

**ZXTR2112F**

**60V INPUT, 12V 15mA REGULATOR TRANSISTOR**

**Description**

The ZXTR2112F 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.

**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**

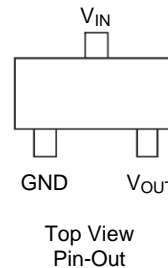
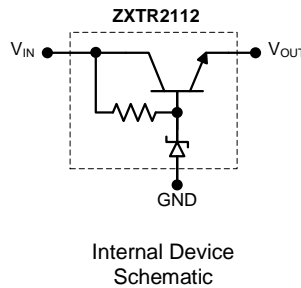
**Applications**

Supply voltage regulation for:

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

**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)



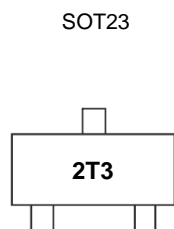
Pin Name	Pin Function
V <sub>IN</sub>	Input Supply
GND	Power Ground
V <sub>OUT</sub>	Voltage Output

**Ordering Information** (Note 4)

Product	Compliance	Marking	Reel size (inches)	Tape width (mm)	Quantity per reel
ZXTR2112F-7	AEC-Q101	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. 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 at V<sub>IN</sub> = 24V** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Continuous Output Current (Note 7)	I <sub>OUT</sub>	50	mA
Pulsed Output Current (Note 8)	I <sub>OM</sub>	2,000	mA
		500 (Note 9)	

**Thermal Characteristics**

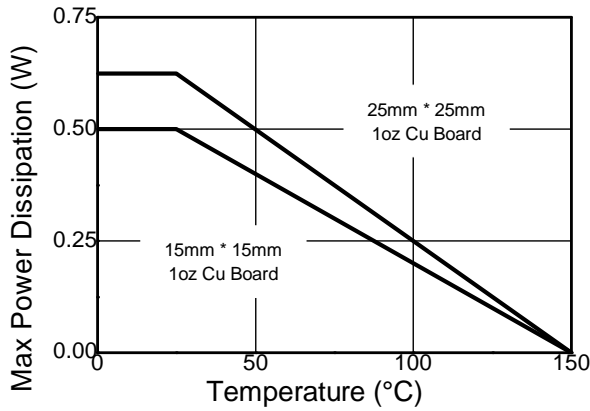
Characteristic	Symbol	Value	Unit
Power Dissipation (Note 5)	P <sub>D</sub>	625	mW
		500 (Note 6)	
Thermal Resistance, Junction to Ambient (Note 5)	R <sub>θJA</sub>	200	°C/W
		250 (Note 6)	
Thermal Resistance, Junction to Lead (Note 10)	R <sub>θJL</sub>	197	
Thermal Resistance, Junction to Case (Note 10)	R <sub>θJC</sub>	17	
Maximum Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>STG</sub>	-65 to +150	

**ESD Ratings** (Note 11)

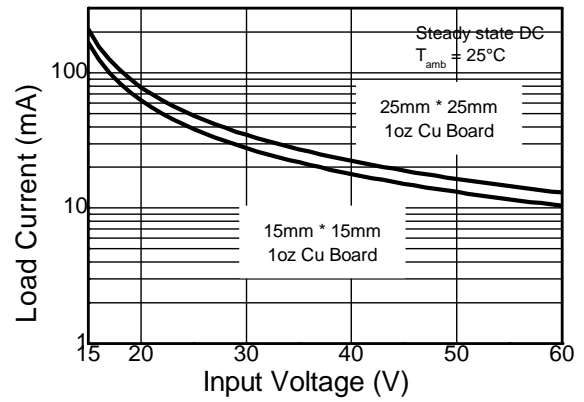
Characteristics	Symbols	Value	Unit	JEDEC Class
Electrostatic Discharge – Human Body Model	ESD HBM	4,000	V	3A
Electrostatic Discharge – Machine Model	ESD MM	400	V	C

- 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 5, except mounted on 15mm x 15mm 1oz copper.
  - Same as note 5, whilst operating at V<sub>IN</sub>=24V. Refer to Safe Operating Area for other Input Voltages.
  - Same as note 5, except measured with a single pulse width = 100µs and V<sub>IN</sub>=24V.
  - Same as note 5, 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.

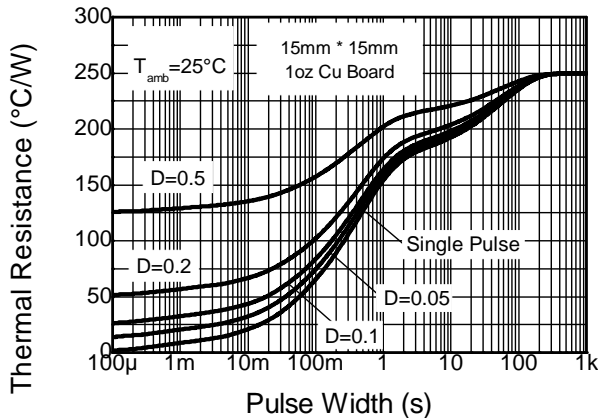
**Thermal Characteristics and Derating Information**



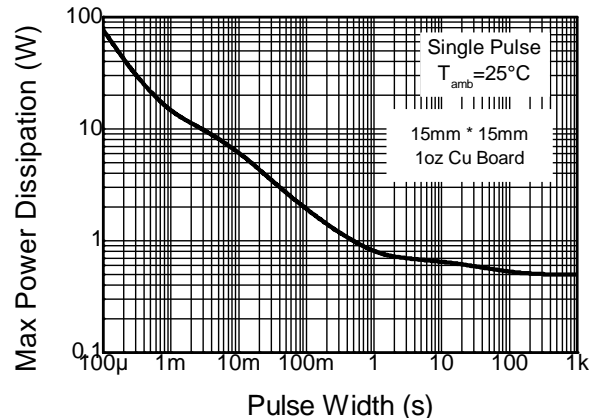
**Derating Curve**



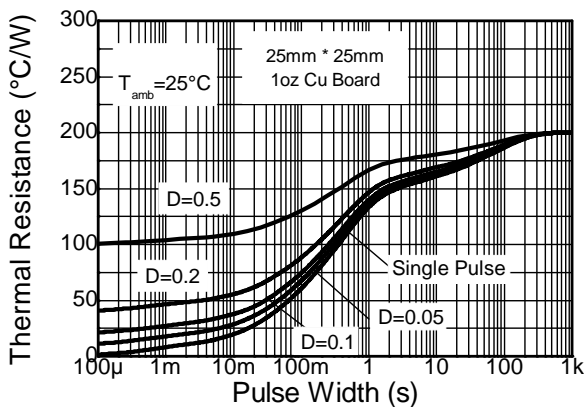
**Safe Operating Area**



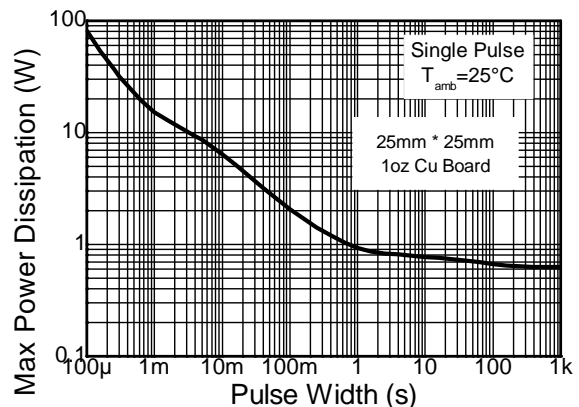
**Transient Thermal Impedance**



**Pulse Power Dissipation**



**Transient Thermal Impedance**



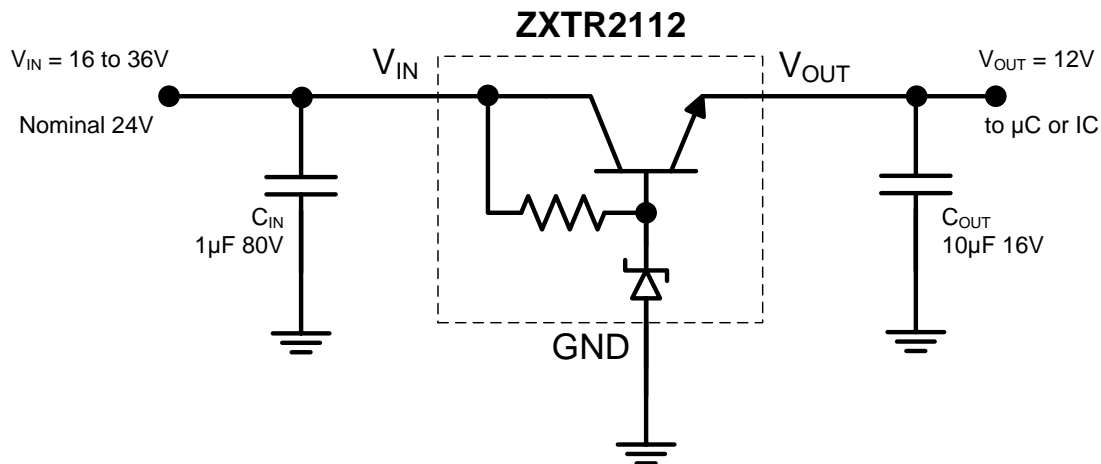
**Pulse Power Dissipation**

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

Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
Output Voltage (Note 12)	V <sub>OUT</sub>	10.8	12	13.2	V	V <sub>IN</sub> = 24V, I <sub>OUT</sub> = 15mA
Line Regulation (Notes 12 & 13)	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
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 12 & 14)	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:
- 12. Measured under pulsed conditions. Pulse width ≤ 300μs. Duty cycle ≤ 2%.
  - 13. Line regulation  
 $\Delta V_{OUT} = V_{OUT}(@V_{IN}=24V) - V_{OUT}(@V_{IN} = 18V)$   
 $\Delta V_{OUT} = V_{OUT}(@V_{IN}=60V) - V_{OUT}(@V_{IN} = 15V)$   
 $\Delta V_{OUT} = V_{OUT}(@V_{IN}=60V) - V_{OUT}(@V_{IN} = 18V)$
  - 14. Load regulation  
 $\Delta V_{OUT} = V_{OUT}(@I_{OUT} = 20mA) - V_{OUT}(@I_{OUT} = 10mA)$   
 $\Delta V_{OUT} = V_{OUT}(@I_{OUT} = 50mA) - V_{OUT}(@I_{OUT} = 0.1mA)$

**Typical Application Circuit**

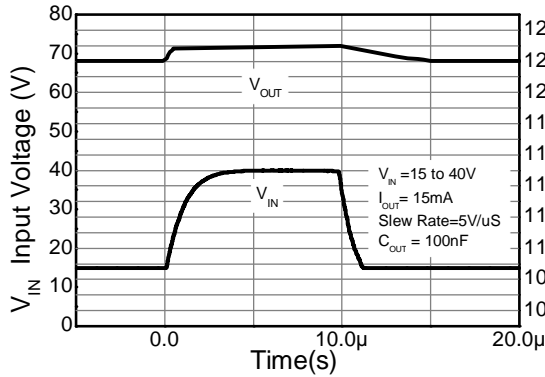


Example of a 12V regulated supply from a nominal 24V for powering a Controller IC.

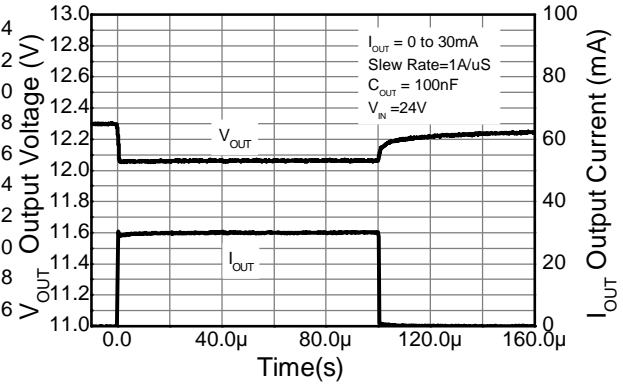
**Pin Functions**

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.

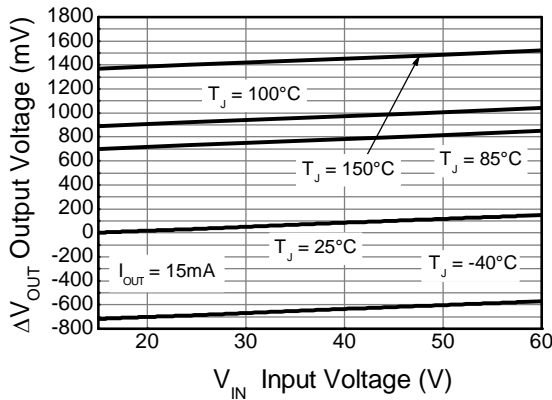
**Typical Electrical Characteristics** (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)



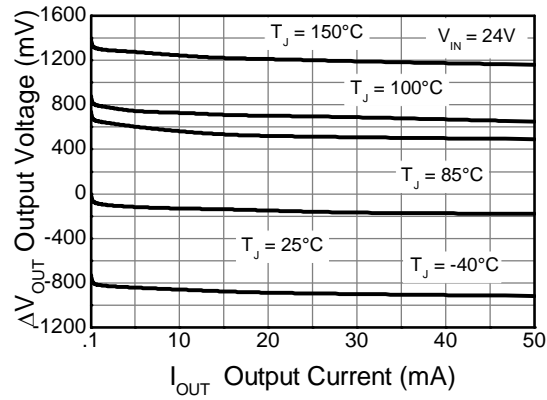
**Line transient response**



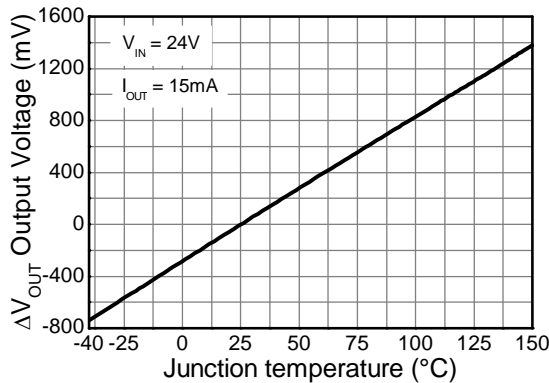
**Load transient response**



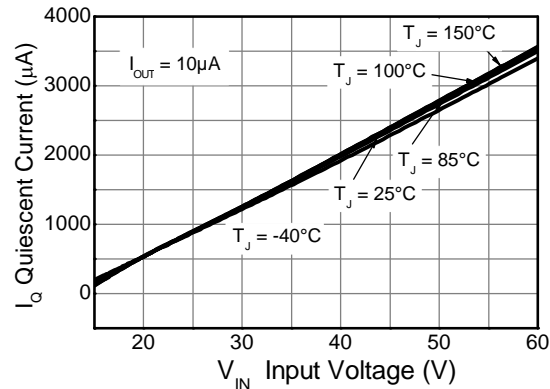
**Line Regulation (Note 15)**



**Load Regulation (Note 16)**



**Temperature Coefficient (Note 17)**

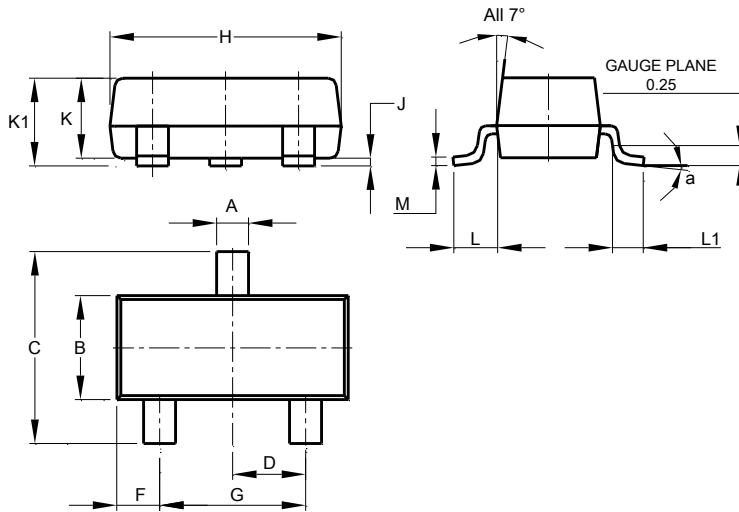


**Quiescent Current**

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

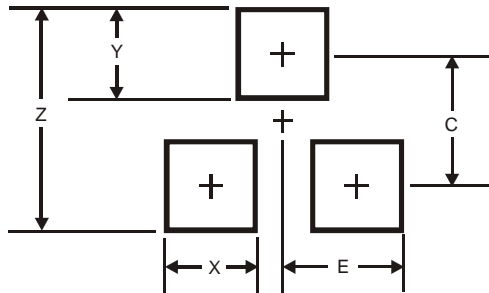
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for the latest version.



SOT23			
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.



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

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