International IƆR Rectifier

FRED

HFA40HF120

Ultrafast, Soft Recovery Diode

Features

- Reduced RFI and EMI
- Reduced Snubbing
- Extensive Characterization of Recovery Parameters
- Hermetic
- Surface Mount

$V_R = 1200V$

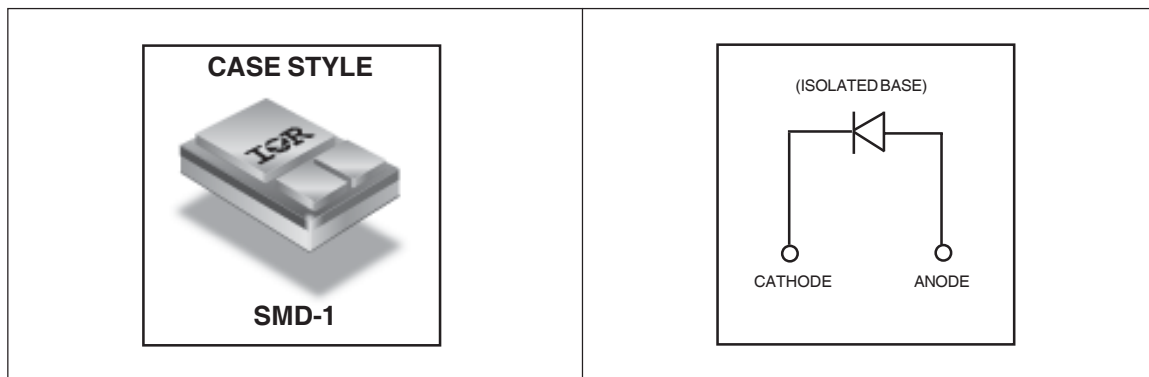$V_F = 3.1V$

$Q_{rr} = 510nC$

$di_{(rec)M}/dt = 350A/\mu s$

Description

These Ultrafast,soft recovery diodes are optimized to reduce losses and EMI/RFI in high frequency power conditioning systems. An extensive characterization of the recovery behavior for different values of current, temperature and di/dt simplifies the calculations of losses in the operating conditions. The softness of the recovery eliminates the need for a snubber in most applications. These devices are ideally suited for power converters, motors drives and other applications where switching losses are significant portion of the total losses.

Absolute Maximum Ratings

	Parameter	Max.	Units
V_R	Cathode to Anode Voltage	1200	V
$I_{F(AV)}$	Continuous Forward Current, ① $T_C = 100°C$	11	A
I_{FSM}	Single Pulse Forward Current, ② $T_C = 25°C$	190	
P_D @ $T_C = 25°C$	Maximum Power Dissipation	83	W
T_J, T_{STG}	Operating Junction and Storage Temperature Range	-55 to +150	°C

Note: ① D.C. = 50% rect. wave
② 1/2 sine wave, 60 Hz , PW. = 8.33 ms

CASE STYLE

SMD-1

(ISOLATED BASE)

CATHODE   ANODE

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Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
V_{BR}	Cathode Anode Breakdown Voltage	1200	—	—	V	I_R = 100µA
V_F	Forward Voltage	—	—	3.2		I_F = 11A T_J = -55°C
	See Fig. 1	—	—	3.1	V	I_F = 11A
		—	—	4.0		I_F = 22A
		—	—	2.7		I_F = 11A, T_J = 125°C
I_R	Max Reverse Leakage Current	—	—	10	µA	V_R = V_R Rated
	See Fig. 2	—	—	1.0	mA	V_R = 960V, T_J = 125°C
C_T	Junction Capacitance, See Fig. 3	—	28	42	pF	V_R = 200V
L_S	Series Inductance	—	5.9	—	nH	Measured from center of cathode pad the center of anode pad

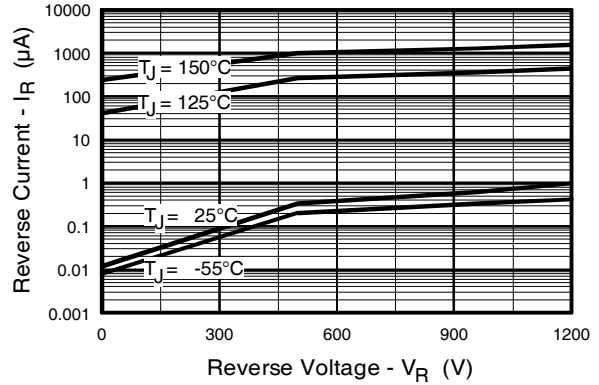## Dynamic Recovery Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Test Conditions		
t_{rr1}	Reverse Recovery Time	—	80	120	ns	T_J = 25°C	See Fig.	
t_{rr2}		—	130	195		T_J = 125°C	5	I_F = 11A
I_{RRM1}	Peak Recovery Current	—	7.25	10.9	A	T_J = 25°C	See Fig.	
I_{RRM2}		—	10.2	15.3		T_J = 125°C	6	V_R = 200V
Q_{rr1}	Reverse Recovery Charge	—	340	510	nC	T_J = 25°C	See Fig.	
Q_{rr2}		—	825	1240		T_J = 125°C	7	di_f/dt = 200A/µs
$di_{(rec)M}/dt1$	Peak Rate of Fall of Recovery Current	—	230	350	A/µs	T_J = 25°C	See Fig.	
$di_{(rec)M}/dt2$	During t_b	—	160	240		T_J = 125°C	8	

Thermal - Mechanical Characteristics

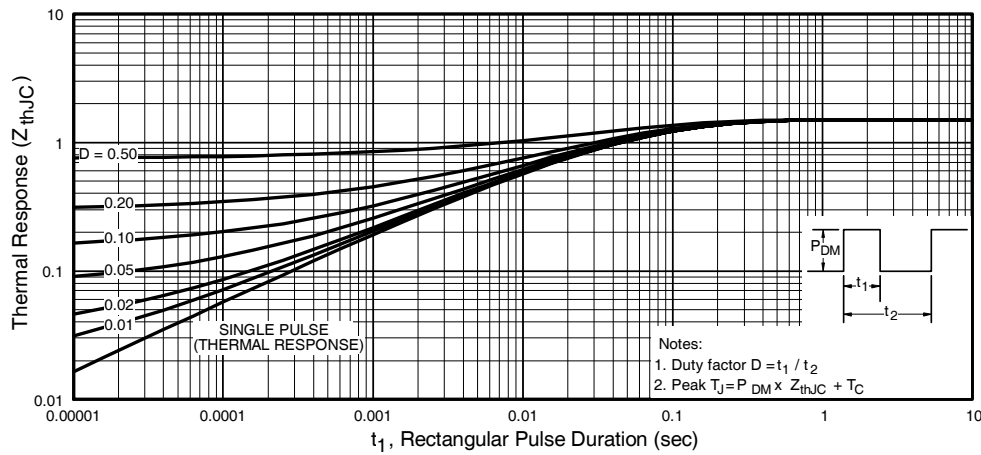|	Parameter	Typ.	Max.	Units
R_{thJC}	Junction-to-Case	—	1.5	°C/W
Wt	Weight	2.6	—	g

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Fig. 1 - Typical Forward Voltage Drop Vs.
Instantaneous Forward Current

Fig. 2 - Typical Reverse Current Vs. Reverse Voltage

Fig. 3 - Typical Junction Capacitance Vs. Reverse Voltage

Notes:
1. Duty factor $D = t_1 / t_2$
2. Peak $T_J = P_{DM} \times Z_{thJC} + T_C$

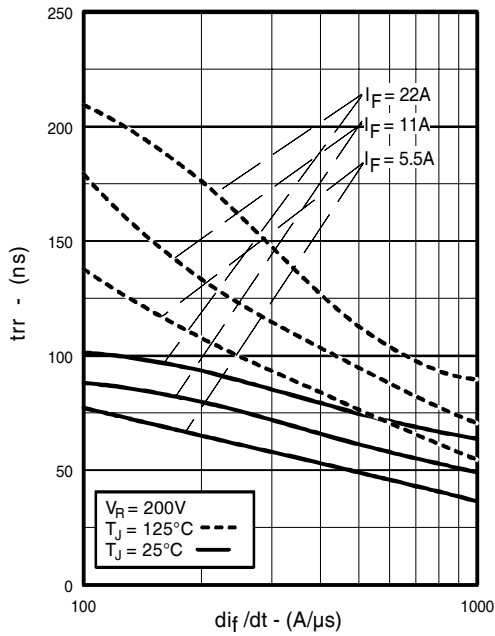**Fig. 4** - Maximum Thermal Impedance Z_{thjc} Characteristics

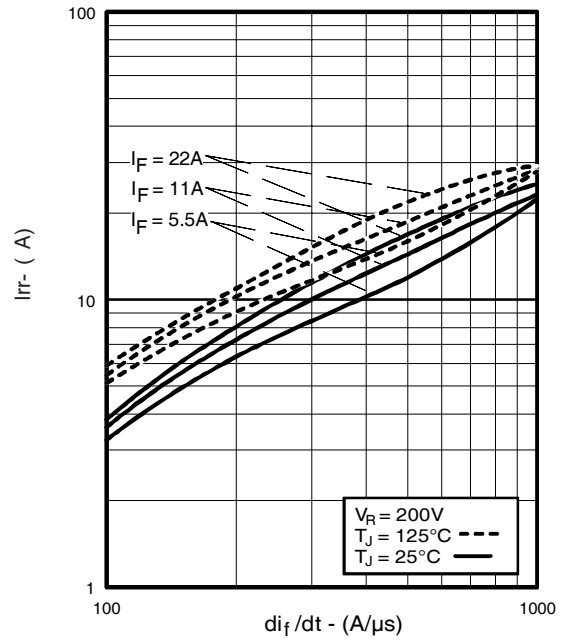**Fig. 5** - Typical Reverse Recovery vs. di$_f$/dt,
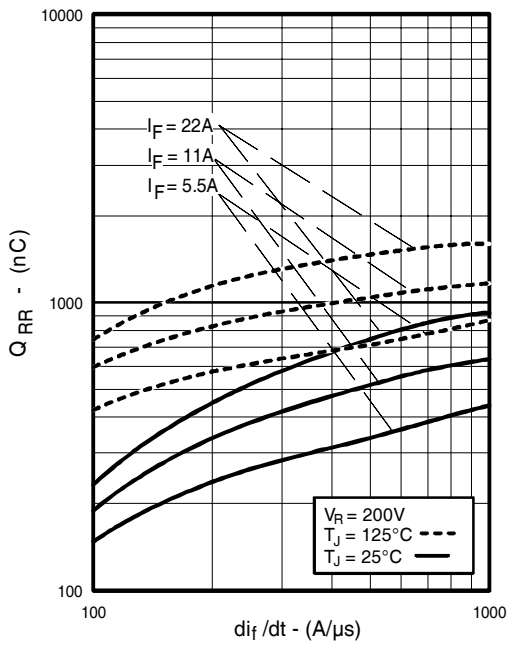

Fig. 6 - Typical Recovery Current vs. di$_f$/dt,
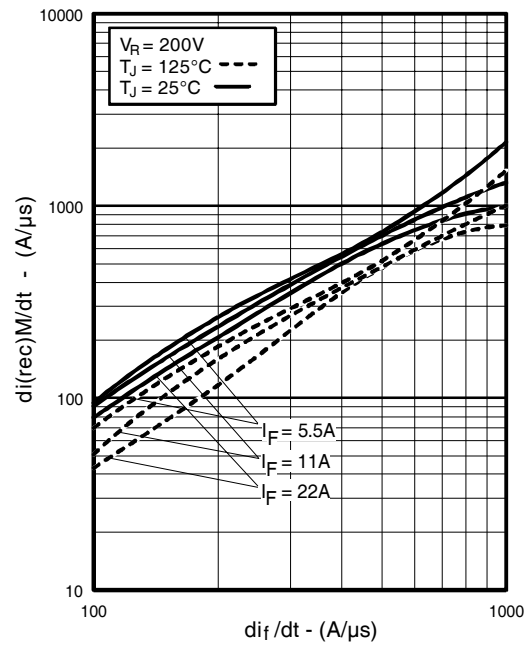

Fig. 7 - Typical Stored Charge vs. di$_f$/dt

Fig. 8 - Typical di$_{(rec)M}$/dt vs. di$_f$/dt

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REVERSE RECOVERY CIRCUIT

$V_R = 200V$

0.01 Ω

$L = 70\mu H$

D.U.T.

dif/dt ADJUST

D

G IRFP250

S

I_F

0

t_{rr} ③

t_a t_b

Q_{rr} ④

I_{RRM} ②

0.5 I_{RRM}

di(rec)M/dt ⑤

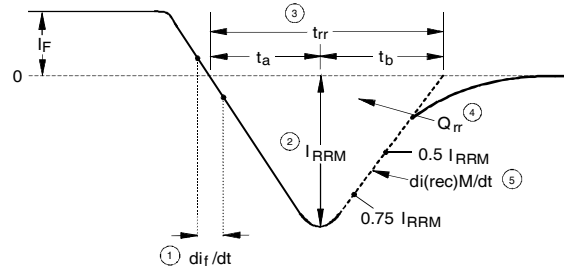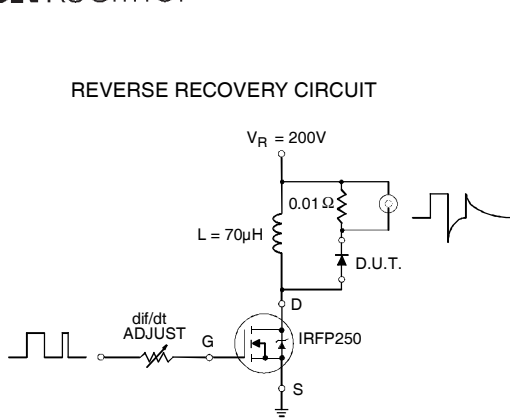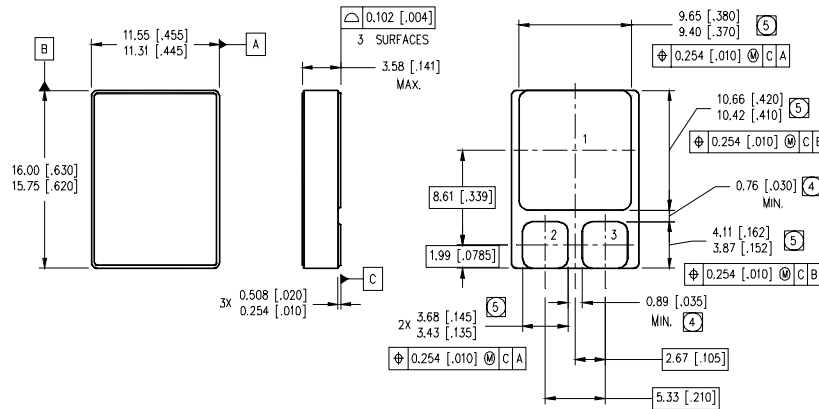0.75 I_{RRM}

di$_f$/dt ①

1. di$_f$/dt - Rate of change of current through zero crossing

2. I_{RRM} - Peak reverse recovery current

3. trr - 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. 9 - Reverse Recovery Parameter Test Circuit   **Fig. 10** - Reverse Recovery Waveform and Definitions

Case Outline and Dimensions — SMD-1

11.55 [.455]
11.31 [.445]

B   A

16.00 [.630]
15.75 [.620]

0.102 [.004]
3 SURFACES

3.58 [.141]
MAX.

C

3X 0.508 [.020]
0.254 [.010]

9.65 [.380]
9.40 [.370] ⑤

⊕ 0.254 [.010] Ⓜ C A

10.66 [.420]
10.42 [.410] ⑤

⊕ 0.254 [.010] Ⓜ C B

0.76 [.030] ④
MIN.

4.11 [.162]
3.87 [.152] ⑤

⊕ 0.254 [.010] Ⓜ C B

8.61 [.339]

1.99 [.0785]

1

2 3

0.89 [.035]
MIN. ④

2.67 [.105]

2X 3.68 [.145]
3.43 [.135] ⑤

⊕ 0.254 [.010] Ⓜ C A

5.33 [.210]

NOTES:

1. DIMENSIONING & TOLERANCING PER ASME Y14.5M–1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
④ DIMENSION INCLUDES METALLIZATION FLASH.
⑤ DIMENSION DOES NOT INCLUDE METALLIZATION FLASH.

PAD ASSIGNMENTS
1 = CATHODE
2 = ANODE
3 = N / C

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