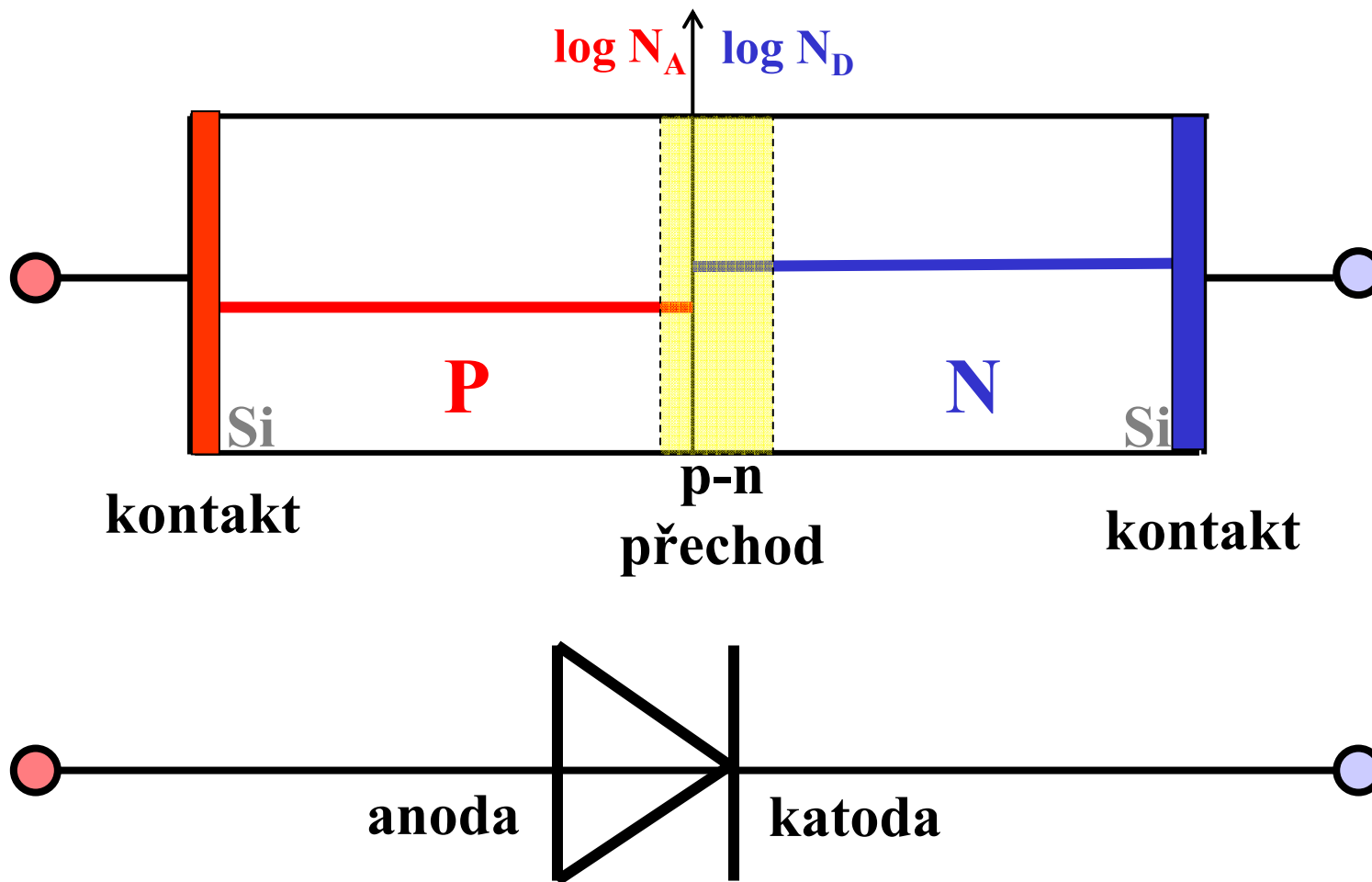


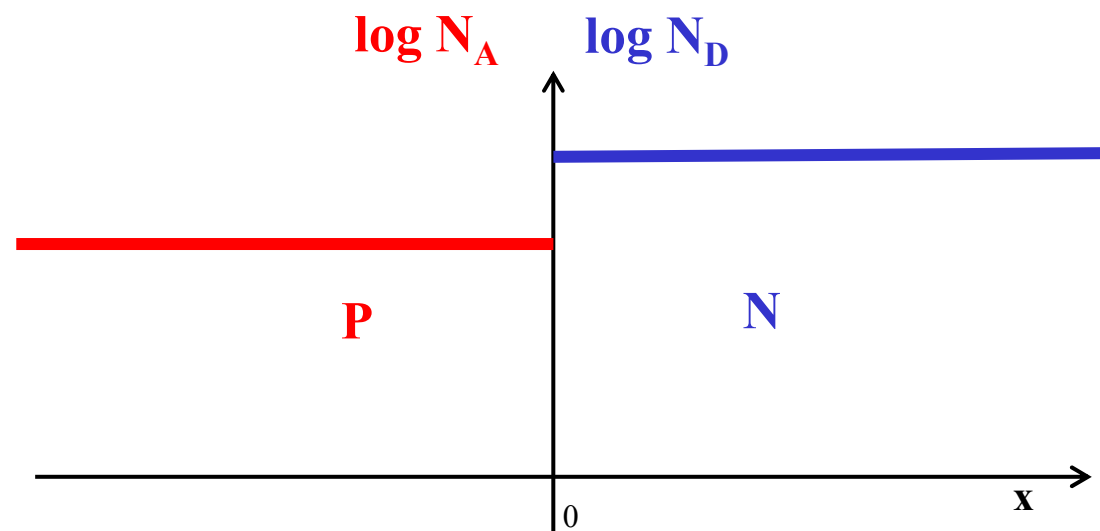
### 3. přednáška 2005

## p-n přechod (*p-n junction*)



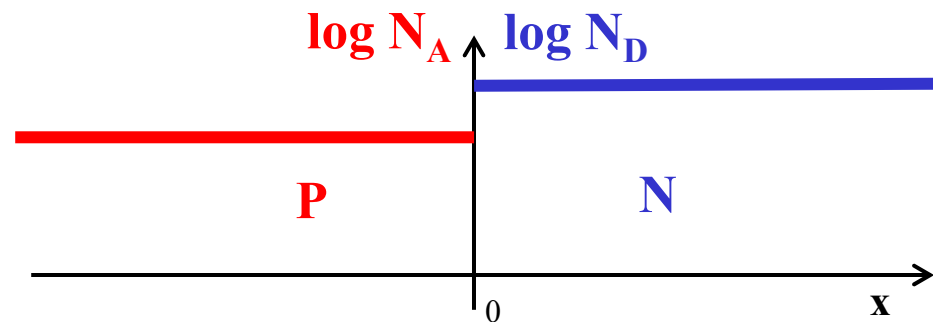
# p-n přechod (*p-n junction*)

Příměsi (*Doping*)



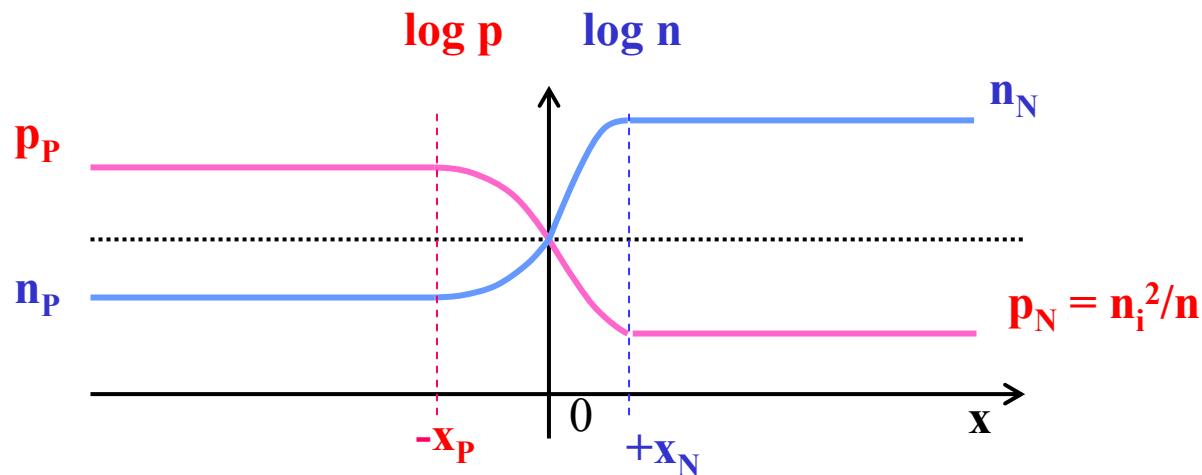
# p-n přechod

Příměsi (Doping)



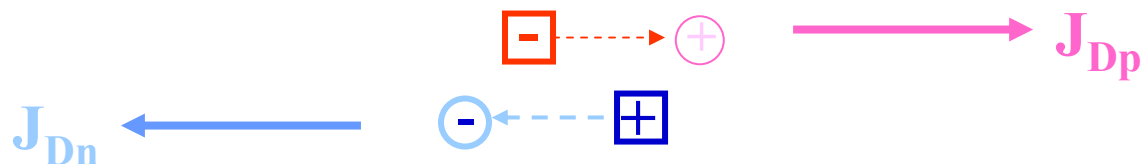
vázané v mřížce  
(nepohyblivé)

Volné nosiče



pohyblivé  
v mřížce

difúze

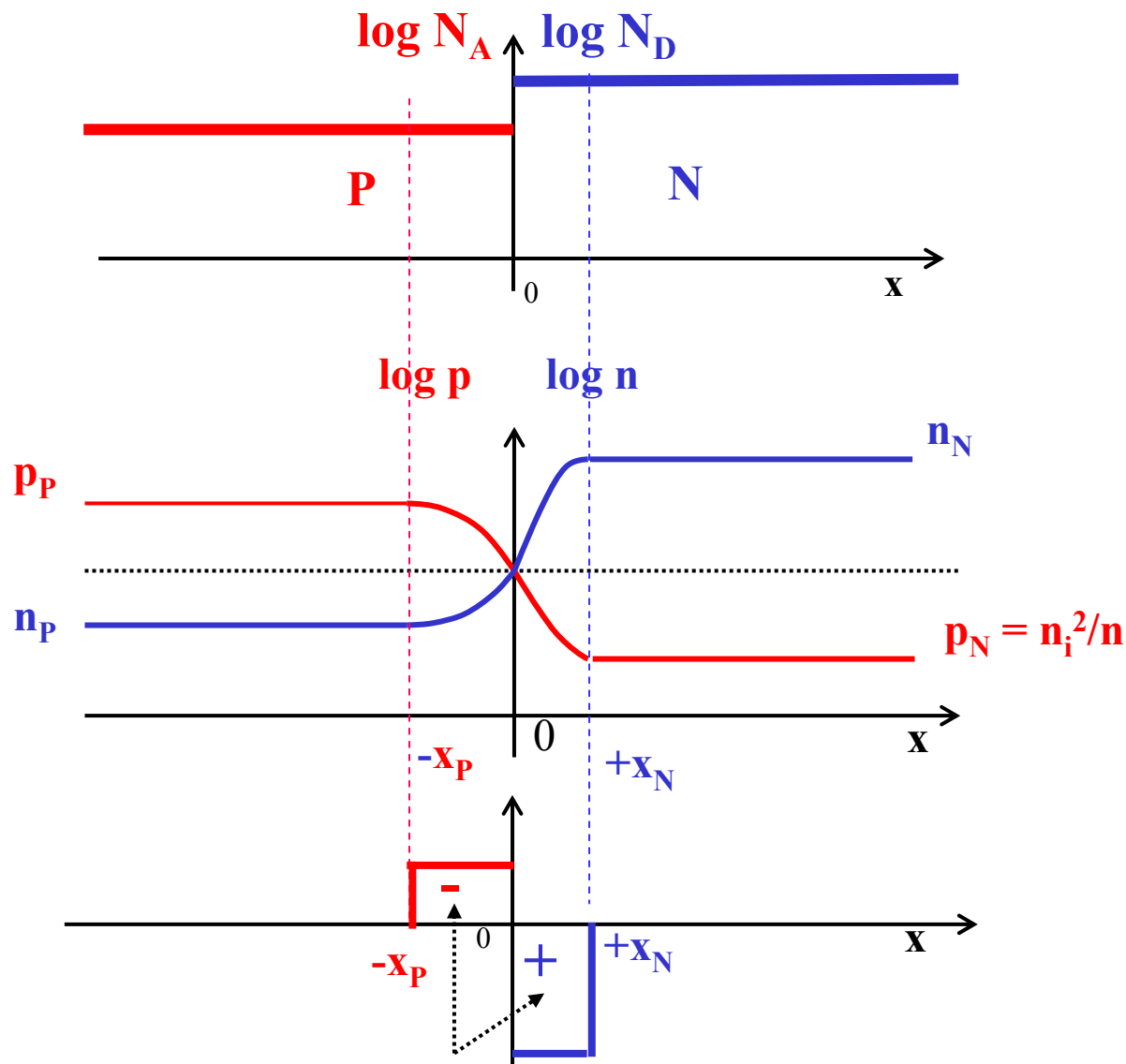


# p-n přechod

Vázaný náboj

Volné nosiče  
Free Carriers

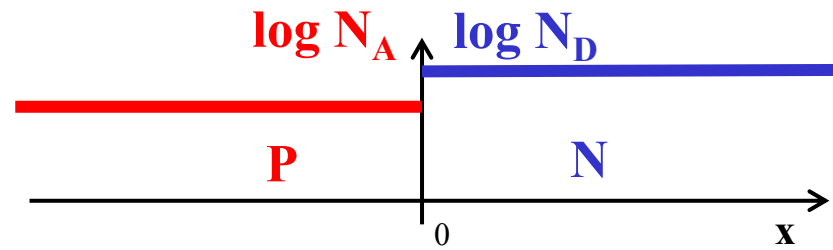
Příměsi (Doping)  
nepohyblivý  
nekompenzovaný



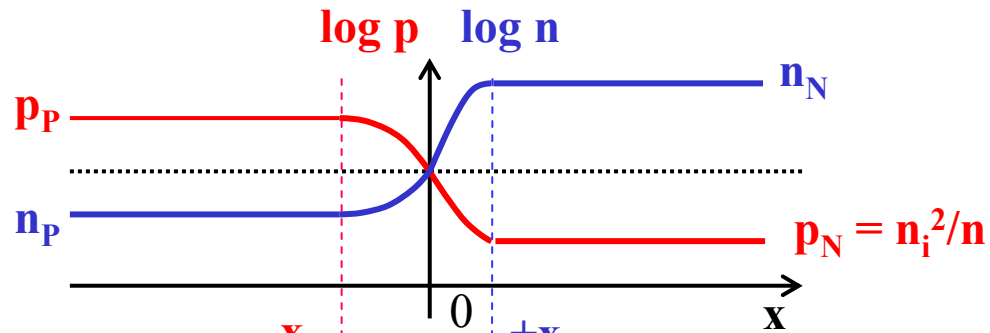
Oblast Prostorového Náboje - OPN

# p-n přechod

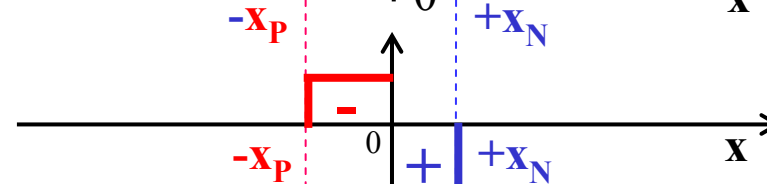
Příměsi (Doping)



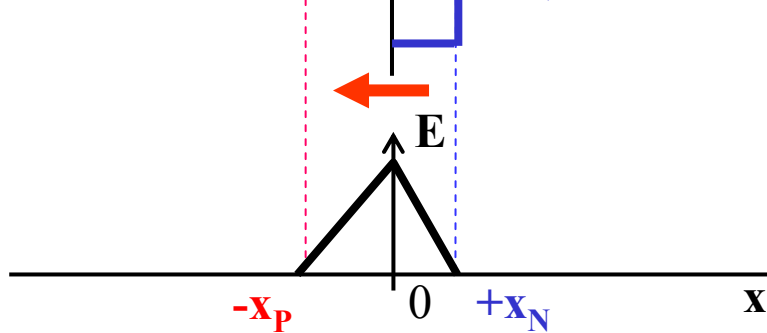
Volné nosiče



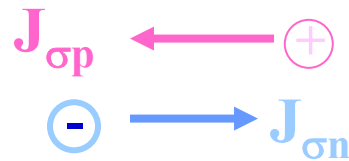
Vázaný náboj



Elektrické pole



drift

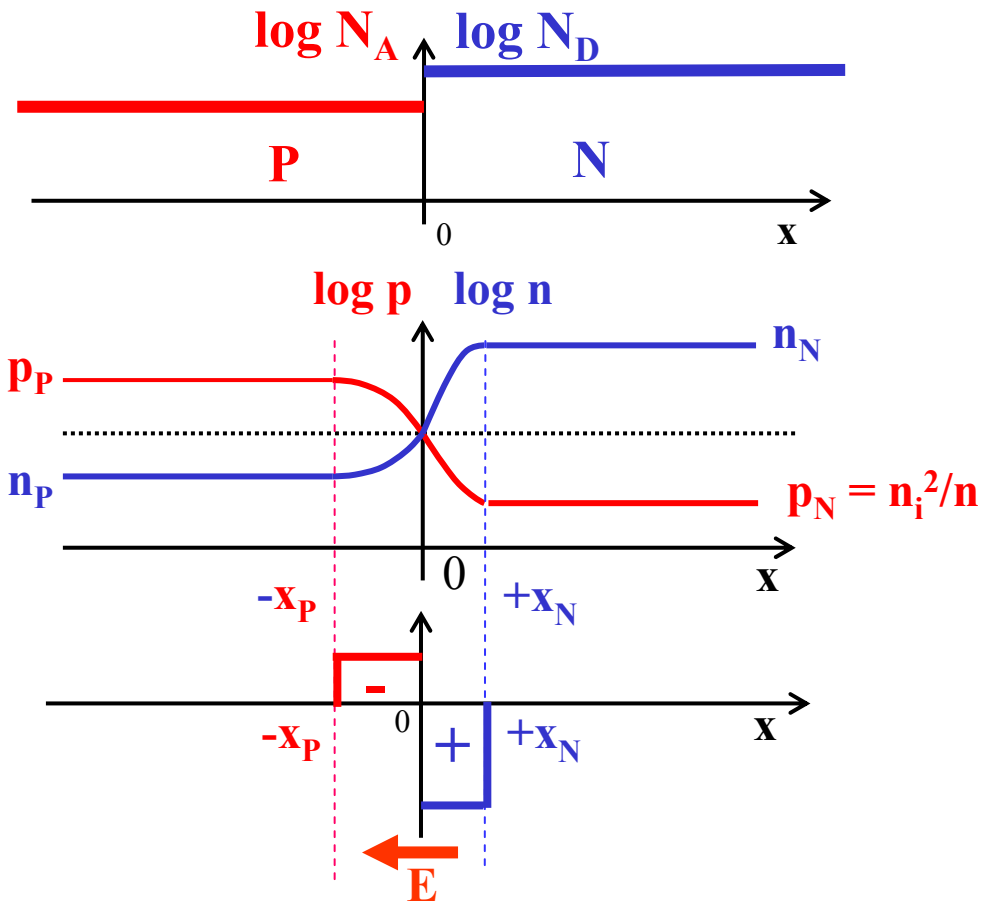


# p-n přechod

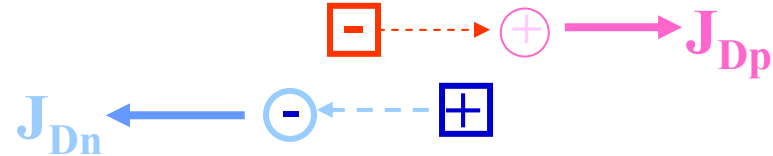
Příměsi (Doping)

Volné  
nosiče

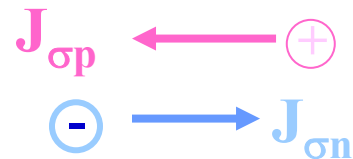
Vázaný  
náboj



difúze

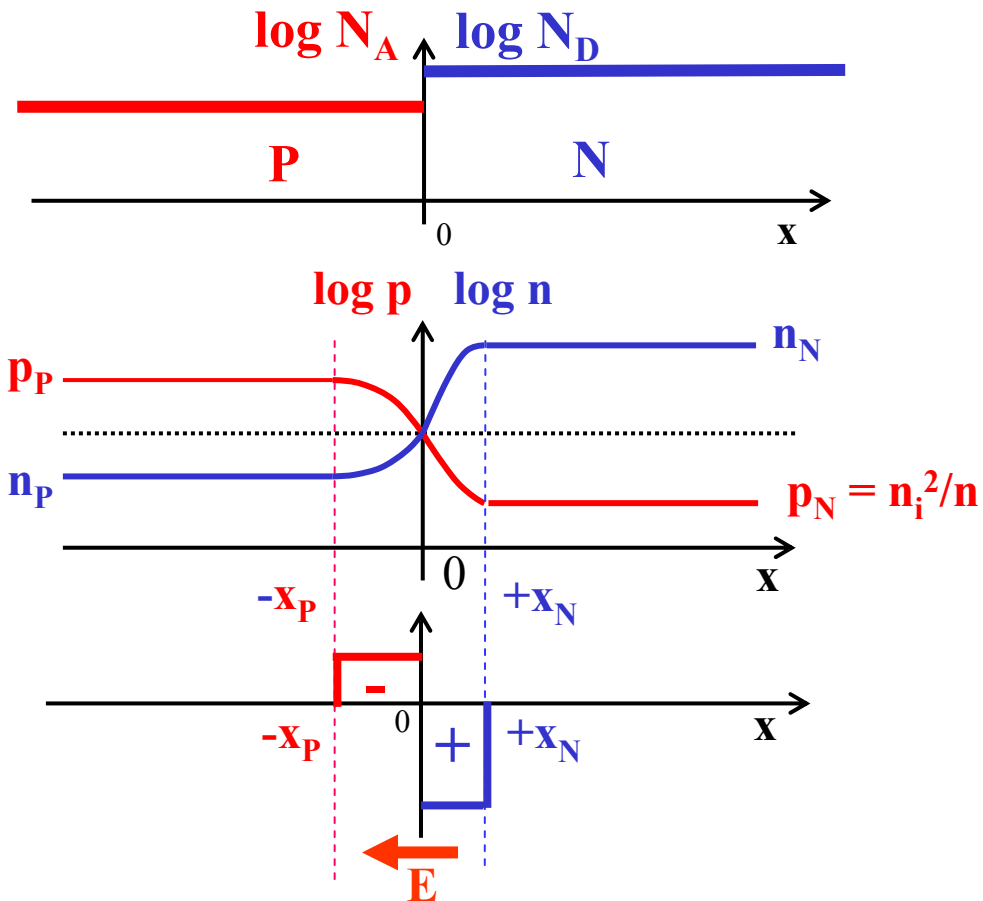


drift

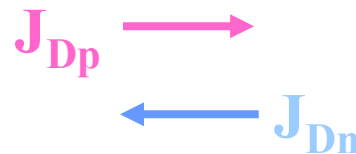


# Rovnováha na p-n přechodu

Příměsi (Doping)  
Volné nosiče  
Vázaný náboj

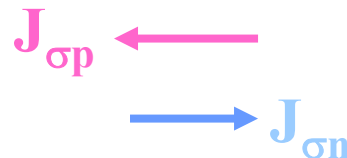


difúze



$$J_{Dp} = J_{\sigma p}$$

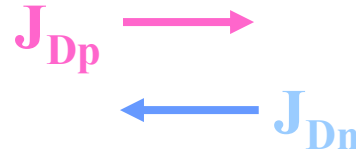
drift



$$J_{Dn} = J_{\sigma n}$$

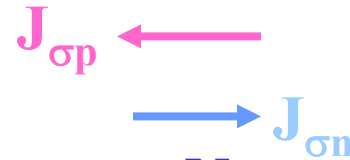
# Rovnováha na p-n přechodu

difúze

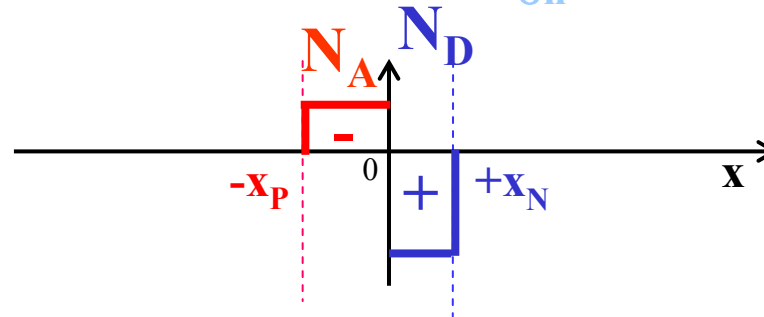


$$J_{Dp} = J_{\sigma p}$$

drift



$$J_{Dn} = J_{\sigma n}$$



Plošná hustota náboje dvojvrstvy OPN

$$N_A \cdot x_p = N_D \cdot x_n$$

**Nízká úroveň dotace  $\Rightarrow$  široká OPN**

**Vysoká úroveň dotace  $\Rightarrow$  úzká OPN**



Příměsi (*Doping*)

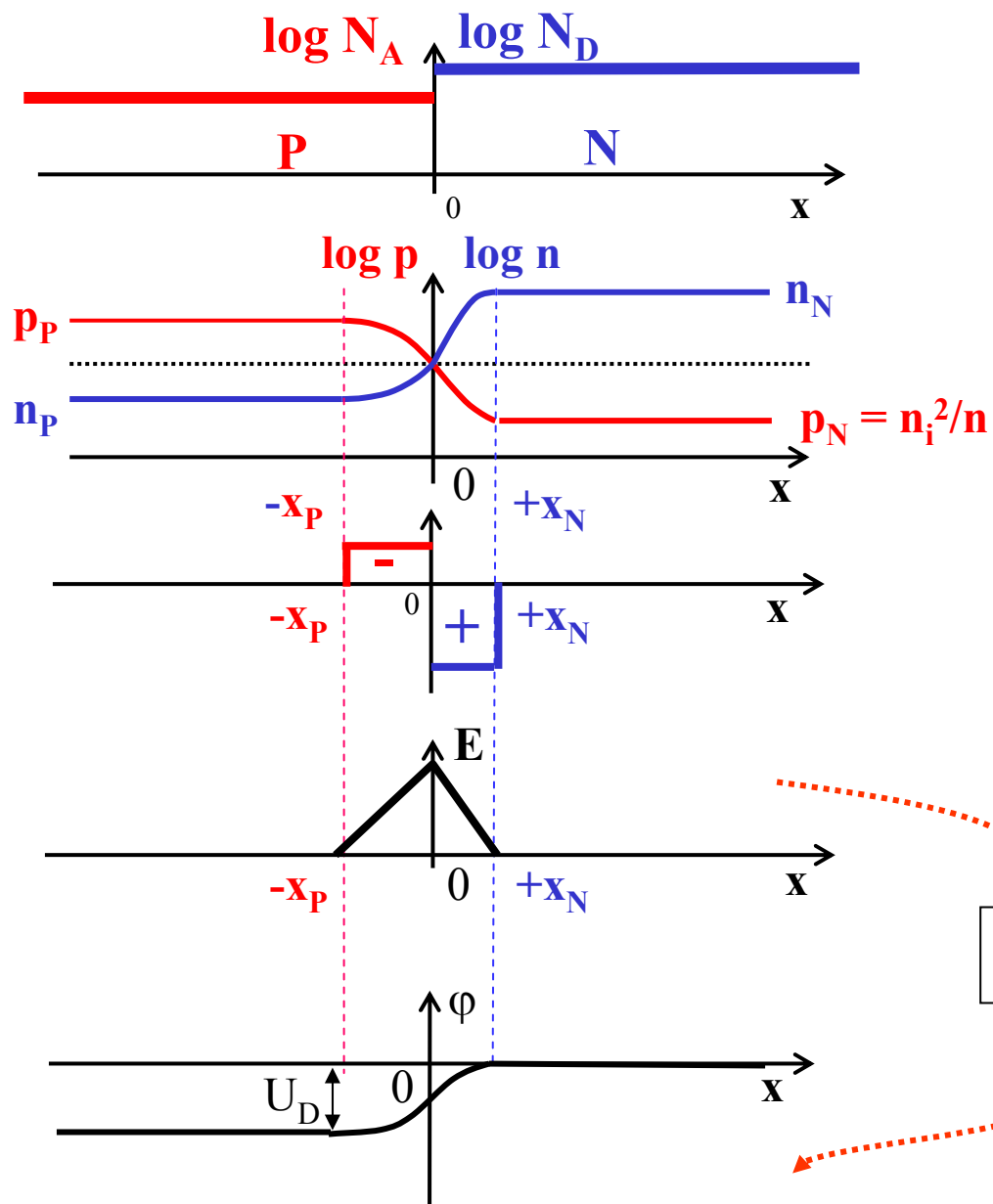
Volné nosiče

Vázaný náboj

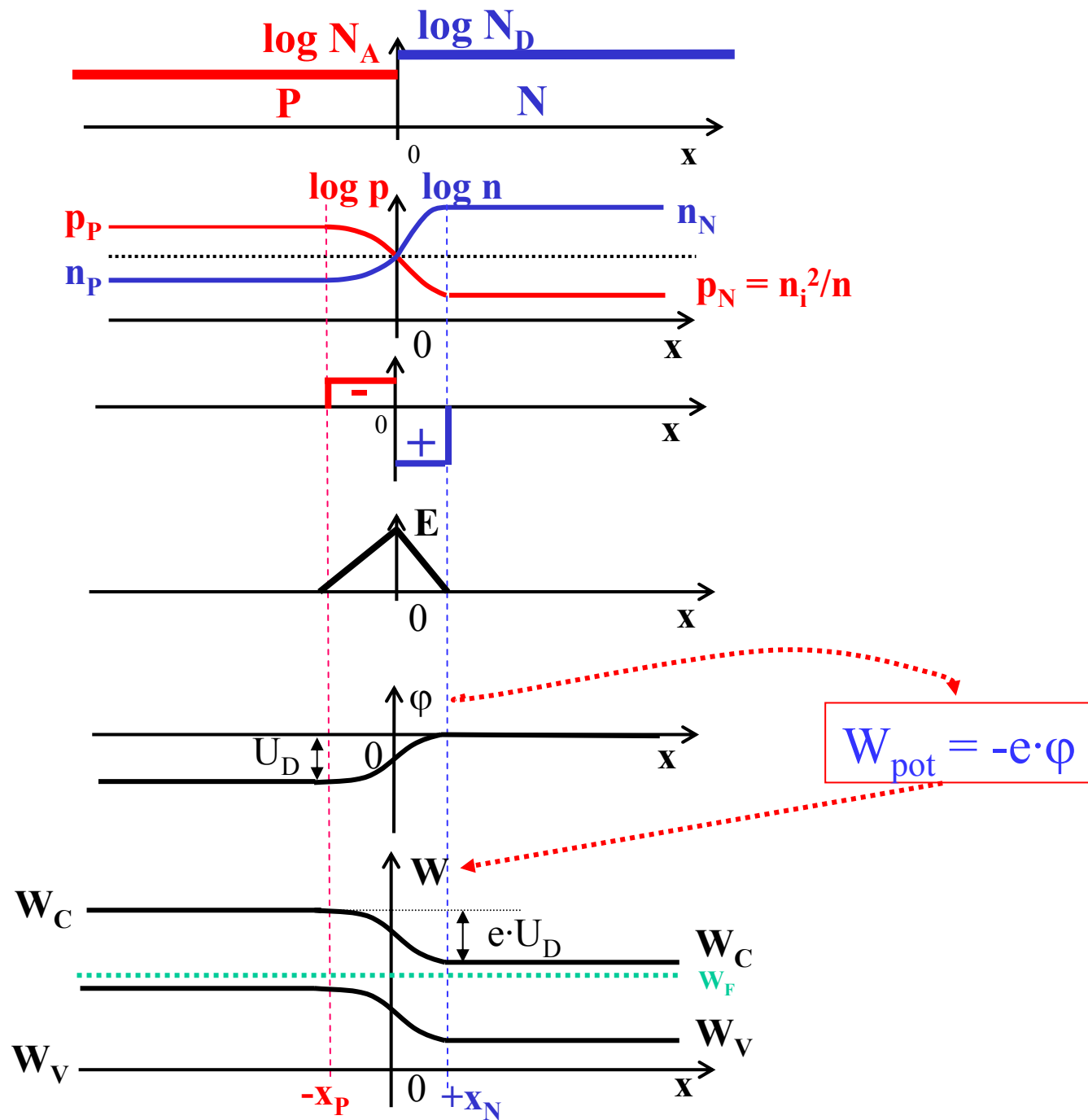
Elektrické pole

Potenciál

# p-n přechod

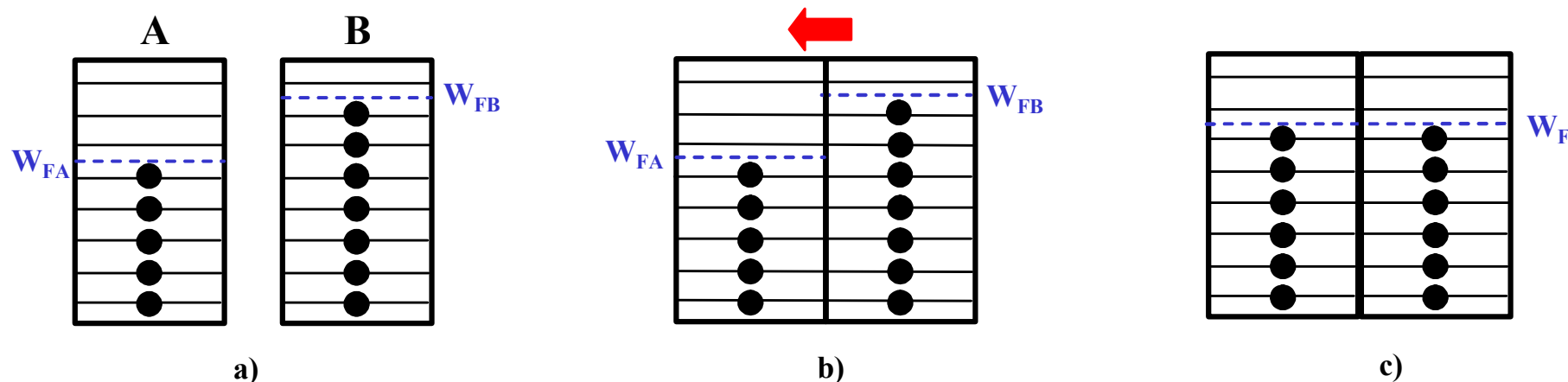


Vázaný náboj  
 Příměsi (*Doping*)  
 Volné nosiče  
 Elektrické pole  
 Potenciál  
 Energetický pásový diagram

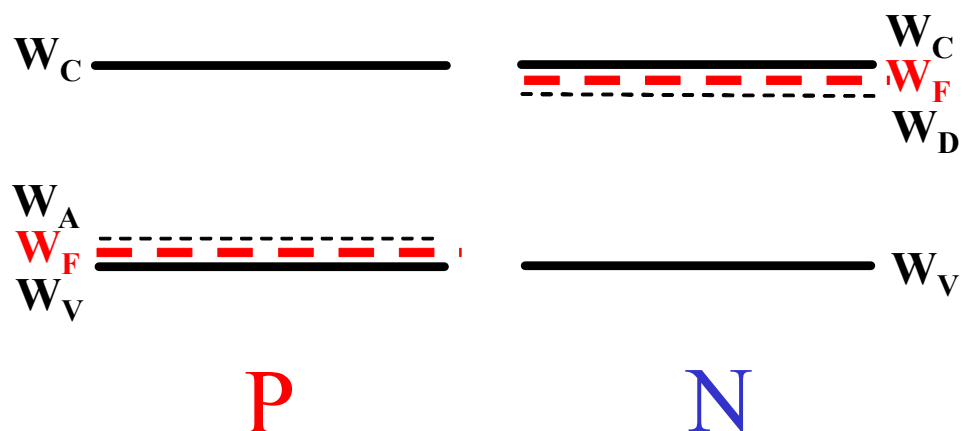


# Termodynamická rovnováha: $U=0V$ , $I=0A$

Elektrony v tepelné rovnováze s mřížkou, ve stavech s minimální energií.

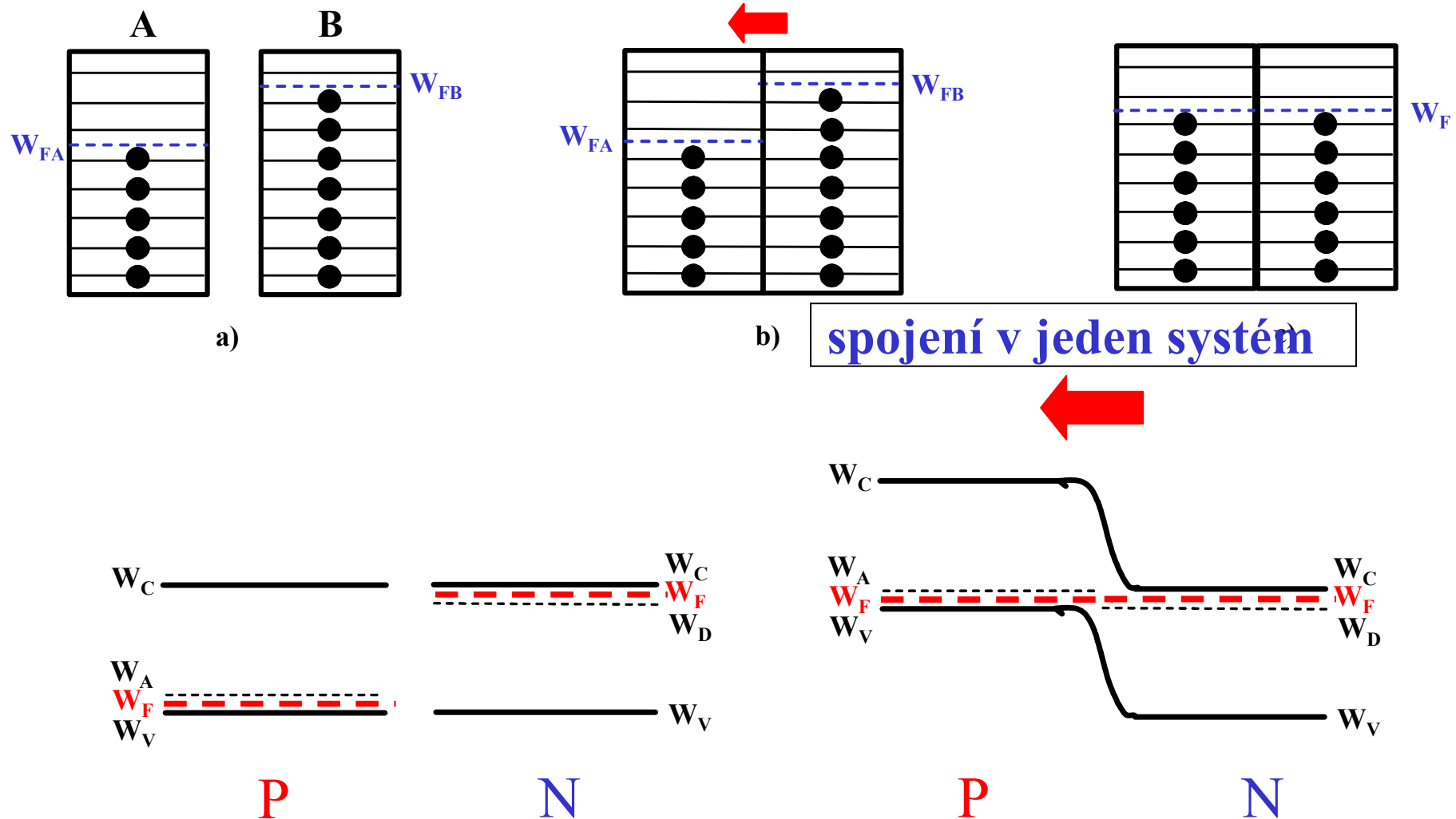


## 2 izolované systémy



# Termodynamická rovnováha: $U=0V$ , $I=0A$

Elektrony v tepelné rovnováze s mřížkou, ve stavech s minimální energií.

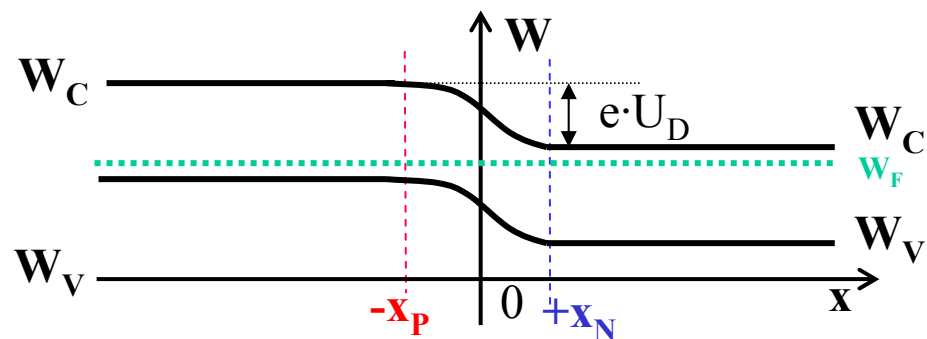


Rovnováha mezi difúzí a driftem volných nosičů nastane po vyrovnnání  $W_F$  (nejvýše obsazený energetický stav je v celém objemu totožný).

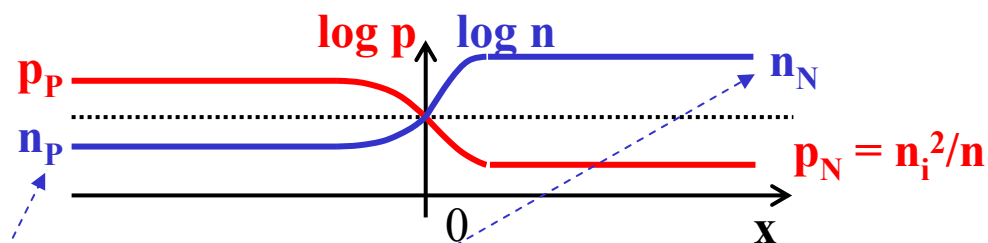
## Energetická bariéra $e \cdot U_D$ na p-n přechodu

$$U_D = \frac{kT}{e} \cdot \ln\left(\frac{N_D \cdot N_A}{n_i^2}\right) = \frac{kT}{e} \cdot \ln\left(\frac{n_{N0}}{n_{P0}}\right) = \frac{kT}{e} \cdot \ln\left(\frac{p_{P0}}{p_{N0}}\right)$$

Energetický  
pásový  
diagram



Volné  
nosiče



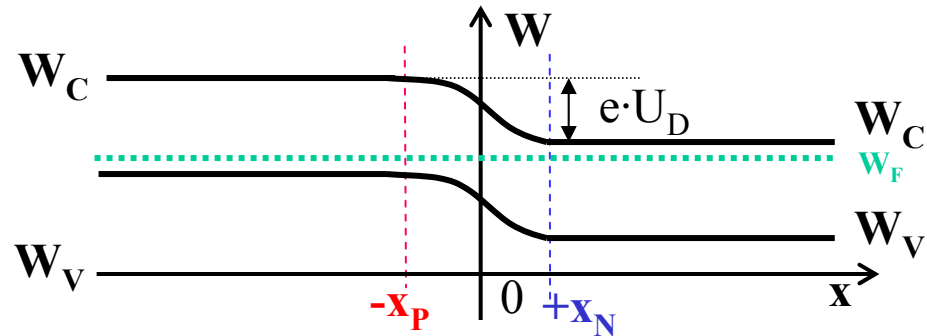
$$n_P = n_N \cdot \exp\left(\frac{-e \cdot U_D}{kT}\right) \Rightarrow n_P \ll n_N$$

Boltzmann factor

Bariéra udržuje velký koncentrační rozdíl mezi oblastmi P a N.

## Difúzní napětí (*Built-in voltage*)

Energetický  
pásový  
diagram



$$U_D = \frac{kT}{e} \cdot \ln\left(\frac{N_D \cdot N_A}{n_i^2}\right) = \frac{kT}{e} \cdot \ln\left(\frac{n_{N0}}{n_{P0}}\right) = \frac{kT}{e} \cdot \ln\left(\frac{p_{P0}}{p_{N0}}\right)$$

Teplotní napětí:  $kT/e \approx 26\text{mV}$  @  $T = 300\text{K}$

$$U_D \approx 0.7 \text{ V @ Si @ } T = 300\text{K}$$

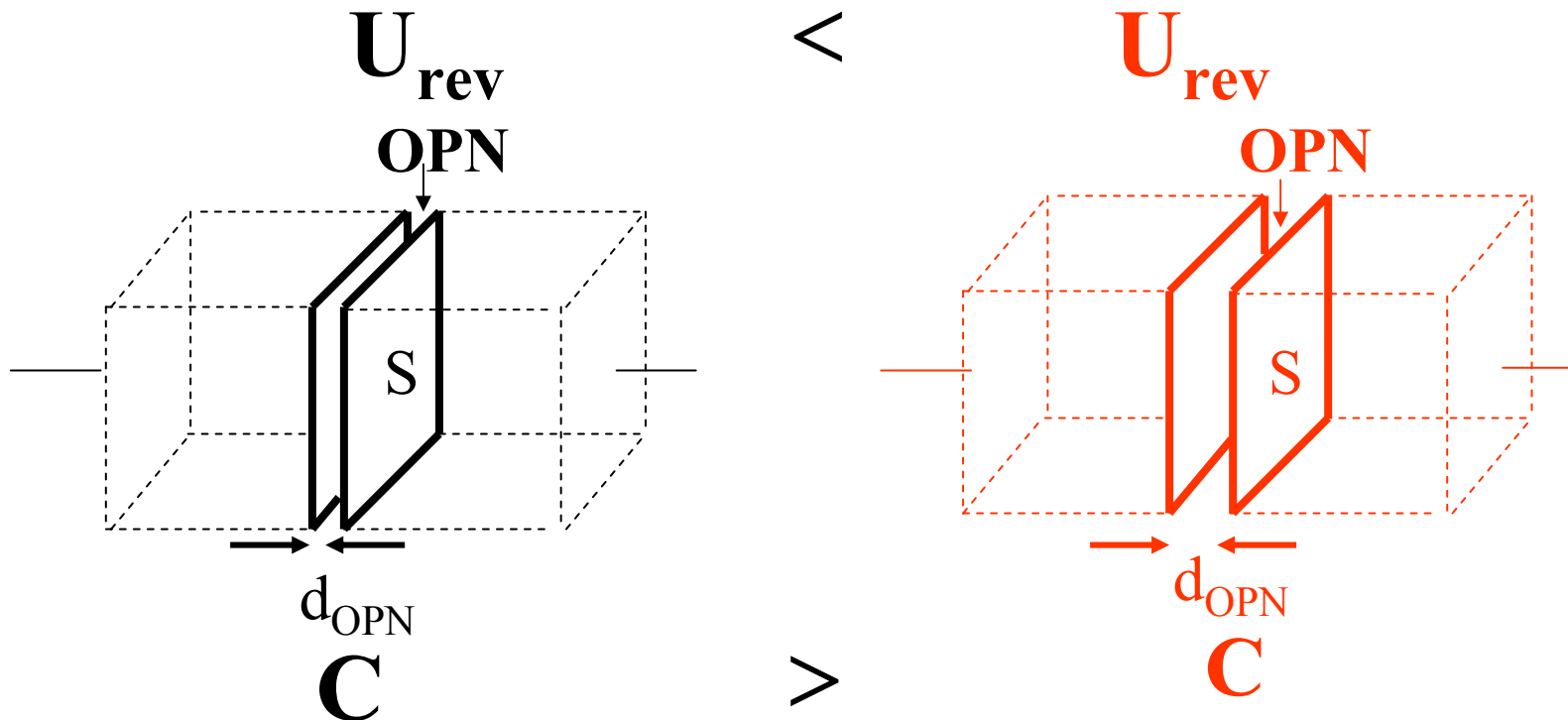
$$U_D \approx 0.25 \text{ V @ Ge @ } T = 300\text{K}$$

# Praktické využití kapacity OPN p-n přechodu

## Varikap (*Variable capacitor*) kapacitní dioda

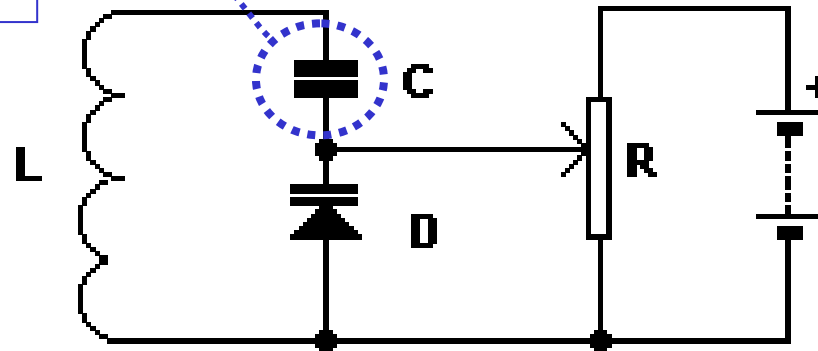
$$C = \varepsilon_r \cdot \varepsilon_0 \cdot S / d_{\text{OPN}} \quad d_{\text{OPN}} = f(U_{\text{rev}}) \Rightarrow C = f(U_{\text{rev}})$$

nastaveno dotačným profilem



brání ~ zkratu L  
zdrojem napětí

# Varikap




Philips Semiconductors

Varicap diodes

Selection guide

VARICAP DIODES (continued)

TV/SATELLITE VARICAP DIODES

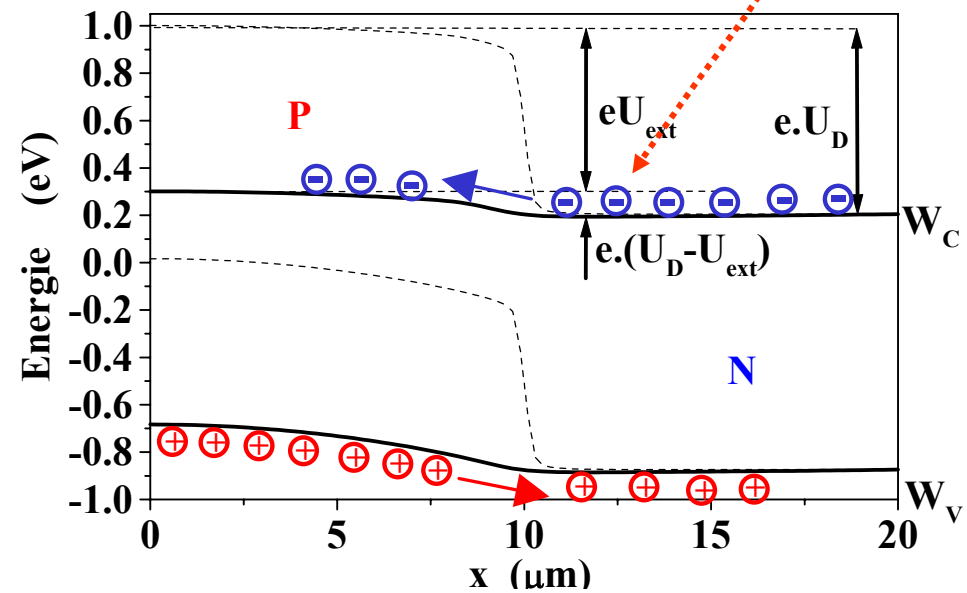
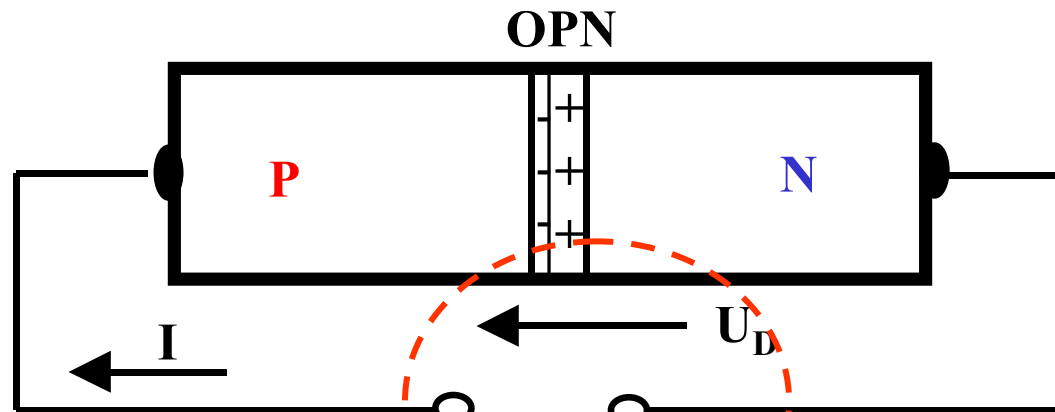
TYPE NUMBER	C <sub>d</sub> @ V <sub>R</sub>		TUNING RANGE			r <sub>s</sub> max.	MATCHED SETS	DOUBLE DIODE	PACKAGE (not to scale)
			C <sub>d</sub> over voltage range						
	ratio	V <sub>1</sub>	to V <sub>2</sub>	(Ω)	(%)				
	(pF)	(V)		(V)	(V)				
VHF tuning									
BB809	4.7	28	9	1	28	0.6	3	no	 SOD68 (DO34)
BB909A	>2.6	28	13.5	1	28	0.9	2.5	no	
BB909B	>2.8	28	13.5	1	28	0.9	2.5	no	
BB910	2.5	28	16	0.5	28	1	2.5	no	
BB911/A	2.7	28	25	0.5	28	2	2.5	no	



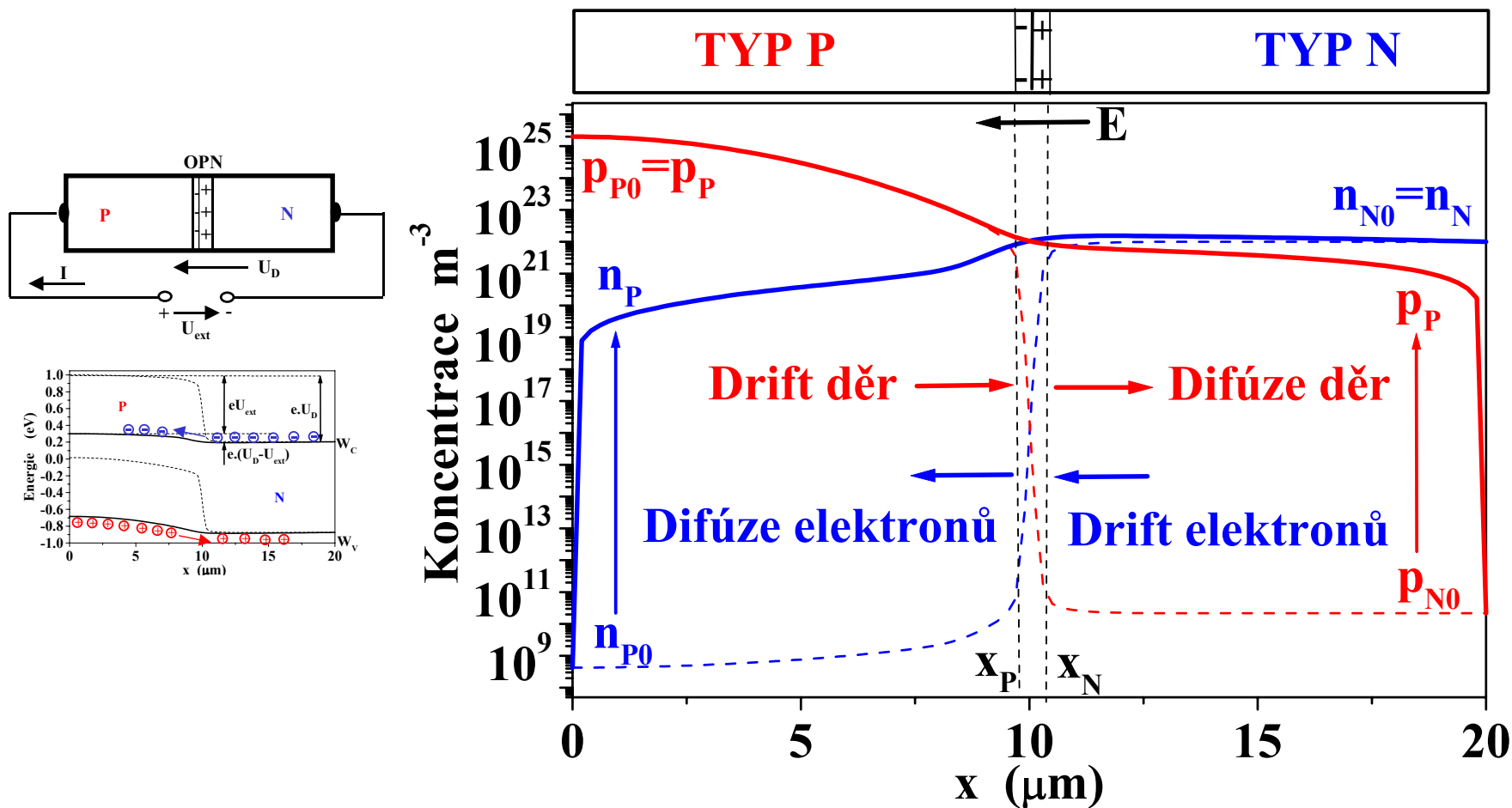
# p-n přechod

## s přiloženým vnějším napětím

## Propustný směr – *Forward Direction*



# Propustný směr – *Forward Direction*



elektrony:

difúze

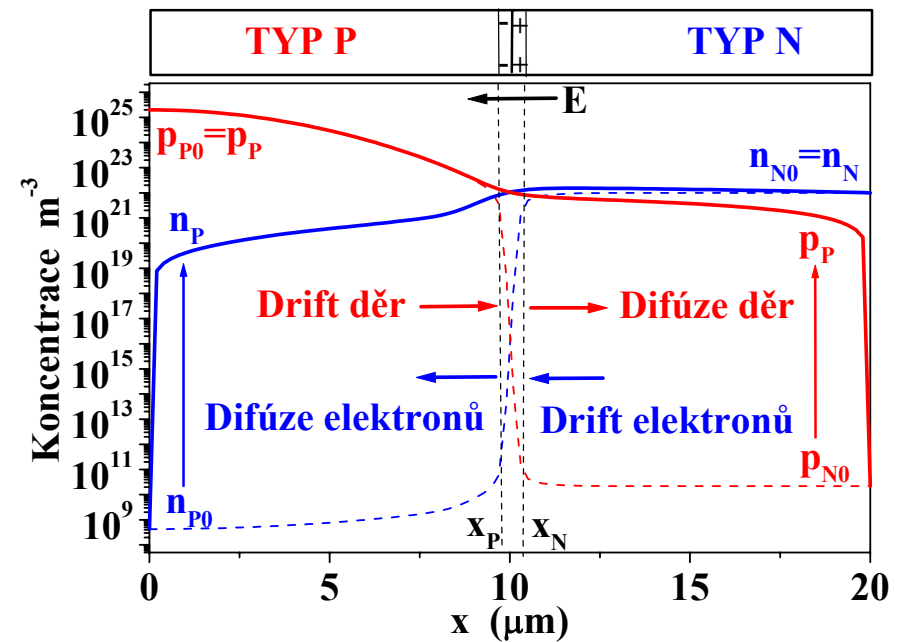
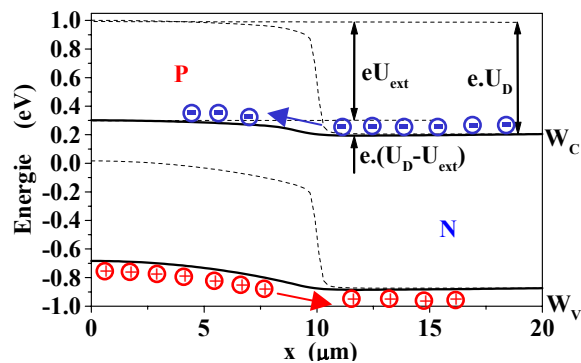
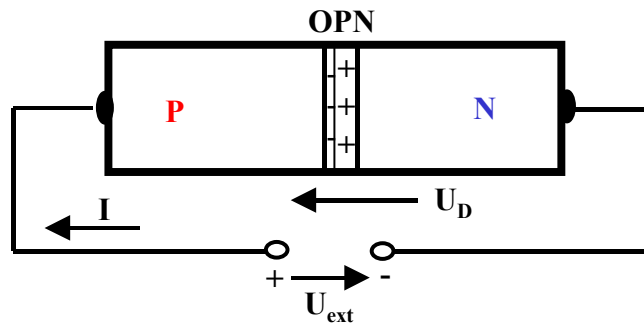


injekce

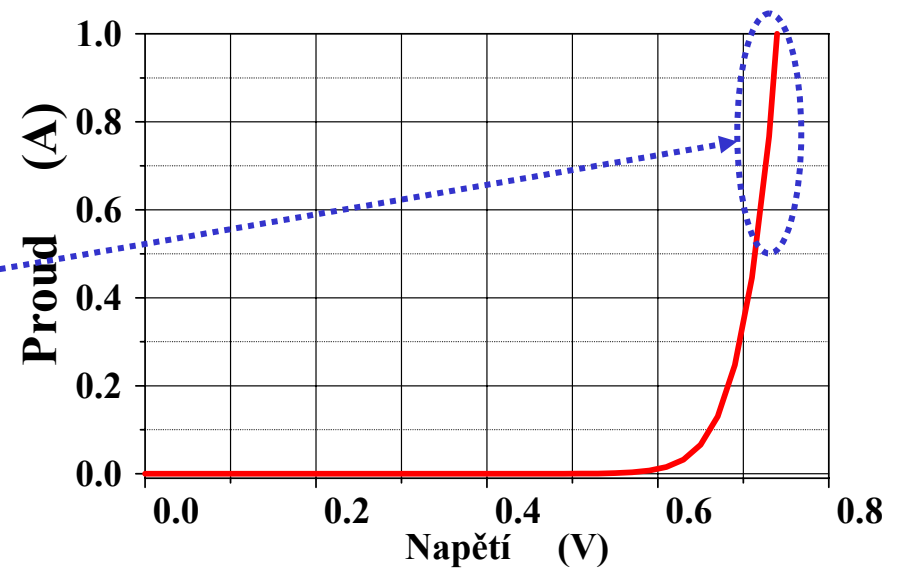


drift

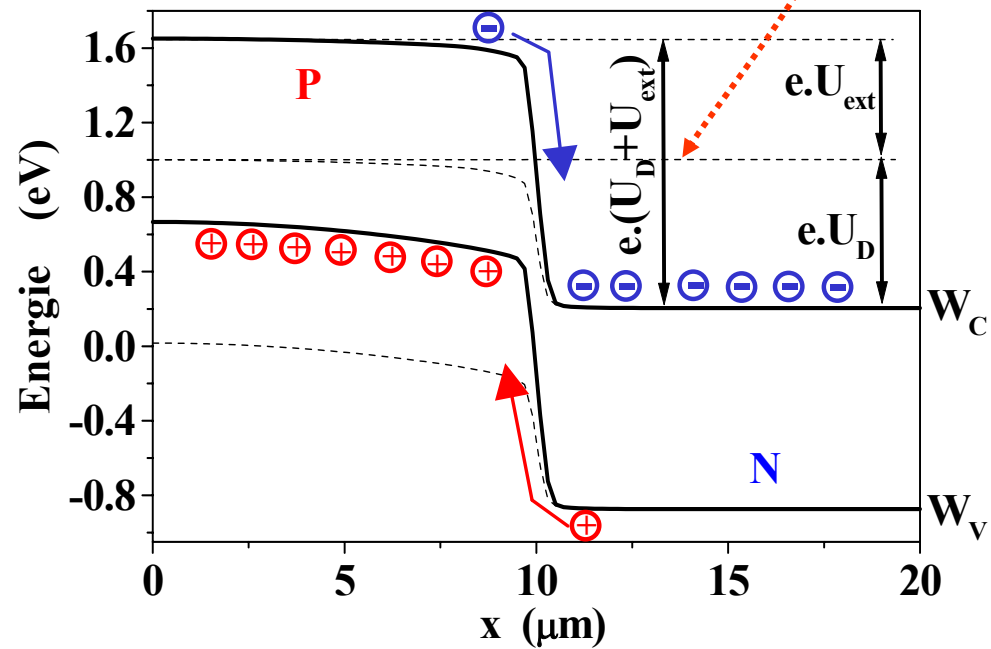
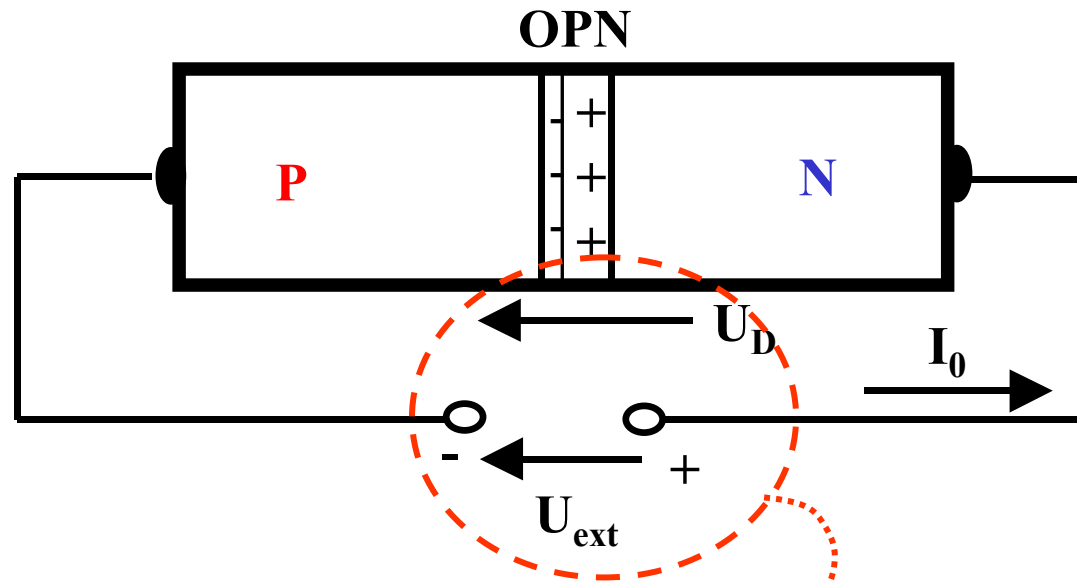
## Propustný směr – *Forward Direction*



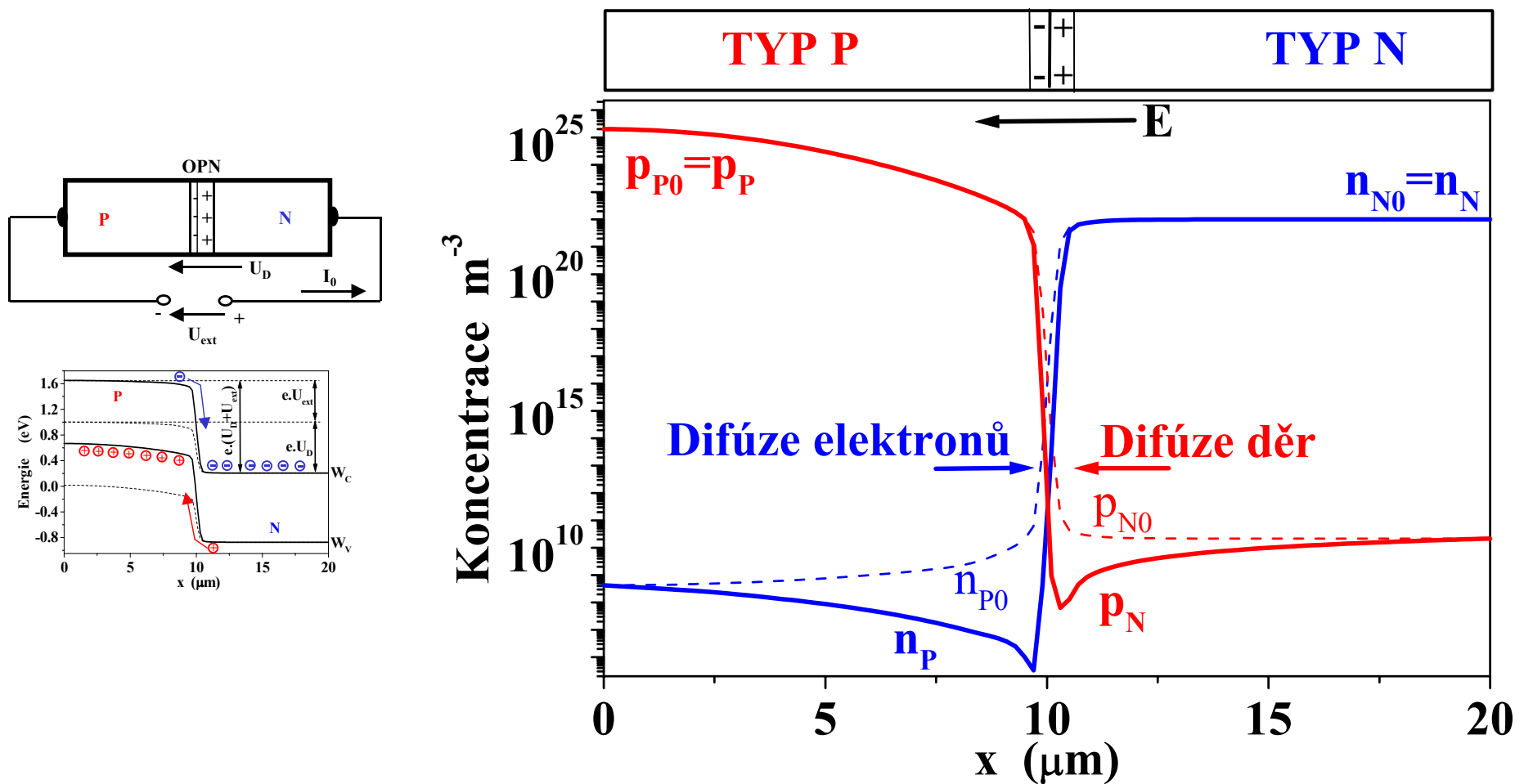
Při propustné polarizaci p-n  
přechodu protéká  
velká hodnota proudu.



## Závěrný směr – *Reverse Direction*



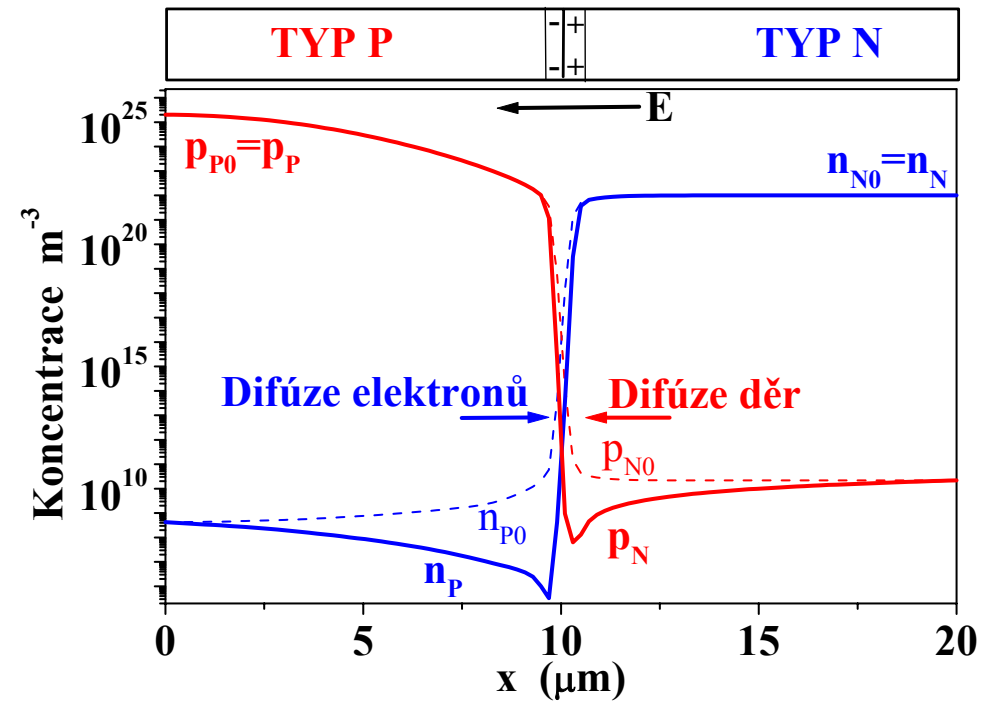
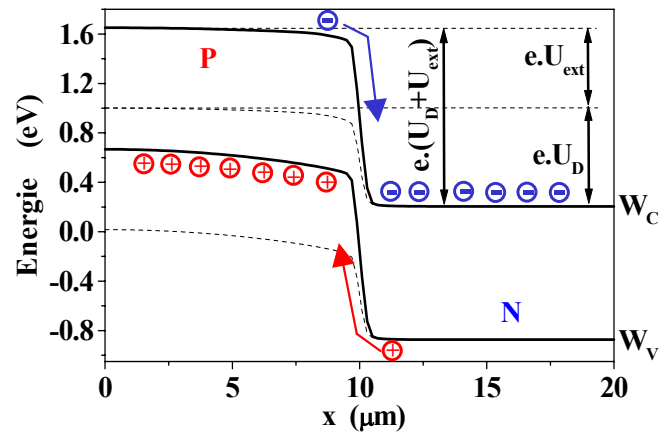
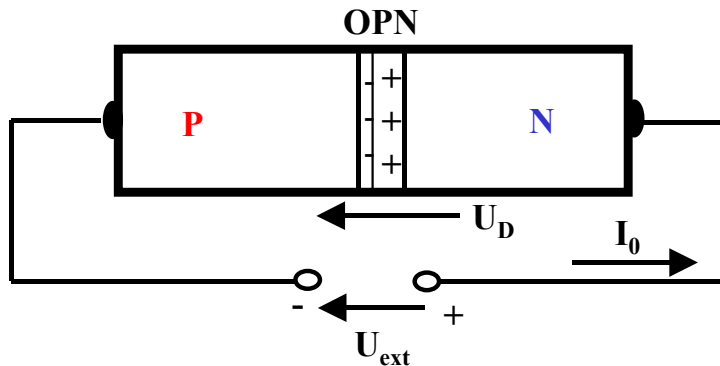
## Závěrný směr – *Reverse Direction*



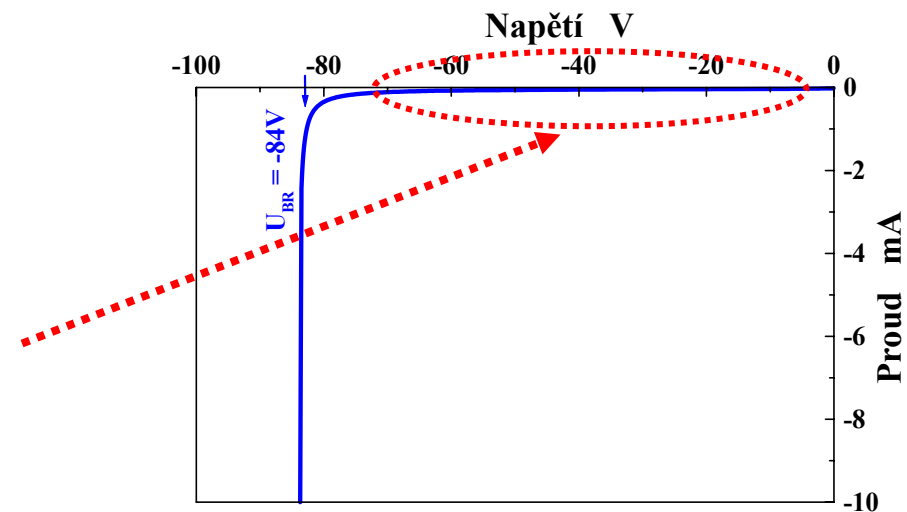
elektrony:



## Závěrný směr – *Reverse Direction*

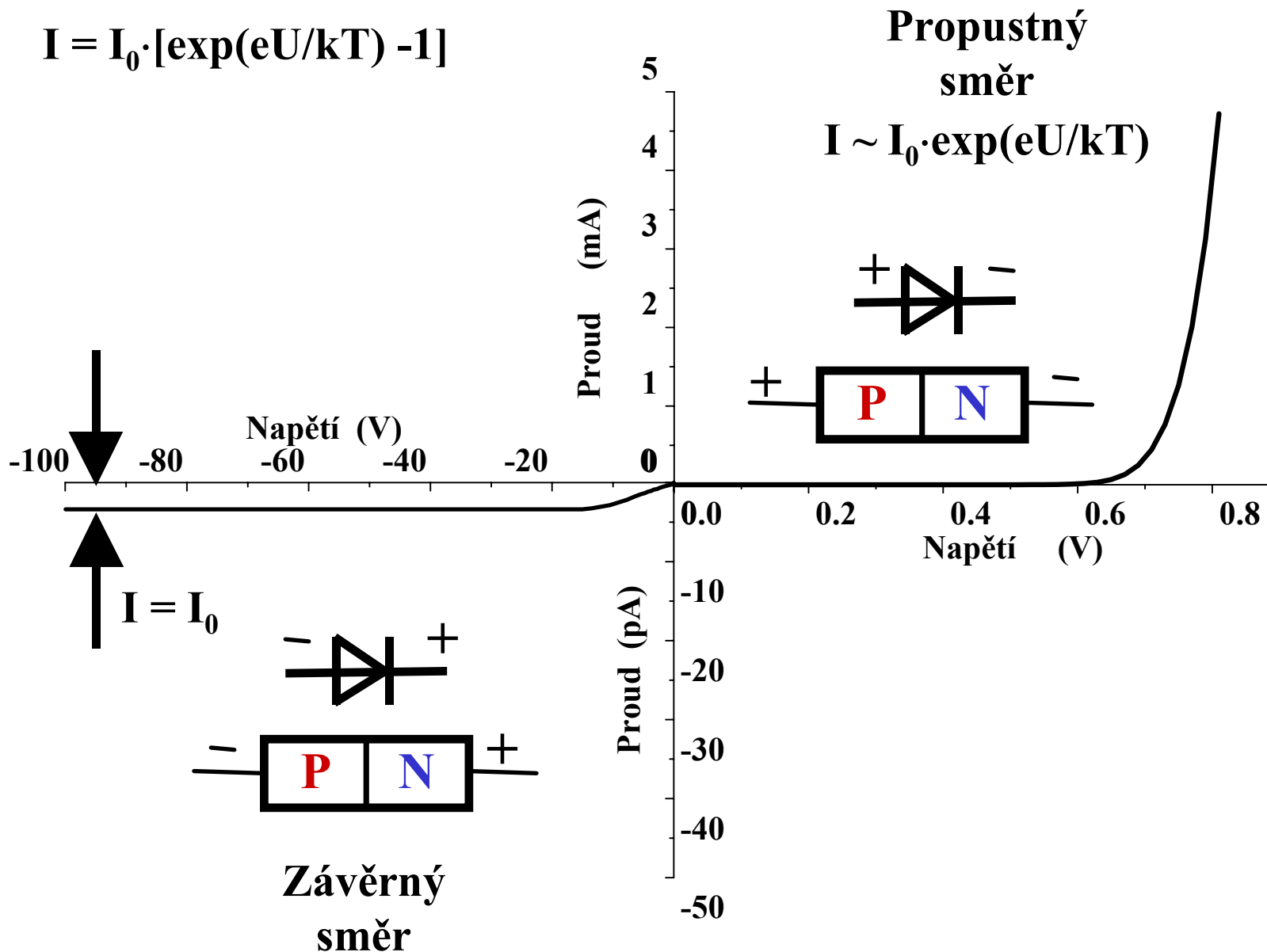


Při závěrné polarizaci p-n přechodu protéká zanedbatelná hodnota proudu ( $T=300\text{K}$ ).



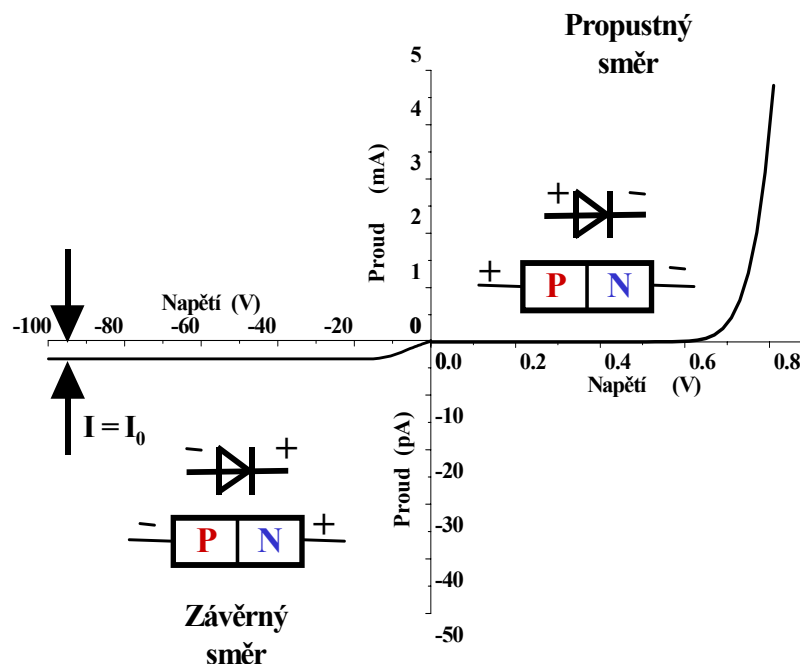
## V-A charakteristika p-n přechodu (ideální případ)

$$I = I_0 \cdot [\exp(eU/kT) - 1]$$





polovodič P & p-n přechod & polovodič N & kontakty = **dioda**



**Dioda usměrňuje napětí a proud.**

**Ideální případ:**

**V propustném směru teče proud po překonání prahového napětí.  
V závěrném směru proud neteče.**

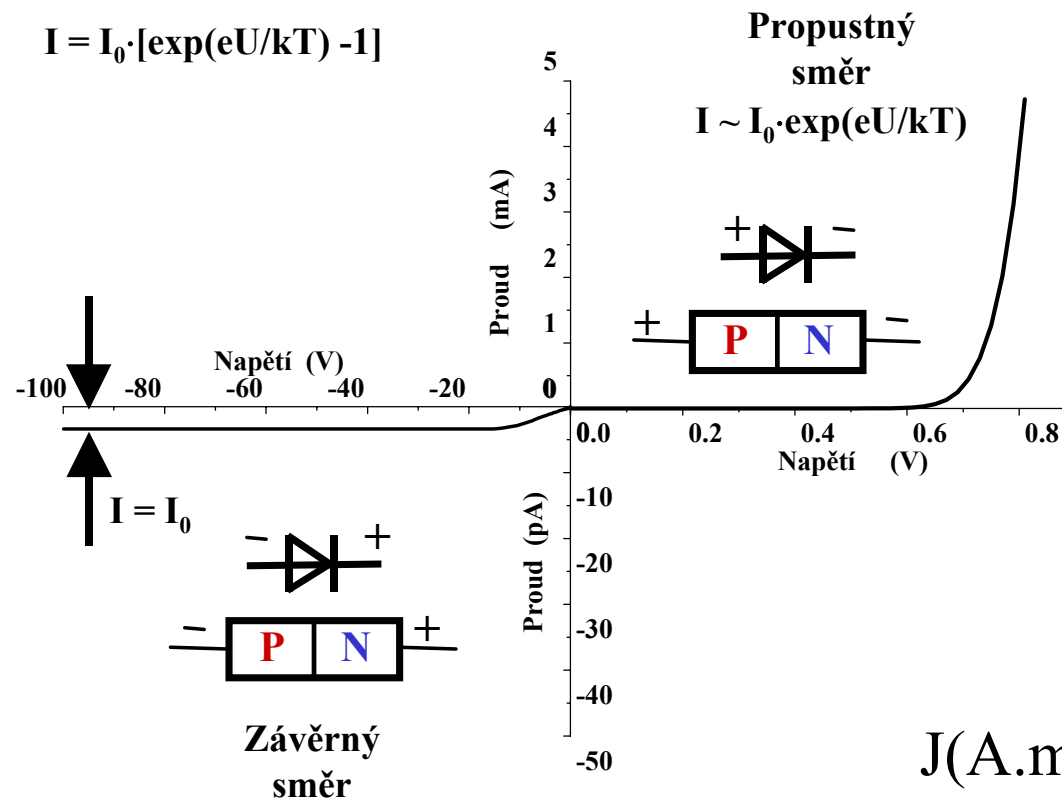
# Shockleyho rovnice

## V-A charakteristiky ideálního p-n přechodu

$$J = J_0 \cdot \left( \exp \frac{e \cdot U}{kT} - 1 \right)$$



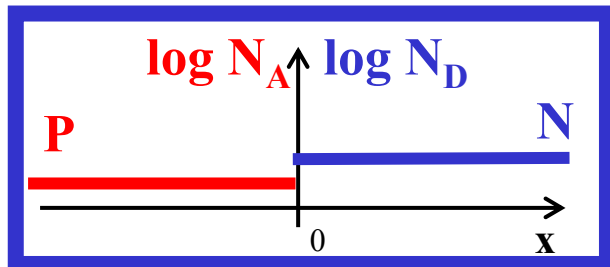
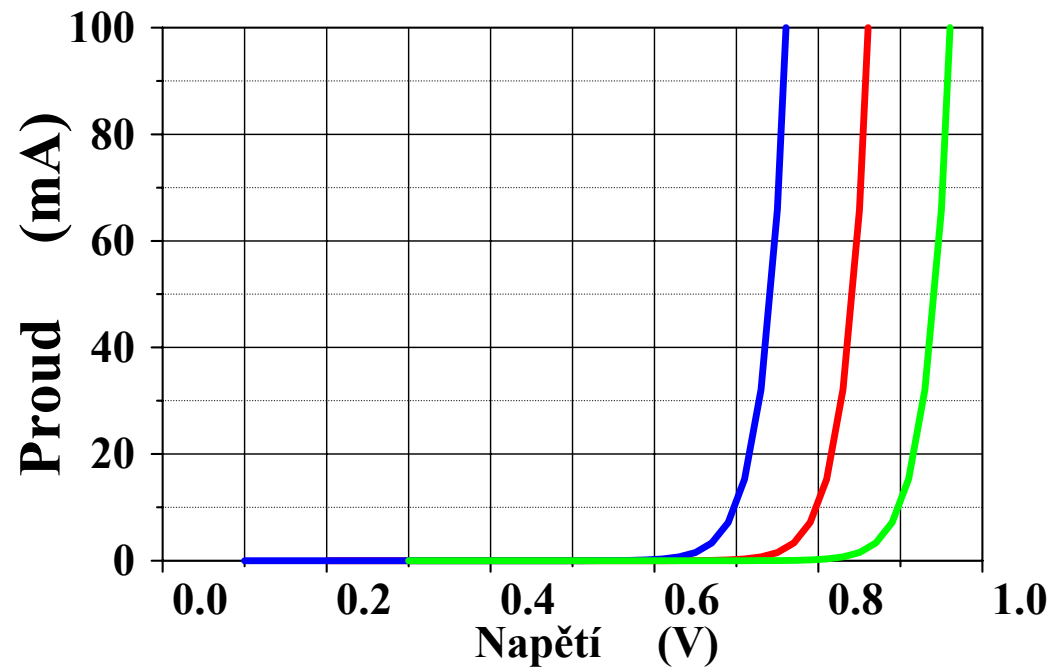
William Shockley



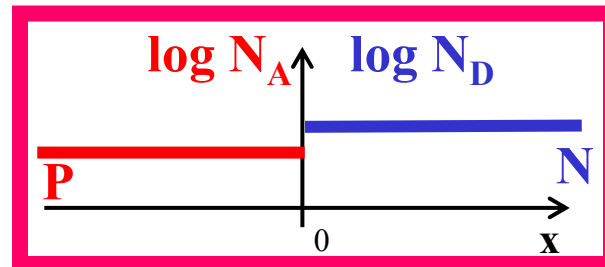
$$J(\text{A} \cdot \text{m}^{-2}) = I(\text{A}) / S(\text{m}^2)$$

## Difúzní napětí (*Built-in voltage*):

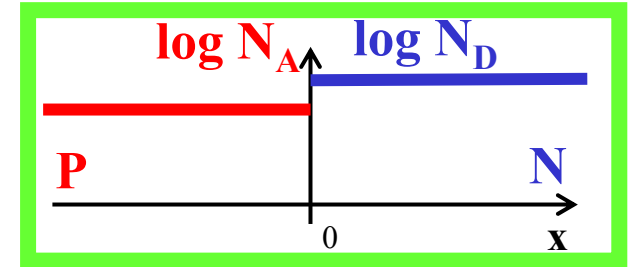
$$U_D = \frac{kT}{e} \cdot \ln\left(\frac{N_D \cdot N_A}{n_i^2}\right) = \frac{kT}{e} \cdot \ln\left(\frac{n_{N0}}{n_{P0}}\right) = \frac{kT}{e} \cdot \ln\left(\frac{p_{P0}}{p_{N0}}\right)$$



DIODA



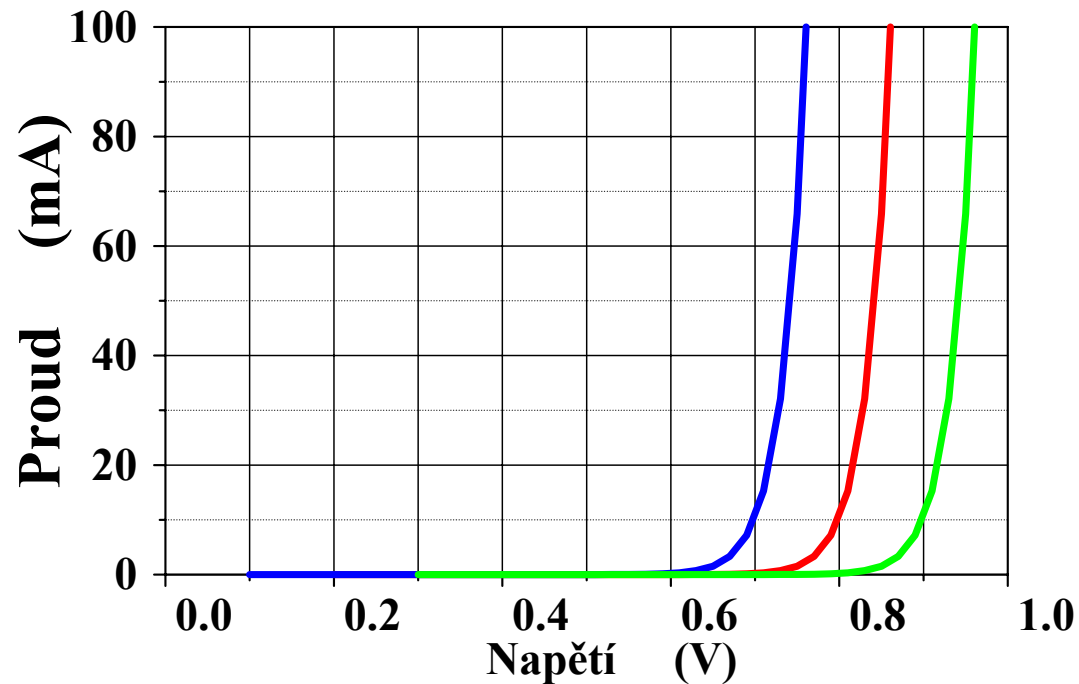
NPN, PNP B-E



TYRISTOR G-K

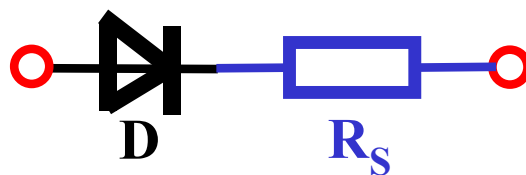
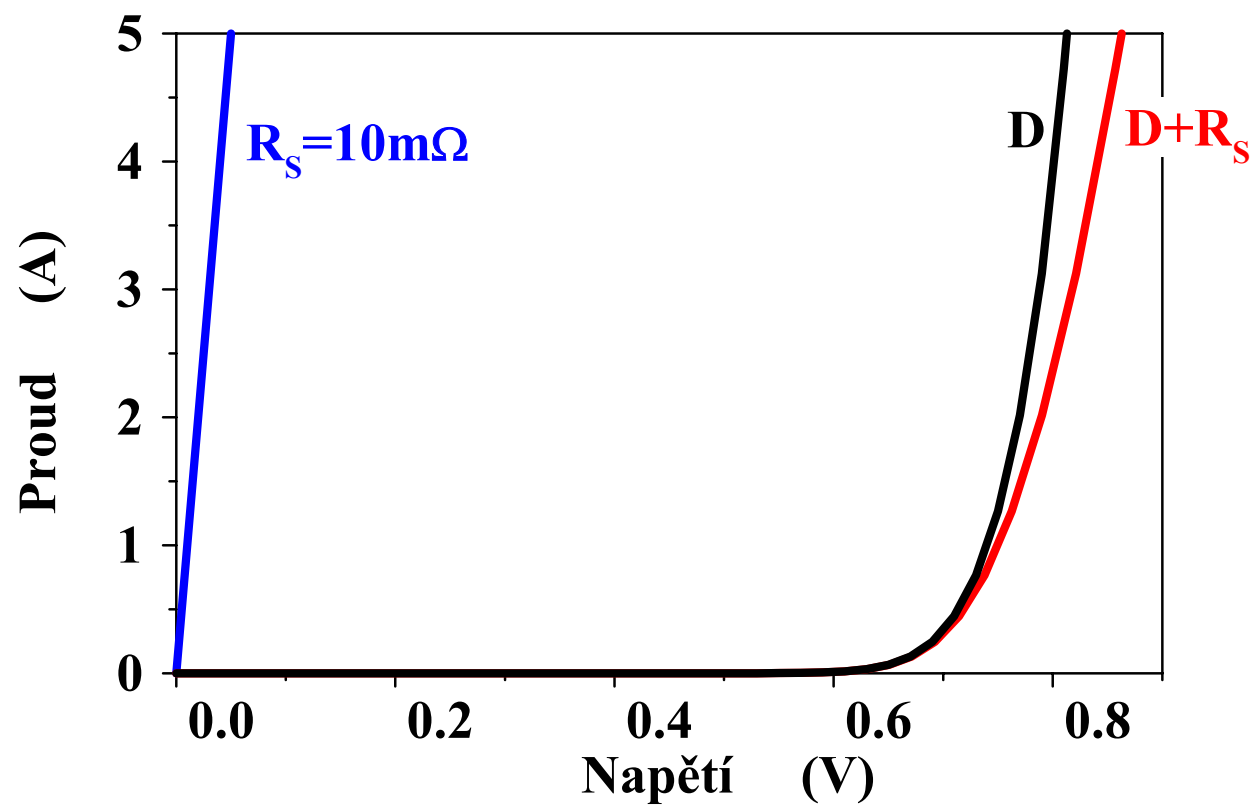
Difúzní napětí (*Built-in voltage*):

$$U_D = \frac{kT}{e} \cdot \ln\left(\frac{N_D \cdot N_A}{n_i^2}\right) = \frac{kT}{e} \cdot \ln\left(\frac{n_{N0}}{n_{P0}}\right) = \frac{kT}{e} \cdot \ln\left(\frac{p_{P0}}{p_{N0}}\right)$$



**S rostoucí koncentrací příměsí narůstá difúzní (prahové napětí) diody s p-n přechodem.**

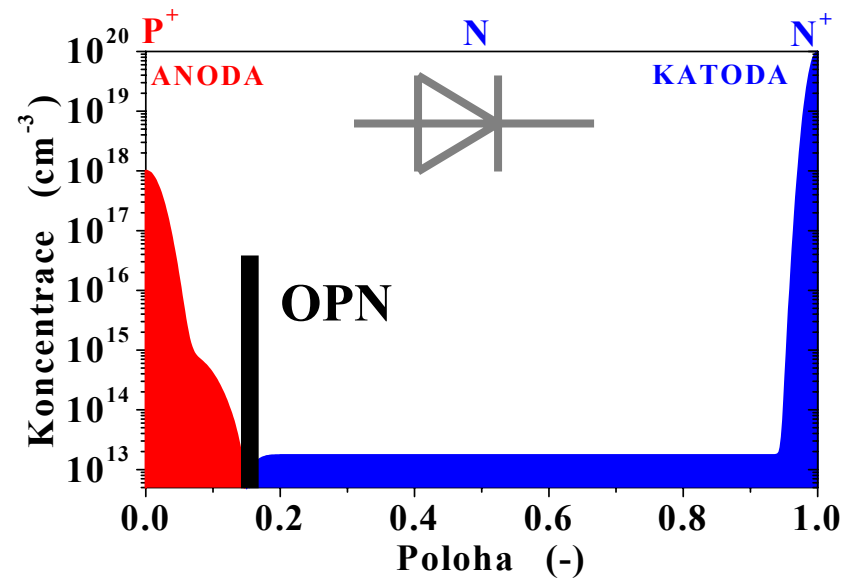
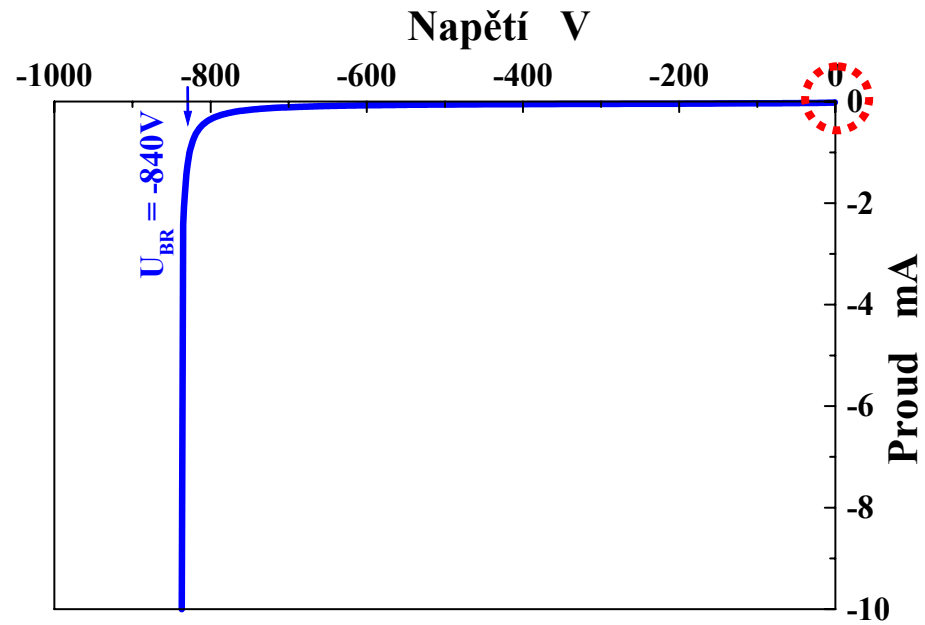
## V-A charakteristika reálné diody propustný směr



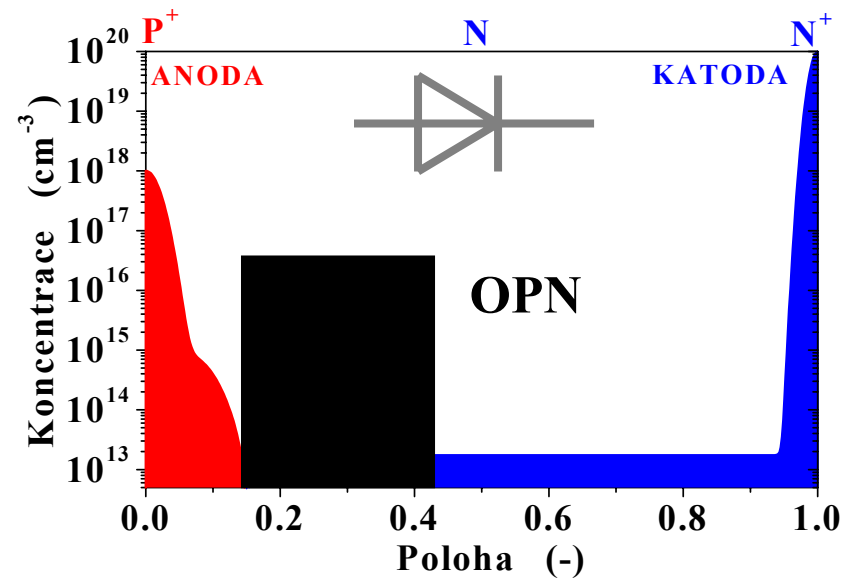
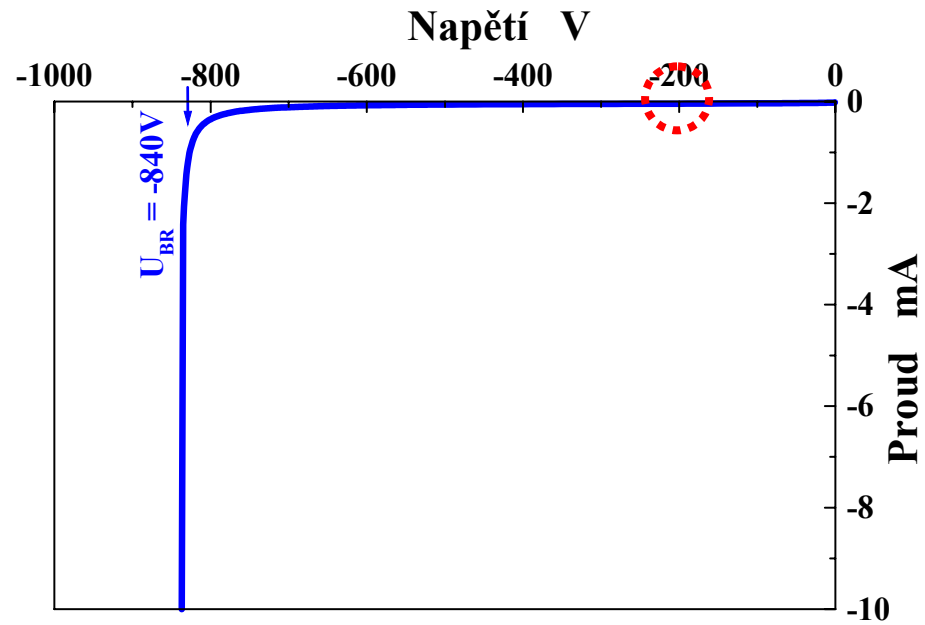
**D** = ideální dioda  
p-n přechod

$R_s$  = sériový odpor přívodů, kontaktů, polovodiče

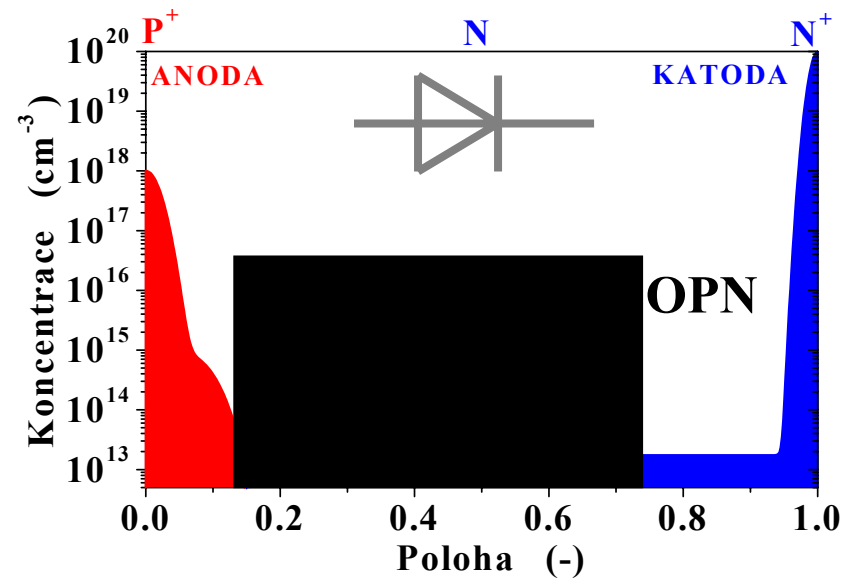
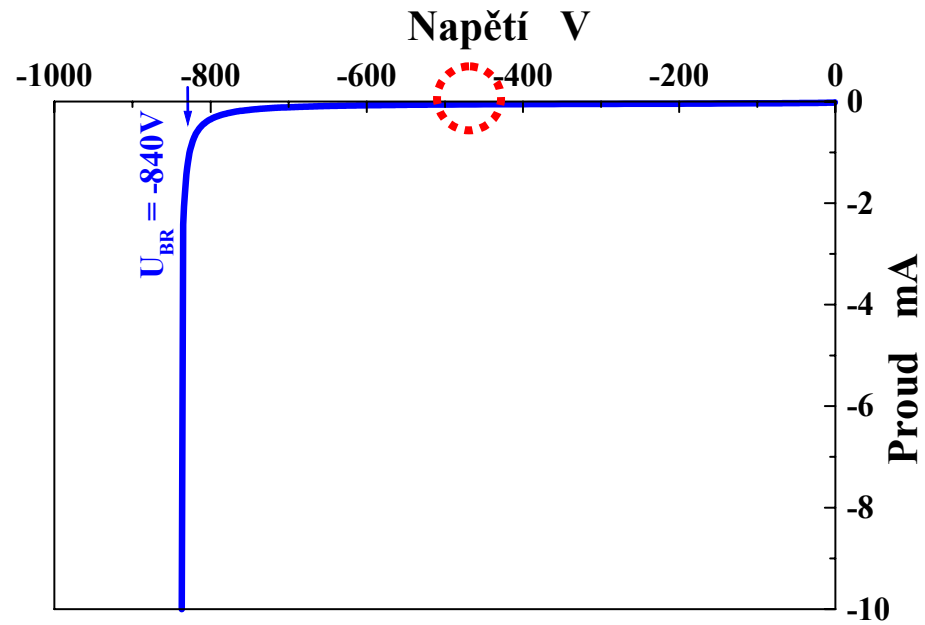
## V-A charakteristika reálné diody - závěrný směr



## V-A charakteristika reálné diody - závěrný směr

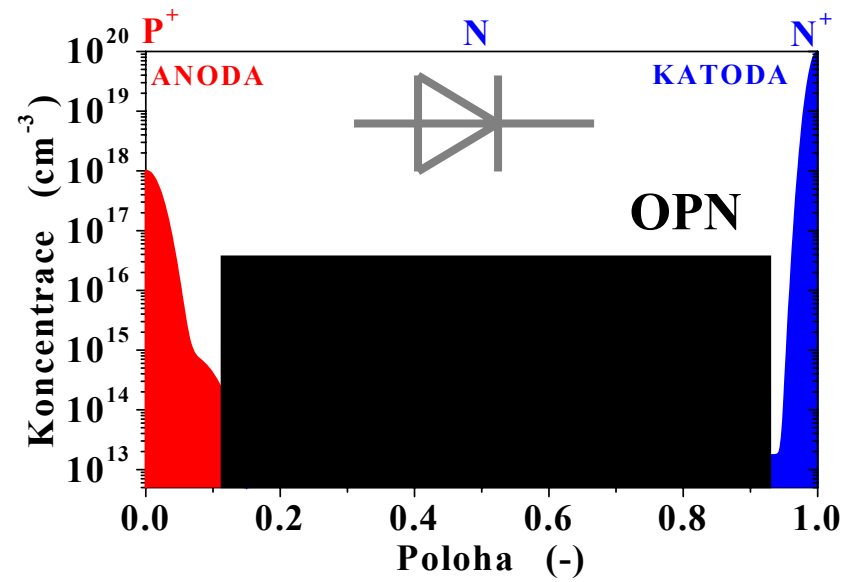
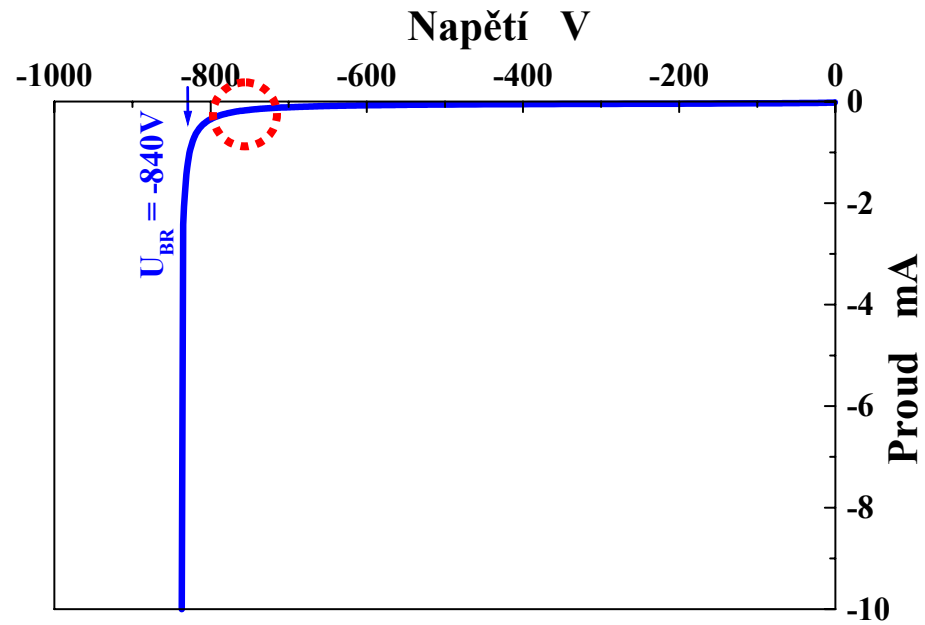


## V-A charakteristika reálné diody - závěrný směr

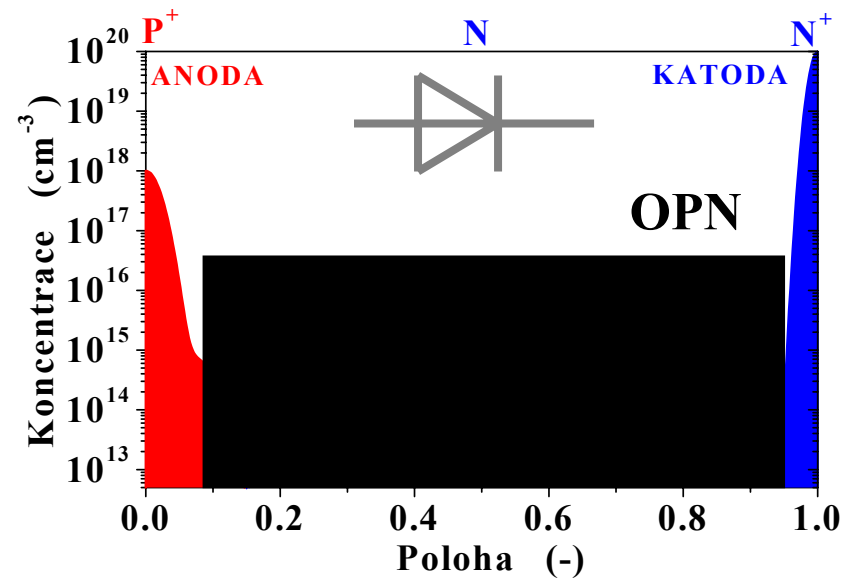
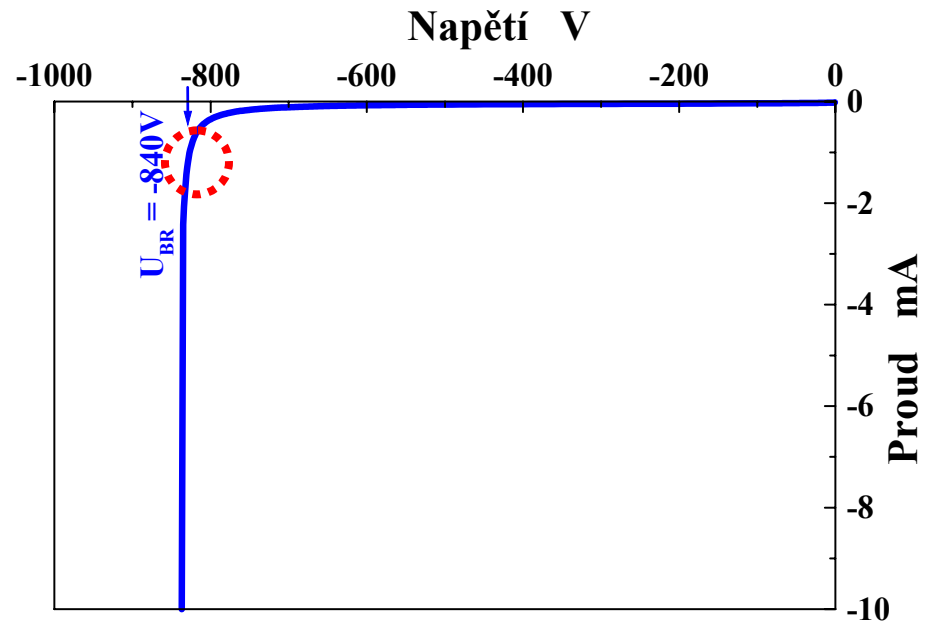




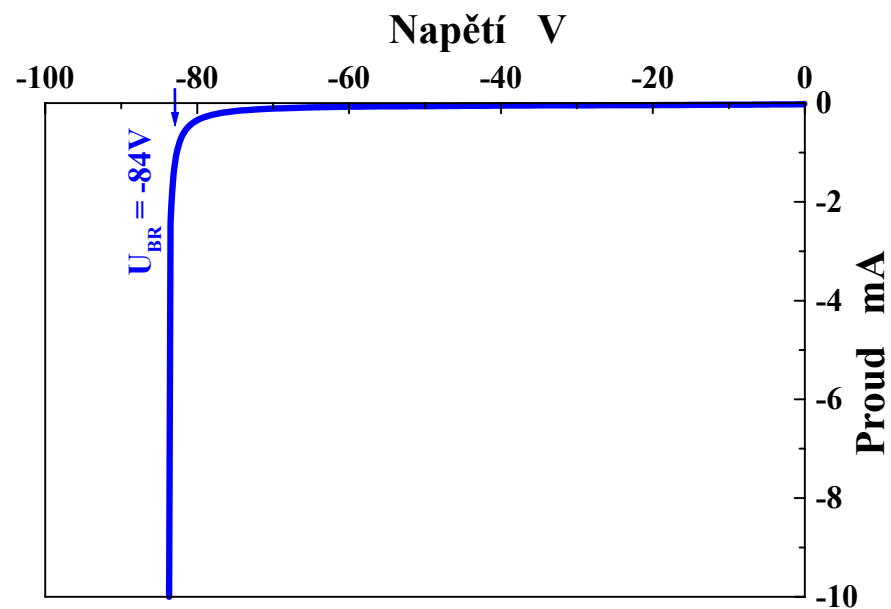
## V-A charakteristika reálné diody - závěrný směr



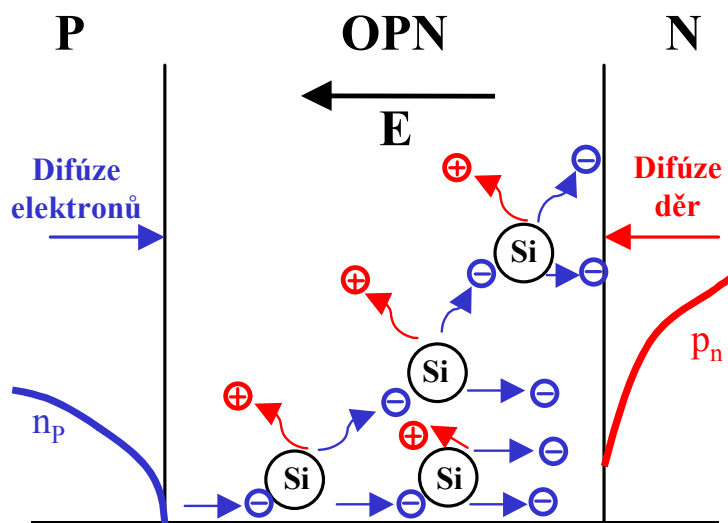
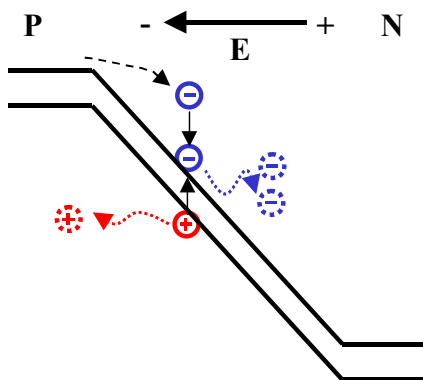
## V-A charakteristika reálné diody - závěrný směr



## V-A charakteristika reálné diody - závěrný směr

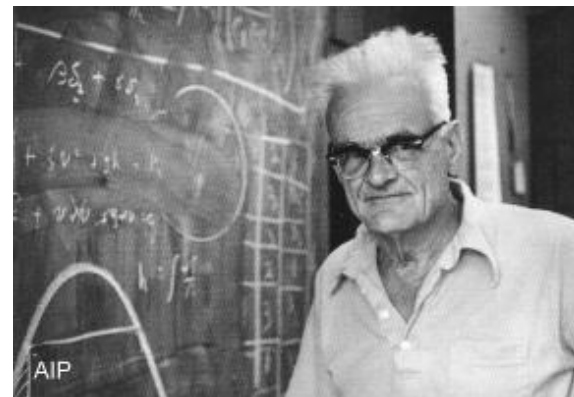
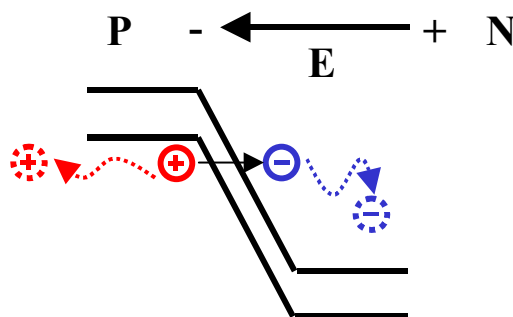


### Nárazová ionizace

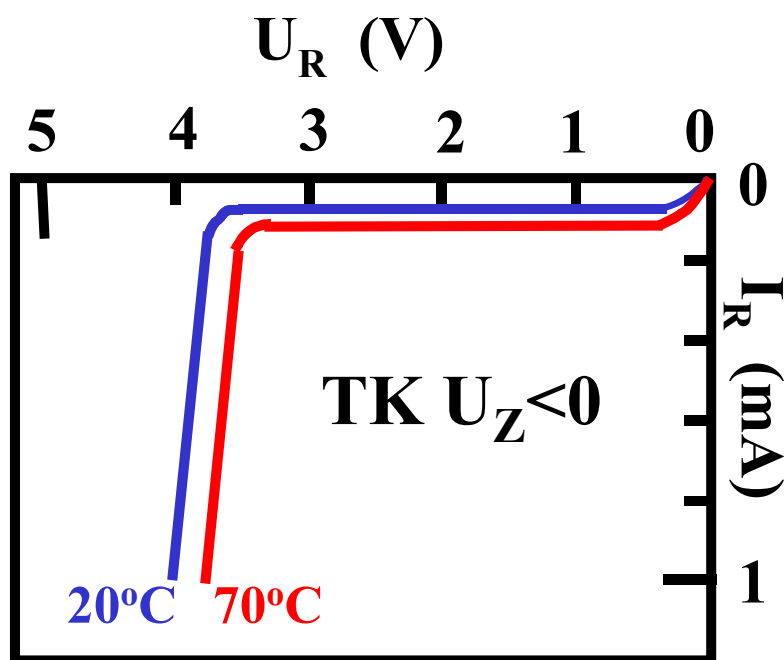


## V-A charakteristika reálné diody - závěrný směr

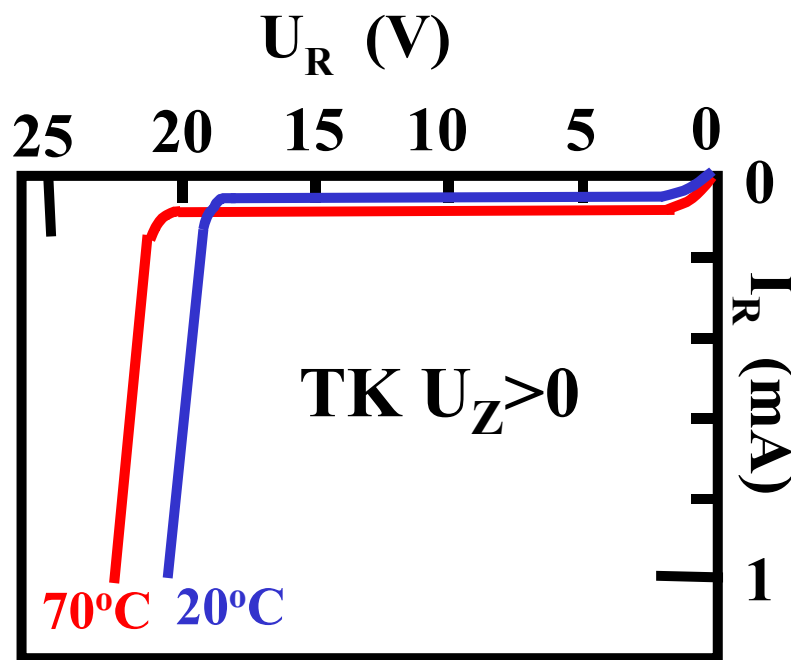
### Tunelový jev



Clarence Zener

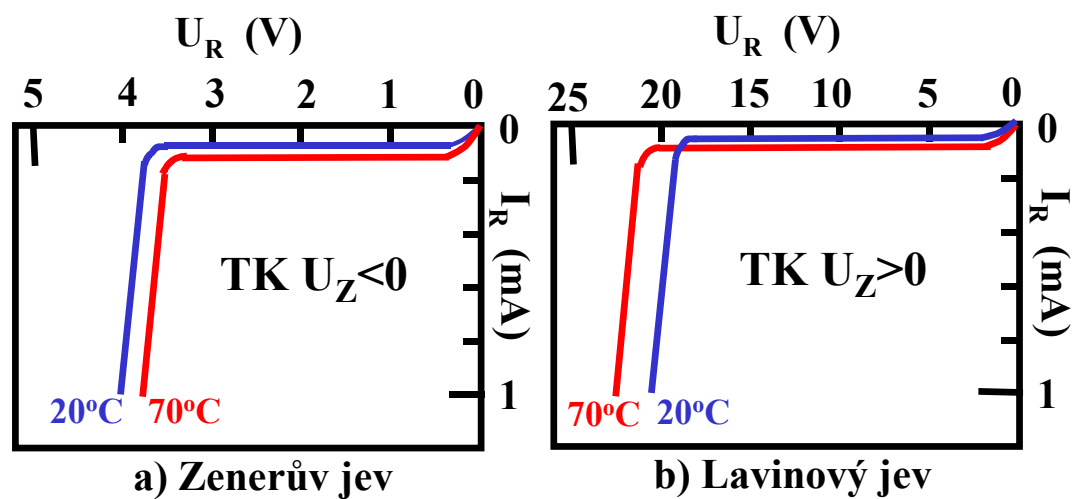
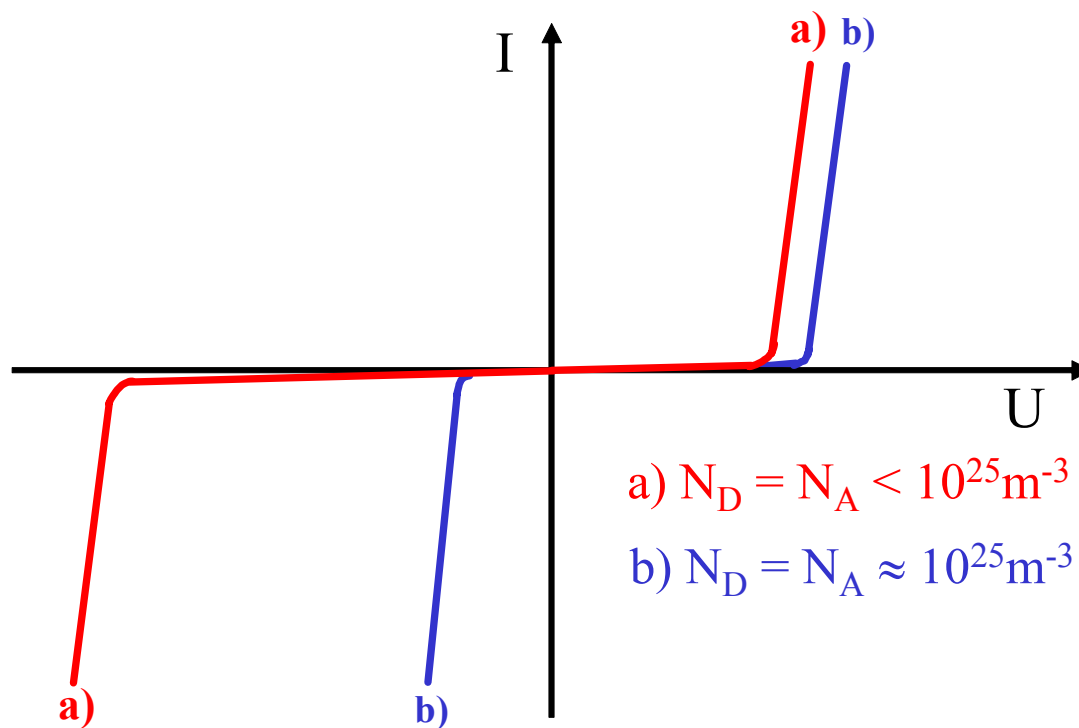


a) Zenerův jev



b) Lavinový jev

## V-A charakteristika reálné diody - závěrný směr

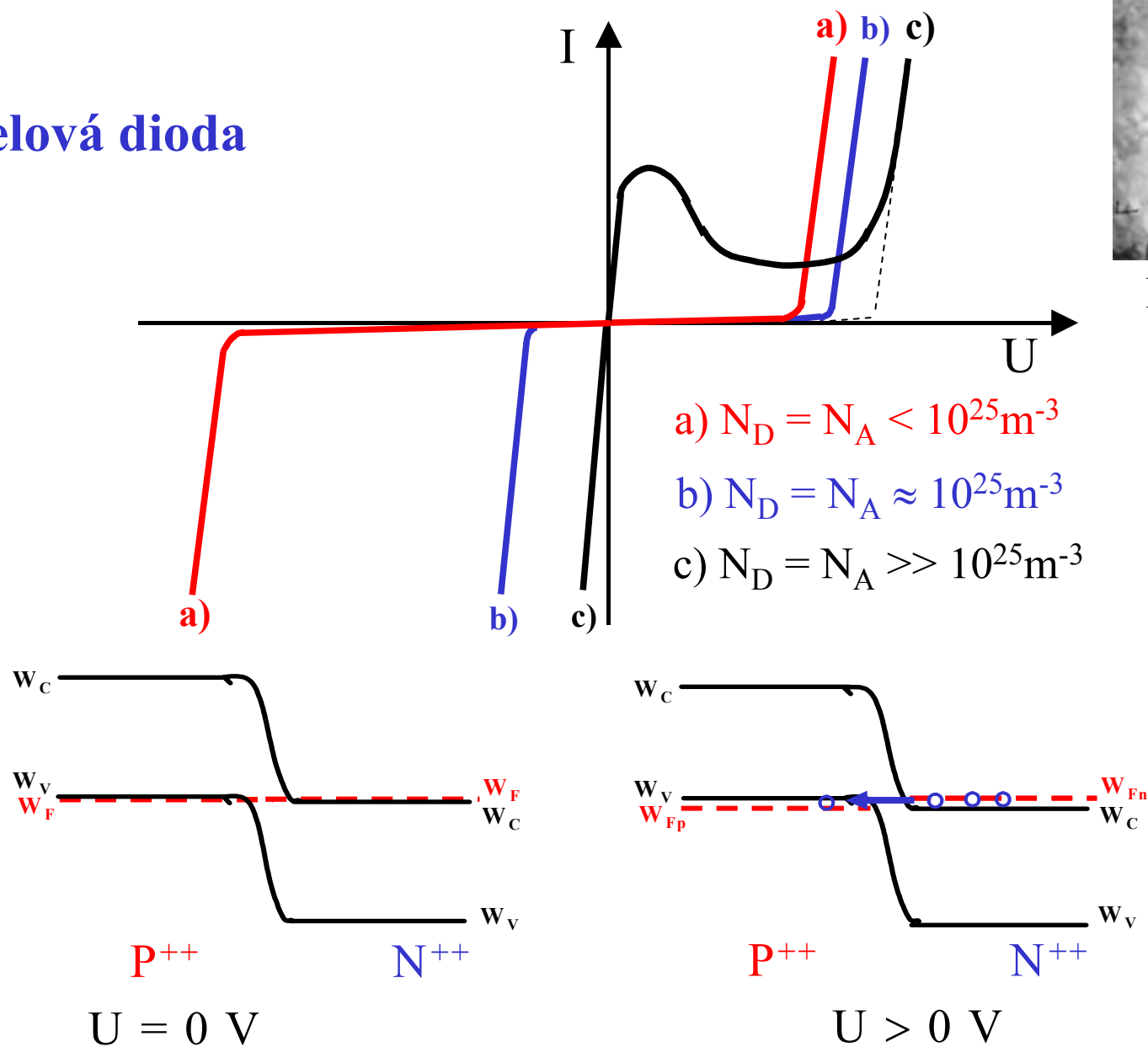


# V-A charakteristika reálné diody - závěrný směr

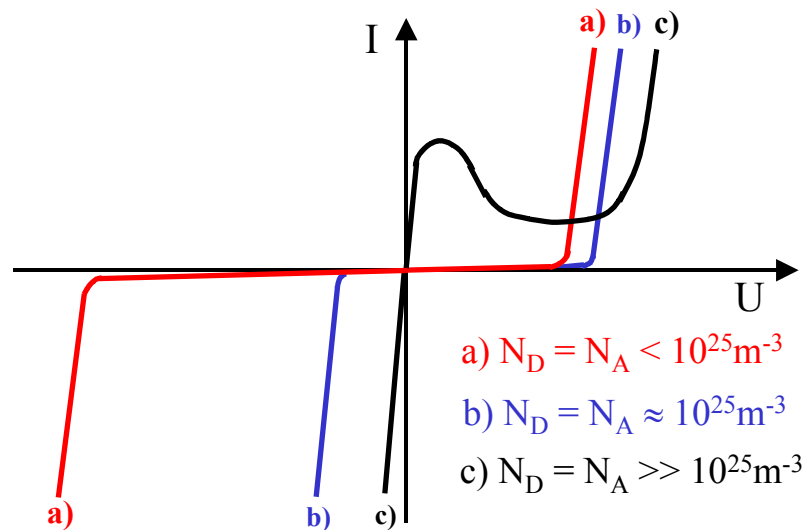
## Tunelová dioda



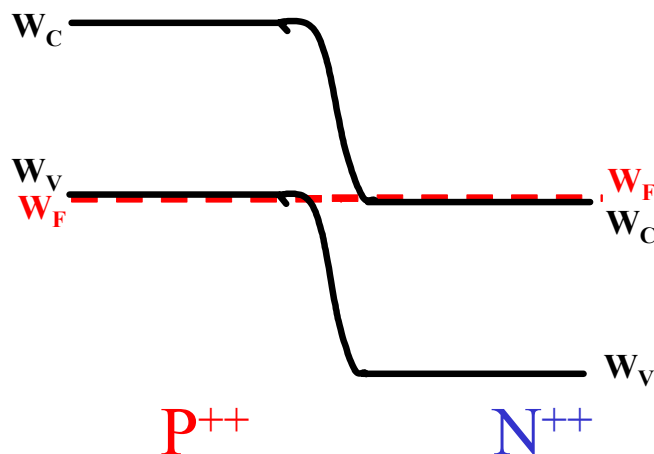
Leo Esaki



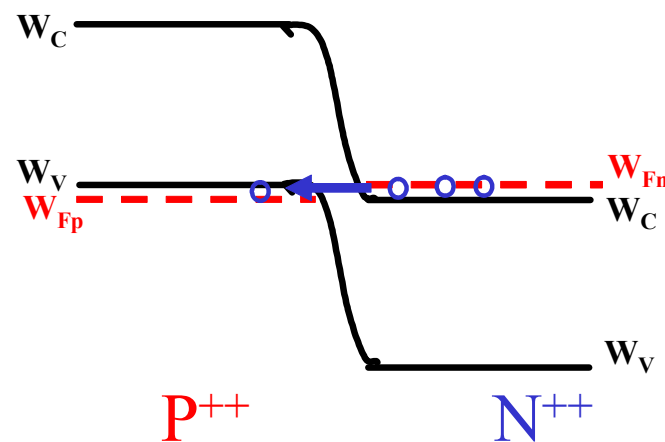
# Tunelová dioda



Volné energetické stavy elektronů musí existovat na obou stranách pn přechodu a na stejné energetické úrovni  $\Rightarrow$  polovodiče musí být degenerované ( $W_F$  ve  $W_C, W_V$ )



$U = 0 \text{ V}$



$U > 0 \text{ V}$

# Parametry součástek

## A) MEZNÍ

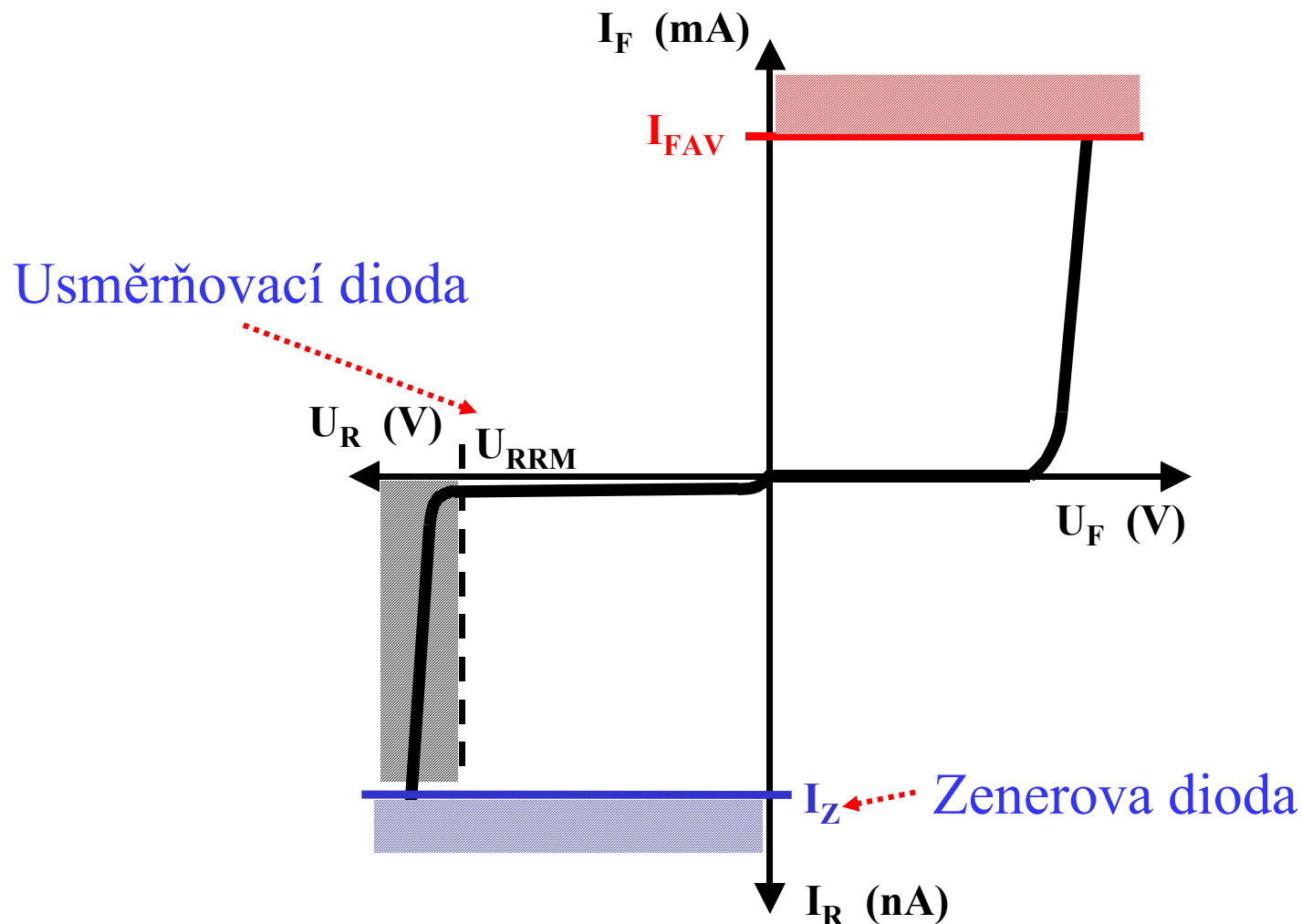
**Mezní hodnota proudu, napětí, teploty apod.,  
po jejímž překročení dojde k destrukci**

## B) CHARAKTERISTICKÉ

**Hodnota proudu, napětí, kmitočtu, atd. po jejímž  
překročení nedojde k destrukci, ale pouze ke ztrátě funkce  
Příklad: mezní frekvence**



# Mezní parametry diod

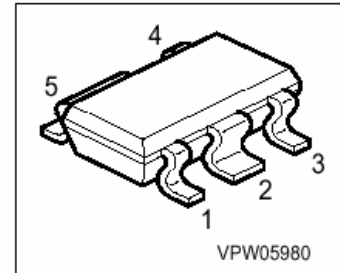


$U_{RRM}$ : *Reverse Repetitive Maximum* voltage  
závěrné opakovatelné špičkové napětí

$I_{FAV}$ : *Forward AVerage* current  
střední hodnota propustného proudu

## Silicon Switching Diode

- Switching applications
- High breakdown voltage



Type	Marking	Pin Configuration					Package
BAW78M	GDs	1 = A	2 = C	3 n.c.	4 n.c.	5 = C	SCT595

## Maximum Ratings

Parameter	Symbol	Values	Unit
Diode reverse voltage	$V_R$	400	V
Peak reverse voltage	$V_{RM}$	400	V
Forward current	$I_F$	1	A
Peak forward current	$I_{FM}$	1	A
Surge forward current, $t = 1 \mu s$	$I_{FS}$	10	A
Total power dissipation, $T_S \leq 110 \text{ }^\circ\text{C}$	$P_{tot}$	1	W
Junction temperature	$T_j$	150	$^\circ\text{C}$
Storage temperature	$T_{stg}$	-65 ... 150	$^\circ\text{C}$

## AC characteristics

Diode capacitance $V_R = 0 \text{ V}$ , $f = 1 \text{ MHz}$	$C_D$	-	10	-	pF
Reverse recovery time $I_F = 200 \text{ mA}$ , $I_R = 200 \text{ mA}$ , $R_L = 100 \text{ }\Omega$ , measured at $I_R = 20 \text{ mA}$	$t_{rr}$	-	1	-	$\mu s$

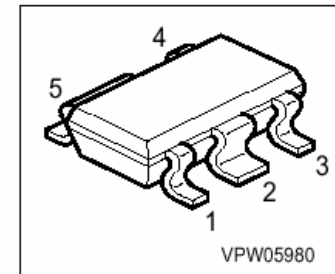
# Charakteristické parametry diod



BAW78M

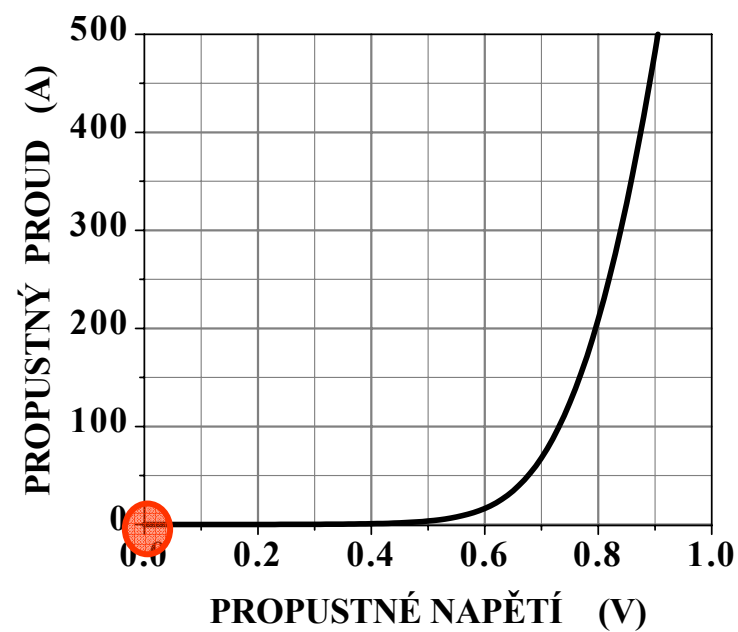
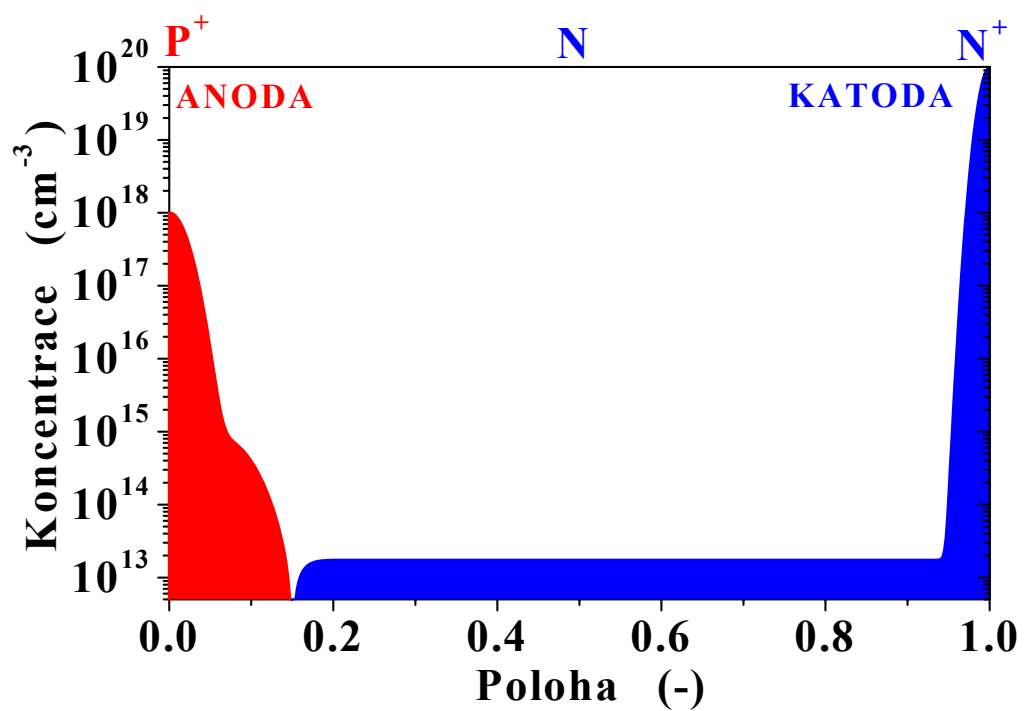
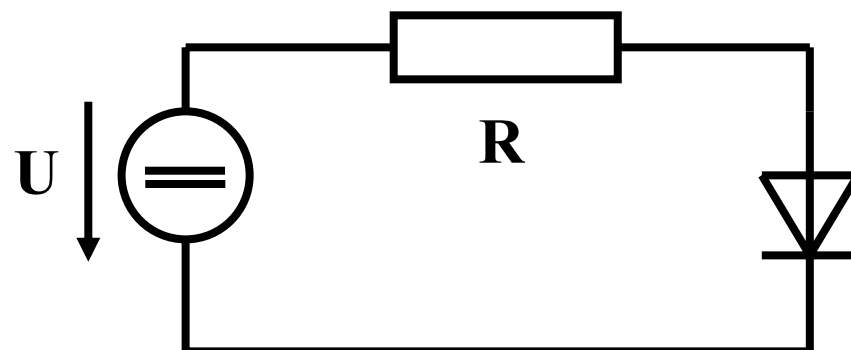
Silicon Switching Diode

- Switching applications
- High breakdown voltage

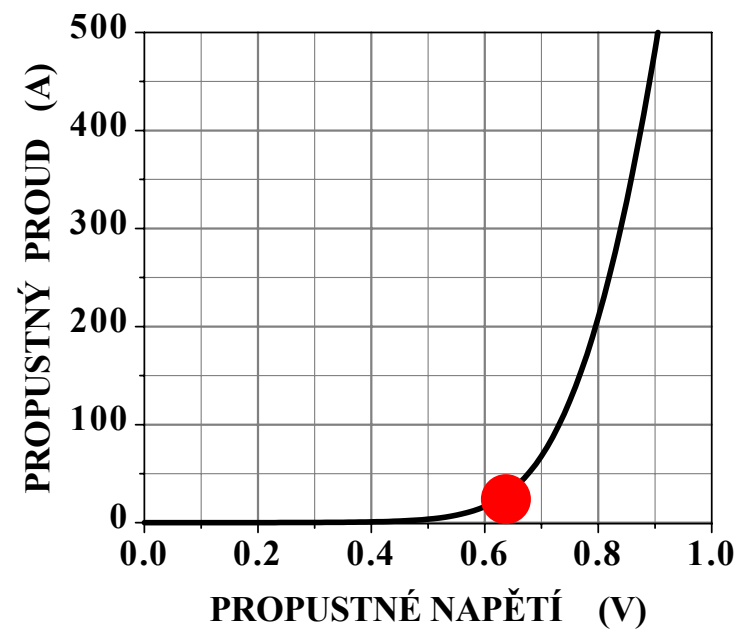
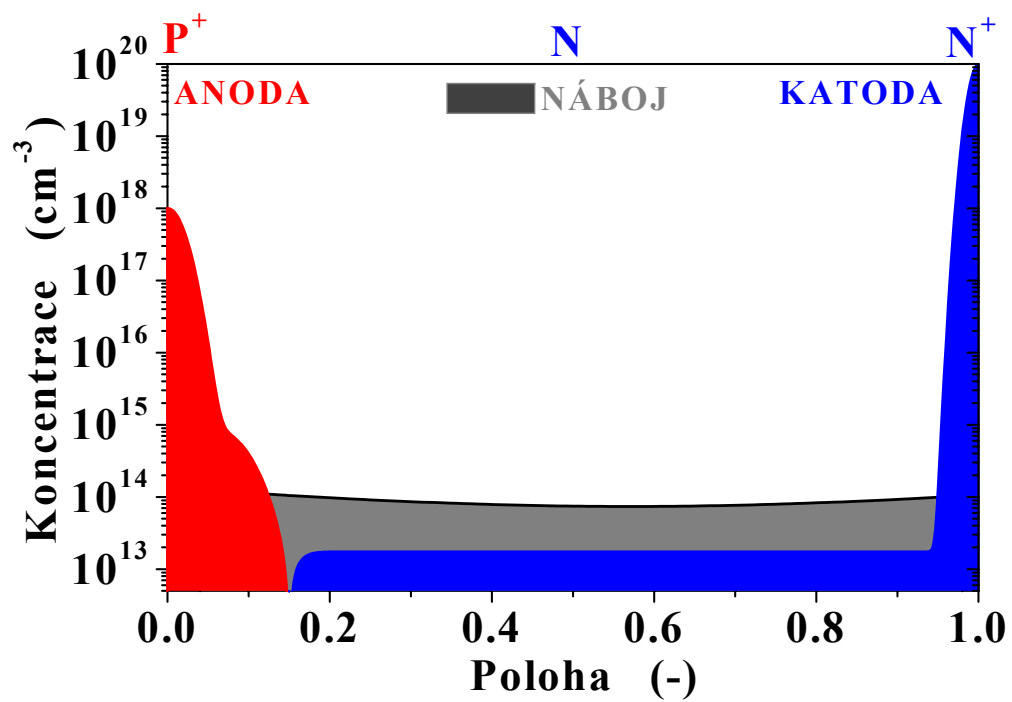
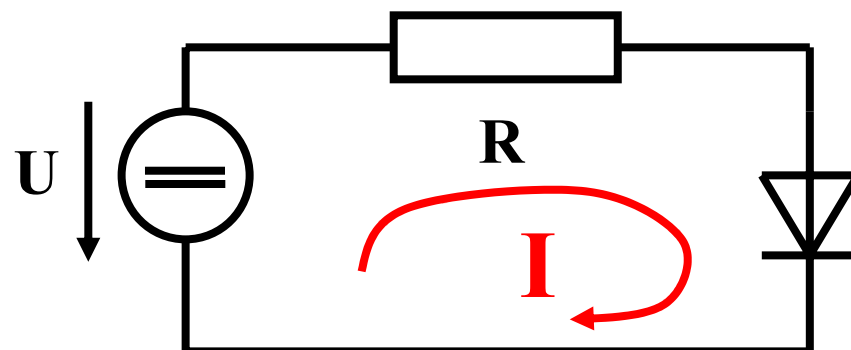


## AC characteristics

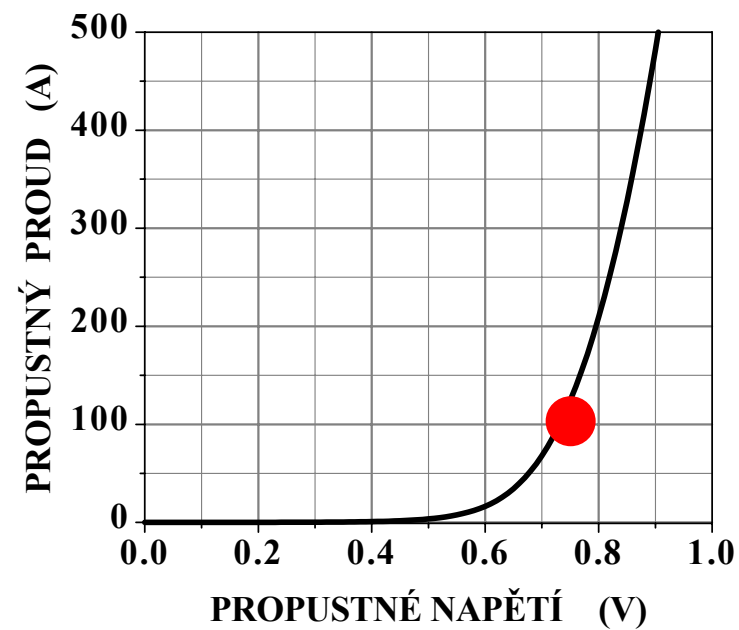
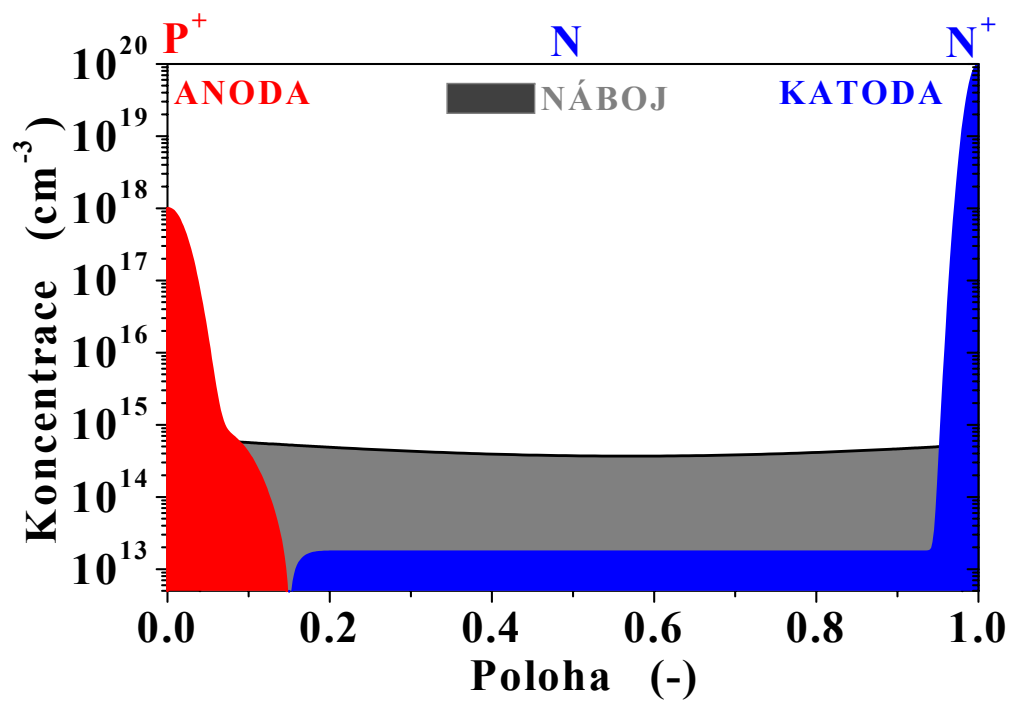
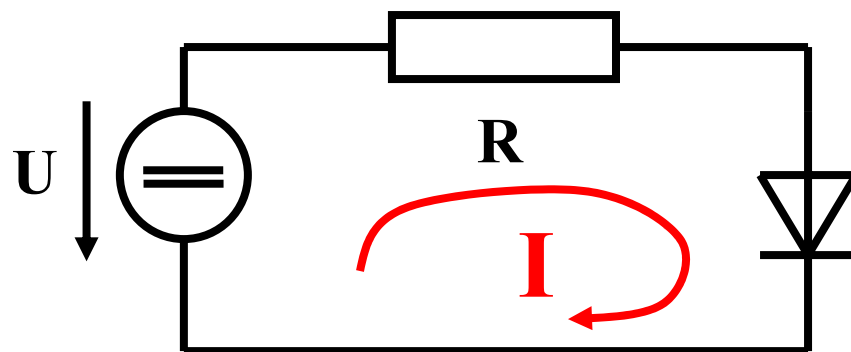
Diode capacitance $V_R = 0 \text{ V}$ , $f = 1 \text{ MHz}$	$C_D$	-	10	-	pF
Reverse recovery time $I_F = 200 \text{ mA}$ , $I_R = 200 \text{ mA}$ , $R_L = 100 \Omega$ , measured at $I_R = 20 \text{ mA}$	$t_{rr}$	-	1	-	$\mu\text{s}$



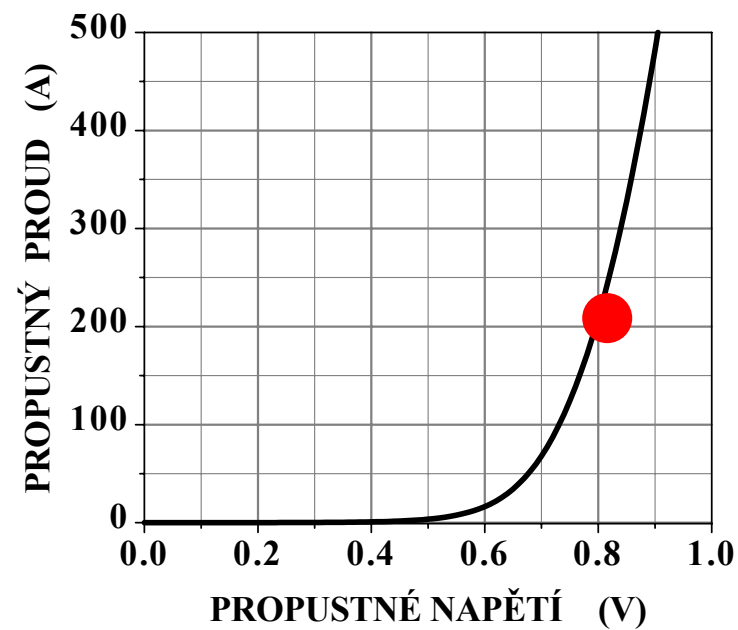
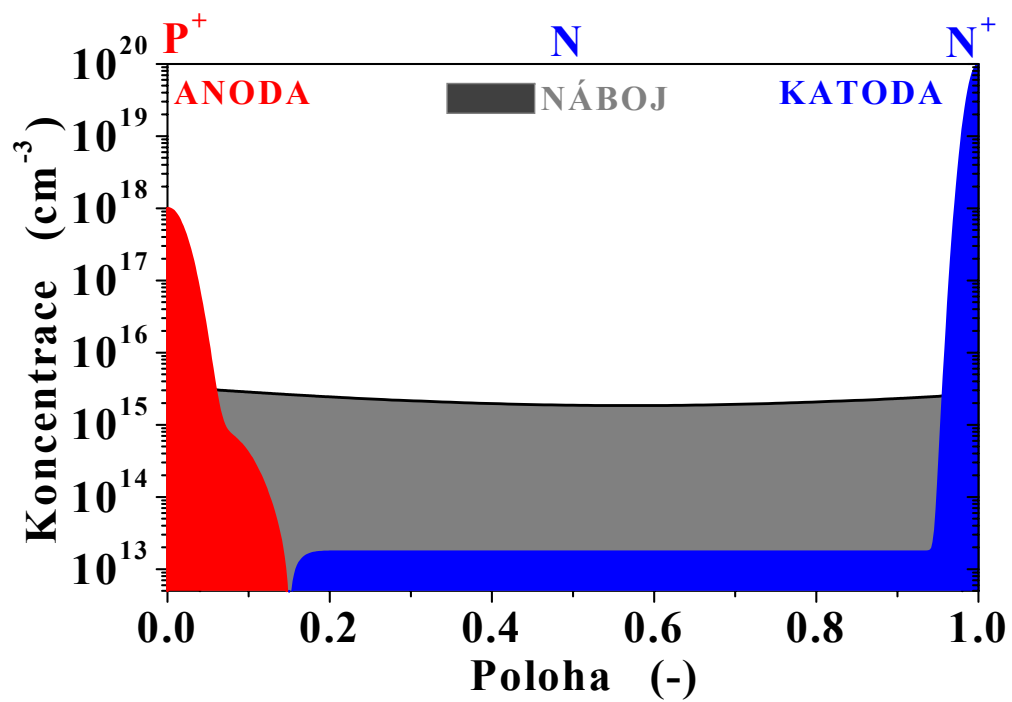
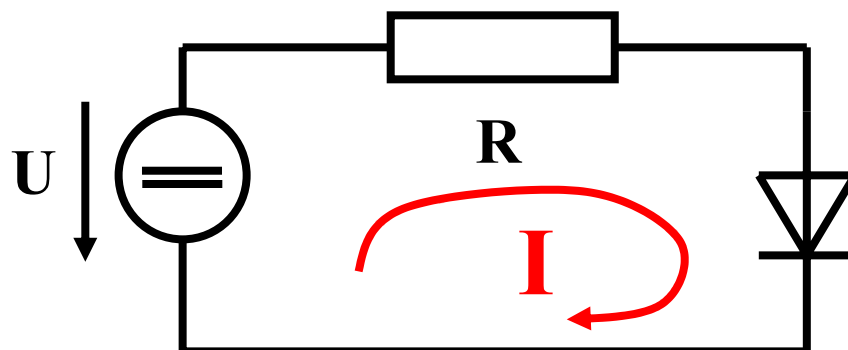
$R_{\text{DIF}} \rightarrow \infty$



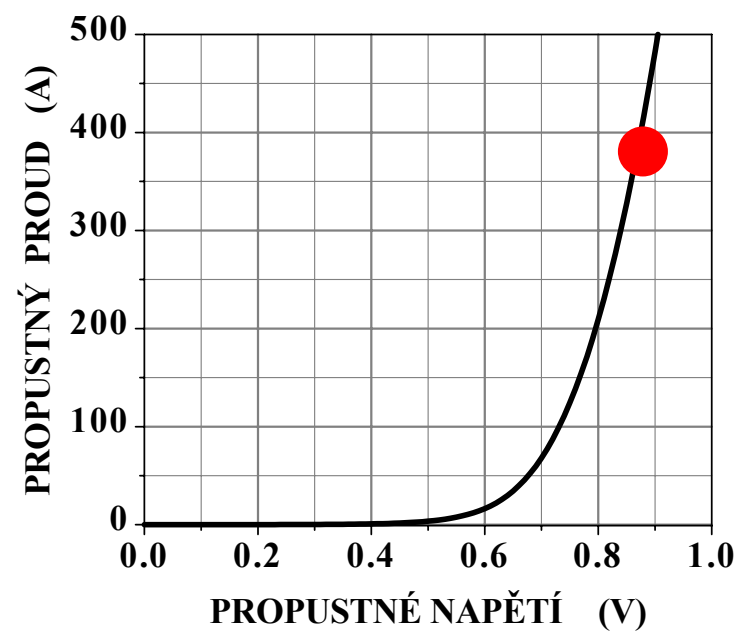
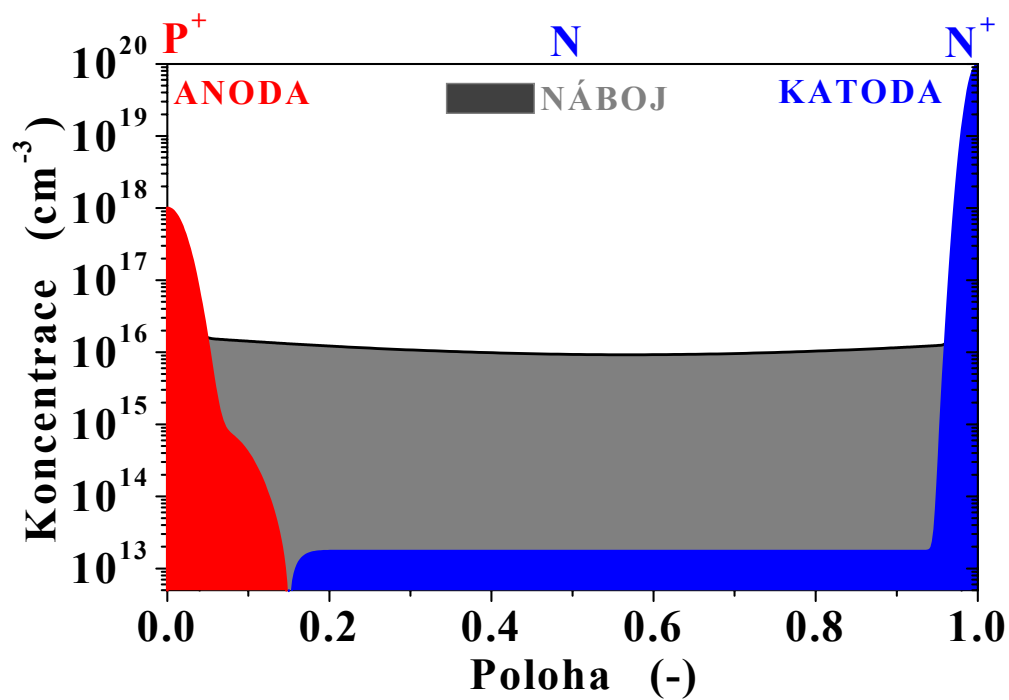
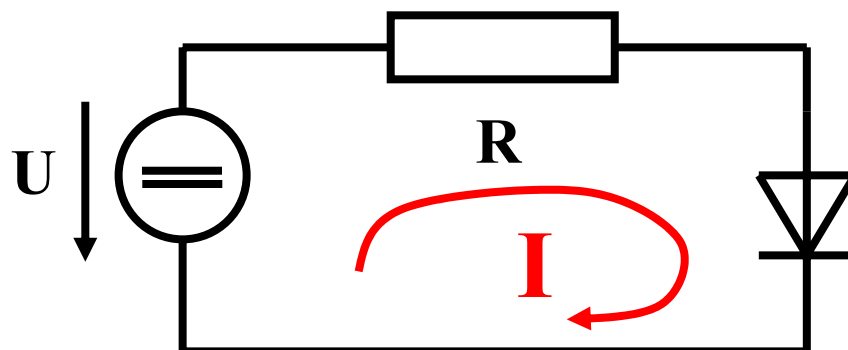
$R_{DIF}$  klesá



$R_{DIF}$  klesá

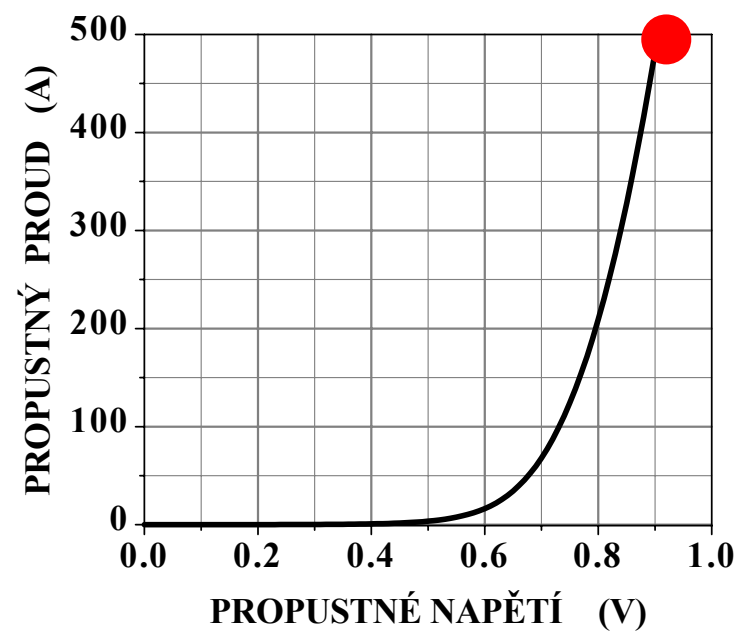
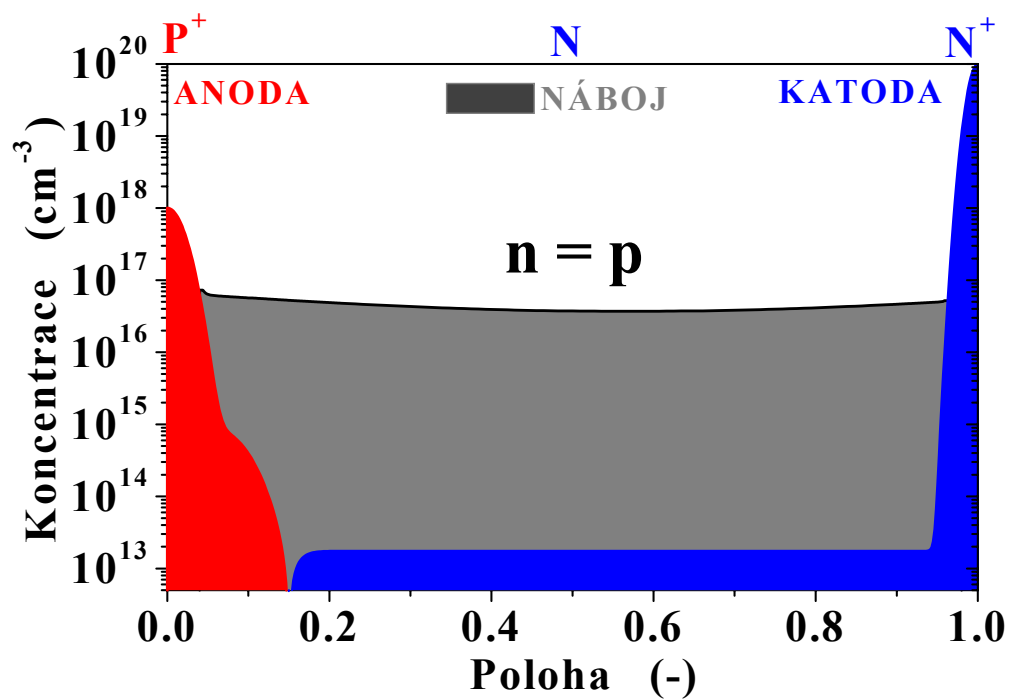
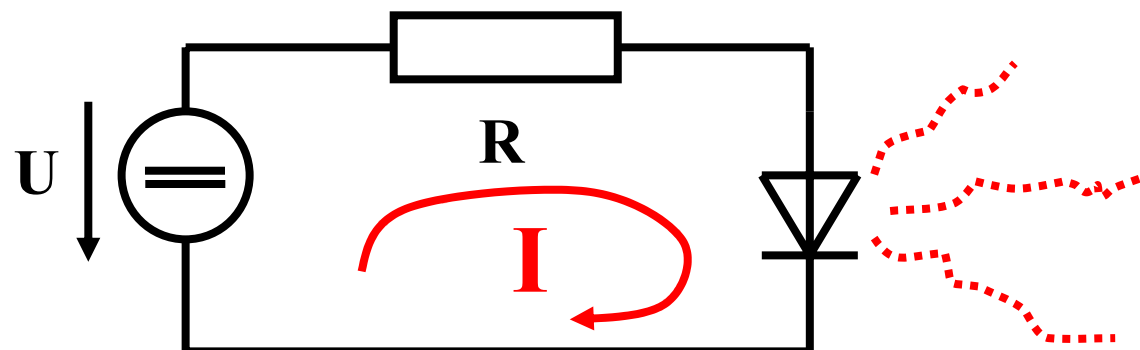


$R_{\text{DIF}}$  klesá



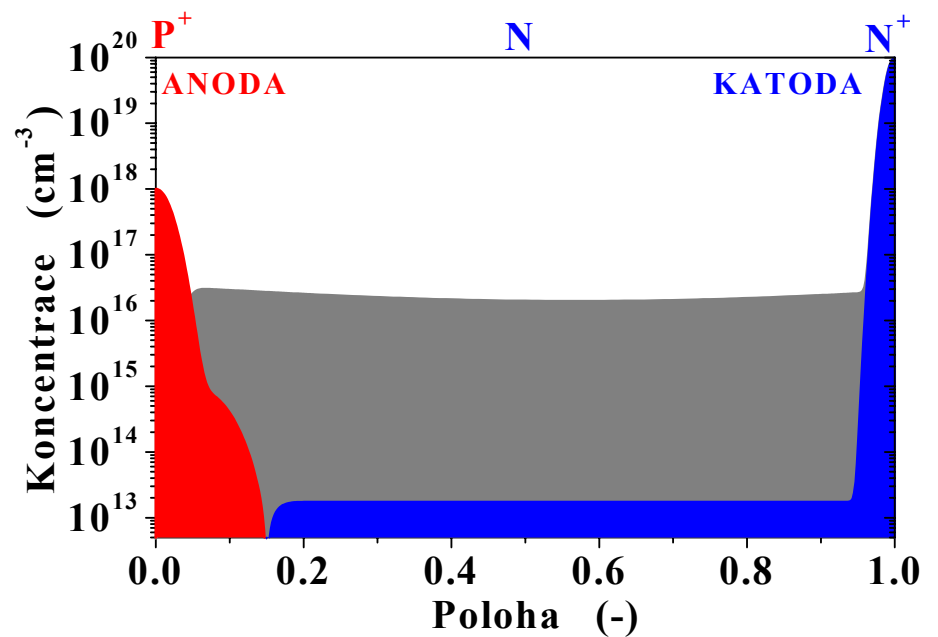
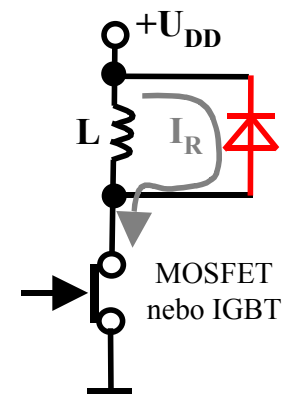
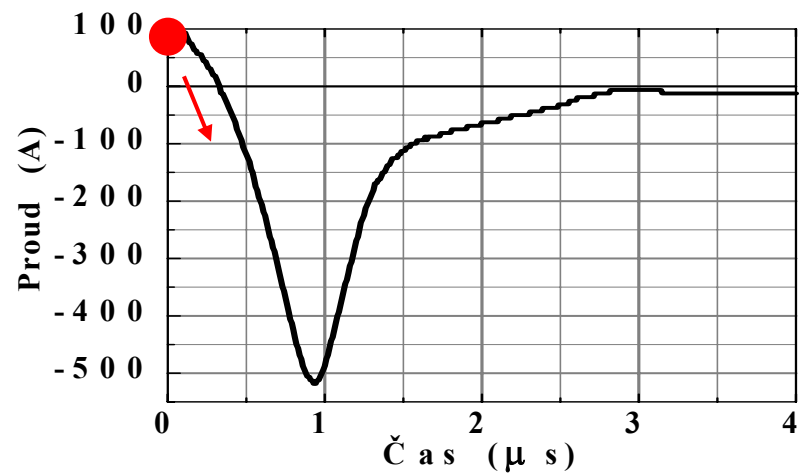
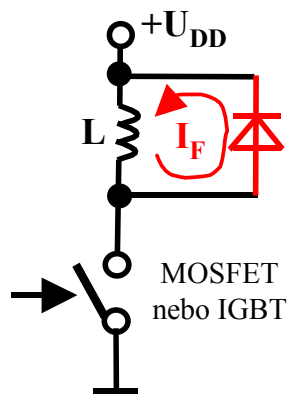
$R_{\text{DIF}}$  klesá





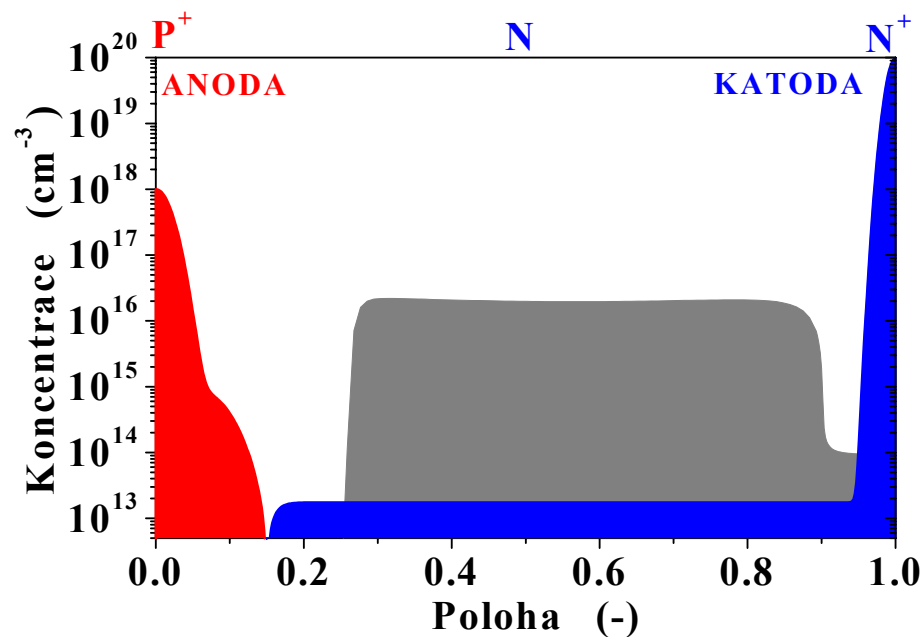
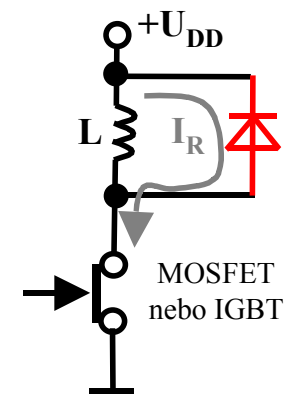
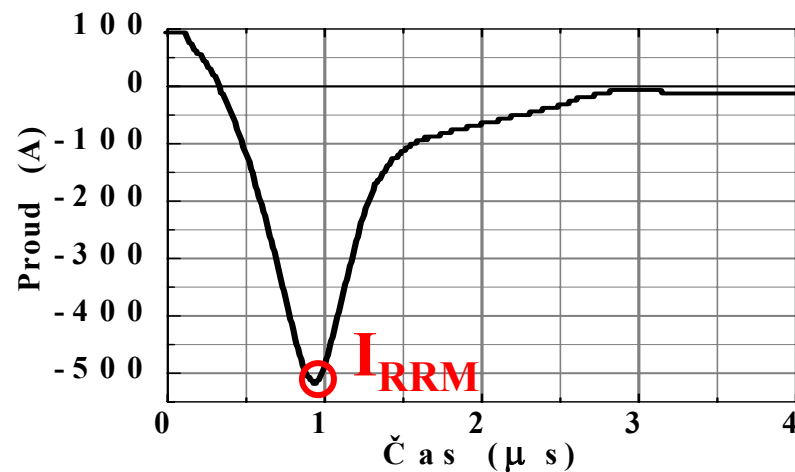
$R_{\text{DIF}}$  je malý

# Komutace diody



malý odpor

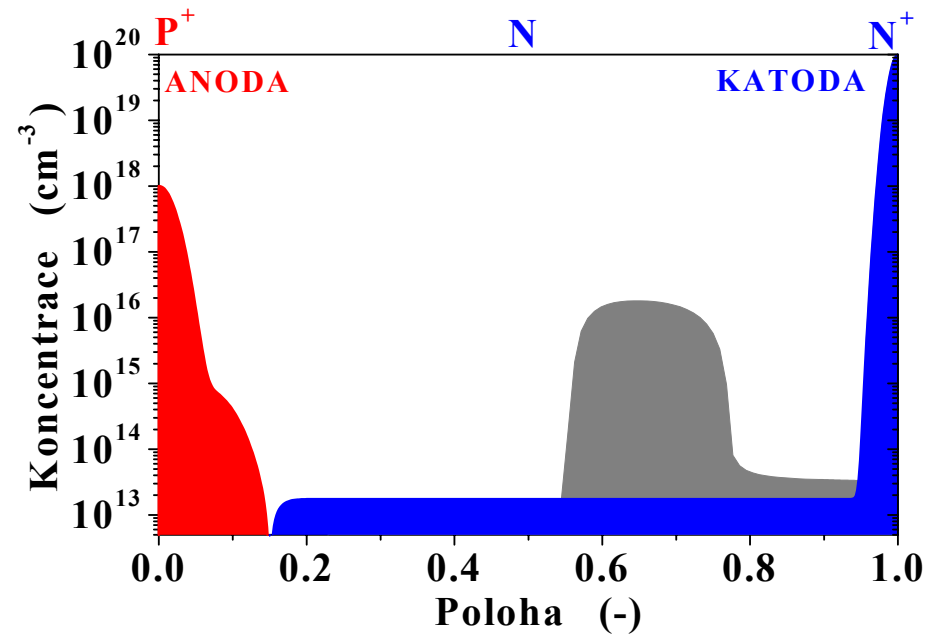
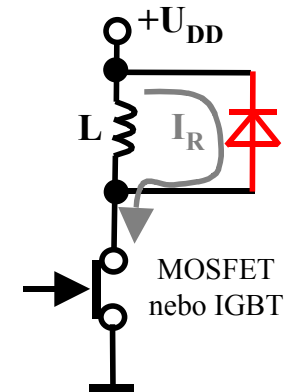
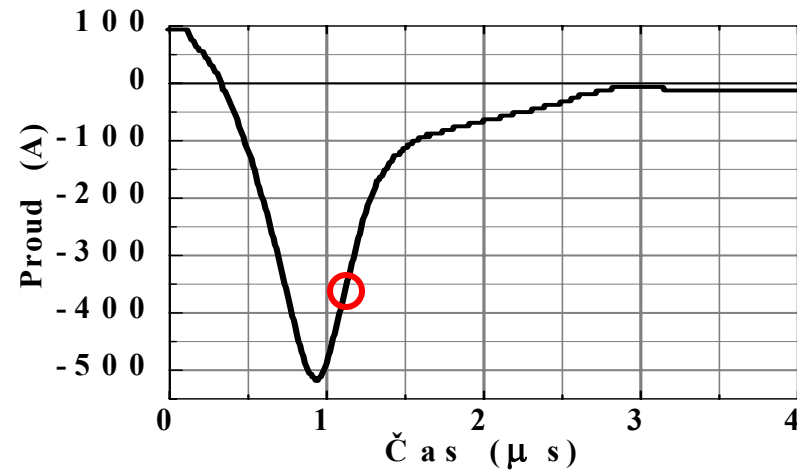
# Komutace diody



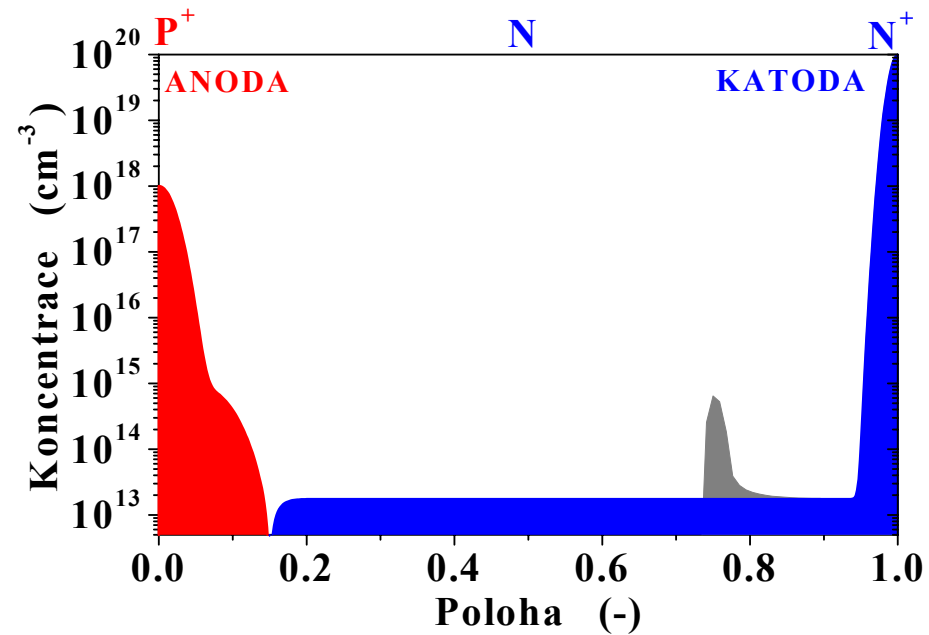
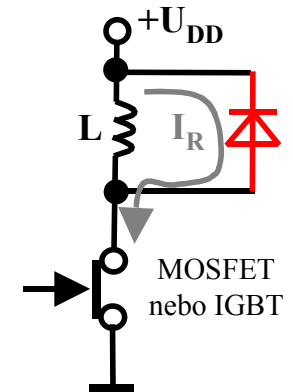
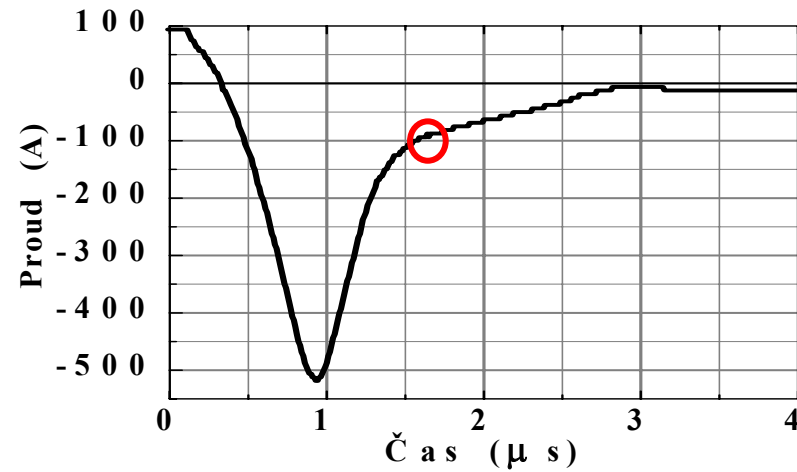
velký odpor — **OPN** — — malý odpor

⇒ omezení proudu na  $I_{RRM}$

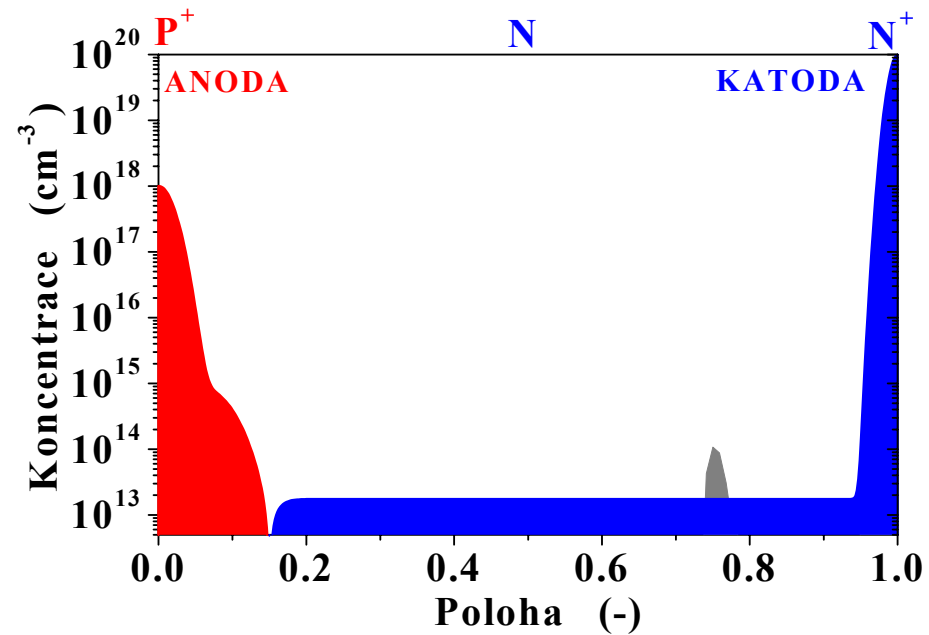
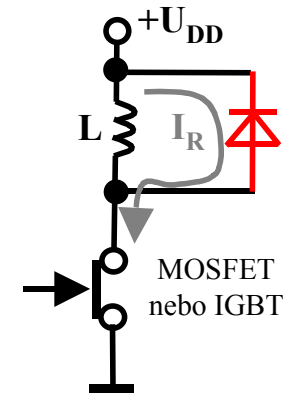
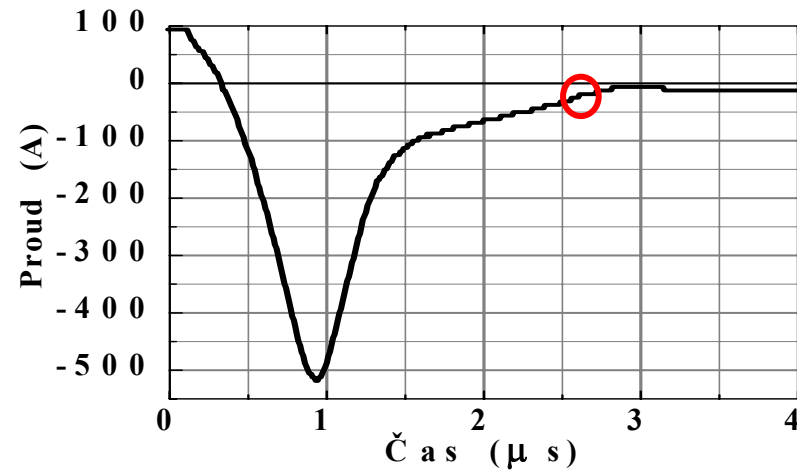
# Komutace diody



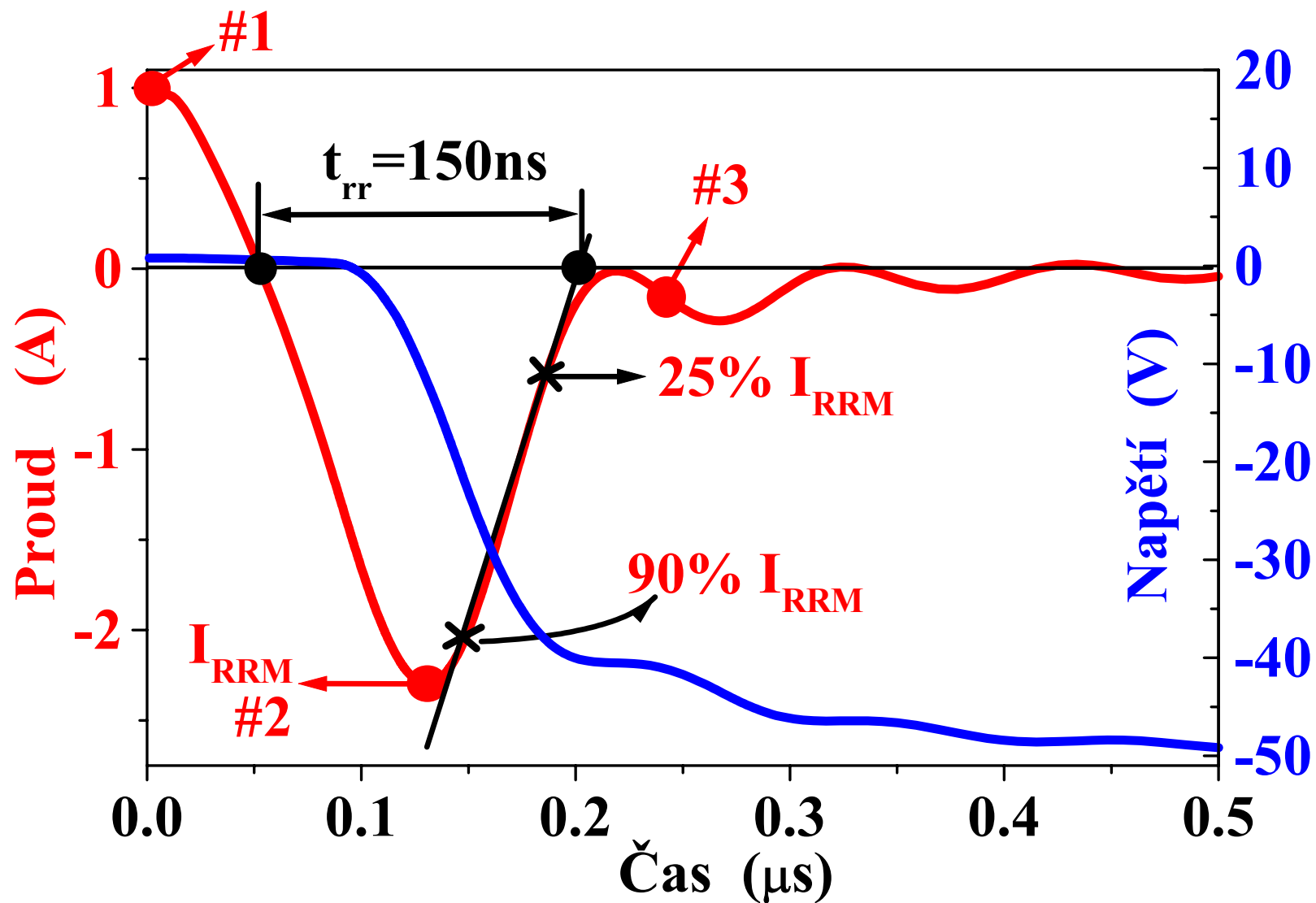
# Komutace diody



# Komutace diody



# Závěrné zotavení – Reverse Recovery



# Diody

## Bipolární

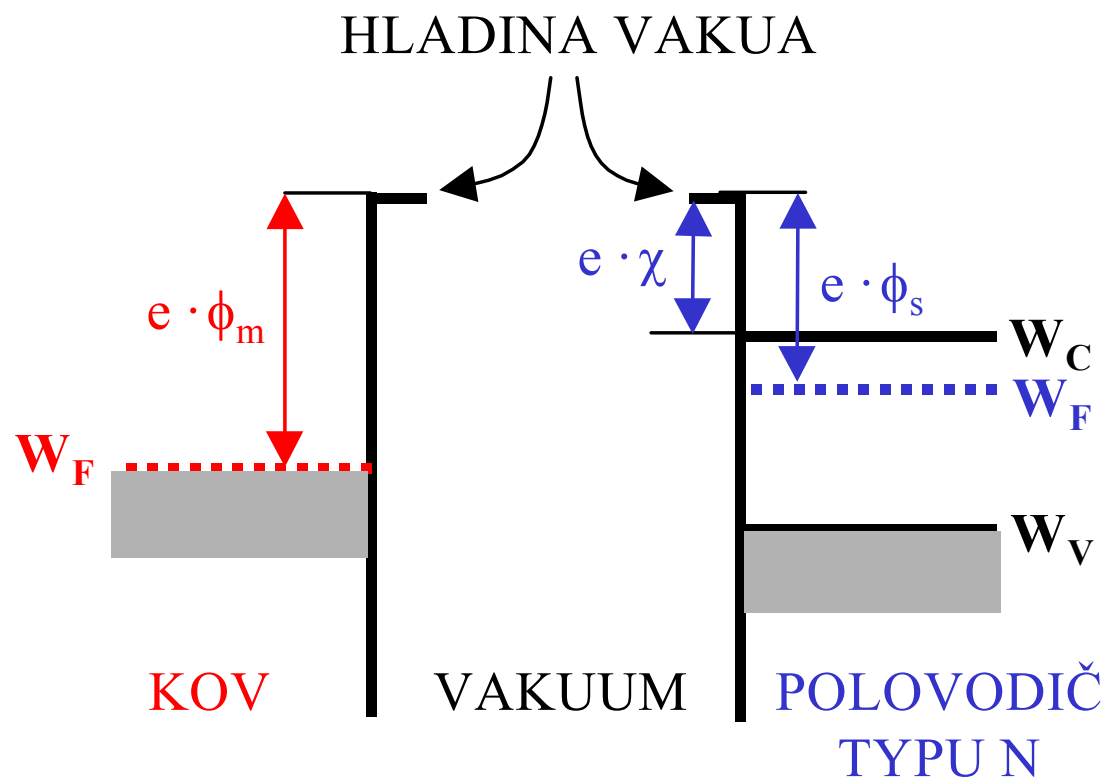
- nosiče náboje obojí polarity
  - p-n přechod

## Unipolární

- nosiče náboje jedné polarity
  - přechod kov-polovodič



# Přechod kov-polovodič



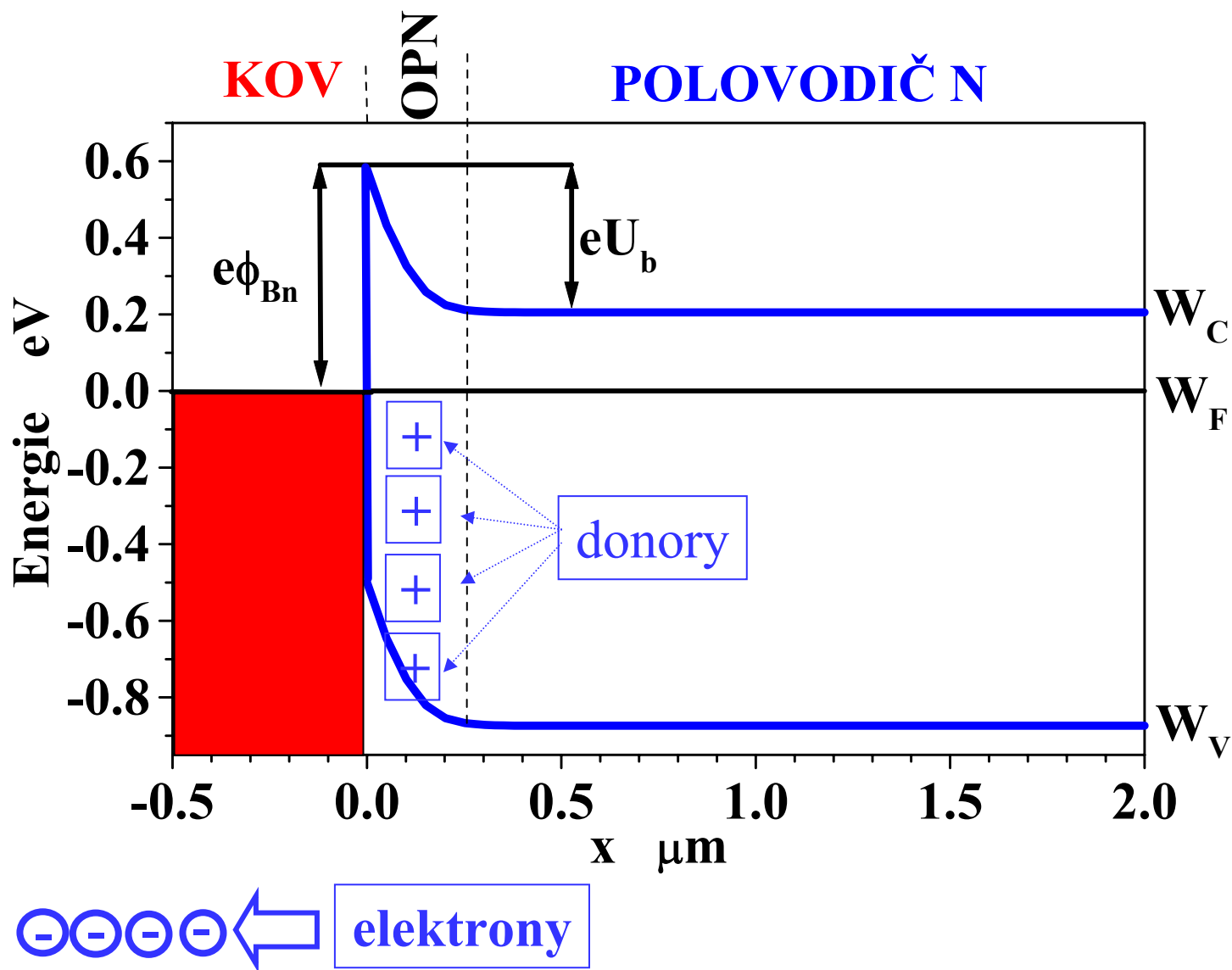
Po „spojení“ musí nastat termodynamická rovnováha  $\Rightarrow$

$\Rightarrow$  nejvyšší obsazené elektronové stavy jsou na stejné energet. úrovni

$\Rightarrow$  Fermiho hladina musí být na stejné úrovni v kovu i v polovodiči

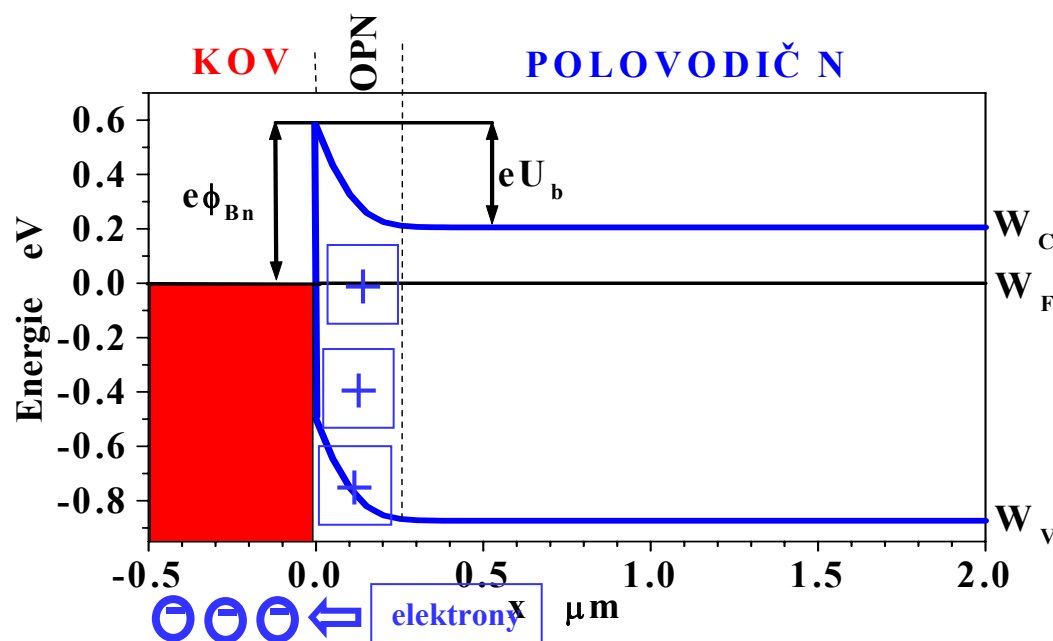
# Přechod kov-polovodič

termodynamická rovnováha



# Přechod kov-polovodič

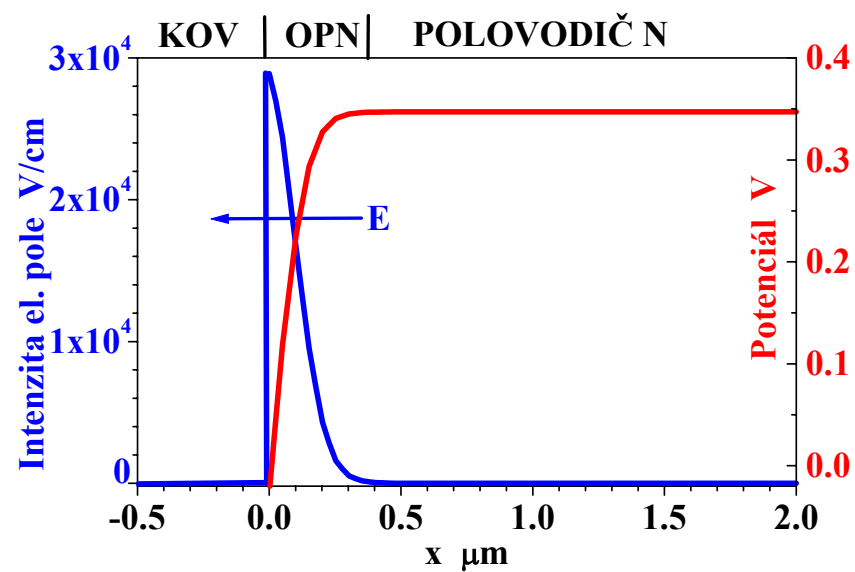
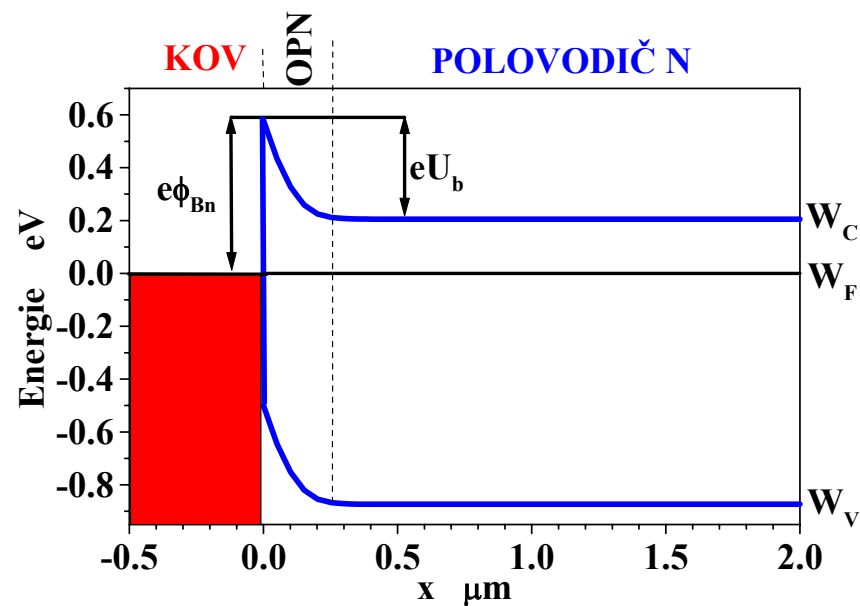
termodynamická rovnováha



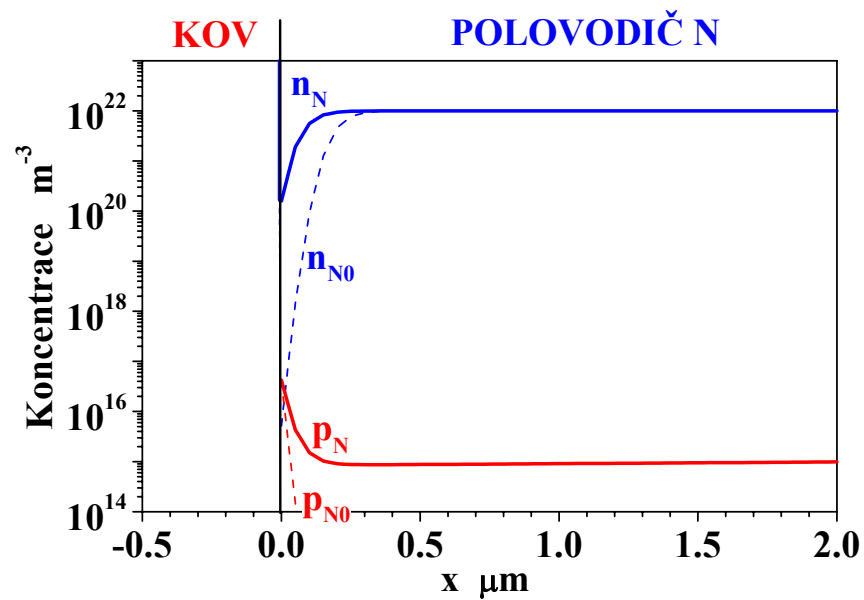
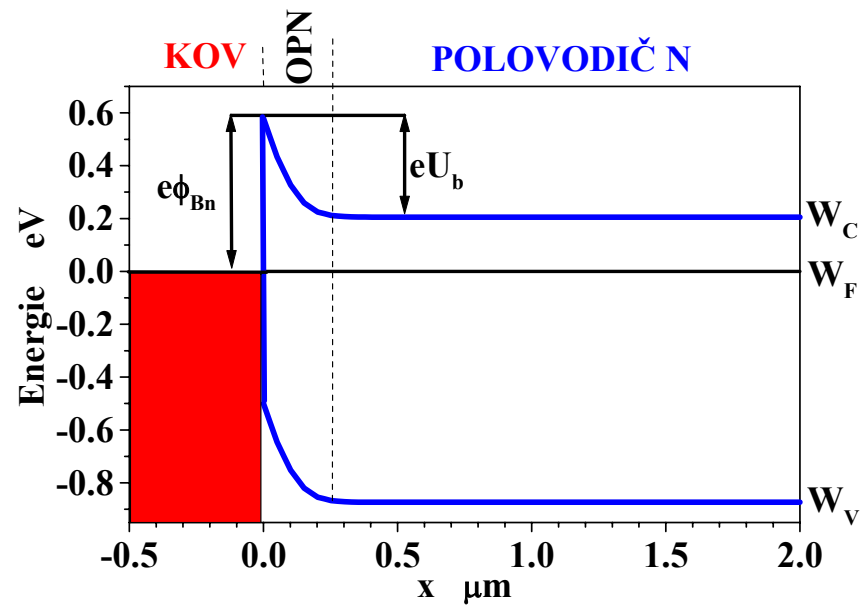
V rovnováze existuje na přechodu kov-polovodič  
Oblast Prostorového Náboje (OPN).

OPN udržuje mnohem větší koncentraci elektronů v kovu  
oproti polovodiči nutnou pro zajištění  $W_F(x) = \text{konst.}$

# Přechod kov-polovodič



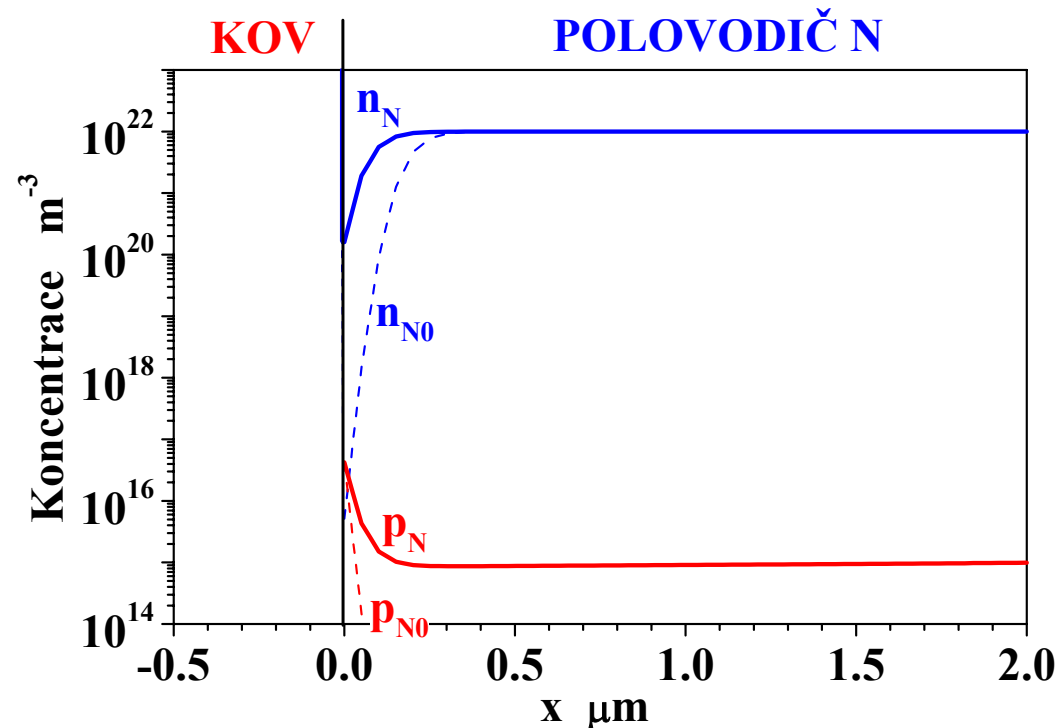
# Přechod kov-polovodič



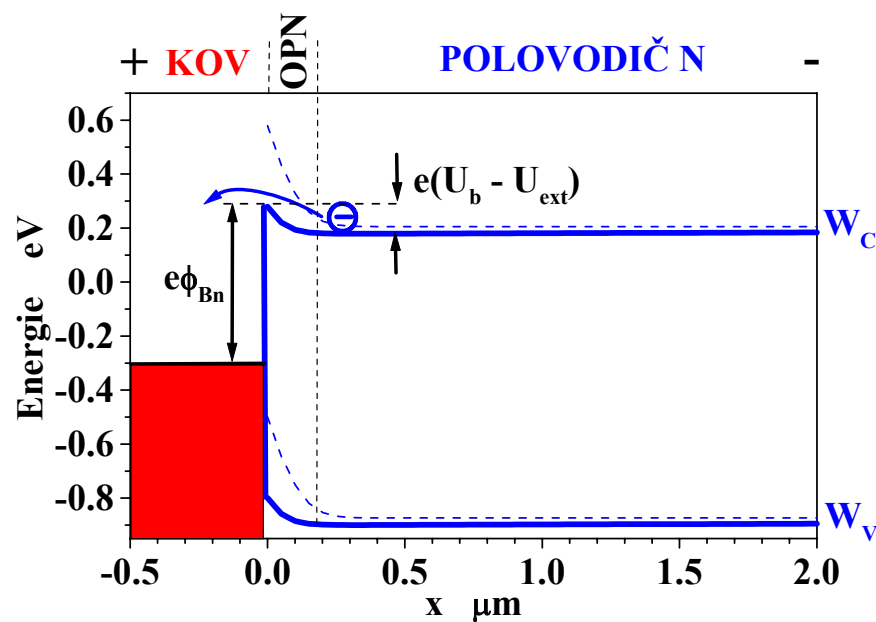
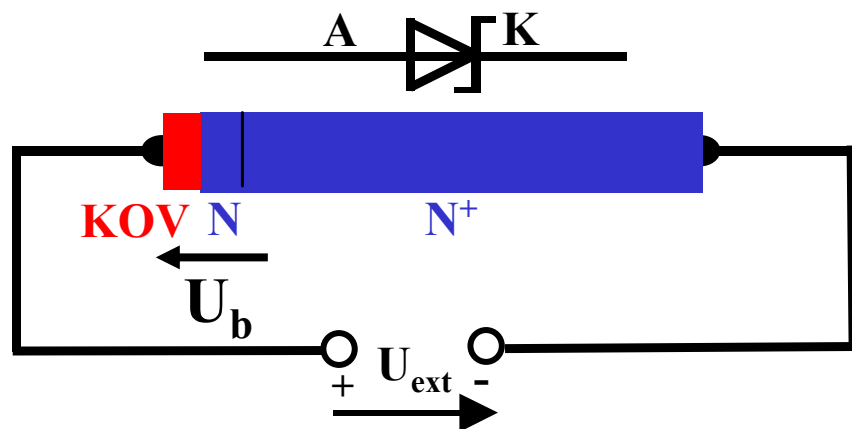
# Přechod kov-polovodič

Koncentrace minoritních nosičů je zanedbatelná.  $\Rightarrow$   
O vlastnostech rozhodují jen majoritní nosiče.

**= předpoklad velmi dobrých dynamických vlastností**  
(dioda nevypíná až když nosiče zrekombinují jako v případě p-n přechodu)



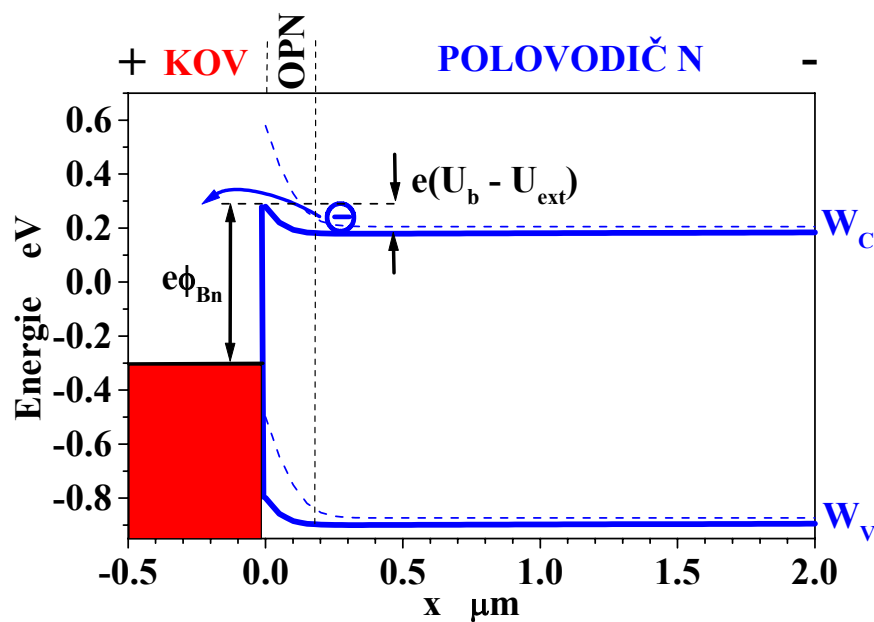
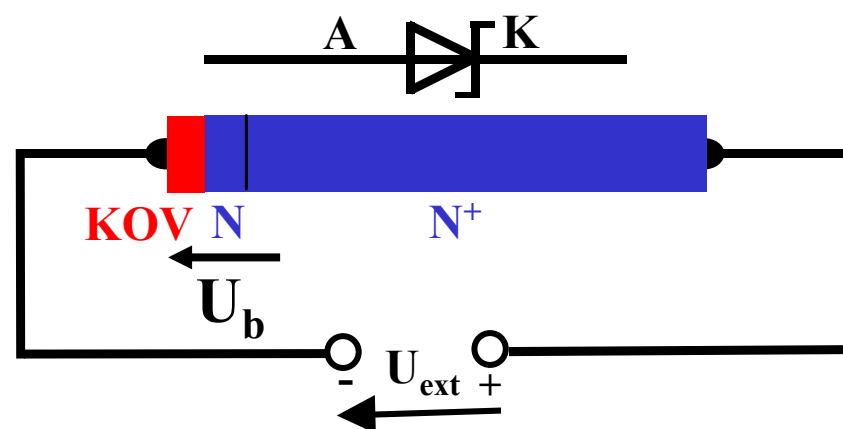
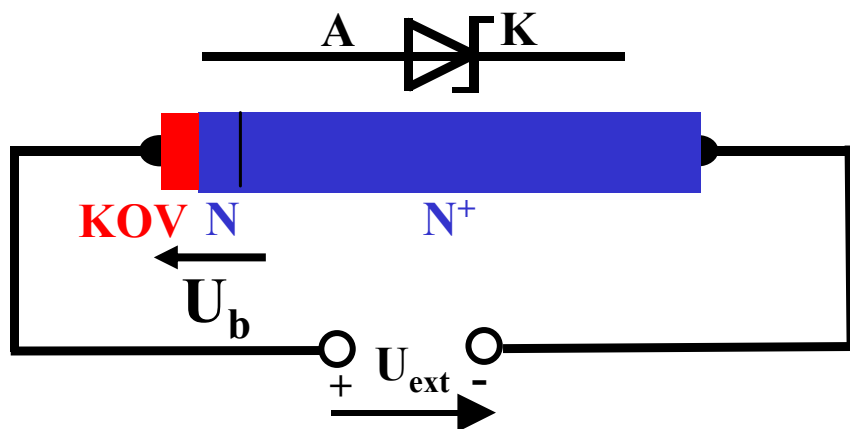
# Přechod kov-polovodič



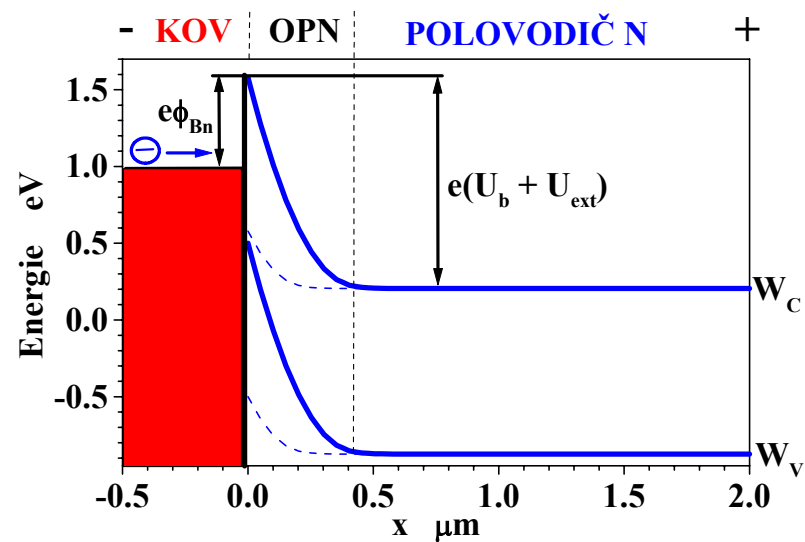
emise majoritních nosičů  
přes energetickou bariéru

a) PROPUSTNÝ SMĚR

# Přechod kov-polovodič



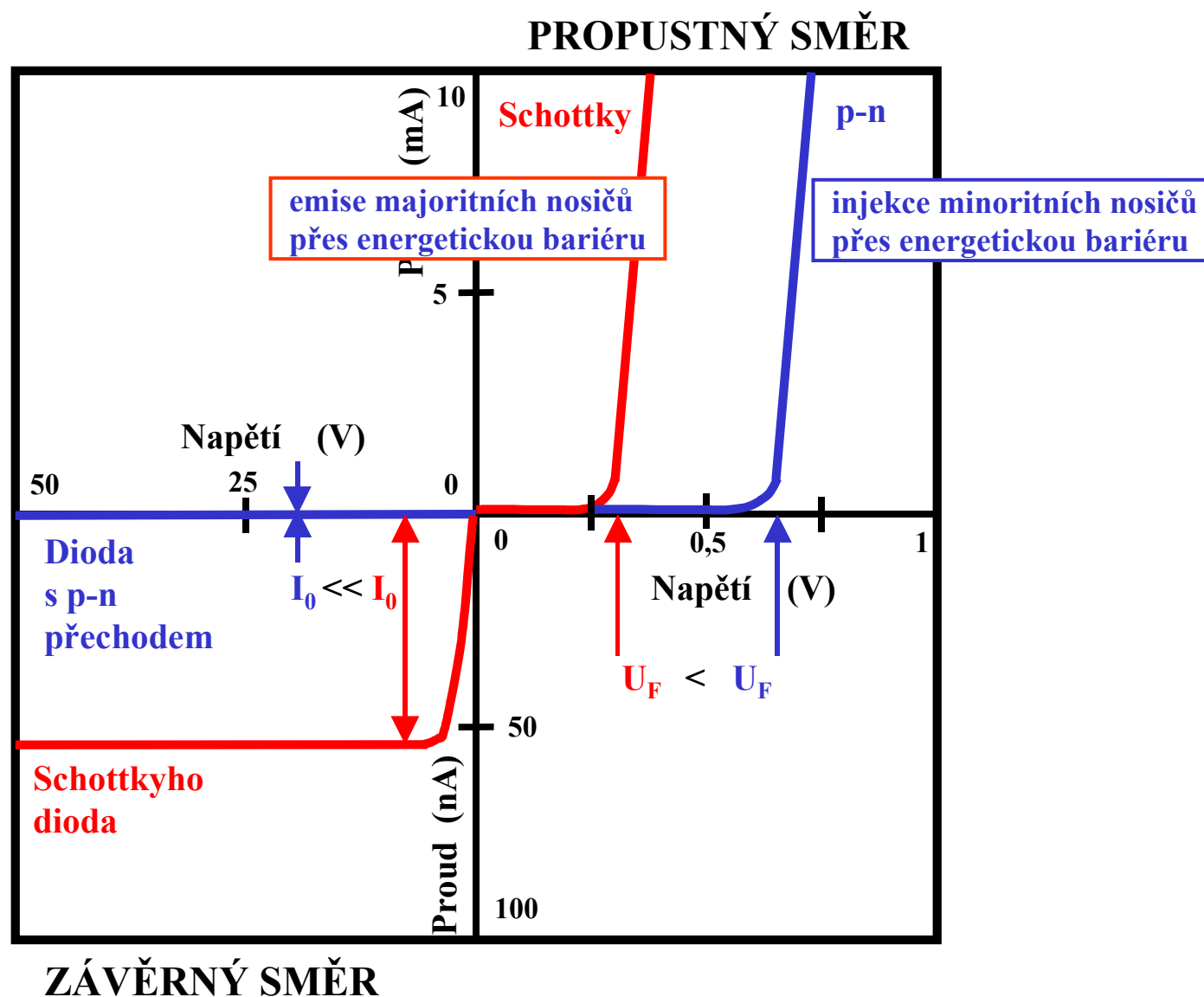
a) PROPUSTNÝ SMĚR



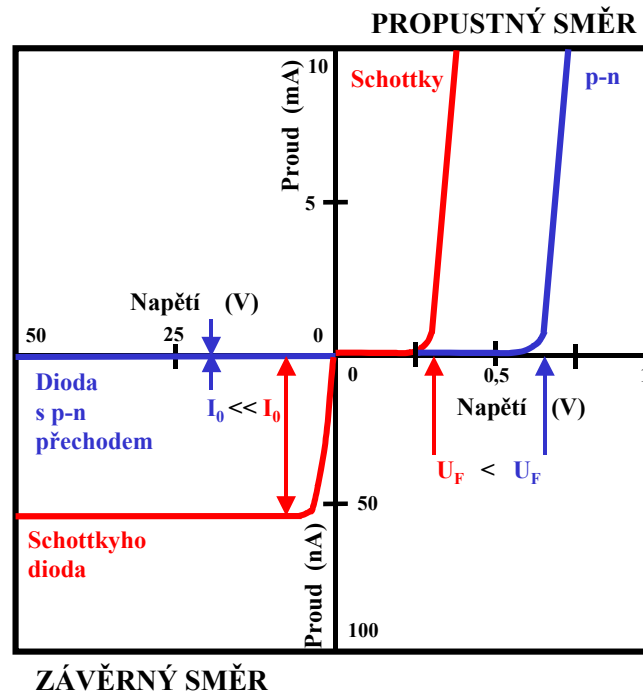
b) ZÁVĚRNÝ SMĚR



# Přechod kov-polovodič



# Přechod kov-polovodič



$$I = I_0 \cdot \left( \exp \frac{e \cdot U}{kT} - 1 \right) = A^* \cdot T^2 \cdot S \cdot \exp \left( \frac{-e \cdot \phi_{Bn}}{kT} \right) \cdot \left( \exp \frac{e \cdot U}{kT} - 1 \right)$$

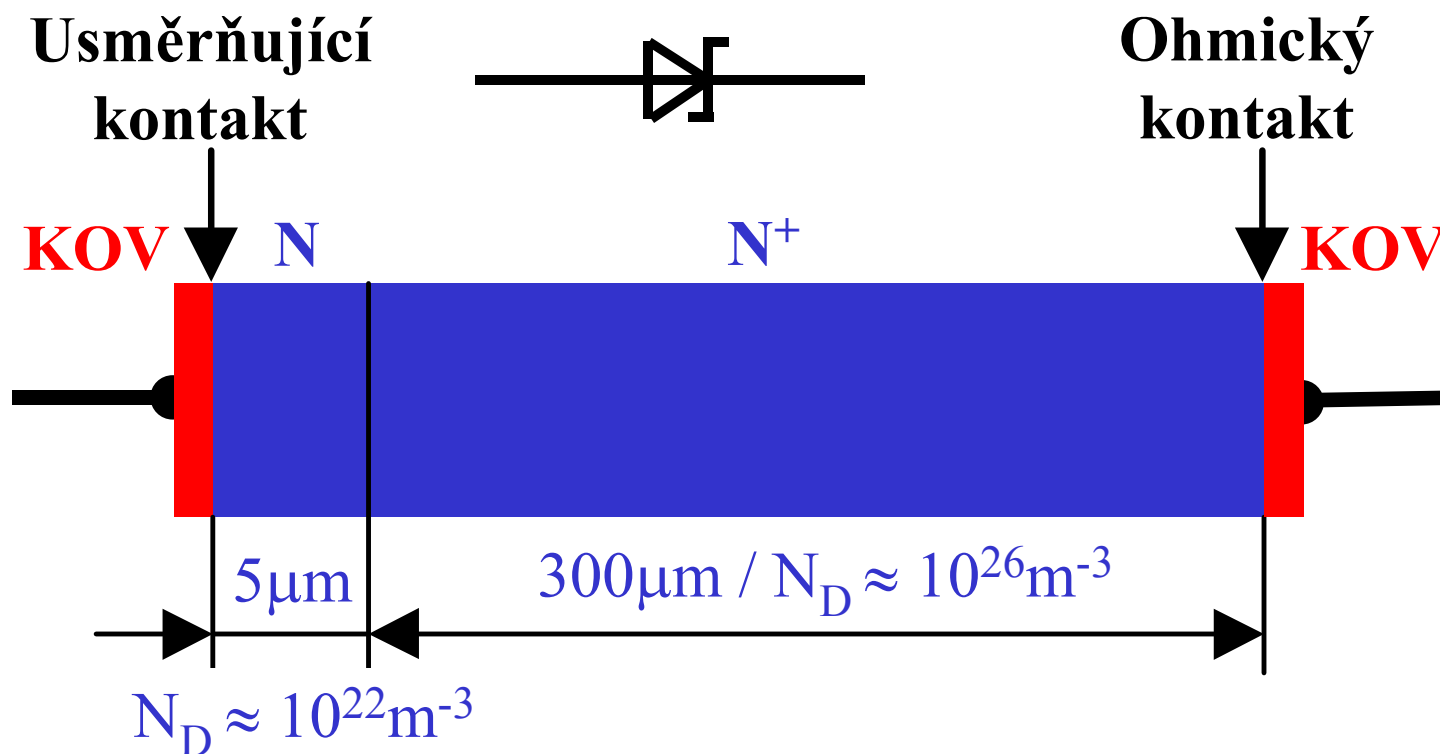
$$I_0 \gg I_0 \Rightarrow U_F \gg U_F \wedge U_{RRM} \gg U_{RRM}$$

# Schottkyho dioda

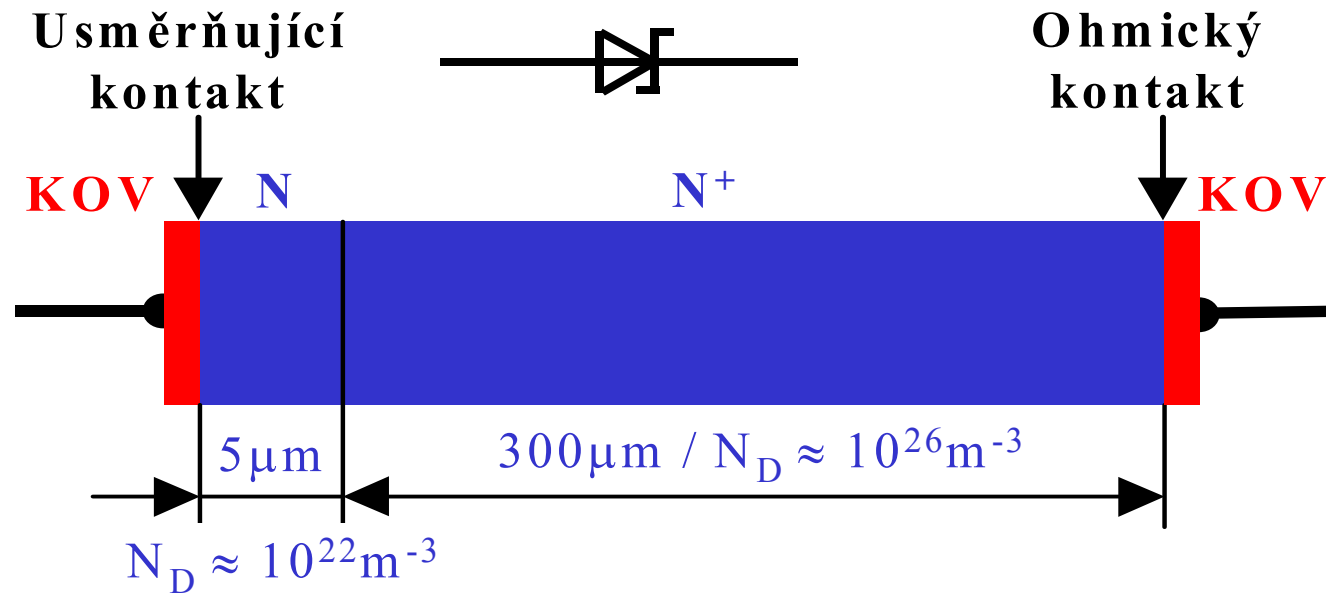
Walter Schottky



Bardeen, Brattain



# Schottkyho dioda



$$I = I_0 \cdot \left( \exp \frac{e \cdot U}{kT} - 1 \right) = A^* \cdot T^2 \cdot S \cdot \exp \left( \frac{-e \cdot \phi_{Bn}}{kT} \right) \cdot \exp \left( \frac{e \cdot \Delta \phi}{kT} \right) \cdot \left( \exp \frac{e \cdot U}{kT} - 1 \right)$$

**Schottkyho jev: pokles výšky bariéry s rostoucí intenzitou el. pole ⇒  
malá hodnota U<sub>RRM</sub> pro Si**

# Schottkyho dioda

Si

## 1 AMP SCHOTTKY BARRIER RECTIFIERS

### FEATURES

- Metal-semiconductor junction with guard ring
- Epitaxial Construction
- Low forward voltage drop
- High current capacity
- For use in low voltage, high frequency inverters, free wheeling, and polarity protection applications

### MECHANICAL DATA

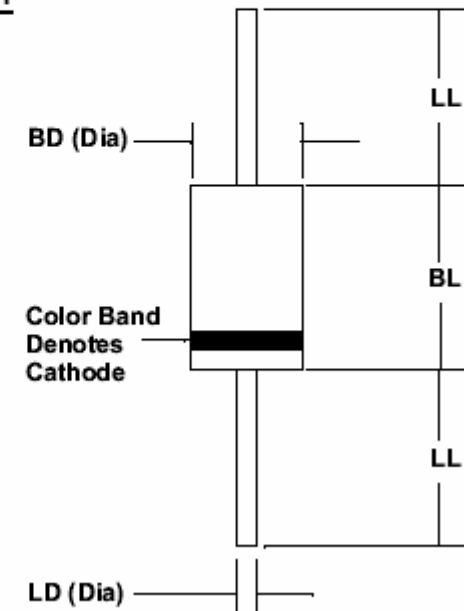
- Case: JEDEC DO-41, molded epoxy (UL Flammability Rating 94V-0)
- Terminals: Plated axial leads
- Soldering: Per MIL-STD 202 Method 208 guaranteed

### MECHANICAL SPECIFICATION

ACTUAL SIZE OF  
DO-41 PACKAGE

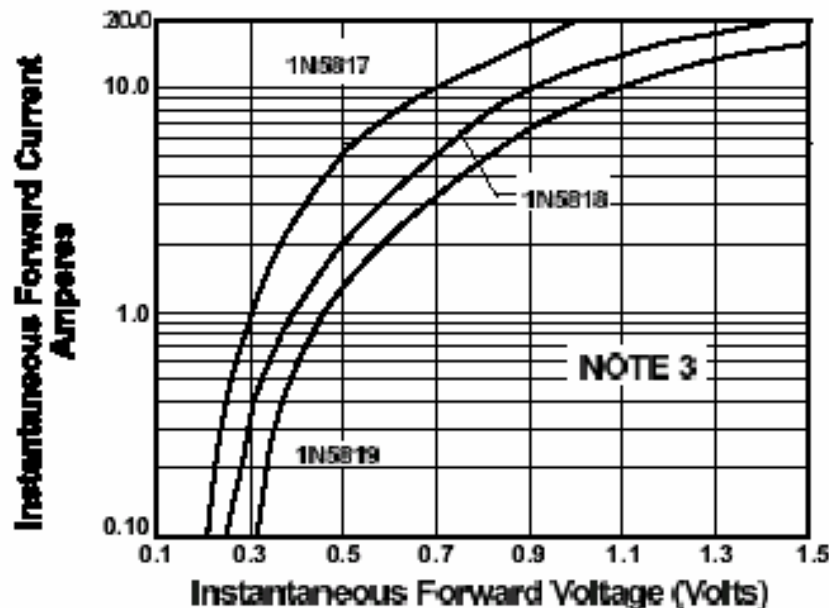
SERIES 1N5817 - 1N5819

DO - 41



# Schottkyho dioda

Si



## TRICAL CHARACTERISTICS

SYMBOL	RATINGS			UNITS
	1N5817	1N5818	1N5819	
V <sub>RM</sub>	20	30	40	VOLTS
V <sub>RMS</sub>	14	21	28	
V <sub>RRM</sub>	20	30	40	
I <sub>O</sub>	1			AMPS
I <sub>FSM</sub>	25			
V <sub>FM</sub>	0.45	0.55	0.6	VOLTS
V <sub>FM</sub>	0.75	0.875	0.9	
I <sub>RM</sub>	1 10			mA
R <sub>ΘJA</sub>	80			°C/W
C <sub>J</sub>	110			pF
T <sub>J</sub>	-65 to +125			°C
T <sub>STG</sub>	-65 to +150			

Maximum Forward Voltage at 1 Amp DC

Maximum Forward Voltage at 3 Amps DC

Maximum Average DC Reverse Current @  $T_L = 25^\circ\text{C}$   
At Rated DC Blocking Voltage (Note 1) @  $T_L = 100^\circ\text{C}$

Typical Thermal Resistance, Junction to Ambient

Typical Junction Capacitance (Note 2)

Junction Operating Temperature Range

Storage Temperature Range

NOTES: (1) Lead temperature reference is cathode lead 1/32 in from case.  
(2) Measured at 1MHz & applied reverse voltage of 4 volts

1N5817

A1

# Schottkyho dioda



**SDT02S60**

## Silicon Carbide Schottky Diode

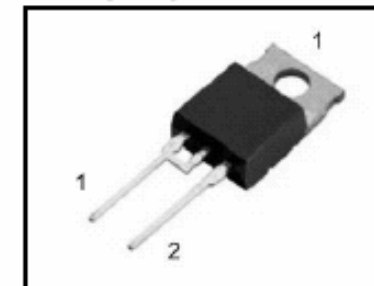
- Worlds first **600V** Schottky diode
- Revolutionary semiconductor material - Silicon Carbide
- Switching behavior benchmark
- No reverse recovery
- No temperature influence on the switching behavior
- No forward recovery

## thinQ!™ SiC Schottky Diode

### Product Summary

$V_{RRM}$	600	V
$Q_C$	4.6	nC
$I_F$	2	A

P-TO220-2-2.



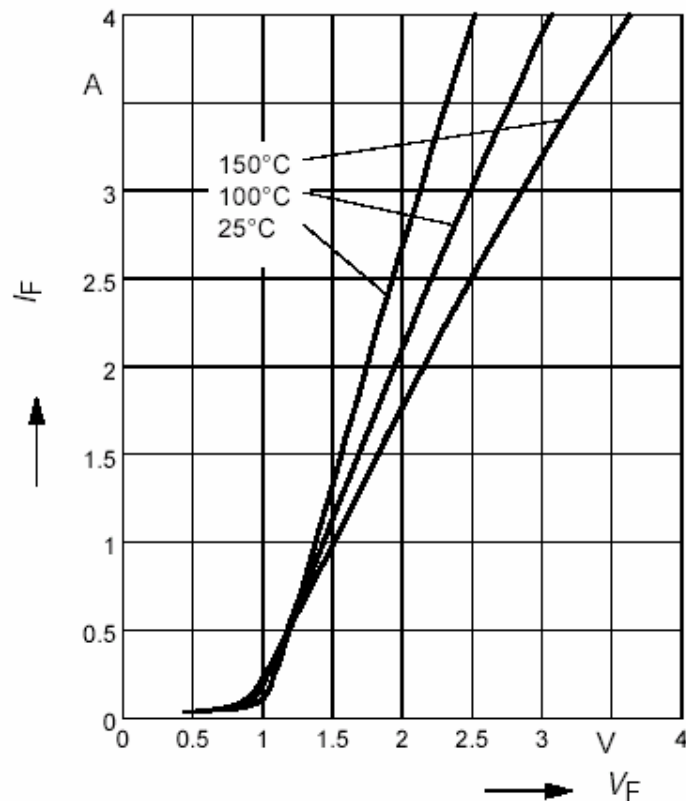
# Schottkyho dioda

SiC

**Maximum Ratings**, at  $T_j = 25^\circ\text{C}$ , unless otherwise specified

Parameter	Symbol	Value	Unit
Continuous forward current, $T_C=100^\circ\text{C}$	$I_F$	2	A
RMS forward current, $f=50\text{Hz}$	$I_{FRMS}$	2.8	
Surge non repetitive forward current, sine halfwave $T_C=25^\circ\text{C}$ , $t_p=10\text{ms}$	$I_{FSM}$	4.1	
Repetitive peak forward current $T_j=150^\circ\text{C}$ , $T_C=100^\circ\text{C}$ , $D=0.1$	$I_{FRM}$	7.3	
Non repetitive peak forward current $t_p=10\mu\text{s}$ , $T_C=25^\circ\text{C}$	$I_{FMAX}$	17	
$i^2t$ value, $T_C=25^\circ\text{C}$ , $t_p=10\text{ms}$	$\int i^2 dt$	0.08	$\text{A}^2\text{s}$
Repetitive peak reverse voltage	$V_{RRM}$	600	V
Surge peak reverse voltage	$V_{RSM}$	600	
Power dissipation, $T_C=25^\circ\text{C}$	$P_{tot}$	15	W
Operating and storage temperature	$T_j, T_{stg}$	-55... +175	$^\circ\text{C}$





# ottkyho dioda

SiC

= 25 °C, unless otherwise specified

	Symbol	Values			Unit
		min.	typ.	max.	
	$V_F$	-	1.75 2.2	2 2.6	V
	$I_R$	-	7 30	100 500	$\mu$ A

## AC Characteristics

Total capacitive charge

$V_R=400V$ ,  $I_F=2A$ ,  $di_F/dt=200A/\mu s$ ,  $T_J=150^\circ C$

Switching time

$V_R=400V$ ,  $I_F=2A$ ,  $di_F/dt=200A/\mu s$ ,  $T_J=150^\circ C$

Total capacitance

$V_R=1V$ ,  $T_C=25^\circ C$ ,  $f=1MHz$

$V_R=300V$ ,  $T_C=25^\circ C$ ,  $f=1MHz$

$V_R=600V$ ,  $T_C=25^\circ C$ ,  $f=1MHz$

Total capacitive charge $V_R=400V$ , $I_F=2A$ , $di_F/dt=200A/\mu s$ , $T_J=150^\circ C$	$Q_C$	-	4.6	-	nC
Switching time $V_R=400V$ , $I_F=2A$ , $di_F/dt=200A/\mu s$ , $T_J=150^\circ C$	$t_{rr}$	-	n.a.	-	ns
Total capacitance $V_R=1V$ , $T_C=25^\circ C$ , $f=1MHz$ $V_R=300V$ , $T_C=25^\circ C$ , $f=1MHz$ $V_R=600V$ , $T_C=25^\circ C$ , $f=1MHz$	$C$	-	50 5.2 5.0	-	pF

# Schottkyho dioda



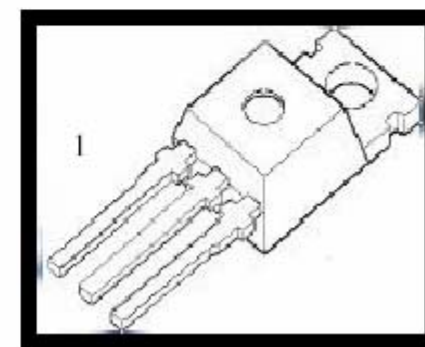
Sch1200\_7P5

## 1200V SiC SCHOTTKY DIODE

### Description:

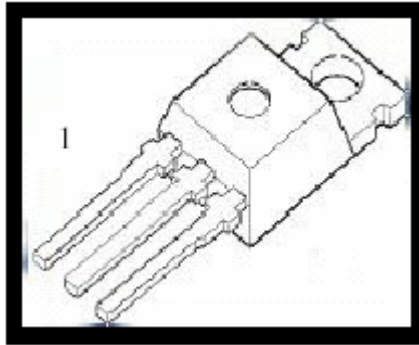
First generation SiC Schottky diode from RSC utilizes advanced processing techniques to achieve zero reverse recovery and benchmark switching behavior.

Package	PIN 1	PIN 2	PIN 3
TO220-3-1	n.c	C	A



$V_F$ $I_F = 7.5A$ $T_J = 25^{\circ}C$ $I_F = 7.5A$ $T_J = 150^{\circ}C$	Diode forward Voltage	2.10	2.12 2.72	2.17	V
$I_R$ $V_R = 1200V$ $T_J = 25^{\circ}C$ $V_R = 1200V$ $T_J = 150^{\circ}C$	Reverse Current	4.1	5.0 25	10	$\mu A$
Operating and Storage Temperature		-55	15	175	C

# Schottkyho dioda



Sch1200\_7P5

## 1200V SiC SCHOTTKY DIODE

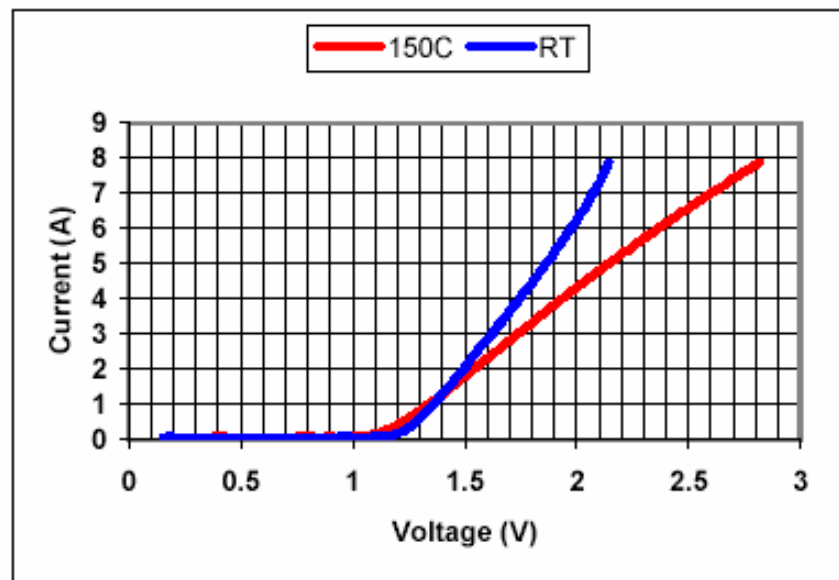


Fig. 1 Typical Forward IV of a 3.7mm<sup>2</sup> SiC Schottky Diode.

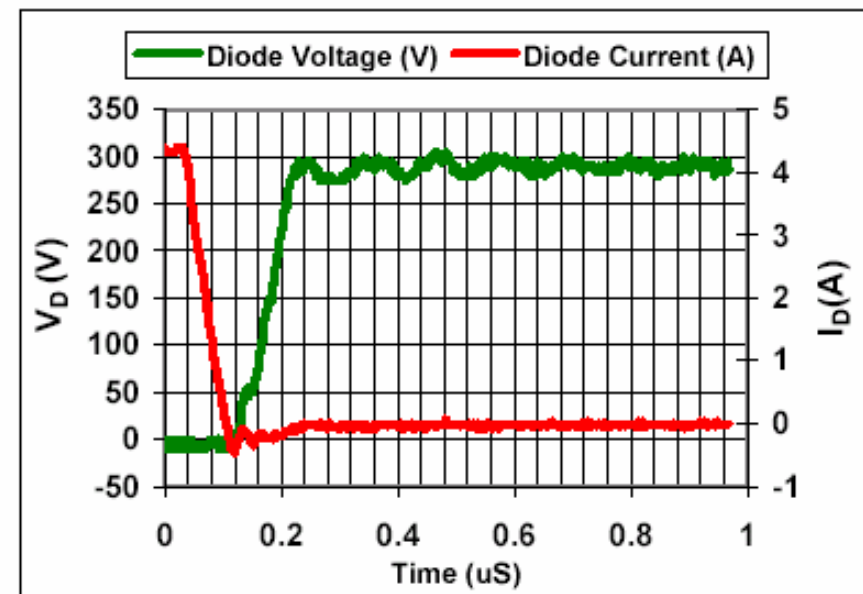


Fig. 3 Typical Reverse Recovery Waveform of 3.7mm<sup>2</sup> SiC Schottky Diode.

# Schotkyho dioda

**IXYS**

DGS 20-018A  
DGSK 40-018A

## Gallium Arsenide Schottky Rectifier

$I_{FAV} = 23 \text{ A}$   
 $V_{RRM} = 180 \text{ V}$   
 $C_{Junction} = 33 \text{ pF}$

$V_{RSM}$ V	$V_{RRM}$ V	Type
180	180	DGS 20-018A

$V_{RSM}$ V	$V_{RRM}$ V	Type
180	180	DGSK 40-018A

Single

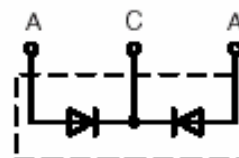


TO-220 AC



A = Anode, C = Cathode, TAB = Cathode

Common cathode



TO-220 AB



# Schottkyho dioda

GaAs

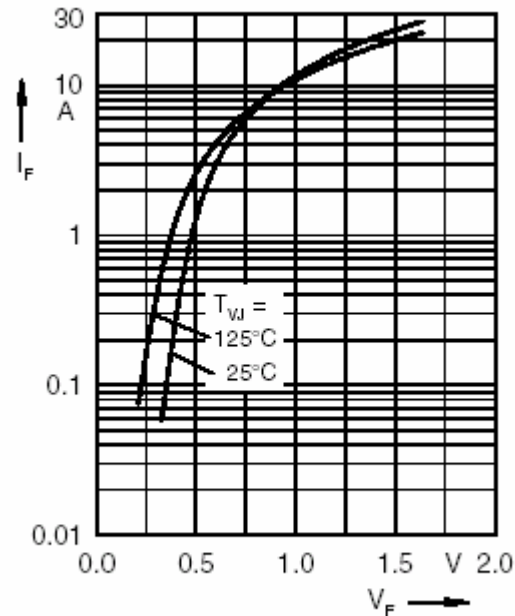


Fig. 1 typ. forward characteristics

## Maximum Ratings

	23	A
	17	A
50 Hz), sine	30	A
	-55...+175	°C
	-55...+150	°C
	48	W
	0.4...0.6	Nm

## Features

- Low forward voltage
- Very high switching speed
- Low junction capacity of GaAs
  - low reverse current peak at turn off
- Soft turn off
- Temperature independent switching behaviour
- High temperature operation capability
- Epoxy meets UL 94V-0

## Applications

- MHz switched mode power supplies (SMPs)
- Small size SMPs
- High frequency converters
- Resonant converters

## Characteristic Values

		typ.	max.	
	$T_{WJ} = 125^{\circ}\text{C}$ $V_R = V_{RRM}$	2.0	2.0	mA mA
$V_F$	$I_F = 7.5 \text{ A}; T_{WJ} = 125^{\circ}\text{C}$	0.8		V
	$I_F = 7.5 \text{ A}; T_{WJ} = 25^{\circ}\text{C}$	0.8	1.0	V
$C_J$	$V_R = 100 \text{ V}; T_{WJ} = 125^{\circ}\text{C}$	33		pF
$R_{thJC}$			3.1	K/W
$R_{thCH}$		0.5		K/W
Weight		2		g

Pulse test: ① Pulse Width = 5 ms, Duty Cycle < 2.0 %

Data according to IEC 60747 and per diode unless otherwise specified

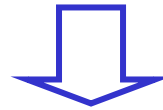
# Vlastnosti Schottkyho diod

Výhody:

- malý  $U_F$  (0.25V) pro malé proudy a malé hodnoty  $U_{RRM}$  (Si)
- žádné závěrné zotavení  $\Rightarrow$  rychlé vypínání

Nevýhody:

- velký  $U_F$  pro velké proudy a vyšší hodnoty  $U_{RRM}$  (Si)
- nízké hodnoty  $U_{RRM}$  (typ. do 200 V u křemíku)



Přechod k materiálům s větší šířkou zakázaného pásu:

GaAs, GaP, SiC

$U_{RRM} \sim 600 \text{ V}, 1200 \text{ V}, \dots$

$U_F \sim 1 - 2 \text{ V}$

vyšší provozní teploty

**k o n e c**