REGULATOR DIODES

Also available to BS9305—F052

A range of diffused silicon diodes in DO-5 metal envelopes, intended for use as voltage regulator and transient suppressor diodes in power stabilization and transient suppression circuits.

The series consists of the following types:
Normal polarity (cathode to stud): BZY91-C7V5 to BZY91-C75.
Reverse polarity (anode to stud): BZY91-C7V5R to BZY91-C75R.

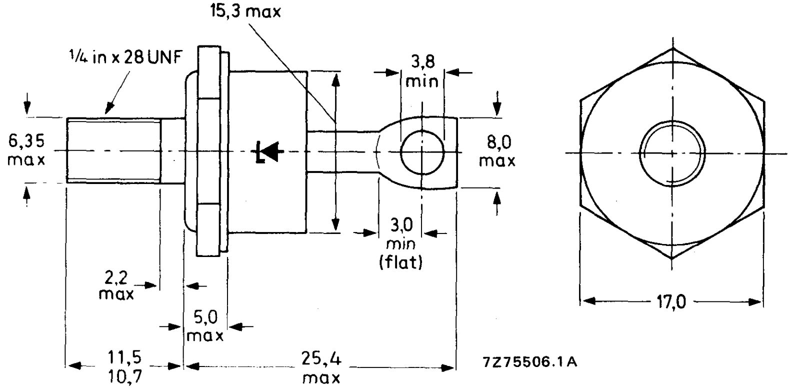
QUICK REFERENCE DATA

			voltage regulator	transient suppressor	
Working voltage (5% range)	V_Z	nom.	7,5 to 75	–	V
Stand-off voltage	V_R		–	5,6 to 56	V
Total power dissipation	P_{tot}	max.	100	–	W
Non-repetitive peak reverse power dissipation	P_{RSM}	max.	–	9,5	kW

MECHANICAL DATA

Dimensions in mm

Fig. 1 DO-5.



Net mass: 22 g

Diameter of clearance hole: max. 6,5 mm

Accessories supplied on request: 56264A
(mica washer, insulating ring, tag)

Supplied with device: 1 nut, 1 lock washer
Nut dimensions across the flats: 11,1 mm

Torque on nut: min. 1,7 Nm (17 kg cm)
max. 3,5 Nm (35 kg cm)

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Peak working current	I_{ZM}	max.	400 A
Average forward current (averaged over any 20 ms period)	$I_{F(AV)}$	max.	20 A
Non-repetitive peak reverse current T_j = 25 °C prior to surge; t_p = 1 ms (exponential pulse); BZY91-C7V5(R) to BZY91-C75(R)	I_{RSM}	max.	1000 to 85 A
Total power dissipation up to T_{mb} = 25 °C	P_{tot}	max.	100 W
at T_{mb} = 65 °C	P_{tot}	max.	75 W
Non-repetitive peak reverse power dissipation T_j = 25 °C prior to surge; t_p = 1 ms (exponential pulse)	P_{RSM}	max.	9,5 kW
Storage temperature	T_{stg}		−55 to + 175 °C
Junction temperature	T_j	max.	175 °C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1,5 °C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0,2 °C/W

CHARACTERISTICS

Forward voltage I_F = 10 A; T_{mb} = 25 °C	V_F	<	1,5 V

OPERATION AS A VOLTAGE REGULATOR (see page 4)

Dissipation and heatsink considerations

a. Steady-state conditions

The maximum permissible steady-state dissipation $P_{s\,max}$ is given by the relationship

$$P_{s\,max} = \frac{T_{j\,max} - T_{amb}}{R_{th\ j\text{-}a}}$$

where: $T_{j\,max}$ is the maximum permissible operating junction temperature
T_{amb} is the ambient temperature
$R_{th\ j\text{-}a}$ is the total thermal resistance from junction to ambient

$$R_{th\ j\text{-}a} = R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a}$$

$R_{th\ mb\text{-}h}$ is the thermal resistance from mounting base to heatsink, that is, 0,2 °C/W.
$R_{th\ h\text{-}a}$ is the thermal resistance of the heatsink.

b. Pulse conditions (see Fig. 2)

The heating effect of repetitive power pulses can be found from the curves in Figs 5 and 6 which are given for operation as a transient suppressor at 50 Hz and 400 Hz respectively. This value ΔT is in addition to the mean heating effect. The value of ΔT found from the curves for the particular operating condition should be added to the known value for ambient temperature used in calculating the required heatsink.
The value of the peak power for a given peak zener current is found from the curves in Figs 3 and 4.

The required heatsink is calculated as follows:

$$R_{th\ j\text{-}a} = \frac{T_{j\ max} - T_{amb} - \Delta T}{P_s + \delta \cdot P_p}$$

where: $T_{j\ max}$ = 175 °C
T_{amb} = ambient temperature
ΔT = from Fig. 5 or 6
P_s = any steady-state dissipation excluding that in pulses
P_p = peak pulse power
δ = duty factor (t_p/T)
$R_{th\ j\text{-}a} = R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a} = 1{,}5 + 0{,}2 + R_{th\ h\text{-}a}$ °C/W.

Thus $R_{th\ h\text{-}a}$ can be found.

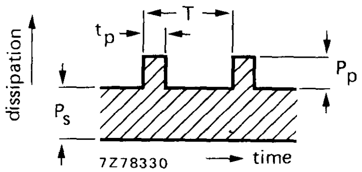


Fig. 2.

OPERATION AS A TRANSIENT SUPPRESSOR (see page 5)

Heatsink considerations

a. For non-repetitive transients, the device may be used without a heatsink for pulses up to 10 ms in duration.
b. For repetitive transients which fall within the permitted operating range shown in Figs 26 and 27 the required heatsink is found as follows:

$$R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a} = \frac{T_{j\ max} - T_{amb}}{P_s + \delta \cdot P_{RRM}}$$

where: $T_{j\ max}$ = 175 °C
T_{amb} = ambient temperature
P_s = any steady-state dissipation excluding that in pulses
δ = duty factor (t_p/T)
$R_{th\ j\text{-}mb}$ = 1,5 °C/W
$R_{th\ mb\text{-}h}$ = 0,2 °C/W

Thus $R_{th\ h\text{-}a}$ can be found.

Notes

1. The stand-off voltage is the maximum reverse voltage recommended for continuous operation; at this value non-conduction is ensured.
2. The maximum clamping voltage is the maximum reverse voltage which appears across the diode at the specified pulse duration and junction temperature. For square pulses see Figs 22 and 23, for exponential pulses see Figs 24 and 25.
3. Duration of an exponential pulse is defined as the time taken for the pulse to fall to 37% of its initial value. It is assumed that the energy content does not continue beyond twice this time.
4. Surge suppressor diodes are extremely fast in clamping, switching on in less than 5 ns.

CHARACTERISTICS – WHEN USED AS VOLTAGE REGULATOR DIODES; T_{mb} = 25 °C

BZY91-...	working voltage *V_Z V		differential resistance *r_Z Ω	temperature coefficient *S_Z %/°C	test I_Z A	reverse current I_R mA	at reverse voltage V_R V
	min.	max.	max.	typ.		max.	
C7V5(R)	7.0	7.9	0.2	0.09	5.0	5.0	2.0
C8V2(R)	7.7	8.7	0.3	0.09	5.0	5.0	5.6
C9V1(R)	8.5	9.6	0.4	0.07	2.0	5.0	6.2
C10(R)	9.4	10.6	0.4	0.07	2.0	1.0	6.8
C11(R)	10.4	11.6	0.4	0.07	2.0	1.0	7.5
C12(R)	11.4	12.7	0.5	0.07	2.0	1.0	8.2
C13(R)	12.4	14.1	0.5	0.07	2.0	1.0	9.1
C15(R)	13.8	15.6	0.6	0.075	2.0	1.0	10
C16(R)	15.3	17.1	0.6	0.075	2.0	1.0	11
C18(R)	16.8	19.1	0.7	0.075	2.0	1.0	12
C20(R)	18.8	21.2	0.8	0.075	1.0	1.0	13
C22(R)	20.8	23.3	0.8	0.075	1.0	1.0	15
C24(R)	22.7	25.9	0.9	0.08	1.0	1.0	16
C27(R)	25.1	28.9	1.0	0.082	1.0	1.0	18
C30(R)	28	32	1.1	0.085	1.0	1.0	20
C33(R)	31	35	1.2	0.088	1.0	1.0	22
C36(R)	34	38	1.3	0.09	1.0	1.0	24
C39(R)	37	41	1.4	0.09	0.5	1.0	27
C43(R)	40	46	1.5	0.092	0.5	1.0	30
C47(R)	44	50	1.7	0.093	0.5	1.0	33
C51(R)	48	54	1.8	0.093	0.5	1.0	36
C56(R)	52	60	2.0	0.094	0.5	1.0	39
C62(R)	58	66	2.2	0.094	0.5	1.0	43
C68(R)	64	72	2.4	0.094	0.5	1.0	47
C75(R)	70	79	2.6	0.095	0.5	1.0	51

*At test I_Z; measured using a pulse method with $t_p \leqslant 100\ \mu s$ and $\delta \leqslant 0.001$ so that the values correspond to a T_j of approximately 25 °C.

CHARACTERISTICS – WHEN USED AS TRANSIENT SUPPRESSOR DIODES; T_{mb} = 25 °C

clamping voltage t_p = 500 µs exp. pulse $V_{(CL)R}$ V		at non-repetitive peak reverse current I_{RSM} A	reverse current at recommended stand-off voltage I_R mA	V_R V	BZY91-. . .
typ.	max.		max.		
–	–	–	–	–	C7V5(R)
9.5	10.5	150	20	6.2	C8V2(R)
10	11	150	20	6.8	C9V1(R)
11	12.5	150	5	7.5	C10(R)
12	13.5	150	5	8.2	C11(R)
13	15	150	5	9.1	C12(R)
14.5	17	150	5	10	C13(R)
16	19	150	5	11	C15(R)
17.5	22	150	5	12	C16(R)
19	26	150	5	13	C18(R)
22	28	100	5	15	C20(R)
24	31	100	5	16	C22(R)
26	34	100	5	18	C24(R)
28	37	100	5	20	C27(R)
31	40	100	5	22	C30(R)
34	44	100	5	24	C33(R)
38	48	100	5	27	C36(R)
40	52	50	5	30	C39(R)
44	56	50	10	33	C43(R)
49	61	50	10	36	C47(R)
54	66	50	10	39	C51(R)
60	72	50	10	43	C56(R)
66	79	50	10	47	C62(R)
72	87	50	10	51	C68(R)
79	97	50	10	56	C75(R)

MOUNTING INSTRUCTIONS

The top connector should neither be bent not twisted; it should be soldered into the circuit so that there is no strain on it.

During soldering the heat conduction to the junction should be kept to a minimum.

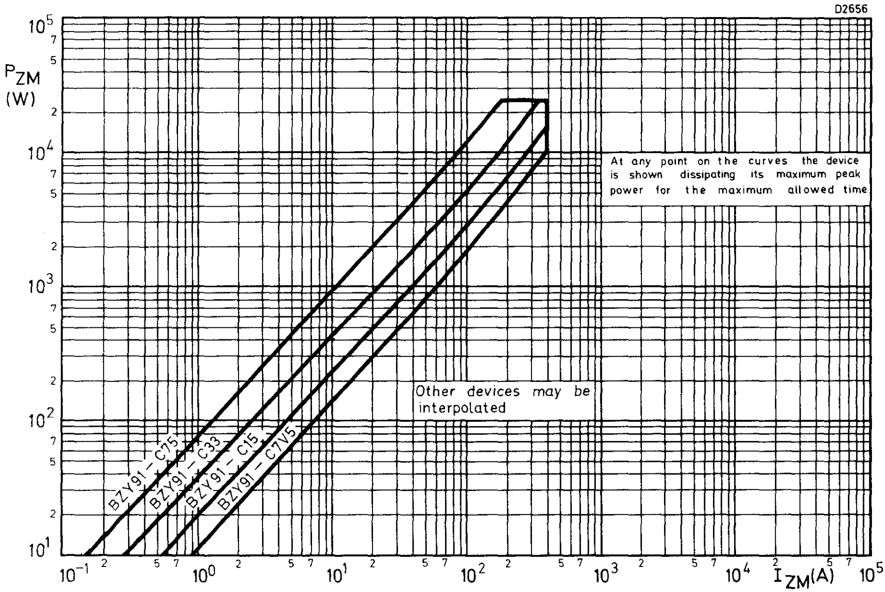

D2656
P_{ZM} (W)
I_{ZM}(A)
At any point on the curves the device is shown dissipating its maximum peak power for the maximum allowed time
Other devices may be interpolated
BZY91 – C75
BZY91 – C33
BZY91 – C15
BZY91 – C7V5

Fig. 3.

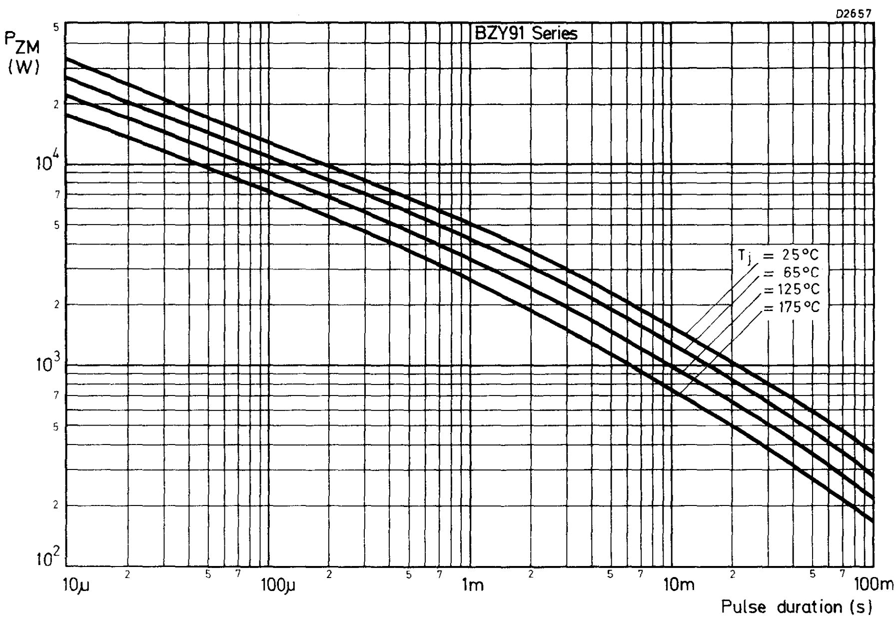

D2657
BZY91 Series
P_{ZM} (W)
T_j = 25 °C
= 65 °C
= 125 °C
= 175 °C
Pulse duration (s)

Fig. 4.

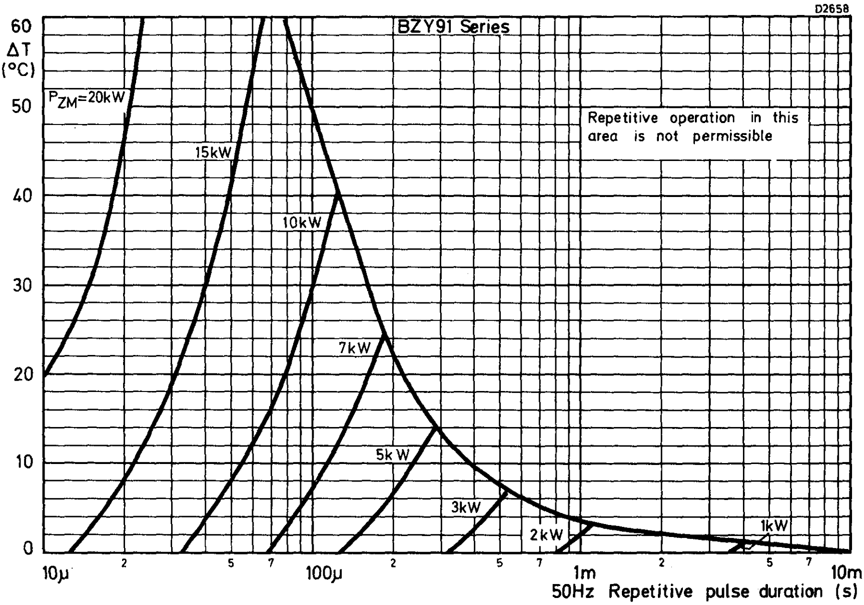

D2658
BZY91 Series
60
ΔT
(°C)
50
40
30
20
10
0
P_{ZM}=20kW
15kW
10kW
7kW
5kW
3kW
2kW
1kW
Repetitive operation in this area is not permissible
10µ
2
5
7
100µ
2
5
7
1m
2
5
7
10m
50Hz Repetitive pulse duration (s)

Fig. 5.

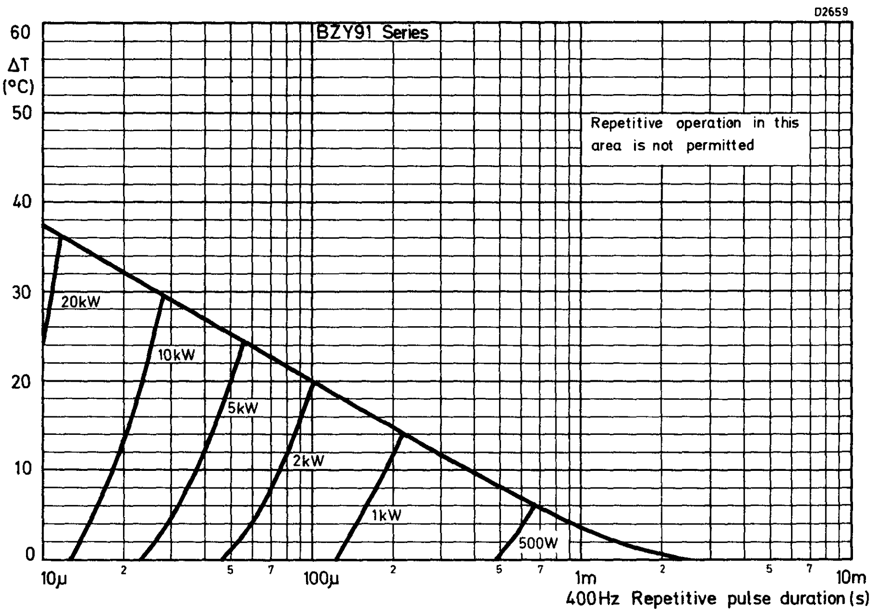

D2659
BZY91 Series
60
ΔT
(°C)
50
40
30
20
10
0
20kW
10kW
5kW
2kW
1kW
500W
Repetitive operation in this area is not permitted
10µ
2
5
7
100µ
2
5
7
1m
2
5
7
10m
400Hz Repetitive pulse duration (s)

Fig. 6.

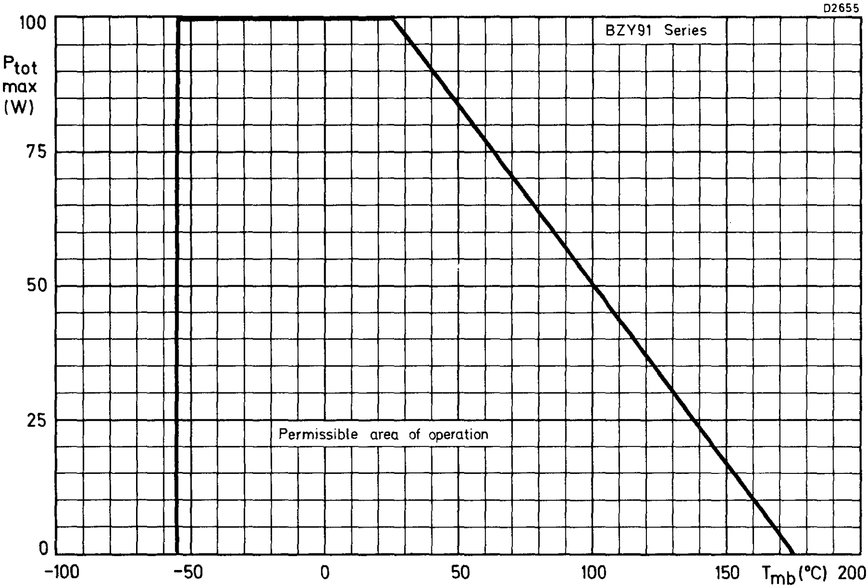


Fig. 7.

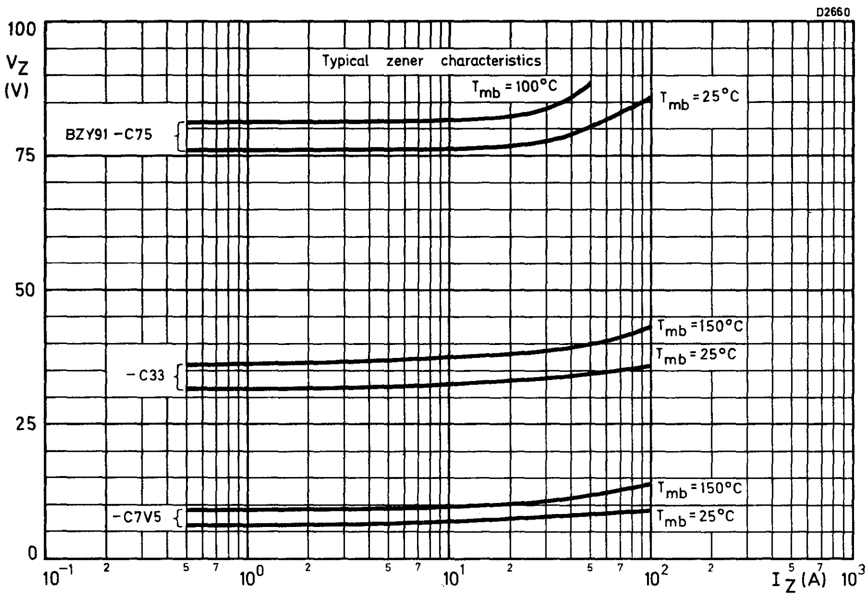


Fig. 8 Typical dynamic zener characteristics.

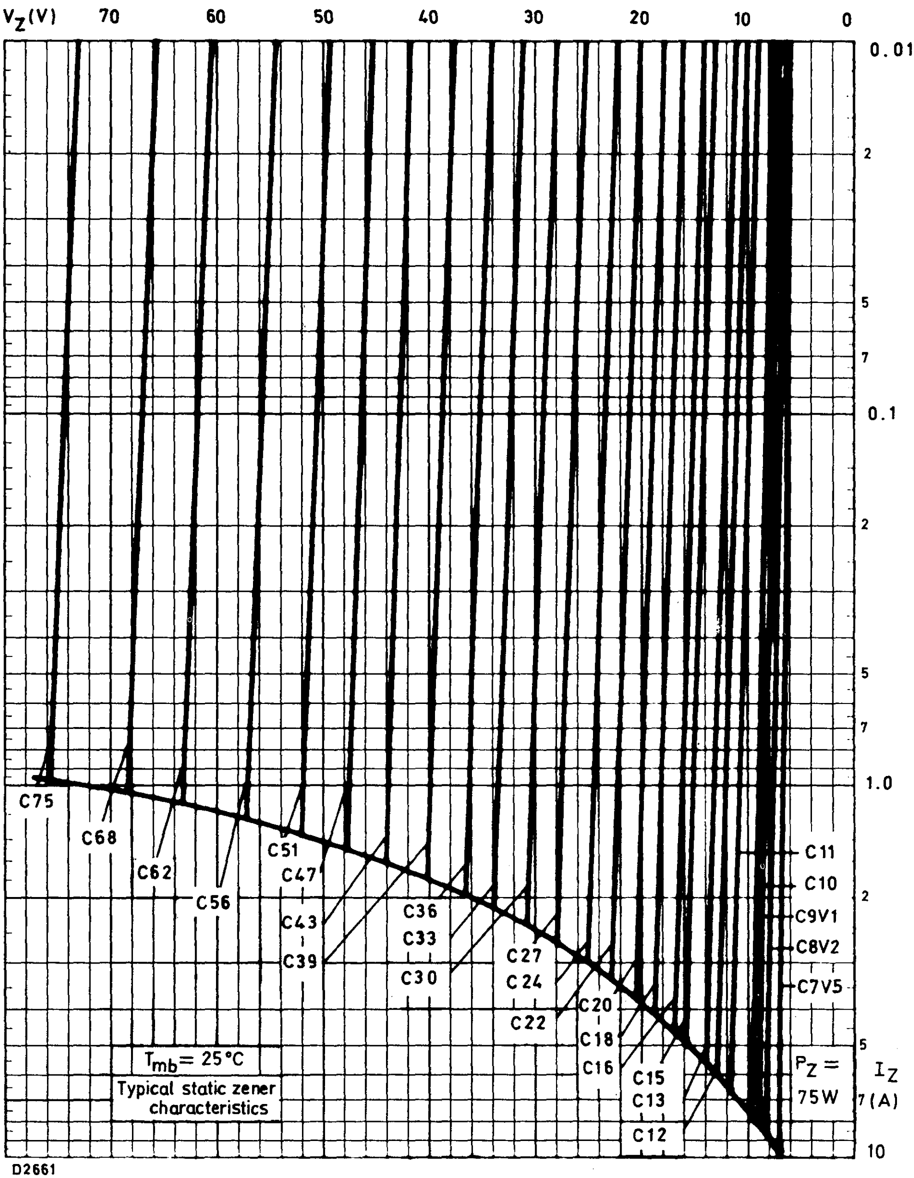


Fig. 9 Typical static zener characteristics.

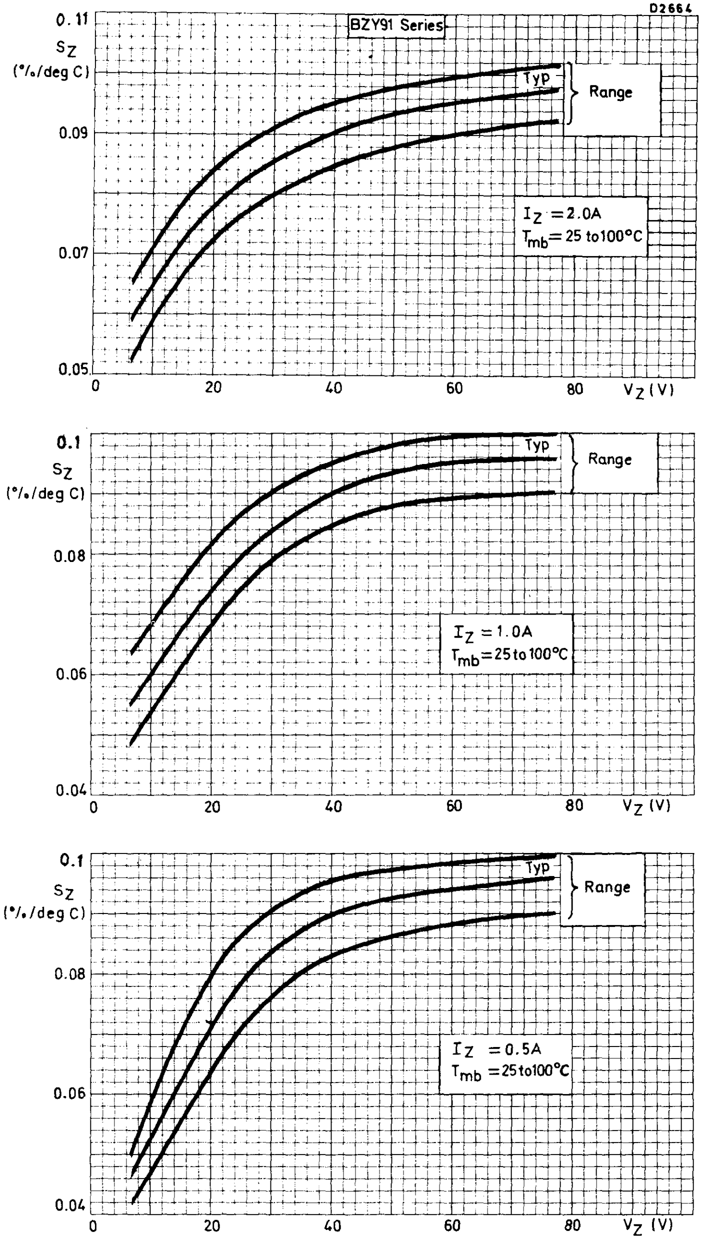
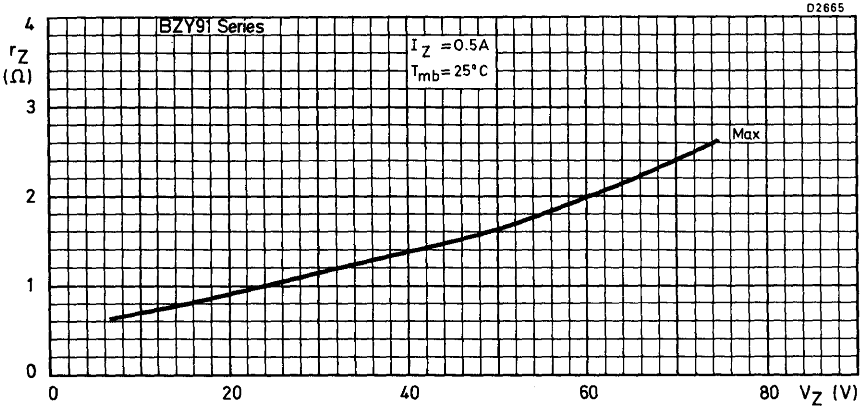
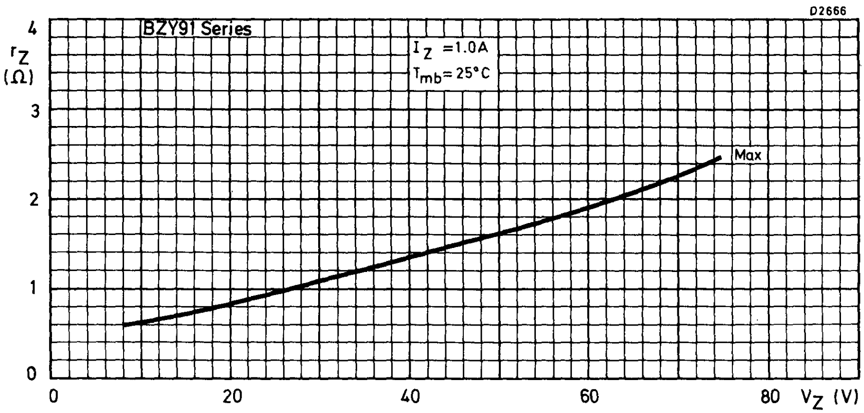

D2664
BZY91 Series
0.11
S_Z
(%/deg C)
0.09
0.07
0.05
Typ
Range
I_Z = 2.0A
T_{mb} = 25 to 100°C
0
20
40
60
80
V_Z (V)
0.1
S_Z
(%/deg C)
0.08
0.06
0.04
Typ
Range
I_Z = 1.0A
T_{mb} = 25 to 100°C
0
20
40
60
80
V_Z (V)
0.1
S_Z
(%/deg C)
0.08
0.06
0.04
Typ
Range
I_Z = 0.5A
T_{mb} = 25 to 100°C
0
20
40
60
80
V_Z (V)

Fig. 10.


D2665
BZY91 Series
I_Z = 0.5A
T_{mb} = 25°C
Max
r_Z (Ω)
0
1
2
3
4
0
20
40
60
80
V_Z (V)


D2666
BZY91 Series
I_Z = 1.0A
T_{mb} = 25°C
Max
r_Z (Ω)
0
1
2
3
4
0
20
40
60
80
V_Z (V)

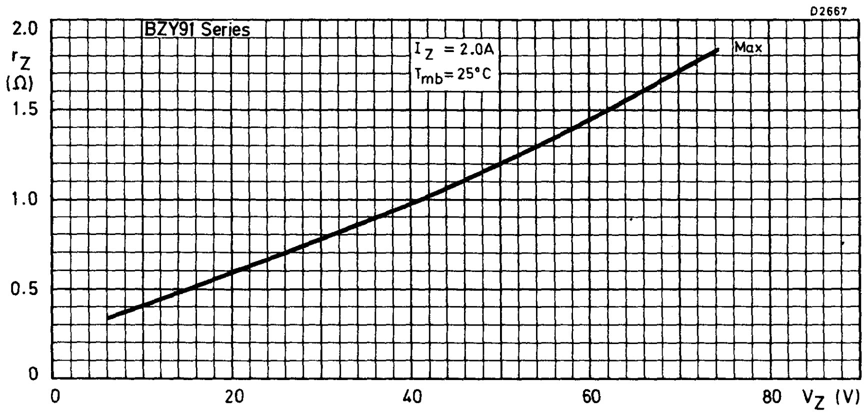

D2667
BZY91 Series
I_Z = 2.0A
T_{mb} = 25°C
Max
r_Z (Ω)
0
0.5
1.0
1.5
2.0
0
20
40
60
80
V_Z (V)

Fig. 11.

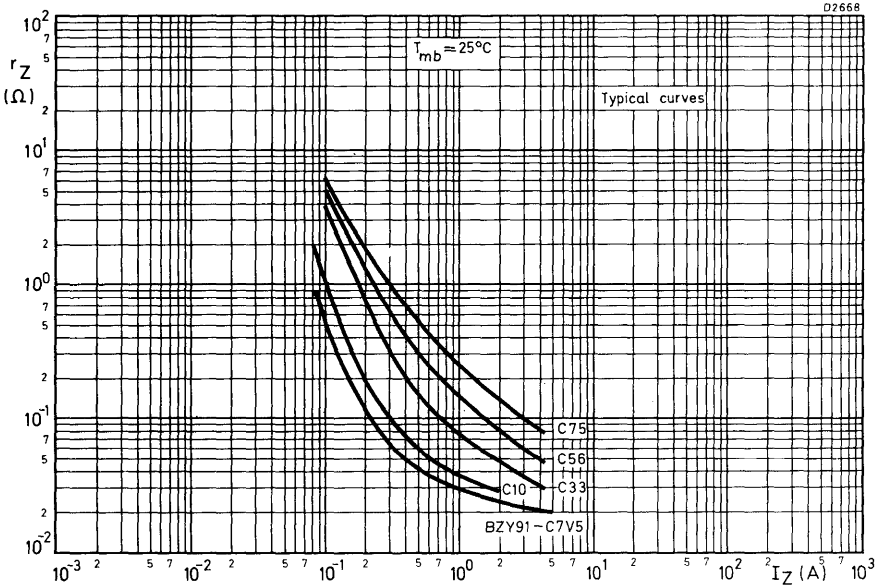

D2668
$T_{mb} = 25°C$
Typical curves
r_Z (Ω)
C75
C56
C33
C10
BZY91 – C7V5
I_Z (A)

Fig. 12.

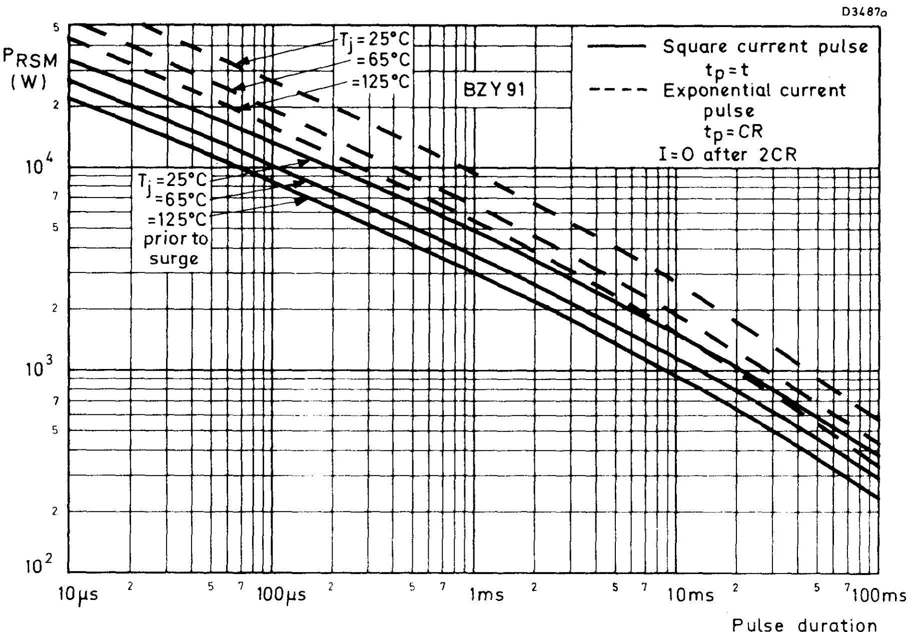

D3487a
P_{RSM} (W)
$T_j = 25°C$
= 65°C
= 125°C
BZY91
Square current pulse
$t_p = t$
Exponential current pulse
$t_p = CR$
I = 0 after 2CR
$T_j = 25°C$
= 65°C
= 125°C
prior to surge
Pulse duration

Fig. 13.

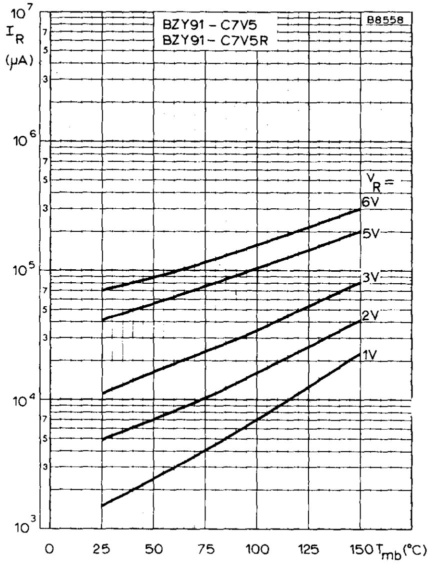


Fig. 14.

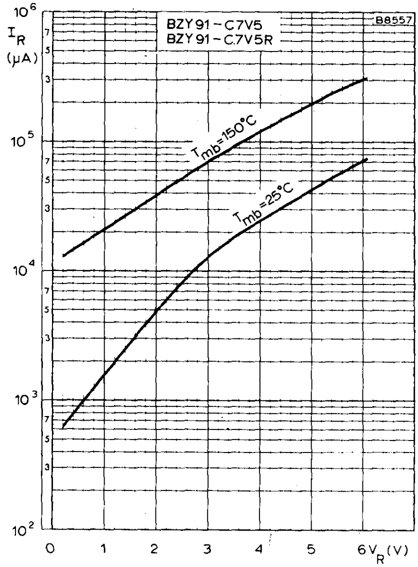


Fig. 15.

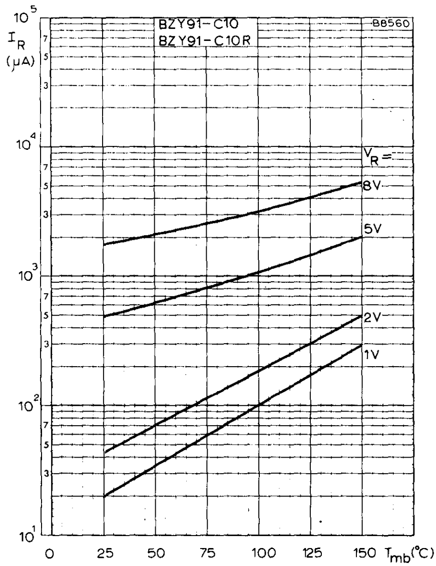


Fig. 16.

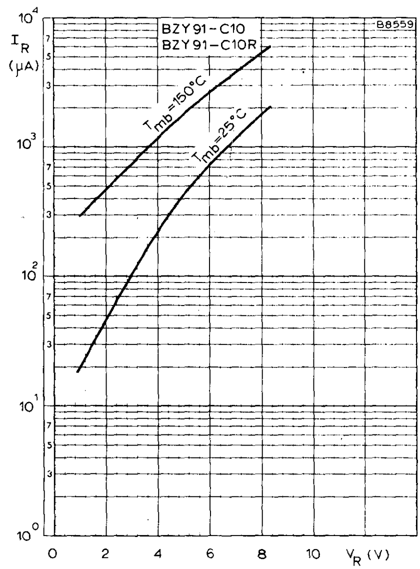


Fig. 17.

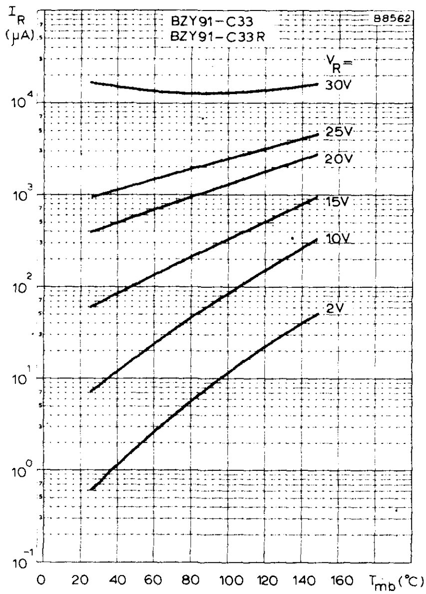


Fig. 18.

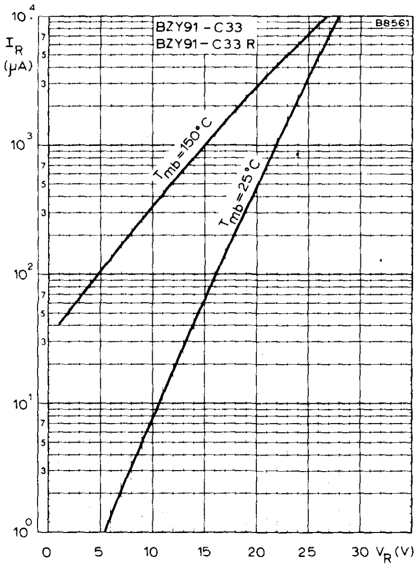


Fig. 19.

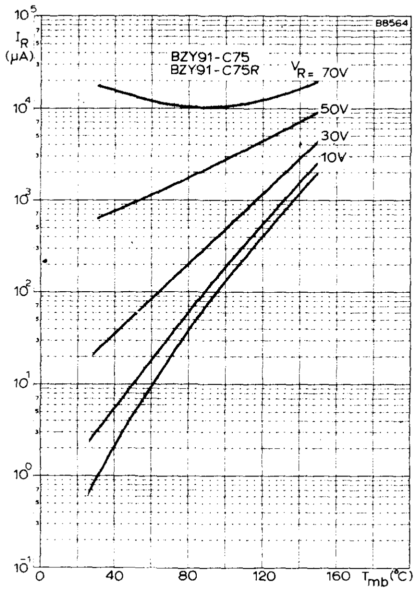


Fig. 20.

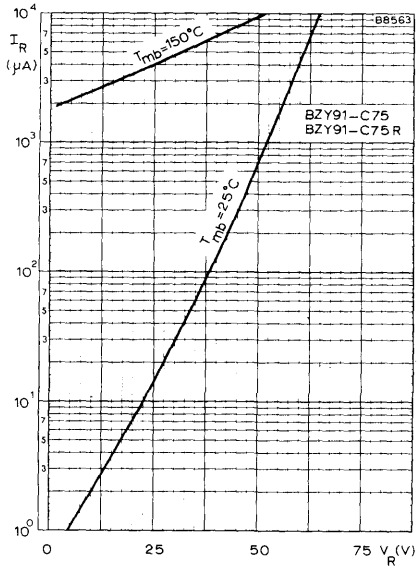


Fig. 21.

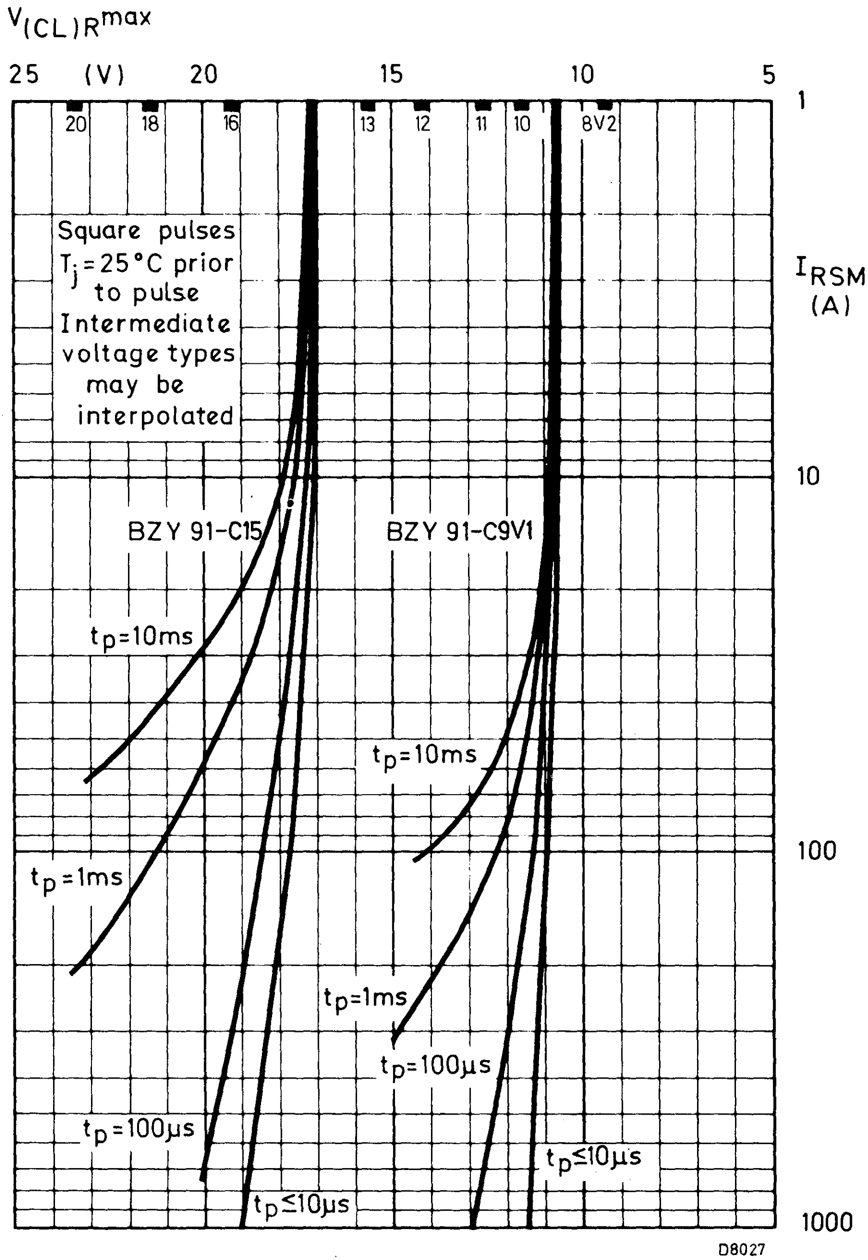

$V_{(CL)R}$max
25
(V)
20
15
10
5
20
18
16
13
12
11
10
8V2
Square pulses
T_j = 25 °C prior to pulse
Intermediate voltage types may be interpolated
I_{RSM} (A)
1
10
100
1000
BZY 91-C15
BZY 91-C9V1
t_p=10ms
t_p =1ms
t_p =100μs
t_p≤10μs
t_p=10ms
t_p=1ms
t_p=100μs
t_p≤10μs
D8027

Fig. 22.

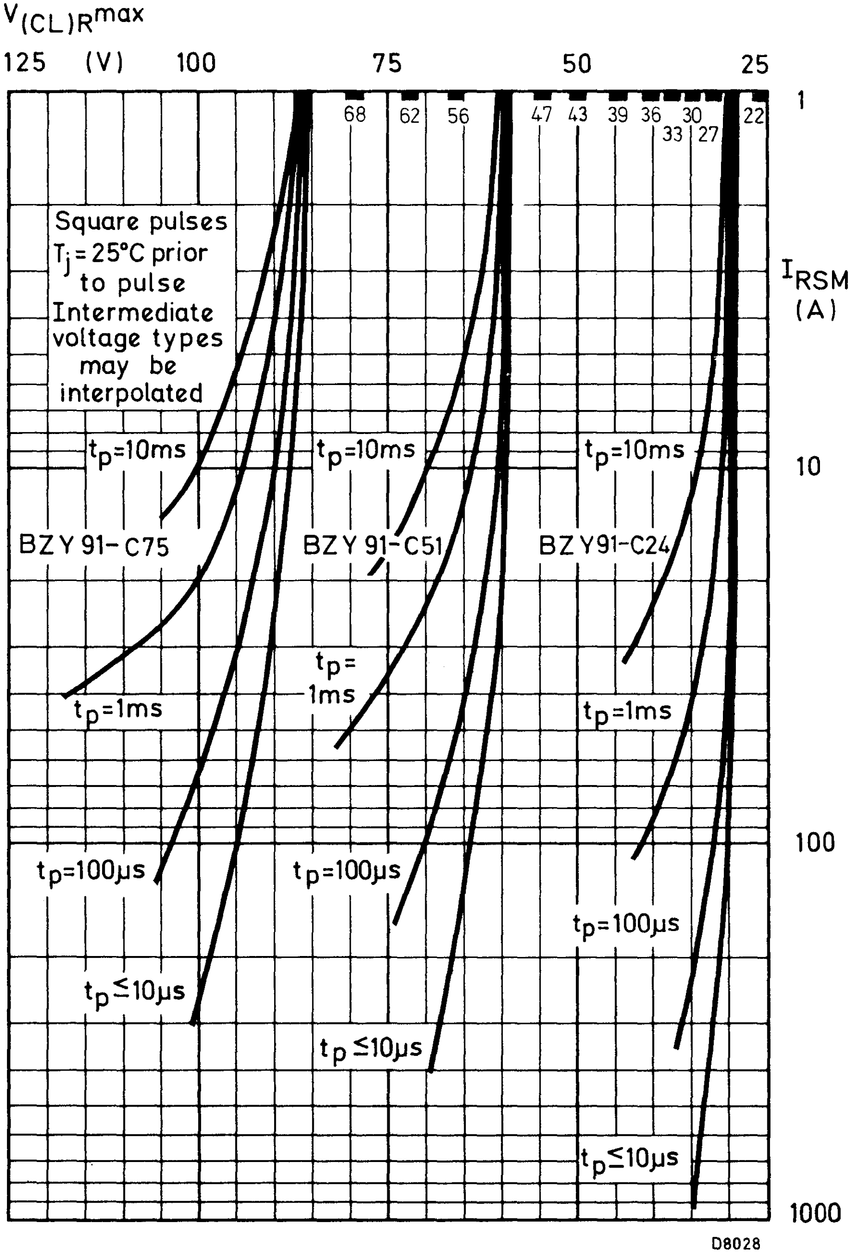

V(CL)Rmax
125
(V)
100
75
50
25
68
62
56
47
43
39
36
30
33
27
22
1
10
100
1000
IRSM
(A)
Square pulses
Tj = 25°C prior
to pulse
Intermediate
voltage types
may be
interpolated
tp=10ms
tp=10ms
tp=10ms
BZY91-C75
BZY91-C51
BZY91-C24
tp=1ms
tp=
1ms
tp=1ms
tp=100µs
tp=100µs
tp=100µs
tp≤10µs
tp≤10µs
tp≤10µs
D8028

Fig. 23.

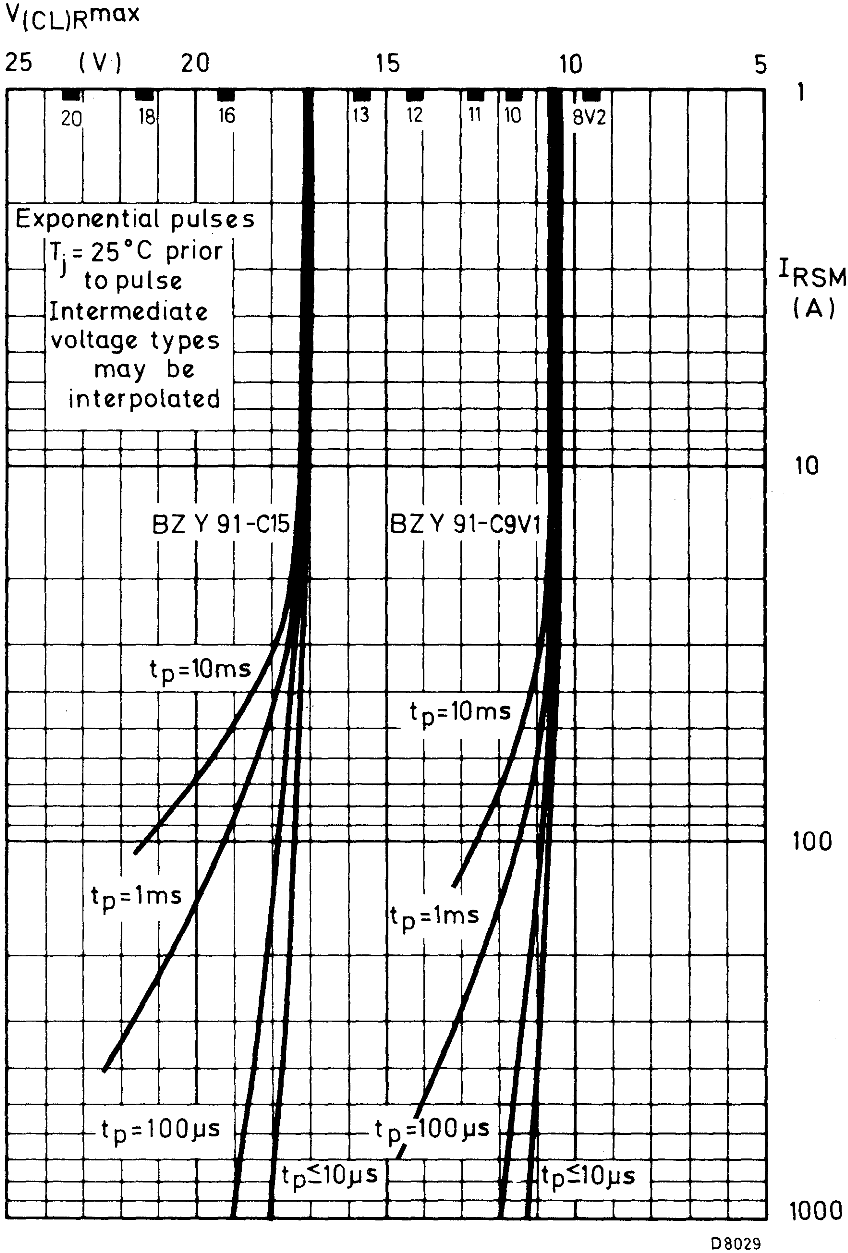

V(CL)Rmax
(V)
25
20
15
10
5
20
18
16
13
12
11
10
8V2
Exponential pulses
Tj = 25 °C prior to pulse
Intermediate voltage types may be interpolated
IRSM
(A)
1
10
100
1000
BZ Y 91-C15
BZ Y 91-C9V1
tp=10ms
tp=1ms
tp=100µs
tp≤10µs
tp=10ms
tp=1ms
tp=100µs
tp≤10µs
D8029

Fig. 24.

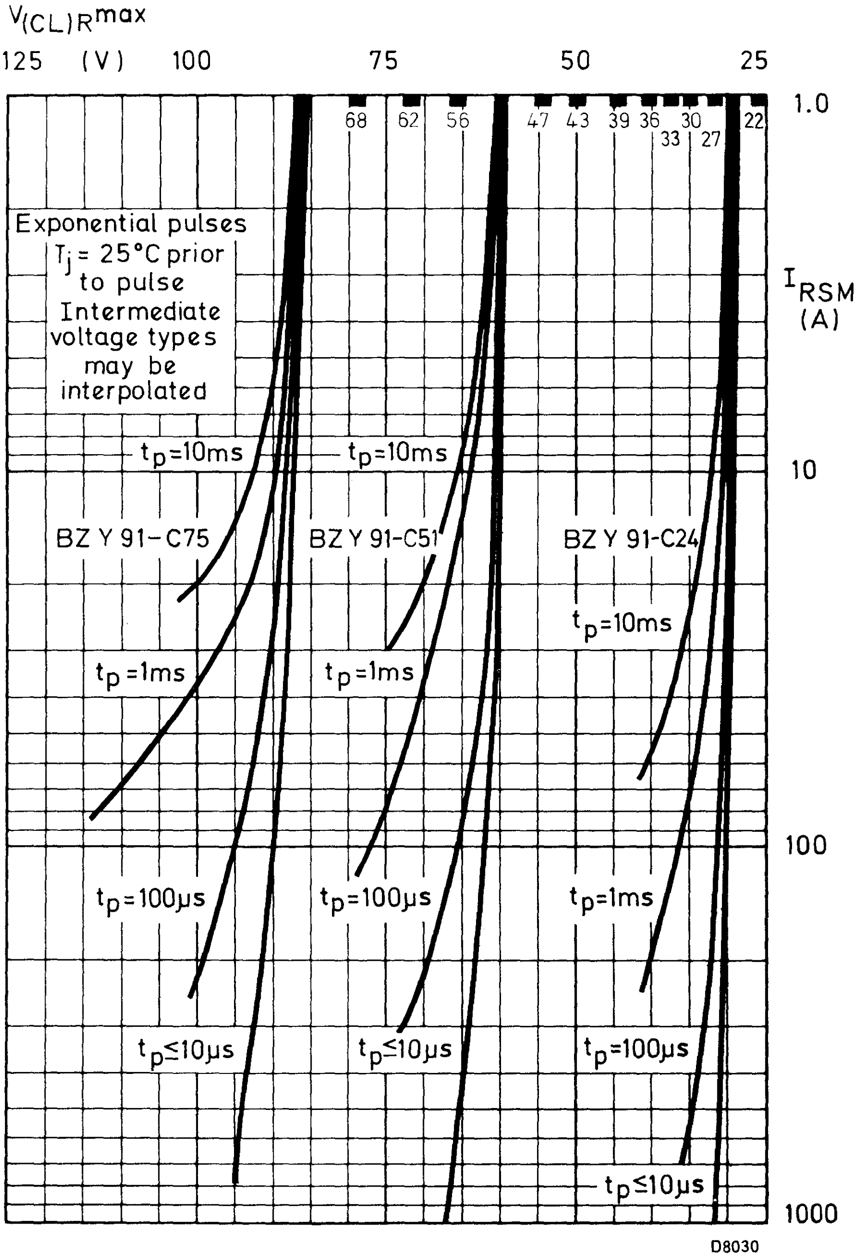

$V_{(CL)R}$max
125 (V) 100 75 50 25
68 62 56 47 43 39 36 30 33 27 22
1.0
10
100
1000
I_{RSM} (A)
Exponential pulses
T_j = 25°C prior to pulse
Intermediate voltage types may be interpolated
t_p=10ms
t_p=10ms
t_p=10ms
BZY91-C75
BZY91-C51
BZY91-C24
t_p=1ms
t_p=1ms
t_p=1ms
t_p=100µs
t_p=100µs
t_p=100µs
t_p≤10µs
t_p≤10µs
t_p≤10µs
D8030

Fig. 25.

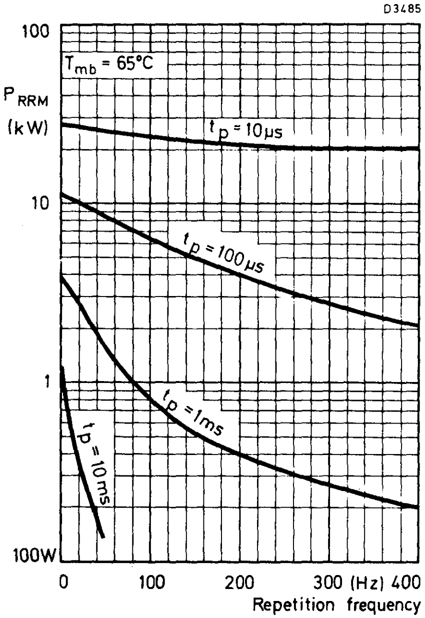


Fig. 26.

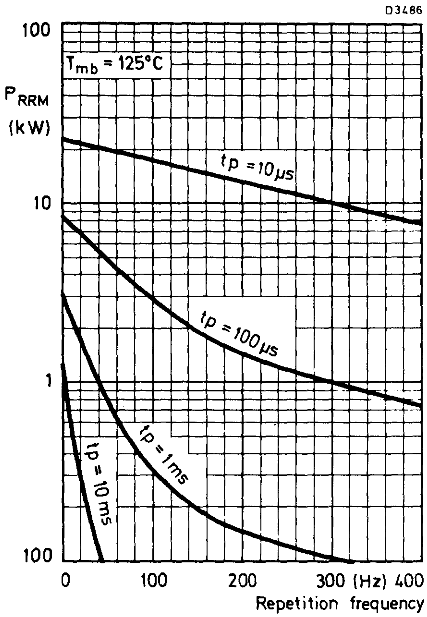


Fig. 27.

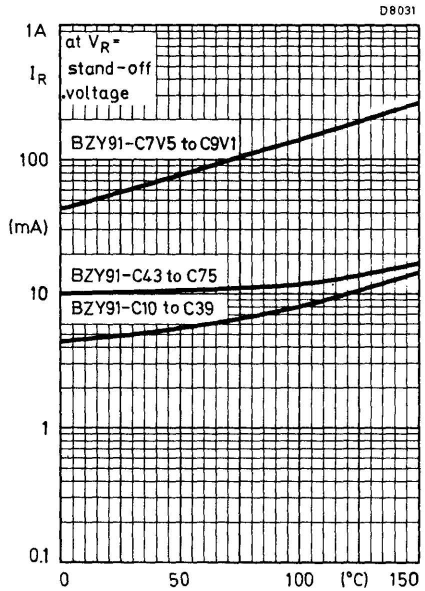


Fig. 28.