STI23NM60ND

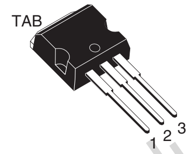
N-channel 600 V, 0.150 Ω typ., 19.5 A, FDmesh™ II Power MOSFET (with fast diode) in a I^2PAK package

Datasheet — production data

Features

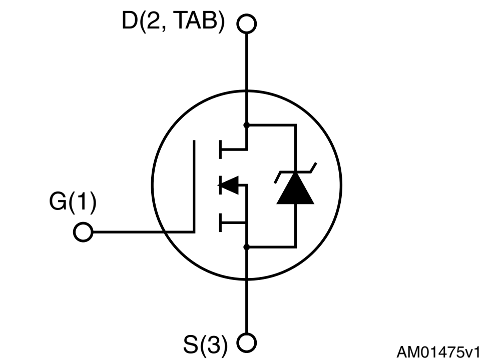
Order code	V_{DSS} @ T_{Jmax}	$R_{DS(on)}$ max	I_D
STI23NM60ND	650 V	< 0.180 Ω	19.5 A

- The worldwide best $R_{DS(on)}$ * area amongst the fast recovery diode devices
- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance
- High dv/dt and avalanche capabilities



I^2PAK

Figure 1. Internal schematic diagram



Applications

- Switching applications

Description

These FDmesh™ II Power MOSFETs with intrinsic fast-recovery body diode are produced using the second generation of MDmesh™ technology. Utilizing a new strip-layout vertical structure, these revolutionary devices feature extremely low on-resistance and superior switching performance. They are ideal for bridge topologies and ZVS phase-shift converters.

Table 1. Device summary

Oreder codes	Marking	Package	Packaging
STI23NM60ND	23NM60ND	TO-220FP	Tube

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	600	V
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at T_C = 25 °C	19.5	A
I_D	Drain current (continuous) at T_C = 100 °C	11.7	A
I_{DM} (1)	Drain current (pulsed)	78	A
P_{TOT}	Total dissipation at T_C = 25 °C	150	W
I_{AS}	Avalanche current, repetitive or not-repetitive (pulse width limited by Tj max)	9	A
E_{AS}	Single pulse avalanche energy (starting T_j= 25 °C, I_D = I_{AS}, V_{DD} = 50 V)	700	mJ
dv/dt (2)	Peak diode recovery voltage slope	40	V/ns
T_{stg}	Storage temperature	-55 to 150	°C
T_j	Max. operating junction temperature	150	°C

1. Pulse width limited by safe operating area
2. $I_{SD} \leq 19.5$ A, di/dt ≤ 600 A/µs, V_{DD} =80% $V_{(BR)DSS}$, $V_{DS(peak)} < V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	0.83	°C/W
$R_{thj-amb}$	Thermal resistance junction-amb max	62.5	°C/W
$R_{thj-pcb}$	Thermal resistance junction-pcb max(1)		°C/W

1. When mounted on 1 inch² FR-4, 2 Oz copper board.

2 Electrical characteristics

(T_{CASE} = 25 °C unless otherwise specified)

Table 4. 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	600			V
dv/dt(1)	Drain-source voltage slope	V_{DD} = 480 V, I_D = 19.5 A, V_{GS} = 10 V		30		V/ns
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = 600 V, V_{DS} = 600 V, T_c=125 °C			1 100	µA µA
I_{GSS}	Gate body leakage current (V_{DS} = 0)	V_{GS} = ±20 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= 10 A		0.150	0.180	Ω

1. Characteristic value at turn off on inductive load

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	V_{DS} = 50 V, f =1 MHz, V_{GS} = 0	-	2100 80 10	-	pF pF pF
$C_{oss\ eq.}$(1)	Equivalent output capacitance	V_{GS} = 0, V_{DS} = 0 to 480 V	-	310	-	pF
Rg	Gate input resistance	f=1 MHz Gate DC Bias=0 Test signal level=20 mV open drain	-	4	-	Ω
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	V_{DD} = 480 V, I_D = 19.5 A V_{GS} = 10 V *(see Figure 14)*	-	69 13 35	-	nC nC nC

1. $C_{oss\ eq.}$ 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 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r $t_{d(off)}$ t_f	Turn-on delay time Rise time Turn-off delay time Fall time	V_{DD} = 300 V, I_D = 10 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 13)	-	21 19 92 42	-	ns ns ns ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD} I_{SDM}(1)	Source-drain current Source-drain current (pulsed)		-		19.5 78	A A
V_{SD}(2)	Forward on voltage	I_{SD} = 19.5 A, V_{GS}=0	-		1.3	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD} = 19.5 A, di/dt =100 A/µs, V_{DD} = 60 V *(see Figure 15)*	-	190 1.2 13		ns µC A
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	V_{DD} = 60 V di/dt =100 A/µs, I_{SD} = 19.5 A T_j = 150 °C *(see Figure 15)*	-	270 2.0 15		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

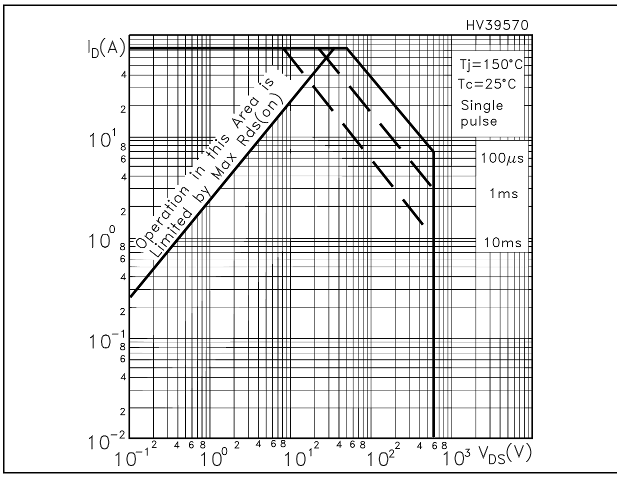


Figure 3. Thermal impedance

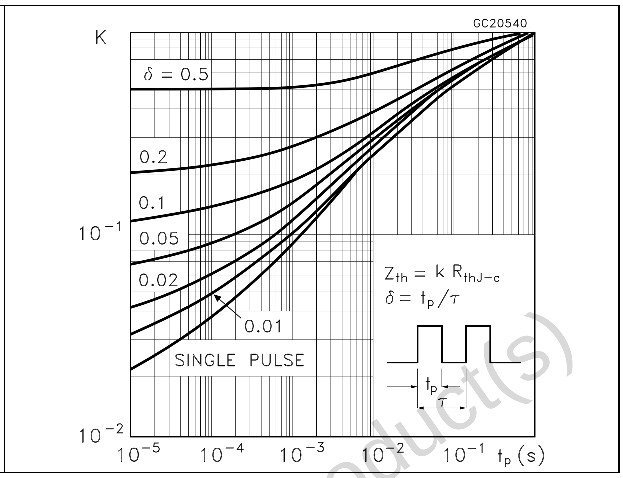


Figure 4. Output characteristics

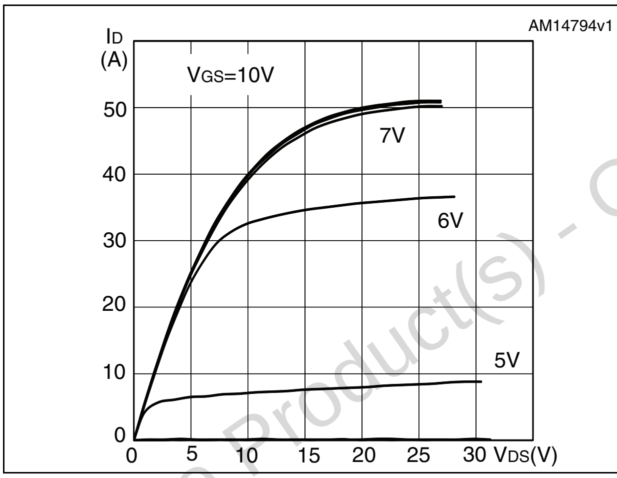


Figure 5. Transfer characteristics

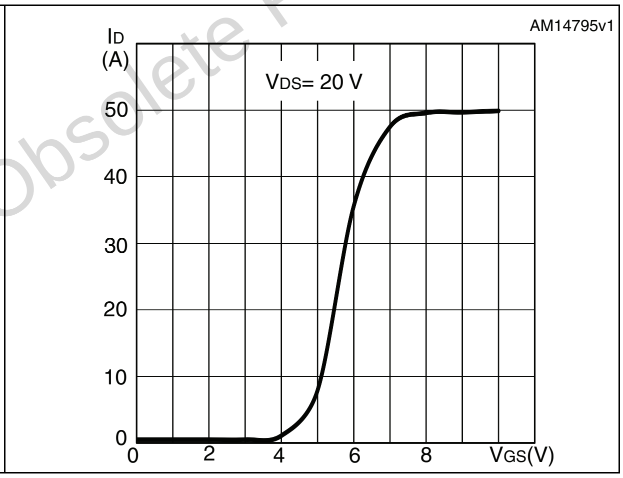


Figure 6. Static drain-source on resistance

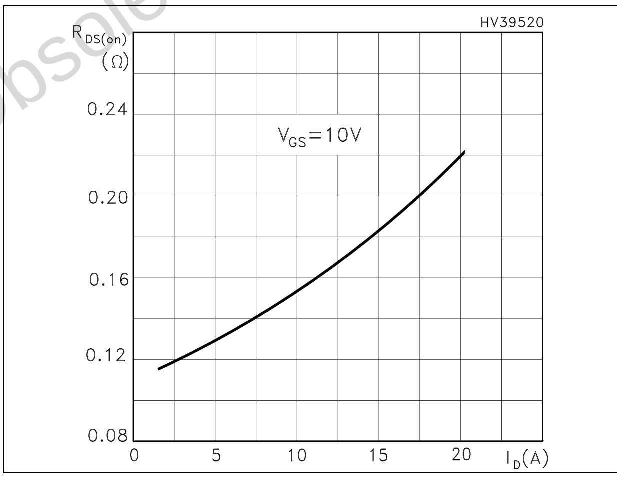


Figure 7. Gate charge vs gate-source voltage

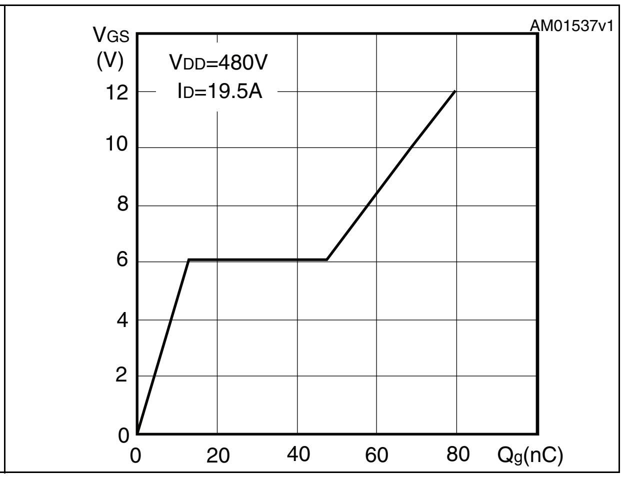


Figure 8. Capacitance variations

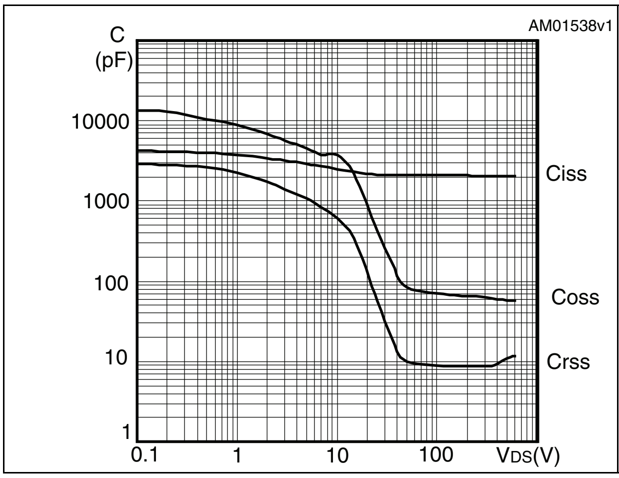


Figure 9. Normalized gate threshold voltage vs temperature

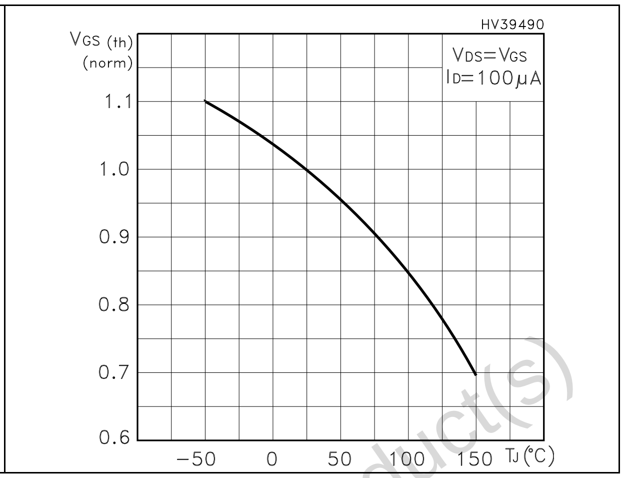


Figure 10. Normalized on-resistance vs temperature

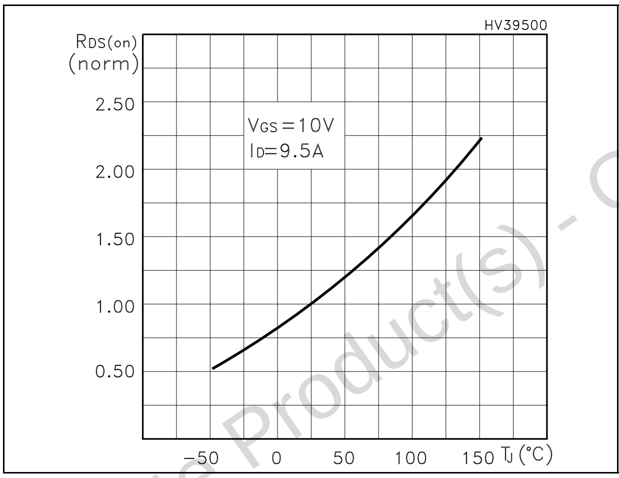


Figure 11. Source-drain diode forward characteristics

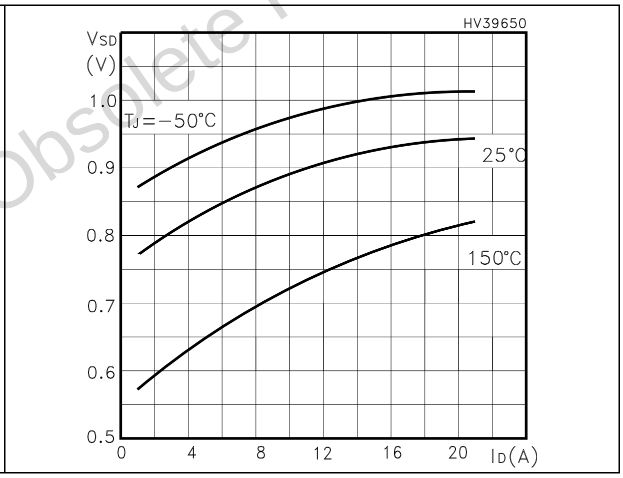
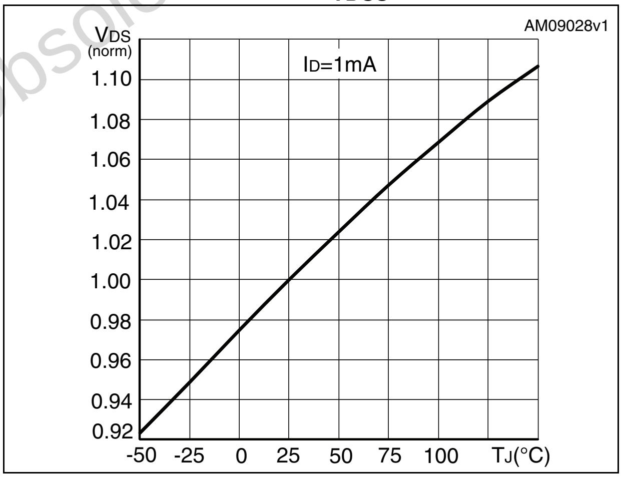


Figure 12. Normalized B_{VDSS} vs temperature



3 Test circuits

Figure 13. Switching times test circuit for resistive load

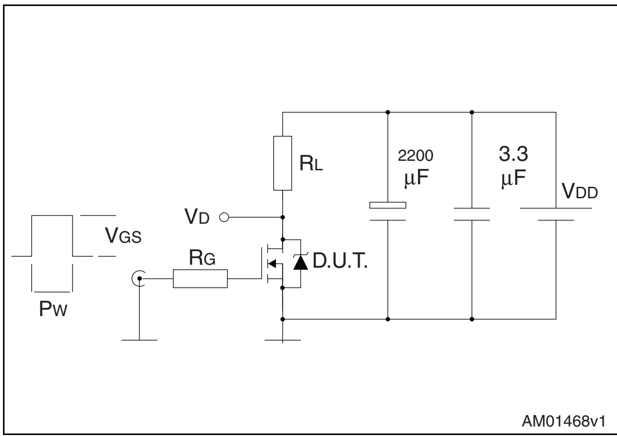


Figure 14. Gate charge test circuit

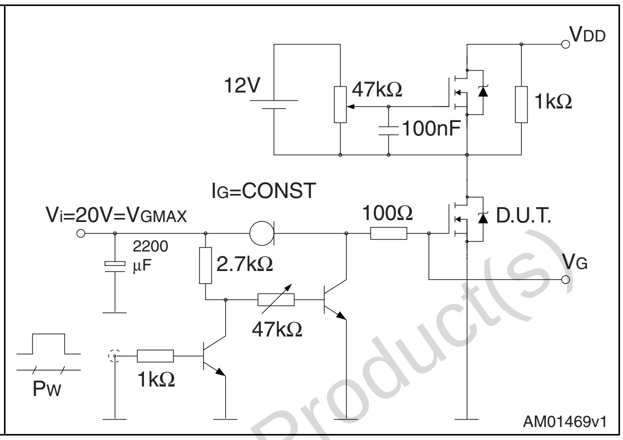


Figure 15. Test circuit for inductive load switching and diode recovery times

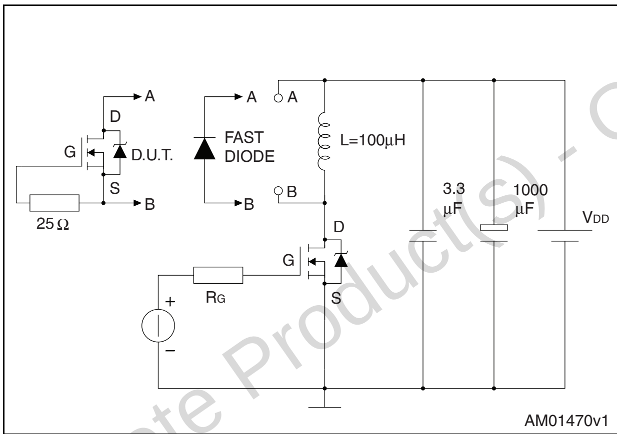


Figure 16. Unclamped inductive load test circuit

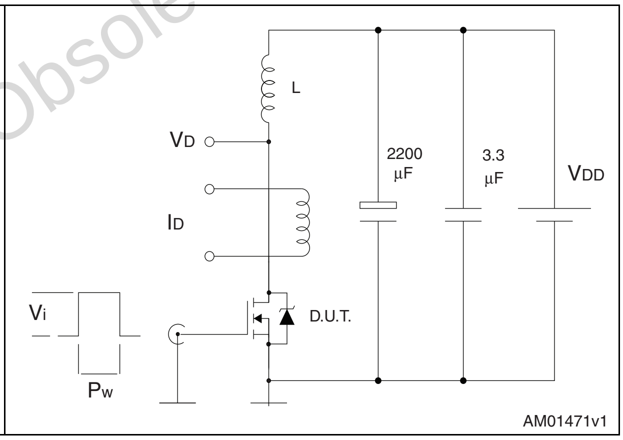


Figure 17. Unclamped inductive waveform

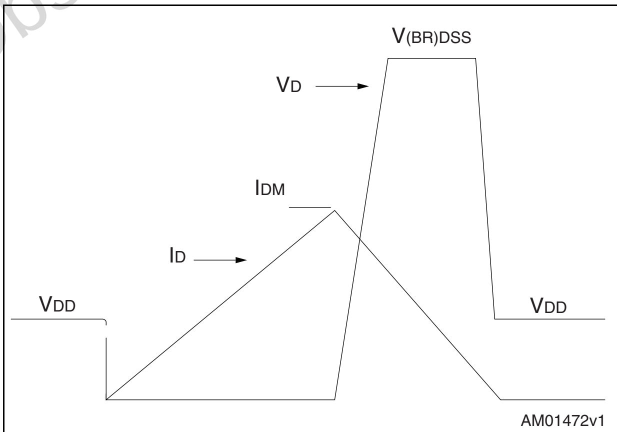
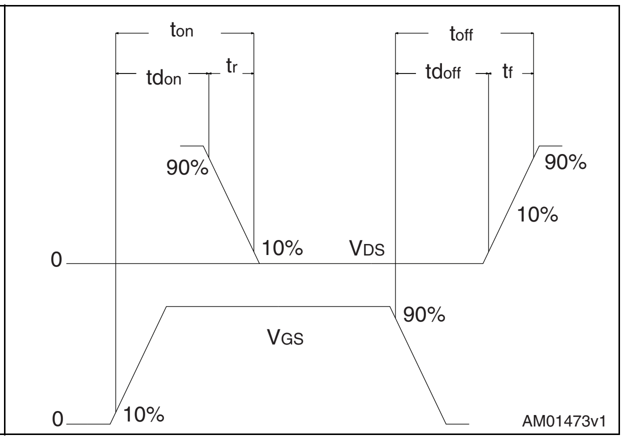


Figure 18. Switching time waveform



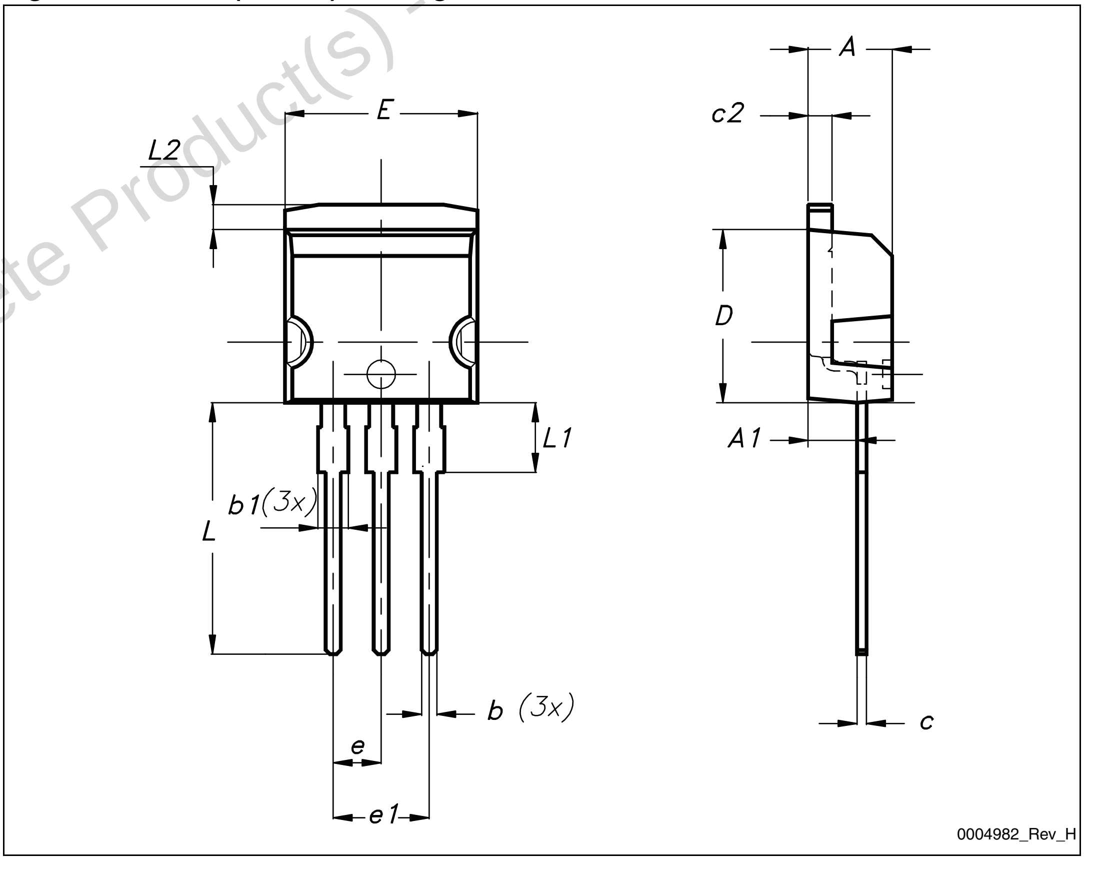
4 Package mechanical data

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.

Table 8. I^2PAK (TO-262) mechanical data

DIM.	mm.		
	min.	typ	max.
A	4.40		4.60
A1	2.40		2.72
b	0.61		0.88
b1	1.14		1.70
c	0.49		0.70
c2	1.23		1.32
D	8.95		9.35
e	2.40		2.70
e1	4.95		5.15
E	10		10.40
L	13		14
L1	3.50		3.93
L2	1.27		1.40

Figure 19. I^2PAK (TO-262) drawing



5 Revision history

Table 9. Document revision history

Date	Revision	Changes
07-Jan-2013	1	Initial release. The part number STI23NM60ND previously included in datasheet CD00183341.