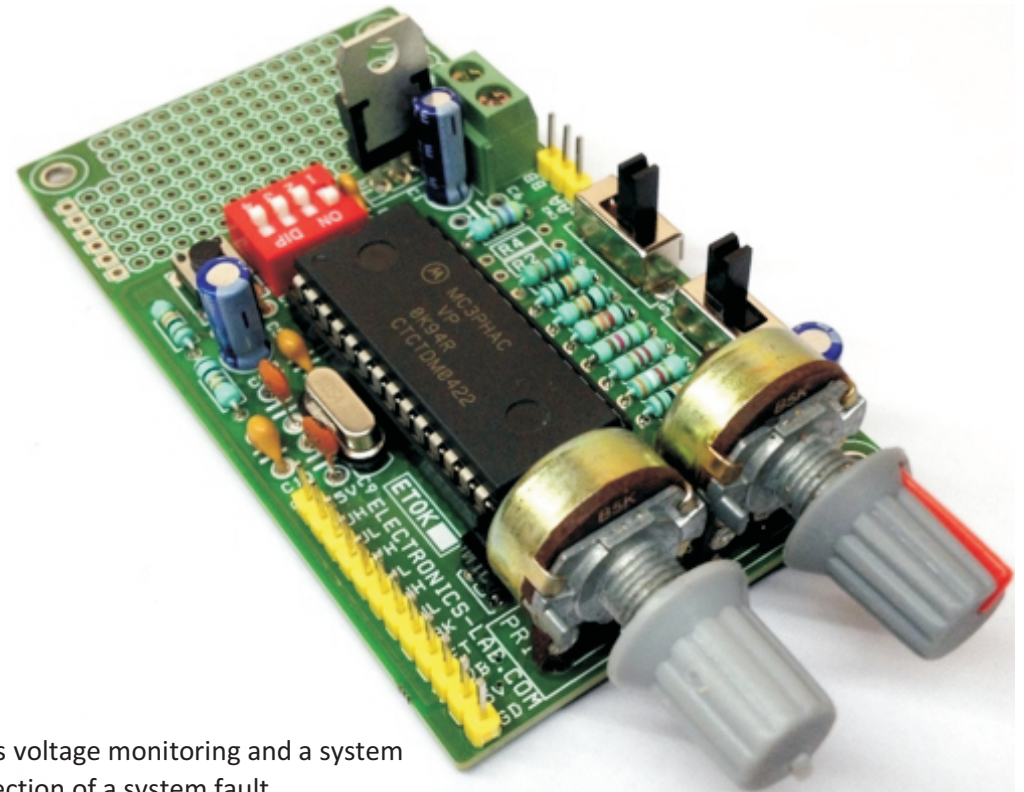


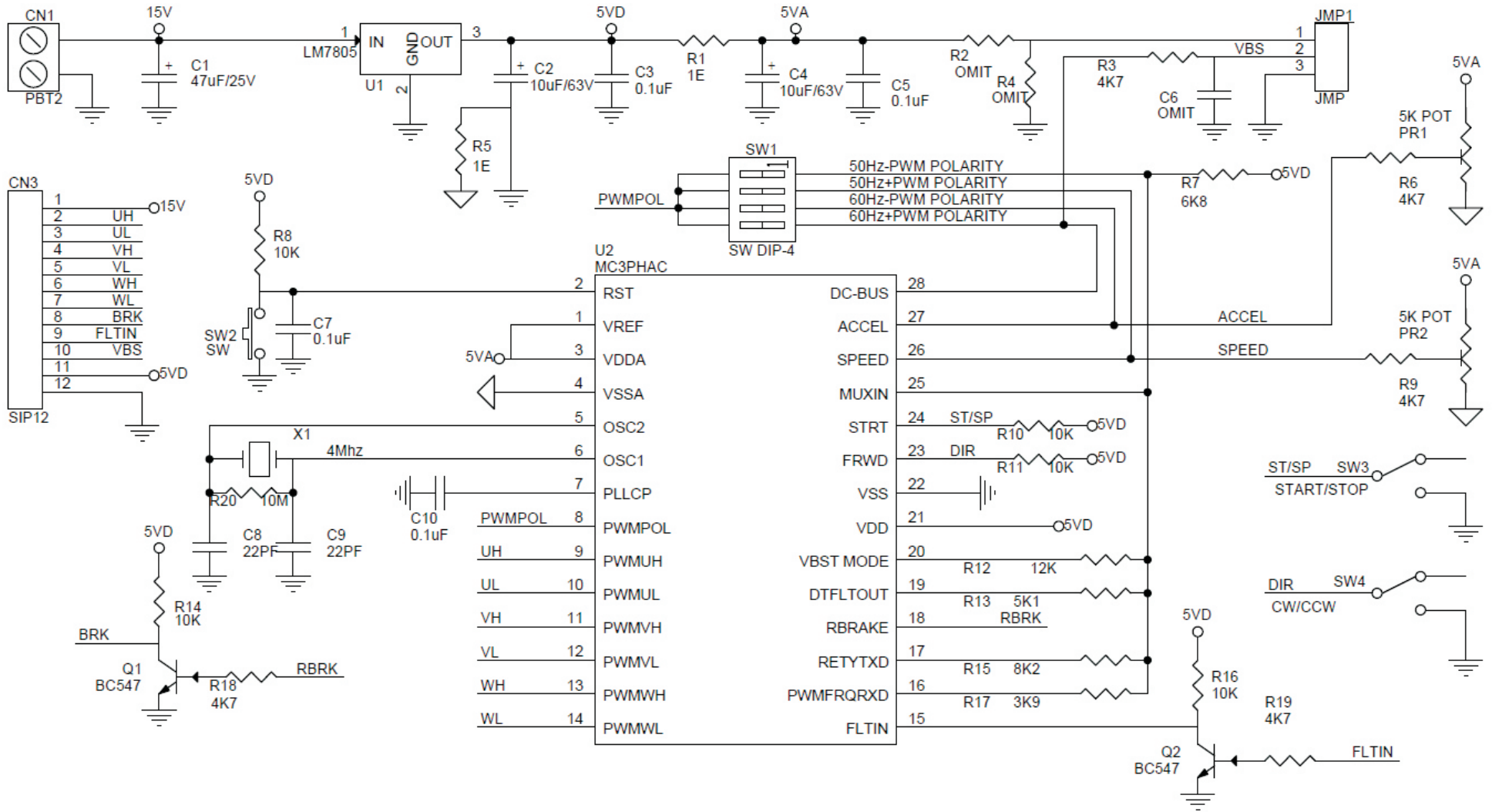
## 6 PWM PULSE GENERATOR FOR 3 PHASE AC MOTOR CONTROLLER

This project made using MCPHAC from NXP Semiconductor. The project generates 6 PWM signals for 3 Phase AC Motor controller. It's very easy to make professional VFD using the projects combining with Intelligent Power Module (IPM) or 3 Phase IGBT/MOSFET with Gate driver. The board provides 6 PWM signals for the IPM or IGBT Inverter and also brake signal. This board works in stand-alone mode and doesn't require any software programming/coding.

### Features

- Supply 7-15V DC
- Potentiometer provided to control the Motor Speed
- Default PWM Frequency 10.582 KHz , Can be Adjust between ( 5.291 kHz - 21.164 kHz)
- Potentiometer For Acceleration Adjust
- Slide Switch for Direction Control
- Slide Switch for Start/Stop
- 6 PWM Signals Output
- Default dead time 4.5uS
- Fault Retry Time 32.8 Seconds
- VBS Input (Bus Voltage Feedback) Under Voltage Control
- Fault In ( Over Current or Short Circuit Input)
- Volts-per-Hertz speed control
- Digital signal processing (DSP) filtering to enhance speed stability
- 32-bit calculations for high-precision operation
- Internet enabled
- No user software development required for operation
- 6-output pulse-width modulator (PWM)
- 3-phase waveform generation
- 4-channel analog-to-digital converter (ADC)
- User configurable for standalone
- Dynamic bus ripple cancellation
- Selectable PWM polarity and frequency
- Selectable 50/60 Hz base frequency
- Phase-lock loop (PLL) based system oscillator
- Low-power supply voltage detection circuit
- Included in the MC3PHAC are protective features consisting of dc bus voltage monitoring and a system
- Fault input that will immediately disable the PWM module upon detection of a system fault.





The MC3PHAC is a high-performance monolithic intelligent motor controller designed specifically to meet the requirements for low-cost, variable-speed, 3-phase ac motor control systems. The device is adaptable and configurable, based on its environment. It contains all of the active functions required to implement the control portion of an open loop, 3-phase ac motor drive. One of the unique aspects of this board is that although it is adaptable and configurable based on its environment, it does not require any software development. This makes the MC3PHAC a perfect fit for customer applications requiring ac motor control but with limited or no software resources available.

Included in the MC3PHAC are protective features consisting of dc bus voltage monitoring and a system fault input that will immediately disable the PWM module upon detection of a system fault.

All outputs are TTL signals, Input supply 5-15V DC, DC Bus voltage should be between 1.75V-4.75V, Dip switch provided to set the motor frequency 60 or 50 Hz also its helps to set the polarity of the output PWM Active Low or Active High, this helps to use this board with any kind of IPM modules since output can be set active low or high. Potentiometer PR2 help to adjust motor speed. Refer data sheet of the IC to change base frequency, PWM Dead Time, other possible parameters.

**Speed Control** — the synchronous motor frequency can be specified in real time to be any value from 1 Hz to 128 Hz by adjusting the PR2 potentiometer. The scaling factor is 25.6 Hz per volt. The SPEED pin is processed by a 24-bit digital filter to enhance the speed stability in noisy environments.

**Acceleration Control** — Motor acceleration can be specified in real time to be in the range from 0.5 Hz/second, ranging to 128 Hz/second, by adjusting the PR1 potentiometer. The scaling factor is 25.6 Hz/second per volt.

**Fault Protection** : The MC3PHAC supports an elaborate range of fault protection and prevention features. If a fault does occur, the MC3PHAC immediately disables the PWMs and waits until the fault condition is cleared before starting a timer to re-enable the PWMs. Refer to the graph in Figure 10 for the resistance value versus retry time from data sheet of the IC. Figure 10 assumes a 6.8 k $\Omega$  pull up resistor. In standalone mode, this timeout interval is specified during the initialization phase by supplying a voltage to the MUX\_IN pin while the RETRY\_TxD pin is being driven low. In this way, the retry time can be specified from 1 to 60 seconds, with a scaling factor of 12 seconds per volt

**External Fault Monitoring:** The FAULTIN pin accepts a digital signal that indicates a fault has been detected via external monitoring circuitry. A high level on this input results in the PWMs being immediately disabled. Typical fault conditions might be a dc bus over voltage, bus over current, or over temperature. Once this input returns to a logic low level, the fault retry timer begins running, and PWMs are re-enabled after the programmed timeout value is reached. FLTIN input pin 9 of the connector CN3 should be high to bring the fault pin low for normal operation.

**Bus Voltage Integrity Monitoring ( Input Pin 10 of the CN3)** The DC\_BUS pin is monitored at a 5.3 kHz frequency (4.0 kHz when the PWM frequency is set to 15.9 kHz), and any voltage reading outside of an acceptable window constitutes a fault condition. In standalone mode, the window thresholds are fixed at 4.47 volts (128 percent of nominal), and 1.75 volts (50 percent of nominal), where nominal is defined to be 3.5 volts. Once the DC\_BUS signal level returns to a value within the acceptable window, the fault retry timer begins running, and PWMs are re enabled after the programmed timeout value is reached. During power-up, it is possible that VDD could reach operating voltage before the dc bus capacitor charges up to its nominal value. When the dc bus integrity is checked, an under voltage would be detected and treated as a fault, with its associated timeout period. To prevent this, the MC3PHAC monitors the dc bus voltage during power-up in standalone mode, and waits until it is higher than the under voltage threshold before continuing. During this time, all MC3PHAC functions are suspended. Once this threshold is reached, the MC3PHAC will continue normally, with any further under voltage conditions treated as a fault.

**Note :** If dc bus voltage monitoring is not desired, a voltage of 3.5 volts  $\pm$  5 percent should be supplied to the DC\_BUS pin. To do this Use following components, R2 Should be 3.3Kohms, R4 4K7 Ohms, C6 0.1uF and close jumper between pin1 and pin 2.

**Regeneration Control** — Regeneration is a process by which stored mechanical energy in the motor and load is transferred back into the drive electronics, usually as a result of an aggressive deceleration operation. In special cases where this process occurs frequently (for example, elevator motor control systems), it is economical to incorporate special features in the motor drive to allow this energy to be supplied back to the ac mains. However, for most low cost ac drives, this energy is stored in the dc bus capacitor by increasing its voltage. If this process is left unchecked, the dc bus voltage can rise to dangerous levels, which can destroy the bus capacitor or the transistors in the power inverter. The MC3PHAC incorporates two techniques to deal with regeneration before it becomes a problem.

**Resistive Braking** The DC\_BUS pin is monitored at a 5.3 kHz frequency (4.0 kHz when the PWM frequency is set to 15.9 kHz), and when the voltage reaches a certain threshold, the RBRAKE pin is driven high. This signal can be used to control a resistive brake placed across the dc bus capacitor, such that mechanical energy from the motor will be dissipated as heat in the resistor versus being stored as voltage on the capacitor. In standalone mode, the DC\_BUS threshold required to assert the RBRAKE signal is fixed at 3.85 volts (110 percent of nominal) where nominal is defined to be 3.5 volts.

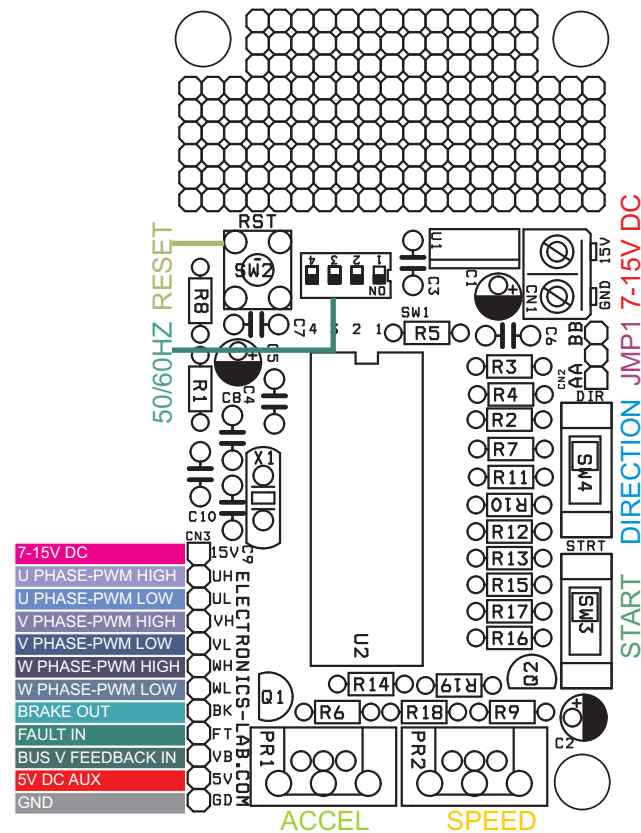
**Selectable PWM Frequency** — The MC3PHAC accommodates four discrete PWM frequencies and can be changed dynamically while the motor is running. This resistor can be a potentiometer or a fixed resistor in the range shown in Table In standalone mode, the PWM frequency is specified by applying a voltage to the MUX\_IN pin while the PWM\_FREQ\_RxD pin is being driven low. Table 4 from data sheet shows the required voltage levels on the MUX\_IN pin and the associated PWM frequency for each voltage range.

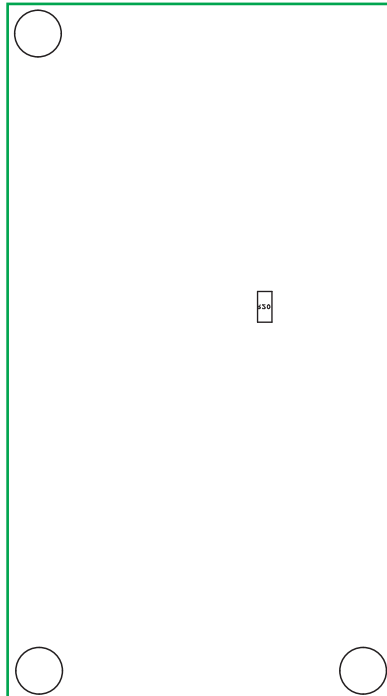
- PR1:** Potentiometer to set the Acceleration
- PR2:** Potentiometer for speed adjust
- SW1:** DIPX4 Switch to set the Frequency 60Hz/50Hz and Also Active low/Active High Output
- SW2:** Reset Switch
- SW3:** Start/Stop Motor
- SW4:** Direction Change CW/CCW of the Motor
- CN1:** DC Supply Input 7-15V DC
- CN2:** Bus Voltage Feed from IPM/IGBT Module for Over/Under Voltage Protection
- CN3:** Interface between IPM Module/IGBT Board Provides 6PWM Out, Brake out and Fault In

**Some target applications for the MC3PHAC include**

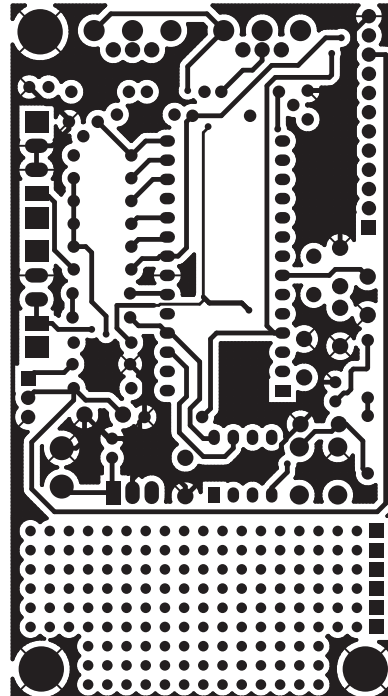
- Low horsepower HVAC motors
- Home appliances
- Commercial laundry and dishwashers
- Process control
- Pumps and fans

| BOM |       |                    |                           |
|-----|-------|--------------------|---------------------------|
| SR. | QNTY. | REF.               | DESC.                     |
| 1   | 1     | CN1                | 2 PIN SCREW TERMINAL      |
| 2   | 1     | CN2                | 3 PIN HEADER              |
| 3   | 1     | CN3                | 12 PIN HEADER             |
| 4   | 1     | C1                 | 47uF/25V                  |
| 5   | 2     | C2,C4              | 10uF/63V                  |
| 6   | 4     | C3,C5,C7,C10       | 0.1uF                     |
| 7   | 3     | R2,R4,C6           | OMIT                      |
| 8   | 2     | C8,C9              | 22PF                      |
| 9   | 2     | PR1,PR2            | 5K POT                    |
| 10  | 2     | Q1,Q2              | BC547                     |
| 11  | 1     | R1                 | 1E                        |
| 12  | 3     | R3,R6,R9           | 4K7                       |
| 13  | 1     | R5                 | 0E                        |
| 14  | 1     | R7                 | 6K8                       |
| 15  | 5     | R8,R10,R11,R14,R16 | 10K                       |
| 16  | 1     | R12                | 12K                       |
| 17  | 1     | R13                | 5K1                       |
| 18  | 1     | R15                | 8K2                       |
| 19  | 1     | R17                | 3K9                       |
| 20  | 2     | R18,R19            | 1K                        |
| 21  | 1     | SW1                | SW DIP-4                  |
| 22  | 1     | SW2                | TACT SWITCH               |
| 23  | 1     | SW3                | SLIDE SWITCH              |
| 24  | 1     | SW4                | SLIDE SWITCH              |
| 25  | 1     | U1                 | LM7805                    |
| 26  | 1     | U2                 | MC3PHAC                   |
| 27  | 1     | X1                 | 4Mhz                      |
| 28  | 1     | SC                 | 28 PIN DIP WIDE IC SOCKET |

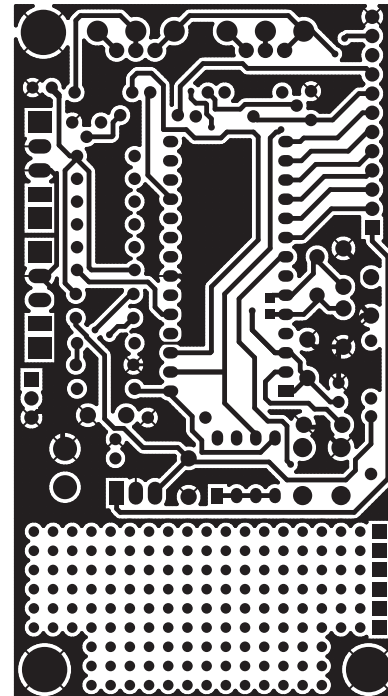




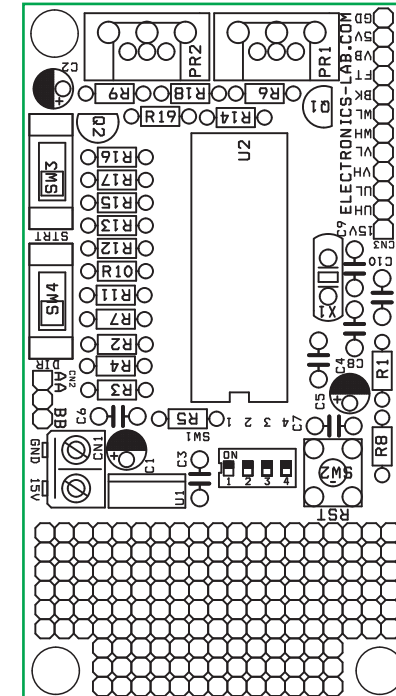
SILK SCREEN BOTTOM



TOP



BOTTOM



SILK SCREEN TOP

