

Voltage Regulator Example

Ying Sun

Voltage Regulator Circuit

V_{in} is 9V. We want to regulate V_{out} at 5V. We use a zener diode of 3.3 V as shown in the attached data sheet.

1) Determine R_1 .

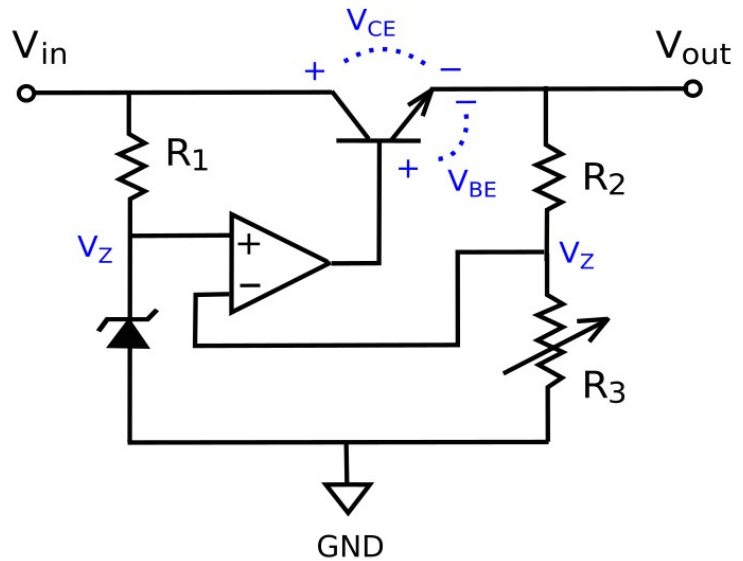
R_1 provides the bias current to keep the zener diode at the constant breakdown voltage V_Z . According to the data sheet, for $V_Z = 3.3$ V, the operating current I_{ZT} should be 76 mA. Thus,

$$R_1 = \frac{V_{in} - 3.3 V}{76 \text{ mA}} = 75 \Omega$$

2) If R_2 is chosen to be 10 K Ω , what should R_3 be?

$$V_Z = V_{out} \frac{R_3}{R_2 + R_3} \Rightarrow R_3 = \frac{R_2 V_Z}{V_{out} - V_Z} = 10 \text{ K} \Omega \frac{3.3 V}{5.0 V - 3.3 V} = 19.4 \text{ K} \Omega$$

Thus, R_3 should be set at 19.4 K Ω .



Zener Diode

1N4728A-1N4764A



Features:

- High reliability.
- Very sharp reverse characteristic.
- Low reverse current level.
- V_z -tolerance $\pm 5\%$.

Applications:

Voltage stabilization

Absolute Maximum Ratings $T_j = 25^\circ\text{C}$

Parameter	Test Conditions	Symbol	Value	Unit
Power dissipation	$T_{\text{amb}} \leq 50^\circ\text{C}$	P_V	1	W
Z-current	-	I_z	P_V/V_z	mA
Junction temperature	-	T_j	200	°C
Storage temperature range	-	T_{stg}	-65 to +175	

Maximum Thermal Resistance $T_j = 25^\circ\text{C}$

Parameter	Test Conditions	Symbol	Value	Unit
Junction ambient	$l = 9.5\text{mm}$ (3/8 inches) $T_L = \text{constant}$	R_{thJA}	100	K/W

Stresses exceeding maximum ratings may damage the device. Maximum ratings are stress ratings only. Functional operation above the recommended operating conditions is not implied. Extended exposure to stresses above the recommended operating conditions may affect device reliability.

Electrical Characteristics $T_j = 25^\circ\text{C}$

Parameter	Test Conditions	Symbol	Maximum	Unit
Forward voltage	$I_F = 200\text{mA}$	V_F	1.2	V

Zener Diode

1N4728A-1N4764A

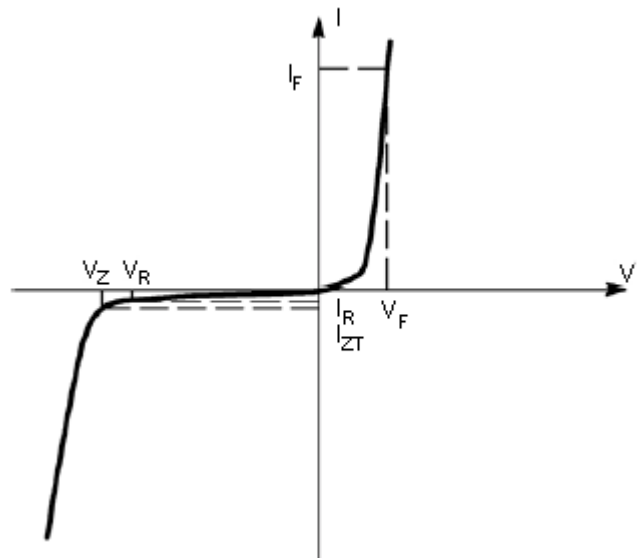
Specification Table

Description	$V_{Znom}^{1)}$	I_{ZT} for	r_{ziT}	r_{ziK} at	I_{ZK}	I_R at	V_R	Part Number
	V	mA	Ω	Ω	mA	μA	V	
Zener Diode	3.3	76	< 10	< 400	1	< 100	1	1N4728A
Zener Diode	3.6	69						1N4729A
Zener Diode	3.9	64						1N4730A
Zener Diode	4.7	53	< 8	< 500		< 10	2	1N4732A
Zener Diode	5.1	49	< 7	< 550				1N4733A
Zener Diode	5.6	45	< 5	< 600				1N4734A
Zener Diode	6.2	41	< 2	< 700	0.5	3	1N4735A	
Zener Diode	6.8	37	< 3.5			4	1N4736A	
Zener Diode	7.5	34	< 4			5	1N4737A	
Zener Diode	8.2	31	< 4.5		0.25	6	1N4738A	
Zener Diode	9.1	28	< 5			7	1N4739A	
Zener Diode	10	25	< 7			7.6	1N4740A	
Zener Diode	62	4	< 125	< 2000		< 5	47.1	1N4759A

1) Based on DC-measurement at thermal equilibrium while maintaining the lead temperature (T_L) at 30°C, 9.5mm (3/8 inches) from the diode body.

Characteristics ($T_j = 25^\circ C$ unless otherwise specified)

Symbol	Parameter
V_Z	Reverse zener voltage at I_{ZT}
I_{ZT}	Reverse current
Z_{ZT}	Maximum zener impedance at I_{ZT}
I_{ZK}	Reverse current
Z_{ZK}	Maximum zener impedance at I_{ZK}
I_R	Reverse leakage current at V_R
V_R	Breakdown voltage
I_F	Forward current
V_F	Forward voltage at I_F

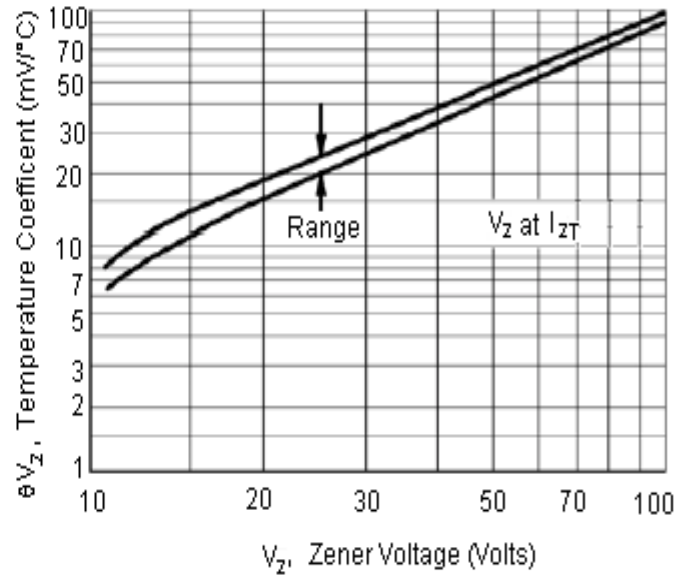
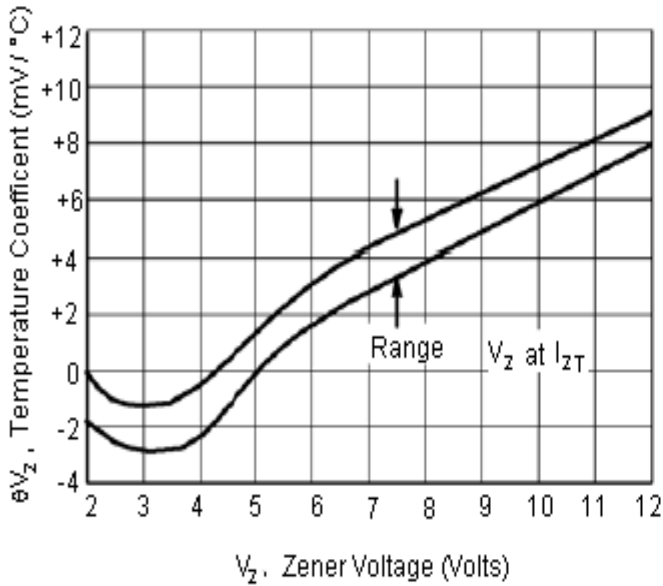


Zener Voltage Regulator

Zener Diode

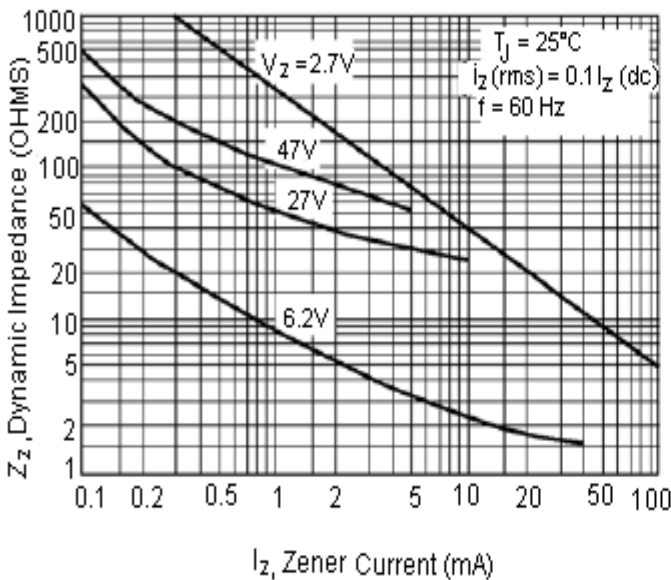
1N4728A-1N4764A

Characteristics ($T_j = 25^\circ\text{C}$ unless otherwise specified)

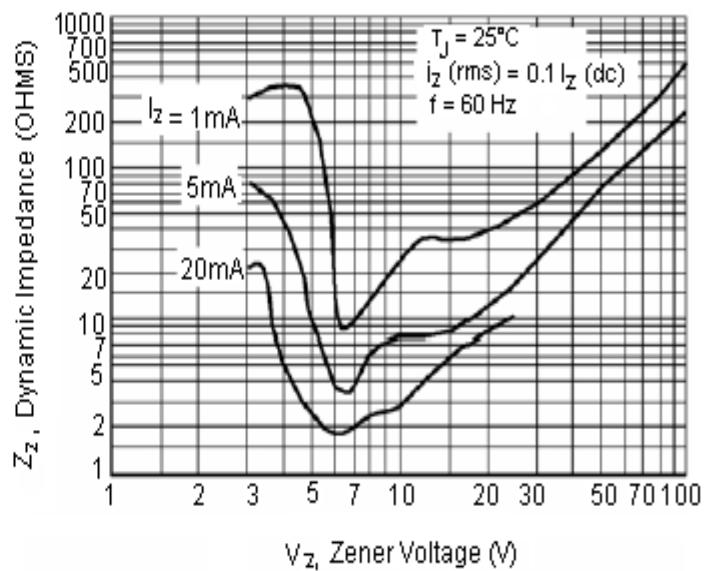


Temperature Coefficients

(-55°C to $+150^\circ\text{C}$ temperature range; 90% of the units are in the ranges indicated.)



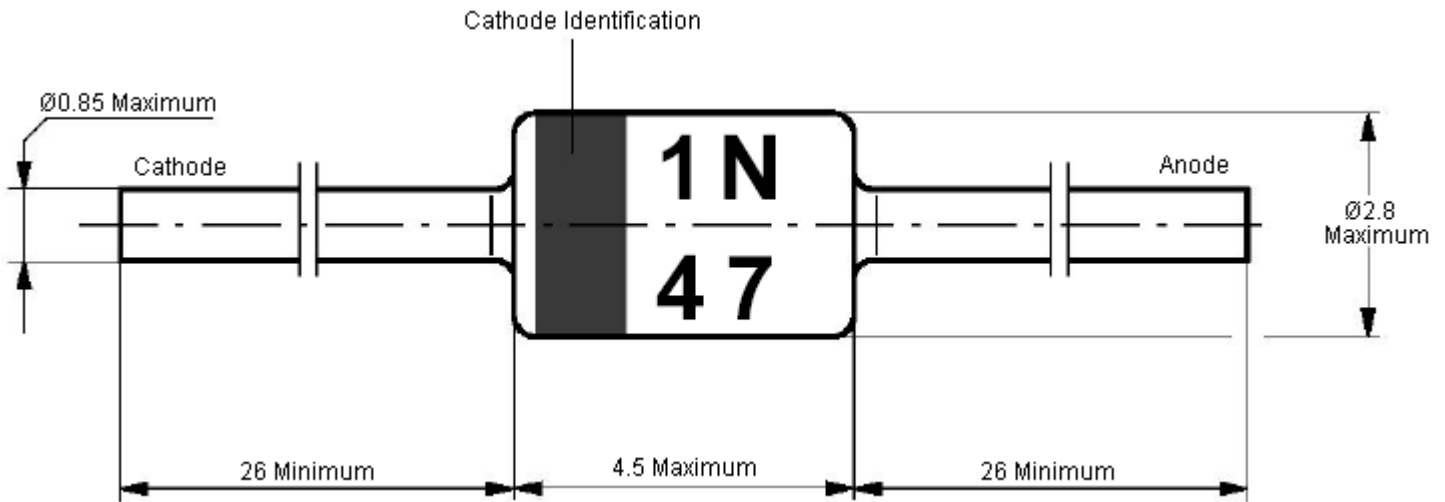
Effect of Zener Current on Zener Impedance



Effect of Zener Voltage on Zener Impedance

Zener Diode

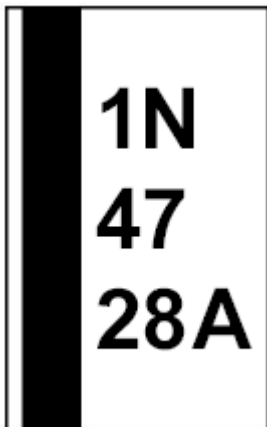
1N4728A-1N4764A



Standard Glass case
JEDEC DO-41

Dimensions: Millimetres

Marking



Important Notice : This data sheet and its contents (the "Information") belong to the members of the Premier Farnell group of companies (the "Group") or are licensed to it. No licence is granted for the use of it other than for information purposes in connection with the products to which it relates. No licence of any intellectual property rights is granted. The Information is subject to change without notice and replaces all data sheets previously supplied. The Information supplied is believed to be accurate but the Group assumes no responsibility for its accuracy or completeness, any error in or omission from it or for any use made of it. Users of this data sheet should check for themselves the Information and the suitability of the products for their purpose and not make any assumptions based on information included or omitted. Liability for loss or damage resulting from any reliance on the Information or use of it (including liability resulting from negligence or where the Group was aware of the possibility of such loss or damage arising) is excluded. This will not operate to limit or restrict the Group's liability for death or personal injury resulting from its negligence. Multicomp is the registered trademark of the Group. © Premier Farnell plc 2011.