Si24HyBdMC1-50V-20A-FHS2, Open-Loop, 50V 20A, Hybrid, Bidirectional Motor Controller with Active Low Soft-Start and Soft-Stop Control, Integrated FHS2 Finned Heat Sink, LCD Port and with 5KHz or 20kHz PWM, Y-Chip

The **Si24HyBdMC1-50V-20A-FHS2** is a 50V 20A, microprocessor based, high-power, Hybrid, Bidirectional, Motor Controller with user selectable Soft-Start and Soft-Stop features. This controller uses a single (9V to 50V at 0 to 20A) DC power supply to control the speed of a DC motor in forward or reverse direction. An onboard microprocessor generates a 5kHz or 20kHz **PWM** carrier signal, controls the load-power (or motor speed), controls the load-current rate (or motor acceleration and deceleration), updates the Liquid Crystal Display (LCD) and monitors the user inputs. The **PWM** carrier frequency is user selectable by the jumper **J2**, 20kHz when **J2** is open and 5kHz when short. This high frequency PWM rate insures a quiet motor environment. 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 1.25Sec, is selected by short-circuit (**J1** jumper installed); while the fast buildup mode, with rise-time/fall-time of 0.05s, is selected by leaving these pins open (no Jumper installed). As the name hybrid (**Hy**) implies the required motor speed (or PWM pulse-duration) is variable from 0 to 100% in 0.83% steps using the analog voltage (\(V_{I,G}=0V=0\%PWM, V_{I,G}=+5V=100\%PWM\)), while the motor direction is selected using two active low digital (0 to +5V) control signals (\(V_{F,N}\) and \(V_{R,N}\)) or switches. All inputs are optically isolated or zener-diode protected. A bicolor LED is used to monitor the motor (or load) voltage (Red = Forward, Green = Reverse). An LCD port (with HITACHI HD44780 Interface Standard and with backlight) is provided for optional display of motor RPM data in a 2 line by 20 character format. A small (2.95"x2.95"x0.8") integrated finned heat-sink is used to operate at 20A current levels. Higher current levels (25A or 1200W) can be achieved with more efficient heat-sinks. Please click on this link and read the **Board Mounting Instructions and Heat Sink Selection Guide**. This board operates in a wide voltage-range (9V to 50V) at max. continuous load current of 20A. Typical applications are: Bi-directional DC Motor-Speed Controller, Peltier Effect TE Coolers, Heat Pumps, DPDT Solid State Relay, etc. This board can be configured and programmed to perform efficiently in many customized applications.

### Motor Control-Action Truth Table, (Pins on Connector CN4)

<table>
<thead>
<tr>
<th>(V_{F,N}) Voltage at Pin F relative to pin N</th>
<th>(V_{R,N}) Voltage at Pin R relative to pin N</th>
<th>Operation Mode of Motor or Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>(V_{F,N}=5V) or pin Open</td>
<td>(V_{R,N}=5V) or pin Open</td>
<td>Stop Rotation (Motor Open)</td>
</tr>
<tr>
<td>(V_{F,N}=0V) or (2mA) Sink</td>
<td>(V_{R,N}=5V) or pin Open</td>
<td>Forward Rotation with (V_{PWM}) Control</td>
</tr>
<tr>
<td>(V_{F,N}=5V) or pin Open</td>
<td>(V_{R,N}=0V) or (2mA) Sink</td>
<td>Reverse Rotation with (V_{PWM}) Control</td>
</tr>
<tr>
<td>(V_{F,N}=0V) or (2mA) Sink</td>
<td>(V_{R,N}=0V) or (2mA) Sink</td>
<td>Stop Rotation (Motor Open)</td>
</tr>
</tbody>
</table>

The motor action or load-current direction is controlled by active low control inputs, (0 to +5V) applied to Pin **F** (Forward) and/or pin **R** (Reverse) relative to Pin **N** (Neutral) on the Connector **CN4**. These pins are optically isolated from the H-Bridge, providing good noise immunity for these inputs. The control actions and the required voltage levels are defined by the Truth-Table listed above. All control lines
(analog and digital) are sampled approximately at 80Hz rate in the fast mode (J1 jumper open), and at 8Hz rate in the slow mode (J1 jumper short).

**Specification and Application of Si24HyBdMC1-50V-20A-FHS2**

- **Typical Operating Temperature at 20A**: 45°C with the Metal Heat-Ring Bolted to the FHS2 Finned Heat-Sink, while it is exposed to air at 25°C (as shown on photograph).

- **Source-Voltage Requirements**: $V_C$ (from pin +C to pin -P): 9V to 30V DC, and for $V_P$ (from pin +P to pin -P) 9V to 50V, both unregulated DC voltages. For low-voltage applications (9V to 30V) a single DC power supply can be used by connecting pin +P and pin +C together.

- **Average Load Voltage (from pin +L to pin -L)**: 0V at 0% Duty-Cycle and $V_P$ at 100% Duty-Cycle.

- **Max. Continuous Load Current**: 20A at 100% Duty-Cycle.

- **Max. Load Current for 5Sec**: 40A at 100% Duty-Cycle.

- **Two User Selectable Motor Acceleration/Deceleration Modes**: Using Jumpers, on Port J1.

- **Load Isolation**: The Load or Motor must be isolated from the source voltage ($V_P$).

- **Power-Conversion Efficiency**: Approximately 98.5% at full-load (50V and 20A).

- **Load-Current Indicator**: An onboard bicolor LED is used to monitor the motor (or load) voltage (Red = Forward, Green = Reverse).

- **About the Voltage Requirement**: The Si24 will work with any DC Load in the 9 V to 50 V range. In addition, the power filters are included on this board. Consequently, only unregulated DC input power is required in most applications.

**A Typical Application of the Si24HyBdMC1-50V-20A-FHS2**

In this open-loop application, the PWM or motor speed (in forward or reverse direction) is adjusted by an external linear 1-turn 5kΩ potentiometer (connected to port CN6, Signal Part number Si5Pot1-5k) and the motor direction is controlled by 4 external switches connected to port CN4 (as shown below). The normally-open switches select the motor direction, while the optional normally-closed limit-switches are included to prevent over-rotation in window-lifting applications. The LCD module can be ordered from Signal with the part number of Si24LCD2L20CH (2x20 display with 8” ribbon cable and 14-pin connector, and with back-light). Warning: The connecting wires to the Load and the Power Supply must be heavy gauge copper wire (#12 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.