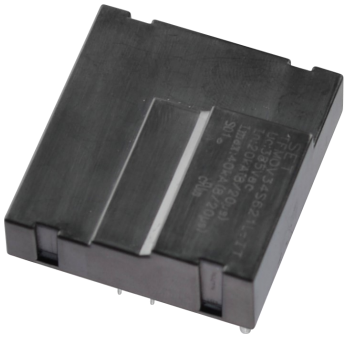
# TFMOV

**Thermal Fuse & MOV（TFMOV）**

**TFMOV34SxxxL Series**

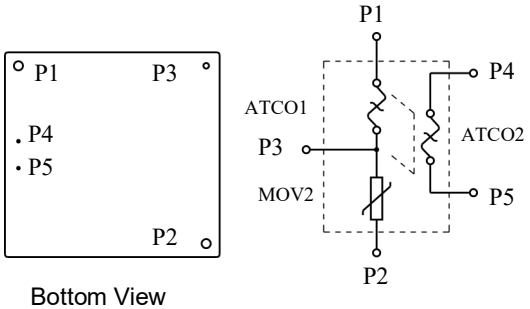
## Description



Thermal Fuse & MOV (TFMOV) is a thermally protected varistor that has all the characteristics of a thermally protected varistor (MOV). TFMOV has all the characteristics of a varistor (MOV) with thermal protection, and there are two types of deterioration: natural deterioration due to long -term operation and deterioration due to an abnormal surge. When a surge occurs, the leakage current of the degraded MOV continues to increase, causing the surface temperature of the MOV to continue to rise and the possibility of fire. At this time, the thermal cutoff (fusible alloy) in the TFMOV senses the abnormal temperature and operates (blows) to disconnect the MOV from the main circuit to protect the entire circuit, and the MOV itself will not continue to heat up and catch fire.

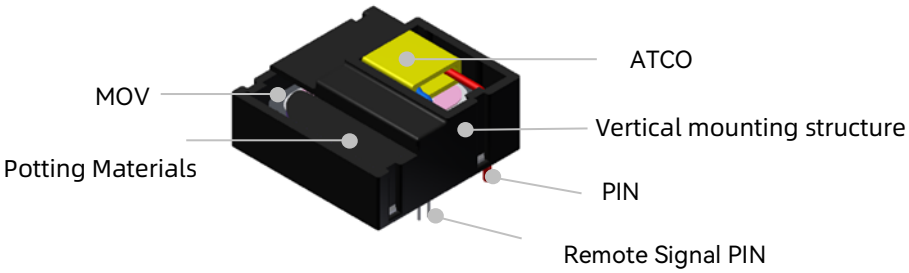
SETsafe | SETfuse Thermal Protection Varistors - Fusible Alloy TFMOV34SxxxL Series are mainly composed of Varistors (MOV), Thermal Cutoffs (Fusible Alloy) (ATCO), Flame Retardant Cases and Metal Components (Pins), Potting Materials. Vertical mounting structure; Nominal discharge current: (10 ~ 20) kA; Maximum continuous operating voltage: (30 ~ 420) VAC; Safety certificates: UL, cUL; RoHS, REACH compliant.

## Schematics




**TFMOV(ATCO)**

## Structure




**TFMOV(ATCO)**

## Features

- Thermal Protection, High Reliability
- Small Size
- Remote Signal Contact for Failure Indication (Optional)
- High Energy Capacity
- Epoxy Sealing Material, Flame-retardant to V0 (UL 94)
- Comply with UL 1449 / IEC 61643-11

## Applications

- Telecom Equipment
- String Inverter in Photovoltaic System
- AC / DC Power Supply
- Uninterruptable Power Supply (UPS)
- Surge Protective Device (SPD)
- Electric Meter
- Power Distribution Unit (PDU)

## Agency Approvals

| Agency Symbol | Standards | The File No. and certification No. obtained by SETsafe \| SETfuse | Category |
|---|---|---|---|
| | UL 1449 | E322662 | Type 4CA |
| | CSA C22.2 NO. 269, CSA ECN 516 | E322662 | Type 4CA |
| Environment | RoHS & REACH | Compliant | |

## Part Numbering System

TFMOV 34 S 621 L -IT - 3 - 001

**Product Category**
TFMOV

**MOV Size (mm)**
34 mm

**MOV Shape**
S: Square
D: Round
R: Rectangle

**Nominal Varistor Voltage**

| 820 | 621 | 102 |
|---|---|---|
| $82\times10^0$ =82 V | $62\times10^1$ =620 V | $10\times10^2$ =1000 V |

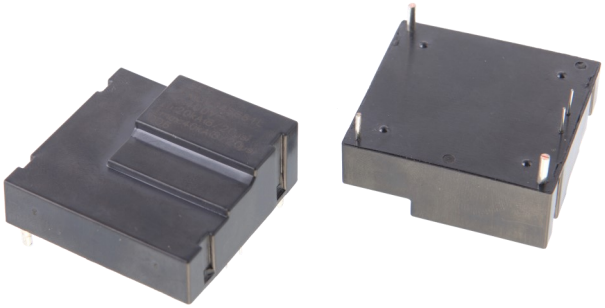
**Other Options**

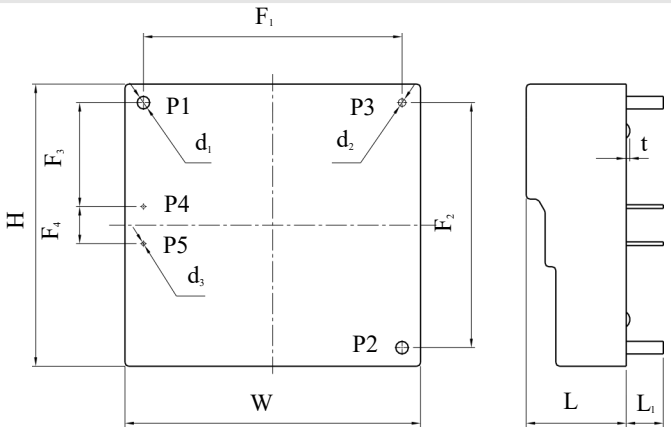
**Pin No.**
2: Without Remote Signal Contact or Status Indication
3: With Status Indication
4: With Remote Signal Contact
5: With Remote Signal Contact and Status Indication

**Remote Signal**
Default: Without Remote Signal Contact
-IT: With Remote Signal Contact

**Installation mode**
Default：Vertical type
L：Horizontal type （Low height）

Reminder:
Part numbering system in the datasheet is only for selecting correct parameter and product features. Before placing order, please contact us for specifications and use the part number and product code in the specifications to place order to ensure the part is correct. Product code is the unique indentification.

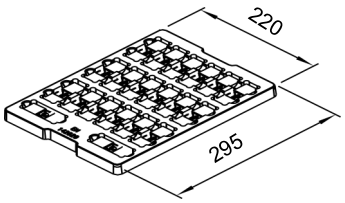




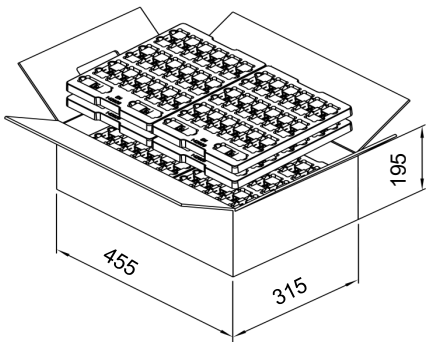

Note:
Pin P3 / P4 / P5 is Optional
Unit: mm

| Nominal Varistor Voltage | L (±1.0) | $L_1$(±1.0) | W (±1.0) | H (±1.0) | $d_1$ (-0.05,+0.15) | $d_2$ (±0.05) | $F_1$ (±0.5) | $F_2$ (±0.5) | $F_3$ (±0.5) | $F_4$ (±0.5) | $F_5$ (±0.5) | t (±0.1) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 470 ~ 151 | 11.5 | 5.0 | 38.0 | 40.0 | 1.70 | 1.05 | 0.50 | 34.9 | 33.0 | 14.0 | 5.0 | 0.5 |
| 181 ~ 561 | 13.0 | 5.0 | 38.0 | 40.0 | 1.70 | 1.05 | 0.50 | 34.9 | 33.0 | 14.0 | 5.0 | 0.5 |
| 621 ~ 681 | 13.5 | 5.0 | 38.0 | 40.0 | 1.70 | 1.05 | 0.50 | 34.9 | 33.0 | 14.0 | 5.0 | 0.5 |

## Packaging Information




12 Tray




Unit: mm
Please contact us if you have special packaging requirements.

| Item | Nominal Varistor Voltage | Tray | Carton |
|---|---|---|---|
| Dimensions (mm) | N/A | 295 × 220 | 455 × 315 × 195 |
| Quantity (PCS) | 470 ~ 681 | 12 | 240 |

## Specifications

| Model | Max. Continuous Operating Voltage | | Varistor Voltage @1 mA DC | | Clamping Voltage (Max.) | | Nominal Dis-charge Current (8/20 μs) | Max. Dis-charge Current (8/20 μs) | Voltage Clamping Ratio[a] | | Max. Energy (Joule) | Typical Capaci-tance (Reference) | Thermal Fuse |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $U_c$ | | Min. | Max. | $V_C$ | $I_P$ | $I_n$ | $I_{max}$ | $R_{cl}$ | $I_n$ | 10/1000 μs | @1 kHz | UL 60691 E214712 |
| | ( VAC ) | ( VDC ) | ( V ) | | ( V ) | ( A ) | ( kA ) | | | ( kA ) | ( J ) | ( pF ) | |
| TFMOV34S470Lx | 30 | 38 | 42 | 52 | 93 | 60 | 10 | 20 | 4.3 | 10 | 96 | 35000 | VQ Series $U_r$: 690 VAC $I_r$: 25 A |
| TFMOV34S560Lx | 35 | 45 | 50 | 62 | 110 | 60 | 10 | 20 | 3.8 | 10 | 115 | 29500 | |
| TFMOV34S680Lx | 40 | 56 | 61 | 75 | 135 | 60 | 10 | 20 | 3.8 | 10 | 136 | 24200 | |
| TFMOV34S820Lx | 50 | 65 | 74 | 90 | 135 | 300 | 15 | 30 | 3.2 | 15 | 156 | 17950 | |
| TFMOV34S101Lx | 60 | 85 | 90 | 110 | 165 | 300 | 15 | 30 | 3.2 | 15 | 195 | 15000 | |
| TFMOV34S121Lx | 75 | 100 | 108 | 132 | 200 | 300 | 15 | 30 | 3.2 | 15 | 235 | 12200 | |
| TFMOV34S151Lx | 95 | 125 | 135 | 165 | 250 | 300 | 20 | 40 | 3.2 | 20 | 296 | 10000 | |
| TFMOV34S181Lx | 115 | 150 | 162 | 198 | 300 | 300 | 20 | 40 | 2.3 | 20 | 350 | 8250 | |
| TFMOV34S201Lx | 130 | 170 | 185 | 225 | 340 | 300 | 20 | 40 | 2.3 | 20 | 400 | 6750 | |
| TFMOV34S221Lx | 140 | 180 | 198 | 242 | 360 | 300 | 20 | 40 | 2.3 | 20 | 450 | 6400 | |
| TFMOV34S241Lx | 150 | 200 | 216 | 264 | 395 | 300 | 20 | 40 | 2.3 | 20 | 480 | 5650 | |
| TFMOV34S271Lx | 175 | 225 | 243 | 297 | 455 | 300 | 20 | 40 | 2.3 | 20 | 540 | 5100 | |
| TFMOV34S301Lx | 190 | 250 | 270 | 330 | 500 | 300 | 20 | 40 | 2.3 | 20 | 600 | 4510 | |
| TFMOV34S331Lx | 210 | 275 | 297 | 363 | 550 | 300 | 20 | 40 | 2.3 | 20 | 656 | 4150 | |
| TFMOV34S361Lx | 230 | 300 | 324 | 396 | 595 | 300 | 20 | 40 | 2.3 | 20 | 745 | 3750 | |
| TFMOV34S391Lx | 250 | 320 | 351 | 429 | 650 | 300 | 20 | 40 | 2.3 | 20 | 830 | 3500 | |
| TFMOV34S431Lx | 275 | 350 | 387 | 473 | 710 | 300 | 20 | 40 | 2.3 | 20 | 920 | 2950 | |
| TFMOV34S471Lx | 300 | 385 | 423 | 517 | 775 | 300 | 20 | 40 | 2.3 | 20 | 1000 | 2880 | |
| TFMOV34S511Lx | 320 | 415 | 459 | 561 | 845 | 300 | 20 | 40 | 2.3 | 20 | 1060 | 2650 | |
| TFMOV34S561Lx | 350 | 460 | 504 | 616 | 925 | 300 | 20 | 40 | 2.3 | 20 | 1150 | 2450 | |
| TFMOV34S621Lx | 385 | 505 | 558 | 682 | 1025 | 300 | 20 | 40 | 2.3 | 20 | 1250 | 2200 | |
| TFMOV34S681Lx | 420 | 560 | 612 | 748 | 1120 | 300 | 20 | 40 | 2.3 | 20 | 1250 | 2000 | |

Note:

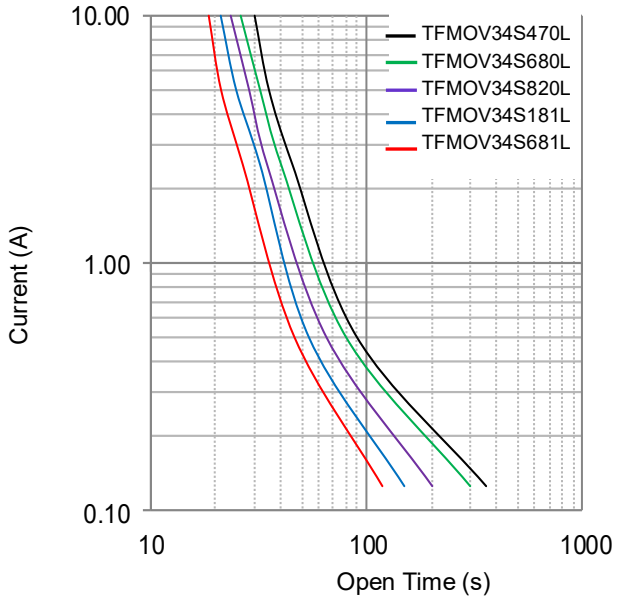
a: $R_{cl} = \frac{V_C}{V_N}$, $U_p \geq V_C$, $V_C$: Clamping Voltage (@ $I_n$), $V_N$: Varistor Voltage, $U_p$: Voltage Protection Level.

The Value of Voltage Protection Level ($U_p$) is determined according to IEC 61643-11:2011 clause 6.4.

Preferred values of voltage protection level (kV): 0.08, 0.09, 0.10, 0.12, 0.15, 0.22, 0.33, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.2, 1.5, 1.8, 2.0, 2.5, 3.0, 4.0, 5.0, 6.0, 8.0, 10.

## Performance Curve for Reference

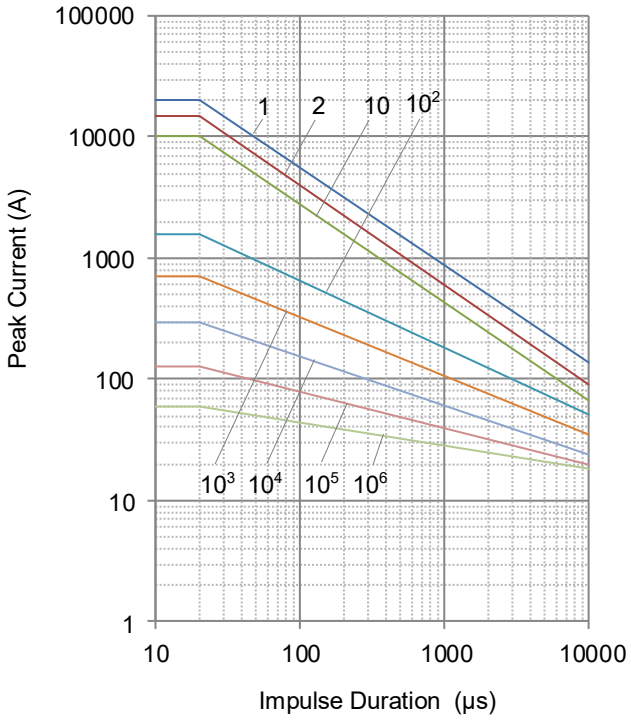
Limited Current Test Curve (UL 1449 clause 44.4)



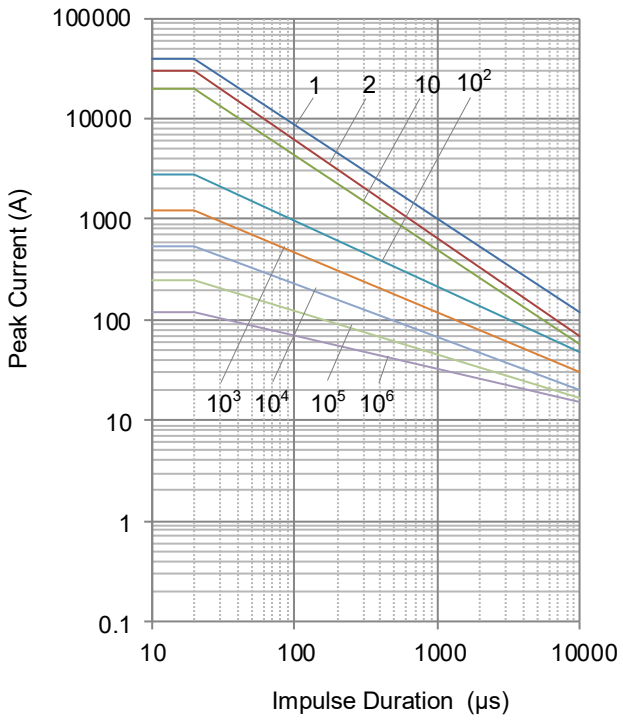

Note: The limited current curve is for reference only.

Max. Peak Current Derating Curve

TFMOV34S470L to TFMOV34S680L

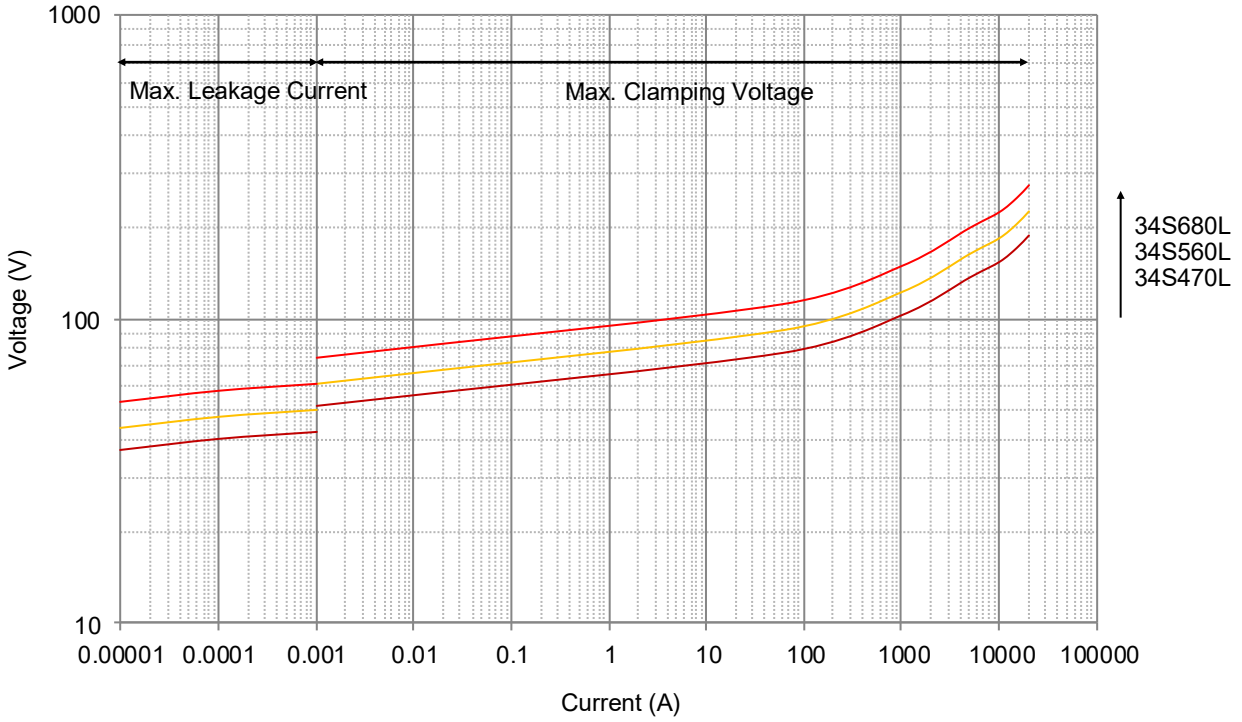


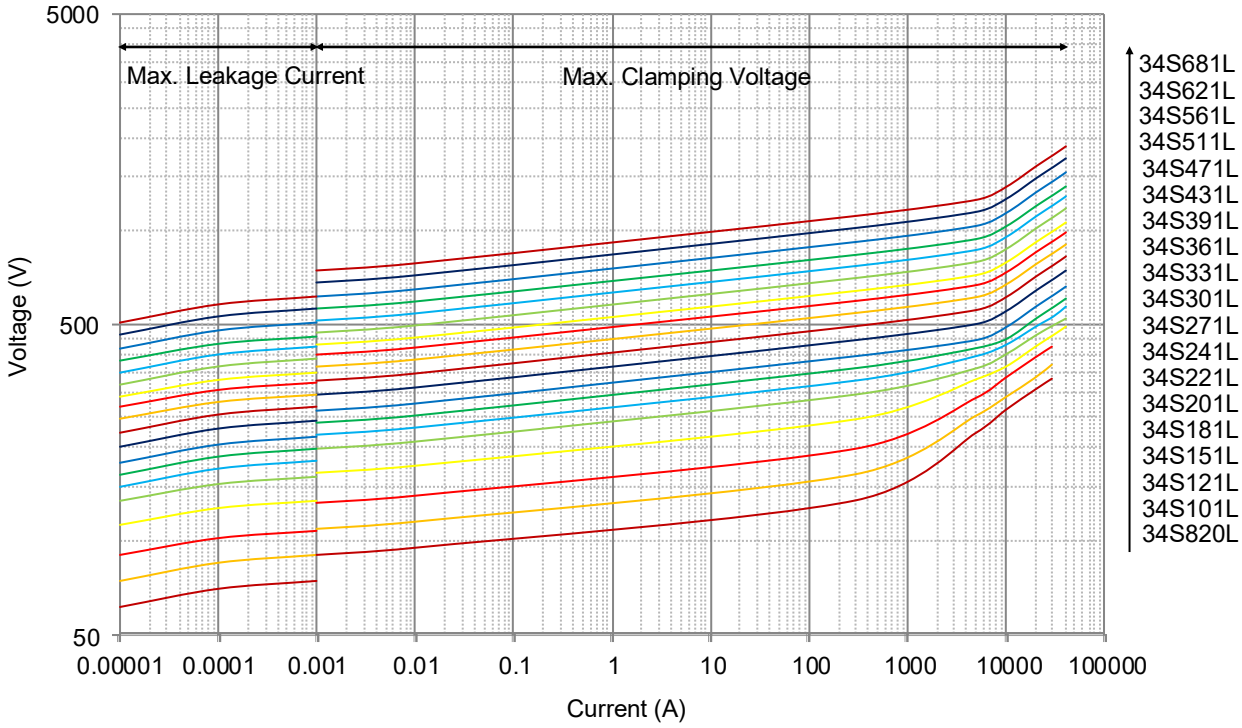

TFMOV34S820L to TFMOV34S681L



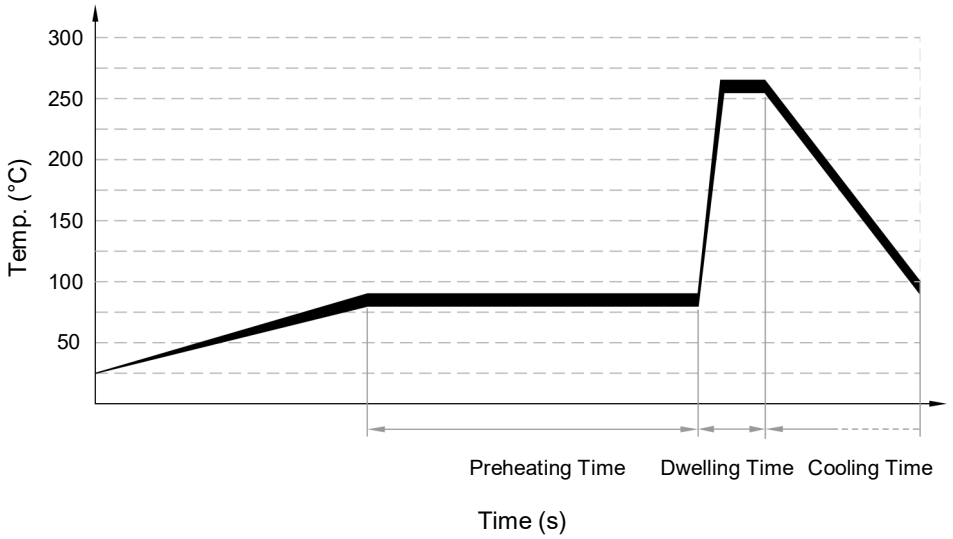

Note: 1, 2, 10, $10^2$, $10^3$,$10^4$, $10^5$, $10^6$ Stand for repetitions.

## Voltage-Current Characteristic Curves



## Wave Soldering Parameters (Reference)



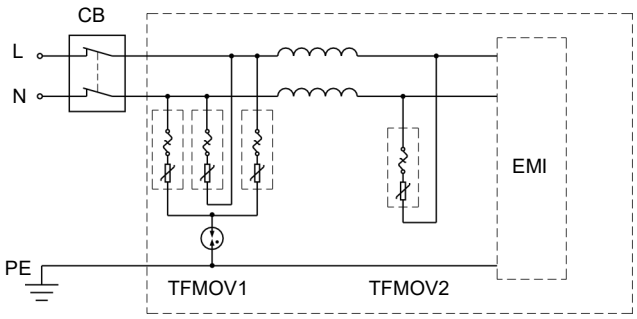

| Item | Temp. (°C) | Time (s) |
|---|---|---|
| Preheating | 80 to 90 | 60 to 150 |
| Dwelling | 250 to 260 | 2 to 4 |

## Recommended Hand-Soldering Parameters

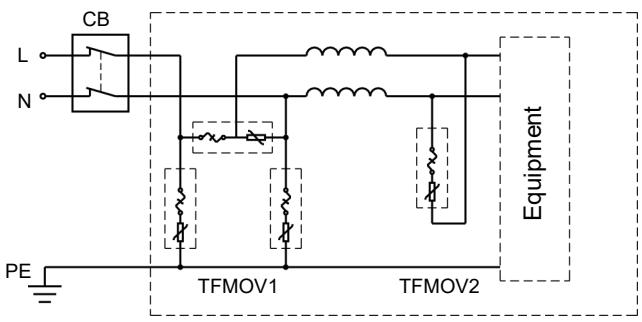
| Item | Condition |
|---|---|
| Iron Temperature | 350 °C (Max.) |
| Soldering Time | 4 seconds (Max.) |
| Distance between Soldering Point and the Bottom of Product | 2 mm (Min.) |

## Application Options

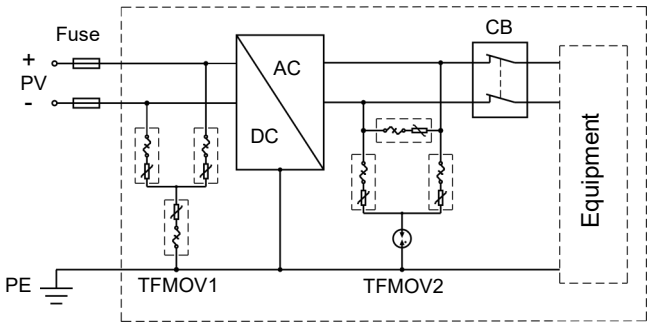
Remote Radio Unit (AC Type)



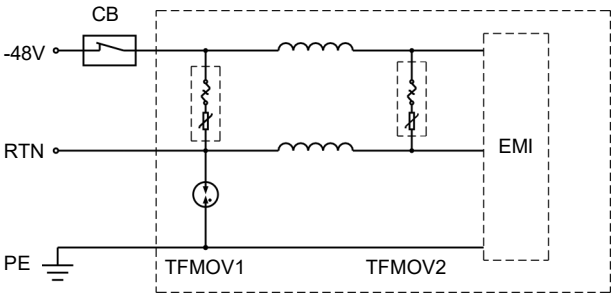

Power Strips (Surge Protector)




PV Inverter




Remote Radio Unit (DC Type)




## Design

When a single TFMOV surge capacity can`t meet the requirement of customers, paralleling more TFMOVs is recommended. Due to its nonlinear current-voltage characteristics, please pay attention to below tips:

1. Use the TFMOV from the same manufacturer with same model to parallel.
2. Control the varistor voltage; Typically, the varistor voltage deviation should be less than 1% in the same group (between the Max and Min), and meet the next tip at the same time.
3. Calculate the average surge capacity for each TFMOV and keep a margin at least 10%.
4. Design the layout like Figure.2. to make sure the surge capacity is divided averagely.

The Design not Recommended

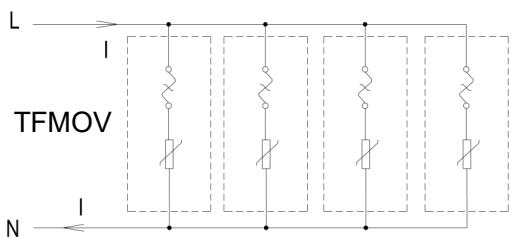



Figure .1

The Design Recommended

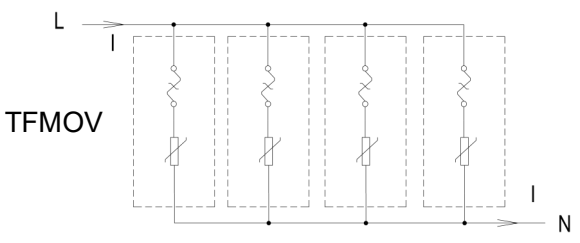
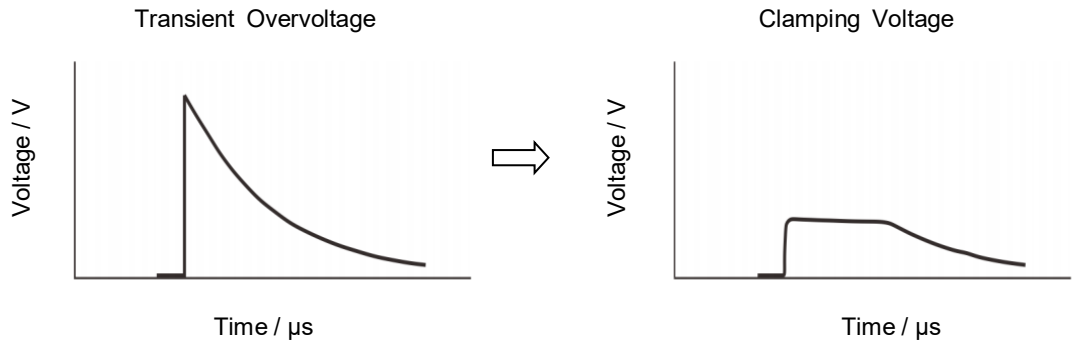



Figure .2

## MOV Operation Principle




## MOV Thermal Protection

Figure a is a surge protection circuit commonly used in power supplies. MOV is used to suppress the surge voltage and protect the subsequent circuit. There is a risk of burning when the varistor degrades or fails. In the high-reliability surge protection circuit of Figure b, in order to improve the safety of the circuit, a thermal protection varistor TFMOV is used as the surge voltage protection element. TFMOV is a combination of varistors (MOV) and thermal protection component. When the temperature of the MOV is abnormally exceeded, the thermal fuse will be opened first, so that the failure mode of the MOV appears to be open-circuit failure.

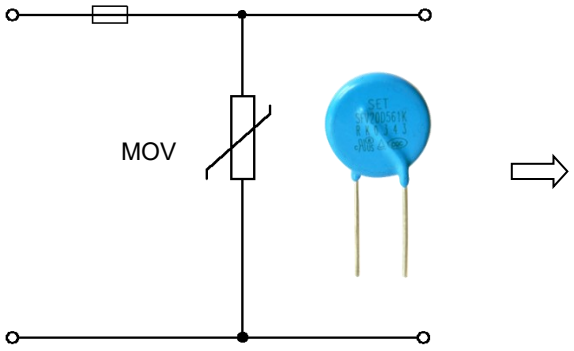



Figure a Typical surge protection circuit

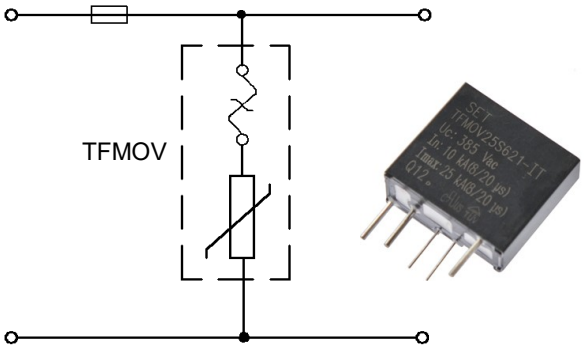
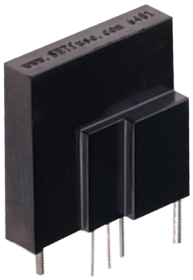


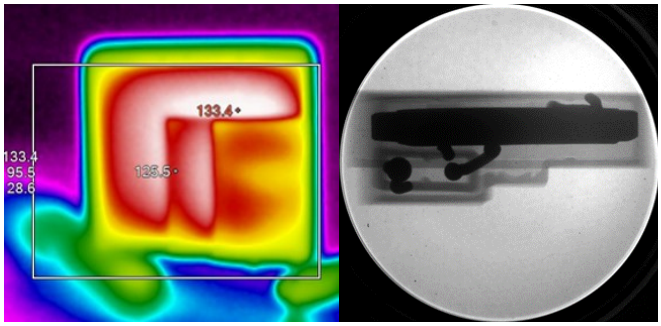

Figure b: High reliability surge protection circuit

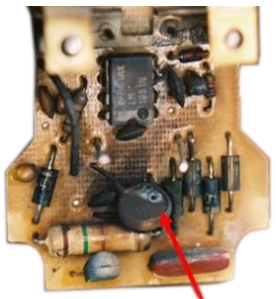
## Benefits




**Safety**

**Hidden Danger**




### TFMOV Failure Simulation

During the electrical performance degrading of varistor, the inbuilt ATCO will open the circuit when the leakage current of varistor increases to tens of micro Amperes. As shown in the figure above, this is a safe open circuit failure.

### MOV Failure Simulation

The electrical performance of varistor degrades with operating, mostly the varistor voltage drops, and leakage current increases. The heat accumulation can cause the temperature increase sharply and varistor results in thermal breakdown to short circuit status. It’s very dangerous.

## Glossary

| Item | Description |
|---|---|
| $V_N$ | **Nominal Varistor Voltage**<br>Voltage, at specified d.c. current used as a reference point in the component characteristic. |
| **8/20 μs** | **8/20 Current Impulse**<br>Current impulse with a nominal virtual front time of 8 μs and a nominal time to half-value of 20 μs.<br>— (IEC 61643-11) |
| **1.2/50 μs** | **1.2/50 Voltage Impulse**<br>Voltage impulse with a nominal virtual front time of 1.2 μs and a nominal time to half-value of 50 μs.<br>— (IEC 61643-11) |
| $U_c$ | **Maximum Continuous Operating Voltage**<br>Maximum r.m.s. voltage, which may be continuously applied to the SPD's mode of protection.<br>— (IEC 61643-11) |
| $I_n$ | **Nominal Discharge Current**<br>Crest value of the current through the SPD having a current waveshape of 8/20 μs.<br>— (IEC 61643-11) |
| $I_{imp}$ | **Impulse Discharge Current for Class I Test**<br>Crest value of a discharge current through the SPD with specified charge transfer Q and specified energy W/R in the specified time.<br>— (IEC 61643-11) |
| $I_{max}$ | **Maximum Discharge Current**<br>Crest value of a current through the SPD having an 8/20 μs waveshape and magnitude according to the manufacturers specification. $I_{max}$ is equal to or greater than $I_n$.<br>— (IEC 61643-11) |
| $V_C$ | **Clamping Voltage**<br>Peak voltage developed across the varistor terminations under standard atmospheric conditions, when passing an 8/20 μs class current pulse. |
| $C_V$ | **Capacitance**<br>Capacitance across the MOV measured at a specified frequency and voltage. |
| **Modes of protection** | **Modes of protection**<br>An intended current path, between terminals that contains protective components, e.g. line-to-line, line-to-earth, line-to-neutral, neutral-to-earth.<br>— (IEC 61643-11) |
| $U_p$ | **Voltage Protection Level**<br>Maximum voltage to be expected at the SPD terminals due to an impulse stress with defined voltage steepness and an impulse stress with a discharge current with given amplitude and wave shape.<br>— (IEC 61643-11) |
| **TCO** | **Thermal-Link**<br>A non-resettable device incorporating a THERMAL ELEMENT which will open a circuit once only when exposed for a sufficient length of time to a temperature in excess of that for which it has been designed. |
| **ATCO** | **Alloy Thermal-Link**<br>Alloy Type Thermal-Link, Alloy is the thermal element. |
| **MOV** | **Varistors**<br>A resistive device with nonlinear voltammetry characteristics |

## Patents

| Name | Region | Category | Patent NO. |
|---|---|---|---|
| Varistor with In-built Alloy-Type Thermal Fuse | China | Patent for Invention | ZL 200510044661.5 |
| A Protection Pluggable Module with Over Current、Over Voltage、and Over Temperature Protection Function | China | Utility Model | ZL 201020244488.X |
| A Varistor with Double Protection Function | China | Utility Model | ZL 201020255481.8 |
| Surge Protection Module Applicable for Power Strip | China | Utility Model | ZL 201120107173.5 |
| A Surge Protection Module Applicable for Power Strip | China | Patent for Invention | ZL 201110092261.7 |
| A New Type of Varistor and Surge Protective Device with Thermal Protection | China | Utility Mode | ZL 201420306127.1 |
| A Surge Protective Device | China | Utility Modeel | ZL 201420415059.2 |
| A Varistor and Thermal Protection Component Combination | China | Utility Mode | ZL 201520376567.9 |
| 合金型温度ヒューズ付のバリスタ | Japan | Utility Mode | 3142835 |
| Varistor with an Alloy-Type Temperature Fuse | Australia | Utility Mode | 2007100456 |
| Varistor with an Alloy-Type Temperature Fuse | Taiwan | Utility Model | M 300855 |
| Varistor with an Alloy-type Temperature Fuse | Canada | Patent for Invention | 2588819 |
| Metal Oxide Varistor with Built-in Alloy-Type Temperature Fuse | USA | Patent for Invention | US 8780521 |
| Varistor with In-built Alloy Type Thermal Fuse (with Housing) | USA | Patent for Invention | US 9355763 |

# ATTENTION

## Usage

1. Frequency range is from 47 Hz to 63 Hz.
2. The voltage applied continuously to the TFMOV can not exceed its maximum continuous operating voltage $U_c$.
3. When atmosphere press is from 80 kPa to 106 kPa, the related altitude shall be from 2000 meters to - 500 meters.
4. Do not touch the product body or pins directly when power is on, to avoid electric shock.
5. Do not clean the TFMOV with strong polar solvent such as ketone, esters, benzene, halogenated hydrocarbon, to avoid damaging the enclosure.
6. It should have a reliable grounding when using these products.

## Replacement

TFMOV is a non-repairable product. For safety sake, please use equivalent TFMOV for replacement.

## Storage

Do not store TFMOV at high temperature, high humidity or corrosive gas environment. To avoid reducing the solderability of the pins, please use them up within 1 year after receiving the goods.

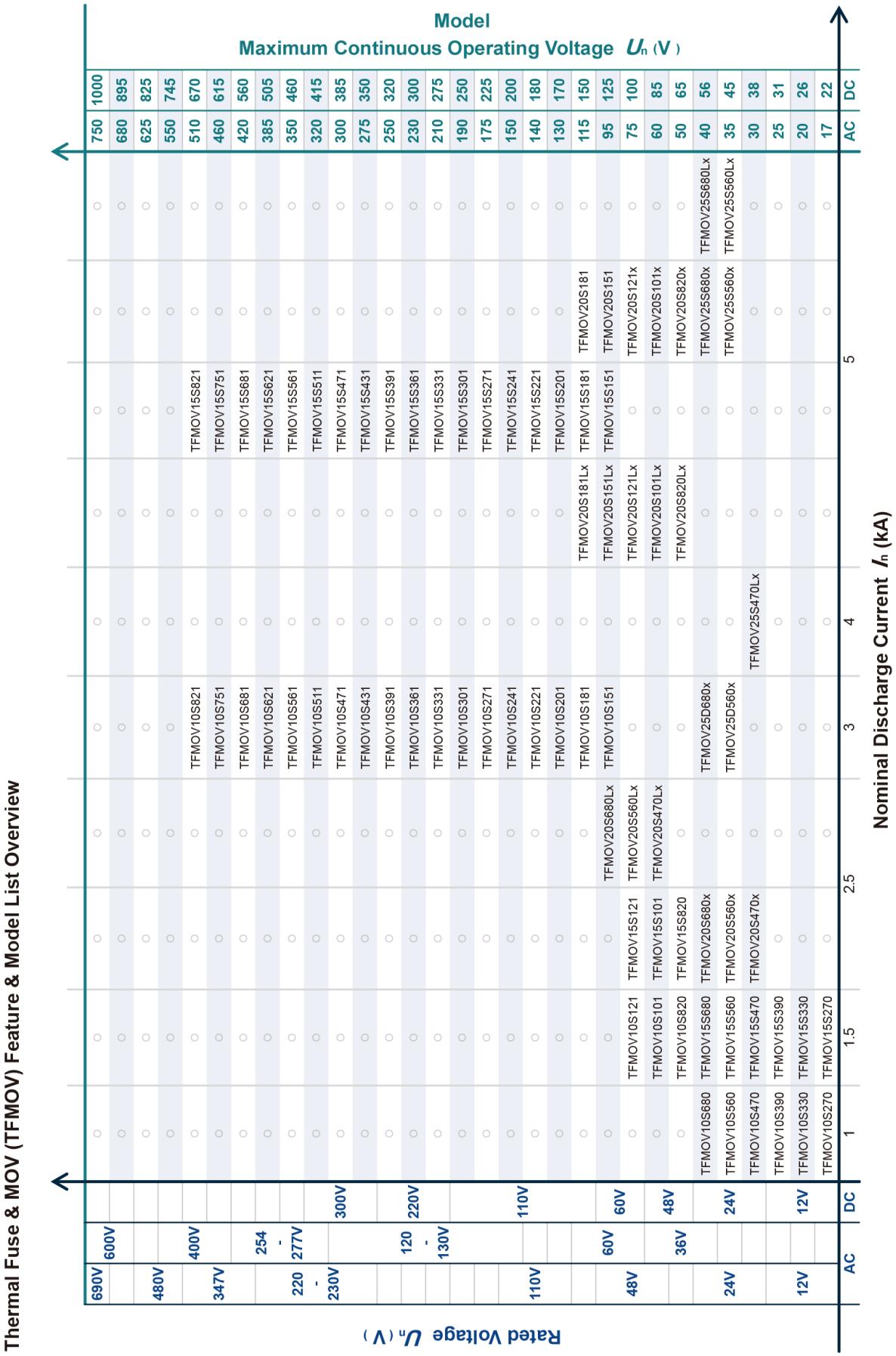
## Installation Position

Do not install the TFMOV on a place that may often suffer severe continuous vibration.

## Mechanical Stress

Do not take violent action such as knocking when assembling to avoid mechanical damage.

## Thermal Fuse & MOV (TFMOV) Feature & Model List Overview



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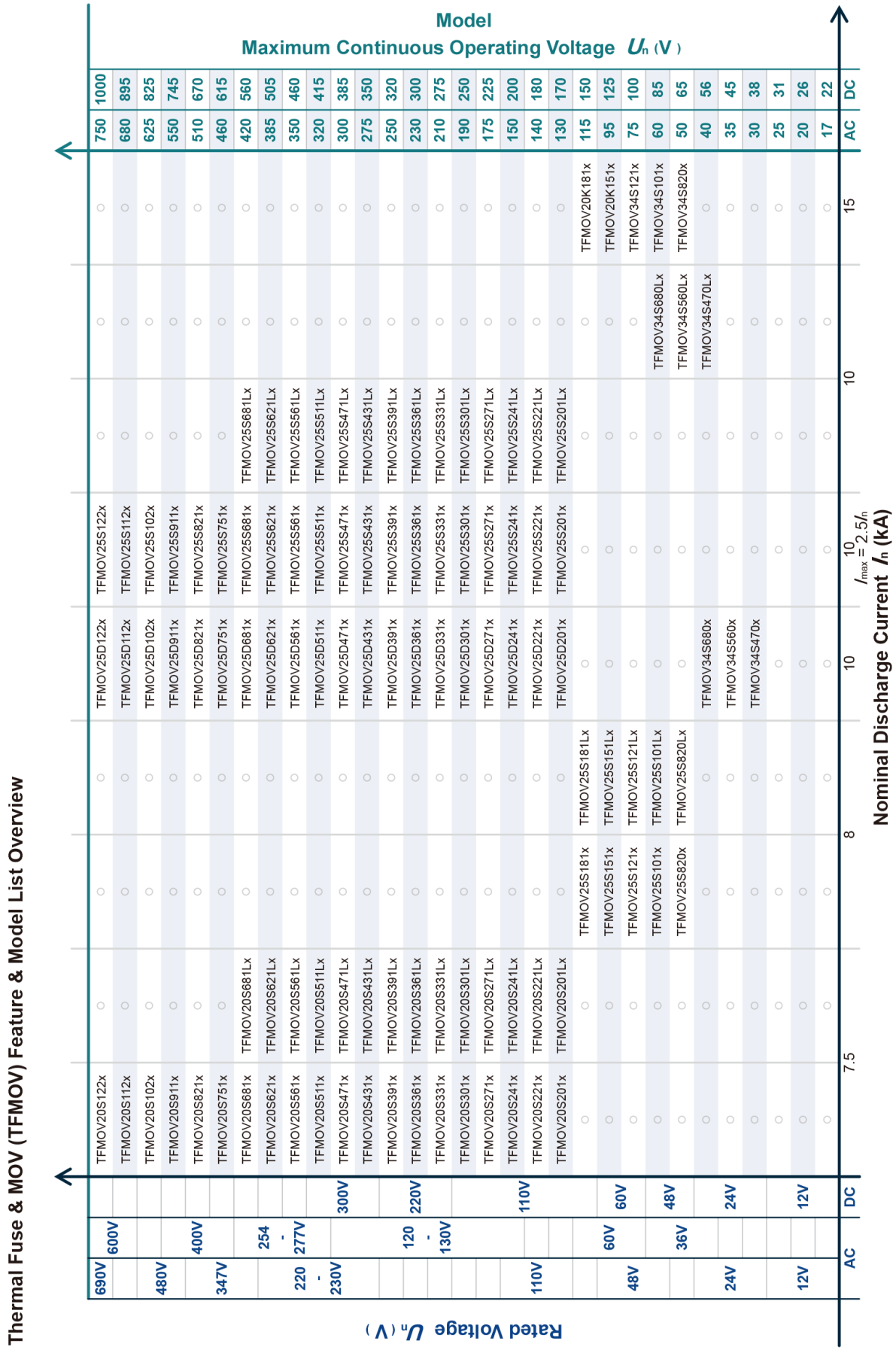

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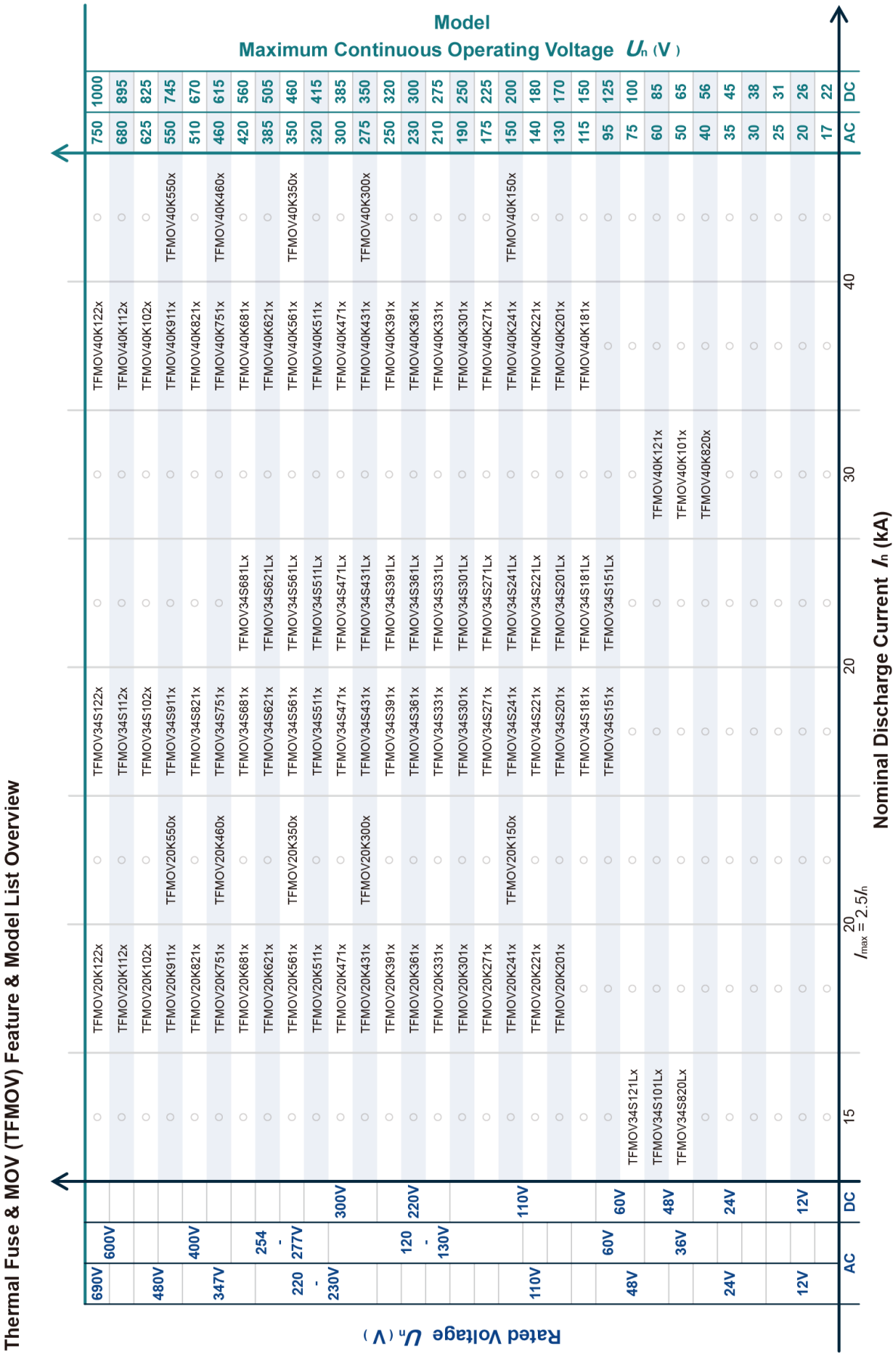

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