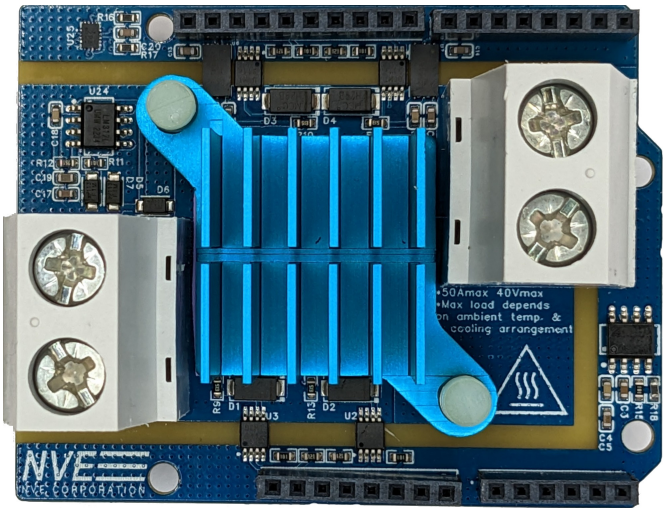
NVE CORPORATION

# SHIELD01:
# 40-Volt / 50-Amp H-Bridge Arduino Shield




Scan for Arduino programs and more information
https://github.com/NveCorporation/Arduino-H-bridge-shield

NVE Corporation (800) 467-7141 iso-apps@nve.com www.nve.com

# H-Bridge Shield Overview

**Features**

- Fully Arduino compatible
- Simple three-wire Arduino interface (PWM, Dir, and Enable)
- Motor control up to 2 kW (2.5 HP)
- Thermal vias and heat-sinking
- Standard Arduino Shield form factor
- Easy connections with large screw terminals
- Arduino example programs available for download

**Specifications**

- Max. load: 2 kW (40 V / 50 A)
- Load supply line: 8 V to 40 V
- Arduino supply: 7 V to 20 V via power connector or 5V via USB; 500 mA
- Logic-to-load isolation: 2.5 $kV_{RMS}$ per UL 1577
- Rds On: 1.2 mΩ typ. each MOSFET
- Operating Temperature Range: –40 °C to 85 °C
- Dimensions: 2.1 in. by 2.7 in. (53.4 mm by 68.6 mm)

**Applications**

- Motor speed and direction control
- Robotics
- DC-to-AC invertors

# Quick Start

⇒ Connect the Shield board to an Arduino.

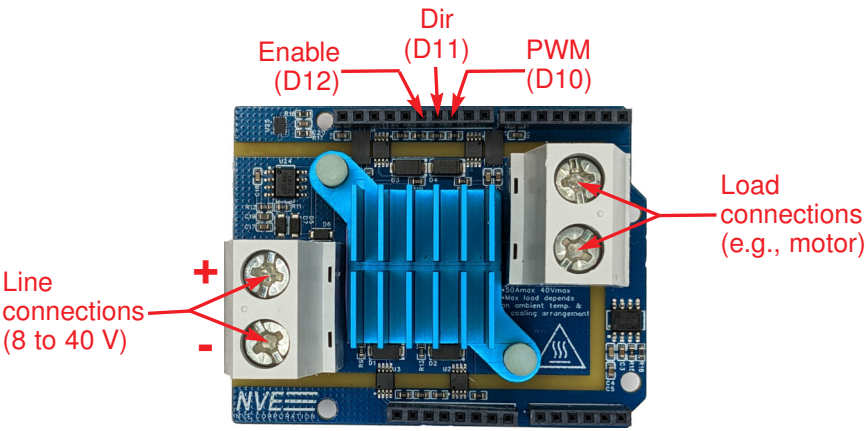
⇒ Connect the “line side” screw terminals to a motor power supply (8 to 40 V).

⇒ Connect the “load side” screw terminals to a motor.

⇒ Scan the QR Code on the front cover to download an example Arduino program from the NVE GitHub repository.

⇒ Run the Arduino program.

⇒ Modify the Arduino program for your application.



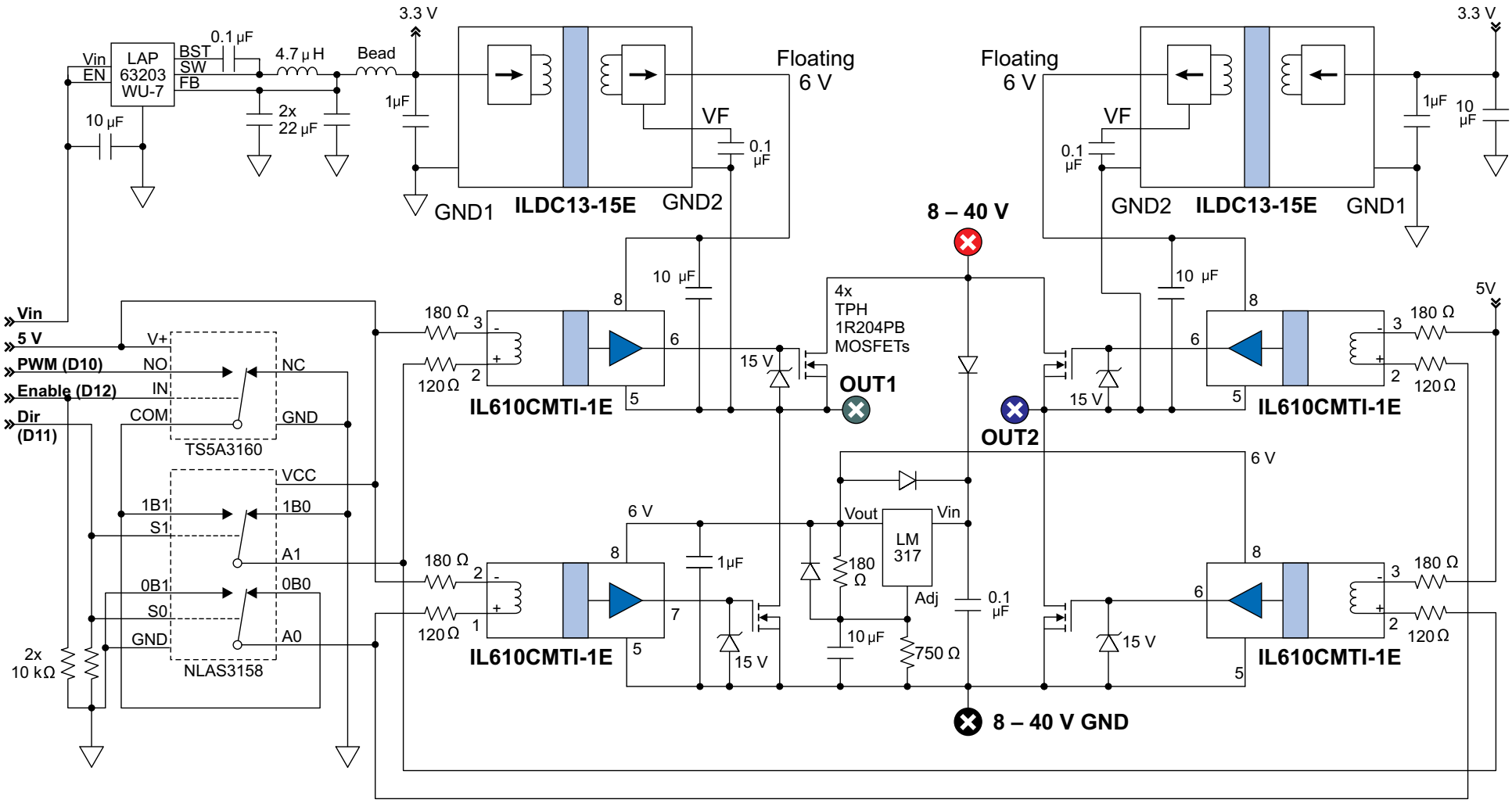

# Precautions

**Warning!** The heatsink and certain components may become hot during operation. Do not touch.

**Caution!** Inductive surges can cause MOSFFET voltages to exceed the motor supply voltage. Allow adequate margin to avoid damaging the MOSFETs.

**Caution!** Disable the control (set enable LOW) while reversing direction to avoid damaging the MOSFETs.

# Schematic


3.3 V
Vin
EN
LAP
63203
WU-7
BST
SW
FB
0.1 µF
4.7 µH
Bead
10 µF
2x
22 µF
1µF
GND1
ILDC13-15E
GND2
VF
0.1
µF
Floating
6 V
8 – 40 V
10 µF
4x
TPH
1R204PB
MOSFETs
OUT1
OUT2
180 Ω
120 Ω
IL610CMTI-1E
15 V
5V
Vin
5 V
PWM (D10)
Enable (D12)
Dir
(D11)
V+
NO
IN
COM
NC
GND
TS5A3160
VCC
1B1
1B0
S1
A1
0B1
0B0
S0
A0
GND
2x
10 kΩ
NLAS3158
6 V
Vout
Vin
LM
317
Adj
180
Ω
750 Ω
8 – 40 V GND

# Circuit Description

The heart of the H-bridge Arduino Shield is four power MOSFETs, four ultrahigh CMTI isolated MOSFET drivers, and two ultraminiature isolated DC-to-DC convertors.

The two low-side IL610CMTI-1E isolators level-shift the Arduino outputs to six volts to drive the low-side MOSFETs. The high-side isolators drive the high-side MOSFETs, as the MOSFET source voltages float with the load. The two ILDC13-15E DC-to-DC convertors generate floating six-volt supplies referenced to the MOSFET source pins to power the high-side isolator/gate drivers.

The isolators have extremely high Common-Mode Transient Immunity (CMTI), so they do not glitch even when MOSFET source-pin voltages change rapidly as the MOSFETs switch. The resistors in series with the isolator input coils set the input current to approximately 12 mA. The resistor values maximize CMTI.

The NLAS3158 analog switch provides PWM and Direction inputs for a simple Arduino interface. The switch's short break-before-make time prevents two MOSFETs on the same side being on at the same time ("shoot-through"). The TS5A3160 analog switch provides an Enable line, allowing all four MOSFETs to be disabled such as during a reversal. The 10 kΩ pull-down resistors ensure the load is disabled until the Arduino powers up and provides outputs.

The AP63203WU-7 buck regulator provides 3.3 volts to power the DC-to-DC convertors and supports the Arduino's 20 V maximum input voltage; a linear regulator could be used for lower input voltages. A ferrite bead, optimized for the 113 MHz convertor frequency, mitigates DC-to-DC convertor EMI.

An LM317 regulator provides six volts from the line input supply to power the low-side gate drivers. The LM317 circuit includes diodes for short-circuit and reverse voltage protection.

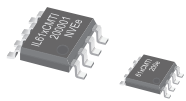
Zener diodes protect the MOSFET gates from overvoltage. The MOSFET and LM317 ratings limit the maximum line input supply to 40 volts. The Shield's 50-amp drive current specification is set by PCB trace and thermal limitations; the MOSFETs are rated to 150 amps.

# Bill of Materials

| Qty | Designator | Part Number | Mfr | Description |
|---|---|---|---|---|
| 2 | U6,U7 | ILDC13-15E | NVE | Ultramini Isolated 1/4W 3.3-6V DC-DC Conv |
| 4 | U2,U3,U4,U8 | IL610CMTI | NVE | 1-Ch Ultrahigh CMTI Isolator, 2.5 kV, MSOP |
| 4 | M1,M2,M3,M4 | TPH1R204PB,L1Q | Toshiba | MOSFET N-CH 40V 150A 8SOP |
| 1 | U28 | AP63203WU-7 | Diodes | IC REG BUCK 3.3V 2A TSOT26 |
| 1 | U5 | NCV317MBSTT3G | onsemi | IC REG LIN POS ADJ 500MA SOT223 |
| 1 | U19 | NLAS3158MNR2G | onsemi | IC SWITCH SPDT X 2 13OHM 12DFN |
| 1 | U27 | TS5A3160DCKR | TI | IC SWITCH SPDTX1 900MOHM SC70-6 |
| 1 | x | ATS-CPX025025020 | ATS | HEATSINK 25X25X20MM L-TAB CP |
| 1 | x | TG-A4500-25-25-1.0 | t-Global | THERM PAD 25MMX25MM PURP |
| 1 | x | ATS-HK127-R0 | ATS | HEATSINK PLASTIC PIN/SPRING 1=2 |
| 3 | D5-D7 | F1M | Yangjie | DIODE GEN PURP 1KV 1A SOD123FL |
| 4 | D1-D4 | 3SMAJ5929B-TP | MCC | DIODE ZENER 15V 3W DO214AC |
| 2 | H1,H2 | 691256610002 | Würth | TERM BLK 2P SIDE ENT 10.16MM PCB |
| 1 | H4 | SSW-106-03-T-S | Samtec | CONN RCPT 6POS 0.1 TIN PCB |
| 2 | H3,H6 | SSW-108-03-T-S | Samtec | CONN RCPT 8POS 0.1 TIN PCB |
| 1 | H7 | SSQ-110-03-T-S | Samtec | CONN RCPT 10POS 0.1 TIN PCB |
| 4 | R2,R4,R6,R8 | RMCF0603JG120R | Stackpole | RES 120 OHM 5% 1/10W 0603 |
| 5 | R1,R3,R5,R7,R11 | RMCF0603JT180R | Stackpole | RES 180 OHM 5% 1/10W 0603 |
| 4 | R9,R10,R13,R14 | RMCF0603JT51K0 | Stackpole | RES 51K OHM 5% 1/10W 0603 |
| 2 | R16,R17 | RMCF0603JT10K0 | Stackpole | RES 10K OHM 5% 1/10W 0603 |
| 1 | R12 | RMCF0603JT750R | Stackpole | RES 750 OHM 5% 1/10W 0603 |
| 4 | C8,C9,C18,C30 | CL10B104KC8NNNC | Samsung | 0.1 µF ±10% 100V Cer Cap X7R 0603 |
| 5 | C1-2,C6,C12,C17 | CL10A105KB8NNNC | Samsung | 1 µF ±10% 50V Cer Cap X5R 0603 |
| 4 | C19,C28,C29,C33 | CL10A106MA8NRNC | Samsung | 10 µF ±20% 25V Cer Cap X5R 0603 |
| 2 | C31,C32 | CL21A226MQQNNNG | Samsung | 22 µF ±20% 6.3V Cer Cap X5R 0805 |
| 1 | L5 | SDEM25201B-4R7MS | Delta Elec | FIXED IND 4.7UH 1.6A 240MOHM SMD |
| 1 | L6 | BBPY00100505102Y00 | Murata | 600 Ohms @ 100 MHz Ferrite Bead 0402 |

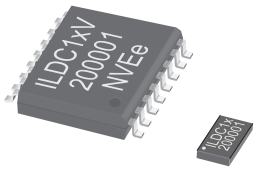
**IL61xCMTI: Ultrahigh CMTI Isolated MOSFET Drivers**

- 200 kV/µs guaranteed CMTI; 300 kV/µs with deglitch circuitry
- Extended 3 to 6.6 volt power supply range
- 2.5 kV isolation
- Single- and dual-channel configurations
- 8-pin MSOP and SOIC packages



**ILDC1x: Ultraminiature Isolated DC-to-DC Convertors**

- World's smallest isolated DC-to-DC convertors
- Ultraminiature 3 x 5.5 x 0.9 mm DFN or 8 mm creepage SOIC16-WB
- 3.3 volt input; 3.3, 5, or 6 volt output options
- ¼ watt, fully-regulated output
- No minimum load
- Low EMI without ferrite beads or inductors
- 2.5 kV or 4 kV isolation
- –40 °C to 125 °C with no derating



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