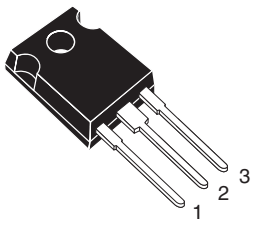
STW45NM50FD

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



TO-247

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

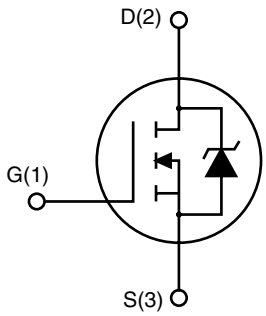


Table 1. Device summary

Order code	Marking	Package	Packaging
STW45NM50FD	W45NM50FD	TO-247	Tube

Contents

1 Electrical ratings

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 °C	45	A
I_D	Drain current (continuous) at T_C=100 °C	28.4	A
I_{DM}(1)	Drain current (pulsed)	180	A
P_{TOT}	Total dissipation at T_C = 25 °C	417	W
	Derating factor	2.08	W/°C
dv/dt(2)	Peak diode recovery voltage slope	20	V/ns
T_J T_{stg}	Operating junction temperature Storage temperature	-65 to 150	°C

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

Table 3. Thermal resistance

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

Table 4. Avalanche data

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

2 Electrical characteristics

(T_{CASE} = 25 °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 µA, V_{GS}= 0	500			V
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = Max rating, V_{DS} = Max rating @125 °C			10 100	µA µA
I_{GSS}	Gate body leakage current (V_{DS} = 0)	V_{GS} = ± 30 V			±100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS}= V_{GS}, I_D = 250 µA	3	4	5	V
$R_{DS(on)}$	Static drain-source on resistance	V_{GS}= 10 V, I_D= 22.5 A		0.07	0.10	Ω

Table 6. Dynamic

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

1. Pulsed: pulse duration=300µs, duty cycle 1.5%
2. $C_{oss\ eq.}$ 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
$t_{d(on)}$ t_r	Turn-on delay time Rise time	V_{DD}=250 V, I_D= 22.5 A, R_G=4.7 Ω, V_{GS}=10 V *Figure 15*	-	26.5 107.5	-	ns ns
$t_{r(Voff)}$ t_f t_c	Off-voltage rise time Fall time Cross-over time	V_{DD}=400 V, I_D= 45 A, R_G=4.7 Ω, V_{GS}=10 V *Figure 15*	-	21.6 87.7 110.9	-	ns ns 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 A, V_{GS} = 0	-		1.5	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD} = 45 A, V_{DD} = 100 V di/dt = 100 A/µs, (see Figure 18)	-	200 1600 16		ns nC A
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD}= 45 A, Tj = 150 °C di/dt = 100 A/µs, V_{DD}=100 V, (see Figure 18)	-	324 4017 24.8		ns nC A

1. Pulse width limited by safe operating area
2. Pulsed: pulse duration=300µs, duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

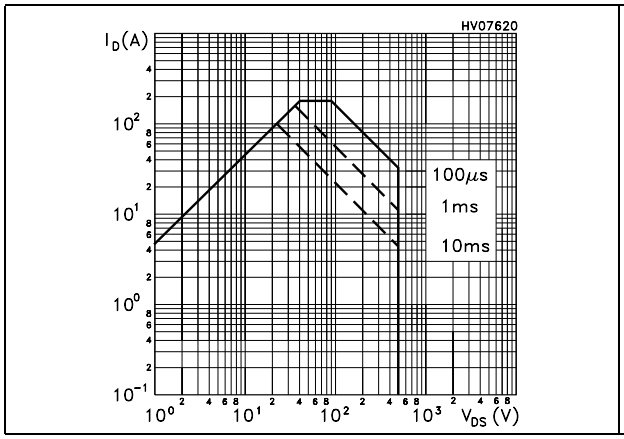


Figure 3. Thermal impedance

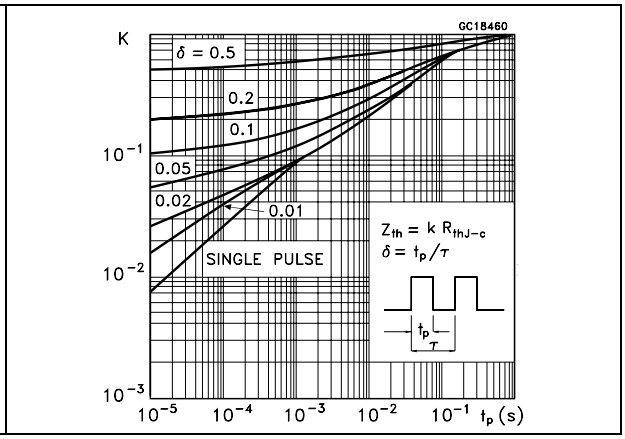


Figure 4. Output characteristics

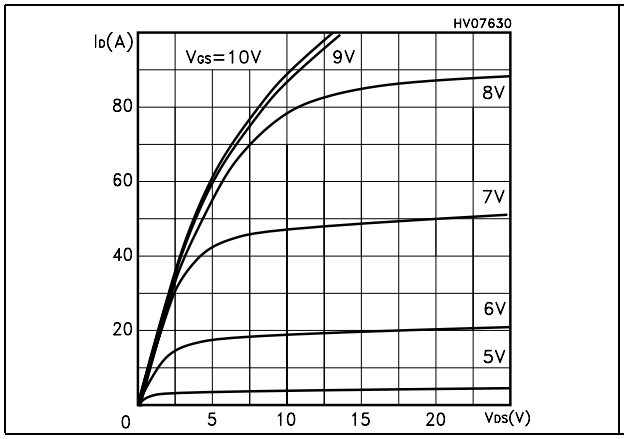


Figure 5. Transfer characteristics

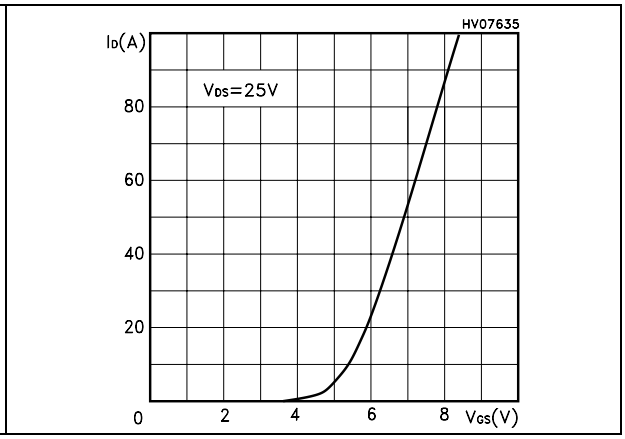


Figure 6. Transconductance

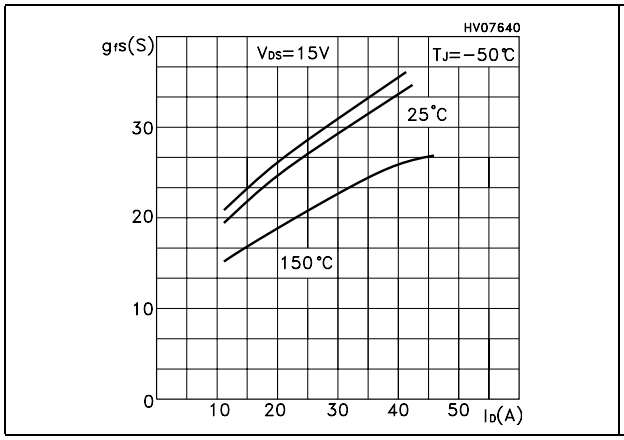


Figure 7. Static drain-source on resistance

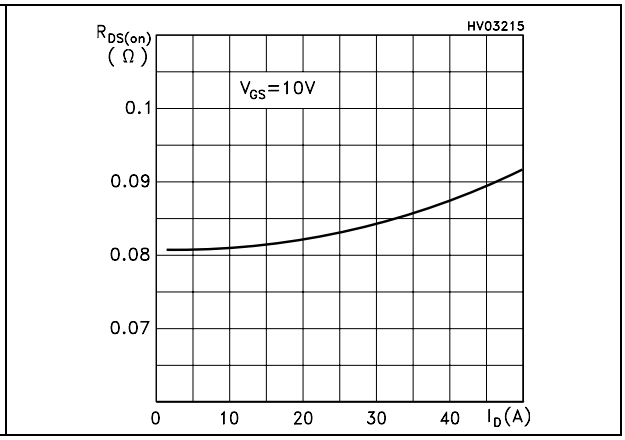


Figure 8. Gate charge vs gate-source voltage

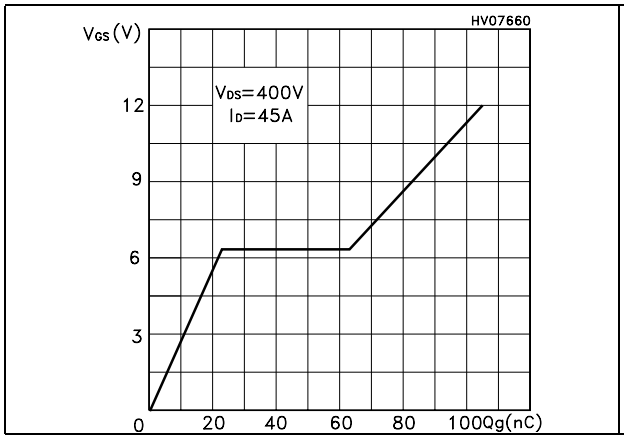


Figure 9. Capacitance variations

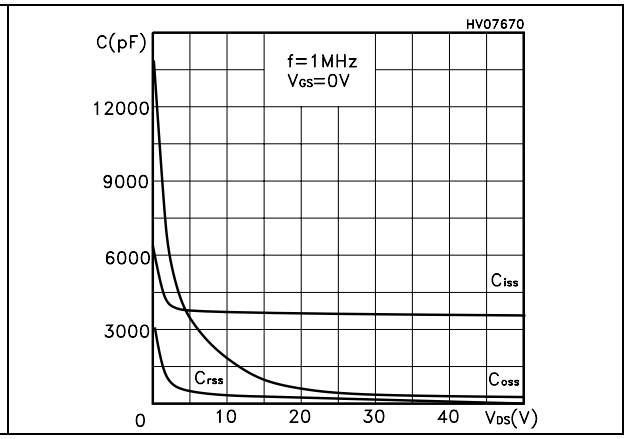


Figure 10. Normalized gate threshold voltage vs temperature

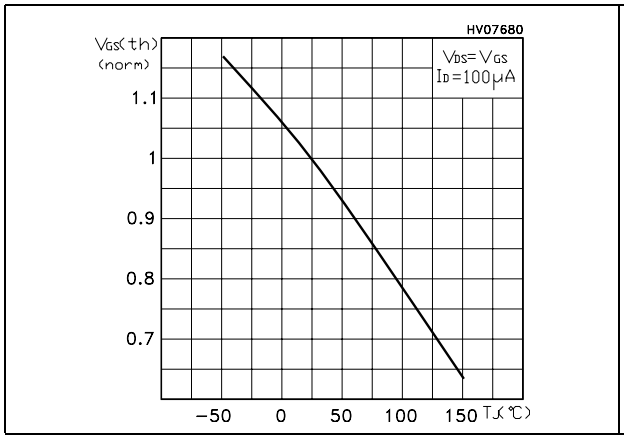


Figure 11. Normalized on resistance vs temperature

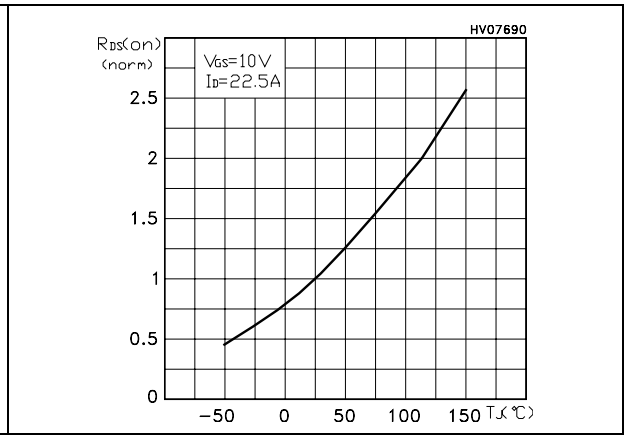
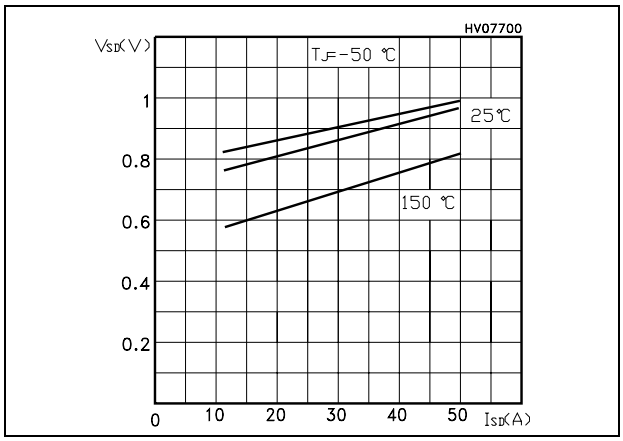


Figure 12. Source-drain diode forward characteristics



3 Test circuits

Figure 13. Switching times test circuit for resistive load

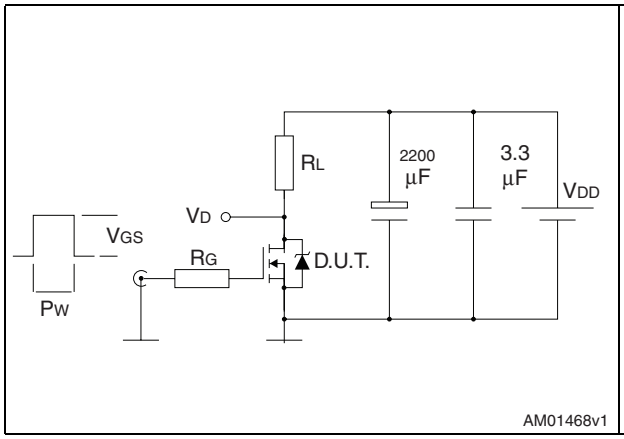


Figure 14. Gate charge test circuit

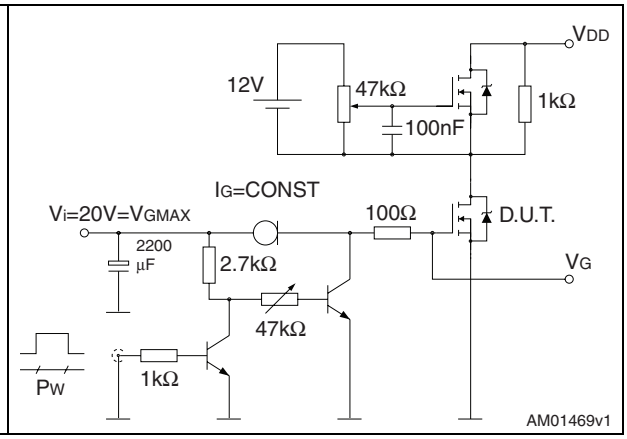


Figure 15. Test circuit for inductive load switching and diode recovery times

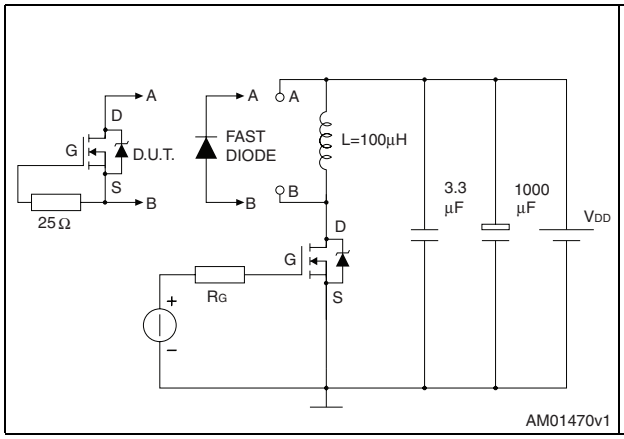


Figure 16. Unclamped inductive load test circuit

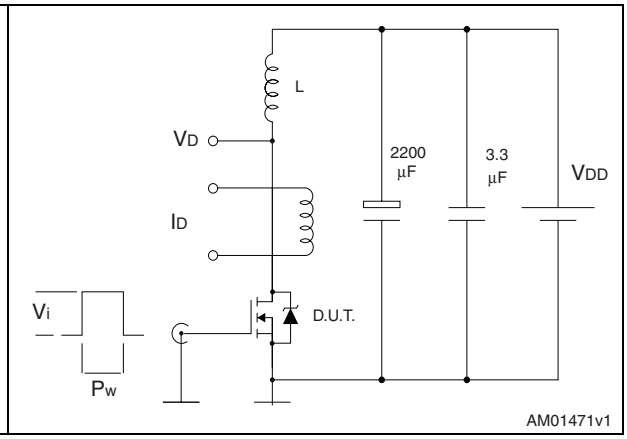


Figure 17. Unclamped inductive waveform

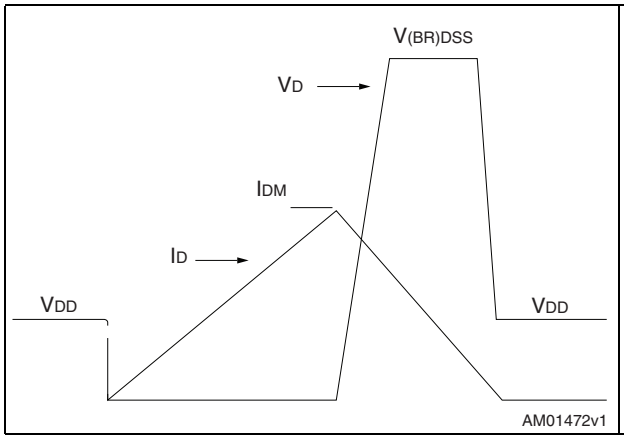
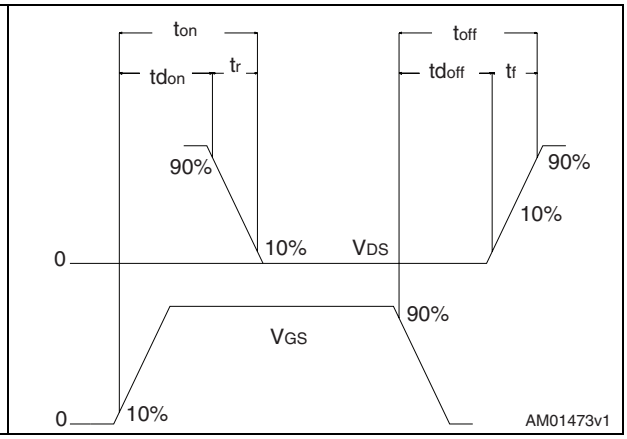


Figure 18. Switching time waveform

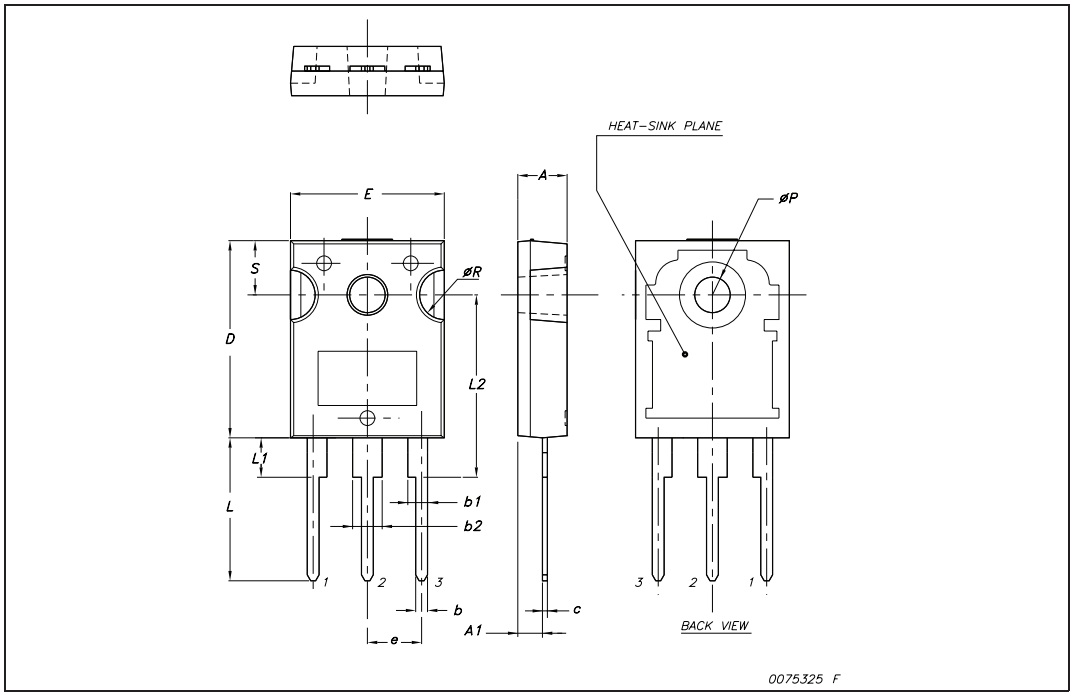


4 Package mechanical data

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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