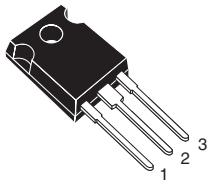
STW9NK95Z

N-channel 950 V - 1.15 Ω - 7 A - TO-247
Zener-protected SuperMESH™ Power MOSFET

Features

Type	V_{DSS}	$R_{DS(on)}$ Max	I_D	Pw
STW9NK95Z	950 V	< 1.38 Ω	7 A	160 W

- Extremely high dv/dt capability
- 100% avalanche tested
- Gate charge minimized



TO-247

Application

- Switching applications

Description

The SuperMESH™ series is obtained through an extreme optimization of ST's well established strip-based PowerMESH™ layout. In addition to pushing on-resistance significantly down, special care is taken to ensure a very good dv/dt capability for the most demanding applications.

Figure 1. Internal schematic diagram

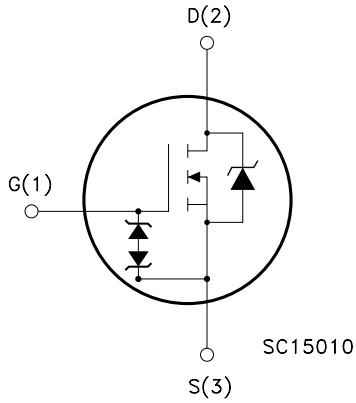


Table 1. Device summary

Order code	Marking	Package	Packaging
STW9NK95Z	9NK95Z	TO-247	Tube

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage (V_{GS} = 0)	950	V
V_{GS}	Gate-source voltage	± 30	V
I_D	Drain current (continuous) at T_C = 25 °C	7	A
I_D	Drain current (continuous) at T_C=100 °C	4.41	A
I_{DM}(1)	Drain current (pulsed)	28	A
P_{TOT}	Total dissipation at T_C = 25 °C	160	W
	Derating Factor	1.28	W/°C
Vesd(G-S)	G-S ESD (HBM C=100 pF, R=1.5 kΩ)	4000	V
dv/dt(2)	Peak diode recovery voltage slope	4.5	V/ns
T_J T_{stg}	Operating junction temperature Storage temperature	-55 to 150	°C

1. Pulse width limited by safe operating area
2. $I_{SD} \leq 7$ A, di/dt $\leq$ 100 A/µs,$V_{DD} \leq$ 80% $V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case max	0.78	°C/W
$R_{thj\text{-}a}$	Thermal resistance junction-ambient max	50	°C/W
T_l	Maximum lead temperature for soldering purpose	300	°C

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AS}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_J Max)	7	A
E_{AS}	Single pulse avalanche energy (starting T_J=25 °C, I_D=I_{AS}, V_{DD}=50 V) *(see Figure 17)and (see Figure 18)*	300	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 = 1 mA, V_{GS}= 0	950			V
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = max rating, V_{DS} = max rating @125 °C			1 50	µA µA
I_{GSS}	Gate body leakage current (V_{DS} = 0)	V_{GS} = ±20 V, V_{DS} = 0			±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS}= V_{GS}, I_D = 100 µA	3	3.75	4.5	V
$R_{DS(on)}$	Static drain-source on resistance	V_{GS}= 10 V, I_D= 3.6 A		1.15	1.38	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
g_{fs} (1)	Forward transconductance	V_{DS} =15 V, I_D = 3.6 A		5.7		S
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	V_{DS} = 25 V, f=1 MHz, V_{GS} = 0		2256 189 30		pF pF pF
$C_{oss\ eq}$ (2).	Equivalent output capacitance	V_{GS}=0, V_{DS} =0 to 760 V		37		pF
R_G	Intrinsic gate resistance	f=1 MHz, open drain		1.6		Ω
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	V_{DD} = 760 V, I_D = 7.2 A V_{GS} = 10 V *(see Figure 15)*		56 10 30		nC nC nC

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}= 475 V, I_D= 3.6 A, R_G= 4.7 Ω, V_{GS}= 10 V *(see Figure 14)* *(see Figure 19)*		22 15		ns ns
$t_{d(off)}$ t_f	Turn-off delay time Fall time	V_{DD}= 475 V, I_D= 3.6 A, R_G= 4.7 Ω, V_{GS}= 10 V *(see Figure 14)* *(see Figure 19)*		51 22		ns ns

Table 8. Gate-source Zener diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
BV_{GSO} (1)	Gate-source breakdown voltage	Igs=±1 mA(open drain)	30			V

1. The built-in back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

Table 9. Source drain diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
I_{SD}	Source-drain current				7	A
I_{SDM} (1)	Source-drain current (pulsed)				28	A
V_{SD} (2)	Forward on voltage	I_{SD}= 7.2 A, V_{GS}=0			1.6	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD}= 7.2 A, di/dt = 100 A/µs, V_{DD}= 60V, Tj = 25°C *(see Figure 16)*		660 5.9 18		ns µC A
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD}= 7.2 A, di/dt = 100 A/µs, V_{DD}= 60V, Tj = 150°C *(see Figure 16)*		800 7.4 18.6		ns µC 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

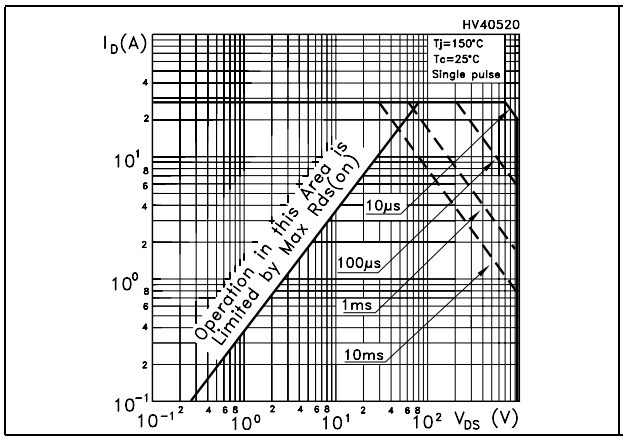


Figure 3. Thermal impedance

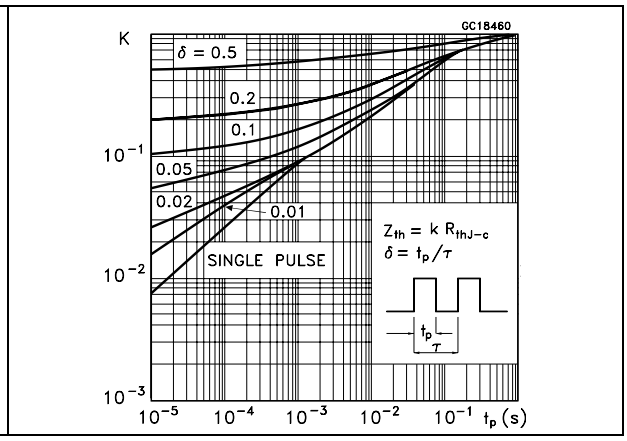


Figure 4. Output characteristics

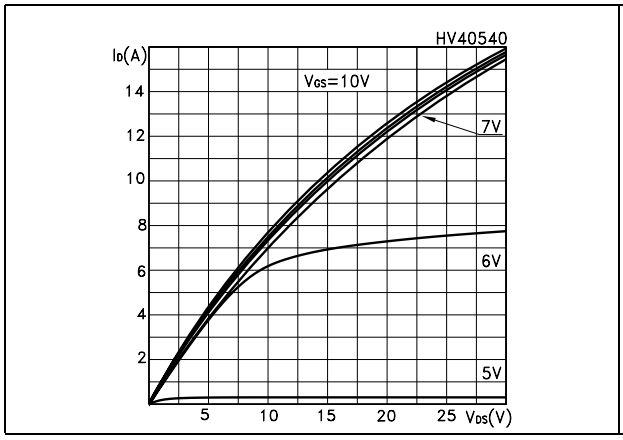


Figure 5. Transfer characteristics

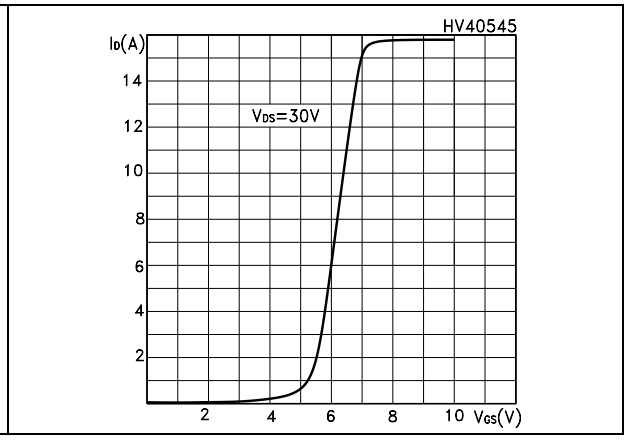


Figure 6. Normalized B_{VDSS} vs temperature

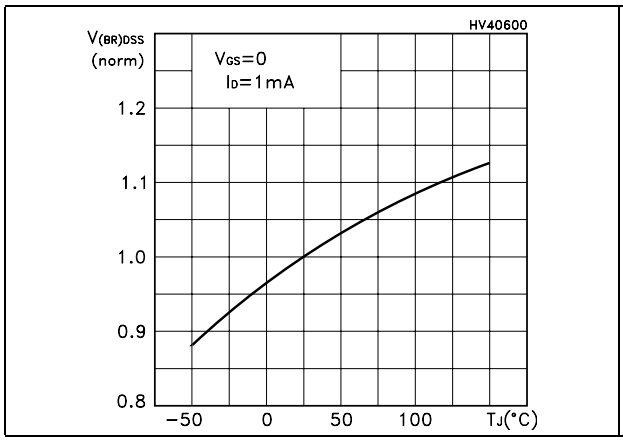


Figure 7. Static drain-source on resistance

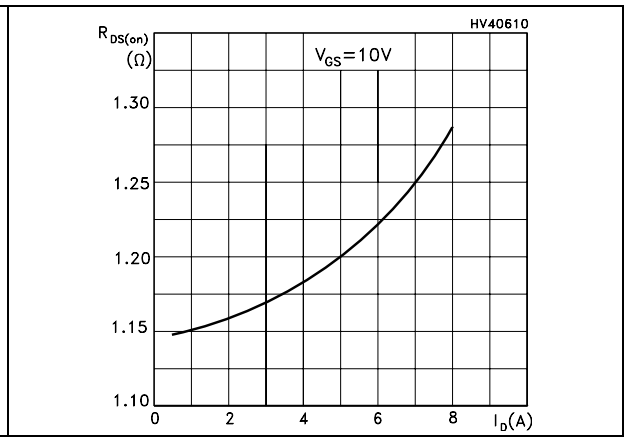


Figure 8. Gate charge vs gate-source voltage

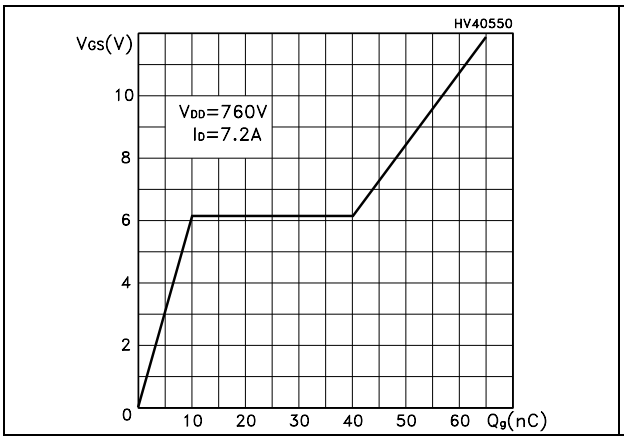


Figure 9. Capacitance variations

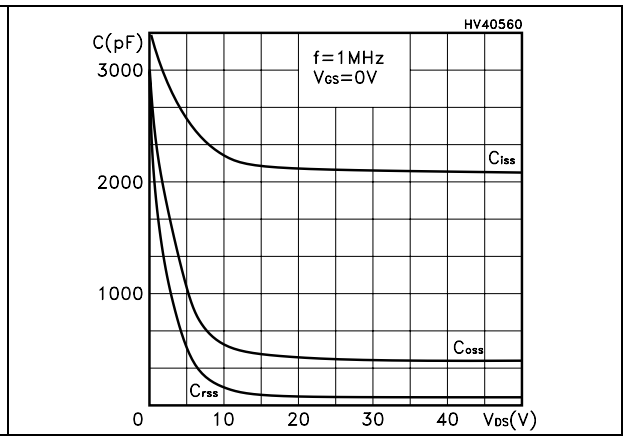


Figure 10. Normalized gate threshold voltage vs temperature

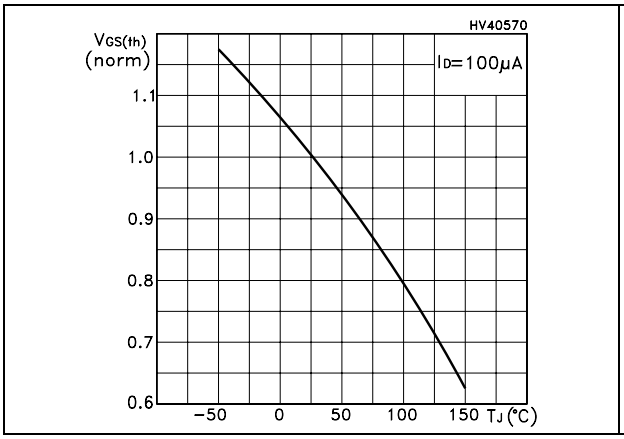


Figure 11. Normalized on resistance vs temperature

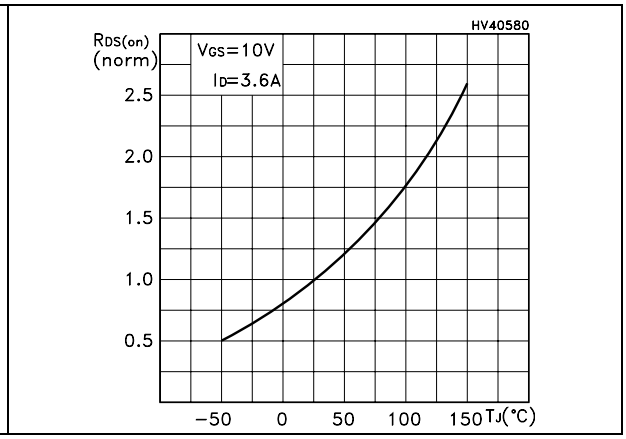


Figure 12. Source-drain diode forward characteristics

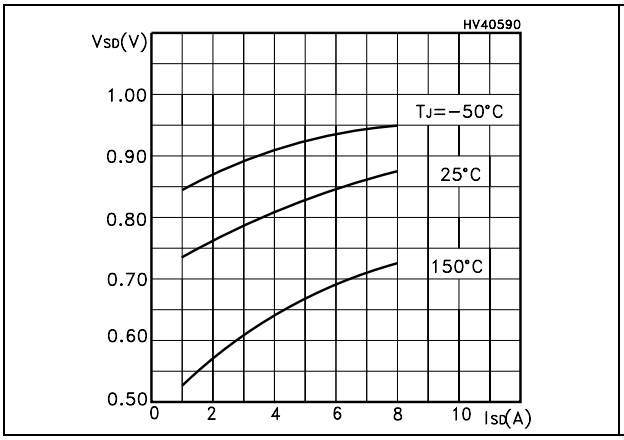
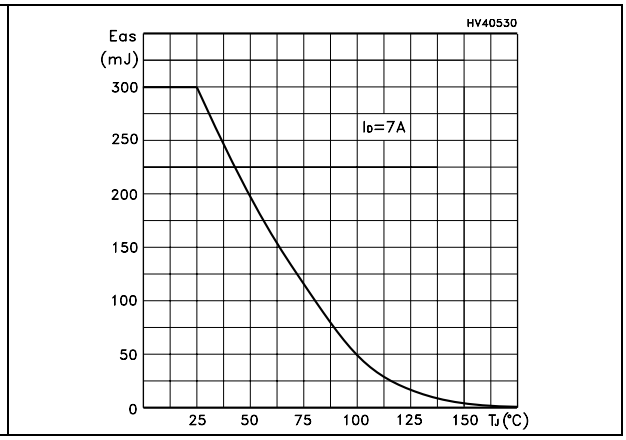


Figure 13. Maximum avalanche energy vs temperature



3 Test circuits

Figure 14. Switching times test circuit for resistive load

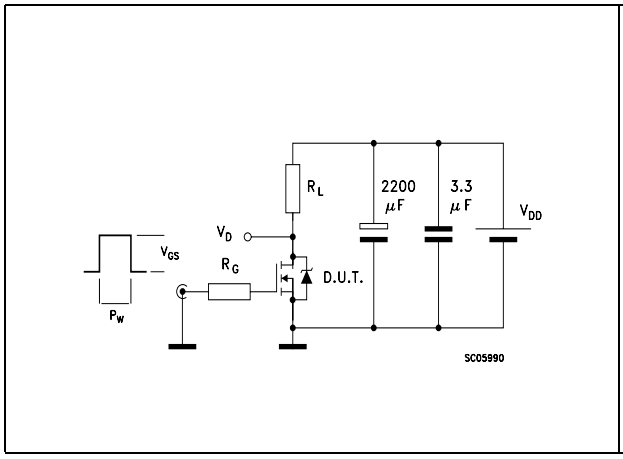


Figure 15. Gate charge test circuit

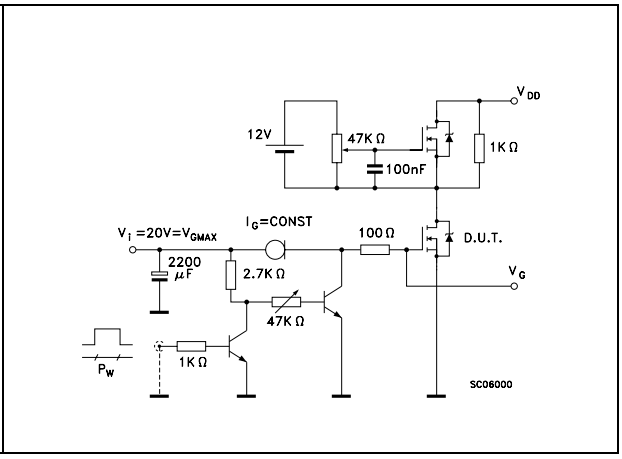


Figure 16. Test circuit for inductive load switching and diode recovery times

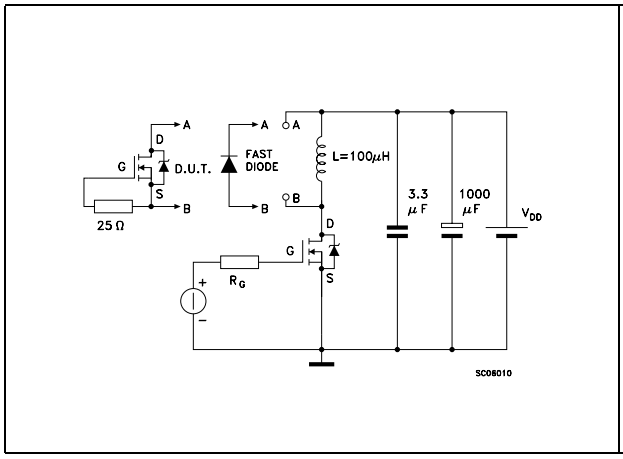


Figure 17. Unclamped Inductive load test circuit

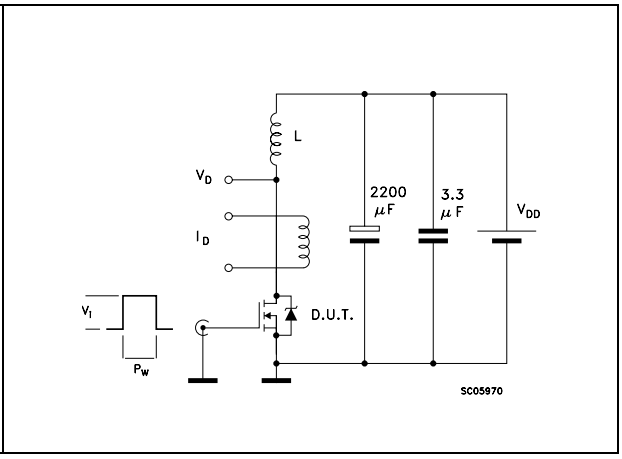


Figure 18. Unclamped inductive waveform

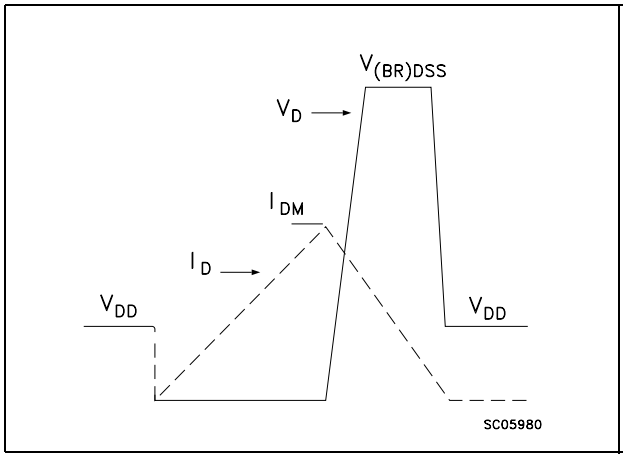
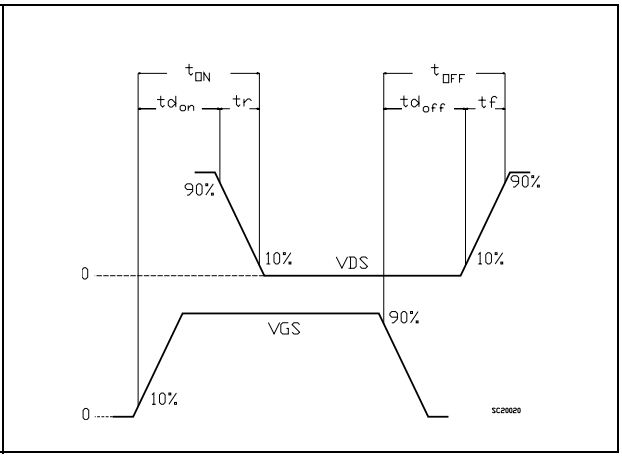


Figure 19. Switching time waveform

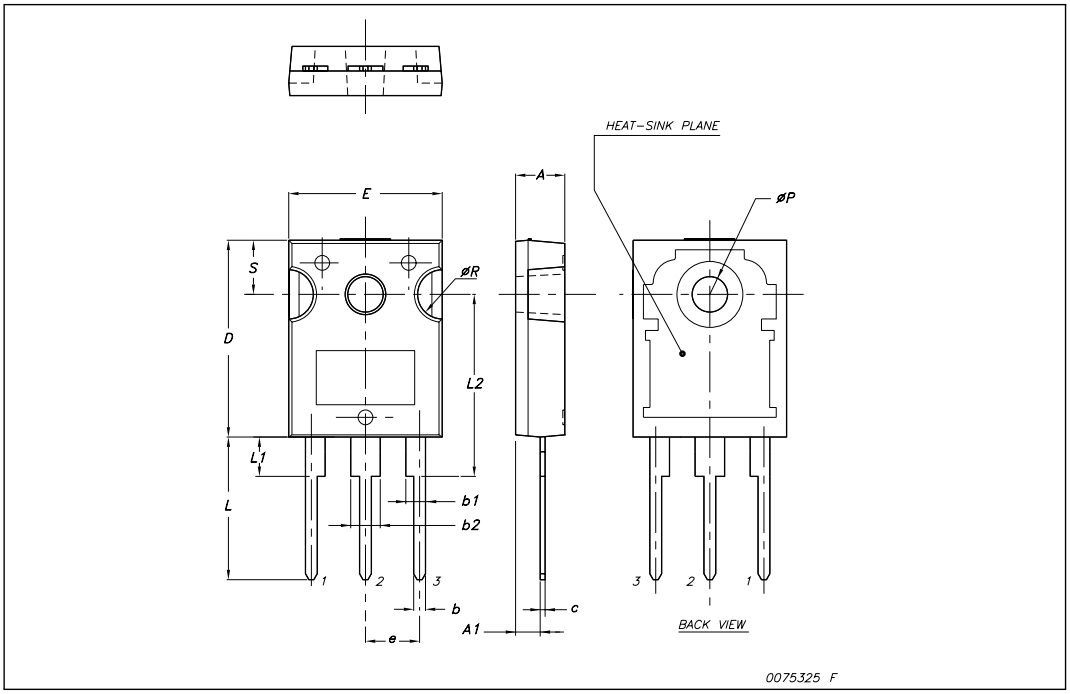


4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com

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 10. Document revision history

Date	Revision	Changes
11-Oct-2006	1	Initial release
03-Jul-2008	2	Updated *Figure 6, Figure 7, Figure 9*

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