

## Description

The ZXTR2012K monolithically integrates a transistor, zener diode and resistor to function as a high-voltage linear regulator. The device regulates with a 12V nominal output at 15mA. It's designed for use in high-voltage applications where standard linear regulators cannot be used. This function is fully integrated into a TO252 package, minimizing PCB area and reducing a number of components when compared with a multi-chip discrete solution.

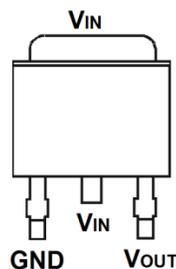
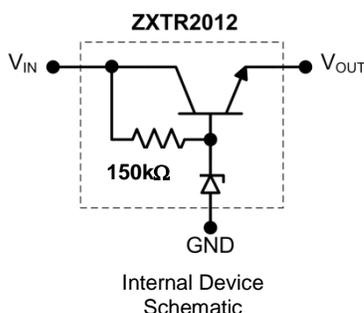
## Applications

Supply voltage regulation in:

- Startup switch in DC-DC converters
- Networking
- Telecom
- Power over Ethernet (PoE)



Top View



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 = 15V to 100V (For regulated output voltage)
- Output Voltage = 12V ± 10%
- 150kΩ resistor to limit quiescent current
- Fully integrated into a TO252 package
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **Qualified to AEC-Q101 for High Reliability**

## Mechanical Data

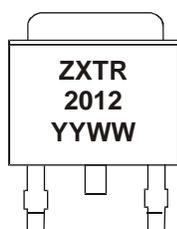
- Case: TO252-3L (DPAK)
- Case Material: Molded Plastic, "Green" Molding Compound.
- UL Flammability Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish - Matte Tin Plated Leads.  
Solderable per MIL-STD-202, Method 208 (E3)
- Weight: 0.34 grams (Approximate)

## Ordering Information (Note 4)

Product	Package	Marking	Reel size (inches)	Tape width (mm)	Quantity per reel
ZXTR2012K-13	TO252-3L	ZXTR 2012	13	16	2,500

- 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



ZXTR 2012 = Product Type Marking Code  
 YYWW = Date Code Marking  
 YY = Last Digit of Year, (ex: 17 = 2017)  
 WW = Week Code 01 - 52

**Absolute Maximum Ratings** (Voltage relative to GND, @ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Input Supply Voltage	$V_{IN}$	-0.3 to 100	V
Continuous Input & Output Current	$I_{IN}, I_{OUT}$	750	mA
Peak Pulsed Input & Output Current	$I_{IM}, I_{OM}$	2	A
Maximum Voltage applied to $V_{OUT}$	$V_{OUT(max)}$	Smaller of $V_{IN}+12\text{V}$ or 18V	V

**Maximum Current at  $V_{IN} = 48\text{V}$**  (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Continuous Output Current	$I_{OUT}$	60	mA
Pulsed Output Current	$I_{OM}$	960	mA
		200	

**Thermal Characteristics**

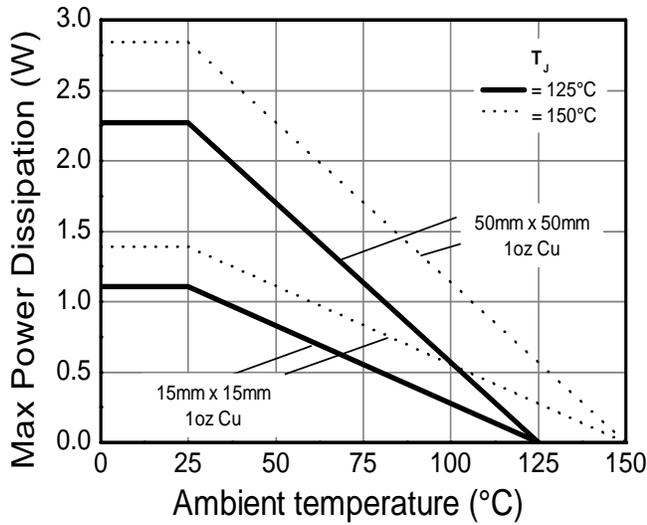
Characteristic	Symbol	Value	Unit
Power Dissipation	$P_D$	2.3	W
		1.1	
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	44	$^\circ\text{C/W}$
		90	
Thermal Resistance, Junction to Lead	$R_{\theta JL}$	8.4	
Thermal Resistance, Junction to Case	$R_{\theta JC}$	14.6	
Recommended Operating Junction Temperature Range	$T_J$	-40 to +125	$^\circ\text{C}$
Maximum Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-65 to +150	

**ESD Ratings** (Note 11)

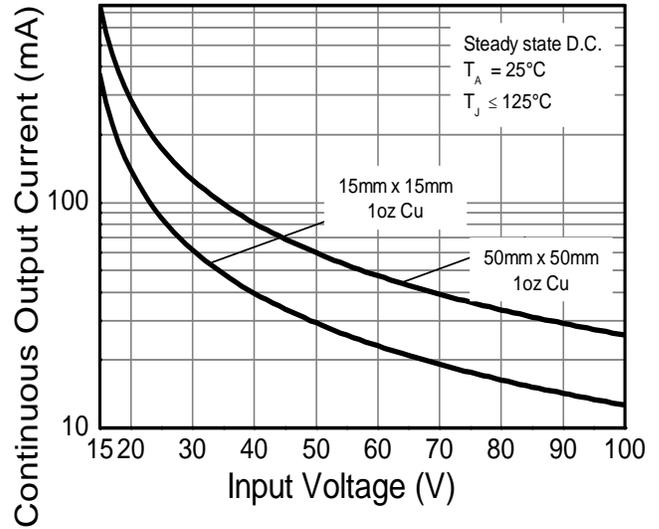
Characteristics	Symbols	Value	Unit	JEDEC Class
Electrostatic Discharge – Human Body Model	ESD HBM	4000	V	3A
Electrostatic Discharge – Machine Model	ESD MM	400	V	C

- Notes:
- For a device mounted with the exposed  $V_{IN}$  pad on 50mm x 50mm 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  $V_{IN} = 48\text{V}$ . Refer to Safe Operating Area for other Input Voltages.
  - Same as note 5, except measured with a single pulse width = 100 $\mu\text{s}$  and  $V_{IN} = 48\text{V}$ .
  - Same as note 5, except measured with a single pulse width = 10ms and  $V_{IN} = 48\text{V}$ .
  - $R_{\theta JL}$  = Thermal resistance from junction to solder-point (on the exposed  $V_{IN}$  pad).
  - $R_{\theta JC}$  = Thermal resistance from junction to the top of case.
  - Refer to JEDEC specification JESD22-A114 and JESD22-A115.

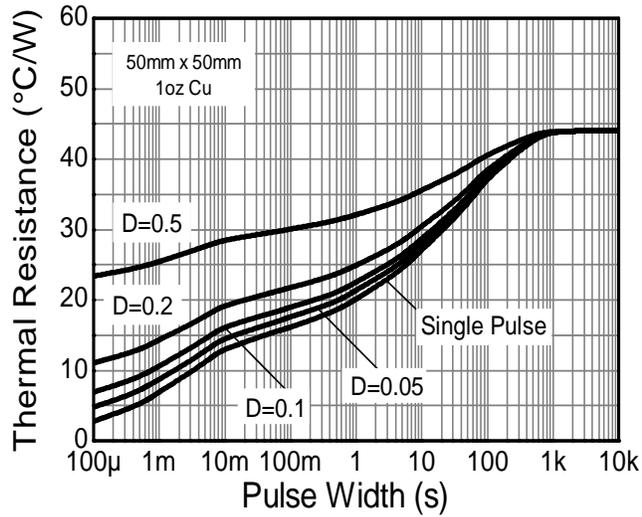
**Thermal Characteristics and Derating Information**



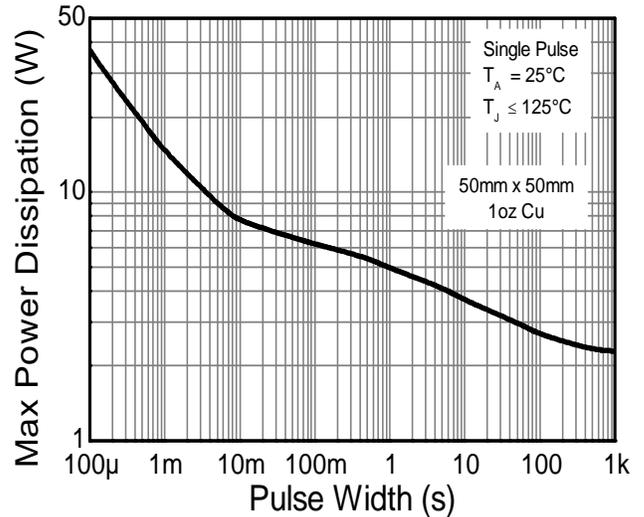
**Derating Curve**



**Safe Operating Area**



**Transient Thermal Impedance**

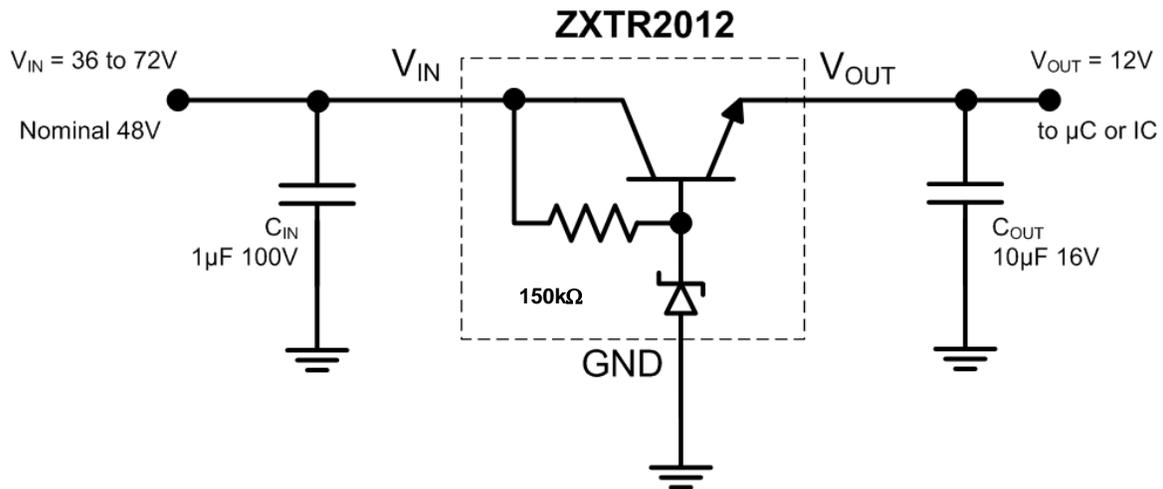


**Pulse Power Dissipation**

**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> = 48V, I <sub>OUT</sub> = 15mA
Line Regulation (Notes 12 & 13)	ΔV <sub>OUT</sub>	—	240	750	mV	V <sub>IN</sub> = 15 to 72V, I <sub>OUT</sub> = 15mA
Temperature Coefficient	ΔV <sub>OUT</sub> /ΔT	—	8.0	—	mV/°C	T <sub>J</sub> = -40°C to +125°C V <sub>IN</sub> = 48V, I <sub>OUT</sub> = 15mA
Load Regulation (Notes 12 & 14)	ΔV <sub>OUT</sub>	—	-450 -600	-600 -750	mV	I <sub>OUT</sub> = 0.1 to 30mA, V <sub>IN</sub> = 48V I <sub>OUT</sub> = 0.1 to 100mA, V <sub>IN</sub> = 48V
Minimum Value of Input Voltage Required to Maintain Line Regulation	V <sub>IN(MIN)</sub>	15	—	—	V	—
Quiescent Current	I <sub>Q</sub>	—	240 590	400 900	μA	V <sub>IN</sub> = 48V, I <sub>OUT</sub> = 10μA V <sub>IN</sub> = 100V, I <sub>OUT</sub> = 10μA
Power Supply Rejection Ratio	ΔV <sub>IN</sub> /ΔV <sub>OUT</sub>	—	45	—	dB	C <sub>OUT</sub> = 100nF, I <sub>OUT</sub> = 15mA, V <sub>OUT</sub> = 12V, V <sub>IN</sub> = 15 to 100V, f = 100Hz

Notes: 12. Measured under pulsed conditions. Pulse width ≤ 300μs. Duty cycle ≤ 2%  
 13. Line regulation ΔV<sub>OUT</sub> = V<sub>OUT</sub>(@ V<sub>IN</sub> = 72V) - V<sub>OUT</sub>(@ V<sub>IN</sub> = 15V)  
 14. Load regulation ΔV<sub>OUT</sub> = V<sub>OUT</sub>(@ I<sub>OUT</sub> = 30mA) - V<sub>OUT</sub>(@ I<sub>OUT</sub> = 0.1mA)  
 ΔV<sub>OUT</sub> = V<sub>OUT</sub>(@ I<sub>OUT</sub> = 100mA) - V<sub>OUT</sub>(@ I<sub>OUT</sub> = 0.1mA)

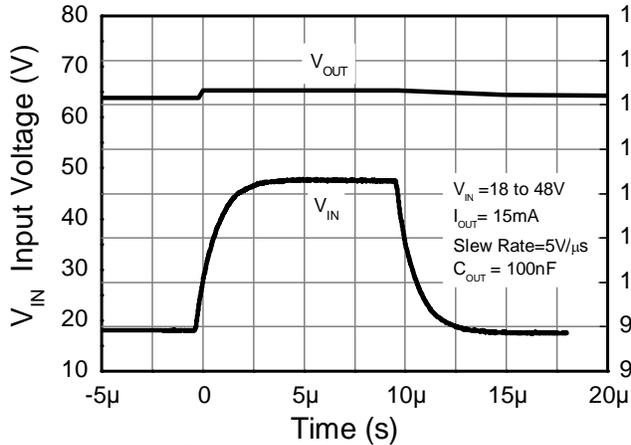
**Typical Application Circuit**


Example of an 12V regulated supply from a nominal 48V for powering a Controller IC.

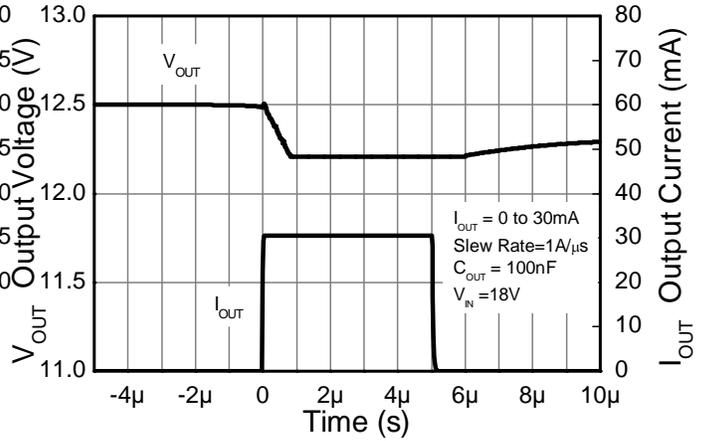
**Pin Functions**

Pin Name	Pin Function	Notes
V <sub>IN</sub>	Input Supply	Input voltage can vary from -0.3V to 100V with respect to GND; for V <sub>OUT</sub> regulated then 15V ≤ V <sub>IN</sub> ≤ 100V. 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> ≤ 100V. When V <sub>IN</sub> < 15V, then V <sub>OUT</sub> maximum = V <sub>IN</sub> - 1.5V. The pin can be pulled high to a maximum of +18V with respect to GND, or +12V 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.

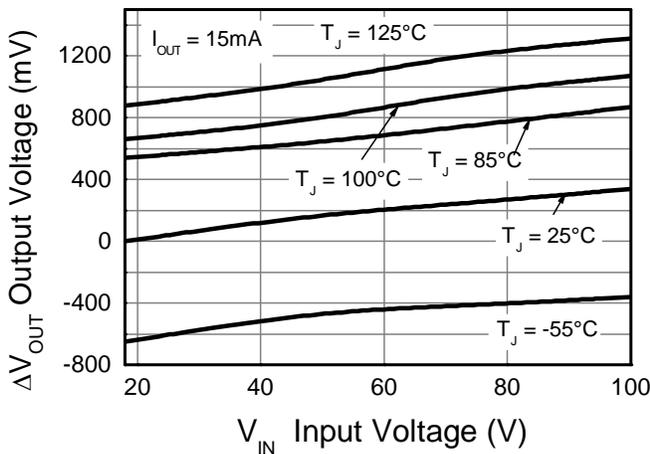
**Typical Electrical Characteristics** (@T<sub>A</sub> = +25°C, unless otherwise specified.)



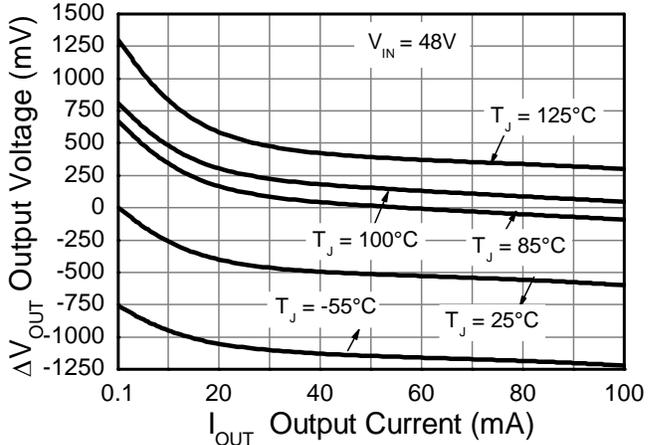
**Line transient response**



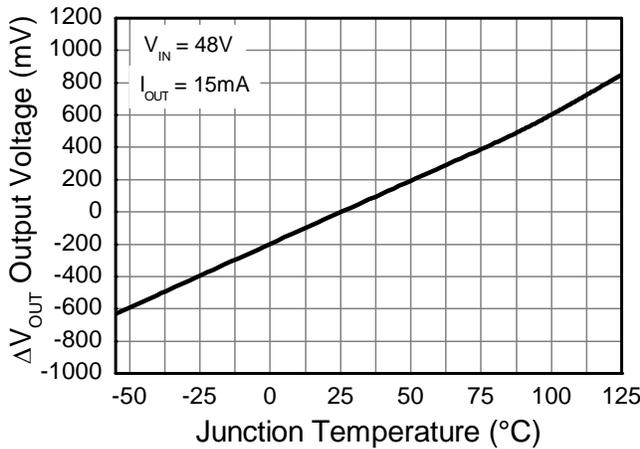
**Load transient response**



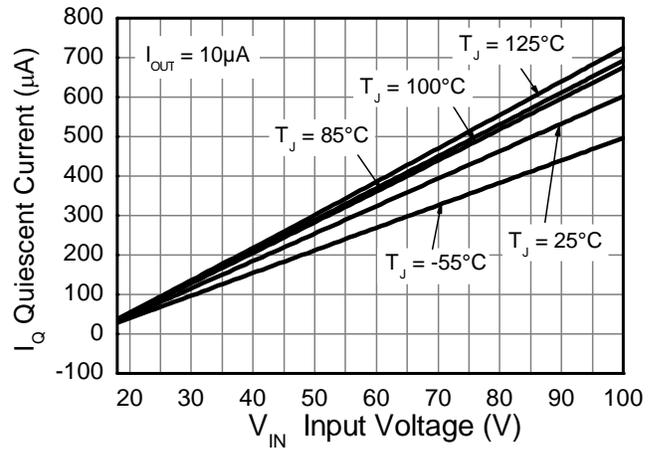
**Line Regulation (Note 15)**



**Load Regulation (Note 16)**



**Temperature Coefficient (Note 17)**

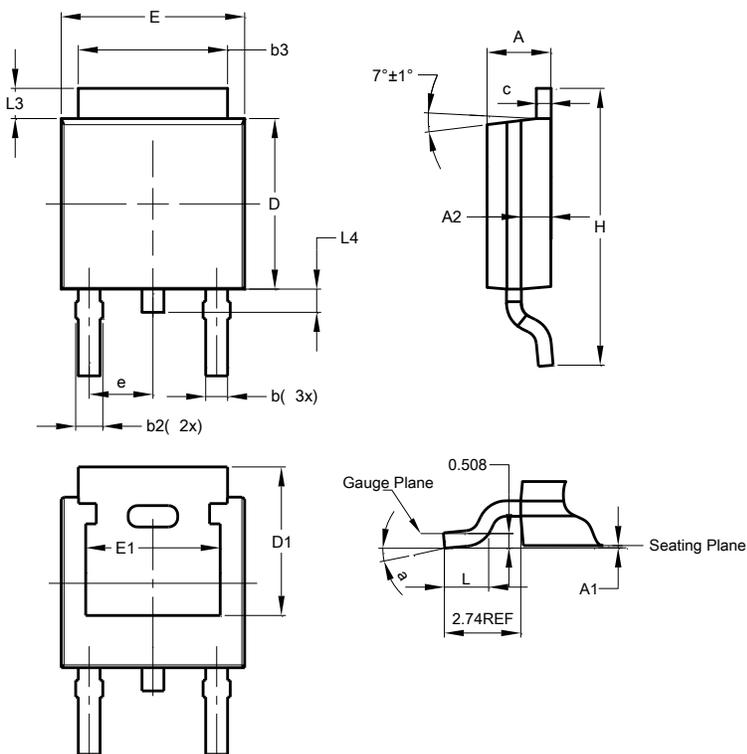


**Quiescent Current**

Notes: 15. Line regulation ΔV<sub>OUT</sub> = V<sub>OUT</sub> - V<sub>OUT</sub>(@ V<sub>IN</sub> = 15V, I<sub>OUT</sub> = 15mA, T<sub>J</sub> = +25°C)  
16. Load regulation ΔV<sub>OUT</sub> = V<sub>OUT</sub> - V<sub>OUT</sub>(@ V<sub>IN</sub> = 48V, I<sub>OUT</sub> = 0.1mA, T<sub>J</sub> = +25°C)  
17. Temperature Coefficient ΔV<sub>OUT</sub> = V<sub>OUT</sub> - V<sub>OUT</sub>(@ V<sub>IN</sub> = 48V, I<sub>OUT</sub> = 15mA, T<sub>J</sub> = +25°C)

**Package Outline Dimensions**

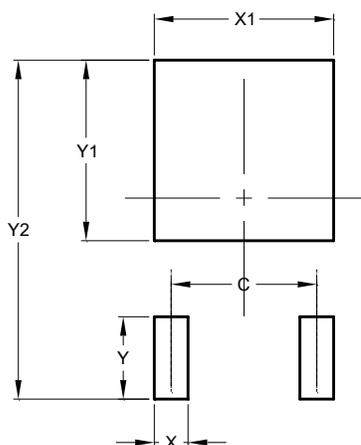
Please see <http://www.diodes.com/package-outlines.html> for the latest version.



TO252 (DPAK)			
Dim	Min	Max	Typ
A	2.19	2.39	2.29
A1	0.00	0.13	0.08
A2	0.97	1.17	1.07
b	0.64	0.88	0.783
b2	0.76	1.14	0.95
b3	5.21	5.46	5.33
c	0.45	0.58	0.531
D	6.00	6.20	6.10
D1	5.21	-	-
e	-	-	2.286
E	6.45	6.70	6.58
E1	4.32	-	-
H	9.40	10.41	9.91
L	1.40	1.78	1.59
L3	0.88	1.27	1.08
L4	0.64	1.02	0.83
a	0°	10°	-
<b>All Dimensions in mm</b>			

**Suggested Pad Layout**

Please see <http://www.diodes.com/package-outlines.html> for the latest version.



Dimensions	Value (in mm)
C	4.572
X	1.060
X1	5.632
Y	2.600
Y1	5.700
Y2	10.700

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