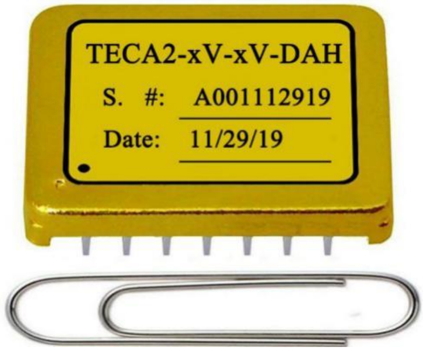

Figure 1. Physical Photo of TECA2-xV-xV-DAH

FEATURES

- High Efficiency: ≥90%
- Maximum Output Current: 1.5A
- Maximum Output Voltage: V_{VPS} – 0.3V
- Actual Object Temperature Monitoring
- High Stability: 0.01°C
- High Precision
- High Reliability
- Zero EMI
- Compact Size
- 100 % lead (Pb)-free and RoHS compliant

DESCRIPTION

The TECA2-xV-xV-DAH is an electronic module designed for driving TECs (Thermo-Electric Coolers) with high stability in regulating the object temperature, high energy efficiency, zero EMI, and small package. Figure 1 is the photo of an actual TECA2-xV-xV-DAH.

The module provides interface components for users to configure desired object temperature range, i.e. set-point temperature range; maximum voltage across TEC, i.e. maximum TEC voltage; and the compensation network. The compensation network compensates the high order thermal load and thus stabilizes the temperature control loop.

It provides these functions: thermistor T-R curve linearization, temperature measurement and monitoring, temperature control loop status indication, TEC voltage monitoring, power up delay, and shut down.

The TECA2-xV-xV-DAH comes with a high stability low noise 3.0V voltage reference which can be used for setting the desired object temperature by using a POT (Potentiometer) or a DAC (Digital to Analog Converter). When using this reference for setting the set-point temperature, the set-point temperature error is independent of this reference voltage. This is because the internal temperature measurement network also uses this voltage as the reference, the errors in setting the temperature and measuring the temperature cancel with each other, setting the object temperature with higher stability. This reference can also be utilized by an ADC (Analog to Digital Converter), for the same reason, the measurement error will also be independent of the reference voltage, resulting in a more accurate measurement.

Figure 1 is the photo of the actual TECA2-xV-xV-DAH controller. Figure 2 is the real size top view of the controller showing the pin names and locations with the actual size. The pin functions are shown in Table 1.

Warning: This controller module can only be soldered manually on the board by a solder iron of < 310°C (590°F), it cannot go through a reflow oven process.

The TECA2-xV-xV-DAH 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.

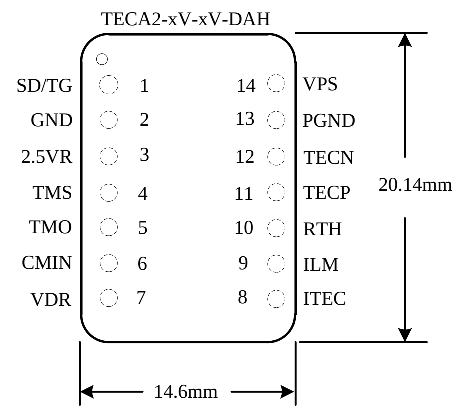

Figure 2. Pin Names and Locations

SPECIFICATIONS

Table 1. Pin Function Descriptions

Pin #	Pin Name	Type	Description
1	**SD/TG**	Both analog input and output	Shutdown/Temperature good. When this pin is pulled low, the device shuts down. If this pin is left unconnected: When the actual temperature is lower than the preset temperature, the output voltage is $0.5V_{VPS}$; when the actual temperature reaches the preset one, the output voltage is V_{VPS}.
2	**GND**	Ground	Signal ground for the POT, ADC, DAC and the thermistor.
3	**2.5VR**	Analog output	2.5V Reference Output.
4	**TMS**	Analog input	Object set-point temperature input port. It is internally tied by a 500k resistor to the half value of the reference voltage, 1.25V. The open circuit voltage of this pin is thus 1.25V, corresponding to a set-point temperature of 25°C by using the default temperature network (with the set-point temperature range being from 15°C to 35°C). It is highly recommended to set this pin's voltage by using the controller's voltage reference. The lower limit of the setting voltage for this pin is 0.1V. Setting this pin to a <0.1V voltage may cause the controller over cooling the object.
5	**TMO**	Analog output	Actual object temperature. 0.1V to 2.5V indicates the default temperature network from 15°C to 35°C.
6	**CMIN**	Analog input	Compensation input pin for the thermal control loop. Leave it open in production.
7	**VDR**	Analog output	When V_{VDR} is $< 0.5V_{REF}$, it is in cooling mode; when V_{VDR} is $> 0.5V_{REF}$, it is in heating mode.
8	**ITEC**	Analog output	TEC Current Output. $I_{COOLING} = (V_{ITEC\_COOLING} – 1.25)/0.525$. $I_{HEATING} = (1.25V – V_{ITEC\_HEATING})/0.525$.
9	**ILM**	Digital input	Current Limit. This pin sets the TEC cooling and heating current limits. $V_{ILIM\_HEATING} = 2.5 \times Rb/(Ra+Rb)$ $V_{ILIM\_COOLING} = V_{ILIM\_HEATING} + 40 \times Ra \parallel Rb$ $I_{TEC\_MAX\_COOLING} = (V_{ILIM\_COOLING} – 1.25V)/0.525$ $I_{TEC\_MAX\_HEATING} = (1.25V – V_{ILIM\_HEATING})/0.525$ $V_{ILIM\_HEATING}$ must not exceed 1.2V and $V_{ILIM\_COOLING}$ must be more than 1.3V to leave proper margins between the heating and the cooling modes.
10	**RTH**	Analog input	Connect to the thermistor for sensing the desired object temp. Thermistor's other end connects to the signal ground, pin 2. Rth = 10kΩ@25°C. Other thermistors or temperature sensors can also be used, consult with us. See Figure 4 for the connection.
11	**TECP**	Analog power output	Connects to TEC positive terminal
12	**TECN**	Analog power output	Connects to TEC negative terminal
13	**PGND**	Power ground	Power ground for connecting to the power supply
14	**VPS**	Power input	Positive power supply rail. The value is 5V.

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

1161 Ringwood Ct, #110, San Jose, CA 95131, U. S. A. Tel.: (408) 748-9100, Fax: (408) 770-9187 www.analogtechnologies.com
 Email: staff@analogti.com/sales@analogti.com

Parameter	Test Condition	Value	Unit/Note
Object* temp. stability vs. ambient temp	V_{VPS}=5V, R_{load}=1.2Ω	0.0002	°C/°C
Object temp.vs.set-point.offset	$T_{ambient}$ is 0 ~ 50°C, set-point temp. is 15°C ~35°C	±0.1°C or ±15mV	
Object temp. response time	≤0.1 to the set-point temperature at a 1°C step	<5S	S
Efficiency	V_{VPS}=5V, R_{load}=3.2Ω	≥90%	-
Max. output current	V_{VPS} =5V, R_{load}=3.2Ω	1.5	A
Max. output voltage	V_{VPS} =5V, R_{load}=3.2Ω	0 ~ (V_{VPS} − 0.3)	V
PWM frequency		1	MHz
Power supply voltage	—	4.75 ~ 5.25 (Typically 5)	V
Set-point temp.** control voltage	V_{VPS} =5V, R_{load}=3.2Ω	0.1 ~ 2.5	V
Default set-point temp. range***	V_{VPS}=3V	15 ~ 35	°C
Operating temp. range	V_{VPS} =5V, R_{load}=3.2Ω	−40 ~ 85	°C
Storage temp. range		−55 ~ 125	°C

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

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

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

**** This TEC controller can only drive the TECs having > 1Ω impedance, which equals V_{MAX}/I_{MAX}.

***** After many experiments, according to the parameter and the figuring method of R_{load}, we advise customers to use R_{load} of 3.2Ω.

BLOCK DIAGRAM

The block diagram of the controller is shown in Figure 3.

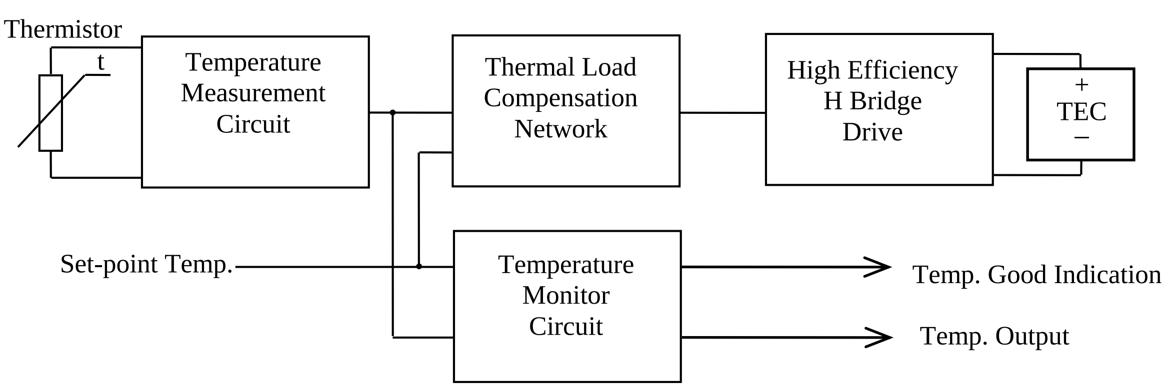

Figure 3. TEC Controller Block Diagram

APPLICATIONS

TEC controller connections are shown in Figure 4.

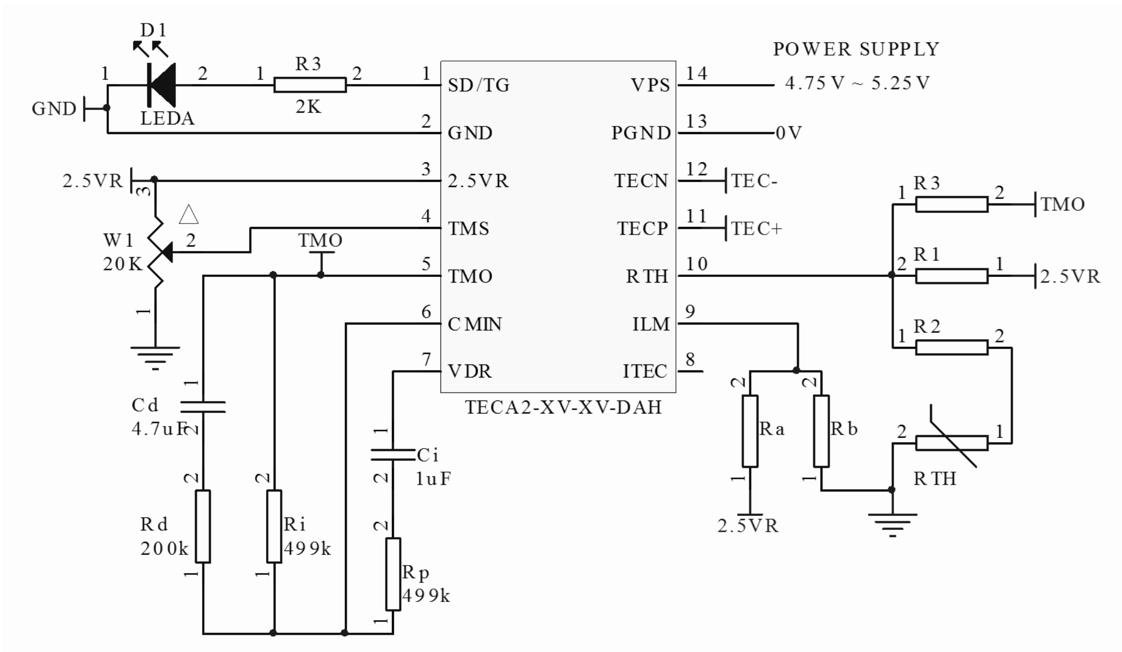

Figure 4. TEC Controller Connections

If you want to use this TEC controller for other applications not discussed here, such as using it with wave locker controllers, please consult us. The same as to other customizations, such as setting the **TEMPSP** by using a voltage source swings above 3V and/or VPS.

The TECA1 controller comes with a default temperature setting network, it sets the set-point temperature to be between 15°C to 35°C when setting the TEMPSP pin voltage to be between 0V to 3V linearly and using a specific de-facto "standard" 10k @ 25°C thermistor, with its R-T value data listed in Figure 6. When using different thermistors and/or needing different set-point temperature ranges, please contact us, we will configure the internal temperature network for you.

Note: This TEC controller doesn't come with an internal compensation network and we don't recommend using internal compensation network either. The compensation network is made of 5 components: 3 resistors and 2 capacitors and the values of the components in the network are the default values shown in Figure 4. Implementing the network externally is highly recommended since it can be modified for driving different thermal load and/or the thermal load characteristics is not certain or fixed at the early design stage.

Resistor Values

R1, R2, R3 are TEC temperature control parameters, see Figure 4. Required temperature parameters can be achieved through adjusting R1, R2 and R3, thus the TEC controller can detect the temperature range that users require.

In different temperature ranges, R1, R2 and R3 have different corresponding resistances. R1, R2 and R3 can be determined by:

$$R1 = R_{MID} + \frac{R_{MID}(R_{LOW} + R_{HIGH}) - 2 * R_{LOW} * R_{HIGH}}{R_{LOW} + R_{HIGH} - 2 * R_{MID}}$$

$$R2 = R1 - R_{MID}$$

$$R3 = \frac{R1(R1 + R_{LOW} - R_{MID})}{R_{LOW} - R_{MID}}$$

Where R_{HIGH} is the resistance of R_{TH} in the highest temperature of the set temperature range; R_{MID} is the resistance of R_{TH} in the medium temperature of the set temperature range; R_{LOW} is the resistance of R_{TH} in the lowest temperature of the set temperature range. For example, set the highest temperature 35 ℃ and the lowest temperature 15 ℃, so the medium value is 25 ℃. By using the R-T table of a thermistor, R_{HIGH}, R_{MID} and R_{LOW} can be achieved:
R_{HIGH} = 6.5kΩ; R_{MID} = 10kΩ; R_{LOW} = 15.7kΩ

In accordance with the above three formulas, R1, R2 and R3 can be calculated:
R1=17.6kΩ; R2=7.6kΩ; R3=71.8kΩ

TYPICAL CHARACTERISTICS

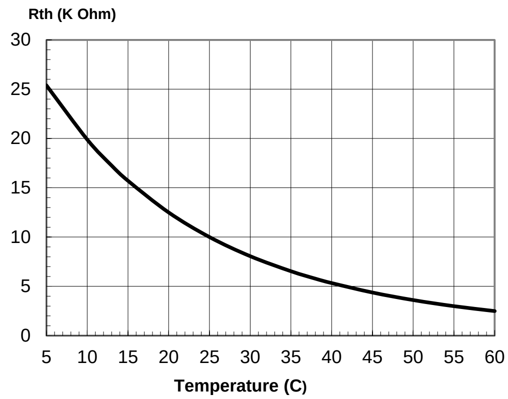

Figure 5. Rth vs. Temperature

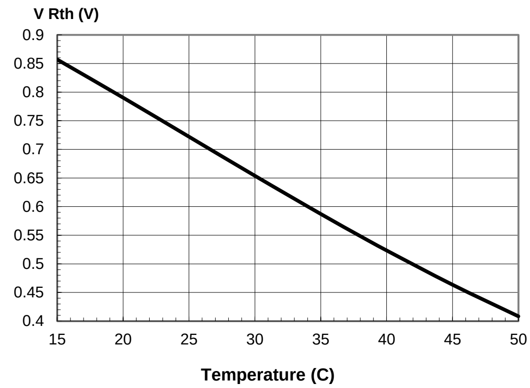

Figure 8. V_{Rth} vs. Temperature

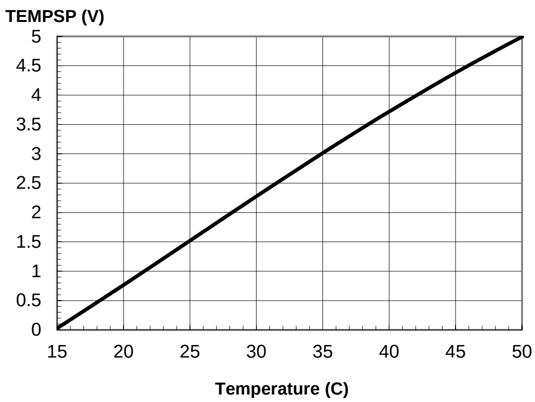

Figure 6. TEMPSP vs. Temperature

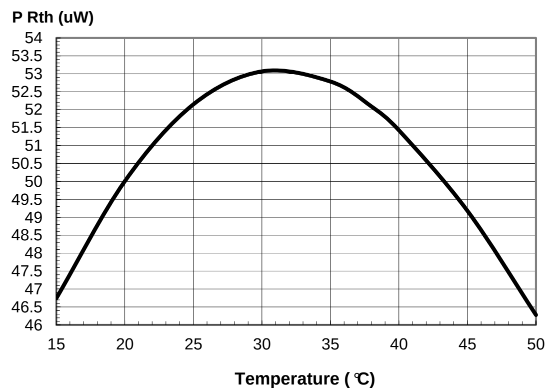

Figure 9. P_{Rth} vs. Temperature

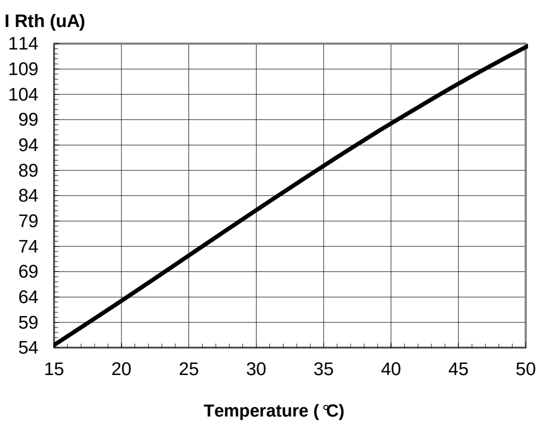

Figure 7. I_{Rth} vs. Temperature

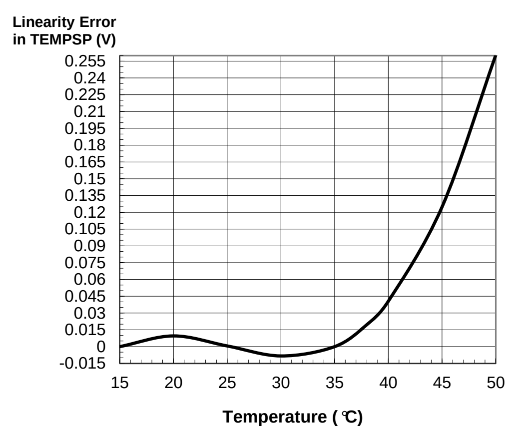

Figure 10. Linearity error in TEMPSP vs. Temperature

MECHANICAL DIMENSIONS

The controller comes in two packages: one is DIP or D package, the other is SMT or S package. We have just introduced the DIP one in this doc, which comes with a part number: TECA2-xV-xV-DAH. You can also order the SMT one. Dimensions of the DIP package controller is shown in Figure 11.

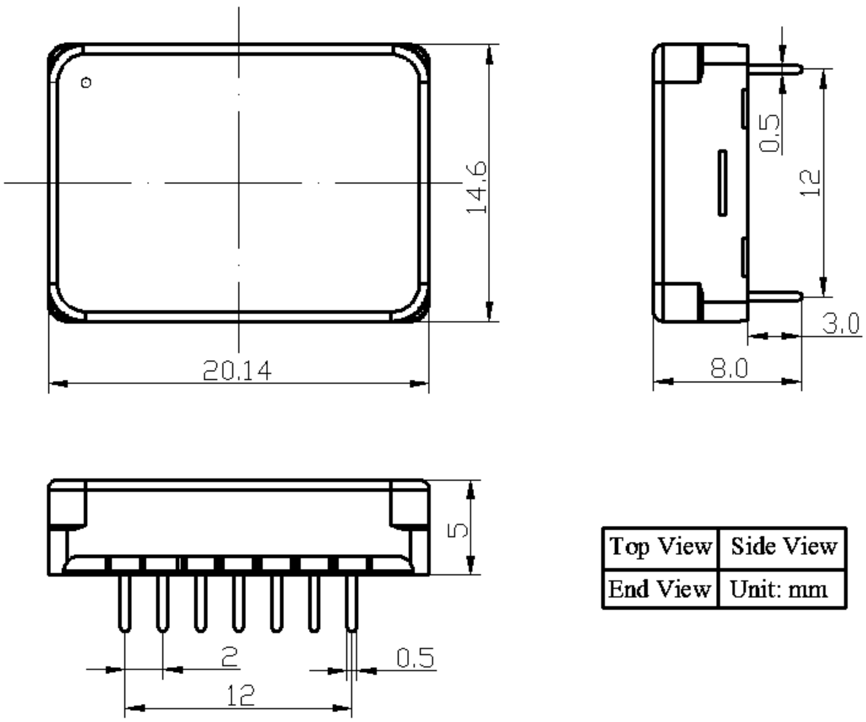

Figure 11. Dimensions of the DIP Package Controller of TECA2-xV-xV-DAH

ORDERING INFORMATION

Table 3. Unit Price

Quantity	1 - 9	10 - 49	50 - 199	200 - 499	≥500
TECA2-xV-xV-DAH	$54	$51	$48	$45	$43

WARNING: Both the surface mount and the through hole types of modules can only be soldered manually on the board by a solder iron of < 310°C (590°F), they cannot go through a reflow oven process.

NOTE: The power supply may have overshoot, when happens, it may exceed the maximum allowed input voltage, 6V, of the controller and damage the controller permanently. To avoid this from happening, do the following:

1. **Connect the controller solid well with the power supply before turning on the power.**
2. **Make sure that the power supply has sufficient output current. It is suggested that the power supply can supply 1.2 to 1.5 times the maximum current the controller requires.**
3. **When using a bench top power supply, set the current limit to >1.5 times higher than the maximum current the controller requires.**

NOTICE

1. ATI warrants performance of its products for one year to the specifications applicable at the time of sale, except for those being damaged by excessive abuse. Products found not meeting the specifications within one year from the date of sale can be exchanged free of charge.
2. ATI reserves the right to make changes to its products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete.
3. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgment, including those pertaining to warranty, patent infringement, and limitation of liability. Testing and other quality control techniques are utilized to the extent ATI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.
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