

### FEATURES

- High Output Voltage: 24V
- High Output Current: 10A
- High Efficiency: >98%
- High Temperature Stability:  $\pm 0.01^{\circ}\text{C}$
- Programmable Current Limit
- Complete Shielding
- 100 % Lead (Pb)-free and RoHS Compliant
- Compact Size:  $38.8 \times 34.5 \times 7.5$  (mm)
- SMT Package Available

### APPLICATIONS

High power TEC control with high temperature stability.

### INTRODUCTION

TEC (ThermoElectric Cooler) is a semiconductor device which can cool down or heat up the temperature of a target according to the direction of the current going through. By using our TEC controller, the target temperature can be regulated precisely by controlling the direction and magnitude of the current going through the TEC.

Our TEC controller, ATEC24V10A1, is an electronic module designed for driving high power TECs to achieve high temperature stability at high power efficiency. It has a wide input voltage range, 5V to 25V and allows setting the output current limit and set-point temperature by a voltage signal. The set-point temperature range can be programmed externally by using only 3 resistors. A formula is given for calculating the values of these resistors according to the R-T characteristics of the thermistor and the set-point temperature range required.

Both the output current flowing through the TEC and the voltage difference across the TEC can be monitored simultaneously by two analog voltage signals respectively. Please notice that the TEC voltage indication circuit is still working when the TEC drive circuit is disabled by pulling the SDN pin half way low (detail descriptions are given in later sections). In this way, the TEC's Sebeck voltage is measured, thus, the temperature difference between the two TEC side plates can be derived. The TEC's health strength and/or the thermal load status can also be derived from the Sebeck voltage measured.

This controller comes with another useful feature: temperature good indication. When the target temperature equals to the set-point temperature, an indication voltage is set high, on the TMPG pin (#2), see Figure 1 below.

In order to achieve high temperature stability and high response speed, a compensation network is utilized for matching the thermal load characteristics. This network is implemented by using external components so that the network parameters can be set differently for different

thermal loads.

A high stability low noise 2.5V reference voltage is provided by the controller for setting the output current limit and set-point temperature. This reference can also be used as the voltage reference for external ADCs (Analog to Digital Converters) and DACs (Digital to Analog Converters).

The ATEC24V10A1 has a switch mode output stage. Its switching frequency can be synchronized by an external clock signal in order to eliminate any possible beating noise on the power supply rails. The synchronization port outputs a clock signal, which is triggered by the switching signal of the switch mode output stage and can be used as the source clock signal for synchronizing other switch mode electronics module.

The ATEC24V10A1 is packaged in a 6 sided metal enclosure, which blocks EMIs (Electro-Magnetic Interferences) to prevent the controller and other electronics from interfering each other.

Figure 1 is the **actual size** top view of the ATEC24V10A1, which shows the pin names and locations. Its thickness is 7.5mm.

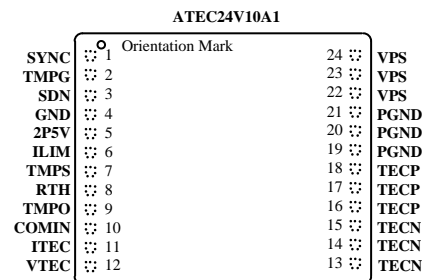


Figure 1. Pin Names and Locations

This TEC controller has 2 types of mounting styles: through hole mount and surface mount. The former can be soldered by wave solder process; **the latter must be soldered manually, not by standard reflow solder process.**

### SPECIFICATIONS

- Maximum output voltage: 0.98xVps (power supply voltage)
- Output current limit: 0.04A – 10A
- Temperature stability:  $\pm 0.01^{\circ}\text{C}$
- Efficiency at full load:  $\geq 98\%$
- Set-point temp. range: externally programmable
- Power supply voltage: 5V to 25V
- Output ripple voltage: <40mVp-p
- Package style: through hole or SMT
- Operating ambient temp. range:  $-25^{\circ}\text{C}$  to  $65^{\circ}\text{C}$



PIN FUNCTIONS

#	Name	Meaning	Type	Usage Description	Note
1	SYNC	Synchronization	Digital input and output	This serves as both synchronization input port and provides synchronization output signal as well.	
2	TMPG	Temperature good	Digital output	When the actual target temperature equals to the set-point temperature, this pin is set to logic high. It can be used for driving an LED directly or send it to an microcontroller's input port.	
3	SDN	Shut down negative logic	Digital input	Sets this pin low will shuts down the whole controller.	
4	GND	Ground	Ground	Connect all control signal related ground to here.	
5	2P5V	2.5V	Analog output	Reference voltage.	
6	ILIM	Current limit set	Analog input	Sets the current limit.	
7	TMPS	Temperature set	Analog input	Sets the set-point temperature.	
8	RTH	Thermistor resistor	Analog input	Receives temperature sensing signal. See the application section for more detail.	
9	TMPO	Temperature output	Analog output	This voltage is proportional to the actual target temperature.	
10	COMIN	Compensation input	Analog input	Connects the compensation network central tab to here as shown in Figure 3.	
11	ITEC	TEC current output	Analog output	This voltage is proportional to the TEC current.	
12	VTEC	TEC voltage output	Analog output	This voltage is proportional to the TEC voltage.	
13	TECN	TEC negative terminal	Power input	Tie all these pins together and connect them to the negative terminal of the TEC.	
14					
15					
16	TECP	TEC positive terminal	Power input	Tie all these pins together and connect them to the positive terminal of the TEC.	
17					
18					
19	PGND	Power ground	Power ground	Tie all these pins together and connect them to the return terminal of the power supply.	
20					
21					
22	VPS	Power supply voltage	Power input	Tie all these pins together and connect them to the positive terminal of the power supply.	
23					
24					



#### APPLICATIONS INFORMATION

A typical application schematic is shown in Figure 2.

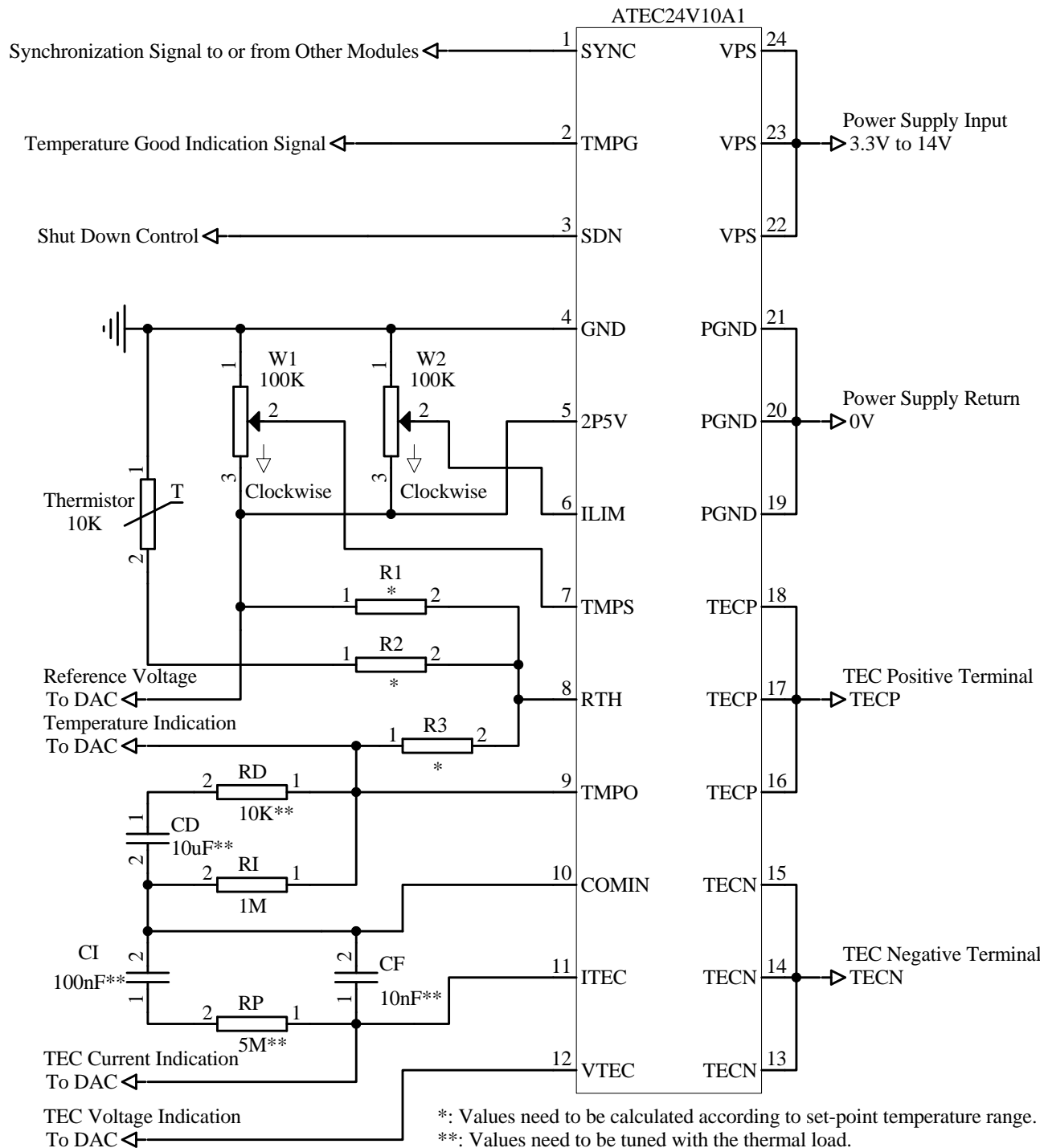


Figure 2. A Typical Stand-alone Application Schematic



Turning the Controller On and Off

The controller can be turned on and off by setting the SDN pin high and lower respectively. It is recommended to turn the controller on by this sequence:

To turn on: turn on the power (by providing the voltage at the VPS pins), then turn on the controller by using the SDN pin.

To turn off: turn off the controller by using the SDN pin, then turn off the power.

The user can choose not to control the controller's SDN pin by leaving it unconnected. There is an internal pull up resistor of 100K, pulling this pin up to an internal 5V power supply.

The user can also use an open drain output, or simply use a SPST switch, to pull the SDN pin down for turning off the controller.

Setting the Output Current

The maximum output current magnitude, for both heating and cooling mode, is set through a DC voltage on the ILIM pin (#6). The input impedance of this pin is >10MOhm. This pin can be set by a potentiometer as shown in Figure 3 or by an DAC. The relationship between the set voltage and the output current limit is:

Iout\_max = ILIM/2.5V\*10A.

When needing the maximum output current to be 10A, simply tying this pin, ILIM, to the reference voltage, 2P5V (#5).

Please notice that the operating voltage range for this pin is 0.1V to 2.5V. Therefore, the minimum output current 0.04A.

Setting the Set-point Temperature

The same as setting the current limit as described above, the set-point temperature can also be set by using a potentiometer or a DAC. The relationship between the set voltage and the set-point temperature is given in the next paragraph.

Setting the Set-point Temperature Range

Depending on the applications, usually the target temperature needs to be adjust within certain range. After know this temperature range, the input temperature network can be designed.

Based on the temperature sensor utilized for sensing the target temperature, the input temperature measurement network must be designed differently.

A. Using an NTC Thermistor as the Temperature Sensor

The NTC (Negative Temperature Coefficient) thermistor is the most common temperature sensor used in practice for sensing the temperatures. The temperature measurement

circuit for interfacing with the NTC thermistors is shown in Figure 2.

This is the way for calculating the values of the 3 resistors in the network, R1, R2, and R3.

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B. Using an RTD as the Temperature Sensor

C. Using a Silicon IC as the Temperature Sensor

D. Using a Thermal Couple as the Temperature Sensor

Compensation Network Design and Tuning

Output Current Monitoring

Output Voltage Monitoring

Seaback Voltage Measurement

Frequently Asked Questions

### Mounting the module on PCB

#### A. Through hole package

Figure 3 is the side view of this package.

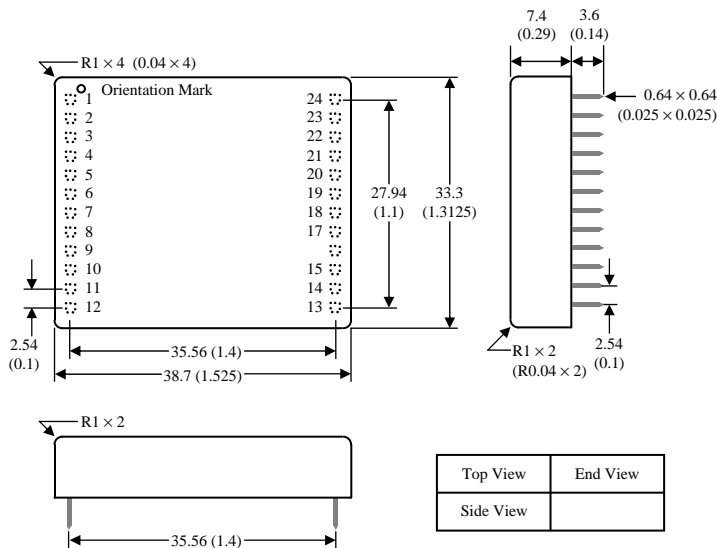


Figure 3. Mechanical Drawings for ATEC24V10A1

It would be better for heat dissipation purpose to lay out a few copper fills as shown in Figure 5. If PCB space permits, place the copper fills on both layers and make them as large as possible. Under a full load, i.e. 10V 10A output, the module needs to dissipate about 3W of power. The temperature rise without any heat sinking is about 25°C.

It should be noted that most of the heat inside the module is internally conducted to pin 13 to 24.

#### B. SMT package

The ATEC25V10A1-S has an SMT package. However, being called SMT package, **it cannot be soldered by a reflow oven, and must be soldered manually by a conventional solder iron.**

The mechanical dimensions are shown in Figure 4 and the recommended PCB foot-print is shown in Figure 5, where the copper fills is for helping dissipate the heat from the module. As mentioned above that most of the heat inside the module is internally conducted to pin 16 to 24.

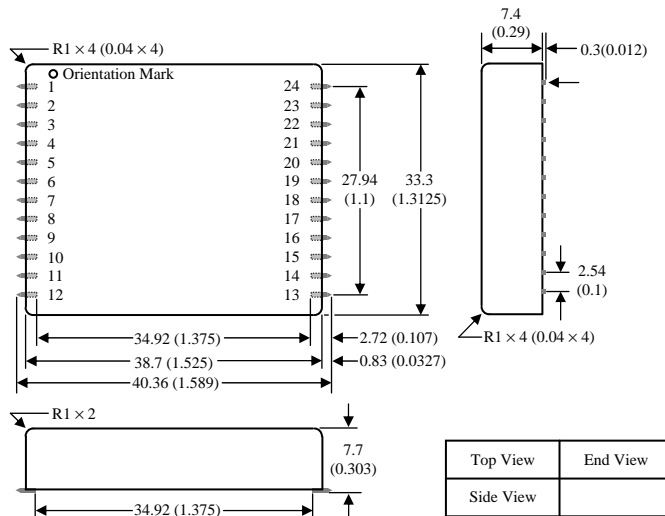


Figure 4. Mechanical Drawings for ATEC24V10A1

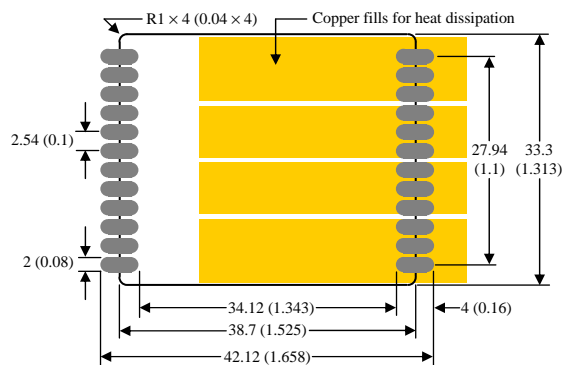


Figure 5. Recommended Foot-print for the SMT Package



ORDERING INFORMATION

Part #	Description
ATEC24V10A1-D	Controller in DIP package
ATEC24V10A1-S*	Controller in SMT package*

\* This surface mount package cannot be soldered by reflow oven. It must be soldered manually with the iron temperature < 610°F (≈321°C).

PRICES

Quantity	1 – 9	10-49	50-1 99	200 – 499	≥500
ATEC24V10A1-D	\$320.0	\$304.0	\$288.0	\$272.0	\$256.0
ATEC24V10A1-S	\$320.0	\$304.0	\$288.0	\$272.0	\$256.0

EVALUATION BOARD

In order to evaluation the ATEC24V10A1 with convenience, an evaluation board is available.

The part number is: ATEC24V10A1EV-D or ATEC24V10A1EV-S. The former is for evaluating the DIP package controller; the latter is for evaluating the SMT type.

It comes with:

1. A configurable temperature measurement network, which configures the set-point temperature range.
2. A tunable compensation network, which can be tuned to match the thermal load, thus, achieving the highest thermal response speed and maintain highest temperature stability as the thermal load and/or ambient temperature changes.

The datasheet of this evaluation board can down-loaded on our website.

**Please notice that there 2 types of connection designs: DIP socket and SMT soldering pads, the former is for evaluating DIP package controller and the latter is for the SMT version. For the DIP type, the controller can be plugged and unplugged conveniently, but the SMT version can only be soldered for mounting it on and desoldered for taking it off the board. Therefore, it is recommended to use the DIP type for evaluation purpose.**

For the users who need SMT package in the application but do not want to purchase the DIP package controller only for evaluation, there is a free loan program we offer:

1. Pay us a down payment for the full price or send us a P.O. if there is an account set up in our system, we send the controller with the evaluation board.
2. Evaluate it for 30 days free of charge, send it back after using and we will refund the payment.



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