires minimal knowledge of electronics to operate.

The driver enhances both actuation (time to open), and latch-out (time to close) of a solenoid. The driver achieves this by converting each input pulse to a stepped output voltage pulse of the same duration as the input pulse. The stepped output voltage consists of an elevated “spike” voltage, a reduced hold voltage, and finally a short duration inverse voltage. The spike voltage rapidly actuates the solenoid. The reduced hold voltage minimizes resistive heating and power consumption which avoids thermal damage to the solenoid and minimizes fluid heating. Finally, the third stage utilizes an integrated Zener flyback diode which produces an inverse voltage, enhancing the solenoid’s latch-out response.

These same features also enable the drive to reduce average power consumption and solenoid heating by as much as 90%. Many solenoid valves are not limited by duty cycle; In these cases, the use of a spike & hold driver is optional to reduce power consumption. Some solenoid valves are duty cycle limited, however a spike and hold driver can overcome those limitations and allow continuous usage.



Caution: *Despite the power reduction enabled by this driver, it is still possible to overheat a valve to failure. This is possible when the spike duration and/or duty cycle are high such that the solenoid coil does not have enough time or ability to dissipate heat. There are many parameters that effect the maximum duty cycle of a valve. Some of these are: external cooling, internal cooling via the flow of fluid through the valve, environmental temperatures, contact with a heat sink/source, and spike duration. During system development, it is important to monitor temperatures to prevent overheating.*

1. Driver Operation

a. Operating Principles

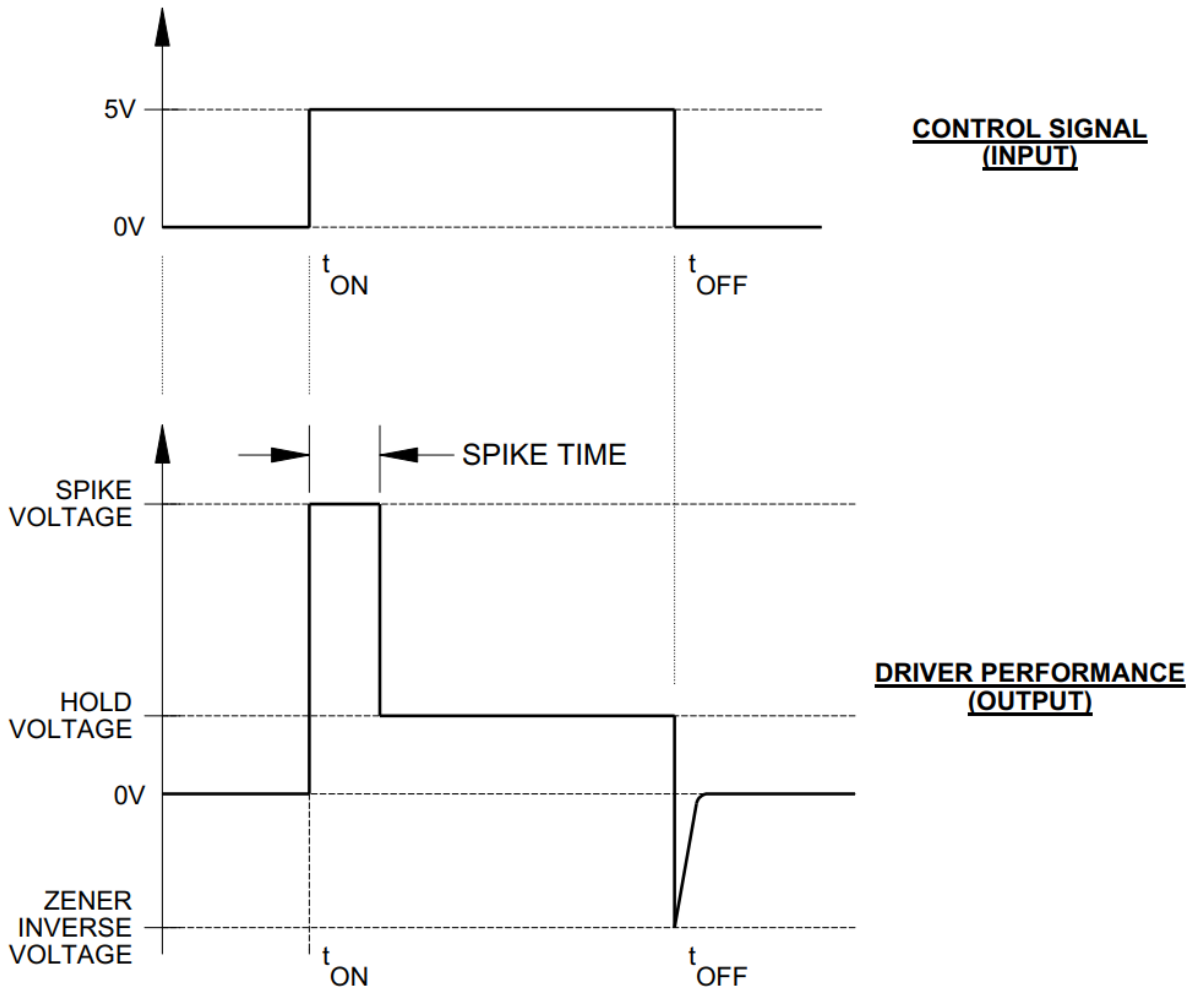


Figure 1: Control signal input and corresponding driver performance as measured with a solenoid connected to the driver.

Figure 1 depicts the relationship between the inputs and outputs of the driver. A control signal, supplied by the user, triggers the spike voltage and starts a timer within the driver. This control signal determines the total on-time of the valve.

When the function generator control signal is low (0 Vdc), the circuit and valve are not energized. When the signal is high (5 Vdc), the circuit energizes the spike timer, sending the spike voltage to the valve. The spike timer is factory preset at either 0.30ms or 50ms, depending on the driver part number. After the duration of the spike pulse, the

circuit switches to the hold voltage while the valve remains energized for as long as the control signal remains high. When the control signal is low (0 Vdc), all power to the valve is turned off, regardless of the spike timer status.

b. Spike Time Adjustment

Adjustment of the spike time requires an oscilloscope and an understanding of electronics or damage to the valve or driver may result.

The spike time for IECX0501350A is pre-set to 0.30ms and can provide spike times up to 5ms. The default spike time will work with most standard VHS series solenoid valves operating under nominal conditions. Consult The Lee Company or the inspection drawing for each valve part number to ensure that the preset spike duration is suitable for actuating your valve.

The IECX0501500A driver is preset for a 50ms spike time and may be used to apply spike times up to 100ms, consult the valve inspection drawing or The Lee Company for the recommended actuation time for your application.

The spike time for both models can be adjusted by the user. The spike time is adjustable by turning the potentiometer adjustment screw, located on the top left corner of the driver circuit (see Figure 3). A clockwise rotation increases the spike time, and a counterclockwise rotation decreases the spike time. Both IECX0501350A and IECX0501500A utilize a potentiometer where the full spike time range can be realized through 10 full revolutions. After 10 revolutions the screw will still turn, but no further adjustment will be achieved.

Part Number	Pre-Set Spike Time	Spike Time Range
IECX0501350A	0.30ms	0.1ms – 5ms
IECX0501500A	50ms	1ms – 100ms

Table 1: Capability of driver models.

c. Voltage & Spike Time Measurement

The spike time and individual spike and hold voltages can be measured by using an oscilloscope with an active differential probe, or by connecting each of the positive leads from two channels of the scope and subtracting the signal of **Terminal 6** from **Terminal 5**. To properly visualize the signal an inductive load, such as a solenoid coil, is required. The voltage waveform across the valve should resemble the “Driver Performance” depicted in Figure 1.



Note: *When a solenoid coil is de-energized, an inverse Zener voltage spike develops with an approximate magnitude of -50 Vdc. A 10X oscilloscope probe may be needed to measure the entire waveform, although this is not necessary for normal operation.*



Note: *There is a small voltage drop between the power supplies and valve due to internal components of the spike and hold driver and lead wires. It is important to ensure that the voltage delivered to the solenoid’s pins is consistent with its specifications. The voltage drop may be measured by subtracting the spike voltage and hold voltage measured at the valve’s pins from the power supply voltages. Any voltage drop can be compensated by increasing the voltage at the power supply.*



Caution: *The ground of the oscilloscope should never be attached to either lead of the valve. If the ground lead of the oscilloscope is attached to either valve lead, there will be permanent damage to the valve, driver circuit, and/or power supplies.*

2. Hardware

a. Required Materials

The Spike & Hold driver is designed to convert the input of DC power supplies and a control signal into the required output to drive a solenoid valve.

The user supplies the DC inputs required for the specific solenoid valve being tested. The spike and hold voltages vary based on the model of solenoid valve, consult the inspection drawing or The Lee Company for information on your specific valve. See section 2b for more information about how to choose power supplies and a suitable control signal.

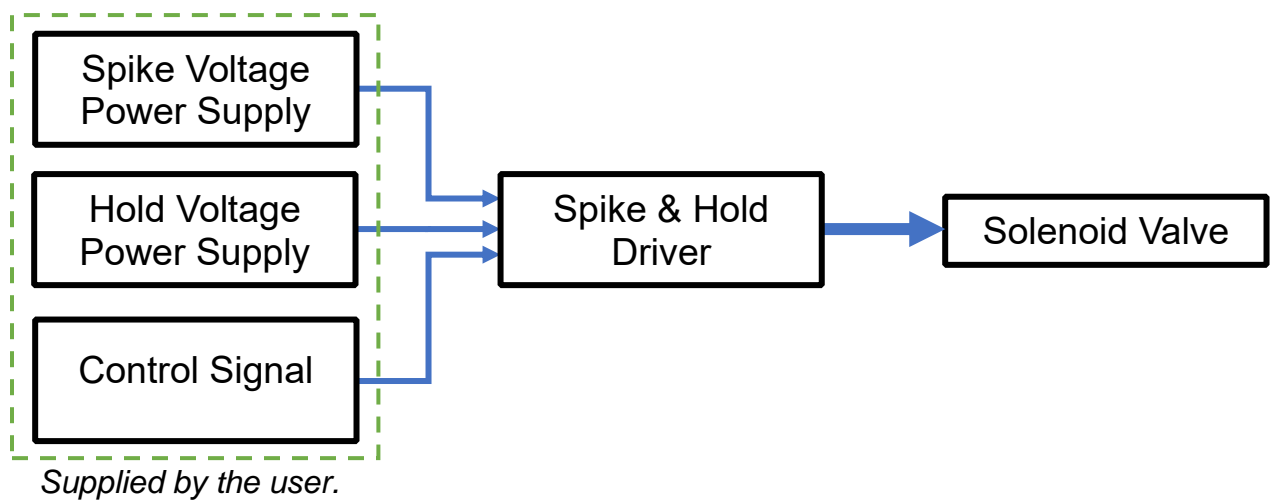


Figure 2: Required materials block diagram.

b. Connection Guide

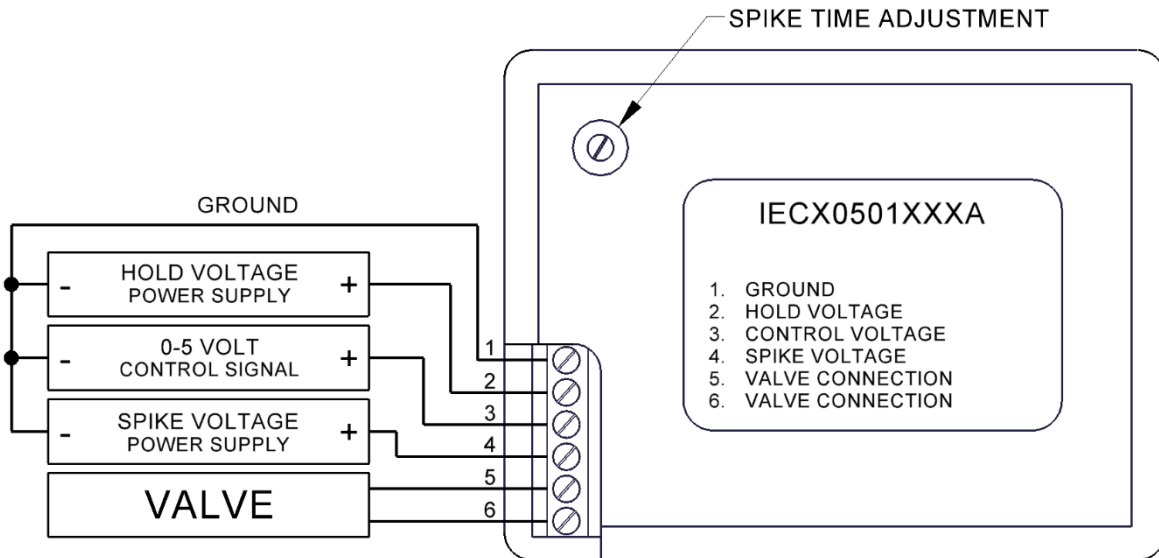


Figure 3: Connection schematic for Spike & Hold driver.

Terminal 1 - System Ground

The ground connections for the power supplies and the control signal are connected to this terminal. It is important to connect all three ground wires to this terminal to ensure a common ground reference across the circuit.

Terminal 2 - Hold Voltage

The positive (+) lead from the “hold voltage” power supply is connected to this terminal. The ground (-) is connected to **Terminal 1**. The hold voltage is lower than the spike voltage. For most valves, the hold voltage power supply should be capable of supplying 2 watts minimum.



Caution: Reversing the hold voltage and spike voltage supplies can result in permanent damage to the valve due to overheating. Supplying a hold voltage greater than 40 Vdc will result in damage to the driver.

Terminal 3 - Control Signal

The positive lead (+) from a digital Control Signal (pulse generator or microcontroller) is attached to this terminal. The ground (-) lead is attached to **Terminal 1**. The valve will open and remain open for as long as the control signal is high (5 Vdc). A rapidly rising Control Signal (square wave) is required to trigger the spike timing circuit within the driver.



Caution: Supplying a control voltage greater than 5 Vdc will result in damage to the driver.

Terminal 4 – Spike Voltage

The positive lead (+) from the spike voltage power supply is attached to this terminal. The ground (-) lead is attached to **Terminal 1**. The spike voltage is greater than the hold voltage. The spike power supply should be capable of supplying 1.5 times the power consumption of the valve(s) attached to the driver.



Caution: *Reversing the spike voltage and hold voltage supplies may result in permanent damage to the valve due to overheating. Supplying a spike voltage greater than 40 Vdc will result in damage to the driver and may damage the valve and power supply.*

Terminals 5 & 6 – Valve Connections

The two leads of a solenoid valve are connected to these terminals. Solenoid coils do not have polarity; therefore, the leads may be connected in either order.



Caution: *Connecting either valve connection terminal to ground (**Terminal 1**) may result in permanent damage to the valve, driver chip, and power supply.*



Note: *Latching solenoid valves have polarity, this driver is not suitable for actuating latching solenoids.*



Note: *Up to 4 solenoid valves can be connected to this driver and will operate simultaneously. If independent control is required, additional drivers are needed.*