

N-channel 500 V, 0.2 Ω typ., 14 A MDmesh™ II Power MOSFETs
in TO-220FP, TO-220 and TO-247 packages

Datasheet - production data

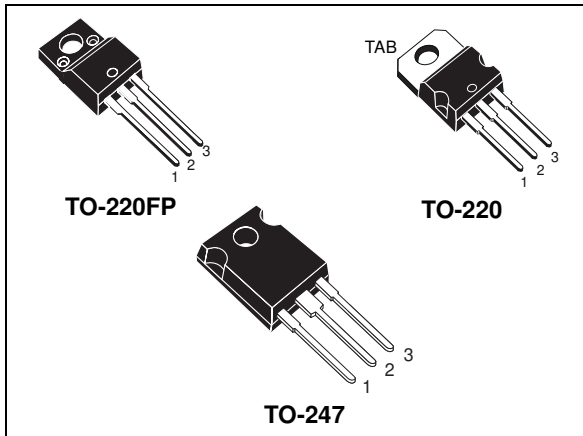
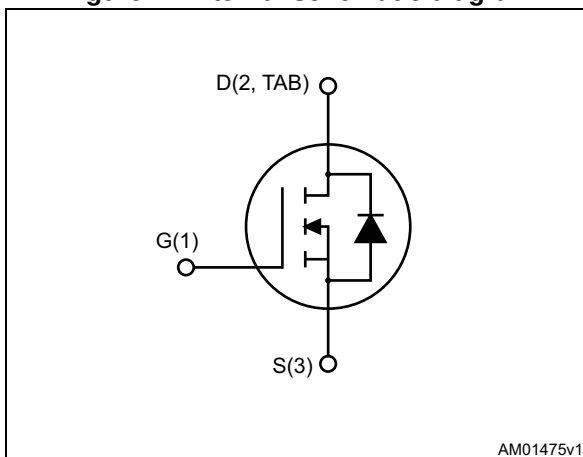


Figure 1. Internal schematic diagram



Features

Order codes	$V_{DS} @ T_{Jmax}$	$R_{DS(on) max}$	I_D
STF19NM50N	550 V	0.25 Ω	14 A
STP19NM50N			
STW19NM50N			

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

Applications

- Switching applications

Description

These devices are N-channel Power MOSFETs developed using the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters.

Table 1. Device summary

Order codes	Marking	Packages	Packaging
STF19NM50N	19NM50N	TO-220FP	Tube
STP19NM50N		TO-220	
STW19NM50N		TO-247	

Contents

1	Electrical ratings	3
2	Electrical characteristics	4
	2.1 Electrical characteristics (curves)	6
3	Test circuits	9
4	Package mechanical data	10
5	Revision history	17

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		TO-220	TO-247	TO-220FP	
V_{DS}	Drain-source voltage	500			V
V_{GS}	Gate-source voltage	± 25			V
I_D	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	14		14 ⁽¹⁾	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	10		10 ⁽¹⁾	A
$I_{DM}^{(2)}$	Drain current (pulsed)	56		56 ⁽¹⁾	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	110		30	W
$dv/dt^{(3)}$	Peak diode recovery voltage slope	15			V/ns
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; $T_C = 25\text{ }^\circ\text{C}$)	2500			V
T_{stg}	Storage temperature	- 55 to 150			$^\circ\text{C}$
T_j	Max. operating junction temperature	150			$^\circ\text{C}$

- Limited by maximum junction temperature
- Pulse width limited by safe operating area
- $I_{SD} \leq 14\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DS\text{ peak}} \leq V_{(BR)DSS}$, $V_{DD} = 80\% V_{(BR)DSS}$.

Table 3. Thermal data

Symbol	Parameter	Value			Unit
		TO-220	TO-247	TO-220FP	
$R_{thj-case}$	Thermal resistance junction-case max	1.14		4.17	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	62.5	50	62.5	$^\circ\text{C}/\text{W}$

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max)	6	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	208	mJ

2 Electrical characteristics

($T_C = 25\text{ °C}$ unless otherwise specified)

Table 5. On /off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0$	500			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 500\text{ V}$ $V_{DS} = 500\text{ V}$, $T_C = 125\text{ °C}$			1 100	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 25\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 7\text{ A}$		0.2	0.25	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 50\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$	-	1000	-	pF
C_{oss}	Output capacitance		-	72	-	pF
C_{riss}	Reverse transfer capacitance		-	3	-	pF
$C_{oss\text{ eq}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ to }400\text{ V}$, $V_{GS} = 0$	-	202	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}$, $I_D = 0$	-	4.4	-	Ω
Q_g	Total gate charge	$V_{DD} = 400\text{ V}$, $I_D = 14\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 17)	-	34	-	nC
Q_{gs}	Gate-source charge		-	5	-	nC
Q_{gd}	Gate-drain charge		-	18	-	nC

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

Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 250\text{ V}$, $I_D = 7\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 18)	-	12	-	ns
t_r	Rise time		-	16	-	ns
$t_{d(off)}$	Turn-off-delay time		-	61	-	ns
t_f	Fall time		-	17	-	ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		14	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		56	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 14\text{ A}$, $V_{GS} = 0$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 14\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 21)	-	296		ns
Q_{rr}	Reverse recovery charge		-	3.5		μC
I_{RRM}	Reverse recovery current		-	23		A
t_{rr}	Reverse recovery time	$I_{SD} = 14\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 21)	-	346		ns
Q_{rr}	Reverse recovery charge		-	4		μC
I_{RRM}	Reverse recovery current		-	24		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 for TO-220FP

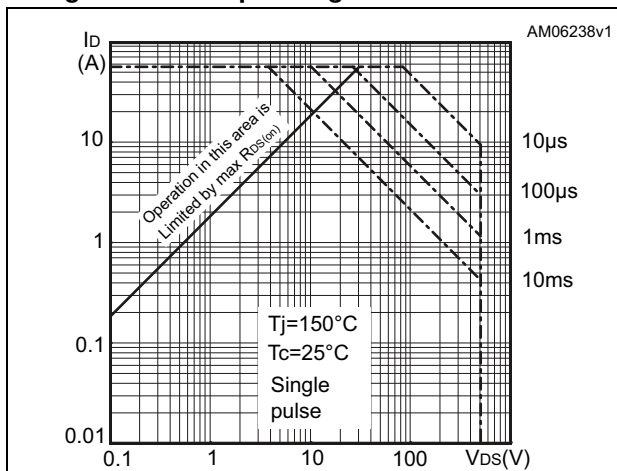


Figure 3. Thermal impedance for TO-220FP

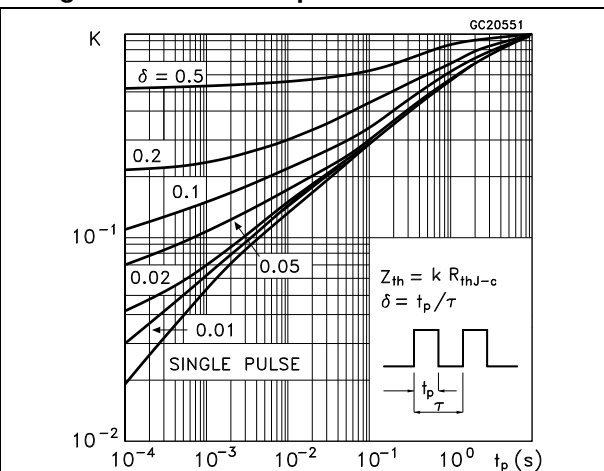


Figure 4. Safe operating area for TO-220

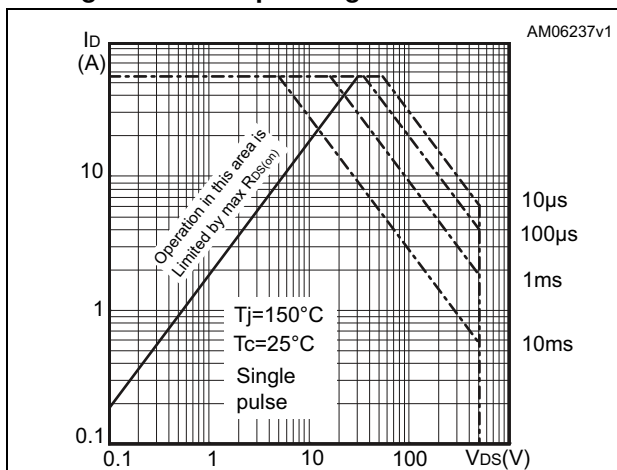


Figure 5. Thermal impedance for TO-220

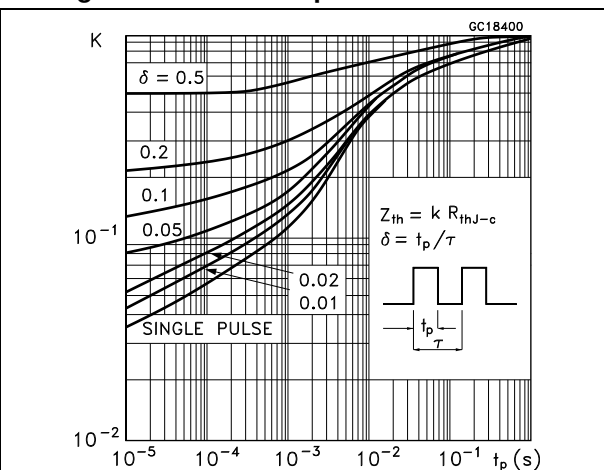


Figure 6. Safe operating area for TO-247

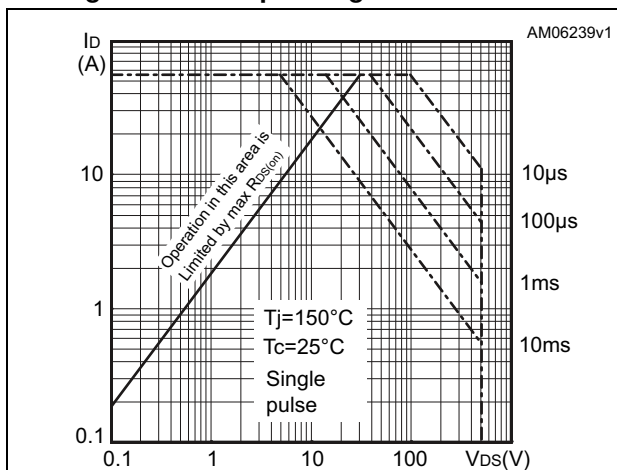


Figure 7. Thermal impedance for TO-247

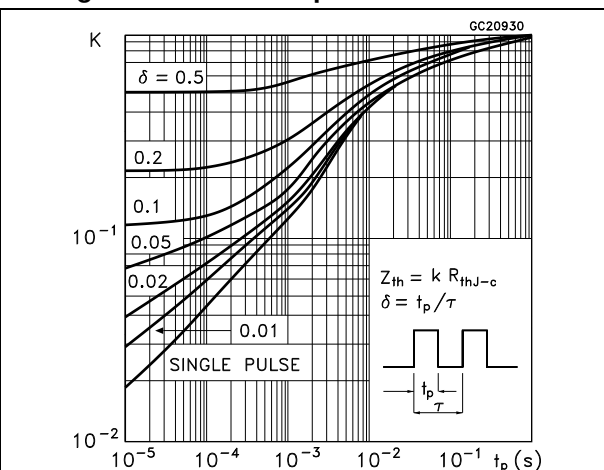


Figure 8. Output characteristics

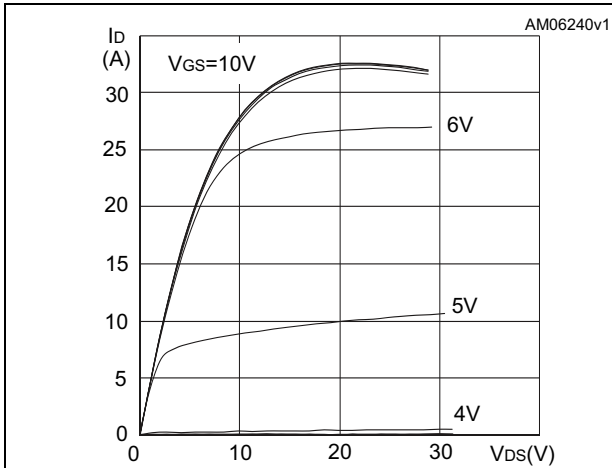


Figure 9. Transfer characteristics

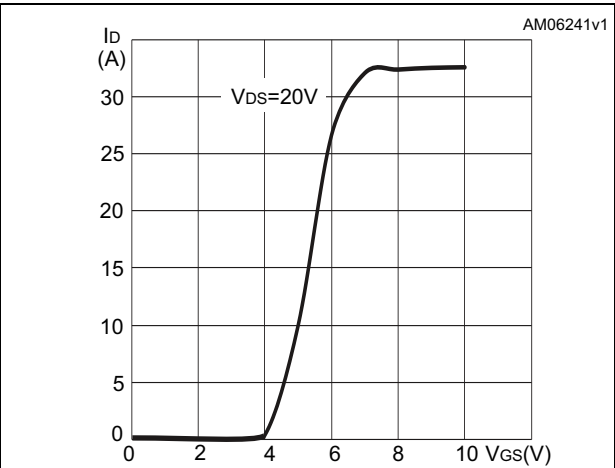


Figure 10. Normalized V_{DS} vs temperature

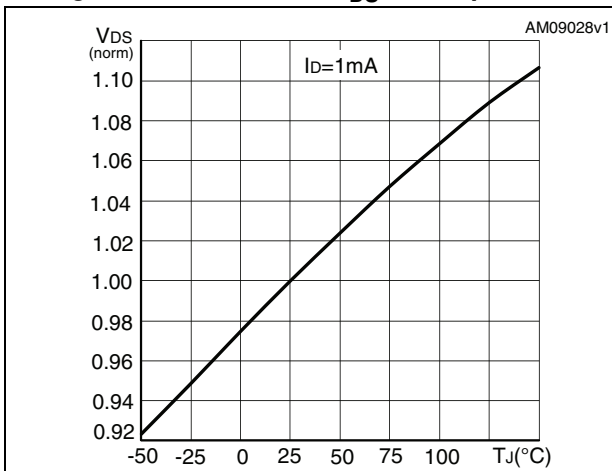


Figure 11. Static drain-source on resistance

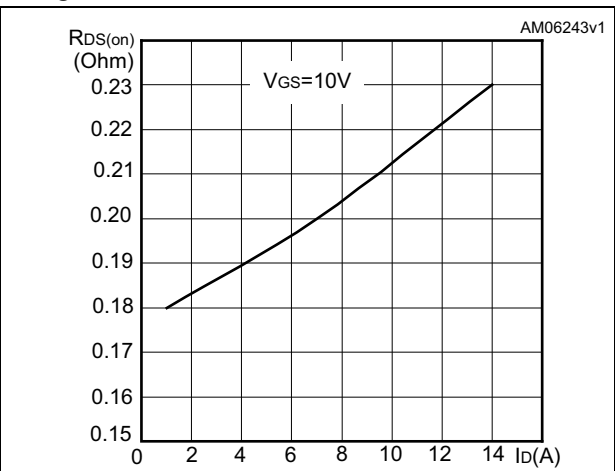


Figure 12. Gate charge vs gate-source voltage

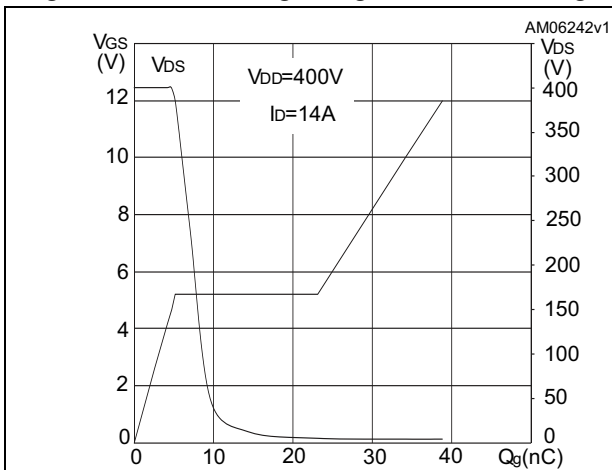


Figure 13. Capacitance variations

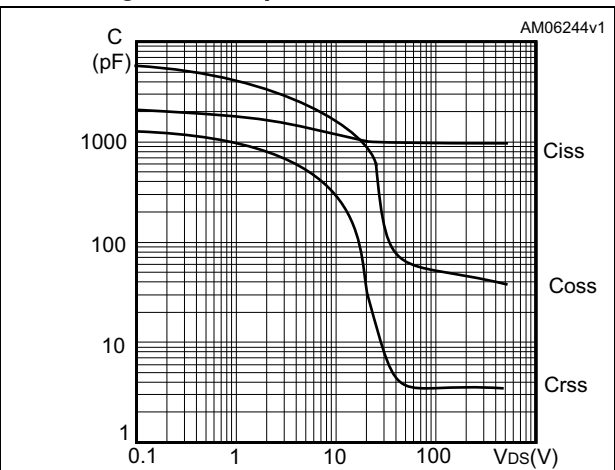


Figure 14. Normalized gate threshold voltage vs temperature

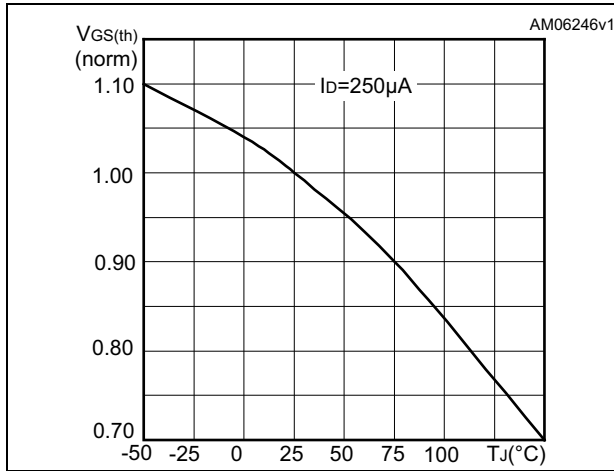
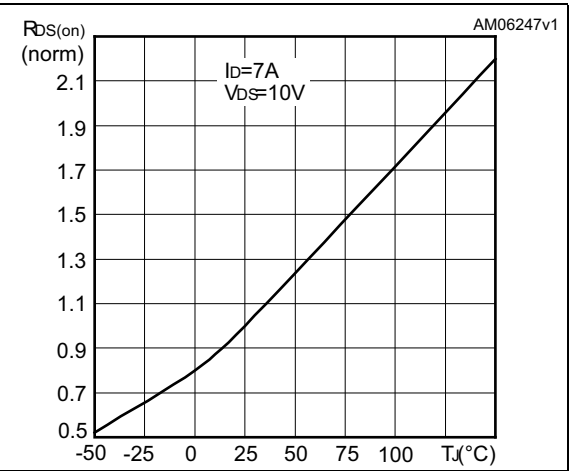
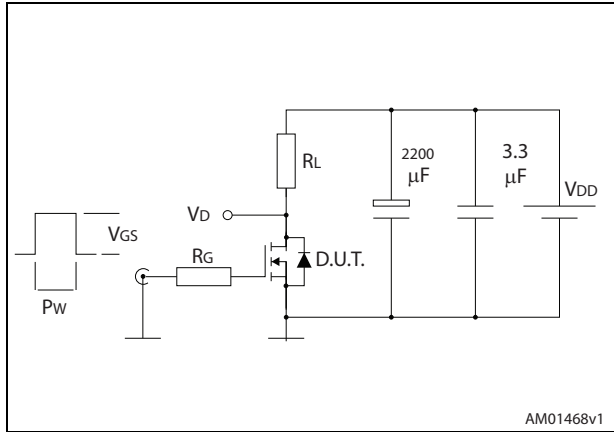


Figure 15. Normalized on-resistance vs temperature



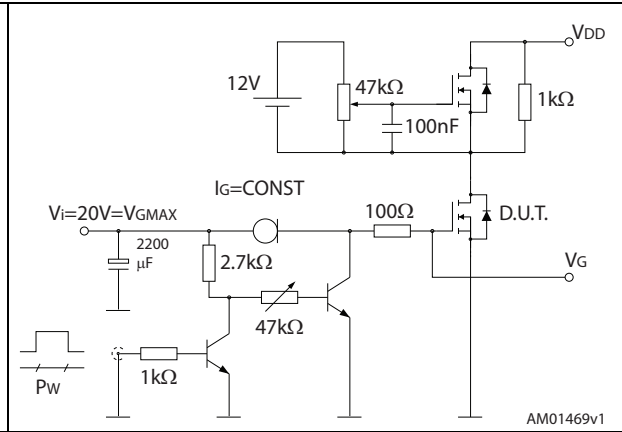
3 Test circuits

Figure 16. Switching times test circuit for resistive load



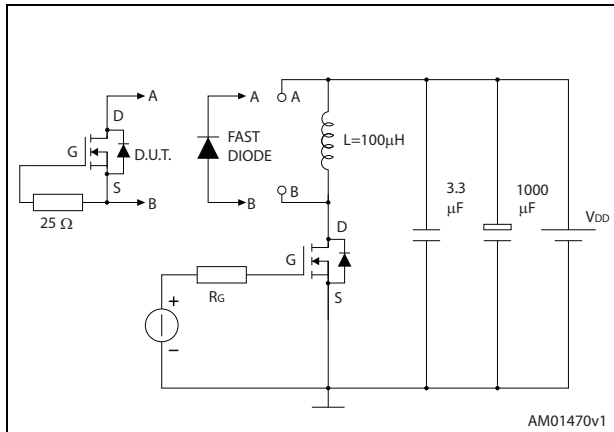
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Figure 17. Gate charge test circuit



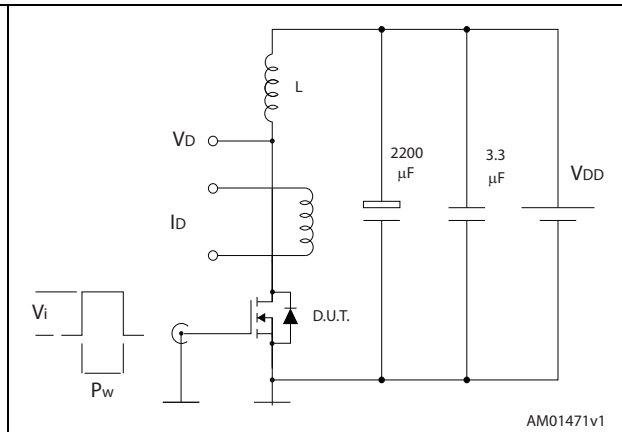
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Figure 18. Test circuit for inductive load switching and diode recovery times



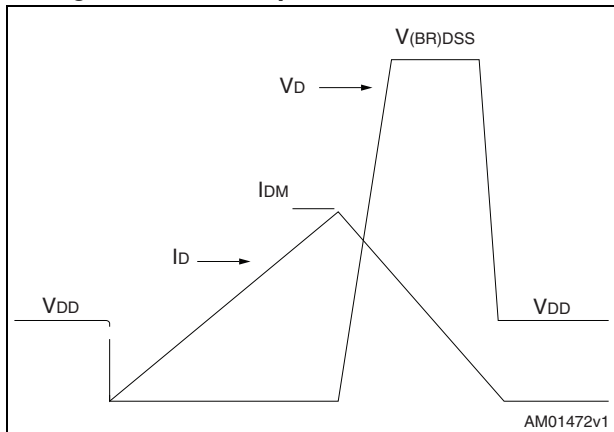
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Figure 19. Unclamped inductive load test circuit



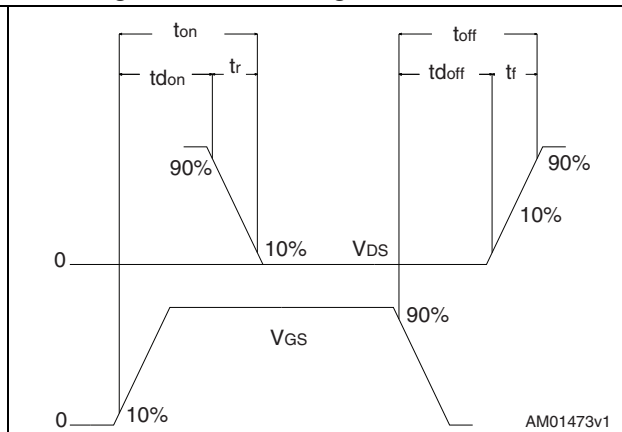
AM01471v1

Figure 20. Unclamped inductive waveform



AM01472v1

Figure 21. Switching time waveform



AM01473v1

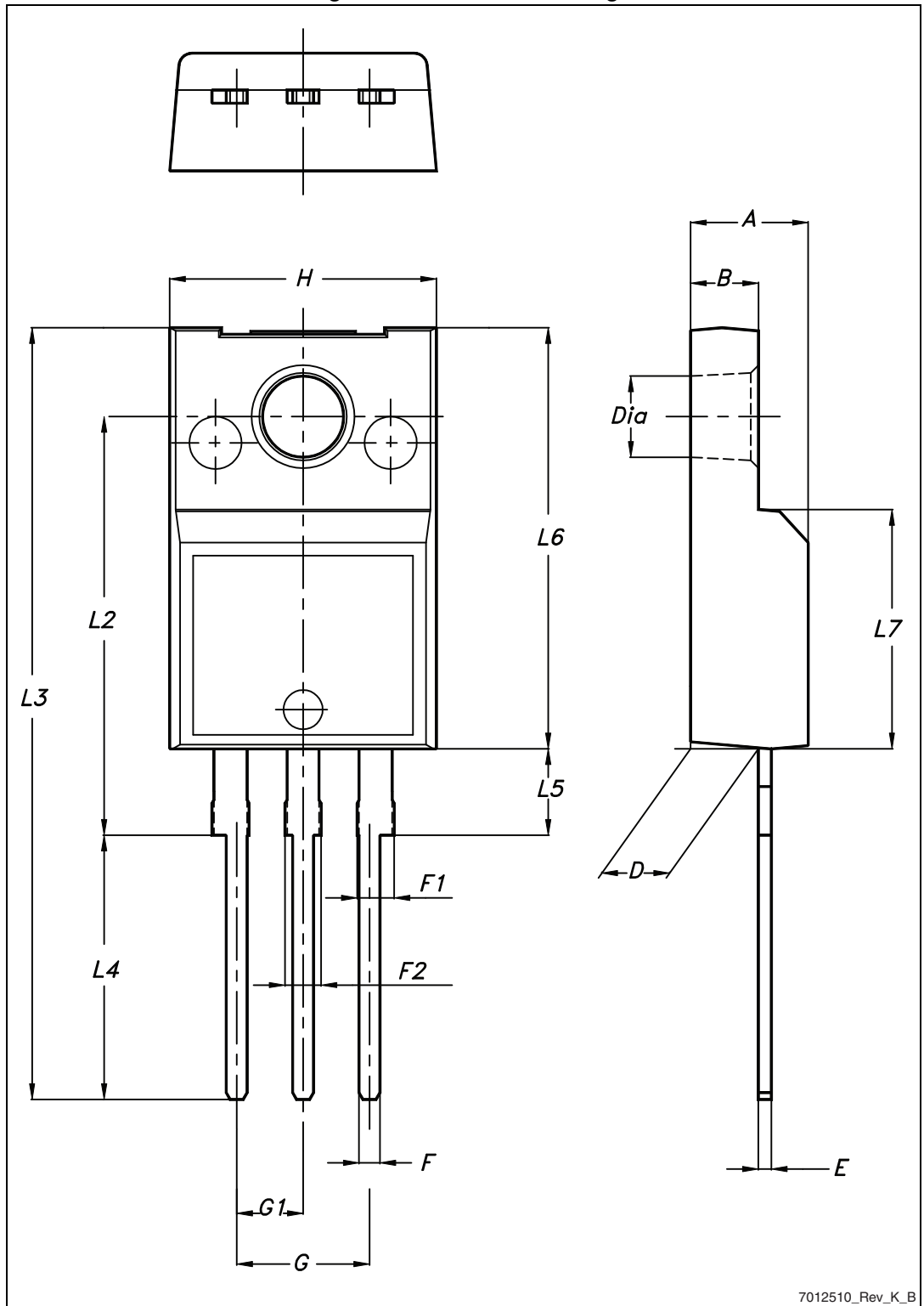
4 Package mechanical data

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 9. TO-220FP mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2

Figure 22. TO-220FP drawing



7012510_Rev_K_B

Table 10. TO-220 type A mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
ØP	3.75		3.85
Q	2.65		2.95

Figure 23. TO-220 type A drawing

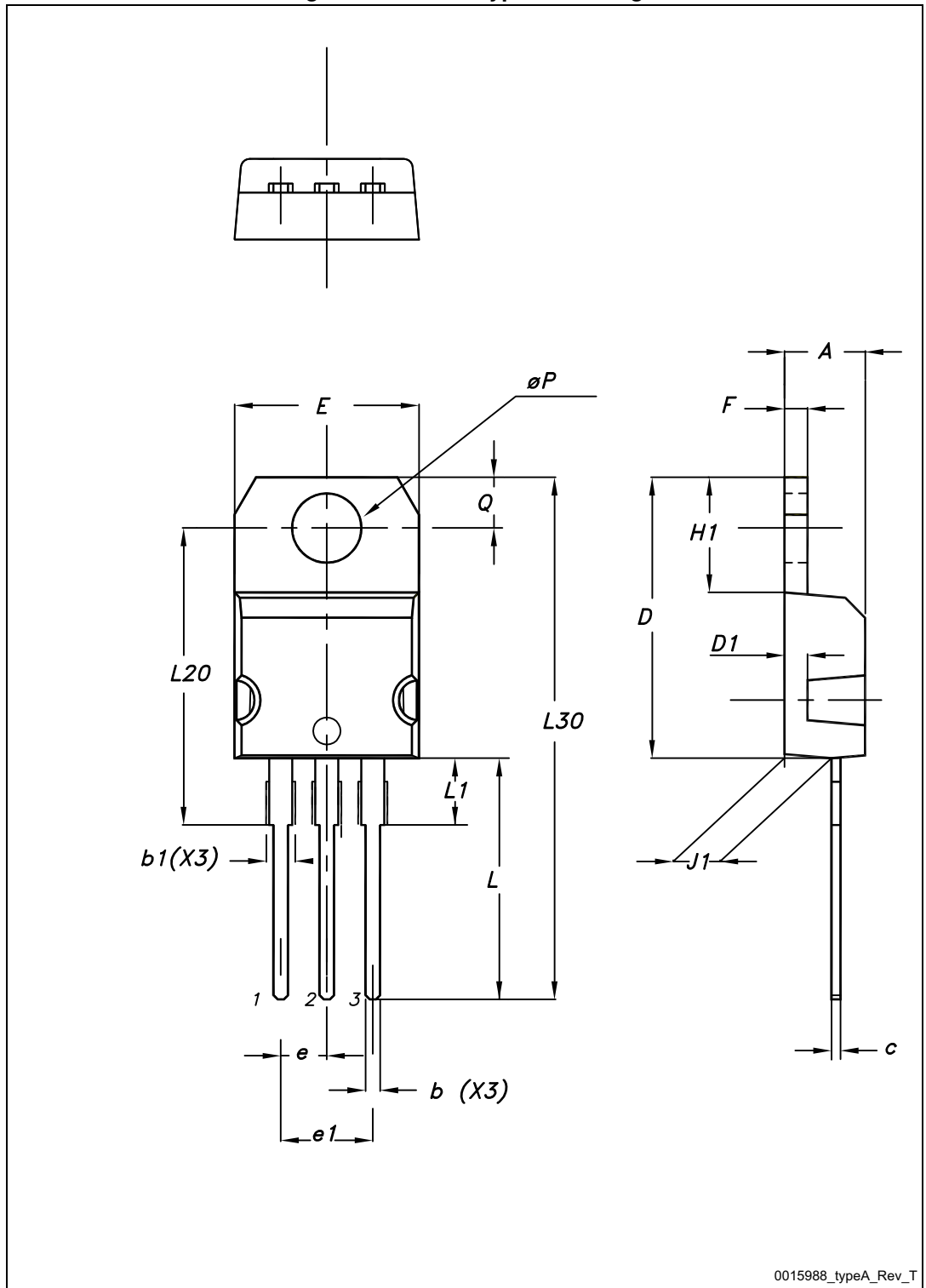
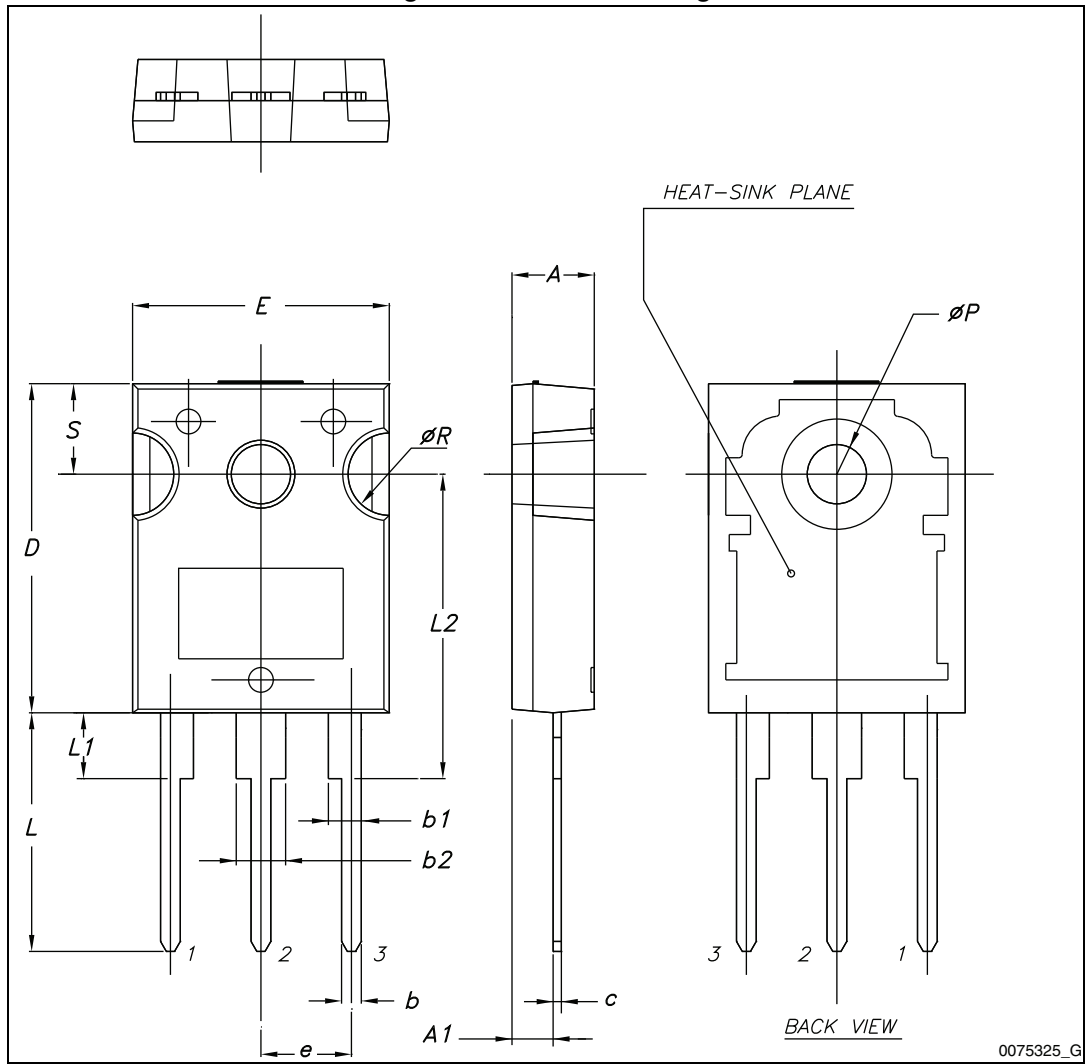


Table 11. TO-247 mechanical data

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	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70

Figure 24. TO-247 drawing



0075325_G

5 Revision history

Table 12. Document revision history

Date	Revision	Changes
09-Feb-2010	1	First release
03-Sep-2013	2	<ul style="list-style-type: none">– Updated: Section 2.1: Electrical characteristics (curves)– Updated: Section 4: Package mechanical data– Minor text changes.

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