

# MOSFET

Metal Oxide Semiconductor Field Effect Transistor

## OptiMOS™

OptiMOS™ Power-MOSFET, 40V  
BSZ023N04LS

## Data Sheet

Rev. 2.0  
Final

## 1 Description

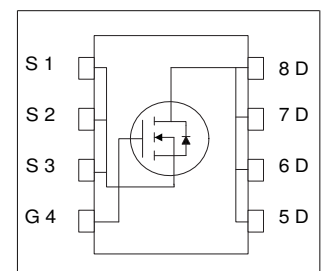
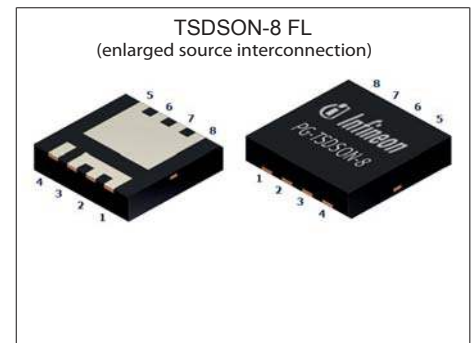
This N-channel MOSFET is optimized for low on-state resistance, gate charge and reverse recovery charge which make it a perfect choice for synchronous rectification in switch mode power supplies such as in servers.

### Features

- Optimized for synchronous rectification
- Very low on-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
- Qualified according to JEDEC for target applications
- Higher solder joint reliability due to enlarged source interconnection

### Applications

- Synchronous rectification
- Isolated DC/DC converters
- Motor control for 12-24V systems
- Or-ing switches



**Table 1 Key Performance Parameters**

Parameter	Value	Unit
$V_{DS}$	40.0	V
$R_{DS(on),max}$	2.35	m $\Omega$
$I_D$	40.0	A
$Q_{OSS}$	33.0	nC
$Q_G(0V..10V)$	37.0	nC

Type / Ordering Code	Package	Marking	Related Links
BSZ023N04LS	PG-TSDSON-8 FL	023N04L	-

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## 2 Maximum ratings

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

**Table 2 Maximum ratings**  
at  $25\text{ °C}$

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current	$I_D$	-	-	40	A	$V_{GS}=10\text{ V}$ , $T_C=25\text{ °C}$ $V_{GS}=10\text{ V}$ , $T_C=100\text{ °C}$ $V_{GS}=4.5\text{ V}$ , $T_C=25\text{ °C}$ $V_{GS}=4.5\text{ V}$ , $T_C=100\text{ °C}$ $V_{GS}=10\text{ V}$ , $T_A=25\text{ °C}$ , $R_{thJA}=60\text{ K/W}$
Pulsed drain current <sup>1)</sup>	$I_{D,pulse}$	-	-	160	A	$T_C=25\text{ °C}$
Avalanche current, single pulse <sup>2)</sup>	$I_{AS}$	-	-	20	A	$T_C=25\text{ °C}$
Avalanche energy, single pulse	$E_{AS}$	-	-	130	mJ	$I_D=20\text{ A}$ , $R_{GS}=25\text{ }\Omega$
Gate source voltage	$V_{GS}$	-20	-	20	V	-
Power dissipation	$P_{tot}$	-	-	69	W	$T_C=25\text{ °C}$
Power dissipation (for PCB version) <sup>3)</sup>	$P_{tot}$	-	-	2.1	W	$T_A=25\text{ °C}$ , $R_{thJA}=60\text{ K/W}$
Operating and storage temperature	$T_j$ , $T_{stg}$	-55	-	150	°C	-

## 3 Thermal characteristics

**Table 3 Thermal characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	$R_{thJC}$	-	-	1.8	K/W	-
Device on PCB <sup>4)</sup>	$R_{thJA}$	-	-	60	K/W	6 cm <sup>2</sup> cooling area

<sup>1)</sup> See diagram 3 for more detailed information

<sup>2)</sup> See diagram 13 for more detailed information

<sup>3)</sup> See diagram 3 for more detailed information

<sup>4)</sup> Referred to condition: Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm<sup>2</sup> (one layer, 70 µm thick) copper area for drain connection. PCB is vertical in still air.

## 4 Electrical characteristics

**Table 4 Static characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	40	-	-	V	$V_{GS}=0\text{ V}$ , $I_D=1\text{ mA}$
Gate threshold voltage	$V_{GS(th)}$	1.2	-	2.0	V	$V_{DS}=V_{GS}$ , $I_D=250\text{ }\mu\text{A}$
Zero gate voltage drain current	$I_{DSS}$	-	0.1 10	1.0 100	$\mu\text{A}$	$V_{DS}=40\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ }^\circ\text{C}$ $V_{DS}=40\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=125\text{ }^\circ\text{C}$
Gate-source leakage current	$I_{GSS}$	-	10	100	nA	$V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$
Drain-source on-state resistance	$R_{DS(on)}$	-	2.4 2.0	3.2 2.35	m $\Omega$	$V_{GS}=4.5\text{ V}$ , $I_D=20\text{ A}$ $V_{GS}=10\text{ V}$ , $I_D=20\text{ A}$
Gate resistance	$R_G$	-	1.1	-	$\Omega$	-
Transconductance	$g_{fs}$	55	110	-	S	$ V_{DS} >2 I_D R_{DS(on)max}$ , $I_D=20\text{ A}$

**Table 5 Dynamic characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	$C_{iss}$	-	2630	-	pF	$V_{GS}=0\text{ V}$ , $V_{DS}=20\text{ V}$ , $f=1\text{ MHz}$
Output capacitance	$C_{oss}$	-	750	-	pF	$V_{GS}=0\text{ V}$ , $V_{DS}=20\text{ V}$ , $f=1\text{ MHz}$
Reverse transfer capacitance	$C_{riss}$	-	60	-	pF	$V_{GS}=0\text{ V}$ , $V_{DS}=20\text{ V}$ , $f=1\text{ MHz}$
Turn-on delay time	$t_{d(on)}$	-	13	-	ns	$V_{DD}=20\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=20\text{ A}$ , $R_{G,ext}=1.6\text{ }\Omega$
Rise time	$t_r$	-	38	-	ns	$V_{DD}=20\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=20\text{ A}$ , $R_{G,ext}=1.6\text{ }\Omega$
Turn-off delay time	$t_{d(off)}$	-	42	-	ns	$V_{DD}=20\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=20\text{ A}$ , $R_{G,ext}=1.6\text{ }\Omega$
Fall time	$t_f$	-	8.0	-	ns	$V_{DD}=20\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=20\text{ A}$ , $R_{G,ext}=1.6\text{ }\Omega$

**Table 6 Gate charge characteristics**

see table 16 for more details

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	$Q_{gs}$	-	6.3	-	nC	$V_{DD}=20\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$
Gate charge at threshold	$Q_{g(th)}$	-	4.2	-	nC	$V_{DD}=20\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$
Gate to drain charge	$Q_{gd}$	-	6.0	-	nC	$V_{DD}=20\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$
Switching charge	$Q_{sw}$	-	8.1	-	nC	$V_{DD}=20\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$
Gate charge total	$Q_g$	-	37	-	nC	$V_{DD}=20\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$
Gate plateau voltage	$V_{plateau}$	-	2.4	-	V	$V_{DD}=20\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$
Gate charge total	$Q_g$	-	19	-	nC	$V_{DD}=20\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$
Gate charge total, sync. FET	$Q_{g(sync)}$	-	32	-	nC	$V_{DS}=0.1\text{ V}$ , $V_{GS}=0\text{ to }10\text{ V}$
Output charge	$Q_{oss}$	-	33	-	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	$I_S$	-	-	40	A	$T_C=25\text{ °C}$
Diode pulse current	$I_{S,pulse}$	-	-	160	A	$T_C=25\text{ °C}$
Diode forward voltage	$V_{SD}$	-	0.8	1.0	V	$V_{GS}=0\text{ V}, I_F=20\text{ A}, T_J=25\text{ °C}$
Reverse recovery time	$t_{rr}$	-	24	-	ns	$V_R=20\text{ V}, I_F=20\text{ A}, di_F/dt=400\text{ A}/\mu\text{s}$
Reverse recovery charge	$Q_{rr}$	-	20	-	nC	$V_R=20\text{ V}, I_F=20\text{ A}, di_F/dt=400\text{ A}/\mu\text{s}$

## 5 Electrical characteristics diagrams

Table 8

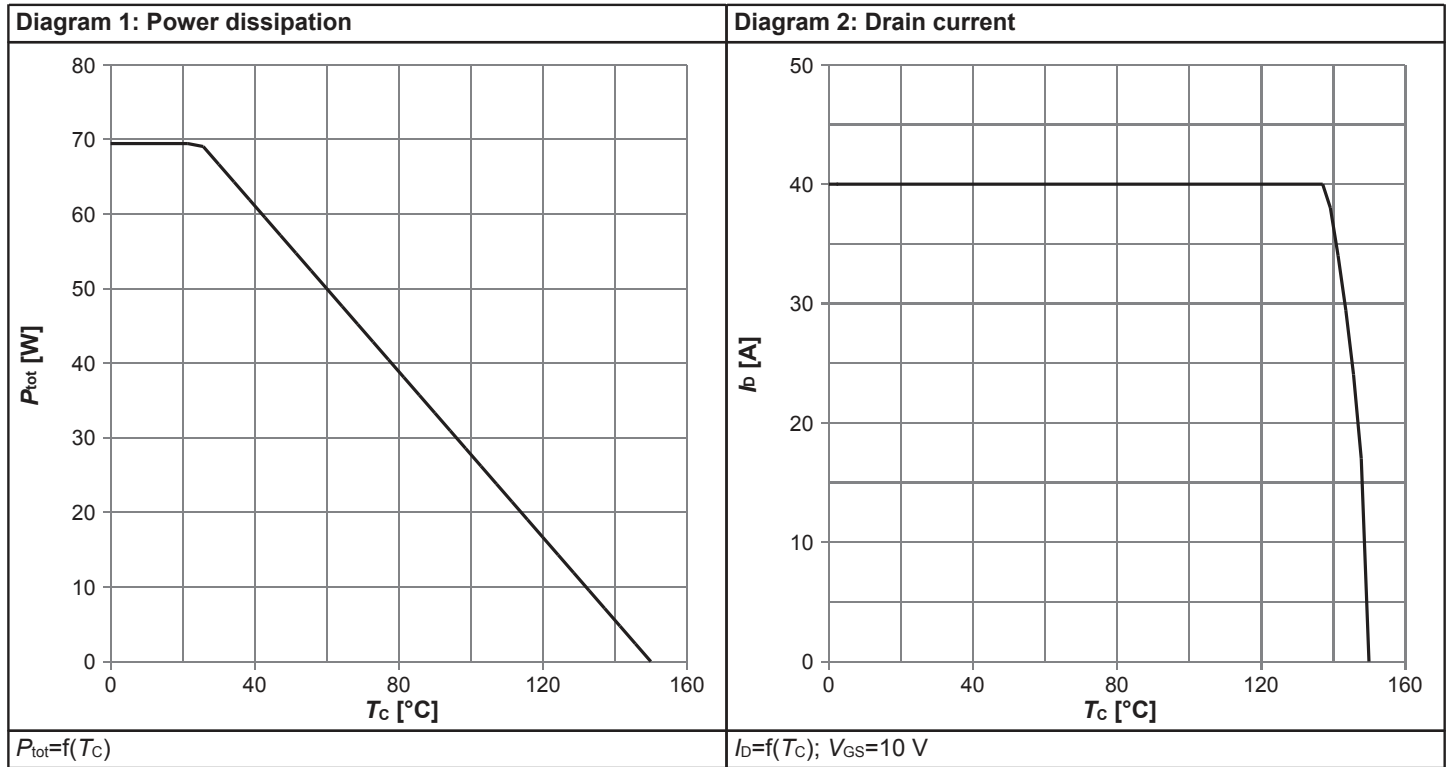


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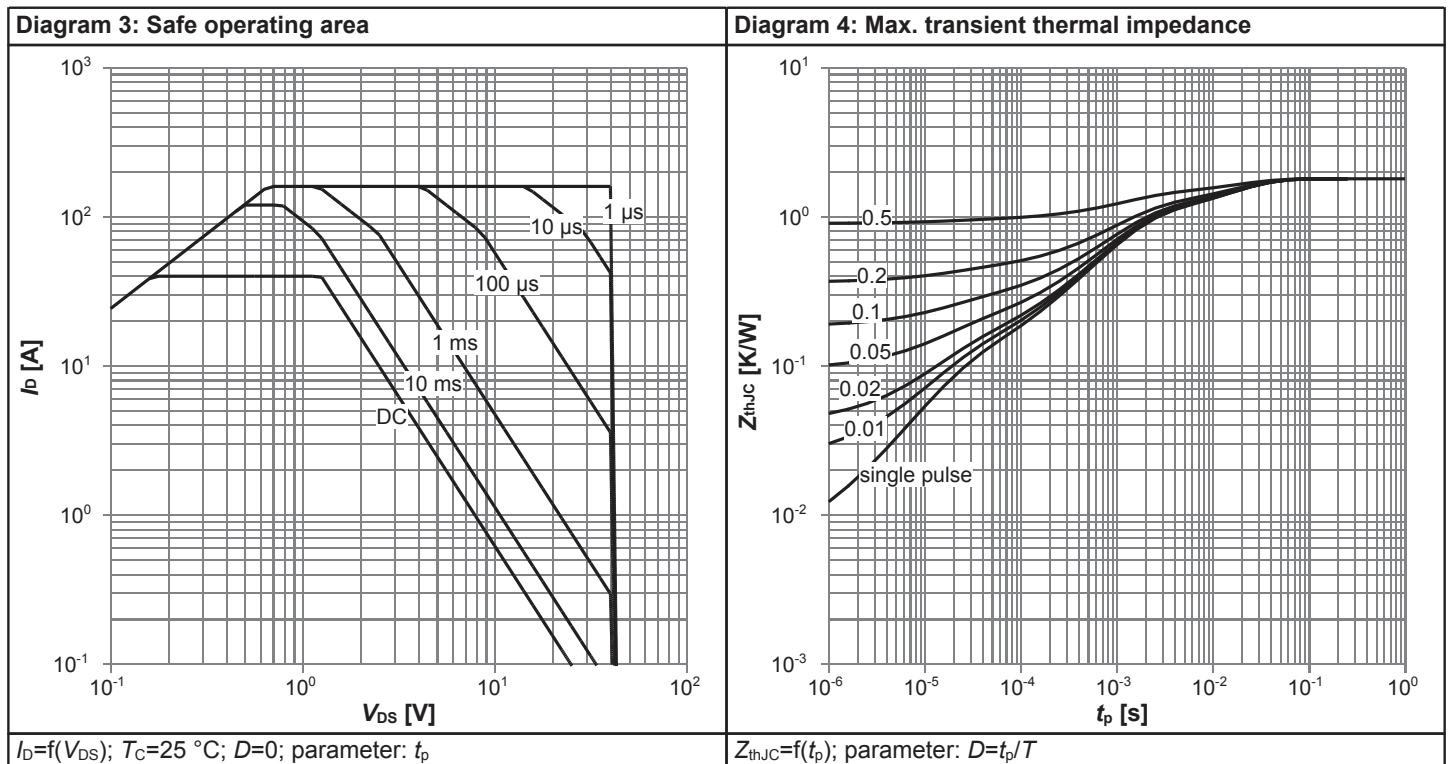


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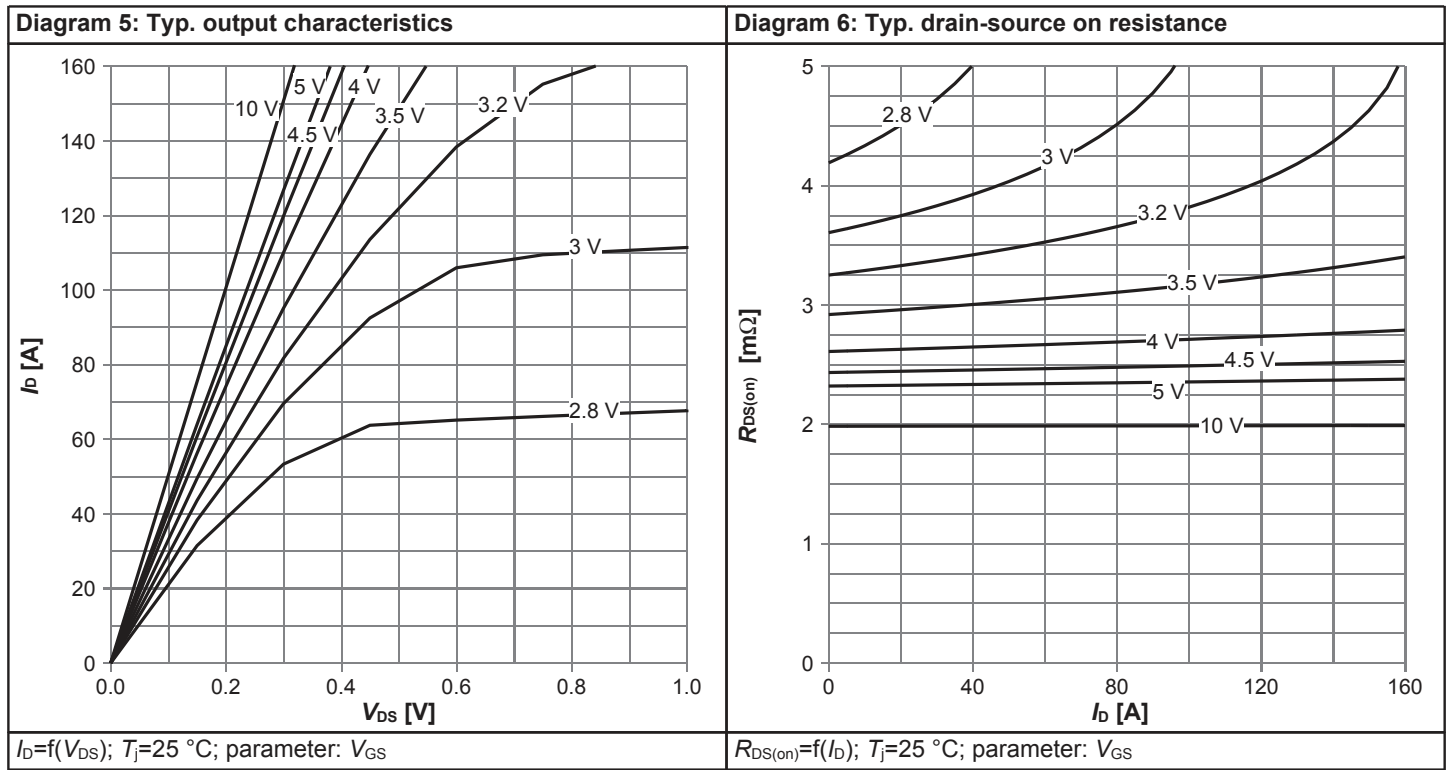


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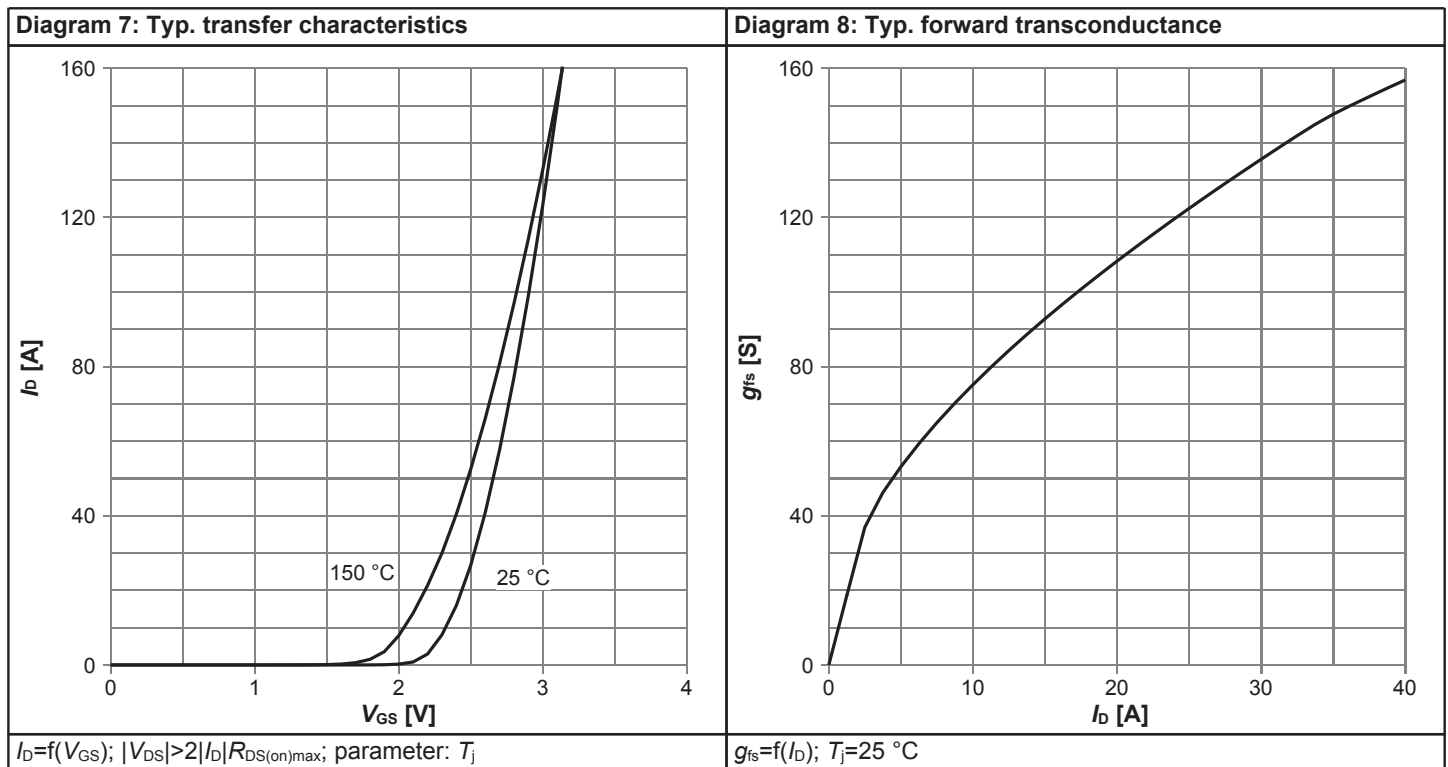




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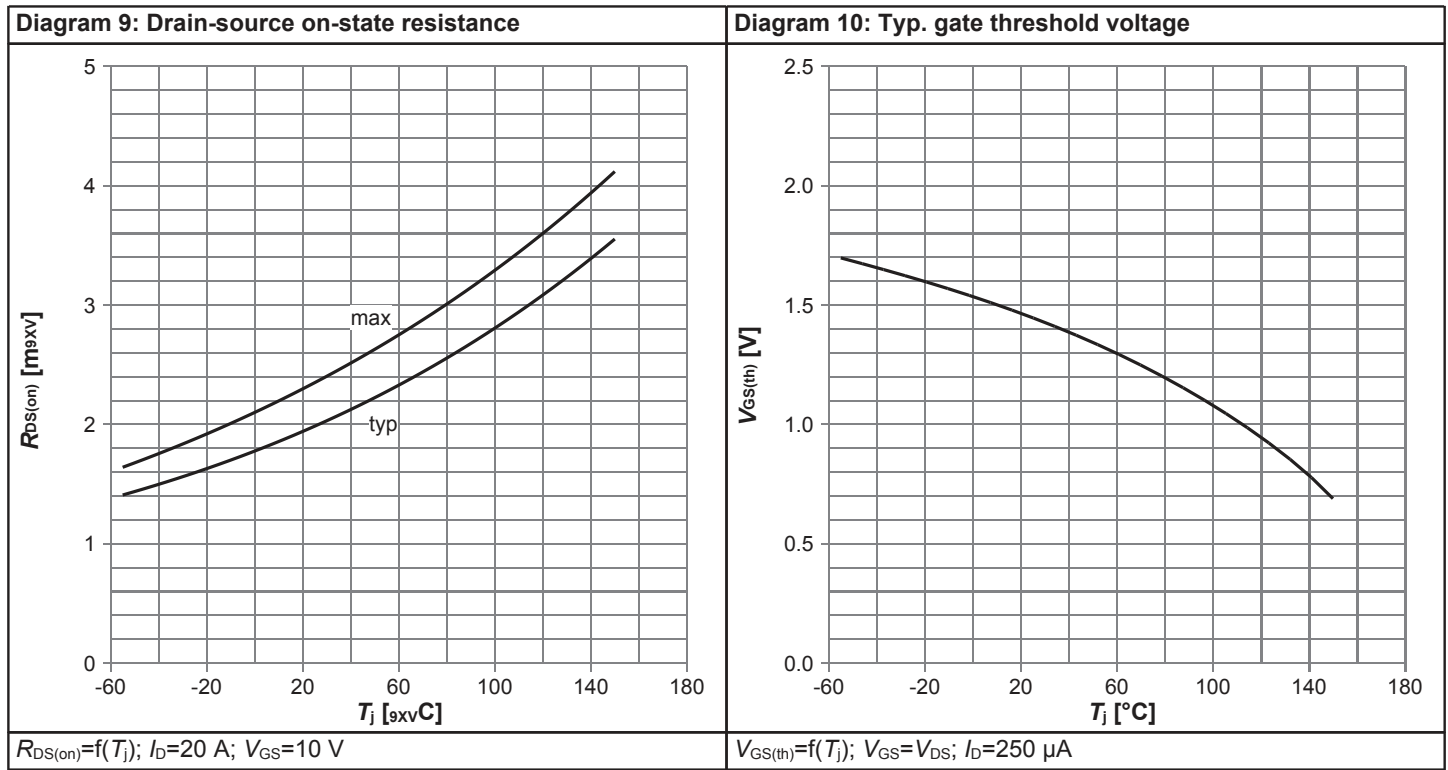


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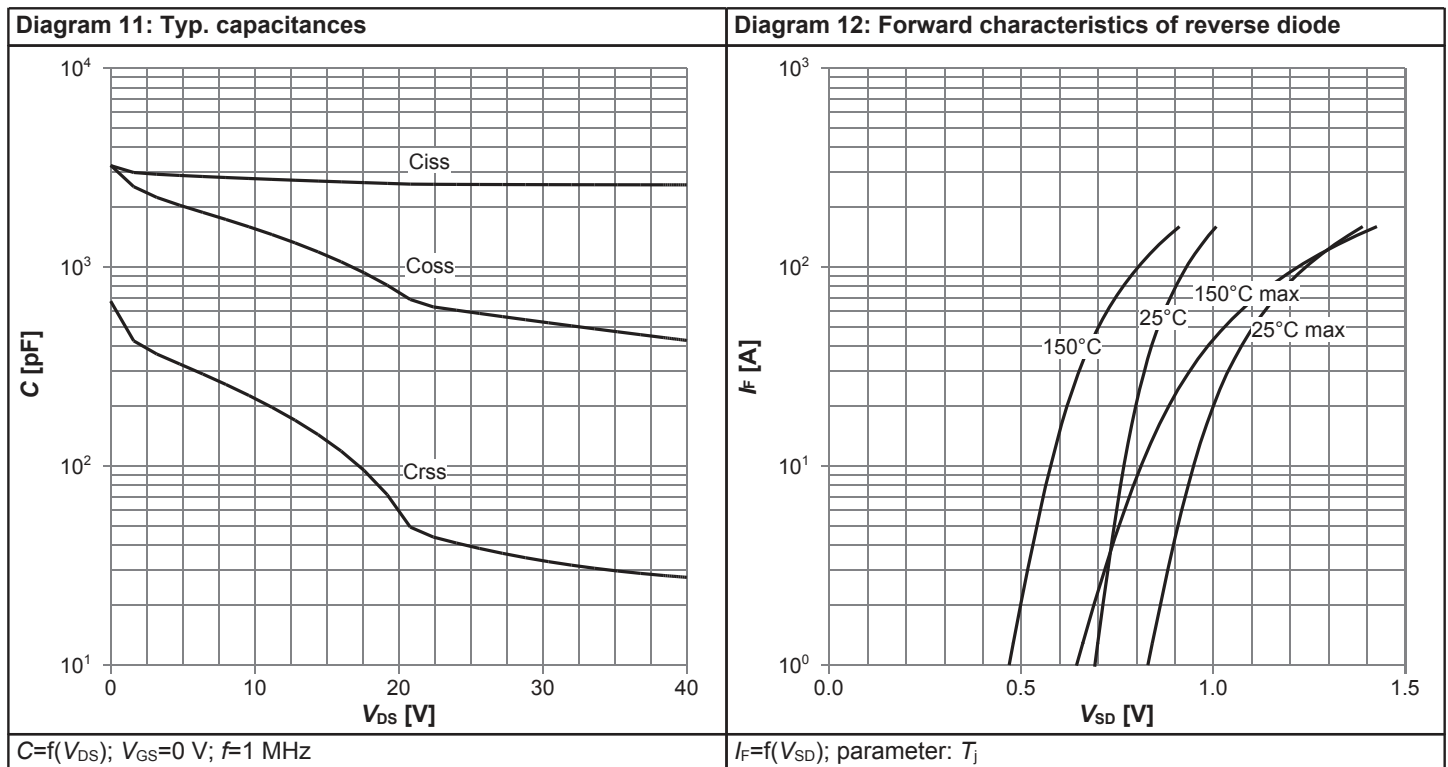


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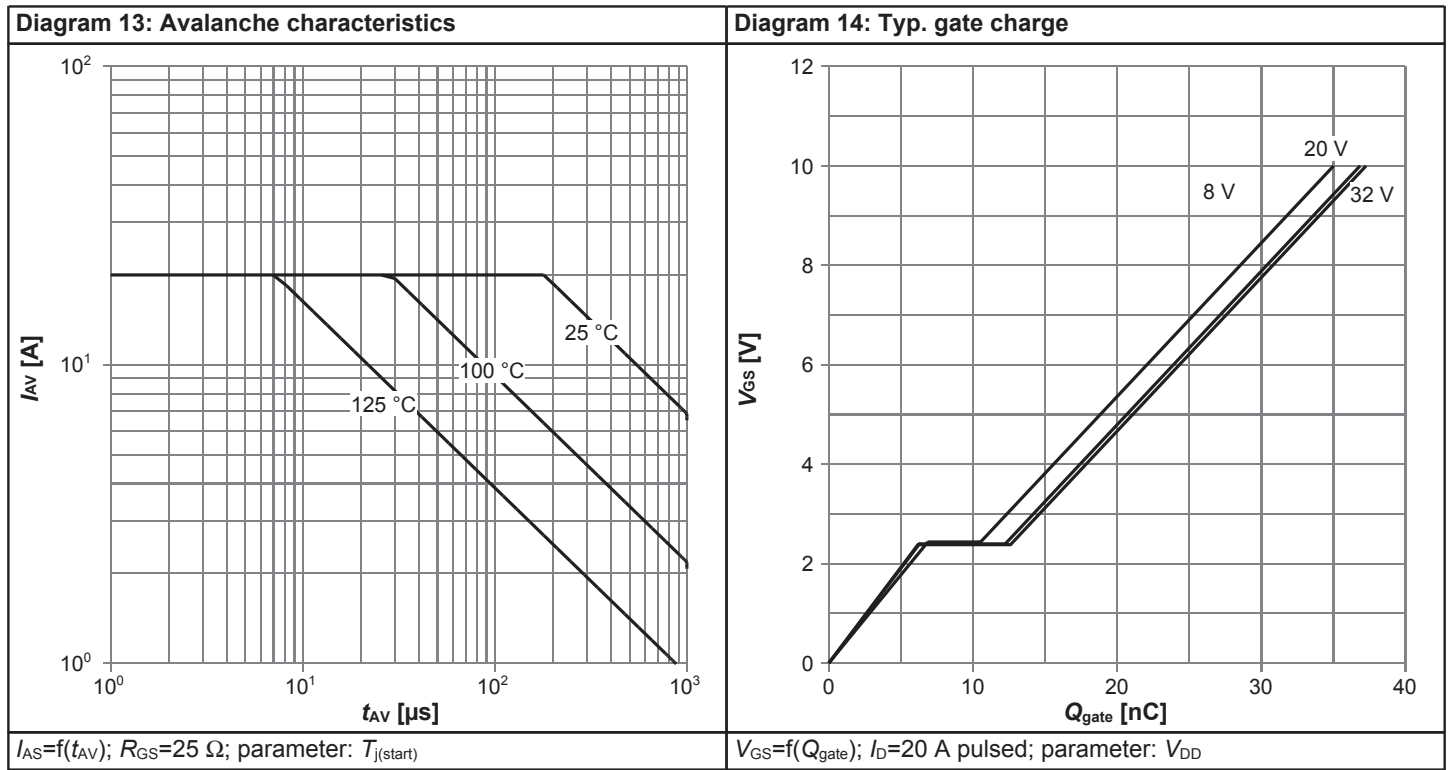
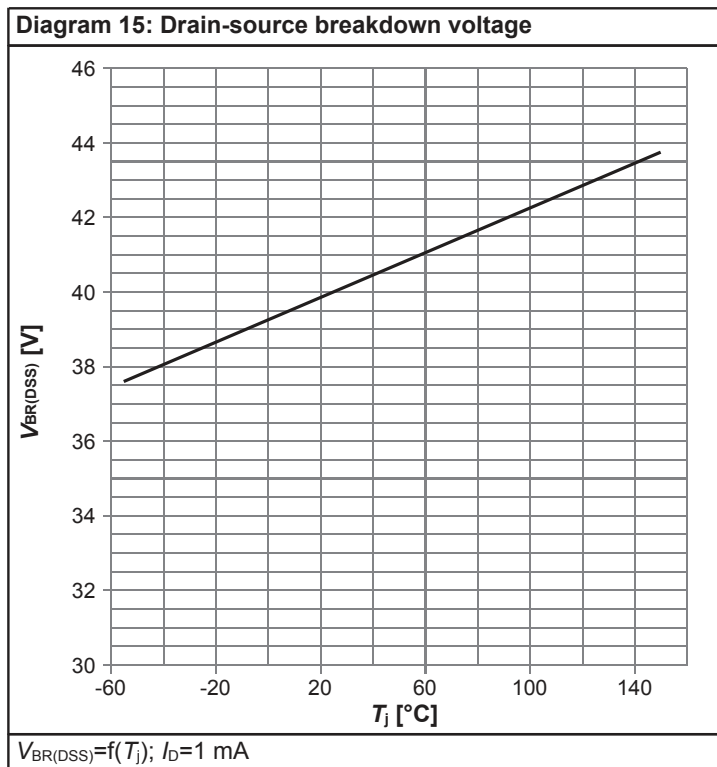
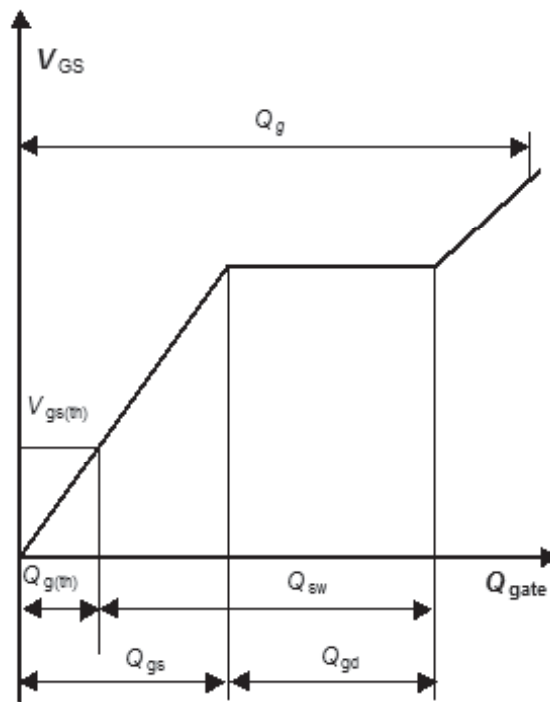


Table 15



## 6 Test Circuits

Table 16 Gate Charge Waveform



## 7 Package Outlines

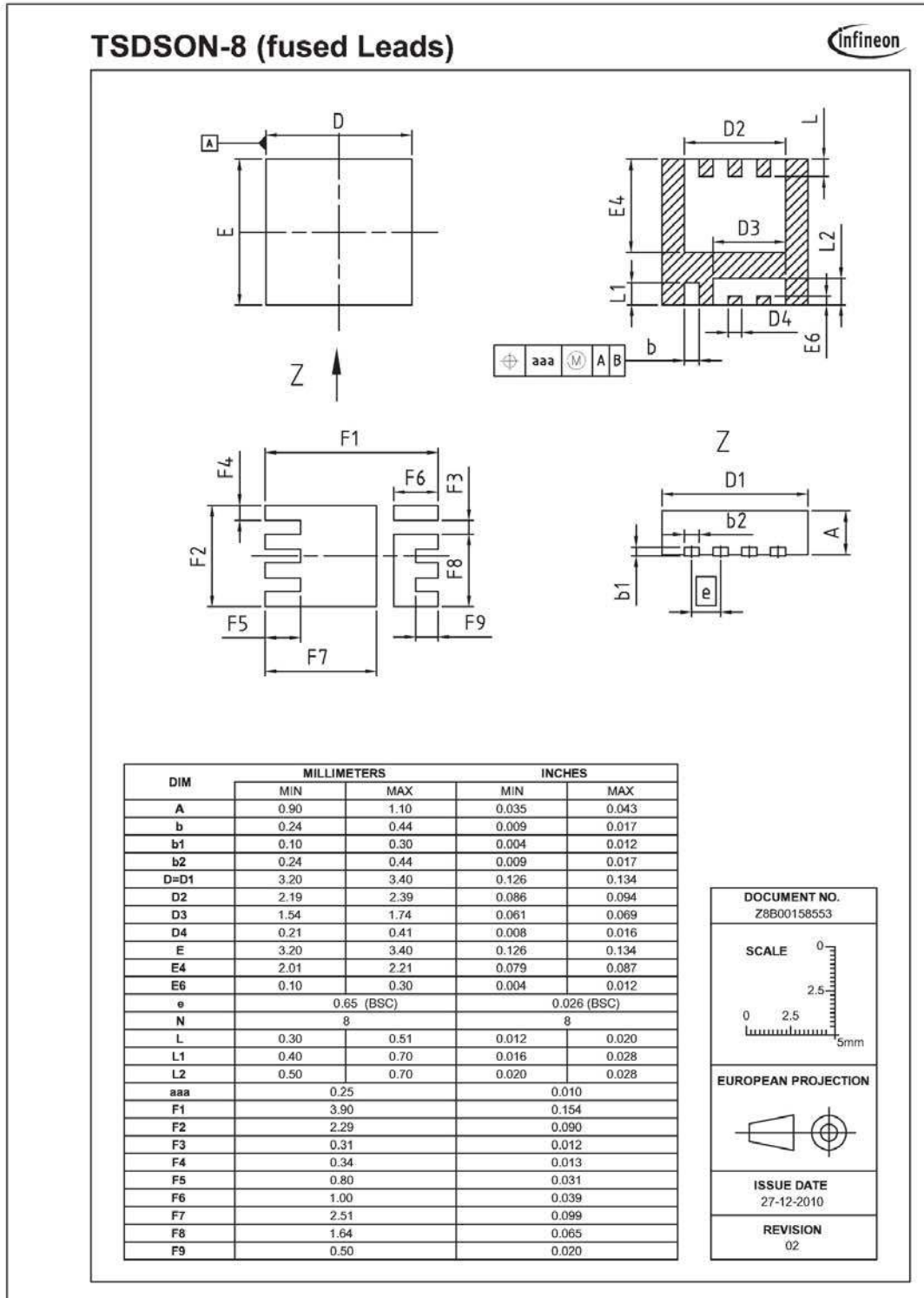


Figure 1 Outline PG-TSDSON-8 FL, dimensions in mm/inches

## Revision History

BSZ023N04LS

**Revision: 2012-11-22, Rev. 2.0**

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2012-11-22	Release of final version

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