

# IRXPT60R022S7

PPD-98018

## MOSFET 600V CoolMOS™ SJ S7 Technology

### Features

- CoolMOS™ S7 Technology enables  $22\text{m}\Omega$   $R_{DS(on)}$  in the smallest footprint
- Optimized price performance in low frequency switching applications
- High pulse current capability
- Kelvin Source pin improves switching performance at high current
- TOLL package is MSL1 compliant and has easy visual inspection leads
- Lead solder dipped

### Potential Applications

- Solid state relays and circuit breakers
- Line rectification in high power/performance applications e.g. Computing, Telecom, UPS and Solar

### Product Validation

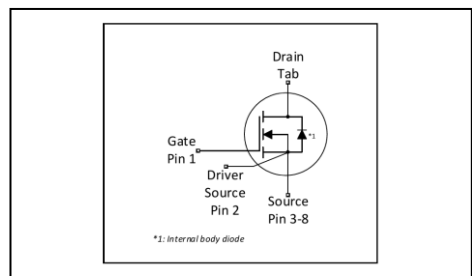
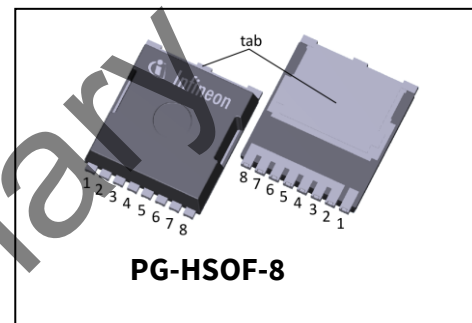
JESD-22 Qualification

### Description

IRXPT60R022S7 enables the best price performance for low frequency switching applications. CoolMOS™ S7 boasts the lowest  $R_{DS(on)}$  values for a HV SJ MOSFET, with distinctive increase of energy efficiency. CoolMOS™ S7 is optimized for “static switching” and high current applications. It is an ideal fit for solid state relay and circuit breaker designs as well as for line rectification in SMPS and inverter topologies. The package is offered in lead solder dipped.

### Product Summary

- $BV_{DSS}$ : 600V
- Pulsed  $I_{SD}$ ,  $I_{DS}$ : 375A
- $R_{DS(on), max}$ :  $22\text{m}\Omega$
- $Q_G$ : 150nC
- $V_{SD}$ : 0.82V



### Ordering Information

**Table 1**      **Ordering options**

Part number	Package	Part Marking	Standard Pack	
			Form	Quantity
IRXPT60R022S7	PG-HSOF-8	60IR22S7	Tape and Reel	TBD

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Preliminary

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## Absolute Maximum Ratings

## 1 Absolute Maximum Ratings

Table 2 Absolute Maximum Ratings

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
$I_D$	Drain current rating	—	—	23	A	$T_C = 140^\circ\text{C}$ Current is limited by $T_{j\text{max}} = 150^\circ\text{C}$ Lower case temp does increase current capability
$I_{D,\text{pulse}}$	Pulsed drain current <sup>1</sup>	—	—	375	A	$T_C = 25^\circ\text{C}$
$E_{AS}$	Avalanche energy, single pulse	—	—	289	mJ	$I_D = 3.8\text{A}$ , $V_{DD} = 50\text{V}$ , see Fig 19, 20
$I_{AS}$	Avalanche current, single pulse	—	—	3.8	A	—
$dv/dt$	MOSFET $dv/dt$ ruggedness <sup>2</sup>	—	—	20	V/ns	$V_{DS} = 0\text{V}$ to $300\text{V}$
$V_{GS}$	Gate source voltage (static)	-20	—	20	V	Static
$V_{GS}$	Gate source voltage (dynamic)	-30	—	30	V	AC ( $f > 1\text{Hz}$ )
$P_{\text{tot}}$	Power dissipation	—	—	390	W	$T_C = 25^\circ\text{C}$
$T_{\text{stg}}$	Storage temperature	-55	—	150	$^\circ\text{C}$	—
$T_j$	Operating junction temperature	-55	—	150	$^\circ\text{C}$	—
—	Mounting torque	—	—	n.a.	Ncm	—
$I_S$	Diode forward current rating	—	—	23	A	$T_C = 140^\circ\text{C}$ Current is limited by $T_{j\text{max}} = 150^\circ\text{C}$ Lower case temp does increase current capability
$I_{S,\text{pulse}}$	Diode pulse current <sup>1</sup>	—	—	375	A	$T_C = 25^\circ\text{C}$
$dv/dt$	Reverse diode $dv/dt$ <sup>3</sup>	—	—	5	V/ns	$V_{DS} = 0$ to $300\text{V}$ , $I_{SD} \leq 23\text{A}$ , $T_j = 25^\circ\text{C}$ see Fig 17, 18
$d_{if}/dt$	Maximum diode commutation speed	—	—	1000	A/ $\mu\text{s}$	$V_{DS} = 0$ to $300\text{V}$ , $I_{SD} \leq 23\text{A}$ , $T_j = 25^\circ\text{C}$ see Fig 17, 18
$V_{ISO}$	Insulation withstand voltage	—	—	n.a.	V	$V_{\text{rms}}$ , $T_C = 25^\circ\text{C}$ , $t = 1\text{min}$

<sup>1</sup> Pulse width  $t_p$  limited by  $T_{j\text{max}}$ <sup>2</sup> The  $dv/dt$  has to be limited by appropriate gate resistor<sup>3</sup> Identical low side and high side switch

## 600V CoolMOS™ SJ S7 Technology

## Device Characteristics

## 2 Device Characteristics

### 2.1 Electrical Characteristics

For applications with applied blocking voltage >70% of the specified blocking voltage, it is required that the customer evaluates the impact of cosmic radiation effect in early design phase and contacts the Infineon sales office for the necessary technical support by IR Hirel

**Table 3 Static and Dynamic Electrical Characteristics @ T<sub>J</sub> = 25°C (Unless Otherwise Specified)**

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
V <sub>(BR)DSS</sub>	Drain-to-source breakdown voltage	600	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 1mA
R <sub>DS(on)</sub>	Static drain-to-source on-state resistance	—	20	22	mΩ	V <sub>GS</sub> = 12V, I <sub>D</sub> = 23A, T <sub>J</sub> = 25°C
		—	46	—		V <sub>GS</sub> = 12V, I <sub>D</sub> = 23A, T <sub>J</sub> = 150°C
V <sub>GS(th)</sub>	Gate threshold voltage	3.5	4.0	4.5	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 1.44mA
I <sub>DSS</sub>	Zero gate voltage drain current	—	—	5	μA	V <sub>DS</sub> = 600V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 25°C
		—	50	—		V <sub>DS</sub> = 600V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 150°C
I <sub>GSS</sub>	Gate-to-source leakage current	—	—	100	nA	V <sub>GS</sub> = 20V, V <sub>DS</sub> = 0V
Q <sub>G</sub>	Total gate charge	—	150	—	nC	I <sub>D</sub> = 23A V <sub>DD</sub> = 300V V <sub>GS</sub> = 0 to 12V
Q <sub>GS</sub>	Gate-to-source charge	—	31	—		
Q <sub>GD</sub>	Gate-to-drain ('Miller') charge	—	49	—		
V <sub>plateau</sub>	Gate plateau voltage	—	5.4	—	V	
t <sub>d(on)</sub>	Turn-on delay time	—	30	—	ns	I <sub>D1</sub> = 23A ** V <sub>DD</sub> = 300V R <sub>G</sub> = 5.3Ω V <sub>GS</sub> = 13V, see Fig 21,22
t <sub>r</sub>	Rise time	—	4.0	—		
t <sub>d(off)</sub>	Turn-off delay time	—	150	—		
t <sub>f</sub>	Fall time	—	9.0	—		
C <sub>iss</sub>	Input capacitance	—	5639	—	pF	V <sub>GS</sub> = 0V V <sub>DS</sub> = 300V f = 250kHz
C <sub>oss</sub>	Output capacitance	—	89	—		
C <sub>O(er)</sub>	Effective output capacitance, energy related <sup>1</sup>	—	303	—		
C <sub>O(tr)</sub>	Effective output capacitance, time related <sup>2</sup>	—	2678	—		I <sub>D</sub> = constant, V <sub>GS</sub> = 0V, V <sub>DS</sub> = 0 to 300V
Q <sub>OSS</sub>	Output charge	—	803	—	nC	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 0 to 300V
R <sub>G</sub>	Gate resistance	—	0.80	—	Ω	f=1MHz, open drain

<sup>1</sup> C<sub>O(er)</sub> is a fixed capacitance that gives the same stored energy as C<sub>OSS</sub> while V<sub>DS</sub> is rising from 0 to 300V

<sup>2</sup> C<sub>O(tr)</sub> is a fixed capacitance that gives the same charging time as C<sub>OSS</sub> while V<sub>DS</sub> is rising from 0 to 300V

## 600V CoolMOS™ SJ S7 Technology

## Device Characteristics

## 2.2 Source-Drain Diode Ratings and Characteristics

Table 4 Source-Drain Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
$V_{SD}$	Diode forward voltage	—	0.82	—	V	$T_J = 25^\circ\text{C}$ , $I_S = 23\text{A}$ , $V_{GS} = 0\text{V}$
$t_{rr}$	Reverse recovery time	—	460	—	ns	$T_J = 25^\circ\text{C}$ , $I_F = 23\text{A}$ , $V_R = 300\text{V}$ $di/dt = 100\text{A}/\mu\text{s}$ see Fig 17, 18
$Q_{rr}$	Reverse recovery charge	—	9.0	—	$\mu\text{C}$	
$I_{rrm}$	Peak reverse recovery current	—	40	—	A	
$t_{on}$	Forward turn-on time	Intrinsic turn-on time is negligible				

## 2.3 Thermal Characteristics

Table 5 Thermal Resistance

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
$R_{\theta JC}$	Thermal resistance, junction - case	—	—	0.32	—	—
$R_{\theta JA}$	Thermal resistance, junction - ambient	—	—	62	—	Device on PCB, minimal footprint
$R_{\theta JA}$	Thermal resistance, junction - ambient for SMD version	—	35	45	$^\circ\text{C}/\text{W}$	Device on 40mm*40mm*1.5mm epoxy PCB FR4 with 6cm <sup>2</sup> (one layer, 70 $\mu\text{m}$ thickness) copper area for drain connection and PCB is vertical without air stream cooling.
$T_{sold}$	Soldering temperature, wave- & reflow soldering allowed	—	—	260	$^\circ\text{C}$	—

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Electrical Characteristics Curves

3 Electrical Characteristics Curves

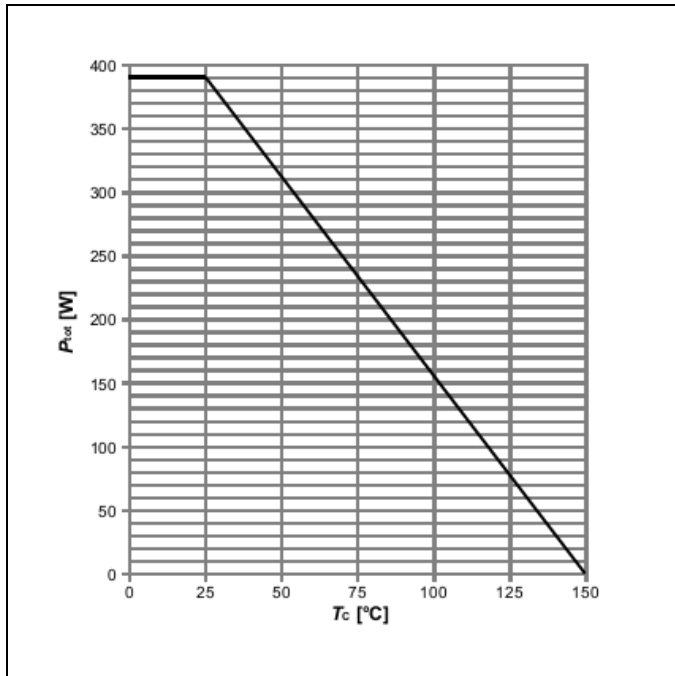


Figure 1 Power dissipation ( $P_{tot}=f(T_c)$ )

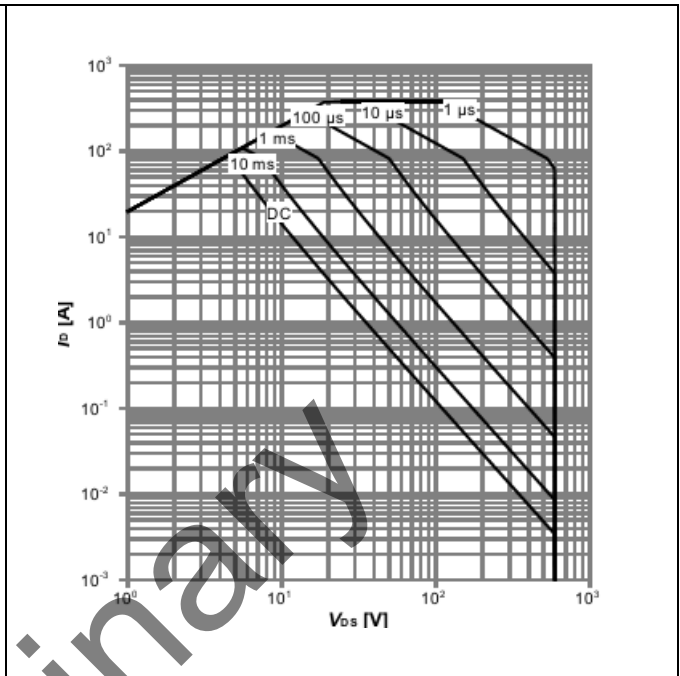


Figure 2 Safe operating area  
( $I_D=f(V_{DS}); T_c=25^\circ\text{C}; D=0; \text{parameter: } t_p$ )

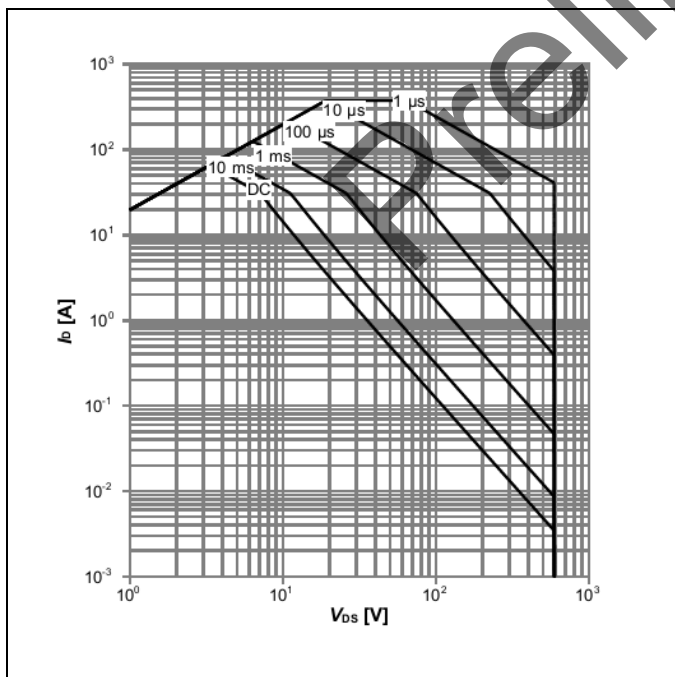


Figure 3 Safe operating area  
( $I_D=f(V_{DS}); T_c=80^\circ\text{C}; D=0; \text{parameter: } t_p$ )

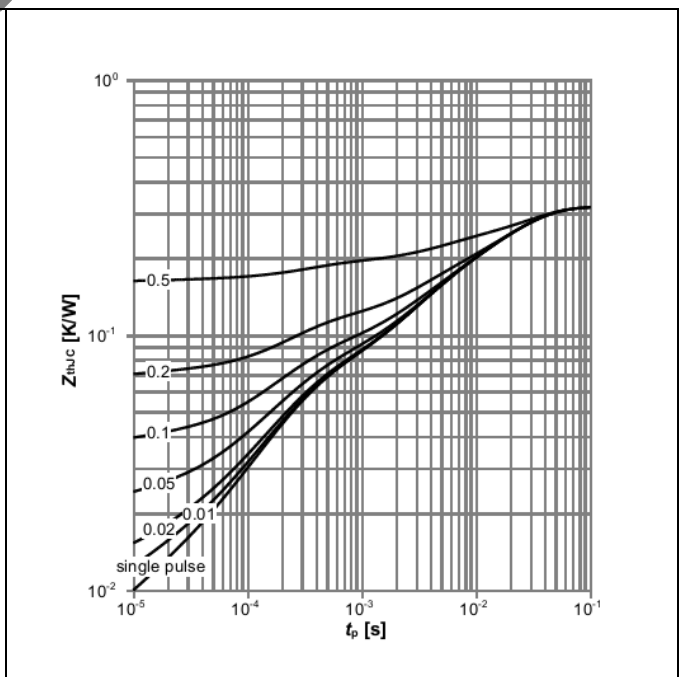
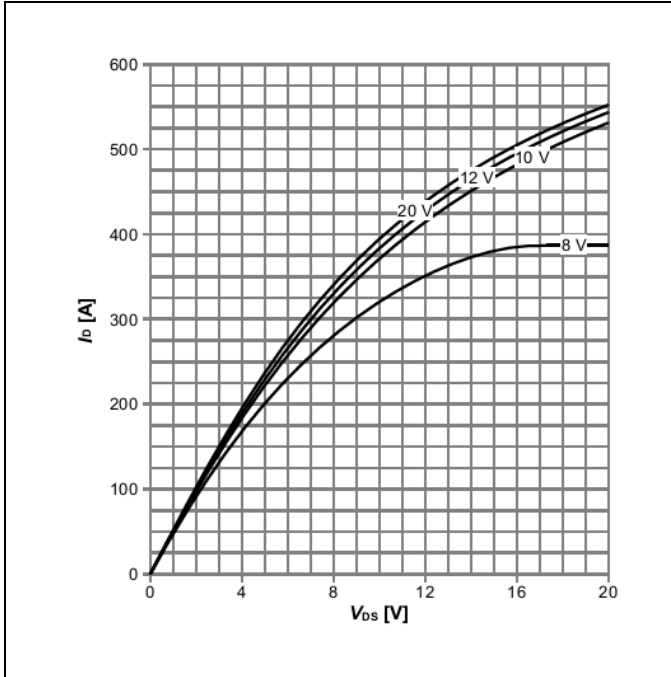


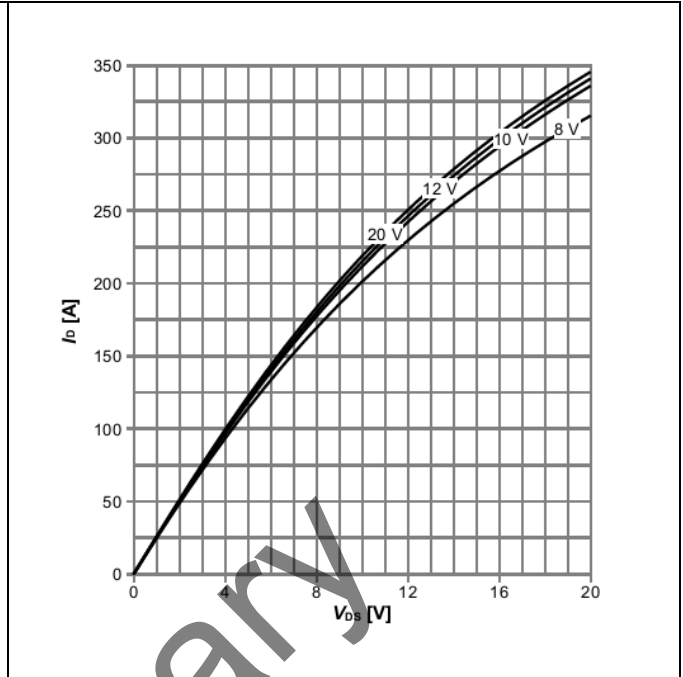
Figure 4 Max. transient thermal impedance  
( $Z_{thJC}=f(t_p); \text{parameter: } D=t_p/T$ )

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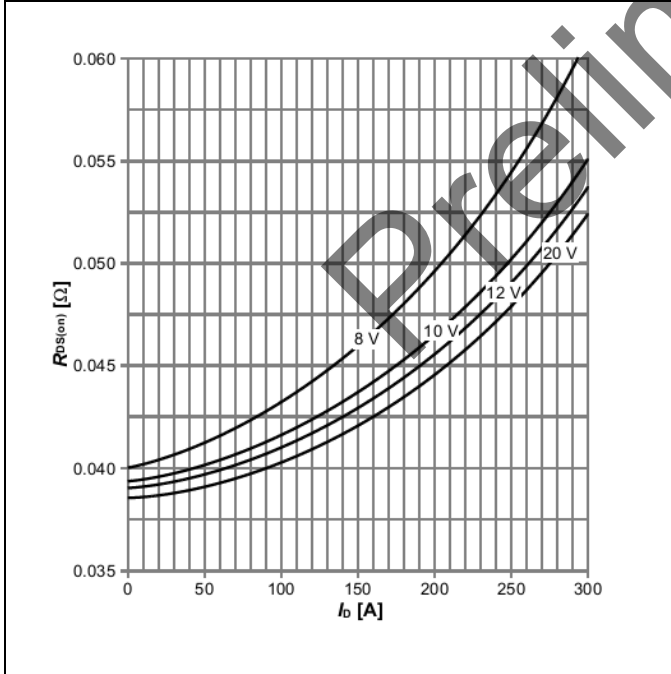
Electrical Characteristics Curves



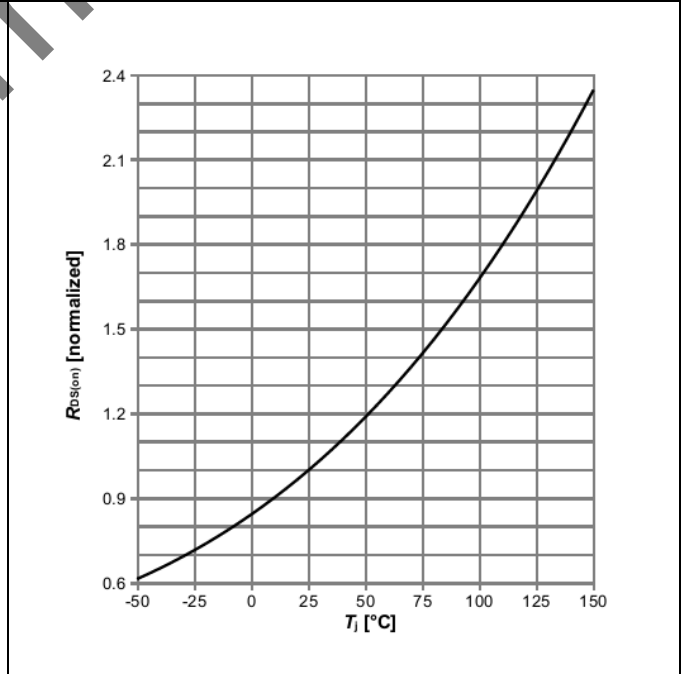
**Figure 5 Typical output characteristics**  
( $I_D=f(V_{DS})$ ;  $T_j=25^\circ\text{C}$ ; parameter:  $V_{GS}$ )



**Figure 6 Typical output characteristics**  
( $I_D=f(V_{DS})$ ;  $T_j=125^\circ\text{C}$ ; parameter:  $V_{GS}$ )



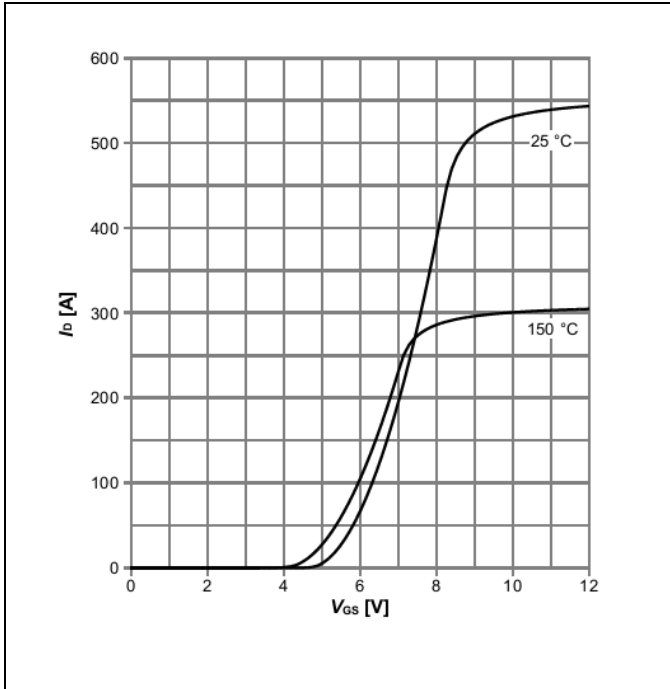
**Figure 7 Typical drain -source on state resistance**  
( $R_{DS(on)}=f(I_D)$ ;  $T_j=125^\circ\text{C}$ ; parameter:  $V_{GS}$ )



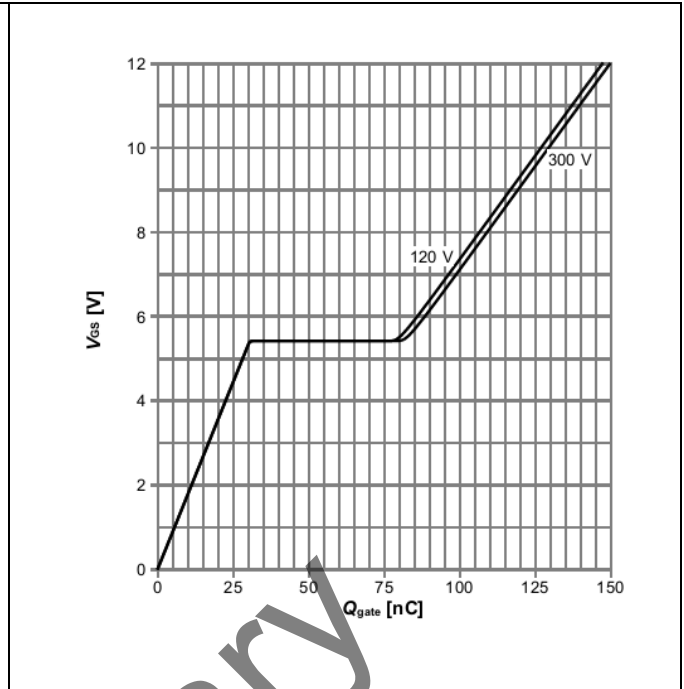
**Figure 8 Drain-source on -state resistance**  
( $R_{DS(on)}=f(T_j)$ ;  $I_D=23.0\text{A}$ ;  $V_{GS}=12\text{V}$ )

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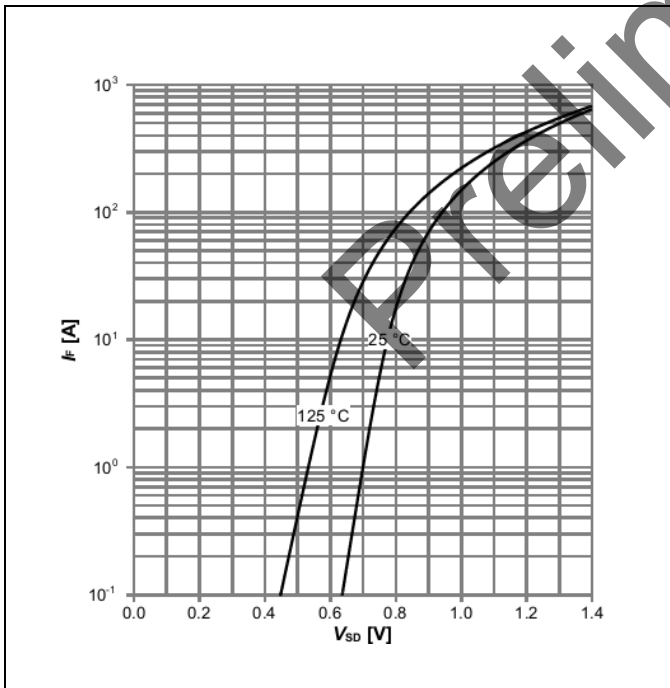
Electrical Characteristics Curves



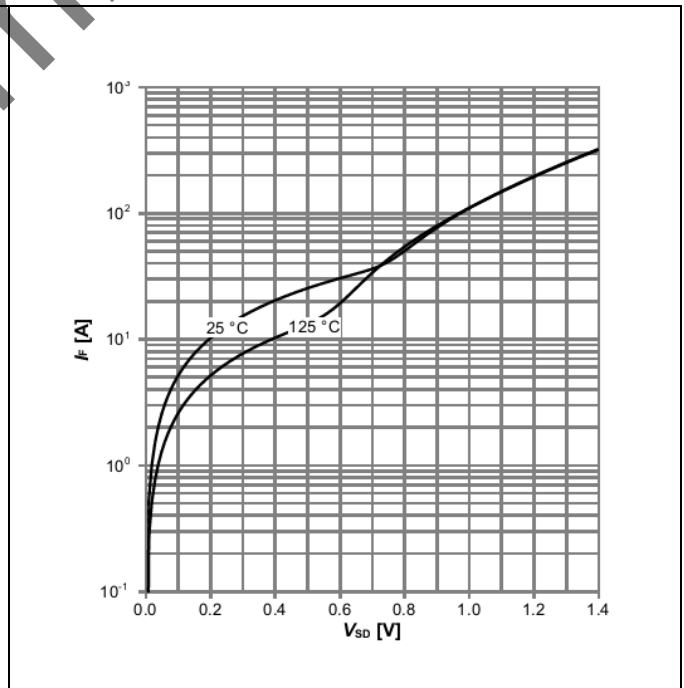
**Figure 9 Typical transfer characteristics**  
( $D=f(V_{GS}); V_{DS}=20V; \text{parameter: } T_j$ )



**Figure 10 Typical gate charge**  
( $V_{GS}=f(Q_{gate}); I_D=23.0A \text{ pulsed}; \text{parameter: } V_{DD}$ )



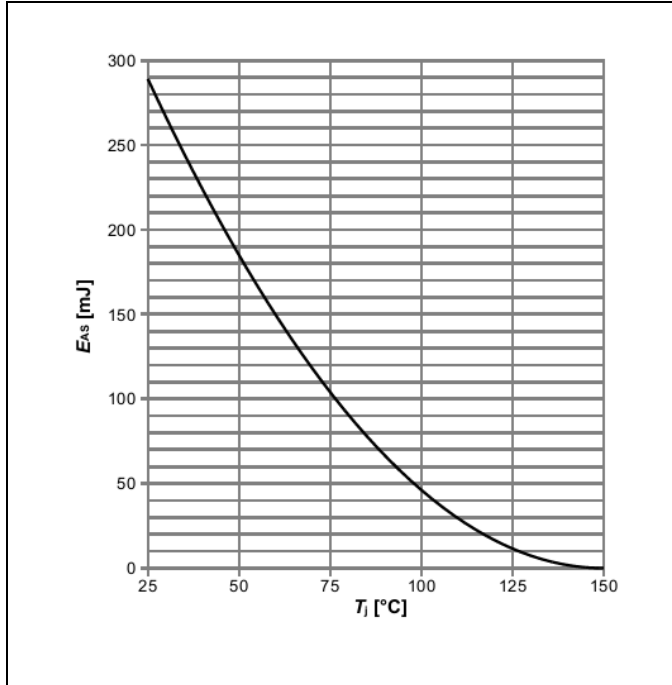
**Figure 11 Forward characteristics of reverse diode**  
( $I_F=f(V_{SD}); V_{GS}=0V; \text{parameter: } T_j$ )



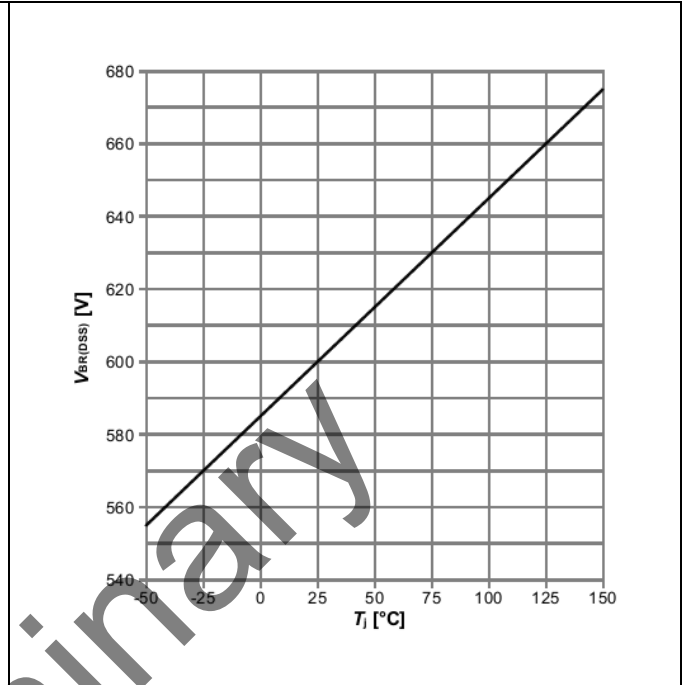
**Figure 12 Forward characteristics of reverse diode**  
( $I_F=f(V_{SD}); V_{GS}=12V; \text{parameter: } T_j$ )

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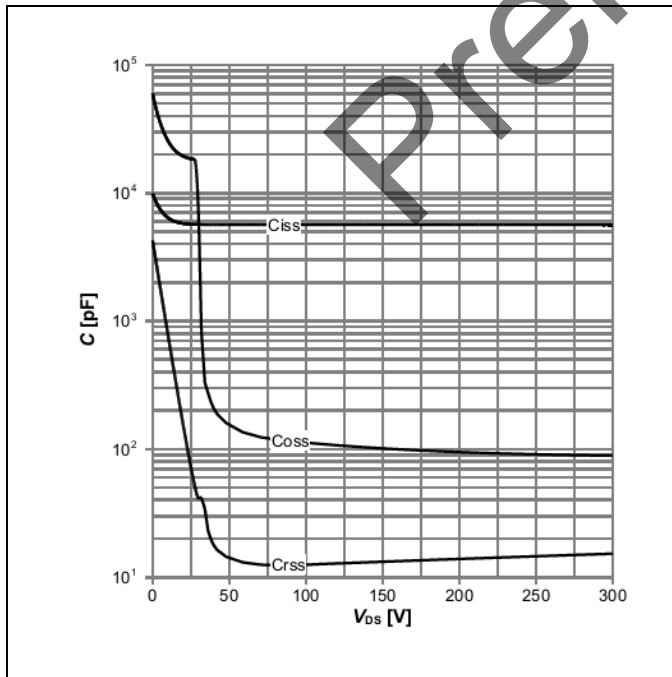
Electrical Characteristics Curves



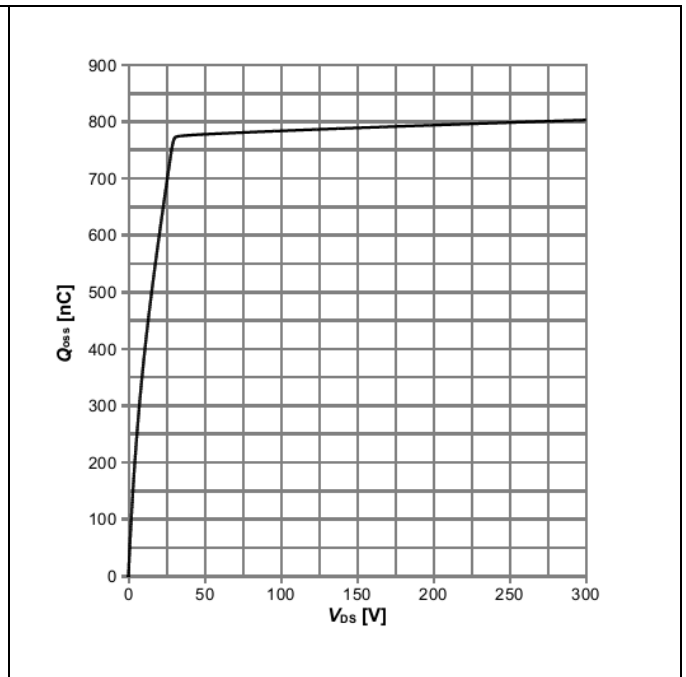
**Figure 13** Avalanche energy  
( $E_{AS}=f(T_j)$ ;  $I_D=3.8A$ ;  $V_{DD}=50V$ )



**Figure 14** Drain-source breakdown voltage  
( $V_{BR(DSS)}=f(T_j)$ ;  $I_D=1mA$ )



**Figure 15** Typical capacitances  
( $C=f(V_{DS})$ ;  $V_{GS}=0V$ ;  $f=250kHz$ )



**Figure 16** Typical  $Q_{oss}$  output charge  
( $Q_{oss}=f(V_{DS})$ ;  $V_{GS}=0V$ )

600V CoolMOS™ SJ S7 Technology

Test Circuits

4 Test Circuits

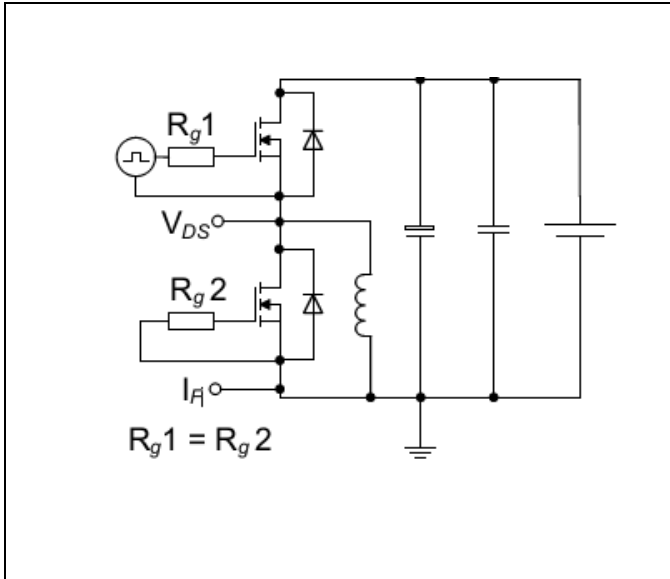


Figure 17 Test circuit for diode characteristics

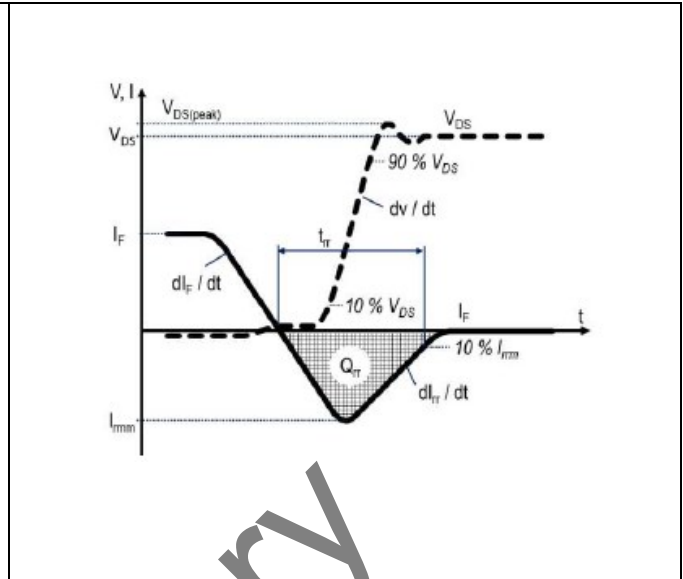


Figure 18 Diode recovery waveform

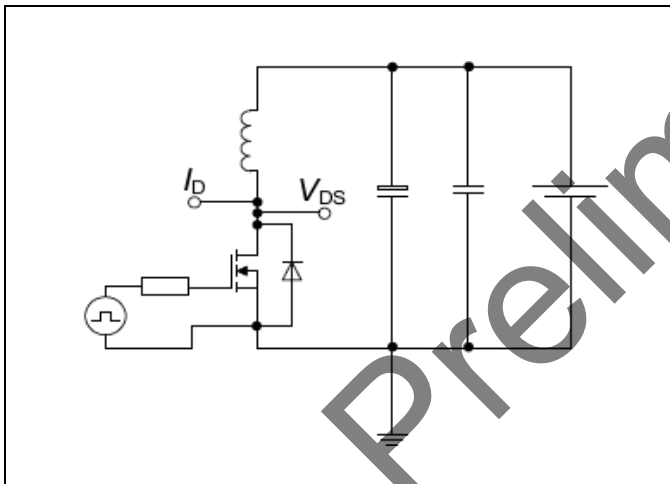


Figure 19 Unclamped inductive load test circuit

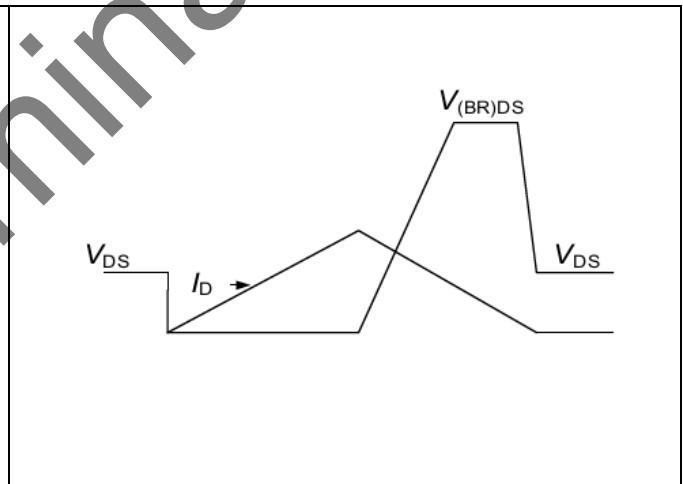


Figure 20 Unclamped inductive waveform

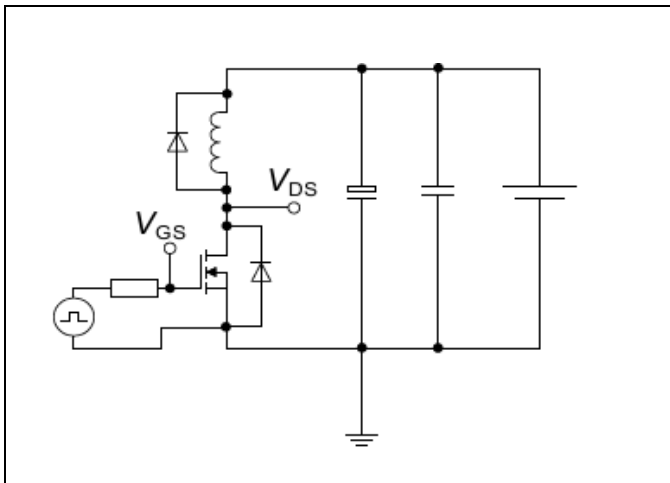


Figure 21 Switching time test circuit

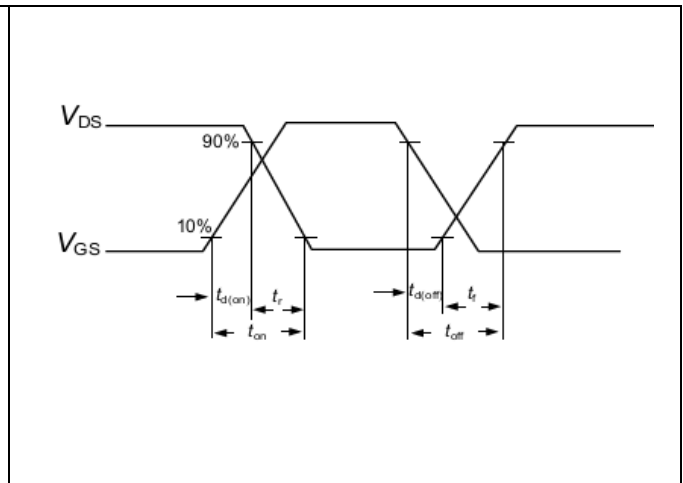


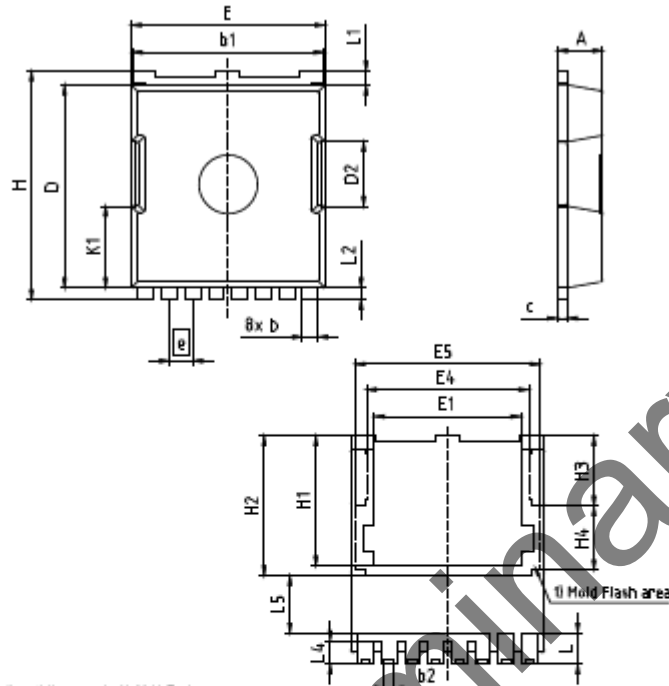
Figure 22 Switching time waveforms

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Package Outline

5 Package Outline

Note: For the most updated package outline, please see the website: [PG-HSOF-8, dimensions in mm/inches](#)



1) partially covered with Mold Flash

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.20	2.40	0.087	0.094
b	0.70	0.90	0.028	0.035
b1	9.70	9.90	0.382	0.390
b2	0.42	0.50	0.017	0.020
c	0.40	0.60	0.016	0.024
D	10.28	10.58	0.405	0.416
D2	3.30		0.130	
E	9.70	10.10	0.382	0.398
E1	7.50		0.295	
E4	8.20		0.323	
E5	9.45		0.372	
e	1.30 (0.005)		0.051 (0.002)	
H	11.48	11.58	0.452	0.456
H1	8.55	8.75	0.336	0.346
H2	1.15		0.045	
H3	3.79		0.149	
H4	2.26		0.089	
H5	8		0.315	
L	1.48	1.80	0.058	0.071
L1	0.70	0.90	0.028	0.035
L2	0.50	0.70	0.020	0.028
L4	1.00	1.30	0.039	0.051
L5	2.62	2.81	0.103	0.111

DOCUMENT NO.  
29D 00176939

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EUROPEAN PROJECTION

ISSUE DATE  
26-04-2015

REVISION  
01

**Revision history**

**Revision history**

<b>Document version</b>	<b>Date of release</b>	<b>Description of changes</b>
	06/03/2024	Preliminary datasheet with PPD number (PPD-98018)

Preliminary

Preliminary

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**Edition 2024-06-03**

#### Published by

**International Rectifier HiRel Products,  
Inc.**

**An Infineon Technologies company  
El Segundo, California 90245 USA**

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