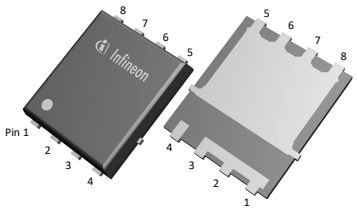
THE DATASHEET OF

MIC2012ZM

MOSFET

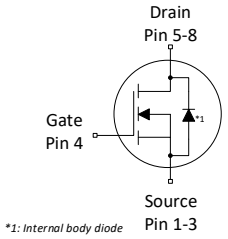
PG-TDSON-8

OptiMOS™ Power-MOSFET, 40 V



Features

- Optimized for synchronous rectification
- 175°C rated
- Very low on-state resistance $R_{DS(on)}$
- 100% avalanche tested
- Superior thermal resistance
- N-channel, logic level
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21
- Higher solder joint reliability due to enlarged source interconnection



Product validation

Fully qualified according to JEDEC for Industrial Applications

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS}	40	V
$R_{DS(on),max}$	1.4	mΩ
I_D	205	A
Qoss	54	nC
Qg(0V..10V)	61	nC

Type/Ordering Code	Package	Marking	Related Links
BSC014N04LS	PG-TDSON-8	014N04LS	-

Table of Contents

1 Maximum ratings

unless otherwise specified

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Continuous drain current [1]	I_D	-	-	205 145 176 124 33	A	V_{GS}=10 V, T_C=25 °C V_{GS}=10 V, T_C=100 °C V_{GS}=4.5 V, T_C=25 °C V_{GS}=4.5 V, T_C=100 °C V_{GS}=10 V, T_A=25 °C, R_{thJA}=50 K/W [2]
Pulsed drain current [3]	$I_{D,pulse}$	-	-	820	A	T_C=25 °C
Avalanche current, single pulse [4]	I_{AS}	-	-	50	A	T_C=25 °C
Avalanche energy, single pulse	E_{AS}	-	-	170	mJ	I_D=50 A, R_{GS}=25 Ω
Gate source voltage [5]	V_{GS}	-20	-	20	V	-
Power dissipation	P_{tot}	-	-	115 3.0	W	T_C=25 °C T_A=25 °C, R_{thJA}=50 K/W [2]
Operating and storage temperature	T_j, T_{stg}	-55	-	175	°C	-

[1] Rating refers to the product only with datasheet specified absolute maximum values, maintaining case temperature at 25°C. For higher case temperature please refer to Diagram 2. De-rating will be required based on the actual environmental conditions.

[2] Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm^2 (one layer, 70 µm thick) copper area for drain connection. PCB is vertical in still air.

[3] See Diagram 3 for more detailed information

[4] See Diagram 13 for more detailed information

[5] The negative rating is for low duty cycle pulse occurrence. No continuous rating is implied

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case, bottom	R_{thJC}	-	0.8	1.3	K/W	-
Thermal resistance, junction - case, top	R_{thJC}	-	-	20	K/W	-
Device on PCB, 6 cm^2 cooling area [6)]	R_{thJA}	-	-	50	K/W	-

[6)] Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm^2 (one layer, 70 µm thick) copper area for drain connection. PCB is vertical in still air.

3 Electrical characteristics

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 V, I_D=1 mA
Gate threshold voltage	$V_{GS(th)}$	1.2	-	2	V	V_{DS}=V_{GS}, I_D=250 µA
Zero gate voltage drain current	I_{DSS}	-	0.1 10	1 100	µA	V_{DS}=40 V, V_{GS}=0 V, T_j=25 °C V_{DS}=40 V, V_{GS}=0 V, T_j=125 °C
Gate-source leakage current	I_{GSS}	-	10	100	nA	V_{GS}=20 V, V_{DS}=0 V
Drain-source on-state resistance	$R_{DS(on)}$	-	1.5 1.1	1.9 1.4	mΩ	V_{GS}=4.5 V, I_D=50 A V_{GS}=10 V, I_D=50 A
Gate resistance [7]	R_G	0.45	0.9	1.8	Ω	-
Transconductance	g_{fs}	120	230	-	S	$\|V_{DS}\|>2\|I_D\|R_{DS(on)max}$, I_D=50 A

[7] Defined by design. Not subject to production test

Table 5 Dynamic characteristics [8]

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	4300	6020	pF	V_{GS}=0 V, V_{DS}=20 V, f=1 MHz
Output capacitance	C_{oss}	-	1200	1680	pF	V_{GS}=0 V, V_{DS}=20 V, f=1 MHz
Reverse transfer capacitance	C_{rss}	-	100	200	pF	V_{GS}=0 V, V_{DS}=20 V, f=1 MHz
Turn-on delay time	$t_{d(on)}$	-	8	-	ns	V_{DD}=20 V, V_{GS}=10 V, I_D=50 A, $R_{G,ext}$,ext=1.6 Ω
Rise time	t_r	-	9	-	ns	V_{DD}=20 V, V_{GS}=10 V, I_D=50 A, $R_{G,ext}$,ext=1.6 Ω
Turn-off delay time	$t_{d(off)}$	-	35	-	ns	V_{DD}=20 V, V_{GS}=10 V, I_D=50 A, $R_{G,ext}$,ext=1.6 Ω
Fall time	t_f	-	7	-	ns	V_{DD}=20 V, V_{GS}=10 V, I_D=50 A, $R_{G,ext}$,ext=1.6 Ω

[8] Defined by design. Not subject to production test

Table 6 Gate charge characteristics [9]

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	11	-	nC	V_{DD}=20 V, I_D=50 A, V_{GS}=0 to 10 V
Gate charge at threshold	$Q_{g(th)}$	-	6.9	-	nC	V_{DD}=20 V, I_D=50 A, V_{GS}=0 to 10 V
Gate to drain charge	Q_{gd}	-	9.8	14	nC	V_{DD}=20 V, I_D=50 A, V_{GS}=0 to 10 V

Table 6 Gate charge characteristics [9)]

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Switching charge	Q_{sw}	-	14	-	nC	V_{DD}=20 V, I_D=50 A, V_{GS}=0 to 10 V
Gate charge total	Q_g	-	61	85	nC	V_{DD}=20 V, I_D=50 A, V_{GS}=0 to 10 V
Gate plateau voltage	$V_{plateau}$	-	2.5	-	V	V_{DD}=20 V, I_D=50 A, V_{GS}=0 to 10 V
Gate charge total	Q_g	-	31	44	nC	V_{DD}=20 V, I_D=50 A, V_{GS}=0 to 4.5 V
Gate charge total, sync. FET	$Q_{g(sync)}$	-	24	-	nC	V_{DS}=0.1 V, V_{GS}=0 to 4.5 V
Output charge	Q_{oss}	-	54	76	nC	V_{DD}=20 V, V_{GS}=0 V

[9)] See "Gate charge waveforms" for parameter definition. Defined by design. Not subject to production test

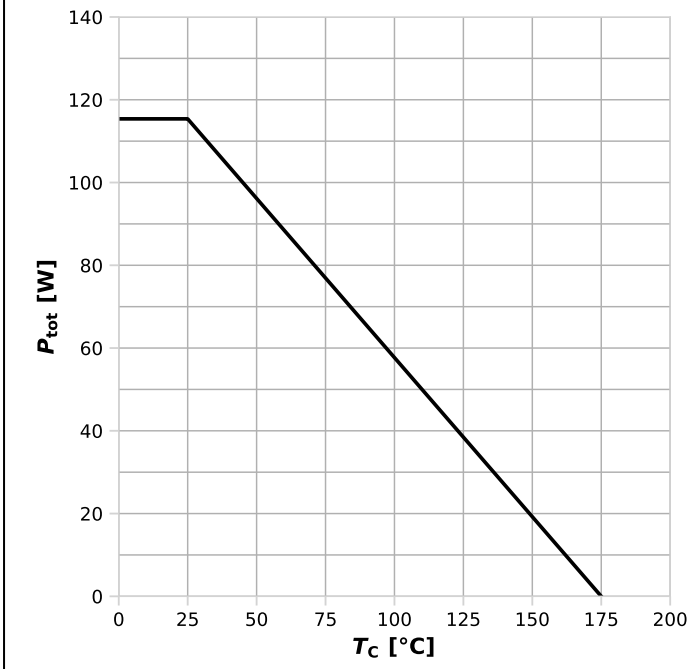
Table 7 Reverse diode

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Diode continuous forward current	I_S	-	-	115	A	T_C=25 °C
Diode pulse current	$I_{S,pulse}$	-	-	820	A	T_C=25 °C
Diode forward voltage	V_{SD}	-	0.82	1	V	V_{GS}=0 V, I_F=50 A, T_j=25 °C
Reverse recovery time [10)]	t_{rr}	-	32	64	ns	V_R=20 V, I_F=50A, di_F/dt=400 A/µs
Reverse recovery charge [10)]	Q_{rr}	-	44	-	nC	V_R=20 V, I_F=50A, di_F/dt=400 A/µs

[10)] Defined by design. Not subject to production test

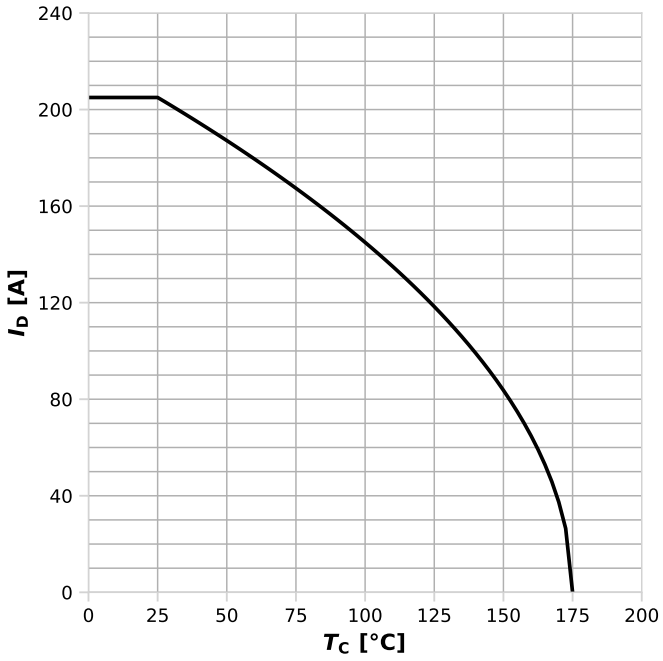
4 Electrical characteristics diagrams

Diagram 1: Power dissipation



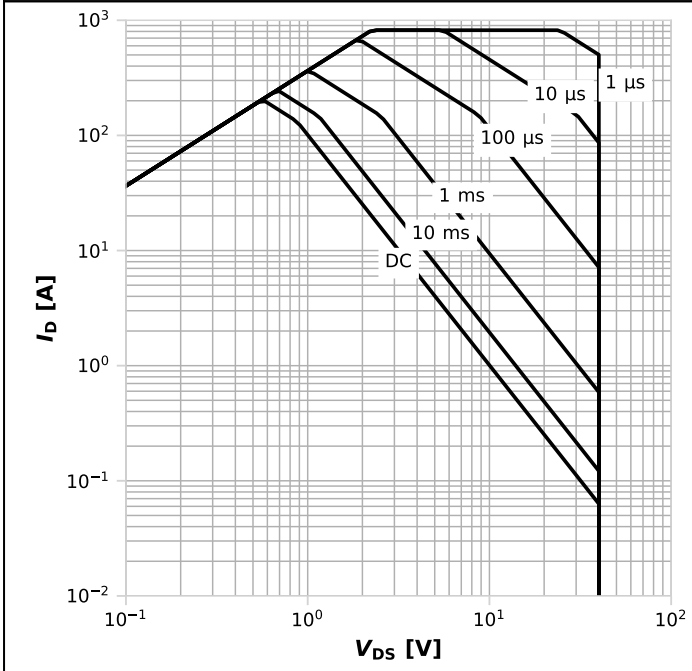
P_{tot}=f(T_C)

Diagram 2: Drain current



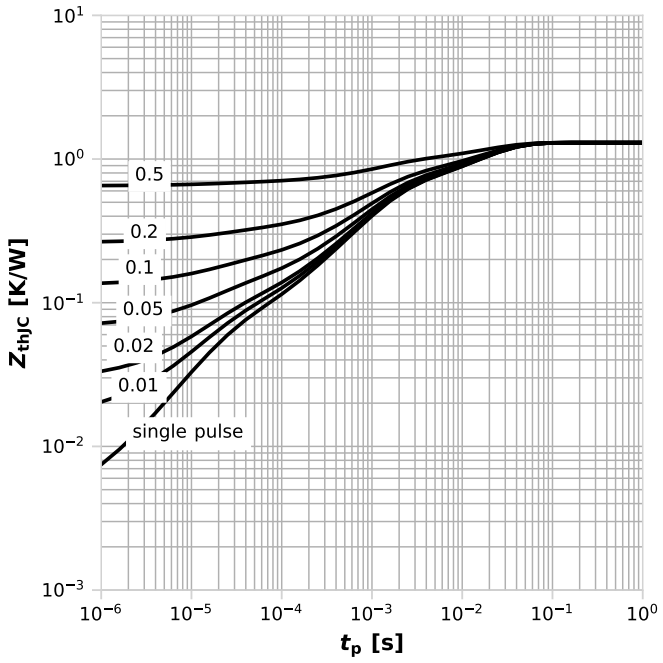
I_D=f(T_C); V_{GS}≥10 V

Diagram 3: Safe operating area



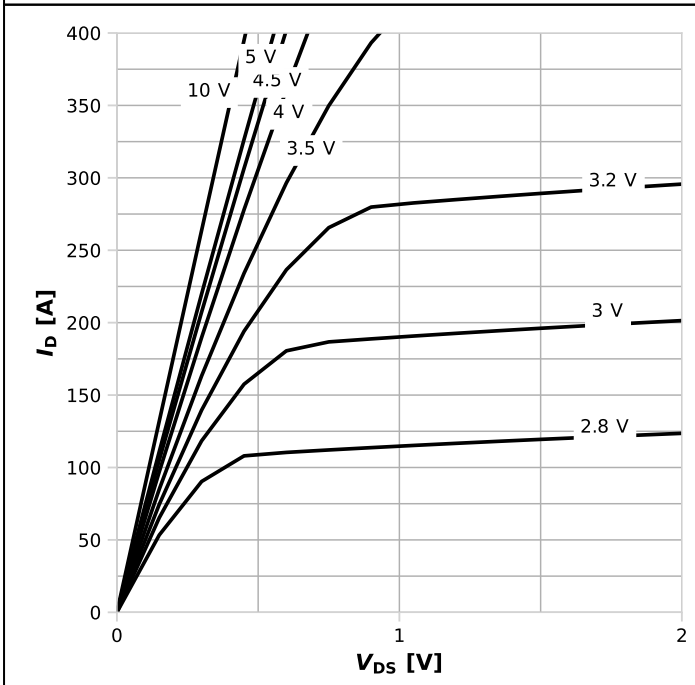
I_D=f(V_{DS}); T_C=25 °C; D=0; parameter: t_p

Diagram 4: Max. transient thermal impedance



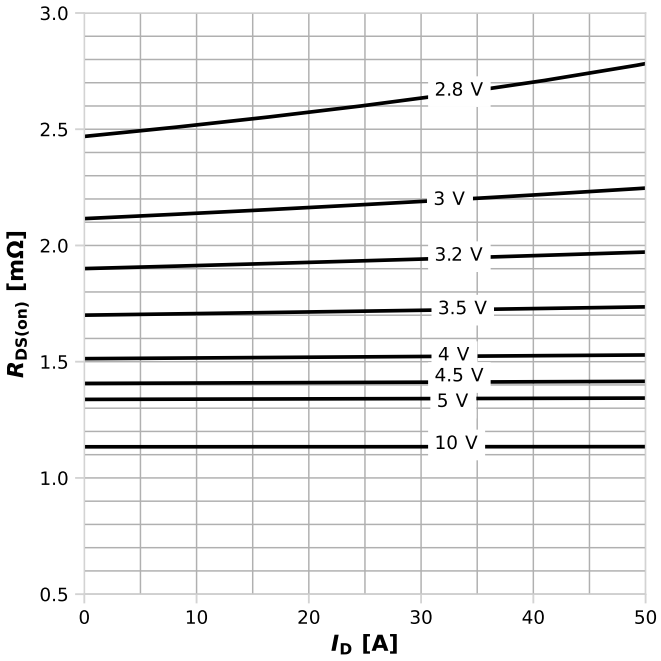
Z_{thJC}=f(t_p); parameter: D=t_p/T

Diagram 5: Typ. output characteristics



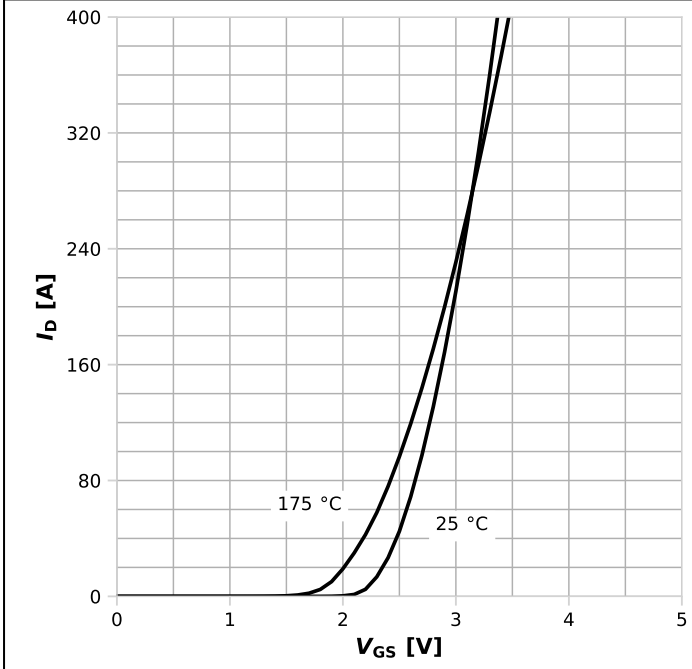
I_D=f(V_{DS}); T_j=25 °C; parameter: V_{GS}

Diagram 6: Typ. drain-source on resistance



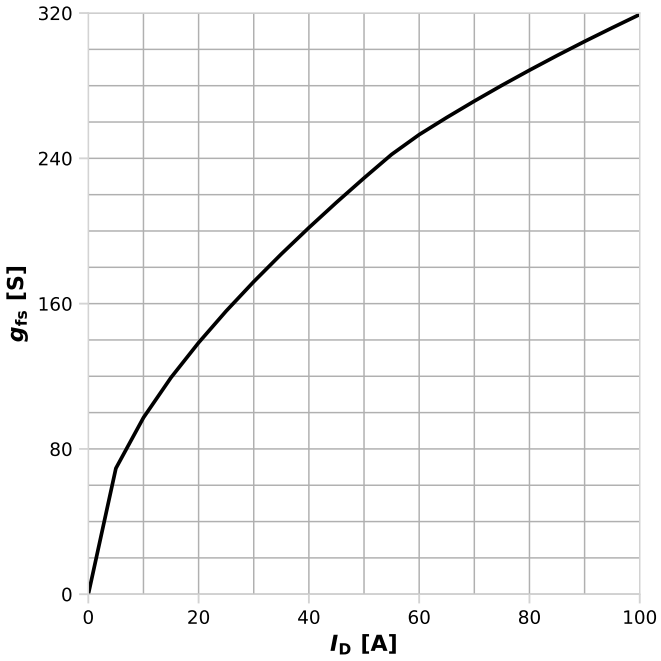
$R_{DS(on)}$=f(I_D), T_j=25 °C; parameter: V_{GS}

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. forward transconductance



g_{fs}=f(I_D); T_j=25 °C

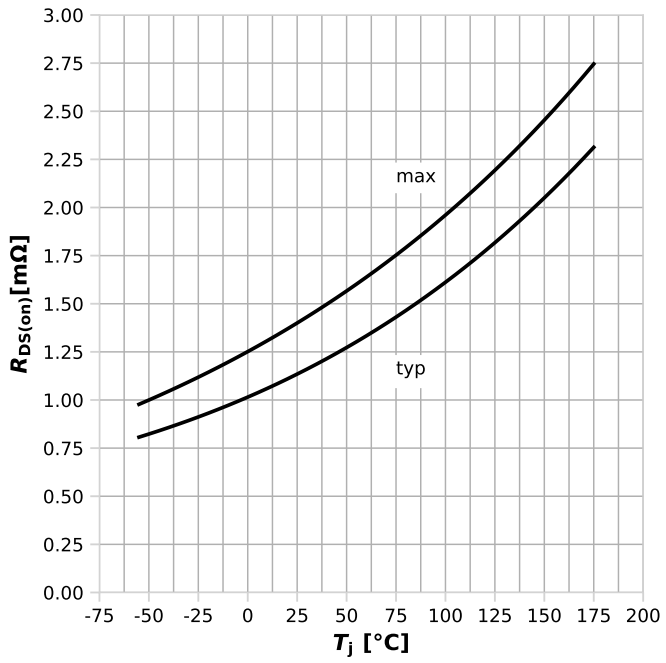
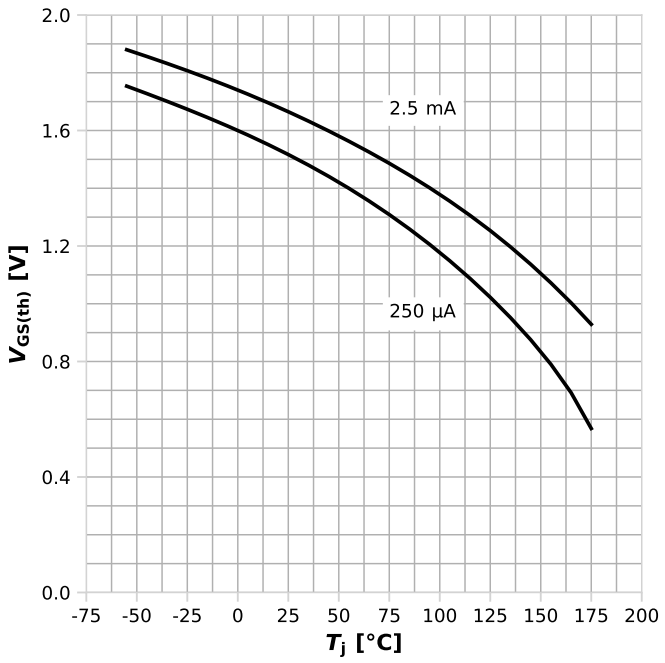
Diagram 9: Drain-source on-state resistance	Diagram 10: Typ. gate threshold voltage
	
$R_{DS(on)}$=f(T_j); I_D=50 A; V_{GS}=10 V	$V_{GS(th)}$=f(T_j); V_{GS}=V_{DS}; I_D=250 µA

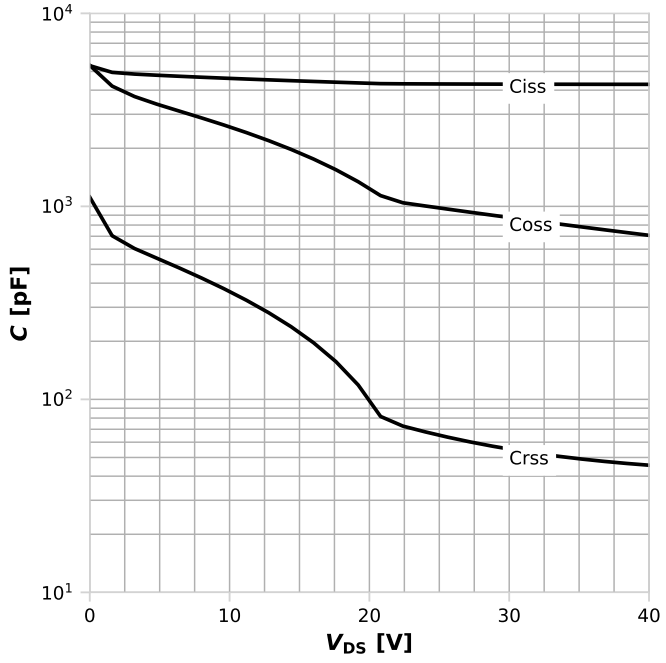
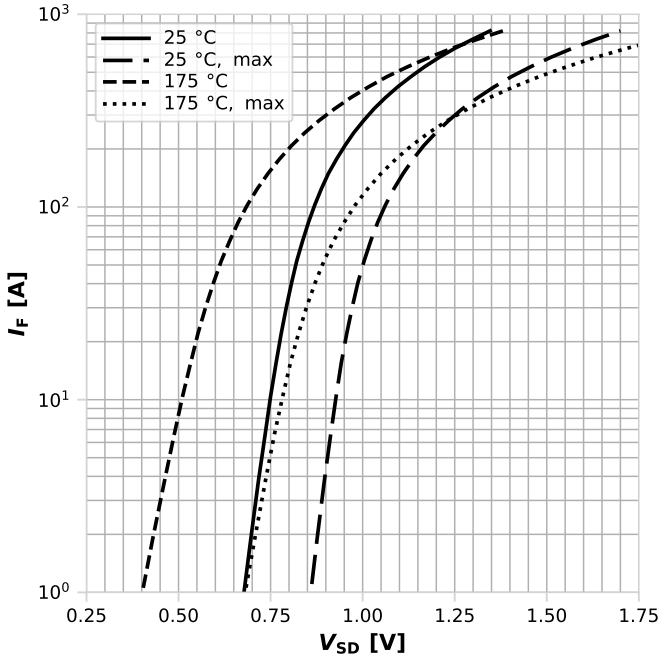
Diagram 11: Typ. capacitances	Diagram 12: Forward characteristics of reverse diode
	
C=f(V_{DS}); V_{GS}=0 V; f=1 MHz	I_F=f(V_{SD}); parameter: T_j

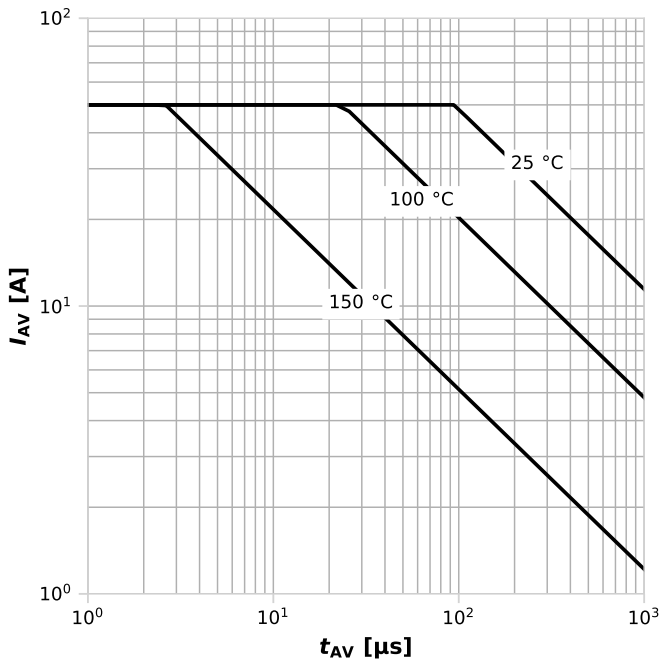
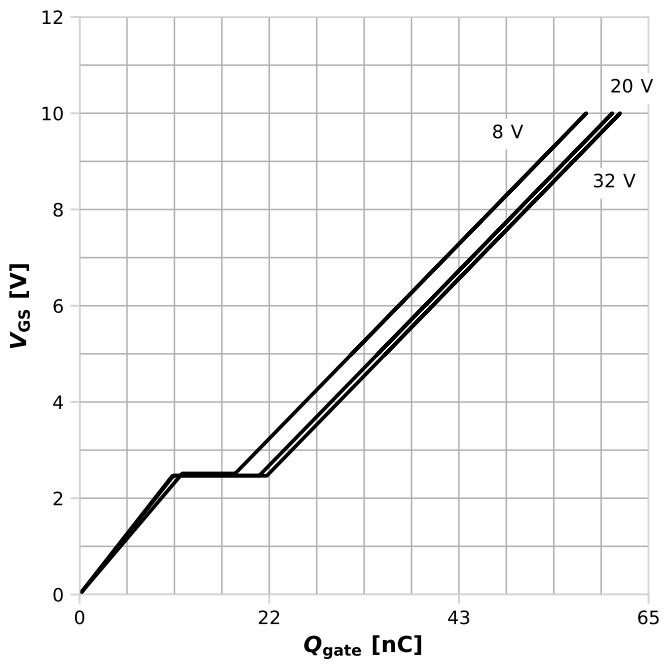
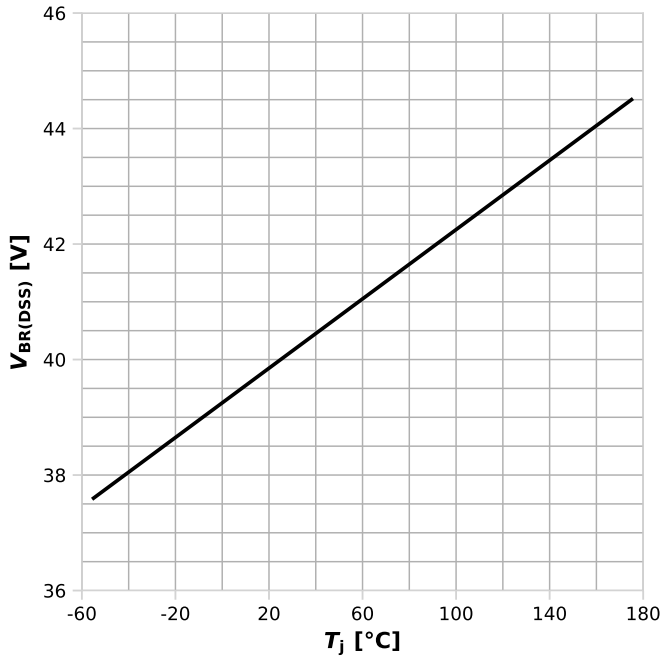
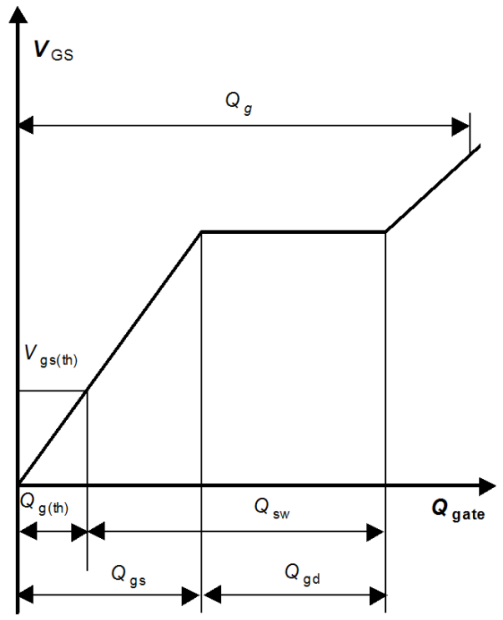
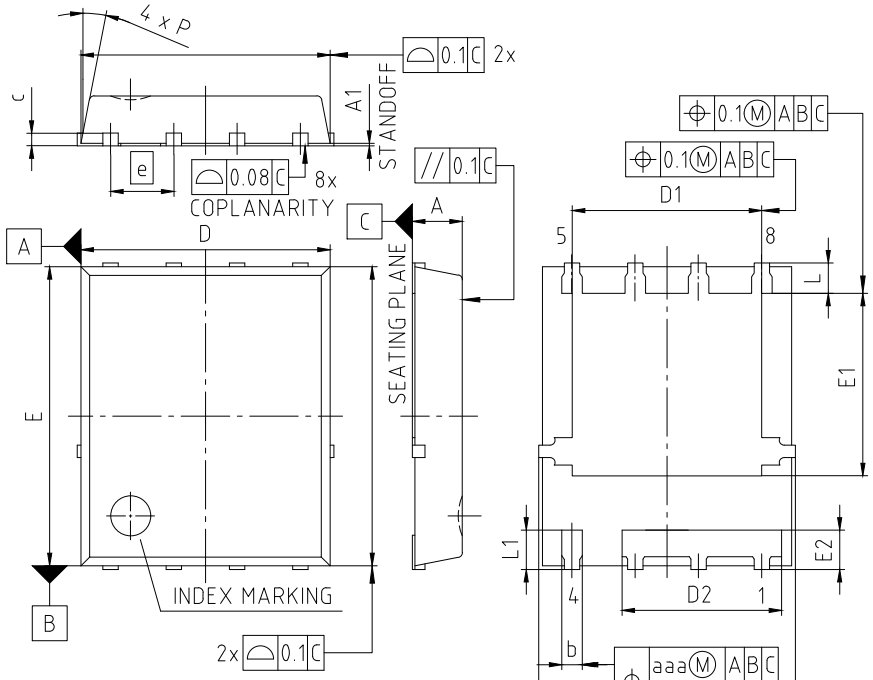
Diagram 13: Avalanche characteristics	Diagram 14: Typ. gate charge
	
I_{AS}=f(t_{AV}); R_{GS}=25 Ω; parameter: $T_{j(start)}$	V_{GS}=f(Q_{gate}); I_D=50 A pulsed; parameter: V_{DD}

Diagram 15: Drain-source breakdown voltage	Gate charge waveforms
	
$V_{BR(DSS)}$=f(T_j); I_D=1 mA	-

5 Package Outlines



PACKAGE - GROUP NUMBER:	PG-TDSON-8-U04	
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	0.90	1.20
A1	0	0.05
b	0.26	0.54
c	0.15	0.35
D	4.80	5.35
D1	3.70	4.40
D2	2.94	3.25
D3	4.80	5.15
E	5.70	6.10
E1	3.40	3.76
E2	0.69	0.90
e	1.27	
L	0.45	0.72
L1	0.69	0.90
aaa	0.10	0.25
P	8°	12°

1) EXCLUDING MOLD FLASH
2) REMOVAL ON MOLD GATE
   INTRUSION 0.1 MM
   PROTRUSION 0.1 MM
3) LEAD LENGTH UP TO ANTI FLASH LINE
4) ALL METAL SURFACES ARE PLATED,
   EXCEPT AREA OF CUT

Figure 1 Outline PG-TDSON-8, dimensions in mm

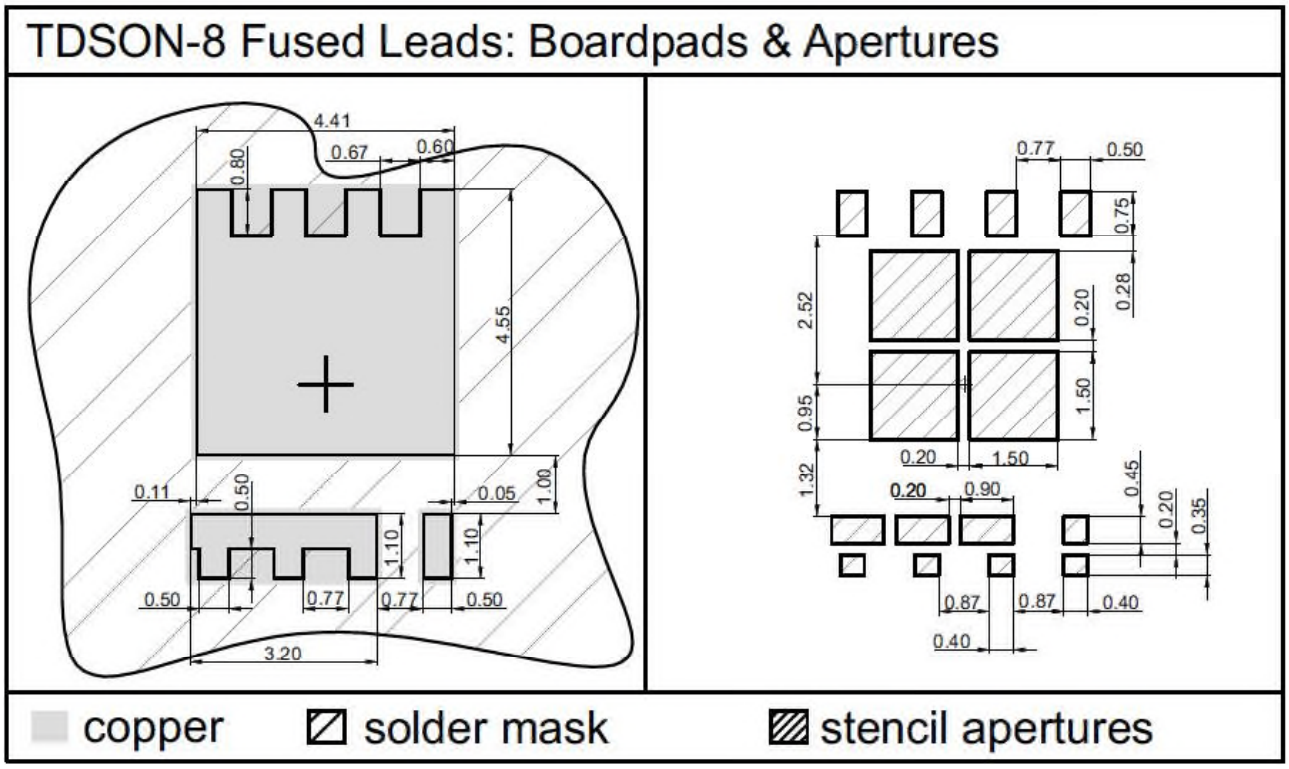


Figure 2 Outline PG-TDSON-8, dimensions in mm

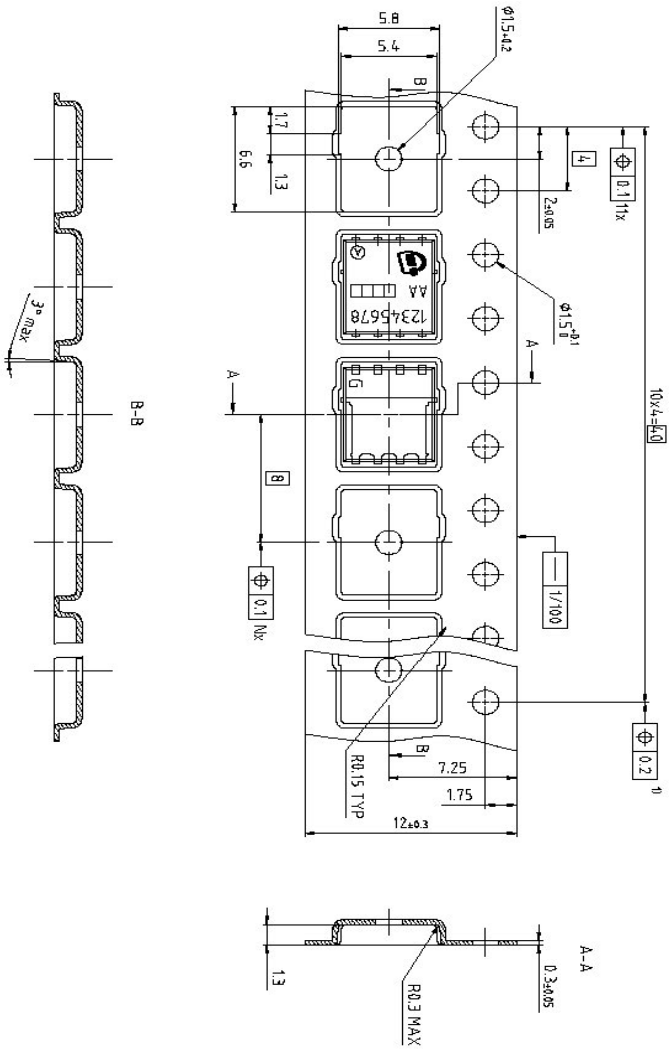


Figure 3 Outline PG-TDSON-8, dimensions in mm

Revision History

BSC014N04LS

Revision 2024-06-11, Rev. 2.9

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2012-10-11	Release of final version
2.1	2012-10-12	New diagram titles.
2.2	2013-02-27	Rev. 2.1
2.4	2016-05-04	Update footnotes and insert max values
2.5	2017-03-27	Update Qrr
2.6	2020-02-07	Update package drawings
2.7	2020-05-15	Update current rating
2.8	2023-04-20	Update package outline drawings
2.9	2024-06-11	Upgrade Operating and storage temperature max to 175°C. Update drawings in section 5 Package Outlines. Production validation added on page1.Updated foot notes.

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