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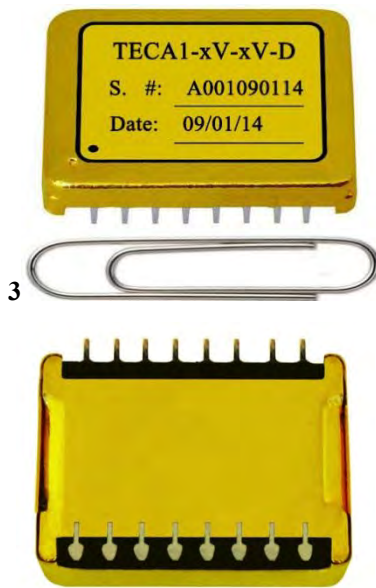


Figure 1. The Photos of Actual TECA1-xV-xV-D

### FEATURES

- High Efficiency:  $\geq 90\%$
- Maximum Output Current: 2.5A
- Actual Object Temperature Monitoring
- High Stability:  $0.01^{\circ}\text{C}$
- High Reliability and Zero EMI
- Compact Size
- 100% lead (Pb)-free and RoHS compliant

### DESCRIPTION

The TECA1-xV-xV-D is an electronic module designed for driving TECs (Thermo-Electric Coolers) with high stability in regulating an object's temperature, high energy efficiency, zero EMIs, and small package. Figure 1 is the photo of an actual TECA1-xV-xV-D TEC controller.

This module provides interface ports for users to set the desired object's temperature, i.e. set-point temperature; the maximum output voltage across TEC; and the compensation network. The compensation network makes automatic adjustments for any deficiencies to achieve and maintain high order thermal load and thus stabilizes 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 TECA1-xV-xV-D comes with a high stability low noise 3.0V voltage reference, which can be used for setting the desired object's 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 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's 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 2 is the real size top view of the controller showing the pin names and locations. The functions of all the pins are shown in Table 1.

**Warning:** This controller module can only be soldered manually onto the board by a solder iron at  $< 310^{\circ}\text{C}$  ( $590^{\circ}\text{F}$ ), it cannot go through a reflow oven process.

The TECA1-xV-xV-D 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.

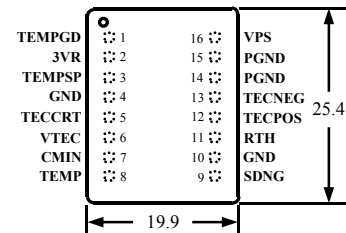
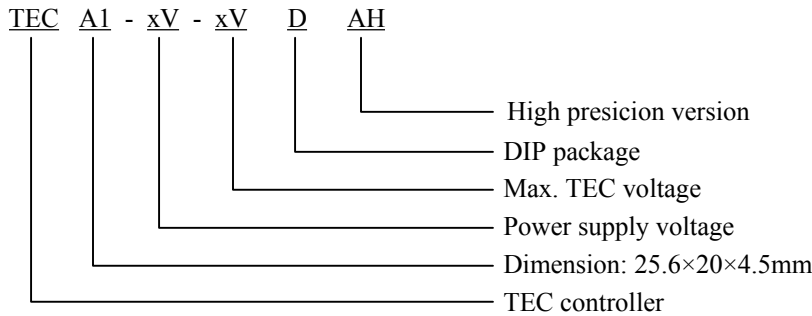


Figure 2. Pin names and Locations

The TECA1-xV-xV-D TEC controller can be ordered with or without an internal compensation network for stabilizing the temperature control loop. The compensation network with the default values shown in Figure 6 matches most of the commonly used butterfly packaged TEC thermal loads. The part number TECA1LD-xV-xV-D, with the "LD" suffix, stands for the controller with an internal compensation network; while the part number TECA1-xV-xV-D, without the "LD" suffix, stands for the controller without the internal compensation network and an external compensation network will be required for the controller to operate. The compensation network is made of 5 components: 3 resistors and 2 capacitors. This network can be implemented either internally by embedding them into the controller circuitries inside the controller enclosure or externally by soldering the 5 components onto the PCB (Printed Circuit Board) on which the TEC controller is mounted. Implementing the network externally is highly recommended since it can be modified for driving different thermal loads and/or the thermal load characteristics are not certain or fixed at the early design stage. The part number TECA1LD-xV-xV-D denotes the controller with an internal compensation network, the values of the components in the network are either the default values shown in Figure 6 or the values specified in the part number, the naming rules are shown in Table 3.



**NAMING**



**SPECIFICATIONS**

Table 1. Pin Function Descriptions

Pin #	Pin Name	Type	Description
1	TEMPGD	Digital output	Temperature good indication. It is pulled high when the set-point temperature and the actual desired object temperature are $<0.1^{\circ}\text{C}$ in temperature difference when the set-point temperature range is $20^{\circ}\text{C}$ ; or $<3\text{mV}$ in voltage difference between the voltages of TEMP and TEMPSP nodes. On this pin, there is an internal pull up resistor of $10\text{k}$ tied to the VPS rail. When going low, this pin is pulled down by an open drain FET with a resistance of $250\Omega @ \text{VPS} = 5\text{V}$ or $350\Omega @ \text{VPS} = 3.3\text{V}$ .  *A <b>100nF capacitor to GND</b> needs to be added to this TEC controller manufactured before March 27 <sup>th</sup> , 2012. Otherwise, there will be an interference of $V_{p,p}=200\text{mV}$ , $f=500\text{kHz}$ .
2	3VR	Analog output	Reference voltage output, 3V. It can be used by a POT or DAC for setting the set-point temperature voltage on the TEMPSP pin and/or a DAC for measuring the temperature through the TEMP pin. The maximum sourcing current capability is 1.5mA and the maximum sinking is 4mA with a stability of $<50\text{ppm}/^{\circ}\text{C}$ max.
3	TEMPSP	Analog input	Object set-point temperature input port. It is internally tied by a $4.99\text{M}\Omega$ resistor to the half value of the reference voltage, 1.5V. The open circuit voltage of this pin is thus 1.5V, corresponding to a set-point temperature of $25^{\circ}\text{C}$ by using the default temperature network (with the set-point temperature range being from $15^{\circ}\text{C}$ to $35^{\circ}\text{C}$ ). 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 $<0.1\text{V}$ voltage may cause the controller over cooling the object. This pin can also be set to a voltage that is about 0.2V away from the VPS rail. For example, when $\text{VPS} = 5\text{V}$ , this pin can be set up to $V_{\text{VPS}} - 0.1\text{V}$ , corresponding to approximately $50^{\circ}\text{C}$ in temperature when the default temperature network is in place, see the curve shown in Figure 11. This pin can be set by using a POT or DAC. When the set-point temperature needs to be at $25^{\circ}\text{C}$ , leave this pin unconnected.
4	GND	Ground	Signal ground for the POT, ADC, DAC and the thermistor, see Figure 6.
5	TECCRT	Both analog input and output	TEC control voltage. It can be left unconnected or used to control the TEC voltage directly. Set TECCRT between 0V to VPS, the voltage across TEC will be: TEC voltage = $2 \times \text{TECCRT} / \text{VPS}$ . It can also be used to configure the maximum voltage cross the TEC: Max. TEC voltage = $V_{\text{TEC\_Max}} \times R_m / (R_m + 10\text{k})$ , where $V_{\text{TEC\_Max}}$ is the maximum output voltage of the TEC controller configured by the internal limiting circuit when the controller is released by the factory, it is marked on the TEC controller label;  $R_m$ is the resistance of the two resistors one between TECCRT to GND and the other between TECCRT to VPS, as shown in Figure 6.



			When the resistors Rm are in place, the TECRT pin is used for controlling the TEC voltage directly. This pin can be utilized for monitoring the voltage across the TEC: TEC voltage = $V_{TEC\_Max} \times (1 - 2 \times TECRT/VPS)$ . The output impedance of this pin is 5kΩ.
6	VTEC	Analog output	TEC voltage indication. When the Rm's mentioned above or the TECRT is not used for controlling the output TEC voltage directly, this pin can be utilized for monitoring the output voltage across the TEC: TEC voltage = $V_{TEC\_Max} \times (1 - 2 \times V_{TEC}/VPS)$ . The maximum driving current of this pin is 30mA and the output voltage swing is 0V to VPS.
7	CMIN	Analog input	Compensation input pin for the thermal control loop. Connect the compensation network to this pin as shown in Figure 6 or leave it unconnected if the TEC controller has an internal compensation network already. This pin is noise sensitive. Do not connect this pin with a long wire in the air or long trace on the PCB when layout the board for the TEC controller.
8	TEMP	Analog output	Actual object temperature indication. It swings from 0V to VPS. By a default internal temperature network, it represents 15°C to 35°C when this pin's voltage swings 0V to 3V linearly; when changing from 0V to 5V, it represents 15°C to 50°C in temperature, see Figure 11.
9	SDNG	Digital input	Shut down control. When pulled low, it shuts down the controller. Leave it open or pull it high to activate the controller. The threshold voltage is 0.8V. This pin is internally pulled up by a resistor of 100k to VPS. The threshold voltages of this pin are: before shuts down, the quiescent current is about 45mA; when going down, SDNG = 1.36V shuts down the TECNEG output stage and the quiescent current becomes 26mA; SDNG = 0.8V shuts down TECPOS output stage and the quiescent current becomes 6mA; when going up, SDNG = 1.0V activates the TECPOS output stage and the quiescent current goes back to 26mA; SDNG = 1.37V activates the TECNEG output stage and the quiescent current goes back to the full normal value of 45mA. The maximum input voltage range allowed on this pin is from 0V to 6V. <b>Please note</b> that for all the controllers manufactured <b>before Dec. 2010</b> , when $V_{SDNG}=0$ , only TEMP works. For the controllers manufactured <b>from Dec. 2010 through 2014</b> , when $V_{SDNG}=0$ , all the pins including TEMP will not work. For the controllers manufactured <b>in 2015 and later</b> , when $V_{SDNG}=0$ , only TEMP works.
10	GND	ground	Signal ground, internally connected to Pin 4 GND. It can be used for connecting the return path of the thermistor.
11	RTH	Analog input	Connect to the thermistor for sensing the object temperature. By using the default temperature network that comes with the standard TEC controller, the thermistor is expected to have a 10kΩ @ 25°C and the R-T curve data are given in Figure 11. It's recommended to use our ntc thermistor, <a href="#">ATH10K1R25</a> .
12	TECPOS	Analog power output	Connects to TEC positive terminal
13	TECNEG	Analog power output	Connects to TEC negative terminal
14	PGND	Power ground	Power ground for connecting to the power supply
15	PGND	Power ground	Power ground for connecting to the power supply, internally connected with pin 14
16	VPS	Power input	Positive power supply rail. Two possible values: 3.3V and 5V, depending on the module.

Table 2. Characteristic ( $T_{Ambient}=25^{\circ}\text{C}$ )

Parameter	Test Condition	Value	Unit/Note
Object* temp. stability vs. ambient temp	$V_{VPS} = 5\text{V}, R_{Load} = 2\Omega$	0.0002	$^{\circ}\text{C}/^{\circ}\text{C}$
Offset Object temp. vs. set-point temp.	$T_{Ambient}$ is $0\sim 50^{\circ}\text{C}$ Set-point temp. is $15^{\circ}\text{C}$ $\sim 35^{\circ}\text{C}$	$\pm 0.1^{\circ}\text{C}$ or $\pm 15\text{mV}$	
Object temp. response time	$\leq 0.1$ to the set-point temperature at a $1^{\circ}\text{C}$ step	$< 5$	s
Efficiency	$V_{VPS} = 5\text{V}, R_{Load} = 2\Omega$	$\geq 90\%$	-
Max. output current	$V_{VPS} = 5\text{V}, R_{Load} = 2\Omega$	2.5	A
Max. output voltage	$V_{VPS} = 5\text{V}, R_{Load} = 2\Omega$	$0 \sim (V_{VPS} - 0.2)$	V
PWM frequency		500	kHz
Power supply voltage	—	$3.1 \sim 3.5$ or $4.75 \sim 5.25$ (Typically 3.3 or 5)	V
Set-point temp.** control voltage	$V_{VPS} = 5\text{V}, R_{Load} = 2\Omega$	$0.1 \sim V_{VPS}$	V
Default set-point temp. range***	$V_{VPS} = 3\text{V}$	$15 \sim 35$	$^{\circ}\text{C}$
Operating temp. range	$V_{VPS} = 5\text{V}, R_{Load} = 2\Omega$	$-40 \sim 85$	$^{\circ}\text{C}$

\* Object temperature refers to the actual temperature of the object which is mounted on the cold side the TEC and its temperature needs to be regulated by the TEC. This object is often a metal block on which a laser diode or an optical crystal is mounted.

\*\* Set-point temperature is the temperature of the object desired to achieve.

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

\*\*\*\* This TEC controller can only drive the TECs having  $> 1\Omega$  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  $2\Omega$  to get the ideal character. We can also make the Maximum Output Voltage reach any value of  $(VPS - 0.1 \times I_{OUT})$  if you need.

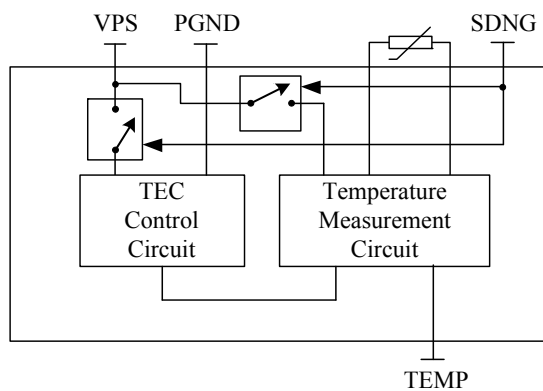


Figure 3. TEMP Do Not Work @  $SDNG = 0$   
For all TECA1-xV-xV-D, which TEMP do not work @  $SDNG = 0$

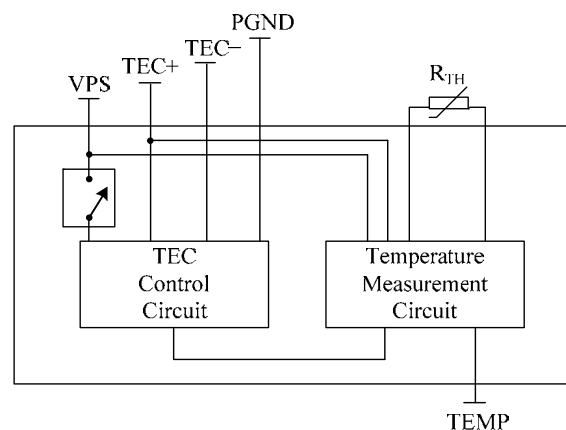


Figure 4. TEMP Work @  $SDNG = 0$

Only for TECA1-xV-xV-DA, which TEMP work @  $SDNG = 0$

### BLOCK DIAGRAM

The block diagram of the controller is shown in Figure 5.

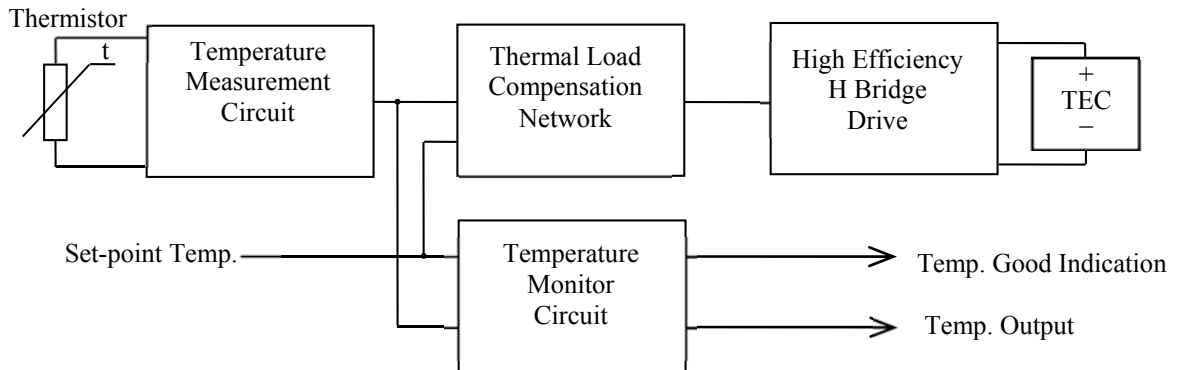


Figure 5. TEC Controller Block Diagram

### APPLICATIONS

TEC controller connections are shown in Figure 6.

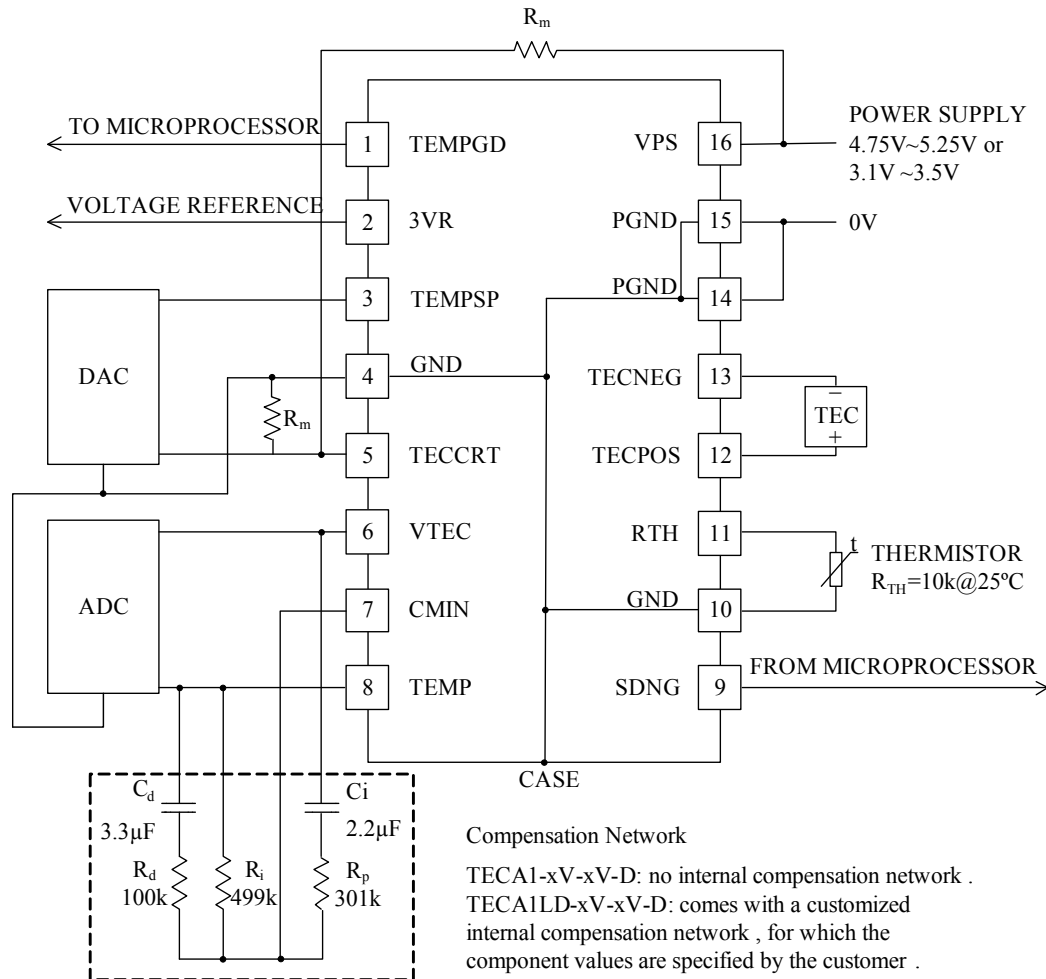


Figure 6. Microprocessor Based Application Circuit

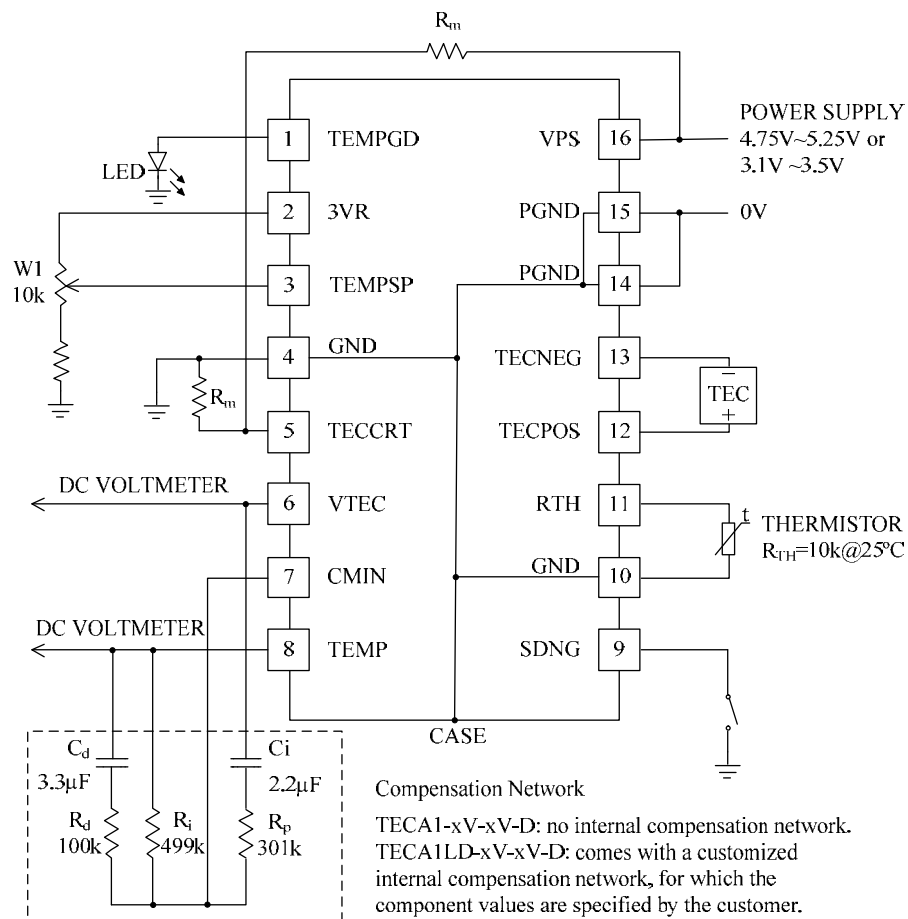


Figure 7. Stand-Alone Application Circuit

When the TEC controller is used stand-alone, using a POT or a pair of resistors to replace the POT to set the voltage for the set-point temperature pin TEMPSP as shown in Figure 3. The input voltage range on the TEMPSP pin must be  $>0.1V$  and the maximum voltage on this pin is  $VPS - 0.1V$ . The VTEC can be utilized for measuring the voltage across the TEC as described in Table 2. The actual object temperature can be monitored by measuring the voltage on the TEMP pin. The relationship between the actual temperature and the TEMP voltage is determined by the internal temperature network. When using the default temperature network, the relationship is shown in Figure 7, the approximate formula is:

$$\beta = \log_{10}(R_0 T_1 / R_0 T_2) / [(1/T_1 - 1/T_2) \times \log_{10} e]$$

$R_0 T_1$  stands for the zero power resistance at absolute temperature  $T_1$

$R_0 T_2$  stands for the zero power resistance at absolute temperature  $T_2$

$T_1$  is the temperature 1, expressed in degree Kelvin.

$T_2$  is the temperature 2, expressed in degree Kelvin.

The maximum error between the actual output voltage and approximated voltage is 0.013V, equivalent to 1.3% error.

If this TEC controller is to be used for other applications not discussed here, such as use it with wave locker controllers, please consult with us and we can help. The same as to other customizations, such as setting the TEMPSP by using a voltage source swinging above 3V and/or VPS. The TECA1-xV-xV-D controller comes with a default temperature setting network, it sets the set-point temperature to be between  $15^{\circ}C$  to  $35^{\circ}C$  when setting the TEMPSP pin voltage to be between 0V to 3V linearly and using a specific de-facto “standard”  $10k @ 25^{\circ}C$  thermistor, with its R-T value data listed in Figure 11 and Table 3. When using different thermistors and/or needing different set-point temperature ranges, please contact us, we will configure the internal temperature network for you.

In order to change the set-point temperature, an external resistor can be used to combine with your thermistor to make it equal to  $10k\Omega$ . For example, at  $4^{\circ}C$ , the thermistor is about  $25k\Omega$ , add another resistor in parallel, therefore, the total resistance is  $10k\Omega$ . After this, set the set-point temperature pin, TEMPSP, to 1.5V, the actual set-point temperature will be about  $4^{\circ}C$ . At  $37^{\circ}C$ , the thermistor is about  $5k\Omega$ , put an external resistor  $5k\Omega$  in series with this thermistor, therefore, the total resistance will be about  $10k\Omega$

at 37°C. Now, set TEMPSP pin to 1.5V, the actual set-point temperature will be about 37°C.

When using, users need to connect the pins of VTEC and CMIN together. Connect the TEMPSP pin to DAC. About ADC, users can figure it yourself.

**Note:** A socket strip can be used for mounting this TEC controller. More detail technical data about this socket can be found here:

<http://www.digikey.com/product-detail/en/SS-132-G-2/SAM1115-32-ND/1105559>

### Using TEC Controllers for Driving A Heater

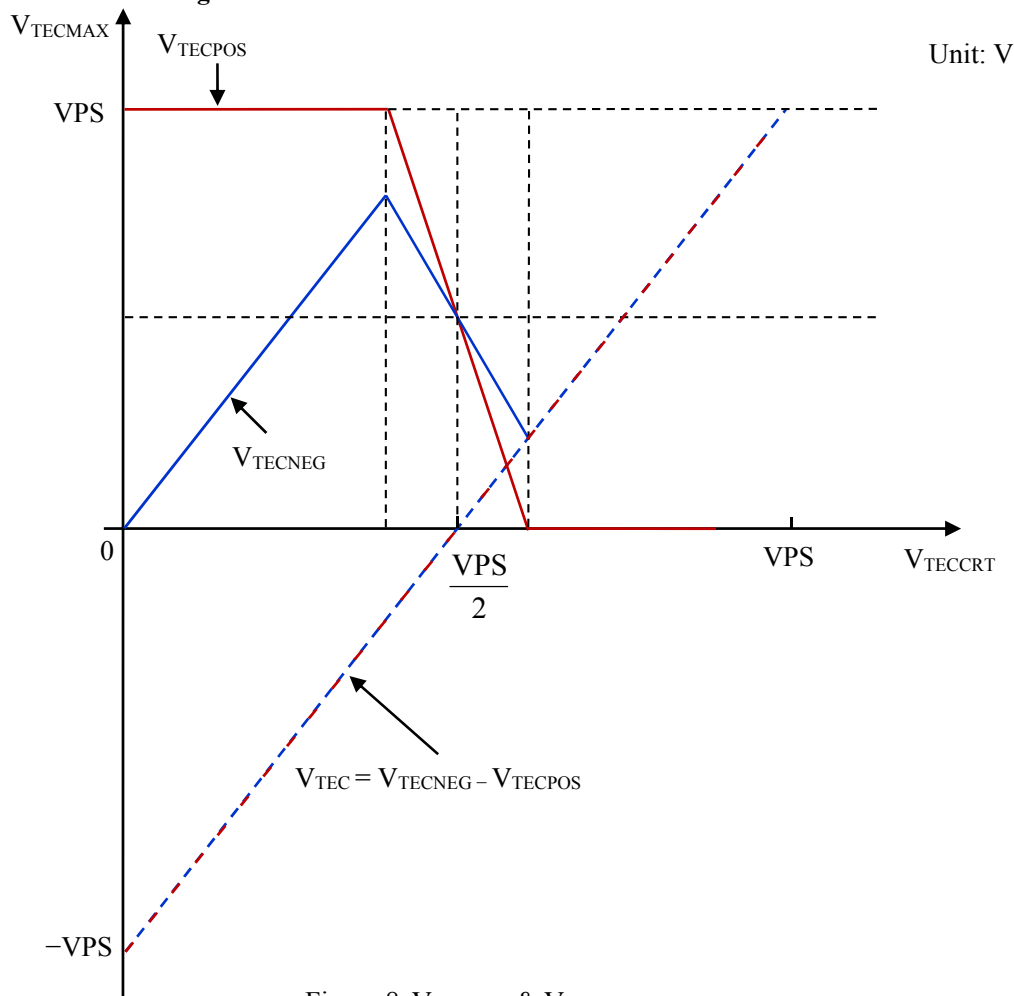


Figure 8.  $V_{TECMAX}$  &  $V_{TECCRT}$



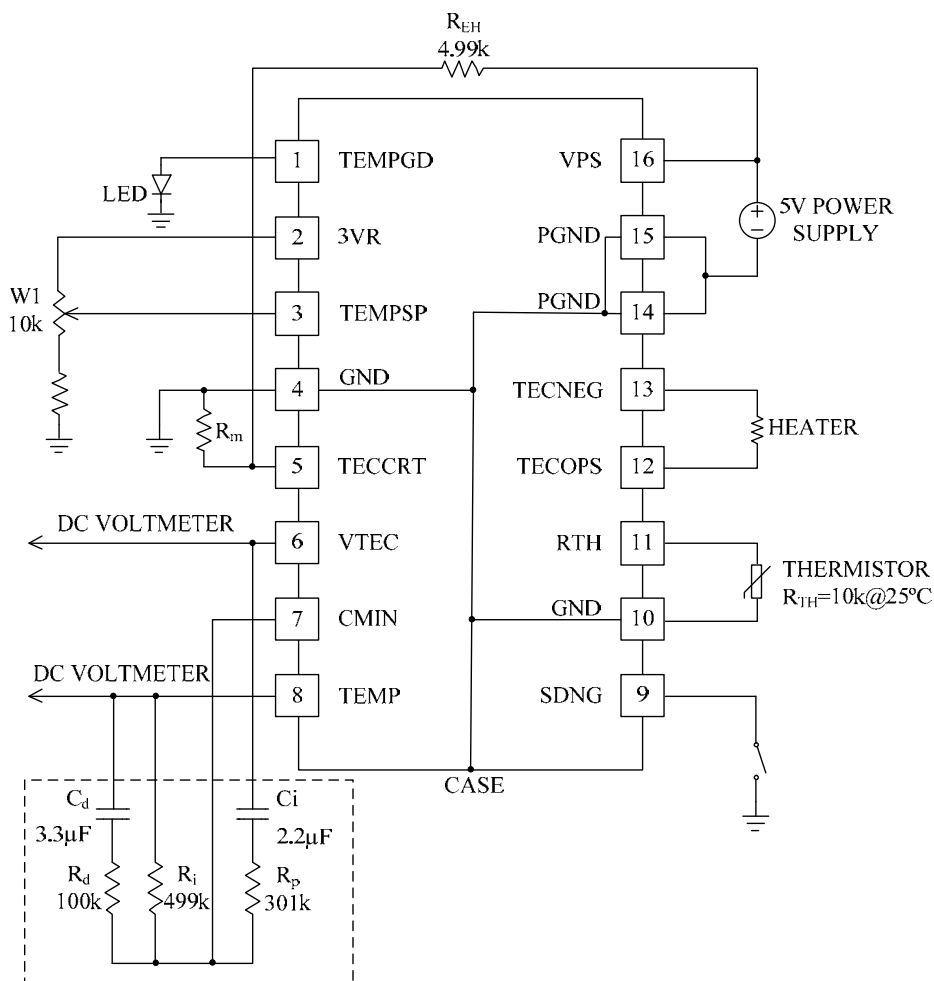


Figure 9. Driving a Heater for  $<3.3V @ \leq 3A$

If  $V_{HTMAX} < 3.3V$ , the part # is TECA1-5V-[ $V_{HTMAX}$ ]V-D. For example,  $V_{HTMAX} = 2.5V$ , the part number will become: TECA1-5V-2.5V-D, when using a 5V power supply. If powered by a 3.3V power supply, the part number will be: TECA1-3V-2.5V-D.

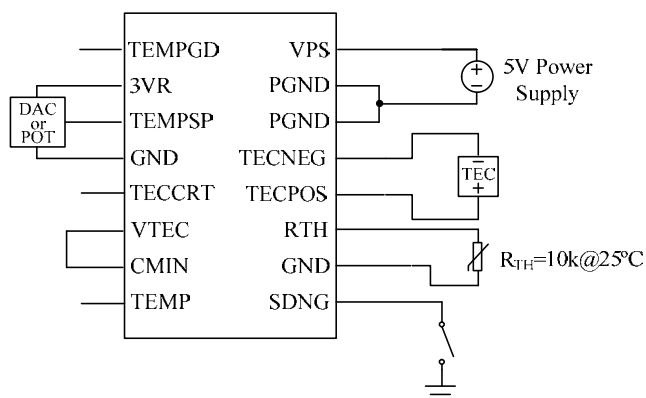


Figure 10. Control the Current Direction of the TEC Module by Pin 3 TEMPSP

When  $V_{TECPOS} - V_{TECNEG} > 0$ , it is forward current, which cools the object down;

When  $V_{TECPOS} - V_{TECNEG} < 0$ , it is reverse current, which heats the object up;

The relationship between  $V_{TEMPSP}$  and  $(V_{TECPOS} - V_{TECNEG})$  is:  $(V_{TECPOS} - V_{TECNEG}) = -2 \times V_{TEMPSP} + V_{VPS}$

For example, TECA1-5V-5V-DAH, when  $V_{TEMPSP} = 2V$ ,  $(V_{TECPOS} - V_{TECNEG}) = -2 \times 2 + 5 = 1V$ .



TYPICAL CHARACTERISTICS

Table 3. Measurement Data of Rth vs. Temperature

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Rth (kΩ)	32.74	31.1	29.57	28.11	26.73	25.43	24.21	23.04	21.94	20.91	19.92	18.98	18.1	17.26	16.47	15.72	15
Temperature (°C)	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Rth (kΩ)	14.33	13.68	13.07	12.49	11.94	11.42	10.92	10.45	10	9.57	9.17	8.78	8.41	8.06	7.72	7.40	7.10
Temperature (°C)	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Rth (kΩ)	6.81	6.53	6.27	6.02	5.78	5.55	5.33	5.12	4.92	4.73	4.55	4.37	4.21	4.05	3.89	3.75	3.61

Table 4. Measurement Data of Rth vs. V<sub>TEMP</sub>.

V <sub>TEMP</sub> (V)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5
Rth (kΩ)	15.72	14.80	14.33	13.91	13.49	13.07	12.70	12.32	11.94	11.60	11.26	10.92	10.62	10.31	10.00
V <sub>TEMP</sub> (V)	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0
Rth (kΩ)	9.73	9.45	9.17	8.91	8.66	8.41	8.18	7.95	7.72	7.52	7.31	7.10	6.91	6.72	6.53

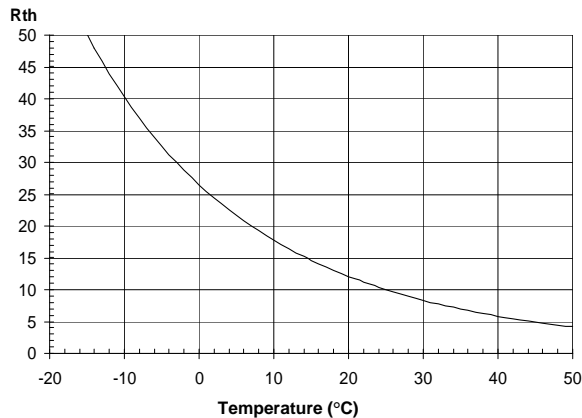


Figure 11. Rth vs. Temperature

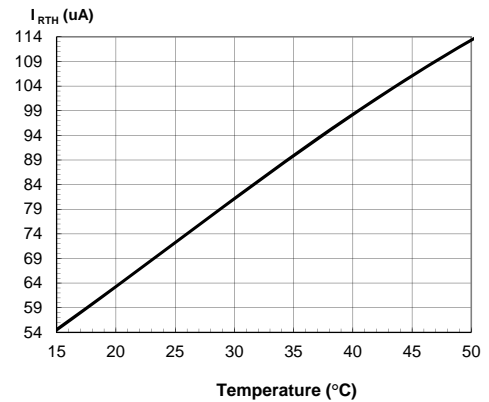


Figure 13. I<sub>Rth</sub> vs. Temperature

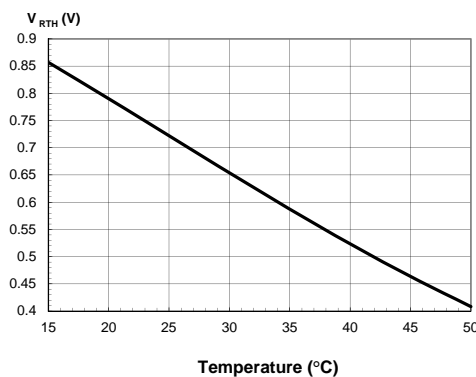


Figure 12. V<sub>Rth</sub> vs. Temperature

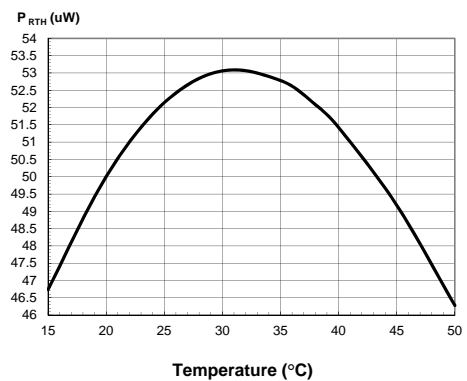


Figure 14. P<sub>Rth</sub> vs. Temperature

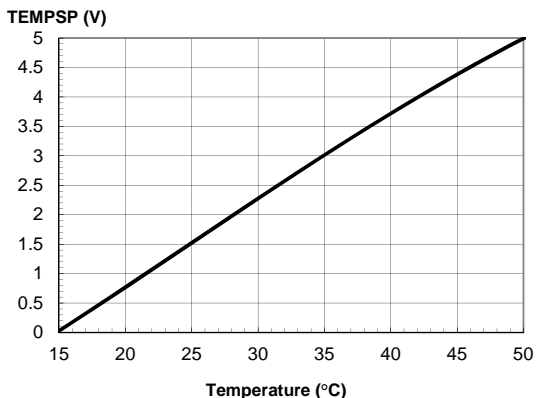


Figure 15. TEMPSP vs. Temperature

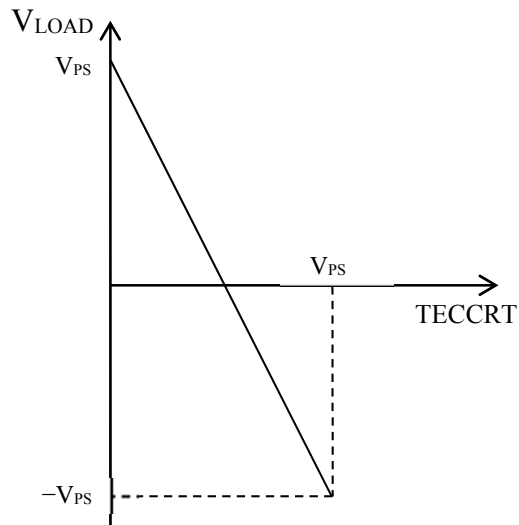
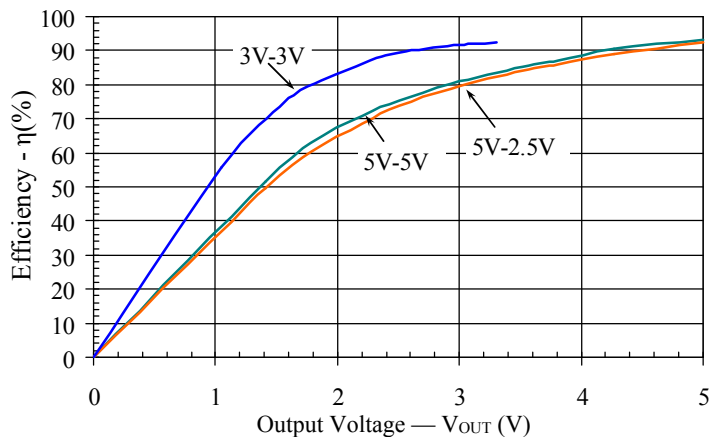
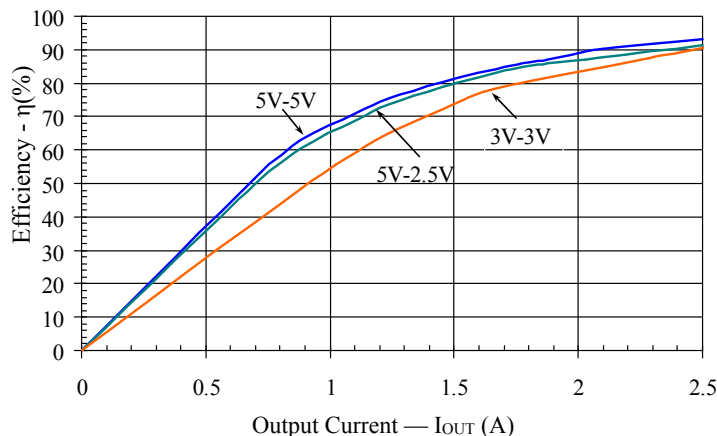

 Figure 16.  $V_{Load}$  vs. TECCRT

Figure 16 shows the relationship between  $V_{Load}$  and TECCRT. With the increase of the voltage of TECCRT pin,  $V_{Load}$  will decrease linearly. The approximate formula is  $V_{Load} = TECPOS - TECNEG$ . When the TECCRT voltage reaches half of  $V_{PS}$ ,  $V_{Load}$  is zero; when it reaches  $V_{PS}$ , the voltage will be  $-V_{PS}$ .

In order to conveniently show the customers the characteristics of TECA1-xV-xV-D, we offer the efficiency curves. Figure 17 shows the relation between Output Voltage and Efficiency, Figure 18 shows the relation between Output Current and Efficiency.  $V_{OUT}=4V$ .


 Figure 17. Efficiency vs.  $V_{OUT}$ 

 Figure 18. Efficiency vs.  $I_{OUT}$

**TEMPGD INTERNAL CIRCUIT**

When temperature difference between the actual temperature and the set-point temperature  $< 0.1^{\circ}\text{C}$ , the pull-up resistor R1 of TEMPGD is  $130\Omega$ ; When temperature difference between the actual temperature and the set-point temperature  $> 0.1^{\circ}\text{C}$ , the pull-down resistor R2 of TEMPGD is  $12.7\Omega$ . See Figure 19.

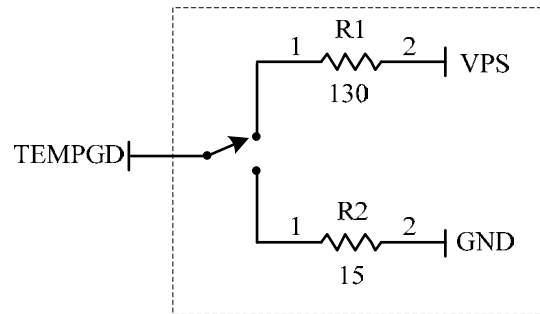


Figure 19. Internal Equivalent Circuit on TEMPGD Pin

**OVERRIDE INTERNAL VOLTAGE SETTING**

When the controller does not connect anything externally, the  $V_{\text{TEMPSP}}$  is 1.5V. If the controller connects a DAC or Potentiometer externally, remove the two  $10\text{M}\Omega$  resistors in the circuit in Figure 20.

For applications that do not need the internal resistors in Figure 20, the part number becomes TECA1-xV-xV-D-OP.

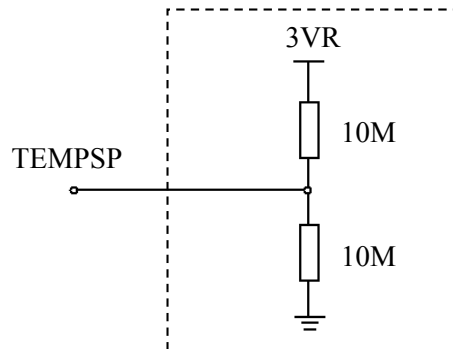


Figure 20. Internal Equivalent Circuit on TEMPSP Pin

**QUIESCENT CURRENT VS. SHUTDOWN VOLTAGE**

Figure 21 shows how the quiescent current ( $I_Q$ ) changes with the voltage of Pin SDNG ( $V_{SDNG}$ ).

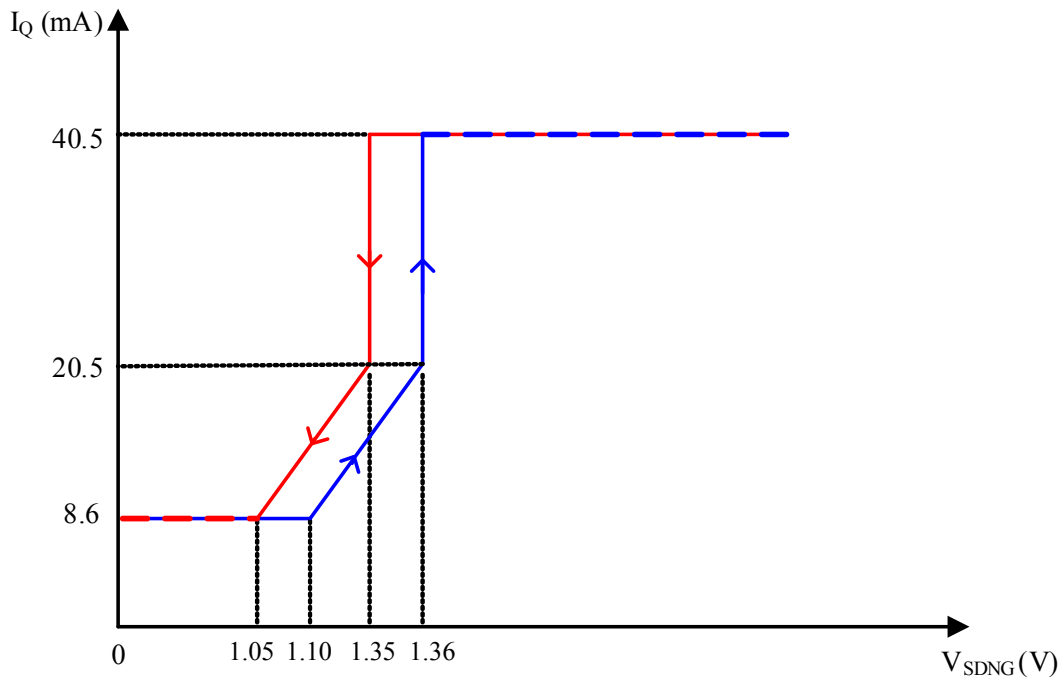


Figure 21.  $I_Q$  vs.  $V_{SDNG}$

**MECHANICAL DIMENSIONS**

The controller comes in two packages: one is DIP (Dual In-line Package) or D (short for DIP) package, and the other is SMT (Surface Mount Technology) or S (short for SMT) package. The former D package comes with a part number: TECA1-xV-xV-D, and the latter S package comes with a part number: TECA1-xV-xV-S. Dimensions of the DIP package and SMT package controller are shown in Figure 22 and Figure 23 respectively.

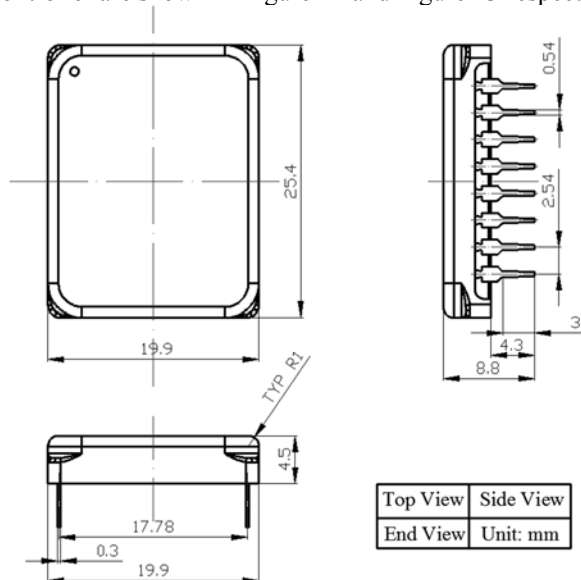


Figure 22. Dimensions of the DIP Package Controller of TECA1-xV-xV-D

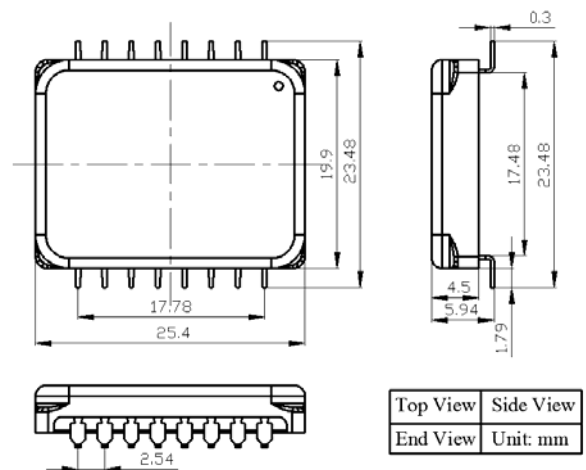


Figure 23. Dimensions of the SMT Package Controller of TECA1-xV-xV-S



CUSTOMIZATIONS

It is often found that some of the default specifications do not meet our users' particular need. We offer customizations on these specifications:

1. Maximum output voltage across TEC. When ordering, the part number will become: TECA1-5V-(max. TEC voltage)-D. E.g., TECA1-5V-2.5V-D
2. Set-point temperature range. When ordering, specify the lower limit, the upper limit, and the open circuit temperature. The part number will become: TECA1-5V-2.5V- (lower temp. limit)/(upper temp. limit)/(open circuit temp.), where lower temp. limit is the temperature corresponding to **TEMPSP** = 0V; upper temp. limit is the corresponding to **TEMPSP** = 3V; open circuit temp. corresponding to **TEMPSP** = 1.5V or being left unconnected. e.g., TECA1-5V-2.5V-D (20/80/50).
3. Asymmetrical maximum TEC voltage. The maximum TEC voltage for heating and cooling are not the same. When ordering, the part number will become: TECA1-5V- (max. TEC voltage for cooling/Max. TEC voltage for heating), e.g. TECA1-5V-2.5V/1.5V-D.

**WARNING:** This controller module can only be soldered manually on the board by a solder iron at < 310°C (590°F), and it 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.

If a higher precision TEC controller is needed, TECA1-xV-xV-DAH meets your need. please check the info. below.

Part #	Maximum $ V_{TEMP} - V_{TEMPSP} $ (mV)
TECA1-xV-xV-DAH	$\leq 0.5$
TECA1-xV-xV-D	$\leq 5$



ORDERING INFORMATION

Table 5. Ordering info.

Part Number	Internal Compensation Network	Description	Difference
TECA1-5V-xV*-D/S	No	5V power supply in DIP/SMT package	TEMP=On@SDNG=0 Maximum output voltage across TEC can be selected from 5V, 4.8V, 4V, 3.5V, 3V, 2.5V and 2V or required one.
TECA1LD-5V-xV*-D/S	Yes		
TECA1-3V-xV*-D/S	No	3.3V power supply in DIP/SMT package	TEMP=On@SDNG=0 Maximum output voltage across TEC can be selected from 3V, 2.5V and 2V or required one.
TECA1LD-3V-xV*-D/S	Yes		
TECA1-xV-xV-DB	No	3.3V/5V power supply in DIP package	TEMP=Off@SDNG=0
TECA1-xV-xV-D-OP	No	Remove two 100k internal resistors; DIP package	TEMP=On@SDNG=0 Maximum output voltage across TEC can be selected from 5V, 4.8V, 4V, 3.5V, 3V, 2.5V and 2V or required one.
TECA1-5V-xV*-DAH	No	5V power supply in DIP package	<b>High precision</b> TEMP=On@SDNG=0 Voltage difference between TEMP and TEMPSP is -0.02mV ~ 0.5mV, ten times lower than TECA1-5V-xV-D, 4~5mV.
TECA1LD-5V-xV*-DAH	Yes		
TECA1-3V-xV*-DAH	No	3.3V power supply in DIP package	
TECA1LD-3V-xV*-DAH	Yes		
TECA1-xV-xV*-DAH-OP	No	Remove two 100k internal resistors; DIP package	<b>High precision</b> TEMP=On@SDNG=0 Maximum output voltage across TEC can be selected from 5V, 4.8V, 4V, 3.5V, 3V, 2.5V and 2V or required one.

\*xV stands for the maximum output voltage across TEC. e.g. TECA1-5V-3.5V-D.

Table 7. Unit Price

Quantity	1 - 9	10 - 49	50 - 199	200 - 499	≥500
TECA1-5V-xV*-D/S	\$73	\$70	\$67	\$63	\$59
TECA1LD-5V-xV*-D/S					
TECA1-3V-xV*-D/S					
TECA1LD-3V-xV*-D/S					
TECA1-xV-xV-DB					
TECA1-xV-xV-D-OP					
TECA1-5V-xV-DAH	\$78	\$74	\$70	\$66	\$62
TECA1LD-5V-xV-DAH					
TECA1-3V-xV-DAH					
TECA1LD-3V-xV-DAH					
TECA1-xV-xV-DAH-OP					



SPECIAL NOTE

If you experience a high current spike when you change TEMPSP voltage quickly by a large amount, such as > 0.1V, a capacitor of 1uF can be added between TECCRT and GND. For TEC controllers manufactured after Nov. 10, 2015, there is no such a problem.

RELATED PRODUCTS

Part #	Description	Comments
<a href="#">TECEV104</a>	Evaluation Board TECEV104 for TEC Controllers TECA1-xV-xV-D	1. Setting maximum output voltage 2. Setting set-point temperature 3. Monitoring output voltage 4. Monitoring actual thermal load temperature 5. Tuning the compensation network so as to match thermal load

NOTICE

- 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.
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- Customers are responsible for their applications using ATI components. In order to minimize risks associated with the customers' applications, adequate design and operating safeguards must be provided by the customers to minimize inherent or procedural hazards. ATI assumes no liability for applications assistance or customer product design.
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