

> Guide to Fuse Selection



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ELECTRONIC COMPONENTS



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> Purpose of Fuses



- > Circuit protection is critical, and in many cases required, in electrical and electronic products.
- > Fuses are an inexpensive and effective way to protect your device from damage due to overcurrent conditions.
- > Fuses can prevent safety hazards to the end user such as fire and catastrophic failure of the product.
- > Fuses help design engineers comply with regulatory agencies such as UL and IEC.

> Characteristics of Fuses



Schurter offers a wide variety of fuses to meet any application:

- > Package type (SMD, thru hole, cartridge)
- > Current and voltage ratings (AC and DC power)
- > Trip characteristics (quick-acting or time-lag)
- > Breaking capacity ratings
- > Approvals (UL, CSA, ENEC, CCC)



> | Size and Mounting



- > Schurter offers 0402, 0603, 1206 SMD fuses
- > Thru hole microfuses
- > Cartridge fuses 5x20mm, 6.3x32mm and 10.3x38mm
- > Cartridge fuses can be mounted in fuseholders, fuseblocks or fuseclips
- > We also offer pigtails for a low cost thru hole solution

> Fuse Current Rating



- > The rated current of the fuse is either designed according to IEC characteristic or UL characteristic.
 - > A fuse, which is designed according to a IEC standard, can continuously operate at **100%** of rated current of the fuse.
 - > A fuse, which is designed according to a UL standard, can continuously operate at **75%** of rated current of the fuse.
 - > The fuse current rating should be based on the operating current in the application.

USI 1206									
Rated Current [A]	Rated Voltage [VAC]	Rated Voltage [VDC]	Marking	Breaking Capacity	Voltage Drop 1.0 In max. [mV]	Voltage Drop 1.0 In typ. [mV]	Cold Resistance typ. [mΩ]	Melting I ² t 10.0 Intyp. [A ² s]	Order Number
0.5	32	63	e	1)	600	201	330	0.041	3413.0213.xx

USE 1206								
Rated Current [A]	Rated Voltage [VAC]	Rated Voltage [VDC]	Marking	Breaking Capacity	Voltage Drop 1.0 In typ. [mV]	Cold Resistance typ. [mΩ]	Melting I ² t 8.0 In typ. [A ² s]	Order Number
0.5	125	125	F	1)	100	190	0.02	3413.0113.xx

> Breaking Capacity



- > Breaking capacity is the maximum short circuit current a fuse can safely blow without a catastrophic failure such as a fire, breakage or explosion.
- > Low and high breaking capacity ratings typically range from 35A up to 10kA.
- > The short circuit condition in the final product determines what fuse breaking capacity is needed.
- > Our UMT is a compact SMD fuse with a high breaking capacity of 200A.

UMT 250

IEC 60127-4 · 250VAC · 125VDC · Time-Lag T

Description

- High current range from 80 mA to 10 A
- High breaking capacity of 200 A @ 250 VAC (IEC)
- UL approval for 277 VAC and 250 VDC

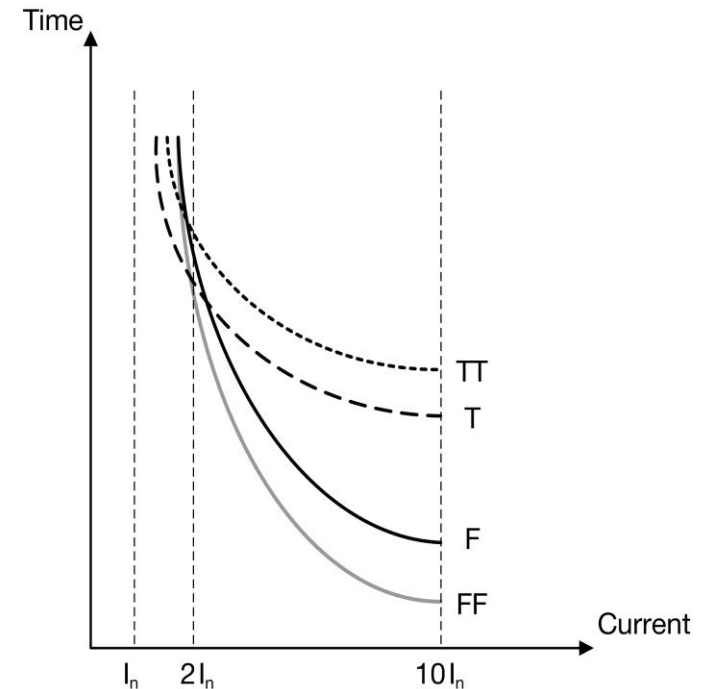


> Trip Characteristic



- > Fuses are either quick-acting or time-lag.
- > Time-lag fuses trip at a slower rate at high currents.

	Quick-acting	Time-lag
Load type	Resistive	Capacitive
Inrush Current Withstand	Low	High (10 times rated current)
Applications	<ul style="list-style-type: none"> •Data/signal lines •Electronic components 	<ul style="list-style-type: none"> •Power supplies •Motors •Circuits with capacitors
Advantage	•Avoid damage downstream due to inrush	•Avoid nuisance tripping during inrush



> Temperature Derating



- > Fuse current ratings are measured at 23degC.
- > Fuses are temperature dependant so higher the ambient temperature the quicker the fuse will blow.
- > Ambient temperature of the application must be considered when choosing the current rating of the fuse.



> Temperature Derating

Example UMT 250 SMD Fuse

Application example:

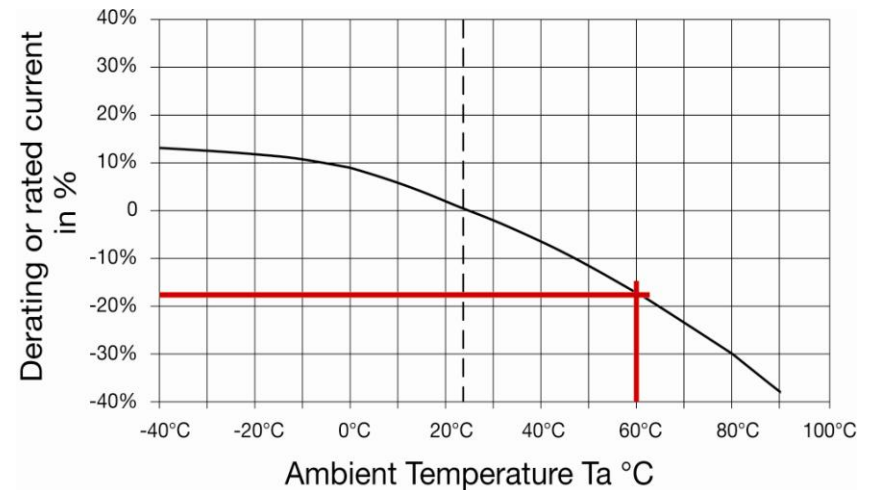
Fuse type: UMT 250
 Operating current: 1.0 A @ 60 °C
 Operating voltage: 230 VAC
 Ambient temperature: < 60 °C

Calculation of rated current of the fuse with the derating curve:

$$I_N = \frac{I_{\text{Operating}}}{\text{DeratingFactor}} = \frac{1.0\text{A}}{0.82} = 1.22\text{A}$$

Choice: UMT 250, 1.25 A
 (1 A @ 60 °C)

Derating-curve **UMT 250** (see data sheet)



> Heat Issues



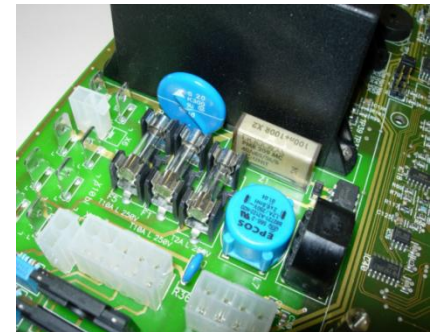
- > Heat dissipated from fuses can affect other components in close proximity and vice versa.
- > Sufficient airflow and ventilation should be considered when designing fuses in the application.
- > Schurter fuseholder and fused module datasheets have power acceptance ratings which show how much heat dissipation it can withstand safely.
- > If a fuse dissipates more heat than the fuseholder can withstand, the fuseholder can degrade such as melt or burn.



Fused module



Fuse and fuseholder




> Power(heat)Dissipation



- > Fuses dissipate heat during normal operation and this can increase as ambient temperature increases.
- > Time-lag fuses generally have lower power dissipation values than quick-acting fuses because they have a thicker fuse wire diameter.
- > Here's our FST spec sheet where we publish the typical Power Dissipation value.
- > When choosing a fuseholder or fused module, the power acceptance value should exceed the fuse power dissipation value.



FST 5x20							Non resettable fuses			
Variants										
Rated Current [A]	Rated Voltage [VAC]	Breaking Capacity	Voltage Drop 1.0 In max. [mV]	Voltage Drop 1.0 In typ. [mV]	Power Dissipation 1.5 I _n max. [mW]	Power Dissipation 1.5 I _n typ. [mW]	Melting Ft 10.0 Intyp. [A ² s]		Order Number	
0.02	250	1)	-	2700	-	100	0.0012		0034.3101	
0.032	250	1)	5000	3000	1600	200	0.0019	•	0034.3102	
0.04	250	1)	4000	2100	1600	200	0.0027	• • •	0034.3103	

> Inrush Current



- > Many applications will have inrush or peak currents at start-up and sometimes during normal operation.
- > The inrush current in the application should be measured and used to calculate the proper fuse I^2t value.
- > I^2t is the amount of heat energy, in terms of current and time, required to melt the fuse link

UST 1206

Non resettable fuses

www.schurter.com/pg01_2

Variants

Rated Current [A]	Rated Voltage [VAC]	Rated Voltage [VDC]	Marking	Breaking Capacity	Voltage Drop 1.0 In typ. [mV]	Cold Resistance typ. [mΩ]	Melting I^2t 8.0 In typ. [A ² s]	Order Number
7	32	63	mm	1)	73	8.5	8.7 ●	3413.0326.xx
8	32	63	nn	1)	60	6.3	14 ●	3413.0327.xx
10	32	63	oo	1)	69	5.45	21 ●	3413.0328.xx



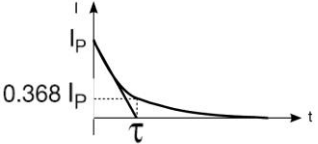
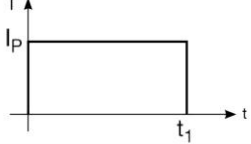
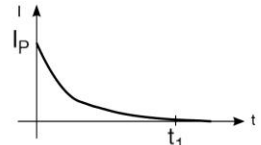
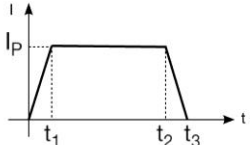
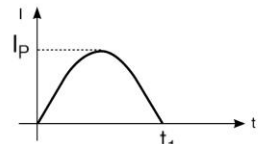
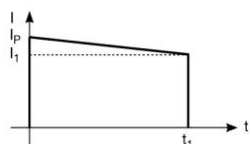
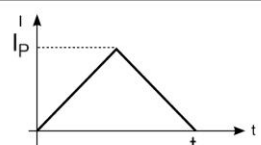
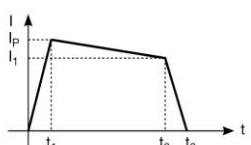
> Waveforms

Inrush Current Peak

Procedure

> Step 1: Selection of the appropriate waveform of the inrush current.

Most used curve

Wave shapes	Formulas	Wave shapes	Formulas
	$I^2 t = \frac{1}{2} I_p^2 \tau$		$I^2 t = I_p^2 t_1$
	$I^2 t = \frac{1}{5} I_p^2 t_1$		$I^2 t = \frac{1}{3} I_p^2 t_1 I_p^2 (t_2 - t_1) + \frac{1}{3} I_p^2 (t_3 - t_2)$
	$I^2 t = \frac{1}{2} I_p^2 t_1$		$I^2 t = I_1 I_p t_1 + \frac{1}{3} (I_p - I_1)^2 t_1$
	$I^2 t = \frac{1}{3} I_p^2 t_1$		$I^2 t = \frac{1}{3} I_p^2 t_1 + (I_p I_1 + \frac{1}{3} (I_p - I_1)^2) (t_2 - t_1) + \frac{1}{3} I_1^2 (t_3 - t_2)$



> I²t Calculation Inrush Current Peak

> Step 2: Calculation of the I²t-value of the application

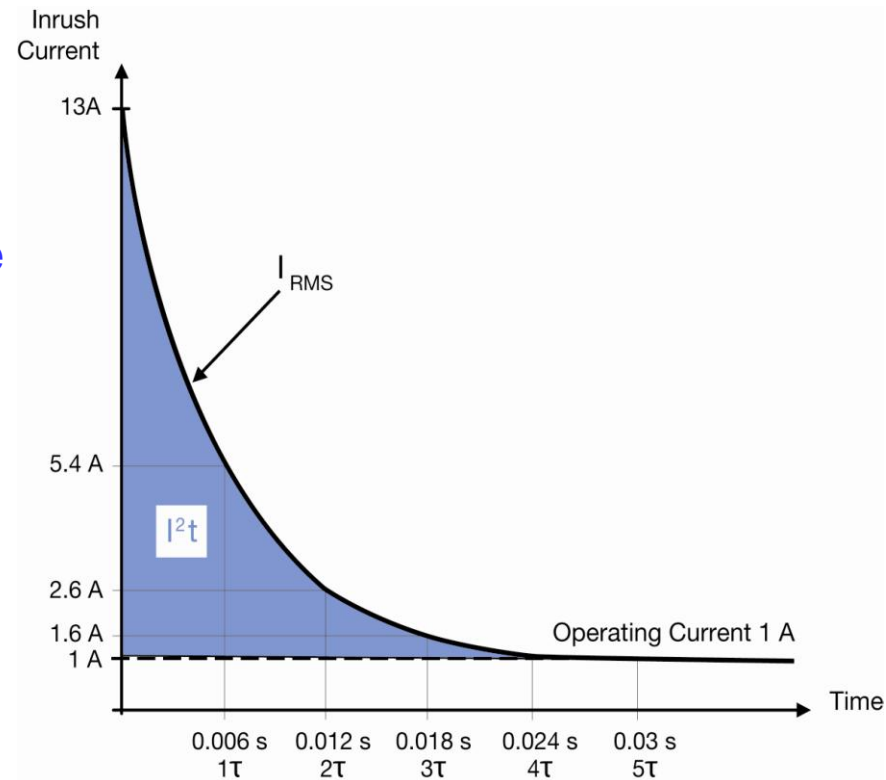
Application example:

Inrush current peak: $I_p = 13 \text{ A}$, $\tau = 0.006 \text{ s}$

Type of waveform: Typical discharge curve

Calculation of the I²t-value

$$I^2t_{\text{Application}} = \frac{1}{2} I_p^2 * \tau = \frac{1}{2} (13 \text{ A})^2 * 0.006 \text{ s} = 0.507 \text{ A}^2 \text{ s}$$

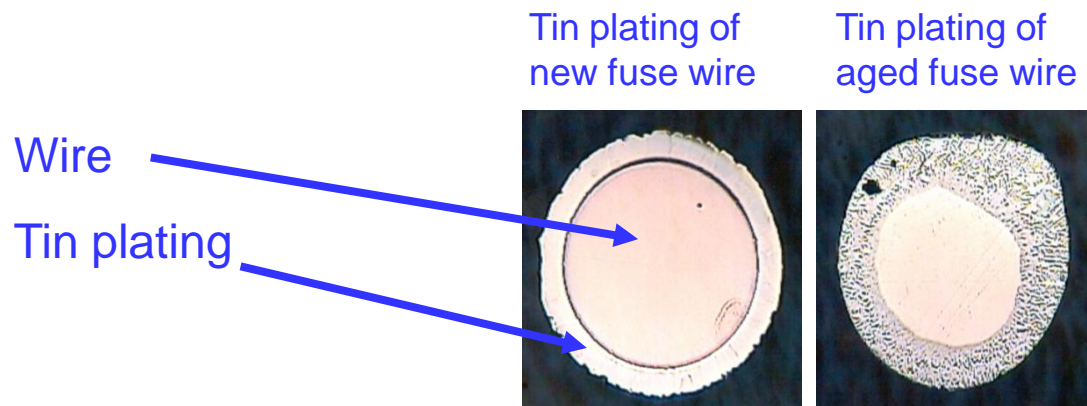


After 5τ , the inrush current has reached operating current.

> Pulse Factor Derating Inrush Current Peak



- > Continuous exposure to pulses of high current could prematurely age the fuse.
- > The number of pulses the fuse would be exposed to in the application should also be considered when choosing a fuse.



> Pulse Factor Derating Inrush Current Peak

> Step 3: Determine the minimum value of the I^2t -value of the fuse.

Application example:

Total number of pulses in life cycle: 10,000

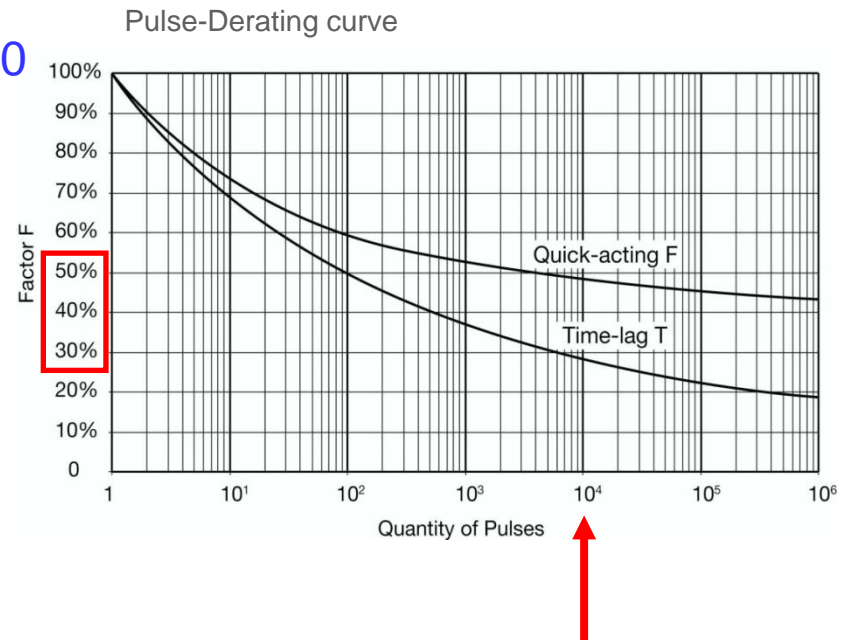
UMT 250 = time-lag fuses

Calculation of **time-lag T** fuses

$$I^2t_{\text{Fuse}_T_{\min}} = \frac{I^2t_{\text{Application}}}{F} = \frac{0.507A^2s}{0.29} = 1.748A^2s$$

(Calculation of **quick-acting F** fuses)

$$I^2t_{\text{Fuse}_F_{\min}} = \frac{I^2t_{\text{Application}}}{F} = \frac{0.507A^2s}{0.49} = 1.035A^2s$$



> Selecting a Fuse Part Number



- > Step 4: Selection of the correct fuse rating and part number from Schurter's product line.
- > Typical I^2t -values at $10 \cdot I_n$ for Schurter 1 A time-lag T fuses
- > MST 250 (12 A²s), UMT 250 (2.8 A²s), FST 5x20 (3.3 A²s), SPT 5x20 (1.1 A²s)

Varianten

Bestell-Nummer	Nennstrom [A]	Nennspannung [VAC]	Nennspannung [VDC]	Ausschaltvermögen	Spannungsabfall 1.0 In max. [mV]	Spannungsabfall 1.0 In typ [mV]	Verlustleistung 1.25 In typ [mW]	Schmelzintegral 10.0 In typ [A ² s]	UL	FM	PS	CCC	JET
3403.0155.xx	0.08	250	125	1)	1300	850	200	0.25	•	•	•	•	•
3403.0161.xx	0.315	250	125	1)	750	343	500	0.27	•	•	•	•	•
3403.0162.xx	0.4	250	125	1)	700	290	500	0.4	•	•	•	•	•
3403.0163.xx	0.5	250	125	1)	600	257	500	0.54	•	•	•	•	•
3403.0164.xx	0.63	250	125	1)	500	216	500	1.1	•	•	•	•	•
3403.0165.xx	0.8	250	125	1)	400	190	500	1.4	•	•	•	•	•
3403.0166.xx	1	250	125	1)	300	164	500	2.8	•	•	•	•	•
3403.0167.xx	1.25	250	125	1)	300	138	1000	4.5	•	•	•	•	•

- > (Typical I^2t -values at $10 \cdot I_n$ for Schurter 1 A quick-acting F fuses)
- > OMF 250 (0.23 A²s), MSF 250 (0.33 A²s), FSF 5x20 (1.13 A²s), SP 5x20 (0.75 A²s)

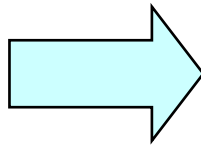
Choice: UMT 250, 1 A
(2.8 A²s > 1.748 A²s)



> Fuse Selection



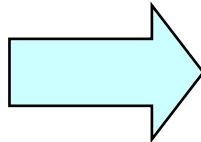
> Normal Operating Mode



Choice: UMT 250, **1.25 A**
(1 A @ 60 °C)



> Inrush Current Peak



Choice: UMT 250, **1 A**
(2.8 A²s > 1.748 A²s)


- > The higher value determines the selection of the rated current of the fuse.
- > The normal operating mode current **exceeds** that of the inrush current peak. Therefore, the **1.25 A fuse** is the recommended fuse rating.

> Website

Selection, Datasheets, Approval Documents, CAD Drawings



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Thank you