FAIRCHILD SEMICONDUCTOR®

November 2002

# ISL9R1560G2, ISL9R1560P2, ISL9R1560S2, ISL9R1560S3S

## 15A, 600V Stealth™ Diode

### General Description

The ISL9R1560G2, ISL9R1560P2, ISL9R1560S2 and ISL9R1560S3S are Stealth™ diodes optimized for low loss performance in high frequency hard switched applications. The Stealth™ family exhibits low reverse recovery current ($I_{RM(REC)}$) and exceptionally soft recovery under typical operating conditions.

This device is intended for use as a free wheeling or boost diode in power supplies and other power switching applications. The low $I_{RM(REC)}$ and short $t_a$ phase reduce loss in switching transistors. The soft recovery minimizes ringing, expanding the range of conditions under which the diode may be operated without the use of additional snubber circuitry. Consider using the Stealth™ diode with an SMPS IGBT to provide the most efficient and highest power density design at lower cost.

Formerly developmental type TA49410.

### Features

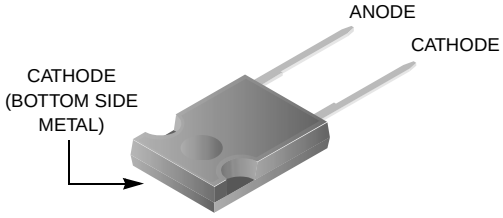
- Soft Recovery . . . . . $t_b / t_a > 1.2$
- Fast Recovery . . . . . $t_{rr} < 30ns$
- Operating Temperature . . . . . $175^oC$
- Reverse Voltage . . . . . 600V
- Avalanche Energy Rated

### Applications

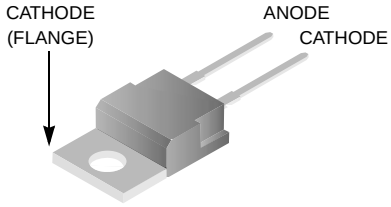
- Switch Mode Power Supplies
- Hard Switched PFC Boost Diode
- UPS Free Wheeling Diode
- Motor Drive FWD
- SMPS FWD
- Snubber Diode

### Package

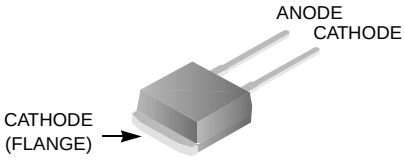
JEDEC STYLE TO-247



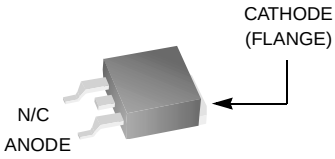

JEDEC TO-220AC




JEDEC STYLE TO-262




JEDEC TO-263AB




### Symbol


## Device Maximum Ratings $T_C$ = 25°C unless otherwise noted

| Symbol | Parameter | Ratings | Units |
|---|---|---|---|
| $V_{RRM}$ | Repetitive Peak Reverse Voltage | 600 | V |
| $V_{RWM}$ | Working Peak Reverse Voltage | 600 | V |
| $V_R$ | DC Blocking Voltage | 600 | V |
| $I_{F(AV)}$ | Average Rectified Forward Current ($T_C$ = 145°C) | 15 | A |
| $I_{FRM}$ | Repetitive Peak Surge Current (20kHz Square Wave) | 30 | A |
| $I_{FSM}$ | Nonrepetitive Peak Surge Current (Halfwave 1 Phase 60Hz) | 200 | A |

| Symbol | Parameter | Ratings | Units |
|---|---|---|---|
| $P_D$ | Power Dissipation | 150 | W |
| $E_{AVL}$ | Avalanche Energy (1A, 40mH) | 20 | mJ |
| $T_J$, $T_{STG}$ | Operating and Storage Temperature Range | -55 to 175 | ℃ |
| $T_L$ | Maximum Temperature for Soldering | | |
| $T_{PKG}$ | Leads at 0.063in (1.6mm) from Case for 10s | 300 | ℃ |
| | Package Body for 10s, See Techbrief TB334 | 260 | ℃ |

CAUTION: Stresses above those listed in "Device Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

## Package Marking and Ordering Information

| Device Marking | Device | Package | Tape Width | Quantity |
|---|---|---|---|---|
| R1560G2 | ISL9R1560G2 | TO-247 | N/A | 30 |
| R1560P2 | ISL9R1560P2 | TO-220AC | N/A | 50 |
| R1560S2 | ISL9R1560S2 | TO-262 | N/A | 50 |
| R1560S3S | ISL9R1560S3S | TO-263AB | 24mm | 800 |

## Electrical Characteristics $T_C$ = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **Off State Characteristics** | | | | | | | |
| $I_R$ | Instantaneous Reverse Current | $V_R$ = 600V | $T_C$ = 25°C | - | - | 100 | µA |
| | | | $T_C$ = 125°C | - | - | 1.0 | mA |
| **On State Characteristics** | | | | | | | |
| $V_F$ | Instantaneous Forward Voltage | $I_F$ = 15A | $T_C$ = 25°C | - | 1.8 | 2.2 | V |
| | | | $T_C$ = 125°C | - | 1.65 | 2.0 | V |
| **Dynamic Characteristics** | | | | | | | |
| $C_J$ | Junction Capacitance | $V_R$ = 10V, $I_F$ = 0A | | - | 62 | - | pF |
| **Switching Characteristics** | | | | | | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 1A, $dI_F/dt$ = 100A/µs, $V_R$ = 30V | | - | 25 | 30 | ns |
| | | $I_F$ = 15A, $dI_F/dt$ = 100A/µs, $V_R$ = 30V | | - | 35 | 40 | ns |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 15A, $dI_F/dt$ = 200A/µs, $V_R$ = 390V, $T_C$ = 25℃ | | - | 29.4 | - | ns |
| $I_{RM(REC)}$ | Maximum Reverse Recovery Current | | | - | 3.5 | - | A |
| $Q_{RR}$ | Reverse Recovered Charge | | | - | 57 | - | nC |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 15A, $dI_F/dt$ = 200A/µs, $V_R$ = 390V, $T_C$ = 125℃ | | - | 90 | - | ns |
| S | Softness Factor ($t_b/t_a$) | | | - | 2.0 | - | |
| $I_{RM(REC)}$ | Maximum Reverse Recovery Current | | | - | 5.0 | - | A |
| $Q_{RR}$ | Reverse Recovered Charge | | | - | 275 | - | nC |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 15A, $dI_F/dt$ = 800A/µs, $V_R$ = 390V, $T_C$ = 125℃ | | - | 52 | - | ns |
| S | Softness Factor ($t_b/t_a$) | | | - | 1.36 | - | |
| $I_{RM(REC)}$ | Maximum Reverse Recovery Current | | | - | 13.5 | - | A |
| $Q_{RR}$ | Reverse Recovered Charge | | | - | 390 | - | nC |
| $dI_M/dt$ | Maximum di/dt during $t_b$ | | | - | 800 | - | A/µs |
| **Thermal Characteristics** | | | | | | | |
| $R_{\theta JC}$ | Thermal Resistance Junction to Case | | | - | - | 1.0 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance Junction to Ambient | TO-247 | | - | - | 30 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance Junction to Ambient | TO-220 | | - | - | 62 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance Junction to Ambient | TO-262 | | - | - | 62 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance Junction to Ambient | TO-263 | | - | - | 62 | °C/W |

## Typical Performance Curves

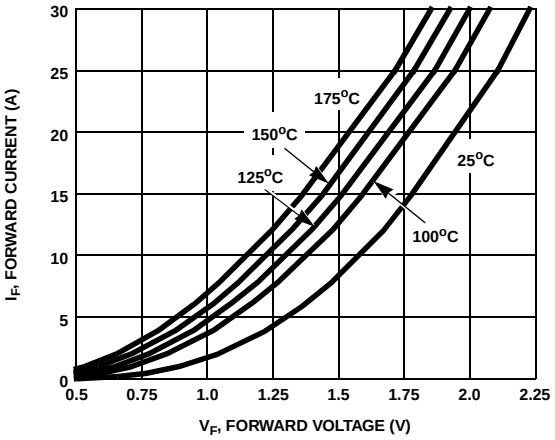



**Figure 1. Forward Current vs Forward Voltage**

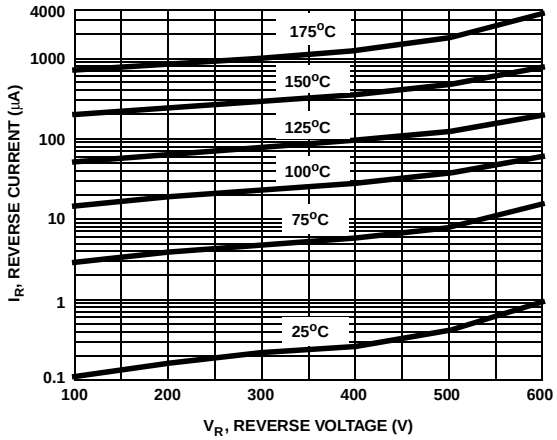



**Figure 2. Reverse Current vs Reverse Voltage**

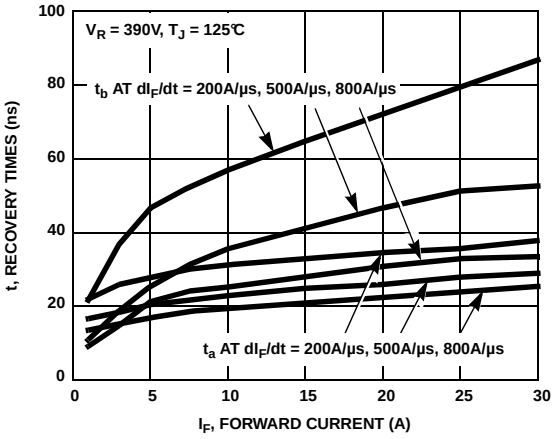



**Figure 3. $t_a$ and $t_b$ Curves vs Forward Current**

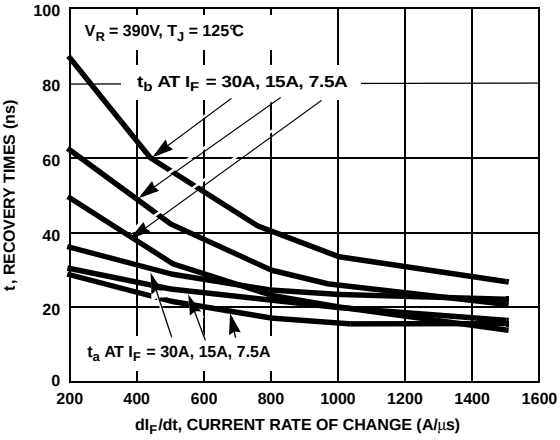



**Figure 4. $t_a$ and $t_b$ Curves vs $dI_F/dt$**

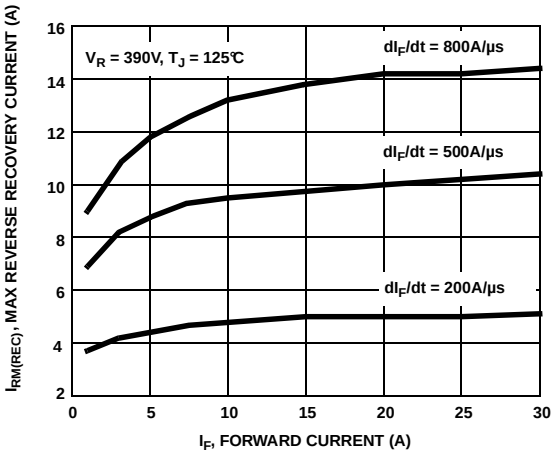



**Figure 5. Maximum Reverse Recovery Current vs Forward Current**

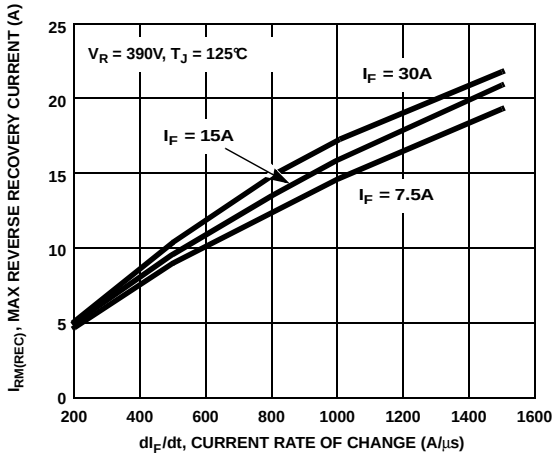



**Figure 6. Maximum Reverse Recovery Current vs $dI_F/dt$**

## Typical Performance Curves (Continued)

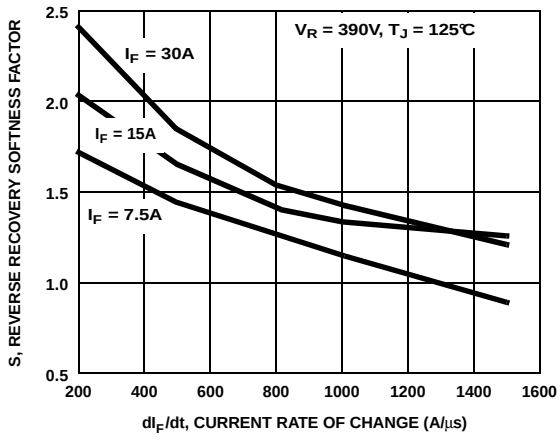



**Figure 7. Reverse Recovery Softness Factor vs $dI_F/dt$**

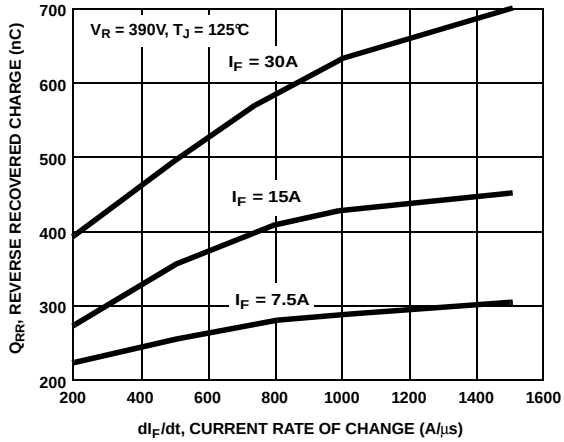



**Figure 8. Reverse Recovered Charge vs $dI_F/dt$**

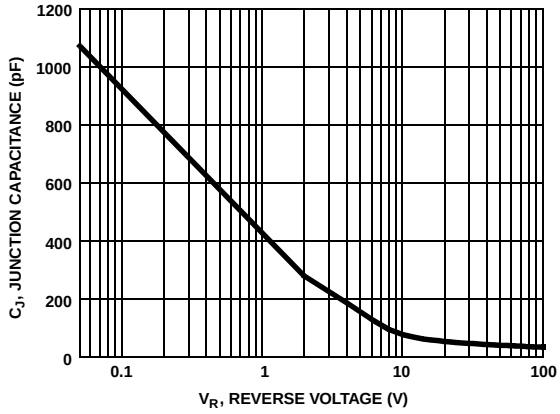



**Figure 9. Junction Capacitance vs Reverse Voltage**

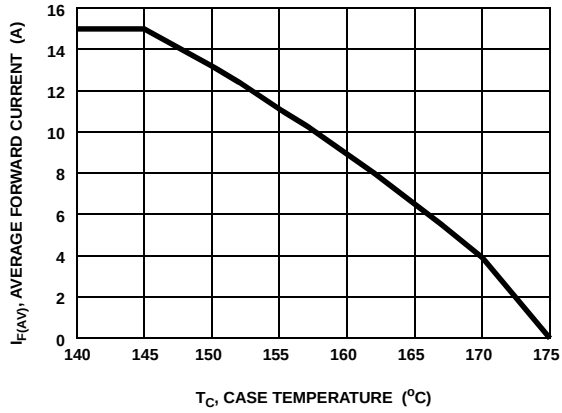



**Figure 10. DC Current Derating Curve**

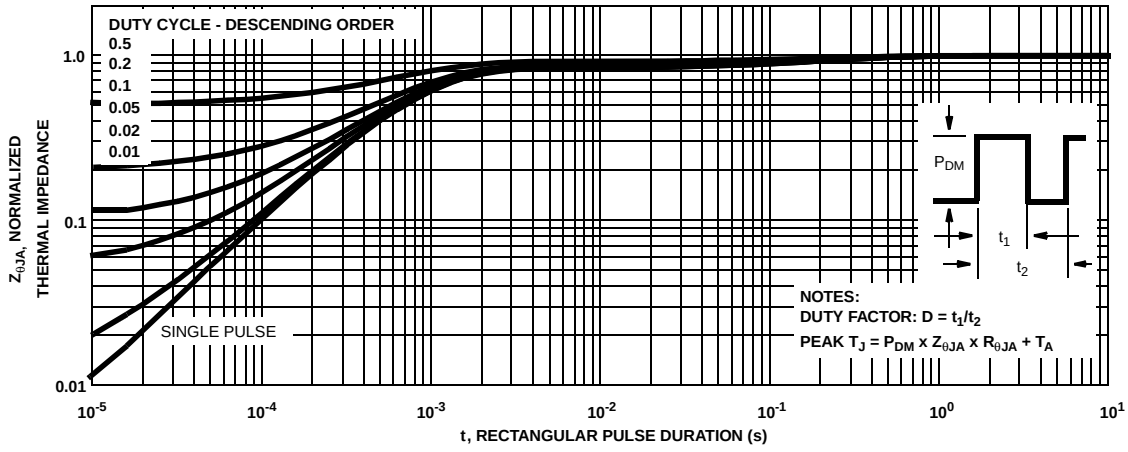



**Figure 11. Normalized Maximum Transient Thermal Impedance**

## Test Circuit and Waveforms

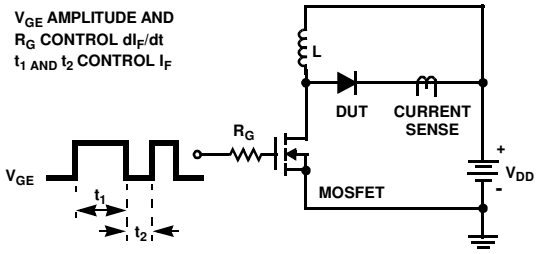



**Figure 12. $t_{rr}$ Test Circuit**

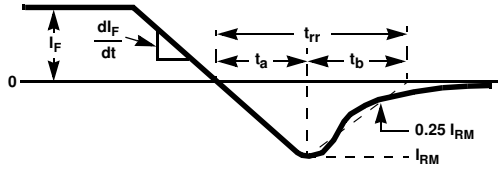



**Figure 13. $t_{rr}$ Waveforms and Definitions**

I = 1A
L = 40mH
R < 0.1Ω
$V_{DD}$ = 50V
$E_{AVL} = 1/2LI^2 [V_{R(AVL)}/(V_{R(AVL)} - V_{DD})]$
$Q_1$ = IGBT ($BV_{CES}$ > DUT $V_{R(AVL)}$)

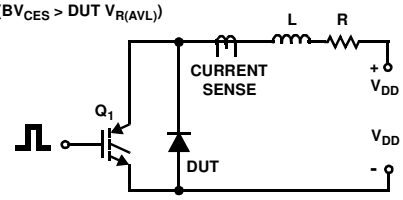



**Figure 14. Avalanche Energy Test Circuit**

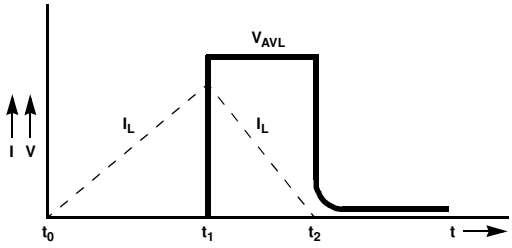



**Figure 15. Avalanche Current and Voltage Waveforms**

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| $EnSigna^{TM}$ | $I^2C$™ | OCX™ | RapidConfigure™ | UHC™ |
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