Figure 1. Photo of ATW5V4A311D

FEATURES

- The World's First Window Based TEC Controller – shuts down itself when the object temperature is within a pre-set temperature window
- Seebeck Voltage Available for Measuring TEC plates' Temperature Difference
- Programmable Maximum Output Voltage: up to ±VPS
- Switching Frequency Synchronizable with an External Signal Source
- Configurable Set-point Temperature Window
- High Efficiency: ≥ 90%
- Actual Object Temperature Monitoring
- Completely Shielded
- Compact Size
- Both DIP and SMT Packages are Available

DESCRIPTIONS

The ATW5V4A311 is a window based TECs (Thermo-Electric Coolers) controller to regulate the target temperature to be within a preset window. When the target temperature is within the window, the TEC is set to an energy saving standby mode; when the target temperature reaches the upper bound of the temperature window, the controller cools down the target; when the target temperature reaches the lower bound of the window, the controller heats up the target, as shown in Figure 2.

The ATW5V4A311 provides interface ports for users to set the desired temperature window range, from 10°C ~ 40°C as default; the maximum output voltage, and the maximum output current.

The ATW5V4A311 provides these functions: thermistor T-R curve linearization, temperature measurement, and target temperature monitoring, temperature control loop status indication, TEC voltage and current monitoring, switching frequency synchronization input and output, soft start, and shut down.

The ATW5V4A311 comes with a 2.5V voltage reference which can be used for setting the parameters for the controller, or by DACs (Digital to Analog Converters) or ADCs (Analog to Digital Converters) as the voltage reference. When using this reference voltage for setting the set-point temperature window by a resistor divider, a potentiometer, or an DAC, or use an ADC for measuring the target temperature, the error is independent of this reference voltage. This is because that the internal temperature measurement network also uses this voltage as a reference. The errors caused by the reference voltage in setting the temperature and/or measuring the temperature cancel with each other. Therefore, it is highly recommended to use the controller's reference voltage for setting the temperature window or by the ADCs and the DACs as the voltage references.

The ATW5V4A311 is packaged in a 6 sided metal enclosure which blocks EMIs (Electro-Magnetic Interferences) to prevent the controller and other electronics from interfering with each other. The metal case is internally grounded.

Figure 3 is the top view of the controller showing the pin names and locations. The ATW5V4A311 pin functions are shown in Table 1.

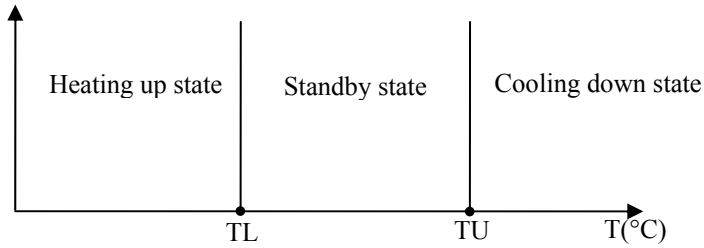

Figure 2. States of ATW5V4A311 in Temperature Steps

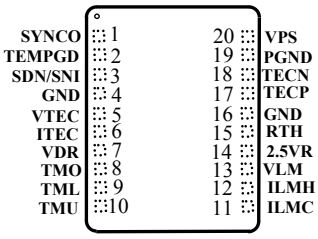

Figure 3. Pin Assignment

Table 1. Pin Function Descriptions

Pin #	Pin Name	Type	Description
1	SYNCO	Digital output	Synchronization output. Synchronizes input of another SM controller.
2	TEMPGD	Digital output	Temperature good indication. It is pulled high when the set-point temperature and the actual desired object temperature are < 0.1°C in temperature difference. When the set-point temperature range is 20°C; or < 3mV in voltage difference between the voltages of TMO and TEMPSP nodes. On this pin, there is an internal pull up resistor of 10K tied to the VPS rail. When going low, this pin is pulled down by an open drain FET with a resistance of 250Ω @ VPS = 5V.
3	SDN/SNI	Digital input	Optional clock input. SYNC frequency is set by a digital clock or by SYNOC pin from another controller. If SYNC not used, this pin can be used as shutdown. Drive pin low to put the controller into shutdown mode, and drive high to turn on module.
4	GND	Ground	Signal ground for the Potentiometers, ADC, DAC and the thermistor.
5	VTEC	Analog output	TEC voltage indication. VTEC is an analog voltage output pin with a voltage proportional to the actual voltage across the TEC. A center VTEC voltage of 1.25V corresponds to 0V across TEC. The output voltage is calculated as: VTEC voltage = 1.25 + 0.25 × (TECP – TECN).
6	ITEC	Analog output	TEC current indication. ITEC is an analog voltage output pin with a voltage proportional to the actual current through the TEC. ITEC center voltage is 1.25V and corresponds to 0A through the TEC. The output voltage is calculated as: ITEC voltage = 4 × (VITEC – 1.25).
7	VDR	Analog input	Compensation input pin for the thermal control loop.
8	TMO	Analog output	Compensation input pin for the thermal control loop. Actual object temperature. It swings from 0V to VPS, corresponding to 10°C to 40°C when VPS equals to 5V.
9	TML	Analog input	To set the lower limit temperature for the temperature limiting window.
10	TMU	Analog input	To set the upper limit temperature for the temperature limiting window.
11	ILMC	Analog input	To set the limit current for cooling, and the maximum value can be calculated as: ILMC = (50 + 2.5R1) / (40 + R1). (The unit of R1 is KΩ).
12	ILMH	Analog input	To set the limit current for heating, and the maximum value can be calculated as: ILMH = 50 / (R2 + 40). (The unit of R2 is KΩ).
13	VLM	Analog input	Sets maximum output voltage across TEC. To protect the TEC from being overdriven, adjust the VLM voltage. The maximum voltage applied across the TEC can be limited. This voltage is VVLM = VTMAX / 5. VVLM is the voltage set at the VLM pin. VTMAX is the maximum voltage across the TEC. For example, to set a maximum TEC voltage equal to 4V, use the following equation: VVLM = 4 / 5 = 0.8V.
14	2.5VR	Analog output	Reference voltage output is 2.5V. It can be used by a Potentiometer or DAC for setting the set-point temperature window voltages on the TMU and TML pins and/or a DAC for measuring the temperature through the TMO pin. The maximum sourcing current capability is 1.5mA and the maximum sinking is 4mA with a stability of <50ppm/°C max.
15	RTH	Analog input	Connect to the thermistor for sensing the desired object temp. Thermistors the other end connects to the signal ground, pin 4 or pin 16. Rth = 10KΩ @ 25°C. Other thermistors or temperature sensors can also be used, consult with us.

16	GND	Signal ground	Signal ground, internally connected to Pin 4 GND. It can be used for connecting the thermistor.
17	TECP	Analog power output	Connects to TEC positive terminal.
18	TECN	Analog power output	Connects to TEC negative terminal.
19	PGND	Power ground	Power ground for connecting to the power supply.
20	VPS	Power input	Power supply. The value is 5V.

SPECIFICATIONS

Table 2. Characteristics ($T_{ambient}$ = 25°C)

Parameter	Test Condition	Value	Unit/Note
Window temperature default range (When ordering, it can be specified.)		10 ~ 40	°C
Default setting voltage range for TML and TMU inputs		0.1 ~ 2.4	V
Hysteresis voltage between trigger-in and trigger-out voltage for the TMO voltage		0.1	V
Object* temp. stability vs. ambient temp	VPS=5V, R_{load}=0.8Ω	0.0002	°C/°C
Object temp.vs.set-point.offset	$T_{ambient}$ is 0 ~ 50°C, set-point temp. is 10°C ~ 40°C	±0.1	°C
Module Thermal Resistance		10.59	°C/W
Object temp. response time	≤0.1 to the set-point temperature at a 1°C step	< 5S	S
Efficiency	VPS=5V, R_{load}=0.8Ω	≥ 94%	-
Max. output current	VPS=5V, R_{load}=0.8Ω	2.5	A
Max. output voltage	VPS=5V, R_{load}=0.8Ω	0 ~ (VPS - 0.3)	V
Power supply voltage	—	4.75 ~ 6 (specify 5V)	V
Set-point temp.** control voltage	V_{in}=5V, R_{load}=0.8Ω	0.1 ~ VPS	V
Default set-point temp. range***		10 ~ 40	°C
Operating ambient temp. range	V_{in}=5V, R_{load}=0.8Ω	-25 ~ 85	°C

* Object temperature refers to the actual cold side temperature of the TEC, on where the object is mounted.

** Set-point temperature is the temperature desired to have on the object.

*** Can be customized to any range according to requirement.

BLOCK DIAGRAM

The block diagram of the controller is shown in Figure 4.

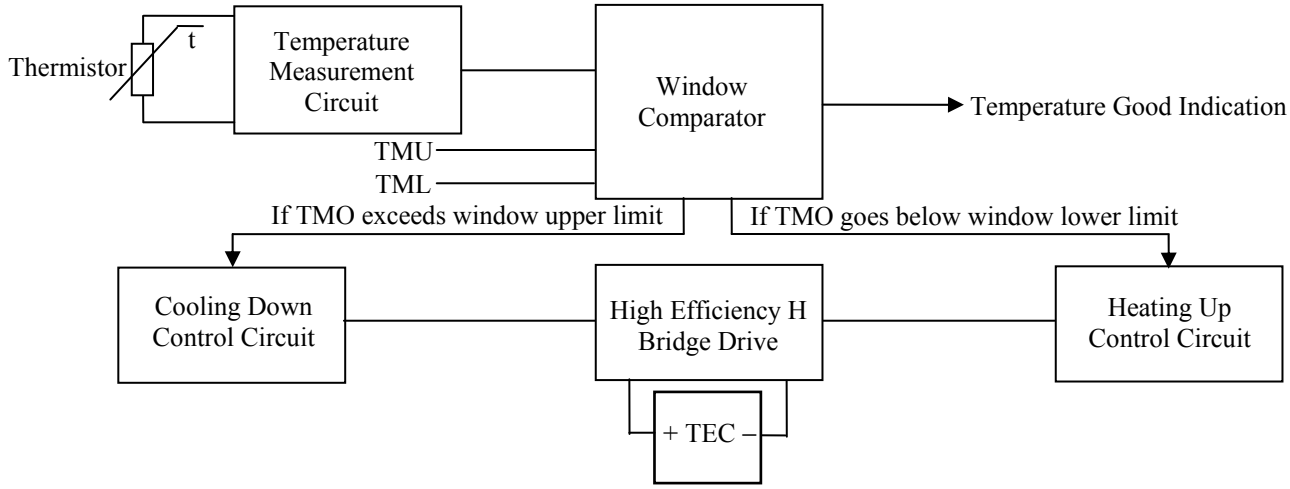

Figure 4. Window TEC Controller Block Diagram

APPLICATIONS

TEC controller connections are shown in Figure 5.

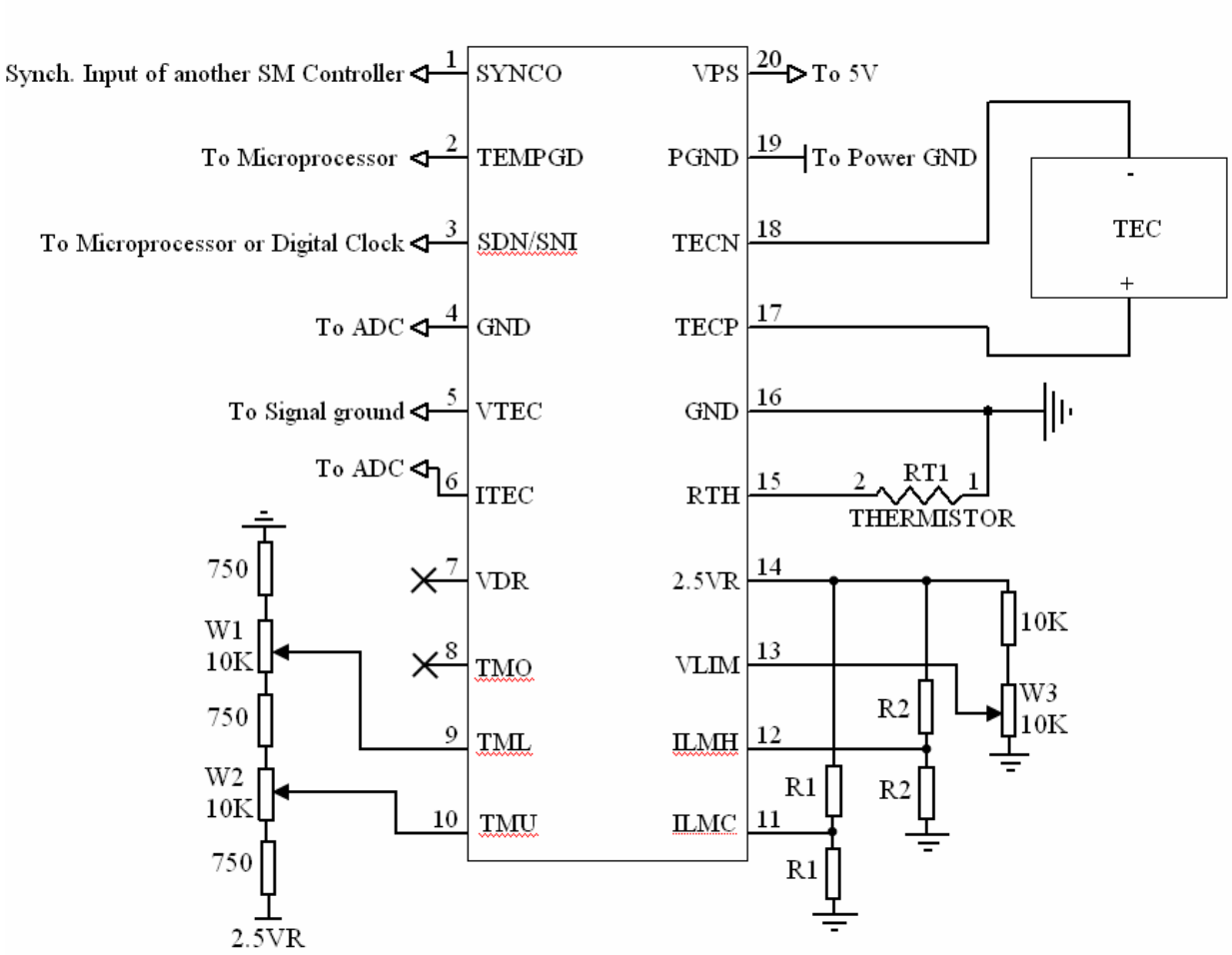

Figure 5. TEC Controller Connections

If you want to use this TEC controller for other applications not discussed here, such as use it with wave locker controllers, please consult with us. The same as to other customizations, such as setting the TMU and TML by using a voltage source swings above 2.5V and/or VPS.

TYPICAL CHARACTERISTICS

Table 3. Measurement Datas of Rth vs. Temperature

Temperature	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Rth	26.49	25.44	24.44	23.48	22.56	21.68	20.83	20.02	19.42	18.5	17.78	17.1	16.44	15.81	15.21	14.63	14.07
Temperature	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Rth	13.54	13.03	12.54	12.07	11.62	11.19	10.78	10.38	10	9.635	9.286	8.95	8.629	8.32	8.024	7.74	7.746
Temperature	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Rth	7.205	6.954	6.714	6.481	6.258	6.044	5.839	5.641	5.451	5.269	5.093	4.924	4.762	4.605	4.455	4.455	4.171

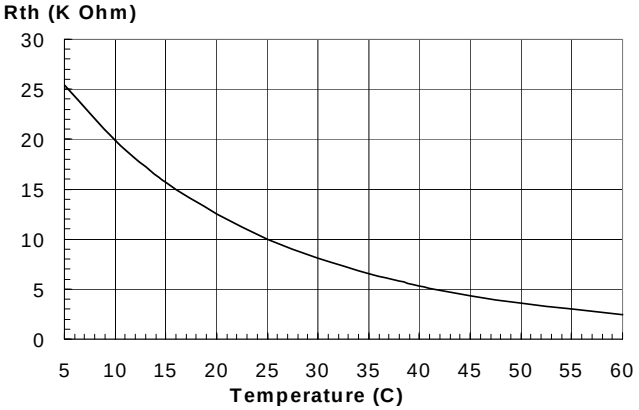

Figure 6. Rth vs. Temperature

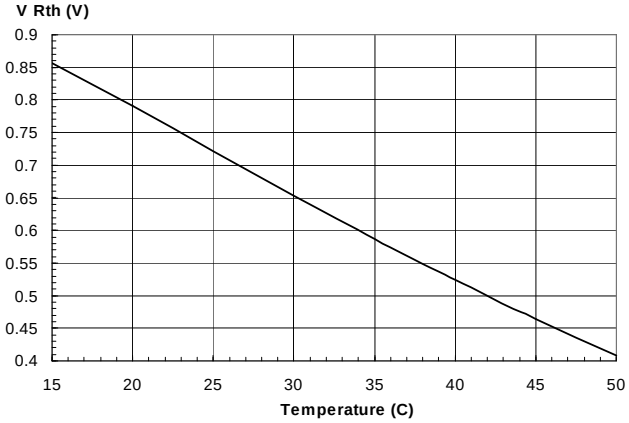

Figure 8. V_{Rth} vs. Temperature

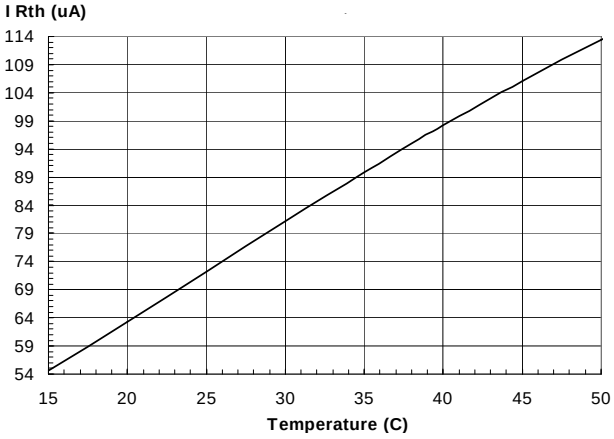

Figure 7. I_{Rth} vs. Temperature

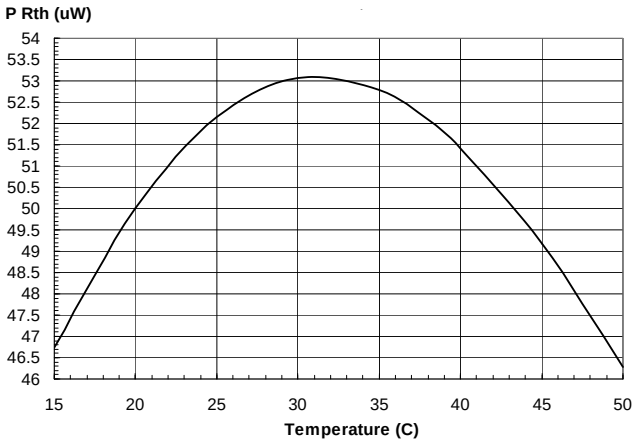

Figure 9. P_{Rth} vs. Temperature

MECHANICAL DIMENSIONS

The controller comes in 2 packages: DIP and SMT. The controller named ATW5V4A311D indicates the DIP packaged one, and the controller named ATW5V4A311S indicates the SMT packaged one. Dimensions of the DIP packaged controller is shown in Figure 10, dimensions of the SMT packaged controller is shown in Figure 11.

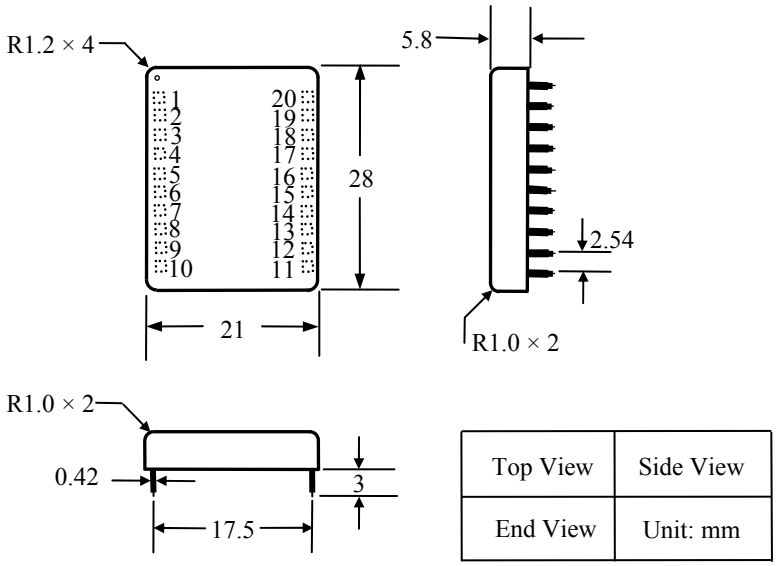

Figure 10. Dimensions of the DIP Package Controller

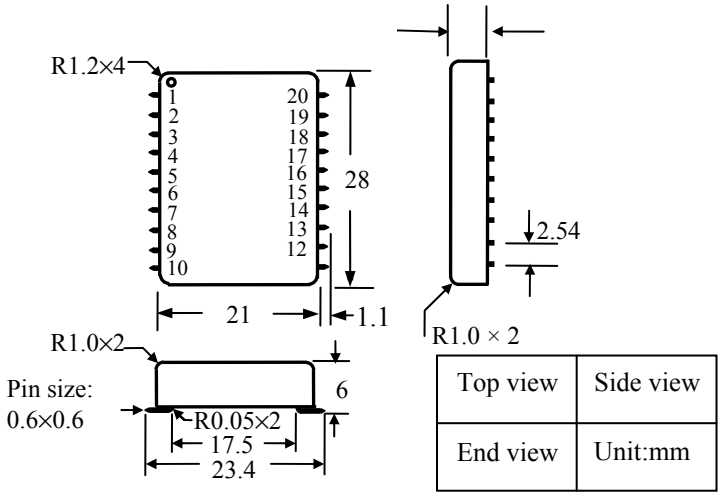

Figure 11. Dimensions of the SMT Package Controller

ORDERING INFORMATIONS

Table 4. Part Number

Part #	Description
ATW5V4A311D	It has a maximum output current of 4A and is packed in DIP package.
ATW5V4A311S	It has a maximum output current of 4A and is packed in SMT package.

Table 5. Unit Price

Part # \ Price	1 - 9	10 – 49	50 - 199	200 - 499	≥500
ATW5V4A311D	$92.4	$87.2	$81.9	$76.7	$71.4
ATW5V4A311S	$92.4	$87.2	$81.9	$76.7	$71.4

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7. After many experiment, according to the parameter and the figuring method of R_{load}, we advice customers to use R_{load} of 0.8Ω. We advise customers to use voltage of 6V as the power supply.