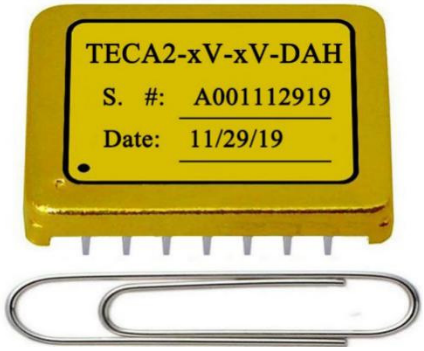

Figure 1. Physical Photo of TECA2-xV-xV-DAH

FEATURES

- High Efficiency: ≥90%
- Maximum Output Current: 3.5A
- Maximum Output Voltage: ±V_{VPS}
- 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 2.5V 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.

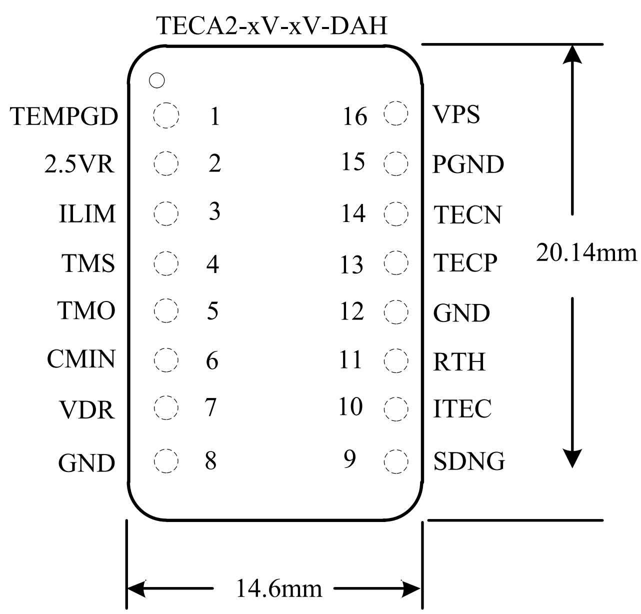

Figure 2. Pin Names and Locations

SPECIFICATIONS

Table 1. Pin Function Descriptions

Pin #	Pin Name	Type	Description
1	**TEMPGD**	Digital Output	Temperature good indication.
2	**2.5VR**	Analog output	2.5V Reference Output.
3	**ILIM**	Analog Input	Current Limit. This pin sets the TEC cooling and heating current limits. $V_{ILIM\_HEATING} = 2.5V \times Rd/(Rc + Rd)$ $V_{ILIM\_COOLING} = V_{ILIM\_HEATING} + 40\mu A \times Rc \parallel Rd$ $I_{TEC\_MAX\_COOLING} = (V_{ILIM\_COOLING} - 1.25V)/0.285$ $I_{TEC\_MAX\_HEATING} = (1.25V - V_{ILIM\_HEATING})/0.285$ $V_{ILIM\_HEATING}$ 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.
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	**GND**	Ground	Signal ground for the POT, ADC, DAC and the thermistor.
9	**SDNG**	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}.
10	**ITEC**	Analog Output	TEC current output. $I_{TEC} = (V_{ITEC} - 1.25)/0.285$, where I_{TEC} is the TEC current, defined as the current flowing into the positive TEC terminal (TEC+) and out of the negative TEC terminal (TEC−).
11	**RTH**	Analog Input	Inverting input to error amplifier.
12	**GND**	Ground	Signal ground for the POT, ADC, DAC and the thermistor.
13	**TECP**	Analog power output	Connects to TEC positive terminal.
14	**TECN**	Analog power output	Connects to TEC negative terminal.
15	**PGND**	Power ground	Power ground for connecting to the power supply.
16	**VPS**	Power input	Positive power supply rail. The value is 5V.

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

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	<5	s
Efficiency	V_{VPS}=5V, R_{load}=3.2Ω	≥90%	-
Max. output current	V_{VPS} =5V, R_{load}=3.2Ω	3.5	A
Max. output voltage	V_{VPS} =5V, R_{load}=3.2Ω	0 ~ V_{VPS}	V
PWM frequency		2	MHz
Power supply voltage	—	2.7 ~ 5.5 (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.

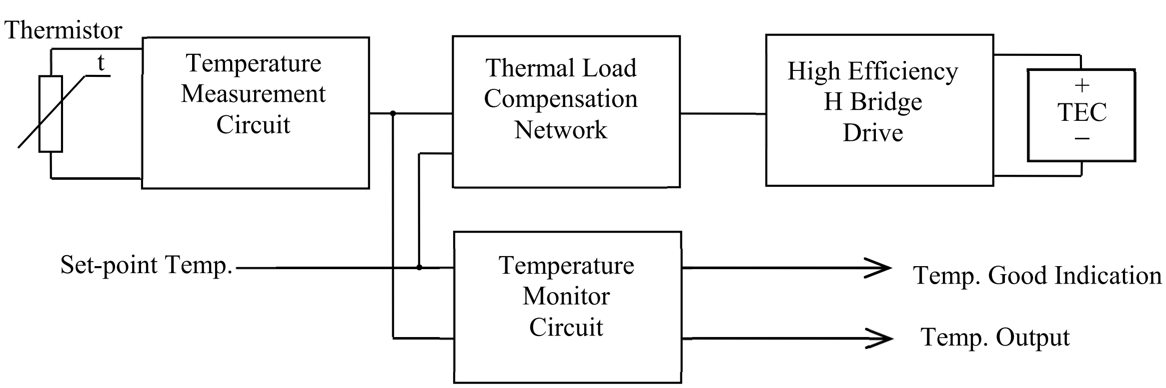

Figure 3. TEC Controller Block Diagram

TYPICAL CHARACTERISTICS

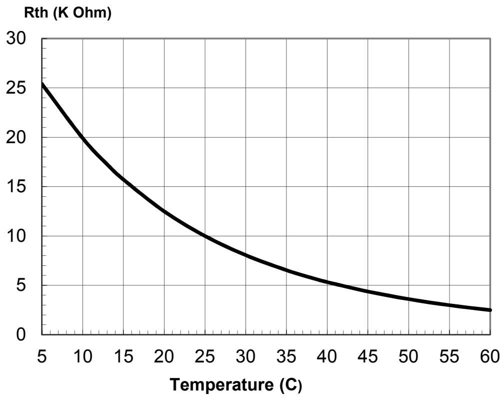

Figure 4. Rth vs. Temperature

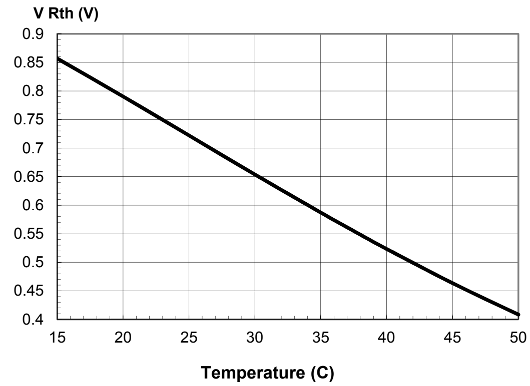

Figure 7. V_{Rth} vs. Temperature

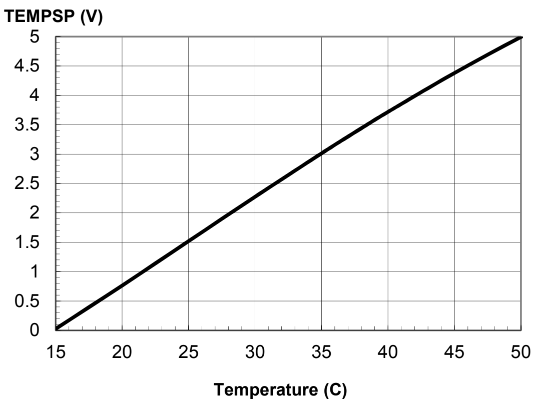

Figure 5. TEMPSP vs. Temperature

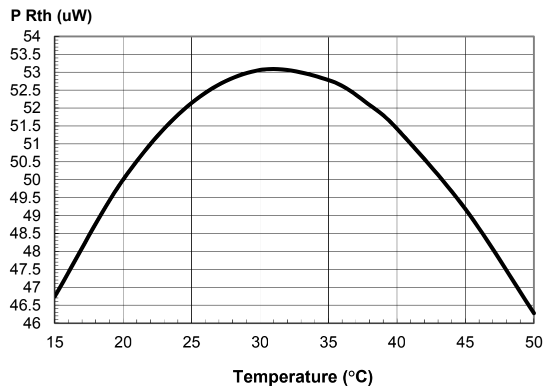

Figure 8. P_{Rth} vs. Temperature

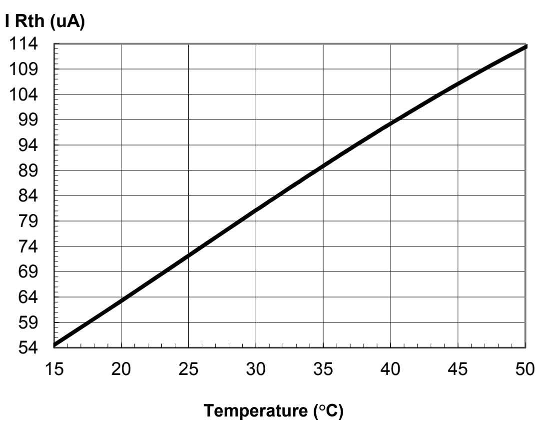

Figure 6. I_{Rth} vs. Temperature

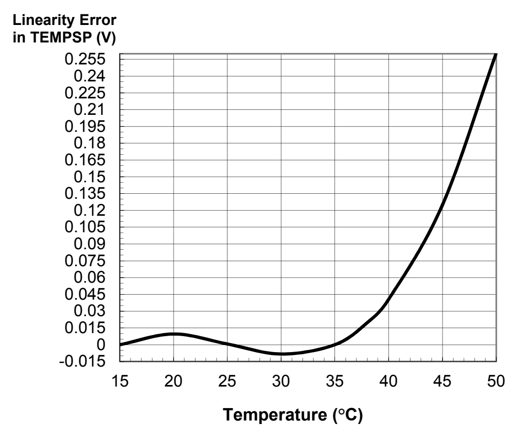

Figure 9. Linearity error in TEMPSP vs. Temperature

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 10.

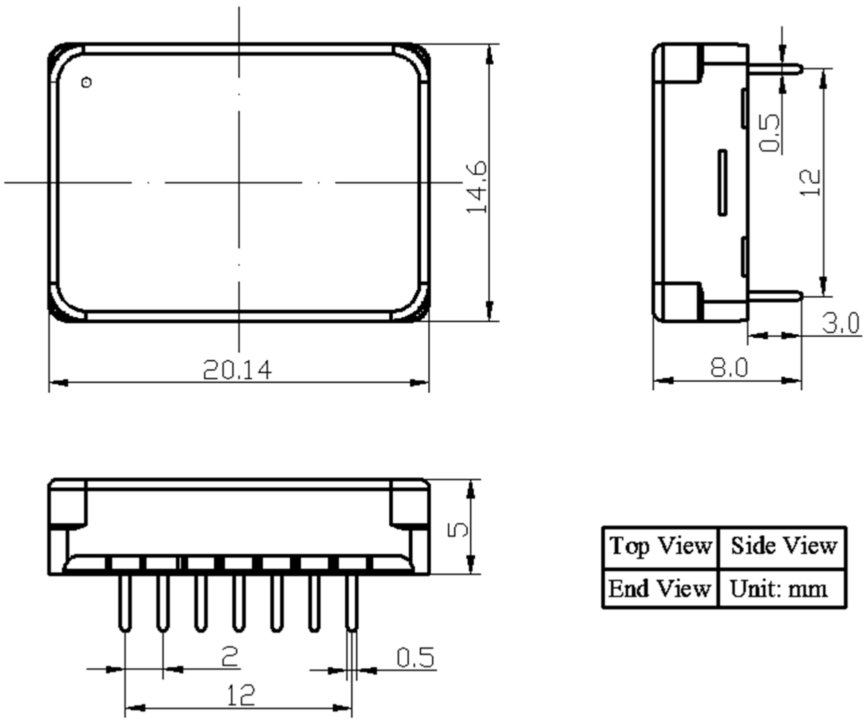

Figure 10. Dimensions of the DIP Package Controller of TECA2-xV-xV-DAH

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.**

SELECTION GUIDE

Part #	V_{IN}	V_{OUT}	Dimensions (mm)	Difference
TEC14M5V3R5AS	2.7V ~ 5.5V	$\pm V_{VPS}$	14.0×14.0×2.1	Micro TEC controller
TEC28V15A	5.5V~25V	±20V	35.7×35.7×7.2	High voltage high current
TEC5V6A-D	4.5V ~ 5.5V	$\pm V_{VPS}$	25.4×19.9×8.8	Max. $\lvert V_{TEMP} - V_{TEMPSP}\rvert \leqslant$ 5mV
TEC5V6A-DA	4.5V ~ 5.5V	$\pm V_{VPS}$	25.4×19.9×8.8	Max. $\lvert V_{TEMP} - V_{TEMPSP}\rvert \leqslant$ 2mV
TEC5V6A-DAH	4.5V ~ 5.5V	$\pm V_{VPS}$	25.4×19.9×8.8	Max. $\lvert V_{TEMP} - V_{TEMPSP}\rvert \leqslant$ 0.5mV
TEC5V6A-NT	4.5V ~ 5.5V	$\pm V_{VPS}$	25.4×19.9×8.8	No internal temperature range setting network
TEC5V4A-D	4.5V ~ 5.5V	$\pm V_{VPS}$	25.4×19.9×8.8	TEMP=On@SDNG=0 Max. $\lvert V_{TEMP} - V_{TEMPSP}\rvert \leqslant$ 5mV
TEC5V4A-DA	4.5V ~ 5.5V	$\pm V_{VPS}$	25.4×19.9×8.8	TEMP=On@SDNG=0 Max. $\lvert V_{TEMP} - V_{TEMPSP}\rvert \leqslant$ 2mV
TEC5V4A-DB	4.5V ~ 5.5V	$\pm V_{VPS}$	25.4×19.9×8.8	TEMP=Off@SDNG=0 Max. $\lvert V_{TEMP} - V_{TEMPSP}\rvert \leqslant$ 2mV
TEC5V4A-DAH	4.5V ~ 5.5V	$\pm V_{VPS}$	25.4×19.9×8.8	TEMP=On@SDNG=0 Max. $\lvert V_{TEMP} - V_{TEMPSP}\rvert \leqslant$ 0.5mV
TEC5V4A-NT	4.5V ~ 5.5V	$\pm V_{VPS}$	25.4×19.9×8.8	No internal temperature range setting network
TECA1-xV-xV-DAH	3.3V/5.5V	$\pm V_{VPS}$	25.4×19.9×8.8	TEMP=On@SDNG=0 Max. $\lvert V_{TEMP} - V_{TEMPSP}\rvert \leqslant$ 0.5mV
TECA1-xV-xV-DAH-OP	3.3V/5.5V	$\pm V_{VPS}$	25.4×19.9×8.8	Remove two 100kΩ internal resistors
TECA1LD-xV-xV-DAH	3.3V/5.5V	$\pm V_{VPS}$	25.4×19.9×8.8	With internal compensation network
TECA1-xV-xV-D	3.3V/5.5V	$\pm V_{VPS}$	25.4×19.9×8.8	TEMP=On@SDNG=0 Max. $\lvert V_{TEMP} - V_{TEMPSP}\rvert \leqslant$ 5mV
TECA1-xV-xV-DB	3.3V/5.5V	$\pm V_{VPS}$	25.4×19.9×8.8	TEMP=Off@SDNG=0 Max. $\lvert V_{TEMP} - V_{TEMPSP}\rvert \leqslant$ 5mV
TECA1-xV-xV-D-OP	3.3V/5.5V	$\pm V_{VPS}$	25.4×19.9×8.8	Remove two 100kΩ internal resistors
TECA1LD-xV-xV-D	3.3V/5.5V	$\pm V_{VPS}$	25.4×19.9×8.8	With internal compensation network
TECA1-5V5V-NT	5V	$\pm V_{VPS}$	25.4×19.9×8.8	No internal temperature range setting network
TECA2-xV-xV-DAH	2.7V ~ 5.5V	$\pm V_{VPS}$	20.14×14.6×8.0	Smaller size

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