Protecting circuits against surges

An introduction

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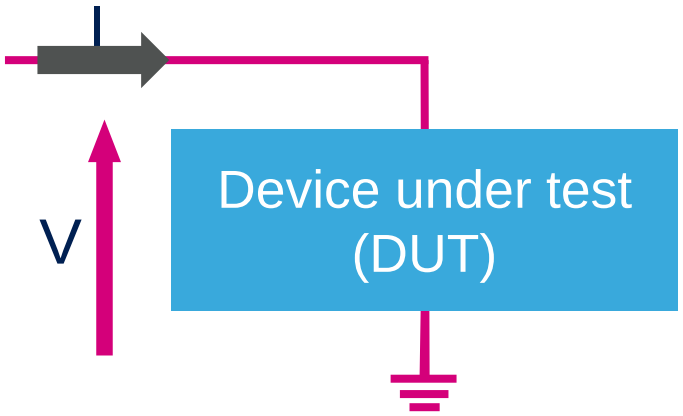
Content

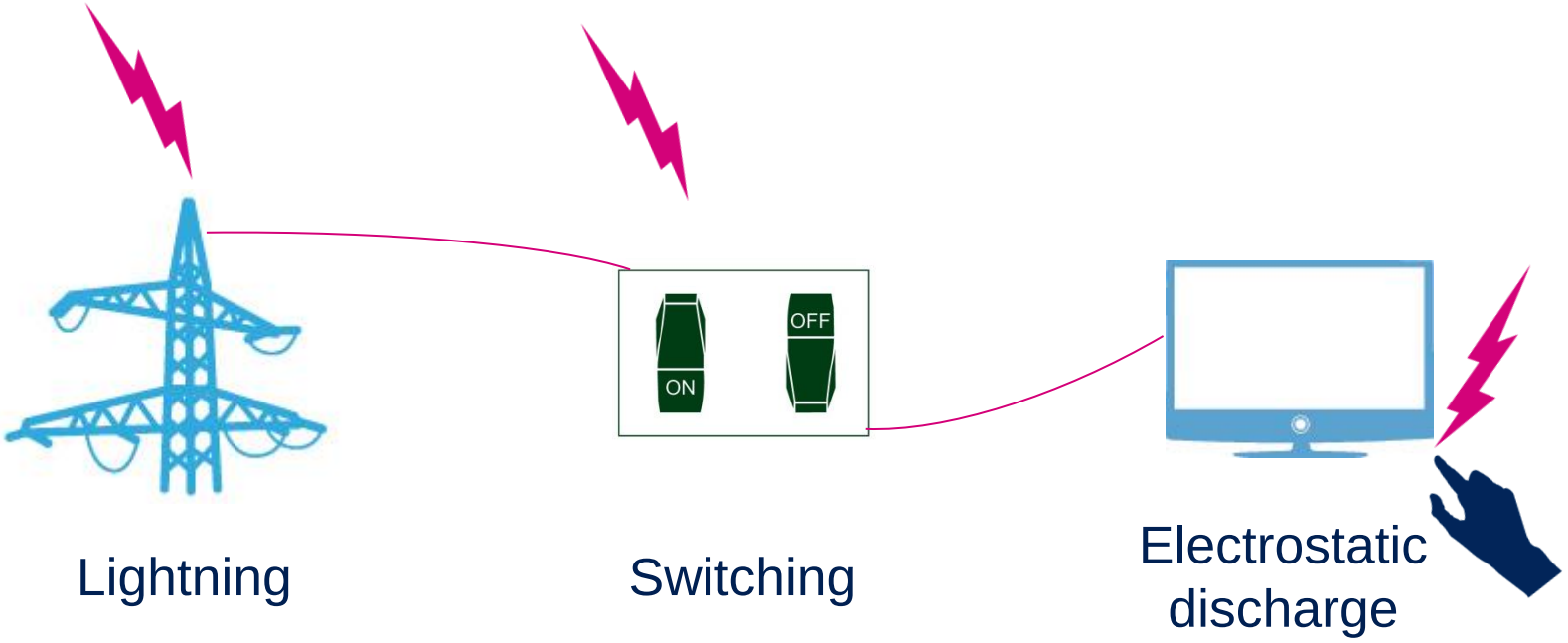
Surges and the corresponding standards

How to protect circuits against a surge

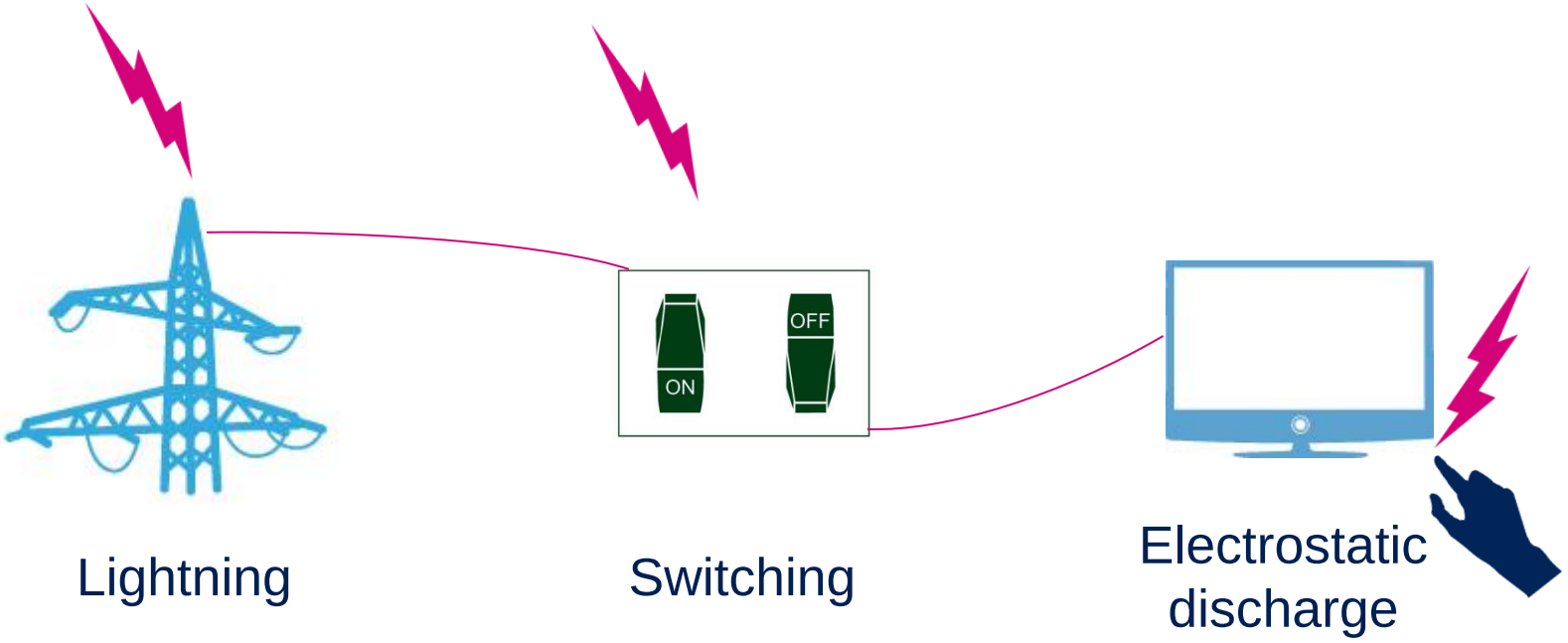
What is a surge?



What causes a surge



Surge standards

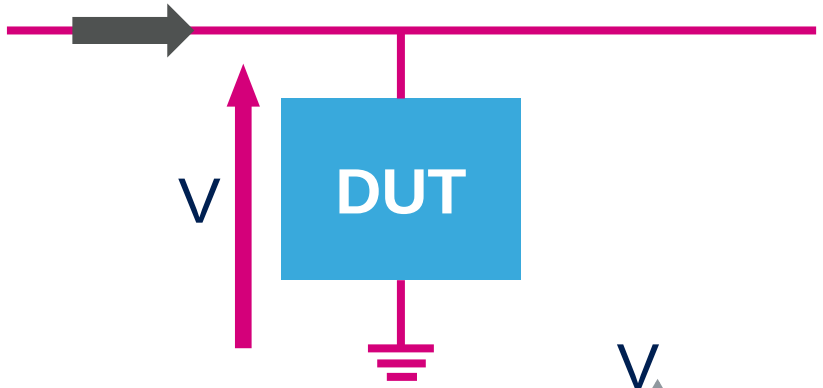


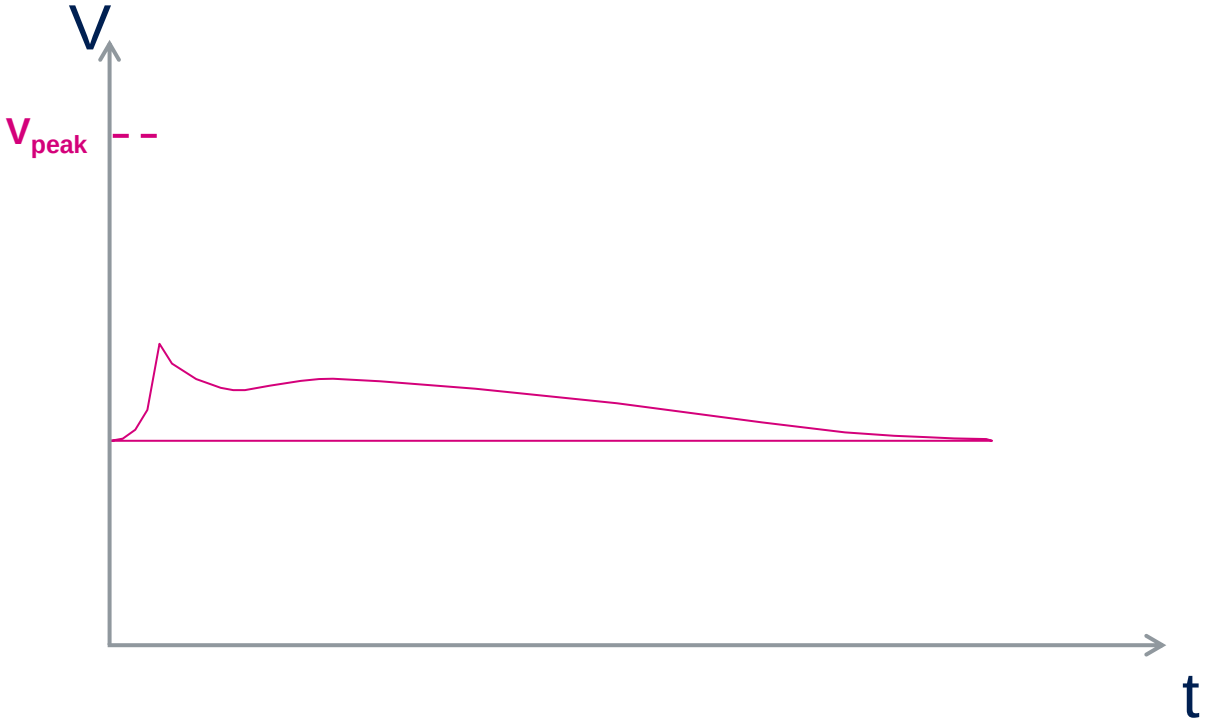
IEC 61000-4-5

IEC 61000-4-2

IEC 61000-4

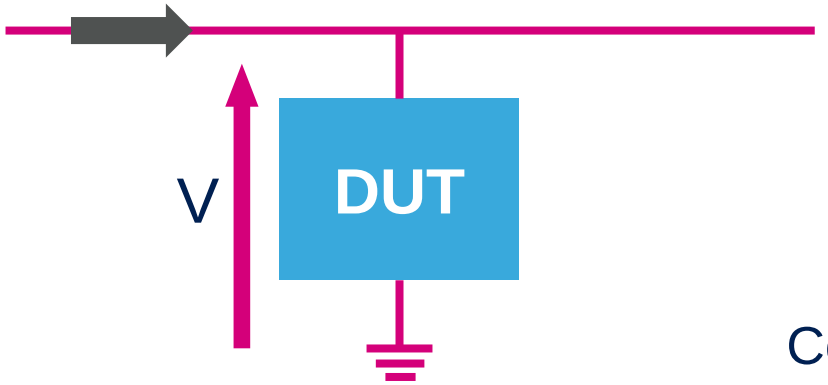
Surge standards
IEC 61000-4-2

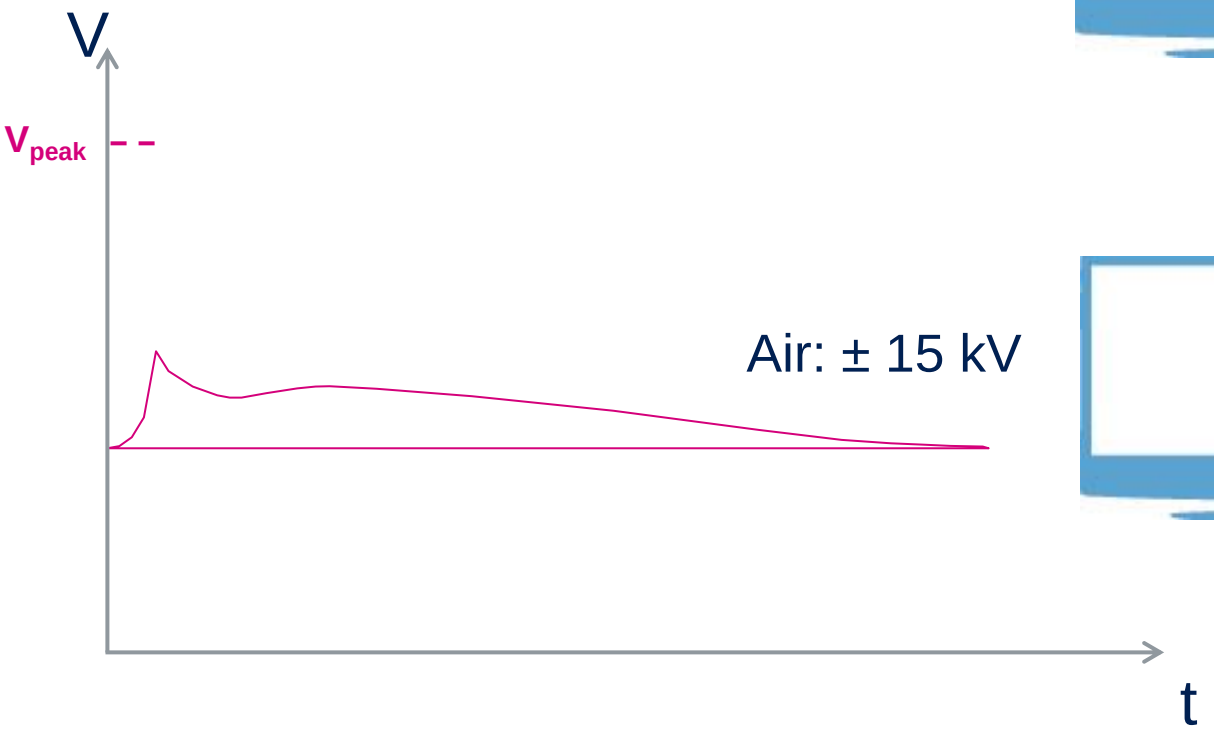




Surge standards

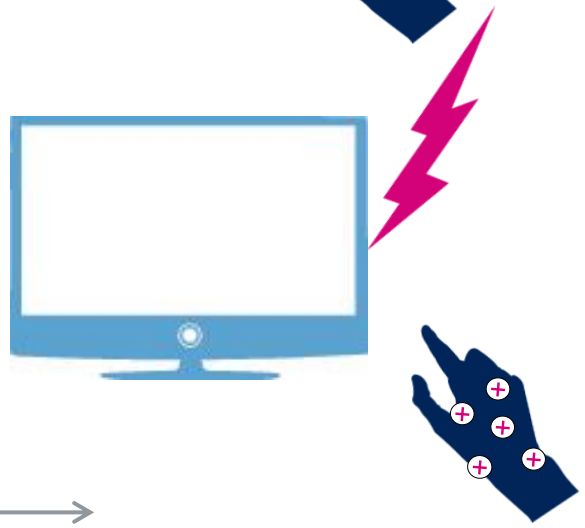
IEC 61000-4-2





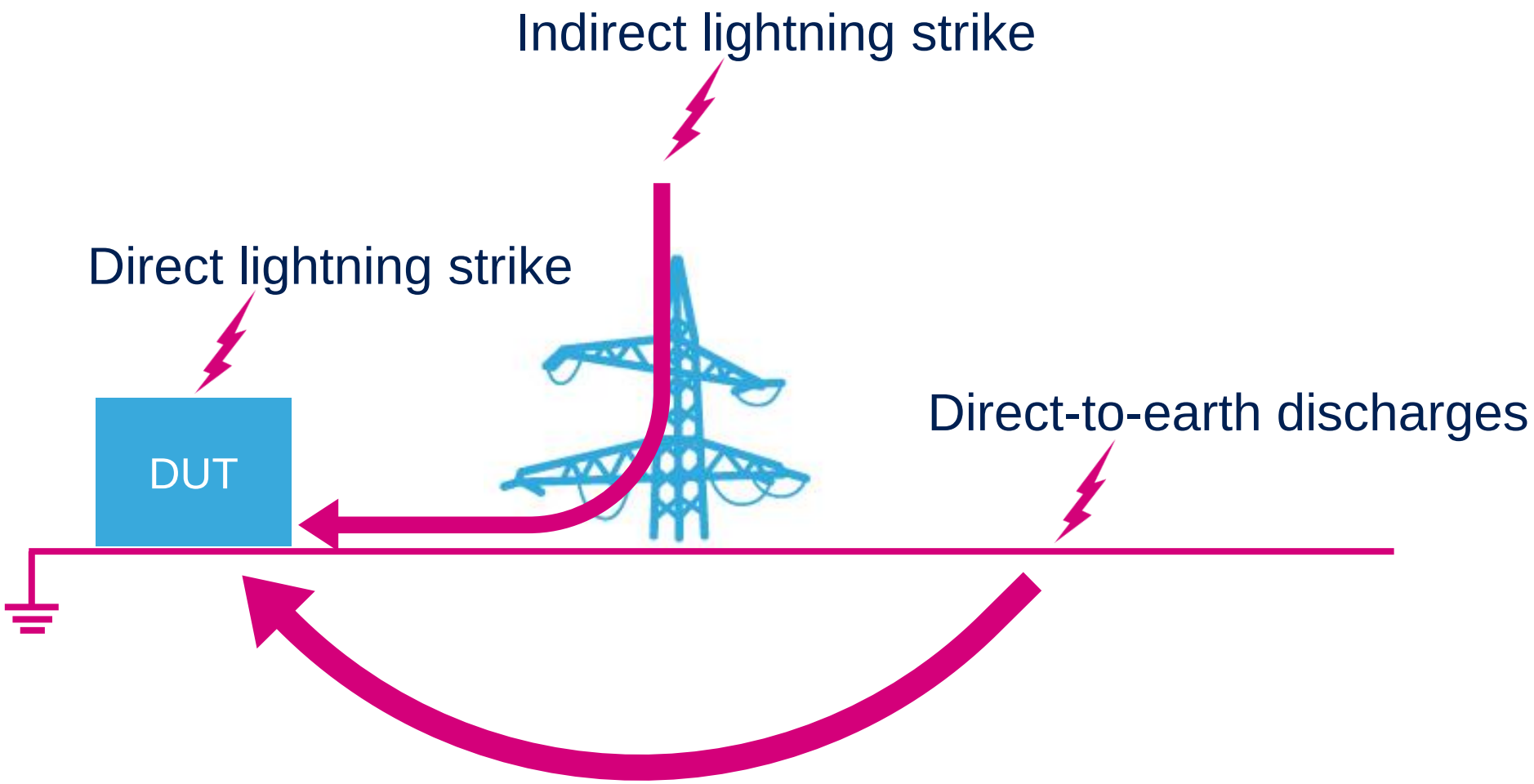
Contact: ± 8 kV

Air: ± 15 kV



Surge standards

IEC 61000-4-5

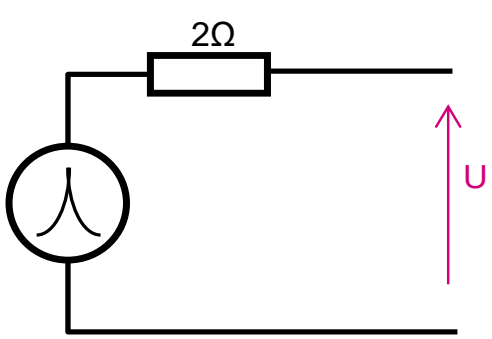


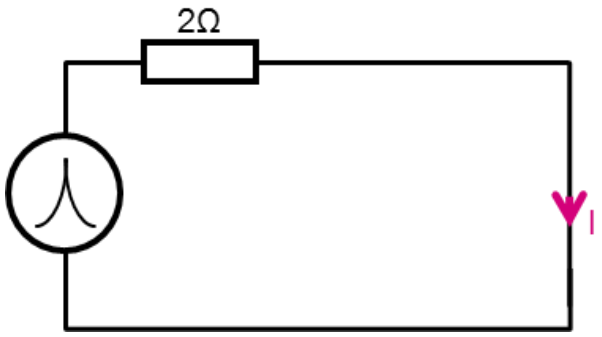
Surge standards

IEC 61000-4-5

Model the surge

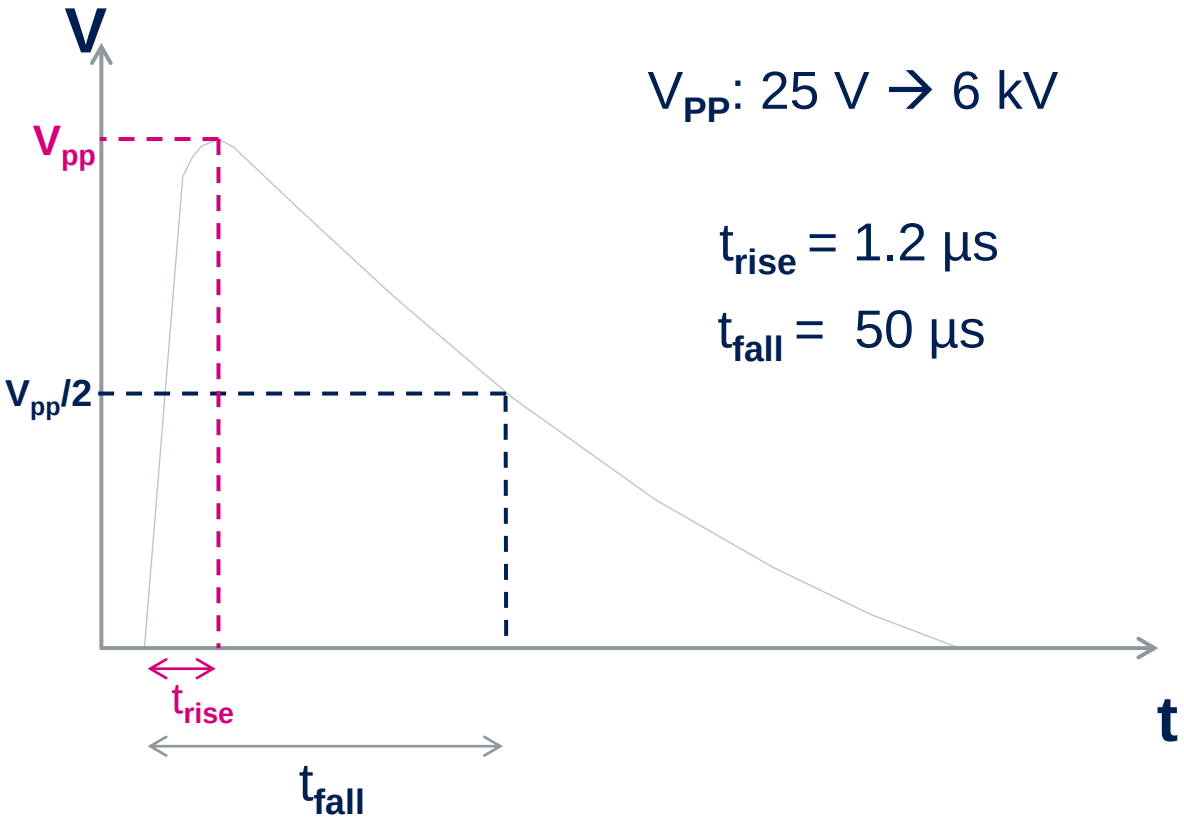
Check if the equipment survives





Surge standards

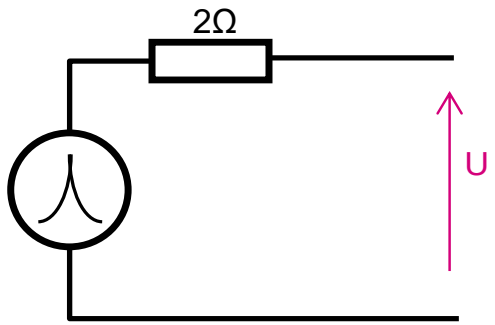
IEC 61000-4-5



V_{PP}: 25 V → 6 kV

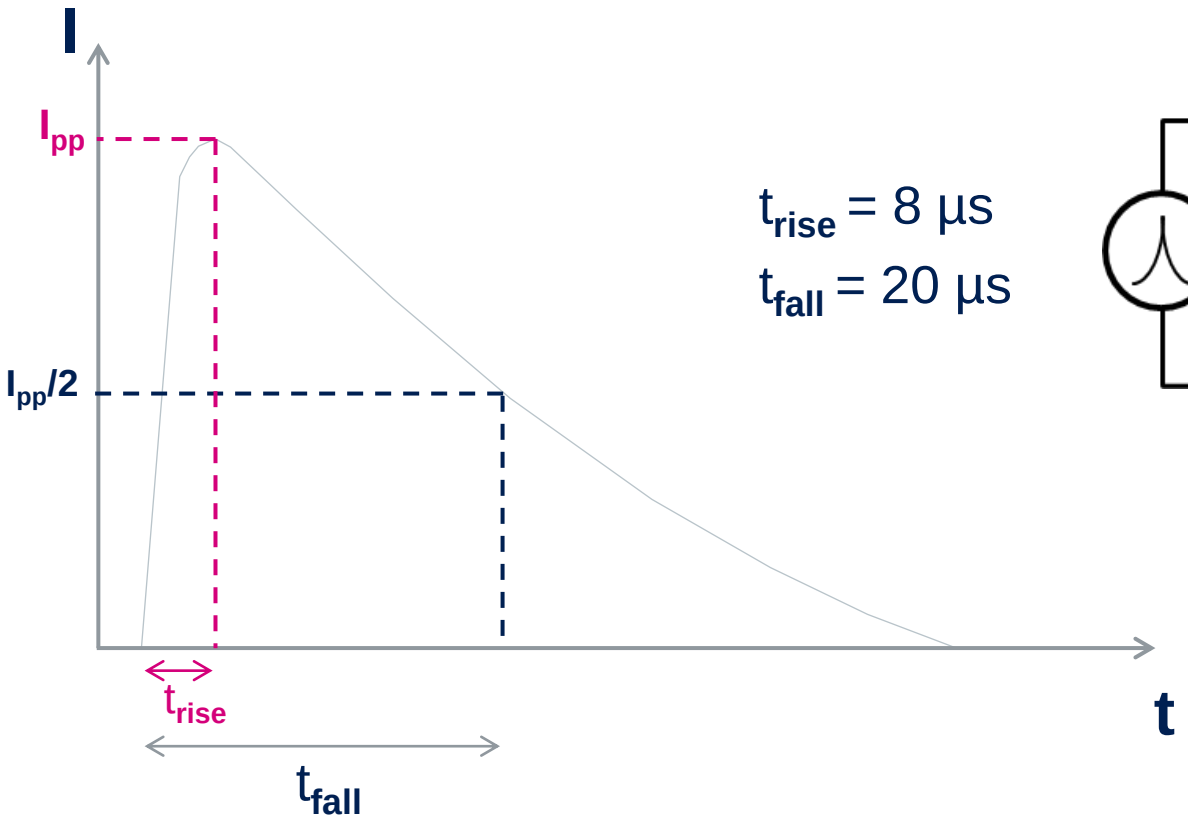
t_{rise} = 1.2 µs

t_{fall} = 50 µs



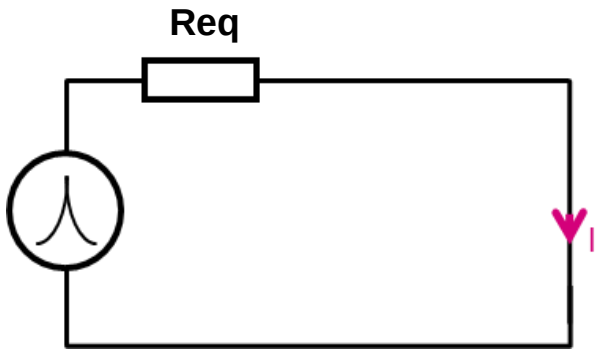
Surge standards

IEC 61000-4-5



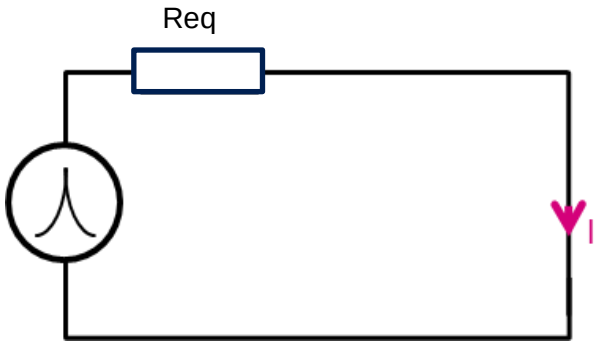
t_{rise} = 8 µs

t_{fall} = 20 µs



Surge standards classes

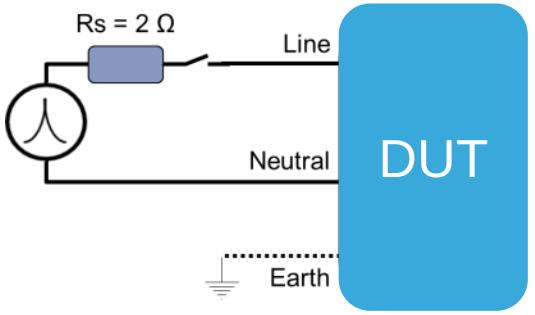
IEC 61000-4-5



	Class 0 25 V	Class 1 500 V	Class 2 1 kV	Class 3 2 kV	Class 4 4 kV	Class X 6 kV
Req = 42 Ω	0.6 A	12 A	24 A	48 A	96 A	143 A
Req = 12 Ω	2.1 A	42 A	84 A	167 A	334 A	500 A
Req = 2 Ω	12.5 A	250 A	500 A	1000 A	2000 A	3000 A

Surge standards classes

IEC 61000-4-5



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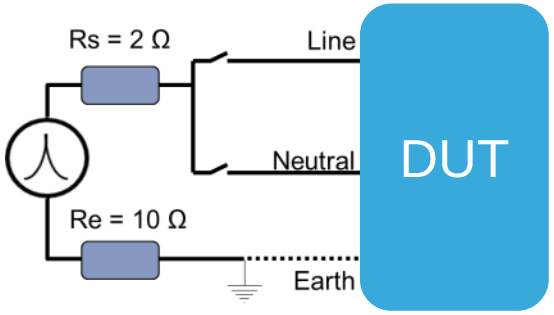
Surge standards classes

IEC 61000-4-5



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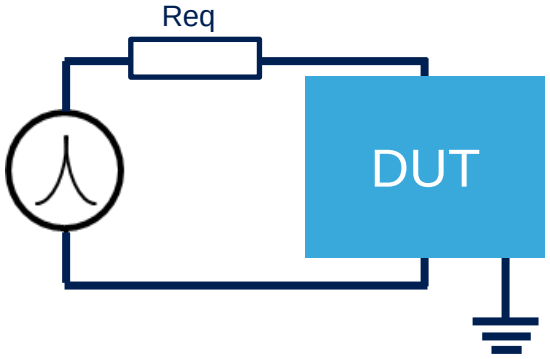
Surge standards classes

IEC 61000-4-5



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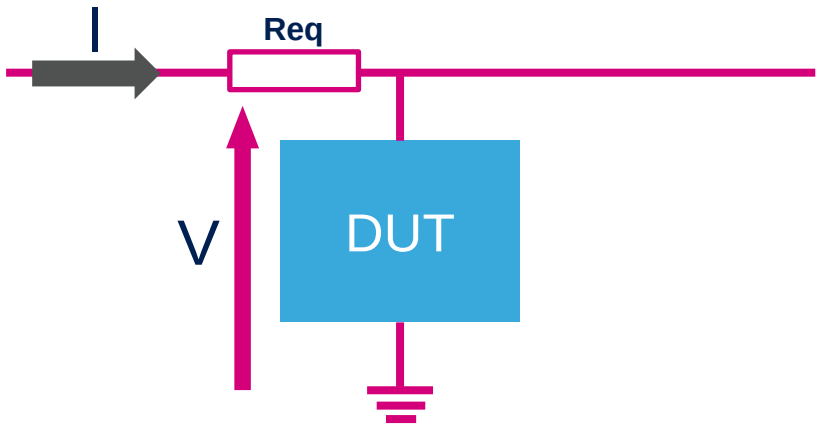
Surge standards summary

IEC 61000-4-5



V_{Peak}: 25 V → 6 kV (depending on DUT location in the circuit and the level of primary protection upstream)

Duration

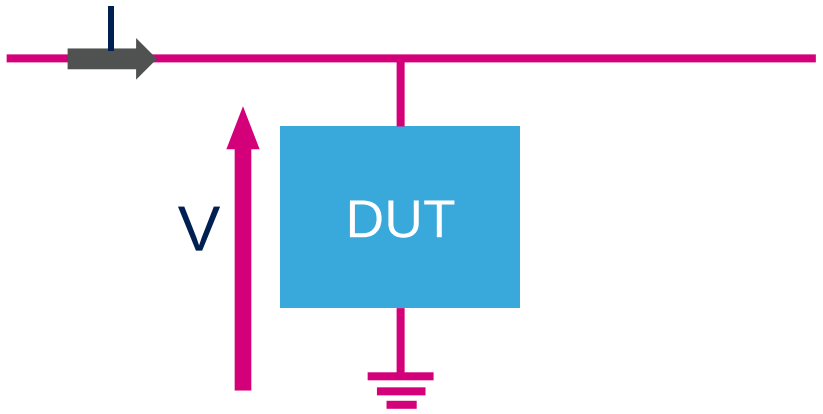
- 8/20 µs (current waveform for short-circuit setup)
- 1.2/50 µs (voltage waveform for open-circuit setup)

Resistance

- 2 Ω (line to line)
- 12 Ω (line to ground)
- 42 Ω (dataline)

How to protect against a surge

2 approaches



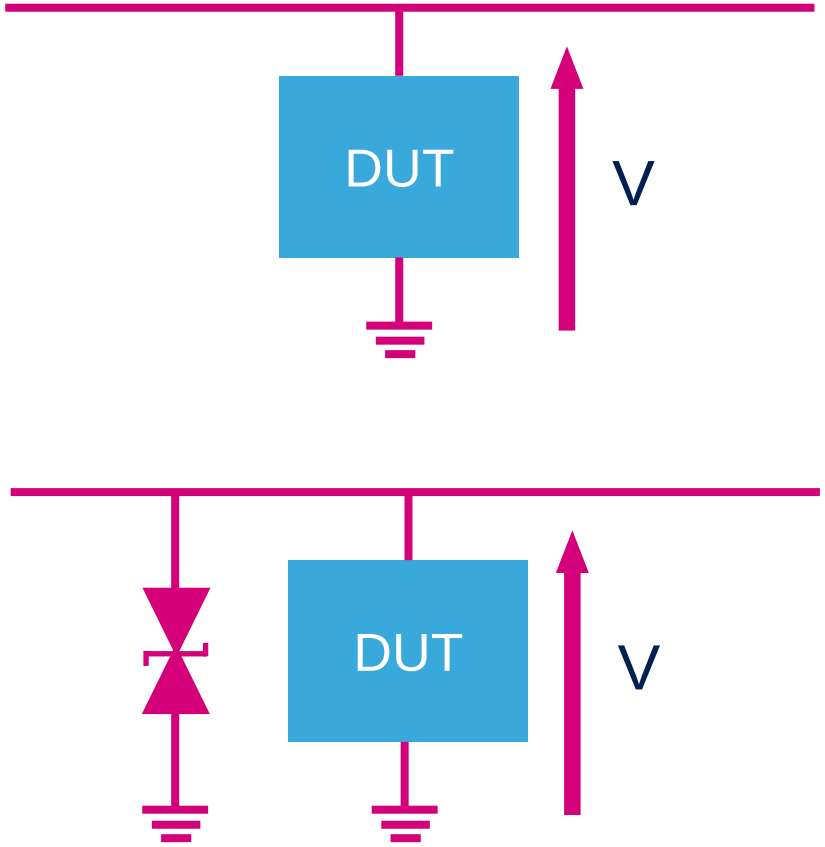
Transil™

TVS, clamping diodes

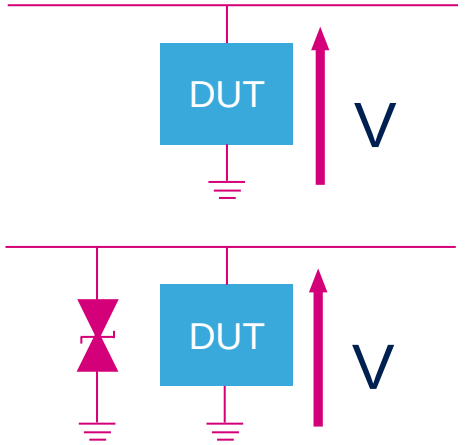
Trisil™

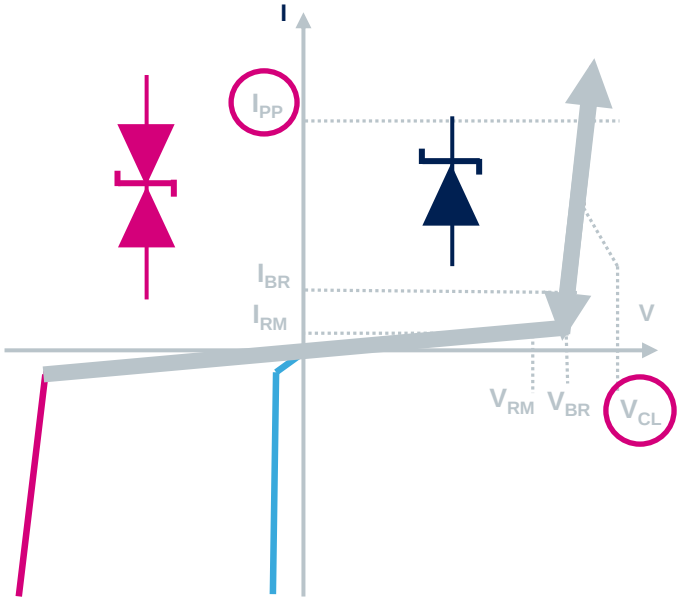
Crowbar diodes

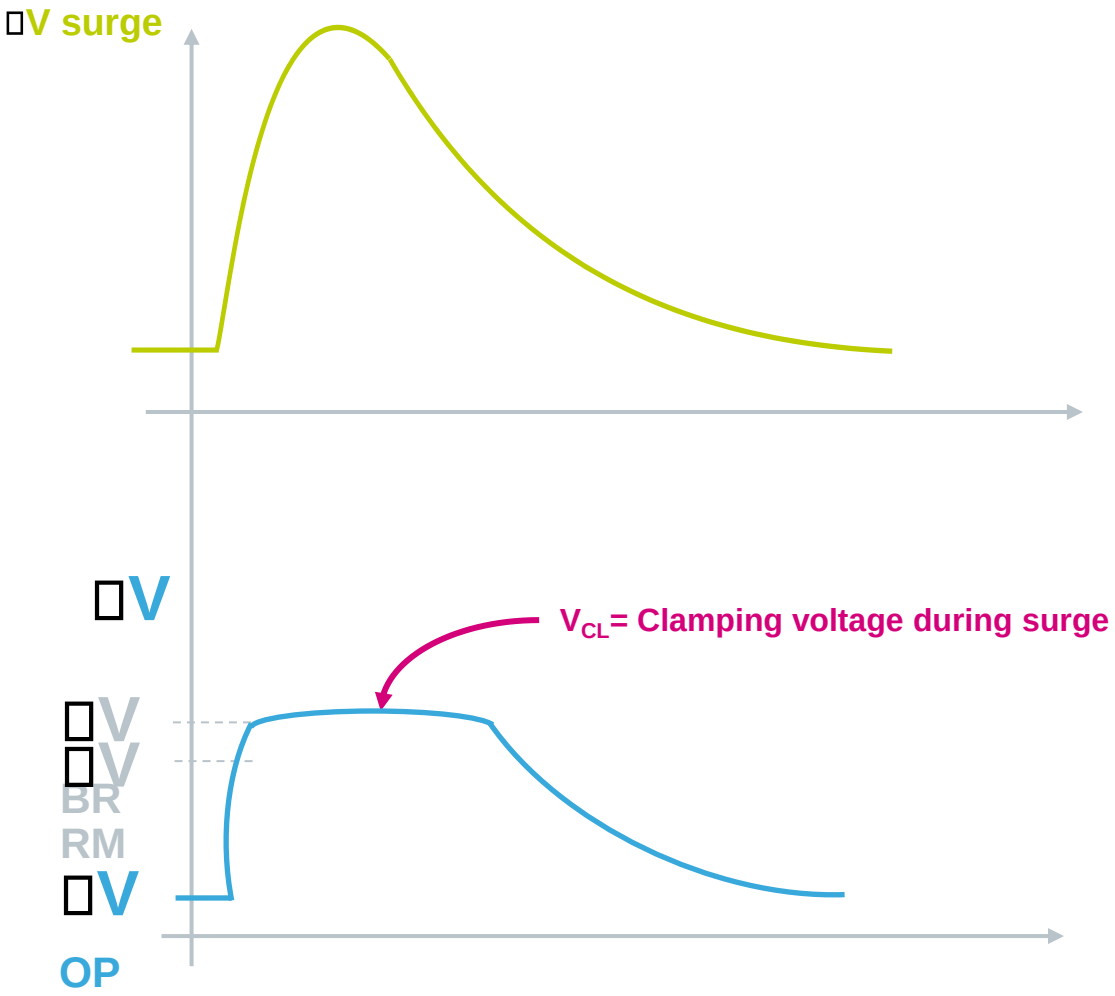
Transil™ protection (TVS)



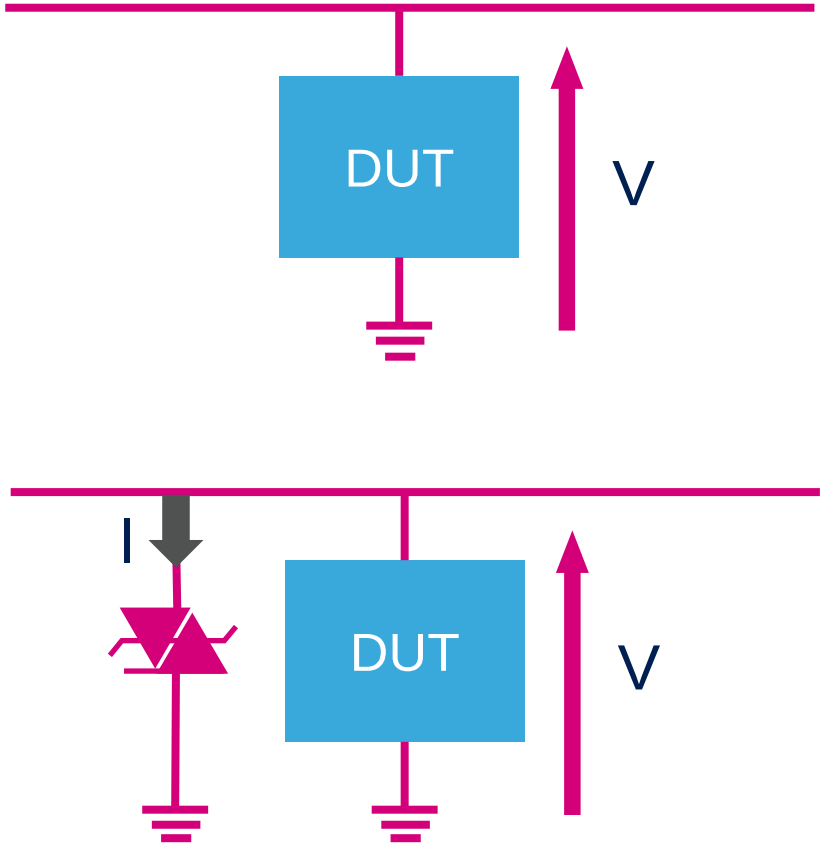
Transil™ (TVS) electrical behavior



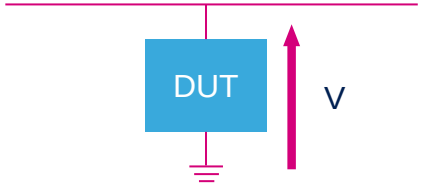


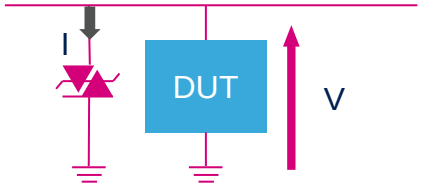


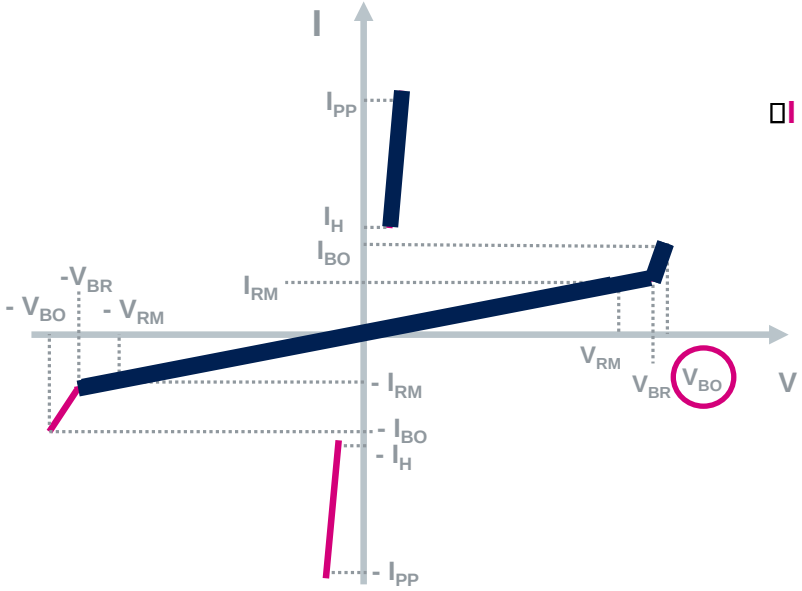
Trisil™ protection (crowbar)

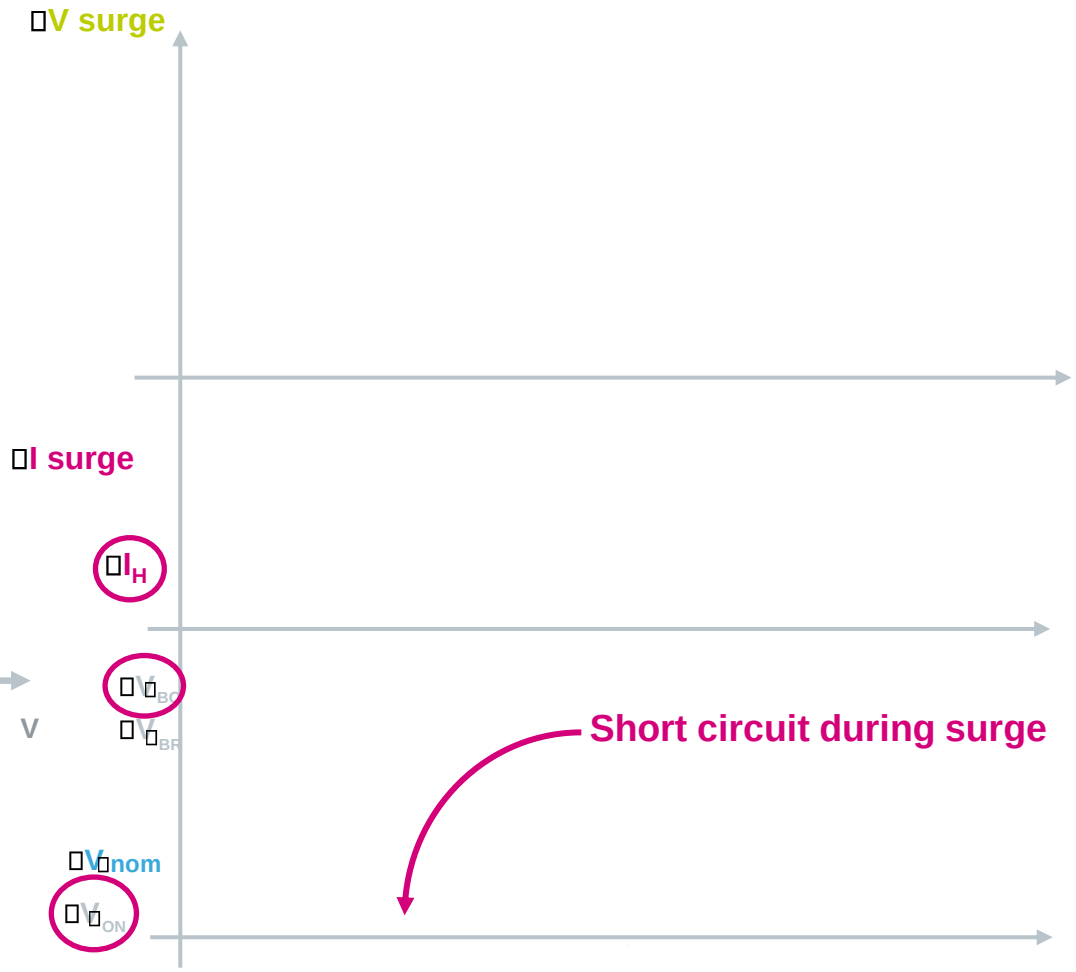


Trisil™ (crowbar) electrical behavior









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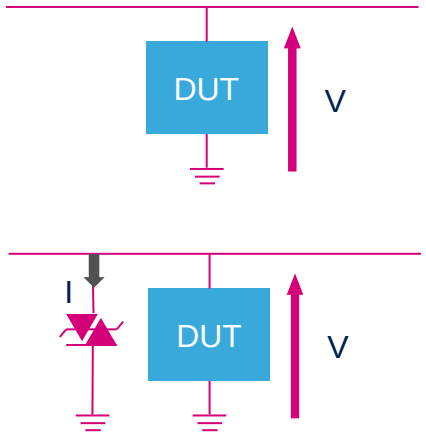
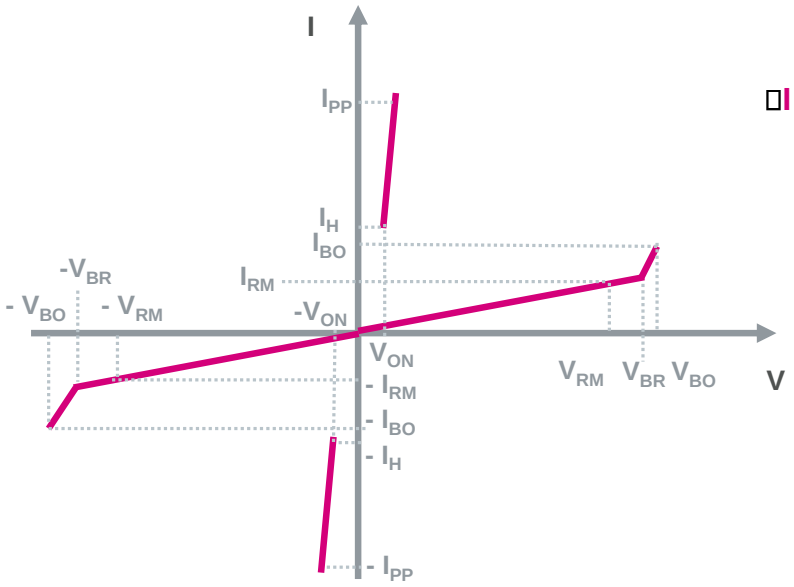
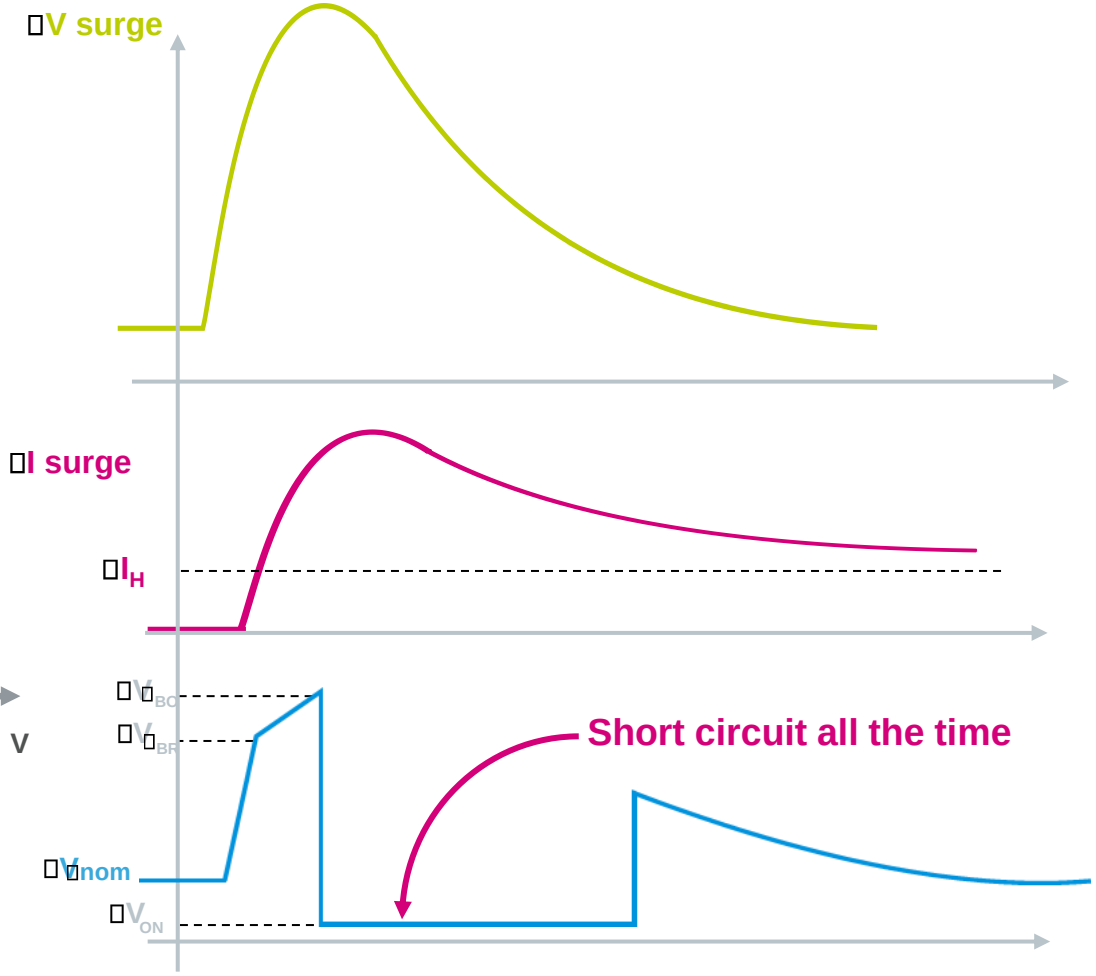
I_H: key parameter for Trisil protection







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Summary

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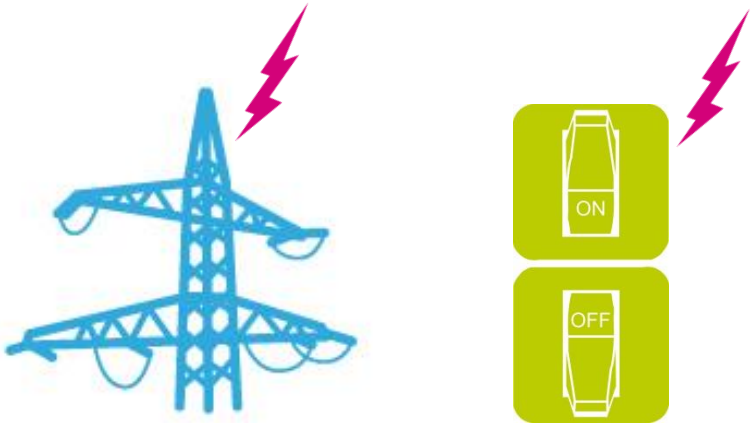
Surge standards summary

IEC 61000-4-2

Contact: 8 kV
Air: 15 kV



IEC 61000-4-5

V_{peak}: 25 V → 6 kV

Duration

- 8/20 µs (current)
- 1.2/50 µs (voltage)

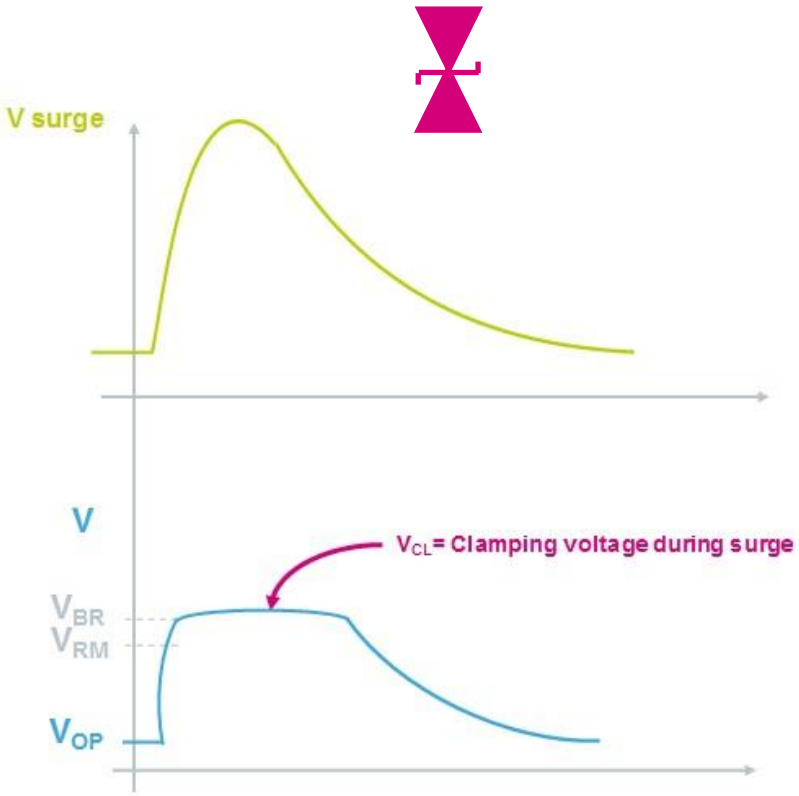
Resistance

- 2 Ω (line to line)
- 12 Ω (line to ground)
- 42 Ω (dataline)

Protection type summary

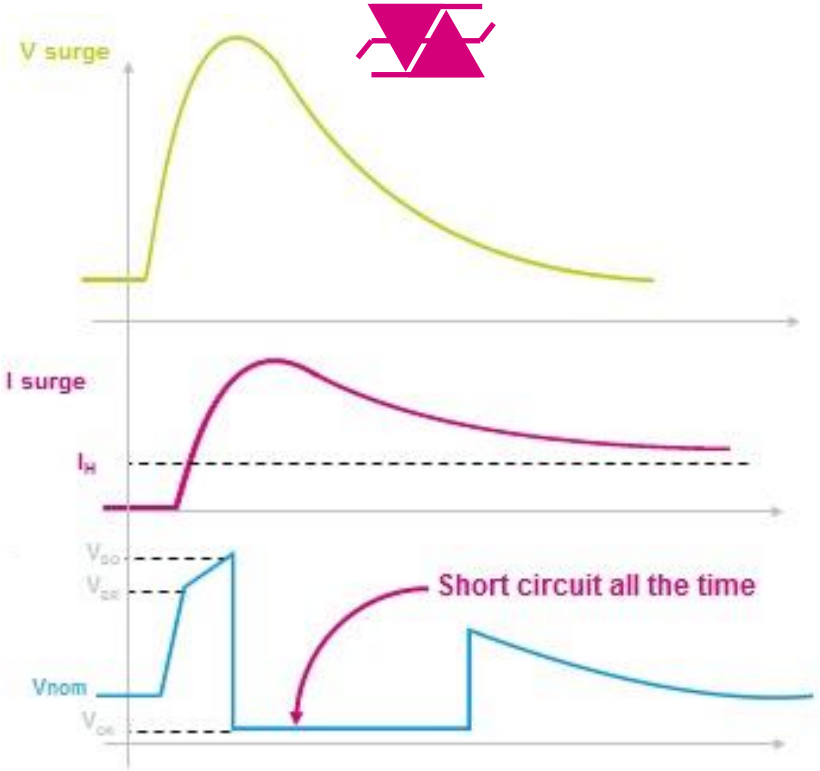
Transil™

Transient voltage suppressor



Trisil™

Crowbar diode



For more information, visit

www.st.com/protection

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