

# IPW65R090CFD7-VB Datasheet

## N-Channel 650V (D-S) Super Junction Power MOSFET

**PRODUCT SUMMARY**

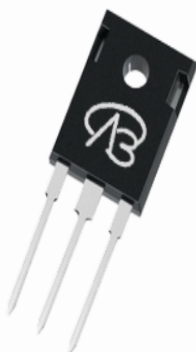
$V_{DS}$ (V) at $T_J$ max.	650	
$R_{DS(on)}$ at 25 °C ( $\Omega$ )	$V_{GS} = 10$ V	0.075

**FEATURES**

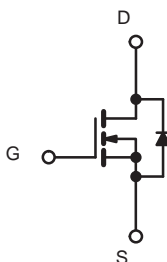
- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- Low input capacitance ( $C_{iss}$ )
- Reduced switching and conduction losses
- Ultra low gate charge ( $Q_g$ )
- Avalanche energy rated (UIS)

**RoHS****APPLICATIONS**

- Server and telecom power supplies
- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- Lighting
  - High-intensity discharge (HID)
  - Fluorescent ballast lighting

**TO-247**

Top View



N-Channel MOSFET

**ABSOLUTE MAXIMUM RATINGS** ( $T_C = 25$  °C, unless otherwise noted)

PARAMETER			SYMBOL	LIMIT	UNIT
Drain-Source Voltage			$V_{DS}$	650	V
Gate-Source Voltage			$V_{GS}$	± 30	
Continuous Drain Current ( $T_J = 150\text{ }^{\circ}\text{C}$ )	$V_{GS}$ at 10 V	$T_C = 25\text{ }^{\circ}\text{C}$	$I_D$	36	A
		$T_C = 100\text{ }^{\circ}\text{C}$		22	
Pulsed Drain Current <sup>a</sup>			$I_{DM}$	108	
Linear Derating Factor				1.67	W/ $^{\circ}\text{C}$
Single Pulse Avalanche Energy <sup>b</sup>			$E_{AS}$	1400	mJ
Maximum Power Dissipation			$P_D$	210	W
Operating Junction and Storage Temperature Range			$T_J, T_{stg}$	-55 to +150	$^{\circ}\text{C}$
Drain-Source Voltage Slope	$T_J = 125\text{ }^{\circ}\text{C}$		$dV/dt$	50	V/ns
Reverse Diode $dV/dt$ <sup>d</sup>		15			
Soldering Recommendations (Peak Temperature) <sup>c</sup>	for 10 s			260	$^{\circ}\text{C}$


**Notes**

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 100$  V, starting  $T_J = 25$  °C,  $L = 30$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 13$  A.
- 1.6 mm from case.
- $I_{SD} \leq I_D$ ,  $dI/dt = 100$  A/ $\mu$ s, starting  $T_J = 25$  °C.

**THERMAL RESISTANCE RATINGS**

PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	62	°C/W
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	0.38	

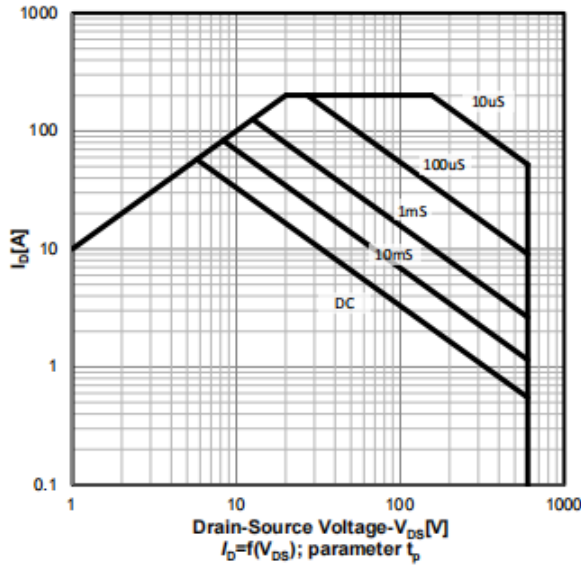
**SPECIFICATIONS** ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$		650	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to 25 °C, $I_D = 1\text{ mA}$		-	0.70	-	V/°C
Gate-Source Threshold Voltage (N)	$V_{GS(th)}$	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$		2.5	-	4.5	V
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 20\text{ V}$		-	-	$\pm 100$	nA
		$V_{GS} = \pm 30\text{ V}$		-	-	$\pm 1$	$\mu\text{A}$
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 650\text{V}$ , $V_{GS} = 0\text{ V}$		-	-	1	$\mu\text{A}$
		$V_{DS} = 520\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$		-	-	100	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 12\text{A}$	-	0.075	-	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = 30\text{ V}$ , $I_D = 12\text{A}$		-	5.6	-	S
Dynamic							
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}$ , $V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$		-	3900	-	pF
Output Capacitance	$C_{oss}$			-	330	-	
Reverse Transfer Capacitance	$C_{rss}$			-	4	-	
Effective Output Capacitance, Energy Related <sup>a</sup>	$C_{o(er)}$	$V_{DS} = 0\text{ V to } 520\text{ V}$ , $V_{GS} = 0\text{ V}$		-	63	-	
Effective Output Capacitance, Time Related <sup>b</sup>	$C_{o(tr)}$			-	213	-	
Total Gate Charge	$Q_g$	$V_{GS} = 10\text{ V}$	$I_D = 20\text{ A}$ , $V_{DS} = 520\text{ V}$	-	60	-	nC
Gate-Source Charge	$Q_{gs}$			-	39	-	
Gate-Drain Charge	$Q_{gd}$			-	47	-	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 520\text{ V}$ , $I_D = 20\text{A}$ , $V_{GS} = 10\text{ V}$ , $R_g = 9.1\text{ }\Omega$		-	18	25	ns
Rise Time	$t_r$			-	24	55	
Turn-Off Delay Time	$t_{d(off)}$			-	80	-	
Fall Time	$t_f$			-	12	-	
Gate Input Resistance	$R_g$	$f = 1\text{ MHz}$ , open drain		-	0.8	-	$\Omega$
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	36	A
Pulsed Diode Forward Current	$I_{SM}$			-	-	108	
Diode Forward Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}$ , $I_S = 8\text{ A}$ , $V_{GS} = 0\text{ V}$		-	-	1.5	V
Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}$ , $I_F = I_S = 8\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}$ , $V_R = 400\text{ V}$		-	520	-	ns
Reverse Recovery Charge	$Q_{rr}$			-	5.8	-	$\mu\text{C}$
Reverse Recovery Current	$I_{RRM}$			-	45	-	A

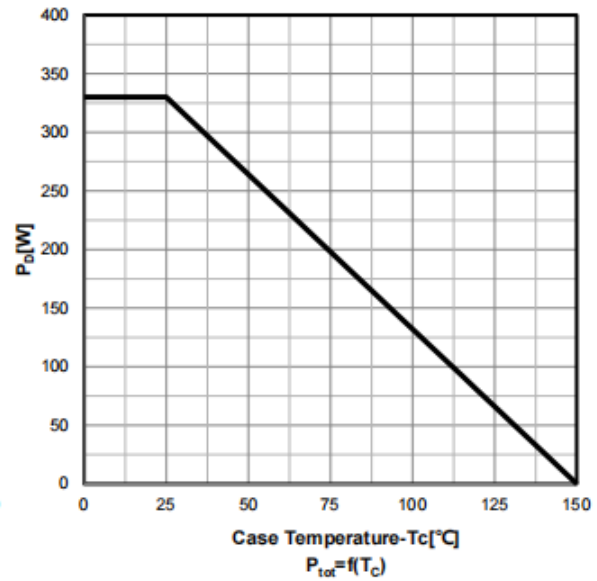
**Notes**

- a.  $C_{oss(er)}$  is a fixed capacitance that gives the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$ .  
 b.  $C_{oss(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$ .

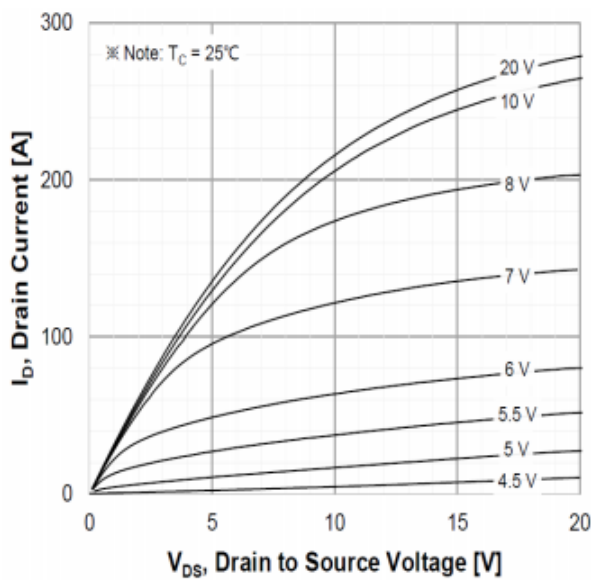
Safe operating area TC=25 °C  
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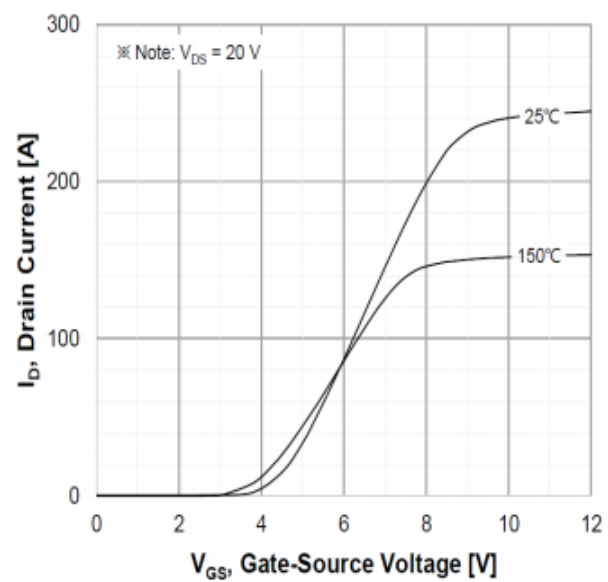
Power dissipation



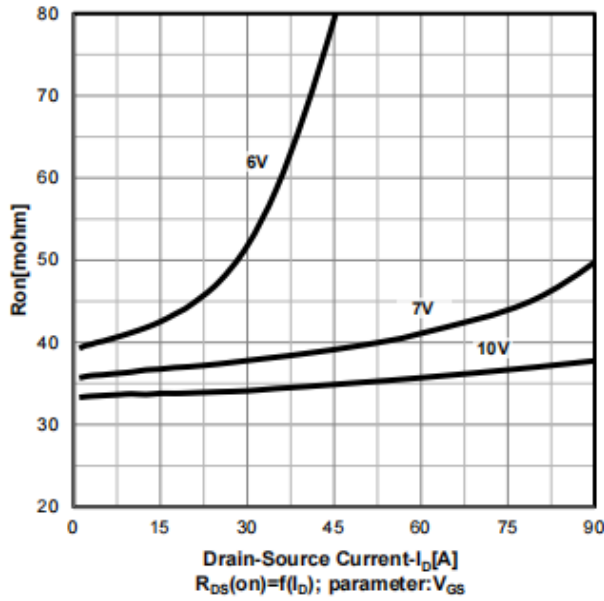
Typ. output characteristics  $T_J=25$  °C



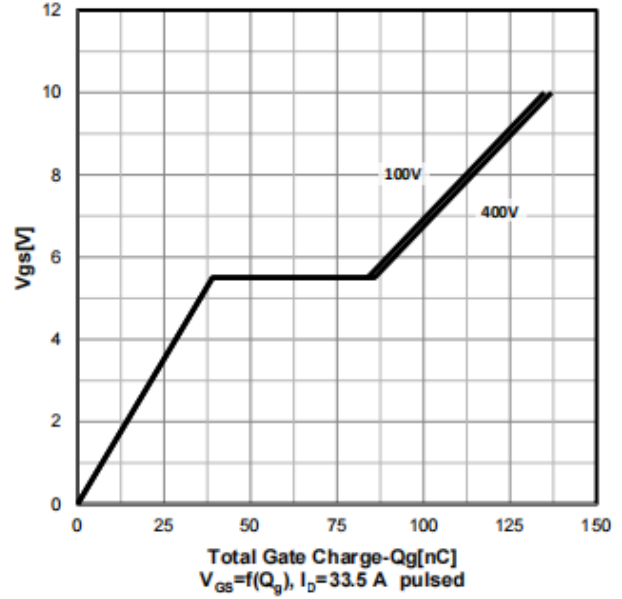
Transfer characteristics



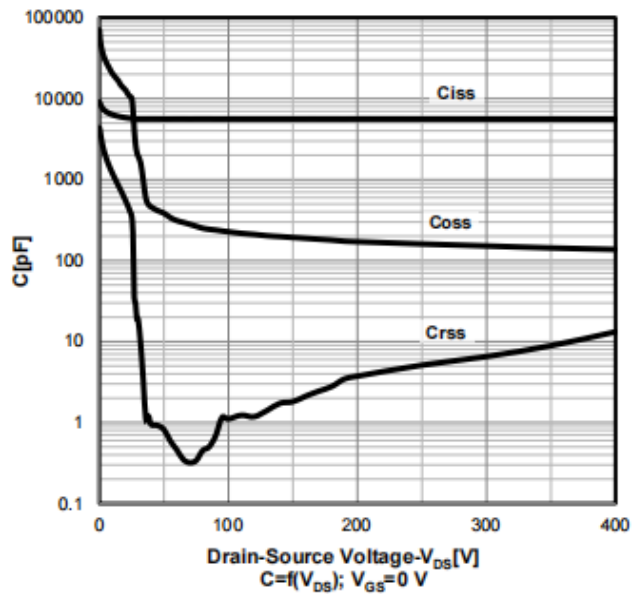
Typ. drain-source on-state resistance



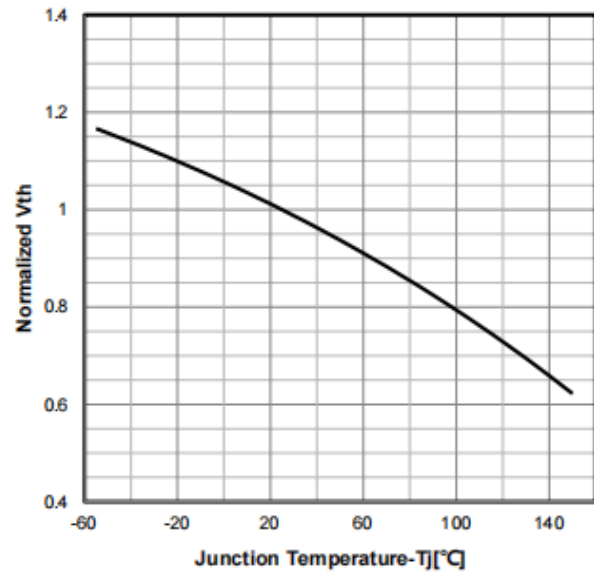
Typ. gate charge characteristics



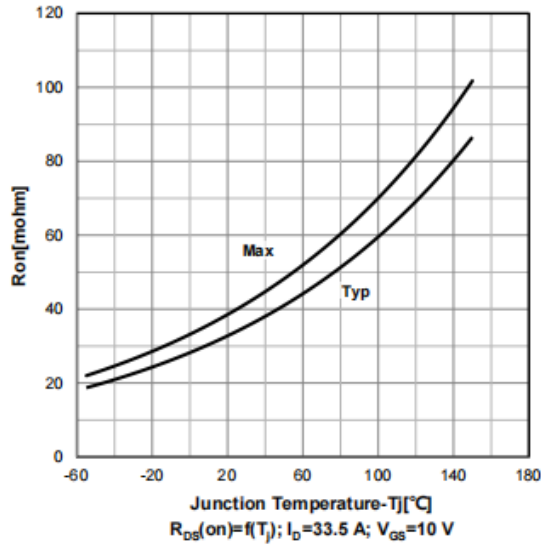
Typ. capacitances



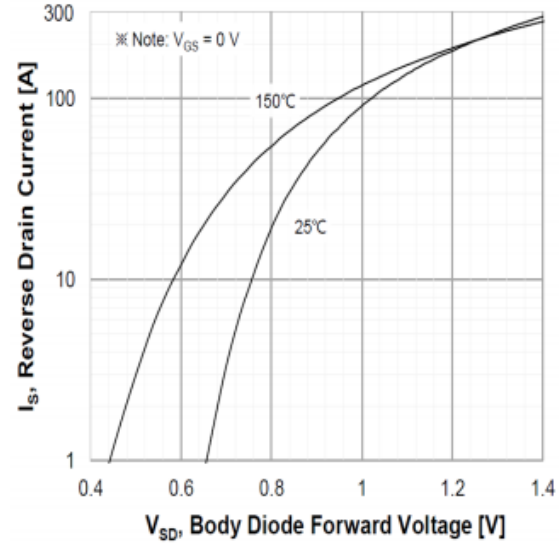
Normalized  $V_{GS(th)}$  characteristics



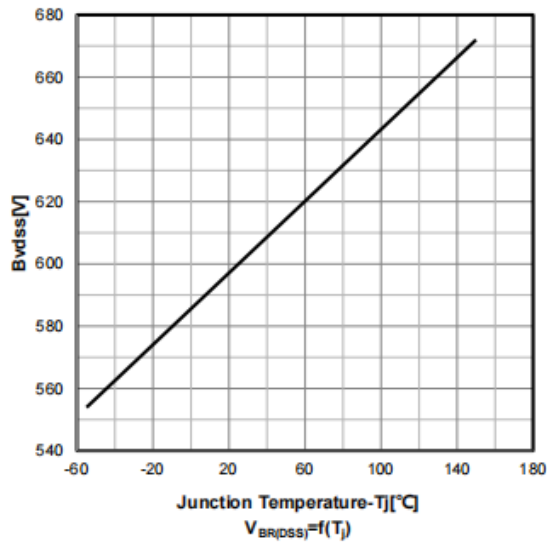
On-resistance vs temperature



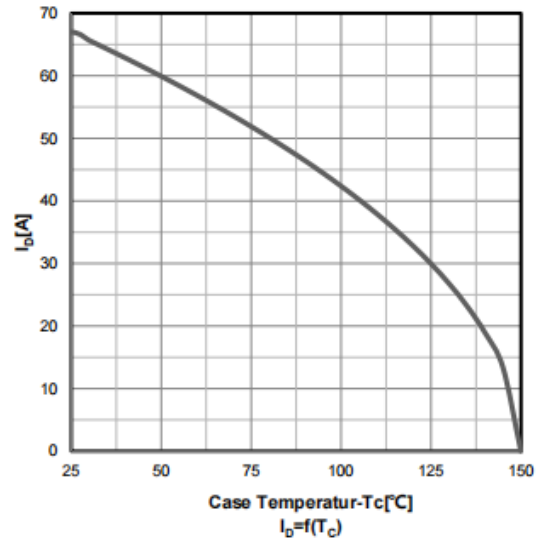
Forward characteristics of reverse diode



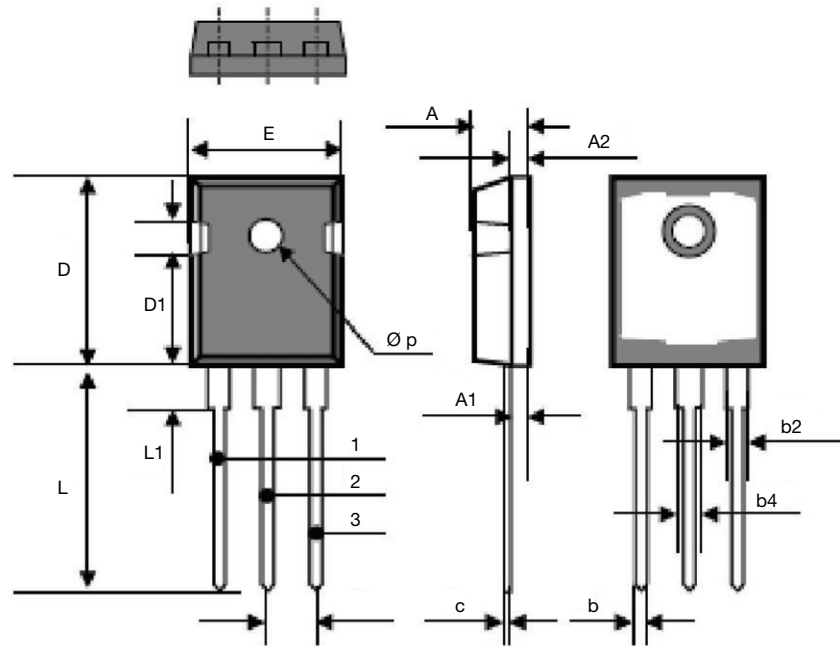
Drain-source breakdown voltage



Drain current vs temperature



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DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.70	5.31	0.185	0.209
A1	2.21	2.59	0.087	0.102
A2	1.50	2.49	0.059	0.098
b	0.99	1.40	0.039	0.055
b2	1.65	2.41	0.065	0.095
b4	2.59	3.43	0.102	0.135
c	0.61 BSC		0.024 BSC	
D	20.80	21.46	0.819	0.845
D1	3.68	5.49	0.145	0.216
(e)	5.46 BSC		0.215 BSC	
E	15.49	16.26	0.610	0.640
L	19.81	20.32	0.780	0.800
L1	4.06	4.50	0.160	0.177
Ø p	3.51	3.66	0.138	0.144

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