

April 1995

## 6A, 400V - 600V Hyperfast Diodes

### Features

- Hyperfast with Soft Recovery..... <30ns
- Operating Temperature ..... +175°C
- Reverse Voltage Up To..... 600V
- Avalanche Energy Rated
- Planar Construction

### Applications

- Switching Power Supplies
- Power Switching Circuits
- General Purpose

### Description

RHRD640, RHRD650, RHRD660, RHRD640S, RHRD650S and RHRD660S are hyperfast diodes with soft recovery characteristics ( $t_{RR} < 30ns$ ). They have half the recovery time of ultrafast diodes and are silicon nitride passivated ion-implanted epitaxial planar construction.

These devices are intended for use as freewheeling/clamping diodes and rectifiers in a variety of switching power supplies and other power switching applications. Their low stored charge and hyperfast soft recovery minimize ringing and electrical noise in many power switching circuits reducing power loss in the switching transistors.

#### PACKAGE AVAILABILITY

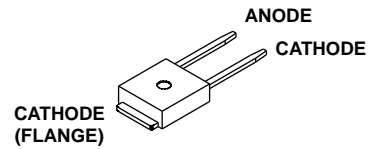
PART NUMBER	PACKAGE	BRAND
RHRD640	TO-251	RHR640
RHRD650	TO-251	RHR650
RHRD660	TO-251	RHR660
RHRD640S	TO-252	RHR640
RHRD650S	TO-252	RHR650
RHRD660S	TO-252	RHR660

NOTE: When ordering, use the entire part number. Add the suffix 9A to obtain the TO-252 variant in tape and reel, e.g. RHRD660S9A.

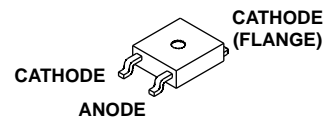
Formerly developmental type TA49057.

### Package

JEDEC STYLE TO-251



JEDEC STYLE TO-252



### Symbol



### Absolute Maximum Ratings $T_C = +25^\circ C$ , Unless Otherwise Specified

	RHRD640 RHRD640S	RHRD650 RHRD650S	RHRD660 RHRD660S	UNITS
Peak Repetitive Reverse Voltage..... $V_{RRM}$	400	500	600	V
Working Peak Reverse Voltage ..... $V_{RWM}$	400	500	600	V
DC Blocking Voltage..... $V_R$	400	500	600	V
Average Rectified Forward Current ..... $I_{F(AV)}$ ( $T_C = +152^\circ C$ )	6	6	6	A
Repetitive Peak Surge Current..... $I_{FSM}$ (Square Wave, 20kHz)	12	12	12	A
Nonrepetitive Peak Surge Current ..... $I_{FSM}$ (Halfwave, 1 Phase, 60Hz)	60	60	60	A
Maximum Power Dissipation ..... $P_D$	50	50	50	W
Avalanche Energy (See Figures 10 and 11)..... $E_{AVL}$	10	10	10	mj
Operating and Storage Temperature ..... $T_{STG}, T_J$	-65 to +175	-65 to +175	-65 to +175	$^\circ C$

# Specifications RHRD640, RHRD650, RHRD660, RHRD640S, RHRD650S, RHRD660S

## Electrical Specifications $T_C = +25^\circ\text{C}$ , Unless Otherwise Specified

SYMBOL	TEST CONDITION	RHRD640, RHRD640S			RHRD650, RHRD650S			RHRD660, RHRD660S			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_F$	$I_F = 6\text{A}, T_C = +25^\circ\text{C}$	-	-	2.1	-	-	2.1	-	-	2.1	V
	$I_F = 6\text{A}, T_C = +150^\circ\text{C}$	-	-	1.7	-	-	1.7	-	-	1.7	V
$I_R$	$V_R = 400\text{V}, T_C = +25^\circ\text{C}$	-	-	100	-	-	-	-	-	-	$\mu\text{A}$
	$V_R = 500\text{V}, T_C = +25^\circ\text{C}$	-	-	-	-	-	100	-	-	-	$\mu\text{A}$
	$V_R = 600\text{V}, T_C = +25^\circ\text{C}$	-	-	-	-	-	-	-	-	100	$\mu\text{A}$
$I_R$	$V_R = 400\text{V}, T_C = +150^\circ\text{C}$	-	-	500	-	-	-	-	-	-	$\mu\text{A}$
	$V_R = 500\text{V}, T_C = +150^\circ\text{C}$	-	-	-	-	-	500	-	-	-	$\mu\text{A}$
	$V_R = 600\text{V}, T_C = +150^\circ\text{C}$	-	-	-	-	-	-	-	-	500	$\mu\text{A}$
$t_{RR}$	$I_F = 1\text{A}, dl_F/dt = 200\text{A}/\mu\text{s}$	-	-	30	-	-	30	-	-	30	ns
	$I_F = 6\text{A}, dl_F/dt = 200\text{A}/\mu\text{s}$	-	-	35	-	-	35	-	-	35	ns
$t_A$	$I_F = 6\text{A}, dl_F/dt = 200\text{A}/\mu\text{s}$	-	16	-	-	16	-	-	16	-	ns
$t_B$	$I_F = 6\text{A}, dl_F/dt = 200\text{A}/\mu\text{s}$	-	8.5	-	-	8.5	-	-	8.5	-	ns
$Q_{RR}$	$I_F = 6\text{A}, dl_F/dt = 200\text{A}/\mu\text{s}$	-	45	-	-	45	-	-	45	-	nC
$C_J$	$V_R = 10\text{V}, I_F = 0\text{A}$	-	20	-	-	20	-	-	20	-	pF
$R_{\theta JC}$		-	-	3	-	-	3	-	-	3	$^\circ\text{C}/\text{W}$

### DEFINITIONS

$V_F$  = Instantaneous forward voltage ( $p_w = 300\mu\text{s}$ ,  $D = 2\%$ ).

$I_R$  = Instantaneous reverse current.

$t_{RR}$  = Reverse recovery time (See Figure 2), summation of  $t_A + t_B$ .

$t_A$  = Time to reach peak reverse current (See Figure 2).

$t_B$  = Time from peak  $I_{RM}$  to projected zero crossing of  $I_{RM}$  based on a straight line from peak  $I_{RM}$  through 25% of  $I_{RM}$  (See Figure 2).

$Q_{RR}$  = Reverse recovery charge.

$C_J$  = Junction capacitance.

$R_{\theta JC}$  = Thermal resistance junction to case.

$E_{AVL}$  = Controlled avalanche energy. (See Figures 10 and 11).

$p_w$  = pulse width.

$D$  = duty cycle.

$V_1$  AMPLITUDE CONTROLS  $I_F$   
 $V_2$  AMPLITUDE CONTROLS  $dl_F/dt$   
 $L_1$  = SELF INDUCTANCE OF  
 $R_4 + L_{\text{LOOP}}$

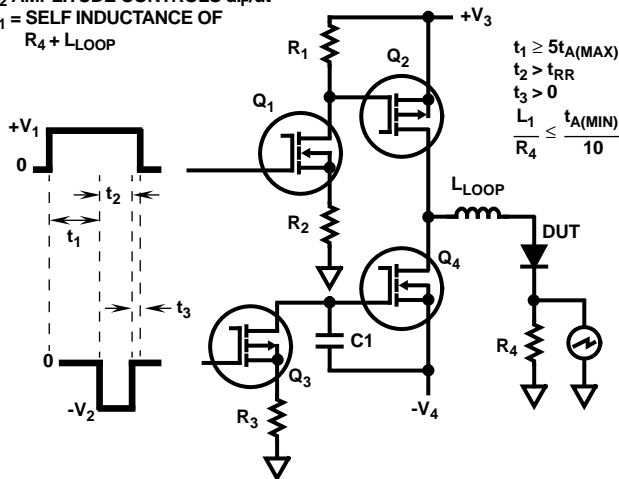


FIGURE 1.  $t_{RR}$  TEST CIRCUIT

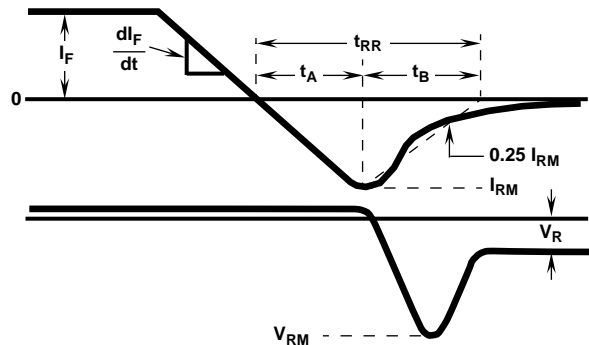


FIGURE 2.  $t_{RR}$  WAVEFORMS AND DEFINITIONS

Typical Performance Curves

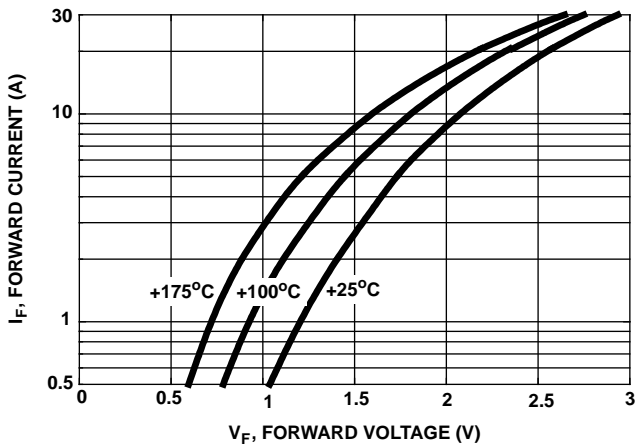


FIGURE 3. TYPICAL FORWARD CURRENT vs FORWARD VOLTAGE DROP

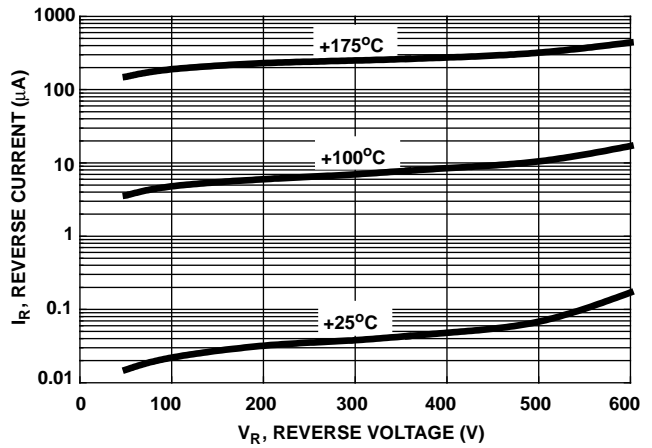


FIGURE 4. TYPICAL REVERSE CURRENT vs REVERSE VOLTAGE

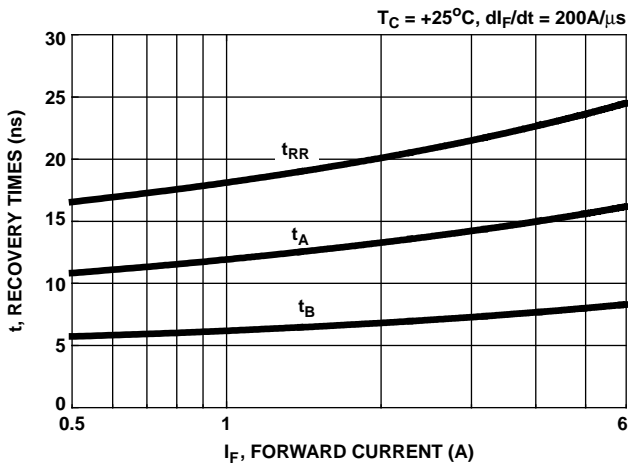


FIGURE 5. TYPICAL  $t_{RR}$ ,  $t_A$  AND  $t_B$  CURVES vs FORWARD CURRENT AT +25°C

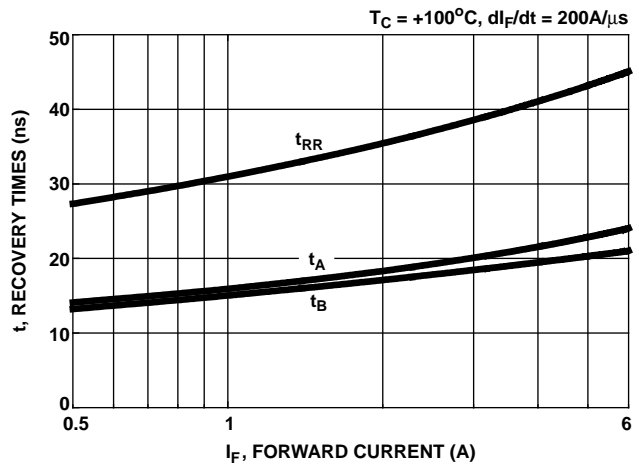


FIGURE 6. TYPICAL  $t_{RR}$ ,  $t_A$  AND  $t_B$  CURVES vs FORWARD CURRENT AT +100°C

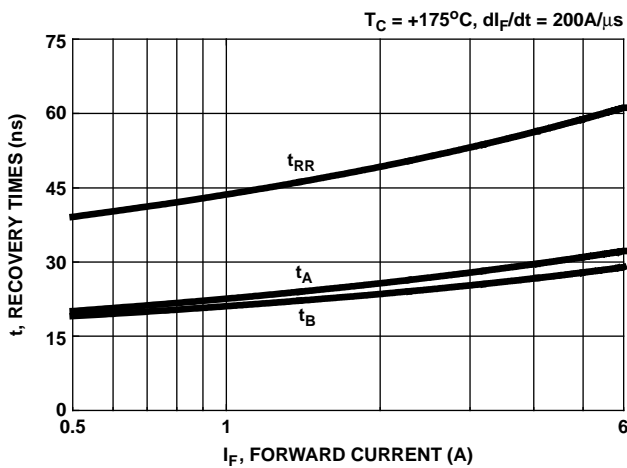


FIGURE 7. TYPICAL  $t_{RR}$ ,  $t_A$  AND  $t_B$  CURVES vs FORWARD CURRENT AT +175°C

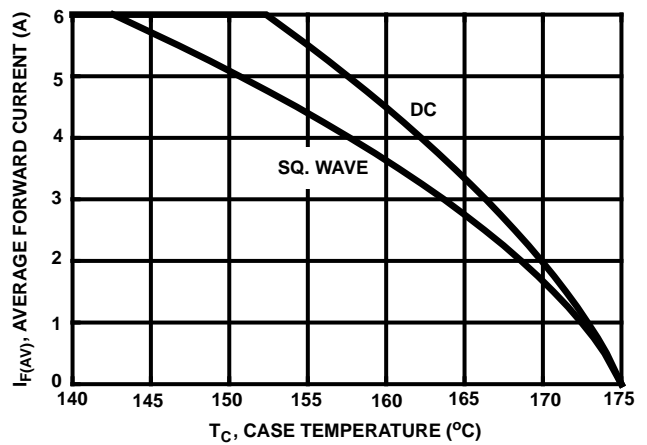


FIGURE 8. CURRENT DERATING CURVE FOR ALL TYPES

Typical Performance Curves (Continued)

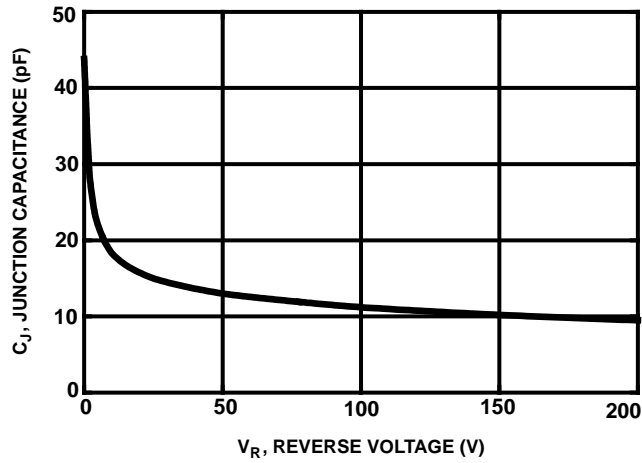


FIGURE 9. TYPICAL JUNCTION CAPACITANCE vs REVERSE VOLTAGE

Test Circuit and Waveforms

$I_{MAX} = 1A$   
 $L = 40mH$   
 $R < 0.1\Omega$   
 $E_{AVL} = 1/2LI^2 [V_{AVL}/(V_{AVL} - V_{DD})]$   
 $Q_1$  AND  $Q_2$  ARE 1000V MOSFETs

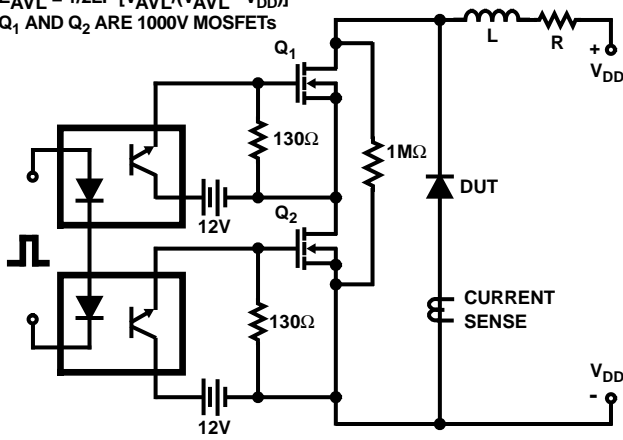


FIGURE 10. AVALANCHE ENERGY TEST CIRCUIT

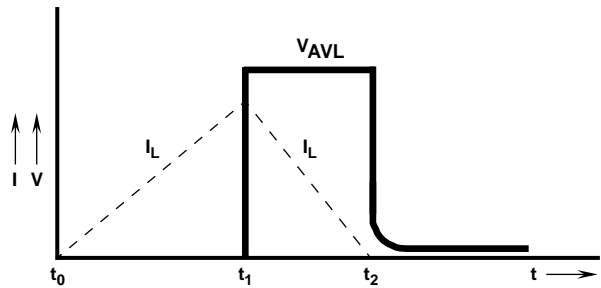


FIGURE 11. AVALANCHE CURRENT AND VOLTAGE WAVEFORMS