

Odvodnici prenapona i odabir u AC i PV(DC) sistemima

Aleksander Cilenšek

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INŽENJERSKA KOMORA CRNE GORE

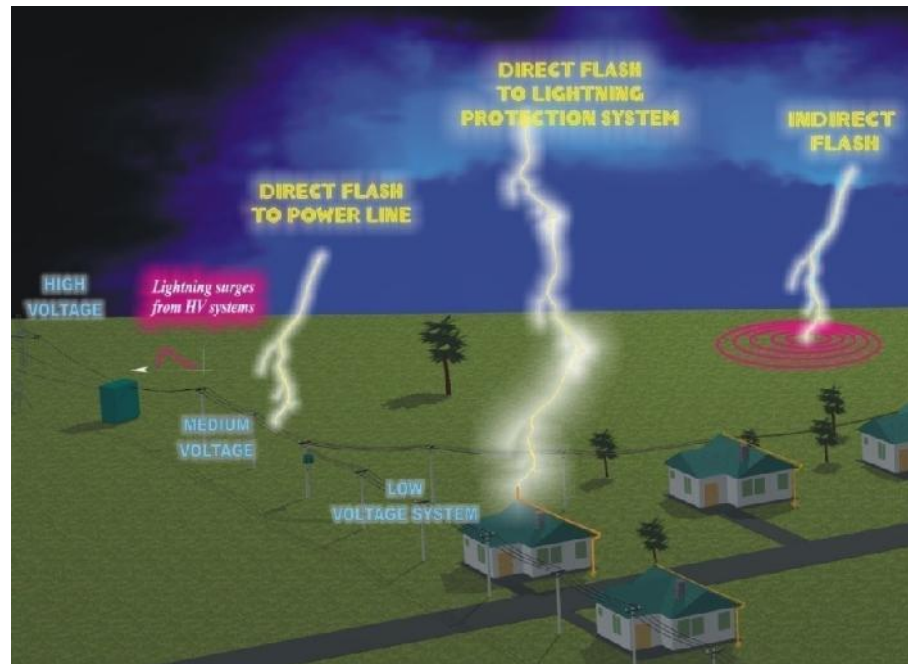
SKEI

ETI

SWITCH TO A SAFE FUTURE

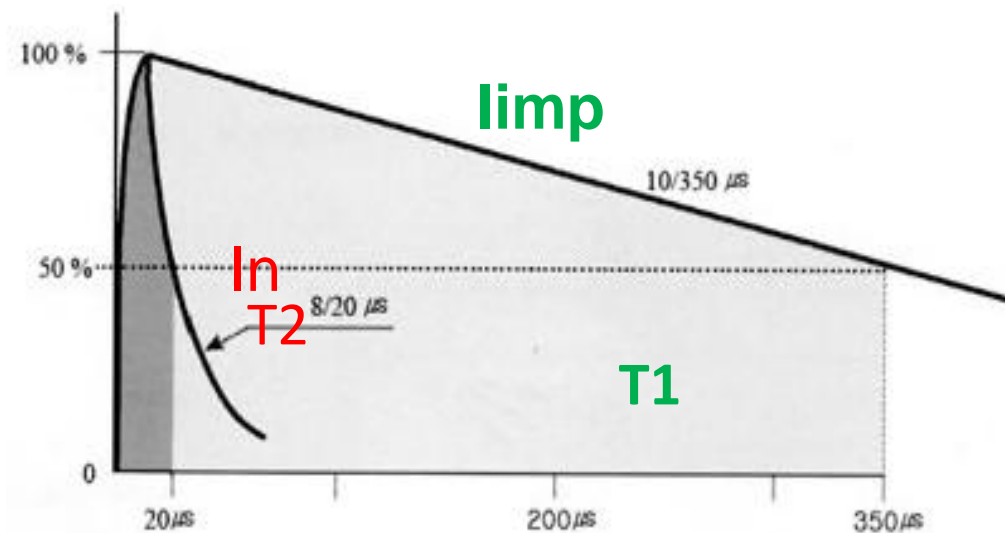
Vrste udara (izvori prenapona)

- Direktni udar
- Djelimi ni direktni udar
- Indirektni udar



Udarni talasi (T1 i T2)

- I_{imp} (10/350 μ s) – direktni udar(T1)
- I_n (8/20 μ s) – indirektni udar (T2)



- Kombinacijski talas $U_{oc}(1.2/50\mu s)/I_{cw}(8/20\mu s)$ (T3)

Vrste SPD prema različitim standardima

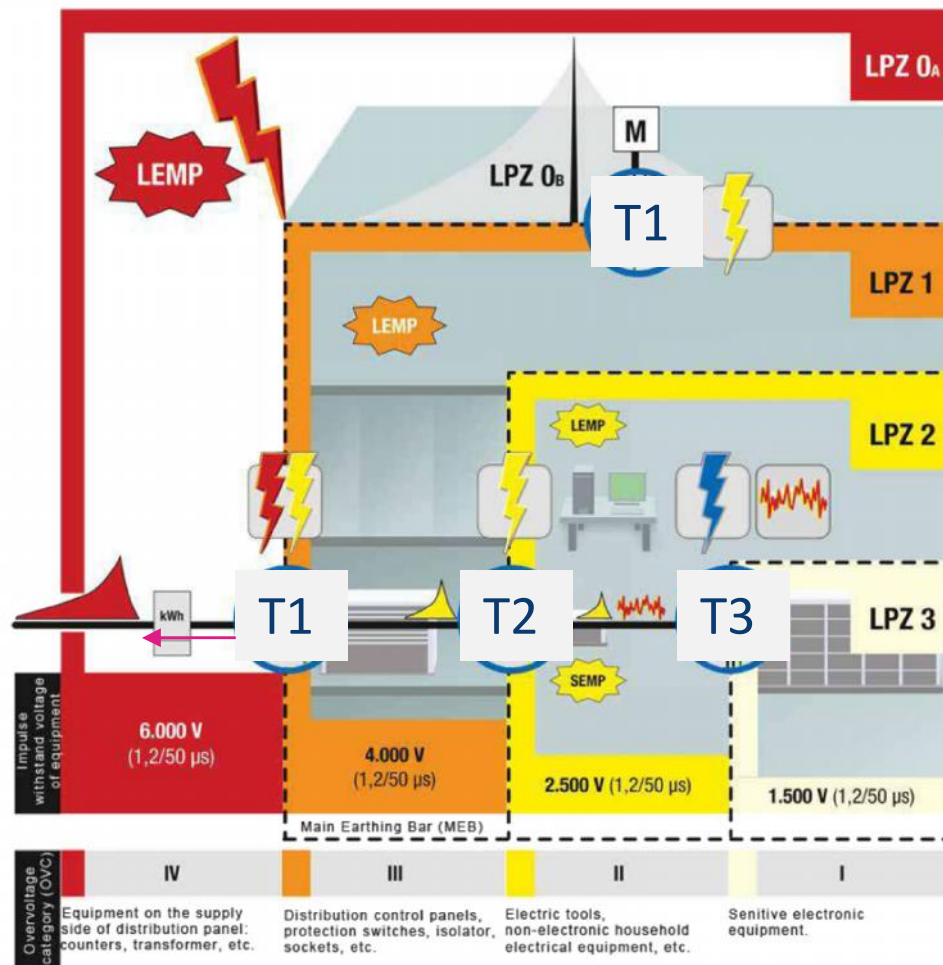
AC:

- T1 – direktni ili indirektni udar, ulaz u zgrade (glavni prik./brojilo)
- T2 – indirektni udar, unutar zgrade (razvodne table)
- T3 – pored osetljivog opterećenja

IEC(61643-11)	EN(61643-11)	VDE(0675)
Class I	Type 1	B
Class II	Type 2	A*,C
Class III	Type 3	D

PV: IEC/EN 61643-31

SPD tipovi prema zonama zaštite

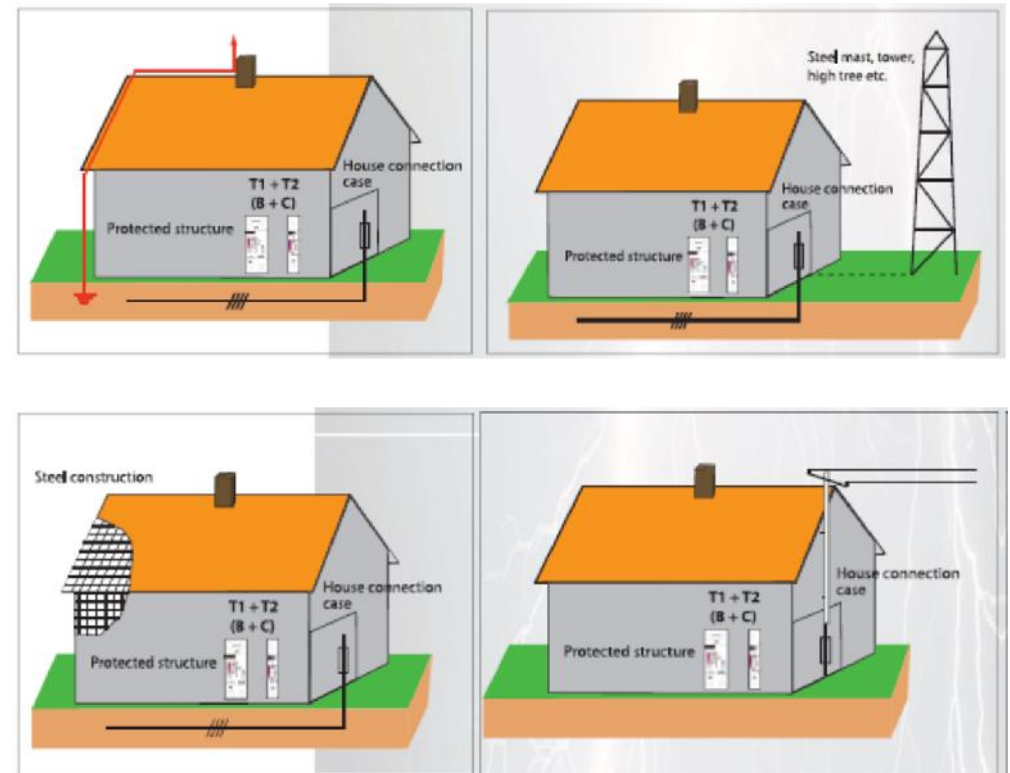


- Koji tip SPD-a prema LPZ zonama zaštite

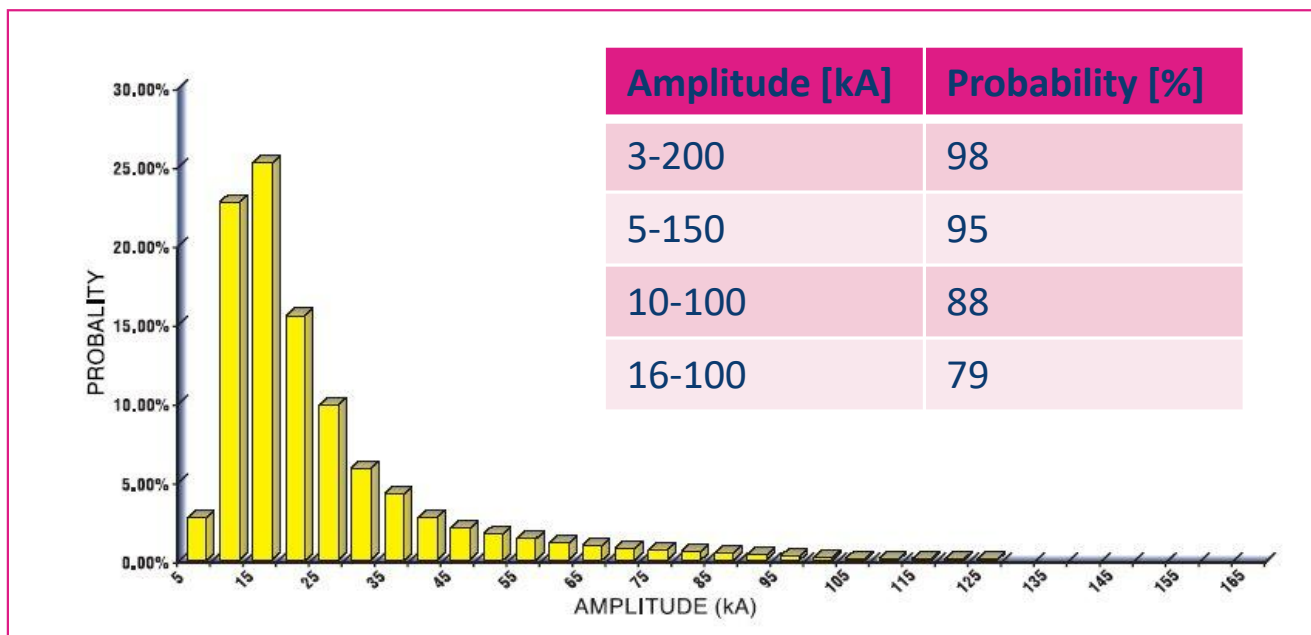
Tip1 (klasa I) – direktni udar In(10/350)

- LPD instalirano
- Visoki objekat ili transformator u blizini
- eli na konstrukcija
- Nadzemni vod
- Prodaja T1 vs T2

2017: T1	2017: T2
1	5



O ekvane amplitude direktnog udara (T1)

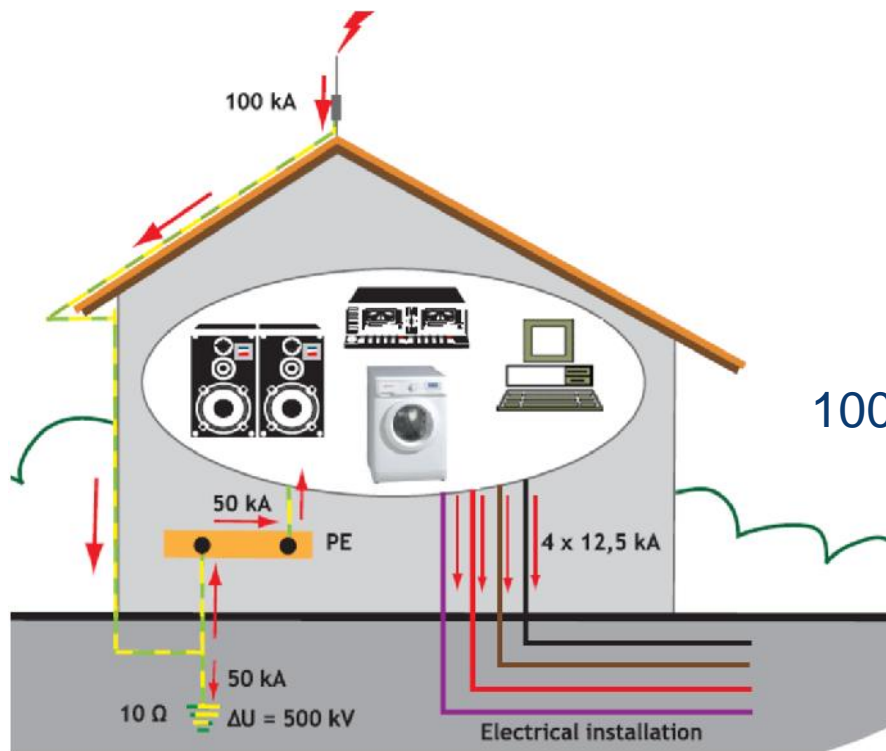


Lightning Protection Level (LPL)	I	II	III	IV
Maximum impulse current	200 kA	150 kA	100 kA	
Time parameter	10 / 350			

EN 62305-1

Nivo zaštite od udara 3 and 4 – Stambene i poslovne zgrade

T1, $I_{imp}=12,5\text{kA/pole}$



$$100\text{kA}/2/4 = 12,5 \text{ kA/pole as minimum}$$

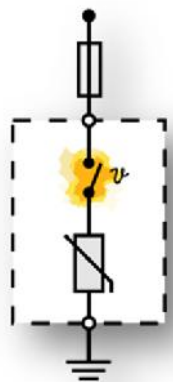
SPD: OSNOVNI ZAŠTITNI ELEMENTI



Component		High energy High current	Low Let-through voltage	No follow-on Current (Non crowbar)
Air Gaps & Gas arrester		✓✓	✗	✗✗
Metal Oxide Varistor		✓	✓	✓
Silicon Avalanche Diodes		✗✗	✓✓	✓

• Optimalno rješenje

MOV SPDs



- Iskljuivanje u slučaju MOV preopterećenja

- Termi ki prekida i indikacija statusa

OK



FALSE

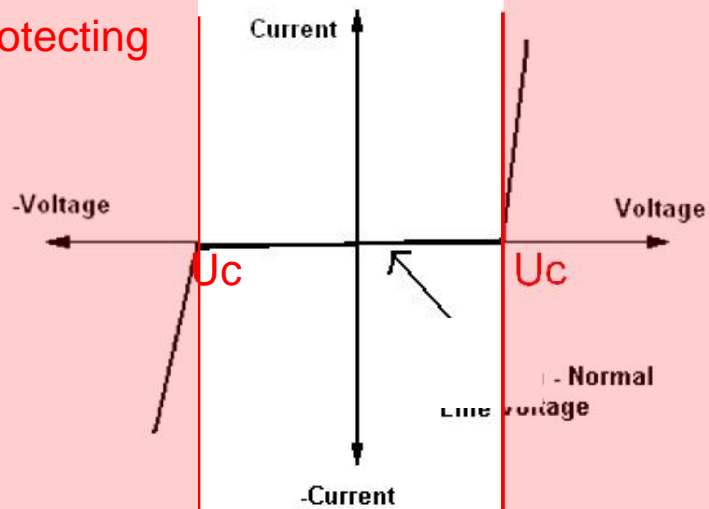


MOV djelovanje

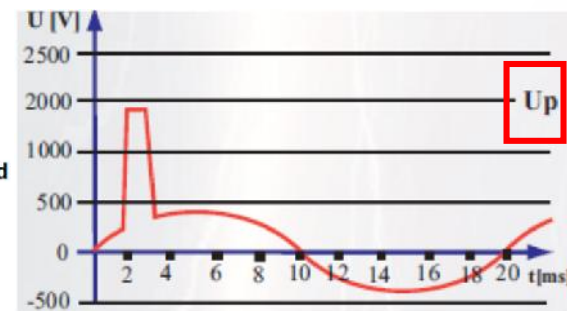
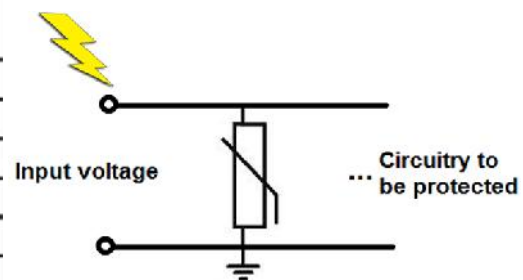
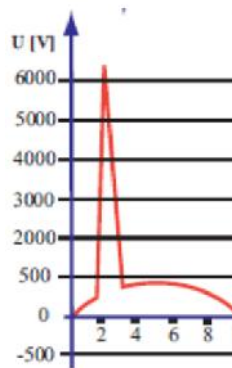


- MOV „cuts“ the voltage !

Active mode
Protecting

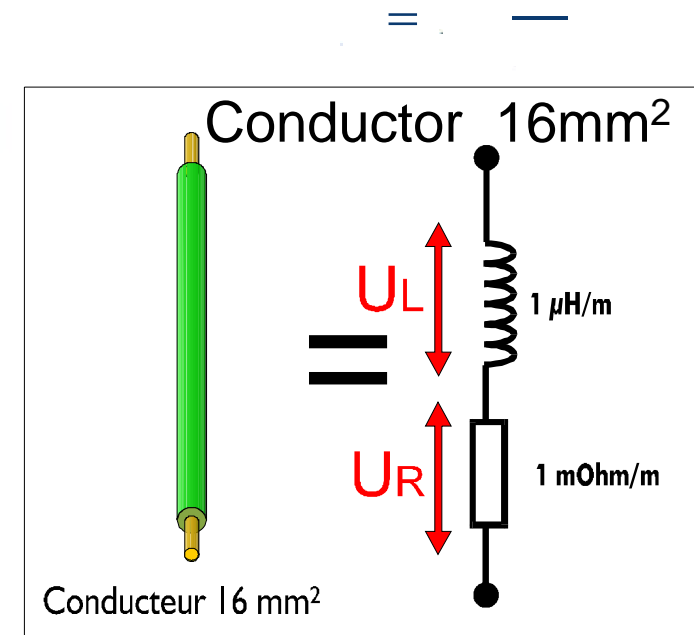
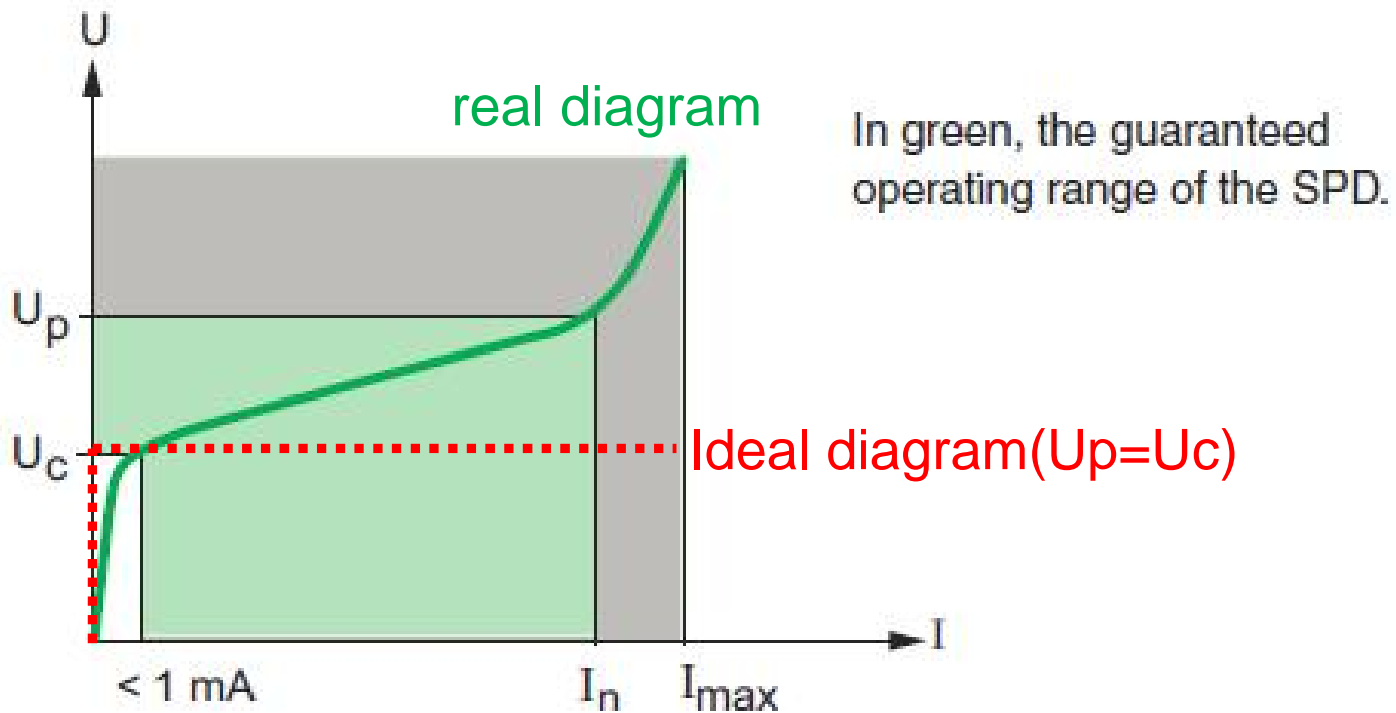


Varistor Volt-Ampere Chara



U_c maksimalni dozvoljeni radni napon

Up (voltage protection level)



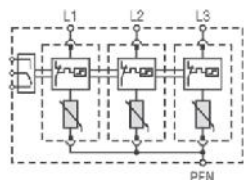
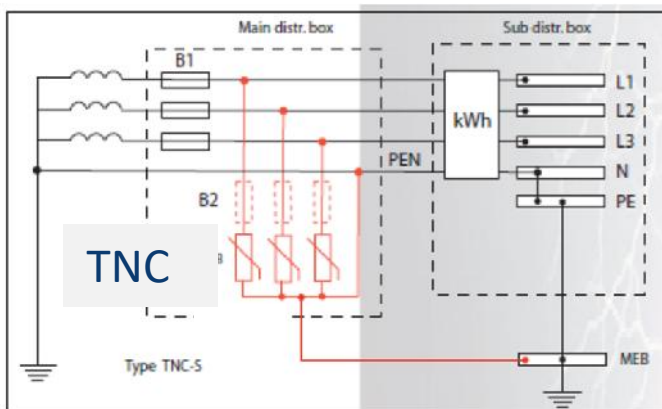
- U_p : remaining voltage on MOV at I_n (8/20)
- + induced voltage (U_L) due to wiring



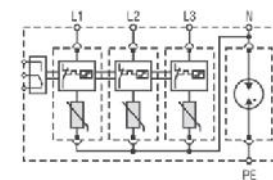
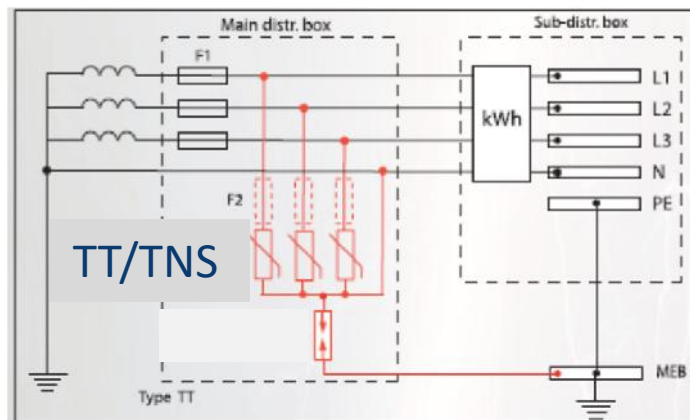
Osnovni SPD parametri

- $U_c[V]$ – maksimalni dozvoljeni radni napon
 - Nr. – broj polova(/mrežni sistem)
 - RC – daljinska signalizacija
 - Type1: $I_{imp}(10/350)$ [kA] 5x
 - Type2: $I_n(8/20)$ [kA] 15x, $I_{max}(8/20)$ [kA] 1x.
 - Type3: U_{oc}/I_{sc}
 - $U_p[kV]$ – voltage protection level
-
- IEC 61643-11:2011 (addons vs 2002): I_{sccr} [A] maksimalna struja kratkog spoja, U_t [V]:privremeni prenapon
 - T2 minimalni zahtjev po standardu = 5kA/pole.

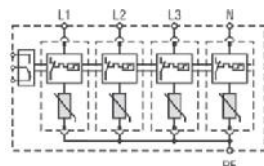
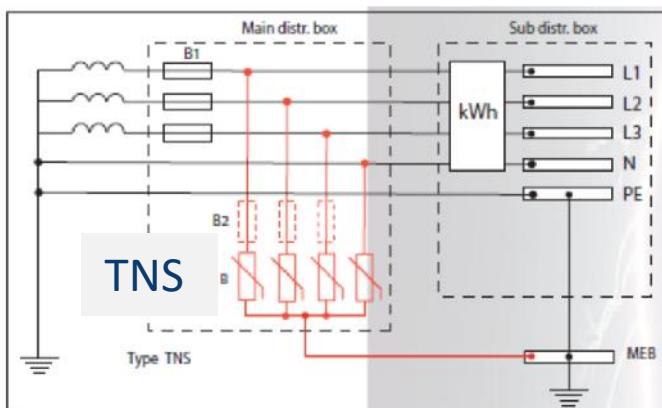
SPD priklju ak prema sistemu uzemljenja



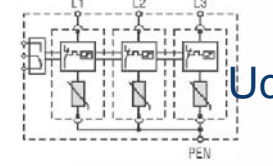
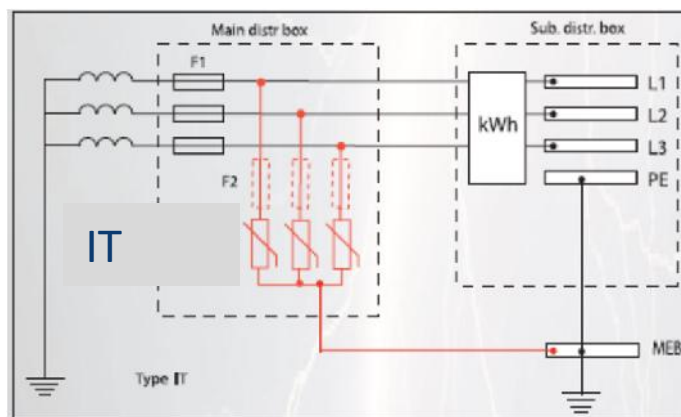
3+0 SPD
1+0 SPD



3+1 SPD
1+1 SPD



4+0 SPD
2+0 SPD



3+0 SPD
1+0 SPD

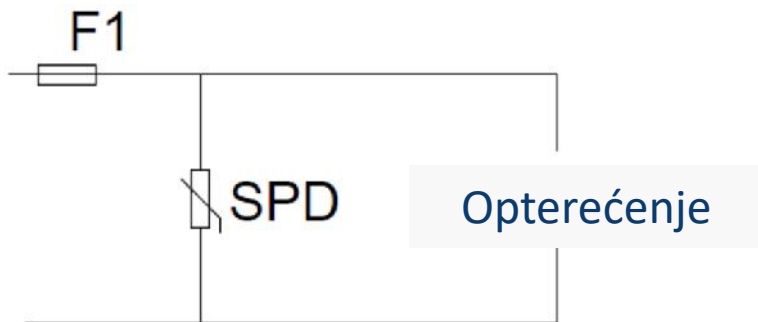
Uc=440V



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Predosigura ? prema glavnom osigura u

F1 max dozvoljeno (tehni ki podaci ili napisano sa strane SPD)



- F2 nepotreban

F1 > max dozvoljeno (tehni ki podaci ili napisano sa strane SPD)



- F2 mora izdržati prenaponsku struju, ali isklju iti kratki spoj.

Predosigura ? prema glavnom osigura u

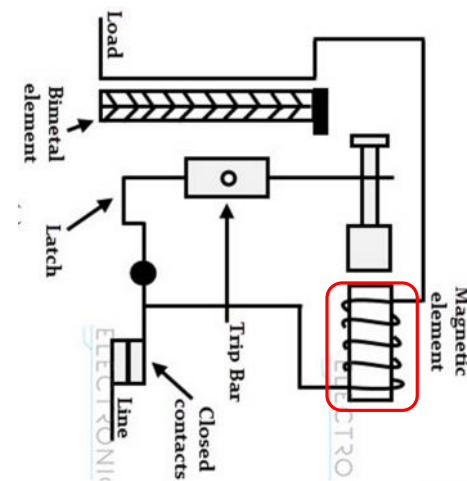
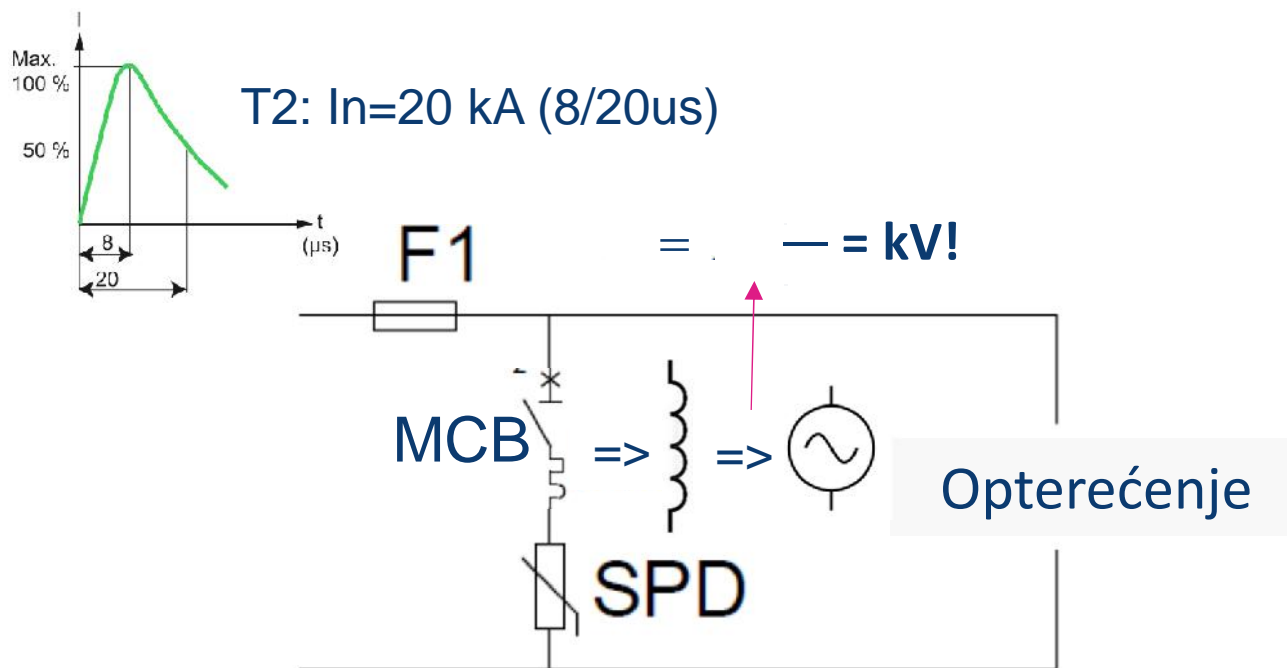
ETITEC ML T123		
Type	ETITEC ML T123 300/12,5 (1+0), (2+0), (3+0)	ETITEC ML T123 300/12,5 (1+1), (3+1)
In accordance with	IEC 61643-11:2011, EN 61643-11:2012+A11:2018	
Category IEC/EN/VDE	T1, T2, T3/I, II, III/B+C+D	
Nominal AC voltage (50/60Hz) U_n	240V	
Max. continuous operating voltage (AC) U_c	300 V (L-N)	300 V (L-N) / 305 (N-PE)
Impulse discharge current per pole (10/350) I_{imp}	12,5 kA	12,5 kA/50 kA
Nominal discharge current (8/20) I_n	20 kA	20 kA (L-N)/50 kA(N-PE)
Max. discharge current (8/20) I_{max}	40 kA	40 kA (L-N)/100 kA(N-PE)
TOV immunity U_T (AC)	337 V (L-N)/5s withstand	
	442V/120 min (L-N) safe fail	442V/120 min (L-N) Safe fail, 1200V (N-PE) withstand 200ms
Charge		
Voltage Protection level for Type2 / for Type 3 U_p	1500 V / 900V	1500 V / 900V (L-N)/(N-PE)
Open circuit voltage Type 3 test U_{oc}	6 kV	
Follow current I_n	-	100 A _{RMS} (N-PE)
Response time t_A	< 25 ns	<25 ns (L-N) / < 100 ns (N-PE)
Residual current I_{pe} at U_{ref}	< 0,3 mA	
Thermal decoupler	✓	
Torque	4,5 Nm	
Back-up fuse (if mains > 160A)	160 A gG	



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Automatski prekida ili Osigura T2 SPD In(8/20)

- Automatski prekida (MCB) kao Predosigura = generator napona !!!



unutar
automatskog
prekida a

Automatski prekida ili Osigura T1 SPD limp(10/350)

- T1 limp test 20kA (steps 0.1, 0.25...1x)
- Automatski prekida , neželjeno aktiviranje pri 5kA



C 125A



- SRF osigura (T1 or T2), NV ekvivalent :



CH22 FUSE

NV 315A

Asortiman AC odvodnika

- T1 ETITEC ML T123, V T12, WENT



- T2: ETITEC C T2, CMT23, V T2, V 2T2

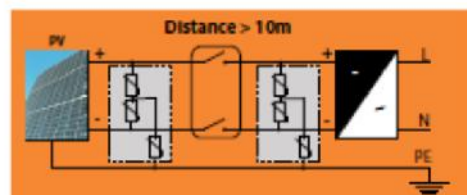
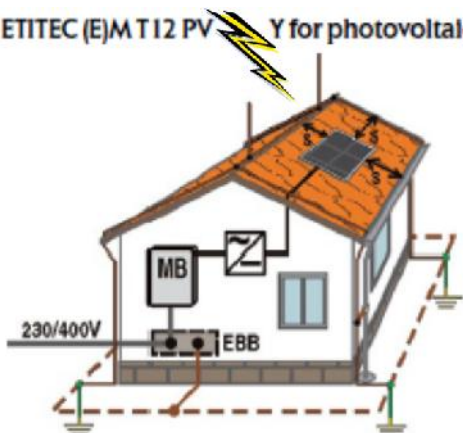


- T3: ETITEC D T3, V 2T3, FILT



SPD u Fotonaponskim sistemima

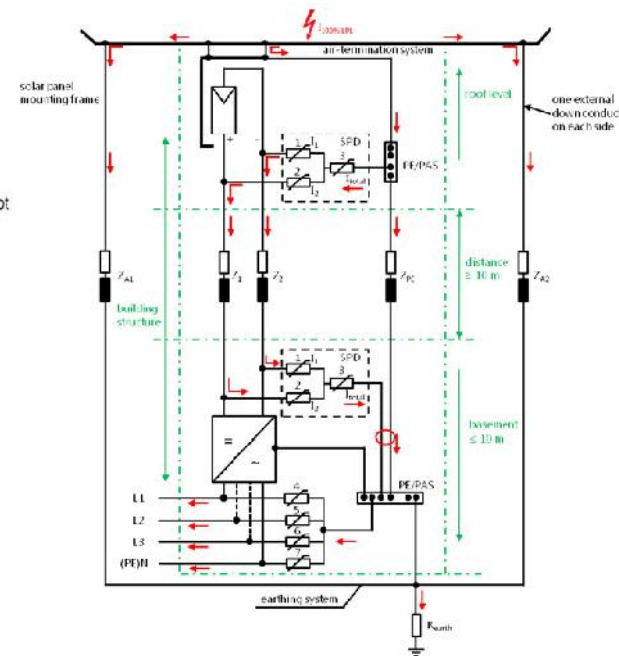
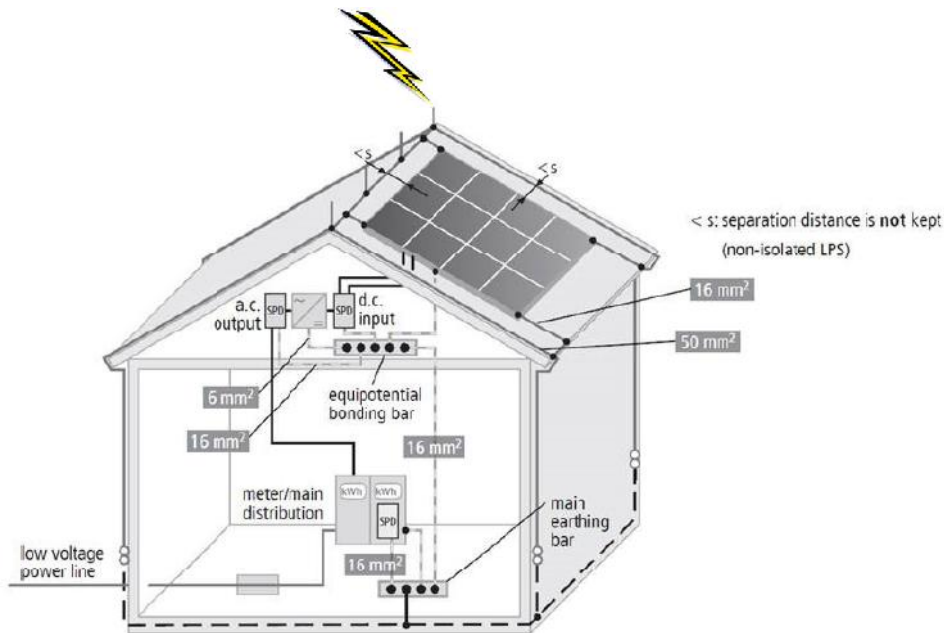
ETITEC (E)M T 12 PV Y for photovoltaic system on a building with External Lightning Protection



- Vanjska gromobranska zaštita -> direktni udar! -> T1 ili T12 potrebno!

SPD u Fotonaponskim sistemima

- Nedavne promjene u standardu IEC/EN 61643-32/50539-12



- Više veza sa uzemljenjem (svaki ugao ku e) sa manjom impendancom nego SPD -> manji $I_{imp}/pole$

SPD u Fotonaponskim sistemima

- Nedavne promjene u standardu IEC/EN 61643-32/50539-12

T1 minimalni zahtjevi :

a. Green field PV installation -> suitable ETITEC M T12 PV

LPL Lightning protection level 10/350		Voltage limiting SPD	
		I_{IMP}	I_{TOTAL}
III or IV	100 kA	5 kA	10 kA



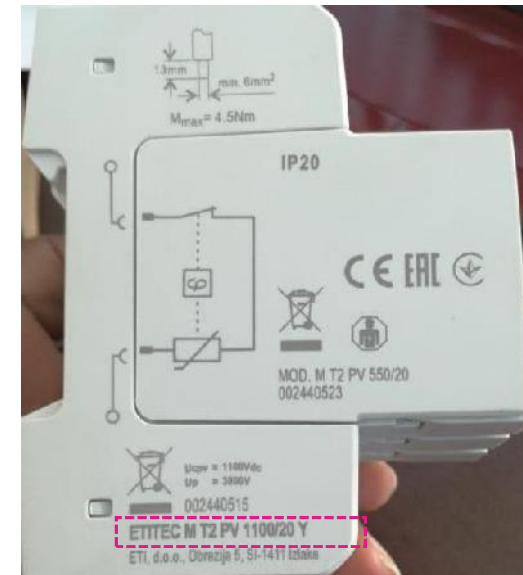
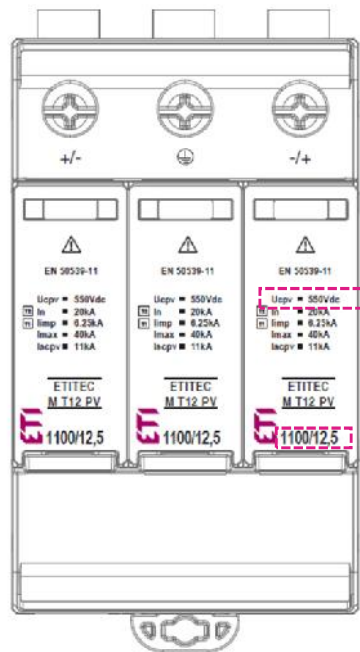
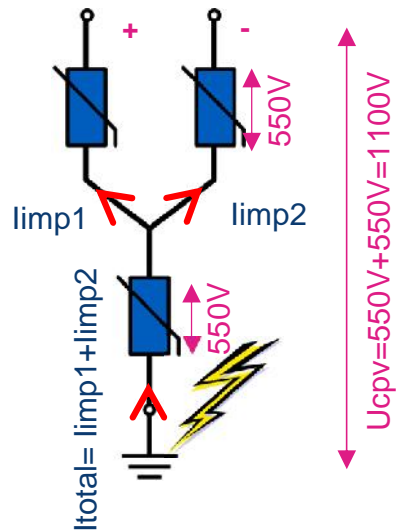
b. Roof PV installations -> suitable ETITEC EM T12 PV

LPL Lightning protection level 10/350		Number of external down-conductors			
		< 4		4	
		I_{IMP}	I_{TOTAL}	I_{IMP}	I_{TOTAL}
I	200 kA	10 kA	20 kA	5 kA	10 kA
II	150 kA	7,5 kA	15 kA	3,75 kA	7,5 kA
III	100 kA	5 kA	10 kA	2,5 kA	5 kA



SPD: Ucpv and Itotal

- Y connection: Itotal (T12) and Ucpv (T12 and T2)



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Asortiman PV odvodnika (IEC 61643-31:2018+A1:2014)

- T12 M series for PV field installations



ETITEC M T12 PV						
Type	Code No.	Max PV voltage U_{SP} [V DC]	I_{SP} [kA]	I_{max} (10/350) [kA]	I_{imp} [kA]	I_n [kA]
ETITEC M T12 PV 1100/12,5 Y	002440511	1100	11	12,5	6,25	20
ETITEC M T12 PV 1100/12,5 Y RC	002440512	1100	11	12,5	6,25	20
ETITEC M T12 PV 1500/12,5 Y	002440513	1500	30	12,5	6,25	20
ETITEC M T12 PV 1500/12,5 Y RC	002440514	1500	30	12,5	6,25	20



- T12 EM series for individual roof installations



ETITEC EM T12 PV						
Type	Code No.	Max PV voltage U_{SP} [V DC]	I_{SP} [kA]	I_{max} (10/350) [kA]	I_{imp} [kA]	I_n [kA]
ETITEC EM T12 PV 1100/6,25 Y	002440580	1100	11	6,25	6,25	20
ETITEC EM T12 PV 1100/6,25 Y RC	002440581	1100	11	6,25	6,25	20
ETITEC EM T12 PV 1500/5 Y	002440582	1500	11	5	5	20
ETITEC EM T12 PV 1500/5 Y RC	002440583	1500	11	5	5	20



T2: Added $U_c = 250V$ and $600V!$



ETITEC M T2 PV				
Type	Code No.	Max PV voltage U_{SP} [V DC]	I_{SP} [kA]	I_n/I_{max} [kA]
ETITEC M T2 PV 250/20 Y	002440732	250	6	20/50
ETITEC M T2 PV 250/20 Y RC	002440733	250	6	20/50
ETITEC M T2 PV 600/20 Y	002440735	600	6	20/50
ETITEC M T2 PV 600/20 Y RC	002440736	600	6	20/50
ETITEC M T2 PV 1100/20 Y	002440515	1100	11	20/40
ETITEC M T2 PV 1100/20 Y RC	002440516	1100	11	20/40
ETITEC M T2 PV 1500/20 Y	002440517	1500	11	20/30
ETITEC M T2 PV 1500/20 Y RC	002440518	1500	11	20/30



ETITEC EM T2 PV				
Type	Code No.	Max PV voltage U_{SP} [V DC]	I_{SP} [kA]	I_n/I_{max} [kA]
ETITEC EM T2 PV 1100/20 Y	002440623	1100	9	20/40
ETITEC EM T2 PV 1100/20 Y RC	002440624	1100	9	20/40
ETITEC EM T2 PV 1500/15 Y	002440625	1500	9	15/40
ETITEC EM T2 PV 1500/15 Y RC	002440626	1500	9	15/40



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SPD izbor Ucpv i Isc

1. Uocmax parametar (negativan koeficijent napona)

$$U_{OC\ MAX} = K_U U_{OC\ STC}$$

$$K_U = 1 + (\alpha U_{OC} / 100) (T_{min} - 25)$$

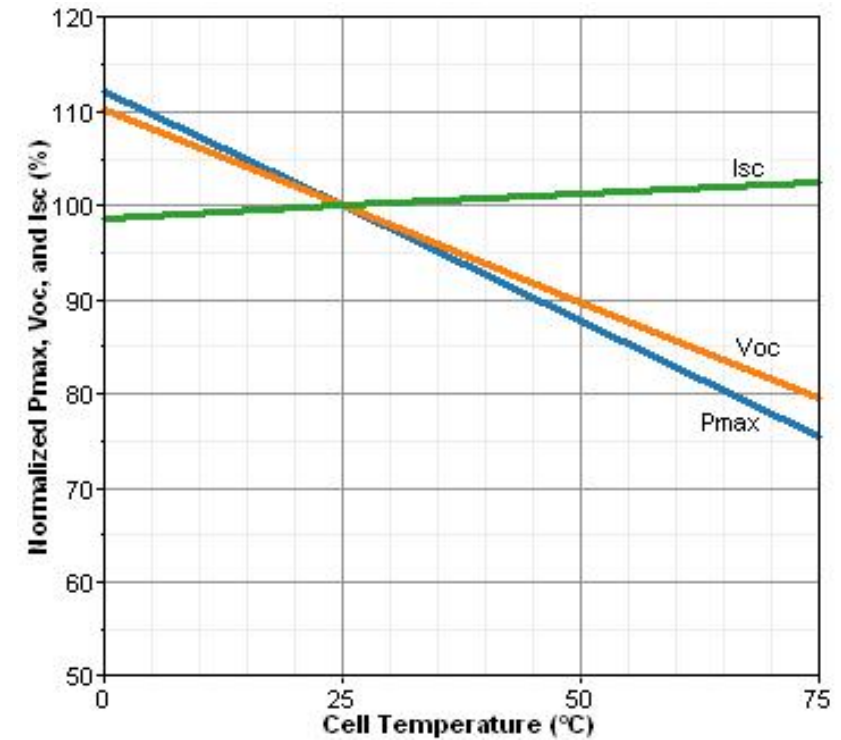
Example:

- Multicrystalline module, $U_{OC\ STC\ Module} = 38,3\ V$ and $\alpha U_{OC} = -133\ mV/^{\circ}C$ / $\alpha U_{OC} \rightarrow 0,35\ \%/^{\circ}C$
- $T_{min} = -15\ ^{\circ}C \rightarrow (T_{min} - 25) = -40\ ^{\circ}C \rightarrow K_U = 1,14 \rightarrow U_{OC\ MAX} = 1,14 U_{OC\ STC}$

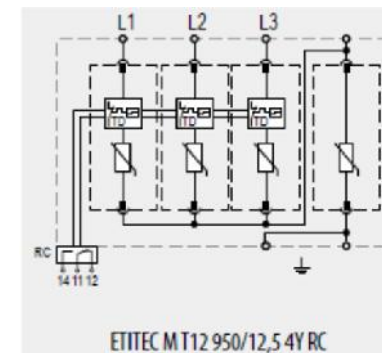
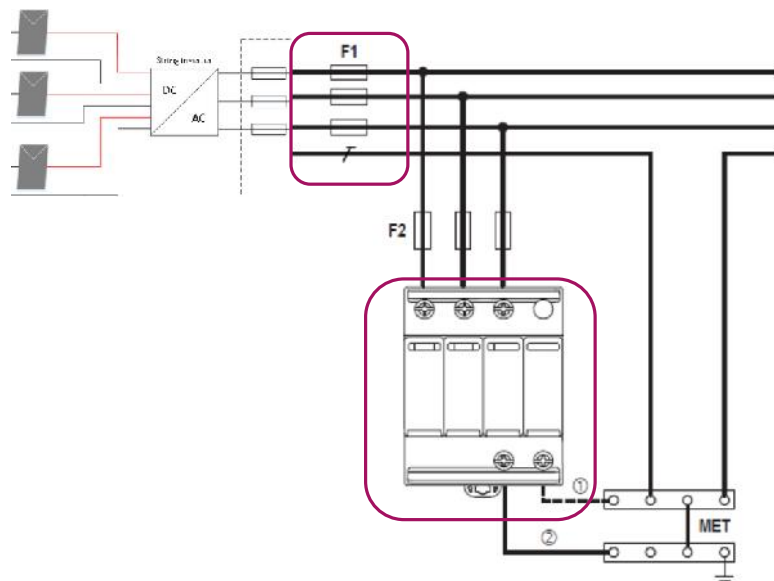
2. Iscmax

$$I_{SC\ MAX} = K_i I_{SC\ STC}$$

Minimum value for K_i is 1,25.



AC 800V, zaštita izlaza invertera - SPD



- **M T12** za direktnu i indirektnu zaštitu od udara

ETITEC M T12 950/12,5 4Y					
Type	Code No.	I_{imp} (10/350) [kA]	I_n/I_{max} (8/20) [kA]	U_c [V AC]	Network
ETITEC M T12 950/12,5 4Y	002440810	12,5	20 / 50	950	TNC / IT
ETITEC M T12 950/12,5 4Y RC	002440811	12,5	20 / 50	950	TNC / IT

- **M T2** za indirektnu zaštitu od udara

ETITEC M T2 950/20 4Y				
Type	Code No.	I_n/I_{max} (8/20) [kA]	U_c [V AC]	Network
ETITEC M T2 950/20 4Y	002440820	20 / 40	950	TNC / IT
ETITEC M T2 950/20 4Y RC	002440821	20 / 40	950	TNC / IT

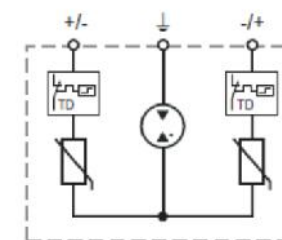


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SPD u DC INSTALACIJAMA

Overview:

- DC short-circuit conditions (risk of arcing) require different disconnection method
- SPDs compliant to **DC supplement** of **UL 1449** 5th edition as UL Listed Type 1 – can be used in any UL application without additional testing
- Compliance to upcoming **IEC 61643-41 DC SPD** standard
- 3 main voltage levels: 500VDC, 1000VDC and 1500VDC
- Configuration – unipolar and bipolar DC systems



002440726	ETITEC SM T12 DC 1000/12,5 Y
002440727	ETITEC SM T12 DC 1000/12,5 Y RC
002440728	ETITEC SM T2 DC 1000/20 Y
002440729	ETITEC SM T2 DC 1000/20 Y RC

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ETI ELEKTROELEMENT d.o.o.,
Obrezija 5, 1411 Izlake,
Slovenia, EU
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