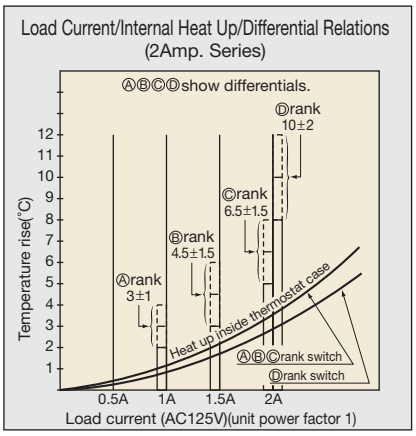
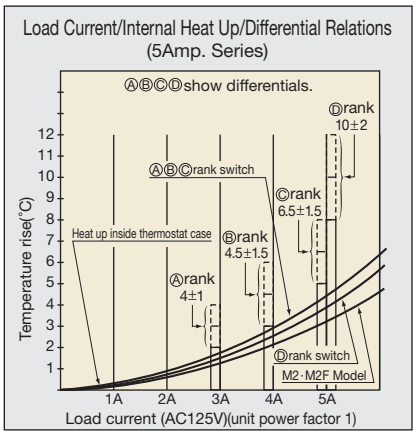
Technical Data (TPS)

Internal Heat Generation vs. Load

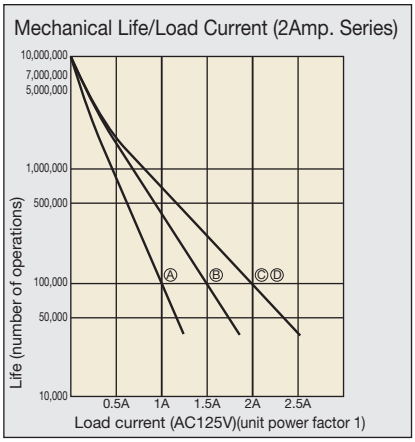
Contact capacity is limited for electrical components such as relays, thermostats or switches with make and break contact, because the contacts generate heat. Since a thermostat, in particular, reacts to temperature change, the heat generated at the contacts affects its operating temperature and differential. Matsuo's thermostats, as seen in the graph, have sufficient current capacity with an ample margin for the heat generated by the contacts.

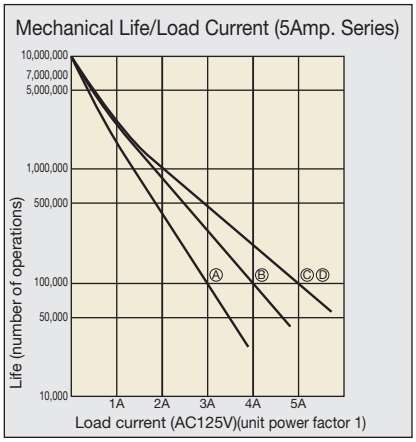




Relation between Life and Load

Temperature Power Sensor, TPS can perform more than 10 million mechanical operations. However, under heavy loads, the life will be reduced due to the wear of contacts. A life of 100,000 cycles of operation is guaranteed at the rated load current. Under reduced loads, the life lasts longer. See the graph on the right.





"Heat Time Constant" of Temperature Power Sensor

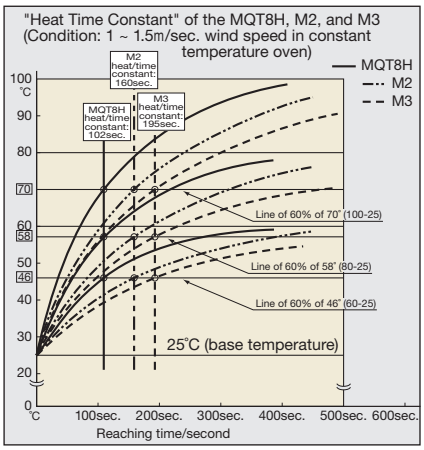
Any object has its own heat capacity. Generally, large objects do not easily assimilate with ambient temperature, on the other hand small objects do. Moreover, objects with good heat conductivity assimilate easily, and objects with small heat conductivity do not easily assimilate. Assimilation with ambient temperature is expressed by a "Heat Time Constant".

We measured the "Heat Time Constant" of the MQT8 Series Temperature Power Sensor.

"Heat Time Constant" (expressed by time to reach 60% of the range of temperature change) are the same as indicated in the chart to the left, regardless the range of temperature change, if the material and measurement conditions are the same.

The "Heat Time Constant" is 102 seconds for the MQT8 series, 160 seconds for the M2, and 195 seconds for the M3 when the device is measured under 1 to 1.5m wind speed, respectively.

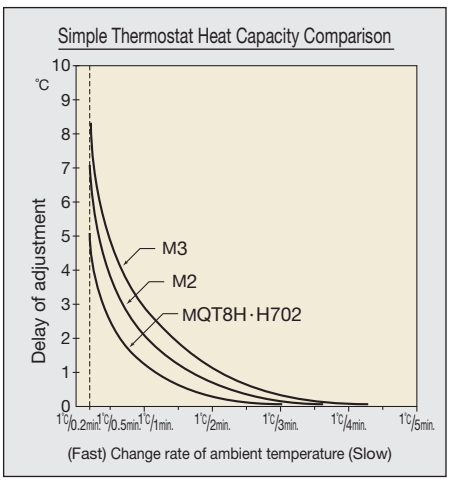
As water takes heat from objects faster than air, the "Heat Time Constant" measured in water is smaller than that measured in air.



Practical Heat Capacity Measurement

A heat/time constant is reasonable indicator in precisely grasping the heat capacity of an object. However, it is too academic. The following chart may help you see how the temperature of thermostats assimilates with the changing ambient temperature.

If the ambient temperature changes faster, the thermostat's affiliation for the ambient temperature is delayed. On the other hand, if it changes slowly, the thermostat can follow the ambient temperature change.



Something to be considered when using a Thermostat with DC Voltage Circuits

1.)The thermostat contacts may be damaged by arcs. How the damage occurs is affected by four factors as follows:
Because the Temperature Power Sensor is small in size, the contact gap (distance between the two contacts) cannot be made large. The standard is 0.1 mm. However, this Sensor has a sharp cut off mechanism and restores the 0.1 mm gap instantaneously.

(a) Voltage
Voltage is reflected by the contact gap. We ensure up to 250V AC or 48V DC (using a spark killer).

(b) Current
The current level mainly relates to what extent the contact is damaged by an arc, not whether the arc is disconnected or not. Because the arc of a high current causes rapid heating to the contact, adverse effects such as early contact melting or surface oxidization of the contact may occur.

(c) Open and close speed of the contact
If the gap between two contacts increases up to 0.1 mm instantaneously, the arc will be easily disconnected. However, if its action is slow, the contact will be damaged faster because it is kept heated until the gap becomes large enough to disconnect the arc.

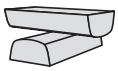
(d) Quality of the contact material and the condition of the contact surface If the contact is damaged and any projection is created (shown on the left), the arc will not be easily disconnected.

2.)As you know, when the contact opens, the arc continues for DC, but easily disconnects for AC. On the other hand, for AC, the phase of voltage alternates every 1/50 to 1/60 of a second, so that any accident in which an arc is drawn does not occur. As DC always runs in one direction, the arc is not easily disconnected.

3.)What does "a contact is damaged" mean exactly?
The surface or fringe of the contact is often contaminated by carbon created by the spark or arc when the contact is activated. Deposits of carbon increase contact resistance between the two contacts. A larger resistance naturally causes heating of the contact and carbon deposition becomes more likely. In addition, the current decreases, and the temperature of the load heater does not easily rise.

Cross Bar Contacts (Micro Capacity Contacts)

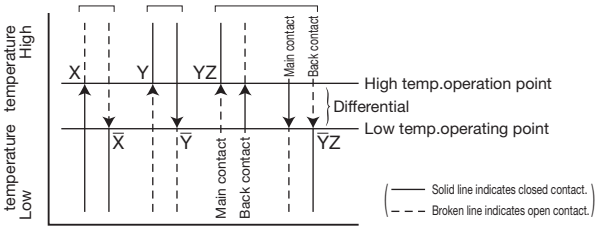
For ordinary contacts, the maximum current is indicated as 2Amp. max. etc. What is the minimum current? This is generally around 50~100 mA. Currents below this range are covered by special contacts for micro current.
The minimum current for ordinary contacts of our 2 Amp. series is also 50 mA. For currents below 50 mA, Crossbar contacts, called K contacts, are applied. Since the current range covered by cross contacts is 1~100 mA, 50~100 mA is covered both by ordinary contacts and micro capacity contacts. As this range is a recommended standard, ordinary contacts can be used for 20 mA as well, however, the possibility of contact failure will increase. Though the rating is indicated as 1~100 mA for crossbar contacts, these contacts may also be used in any amperage out of this range. 1~100 mA is the range that 100% conduction is ensured.



The structure of crossbar contacts is that of two noble metal contacts in trapezoidal shape, contacting with each other crosswise. The benefit of this structure is that there will be smaller possibility for contact failure because it can assure the large contact pressure per unit area.

Contact Type Indication

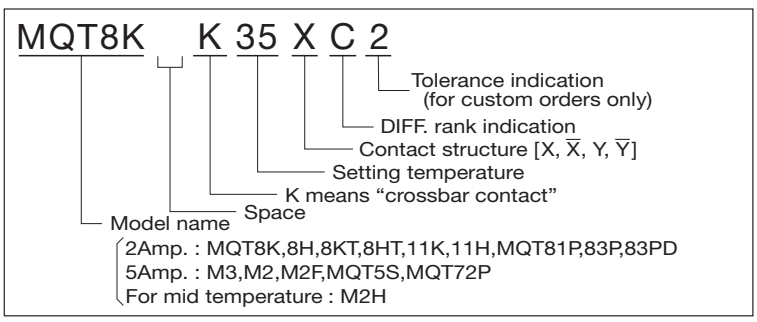
As we manufacture thermostats to be used as controllers, their model designation is more complicated than is the case of protectors. Refer to the diagram on the right.



- Contacts which open when the temperature rises are designated as X, and those which close when the temperature rises are designated as Y. Shown in the diagram is the temperature at which the contacts operate when the temperature rises (the high temperature side).
  $\bar{X}$ [Xbar] and $\bar{Y}$ [Ybar] are used for contacts that operate when the temperature falls (the low temperature side). $\bar{X}$ [Xbar] indicates the contact that closes when the temperature falls. $\bar{Y}$ [Ybar] indicates the contact that opens when the temperature falls. Z indicates transfer contacts. XZ is the main contact that opens when the temperature rises. $\bar{X}Z$ [Xbar Z] is the main contact that closes when the temperature falls.
- C is the standard rank designation for X contacts and B is standard for Y contacts. Please consider X is C ranked and Y is B ranked, unless otherwise indicated.

Model Designation Method

MQT8H K35XC represents a thermostat with crossbar contacts (K means crossbar contact).
For 5 Amp. Series with a back contact, a model name will be, for example, M3 35XZB, where Z means contact with the back contact.



OPERATION TEMPERATURE DATA SHEET

Model: MQT8H 30YB (VDE)

	Operating temperature Characteristics (°C)		
Sample No.	ON 30 ± 3K	OFF	DIFF. 3 — 6
1	30.2	24.4	5.8
2	31.4	25.8	5.6
3	31.8	26.3	5.5
4	29.3	24.0	5.3
5	29.5	23.8	5.7
6	29.4	24.4	5.0
7	30.2	25.2	5.0
8	30.6	24.7	5.9
9	31.6	26.5	5.1
10	29.6	24.0	5.6
Statistical data	Average ON: 30.4°C Average OFF: 24.9°C Average Diff: 5.5K Max deviation: +1.8°C (No.3) Temperature setting tolerance: ± 3K Repeatability: ± 0.2K		

Performance of MQT8H 30YB

This data sheet shows you ON temperature and OFF temperature for 10 pieces of MQT8H 30YB.

Highest ON temperature:
Sample No.3 has the highest ON temperature among of these 10 pieces and its deviation from the setting temperature of 30°C is +1.8°C which is in the range of our standard tolerance of ±3K.
The contacts of sample No.3 will always switch ON at 31.8°C±0.2°C on temperature rise, and OFF at 26.3°C±0.2°C on temperature fall. Repeatability is ±0.2°C.
Each sample has own differential between 3 and 6K, and the differential value of this sample No.3 is 5.5K which is permanently fixed and not fluctuate at all.

Lowest ON temperature:
Sample No.4 has the lowest ON temperature among of these 10 pieces and its deviation from the setting temperature of 30°C is –0.7°C which is in the range of our standard tolerance of ±3K.

Life:
100,000 cycles guaranteed at our specified electrical rating shown below.
0.6A/AC250V, 1A/AC125V for diff. rank A.
0.9A/AC250V, 1.5A/AC125V for diff. rank B
1.3A/AC250V, 2A/AC125V for diff. rank C and D.
Smaller electrical rating makes longer life and mechanical life will be more than 10 million cycles.

Temperature Power Sensor (TPS) is the trade name of Matsuo's high-precision, small-differential, long-life and low-price control-type thermostat.

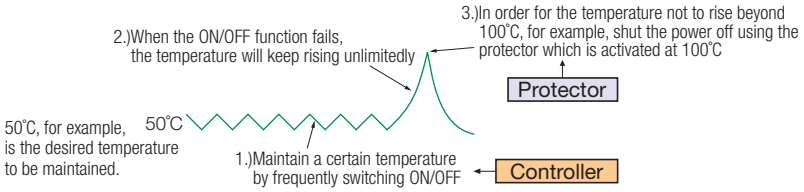
The main features include:

1.)Housed in a compact closed case.
2.)Mechanical service life of 10 million operations and electrical service life of at least 100,000 operations, guaranteed.
At least 500,000 operations for 1/2, 1 million operations for 1/4 and 7 million operations for 1/20 of the rating, guaranteed.
3.)With the narrowest possible differential of about 3°C, the product finds a considerably wide application as a controller.
4.)Moreover, the price is attractive. It is several times cheaper than an electronic thermostat, although it substantially varies by quantity.
5.)FIT = 3 to 4
FIT (Failure in Time) is used to indicate the failure rate. The unit of FIT is how many failures occur in one billion hours. For example, when three failures occur in one billion hours, the failure rate (FIT) is 3.

Technical information (knowledge to design a good temperature control system)

1. Thermostats can be categorized into two groups, controllers and protectors. Please decide which one you want to use.

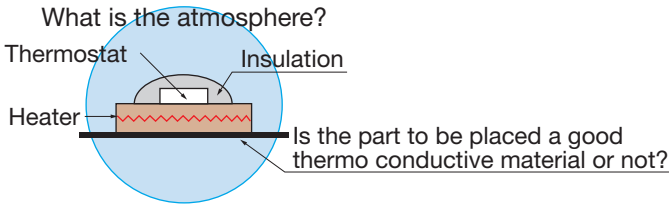
- Controllers are thermostats used to maintain temperature within a specified range.
- Protectors are thermostats used to cut electric power when the temperature rapidly rises and exceeds the specified limit.



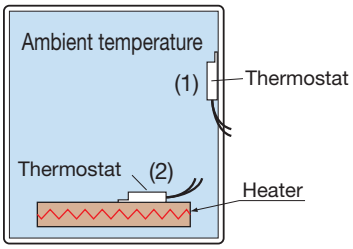
2. First, correctly understand the eventual purpose of yours temperature control, and then start studying the peripheral material.

- A thermostat controls a load such as the heater, motor, fan, lamp and so on, by sensing a change of temperature.

If the thermostat may be affected by the ambient temperature, cover the thermostat with thermal insulation.



- The positional relationship between the thermostat and the heat source (heater or cooler) is important.



To control the ambient temperature within an enclosure, place a thermostat in position (2) in the figure.
A thermostat installed in position (1) cannot provide proper temperature control.

- Determine the optimal differential.

When using a control-type thermostat such as the Temperature Power Sensor (TPS), a customer is likely to select a product grade with a small differential. This selection is the right choice answer in a sense, but this type of thermostat operates more frequently and may have a shorter service life.
The tip to configure your best temperature control system is to combine the mutually contradictory factors "accurate control and long life" appropriately.

Installing a thermostat with silicon adhesive may cause contact failure.

3. Are you using a heater that is too big?

Are you using a heater that is too big in comparison to the heat capacity of the heated object just because you want to reach the desired temperature quickly? If this is the a case, the heater will be operated many times, resulting in a shorter thermostat life, and maintaining the temperature will become unstable due to overshooting of the temperature. If you can wait a little longer for the initial temperature to rise, the life could be extended by three fold.

4. It is recommended that a surge protector using a capacitor/resistor be used to protect the thermostat from unfavorable phenomenon such as a surge or arc.

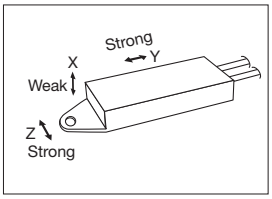
It is sold on the market under the name of “surge killer”, “spark killer” or “arc killer”. As for the installation method, it is usually installed in parallel to the contact. Try to install it as close to the contact as possible. Representative characteristic of the various loads are listed below by their structure. Give enough margin when designing a system.

1.) Resistive Load In- rush current i / rated current i_o = 1
2.) Incandescent lamp $i / i_o \fallingdotseq$ 10 ~15 times, about 1/3 sec
3.) Fluorescent lamp $i / i_o \fallingdotseq$ 3 times, within 10 sec
4.) Mercury lamp $i / i_o \fallingdotseq$ 3 times, about 3 to 5 minutes
5.) Motor and Fan $i / i_o \fallingdotseq$ 5 to 10 times, about 0.2 to 0.3 sec
6.) Solenoid $i / i_o \fallingdotseq$ 10 to 20 times, about 0.1sec
7.) Electromagnetic conductor $i / i_o \fallingdotseq$ 3 to 10 times, about 1/30 sec
8.) Load of capacitor $i / i_o \fallingdotseq$ 20 to 40 times, about 1/30 sec

An experimental test might be necessary to determine the level of surge killer.
If you send an actual load sample to us, we will perform a test on your behalf.

Technical information (precautions for using Temperature Power Sensors)

1. The TPS is an electric component and vulnerable to impact when it is alone.



The Temperature Power Sensor is fragile to impacts in the X direction and strong in the Y and Z directions (see the figure to the left). When a TPS is dropped from a height of 70 cm to the floor and it sustains an impact in the X direction, a temperature setting error between 2 and 3 may occur.
Once a TPS is integrated into your system, it isn't easily affected by extremely low impacts compared to when it is alone. This also applies to a TPS wrapped with corrugated fiberboard during delivery. Individual TPS wrapped with corrugated fiberboard must not be exposed to dangerous impacts.
In other words, extreme caution should be taken until a TPS is installed into your system after unpacking.

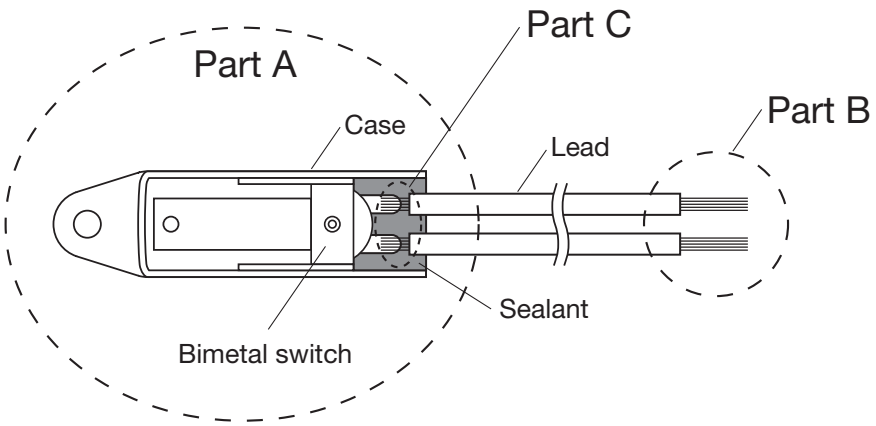
*In case you drop the TPS on the floor, please return it to Matsuo Electric for reinspection.

2. Double sealed construction (DS) ensures excellent waterproof and impact resistant performance.

Double sealed (DS) TPSs are sealed with vinyl tubes to improve waterproof and impact resistant performance.
The DS type has an impact resistance of 240G.

3. Standard TPSs have a dripproof construction.

For standard TPSs, the thermostat is housed in a plastic case with its exits for the leads sealed with a sealant, ensuring dustproof and dripproof performance.
However, repeated material expansion and contraction, and internal air pressure changes caused by thermal cycles may lead to wear of the plastic case and sealant, which consequently deteriorates the sealing performance.
Also, pay attention to possible capillary action of the leads.



Part A has a dripproof construction.
However, if Part B is exposed to water, the water may come into Part C due to capillary action. Part C and its surrounding area are close to the bimetal switch body. Therefore, be careful not to expose Part B to water during use.

4. Storage conditions and period

When storing the product for an extended period of time, keep it in a sealed plastic bag as much as possible.
Always check the contact resistance before use.
Particularly, Type Y and others with the contacts wide apart require extra attention.
The storage period is about one year although it depends on the storage conditions.