



**THE DATASHEET OF
IRL40T209ATMA1**



MOSFET

IR MOSFET - StrongIRFET™

Benefits

- Improved Gate and Avalanche Ruggedness
- Fully Characterized Capacitance and Avalanche SOA
- Improved I_D rating
- Pb-Free ; RoHS Compliant ; Halogen-Free

Potential applications

- Brushed Motor drive applications
- BLDC Motor drive applications
- Battery powered circuits
- Half-bridge and full-bridge topologies
- Synchronous rectifier applications
- Resonant mode power supplies
- OR-ing and redundant power switches
- DC/DC and AC/DC converters
- DC/AC Inverters

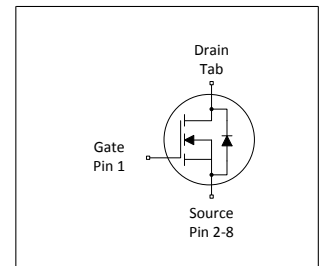


Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS}	40	V
$R_{DS(on),typ}$	0.59	mΩ
$R_{DS(on),max}$	0.72	mΩ
I_D (Silicon Limited)	586	A
I_D (Package Limited)	300	A



Type / Ordering Code	Package	Marking	Related Links
IRL40T209	PG-HSOF-8	RL40T209	-

Table of Contents

Description	1
Maximum ratings	3
Thermal characteristics	3
Electrical characteristics	4
Electrical characteristics diagrams	6
Package Outlines	10
Revision History	11
Trademarks	11
Disclaimer	11

1 Maximum ratings

at $T_C=25\text{ °C}$, unless otherwise specified

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current	I_D	-	-	300 586 347	A	$V_{GS}=10\text{ V}$, $T_C=25\text{ °C}$ $V_{GS}=10\text{ V}$, $T_C=25\text{ °C}$ (silicon limited) $V_{GS}=10\text{ V}$, $T_C=100\text{ °C}$ (silicon limited) ¹⁾
Pulsed drain current ¹⁾	$I_{D,pulse}$	-	-	1200	A	$T_C=25\text{ °C}$
Avalanche energy, single pulse ²⁾	E_{AS}	-	-	875	mJ	$I_D=100\text{ A}$, $R_{GS}=50\text{ }\Omega$
Gate source voltage	V_{GS}	-20	-	20	V	-
Power dissipation	P_{tot}	-	-	500	W	$T_C=25\text{ °C}$
Operating and storage temperature	T_j , T_{stg}	-55	-	175	°C	IEC climatic category; DIN IEC 68-1: 55/175/56

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case, bottom ³⁾	R_{thJC}	-	-	0.3	°C/W	-
Thermal resistance, junction - case, top	R_{thJC}	-	-	20	°C/W	-
Device on PCB, 6 cm ² cooling area ¹⁾	R_{thJA}	-	-	30	°C/W	-
Device on PCB, RTHJA(<10s)	R_{thJA}	-	-	12	°C/W	-

¹⁾ See Diagram 3 for more detailed information

²⁾ See Diagram 13 for more detailed information

³⁾ R_{thJC} is measured at T_J approximately 90°C.

3 Electrical characteristics

at $T_j=25\text{ °C}$, unless otherwise specified

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	40	-	-	V	$V_{GS}=0\text{ V}$, $I_D=250\text{ }\mu\text{A}$
Breakdown voltage temperature coefficient	$dV_{(BR)DSS}/dT_j$	-	31	-	mV/°C	$I_D=5\text{ mA}$, referenced to 25 °C
Gate threshold voltage	$V_{GS(th)}$	1	-	2.4	V	$V_{DS}=V_{GS}$, $I_D=250\text{ }\mu\text{A}$
Zero gate voltage drain current	I_{DSS}	-	-	1 150	μA	$V_{DS}=40\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$ $V_{DS}=40\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=125\text{ °C}$
Gate-source leakage current	I_{GSS}	-	-	100	nA	$V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$
Drain-source on-state resistance	$R_{DS(on)}$	-	0.59 0.75	0.72 1.10	m Ω	$V_{GS}=10\text{ V}$, $I_D=100\text{ A}$ $V_{GS}=4.5\text{ V}$, $I_D=50\text{ A}$
Gate resistance ¹⁾	R_G	-	2.0	-	Ω	-
Transconductance	g_{fs}	-	380	-	S	$ V_{DS} \geq 2 I_D /R_{DS(on)max}$, $I_D=100\text{ A}$

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance ¹⁾	C_{iss}	-	16000	-	pF	$V_{GS}=0\text{ V}$, $V_{DS}=20\text{ V}$, $f=1\text{ MHz}$
Output capacitance ¹⁾	C_{oss}	-	2200	-	pF	$V_{GS}=0\text{ V}$, $V_{DS}=20\text{ V}$, $f=1\text{ MHz}$
Reverse transfer capacitance ¹⁾	C_{rss}	-	1600	-	pF	$V_{GS}=0\text{ V}$, $V_{DS}=20\text{ V}$, $f=1\text{ MHz}$
Turn-on delay time	$t_{d(on)}$	-	60	-	ns	$V_{DD}=20\text{ V}$, $V_{GS}=4.5\text{ V}$, $I_D=30\text{ A}$, $R_{G,ext}=2.7\text{ }\Omega$
Rise time	t_r	-	230	-	ns	$V_{DD}=20\text{ V}$, $V_{GS}=4.5\text{ V}$, $I_D=30\text{ A}$, $R_{G,ext}=2.7\text{ }\Omega$
Turn-off delay time	$t_{d(off)}$	-	190	-	ns	$V_{DD}=20\text{ V}$, $V_{GS}=4.5\text{ V}$, $I_D=30\text{ A}$, $R_{G,ext}=2.7\text{ }\Omega$
Fall time	t_f	-	160	-	ns	$V_{DD}=20\text{ V}$, $V_{GS}=4.5\text{ V}$, $I_D=30\text{ A}$, $R_{G,ext}=2.7\text{ }\Omega$

¹⁾ Defined by design. Not subject to production test.

Table 6 Gate charge characteristics¹⁾

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	43	-	nC	$V_{DD}=20\text{ V}$, $I_D=100\text{ A}$, $V_{GS}=0\text{ to }4.5\text{ V}$
Gate charge at threshold	$Q_{g(th)}$	-	26	-	nC	$V_{DD}=20\text{ V}$, $I_D=100\text{ A}$, $V_{GS}=0\text{ to }4.5\text{ V}$
Gate to drain charge ²⁾	Q_{gd}	-	83	-	nC	$V_{DD}=20\text{ V}$, $I_D=100\text{ A}$, $V_{GS}=0\text{ to }4.5\text{ V}$
Switching charge	Q_{sw}	-	100	-	nC	$V_{DD}=20\text{ V}$, $I_D=100\text{ A}$, $V_{GS}=0\text{ to }4.5\text{ V}$
Gate charge total ²⁾	Q_g	-	179	269	nC	$V_{DD}=20\text{ V}$, $I_D=100\text{ A}$, $V_{GS}=0\text{ to }4.5\text{ V}$
Gate plateau voltage	$V_{plateau}$	-	2.6	-	V	$V_{DD}=20\text{ V}$, $I_D=100\text{ A}$, $V_{GS}=0\text{ to }4.5\text{ V}$
Gate charge total, sync. FET	$Q_{g(sync)}$	-	96	-	nC	$V_{DS}=0.1\text{ V}$, $V_{GS}=0\text{ to }4.5\text{ V}$
Output charge ¹⁾	Q_{oss}	-	84	-	nC	$V_{DD}=20\text{ V}$, $V_{GS}=0\text{ V}$

Table 7 Reverse diode

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode continuous forward current ³⁾	I_S	-	-	300	A	$T_C=25\text{ °C}$
Diode pulse current	$I_{S,pulse}$	-	-	1200	A	$T_C=25\text{ °C}$
Diode forward voltage	V_{SD}	-	-	1.2	V	$V_{GS}=0\text{ V}$, $I_F=100\text{ A}$, $T_j=25\text{ °C}$
Reverse recovery time ²⁾	t_{rr}	-	52	-	ns	$V_R=34\text{ V}$, $I_F=100\text{ A}$, $di_F/dt=100\text{ A}/\mu\text{s}$, $T_j=25\text{ °C}$
Reverse recovery charge ²⁾	Q_{rr}	-	79	-	nC	$V_R=34\text{ V}$, $I_F=100\text{ A}$, $di_F/dt=100\text{ A}/\mu\text{s}$, $T_j=25\text{ °C}$

¹⁾ See "Gate charge waveforms" for parameter definition

²⁾ Defined by design. Not subject to production test.

³⁾ Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm² (one layer, 70 μm thick) copper area for drain connection. PCB is vertical in still air.

4 Electrical characteristics diagrams

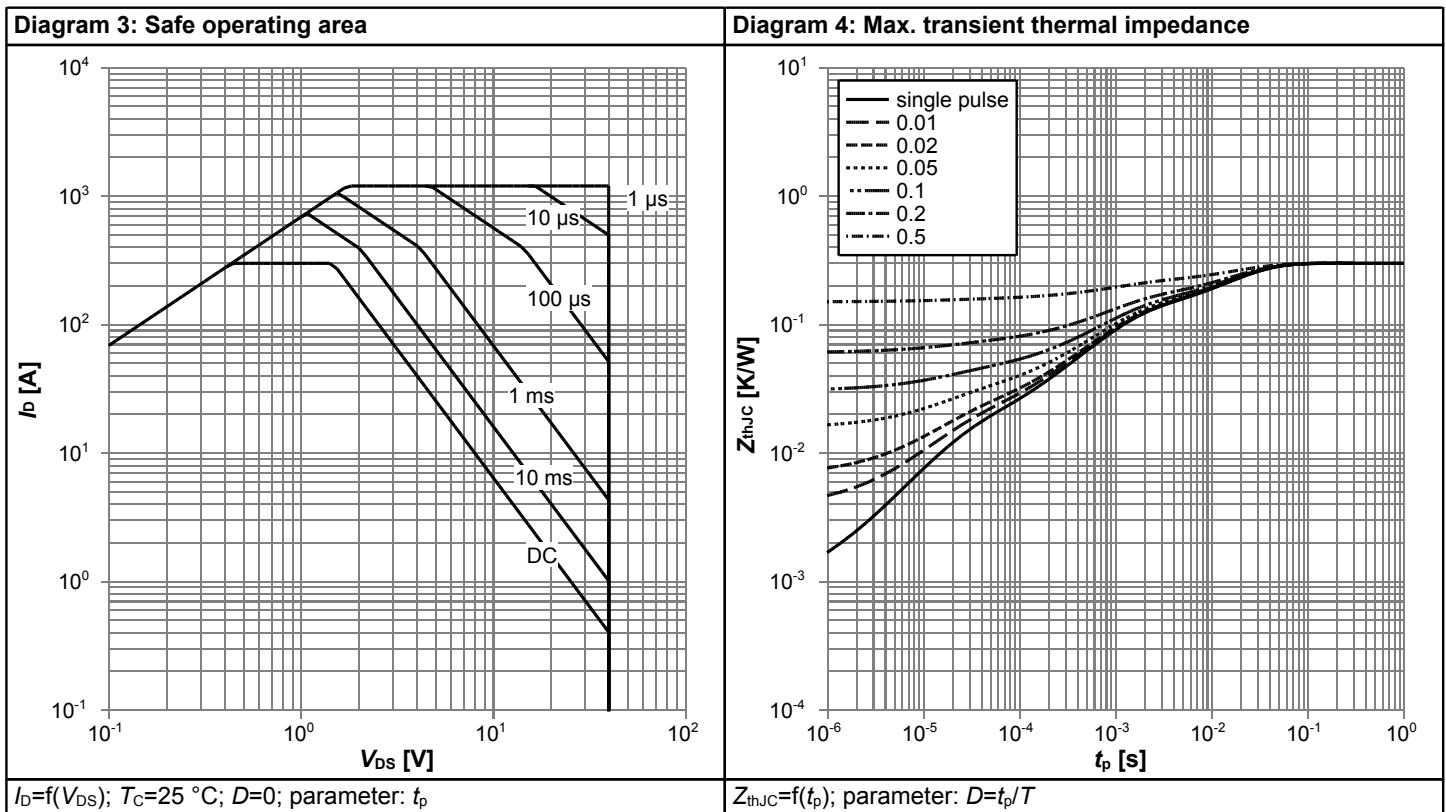
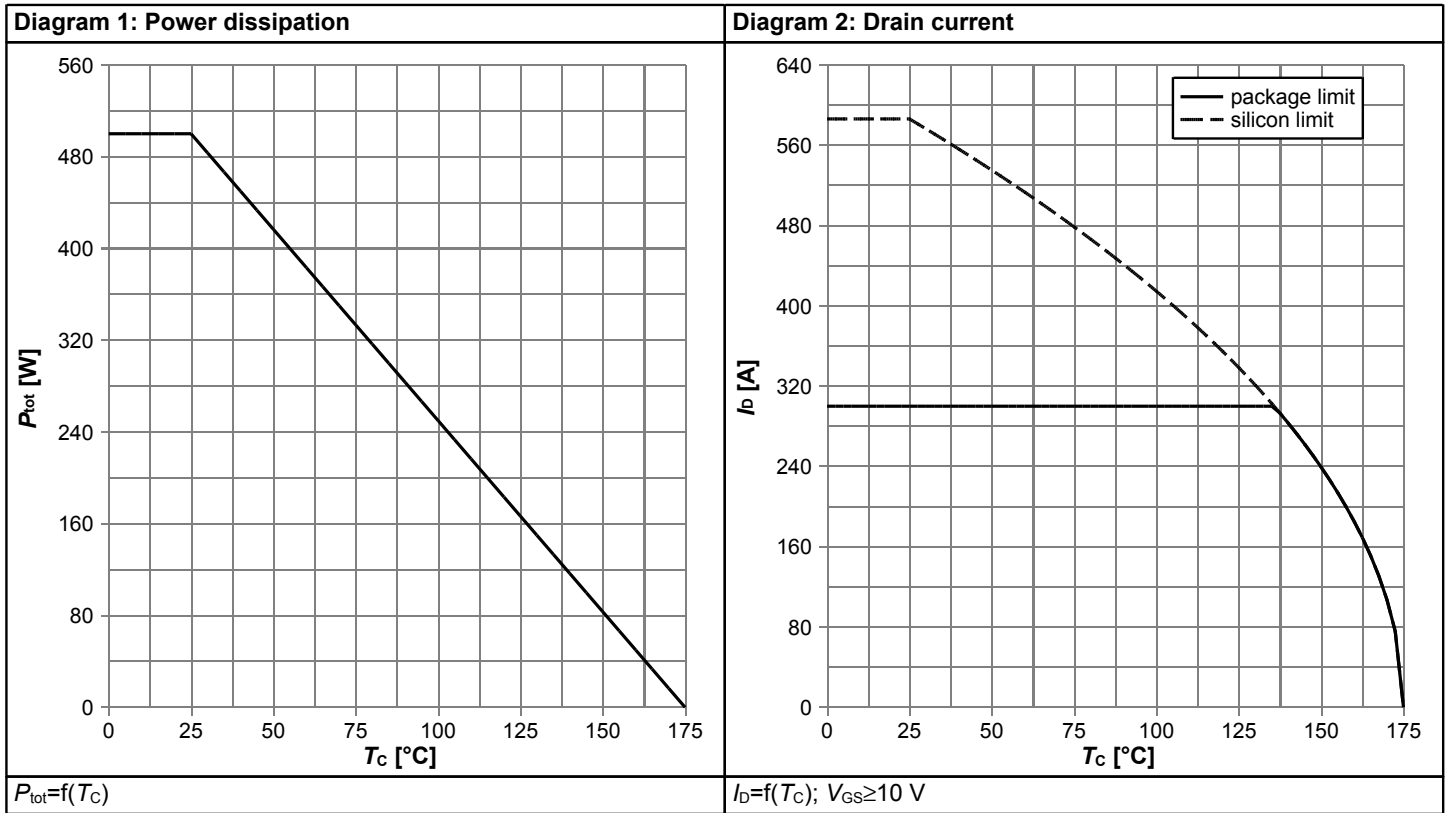
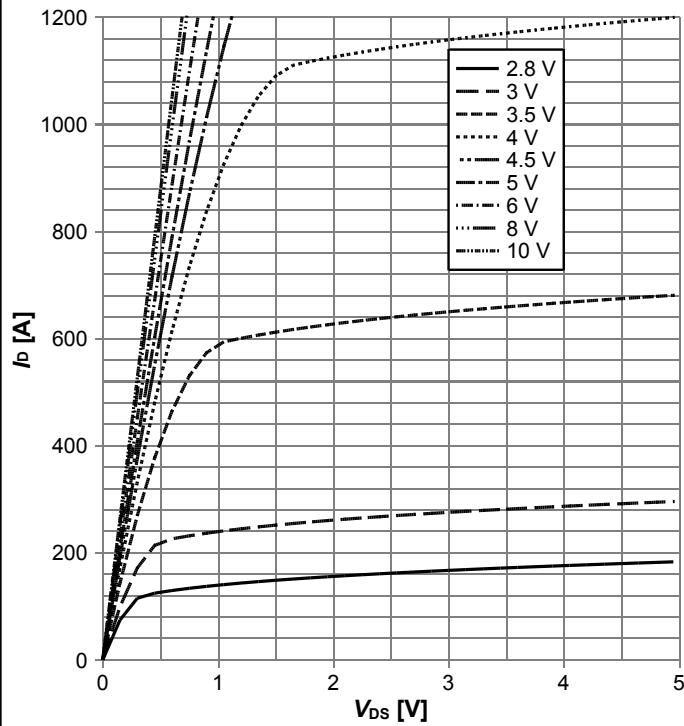
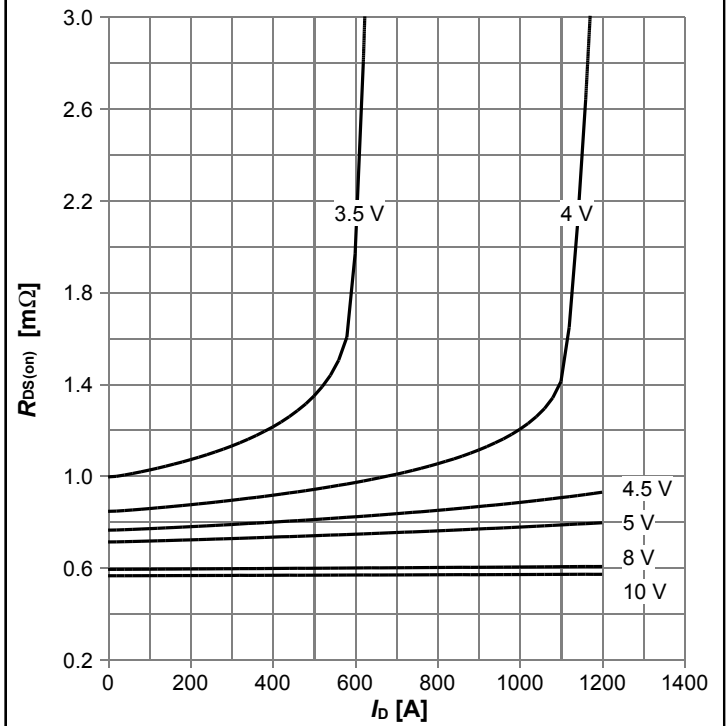


Diagram 5: Typ. output characteristics



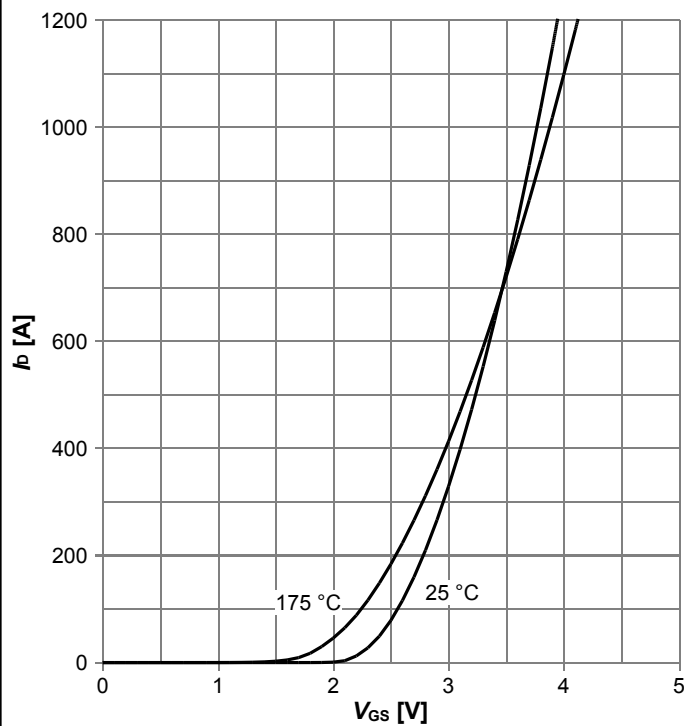
$I_D = f(V_{DS})$, $T_j = 25\text{ °C}$; parameter: V_{GS}

Diagram 6: Typ. drain-source on resistance



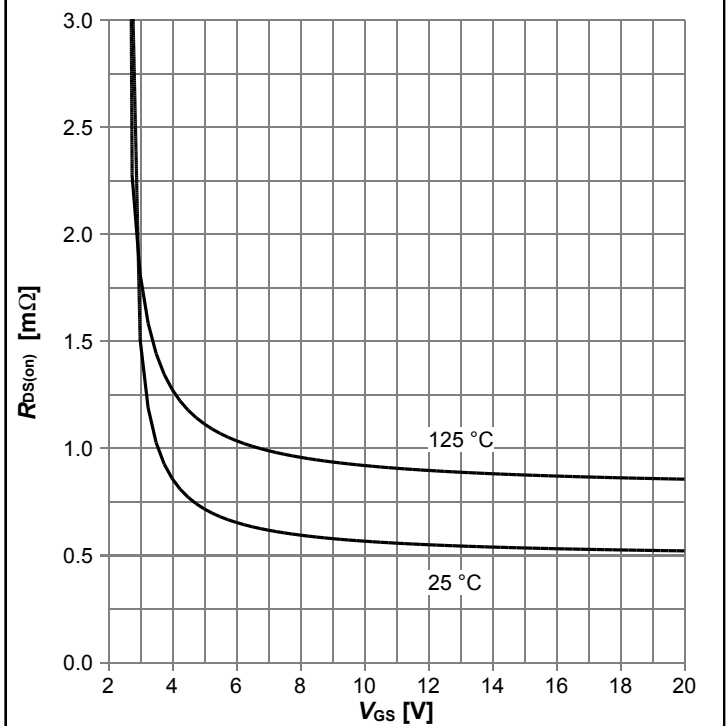
$R_{DS(on)} = f(I_D)$, $T_j = 25\text{ °C}$; parameter: V_{GS}

Diagram 7: Typ. transfer characteristics



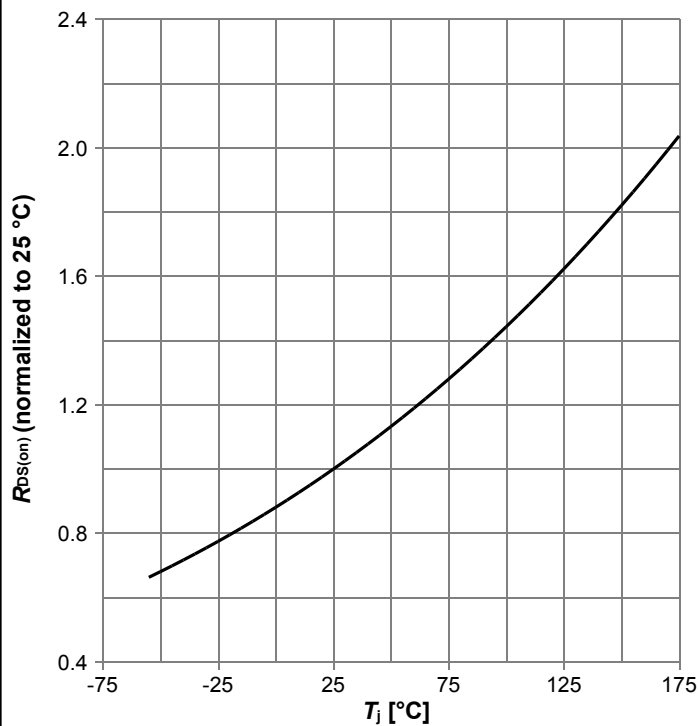
$I_D = f(V_{GS})$, $|V_{DS}| > 2|I_D|R_{DS(on)max}$; parameter: T_j

Diagram 8: Typ. drain-source on resistance



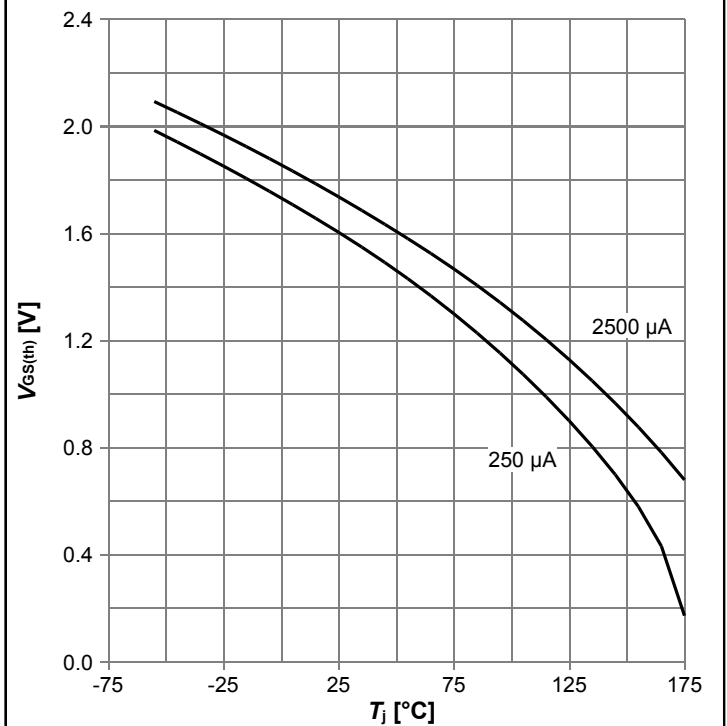
$R_{DS(on)} = f(V_{GS})$, $I_D = 100\text{ A}$; parameter: T_j

Diagram 9: Normalized drain-source on resistance



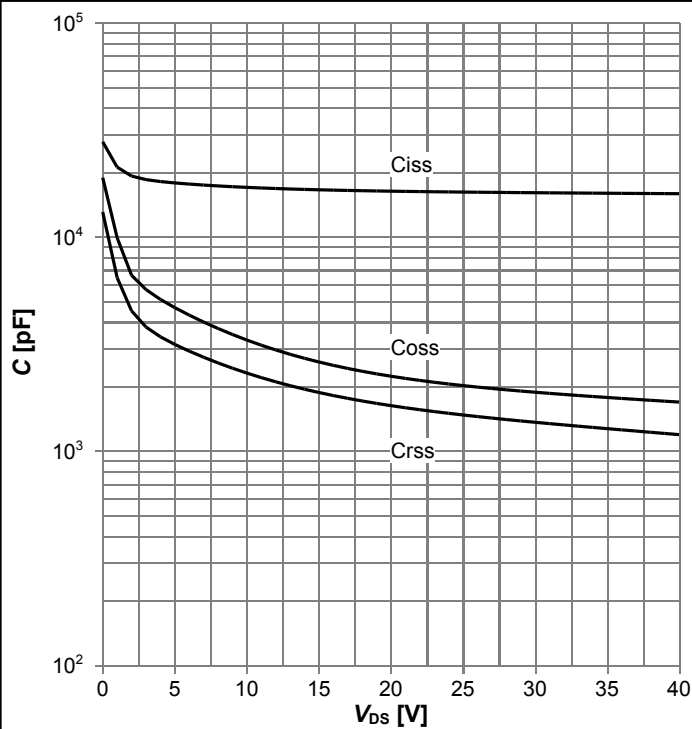
$R_{DS(on)}=f(T_j)$, $I_D=100\text{ A}$, $V_{GS}=10\text{ V}$

Diagram 10: Typ. gate threshold voltage



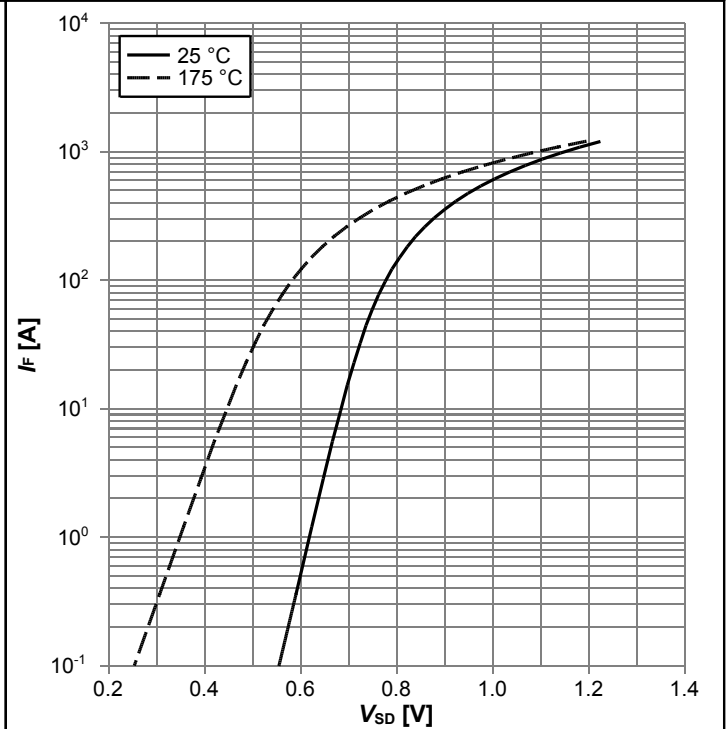
$V_{GS(th)}=f(T_j)$, $V_{GS}=V_{DS}$; parameter: I_D

Diagram 11: Typ. capacitances



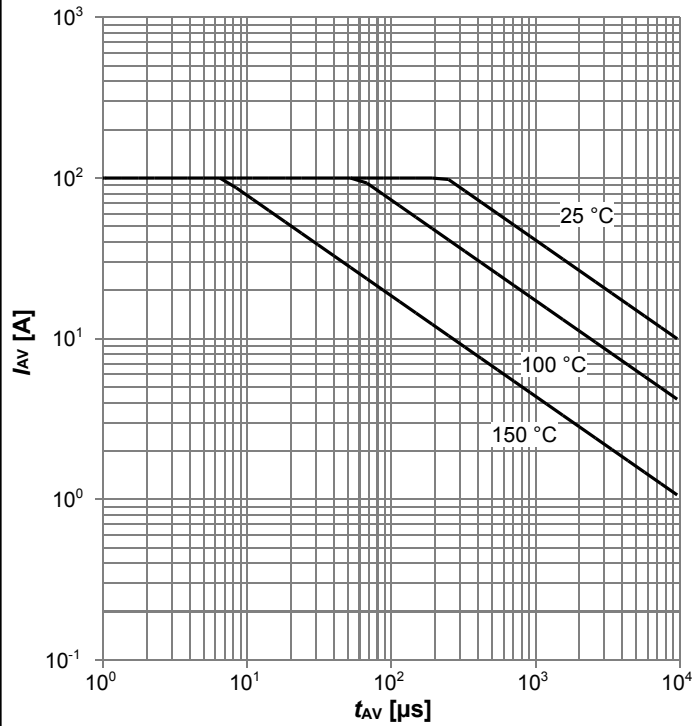
$C=f(V_{DS})$; $V_{GS}=0\text{ V}$; $f=1\text{ MHz}$

Diagram 12: Forward characteristics of reverse diode



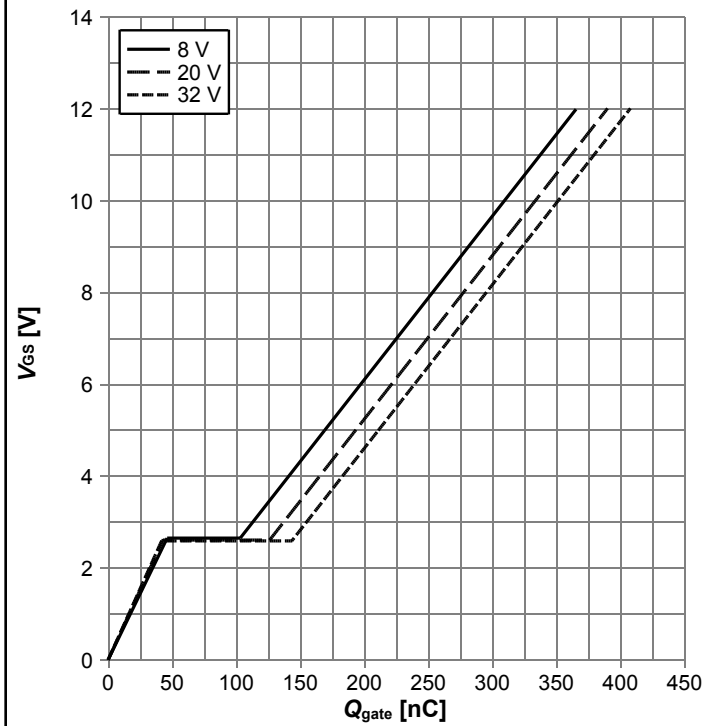
$I_F=f(V_{SD})$; parameter: T_j

Diagram 13: Avalanche characteristics



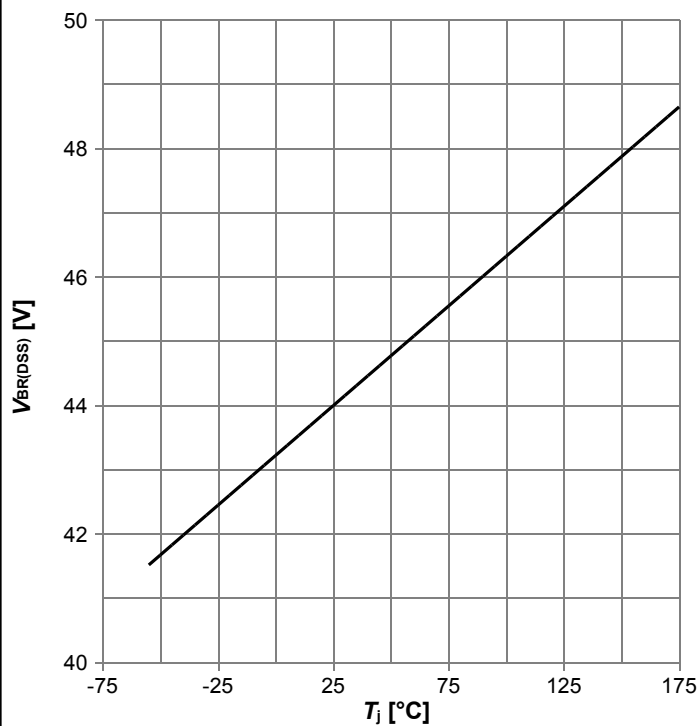
$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega$; parameter: $T_{j,start}$

Diagram 14: Typ. gate charge



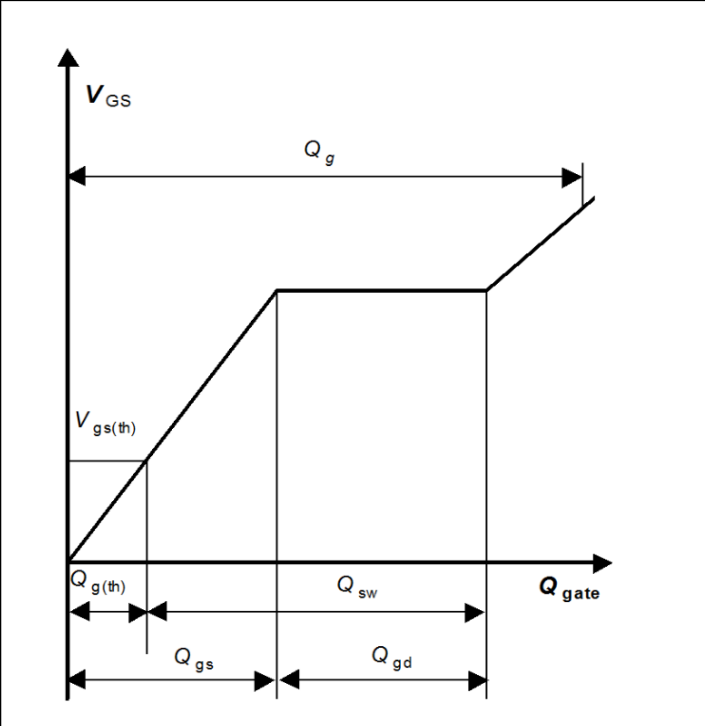
$V_{GS}=f(Q_{gate}), I_D=100$ A pulsed, $T_j=25$ °C; parameter: V_{DD}

Diagram 15: Drain-source breakdown voltage



$V_{BR(DSS)}=f(T_j); I_D=5$ mA

Diagram Gate charge waveforms



5 Package Outlines

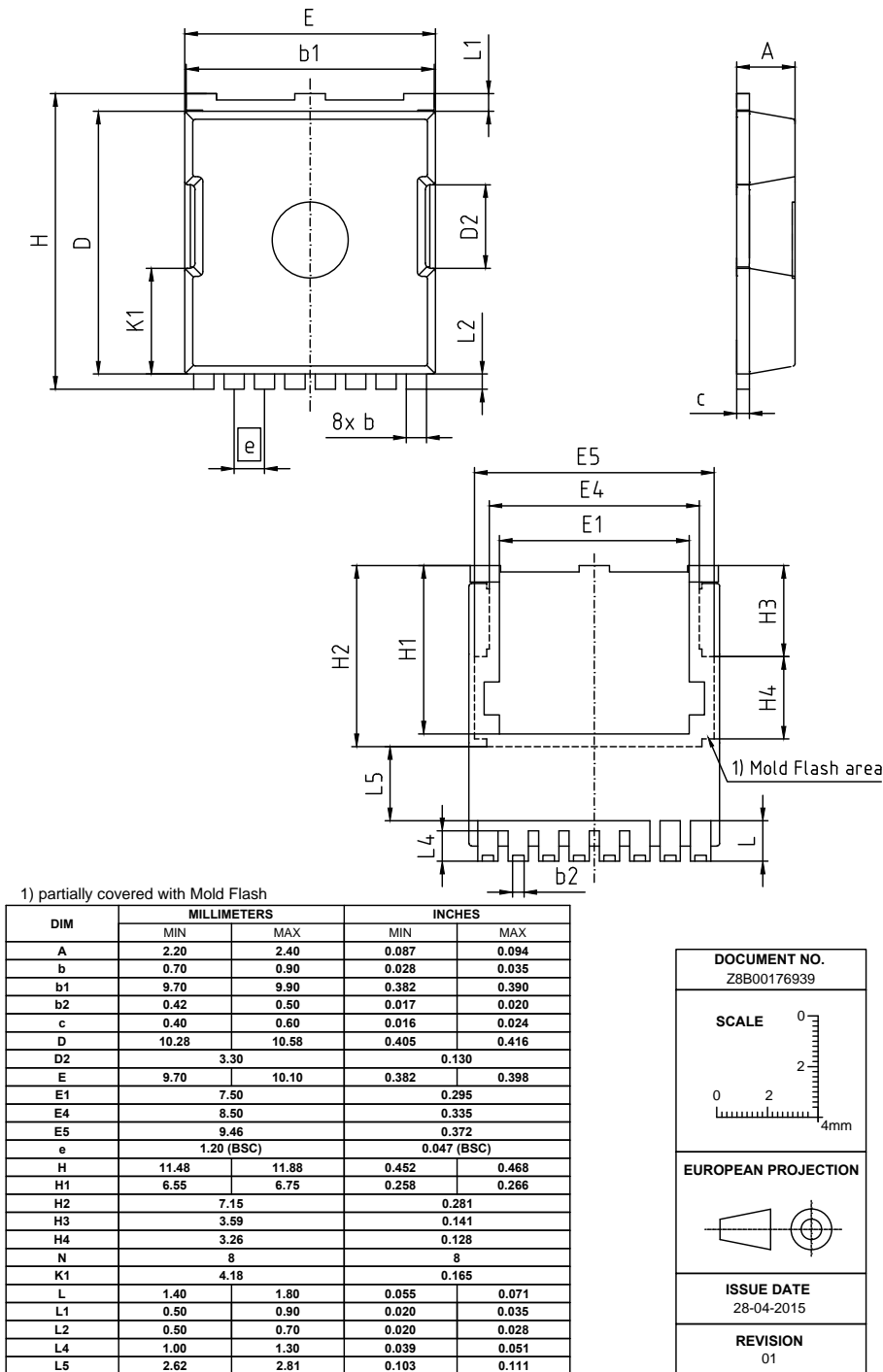


Figure 1 Outline PG-HSOF-8, dimensions in mm/inches

Revision History

IRL40T209

Revision: 2018-05-05, Rev. 2.0

Previous Revision

Revision	Date	Subjects (major changes since last revision)
1.0	2018-04-24	Release of preliminary version
2.0	2018-05-05	Release of final version

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