PRG Series

PTC Thermistor (Resettable Fuse)

PRG Series

Features

- Compact Design to save Board space
- Low profile
- High Reliability
- Less Characteristics change after mounting and energization
- RoHS Compliant and Halogen Free
- Safety Standard (UL : E137188 VDE, TUV etc.)
- Wide range of Operating Temperature (-20 to 85 degree)
- Fastest time to trip
- Current 10 to 75mA
- Voltage up to 32V

Applications

- Automotive
- (LED Lamp/Navigation/Motor/Electrical Component)
- Factory Automation Equipment (Motor Drive, Sensor controller)
- Charger
- USB port protection
- Mobile phone of Battery and Port protection
- Note PC, Tablet PC

Overview

The PRG series is available of 2 kind of function, “Resettable Fuse” and “Current Control”.
“Resettable Fuse” for short protection device features rapid operation to protect the circuit as an abnormal current passing through it, operating in a similar to a fuse. These products automatically return to their initial state when the overcurrent is eliminated and can be used repeatedly.
Use of ceramics material means high reliability and quick protection after short circuits, allowing the customer to make equipment safer and maintenance-free.
Compared with organic PTC elements and chip resistors having the same characteristics, the PRG series features high reliability for less characteristics change after mounting and get long life cycle. This helps the customer downsize equipment and high performance.

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1. Principles of Ceramic PTC Thermistor

1.1 Operating in Ceramic PTC (Temperature-Resistance Characteristic)

Ceramic PTC (positive temperature coefficient) device is one of Thermistor products, and it realizes some kind of function involving “Resettable Fuse as Overcurrent Protector” and “Current Control Device”. PTC indicate Temperature-Resistance characteristic which PTC resistance value is steady during at normal operation, but resistance increase exponentially from a given temperature (it’s called Curie-Temperature). Its unique characteristic is genarated by electorinic property of Ceramic grain boundary. Resistance of grain boundary keeps steady at lower temperature. But, Resistance of grain boundary rises up when the devices temperature increase.

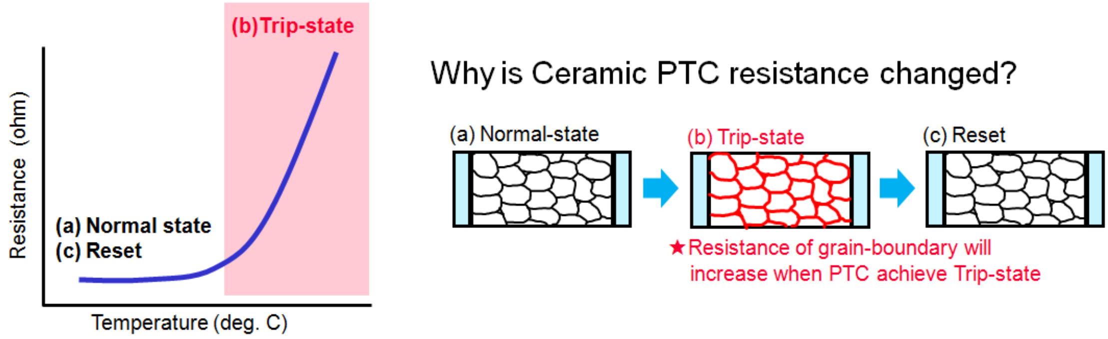


Figure 1.1 PTC temperature-resistance characteristic and its origin

1.2 Current - Voltage Characteristic

Current - Voltage Characteristic is showed in Figure 1.2. In normal operation, PTC resistance remains low and steady, and it behaves like a simple resister that PTC current increase with increasing applied voltage, just temperature of PTC device also start to warm up by its self-heating because of Wattage = I^2R. After temperature of PTC device achieve Curie-Temperature, PTC current will decrease with increasing applied voltage, this region is called Trip-state.

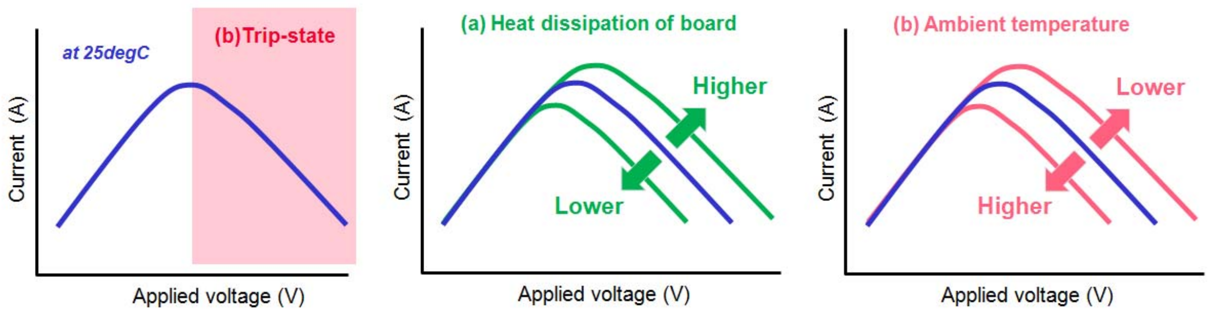


Figure 1.2 Current-Voltage, and it is depending on Heat-dissipation and Ambient-temp.

1.3 Current - Time Characteristic

When inrush current which can bring PTC device to Trip-state is passed through PTC device, PTC will suppress current immediately. Current-Time Characteristic shown figure 1.3, is drawn as operation of current suppressing. And, a period that inrush current fall to one-half, is determined as “Operating Time”. This Operating Time is depending on Inrush current value and ambient temperature. In detail, Operating Time will be less time when bigger Inrush current is applied or ambient temperature is set higher.

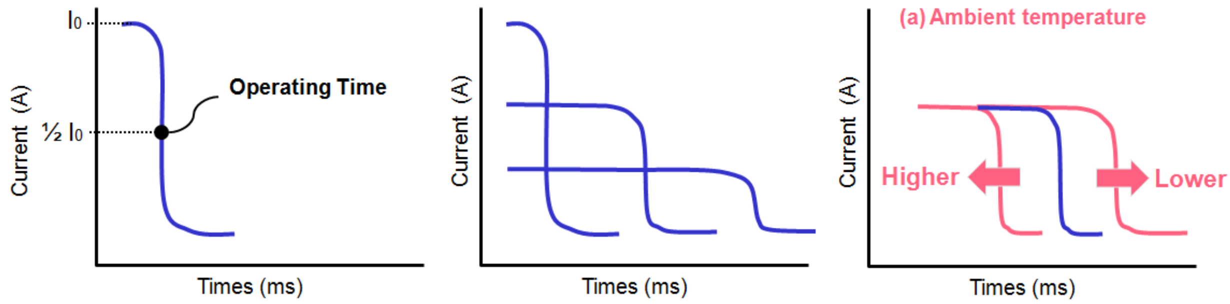


Figure 1.3 Current-Time characteristic

1.4 Feature of Ceramic PTC

Ceramic PTC has Temperature-Resistance characteristic caused by resistance change of Ceramic grain boundary origicagted from electronic proerty. Because of using its behavior, Ceramic PTC indicate non-hysteresis resistance change when PTC operation returns from Trip-state to Inisial-state in its repeatability. Therefore, resistance change of PTC device after soldering and On-Off load test, results in smaller value. These behavier promises reliable peformance in its operation.

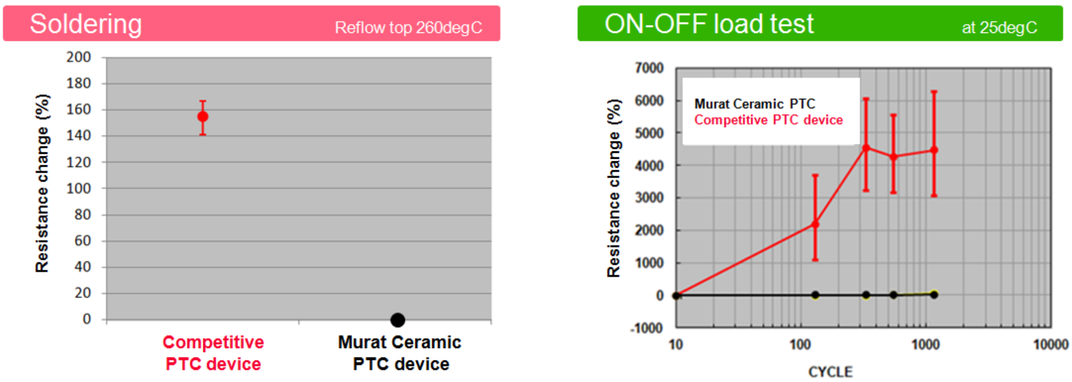


Figure 1.4 Comparison of Murata Ceramic PTC and competitive PTC device

2. Usage for Overcurrent Protection as Resettable Fuse Device

2.1 Overcurrent protection using Ceramic PTC

The PTC device can be used for connecting with power supply and load in series (refer to Figure 2.1). Figure 2.2 is shown operation of PTC device as Resettable Fuse. Basically, PTC can protect the circuit system from overcurrent by increasing PTC resistance exponentially. This PTC operation is similar function as a fuse. PTC resistance value is steady during normal operation. And, when overcurrent is flowed to circuit system, the device temperature starts to heat up rapidly and PTC resistance increases exponentially due to the current passing through it. This large resistance change applies falling current significantly, and resistance remains higher value as long as voltage is applied to circuit system. After power supply is removed completely, PTC resistance starts to decrease with cooling of PTC temperature, after that reset to initial state. Because of non-hysteresis characteristic in Ceramic PTC, there is nearly unchanged between initial resistance and reset resistance.

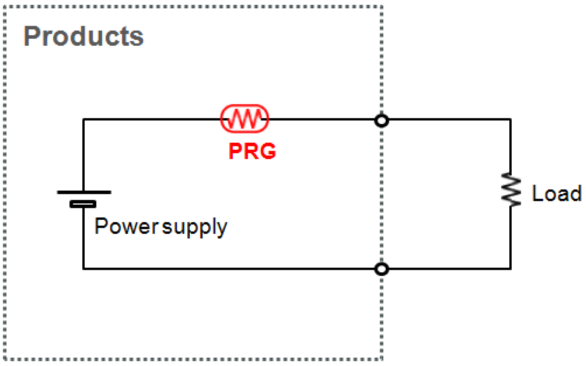


Figure 2.1 Basic circuit using PTC device

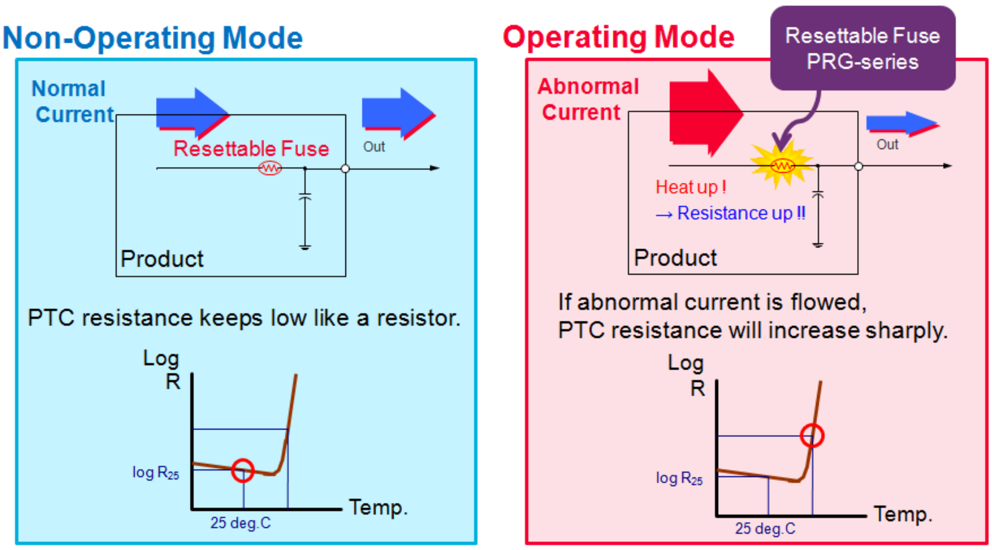
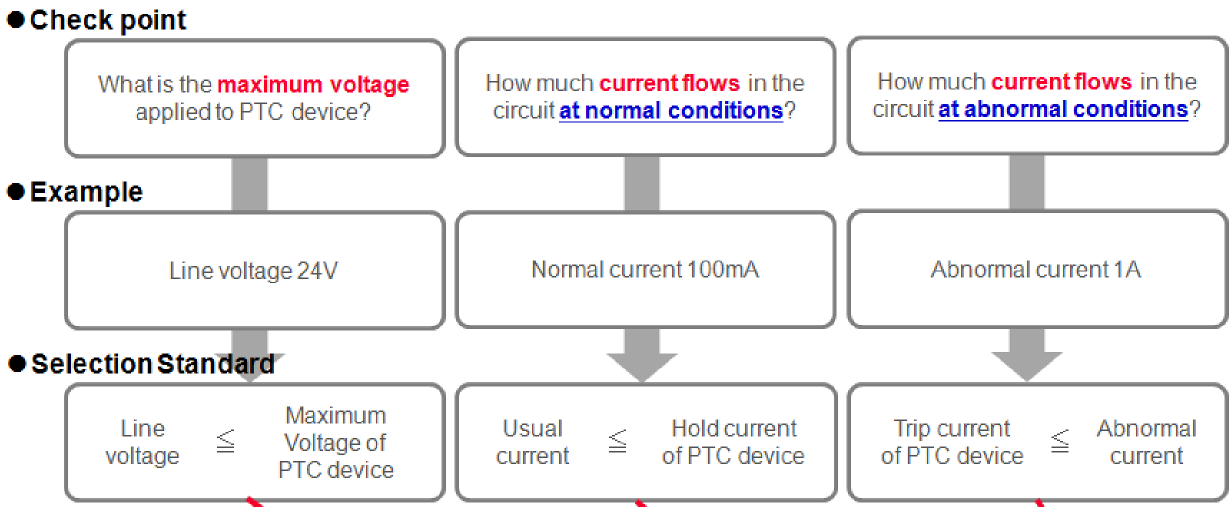


Figure 2.2 Operation of PTC device

2.2 Selection guide of Murata part-number considering circuit voltage and current point of view.

When PTC device will be used for Overcurrent protection, PTC part number can be selected properly through a following process. When PTC device is selected, please check 3 point of to circuit parameter, 1) Maximum voltage, 2) Current at normal condition, and 3) Current at abnormal condition to meet PTC specification or not, firstly.



Size [mm/in.]	Part Number	Resistance at 25°C [ohm]	Max. Voltage [VDC]	Max. Current [A]	Hold Current [mA]					Trip Current [mA]	
					at 25℃	at 60℃	at 70℃	at 75℃	at 85℃	at -20℃	at 25℃
2012/0805	PRG21BC2R2MM1RA	2.2±20%	16	9.10	220	150	125	-	95	620	500
	PRG21BC2R2MM1RK	2.2±20%	27	15.4	220	150	125	-	95	620	500
	PRG21BC3R3MM1RA	3.3±20%	20	7.58	180	120	100	-	75	500	400
	PRG21BC3R3MM1RK	3.3±20%	30	11.4	180	120	100	-	75	500	400
	PRG21BC4R7MM1RA	4.7±20%	30	7.98	155	100	85	-	60	420	330
	PRG21BC4R7MM1RK	4.7±20%	32	8.52	155	100	85	-	60	420	330

Figure 2.3 Selection process of Murata part number

2.3 Hold-current and Trip-current

Hold-current and Trip-current have temperature dependence which features decreasing current value with increasing temperature. Hold-current means a maximum current value which can be flowed in normal operation. And, Trip-current indicates a minimum current value which is necessary for PTC device to move to high-resistance state. What the difference between Hold-current value and Trip-current value is described in gray. This region means PTC device can operate either trip or normal. When circuit will be designed using PTC device, please check Hold current of PTC device will match current level of normal operation in your product, first.

■ Specification

Size [mm/in.]	Part Number	Resistance at 25℃ [ohm]	Max. Voltage [VDC]	Max. Current [A]	Hold Current [mA]					Trip Current [mA]	
					at 25℃	at 60℃	at 70℃	at 75℃	at 85℃	at -20℃	at 25℃
2012/0805	PRG21BC2R2MM1RA	2.2±20%	16	9.10	220	150	125	-	95	620	500
	PRG21BC2R2MM1RK	2.2±20%	27	15.4	220	150	125	-	95	620	500
	PRG21BC3R3MM1RA	3.3±20%	20	7.58	180	120	100	-	75	500	400
	PRG21BC3R3MM1RK	3.3±20%	30	11.4	180	120	100	-	75	500	400
	PRG21BC4R7MM1RA	4.7±20%	30	7.98	155	100	85	-	60	420	330
	PRG21BC4R7MM1RK	4.7±20%	32	8.52	155	100	85	-	60	420	330

■ Protective Threshold Current Range

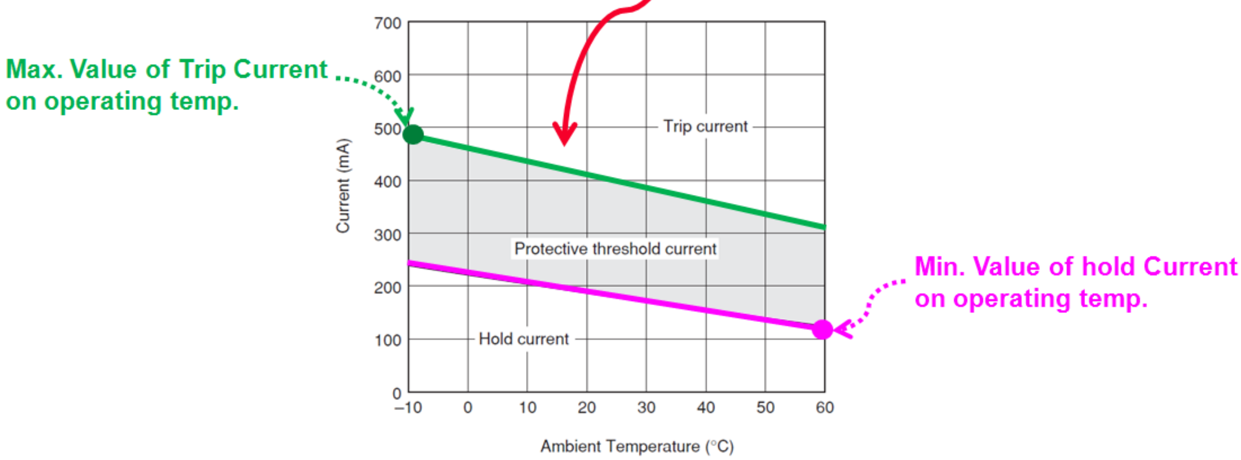


Figure 2.4 Selection process of Hold-current and Trip-current (ex. PRG21BC3R3-type)

2.4 What is the meaning of "Ambient Temperature" in Hold-current and Trip-current

As shown Figure 2.5, PTC device will be used close to heat spot like a CPU, Power Device, Resistor, etc. In these cases, what we can consider "Ambient Temperature" of Hold-current and Trip-current. Murata determine "Ambient temperature" as PTC device temperature with unloaded condition. Figure 2.6 shows our test data, and it explains actual PTC device temperature is higher than atmosphere temperature, caused by heat generation of Resistor. Because 3 pcs. of Resistors were applied voltage, and PTC device was mounted on board and it was close to Resistor. In this case, we can consider "Actual PTC temperature" as "Ambient Temperature".

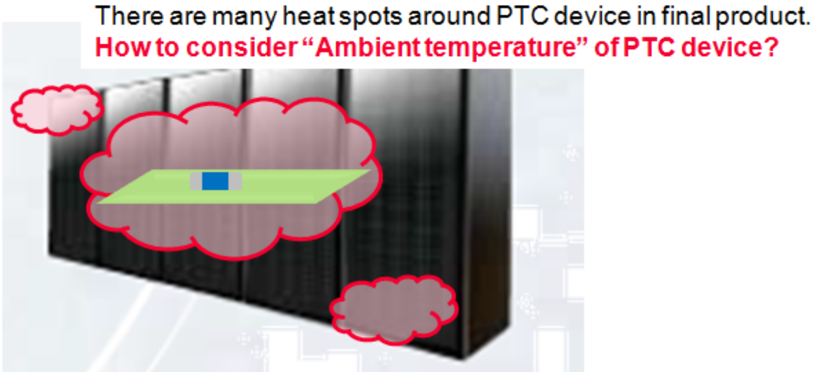


Figure 2.5 Surrounding condition of PTC device in final products

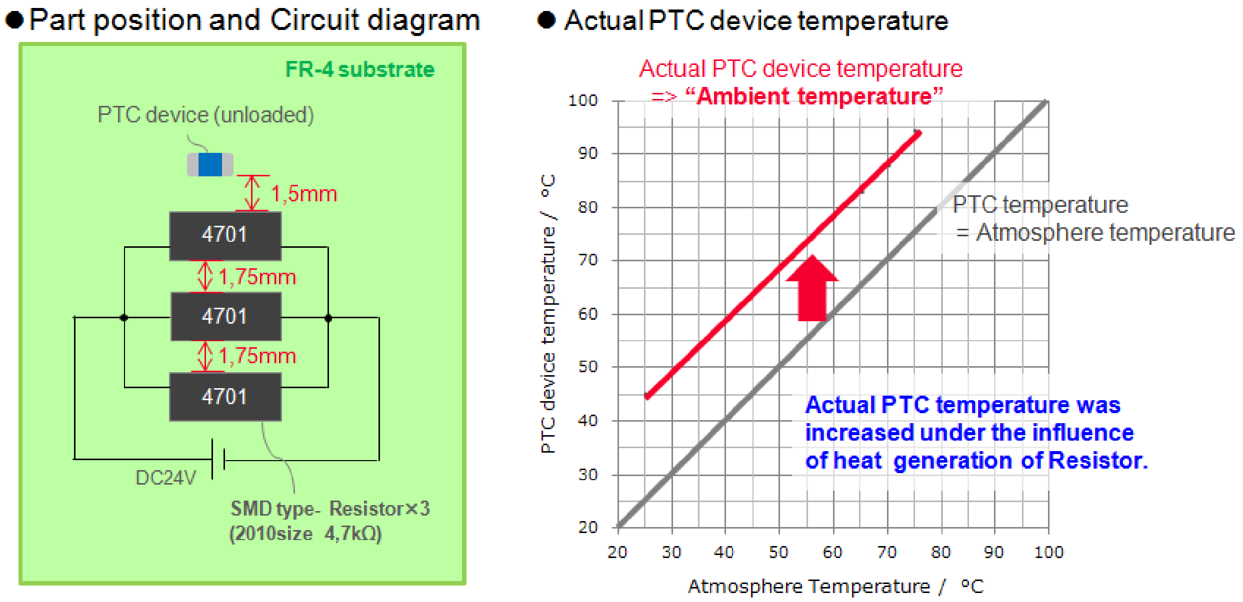


Figure 2.6 Actual PTC device temperature and Atmosphere temperature

2.5 If Hold-current doesn't meet normal current value, using 2 pieces of PTC devices in parallel can solve it.

When PTC device will be used for product which requires higher current than PTC current as listed, 2 pieces of PTC devices in parallel can be chosen to match current level of required normal operation. It realizes current level of normal operation become double its single PTC device. In this case, please note that one of PTC device should be located well away from another PTC device. What happen is occurred when each PTC device is placed close together on board? It will result combined Hold-current becomes less than double as shown Figure 2.8. Because each PTC device gives heating-up to each other (refer to Figure 2.7).

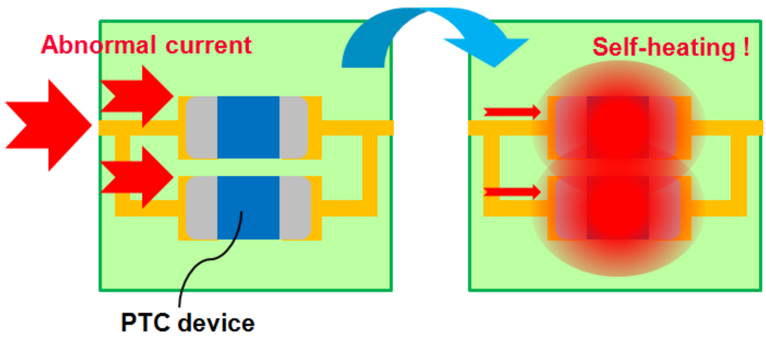


Figure 2.7 **Each PTC device gives heating-up to each other**

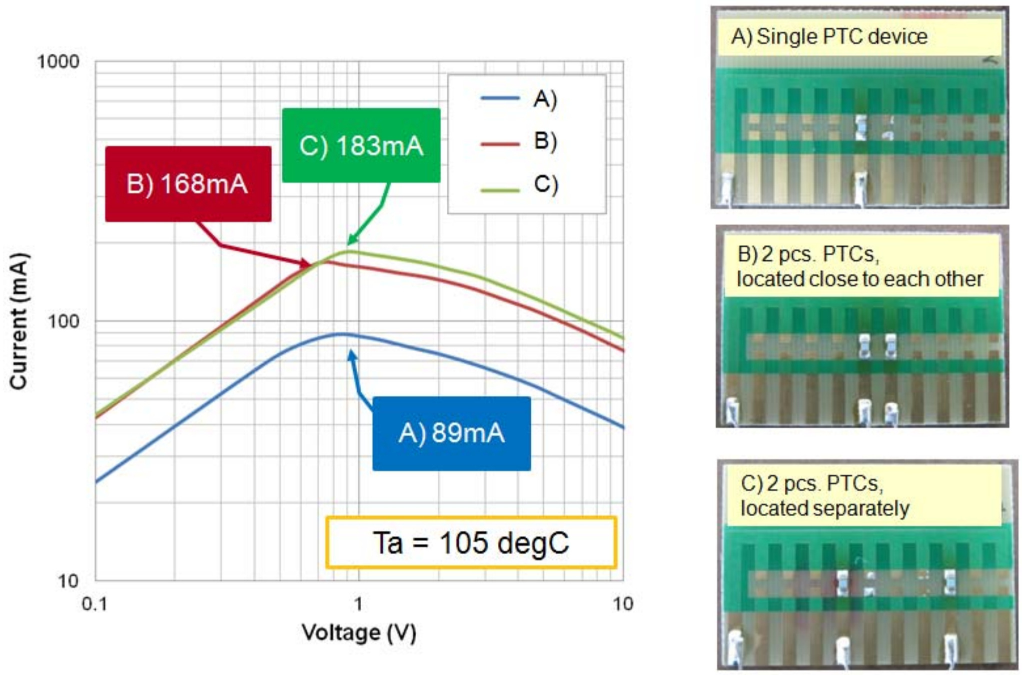


Figure 2.8 Effect of PTCs position

2.6 Time to Trip operation

Time to Trip operation is described in Figure 2.9 and Figure 2.10. Basically, PTC trip operation is created by its self-heating due to Wattage = I^2R. Then, Time to Trip is decreasing with increasing current, because the warming-up speed of PTC device also increasing depending on current level. And, Time to Trip is changed depending on ambient temperature, individual PTC resistance value, and PTC device size.

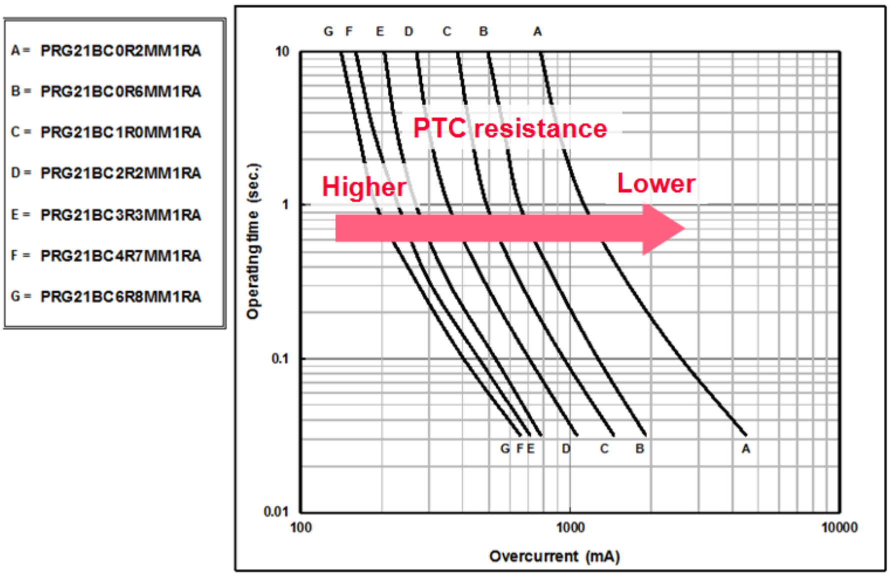


*Figure 2.9 Time trip operation is depending on individual PTC resistance (ex PRG21BC******RA-series)*

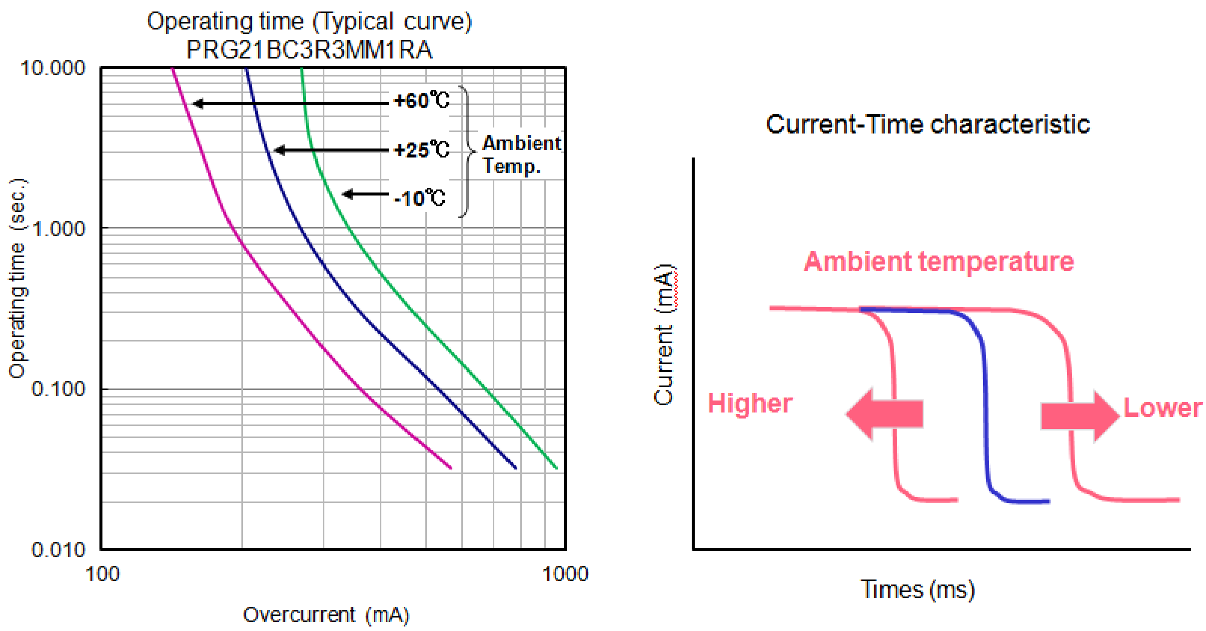


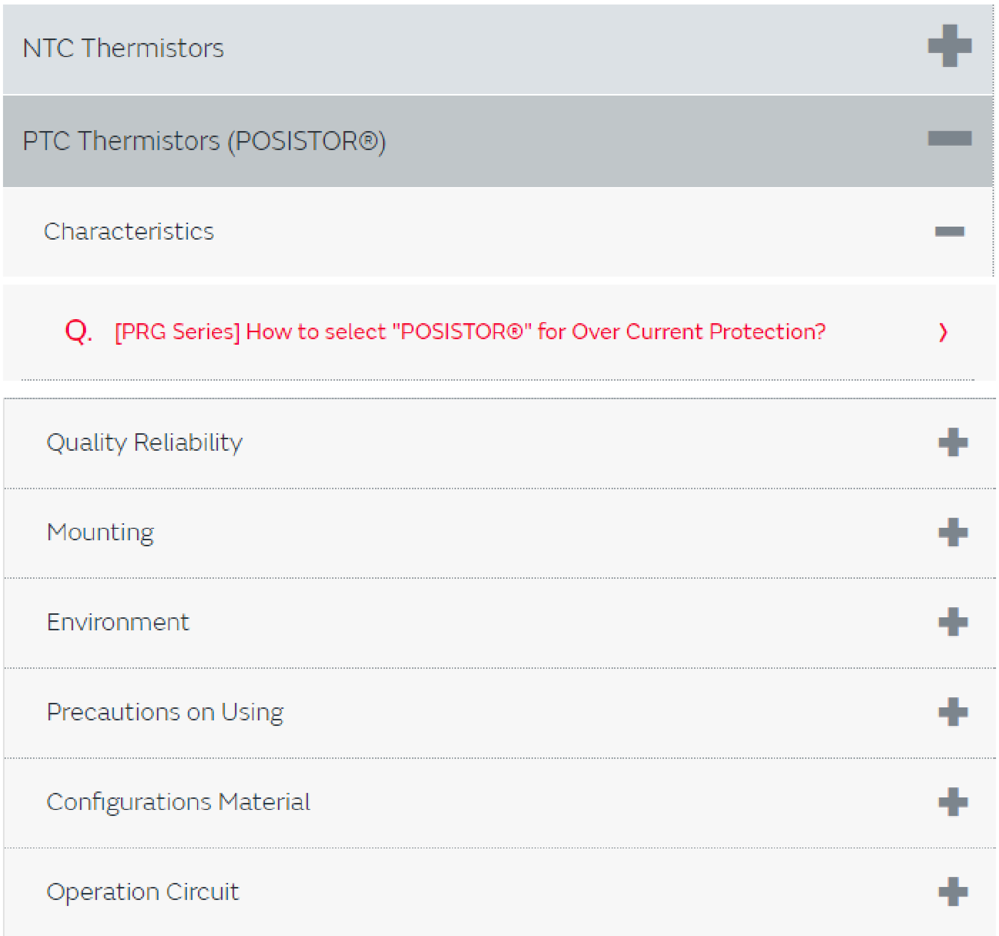
Figure 2.10 Time trip operation is depending on ambient temperature (ex PRG21BC3R3MM1RA)

3. FAQ

3.1 FAQ URL of PRG Series

・Please click here to check the FAQ of PRG Series.

http://www.murata.com/en-global/support/faqs/products/thermistor



3.2 WEB URL of PRG Series

・Please visit our the website

http://www.murata.com/en-global/products/thermistor/ptc/prg