

Univerza v Ljubljani
Fakulteta za elektrotehniko



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Dimmer

Seminarska naloga
pri predmetu
Elektronska vezja, 2.del

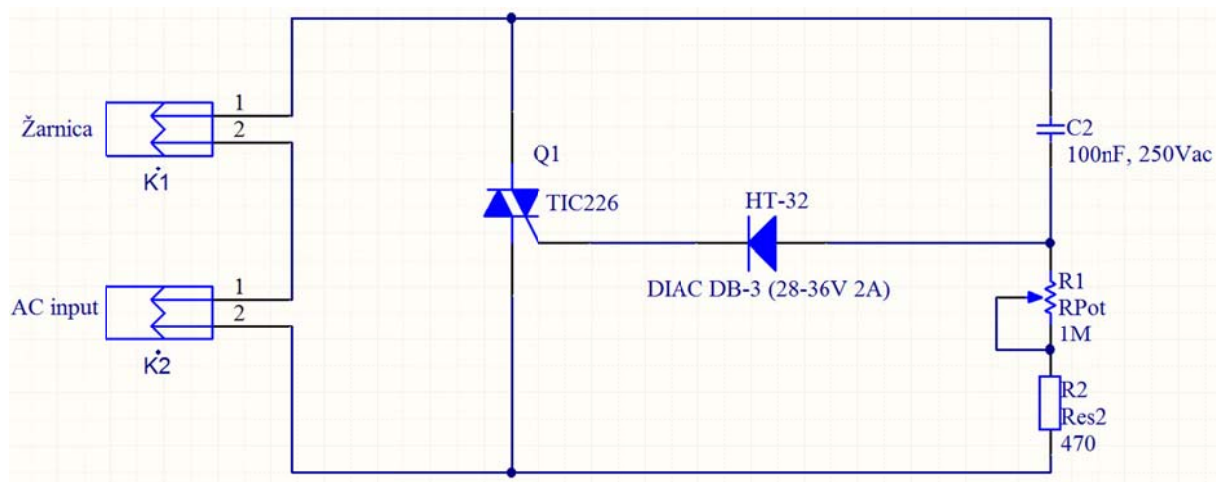
V Ljubljani, julij 2012

1.) Uvod:

O dimmerjih je na spletu napisane veliko literature in že izdelanih projektov. Pri tej seminarski nalogi sem si za cilj postavil izdelati dimmer, ki bo sestavljen iz minimalnega števila elektronskih komponent, ki bodo sestavljale cenovno kar se da ugodno vezje. Število uporabljenih elektronskih komponent sem zreduciral na 7. In sicer 2 konektorja, 2 upora, kondenzator, diak in triak.

2.) Razlaga delovanja:

Izdelal sem sledeče vezje:

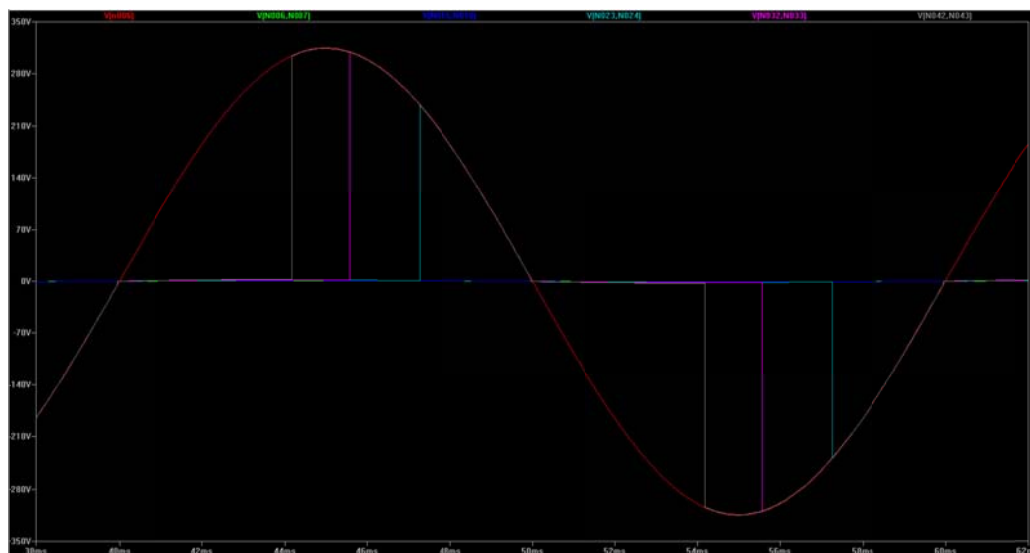


Kot je razvidno z zgornje slike, sem v želji po reduciranju cene uporabil minimalno število komponent. Na konektor K2 priklopimo 230V izmenične napetosti, ki jo pripeljemo iz vtičnice. Na konektor K1 priklopimo žarnico, ki jo bomo osvetljevali/zatemnjevali, t.j. klasična žarnica z žarilno nitko. Naslednja komponenta v seriji je triak, kot prožilni element. Odločil sem se za triak TIC226, ki prenese 600V napetosti ob izklopu in 8A efektivnega toka. Paralelno triaku so vezani prožilni elementi. To je zakasnilni RC člen in diak.

Ob pozitivni polperiodi je triak v stanju visoke impedance in zato skozenj ne teče velik tok. Skozi vzporedno vezani RC člen teče večji tok in dviguje napetost na potenciometru R1. Zakasnitev te napetosti glede na vhodno izmenično napetost z

vtičnice določamo s položajem potenciometra R1. Ko napetost na potenciometru R1 doseže prebojno napetost diaka, t.j. 30V, diak prebije in sproži triak. V trenutku, ko se triak sproži, gre v stanje nizke impedance in skozi žarnico in triak steče tok, ki sedaj omogoča žarnici, da zasveti. Na ta, enostaven, način sedaj lahko z vrtenjem potenciometra R1 določamo zakasnitev v vezju in s tem trenutek v katerem bomo sprožili žarnico. Od tega trenutka, oz. modulacije je odvisno, koliko odstotkov moči se bo dejansko trošilo na žarnici.

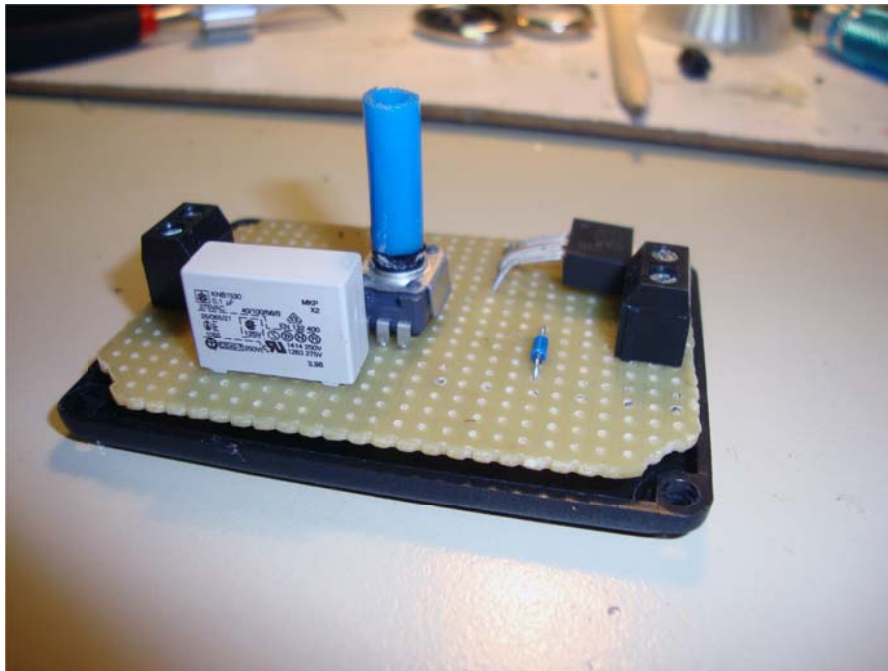
Pri tej seminarski nalogi nisem uporabljal osciloskopa, za razumevanje vezja sem uporabil lastno intuicijo, ki sem jo preveril s programskim paketom LTspice. Prikaz simulacije za različne zatemnitve:



Na zgornji sliki predstavlja rdeč graf omrežno napetost, ostali grafi pa prikazujejo napetost na žarnici pri različnih zakasnilnih RC členih.

3.) Izdelava:

Prej omenjene komponente sem prispajkal na prazno rastersko ploščo, ki sem jo oblikoval tako, da se je tesno prilegala ohišju iz plastike. Komponente sem med seboj povezal z močnejšo žico na spodnji strani plošče. Ohišje sem na zgornji strani zvrтал, na potenciometer pa pritrdil distančnik, ki gre ven iz ohišja na gumb.



Gumb se s strani pritrdi na distančnik in vrtenje je sedaj omogočeno z zunanje strani ohišja. Z leve in desne je na sliki viden še priključek za omrežno napetost in žarnico.

4.) Seznam komponent:

2× dvopolni konektor

1× triak TIC226

1× diak DB-3

1× upor 470Ω

1× potenciometer $1M\Omega$

1× blokirni kondenzator $100nF/250Vac$

Cena zgoraj naštetih komponent znaša manj kot 2€ kar je ugodno glede na ceno tovrstnih vezij v trgovini.

5.) Zaključek:

Nadgradnja tega vezja bi lahko bil dodan filter na vhodu za blokiranje motenj, lahko bi dodal mikrokrmilnik in daljinsko upravljanje vezja, avtomatski vklop/izklop glede na osvetlitev prostora,... skratka omejimo se lahko samo z lastno domišljijo.

Glede osnovnega cilja, se mi zdi realizirana rešitev sprejemljiva, saj je enostavna, zasede minimalno površino vezja ob nizki ceni izdelave.

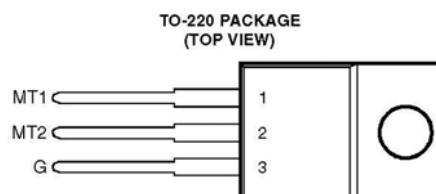
6.) Kataloški podatki:

➤ Triak:

BOURNS®

**TIC226 SERIES
SILICON TRIACS**

- 8 A RMS
- Glass Passivated Wafer
- 400 V to 800 V Off-State Voltage
- Max I_{GT} of 50 mA (Quadrants 1 - 3)



Pin 2 is in electrical contact with the mounting base.

MDC2ACA

absolute maximum ratings over operating case temperature (unless otherwise noted)

RATING	SYMBOL	VALUE	UNIT
Repetitive peak off-state voltage (see Note 1)	TIC226D	400	V
	TIC226M	600	
	TIC226S	700	
	TIC226N	800	
Full-cycle RMS on-state current at (or below) 85°C case temperature (see Note 2)	$I_{T(RMS)}$	8	A
Peak on-state surge current full-sine-wave at (or below) 25°C case temperature (see Note 3)	I_{TSM}	70	A
Peak gate current	I_{GM}	±1	A
Peak gate power dissipation at (or below) 85°C case temperature (pulse width ≤ 200 μs)	P_{GM}	2.2	W
Average gate power dissipation at (or below) 85°C case temperature (see Note 4)	$P_{G(AV)}$	0.9	W
Operating case temperature range	T_C	-40 to +110	°C
Storage temperature range	T_{stg}	-40 to +125	°C
Lead temperature 1.6 mm from case for 10 seconds	T_L	230	°C

- NOTES: 1. These values apply bidirectionally for any value of resistance between the gate and Main Terminal 1.
2. This value applies for 50-Hz full-sine-wave operation with resistive load. Above 85°C derate linearly to 110°C case temperature at the rate of 320 mA/°C.
3. This value applies for one 50-Hz full-sine-wave when the device is operating at (or below) the rated value of on-state current. Surge may be repeated after the device has returned to original thermal equilibrium. During the surge, gate control may be lost.
4. This value applies for a maximum averaging time of 20 ms.

electrical characteristics at 25°C case temperature (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
I_{DRM} Repetitive peak off-state current	$V_D = \text{rated } V_{DRM}$ $I_G = 0$ $T_C = 110^\circ\text{C}$			±2	mA
I_{GT} Gate trigger current	$V_{supply} = +12\text{ V}^\dagger$ $R_L = 10\ \Omega$ $t_{p(g)} > 20\ \mu\text{s}$		6	50	mA
	$V_{supply} = +12\text{ V}^\dagger$ $R_L = 10\ \Omega$ $t_{p(g)} > 20\ \mu\text{s}$		-12	-50	
	$V_{supply} = -12\text{ V}^\dagger$ $R_L = 10\ \Omega$ $t_{p(g)} > 20\ \mu\text{s}$		-10	-50	
	$V_{supply} = -12\text{ V}^\dagger$ $R_L = 10\ \Omega$ $t_{p(g)} > 20\ \mu\text{s}$		25		
V_{GT} Gate trigger voltage	$V_{supply} = +12\text{ V}^\dagger$ $R_L = 10\ \Omega$ $t_{p(g)} > 20\ \mu\text{s}$		0.7	2	V
	$V_{supply} = +12\text{ V}^\dagger$ $R_L = 10\ \Omega$ $t_{p(g)} > 20\ \mu\text{s}$		-0.8	-2	
	$V_{supply} = -12\text{ V}^\dagger$ $R_L = 10\ \Omega$ $t_{p(g)} > 20\ \mu\text{s}$		-0.8	-2	
	$V_{supply} = -12\text{ V}^\dagger$ $R_L = 10\ \Omega$ $t_{p(g)} > 20\ \mu\text{s}$		0.9	2	
V_T On-state voltage	$I_T = \pm 12\text{ A}$ $I_G = 50\text{ mA}$ (see Note 5)		±1.5	±2.1	V

† All voltages are with respect to Main Terminal 1.

PRODUCT INFORMATION

APRIL 1971 - REVISED SEPTEMBER 2002
Specifications are subject to change without notice.

TIC226 SERIES SILICON TRIACS

BOURNS®

electrical characteristics at 25°C case temperature (unless otherwise noted) (continued)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
I_H Holding current	$V_{supply} = +12\text{ V} \uparrow$ $V_{supply} = -12\text{ V} \uparrow$ $I_G = 0$ Init' $I_{TM} = 100\text{ mA}$ Init' $I_{TM} = -100\text{ mA}$		10 -6	30 -30	mA
I_L Latching current	$V_{supply} = +12\text{ V} \uparrow$ $V_{supply} = -12\text{ V} \uparrow$ (see Note 6)			50 -50	mA
dv/dt Critical rate of rise of off-state voltage	$V_{DRM} = \text{Rated } V_{DRM}$ $I_G = 0$ $T_C = 110^\circ\text{C}$		± 100		V/ μs
$dv/dt_{(c)}$ Critical rise of commutation voltage	$V_{DRM} = \text{Rated } V_{DRM}$ $I_{TRM} = \pm 12\text{ A}$ $T_C = 85^\circ\text{C}$ (see figure 7)	± 5			V/ μs

† All voltages are with respect to Main Terminal 1.

NOTES: 5. This parameter must be measured using pulse techniques, $t_p \leq 1\text{ ms}$, duty cycle $\leq 2\%$. Voltage-sensing contacts separate from the current carrying contacts are located within 3.2 mm from the device body.

6. The triacs are triggered by a 15-V (open-circuit amplitude) pulse supplied by a generator with the following characteristics:
 $R_G = 100\ \Omega$, $t_{p(g)} = 20\ \mu\text{s}$, $t_r \leq 15\text{ ns}$, $f = 1\text{ kHz}$.

thermal characteristics

PARAMETER	MIN	TYP	MAX	UNIT
$R_{\theta JC}$ Junction to case thermal resistance			1.8	$^\circ\text{C/W}$
$R_{\theta JA}$ Junction to free air thermal resistance			62.5	$^\circ\text{C/W}$

TYPICAL CHARACTERISTICS

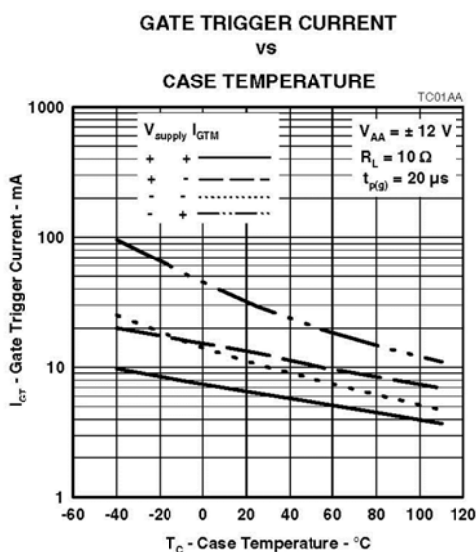


Figure 1.

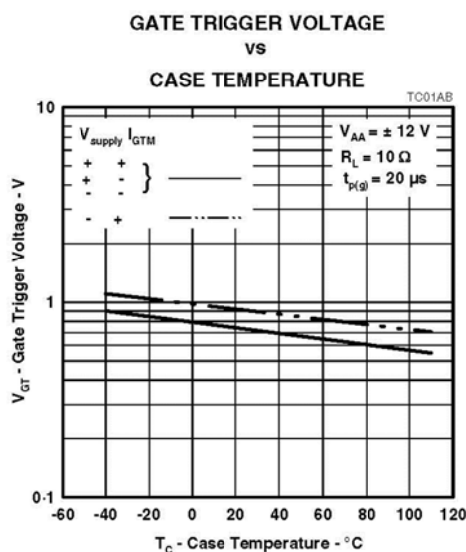


Figure 2.

PRODUCT INFORMATION

TYPICAL CHARACTERISTICS

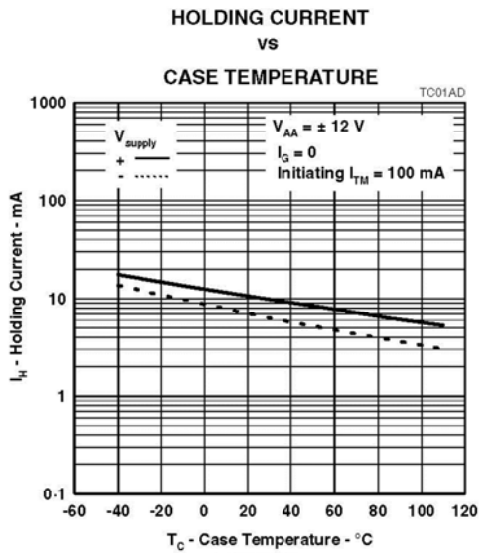


Figure 3.

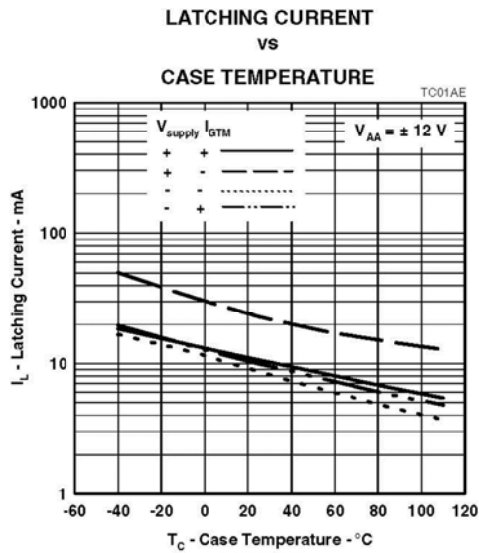


Figure 4.

THERMAL INFORMATION

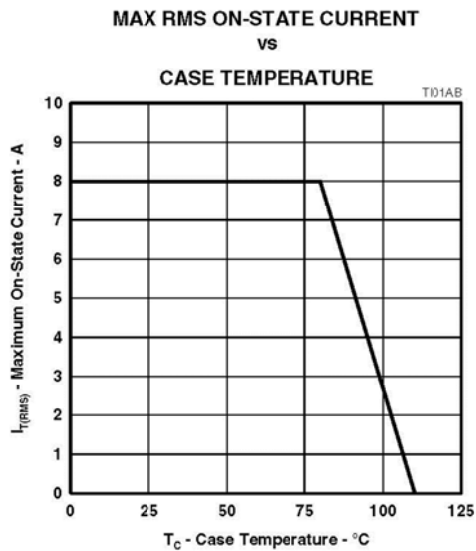


Figure 5.

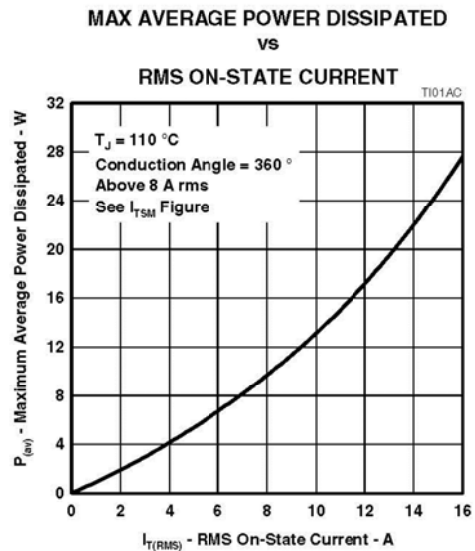


Figure 6.

PRODUCT INFORMATION

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➤ Diak:



DB3 DB4 SMDB3

DIAC

FEATURES

- V_{BO} : 32V and 40V
- LOW BREAKOVER CURRENT

DESCRIPTION

Functioning as a trigger diode with a fixed voltage reference, the DB3/DB4 series can be used in conjunction with triacs for simplified gate control circuits or as a starting element in fluorescent lamp ballasts.

A new surface mount version is now available in SOT-23 package, providing reduced space and compatibility with automatic pick and place equipment.



DO-35
(DB3 and DB4)



SOT-23
(SMDB3)*
Pin 1 and 3 must be shorted together

ABSOLUTE MAXIMUM RATINGS (limiting values)

Symbol	Parameter		Value	Unit
I_{TRM}	Repetitive peak on-state current $t_p = 20 \mu s$ $F = 120 \text{ Hz}$	SMDB3	1.00	A
		DB3 / DB4	2.00	
T_{stg} T_j	Storage temperature range Operating junction temperature range		- 40 to + 125	°C

Note: * SMDB3 indicated as Preliminary spec as product is still in development stage.

DB3 DB4 SMDB3

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions		SMDB3	DB3	DB4	Unit
V _{BO}	Breakover voltage *	C = 22nF **	MIN.	28	28	35	V
			TYP.	32	32	40	
			MAX.	36	36	45	
V _{BO1} - V _{BO2}	Breakover voltage symmetry	C = 22nF **	MAX.	3			V
Δ V	Dynamic breakover voltage *	V _{BO} and V _F at 10mA	MIN.	10	5		V
V _O	Output voltage *	see diagram 2 (R=20Ω)	MIN.	10	5		V
I _{BO}	Breakover current *	C = 22nF **	MAX.	10	50		μA
t _r	Rise time *	see diagram 3	MAX.	0.50	2		μs
I _R	Leakage current *	V _R = 0.5 V _{BO} max	MAX.	1	10		μA
I _P	Peak current *	see diagram 2 (Gate)	MIN.	1	0.30		A

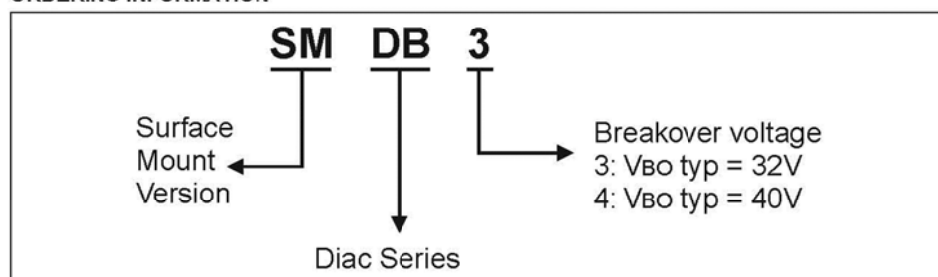
* Applicable to both forward and reverse directions.

** Connected in parallel to the device.

PRODUCT SELECTOR

Part Number	V _{BO}	Package
SMDB3	28 - 36	SOT-23
DB3	28 - 36	DO-35
DB4	35 - 45	DO-35

ORDERING INFORMATION



OTHER INFORMATION

Part Number	Marking	Weight	Base Quantity	Packing Mode
SMDB3	DB3	0.01 g	3000	Tape & Reel
DB3	DB3 (Blue Body Coat)	0.15 g	5000	Tape & Reel
DB4	DB4 (Blue Body Coat)	0.15 g	5000	Tape & Reel

Diagram 1: Voltage - current characteristic curve.

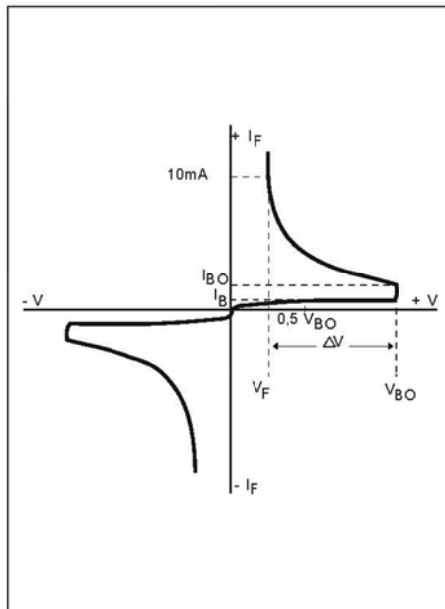


Diagram 2: Test circuit.

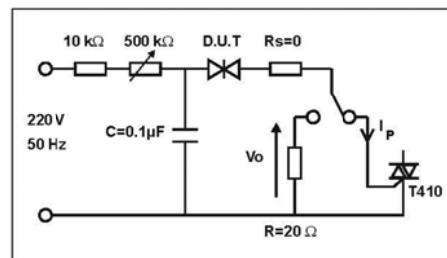


Diagram 3: Rise time measurement.

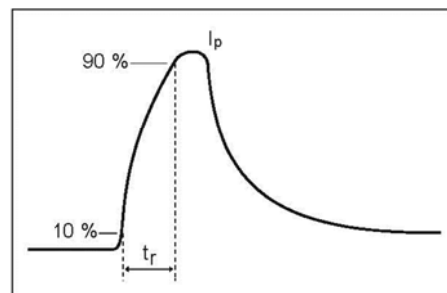
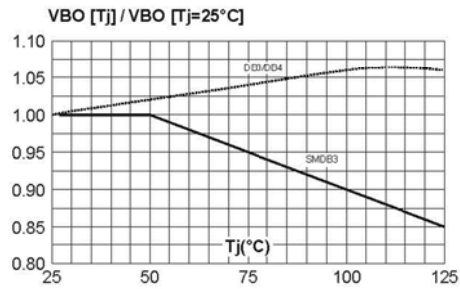
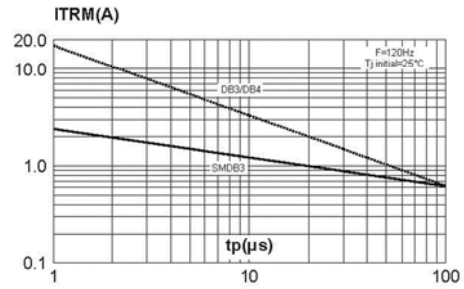
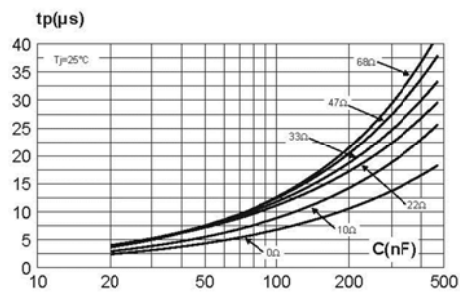
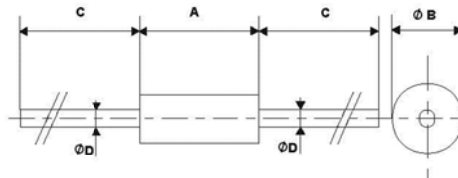


Fig. 1: Relative variation of VBO versus junction temperature (typical values).**Fig. 2:** Repetitive peak pulse current versus pulse duration (maximum values).**Fig. 3:** Time duration while current pulse is higher 50mA versus C and Rs (typical values).**PACKAGE MECHANICAL DATA** (in millimeters)
DO-35

REF.	DIMENSIONS			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	3.05	4.50	0.120	0.177
B	1.53	2.00	0.060	0.079
C	28.00		1.102	
D	0.458	0.558	0.018	0.022