

n-Channel Power MOSFET

OptiMOS™
BSC052N03LS

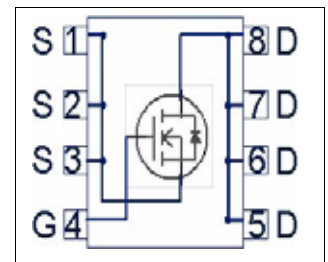
Data Sheet

2.0, 2011-03-01
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 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 JEDEC¹⁾ for target applications
- Superior thermal resistance
- Pb-free plating; RoHS compliant
- Halogen-free according to IEC61249-2-21

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	IFX OptiMOS webpage IFX OptiMOS product brief IFX OptiMOS spice models IFX Design tools
$R_{DS(on),max}$	5.2	mΩ	
I_D	57	A	
Q_{OSS}	7.7	nC	
Q_g^{typ}	12		

Type	Package	Marking
BSC052N03LS	PG-TDSON-8	052N03LS

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	-	-	57	A	$V_{GS}=10\text{ V}, T_C=25\text{ °C}$
		-	-	36		$V_{GS}=10\text{ V}, T_C=100\text{ °C}$
		-	-	48		$V_{GS}=4.5\text{ V}, T_C=25\text{ °C}$
		-	-	31		$V_{GS}=4.5\text{ V}, T_C=100\text{ °C}$
		-	-	17		$V_{GS}=10\text{ V}, T_A=25\text{ °C}, R_{thJA}=50\text{ K/W}^1)$
Pulsed drain current ²⁾	$I_{D,pulse}$	-	-	228		$T_C=25\text{ °C}$
Avalanche current, single pulse ³⁾	I_{AS}	-	-	35		
Avalanche energy, single pulse	E_{AS}	-	-	12	mJ	$I_D=35\text{ A}, R_{GS}=25\text{ }\Omega$
Gate source voltage	V_{GS}	-20	-	20	V	
Power dissipation	P_{tot}	-	-	28	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 cm² (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}	-	-	4.5	K/W	
		-	-	20		top
Device on PCB	R_{thJA}	-	-	50		6 cm ² cooling area ¹⁾

1) 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

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	$V_{GS}=0\text{ V}$, $I_D=1.0\text{ mA}$
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}	-	0.1	1	μA	$V_{DS}=30\text{ V}$, $V_{GS}=0\text{ V}$, $T_J=25\text{ °C}$
		-	10	100		$V_{DS}=30\text{ V}$, $V_{GS}=0\text{ V}$, $T_J=125\text{ °C}$
Gate-source leakage current	I_{GSS}	-	10	100	nA	$V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$
Drain-source on-state resistance	$R_{DS(on)}$	-	5.8	7.2	m Ω	$V_{GS}=4.5\text{ V}$, $I_D=30\text{ A}$,
		-	4.3	5.2		$V_{GS}=10\text{ V}$, $I_D=30\text{ A}$,
Gate resistance	R_G	-	0.65	-	Ω	
Transconductance	g_{fs}	38	75	-	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}	-	770	-	pF	$V_{GS}=0\text{ V}$, $V_{DS}=15\text{ V}$, $f=1\text{ MHz}$
Output capacitance	C_{oss}	-	300	-		
Reverse transfer capacitance	C_{rSS}	-	44	-		
Turn-on delay time	$t_{d(on)}$	-	2.4	-	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	-	3.6	-		
Turn-off delay time	$t_{d(off)}$	-	13	-		
Fall time	t_f	-	2.4	-		

Table 6 Gate charge characteristics¹⁾

Parameter	Symbol	Values			Unit	Note / Test Condition	
		Min.	Typ.	Max.			
Gate to source charge	Q_{gs}	-	2.2	-	nC	$V_{DD}=15\text{ V}$, $I_D=30\text{ A}$, $V_{GS}=0\text{ to }4.5\text{ V}$	
Gate charge at threshold	$Q_{g(th)}$	-	1.2	-			
Gate to drain charge	Q_{gd}	-	1.9	-			
Switching charge	Q_{sw}	-	2.9	-			
Gate charge total	Q_g	-	5.9	-			
Gate plateau voltage	$V_{plateau}$	-	2.8	-	V		
Gate charge total	Q_g	-	12	-	nC	$V_{DD}=15\text{ V}$, $I_D=30\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$	
Gate charge total, sync. FET	$Q_{g(sync)}$	-	4.8	-			$V_{DS}=0.1\text{ V}$, $V_{GS}=0\text{ to }4.5\text{ V}$
Output charge	Q_{oss}	-	7.7	-			$V_{DD}=15\text{ V}$, $V_{GS}=0\text{ V}$

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	-	-	28	A	$T_C=25\text{ °C}$
Diode pulse current	$I_{s,pulse}$	-	-	112		
Diode forward voltage	V_{SD}	-	0.9	1	V	$V_{GS}=0\text{ V}$, $I_F=30\text{ A}$, $T_j=25\text{ °C}$
Reverse recovery charge	Q_{rr}	-	5	-	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

5 Typ. output characteristics $T_c=25\text{ °C}$	6 Typ. drain-source on-state resistance
<p>Graph 5 shows the typical output characteristics of the MOSFET. The y-axis represents the drain current I_D in Amperes [A], ranging from 0 to 240. The x-axis represents the drain-source voltage V_{DS} in Volts [V], ranging from 0 to 3. Five curves are plotted for different gate-source voltages V_{GS}: 10V, 8V, 5V, 4.5V, and 3.3V. The curves show that I_D increases with V_{DS} and is significantly higher for higher V_{GS} values.</p>	<p>Graph 6 shows the typical drain-source on-state resistance $R_{DS(on)}$ in milliwatts [mW] as a function of the drain current I_D in Amperes [A]. The y-axis ranges from 0 to 7, and the x-axis ranges from 0 to 50. Four curves are shown for V_{GS} values of 4.5V, 5V, 8V, and 10V. The resistance is relatively constant with I_D and increases as V_{GS} decreases.</p>
<p>$I_D=f(V_{DS}); T_j=25\text{ °C};$ parameter: V_{GS}</p>	<p>$R_{DS(on)}=f(I_D); T_j=25\text{ °C};$ parameter: V_{GS}</p>

Table 11

7 Typ. transfer characteristics	8 Typ. forward transconductance
<p>Graph 7 shows the typical transfer characteristics, plotting drain current I_D [A] against gate-source voltage V_{GS} [V]. The y-axis ranges from 0 to 240, and the x-axis ranges from 0 to 5. Two curves are shown for junction temperatures T_j of 150 °C and 25 °C. The curves show that I_D increases with V_{GS} and is higher at the lower temperature of 25 °C.</p>	<p>Graph 8 shows the typical forward transconductance g_{fs} in Siemens [S] as a function of the drain current I_D in Amperes [A]. The y-axis ranges from 0 to 160, and the x-axis ranges from 0 to 100. The curve shows that g_{fs} increases with I_D and is highest at $I_D = 100$ A.</p>
<p>$I_D=f(V_{GS}); V_{DS} >2I_D/R_{DS(on)max}$</p>	<p>$g_{fs}=f(I_D); T_j=25\text{ °C}$</p>

Table 12

<p>9 Drain-source on-state resistance</p> <p>$R_{DS(on)} = f(T_j)$; $I_D = 30\text{ A}$; $V_{GS} = 10\text{ V}$</p>	<p>10 Typ. gate threshold voltage</p> <p>$V_{GS(th)} = f(T_j)$; $V_{GS} = V_{DS}$; $I_D = 250\text{ }\mu\text{A}$</p>
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Table 13

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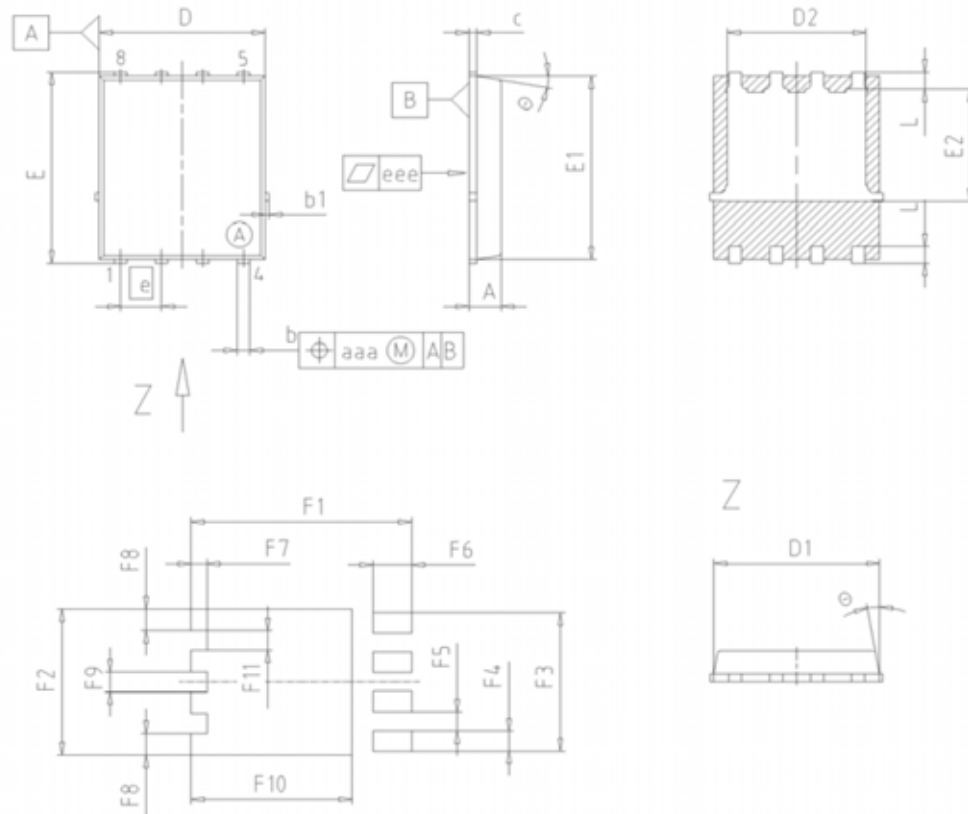
Table 14

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 Drain-source breakdown voltage	16 Gate charge waveforms
$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$	

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

DOCUMENT NO.
Z8B00003332

SCALE

EUROPEAN PROJECTION

ISSUE DATE
08-03-2007

REVISION
03

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

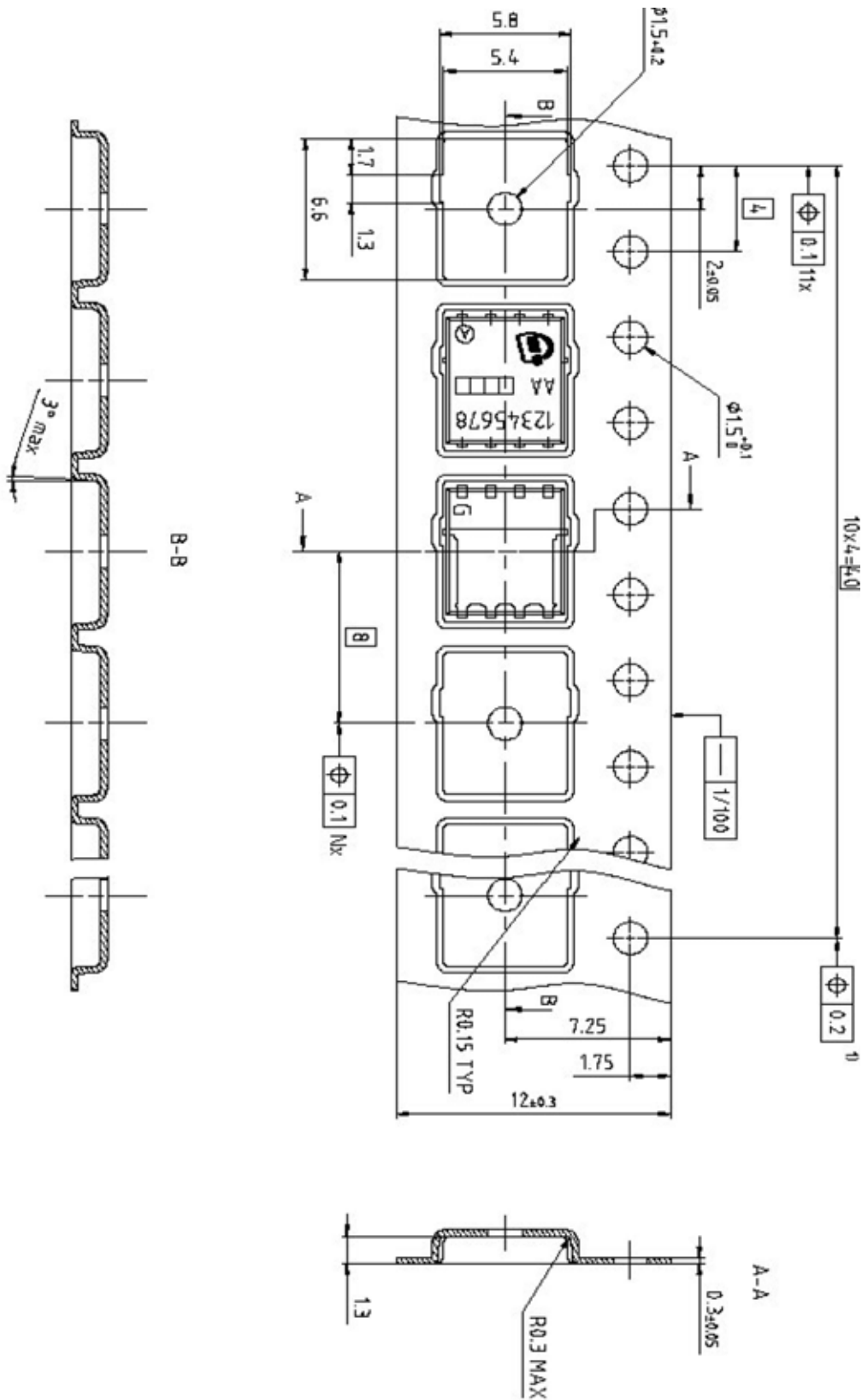


Figure 2 Outlines PG-TDSON-8 tape, dimension in mm/inches

7 Revision History

Revision History: 2011-03-01, 2.0

Previous Revision:

Revision	Subjects (major changes since last revision)
0.4	Release of Target data sheet
1.0	Release of Preliminary data sheet
2.0	Release of Final data sheet

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Edition 2011-03-01

Published by

Infineon Technologies AG

81726 Munich, Germany

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