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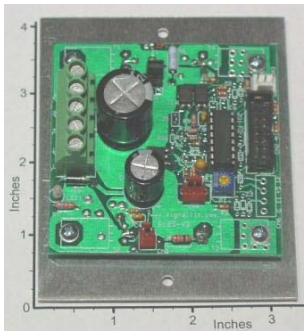
Si24HyTEPTC1-12B-50V-20A

12-Bit Hybrid, Thermo-Electric (TE), Proportional, Temperature Controller with RS232 LCD Port and with PWM, Y-Chip



The **Si24HyTEPTC1-12B-50V-20A** is a 50V 20A, microprocessor based, closed-loop, Hybrid, Thermo-Electric, Proportional Temperature Controller board that heats or cools a thermal-zone. **The temperature is measured with a 12-bit digital sensor and proportionally controlled with 0.0625^{0}C steps in the -25^{0}C to +102^{0}C range**. An efficient high-power H-bridge controls the current (in the 0 to +/- 20A range) to Peltier type Thermo-Electric (TE) cells, functioning as a bidirectional heat-pump. By proportional control, we mean that the amount of correction used in the closed-loop is proportional to the difference between the set and measured temperature values. Four user selectable proportional control grids **G0**,..,**G3** are used to control a wide range of thermal loads. Grid **G0** is used for small loads (typically: 10cm x 10cm x 10cm Aluminum block), and **G3** is for large thermal loads. The grid selection is defined by **Table 1, given below.** Each control grid consists of sixteen non-uniformly spaced temperature levels (centered at the set-temperature value) with eight PWM duty-cycle values are used to control the temperature in 0.0625^0 C steps. **The temperature overshoots and oscillations ("hunting") are limited to approximately + or - 0. 5^{0}C.** The temperature is sampled at approximately 1Hz rate and the control-loop/display is updated with the same rate. An onboard microprocessor measures and controls the temperature; monitors the user inputs; and drives a 2 line x 16 character LCD. A small 12-bit digital thermometer, Signal's part number **Si24DTsens-12B** (connected to port **CN3** and uses the Dallas Semi., DS18B20 sensor) is used to measure and control the temperature in the -25^{0}C to +102^{0}C range, with ½^0 C accuracy. Because this sensor is digital, it is virtually immune to noise and loading; ideally suited for remote sensing. This sensor uses a unique "1-wire interface" (with parasite power mode) that requires only 2-conductors for reliable remote (typical length of 20 meters) temperature sensing. As the name Hybrid (**Hy**) implies, the desired set-temperature is linearly adjusted with the **Si5Pot1-5k** **potentiometer** in the -25^{0}C=0V to +102^{0}C=+5V range, with ½^0 C=19.68mV steps. An LCD port (with 9600 Baud RS232 Interface Standard) is provided for display of the Set and Measured temperature data. The LCD can be order Signal under the part number of **Si14LCD2L16CH** (2-Line by 16-Char display with 12" cable and 4-pin connectors, and with back-light). A bicolor LED is used to monitor the TE cell (or load) voltage (Red = Heat, Green = Cold). This board operates with a single unregulated voltage source (9V to 50V range). A small Aluminum plate (3.3"x4.0"x0.065") is required to operate at 1000W power level. Higher power-levels can be achieved with more efficient heat-sinks. Typical applications are: Peltier Effect TE Coolers, Heat Pumps, etc. This board can be configured and programmed to perform efficiently in many customized applications.

Specification and Application of Si24HyTEPTC1-12B-50V-20A

- **Typical Operating Temperature at 20A:** 45^{0}C with the Metal Heat-Ring Bolted to a small Aluminum plate (3.3"x4.0"x0.065") acting as a Heat-Sink, while the plate is exposed to air at 25^{0}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 Current of $i_L(t)$:** 0A at 0% Duty-Cycle and 20A max. at 100% Duty-Cycle.
- **Load Isolation:** The Load or TE cell must be isolated from the source voltage (V_P).

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- **Power-Conversion Efficiency:** Approximately 98.5% at full-load (50V and 20A).
- **Set-Temperature** is adjustable with **a 5k Ohm potentiometer** in the -25^{0}C to +102^{0}C range, with 0. 5^0 C steps.
- **Measured-Temperature** is determined in the -25^{0}C to +102^{0}C range, with ½^0 C accuracy using the Dallas Semi. DS18B20 (in TO-92 casing) Digital Thermometer.
- **Four User Selectable Proportional Temperature Control Grids G0,..,G3 are Used:** Grid G0 is used for small thermal loads and G3 is used for large loads. Each control grid uses sixteen non-uniformly spaced temperature levels with eight PWM duty-cycle values, controlling the temperature with 0.0625^0 C steps. The temperature overshoots and oscillations ("hunting") are limited to approximately + or - 0. 5^0 C. The grid selection is defined by **Table 1, given below.**
- **Sampling Rate:** The temperature is sampled at approximately 1Hz rate and the control-loop/display is updated with this same rate.
- **Load-Current Indicator and Protection:** An onboard bicolor LED is used to monitor the motor (or load) voltage (red = heat, green = cold). The analog control inputs are zener-diode protected.
- **Alarm Kill Switch:** A normally open switch (or an Open Collector npn Transistor) can be connected to jumper **J2** (as shown below), **J2** Open=Normal operation, **J2** Short=Load (TE Cell) is open. The active pin on **J2** is pulled to +5V through a 4.7k Ohm resistor, while the other pin (G) is at ground.
- **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. Only unregulated DC input power is required in most applications.

Grid Selection, Table 1

Heat Jumper J4	Cole Jumper J3	Grid Number	Start Heat PWM at:	Start Cole PWM at:
Short	Short	G0	Set Temperature - 9.00 C	Set Temperature + 2.18 C
Short	Open	G1	Set Temperature - 9.00 C	Set Temperature + 1.32 C
Open	Short	G2	Set Temperature - 4.50 C	Set Temperature + 2.18 C
Open	Open	G3	Set Temperature - 4.50 C	Set Temperature + 1.32 C

Note that each jumper defines two heating and two cooling ranges centered at the Set Temperature. Heating and Cooling Pulse Width Modulation (PWM) starts when the measured temperature is within this user selected range; otherwise the PWM is 100%. This table controls the amount of power is applied to the TE cell as the measured temperature approaches the Set Temperature. Note this table is not uniform; because the TE cells are more efficient in heating mode than in cooling mode. The user can control temperature overshoots and oscillations ("hunting") by choosing the proper Grid Number for his application.

2-Line by 16-Character LCD Display Format:

An optional 2-Line by 16-Character serial LCD (**Si14LCD2L16CH**) can be connected to port CN2. This +5V, RS232 serial LCD operate at 9600 Baud rate with: 1 Start-Bit, 8 Data-Bits, 1 Stop-Bit, No Parity-Bit. A typical LCD display is given below:

Line 1: ST=+025.00 C Py
Line 2: MT=+025.00 C Gx

Where: ST=Set-Temperature, Py= PWM value in use, y=0=0%, y=1=12.5%, y=2=25.0%,… y=7=100%, MT=Measured-Temperature, Gx=Grid Number in use, x=0,1,2,3.

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A Typical Application of the Si24HyTEPTC1-12B-50V-20A

In this 12-bit, closed-loop, proportional temperature control application, the Set-Temperature is linearly adjusted (in the -25^{0}C=0V to +102^{0}C=+5V range, with 0. 5^{0}C=19.68mV steps) with the **Si5Pot1-5k potentiometer**, connected to port **CN6**. The Peltier type Thermo-Electric (TE) cell is functioning as a bidirectional heat-pump; operating with 12VDC (unregulated) at 20A max. The TE cells can be purchased from: **www.customthermoelectric.com/**. The temperature of the enclosed and insolated Hot/Cold Environment is measured with the Dallas Semi. DS18B20 (in TO-92 casing) Digital Thermometer, **Si24DTsens-Spec1-DS18B20**.This sensor can be purchased from Signal Consulting, LLC as **Si24DTsens-12B** (DS18B20 with 12" leads and connector). The LCD module can be ordered from Signal with the part number of **Si14LCD2L16CH** (2x16 display with 12" cable and 4-pin connectors, and with back-light). **Warning: The connecting wires to the Load and the Power Supply must be heavy gage copper wire (#12 AWG or heavier) to handle the rated current level. In addition, these heavy gage wires act as a heat sink, protecting the board from overheating.**