

# International IRF Rectifier

## 47CTQ020SPbF 47CTQ020-1PbF

SCHOTTKY RECTIFIER

40 Amp

$$I_{F(AV)} = 40\text{Amp}$$

$$V_R = 20\text{V}$$

### Major Ratings and Characteristics

Characteristics	Values	Units
$I_{F(AV)}$ Rectangular waveform	40	A
$V_{RRM}$	20	V
$I_{FSM}$ @tp=5 $\mu$ s sine	1000	A
$V_F$ @20Apk, $T_J = 125^\circ\text{C}$	0.34	V
$T_J$	-55 to 150	$^\circ\text{C}$

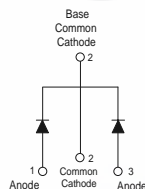
### Description/ Features

This center tap Schottky rectifier has been optimized for ultra low forward voltage drop specifically for 3.3V output power supplies. The proprietary barrier technology allows for reliable operation up to 150  $^\circ\text{C}$  junction temperature. Typical applications are in parallel switching power supplies, converters, reverse battery protection, and redundant power subsystems.

- 150  $^\circ\text{C}$   $T_J$  operation
- Center tap configuration
- Optimized for 3.3V application
- Ultra low forward voltage drop
- High frequency operation
- Guard ring for enhanced ruggedness and long term reliability
- High purity, high temperature epoxy encapsulation for enhanced mechanical strength and moisture resistance
- Lead-Free ("PbF" suffix)

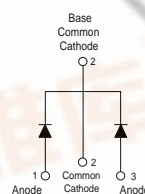
### Case Styles

47CTQ020SPbF



D<sup>2</sup>PAK

47CTQ020-1PbF



TO-262

47CTQ020SPbF, 47CTQ020-1PbF

Bulletin PD-21038 rev. A 07/06



Voltage Ratings

Part number	47CTQ020SPbF, 47CTQ020-1PbF		
$V_R$ Max. DC Reverse Voltage (V)	@ 125° C	20	
$V_R$ Max. DC Reverse Voltage (V)	@ 150° C	10	

Absolute Maximum Ratings

Parameters	47CTQ	Units	Conditions
$I_{F(AV)}$ Max. Average Forward Current (Per Device) (Per Leg)	40 20	A	50% duty cycle @ $T_C = 135^\circ\text{C}$ , rectangular wave form
$I_{FSM}$ Max. Peak One Cycle Non-Repetitive Surge Current (Per Leg)	1000 250	A	5 $\mu\text{s}$ Sine or 3 $\mu\text{s}$ Rect. pulse 10ms Sine or 6ms Rect. pulse Following any rated load condition and with rated $V_{RM}$ applied
$E_{AS}$ Non-Repetitive Avalanche Energy (Per Leg)	18	mJ	$T_J = 25^\circ\text{C}$ , $I_{AS} = 3\text{Amps}$ , $L = 3\text{mH}$
$I_{AR}$ Repetitive Avalanche Current (Per Leg)	3	A	Current decaying linearly to zero in 1 $\mu\text{sec}$ Frequency limited by $T_J$ max. $V_A = 1.5 \times V_R$ typical

Electrical Specifications

Parameters	47CTQ	Units	Conditions
$V_{FM}$ Max. Forward Voltage Drop (Per Leg) (1)	0.45	V	@ 20A $T_J = 25^\circ\text{C}$
	0.51	V	@ 40A
	0.34	V	@ 20A $T_J = 125^\circ\text{C}$
	0.44	V	@ 40A
	0.31	V	@ 20A $T_J = 150^\circ\text{C}$
	0.42	V	@ 40A
$I_{RM}$ Max. Reverse Leakage Current (Per Leg) (1)	3	mA	$T_J = 25^\circ\text{C}$ $V_R = \text{rated } V_R$
	310	mA	$T_J = 125^\circ\text{C}$
	60	mA	$T_J = 125^\circ\text{C}$ $V_R = 5\text{V}$
	45	mA	$T_J = 125^\circ\text{C}$ $V_R = 3.3\text{V}$
	306	mA	$T_J = 150^\circ\text{C}$ $V_R = 10\text{V}$
$V_{F(TO)}$ Threshold Voltage	0.188	V	$T_J = T_J \text{ max.}$
$r_t$ Forward Slope Resistance	5.9	m $\Omega$	
$C_T$ Max. Junction Capacitance (Per Leg)	3000	pF	$V_R = 5V_{DC}$ (test signal range 100Khz to 1Mhz) $25^\circ\text{C}$
$L_S$ Typical Series Inductance (Per Leg)	5.5	nH	Measured lead to lead 5mm from package body
dv/dt Max. Voltage Rate of Change	10000	V/ $\mu\text{s}$	(Rated $V_R$ )

(1) Pulse Width < 300 $\mu\text{s}$ , Duty Cycle <2%

Thermal-Mechanical Specifications

Parameters	47CTQ	Units	Conditions
$T_J$ Max. Junction Temperature Range	-55 to 150	$^\circ\text{C}$	
$T_{stg}$ Max. Storage Temperature Range	-55 to 150	$^\circ\text{C}$	
$R_{thJC}$ Max. Thermal Resistance Junction to Case (Per Leg)	1.5	$^\circ\text{C/W}$	DC operation
$R_{thJC}$ Max. Thermal Resistance Junction to Case (Per Package)	0.75	$^\circ\text{C/W}$	DC operation
$R_{thCS}$ Typical Thermal Resistance, Case to Heatsink	0.50	$^\circ\text{C/W}$	Mounting surface, smooth and greased (only for TO-220)
wt Approximate Weight	2 (0.07)	g (oz.)	
T Mounting Torque	Min.	6 (5)	Kg-cm (lbf-in)
	Max.	12 (10)	
Marking Device	47CTQ020S	Case style D <sup>2</sup> Pak	
	47CTQ020-1	Case style TO-262	

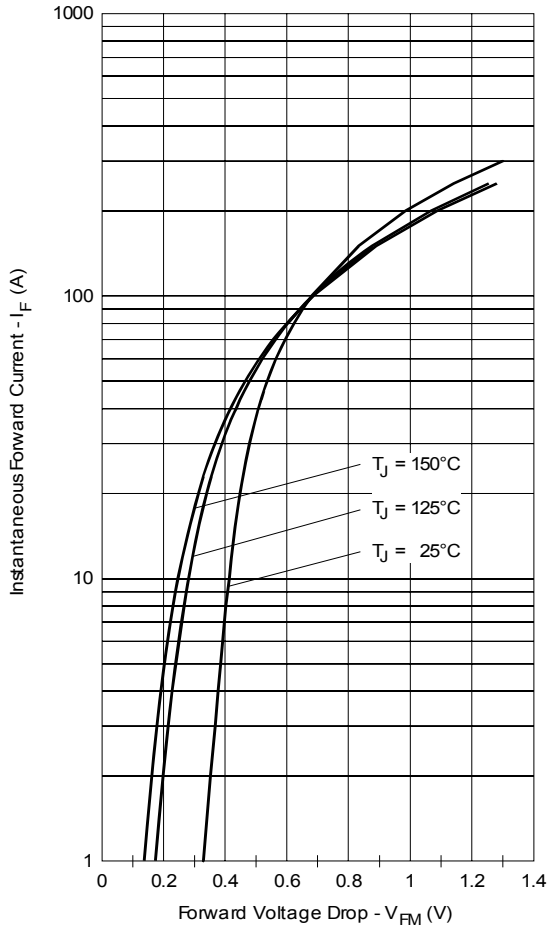


Fig. 1 - Max. Forward Voltage Drop Characteristics (Per Leg)

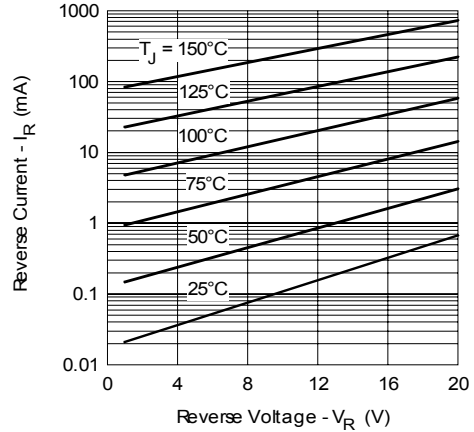


Fig. 2 - Typical Values Of Reverse Current Vs. Reverse Voltage (Per Leg)

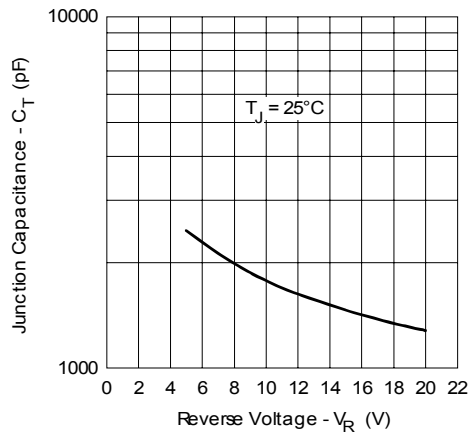


Fig. 3 - Typical Junction Capacitance Vs. Reverse Voltage (Per Leg)

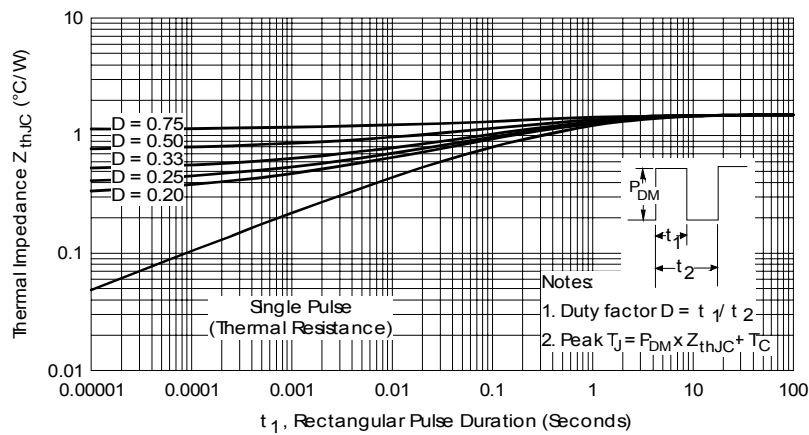


Fig. 4 - Max. Thermal Impedance  $Z_{thJC}$  Characteristics (Per Leg)

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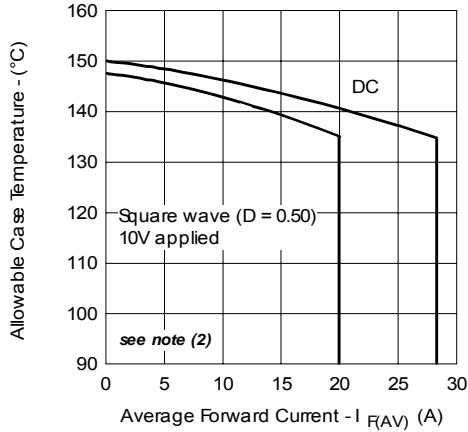


Fig. 5 - Max. Allowable Case Temperature Vs. Average Forward Current (Per Leg)

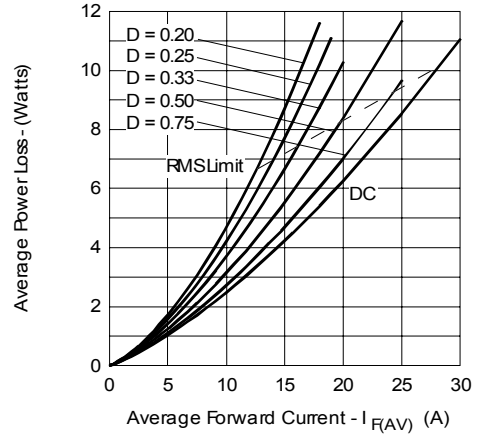


Fig. 6 - Forward Power Loss Characteristics (Per Leg)

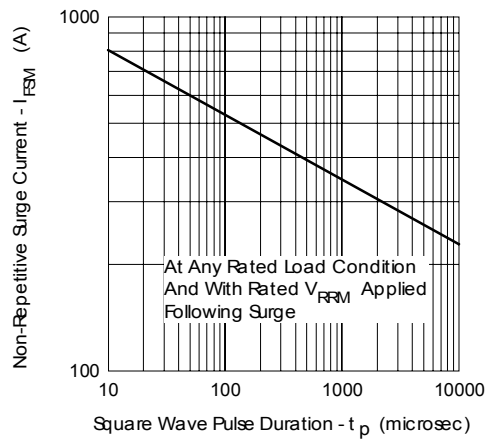


Fig. 7 - Max. Non-Repetitive Surge Current (Per Leg)

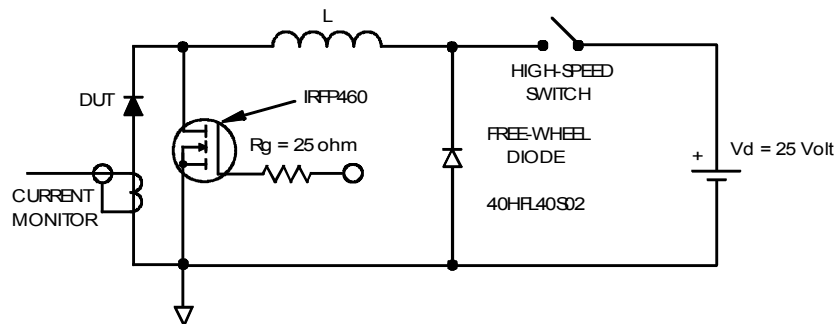


Fig. 8 - Unclamped Inductive Test Circuit

(2) Formula used:  $T_c = T_j - (P_d + P_{d_{REV}}) \times R_{thJC}$ ;

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

$P_{d_{REV}} = \text{Inverse Power Loss} = V_{R1} \times I_{R1} (1 - D)$ ;  $I_{R1} @ V_{R1} = 10 \text{ V}$

Outlines 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 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.  
4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.  
5. CONTROLLING DIMENSION: INCH.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	4
A1	0.00	0.254	.000	.010	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	
b2	1.14	1.78	.045	.070	4
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	4
c2	1.14	1.65	.045	.065	
D	8.51	9.65	.335	.380	3
D1	6.86		.270		
E	9.65	10.67	.380	.420	3
E1	6.22		.245		
e	2.54 BSC		.100 BSC		
H	14.61	15.88	.575	.625	
L	1.78	2.79	.070	.110	
L1		1.65		.065	
L2	1.27	1.78	.050	.070	
L3	0.25 BSC		.010 BSC		
L4	4.78	5.28	.188	.208	
m	17.78		.700		
m1	8.89		.350		
n	11.43		.450		
o	2.08		.082		
p	3.81		.150		
R	0.51	0.71	.020	.028	
θ	90°	93°	90°	93°	

**LEAD ASSIGNMENTS**  
HEXFET  
1.- GATE  
2, 4.- DRAIN  
3.- SOURCE

**IGBTs\_CoPACK**  
1.- GATE  
2, 4.- COLLECTOR  
3.- EMITTER

**DIODES**  
1.- ANODE \*  
2, 4.- CATHODE  
3.- ANODE

\* PART DEPENDENT.

**Conform to JEDEC outline D<sup>2</sup>Pak (SMD-220)**  
Dimensions in millimeters and (inches)

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 [0.005"] 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	5
A1	2.03	3.02	.080	.119	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	
b2	1.14	1.78	.045	.070	5
b3	1.14	1.73	.045	.068	
c	0.38	0.74	.015	.029	5
c1	0.38	0.58	.015	.023	
c2	1.14	1.65	.045	.065	4
D	8.38	9.65	.330	.380	
D1	6.86		.270		4
E	9.65	10.67	.380	.420	
E1	6.22		.245		4
e	2.54 BSC		.100 BSC		
L	13.46	14.10	.530	.555	4
L1		1.65		.065	
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

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

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 Bulletin PD-21038 rev. A 07/06



Part Marking Information

**D<sup>2</sup>PAK**

EXAMPLE: THIS IS A 47CTQ020S  
 LOT CODE 8024  
 ASSEMBLED ON WW 02, 2000

Note: "P" in assembly line position indicates "Lead-Free"

INTERNATIONAL RECTIFIER LOGO  
 PART NUMBER  
 DATE CODE  
 YEAR 0 = 2000  
 WEEK 02  
 P = LEAD-FREE

**TO-262**

EXAMPLE: THIS IS A 47CTQ020-1  
 LOT CODE 1789  
 ASSEMBLED ON WW 19, 2002

Note: "P" in assembly line position indicates "Lead-Free"

INTERNATIONAL RECTIFIER LOGO  
 PART NUMBER  
 DATE CODE  
 YEAR 2 = 2002  
 WEEK 19  
 P = LEAD-FREE

Tape & Reel Information

SECTION Y-Y

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<sup>6</sup> 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)

Ordering Information Table

Device Code							
<b>47</b>	<b>C</b>	<b>T</b>	<b>Q</b>	<b>020</b>	<b>S</b>	<b>TRL</b>	<b>PbF</b>
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>1</b>	-	Current Rating (40A)					
<b>2</b>	-	Circuit Configuration					
		C = Common Cathode					
<b>3</b>	-	T = TO-220					
<b>4</b>	-	Schottky "Q" Series					
<b>5</b>	-	Voltage Rating (020 = 20V)					
<b>6</b>	-	• S = D <sup>2</sup> Pak					
		• -1= TO-262					
<b>7</b>	-	• none = Tube (50 pieces)					
		• TRL = Tape & Reel (Left Oriented - for D <sup>2</sup> Pak only)					
		• TRR = Tape & Reel (Right Oriented - for D <sup>2</sup> Pak only)					
<b>8</b>	-	• none = Standard Production					
		• PbF = Lead-Free					

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.