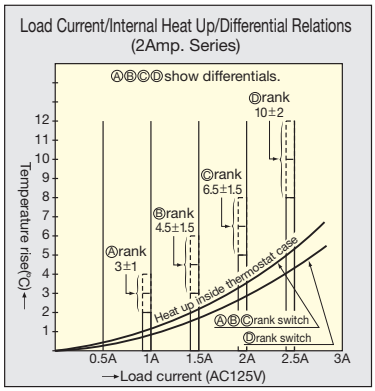
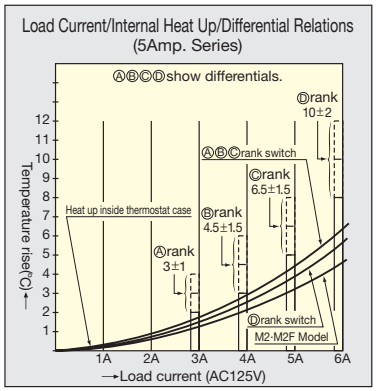
Technical information (1)

Internal Heat Generation vs. Load

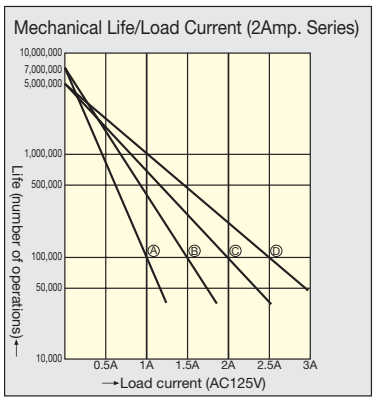
Contact capacity is limited for electrical components such as relays, thermostats or switches with make and break contact,
because the contacts generate heat. Since a thermostat, in particular, reacts to temperature change, the heat generated at the contacts affects its operating temperature and differential.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

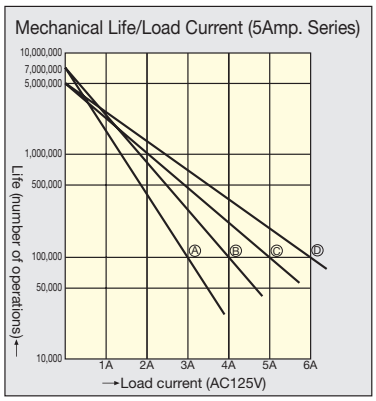




Relation between Life and Load

Temperature Power Sensor, TPS can perform more than 2 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.





Subject to be considered when using Thermostat with DC Voltage Circuits

1. Basically, this sensor complies with the ratings specified in the contact capacity list by voltage/differential on the upper columns in page 12 of this catalogue.
   In short, 5A for 125V AC and 12V DC or 3A for 250V AC and 24V DC respectively.
2. The followings are the factors that cause damage to contacts.
   (a) Voltage
   (b) Current
   (c) Open and close speed of the contact
   (d) Quality of the contact material and the condition of the contact surface

   Because the Temperature Power Sensor is small, the contact gap (distance between the two contacts) cannot be made large. The standard is 0.1㎜. However, this sensor has a sharp cut off mechanism and restores 0.1㎜ gap instantaneously.

   (a) Voltage is reflected by the contact gap. We ensure up to 250V AC or 48V DC. If you request up to 75V DC, we can produce a product for your request. However, we will not be able to produce A or B rank product with a smaller differential. The structure of our thermostat can not withstand 100V DC.

   (b) Current mainly relates not to whether arc is disconnected or not but to what extent the contact is damaged by arc. Because the arc of high current causes rapid heating on the contact, contact melting or surface oxidization of the contact may occur.

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

   (d) If the contact is damaged and any projection is created (shown on the left), the arc will not be easily disconnected.
3. 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 1/50～1/60 second, so that any accident that arc is drawn does not occur. As DC always runs in one direction, the arc is not easily disconnected.
4. What is the definition of "contact damaging"?
   (e) Melting of contact material
   Closing of the melted contact directly leads to deposition. The characteristics of alloy contact surface may change due to deposition of elements caused by melting. Materials of one contact may transfer to the other contact to deform surface into convex and concave shapes, so that the two contacts may lock when they close.

   (f) 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 increases contact resistance between the two contacts. Larger resistance naturally causes heating of the contact and deposition becomes more likely. In addition, current decreases, and the temperature of the load heater does not easily rise.

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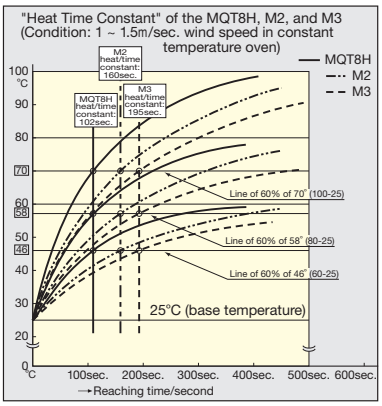
Technical information (2)

"Heat Time Constant" of Temperature Power Sensor

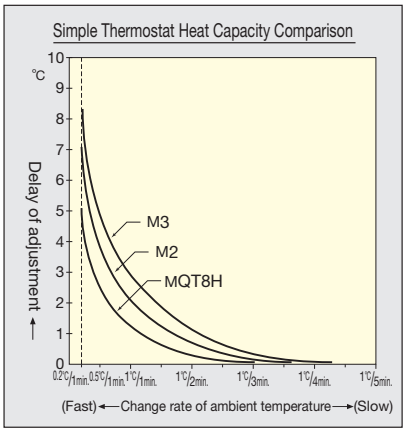
Any object has its own heat capacity. Generally, large objects do not easily assimilate with ambient temperature, on the other hand small objects do. Moreover, objects with good heat conductivity assimilate easily, and objects with small heat conductivity do not easily assimilate. Assimilation with ambient 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

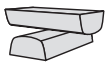
A heat/time constant is reasonable indicator in precisely grasping the heat capacity of an object. However, it is too academic. The following chart may help you see how the temperature of thermostats assimilates with the changing ambient temperature.



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.

Cross Bar Contacts (Micro Capacity Contacts)

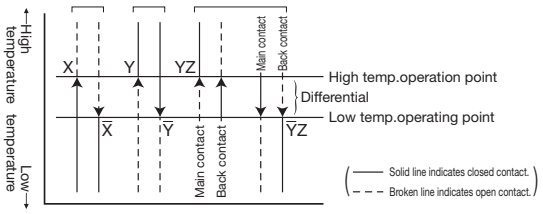
For ordinary contacts, the maximum current is indicated as 2 or 5 A max. etc. What is the minimum current? This is generally around 50~100 mA. Currents below this range are covered by special contacts for micro current.
The minimum current for ordinary contacts of our 2 Amp./5 Amp. series is also 50 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

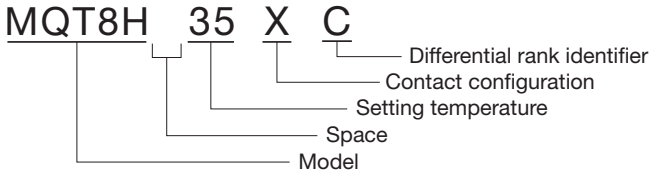
As we manufacture thermostats to be used as controllers, their model designation is more complicated than is the case of protectors. Refer to the diagram on the right.



- 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).
  $\overline{X}$ [Xbar] and $\overline{Y}$ [Ybar] are used for contacts that operate when the temperature falls (the low temperature side). $\overline{X}$ [Xbar] indicates the contact that closes when the temperature falls. $\overline{Y}$ [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. $\overline{XZ}$ [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 70XZB, where Z means contact with the back contact.



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