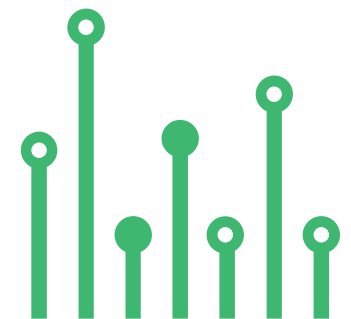


THE  
**electronics-lab**  
.com  
from ideas to  
**boards**

[electronics-lab - Projects](#) | [Embedded News](#) | [Online Community](#) | [e-Shop](#)

Open Source Hardware Electronics Projects

[electronics-lab.com /projects](https://electronics-lab.com/projects)





# 3 Phase IPM Module for Small Power AC Motor



SKU: EL148132

# 3 Phase IPM Module for Small Power AC Motor



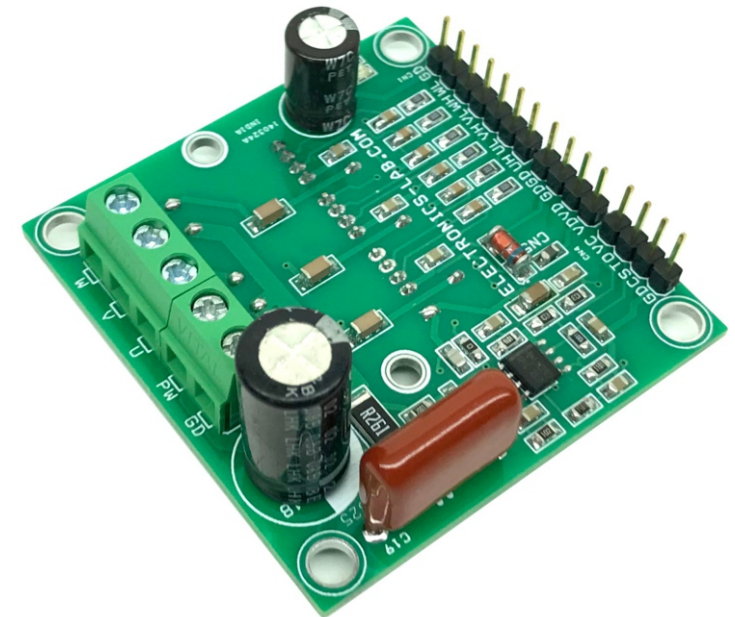
This is a 3-Phase Inverter Driver project designed for Small Power AC Motors. The project is built using FSB50550AT IPM chip. This compact and reliable inverter project is ideal for small power motors such as fans and pumps. An H-bridge configuration can also be created for low current high-voltage brushed DC motors. The Inverter board supports a load up to 2A. The DC power supply voltage is up to 400V DC. The project operates with 6 x PWM signals. Parameters for bootstrap circuit elements are dependent on the PWM algorithm. For 15 kHz switching frequency, Bootstrap capacitors C3, C4, and C5 value is 1uF. Resistor R4, R6, R7, R11, R15, R16 and capacitor C9, C10, C11, C12, C16, C17 prevent improper signal due to surge-noise. The logic supply is protected with a 20V Zener diode, which prevents surges under severe conditions.



The project operates with lethal voltage, user must take care of safety and all necessary precautions before testing the project.

## FEATURES

- Load Power Supply Up to 400V DC
  - Load Current Continues 2A
  - Logic Supply 15V DC, Current 100mA Minimum
  - Power Supply for Over Current/Temperature Circuit (Comparator U2) 5V DC
  - One Board Power LED for Logic Supply
  - Shunt and Comparator Based Over Current Output
  - Over temperature threshold is 80 degrees centigrade.
  - HVIC for gate driving and under-voltage protection
  - Active-High interface, can work with 3.3V/5V logic (PWM Signals)
  - On Threshold Voltage 2.9V, Off Threshold Voltage 0.8V
  - Optimized for low electromagnetic interference
  - Isolation voltage rating of 1500Vrms for 1min
- PCB Dimensions 53.34X52.55MM



Comparator U2A provides low output when an overcurrent condition occurs, it measures the current across shunt resistor R13, and normal output is high. Comparator U2B is provided for over-temperature detection, the output of U2B is high when IPM temperature is below 80 degrees C, and goes low when the temperature reaches the threshold. A heatsink is a must for full load current, thus 2 mounting holes are provided throughout the PCB to mount the heatsink as shown in the Figure below. Silicone thermal compound, also called thermal grease, should be applied between the heat sink and the flat surface of the IPM to fill microscopic air gaps due to imperfect flatness that ultimately reduces the contact thermal resistance. The IPM module should be soldered first. Please take care of excessive torque that may bend the PCB.

## Temperature Sensing Output (VTS) – CN4 Pin 2-TO

**Pin: VTS** This indicates the temperature of the V-phase HVIC with an analog voltage output. HVIC itself creates some power loss, but mainly heat generated from the MOSFETs increases the temperature of the HVIC. Comparator U2B is used for over-temperature detection. Output is high in normal conditions when the temperature is below 80 degrees, and goes low when over-temperature condition occurs. The over-temperature threshold is 80°C.

## Signal Input Pins

- Pins: IN(UL), IN(VL), IN(WL), IN(UH), IN(VH), IN(WH)
- These pins control the operation of the MOSFETs.
- These pins are activated by voltage input signals. The terminals are internally connected to the Schmitt trigger circuit.
- The signal logic of these pins is active HIGH; the MOSFET turns ON when sufficient logic voltage is applied to the associated input pin.
- The wiring of each input needs to be short to protect the module against noise influences.
- An RC filter is used to mitigate signal oscillations or any noise that traces of input signals may pick up.

## Operation Table Input Signals

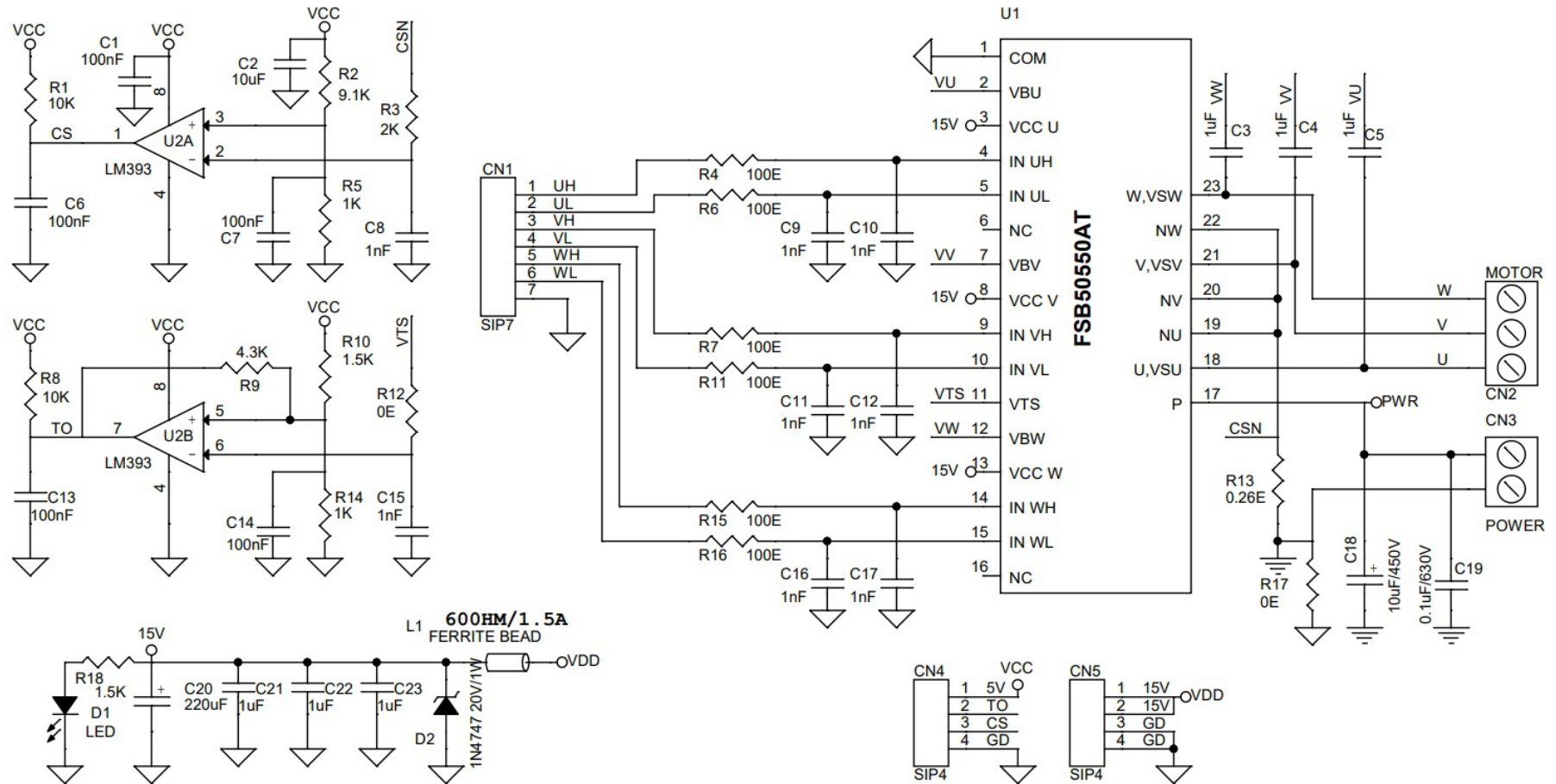
- HIN 0, LIN 0 = Output Z Both MOSFET Off
- HIN 0, LIN 1 = Output 0 Low Side MOSFET On
- HIN 1, LIN 0 = Output VDC High Side MOSFET On
- HIN 1, LIN 1 = Forbidden Shoot Through

## Minimum Pulse Width (Signal Input)

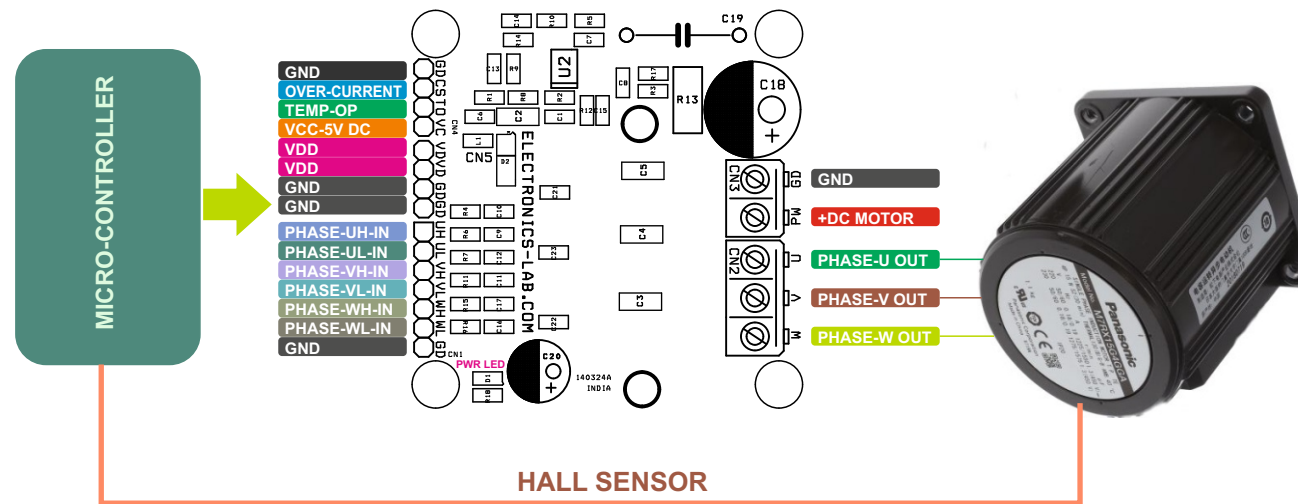
There are input noise filters of 90 ns time constant inside the HVIC. It screens out pulses narrower than the filter time constant. Additional propagation delay in level-shifters and other circuits, together with gate charging time, prevent SPM 5 products from responding to an input pulse narrower than ~120 ns. Gate signal inputs are active-HIGH with 500 kΩ internal pull-down resistors.

**FSB50550AT** is an advanced power module for motion control, based on fast-recovery MOSFET (FRFET®) technology as a compact inverter solution for small power motor drive applications such as fans and pumps. FSB50550AT contains six FRFET MOSFETs, three half-bridge gate driver HVICs with temperature sensing, and three bootstrap diodes in a compact package fully isolated and optimized for thermal performance. FSB50550AT features low electromagnetic interference (EMI) characteristics by optimizing switching speed and reducing parasitic inductance. Since FSB50550AT employs MOSFETs as power switches, it provides much more ruggedness and larger safe operating area (SOA) than IGBT-based power modules. FSB50550AT is the right solution for compact and reliable inverter designs where the assembly space is constrained.

# Schematic



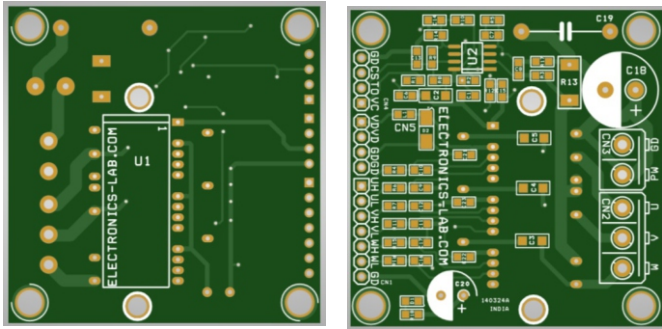
# Connections



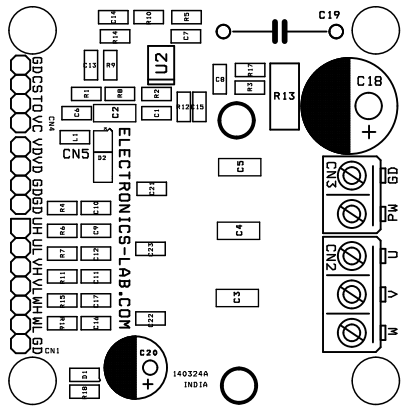
## Connections

- CN1: Pin1 = PWM U-High, Pin 2 = PWM U-Low, Pin 3 = PWM V-High, Pin 4 = PWM V-Low, Pin 5 = PWM W-High, Pin 6 = PWM W-Low, Pin 7 = GND
- CN2: 3 Phase Motor, Pin1 = Phase=W, Pin 2 = Phase-V, Pin 3 = Phase-U
- CN3: Pin1 = Motor Supply 400V DC, Pin 2 = GND
- CN4: Pin1 = VCC 5V, Pin 2 = TO-NTC OUT, Pin 3 = Over Current/Fault, Pin 4 = GND
- CN5: Pin 1,2 = VDD 15V, Pin 3,4 = GND
- D1: Power LED for Logic Supply

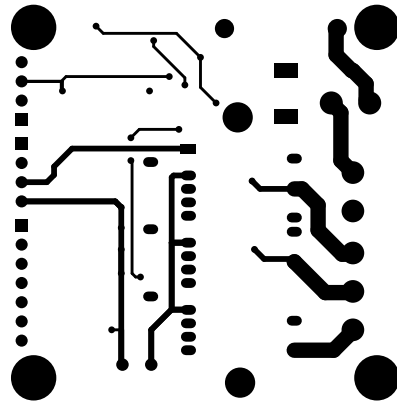
# PCB



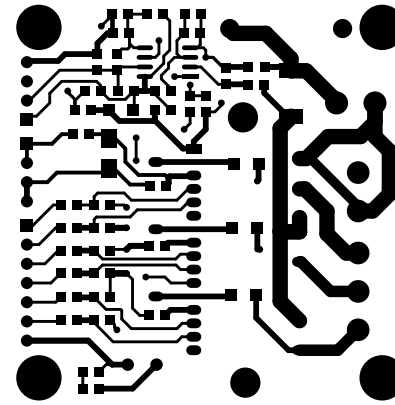
PCB GERBER  
FILES  
AVAILABLE



SILK SCREEN TOP



BOTTOM LAYER



TOP LAYER

PCB DIMENSIONS 53.34X52.55MM



# Parts List

BOM						
NO.	QNTY.	REF.	DESC.	MANUFACTURER	SUPPLIER	SUPPLIER PART NO
1	1	CN1	7 PIN MALE HEADER PITCH 2.54MM	WURTH	DIGIKEY	732-5320-ND
2	1	CN2	3 PIN SCREW TERMINAL PITCH 5.08MM	PHOENIX	DIGIKEY	277-1248-ND
3	1	CN3	2 PIN SCREW TERMINAL PITCH 5.08MM	PHOENIX	DIGIKEY	277-1247-ND
4	2	CN4,CN5	4 PIN MALE HEADER PITCH 2.54MM	WURTH	DIGIKEY	732-5317-ND
5	5	C1,C6,C7,C13,C14	100nF/50V CERAMIC SMD SIZE 0805	MURATA/YAGEO	DIGIKEY	
6	1	C2	10uF/25V CERAMIC SMD SIZE 0805	MURATA/YAGEO	DIGIKEY	
7	8	C8,C9,C10,C11,C12,C15,C16,C17	1nF/50V CERAMIC SMD SIZE 0805	MURATA/YAGEO	DIGIKEY	
8	1	C18	10uF/450V ELECTROLYTIC THT	PANASONIC	DIGIKEY	P13558-ND
9	1	C19	0.1uF/630V THT 18X5MM LEAD PITCH 15MM	KEMET	DIGIKEY	399-19284-1-ND
10	1	C20	220uF/25V ELECTROLYTIC 8MM DIA.	PANASONIC	DIGIKEY	P10271-ND
11	1	D1	LED SMD SIZE 0805	OSRAM	DIGIKEY	
12	1	D2	20V 1W ZENER DIODE SMD	MICROCHIP	DIGIKEY	150-1N4747UR-1/TRCT-ND
13	1	L1	FERRITE BEAD 600OHM SMD SIZE 0805	LAIRD	DIGIKEY	240-2390-1-ND
14	2	R1,R8	10K 5% SMD SIZE 0805	MURATA/YAGEO	DIGIKEY	
15	1	R2	9.1K 1% SMD SIZE 0805	MURATA/YAGEO	DIGIKEY	
16	1	R3	2K 1% SMD SIZE 0805	MURATA/YAGEO	DIGIKEY	
17	6	R4,R6,R7,R11,R15,R16	100E 5% SMD SIZE 0805	MURATA/YAGEO	DIGIKEY	
18	2	R5,R14	1K 5% SMD SIZE 0805	MURATA/YAGEO	DIGIKEY	
19	1	R9	4.3K 1% SMD SIZE 0805	MURATA/YAGEO	DIGIKEY	
20	2	R10,R18	1.5K 1% SMD SIZE 0805	MURATA/YAGEO	DIGIKEY	
21	2	R12,R17	0E SMD SIZE 0805	MURATA/YAGEO	DIGIKEY	
22	1	R13	0.26E/2W 1% SMND SIZE 2512	YAGEO	DIGIKEY	13-PT2512FK-7W0R26L-ND
23	1	U1	FSB50550AT	ON SEMI	DIGIKEY	FSB50550ATOS-ND
24	1	U2	LM393 SOIC8	TI	DIGIKEY	296-1015-1-ND
25	3	C3,C4,C5	1uF/35V CERAMIC SMD SIZE 1206	MURATA/YAGEO	DIGIKEY	
26	3	C21,C22,C23	1uF/25V CERAMIC SMD SIZE 0805	MURATA/YAGEO	DIGIKEY	

# Notes

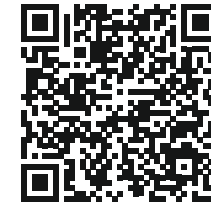
---



## APP

### Android App

DOWNLOAD



Android App launched in 2017 and has 100k+ downloads - rated with 4.5 stars.

SCAN QR CODE





Keep  
In touch..

electronics-lab  
.com

info@electronics-lab.com  
www.electronics-lab.com

from ideas to **boards**

