

MC33035 BRUSHLESS MOTOR DRIVER BREAKOUT BOARD

The board shown here is a breakout board for brushless motor, its required buffer output IPM module or Mosfets to complete the closed loop brushless motor driver. MC33035 IC is the heart of the project; the project provides 6 PWM pulses as well 6 Inverse pulses outputs. On board Jumpers helps to change the Direction, Enable, Brake, and 60/120 phasing Header connector provided to connect the Hall sensors and supply, On board LED for Power and fault, P1 potentiometer helps to change the speed.

The MC33035 is a high performance second generation monolithic brushless DC motor controller containing all of the active functions required to implement a full featured open loop, three or four phase motor control system. This device consists of a rotor position decoder for proper commutation sequencing, temperature compensated reference capable of supplying sensor power, frequency programmable saw tooth oscillator, three open collector top drivers, and three high current totem pole bottom drivers ideally suited for driving power MOSFETs. Also included are protective features consisting of under voltage lockout, cycle-by-cycle current limiting with a selectable time delayed latched shutdown mode, internal thermal shutdown, and a unique fault output that can be interfaced into microprocessor controlled systems. Typical motor control functions include open loop speed, forward or reverse direction, run enable, and dynamic braking. The MC33035 is designed to operate with electrical sensor phasings of 60°/300° or 120°/240°, and can also efficiently control brush DC motors.

Supply 12-18V

Jumpers for Direction, Enable, 60/120 Phasing, Brake

LED D1 Fault

LED D2 Power LED

Pot P1 Speed Control

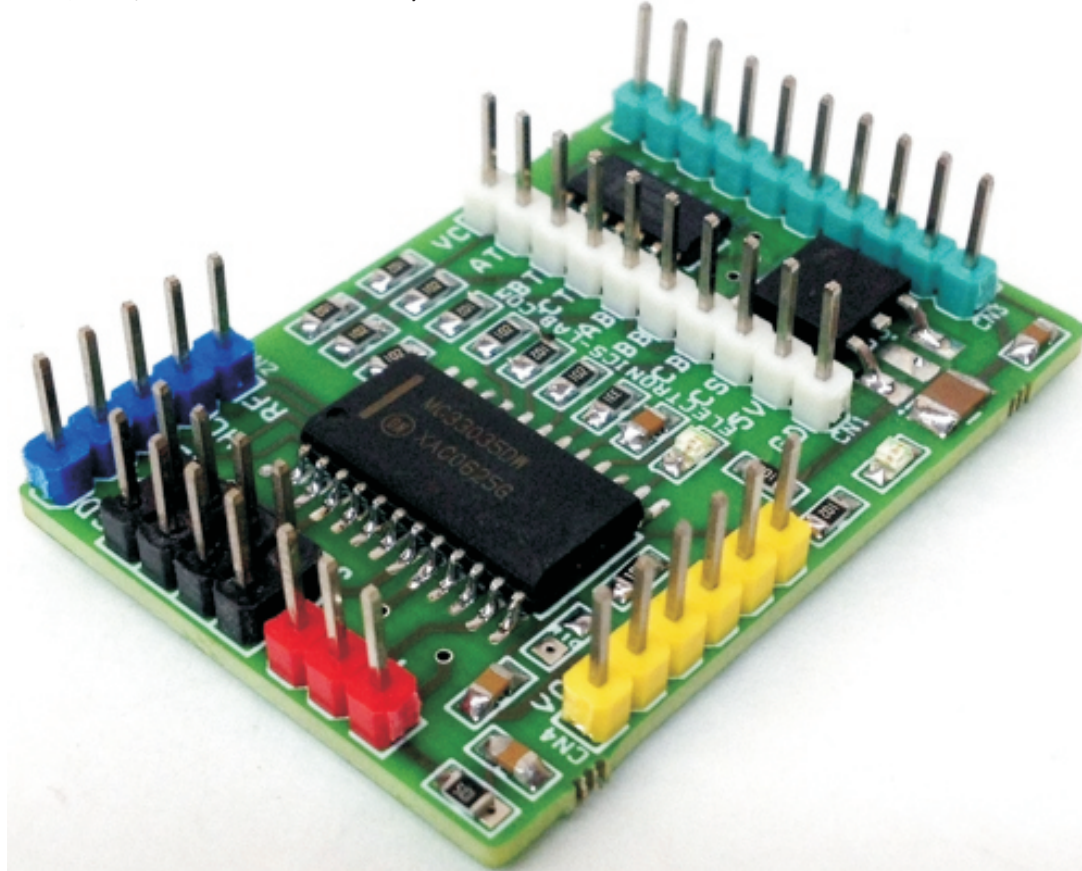
CN1 6 PWM Outputs

CN3 6 Inverse PWM Outputs

CN4 Supply Input

CN2 Hall Sensor Interface

Frequency 18 KHz



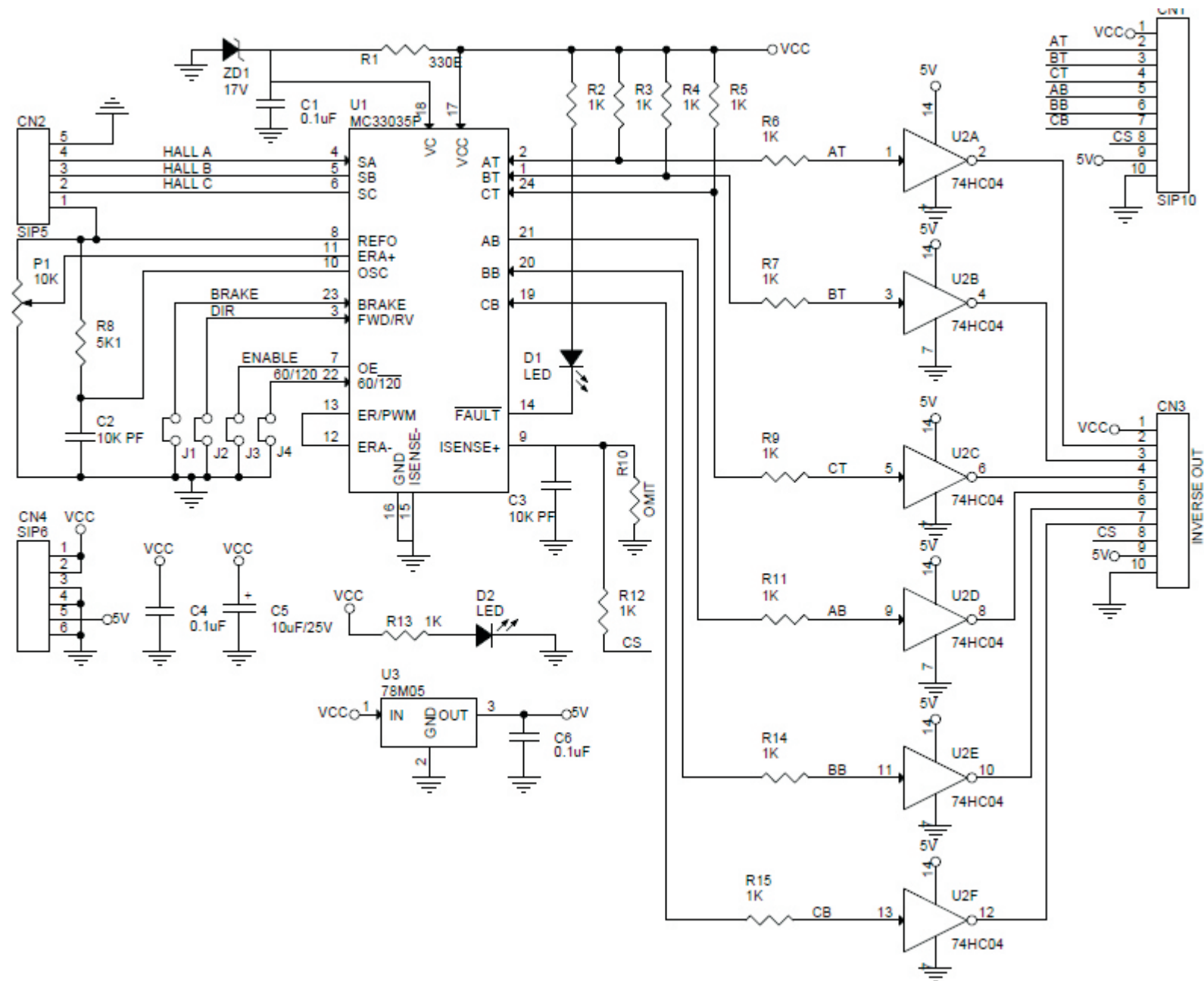
An internal rotor position decoder monitors the three sensor inputs (Pins 4, 5, 6) to provide the proper sequencing of the top and bottom drive outputs. The sensor inputs are designed to interface directly with open collector type Hall Effect switches or opto slotted couplers. Internal pull-up resistors are included to minimize the required number of external components. The inputs are TTL compatible, with their thresholds typically at 2.2 V. The MC33035 series is designed to control three phase motors and operate with four of the most common conventions of sensor phasing. A 60°/120° Select (Pin 22) is conveniently provided and affords the MC33035 to configure itself to control motors having either 60°, 120°, 240° or 300° electrical sensor phasing. With three sensor inputs there are eight possible input code combinations, six of which are valid rotor positions. The remaining two codes are invalid and are usually caused by an open or shorted sensor line. With six valid input codes, the decoder can resolve the motor rotor position to within a window of 60 electrical degrees. The Forward/Reverse input (Pin 3) is used to change the direction of motor rotation by reversing the voltage across the stator winding. When the input changes state, from high to low with a given sensor input code (for example 100), the enabled top and bottom drive outputs with the same alpha designation are exchanged (AT to AB, BT to BB, CT to CB). In effect, the commutation sequence is reversed and the motor changes directional rotation. Motor on/off control is accomplished by the Output Enable (Pin 7). When left disconnected, an internal 25 Ma current source enables sequencing of the top and bottom drive outputs. When grounded, the top drive outputs turn off and the bottom drives are forced low, causing the motor to coast and the Fault output to activate. Dynamic motor braking allows an additional margin of safety to be designed into the final product. Braking is accomplished by placing the Brake Input (Pin 23) in a high state. This causes the top drive outputs to turn off and the bottom drives to turn on, shorting the motor-generated back EMF. The brake input has unconditional priority over all other inputs. The internal 40 kΩ pull-up resistor simplifies interfacing with the system safety-switch by insuring brake activation if opened or disconnected. The commutation logic truth table is shown in Figure 20. A four input NOR gate is used to monitor the brake input and the inputs to the three top drive output transistors. Its purpose is to disable braking until the top drive outputs attain a high state. This helps to prevent simultaneous conduction of the the top and bottom power switches. In half wave motor drive applications, the top drive outputs are not required and are normally left disconnected. Under these conditions braking will still be accomplished since the NOR gate senses the base voltage to the top drive output transistors.

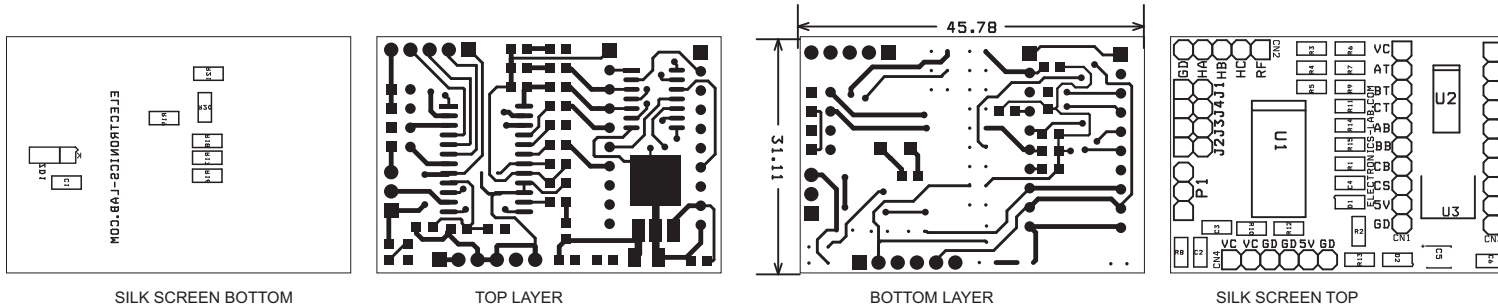
Continuous operation of a motor that is severely over-loaded results in overheating and eventual failure. This destructive condition can best be prevented with the use of cycle-by-cycle current limiting. That is, each on-cycle is treated as a separate event. Cycle-by-cycle current limiting is accomplished by monitoring the stator current build-up each time an output switch conducts, and upon sensing an over current condition, immediately turning off the switch and holding it off for the remaining duration of oscillator ramp-up period. The stator current is converted to a voltage by inserting a ground-referenced sense resistor. The voltage developed across the sense resistor is monitored by the Current Sense Input (Pins 9 and 15), and compared to the internal 100 mV reference. The current sense comparator inputs have an input common mode range of approximately 3.0 V. If the 100 mV current sense threshold is exceeded, the comparator resets the lower sense latch and terminates output switch conduction. The value for the current sense resistor is:

$$R_S = 0.1 / I_{\text{stator(max)}}$$

The Fault output activates during an over current condition. The dual-latch PWM configuration ensures that only one single output conduction pulse occurs during any given oscillator cycle, whether terminated by the output of the error amp or the current limit comparator.





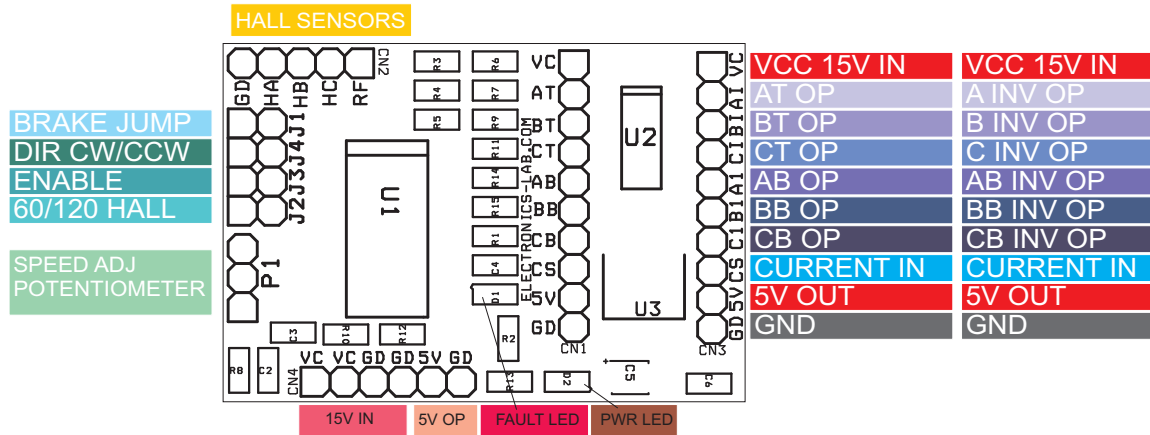


SILK SCREEN BOTTOM

TOP LAYER

BOTTOM LAYER

SILK SCREEN TOP



VCC 15V IN	VCC 15V IN
AT OP	A INV OP
BT OP	B INV OP
CT OP	C INV OP
AB OP	AB INV OP
BB OP	BB INV OP
CB OP	CB INV OP
CURRENT IN	CURRENT IN
5V OUT	5V OUT
GND	GND

BOM			
SR.	QNTY.	REF.	DESC.
1	1	CN1	10 PIN HEADER CONNECTOR
2	1	CN2	5 PIN HEADER CONNECTOR
3	1	CN3	10 PIN HEADER CONNECTOR
4	1	CN4	6 PIN HEADER CONNECTOR
5	3	C1,C4,C6	0.1uF SMD 0805
6	2	C2,C3	10K PF SMD 0805
7	1	C5	10uF/25V SMD 1210
8	2	D1,D2	LED SMD 0805
9	4	J1,J2,J3,J4	2PIN HEADER
10	1	P1	10K POTENTIOMETER
11	1	R1	330E SMD 0805
12	1	R2,R3,R4,R5,R6,R7,R9,R11,R12,R13,R14,R15	10K SMD 0805
13	1	R8	5K1 SMD 0805
14	1	R10	OMIT
15	1	U1	MC33035P SMD
16	1	U2	74HC04 SMD
17	1	U3	78M05 SMD DPAK
18	1	ZD1	17V ZENER SMD