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# Half-Bridge with Ultra-Precise Current Sense Feedback for Solenoid

SKU: EL143637

Open Source Hardware Projects

# Half-Bridge with Ultra-Precise Current Sense Feedback for Solenoid

A Half-bridge converter is widely used in applications such as DC-DC converters, switch mode power supplies, inverters, motor drivers, resistive loads, and solenoid drivers. This project consists of an IR2104 Half-bridge driver chip, 2 x DPAK MOSFETS, and an INA293 precision current sense amplifier. The IR2104 is a half-bridge, high voltage, high-speed power MOSFET and IGBT driver with dependent high and low side referenced output channels. It drives high and low-side N-channel MOSFETs, INA293 chip measures the load current across the shunt resistor connected to the output.

The project is mainly developed for solenoid applications that need current feedback. The circuit can handle load currents up to 2A and can handle higher currents with the help of forced air. IRFR120 MOSFETs are used, but you can use FDD8876 MOSFETs for higher currents. Shunt Resistor 0.01-ohm used to sense the load current, INA293 has Gain 20V/V.

**Inputs and Output**
The circuit requires 2 x signals, HI (PWM) and SD (Shutdown).
SD/LI= High Output enables,
LOW= Disable, both inputs are 3.3V, 5V and 15V logic compatible.

**Current Sense**
Output: 0.2V/A, 2A = 0.4V (400mV)

## FEATURES

- Supply Load 24V DC (VDD)
- Supply Gate Driver 12V-15V (VCC)
- Supply Current Sensor Amplifier INA293 (VI) 5V DC
- Current Feedback Output 0.2V/A
- Input Signal Logic Level 3.3V, 5V and 15V.
- Operating Frequency Upto20Khz
- Two Control Signals PWM and Shutdown
- PCB Dimensions 34.93 x 29.37mm

The INA293 is designed to measure current in a typical solenoid application. The INA293 measures current across the 10-mΩ shunt R3 that is placed at the output of the half-bridge. The INA293 measures the differential voltage across the shunt resistor, and the signal is internally amplified with a gain of 20 V/V. The output of the INA293 can be connected to the analog-to-digital converter (ADC) of an MCU to digitize the current measurements. Solenoid loads are highly inductive and are often prone to failure. Solenoids are often used for position control, precise fluid control, and fluid regulation. Measuring real-time current on the solenoid continuously can indicate premature failure of the solenoid which can lead to a faulty control loop in the system. Measuring high-side current also indicates if there are any ground faults on the solenoid or the FETs that can be damaged in an application. The INA293, with high bandwidth and slew rate, detects fast overcurrent conditions to prevent solenoid damage from short-to-ground faults.

The IR2104(S) are high voltage, high-speed power MOSFET and IGBT drivers with dependent high and low side referenced output channels. Proprietary HVIC and latch-immune CMOS technologies enable ruggedized monolithic construction. The logic input is compatible with standard CMOS or LSTTL output, down to 3.3V logic. The output drivers feature a high pulse current buffer stage designed for minimum driver cross-conduction. The floating channel can drive an N-channel power MOSFET or IGBT in the high-side configuration which operates from 10 to 600 volts.
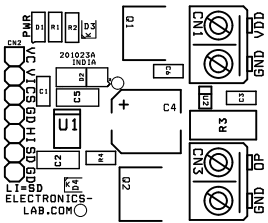
Open Source Hardware Projects
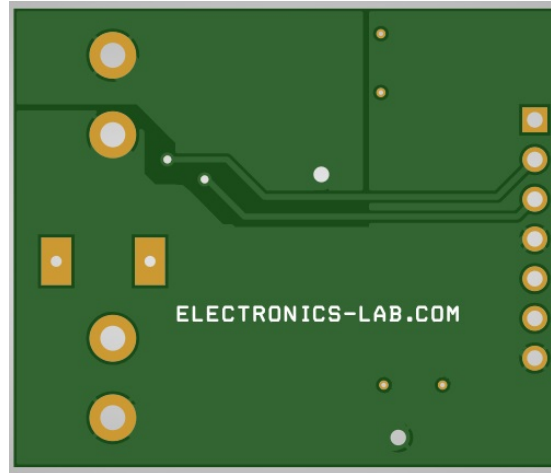
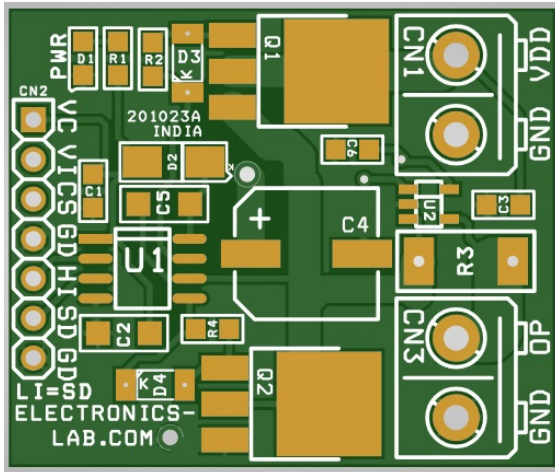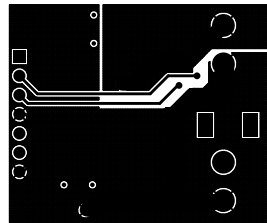# Schematic

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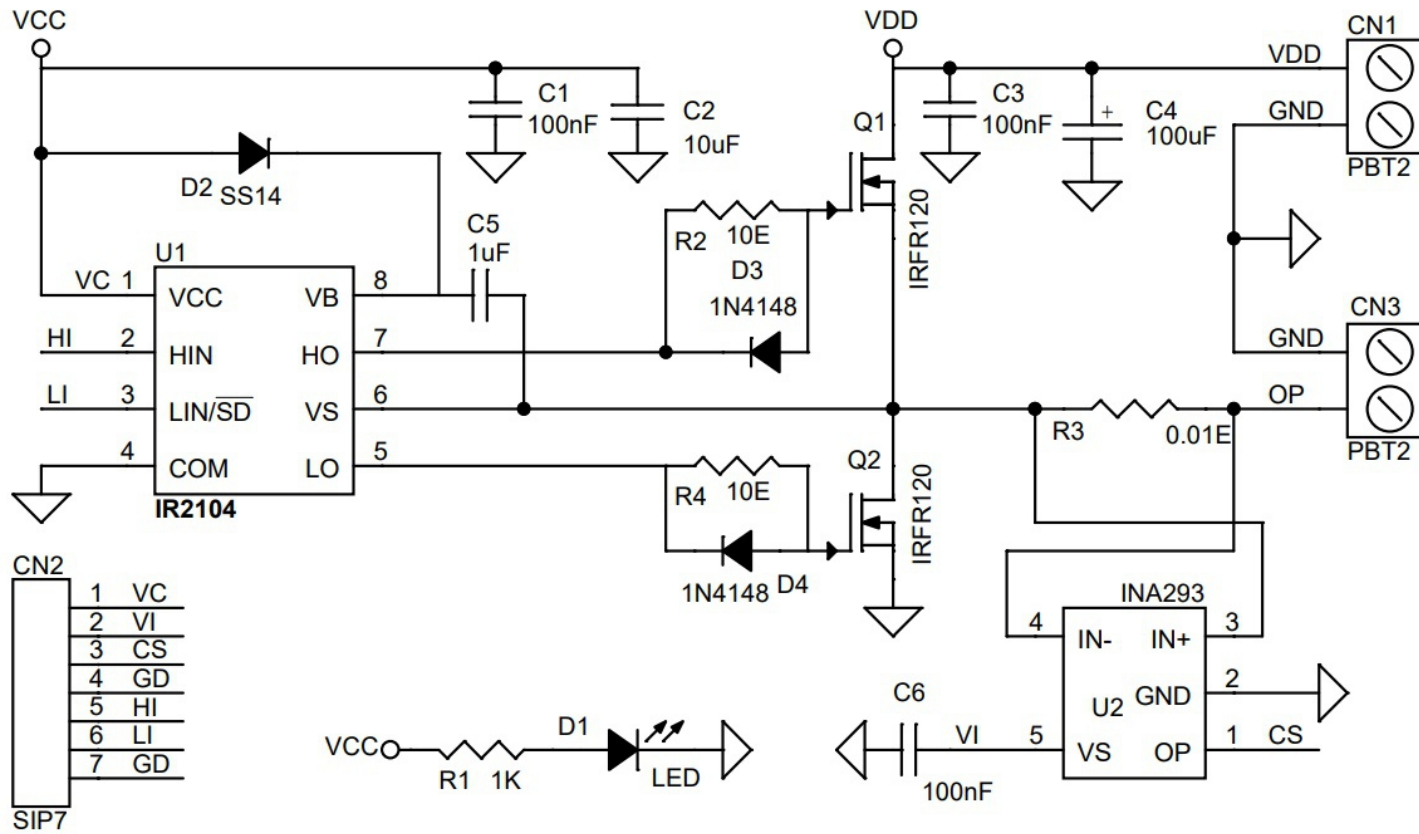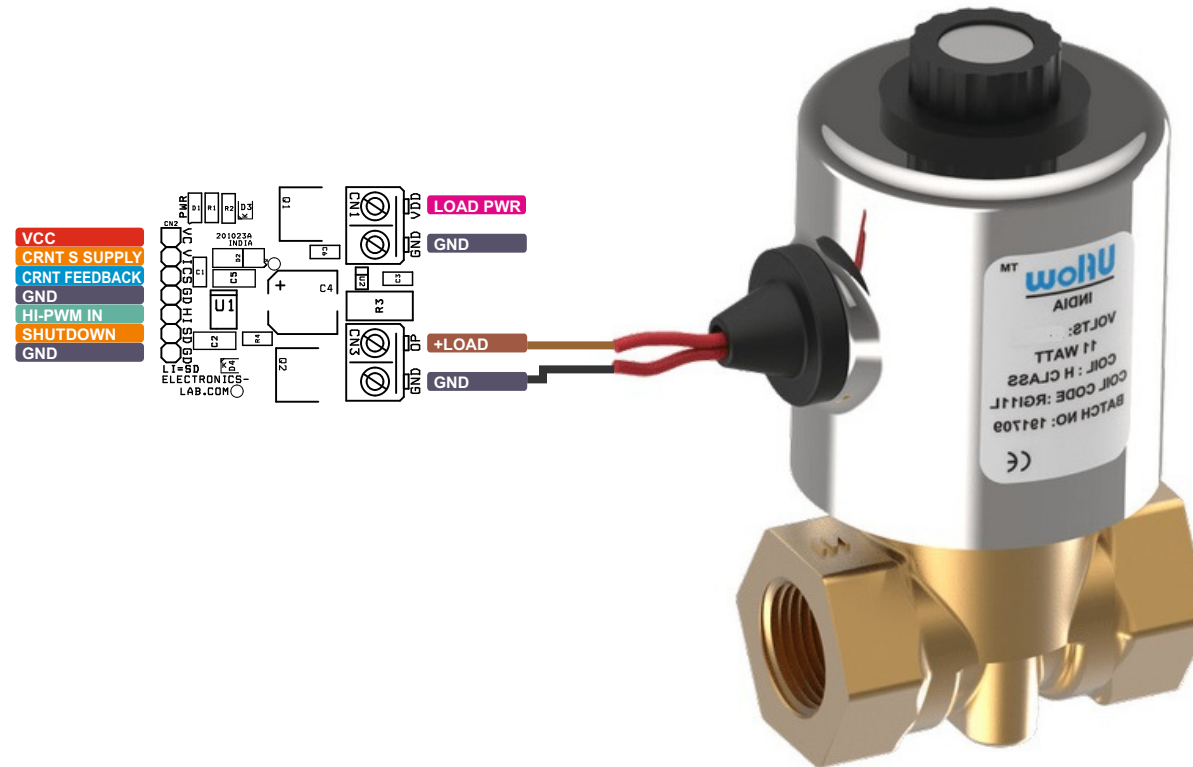
# Connections



## Connections:

- CN1: Pin 1 = VDD-LOAD Supply, Pin 2 = GND
- CN2: Pin 1 = VCC 12V , Pin 2 = VI Current Sense Power Supply, Pin 3 = Curent Sense Output 0.2V/A, Pin 4 = GND, Pin 5 = PWM Input, Pin 6 = LI/SD Shutdown High-  Enable, Pin 7 = GND
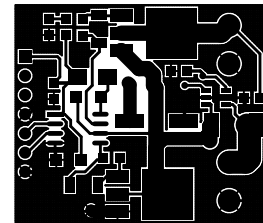- D1: Power LED

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# PCB





PCB GERBER FILES AVAILABLE



SILK SCREEN TOP



BOTTOM LAYER



TOP LAYER

**PCB DIMENSIONS 34.93 X 29.37MM**

# Parts List

| BO NO | QNTY | REF | DESC | MANUFACTURER | SUPPLIER | SUPPLIER PART NO. |
|---|---|---|---|---|---|---|
| 1 | 2 | CN1,CN3 | 2 PIN SCREW TERMINAL PITCH 5.08MM | PHOENIX | DIGIKEY | |
| 2 | 1 | CN2 | 7 PIN MALE HEADER PITCH 2.54MM | WURTH | DIGIKEY | |
| 3 | 3 | C1,C3,C6 | 100nF/50V CERAMIC SMD SIZE 0805 | YAGEO/MURATA | DIGIKEY | |
| 4 | 1 | C2 | 10uF/35V CERAMIC SMD SIZE 1206 | YAGEO/MURATA | DIGIKEY | |
| 5 | 1 | C4 | 100uF/50V ELECTROLYTIC | RUBYCON | DIGIKEY | 1189-2468-1-ND |
| 6 | 1 | C5 | 1uF/35V CERAMIC SMD SIZE 1206 | YAGEO/MURATA | DIGIKEY | |
| 7 | 1 | D1 | LED RED SMD SIZE 0805 | OSRAM | DIGIKEY | 475-1278-1-ND |
| 8 | 1 | D2 | SS34 OR SS14 SMD DIODE | ONSEMI | DIGIKEY | SS14CT-ND |
| 9 | 2 | D3,D4 | 1N4148 SMD | MICROCHIP | DIGIKEY | 1N4148UR-1-ND |
| 10 | 2 | Q1,Q2 | IRFR120 DPAK | INFINEON | DIGIKEY | IRFR120ZTRPBFCT-ND |
| 11 | 1 | R1 | 1K 5% SMD SIZE 0805 | YAGEO/MURATA | DIGIKEY | |
| 12 | 2 | R2,R4 | 10E 5% SMD SIZE 0805 | YAGEO/MURATA | DIGIKEY | |
| 13 | 1 | R3 | 0.01E 1W 1% SMD SIZE 2512 | YAGEO/MURATA | DIGIKEY | |
| 14 | 1 | U1 | IR2104 SOIC8 | INFINEON | DIGIKEY | IR2104SPBF-ND |
| 15 | 1 | U2 | INA293A1 SOT23-5 | TI | DIGIKEY | 296-INA293A1IDBVRCT-ND |

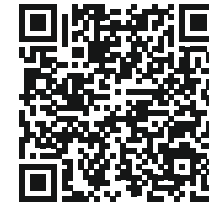Open Source Hardware Projects

# Notes

## APP
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### Android App

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