Bulletin PD-20752 rev. B 10/06

International
IOR Rectifier

16CTU04
16CTU04S
16CTU04-1

Ultrafast Rectifier

t_{rr} = 60ns
$I_{F(AV)}$ = 16Amp
V_R = 400V

Features

- Ultrafast Recovery Time
- Low Forward Voltage Drop
- Low Leakage Current
- 175°C Operating Junction Temperature

Description/ Applications

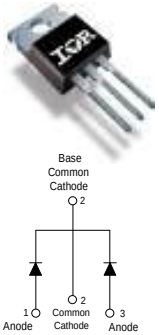
International Rectifier's FRED.. series are the state of the art Ultra fast recovery rectifiers specifically designed with optimized performance of forward voltage drop and ultra fast recovery time.
The planar structure and the platinum doped life time control, guarantee the best overall performance, 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	Per Leg	8	A
	Total Device, (Rated V_R), T_C = 155°C	Total Device	16	
I_{FSM}	Non Repetitive Peak Surge Current, T_C = 25°C		100	
I_{FRM}	Peak Repetitive Forward Current (Rated V_R, Square wave, 20KHz), T_C = 155°C		16	
T_J, T_{STG}	Operating Junction and Storage Temperatures		- 65 to 175	°C

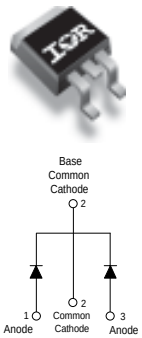
Case Styles

16CTU04



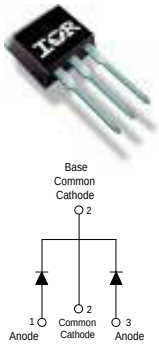
TO-220AB

16CTU04S



D^2PAK

16CTU04-1



TO-262

Electrical Characteristics @ T_J = 25°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 = 100µA
V_F	Forward Voltage	-	1.19	1.3	V	I_F = 8A
		-	0.94	1.0	V	I_F = 8A, T_J = 150°C
I_R	Reverse Leakage Current	-	0.2	10	µA	V_R = V_R Rated
		-	20	500	µA	T_J = 150°C, V_R = V_R Rated
C_T	Junction Capacitance	-	14	-	pF	V_R = 400V
L_S	Series Inductance	-	8.0	-	nH	Measured lead to lead 5mm from package body

Dynamic Recovery Characteristics @ T_J = 25°C, Per Leg (unless otherwise specified)

Parameters		Min	Typ	Max	Units	Test Conditions	
t_{rr}	Reverse Recovery Time	-	35	60	ns	I_F = 1.0A, di_F/dt = 50A/µA, V_R = 30V	
		-	43	-		T_J = 25°C	I_F = 8A V_R = 200V di_F/dt = 200A/µs
			67			T_J = 125°C	
I_{RRM}	Peak Recovery Current	-	2.8	-	A	T_J = 25°C	
		-	6.3	-		T_J = 125°C	
Q_{rr}	Reverse Recovery Charge	-	60	-	nC	T_J = 25°C	
		-	210	-		T_J = 125°C	

Thermal - Mechanical Characteristics

Parameters		Min	Typ	Max	Units
T_J	Max. Junction Temperature Range	-	-	175	°C
T_{Stg}	max. Storage Temperature Range	- 65	-	175	
R_{thJC}	Thermal Resistance, Junction to Case	-	1.8	2	°C/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

① Typical Socket Mount
② Mounting Surface, Flat, Smooth and Greased

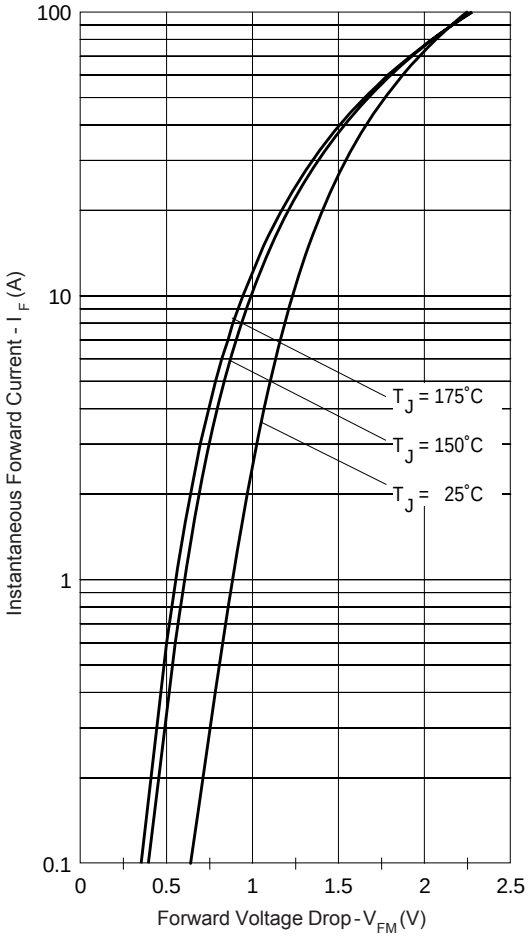


Fig. 1 - Typical Forward Voltage Drop Characteristics

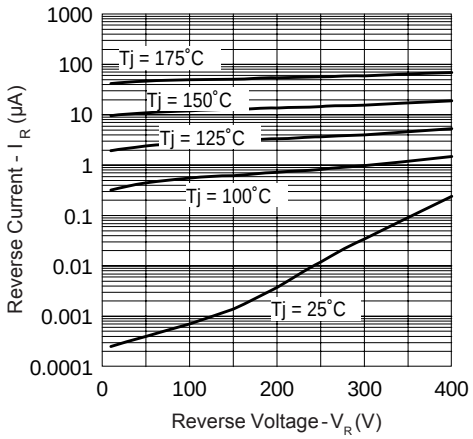


Fig. 2 - Typical Values Of Reverse Current Vs. Reverse Voltage

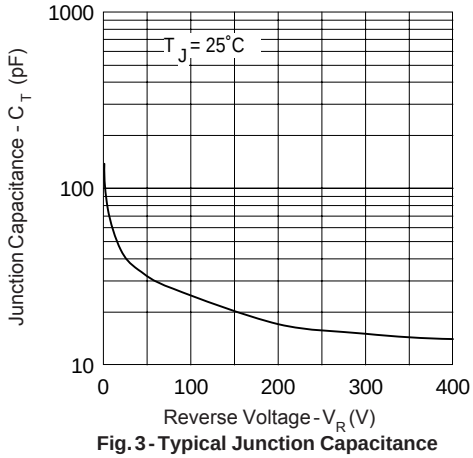


Fig. 3 - Typical Junction Capacitance Vs. Reverse Voltage

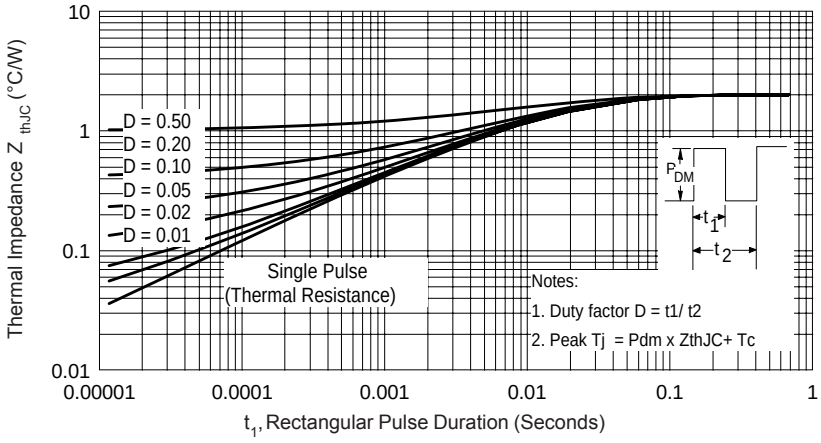


Fig. 4 - Max. Thermal Impedance Z_{thJC} Characteristics

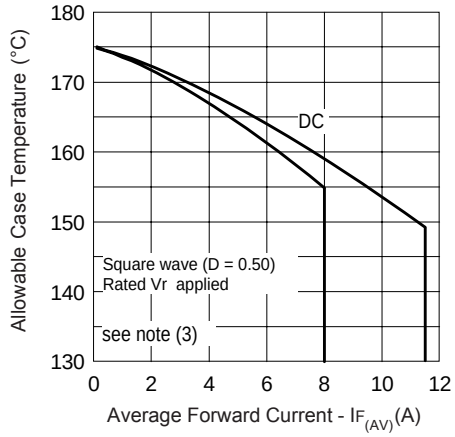


Fig. 5 - Max. Allowable Case Temperature Vs. Average Forward Current

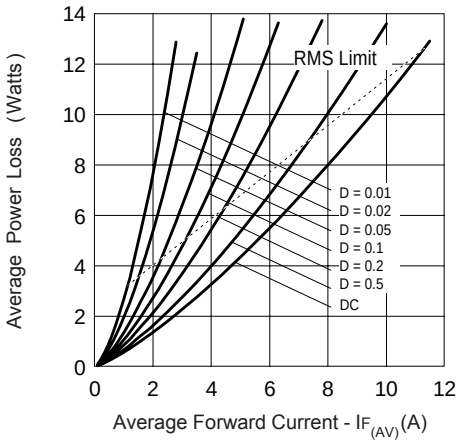


Fig. 6 - Forward Power Loss Characteristics

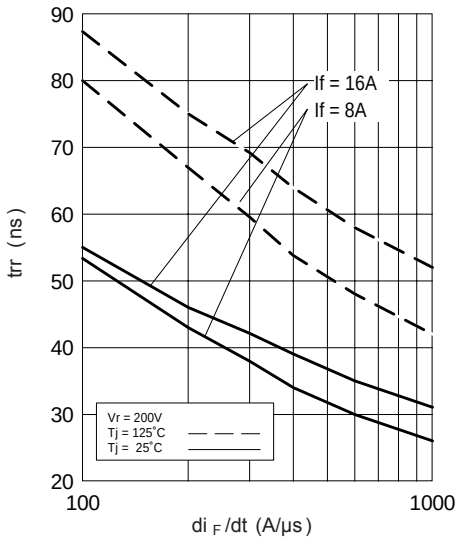


Fig. 7 - Typical Reverse Recovery vs. di_F/dt

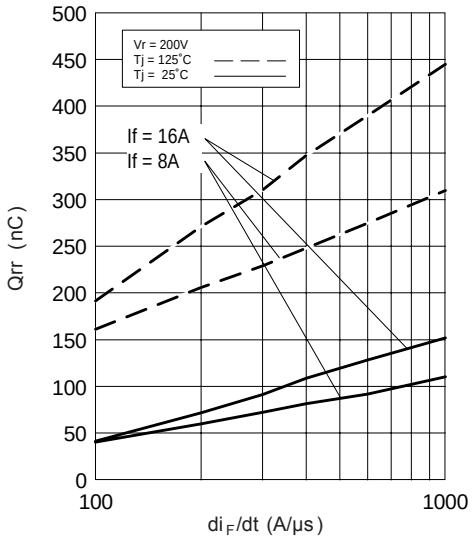


Fig. 8 - Typical Stored Charge vs. di_F/dt

(3) Formula used: $T_C = T_J - (Pd + Pd_{REV}) \times R_{thJC}$;
Pd = Forward Power Loss = $I_{F(AV)} \times V_{FM} @ (I_{F(AV)} / D)$ (see Fig. 6);
Pd_{REV} = Inverse Power Loss = $V_{R1} \times I_R (1 - D)$; $I_R @ V_{R1}$ = rated V_R

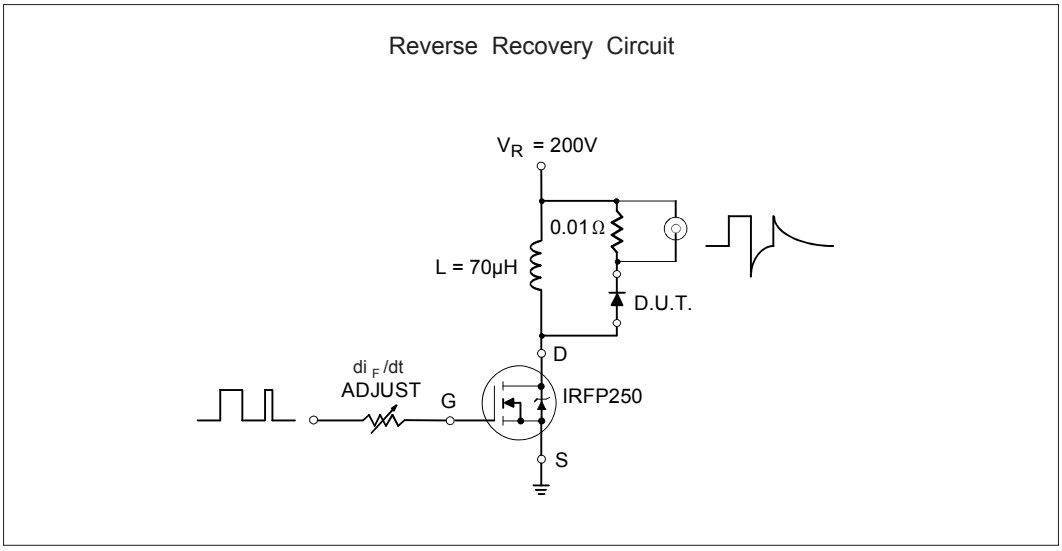
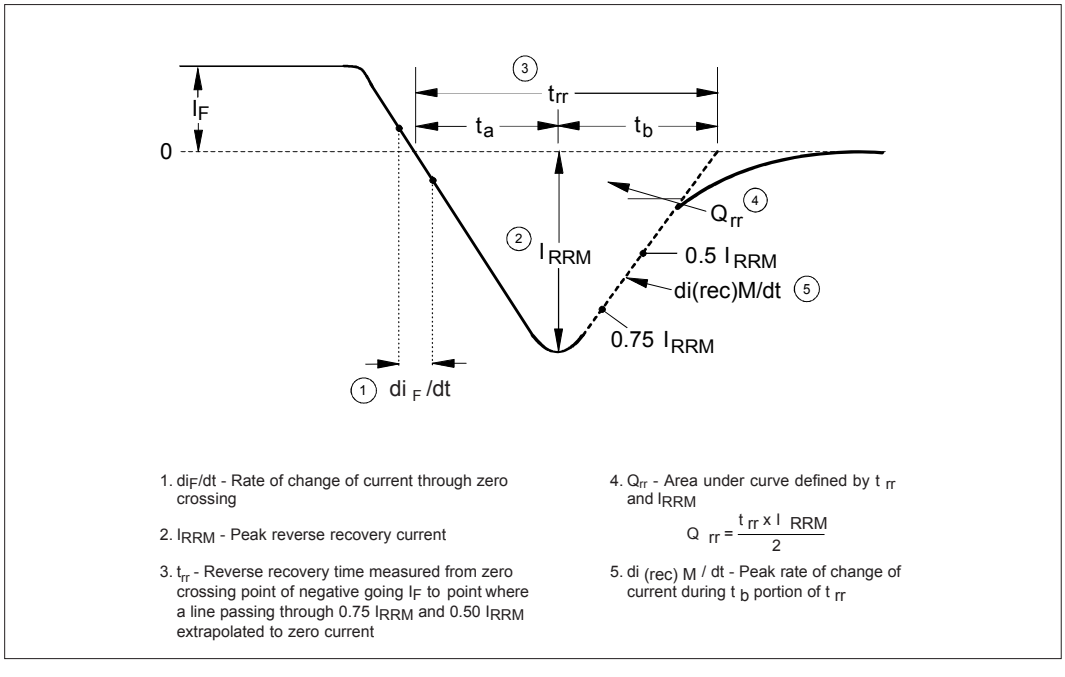


Fig. 9- Reverse Recovery Parameter Test Circuit



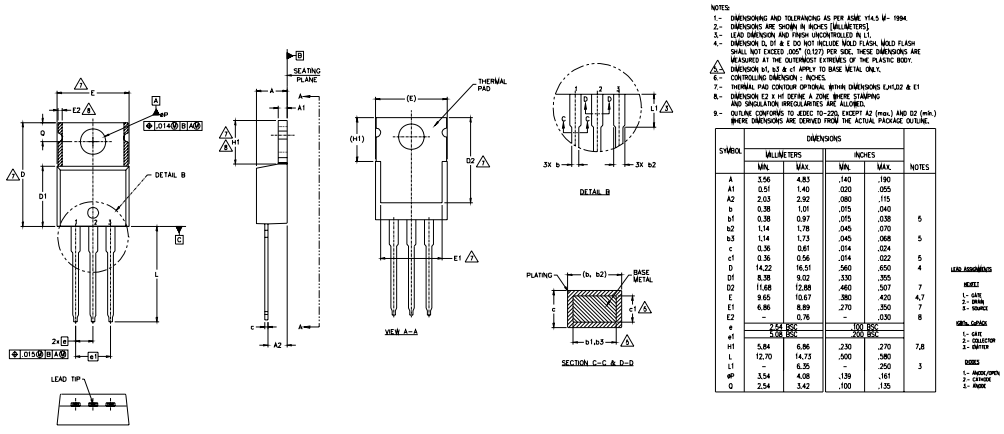
1. di_F/dt - Rate of change of current through zero crossing
2. I_{RRM} - Peak reverse recovery current
3. t_{rr} - Reverse recovery time measured from zero crossing point of negative going I_F to point where a line passing through 0.75 I_{RRM} and 0.50 I_{RRM} extrapolated to zero current
4. Q_{rr} - Area under curve defined by t_{rr} and I_{RRM}

$$Q_{rr} = \frac{t_{rr} \times I_{RRM}}{2}$$

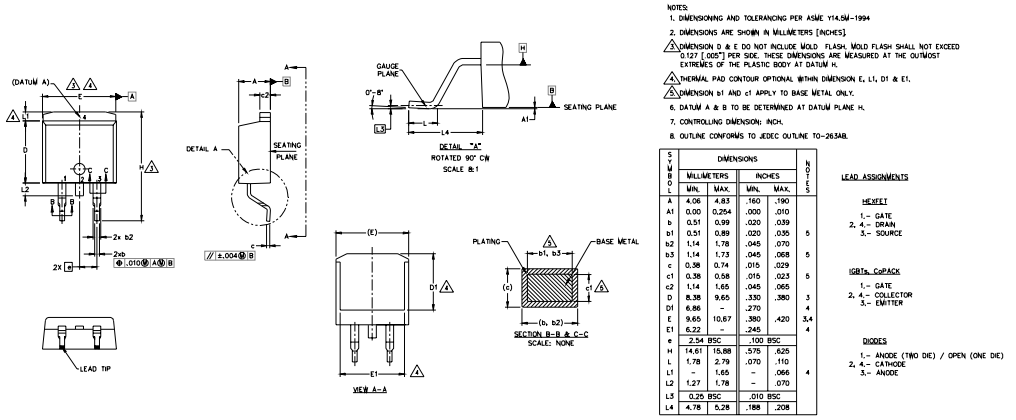
5. $di_{(rec)M}/dt$ - Peak rate of change of current during t_b portion of t_{rr}

Fig. 10 - Reverse Recovery Waveform and Definitions

Outline Table

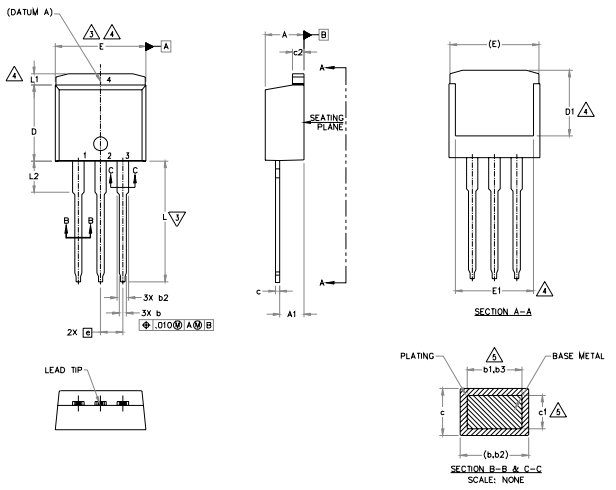


Conform to JEDEC outline TO-220AB



Conform to JEDEC outline D^2Pak (SMD-220)
Dimensions in millimeters and (inches)

Outline Table



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M–1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
5. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
6. CONTROLLING DIMENSION: INCH.
7.– OUTLINE CONFORM TO JEDEC TO-262 EXCEPT A1(max.), b(min.) AND D1(min.) WHERE DIMENSIONS DERIVED THE ACTUAL PACKAGE OUTLINE.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1	2.03	3.02	.080	.119	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	5
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	5
c2	1.14	1.65	.045	.065	
D	8.38	9.65	.330	.380	3
D1	6.86	–	.270	–	4
E	9.65	10.67	.380	.420	3,4
E1	6.22	–	.245		4
e	2.54 BSC		.100 BSC		
L	13.46	14.10	.530	.555	
L1	–	1.65	–	.065	4
L2	3.56	3.71	.140	.146	

LEAD ASSIGNMENTS

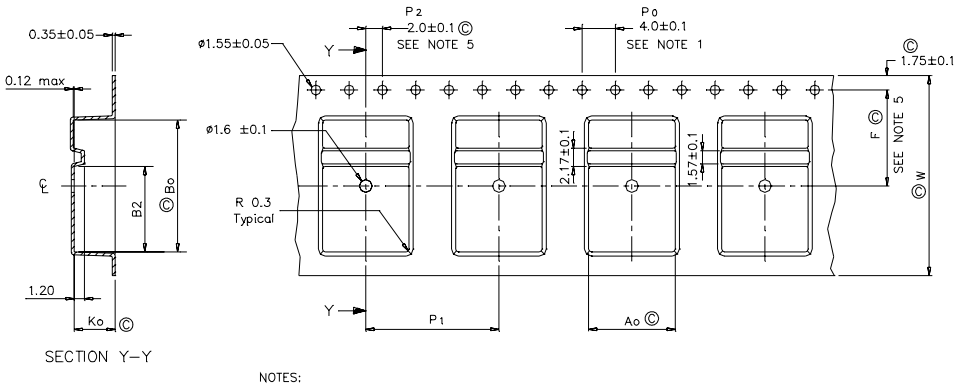
HEXFET
1.– GATE
2.– DRAIN
3.– SOURCE
4.– DRAIN

IGBTs, CoPACK
1.– GATE
2.– COLLECTOR
3.– EMITTER
4.– COLLECTOR

DIODES
1.– ANODE (TWO DIE) / OPEN (ONE DIE)
2, 4.– CATHODE
3.– ANODE

Modified JEDEC outline TO-262
Dimensions in millimeters and (inches)

Tape & Reel Information



Ao	10.50 +/– 0.1
Bo	15.80 +/– 0.1
B2	10.25 +/– 0.1
Ko	4.90 +/– 0.1
F	11.50 +/– 0.1
P1	16.00 +/– 0.1
W	24.00 +/– 0.3

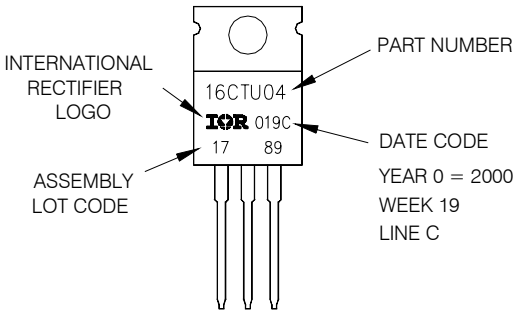
NOTES:
1.0 10 SPROCKET HOLE PITH CUMULATIVE TOLERANCE ±.02
2.0 CAMBER NOT TO EXCEED 1mm In 100mm
3.0 MATERIAL: CONDUCTIVE BLACK STYRENIC ALLOY
4.0 Ko MEASURED FROM A PLANE ON THE INSIDE BOTTOM OF THE POCKET TO THE TOP SURFACE OF THE CARRIER
5.0 MEASURED FROM CENTRELINE OF SPROCKET HOLE TO CENTRELINE OF POCKET
6.0 VENDOR: (OPTIONAL)
7.0 MUST ALSO MEET REQUIREMENTS OF EIA STANDAR #EIA–481A TAPING OF SURFACE MOUNT COMPONENTS FOR AUTOMATIC PLACEMENT
8.0 SURFACE RESISTIVITY OF MOLDED MATL. MUST MEASURE LESS OR EQUAL TO 10^6 OHMS PER SQUARE. MEASURED IN ACCORDANCE TO PROCEDURE GIVEN IN ASTM D–257 & ASTM D–991
9.0 TOTAL LENGTH PER REEL MUST BE 45 METERS
10.0 Ⓒ CRITICAL

Dimensions in millimeters and (inches)

Part Marking Information

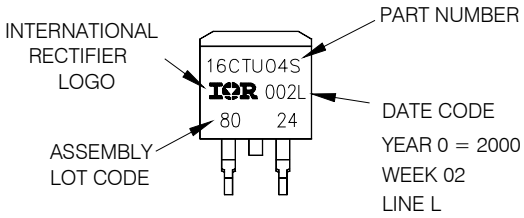
TO-220AB

EXAMPLE: THIS IS A 16CTU04
LOT CODE 1789
ASSEMBLED ON WW 19, 2000
IN THE ASSEMBLY LINE "C"



D²PAK

EXAMPLE: THIS IS A 16CTU04S
LOT CODE 8024
ASSEMBLED ON WW 02, 2000
IN THE ASSEMBLY LINE "L"



TO-262

EXAMPLE: THIS IS A 16CTU04-1
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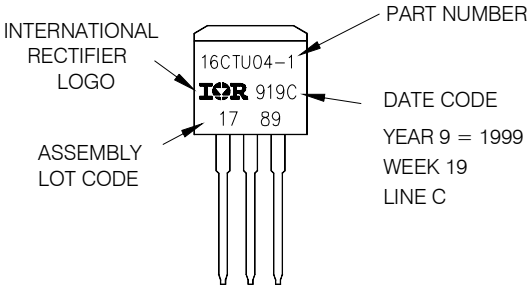
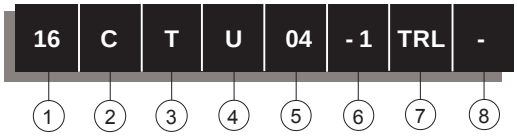
IN THE ASSEMBLY LINE "C"



Ordering Information Table

Device Code



1	-	Current Rating (16 = 16A)
2	-	C = Common Cathode
3	-	T = TO-220
4	-	U = Ultrafast Recovery
5	-	Voltage Rating (04 = 400V)
6	-	None = TO-220AB S = D^2Pak -1 = TO-262 Option
7	-	None = Tube (50 pieces) TRL = Tape & Reel (Left Oriented - for D^2Pak only) TRR = Tape & Reel (Right Oriented - for D^2Pak only)
8	-	• none = Standard Production • PbF = Lead-Free

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

International
IOR Rectifier

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TAC Fax: (310) 252-7309
10/06

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