REGULATOR DIODES

Also available to BS9305–F051

A range of diffused silicon diodes in DO-4 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): BZY93-C7V5 to BZY93-C75.
Reverse polarity (anode to stud): BZY93-C7V5R to BZY93-C75R.

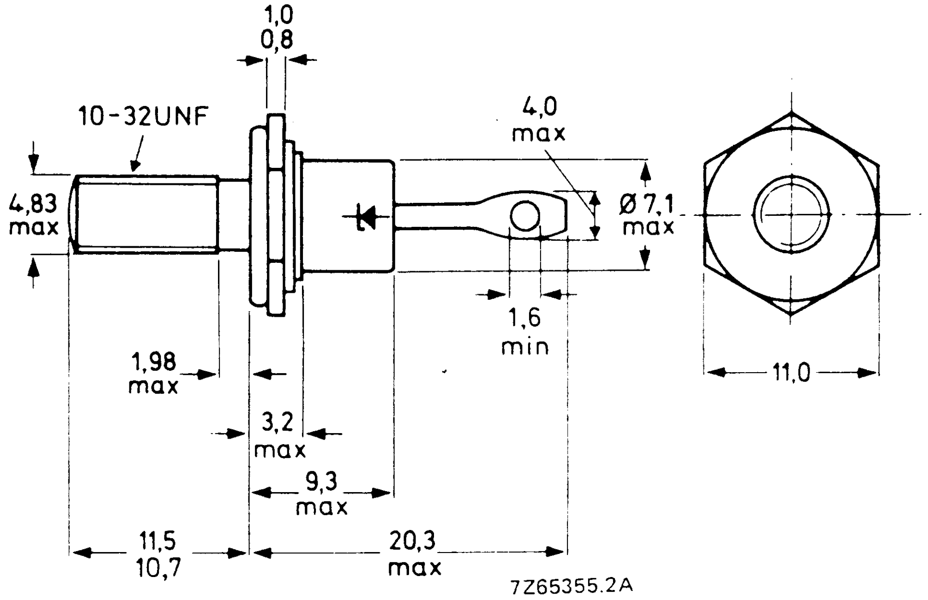
QUICK REFERENCE DATA

			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.	20	–	W
Non-repetitive peak reverse power dissipation	P_{RSM}	max.	–	700	W

MECHANICAL DATA

Dimensions in mm

Fig. 1 DO-4.



Net mass: 6 g

Diameter of clearance hole: max. 5,2 mm

Accessories supplied on request:
see ACCESSORIES section

Supplied with device: 1 nut, 1 lock washer
Nut dimensions across the flats: 9,5 mm

Torque on nut: min. 0,9 Nm (9 kg cm)
max. 1,7 Nm (17 kg cm)

RATINGS

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

Peak working current	I_{ZM}	max.	20	A
Average forward current (averaged over any 20 ms period)	$I_{F(AV)}$	max.	5	A
Non-repetitive peak reverse current T_j = 25 °C prior to surge; t_p = 1 ms (exponential pulse); BZY93-C7V5(R) to BZY93-C75(R)	I_{RSM}	max.	55 to 6	A
Total power dissipation up to T_{mb} = 75 °C	P_{tot}	max.	20	W
Non-repetitive peak reverse power dissipation T_j = 25 °C prior to surge; t_p = 1 ms (exponential pulse)	P_{RSM}	max.	700	W
Storage temperature	T_{stg}		−55 to + 175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	5	°C/W
From junction to ambient	$R_{th\ j\text{-}a}$	=	50	°C/W
From mounting base to heatsink (minimum torque: 0,9 Nm)	$R_{th\ mb\text{-}h}$	=	0,6	°C/W

CHARACTERISTICS

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

OPERATION AS A VOLTAGE REGULATOR

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, 0,6 °C/W.
$R_{th\ h\text{-}a}$ is the thermal resistance of the heatsink.

b. Pulse conditions (see Fig. 2)

The maximum permissible pulse power $P_{p\,max}$ is given by the formula

$$P_{p\,max} = \frac{(T_{j\,max} - T_{amb}) - (P_s \cdot R_{th\ j\text{-}a})}{R_{th\ t} + \delta \cdot R_{th\ mb\text{-}a}}$$

where: P_s is any steady-state dissipation excluding that in pulses

$R_{th\ t}$ is the effective transient thermal resistance of the device between junction and mounting base. It is a function of the pulse duration t_p and duty factor δ.

δ is duty factor (t_p/T)

$R_{th\ mb\text{-}a}$ is the total thermal resistance between the mounting base and ambient ($R_{th\ mb\text{-}a} = R_{th\ mb\text{-}h} + R_{th\ h\text{-}a}$).

The steady-state power P_s when biased in the zener direction at a given zener current can be found from Fig. 14. With the additional pulse power dissipation $P_{p\ max}$ calculated from the above expression, the total peak zener power dissipation $P_{tot} = P_{ZRM} = P_s + P_p$. From Fig. 14 the corresponding maximum repetitive peak zener current at P_{ZRM} can now be read. This repetitive peak zener current is subject to the absolute maximum rating. For pulse durations larger than the temperature stabilization time of the diode t_{stab}, the maximum permissible repetitive peak dissipation P_{ZRM} is equal to the steady-state power P_s. The temperature stabilization time for the BZY93 is 5 seconds.

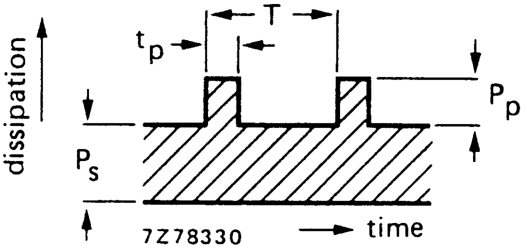


Fig. 2.

OPERATION AS A TRANSIENT SUPPRESSOR

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 19 and 20 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)

$R_{th\ j\text{-}mb}$ = 5 °C/W

$R_{th\ mb\text{-}h}$ = 0,6 °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.
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; $T_{mb} = 25\ ^oC$

BZY93-. . .	working voltage *V_Z V		differential resistance *r_Z Ω		temperature coefficient *S_Z mV/°C	test I_Z A	reverse current I_R µA	at reverse voltage V_R V
	min.	max.	typ.	max.	typ.		max.	
C7V5(R)	7.0	7.9	0.04	0.3	3.0	2.0	100	2.0
C8V2(R)	7.7	8.7	0.05	0.3	4.0	2.0	100	5.6
C9V1(R)	8.5	9.6	0.07	0.5	5.0	1.0	50	6.2
C10(R)	9.4	10.6	0.07	0.5	7.0	1.0	50	6.8
C11(R)	10.4	11.6	0.08	1.0	7.5	1.0	50	7.5
C12(R)	11.4	12.7	0.08	1.0	8.0	1.0	50	8.2
C13(R)	12.4	14.1	0.08	1.0	8.5	1.0	50	9.1
C15(R)	13.8	15.6	0.10	1.2	10	1.0	50	10
C16(R)	15.3	17.1	0.18	1.2	11	0.5	50	11
C18(R)	16.8	19.1	0.2	1.5	12	0.5	50	12
C20(R)	18.8	21.2	0.2	1.5	14	0.5	50	13
C22(R)	20.8	23.3	0.21	1.8	16	0.5	50	15
C24(R)	22.7	25.9	0.22	2.0	18	0.5	50	16
C27(R)	25.1	28.9	0.25	2.0	21	0.5	50	18
C30(R)	28	32	0.3	2.5	25	0.5	50	20
C33(R)	31	35	0.32	3.0	30	0.5	50	22
C36(R)	34	38	0.75	4.0	32	0.2	50	24
C39(R)	37	41	0.85	5.0	35	0.2	50	27
C43(R)	40	46	0.90	6.5	40	0.2	50	30
C47(R)	44	50	1.0	7.0	45	0.2	50	33
C51(R)	48	54	1.2	7.5	50	0.2	50	36
C56(R)	52	60	1.3	8.0	55	0.2	50	39
C62(R)	58	66	1.5	9.0	60	0.2	50	43
C68(R)	64	72	1.8	10	65	0.2	50	47
C75(R)	70	79	2.0	10.5	70	0.2	50	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	BZY93-. . .
typ.	max.		max.		
8	9.2	20	0.5	5.6	C7V5(R)
9	10.2	20	0.5	6.2	C8V2(R)
10	11.5	20	0.5	6.8	C9V1(R)
11	12.5	20	0.1	7.5	C10(R)
12.3	14	20	0.1	8.2	C11(R)
14	16	20	0.1	9.1	C12(R)
15.3	17.5	20	0.1	10	C13(R)
17	19.5	20	0.1	11	C15(R)
19.3	22	20	0.1	12	C16(R)
21	24	20	0.1	13	C18(R)
23	27	10	0.1	15	C20(R)
26	30	10	0.1	16	C22(R)
29	34	10	0.1	18	C24(R)
33	39	10	0.1	20	C27(R)
38	44	10	0.1	22	C30(R)
42	50	10	0.1	24	C33(R)
47	56	10	0.1	27	C36(R)
40	47	5	0.1	30	C39(R)
45	52	5	0.1	33	C43(R)
51	59	5	0.1	36	C47(R)
57	66	5	0.1	39	C51(R)
64	75	5	0.1	43	C56(R)
73	85	5	0.1	47	C62(R)
81	94	5	0.1	51	C68(R)
90	105	5	0.1	56	C75(R)

MOUNTING INSTRUCTIONS

The top connector should neither be bent nor 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.