XTR1N0400

High Temperature 40V Diode Family

Rev 4 – November 2023 (DS-00172-12)

Data Sheet

PRODUCTION

DIP8
XTR1N0415
XTR1N0450

CDFP8
XTR1N0415

TO18-3
XTR1N0415

FEATURES

- Reverse voltage V_R > 55V.
- Operational beyond the -60°C to +230°C temperature range.
- Forward current @ 230°C, V_F=1.2V:
  - XTR1N0415: I_F=280mA per diode.
  - XTR1N0450: I_F=800mA per diode.
- Forward voltage @ 85°C, I_F=1mA:
  - XTR1N0415: V_F=622mV per diode.
  - XTR1N0450: V_F=585mV per diode.
- Ruggedized SMT and thru-hole packages.
- Also available as bare die.

APPLICATIONS

- Reliability-critical, Automotive, Aeronautics & Aerospace, Down-hole.
- General rectification, voltage blocking and clamping, power supplies.

DESCRIPTION

XTR1N0400 is a family of general-purpose diodes with a reverse voltage above 55V. Each part is composed of two or four independent diodes which can be used individually, in half- or full-bridge rectifier architectures or connected in series or parallel.

Typical applications include rectification, demodulation, voltage blocking, voltage clamping, power supplies, charge pumps and voltage multipliers.

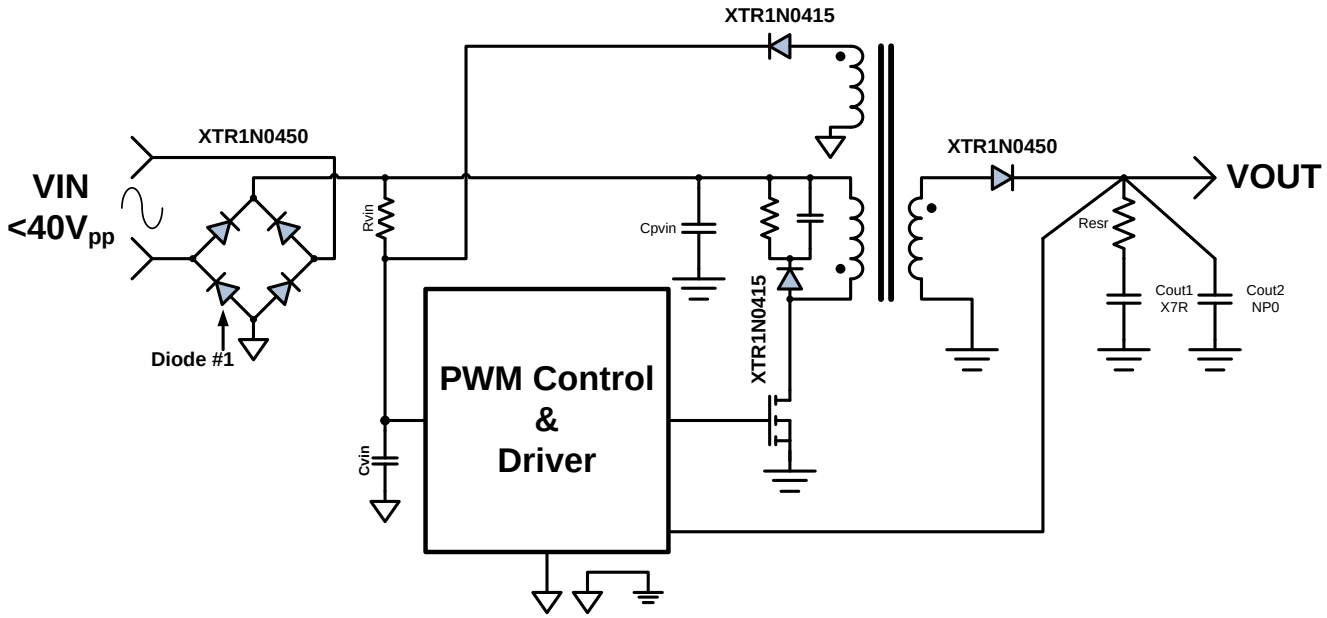
Full functionality is guaranteed from -60°C to +230°C, though operation well below and above this temperature range is achieved.

XTR1N0400 parts have been designed to reduce system cost and ease adoption by reducing the learning curve and providing easy to use features.

Parts from the XTR1N0400 family are available in ruggedized SMT and thru-hole packages. Parts are also available as bare dies.

PRODUCT HIGHLIGHT

Diodes used in half- and full-wave rectification as well as voltage clamping in flyback application



ORDERING INFORMATION

X	TR	1N	04xx
Source : X = X-REL Semi	Process: TR = HiTemp, HiRel	Part family	Part number

Product Reference	Temperature Range	Package	Pin Count	Marking
XTR1N0415-TD	-60°C to +230°C	Tested Bare Die		
XTR1N0415-D	-60°C to +230°C	Ceramic side braze DIP	8	XTR1N0415
XTR1N0415-FE	-60°C to +230°C	Gull-wing flat pack with ePad	8	XTR1N0415
XTR1N0415-T	-60°C to +230°C	TO-18 Metal can	3	XTR1N0415
XTR1N0450-TD	-60°C to +230°C	Tested Bare Die		
XTR1N0450-D	-60°C to +230°C	Ceramic side braze DIP	8	XTR1N0450

Other packages and packaging configurations possible upon request. For some packages or packaging configurations, MOQ may apply.

ABSOLUTE MAXIMUM RATINGS

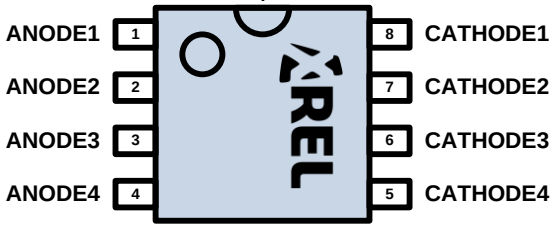
Repetitive peak reverse voltage V_{RRM}	55V
Continuous peak reverse voltage V_R	55V
Continuous forward current I_F @230°C	
XTR1N0415	0.63A
XTR1N0450	1.80A
Operating Junction Temperature Range	-70°C to +300°C

Caution: *Stresses beyond those listed in "ABSOLUTE MAXIMUM RATINGS" may cause permanent damage to the device. These are stress ratings only and functionality of the device at these or any other condition beyond those indicated in the operational sections of the specifications is not implied. Exposure to "ABSOLUTE MAXIMUM RATINGS" conditions for extended periods may permanently affect device reliability.*

PACKAGING OPTIONS

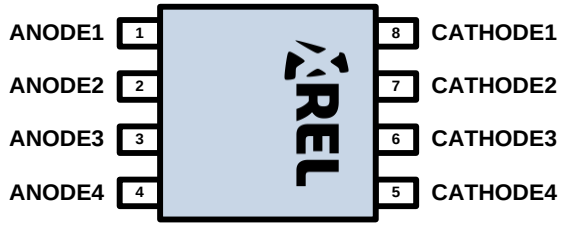
Side Brazed DIP8
XTR1N04XX-D

Top view



CDFP8 with ePad
XTR1N0415-FE

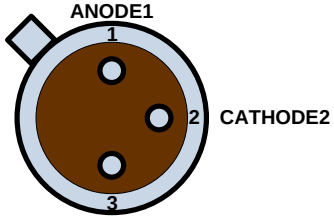
Top view



ePAD (bottom of package) must be connected to pin #1 (ANODE 1).

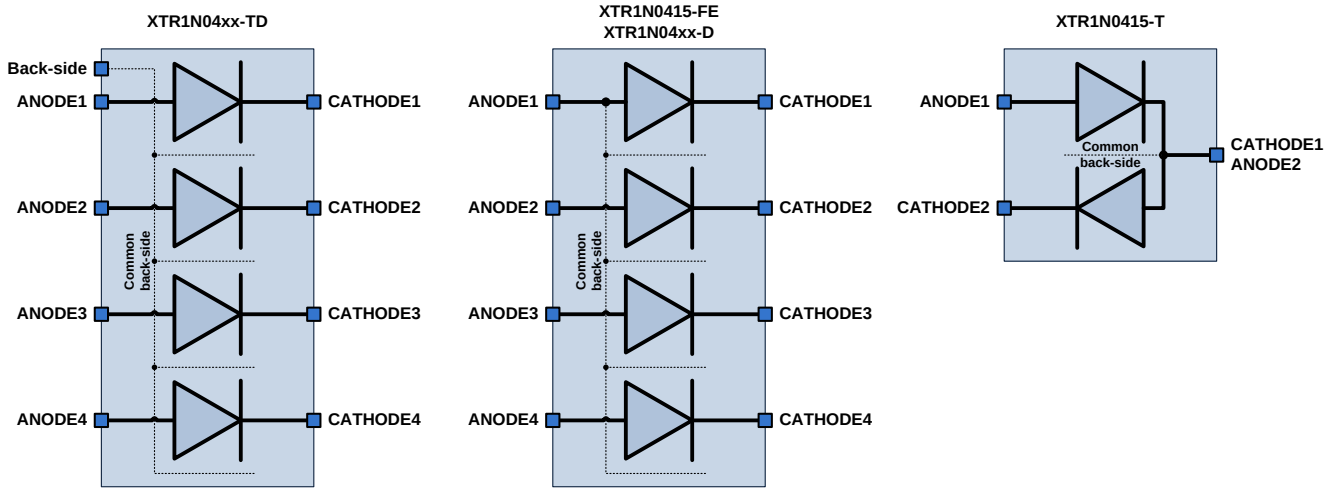
TO-18
XTR1N0415-T

Bottom view



CATHODE1 – ANODE2
Package case connected to pin #3

BLOCK DIAGRAM



Important Notices:
Dashed lines indicate the back-side connection for the different packages.
For best reverse voltage performance, the back-side must be connected to the most negative voltage seen by the diodes.
In case a diode is not used, the diode should be shorted and tied to a fixed voltage in the application or at least to a terminal of any active diode.

THERMAL CHARACTERISTICS

Parameter	Condition	Min	Typ	Max	Units
XTR1N04XX-D (DIP8)					
Thermal Resistance: J-C $R_{Th\_J\text{-}C}$			20		°C/W
Thermal Resistance: J-A $R_{Th\_J\text{-}A}$	Still air.		100		°C/W
XTR1N0415-FE (DFP8 with exposed pad)					
Thermal Resistance: J-C $R_{Th\_J\text{-}C}$	Measured on ePAD.		10		°C/W
Thermal Resistance: J-A $R_{Th\_J\text{-}A}$	ePAD thermally connected to 3cm² PCB copper		75		°C/W
XTR1N0415-T (TO-18)					
Thermal Resistance: J-C $R_{Th\_J\text{-}C}$			50		°C/W
Thermal Resistance: J-A $R_{Th\_J\text{-}A}$	Still air.		300		°C/W

RECOMMENDED OPERATING CONDITIONS

Parameter	Min	Typ	Max	Units
Reverse voltage V_R			40	V
Forward voltage V_F			1.5	V
Continuous forward current per diode @ V_F=1.5V,T_J=85°C I_F XTR1N0415 XTR1N0450		 0.45 1.30		 A
Junction Temperature[1] T_J	-60		230	°C

[1] *Operation beyond the specified temperature range is achieved.*

XTR1N0415 ELECTRICAL SPECIFICATIONS

Unless otherwise stated, specification applies for one diode and -60°C<T_J<230°C.

Parameter	Condition	Min	Typ	Max	Units
Electrical Characteristics					
Forward Voltage **V_F**	I_F=1mA T_C=-60°C T_C=85°C T_C=230°C		 844 622 375		mV
Forward Current **I_F**	V_F=1.2V T_C=-60°C T_C=85°C T_C=230°C		 215 255 280		mA
Reverse Current **I_R**	V_R=40V T_C=-60°C T_C=85°C T_C=230°C		 <0.002 0.004 2.0		µA
Switching Characteristics					
Diode Capacitance **C_d**	F=200KHz, V_R=0V, T_C=230°C F=200KHz, V_R=40V, T_C=230°C		100 21		pF
Reverse Recovery Time **t_{rr}**	I_F = I_{rm} = 100 mA, t_{rr} at 25% of I_{rm} T_C=-60°C T_C=85°C T_C=230°C		 18 25 32		ns
	I_F = 100 mA, V_R = -6V, t_{rr} at 25% of I_{rm} T_C=-60°C T_C=85°C T_C=230°C		 19 30 38		ns

XTR1N0450 ELECTRICAL SPECIFICATIONS

Unless otherwise stated, specification applies for one diode and -60°C<T_J<230°C.

Parameter	Condition	Min	Typ	Max	Units
Electrical Characteristics					
Forward Voltage **V_F**	I_F=1mA T_C=-60°C T_C=85°C T_C=230°C		 830 585 315		mV
Forward Current **I_F**	V_F=1.2V T_C=-60°C T_C=85°C T_C=230°C		 640 730 800		mA
Reverse Current **I_R**	V_R=40V T_C=-60°C T_C=85°C T_C=230°C		 <0.005 0.015 10		µA
Switching Characteristics					
Diode Capacitance **C_d**	F=200KHz, V_R=0V, T_C=230°C F=200KHz, V_R=40V, T_C=230°C		330 73		pF
Reverse Recovery Time **t_{rr}**	I_F = I_{rm} = 100 mA, t_{rr} at 25% of I_{rm} T_C=-60°C T_C=85°C T_C=230°C		 30 40 55		ns
	I_F = 100 mA, V_R = -6V, t_{rr} at 25% of I_{rm} T_C=-60°C T_C=85°C T_C=230°C		 35 52 65		ns

XTR1N0415 TYPICAL PERFORMANCE

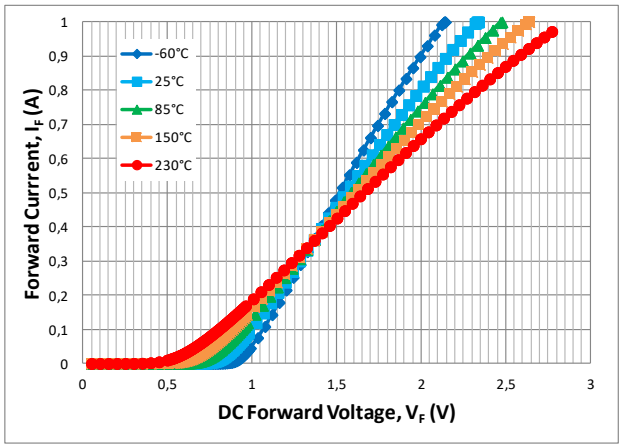


Figure 1. Forward current (I_F).vs DC forward voltage (V_F) for several case temperatures. Linear vertical axis.

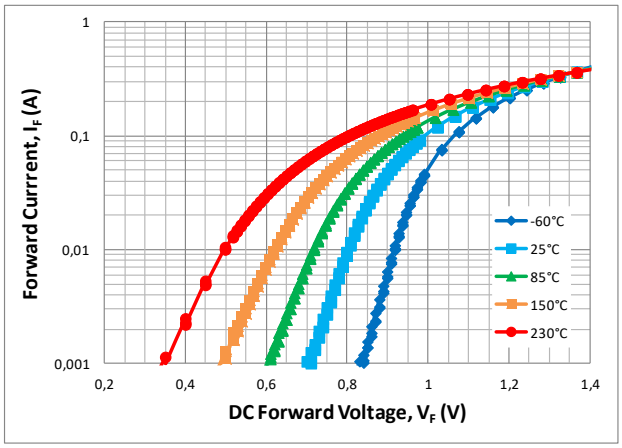


Figure 2. Forward current (I_F).vs DC forward voltage (V_F) for several case temperatures. Logarithmic vertical axis.

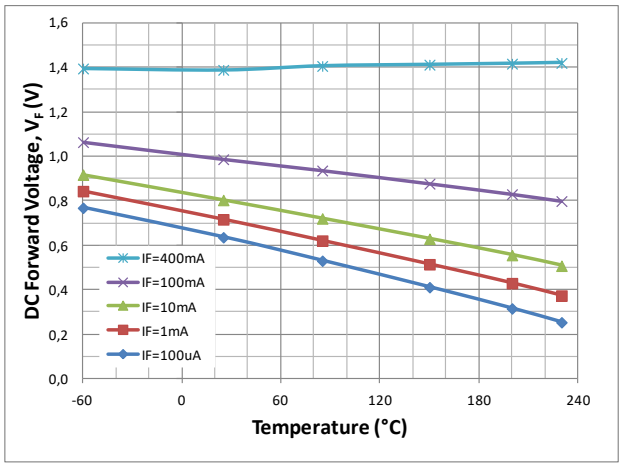


Figure 3. DC forward voltage (V_F) vs case temperature for several forward currents (I_F).

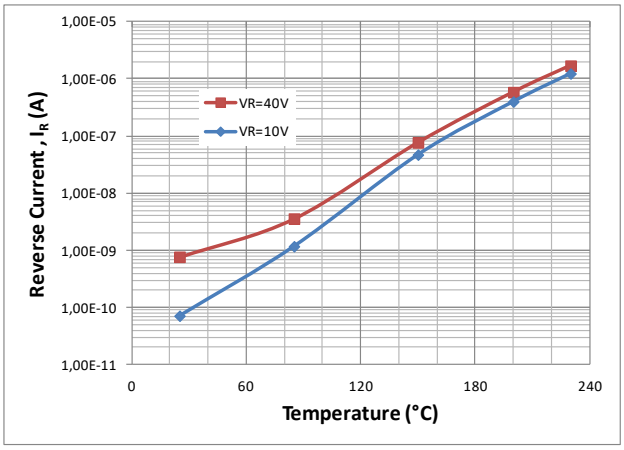


Figure 4. Reverse current (I_R) vs case temperature for two reverse voltages (V_R).

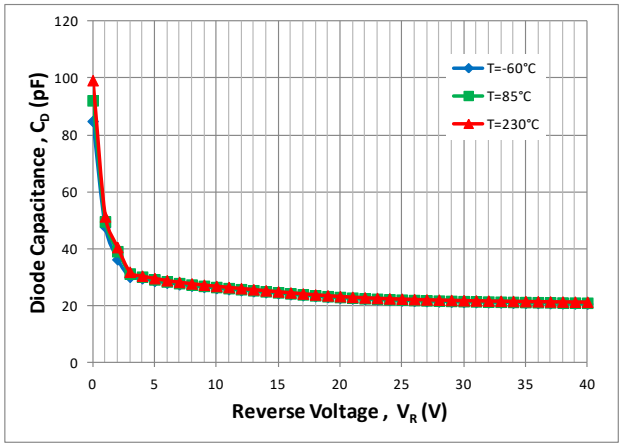


Figure 5. Diode capacitance (C_D) vs reverse voltage (V_R) for several case temperatures (I_F) with F=200KHz.

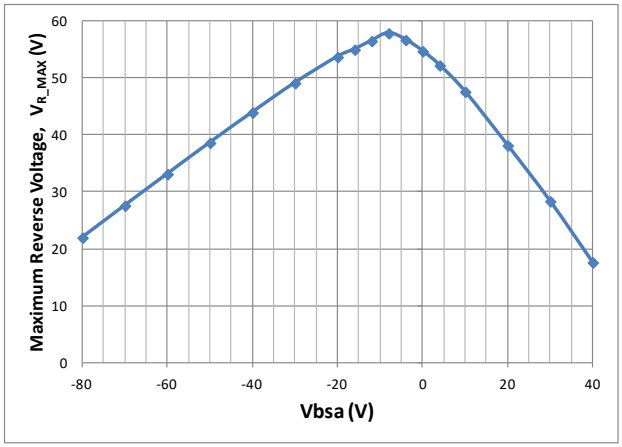


Figure 6. Maximum allowed reverse voltage (V_{R_MAX}) vs back-side to anode voltage (see **Erreur ! Source du renvoi introuvable.** in page **Erreur ! Signet non défini.**). Worst case values.

XTR1N0450 TYPICAL PERFORMANCE

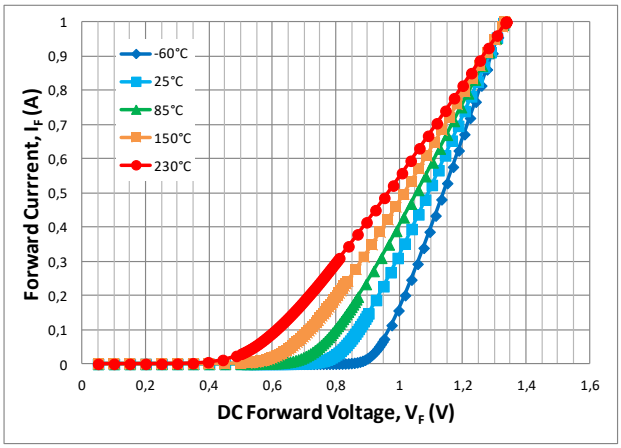


Figure 7. Forward current (I_F).vs DC forward voltage (V_F) for several case temperatures. Linear vertical axis.

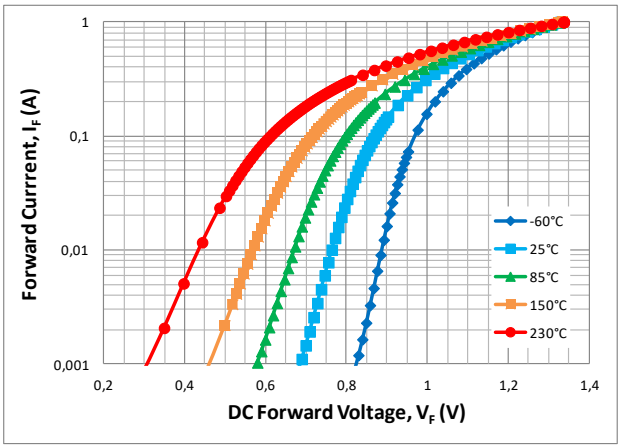


Figure 8. Forward current (I_F).vs DC forward voltage (V_F) for several case temperatures. Logarithmic vertical axis.

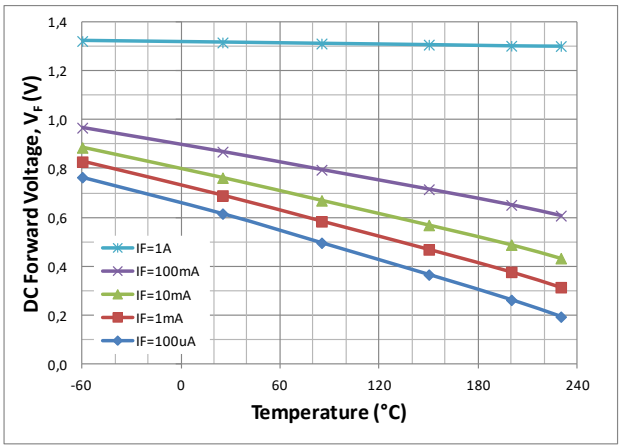


Figure 9. DC forward voltage (V_F) vs case temperature for several forward currents (I_F).

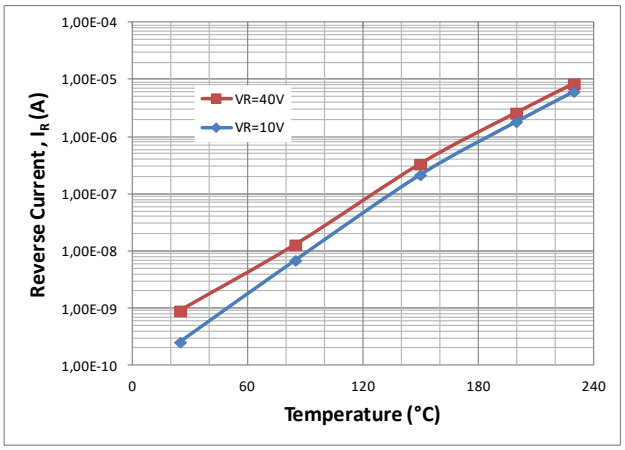


Figure 10. Reverse current (I_R) vs case temperature for two reverse voltages (V_R).

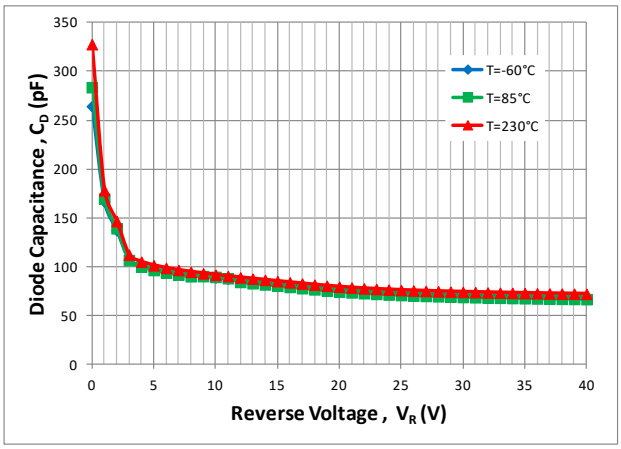


Figure 11. Diode capacitance (C_D) vs reverse voltage (V_R) for several case temperatures (I_F) with F=200KHz.

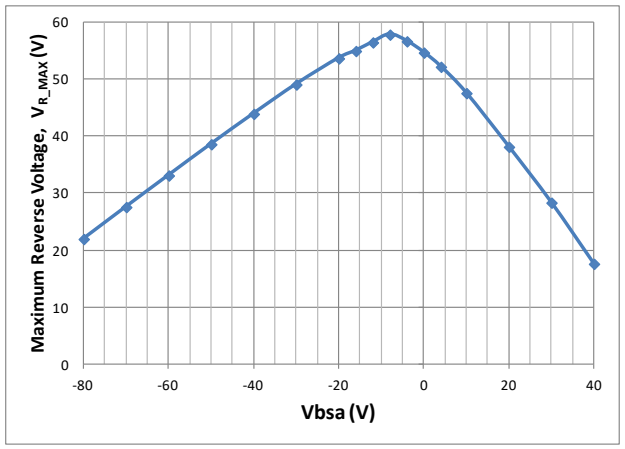


Figure 12. Maximum allowed reverse voltage (V_{R_MAX}) vs back-side to anode voltage (see **Erreur ! Source du renvoi introuvable.** in page **Erreur ! Signet non défini.**). Worst case values.

PARAMETER DEFINITION (TRR)

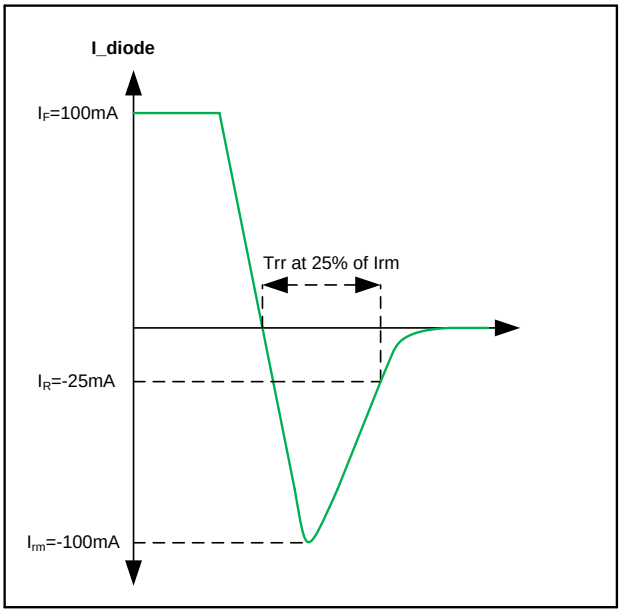


Figure 13. Reverse recovery time definition for I_F=I_{rm}=100mA.

THEORY OF OPERATION

Introduction

The XTR1N0400 is a family of general-purpose diodes able to operate from -60°C to +230°C and withstand reverse voltages up to 55V.

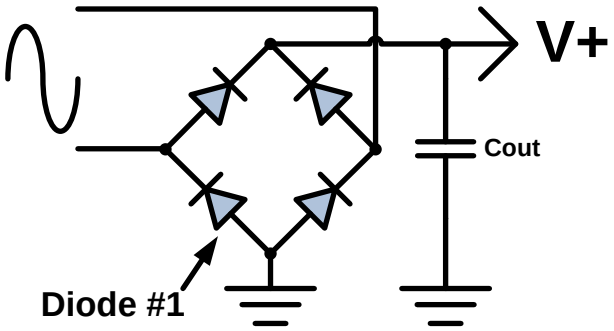
Each die is composed of four independent diodes on top of the same silicon substrate (back-side connection).

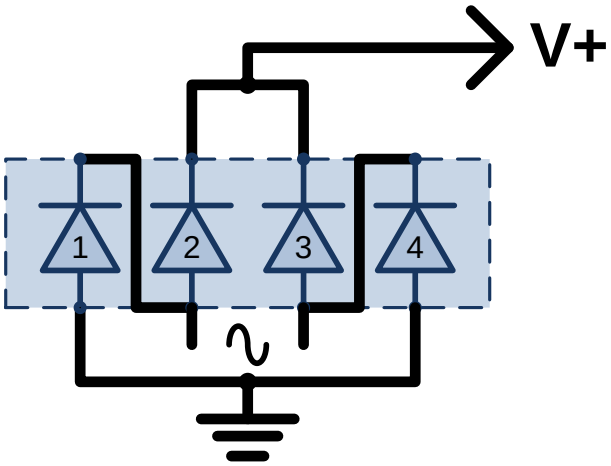
Given the construction of the diodes, the back-side voltage has an influence on the maximum allowed reverse voltage. Optimum performance is achieved for the back-side connected to the most negative voltage see by any of the four diodes.

In TO18 packaged parts, the back-side is connected to the cathode of the first diode (CATHODE1) and the anode of the second diode (ANODE2).

In DIP8 and CDFP8 packaged parts, the back-side is connected to the anode of the first diode (ANODE1).

In the simple full-wave rectifier example below, if DIP8 or CDFP8 packaged versions of XTR1N0415 or XTR1N0450 are used, the optimum result in terms of reverse voltage robustness is achieved by connecting the anode of the first diode to the GND node.



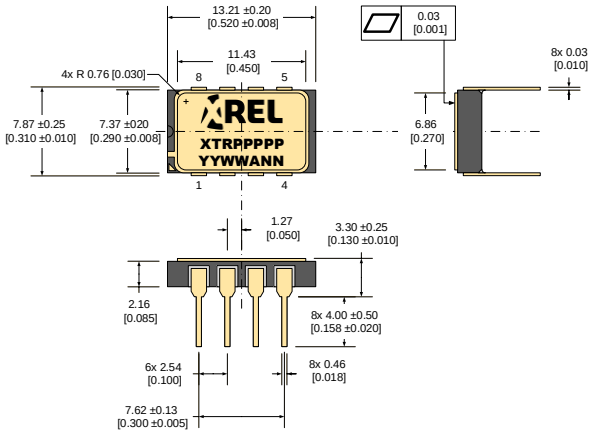


The previous figure shows a simple implementation of the full-bridge rectifier at board level. Bold black lines indicate tracks on the board. In this configuration, as recommended in the previous figure, the anode of the first diode is connected to the GND node in order to offer the best reverse voltage characteristics.

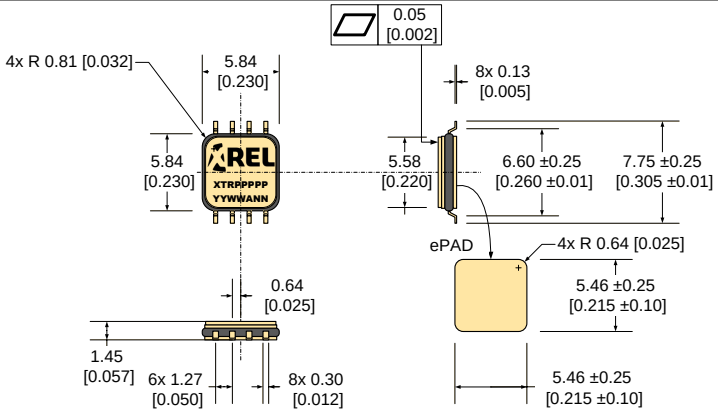
PACKAGE OUTLINES

Dimensions shown in mm [inches]. Tolerance ±0.13 mm [±.005 in], unless otherwise specified.

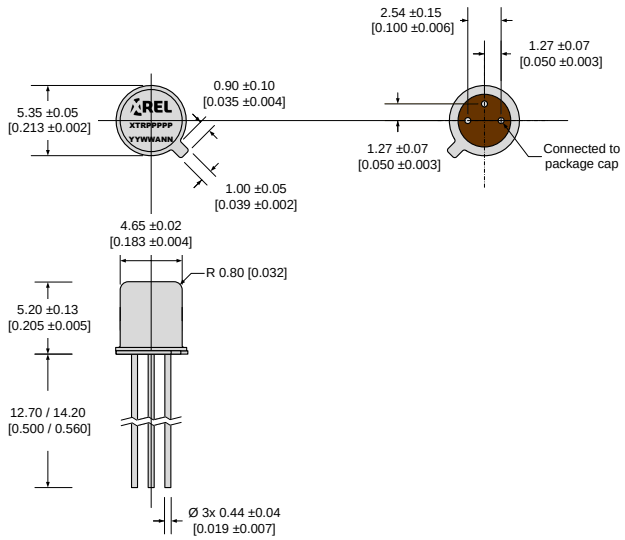
Ceramic Side Braze Dual In-line DIP8



Ceramic Gull-wing Flat Pack with ePad CDFP8



TO-18 Metal Can



Part Marking Convention	
Part Reference: XTRPPPPPP	
XTR	X-REL Semiconductor, high-temperature, high-reliability product (XTRM Series).
PPPPP	Part number (0-9, A-Z).
Unique Lot Assembly Code: YYWWANN	
YY	Two last digits of assembly year (e.g. 11 = 2011).
WW	Assembly week (01 to 52).
A	Assembly location code.
NN	Assembly lot code (01 to 99).

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