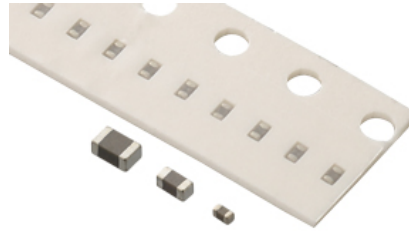


PRF Series



PTC Thermistor

(Ceramic PTC Thermistor for Overheat detection)

PRF Series

Features

- Faster response
- Wide Sensing Temperature
- Compact Design to save Board space
- Low profile
- High Reliability
- RoHS Compliant and Halogen Free
- Safety Standard
(UL : E137188 VDE, TUV etc.)

Applications

- Automotive
(LED Lamp/Navigation/Motor/Electrical Component)
- LED Bulb
- Mobile phone
- Note PC, Tablet PC
- Battery
- Power Supply
- Motor and Motor Controller

Overview

Exploiting the PTC characteristic (a sharp increase in resistance above a certain temperature), the PRF series chip PTC thermistors are used for overheat sensing in FETs, power ICs, and other heat generating areas. Use of the sharp change in electrical resistance translates into outstanding noise resistance. Sharp changes in resistance make it possible to accurately detect overheating in multiple areas using a very simple circuit connecting PTC thermistors in series. This allows the customer to reduce the number of IC ports, thereby downsizing equipment.

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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 generated 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.

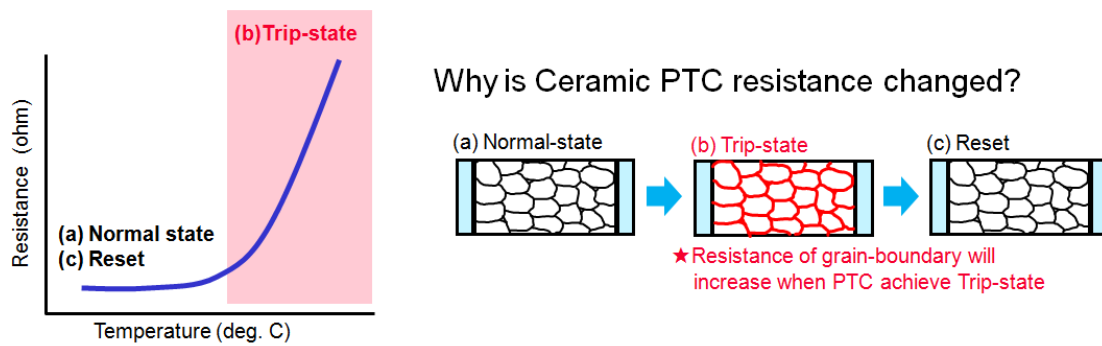


Figure 1.1 PTC temperature-resistance characteristic and its origin

1.2 The definition of Temperature-Resistance Characteristic

For overheat detection, several Temperature-Resistance Characteristics are available, and these are known by the code of Curie Temperature as following figure 1.2. The Curie Temperature is defined by the PTC resistance which is twice value of Resistance at 25 deg.C. Murata list several Curie Temperatures to apply for various overheat temperature.

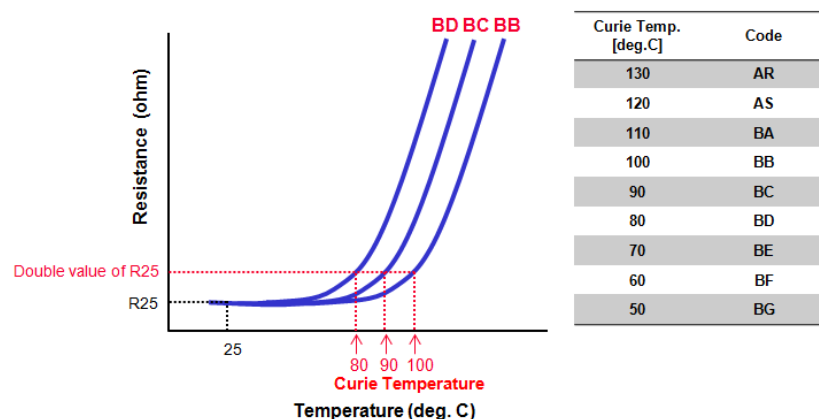


Figure 1.2 Definition of Temperature-Resistance Characteristic

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2. Usage for Overheat Detection

2.1 Overheat detection using PTC Thermistor

The PTC device as overheat protector can be used for placing near overheat spot. And, PTC device can detect overheating using its exponential resistance change, because PTC is warmed by heat transfer from heat spot. For example, Murata part-number PRF18BC471QB5RB indicate 470 ohm at 25 deg.C, and its resistance start to increase quickly when overheat is generated. PRF18BC471QB5RB is specified sensing temperatures 105 deg.C and 120 deg.C by measuring PTC resistance 4.7k ohm and 47k ohm respectively. After removing abnormal overheat, PTC resistance will decrease and return to normal state. PTC device can be detect overheat repeatedly.

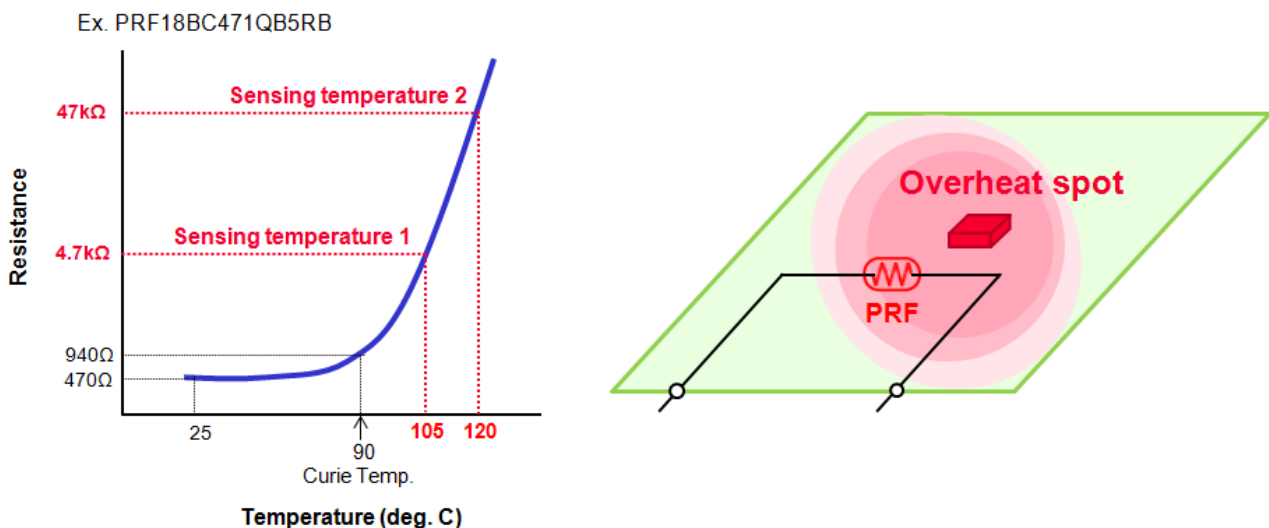


Figure 2.1 the PTC device for overheat sensing.

2.2 Circuit example and its parameter

Figure 2.2 shows circuit example and output voltage (V_{out}) image. When PTC is used for Overheat detection, usually connecting PTC device and resistor in series is built. And, its output voltage (V_{out}) will indicate exponential changing as increasing temperature, because of PTC's resistance-temperature characteristic. Overheating will be found to monitor threshold. An example of circuit is built using PRF15**102QB6RC and resistor 22kohm, and 3.3 DCV is applied to its series circuit as in Figure 2.2. In this circuit parameter esp. PRF15BC102QB6RC, threshold voltage 1.03 DCV and 2.71 DCV are indicated 105 deg.C and 120 deg.C respectively.

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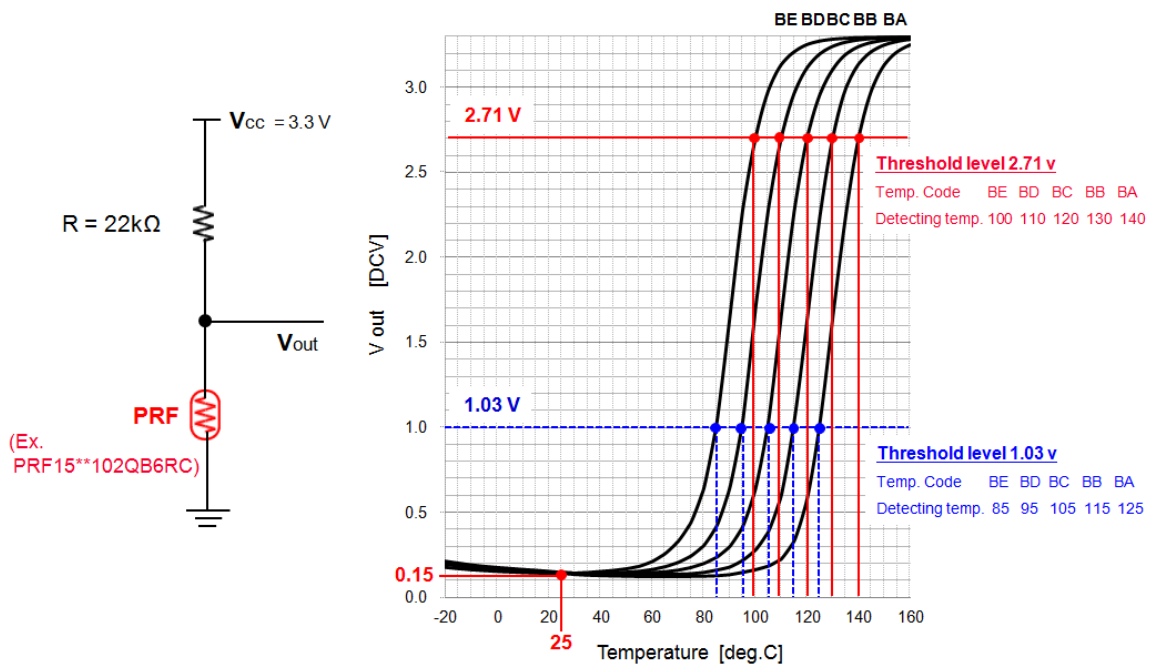
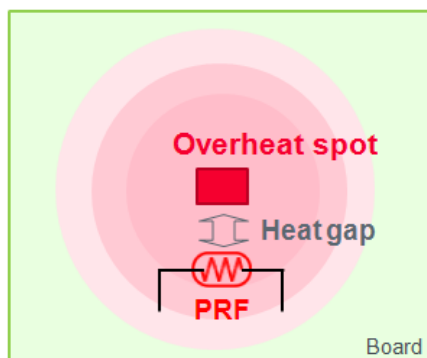


Figure 2.2 Circuit example and Output image (Ex. PRF15**102QB6RC)

2.3 Design guide of overheat detection

Overheating can be detected by building series circuit of PTC device and resistor as in Figure 2.2. And, PTC device is needed to be placed near overheat spot, because heat-gap between overheat spot and PTC device should be smaller. This heat-gap is depending on some factors including distance between overheat spot and PTC device, heat distribution, land pattern, and so on. Even if these factors are designed to minimize heat gap, the slight heat-gap will be remained. Therefore, PTC device can be selected with consideration of its heat-gap. For example, if there is heat-gap of 5 deg.C and heat spot should be detected temperature 115 deg.C, PTC device is needed to monitor 110 deg.C using PRF15BD102QB6RC and threshold 2.71 DCV.



“Heat gap” is depending on

- 1) Distance between Overheat spot and PTC Thermistor.
- 2) Heat-dissipation of board
- 3) Land pattern
- 4) Others

Figure 2.3 where is PTC device placed on board?

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2.4 Temperature accuracy PTC can detect

PTC Thermistor has characteristic variation in its temperature-resistance characteristic. For example, PRF18BC471QB5RB has temperature accuracy 105 $\pm$ 5 deg.C at 4.7kohm and 120 $\pm$ 7 deg.C at 47kohm as in Figure 2.4.

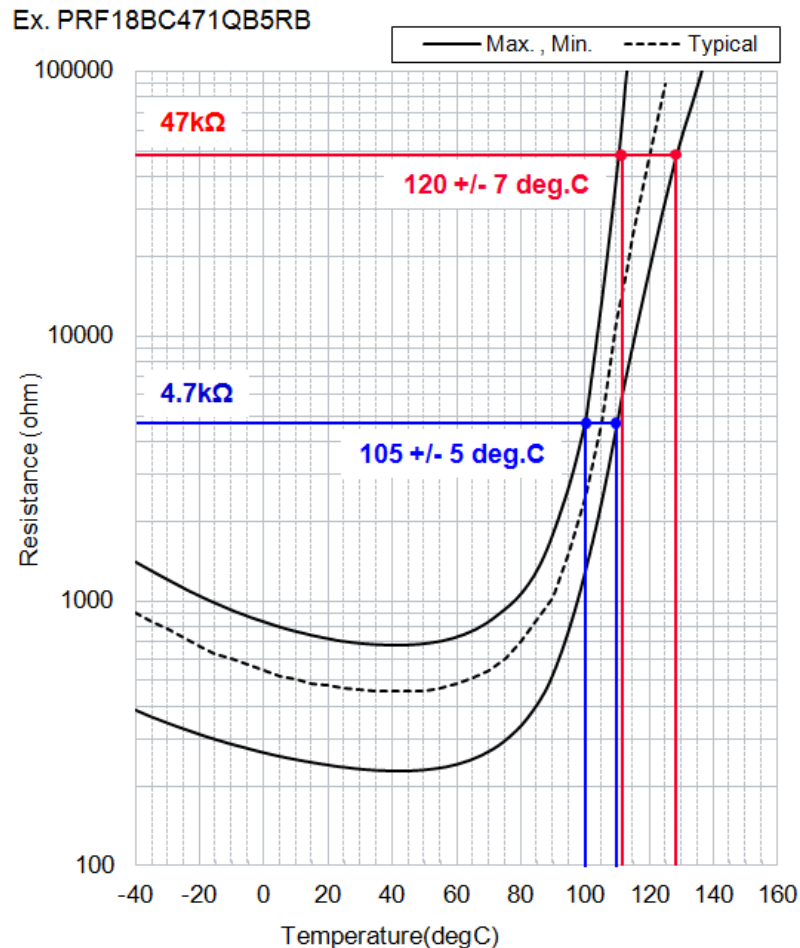


Figure 2.4 what is the accuracy PTC device can detect overheat?

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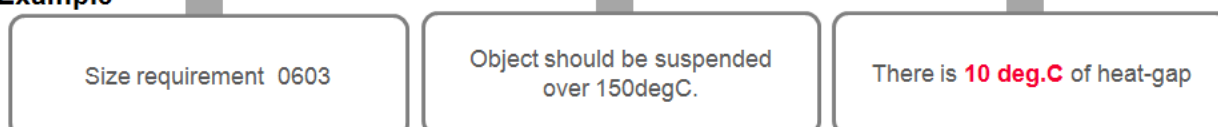
2.5 Selection guide of Murata part-number

Figure 2.5 shows selection guide of Murata part-number. PTC device for overheat detecting can be selected in order of package size, detecting temperature of heat spot, and heat-gap between PTC device and heat spot. The beginning of selection, PTC package can be chosen from listing 0805, 0603, and 0201 size. Next, sensing temperature is selected with consideration of break down temperature. If object should protect over 150 deg.C, sensing temperature has to be set under 150 deg.C. The sensing temperature is eventually determined after deducting heat-gap. If there is 10 deg.C of heat-gap between heat-spot (object) and PTC device, the sending temperature of PTC device should be selected to deduct 10 deg.C from 150 deg.C.

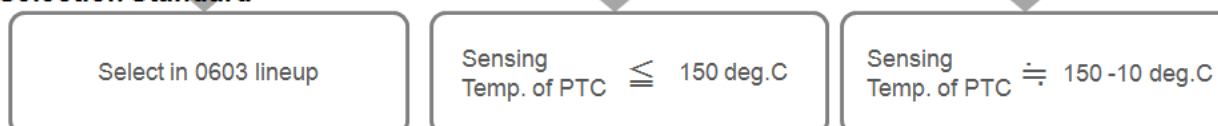
● Check point



● Example



● Selection Standard



Size [mm/in.]	Part Number	Resistance at 25°C [ohm]	*at 4.7kohm Sensing Temperature(°C)	*at 47kohm Sensing Temperature(2) (°C)	Max. Voltage [VDC]	Operation Temp. [°C]
1608/0603	PRF18AS471QB5RB	470+/-50%	145+/-5	-	32V	-20~+160
	PRF18AR471QB5RB	470+/-50%	135+/-5	150+/-7	32V	-20~+160
	PRF18BA471QB5RB	470+/-50%	125+/-5	140+/-7	32V	-20~+150
	PRF18BB471QB5RB	470+/-50%	115+/-5	130+/-7	32V	-20~+140
	PRF18BC471QB5RB	470+/-50%	105+/-5	120+/-7	32V	-20~+130
	PRF18BD471QB5RB	470+/-50%	95+/-5	110+/-7	32V	-20~+120
	PRF18BE471QB5RB	470+/-50%	85+/-5	100+/-7	32V	-20~+110
	PRF18BF471QB5RB	470+/-50%	75+/-5	90+/-7	32V	-20~+100
	PRF18BG471QB5RB	470+/-50%	65+/-5	80+/-7	32V	-20~+90

Figure 2.5 Selection guide of Murata part-number

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2.6 How PTC can detect overheating at multiple spot

PTC device can detect overheating using its exponential resistance change. In other words, individual PTC device can realize monitoring overheating with higher gain. It means PTC device can detect multi spot overheating to connect some PTC devices in series, to use strength of higher gain. Figure 2.6 shows circuit example of multi spot detection and its output voltage behavior. Circuit-2 is connected 4 pcs. PTCs in series, and output voltage (V_{out}) image is described when 1 of PTC can detect overheating. Comparing Circuit-1 and Circuit-2, V_{out} lines at lower temperature region indicate difference, but judging voltage as threshold indicates same level.

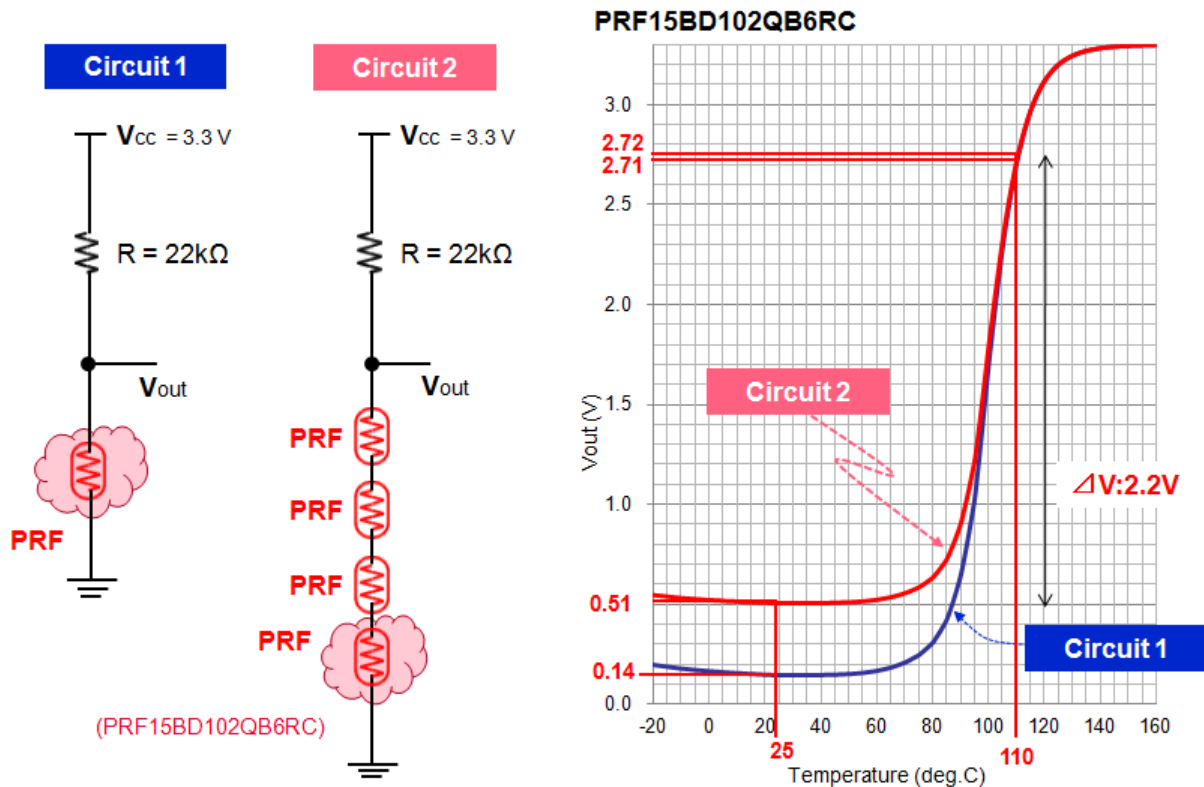


Figure 2.6 PTCs can be connected in series for multi spot detection

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2.7 Utilization procedure of web simulator

Murata prepare simulator for overheat detection on Murata web site.

<http://ds.murata.co.jp/software/sim surfing/en-us/index.html>

This web simulator can calculate threshold voltage and its accuracy for given parameters including PTC part number, sensing temperature, Input voltage (Vcc), and series resistor (R1). It's also enabled for multi spot detection by selecting number of PTC.

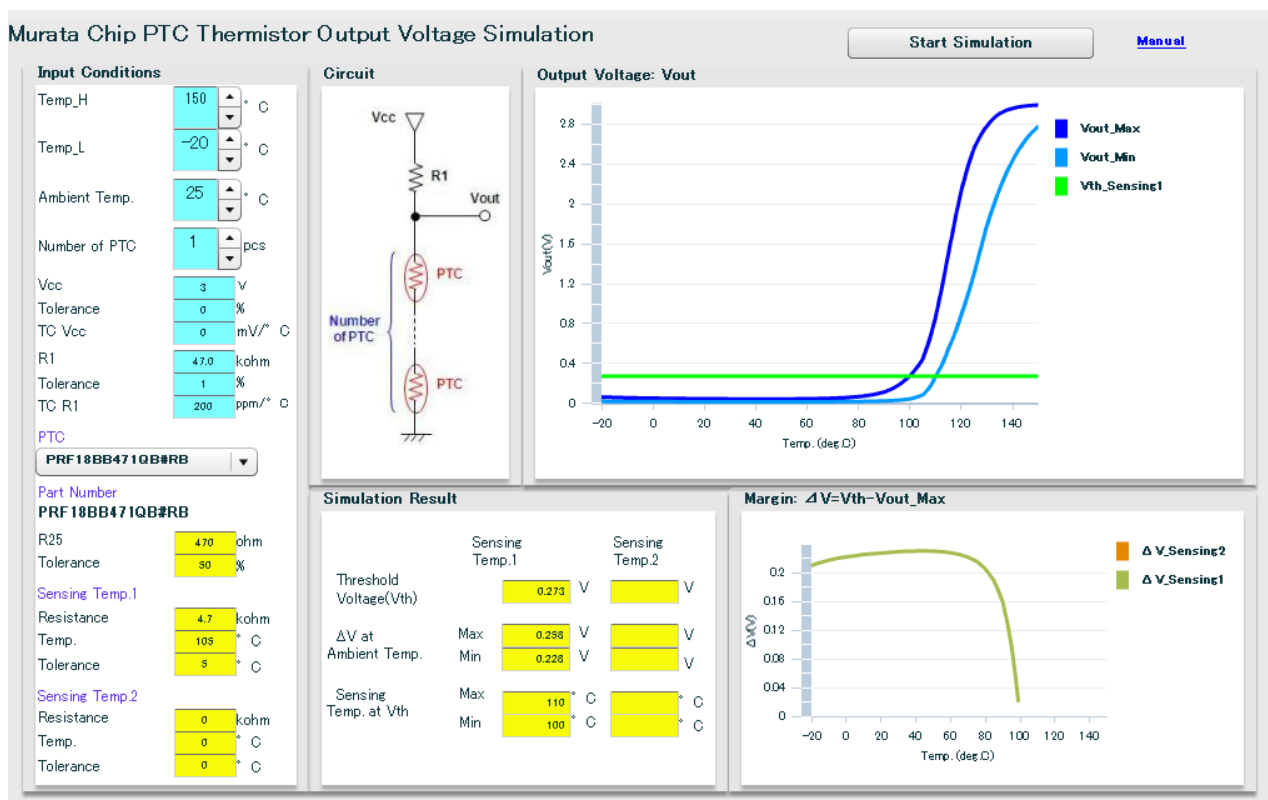


Figure 2.7 the screen of Web simulator

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3. FAQ

3.1 FAQ URL of PRF Series

- Please click here to check the FAQ of PRF Series.

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

NTC Thermistors	+
PTC Thermistors (POSISTOR®)	—
Characteristics	—
Q. [PRF Series] What are the variation of resistance-temperature characteristics?	)
Quality Reliability	+
Mounting	+
Environment	+
Precautions on Using	+
Configurations Material	+
Operation Circuit	+

3.2 WEB URL of PRF Series

- Please visit our the website

<http://www.murata.com/en-global/products/thermistor/ptc/prf>

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