RoHS Compliant Thermal Cutoffs

NEC/SCHOTT

SEFUSE®

SF / E Series

Part Number	Rated Functioning Temperature T_f (°C)	Cut-off Temperature (Functioning Temperature) (°C)	Maximum Temperature Limit T_m (°C)	Holding Temperature T_h T_c (°C)	Safety Standard Approval						
					UL	CSA	VDE	BEAB	CCC	KTL	PSE
SF 70E	73	70 ± 2	150	58	•	•	•	•	•	•	•
SF 76E	77	76 $^{+0,-4}$	150	62	•	•	•	•	•	•	•
SF 96E	99	96 ± 2	150	84	•	•	•	•	•	•	•
SF 113E	113	110 ± 2	160	98	•	•	•	•	•	•	•
SF 119E	121	119 ± 2	150	106	•	•	•	•	•	•	•
SF 129E	133	129 ± 2	159	118	•	•	•	•	•	•	•
SF 139E	142	139 ± 2	159	127	•	•	•	•	•	•	•
SF 152E	157	152 ± 2	172	142	•	•	•	•	•	•	•
SF 169E	172	169 $^{+1,-3}$	189	157	•	•	•	•	•	•	•
SF 184E	184	182 ± 2	210	174	•	•	•	•	•	•	•
SF 188E	192	188 $^{+3,-1}$	375	177	•	•	•	•	•	•	•
SF 214E	216	214 $^{+1,-3}$	375	200	•	•	•	•	•	•	•
SF 226E	227	226 $^{+1,-3}$	240 (UL)	200	•	•	•	•	•	•	•
SF 240E	240	237 ± 2	375	200	•	•	•	•	•	•	•

UL: E71747, **CSA:** 172780 (LR52330), **VDE:** 677802-1171-0002, **BEAB:** C1137, **CCC:** varies by part # **PSE:** varies by part #

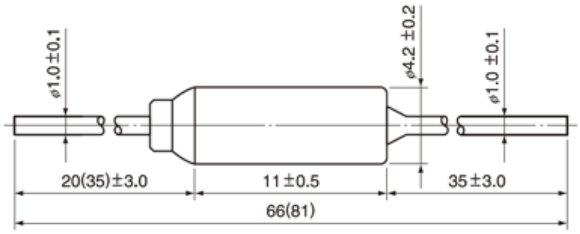
No use of hazardous substances prescribed by WEEE and RoHS with the exception of SF91E.
All products do not use SVHC prescribed by REACH except SF91E that uses a SVHC as the thermo-sensitive pellet.

RATED VOLTAGE	UL	CSA	VDE	BEAB	CCC	KTL	PSE
AC120V	15A (Inductive) (Resistive) 20A (Resistive)						
AC240V	15A (Resistive)						
AC250V	10A (Resistive)	15A (Inductive)	10A	10A	10A	10A	10A
	15A (Resistive)	15A (Resistive)	15A	15A	15A	15A	15A
	17A (Resistive)						
AC277V	15A (Resistive)						

Features

- Non-resettable thermal cutoff using an organic thermo-sensitive thermal element.
- Does not contain lead (Pb) or cadmium (Cd) in compliance with RoHS.
- Does not contain substances of very high concern (SVHC) specified by REACH.
- The SF type contains a sliding contact, two springs and a thermal pellet inside a metal case
- Remarkable sensitivity to temperature rise due to its shape and small size
- High reliability and accuracy due to resin-seal
- Appropriate for electric flows with large currents (6A-15A)

Diagram



Note: The dimensions for long lead devices are in parentheses.

For long lead lengths, a “-1” suffix is used at the end of the part number.

Definition of Terms

Rated Functioning Temperature (Tf)

Rated functioning temperature is the operating temperature of the thermal cutoff, measured using the method specified in the safety standard.

As stated in the Electrical Appliance and Material Safety Law (PSE) of Japan (Appendix 3, Section 3), the thermal cutoff should operate within ±7°C of the specified operating temperature. In cases where Tf is greater than 200°C, the thermal cutoff should operate within ±10°C of the specified operating temperature. In standards that comply with the IEC standard, it is indicated that the thermal cutoff should operate within +0/-10°C of the specified temperature range.

Operating Temperature

Operating temperature and tolerance refers to the operating temperature range measured by the following conditions. A thermal cutoff test sample is placed in the condition where the temperature of a thermostatic oven is raised until 12°C below the rated functioning temperature of the test sample at optionally increasing speed. Then the temperature of the thermostatic oven is raised at the rate of 0.5-1.0°C a minute. At this time, the electric current flowing through the test sample for opening confirmation shall be less than 10mA. Furthermore, the distance between a measuring point and a test sample shall be less than 20 mm.

Holding Temperature (Th)

Th is the maximum temperature measured on the thermal cutoff when it continues to conduct a rated current without changing its state of conductivity for 168 hours.

Maximum Temperature Limit (Tm)

Maximum temperature limit is the maximum temperature for which conductivity does not occur again during the following test. First, the samples are maintained at Tm for a period of 10 minutes. Then, the withstand voltage test is conducted for 2 minutes with twice the rated voltage. During the test, the thermal cutoff must remain in the functioned state, i.e. open. Hence, no current is allowed to pass through. (Functioned state of the SF type: not less than 0.2MΩ; SM type: not less than 2MΩ (between body and lead) and not less than 0.2MΩ (between lead and lead)

*Definitions excerpted from NEC/SCHOTT catalog. For questions, please contact NEC/SCHOTT

Installation Cautions (SEFUSE Brand From NEC/SCHOTT)

For optimal thermal cutoff performance, it is recommended that customers correctly store the thermal protection devices, design appropriate circuits for the appliances and perform evaluations, mounting and testing steps as necessary. Problems arising from the inappropriate execution of the above would be the sole responsibility of the customer, and NEC SCHOTT declines any and all responsibility.

Design

Do not use this device for any purpose other than as a thermal cutoff. The thermal cutoff is designed to detect abnormal rises in temperature and open the electrical circuits as required. It is not a current fuse that cuts off excess current. If the thermal cutoff is used as a current fuse, it may malfunction.

Do not use this device in aerospace equipment, aeronautical equipment, nuclear reactor control systems, life support Equipment or systems, transportation machinery engine control or safety-related equipment. This device is designed for use in household electrical appliances, office automation equipment, audio and video equipment, computer communications equipment, test and measurement equipment, personal electronic equipment and transportation equipment (excluding engine control).

Decisions regarding the type of thermal cutoff, the installation location and the mounting method should be made by the customers, based upon the requirements of the final application. It is recommended that designers test the final design with the selected thermal cutoff under both normal conditions as well as predicted worst-case scenarios.

▼ *Thermal cutoffs should be mounted where it can detect abnormal heat as quickly as possible.*

The thermal cutoff operates when the thermal element within melts. Therefore, if the thermal element does not reach the operating temperature, the cutoff will not activate even if the ambient temperature has risen to the operating temperature. In addition, a short lag time might result in the event of a sudden rise in the ambient temperature or if the thermal cutoff only detects part of the temperature increase.

▼ *Thermal cutoffs* should be mounted such that the temperature gradient is equal throughout the thermal cutoff.*

If lead B of the SF-type, which is caulked to the metal case, is mounted in such a way that it only conducts heat to the metal case, the temperature around the thermal pellet would always be higher than other parts in the metal case. This could lead to the thermal cutoff opening prematurely. Hence, it is recommended that lead A, which is the resin-sealed side, be connected nearer to the heat source.

It should also be mentioned that similarly, if lead A is fixed in a location where the temperature it is exposed to is always lower than that of lead B, the thermal cutoff could also be prematurely triggered. * except SFH-R series

▼ *Cautions about Tm*

Please ensure that the design of the final application does not exceed Tm (the maximum temperature limit) of the thermal cutoff. If used in conditions beyond the rated temperature, a dielectric breakdown could result and the thermal cutoff could re-conduct even after opening.

▼ *Cautions about Th (SF type)*

Continuous exposure to temperatures close to the Th temperature of the thermal cutoff could result in the thermal pellet reducing in size over time, thereby shortening the lifespan of the thermal cutoff. This change in the pellet size is irreversible. Hence, it is important that designers select and test thermal cutoffs suitable for the temperature zone of the final application, based on the temperature recommendations in Table 1. Please also note that the Th temperature test is a one-time test, not a cycle test, conducted continuously for 168 hours.

Designers of the final application should take into account the maximum surface temperature of the thermal cutoff as shown in Table 1, and avoid exceeding this level. If the body temperature of the thermal cutoff is exceeded on a regular basis, the thermal cutoff may start opening at temperatures lower than the normal operating temperature. Malfunctions may also occur. In case of using SM-type in DC rating, please kindly contact NEC SCHOTT.

Table 1

SM Type		SF Type					
		SF/R, SF/K, SF/Y series				SFH/R series	
Part Number	Fuse Body Temperature	Part Number	Fuse Body Temperature	Part Number	Fuse Body Temperature	Part Number	Fuse Body Temperature
SM072A	52°C	SF70R, K, Y, E	50°C	SF144R	122°C	SFH106R	86°C
SM092A, B	72°C	SF76R, K, Y, E	56°C	SF150R, Y	130°C	SFH109R	89°C
SM110A, B, G	90°C	SF81R	61°C	SF152E	132°C	SFH113R	93°C
SM125A, B	96°C	SF90R, K, Y	70°C	SF167R, Y	140°C	SFH117R	97°C
SM137A, B, G	117°C	SF94R, K, Y	74°C	SF169E	140°C	SFH124R	104°C
SM146A, B, G	126°C	SF96K, Y, E	76°C	SF184R, Y, E	140°C	SFH129R	109°C
SM150A, B	126°C	SF113R, Y	88°C	SF188R, K, Y,	140°C	SFH134R	114°C
		SF113E	90°C	SF214R, K, Y,	140°C	SFH152R	132°C
		SF119R, K, Y, E	99°C	SF229R, Y	140°C	SFH162R	140°C
		SF129R,Y, E	109°C	SF240R, Y, E	140°C	SFH172R	140°C
		SF139R, Y, E	119°C				

Thermal cutoffs have a limited life. The thermal elements used are durable substances designed for long-term use. However, the longevity of the thermal cutoff depends on the conditions in which it is exposed to. This is particularly true if the thermal protection device is frequently exposed to temperatures very close to its operating temperature. Hence, it is recommended that designers conduct a reliability test by fixing the thermal protection device onto the actual application and simulating the expected operating conditions to assess the lifetime of the device.

The body temperature of the thermal cutoff increases as current passes through it. The body temperature of the thermal cutoff could rise to levels higher than the ambient temperature current passes through the device. In addition, the body temperature could also increase depending on a number of factors such as the mounting method. Hence, it is recommended that designers measure the body temperature of the thermal cutoff after conducting a reliability test.

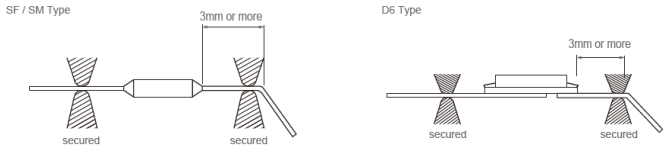
Use the thermal cutoff with a voltage and current level lower than the rated level. If the thermal cutoff is used with a voltage or current level higher than the rated level, the contacts may be welded together in the SF-type, causing the thermal cutoff to malfunction. In the SM-type and D6-type, the body of the thermal cutoff may rupture.

Do not use the thermal cutoff in an atmosphere out of the standard specifications such as in environments exposed to sulfurous acid gas, nitrogen oxide gas, ammonia gas or conditions that contain formic acid. It is also not suitable for high humidity situations and submersion in a liquid. The case of the thermal cutoff* is made with a copper alloy. Hence, installing the thermal cutoff in such conditions or similar, could deteriorate the sealing resin or lead to cracks in the case of the thermal cutoff due to corrosion. The thermal cutoff could thus operate at lower than operating temperatures or not activate even if its operating temperature is exceeded. * SF-K series only

The thermal cutoff corresponds to industrial waste. The thermal cutoff corresponds to industrial waste, and requires disposal according to governmental and provincial regulations. The services of a licensed disposal contractor could also be engaged.

The thermal cutoff is a non-repairable device. In case of replacement, an equivalent thermal cutoff from the same manufacturer should be used. For general consumers who are not aware of the cautions associated with the thermal cutoff, they should be informed not to mount, remove or replace the thermal cutoff through a note to this effect in the user's manual and other related materials.

Cautions Lead wire process When bending the lead wire, it is important not to apply excessive pressure to the root of the lead wire. The lead wire should be secured close to the case and bent (not twisted) at a distance 3 mm or more from the body of the fuse.



●The tensile strength applied to the lead wire should be 49N or less for SF-type and 9.8N or less for SM- and D6-types.

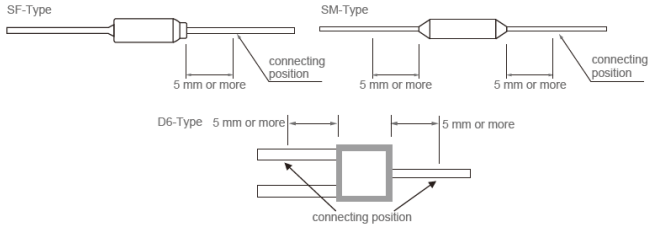
● The strength applied to the body of the thermal cutoff should be 98N or less for SF-type, 49N or less for SM-type, and 4.9N or less for D6 type.

With regards to the SF-type, deformation of the case may change the location of the sliding contact during operation and could lead to the thermal cutoff operating only at temperatures lower than the normal operating temperature range. The thermal cutoff may also not operate even if the thermal cutoff's operating temperature is exceeded.

Mounting

Thermal cutoffs can be mounted by soldering, caulking or welding.

● The connecting position at the lead of the resin-sealed side should be 5 mm or more from the body of the thermal cutoff.



● If soldering, take note that the thermal cutoff may function because of excessive solder temperature. To prevent such malfunctions, for example, holding the lead near the case with a tool is effective for allowing the heat to escape and the soldering should be done in short intervals. Another effective method is to use a lower solder temperature and to solder at a location that is at a distance from the case.

● If caulking or welding, be careful to keep the resistance value of the connecting section low. If the connecting section has a high resistance value, the passing current may generate an abnormally high temperature that will cause the thermal cutoff to operate.

● After mounting the thermal cutoff, be careful not to apply force that may pull, push or twist the lead wires. ● If using a SF-type thermal cutoff, the lead on the resin-sealed side must not be allowed to touch the case. This would cause the current to flow from the lead on the resin-sealed side to the opposite lead resulting in a non-functioning thermal cutoff.

● Note that the body of the SF-type is the same in potential as the circuit. Therefore, it must be electrically isolated from other metallic parts.

Storage

● The body and lead A of the SF-type, and the leads of SM092A and SM092B are silver-plated. Therefore, these parts may discolor because of sulfuration, making the markings on the body illegible or negatively affecting the solder-ability of the lead. To avoid this, the thermal cutoff should not be kept around materials (such as cardboard or rubber, etc.) which generate sulfurous acid gas.

● When storage in cardboard boxes is required, thermal cutoffs should be double packed and sealed in polybags such as polyethylene.

Recommendation

● *NEC SCHOTT recommends the following tests upon receipt and after mounting of the thermal cutoff, as it may have undergone some mechanical load or thermal influence during transportation or when being mounted.*

1. Appearance check
2. Resistance check (comparing before with after), or conductive check
3. X-ray inspection
4. Operation check for sampling

● Be careful when mounting the thermal cutoff because external force, heat or a harmful atmosphere (containing excessive humidity or sulfurous acid gas) may damage the thermal cutoff.

If applicable, it is recommended that the general consumers, who are unaware of the usage cautions for thermal cutoffs, be informed not to mount, remove, or replace the thermal cutoff through a note to this effect in the user's manual and other related material.

All reasonable care has been taken to present the data here and the values contained in this document were obtained under certain testing conditions by us. They are not guaranteed and are for reference only. For any clarifications or more information about these cautions, please kindly contact NEC SCHOTT Components Corporation.

● **The information herein is based on the documents as of December 2013, and is subject to change without notice. Therefore it is recommended to refer to latest individual information such as drawing for mass production designing. The latest product information will also be made available on http://www.nec-schott.co.jp for your reference.**

● Please note that should any problems relevant to the industrial property of third parties occur with the use of products from NEC SCHOTT, the company would not assume any responsibility for matters other than the ones directly related to the structure or the manufacturing process of the products supplied by NEC SCHOTT.

● Although continuous efforts to improve the quality and reliability of our products are in place, the possibility of defects cannot be entirely eliminated. Therefore when using our electronic component products, please ensure that sufficient safety measures are included in the design of the final application, such as redundancy, fire containment and malfunction prevention against physical injuries, fire disasters and social damages in consideration of the said defect occurrences.

Our products are classified into 2 groups: “Standard” and “Special”. The recommended applications of the products according to its quality level are indicated below. If you intend to use our products for applications other than “Standard” level, please consult with our sales representative in advance.

"Standard"

Computers, office equipment, communication equipment, measuring equipment, audio & visual equipment, home electric appliances, machine tools, personal electrical equipment and industrial robots, etc.

"Special"

Transportation equipment (automobiles, trains, ships and others), aircrafts, aerospace equipment, medical equipment for life support, etc.

*Cautions excerpted from NEC/SCHOTT Catalog. For questions and complete cautions, please refer to product catalog or contact NEC/SCHOTT