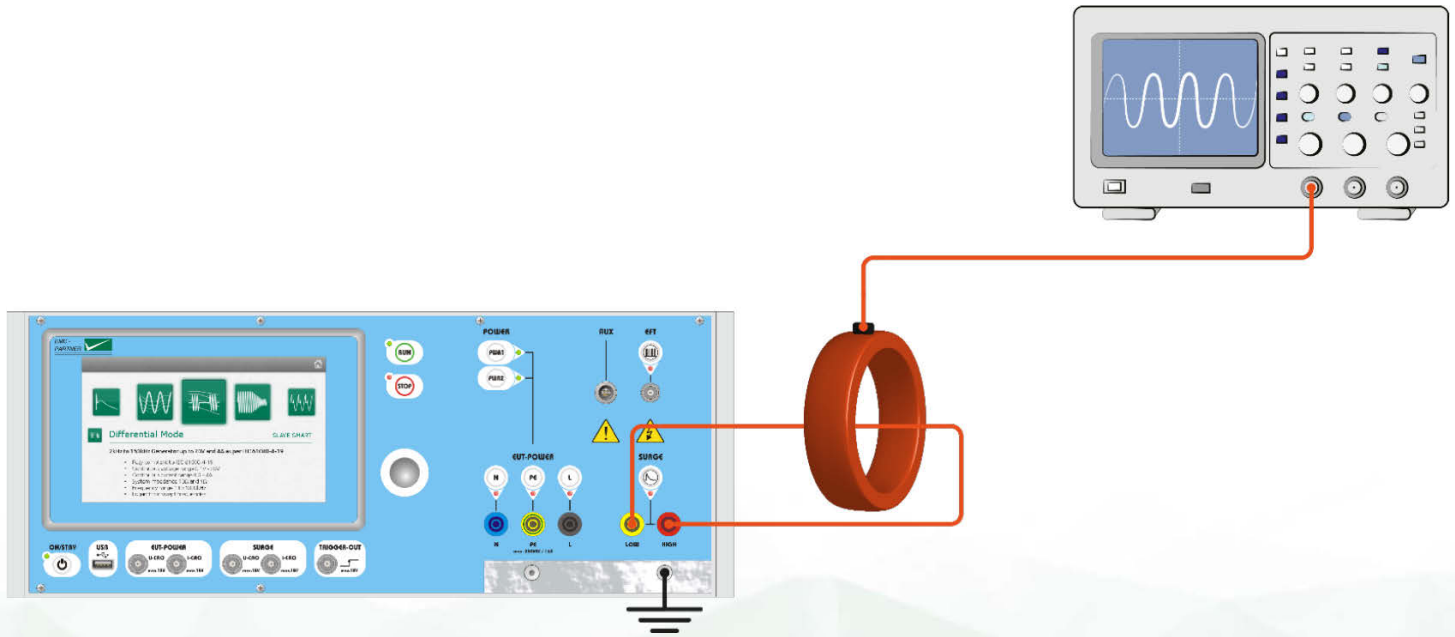
Power line CDNs for surge testing

according to IEC61000-4-5 edition 3.0



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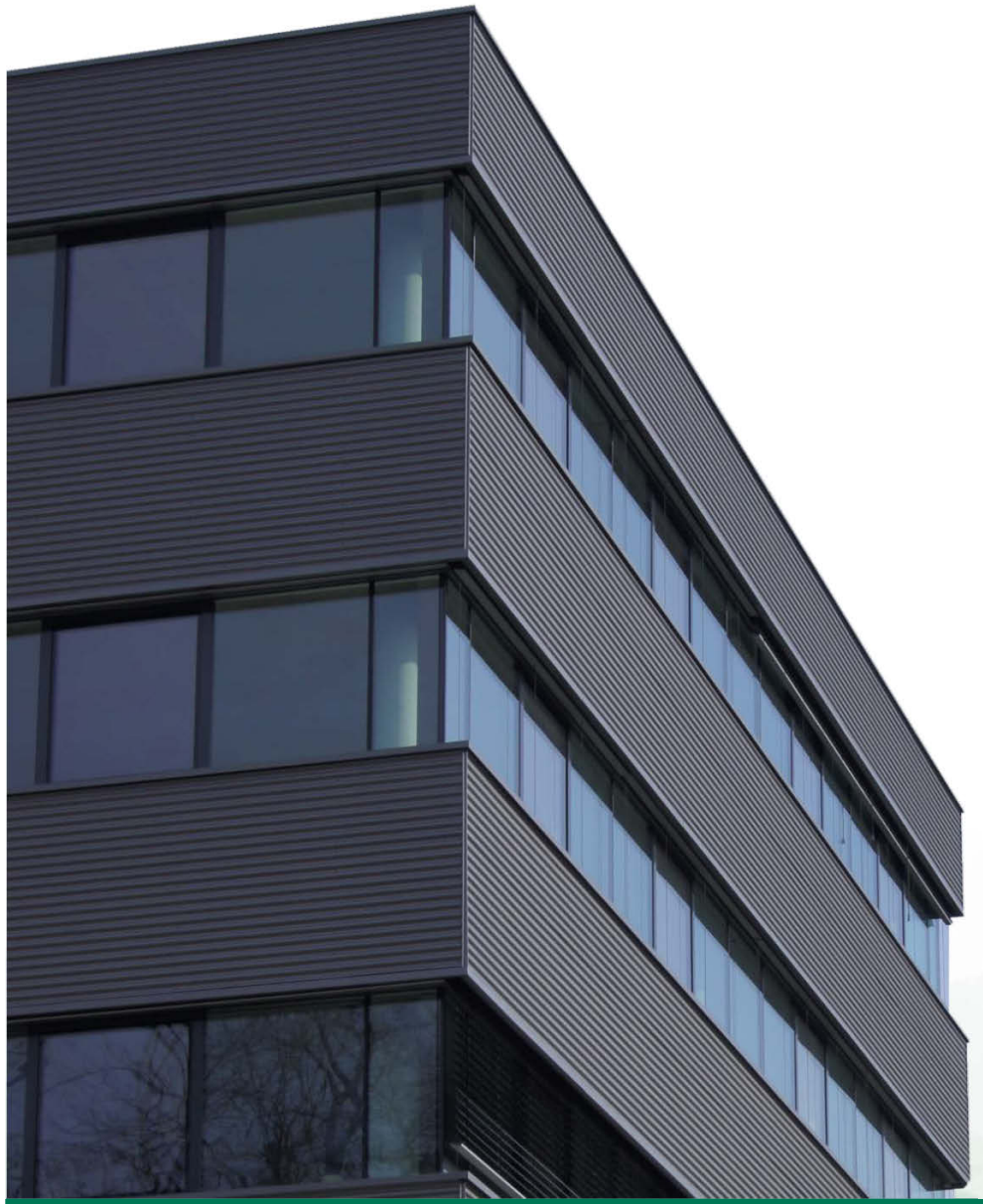


EMC PARTNER AG

- ✓ Founded in 1994
- ✓ Swiss private company, headquarters in Laufen
- ✓ Largest choice of impulse generators
- ✓ Market leading supplier, reputed worldwide
- ✓ Development, production and testing in house
- ✓ Global network of representatives

EMC PARTNER

EMC PARTNER provides conducted immunity test solutions for a broad range of sectors

Industry & Household

Components

Renewable energy

Avionics

Military

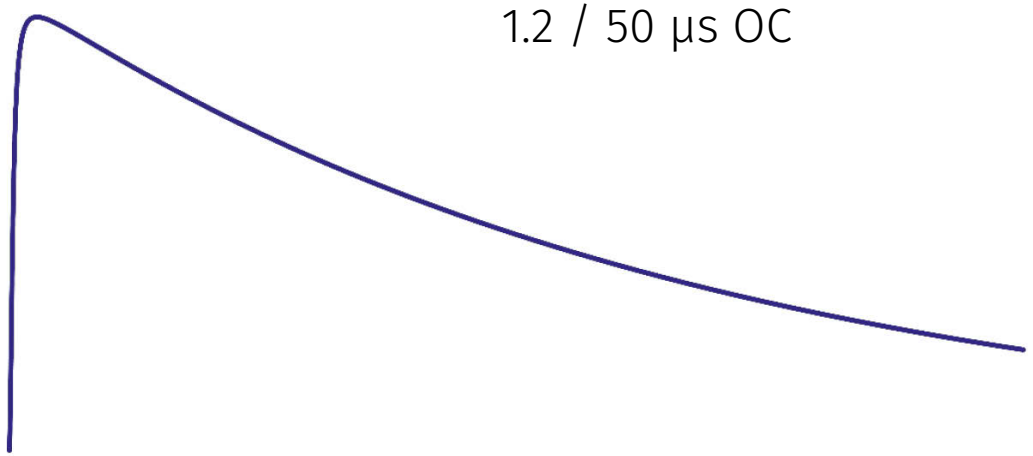
Telecom

Contents

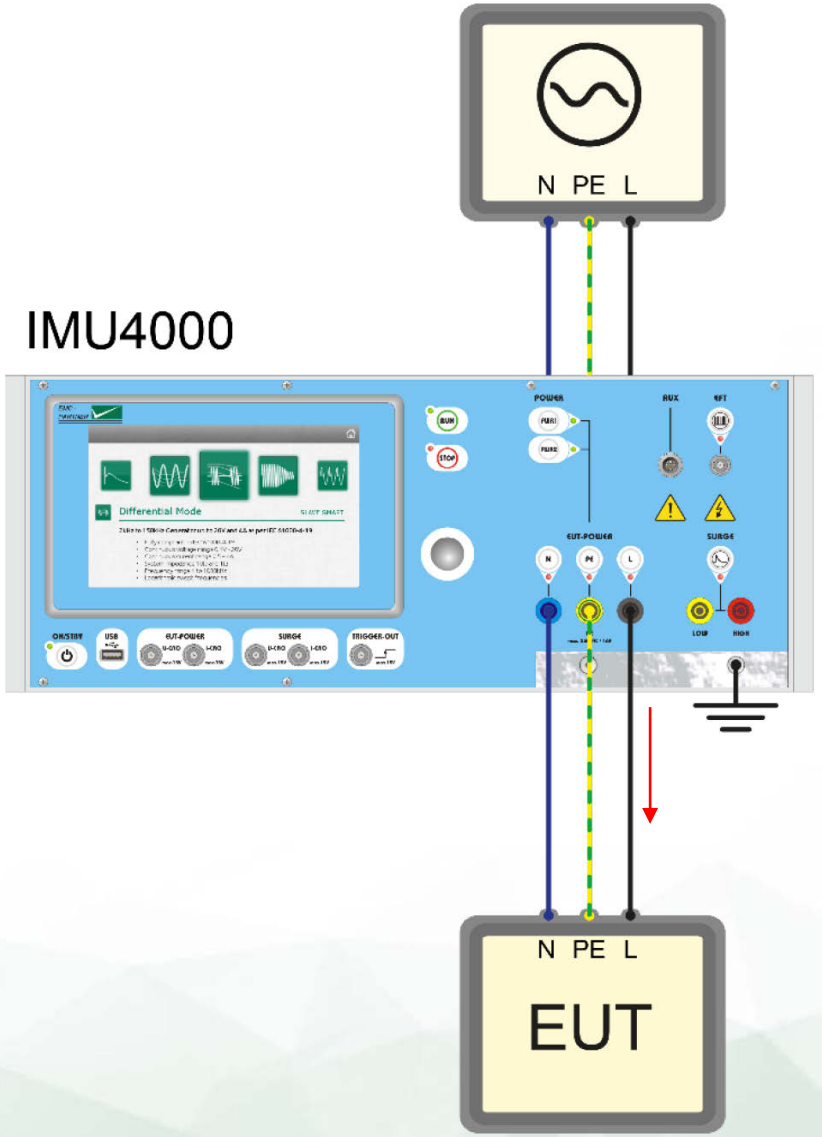
- ✓ Introduction
- ✓ Changes in edition 3 (CDNs)
- ✓ Specification of CDNs for power lines
- ✓ Comparison and analysis
- ✓ Discussion
- ✓ Conclusion

Generator: 1.2/50 µs and 8/20 µs (hybrid-generator)

1.2 / 50 µs OC

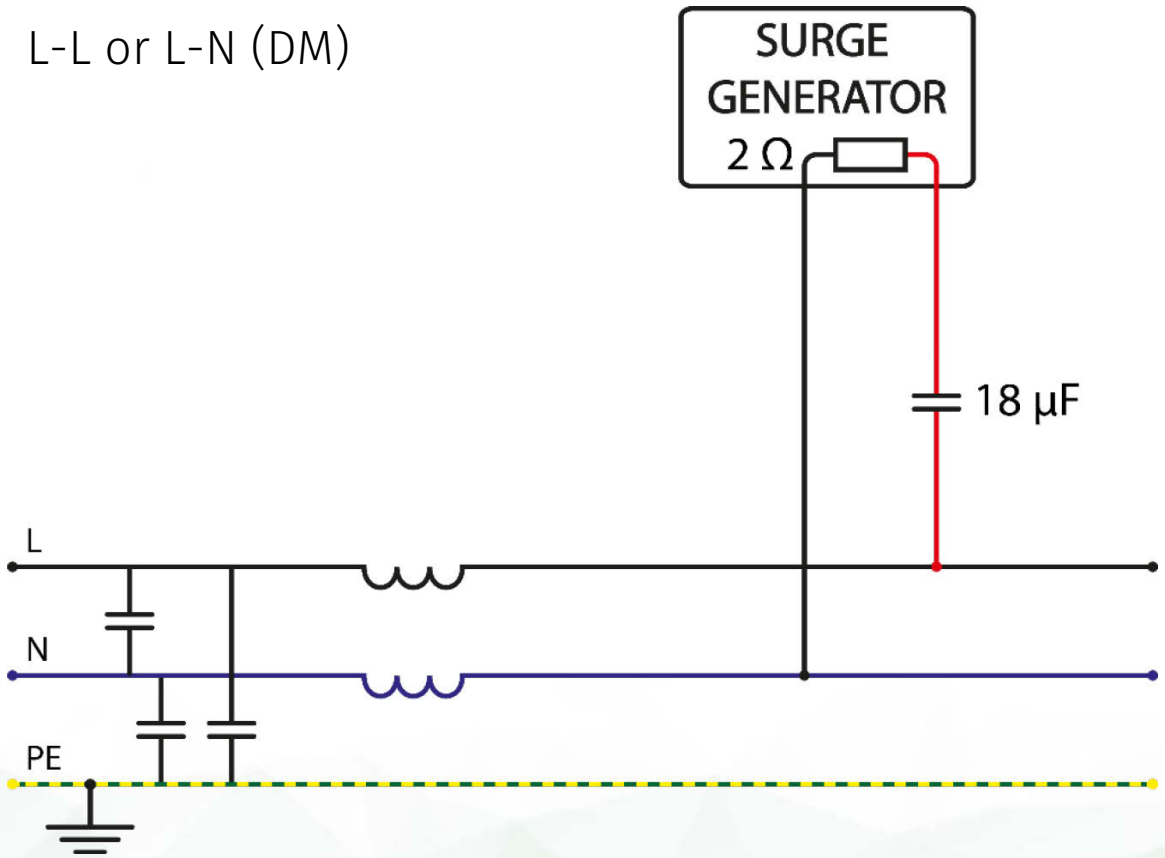


8 / 20 µs SC

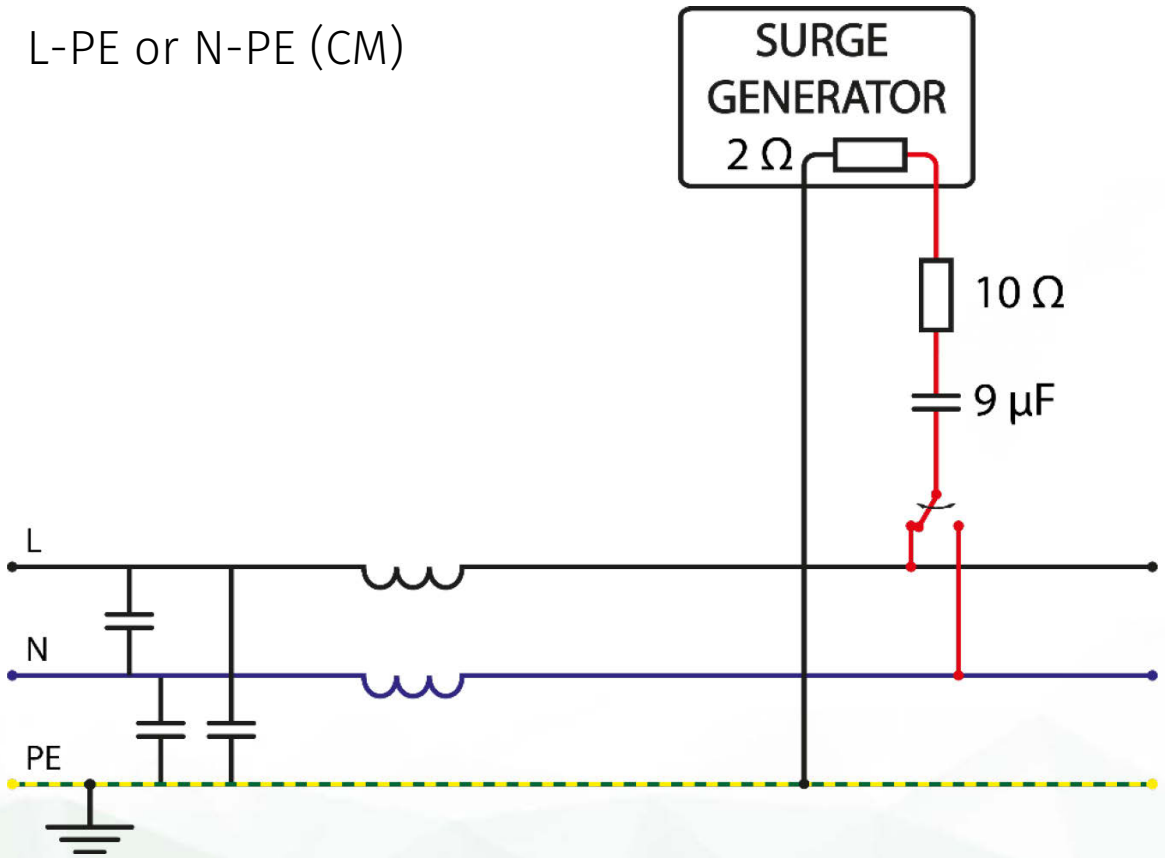


Coupling and decoupling

L-L or L-N (DM)

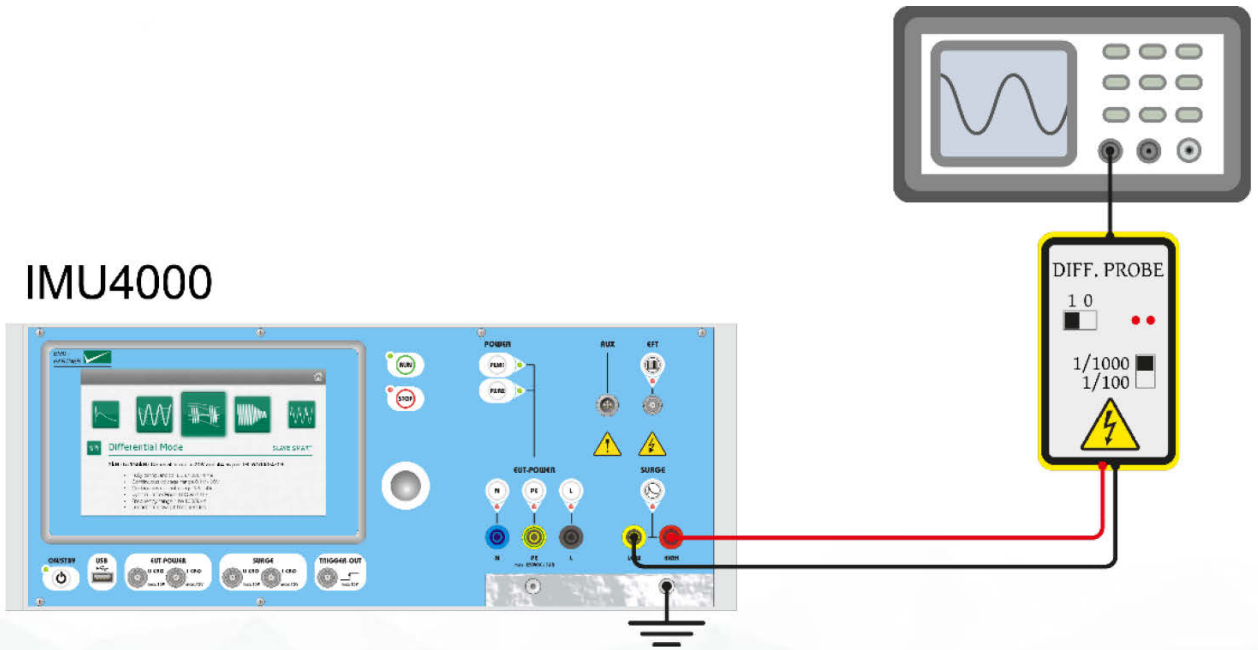


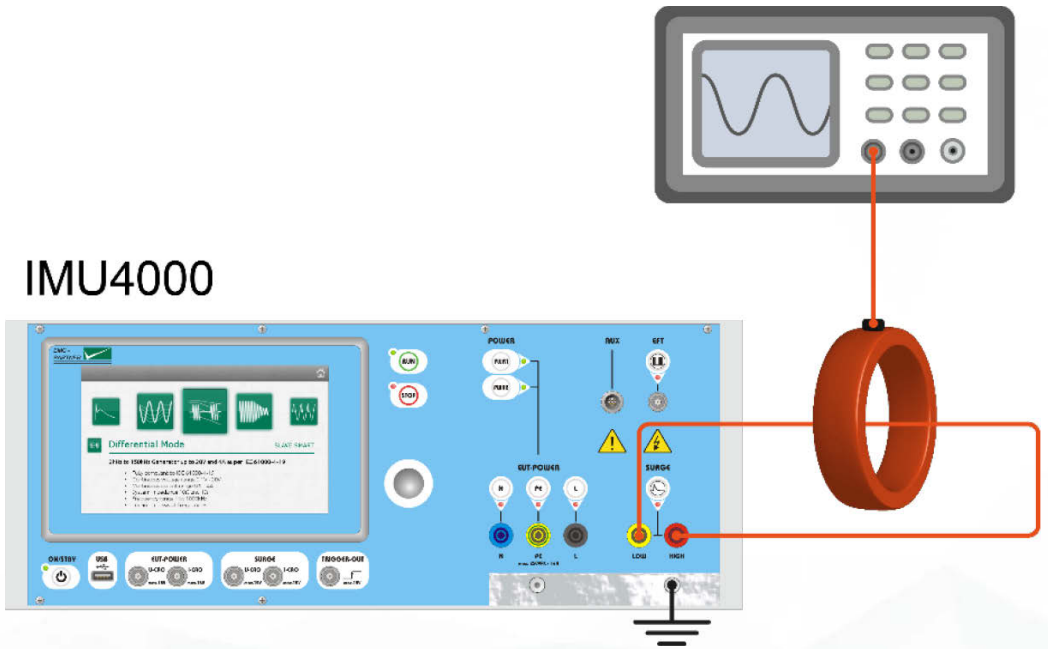
L-PE or N-PE (CM)



Direct output calibration: (V_{OC}/I_{SC} = 2 Ω)

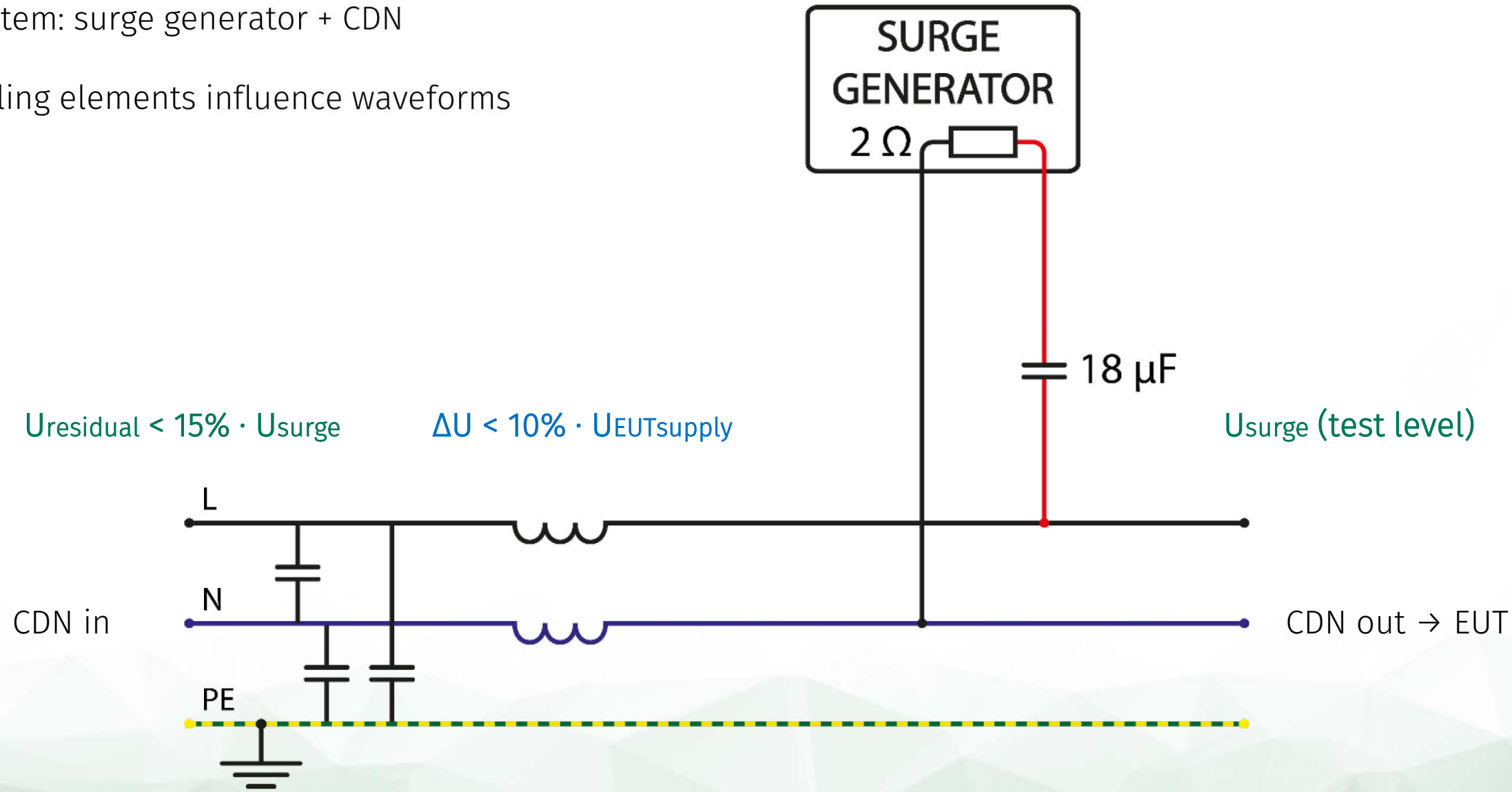
Open circuit and short circuit: all test levels





Test system: surge generator + CDN

Decoupling elements influence waveforms



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EUT current extended from 100 A to 200 A and new definition of tolerances

Edition 2

Parameter	Coupling	
	L-L/N (18 µF)	L/N-PE(10Ω+9µF)
Test level, (peak voltage) U		
	-	-
	-	-
	-	-
	-	-
	-	-
Rise time ts		
	1.2 µs ± 30 %	1.2 µs ± 30 %
Pulse duration td		
I < 25 A	50µs +10 / -10 µs	50µs +10 / -25 µs
	↑↓	↑↓
25 A < I ≤ 60 A	50µs +10 / -15 µs	50µs +10 / -30 µs
60 A < I ≤ 100 A	50µs +10 / -20 µs	50µs +10 / -35 µs
	-	-

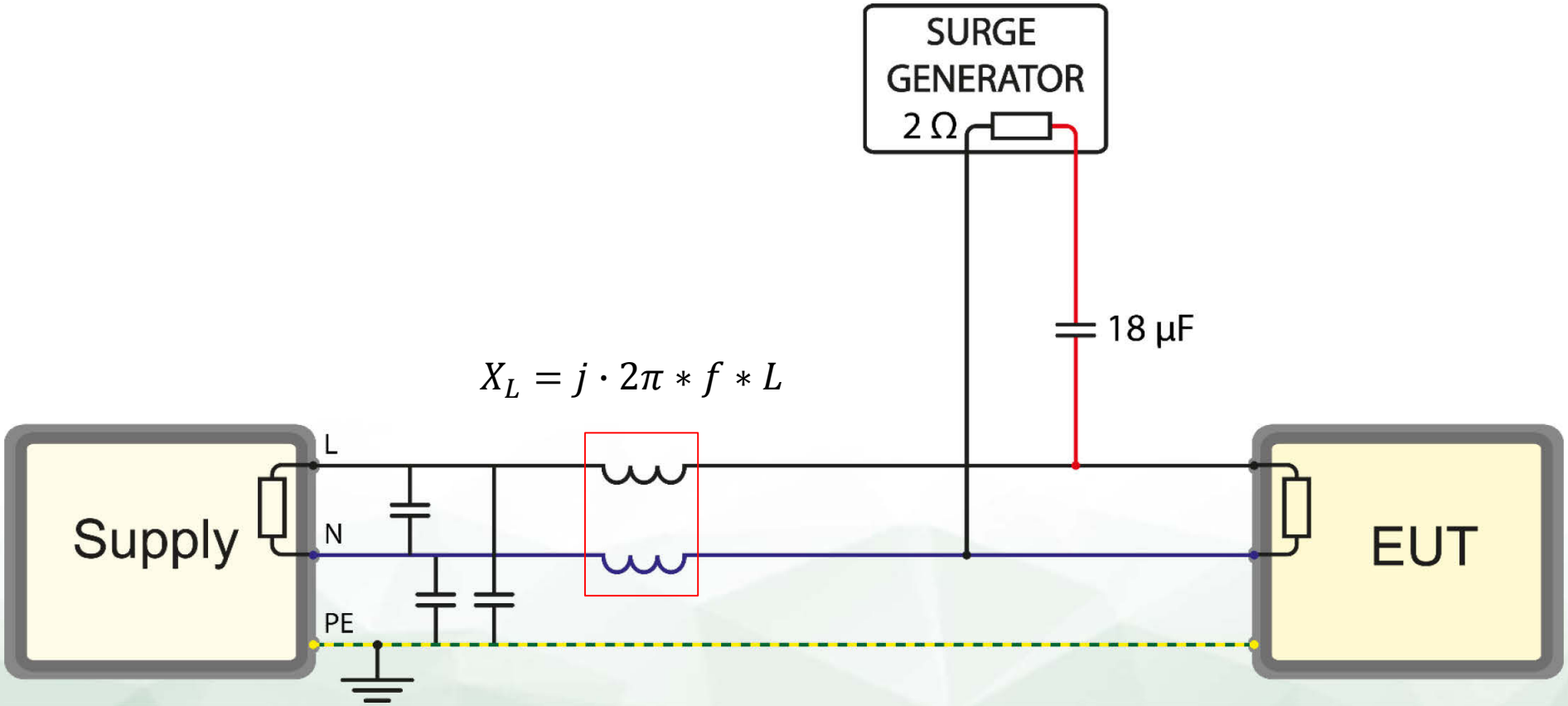
Edition 3

Parameter	Coupling	
	L-L/N (18 µF)	L/N-PE(10Ω+9µF)
Test level, (peak voltage) U		
I < 16 A	U +10 % / -10 %	U +10 % / -10 %
16 A < I ≤ 32 A	U +10 % / -10 %	U +10 % / -10 %
32 A < I ≤ 63 A	U +10 % / -10 %	U +10 % / -15 %
63 A < I ≤ 125 A	U +10 % / -10 %	U +10 % / -20 %
125 A < I ≤ 200 A	U +10 % / -10 %	U +10 % / -25 %
Rise time ts		
	1.2 µs ± 30 %	1.2 µs ± 30 %
Pulse duration td		
I < 16 A	50µs +10 / -10 µs	50µs +10 / -25 µs
16 A < I ≤ 32 A	50µs +10 / -15 µs	50µs +10 / -30 µs
32 A < I ≤ 63 A	50µs +10 / -20 µs	50µs +10 / -35 µs
63A < I ≤ 125 A	50µs +10 / -25 µs	50µs +10 / -40 µs
125 A < I ≤ 200 A	50µs +10 / -30 µs	50µs +10 / -45 µs

Maximum allowed decoupling inductance: 1.5 mH per phase

The higher the inductance, the lower the residual voltage at CDN input

The higher the inductance, the higher the voltage drop across it

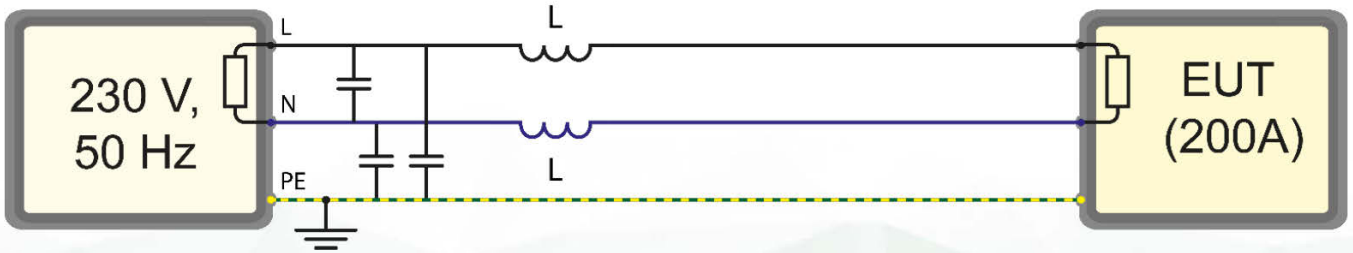


Why is a lower inductance needed for high current EUTs?

✓ Some EUTs do not start when CDN is interposed, higher inductances limit EUT current

Example:

L (inductance)	V_{EUT}	I_{EUT}
0 (no inductance)	230 V	200 A
0.3 mH	218.5 V	190 A
1.5 mH	168.3 V	146.7 A



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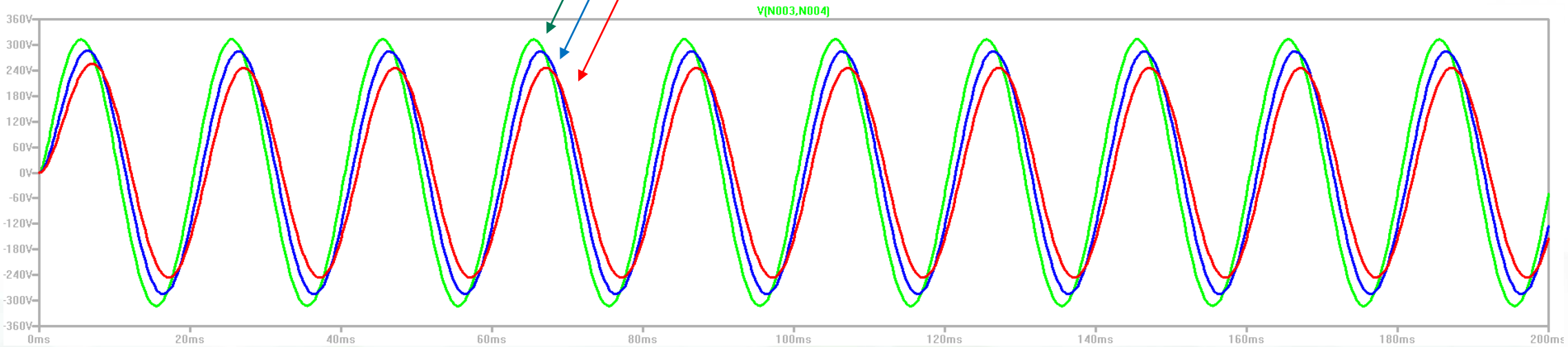

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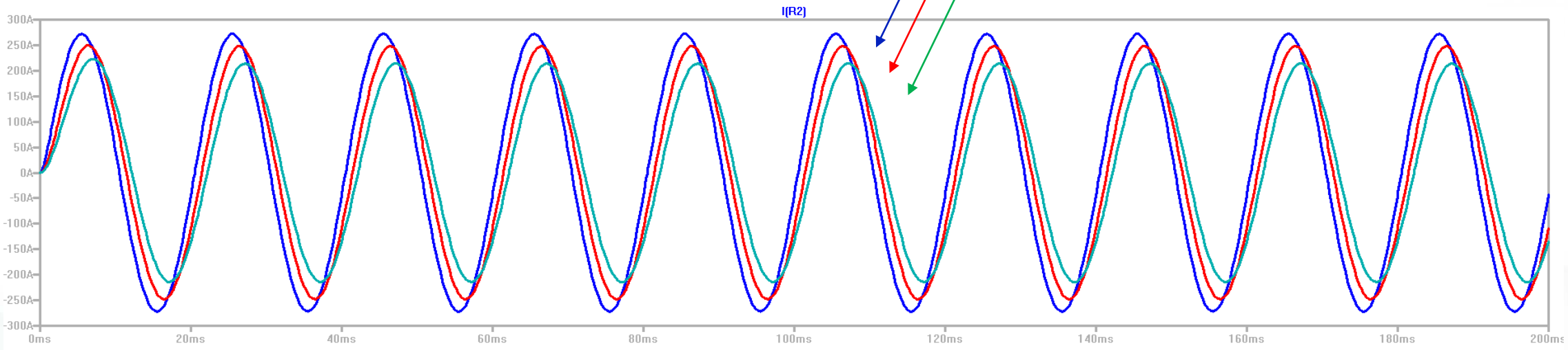


Why is a lower inductance needed for high current EUTs?

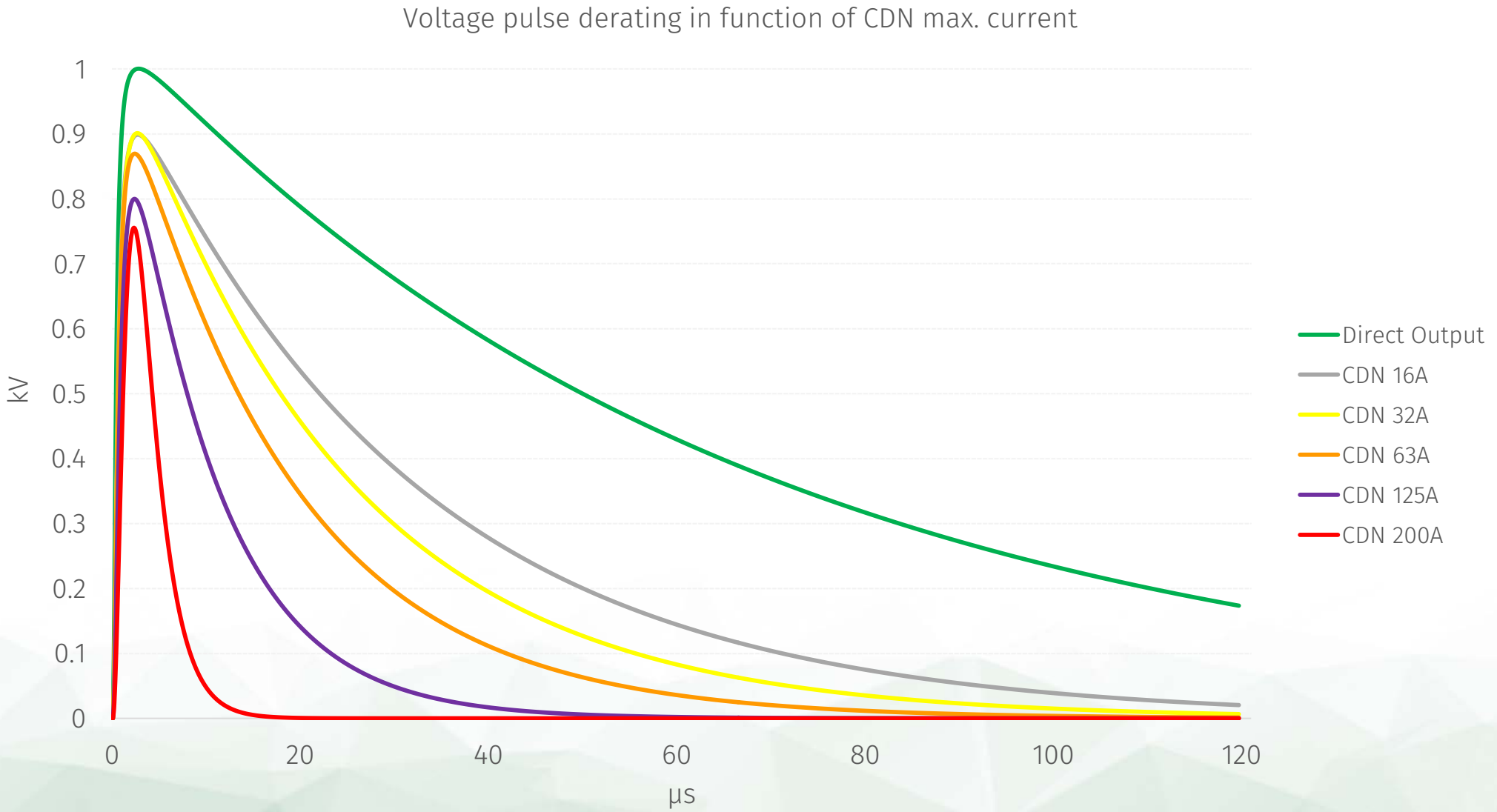
- ✓ Lower inductance in the circuit allows higher EUT currents through the CDN
- ✓ Edition 3 allows lower decoupling inductance for larger current EUTs, but not for smaller current EUTs

Why?

Edition 3

Parameter	Coupling	
	L-L/N (18 µF)	L/N-PE(10Ω+9µF)
Test level, (peak voltage) U		
I< 16 A	U +10 % / -10 %	U +10 % / -10 %
16 A < I ≤ 32 A	U +10 % / -10 %	U +10 % / -10 %
32 A < I ≤ 63 A	U +10 % / -10 %	U +10 % / -15 %
63 A < I ≤ 125 A	U +10 % / -10 %	U +10 % / -20 %
125 A < I ≤ 200 A	U +10 % / -10 %	U +10 % / -25 %
Rise time ts		
	1.2 µs ± 30 %	1.2 µs ± 30 %
Pulse duration td		
I< 16 A	50µs +10 / -10 µs	50µs +10 / -25 µs
16 A < I ≤ 32 A	50µs +10 / -15 µs	50µs +10 / -30 µs
32 A < I ≤ 63 A	50µs +10 / -20 µs	50µs +10 / -35 µs
63A < I ≤ 125 A	50µs +10 / -25 µs	50µs +10 / -40 µs
125 A < I ≤ 200 A	50µs +10 / -30 µs	50µs +10 / -45 µs

Lower decoupling inductance impacts voltage test level and duration of the voltage pulse



Edition 3

Coupling
L/N-PE(10Ω+9µF)
Test level, U [kV]
U +10 % / -10 %
U +10 % / -10 %
U +10 % / -15 %
U +10 % / -20 %
U +10 % / -25 %
Rise time ts
1.2 µs ± 30 %
Pulse duration td
50µs +10 / -25 µs
50µs +10 / -30 µs
50µs +10 / -35 µs
50µs +10 / -40 µs
50µs +10 / -45 µs

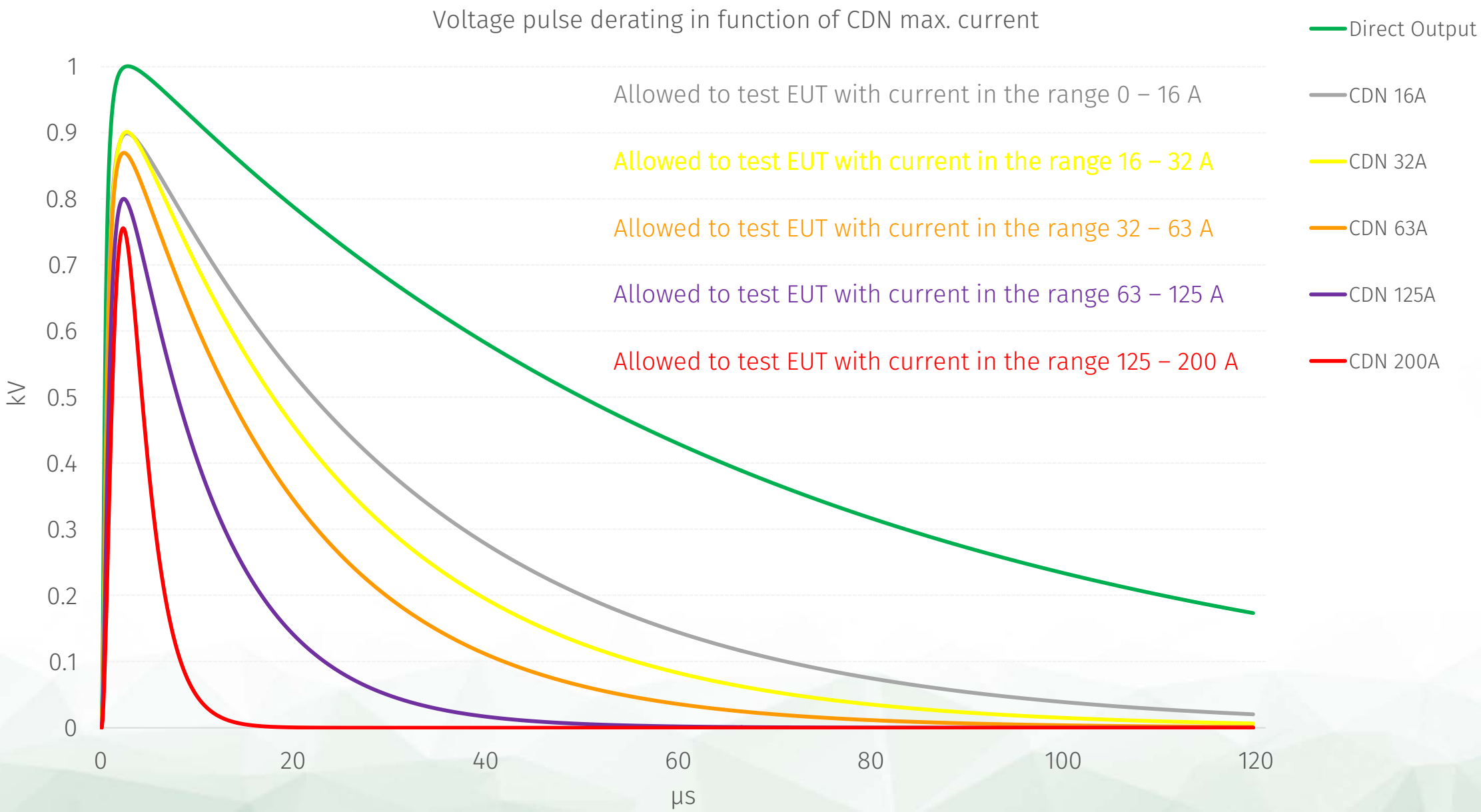
Does the reduction of decoupling inductance impact surge current (short circuit)?

No!

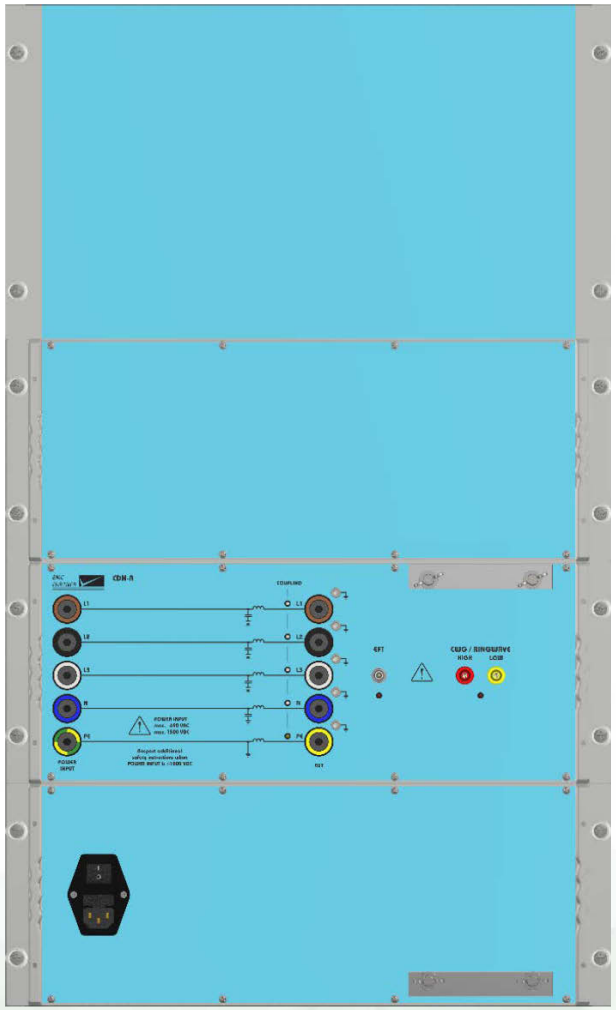
Is it allowed to increase voltage setting in order to obtain larger voltage peaks for higher current CDNs?

No! Voltage increase will also increase short circuit current.

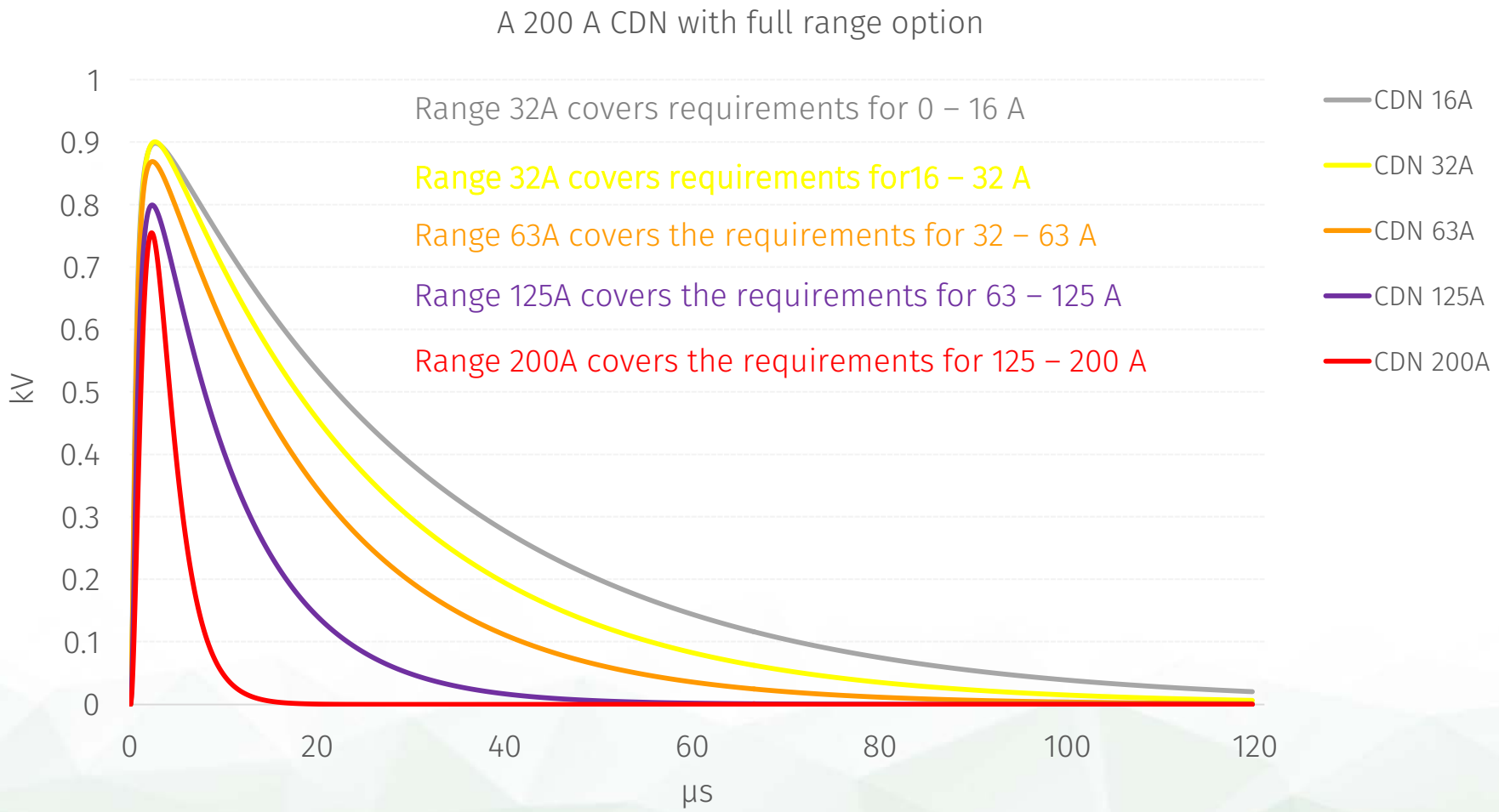
Changes in edition 3 (CDNs)



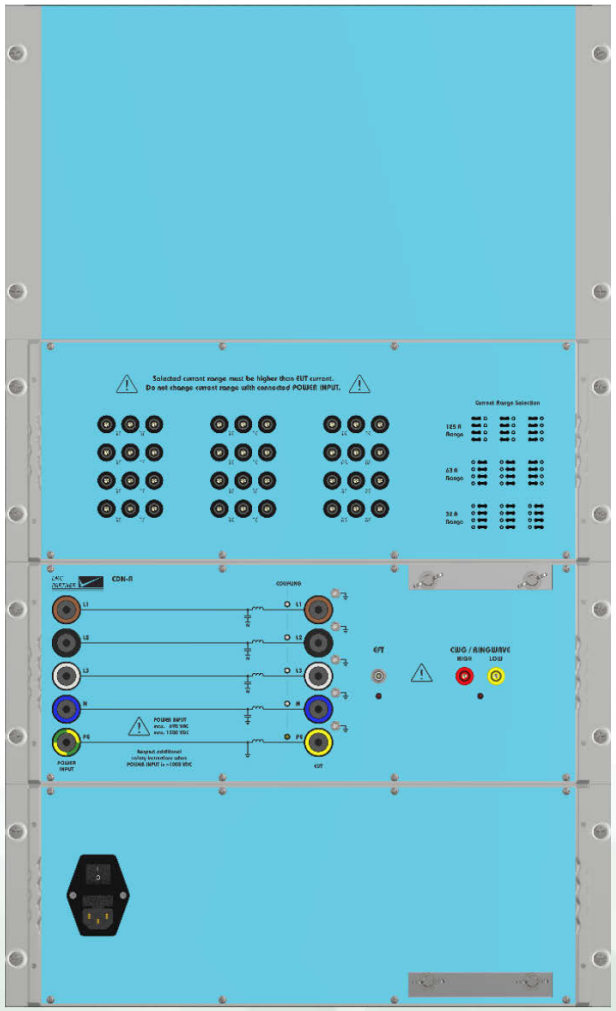
A normal CDN for 200A EUTs can output only this pulse and can be used for EUT current: 125 A – 200 A



A 200A CDN with **FULL RANGE option** can output all these pulses:



CDN 200A +
FULL RANGE option



Q&A