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STW45NM50FD

N-channel 500 V, 0.07 Ω , 45 A, TO-247
FDmesh™ Power MOSFET (with fast diode)

Features

Type	V _{DSS}	R _{DS(on)} max	I _D
STW45NM50FD	500 V	< 0.1 Ω	45 A

- 100% avalanche tested
- High dv/dt and avalanche capabilities
- Low input capacitance and gate charge
- Low gate input resistance

Application

- Switching applications

Description

The FDmesh™ associates all advantages of reduced on-resistance and fast switching with an intrinsic fast-recovery body diode. It is therefore strongly recommended for bridge topologies, in particular ZVS phase-shift converters.

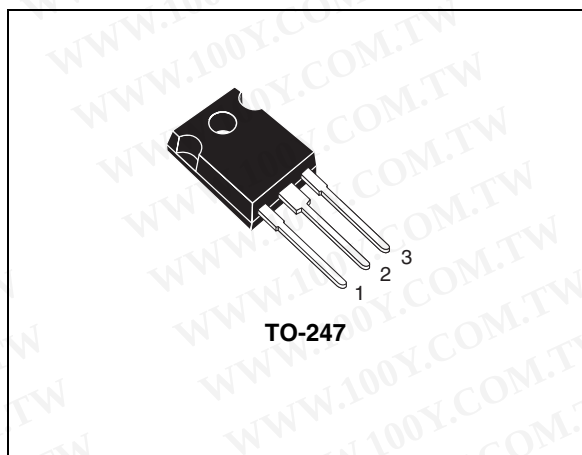


Figure 1. Internal schematic diagram

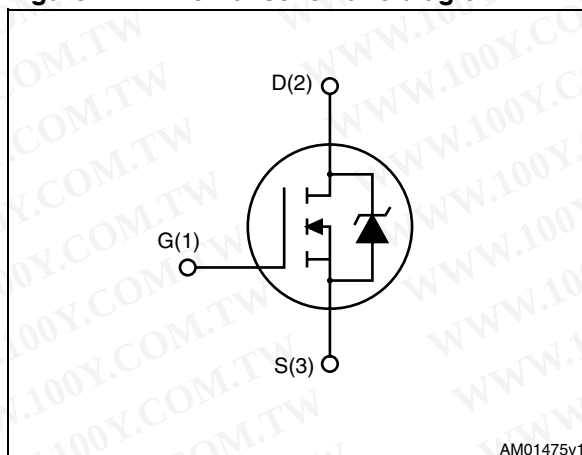


Table 1. Device summary

Order code	Marking	Package	Packaging
STW45NM50FD	W45NM50FD	TO-247	Tube

Contents

1	Electrical ratings	3
2	Electrical characteristics	4
2.1	Electrical characteristics (curves)	6
3	Test circuits	8
4	Package mechanical data	9
5	Revision history	11

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage ($V_{GS} = 0$)	500	V
V_{GS}	Gate-source voltage	± 30	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$	45	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	28.4	A
$I_{DM}^{(1)}$	Drain current (pulsed)	180	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	417	W
	Derating factor	2.08	W/ $^{\circ}\text{C}$
$dv/dt^{(2)}$	Peak diode recovery voltage slope	20	V/ns
T_J T_{stg}	Operating junction temperature Storage temperature	-65 to 150	$^{\circ}\text{C}$

1. Pulse width limited by safe operating area
2. $I_{SD} \leq 45\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DD} = 80\%V_{(BR)DSS}$

Table 3. Thermal resistance

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	0.3	$^{\circ}\text{C}/\text{W}$
R_{thj-a}	Thermal resistance junction-ambient max	30	$^{\circ}\text{C}/\text{W}$
T_I	Maximum lead temperature for soldering purpose	300	$^{\circ}\text{C}$

Table 4. Avalanche data

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_J max)	22.5	A
E_{AS}	Single pulse avalanche energy (starting $T_J = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	800	mJ

2 Electrical characteristics

($T_{CASE} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)

Table 5. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 250\text{ }\mu\text{A}$, $V_{GS} = 0$	500			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = \text{Max rating}$, $V_{DS} = \text{Max rating @ } 125\text{ }^{\circ}\text{C}$			10 100	μA μA
I_{GSS}	Gate body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 30\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$, $I_D = 22.5\text{ A}$		0.07	0.10	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} > I_{D(on)} \times R_{DS(on)max}$ $I_D = 22.5\text{ A}$	-	20		S
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$	-	3600 1260 80		pF pF pF
$C_{oss\text{ eq.}}^{(2)}$	Equivalent output capacitance	$V_{GS} = 0$, $V_{DS} = 0\text{ to } 400\text{ V}$	-	350		pF
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 400\text{ V}$, $I_D = 45\text{ A}$ $V_{GS} = 10\text{ V}$ Figure 14	-	92 22 40	120	nC nC nC
R_G	Gate input resistance	$f = 1\text{ MHz}$ Gate DC Bias = 0 test signal level = 20 mV open drain	-	2		Ω

1. Pulsed: pulse duration=300 μs , duty cycle 1.5%

2. $C_{oss\text{ eq.}}$ is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}

Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD}=250\text{ V}$, $I_D=22.5\text{ A}$, $R_G=4.7\ \Omega$, $V_{GS}=10\text{ V}$	-	26.5	-	ns
t_r	Rise time	Figure 15	-	107.5	-	ns
$t_{r(Voff)}$	Off-voltage rise time	$V_{DD}=400\text{ V}$, $I_D=45\text{ A}$, $R_G=4.7\ \Omega$, $V_{GS}=10\text{ V}$	-	21.6	-	ns
t_f	Fall time	Figure 15	-	87.7	-	ns
t_c	Cross-over time		-	110.9	-	ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		45	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		180	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD}=45\text{ A}$, $V_{GS}=0$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD}=45\text{ A}$, $V_{DD}=100\text{ V}$	-	200		ns
Q_{rr}	Reverse recovery charge	$di/dt=100\text{ A}/\mu\text{s}$, (see Figure 18)	-	1600		nC
I_{RRM}	Reverse recovery current		-	16		A
t_{rr}	Reverse recovery time	$I_{SD}=45\text{ A}$, $T_j=150\text{ }^\circ\text{C}$	-	324		ns
Q_{rr}	Reverse recovery charge	$di/dt=100\text{ A}/\mu\text{s}$, $V_{DD}=100\text{ V}$, (see Figure 18)	-	4017		nC
I_{RRM}	Reverse recovery current		-	24.8		A

1. Pulse width limited by safe operating area

2. Pulsed: pulse duration=300 μs , duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

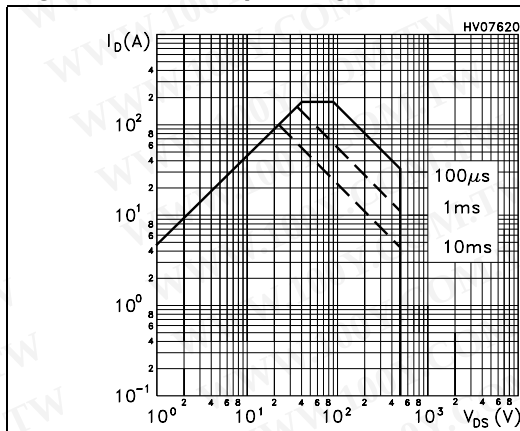


Figure 3. Thermal impedance

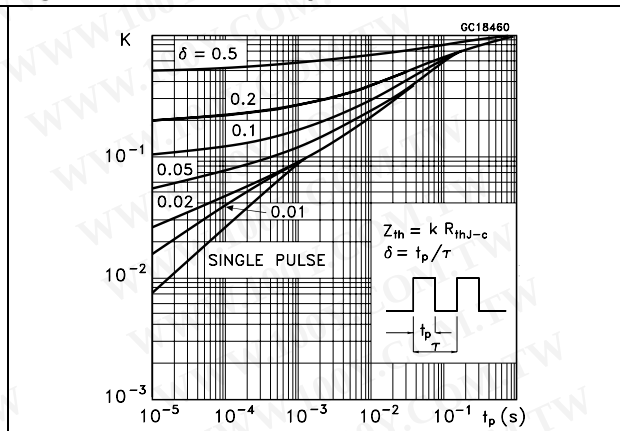


Figure 4. Output characteristics

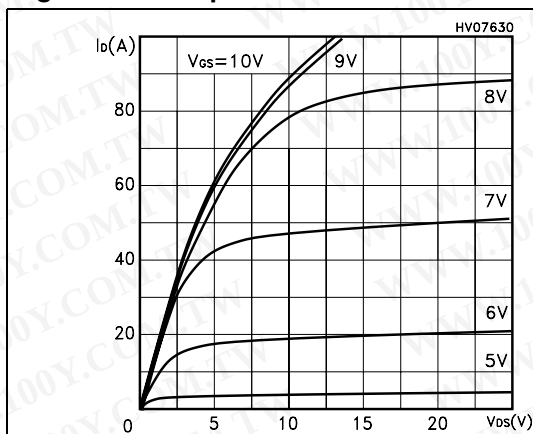


Figure 5. Transfer characteristics

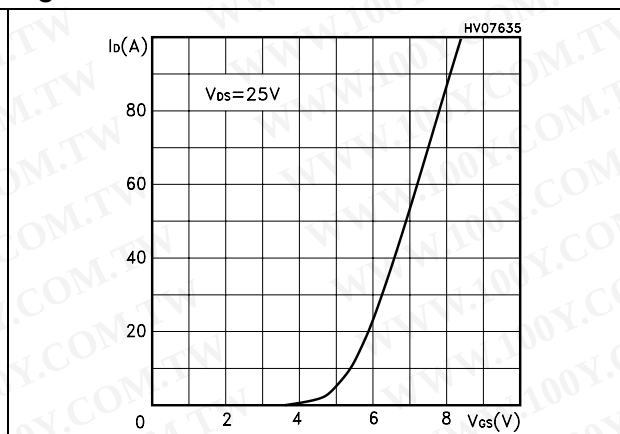


Figure 6. Transconductance

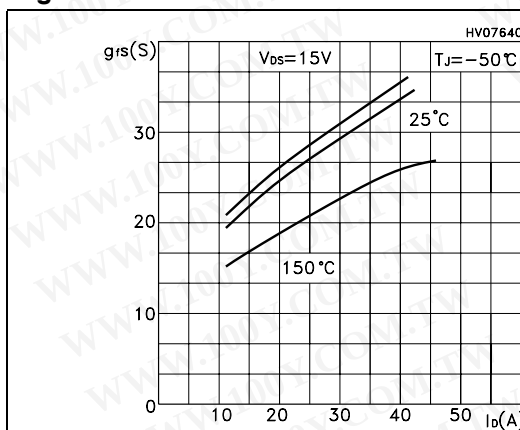


Figure 7. Static drain-source on resistance

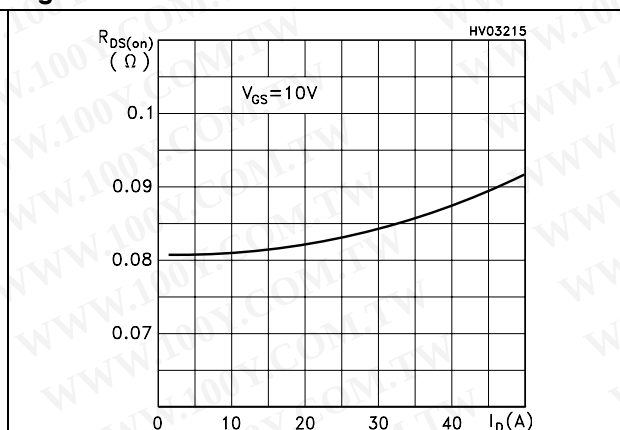


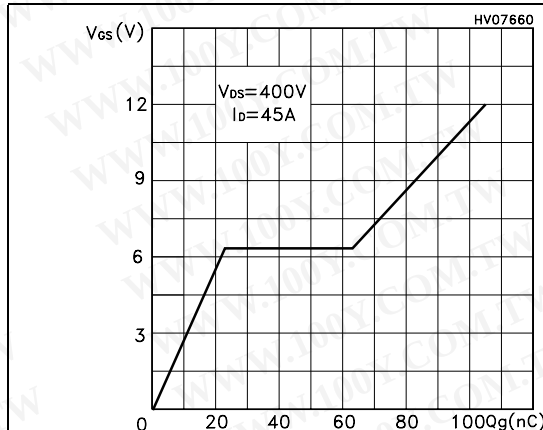
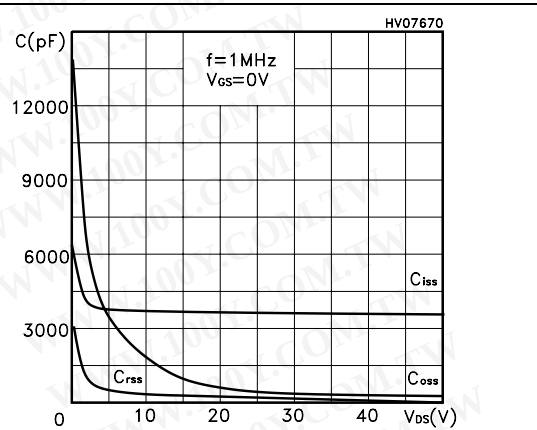
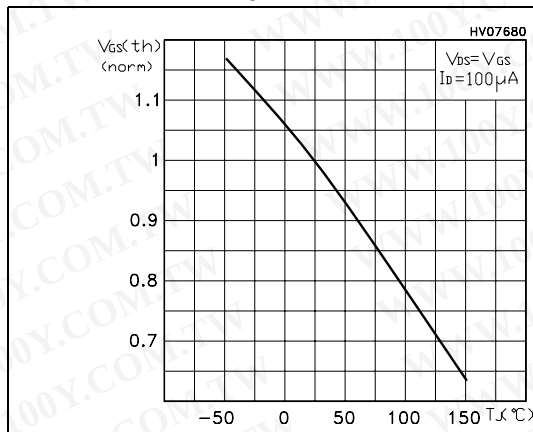
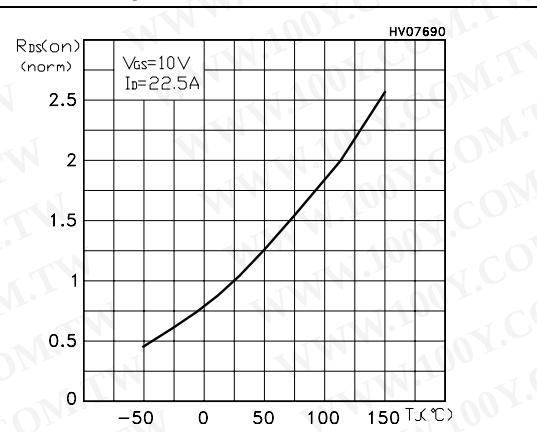
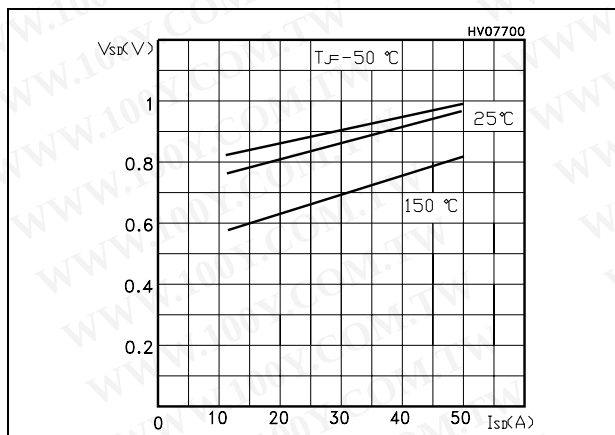
Figure 8. Gate charge vs gate-source voltage**Figure 9. Capacitance variations****Figure 10. Normalized gate threshold voltage vs temperature****Figure 11. Normalized on resistance vs temperature****Figure 12. Source-drain diode forward characteristics**

Figure 13. Switching times test circuit for resistive load

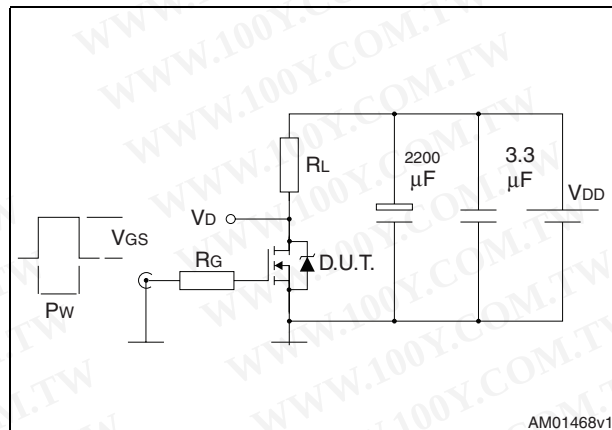


Figure 15. Test circuit for inductive load switching and diode recovery times

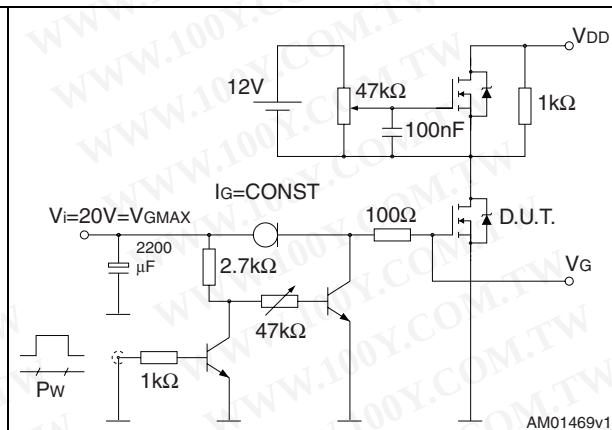


Figure 16. Unclamped inductive load test circuit

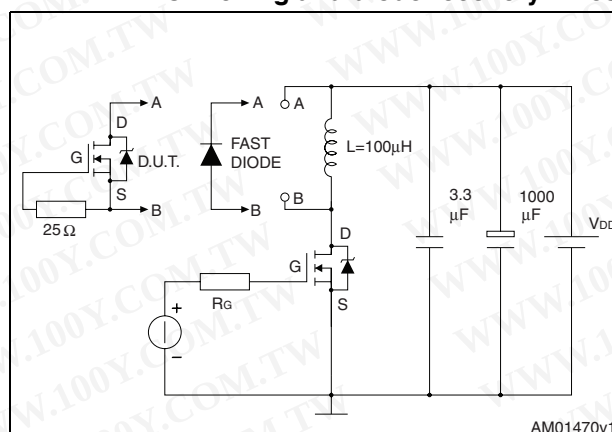


Figure 17. Unclamped inductive waveform

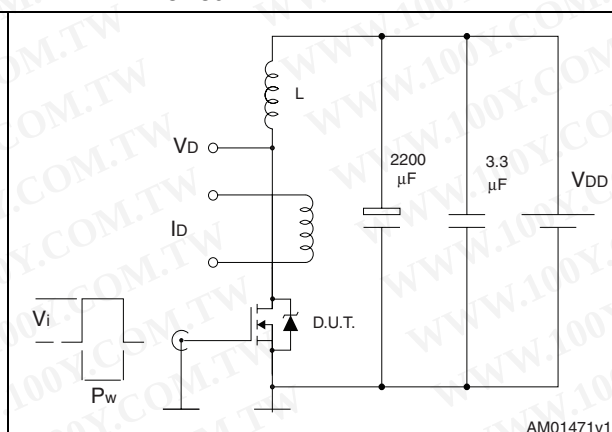
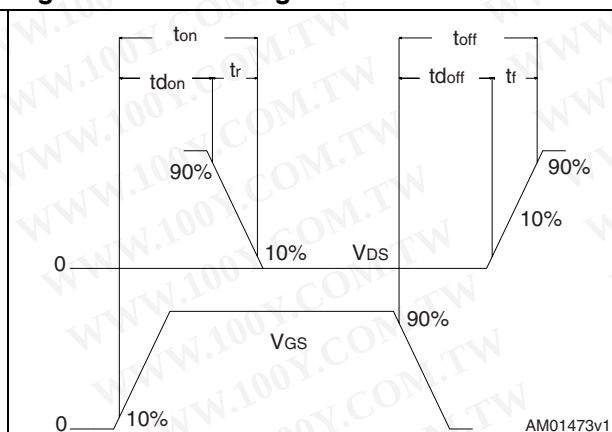
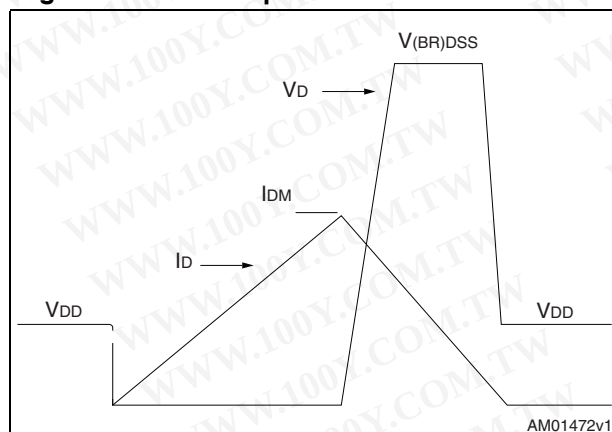


Figure 18. Switching time waveform

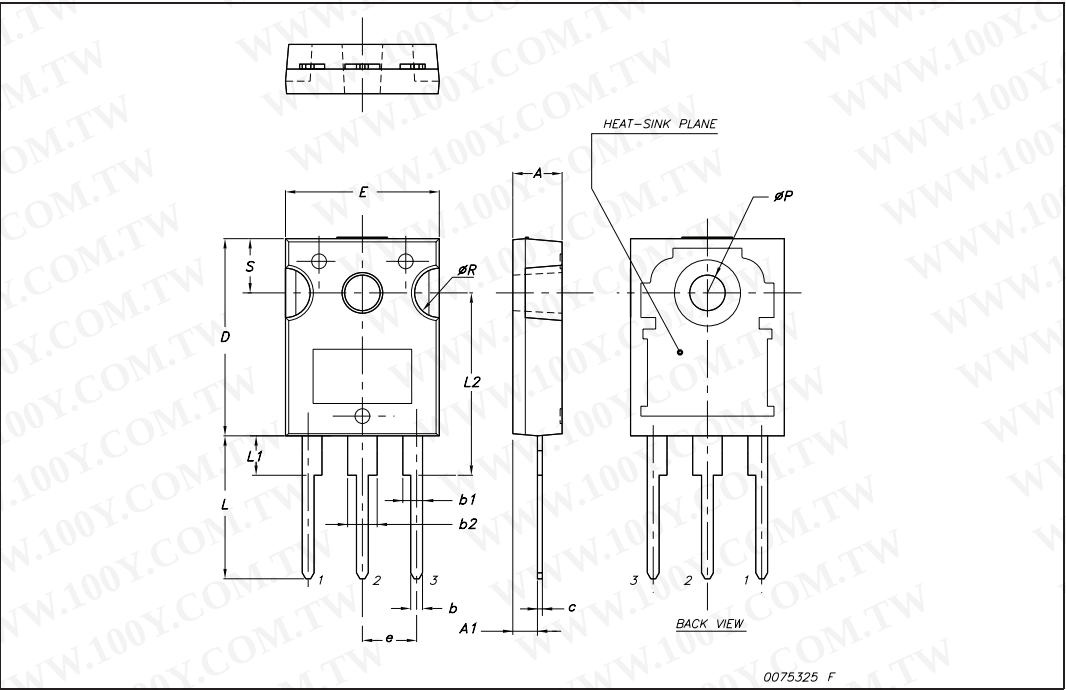


4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

TO-247 Mechanical data

Dim.	mm.		
	Min.	Typ	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e		5.45	
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
øP	3.55		3.65
øR	4.50		5.50
S		5.50	



5 Revision history

Table 9. Document revision history

Date	Revision	Changes
05-Apr-2005	8	Modified value on Source drain diode
26-Apr-2006	9	New template
23-Jul-2009	10	Modified values on Switching times

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