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November 2013

# ISL9R860P2, ISL9R860S3ST 8 A, 600 V, STEALTH™ Diode

### **Features**

- Stealth Recovery trr = 28 ns (@ IF = 8 A)
- Max Forward Voltage, VF = 2.4 V (@ TC = 25°C)
- 600 V Reverse Voltage and High Reliability
- Avalanche Energy Rated
- RoHS Compliant

## **Applications**

- SMPS FWD
- · Hard Switched PFC Boost Diode
- · UPS Free Wheeling Diode
- Motor Drive FWD
- · Snubber Diode

## Description

The ISL9R860P2, ISL9R860S3ST is a STEALTH™ diode optimized for low loss performance in high frequency hard switched applications. The STEALTH™ family exhibits low reverse recovery current (I<sub>RR</sub>) 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<sub>RR</sub> and short ta 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.

# Package JEDEC TO-220AC-2L JEDEC TO-263AB(D<sup>2</sup>-PAK) CATHODE (FLANGE) N/C ANODE N/C ANODE

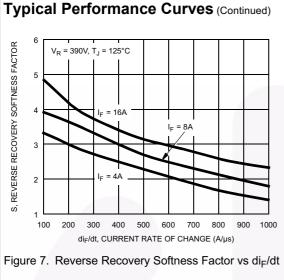
# Device Maximum Ratings T<sub>C</sub>= 25°C unless otherwise noted

Symbol	Parameter	Ratings	Unit
$V_{RRM}$	Peak Repetitive Reverse Voltage	600	V
V <sub>RWM</sub>	Working Peak Reverse Voltage	600	V
V <sub>R</sub>	DC Blocking Voltage	600	V
I <sub>F(AV)</sub>	Average Rectified Forward Current (T <sub>C</sub> = 147°C)	8	Α
I <sub>FRM</sub>	Repetitive Peak Surge Current (20kHz Square Wave)	16	Α
I <sub>FSM</sub>	Nonrepetitive Peak Surge Current (Halfwave 1 Phase 60Hz)	100	Α
P <sub>D</sub>	Power Dissipation	85	W
E <sub>AVL</sub>	Avalanche Energy (1 A, 40 mH)	20	mJ
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range	-55 to 175	°C
T <sub>L</sub> T <sub>PKG</sub>	Maximum Temperature for Soldering Leads at 0.063in (1.6mm) from Case for 10s Package Body for 10s, See Techbrief TB334	300 260	°C

CAUTION: Stresses above those listed in "Absolute 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.

art Num	ber	Top Mark	Package	Packing Met	hod	Reel Size	Tap	oe Wic	lth C	Quantity	
ISL9R860P2		ISL9R860P2	TO-220AC-2L	Tube		N/A		N/A		50	
SL9R860S3ST ISL9R860S3		ISL9R860S3ST	TO-263AB(D <sup>2</sup> -PAK	Reel		13" Dia		24mm		800	
Electric	al (	Characteri	Stics T <sub>C</sub> = 25°C u	nless otherwise n	oted						
Symbol			Test Conditions			Min	Тур	Max	Unit		
Off State	Ch	aracteristics				<u> </u>					
I <sub>R</sub>		Instantaneous Reverse Current		$V_R = 600 \text{ V}$ $T_C$	To:	= 25°C		-	100	μА	
'R	11130				T <sub>C</sub> =	= 125°C		-	1.0	mΑ	
					1.0			1		1	
		aracteristics							•		
V <sub>F</sub>	Inst	antaneous Forwa	rd Voltage	I <sub>F</sub> = 8 A	T <sub>C</sub> =	= 25°C	-	2.0	2.4	V	
					T <sub>C</sub> =	= 125°C	-	1.6	2.0	V	
Dynamic	Ch	aracteristics									
СЈ	Jun	ction Capacitance	Э	V <sub>R</sub> = 10 V, I <sub>F</sub> = 0 A	4		-	30	-	pF	
Switchin	a C	haracteristic	\$					•			
t <sub>rr</sub>		erse Recovery T		I <sub>F</sub> = 1 A, di <sub>F</sub> /dt = 1	00 A/u	s. V <sub>D</sub> = 30 V	· -	18	25	ns	
	The residence of the second se		$I_F = 8 \text{ A, dig/dt} = 100 \text{ A/µs, V}_R = 30 \text{ V}$			-	21	30	ns		
t <sub>rr</sub>	Rev	everse Recovery Time		I <sub>F</sub> = 8 A, di <sub>F</sub> /dt = 200 A/μs, V <sub>R</sub> = 390 V, T <sub>C</sub> = 25°C			-	28	-	ns	
I <sub>rr</sub>	Rev	Leverse Recovery Current					-	3.2	-	Α	
Q <sub>rr</sub>	_	verse Recovery Charge					-	50	-	nC	
t <sub>rr</sub>	Rev	verse Recovery Time		I <sub>F</sub> = 8 A,			-	77	-	ns	
S	Soft	ftness Factor (t <sub>b</sub> /t <sub>a</sub> )		di <sub>F</sub> /dt = 200 A/μs,		-	3.7	-			
I <sub>rr</sub>	Rev	everse Recovery Current		$V_R = 390 \text{ V},$		Ţ	-	3.4	-	Α	
Q <sub>rr</sub>	Rev	erse Recovery C	harge	T <sub>C</sub> = 125°C		-	150	-	nC		
t <sub>rr</sub>	Rev	erse Recovery T	ime	I <sub>F</sub> = 8 A,			-	53	-	ns	
S	Soft	Softness Factor (t <sub>b</sub> /t <sub>a</sub> ) Reverse Recovery Current Reverse Recovery Charge		di <sub>F</sub> /dt = 600 A/µs, V <sub>R</sub> = 390 V, T <sub>C</sub> = 125°C		-	2.5	-			
Irr	_					-	6.5	-	Α		
Q <sub>rr</sub>	Rev						195	-	nC		
dI <sub>M</sub> /dt	Max	imum di/dt durin	g t <sub>h</sub>	l l			-	500	-	A/µs	
\'``.	•									1	
		racteristics								T	
R <sub>θJC</sub>	+	hermal Resistance Junction to Case					-	-	1.75	°C/W	
R <sub>θJA</sub>		Thermal Resistance Junction to Ambient					-	-	62	°C/W	
$R_{ hetaJA}$	1 The	rmal Degistance	Junction to Ambient	TO-263					62	°C/W	

### **Typical Performance Curves** 175°C 150°C REVERSE CURRENT (µA) FORWARD CURRENT (A) 12 10 125°C 8 100°C 100°C 6 2 0.5 0.75 1.25 1.5 1.75 V<sub>F</sub>, FORWARD VOLTAGE (V) V<sub>R</sub>, REVERSE VOLTAGE (V) Figure 1. Forward Current vs Forward Voltage Figure 2. Reverse Current vs Reverse Voltage V<sub>R</sub> = 390V, T<sub>J</sub> = 125°C V<sub>R</sub> = 390V, T<sub>J</sub> = 125°C $t_b$ AT $d_F/dt = 200A/\mu s$ , 500A/ $\mu s$ , 800A/ $\mu s$ 60 t, RECOVERY TIMES (ns) t, RECOVERY TIMES (ns) 60 50 40 30 30 20 10 10 $t_a$ AT $di_F/dt = 200A/\mu s$ , $500A/\mu s$ , $800A/\mu s$ 300 400 500 600 700 800 900 1000 di<sub>F</sub>/dt, CURRENT RATE OF CHANGE (A/µs) 100 I<sub>F</sub>, FORWARD CURRENT (A) Figure 4. t<sub>a</sub> and t<sub>b</sub> Curves vs di<sub>F</sub>/dt Figure 3. t<sub>a</sub> and t<sub>b</sub> Curves vs Forward Current V<sub>R</sub> = 390V, T<sub>J</sub> = 125°C $V_R = 390V, T_J = 125^{\circ}C$ $di_F/dt = 800A/\mu s$ € MAX REVERSE RECOVERY CURRENT (A) 10 MAX REVERSE RECOVERY CURRENT 12 9 10 8 $di_F/dt = 500A/\mu s$ 7 6 6 5 $di_F/dt = 200A/\mu s$ 0 16 I<sub>F</sub>, FORWARD CURRENT (A) di<sub>F</sub>/dt, CURRENT RATE OF CHANGE (A/μs) Figure 5. Maximum Reverse Recovery Current Figure 6. Maximum Reverse Recovery Current vs Forward Current vs di<sub>F</sub>/dt



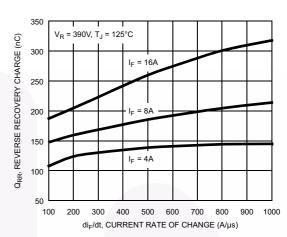


Figure 8. Reverse Recovery Charge vs di<sub>F</sub>/dt

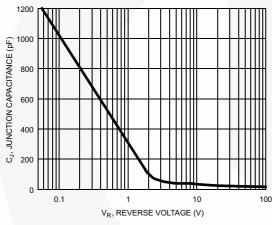


Figure 9. Junction Capacitance vs Reverse Voltage

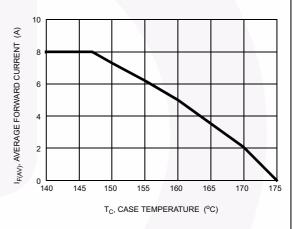


Figure 10. DC Current Derating Curve

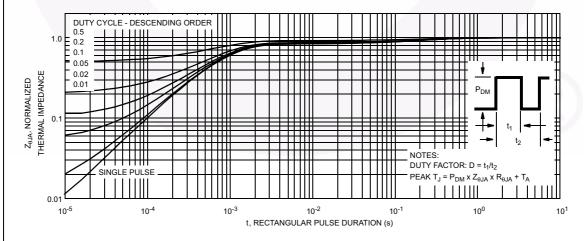
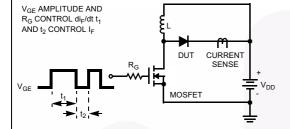


Figure 11. Normalized Maximum Transient Thermal Impedance

# **Test Circuits and Waveforms**



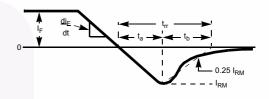
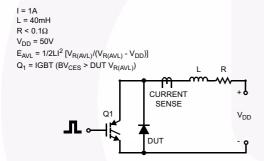


Figure 12. t<sub>rr</sub> Test Circuit

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



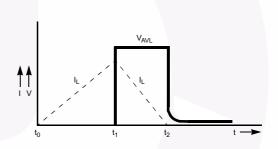


Figure 14. Avalanche Energy Test Circuit

Figure 15. Avalanche Current and Voltage Waveforms

# → 0.36M B AM 10.67 9.65 3.43 2.54 13.40 12.19 16.51 9.40 2 1.78 MAX 6.35 14.73 0.61 (1.91)2.54 ◆ 0.38M B AM 5.08 NOTES: UNLESS OTHERWISE SPECIFIED A) REFERENCE JEDEC, TO—220, ISSUE K, VARIATION AC, DATED APRIL 2002. B) ALL DIMENSIONS ARE IN MILLIMETERS. DIMENSIONS ARE INCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS. C) \_ DIMENSIONING AND TOLERANCING PER ANSI Y14.5 - 1973 D)

Figure 16. TO-220 2L - 2LD,TO220,JEDEC TO-220 VARIATION AC

E)

IS OPTIONAL

PRESENCE OF TRIMMED CENTER LEAD

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# **Package Dimensions** 9.45 10.00 (6.40)1.78 MAX 3.80 (2.12)5.08 LAND PATTERN RECOMMENDATION UNLESS NOTED, ALL DIMS TYPICAL 5.08 → 0.25 M B AM 6.22 MIN 6.86 MIN 15.88 14.61 SEE DETA|L A NOTES: UNLESS OTHERWISE SPECIFIED A) ALL DIMENSIONS ARE IN MILLIMETERS. B) REFERENCE JEDEC, TO-263, VARIATION AB. C) DIMENSIONING AND TOLERANCING PER ANSI Y14,5M - 1994. D) LOCATION OF THE PIN HOLE MAY VARY GAGE PLANE (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE). E) LANDPATTERN RECOMMENDATION PER IPC 0.25 TO254P1524X482-3N F) FILENAME: TO263A02REV6 O.10 B 0.25 MAX (5.38)

Figure 17. TO-263 2L (D2PAK) - 2LD,TO263, SURFACE MOUNT

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