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Si50HyUdMC1-30V-50A, Single, 30V 50A, Open-Loop, Hybrid, Unidirectional Motor Controller with 5kHz or 20kHz PWM, T-Chip

The **Si50HyUdMC1-30V-50A** is a 30V, 50A microprocessor based, Single, Open-Loop, Hybrid, Unidirectional, Motor-Controller board that uses 5kHz or 20kHz pulse-width modulation (**PWM**) to efficiently control the speed of a brush type DC motor (or load current) in the 0 to 1500W power range, and in 12.5W steps. An onboard microprocessor generates a 5kHz or 20kHz **PWM** carrier signal, controls the load-power (or motor speed) and controls the load-current rate (or motor acceleration and deceleration). The **PWM** carrier frequency is user selectable by the jumper **CN4**, 20kHz when **CN4** is open and 5kHz when short. The high frequency PWM rate provides a smooth speed control and insures a quiet motor environment. As the name hybrid (**Hy**) implies, the desired motor speed (or PWM pulse-duration) is set by a variable (0 to +5V) analog input-voltage $\mathbf{V_{I1,G}}$, providing a smooth motor-speed control from 0 to 100% in 0.833% steps; while the other control-signals are digital. This analog input ($\mathbf{V_{I1,G}}$) is zener-diode protected and includes an integrator with a time-constant of 0.01s; accordingly, this input can be driven with DC or PWM signals. The user can choose between slow or fast motor acceleration/deceleration modes by short-circuiting or open-circuiting the pins labeled **J1**. The slow mode, with rise-time/fall-time of 0.5s, is selected by short-circuit (**J1** jumper installed); while the fast buildup mode, with rise-time/fall-time of 0.025s, is selected by leaving these pins open (no Jumper installed). An onboard LED (red) is used to monitor the load-voltage. A small (3.0"x4.0"x1.0") finned heat-sink is required to operate 1200W power level (or at 30V and 40A) Higher current level levels (50A at 30V or 1500W) can be achieved with more efficient heat-sinks (5" x 5" x 1.5" finned heat sink). This board requires a single 9V to 30V DC unregulated power source at a 0A to 50A current range to operate normally. Typical applications are: DC Motor-Speed Controller, Light-Dimmer with variable delay, Power Amplifier, SPST Solid State Relay, etc. This board can be configured and programmed to perform efficiently in many customized applications.

Specification and Application for Si50HyUdMC1-30V-50A

- **Typical Operating Temperature at 50A and 5kHz:** 45^0C with MOSFETs bolted to a small (3.0"x4.0"x1.0") finned heat-sink, while the fins are exposed to ambient air at 25^0C (as shown on photograph).
- **Source-Voltage Requirement ($\mathbf{V_P}$ from pin +P to pin -P):** Any DC voltage from 9V to 30V, unregulated and unfiltered DC.
- **Average Load-Voltage:** Linearly variable from 0 to $\mathbf{V_P}$ in 0.83% steps, using $\mathbf{V_{I1,G}}$ as control input.
- **Average Load-Current:** 0A at 0% duty-cycle and 50A max. at 100% duty-cycle.
- **Load Isolation:** The Load or Motor must be isolated from the source voltage ($\mathbf{V_P}$).
- **Power-Conversion Efficiency:** Approximately 98.5% at full-load (30V and 50A).
- **PWM Switching Frequency:** 5kHz when **CN4** short and 20kHz when **CN4** open.
- **PWM Duty-Cycle:** varies linearly from 0% to 100% in 0.83% steps, using $\mathbf{V_{I1,G}}$ as control voltage (voltage at pin **I1** relative to pin **G** on connector **CN5**): where $\mathbf{V_{I1,G}}$ = 0V yields 0%, and $\mathbf{V_{I1,G}}$ = +5V, yields 100%. This input is zener-diode protected and includes an integrator with time-constant of 10mSec. Accordingly, this control input can be driven with DC or PWM input voltage. Note that the

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Duty-Cycle is defined as the ratio of the load-voltage on-time (t) to the switching period (T) times 100% (i.e. Duty-Cycle = (t /T)100%). These variables are defined and shown below.

- **Load-Current Step-Response Time:** The user can choose between slow or fast motor acceleration/deceleration modes by short-circuiting or open-circuiting the pins labeled **J1**. The slow mode, with rise-time/fall-time of 0.5s, is selected by short-circuit (**J1** jumper installed); while the fast buildup mode, with rise-time/fall-time of 0.025s, is selected by leaving these pins open (no Jumper installed).
- **Motor-Indicator:** An onboard LED (red) is used to monitor the motor (or load) voltage. .

About the Voltage Requirement: The Si50 will work with any DC motor or load in the 9V to 30V voltage range. In addition, the power filters are included on this board, consequently, only unfiltered (full-wave rectified) DC input power is required in most applications.

A Typical Application of the Si50HyUdMC1-30V-50A

In this application, the motor speed (or PWM pulse-duration) is linearly adjusted with the **Si5Pot1-5k** accessory (an external 1-turn 5kΩ pot); and efficiently controlling the motor power from 0 to 1500W in 12.5W steps. The DC Motor can be purchased from Bodine, **www.bodine-electric.com** ; or from other vendors, **http://www.e-motorsonline.com/emotors/dcmproduct_list.php**.

Warning: The connecting wires to the Motor and the Power Supply must be heavy gauge copper wire (#10 AWG or heavier) to handle the rated current level. In addition, these heavy gauge wires act as a heat sink, protecting the board from overheating.

An inexpensive, unregulated DC power supply design is shown in this application drawing. This power supply consists of a transformer, a 70A bridge rectifier and an optional capacitor (recommended with heavy loads) C=6800uF, 35V (www.digikey.com part number **493-1323-ND**). The secondary voltage and current rating of the transformer determines the DC voltage and current output of this power supply. Low-current output transformers can be purchased from www.mpja.com with the following part numbers: for 33V, 10A DC output use transformer **7846-TR**; for 16V, 4A DC output use transformer **7840-TR**. The component cost of this low-current output power supply is under $50. A wide variety of linear and switching power supplies can, also, be used with this board. Consult the most recent catalog on www.mpja.com to purchase these power supplies.