

# International IOR Rectifier

## 16CTU04PbF

### Ultrafast Rectifier

#### Features

- Ultrafast Recovery Time
- Low Forward Voltage Drop
- Low Leakage Current
- 175°C Operating Junction Temperature
- Lead-Free ("PbF" suffix)

$$t_{rr} = 60\text{ns}$$

$$I_{F(AV)} = 16\text{Amp}$$

$$V_R = 400\text{V}$$

#### Description/Applications

International Rectifier's FRED.. series are the state of the art Ultra fast recovery rectifiers specifically designed with optimized performance of forward voltage drop and ultra fast recovery time.

The planar structure and the platinum doped life time control, guarantee the best overall performance, ruggedness and reliability characteristics.

These devices are intended for use in the output rectification stage of SMPS, UPS, DC-DC converters as well as free-wheeling diode in low voltage inverters and chopper motor drives.

Their extremely optimized stored charge and low recovery current minimize the switching losses and reduce over dissipation in the switching element and snubbers.

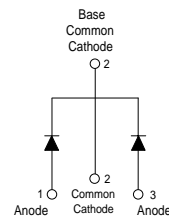
#### Absolute Maximum Ratings

Parameters	Max	Units
$V_{RRM}$ Peak Repetitive Peak Reverse Voltage	400	V
$I_{F(AV)}$ Average Rectified Forward Current	8	A
Per Leg		
Total Device, (Rated $V_R$ ), $T_C = 155^\circ\text{C}$	16	
$I_{FSM}$ Non Repetitive Peak Surge Current, $T_C = 25^\circ\text{C}$	100	
$I_{FRM}$ Peak Repetitive Forward Current	16	°C
(Rated $V_R$ , Square wave, 20KHz), $T_C = 155^\circ\text{C}$		
$T_J, T_{STG}$ Operating Junction and Storage Temperatures	- 65 to 175	

#### Case Styles



TO-220



**Electrical Characteristics @  $T_J = 25^\circ\text{C}$ , Per Leg (unless otherwise specified)**

Parameters	Min	Typ	Max	Units	Test Conditions
$V_{BR}, V_r$ Breakdown Voltage, Blocking Voltage	400	-	-	V	$I_R = 100\mu\text{A}$
$V_F$ Forward Voltage	-	1.19	1.3	V	$I_F = 8\text{A}$
	-	0.94	1.0	V	$I_F = 8\text{A}, T_J = 150^\circ\text{C}$
$I_R$ Reverse Leakage Current	-	0.2	10	$\mu\text{A}$	$V_R = V_R \text{ Rated}$
	-	20	500	$\mu\text{A}$	$T_J = 150^\circ\text{C}, V_R = V_R \text{ Rated}$
$C_T$ Junction Capacitance	-	14	-	pF	$V_R = 400\text{V}$
$L_S$ Series Inductance	-	8.0	-	nH	Measured lead to lead 5mm from package body

**Dynamic Recovery Characteristics @  $T_J = 25^\circ\text{C}$ , Per Leg (unless otherwise specified)**

Parameters	Min	Typ	Max	Units	Test Conditions
$t_{rr}$ Reverse Recovery Time	-	35	60	ns	$I_F = 1.0\text{A}, di_F/dt = 50\text{A}/\mu\text{s}, V_R = 30\text{V}$
	-	43	-		$T_J = 25^\circ\text{C}$
		67			$T_J = 125^\circ\text{C}$
$I_{RRM}$ Peak Recovery Current	-	2.8	-	A	$T_J = 25^\circ\text{C}$
	-	6.3	-		$T_J = 125^\circ\text{C}$
$Q_{rr}$ Reverse Recovery Charge	-	60	-	nC	$T_J = 25^\circ\text{C}$
		-	210	-	$T_J = 125^\circ\text{C}$

**Thermal - Mechanical Characteristics**

Parameters	Min	Typ	Max	Units
$T_J$ Max. Junction Temperature Range	-	-	175	$^\circ\text{C}$
$T_{Stg}$ max. Storage Temperature Range	- 65	-	175	
$R_{thJC}$ Thermal Resistance, Junction to Case	-	1.8	2	$^\circ\text{C}/\text{W}$
$R_{thJA}$ ① Thermal Resistance, Junction to Ambient	-	-	50	
$R_{thCS}$ ② Thermal Resistance, Case to Heatsink	-	0.5	-	
$Wt$ Weight	-	2.0	-	g
	-	0.07	-	(oz)
Mounting Torque	6.0	-	12	Kg-cm
	5.0	-	10	lbf.in
Marking Device	16CTU04			

① Typical Socket Mount

② Mounting Surface, Flat, Smooth and Greased

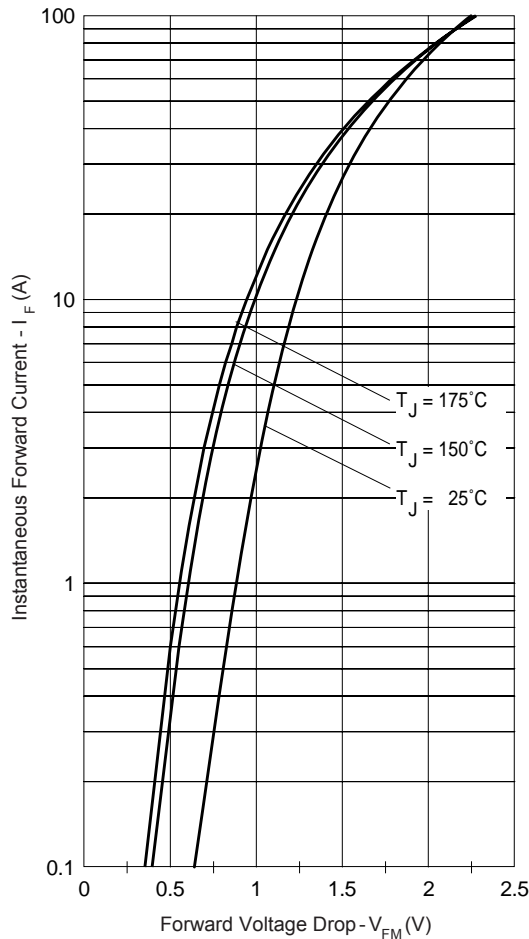


Fig. 1 - Typical Forward Voltage Drop Characteristics

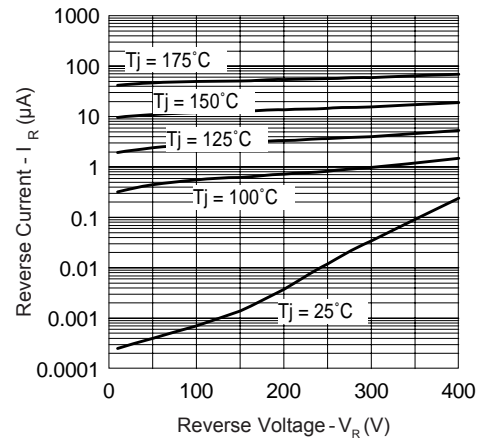


Fig. 2 - Typical Values Of Reverse Current Vs. Reverse Voltage

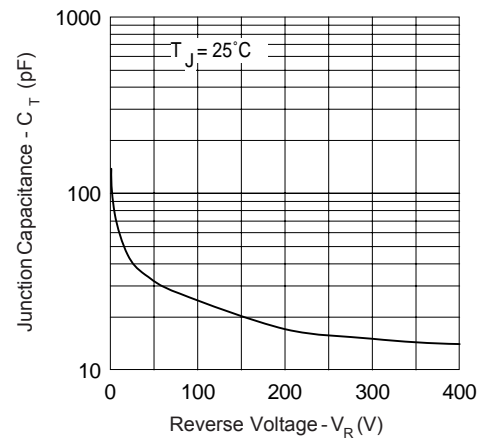


Fig. 3 - Typical Junction Capacitance Vs. Reverse Voltage

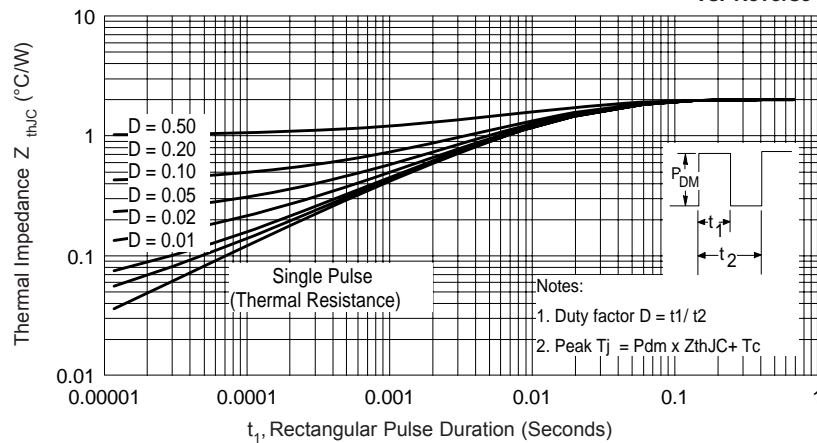
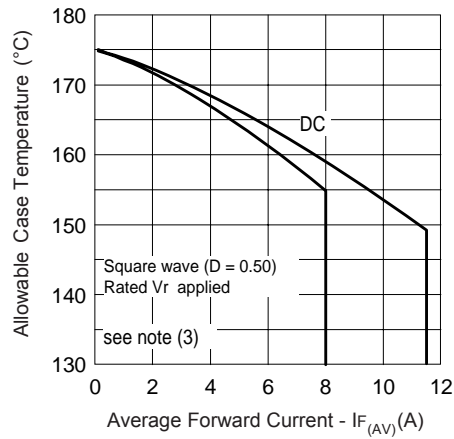
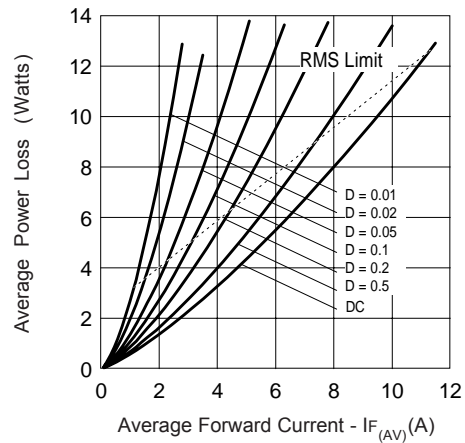


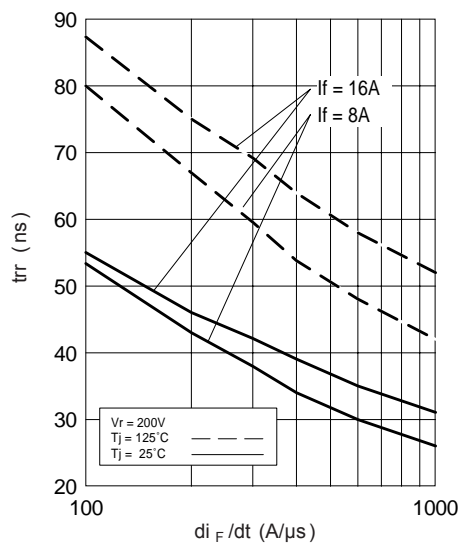
Fig. 4 - Max. Thermal Impedance  $Z_{thJC}$  Characteristics



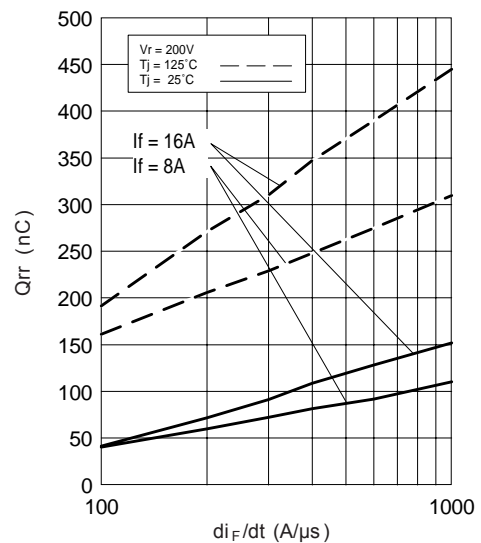
**Fig. 5 - Max. Allowable Case Temperature Vs. Average Forward Current**



**Fig. 6 - Forward Power Loss Characteristics**



**Fig. 7 - Typical Reverse Recovery vs.  $di_F/dt$**

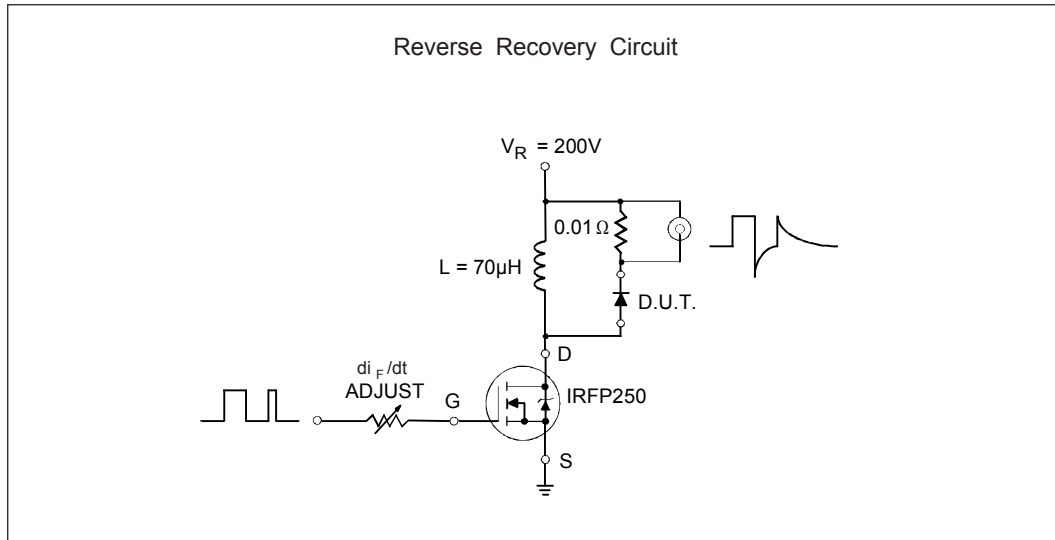


**Fig. 8 - Typical Stored Charge vs.  $di_F/dt$**

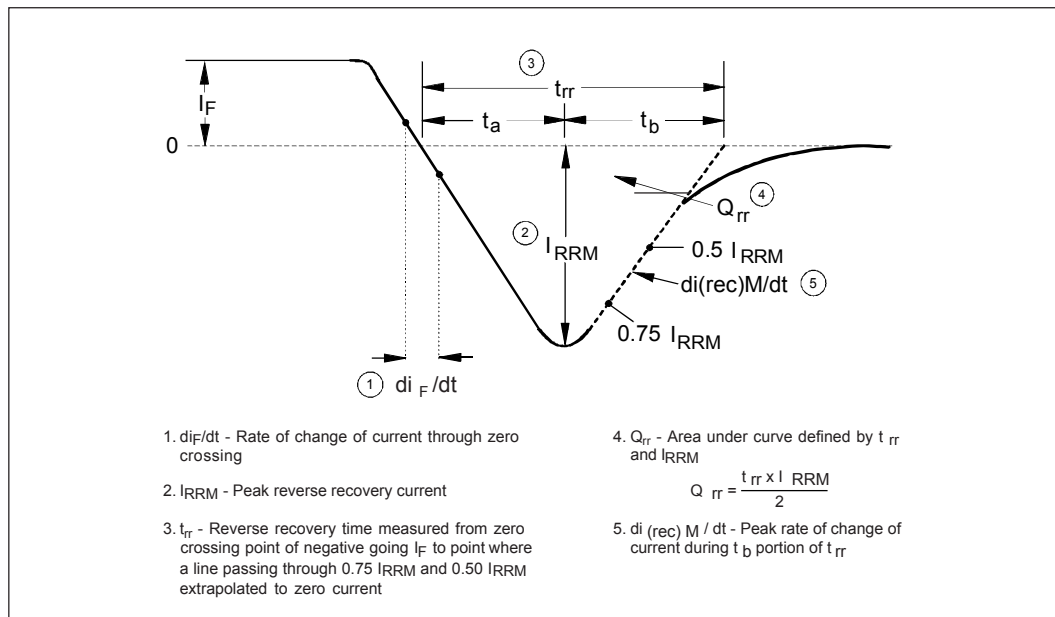
(3) Formula used:  $T_C = T_J - (P_d + P_{d_{REV}}) \times R_{thJC}$ ;

$P_d$  = Forward Power Loss =  $I_{F(AV)} \times V_{FM} @ (I_{F(AV)} / D)$  (see Fig. 6);

$P_{d_{REV}}$  = Inverse Power Loss =  $V_{R1} \times I_R (1 - D)$ ;  $I_R @ V_{R1} = \text{rated } V_R$



**Fig. 9- Reverse Recovery Parameter Test Circuit**



**Fig. 10 - Reverse Recovery Waveform and Definitions**

Technical drawing of a JEDEC TO-220AB package. The drawing includes a top view, a side view, and detail views (DETAIL A and DETAIL B). Dimensions are given in millimeters (mm) and inches (in). The package features a central thermal pad, a base metal, and a plating layer. The drawing is labeled 'CONFORM TO JEDEC OUTLINE TO-220AB'.

**NOTES:**

1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M-1994.
2. DIMENSIONS ARE SHOWN IN MILLIMETERS (IN CH). TOLERANCES:
3. LEAD DIMENSION AND PITCH UNLESS OTHERWISE SPECIFIED.
4. DIMENSION D OF B IS NOT TO INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127mm (0.005 IN). EXCEEDING DIMENSIONS AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
5. DIMENSION A1 IS A11 APPLY TO BASE METAL, PLY.
6. CONTROLLING DIMENSION - NOTES.
7. THERMAL PAD CONTOUR OPTIMAL WITHIN DIMENSIONS C1X2 & E1.
8. DIMENSION C2 X H1 DEFINE A ZONE BEING STAMPING AND SOLDERING PREPARATION ARE ALLOWED.
9. OUTLINE CONFORMS TO JEDEC TO-220, EXCEPT A2 (mm) AND D2 (mm) WHERE DIMENSIONS ARE DERIVED FROM THE ACTUAL PACKAGE OUTLINE.

**DIMENSIONS**

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	3.56	4.83	.140	.190	
A1	0.81	1.40	.020	.055	
A2	2.03	2.82	.080	.115	
b	0.38	1.01	.015	.040	
b1	0.38	0.87	.015	.038	5
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
c	0.38	0.61	.014	.024	
c1	0.38	0.56	.014	.022	
D	14.22	16.51	.560	.650	4
D1	8.88	9.12	.350	.365	
D2	11.68	12.88	.460	.507	7
E	9.66	10.67	.380	.420	4, 7
E1	6.88	8.88	.270	.350	7
E2	-	0.76	-	.030	8
e	1.5	2.0	.060	.080	
e1	1.5	2.0	.060	.080	
H	5.84	6.88	.230	.270	7, 8
H1	12.70	14.73	.500	.580	
L1	-	6.35	-	.250	3
W	3.54	4.08	.138	.161	
W1	2.54	3.42	.100	.135	

**UNIT CONVERSIONS**

UNIT	CONVERSION
1. INCH	25.4 mm
2. mm	0.039 in
3. mm	0.039 in
4. mm	0.039 in
5. mm	0.039 in
6. mm	0.039 in
7. mm	0.039 in
8. mm	0.039 in

**SECTION C-C & D-D**

PLATING (b, b2) BASE METAL

DETAIL A

DETAIL B

LEAD TIP

CONFORM TO JEDEC OUTLINE TO-220AB

The diagram shows a 16CTU04 diode component with four leads. Callouts point to the following information on the component:

- PART NUMBER:** 16CTU04
- DATE CODE:** P119C (P = LEAD-FREE, YEAR 1 = 2001, WEEK 19, LINE C)
- ASSEMBLY LOT CODE:** 17 89
- INTERNATIONAL RECTIFIER LOGO:** IOR

**IRXC Assembly Line**

**EXAMPLE:** THIS IS A 16CTU04  
 LOT CODE 1789  
 ASSEMBLED ON WW 19, 2001  
 IN THE ASSEMBLY LINE "C"

Note: "P" in the beginning of date code indicates "Lead-Free"

## Ordering Information Table

## Device Code

16	C	T	U	04	PbF
①	②	③	④	⑤	⑥

- 1** - Current Rating (16 = 16A)
- 2** - Circuit Configuration  
C = Common Cathode
- 3** - Package  
T = TO-220
- 4** - Ultrafast recovery
- 5** - Voltage Rating (04 = 400A)
- 6** -
  - none = Standard Production
  - PbF = Lead-Free

Tube Standard Pack Quantity : 50 pieces

Data and specifications subject to change without notice.  
This product has been designed and qualified for Industrial Level and Lead-Free.  
Qualification Standards can be found on IR's Web site.

International  
**IR** Rectifier

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10/06



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