

# n-Channel Power MOSFET

OptiMOS™  
BSC0904NSI

## Data Sheet

2.0, 2011-03-29  
Final

Industrial & Multimarket

## 1 Description

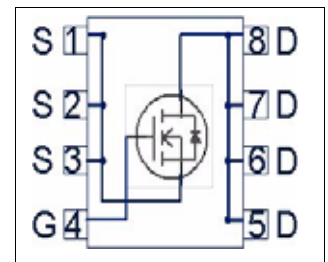
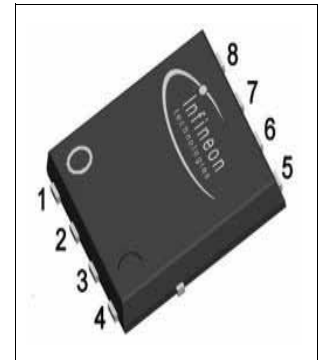
OptiMOS™30V products are class leading power MOSFETs for highest power density and energy efficient solutions. Ultra low gate and output charges together with lowest on state resistance in small footprint packages make OptiMOS™ 30V the best choice for the demanding requirements of voltage regulator solutions in Servers, Datacom and Telecom applications. Super fast switching Control FETs together with low EMI Sync FETs provide solutions that are easy to design in. OptiMOS™ products are available in high performance packages to tackle your most challenging applications giving full flexibility in optimizing space, efficiency and cost. OptiMOS™ products are designed to meet and exceed the energy efficiency and power density requirements of the sharpened next generation voltage regulation standards in computing applications.

### Features

- Optimized SyncFET for high performance buck converters
- 100% avalanche tested
- Very low on-resistance  $R_{DS(on)}$  @  $V_{GS}=4.5\text{ V}$
- N-channel
- Qualified according to JEDEC<sup>1)</sup> for target applications
- Superior thermal resistance
- Pb-free plating; RoHS compliant
- Halogen-free according to IEC61249-2-21
- Integrated monolithic Schottky-like diode

### Applications

- On board power for server
- Power management for high performance computing
- Synchronous rectification
- High power density point of load converters



**Table 1 Key Performance Parameters**

Parameter	Value	Unit	Related Links
$V_{DS}$	30	V	<a href="#">IFX OptiMOS webpage</a> <a href="#">IFX OptiMOS product brief</a> <a href="#">IFX OptiMOS spice models</a> <a href="#">IFX Design tools</a>
$R_{DS(on),max}$	3.7	mΩ	
$I_D$	78	A	
$Q_{OSS}$	12	nC	
$Q_{g,typ}$	17		

Type	Package	Marking
BSC0904NSI	PG-TDSON-8	0904NSI

1) J-STD20 and JESD22

## 2 Maximum ratings

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

**Table 2 Maximum ratings**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current	$I_D$	-	-	78	A	$V_{GS}=10\text{ V}, T_C=25\text{ °C}$
		-	-	49		$V_{GS}=10\text{ V}, T_C=100\text{ °C}$
		-	-	66		$V_{GS}=4.5\text{ V}, T_C=25\text{ °C}$
		-	-	41		$V_{GS}=4.5\text{ V}, T_C=100\text{ °C}$
		-	-	20		$V_{GS}=10\text{ V}, T_A=25\text{ °C}, R_{thJA}=50\text{ K/W}^{(1)}$
Pulsed drain current <sup>2)</sup>	$I_{D,pulse}$	-	-	312		$T_C=25\text{ °C}$
Avalanche current, single pulse <sup>3)</sup>	$I_{AS}$	-	-	30		
Avalanche energy, single pulse	$E_{AS}$	-	-	14	mJ	$I_D=30\text{ A}, R_{GS}=25\text{ }\Omega$
Gate source voltage	$V_{GS}$	-20	-	20	V	
Power dissipation	$P_{tot}$	-	-	37	W	$T_C=25\text{ °C}$
		-	-	2.5		$T_A=25\text{ °C}, R_{thJA}=50\text{ K/W}^{(1)}$
Operating and storage temperature	$T_j, T_{stg}$	-55	-	150	°C	
IEC climatic category; DIN IEC 68-1		55/150/56				

1) 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.

2) See figure 3 for more detailed information

3) See figure 13 for more detailed information

## 3 Thermal characteristics

**Table 3 Thermal characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	$R_{thJC}$	-	-	3.4	K/W	
		-	-	20		top
Device on PCB	$R_{thJA}$	-	-	50		6 cm <sup>2</sup> cooling area <sup>1)</sup>

1) 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

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	$V_{(BR)DSS}$	30	-	-	V	$V_{GS}=0\text{ V}$ , $I_D=10\text{ mA}$
Breakdown voltage temperature coefficient	$\frac{dV_{(BR)DSS}}{dT_j}$	-	15	-	mV/k	$I_D=10\text{ mA}$ , reference to $25\text{ °C}$
Gate threshold voltage	$V_{GS(th)}$	1	-	2.2		$V_{DS}=V_{GS}$ , $I_D=250\text{ }\mu\text{A}$
Zero gate voltage drain current	$I_{DSS}$	-	-	0.5	$\mu\text{A}$	$V_{DS}=24\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ °C}$
		-	1	-		$V_{DS}=24\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=125\text{ °C}$
Gate-source leakage current	$I_{GSS}$	-	10	100	nA	$V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$
Drain-source on-state resistance	$R_{DS(on)}$	-	4.2	5.2	m $\Omega$	$V_{GS}=4.5\text{ V}$ , $I_D=30\text{ A}$ ,
		-	3.1	3.7		$V_{GS}=10\text{ V}$ , $I_D=30\text{ A}$ ,
Gate resistance	$R_G$	-	0.9	-	$\Omega$	
Transconductance	$g_{fs}$	43	86	-	S	$ V_{DS} >2 I_D R_{DS(on)max}$ , $I_D=30\text{ A}$

**Table 5 Dynamic characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	$C_{iss}$	-	1100	-	pF	$V_{GS}=0\text{ V}$ , $V_{DS}=15\text{ V}$ , $f=1\text{ MHz}$
Output capacitance	$C_{oss}$	-	460	-		
Reverse transfer capacitance	$C_{rss}$	-	64	-		
Turn-on delay time	$t_{d(on)}$	-	3.3	-	ns	$V_{DD}=15\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=30\text{ A}$ , $R_G=1.6\text{ }\Omega$
Rise time	$t_r$	-	4.4	-		
Turn-off delay time	$t_{d(off)}$	-	16	-		
Fall time	$t_f$	-	3	-		

**Table 6 Gate charge characteristics<sup>1)</sup>**

Parameter	Symbol	Values			Unit	Note / Test Condition	
		Min.	Typ.	Max.			
Gate to source charge	$Q_{gs}$	-	2.9	-	nC	$V_{DD}=15\text{ V}$ , $I_D=30\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$	
Gate charge at threshold	$Q_{g(th)}$	-	1.7	-			
Gate to drain charge	$Q_{gd}$	-	2.9	-			
Switching charge	$Q_{sw}$	-	4.1	-			
Gate charge total	$Q_g$	-	8.5	-			
Gate plateau voltage	$V_{plateau}$	-	2.7	-	V		
Gate charge total	$Q_g$	-	17	-	nC	$V_{DD}=15\text{ V}$ , $I_D=30\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$	
Gate charge total, sync. FET	$Q_{g(sync)}$	-	6.8	-			$V_{DS}=0.1\text{ V}$ , $V_{GS}=0\text{ to }4.5\text{ V}$
Output charge	$Q_{oss}$	-	12	-			$V_{DD}=15\text{ V}$ , $V_{GS}=0\text{ V}$

1) See figure 16 for gate charge parameter definition

**Table 7 Reverse diode characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode continuous forward current	$I_s$	-	-	37	A	$T_C=25\text{ °C}$
Diode pulse current	$I_{s,pulse}$	-	-	148		
Diode forward voltage	$V_{SD}$	-	0.56	0.7	V	$V_{GS}=0\text{ V}$ , $I_F=3\text{ A}$ , $T_j=25\text{ °C}$
Reverse recovery charge	$Q_{rr}$	-	2	-	nC	$V_R=15\text{ V}$ , $I_F=I_s$ , $di_F/dt=400\text{ A}/\mu\text{s}$

## 5 Electrical characteristics diagrams

Table 8

1 Power dissipation	2 Drain current
$P_{tot} = f(T_c)$	$I_D = f(T_c)$ ; parameter: $V_{GS}$

Table 9

3 Safe operating area $T_c = 25\text{ °C}$	4 Max. transient thermal impedance
$I_D = f(V_{DS})$ ; $T_j = 25\text{ °C}$ ; $D = 0$ ; parameter: $T_p$	$Z_{(th(jc))} = f(t_p)$ ; parameter: $D = t_p / T$



Table 10

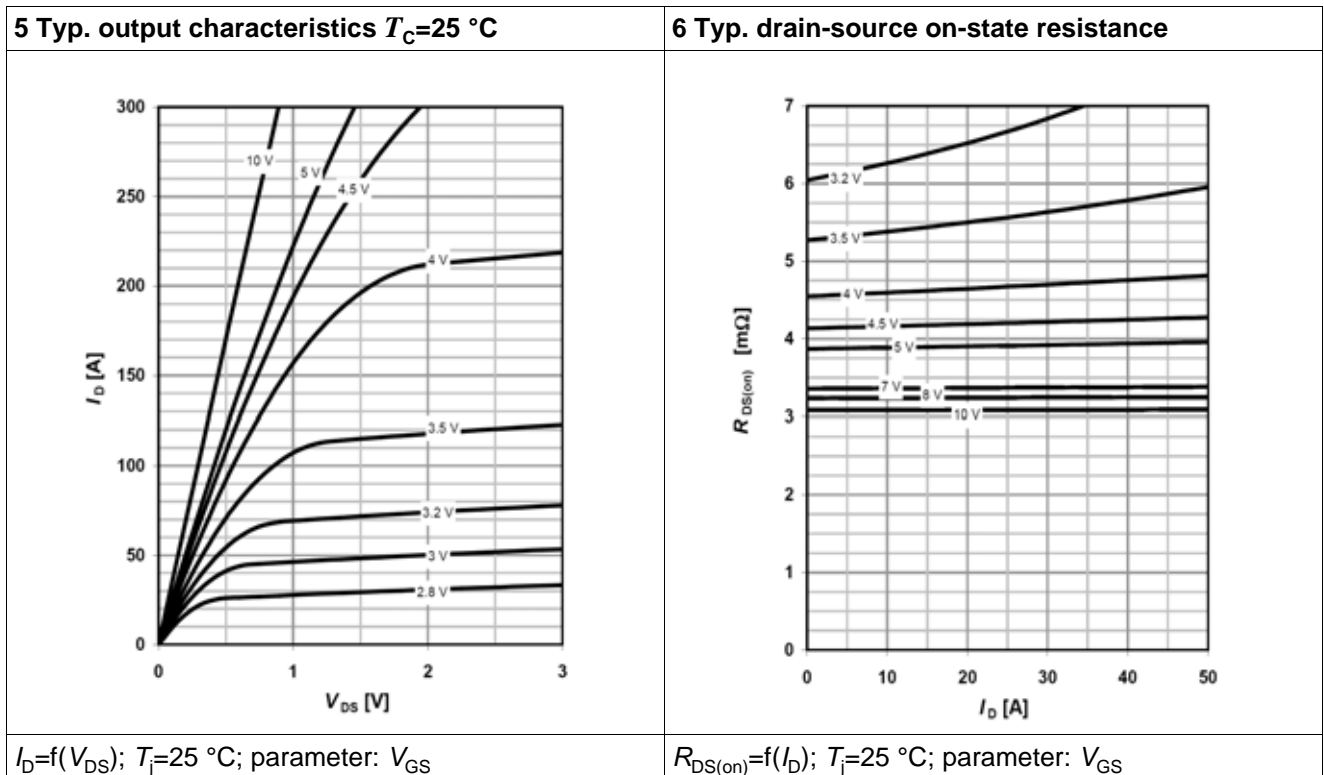


Table 11

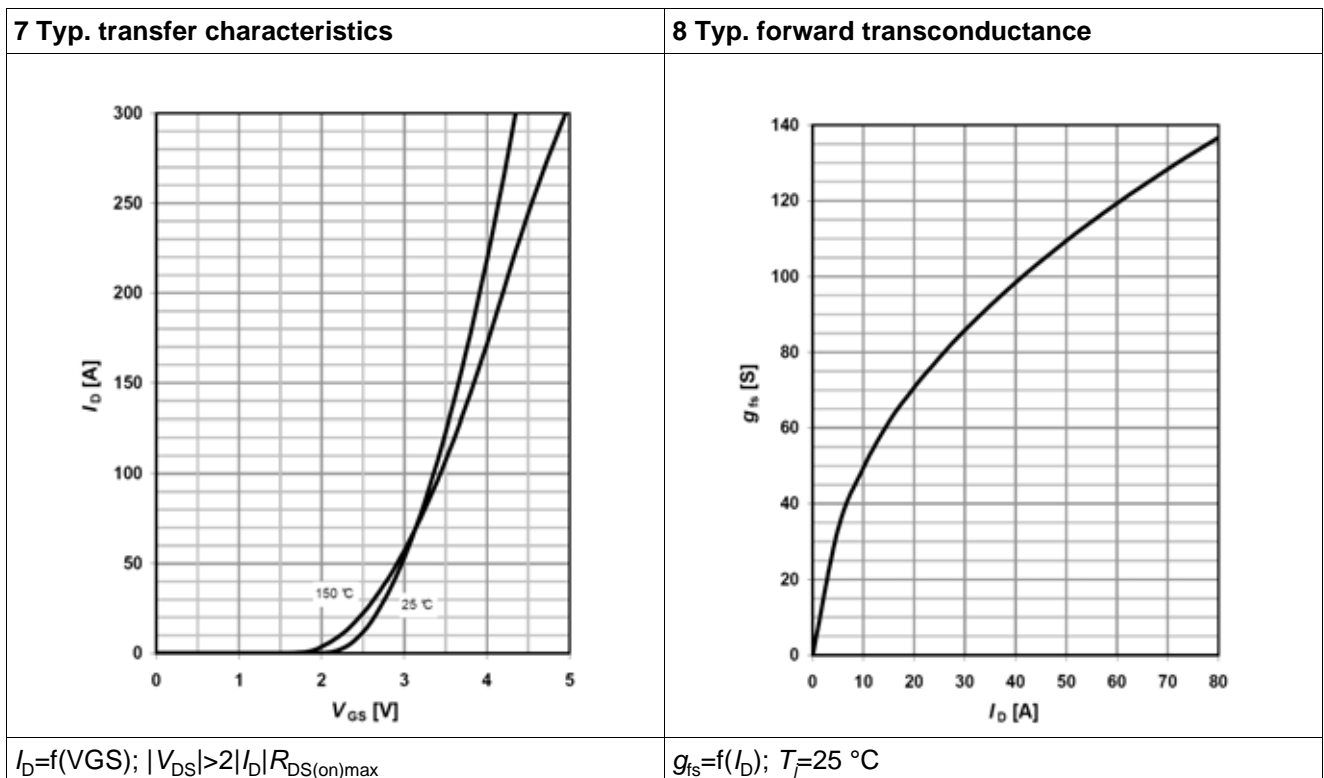


Table 12

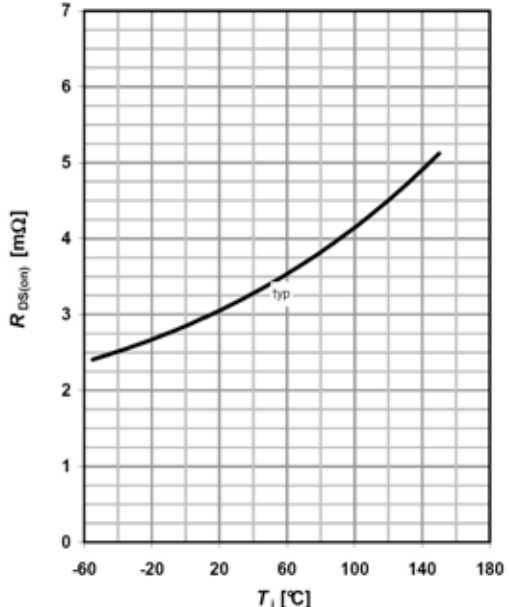
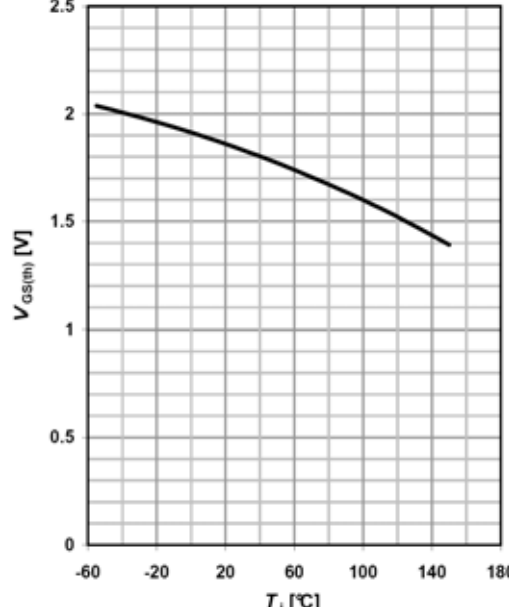
<p><b>9 Drain-source on-state resistance</b></p>  <p><math>R_{DS(on)} = f(T_j)</math>; <math>I_D = 30\text{ A}</math>; <math>V_{GS} = 10\text{ V}</math></p>	<p><b>10 Typ. gate threshold voltage</b></p>  <p><math>V_{GS(th)} = f(T_j)</math>; <math>V_{GS} = V_{DS}</math>; <math>I_D = 10\text{ mA}</math></p>
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Table 13

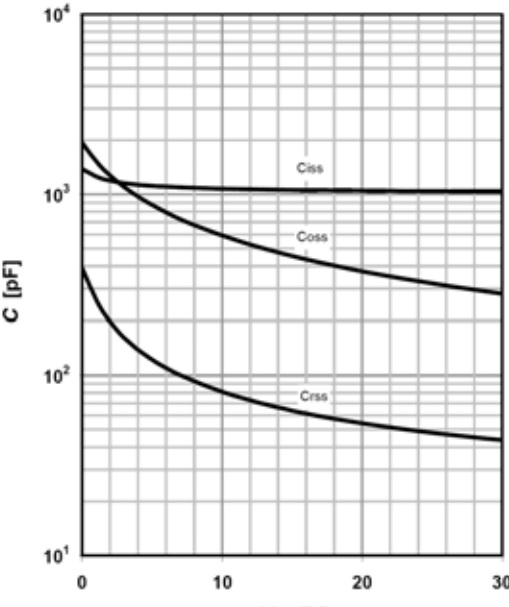
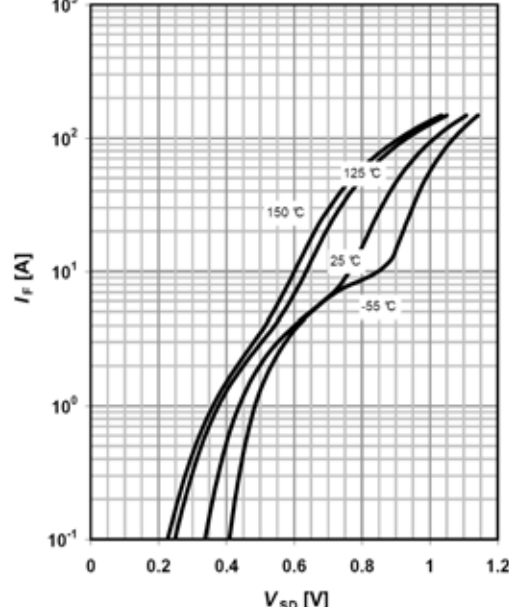
<p><b>11 Typ. capacitances</b></p>  <p><math>C = f(V_{DS})</math>; <math>V_{GS} = 0\text{ V}</math>; <math>f = 1\text{ MHz}</math></p>	<p><b>12 Forward characteristics of reverse diode</b></p>  <p><math>I_F = f(V_{SD})</math>; parameter: <math>T_j</math></p>
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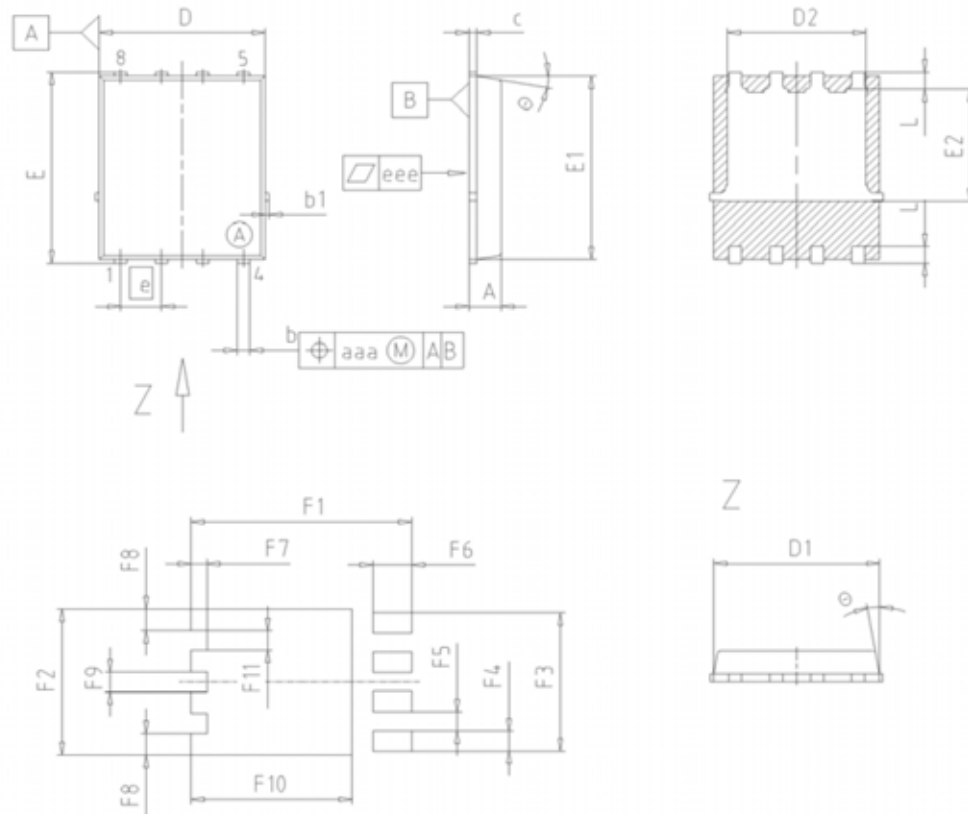
Table 14

13 Avalanche characteristics	14 Typ. gate charge
$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega; \text{parameter: } T_{j(\text{start})}$	$V_{GS}=f(Q_{\text{gate}}); I_D=30 \text{ A pulsed}; \text{parameter: } V_{DD}$

Table 15

15 Typ. drain-source leakage current	16 Gate charge waveforms
$I_{DSS}=f(V_{DS}); V_{GS}=0 \text{ V}$	

6 Package outline



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	0.90	1.10	0.035	0.043
b	0.34	0.54	0.013	0.021
b1	0.02	0.22	0.001	0.008
c	0.15	0.35	0.006	0.014
D=D1	4.95	5.35	0.195	0.211
D2	4.20	4.40	0.165	0.173
E	5.95	6.35	0.234	0.250
E1	5.70	6.10	0.224	0.240
E2	3.40	3.80	0.134	0.150
e	1.27		0.050	
N	8		8	
L	0.45	0.65	0.018	0.026
∠	8.5°	11.5°	8.5°	11.5°
aaa	0.25		0.010	
eee	0.05		0.002	
F1	6.75	6.95	0.266	0.274
F2	4.60	4.80	0.181	0.189
F3	4.36	4.56	0.172	0.180
F4	0.55	0.75	0.022	0.030
F5	0.52	0.72	0.020	0.028
F6	1.10	1.30	0.043	0.051
F7	0.40	0.60	0.016	0.024
F8	0.60	0.80	0.024	0.031
F9	0.53	0.73	0.021	0.029
F10	4.90	5.10	0.193	0.201
F11	0.53	0.73	0.021	0.029

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REVISION  
03

Figure 1 Outlines PG-TDSON-8, dimensions in mm/inches



## 7 Revision History

Revision History: 2011-03-29, 2.0

Previous Revision:

Revision	Subjects (major changes since last revision)
0.1	Release of target data sheet
2.0	Release of final data sheet

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