

## Description

The ZXTR2112FQ monolithically integrates a transistor, zener diode and resistor to function as a linear regulator. The device regulates with a 12V nominal output at 15mA. It is designed for use in high voltage applications where standard linear regulators cannot be used. This function is fully integrated into a SOT23 package, minimizing PCB area and reducing number of components when compared with a multi-chip discrete solution.

This linear regulator is designed to meet the stringent requirements of automotive applications.

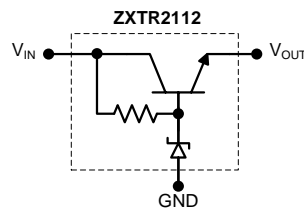
## Applications

Supply voltage regulation for:

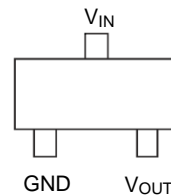
- 24V to 12V Rails
- Other Customized Input Rails



Top View



Internal Device Schematic



Top View Pin-Out

Pin Name	Pin Function
V <sub>IN</sub>	Input Supply
GND	Power Ground
V <sub>OUT</sub>	Voltage Output

## Features

- Series Linear Regulator Using Emitter-Follower Stage
- Input Voltage – 15 to 60V (For Regulated Output Voltage)
- Output Voltage – 12V ± 10%
- Fully Integrated into a SOT23 Package
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. “Green” Device (Note 3)**
- **Qualified to AEC-Q101 Standards for High Reliability**
- **PPAP Capable (Note 4)**

## Mechanical Data

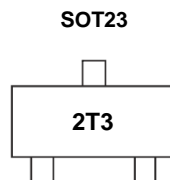
- Case: SOT23
- Case Material: Molded Plastic. “Green” Molding Compound. UL Flammability Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish - Matte Tin Plated Leads. Solderable per MIL-STD-202, Method 208 @3
- Weight: 0.008 grams (Approximate)

## Ordering Information (Notes 4 & 5)

Product	Compliance	Marking	Reel Size (inches)	Tape Width (mm)	Quantity per Reel
ZXTR2112FQ-7	Automotive	2T3	7	8	3,000

- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
  2. See [http://www.diodes.com/quality/lead\\_free.html](http://www.diodes.com/quality/lead_free.html) for more information about Diodes Incorporated’s definitions of Halogen and Antimony free, “Green” and Lead-Free.
  3. Halogen- and Antimony-free “Green” products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
  4. Automotive products are AEC-Q101 qualified and are PPAP capable. Refer to [http://www.diodes.com/quality/product\\_compliance\\_definitions/](http://www.diodes.com/quality/product_compliance_definitions/).
  5. For packaging details, go to our website at <http://www.diodes.com/products/packages.html>.

## Marking Information



2T3 = Product Type Marking Code

**Absolute Maximum Ratings** (Voltage relative to GND, @T<sub>A</sub> = +25°C, unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Input Voltage	V <sub>IN</sub>	-0.3 to 60	V
Continuous Input & Output Current	I <sub>IN</sub> , I <sub>OUT</sub>	320	mA
Peak Pulsed Input & Output Current	I <sub>IM</sub> , I <sub>OM</sub>	2	A
Maximum Voltage applied to V <sub>OUT</sub>	V <sub>OUT(max)</sub>	Smaller of V <sub>IN</sub> +5V or 17V	V

**Maximum Current** (@V<sub>IN</sub> = 24V) (@T<sub>A</sub> = +25°C, unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Continuous Output Current	I <sub>OUT</sub>	50	mA
Pulsed Output Current	I <sub>OM</sub>	2,000	mA
		500	

**Thermal Characteristics**

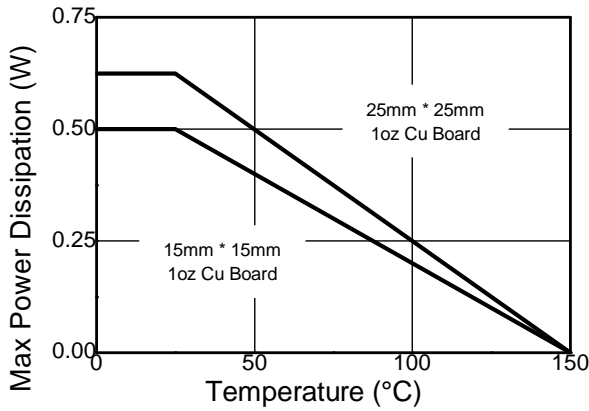
Characteristic	Symbol	Value	Unit
Power Dissipation	P <sub>D</sub>	625	mW
		500	
Thermal Resistance, Junction to Ambient	R <sub>θJA</sub>	200	°C/W
		250	
Thermal Resistance, Junction to Lead	R <sub>θJL</sub>	197	
Thermal Resistance, Junction to Case	R <sub>θJC</sub>	17	
Maximum Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>STG</sub>	-65 to +150	°C

**ESD Ratings** (Note 12)

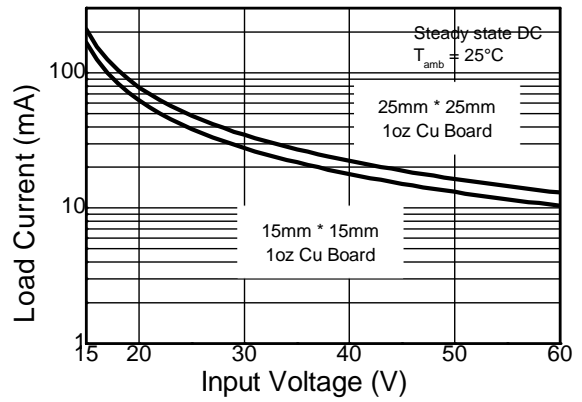
Characteristics	Symbols	Value	Unit	JEDEC Class
Electrostatic Discharge – Human Body Model	ESD HBM	4,000	V	3A
Electrostatic Discharge – Machine Model	ESD MM	400	V	C

- Notes:
- For a device mounted with the V<sub>IN</sub> lead on 25mm x 25mm 1oz copper that is on a single-sided 1.6mm FR4 PCB; device is measured under still air conditions whilst operating in steady-state.
  - Same as Note 6, except mounted on 15mm x 15mm 1oz copper.
  - Same as Note 6, whilst operating at V<sub>IN</sub>=24V. Refer to Safe Operating Area for other Input Voltages.
  - Same as Note 6, except measured with a single pulse width = 100μs and V<sub>IN</sub>=24V.
  - Same as Note 6, except measured with a single pulse width = 10ms and V<sub>IN</sub>=24V.
  - R<sub>θJL</sub> = Thermal resistance from junction to solder-point (at the end of the V<sub>IN</sub> lead). R<sub>θJC</sub> = Thermal resistance from junction to the top of case.
  - Refer to JEDEC specification JESD22-A114 and JESD22-A115.

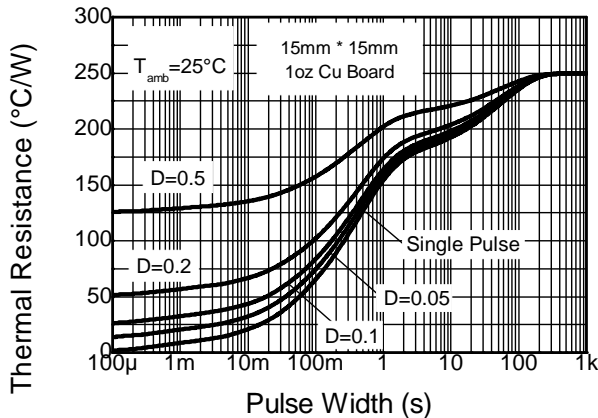
**Thermal Characteristics and Derating Information**



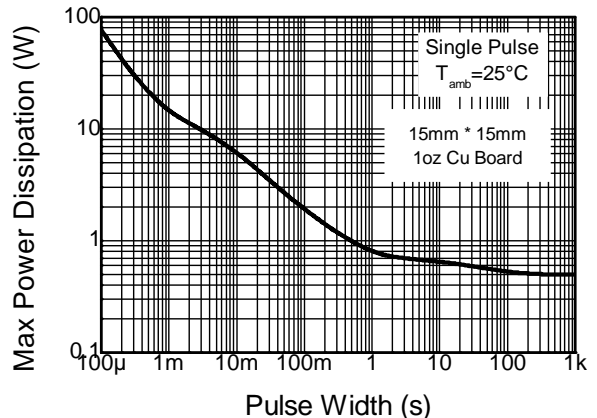
**Derating Curve**



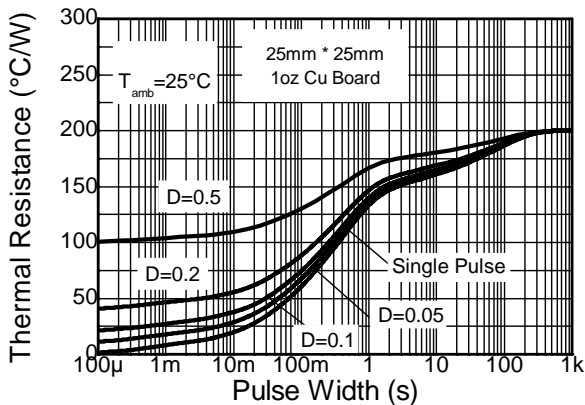
**Safe Operating Area**



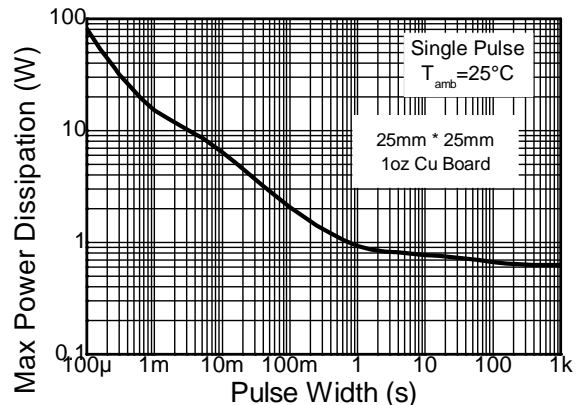
**Transient Thermal Impedance**



**Pulse Power Dissipation**



**Transient Thermal Impedance**

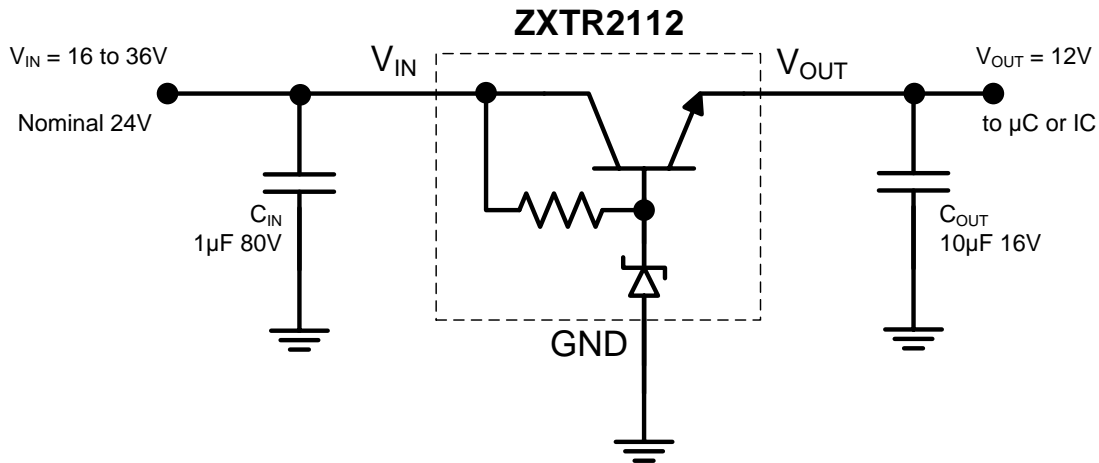


**Pulse Power Dissipation**

**Electrical Characteristics** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
Output Voltage (Note 13)	V <sub>OUT</sub>	10.8	12	13.2	V	V <sub>IN</sub> = 24V, I <sub>OUT</sub> = 15mA
Line Regulation (Notes 13 & 14)	ΔV <sub>OUT</sub>	—	20	50	mV	V <sub>IN</sub> = 18 to 24V, I <sub>OUT</sub> = 15mA
		—	130	—		V <sub>IN</sub> = 18 to 60V, I <sub>OUT</sub> = 15mA
		—	150	—		V <sub>IN</sub> = 15 to 60V, I <sub>OUT</sub> = 15mA
		—	—	—		V <sub>IN</sub> = 15 to 60V, I <sub>OUT</sub> = 15mA
Temperature Coefficient	ΔV <sub>OUT</sub> /ΔT	—	10.4	—	mV/°C	T <sub>J</sub> = -40°C to +125°C V <sub>IN</sub> = 24V, I <sub>OUT</sub> = 15mA
Load Regulation (Notes 13 & 15)	ΔV <sub>OUT</sub>	—	-30 -190	-100 -300	mV	I <sub>OUT</sub> = 10 to 20mA, V <sub>IN</sub> = 24V I <sub>OUT</sub> = 0.1 to 50mA, V <sub>IN</sub> = 24V
Minimum Value of Input Voltage Required to Maintain Line Regulation	V <sub>IN(MIN)</sub>	15	—	—	V	—
Quiescent Current	I <sub>Q</sub>	—	160	360	μA	V <sub>IN</sub> = 15V, I <sub>OUT</sub> = 10μA
		—	3,500	6,000		V <sub>IN</sub> = 60V, I <sub>OUT</sub> = 10μA
Power Supply Rejection Ratio	ΔV <sub>IN</sub> /ΔV <sub>OUT</sub>	—	50	—	dB	C <sub>OUT</sub> = 100nF, I <sub>OUT</sub> = 15mA, V <sub>OUT</sub> = 12V, V <sub>IN</sub> = 15 to 60V, f = 100Hz

- Notes:
- 13. Measured under pulsed conditions. Pulse width ≤ 300μs. Duty cycle ≤ 2%.
  - 14. Line regulation: ΔV<sub>OUT</sub> = V<sub>OUT</sub>(@V<sub>IN</sub>=24V) – V<sub>OUT</sub>(@V<sub>IN</sub> = 18V)  
ΔV<sub>OUT</sub> = V<sub>OUT</sub>(@V<sub>IN</sub>=60V) – V<sub>OUT</sub>(@V<sub>IN</sub> = 15V)  
ΔV<sub>OUT</sub> = V<sub>OUT</sub>(@V<sub>IN</sub>=60V) – V<sub>OUT</sub>(@V<sub>IN</sub> = 18V)
  - 15. Load regulation: ΔV<sub>OUT</sub> = V<sub>OUT</sub>(@I<sub>OUT</sub>= 20mA) – V<sub>OUT</sub>(@I<sub>OUT</sub>= 10mA)  
ΔV<sub>OUT</sub> = V<sub>OUT</sub>(@I<sub>OUT</sub>= 50mA) – V<sub>OUT</sub>(@I<sub>OUT</sub>= 0.1mA)

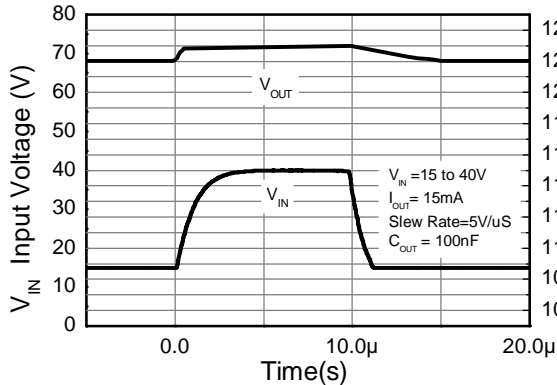
**Typical Application Circuit**


Example of a 12V regulated supply from a nominal 24V for powering a Controller IC.

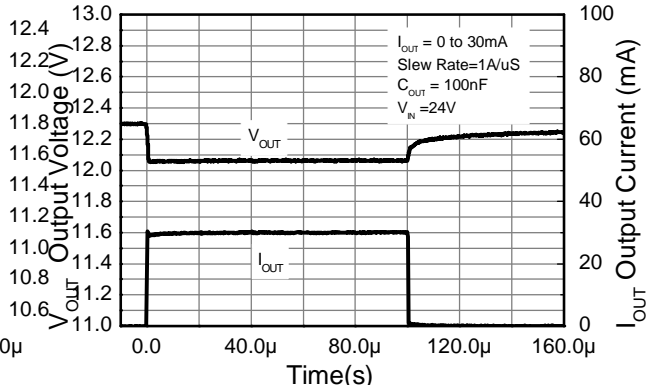
**Pin Functions**

Pin Name	Pin Function	Notes
V <sub>IN</sub>	Input Supply	Input voltage can vary from -0.3V to 60V with respect to GND; for V <sub>OUT</sub> regulated then 15V ≤ V <sub>IN</sub> ≤ 60V. It is recommended to connect a 1μF capacitor to GND.
GND	Power Ground	This pin should be tied to the system ground.
V <sub>OUT</sub>	Voltage Output	Outputs a regulated 12V when 15V ≤ V <sub>IN</sub> ≤ 60V. When V <sub>IN</sub> < 15V, then V <sub>OUT</sub> maximum = V <sub>IN</sub> – 1V. The pin can be pulled high to a maximum of +17V with respect to GND, or +5V with respect to V <sub>IN</sub> , whichever is lower. It is recommended to connect a 10μF capacitor to GND and a minimum of 10μA to be drawn from V <sub>OUT</sub> to maintain regulation.

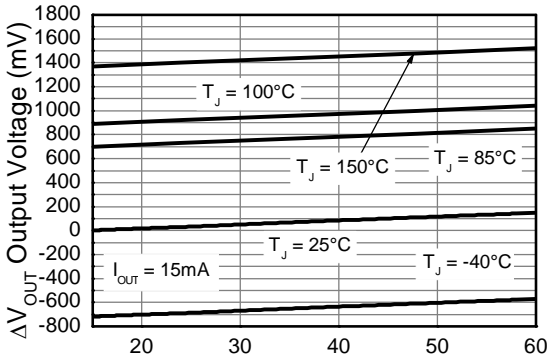
**Typical Electrical Characteristics** (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)



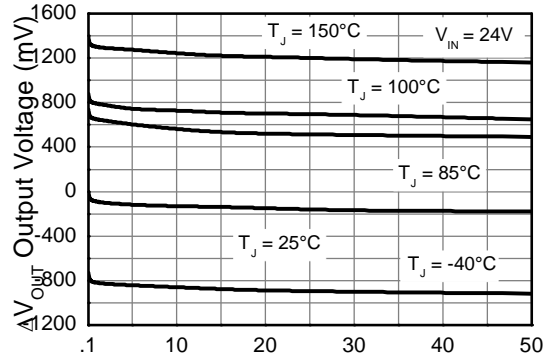
**Line transient response**



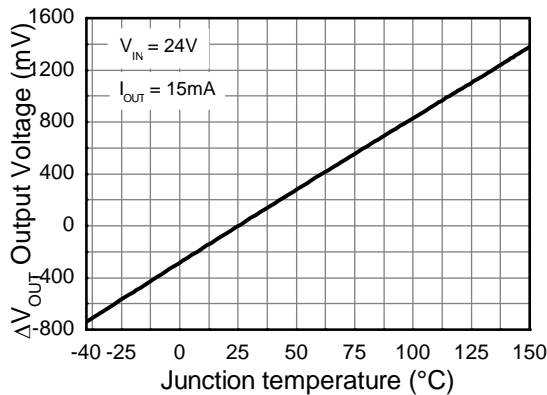
**Load transient response**



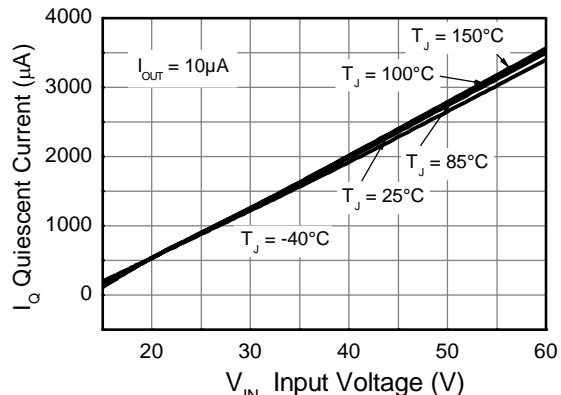
**Line Regulation (Note 16)**



**Load Regulation (Note 17)**



**Temperature Coefficient (Note 18)**



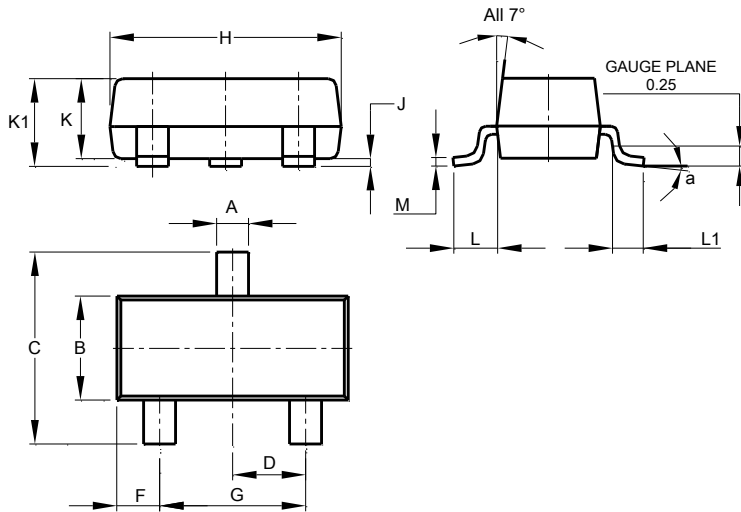
**Quiescent Current**

Notes:  
 16. Line Regulation  $\Delta V_{OUT} = V_{OUT} - V_{OUT}(@ V_{IN} = 15\text{V}, I_{OUT} = 15\text{mA}, T_J = +25^\circ\text{C})$ .  
 17. Load Regulation  $\Delta V_{OUT} = V_{OUT} - V_{OUT}(@ V_{IN} = 24\text{V}, I_{OUT} = 0.1\text{mA}, T_J = +25^\circ\text{C})$ .  
 18. Temperature Coefficient  $\Delta V_{OUT} = V_{OUT} - V_{OUT}(@ V_{IN} = 24\text{V}, I_{OUT} = 15\text{mA}, T_J = +25^\circ\text{C})$ .

**Package Outline Dimensions**

Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for the latest version.

**SOT23**

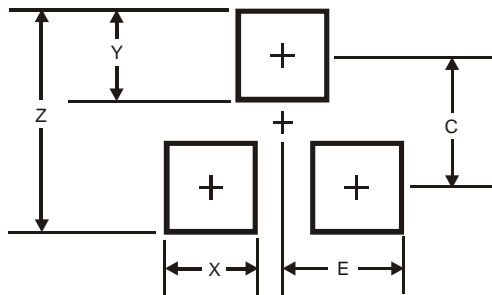


SOT23			
Dim	Min	Max	Typ
A	0.37	0.51	0.40
B	1.20	1.40	1.30
C	2.30	2.50	2.40
D	0.89	1.03	0.915
F	0.45	0.60	0.535
G	1.78	2.05	1.83
H	2.80	3.00	2.90
J	0.013	0.10	0.05
K	0.890	1.00	0.975
K1	0.903	1.10	1.025
L	0.45	0.61	0.55
L1	0.25	0.55	0.40
M	0.085	0.150	0.110
a	8°		
All Dimensions in mm			

**Suggested Pad Layout**

Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.

**SOT23**



Dimensions	Value (in mm)
Z	2.9
X	0.8
Y	0.9
C	2.0
E	1.35

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