Zener Diode Shunt Regulator: Series Resistor and Power

Series resistor, Zener and resistor dissipation and the minimum Zener current of a Zener shunt regulator from the supply range, Zener voltage and load current.

Method: Zener shunt regulator design

Input parameters

Unit system: SI

Parameter	Value	Unit
Minimum input voltage	11.000	V
Maximum input voltage	14.000	V
Zener voltage	5.1000	V
Maximum load current	20.000	mA
Minimum Zener current to stay in regulation	5.0000	mA

Calculated results

Parameter	Value	Unit
Series resistor (largest that still regulates)	236.00	Ω
Resistor dissipation at maximum input	0.33564	W
Zener current at maximum input and no load	37.712	mA
Zener dissipation at maximum input and no load	0.19233	W
Efficiency at minimum input and full load	37.091	%

Notes for this case

• R_s = (V_in,min − V_Z)/(I_L + I_Z,min). The Zener must absorb the whole current when the load is disconnected at maximum input; choose a Zener rated for at least twice P_Z and use the next lower standard resistor value.

Formula and method

$$R_s = \frac{V_{in,min} - V_Z}{I_L + I_{Z,min}}, \quad I_{Z,max} = \frac{V_{in,max} - V_Z}{R_s}, \quad P_Z = V_Z I_{Z,max}$$

Variables

$V_{in,min}$	Minimum input voltage	V
$V_{in,max}$	Maximum input voltage	V
V_Z	Zener voltage	V
I_L	Maximum load current	A
$I_{Z,min}$	Minimum Zener current to stay in regulation	A
R_s	Series resistor (largest that still regulates)	Ω
P_R	Resistor dissipation at maximum input	W
$I_{Z,max}$	Zener current at maximum input and no load	A
P_Z	Zener dissipation at maximum input and no load	W
η	Efficiency at minimum input and full load	-

Method and standards

Shunt regulator design.

Assumptions and limits

- Ideal Zener (zero dynamic resistance).

References

Zener shunt regulator design

Report details

Report reference	FCC-WDMY-AX2P (the same inputs always give the same reference)
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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/electrical/electronics/zener-regulator-design

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.