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STD8NM60ND, STF8NM60ND STP8NM60ND, STU8NM60ND

N-channel 600 V, 0.59 Ω , 7 A, FDmesh™ II Power MOSFET
TO-220, TO-220FP, IPAK, DPAK

Features

Type	V _{DSS} (@T _{Jmax})	R _{DS(on)} max	I _D
STD8NM60ND	650 V	< 0.70 Ω	7 A
STF8NM60ND	650 V	< 0.70 Ω	7 A
STP8NM60ND	650 V	< 0.70 Ω	7 A ⁽¹⁾
STU8NM60ND	650 V	< 0.70 Ω	7 A

1. Limited only by maximum temperature allowed

- 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
- Extremely high dv/dt and avalanche capabilities

Application

- Switching applications

Description

The FDmesh™ II series belongs to the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a new vertical structure to the company's strip layout and associates all advantages of reduced on-resistance and fast switching with an intrinsic fast-recovery body diode. Strongly recommended for bridge topologies, in ZVS phase-shift converters.

Table 1. Device summary

Order codes	Marking	Package	Packaging
STD8NM60ND	8NM60ND	DPAK	Tape and reel
STF8NM60ND	8NM60ND	TO-220FP	Tube
STP8NM60ND	8NM60ND	TO-220	Tube
STU8NM60ND	8NM60ND	IPAK	Tube

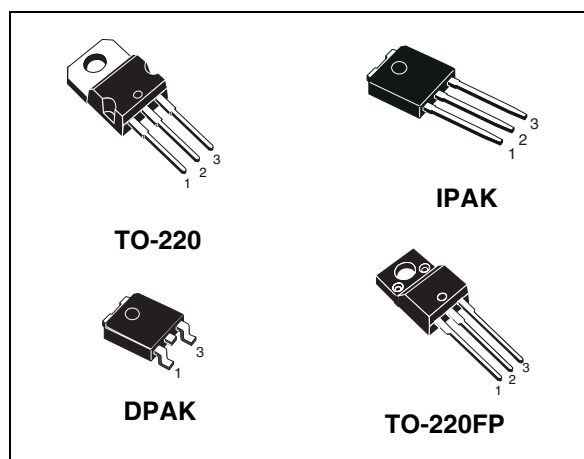
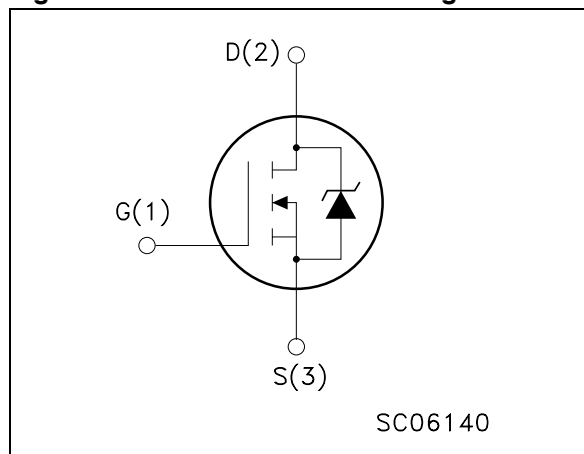


Figure 1. Internal schematic diagram



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Electrical ratings

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value				Unit
		TO-220	DPAK	IPAK	TO-220FP	
V_{DS}	Drain-source voltage ($V_{GS} = 0$)	600				V
V_{GS}	Gate-source voltage	± 30				V
I_D	Drain current (continuous) at $T_C = 25^\circ\text{C}$	7			$7^{(1)}$	A
I_D	Drain current (continuous) at $T_C = 100^\circ\text{C}$	4.4			$4.4^{(1)}$	A
$I_{DM}^{(2)}$	Drain current (pulsed)	28			$28^{(1)}$	A
P_{TOT}	Total dissipation at $T_C = 25^\circ\text{C}$	70			25	W
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink ($t = 1\text{ s}$; $T_C = 25^\circ\text{C}$)				2500	V
$dv/dt^{(3)}$	Peak diode recovery voltage slope	40				V/ns
T_{stg}	Storage temperature	-55 to 150				$^\circ\text{C}$
T_j	Max. operating junction temperature	150				$^\circ\text{C}$

1. Limited only by maximum temperature allowed
2. Pulse width limited by safe operating area
3. $I_{SD} \leq 7\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DD} = 80\% V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	Value				Unit
		TO-220	DPAK	IPAK	TO-220FP	
$R_{thj-case}$	Thermal resistance junction-case	1.79			5	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-amb	62.5		100	62.5	$^\circ\text{C}/\text{W}$
$R_{thj-pcb}$	Thermal resistance junction-pcb		50			$^\circ\text{C}/\text{W}$
T_I	Maximum lead temperature for soldering purpose	300				$^\circ\text{C}$

Table 4. Avalanche characteristics

Symbol	Parameter	Max value	Unit
I_{AS}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max)	2.5	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25^\circ\text{C}$, $I_D = I_{AS}$, $V_{DD} = 50\text{ V}$)	200	mJ

Electrical characteristics

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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	600			V
dv/dt ⁽¹⁾	Drain-source voltage slope	V _{DD} = 480 V, I _D = 7 A, V _{GS} = 10 V	45			V/ns
I _{DSS}	Zero gate voltage drain current (V _{GS} = 0)	V _{DS} = Max rating, V _{DS} = Max rating, 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} = 10V, I _D = 3.5 A		0.59	0.70	Ω

1. Characteristics value at turn off on inductive load

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
g _{fs} ⁽¹⁾	Forward transconductance	V _{DS} = 15 V, I _D = 5 A		7.5		S
C _{iss} C _{oss} C _{rss}	Input capacitance Output capacitance Reverse transfer capacitance	V _{DS} = 50 V, f = 1 MHz, V _{GS} = 0		560 37 4		pF pF pF
C _{oss eq.} ⁽²⁾	Equivalent output capacitance	V _{GS} = 0, V _{DS} = 0 to 480 V		90		pF
R _G	Gate input resistance	f = 1 MHz Gate DC Bias = 0 Test Signal Level = 20 mV Open Drain		6		Ω
Q _g Q _{gs} Q _{gd}	Total gate charge Gate-source charge Gate-drain charge	V _{DD} = 480 V, I _D = 7 A V _{GS} = 10 V <i>Figure 19</i>		22 4 13		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}

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Electrical characteristics
Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}$, $I_D = 7\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ <i>Figure 18</i> , <i>Figure 23</i>		9		ns
t_r	Rise time			22		ns
$t_{d(off)}$	Turn-off delay time			37		ns
t_f	Fall time			22		ns

Table 8. 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	$I_{SD} = 7\text{ A}$, $V_{GS} = 0$			1.3	V
t_{rr}	Reverse recovery time	$I_{SD} = 7\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 30\text{ V}$, <i>Figure 20</i>		120		ns
Q_{rr}	Reverse recovery charge			0.49		μC
I_{RRM}	Reverse recovery current			8		A
t_{rr}	Reverse recovery time	$I_{SD} = 7\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 30\text{ V}$, $T_J = 150^\circ\text{C}$ <i>Figure 20</i>		170		ns
Q_{rr}	Reverse recovery charge			0.75		μC
I_{RRM}	Reverse recovery current			9		A

1. Pulse width limited by safe operating area

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

Electrical characteristics

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2.1 Electrical characteristics

Figure 2. Safe operating area for TO-220

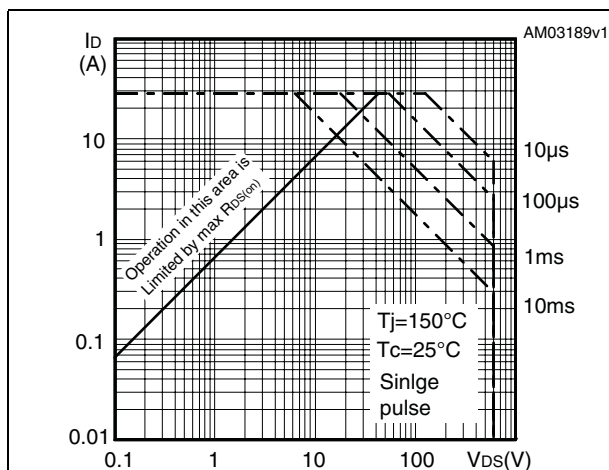


Figure 3. Thermal impedance for TO-220

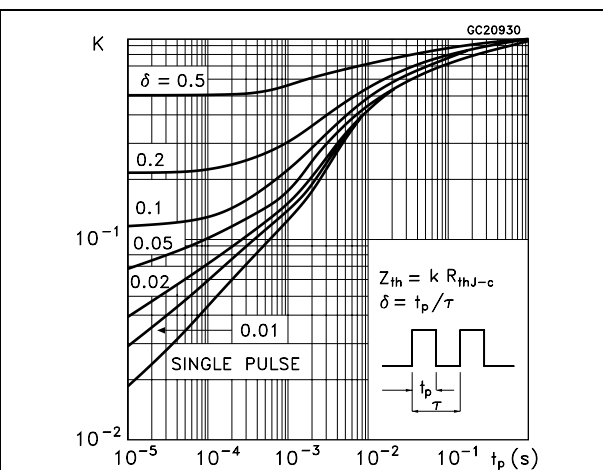


Figure 4. Safe operating area for DPAK, IPAK

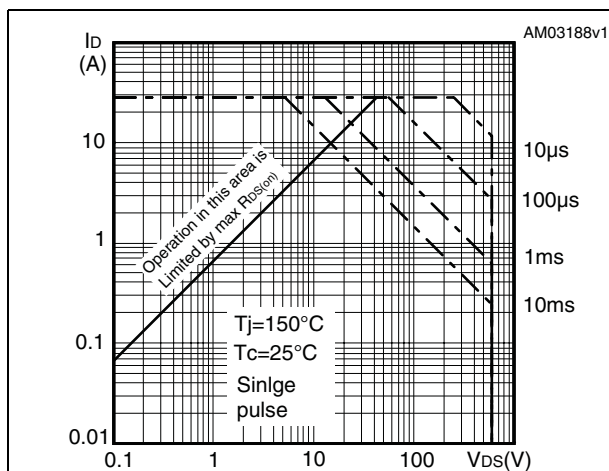


Figure 5. Thermal impedance for DPAK, IPAK

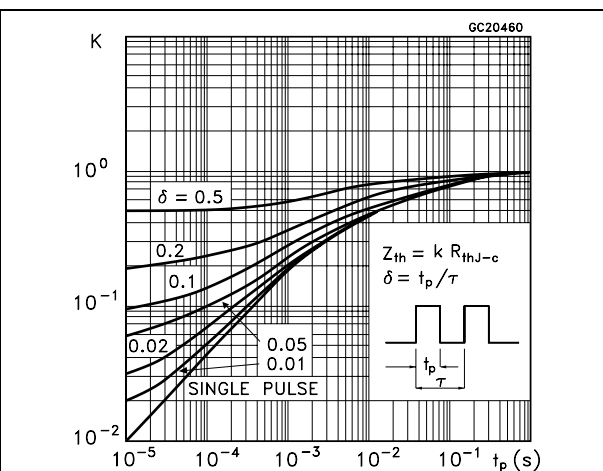


Figure 6. Safe operating area for TO-220FP

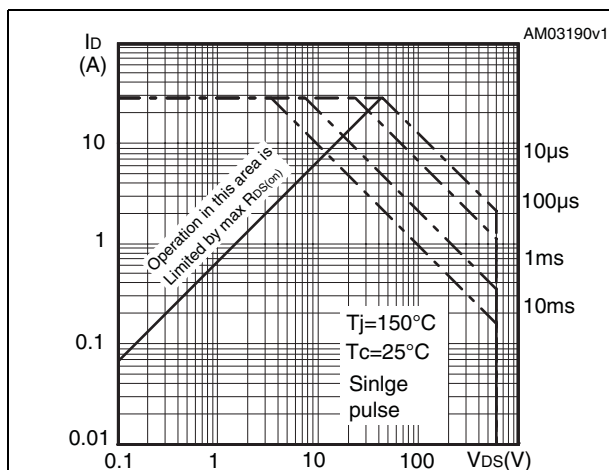
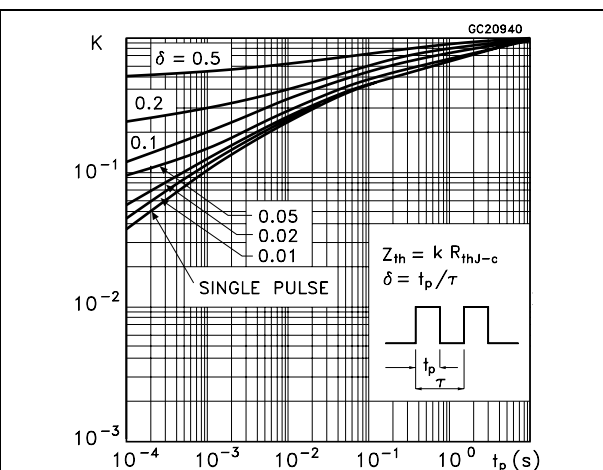


Figure 7. Thermal impedance for TO-220FP



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Electrical characteristics

Figure 8. Output characteristics

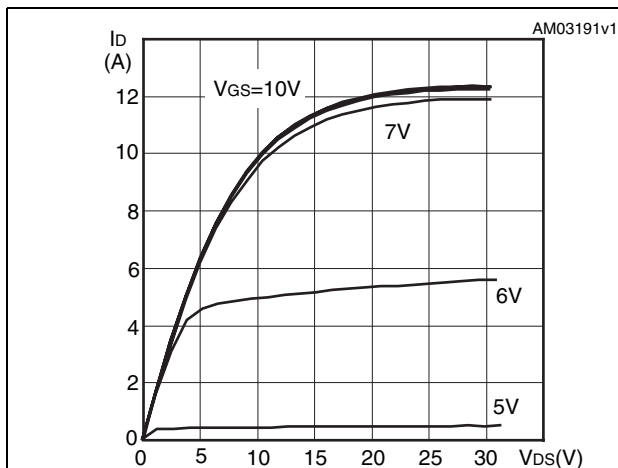


Figure 9. Transfer characteristics

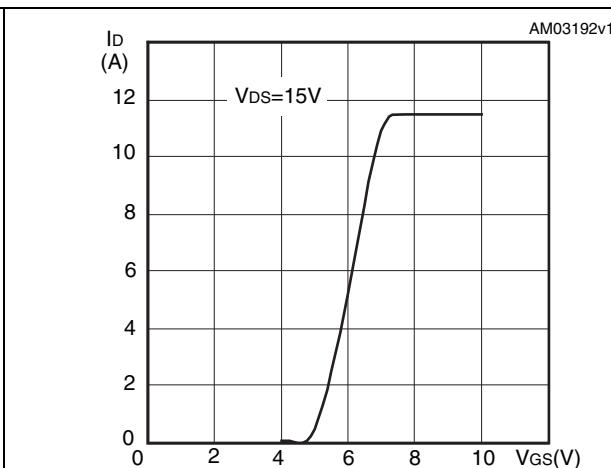


Figure 10. Transconductance

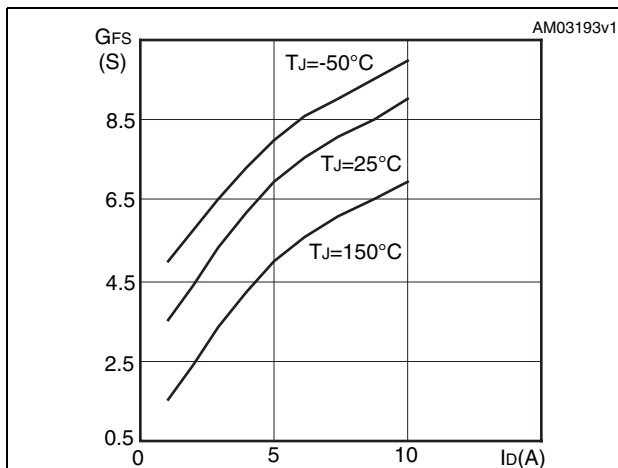


Figure 11. Static-drain source on resistance

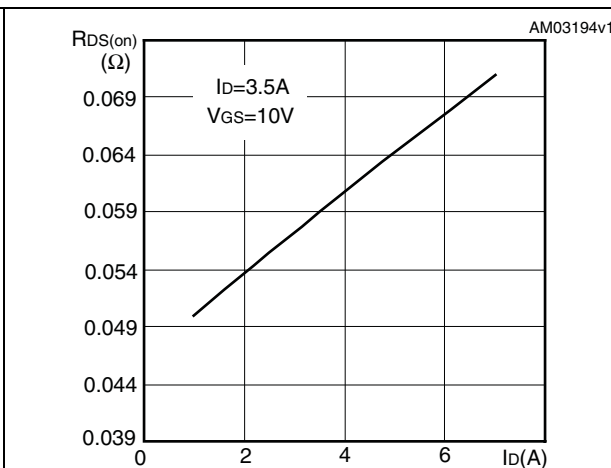


Figure 12. Gate charge vs gate-source voltage

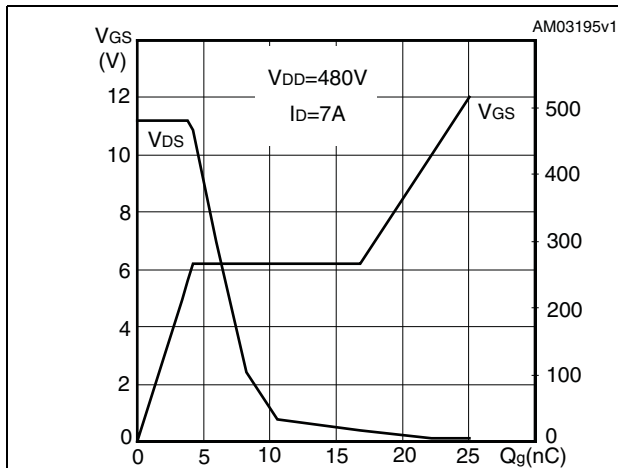
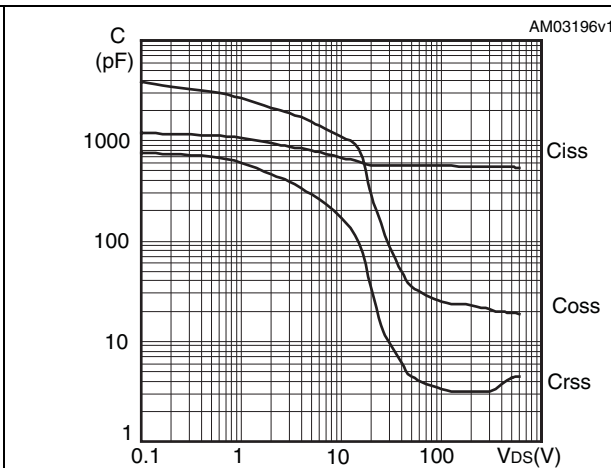


Figure 13. Capacitance variations



Electrical characteristics

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Figure 14. Normalized gate threshold voltage vs temperature

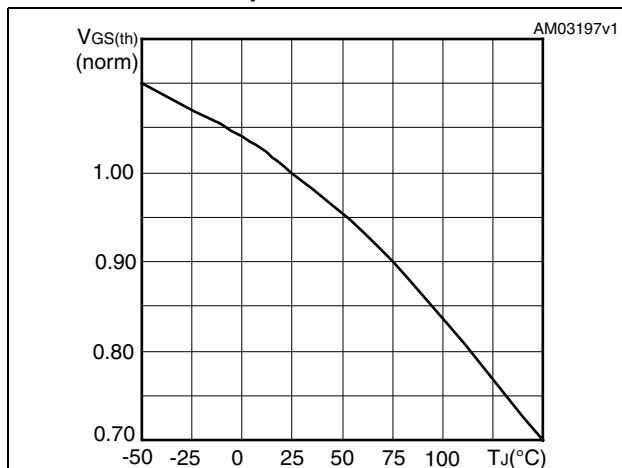


Figure 15. Normalized on resistance vs temperature

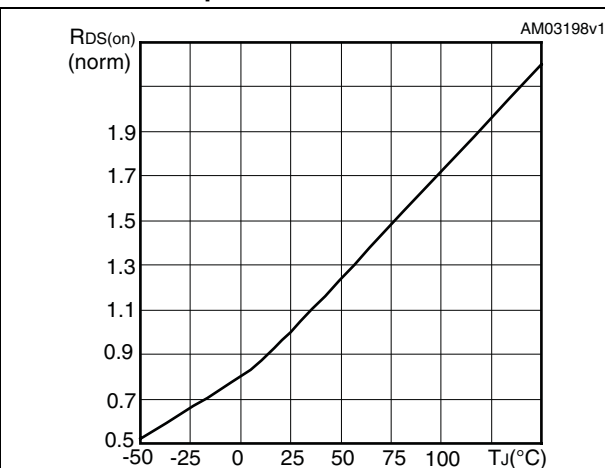


Figure 16. Source-drain diode forward characteristics

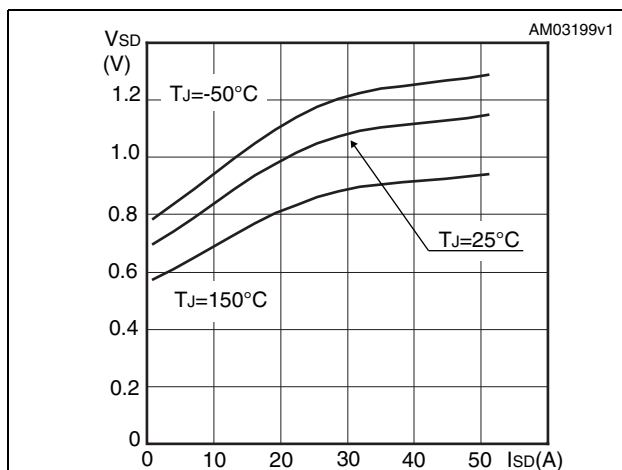
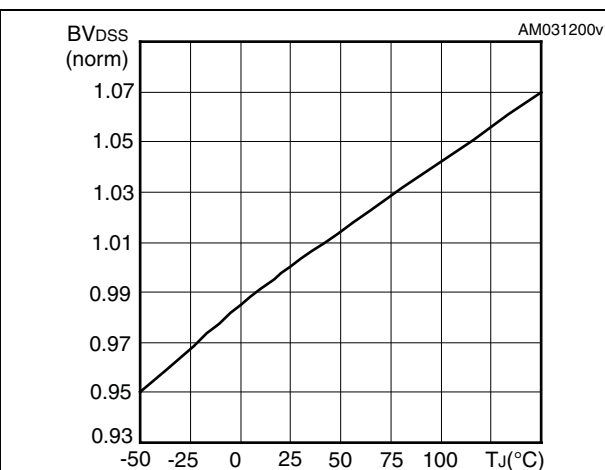


Figure 17. Normalized BV_{DSS} vs temperature



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Test circuits

3 Test circuits

Figure 18. Switching times test circuit for resistive load

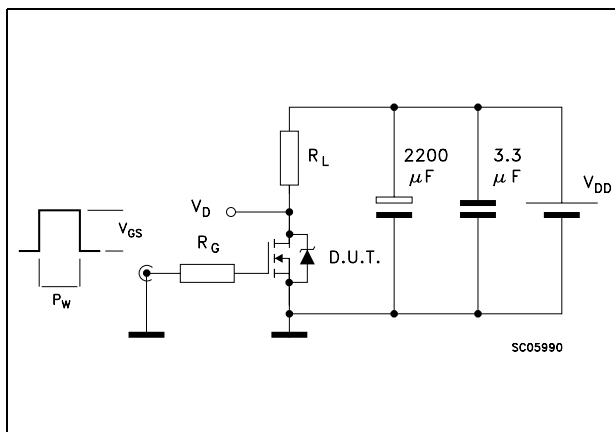


Figure 19. Gate charge test circuit

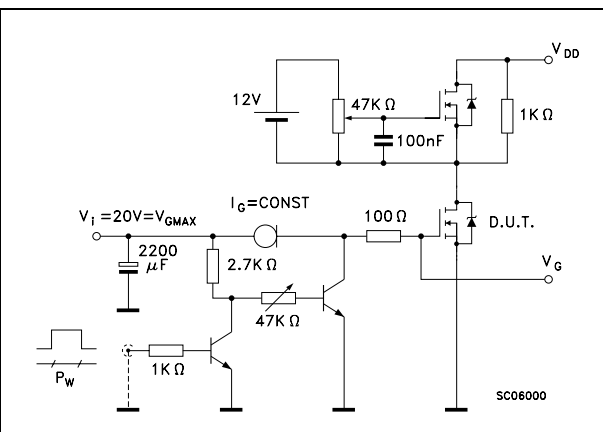


Figure 20. Test circuit for inductive load switching and diode recovery times

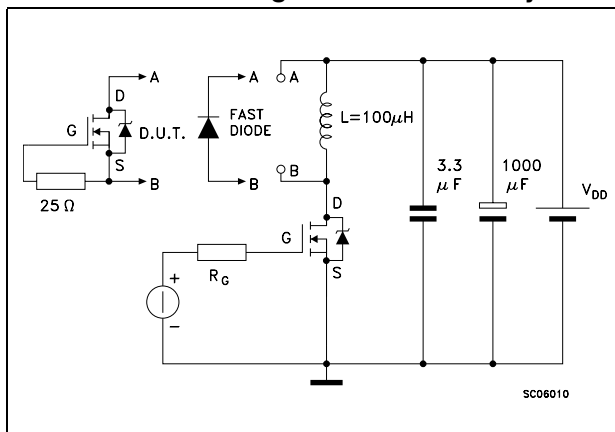


Figure 21. Unclamped inductive load test circuit

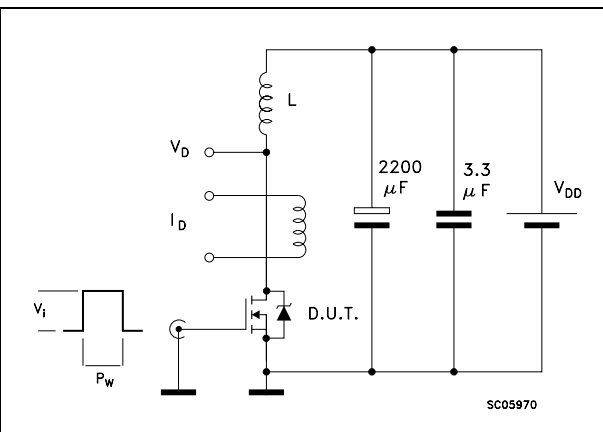


Figure 22. Unclamped inductive waveform

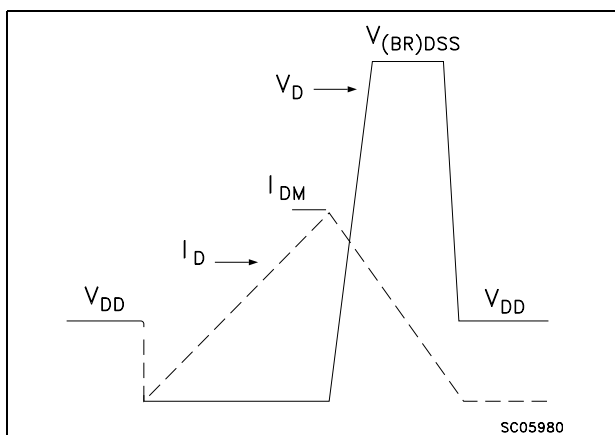
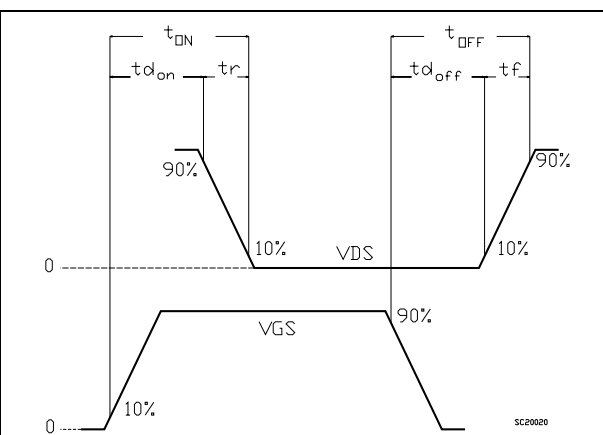


Figure 23. Switching time waveform



4 Package mechanical data

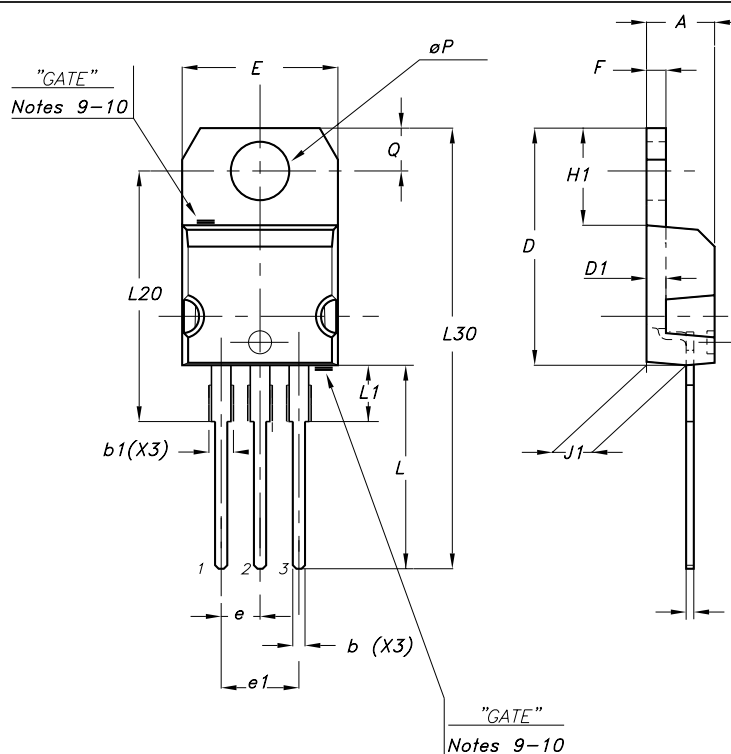
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STx8NM60ND

Package mechanical data

TO-220 mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.48		0.70	0.019		0.027
D	15.25		15.75	0.6		0.62
D1		1.27			0.050	
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.051
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L20		16.40			0.645	
L30		28.90			1.137	
ØP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



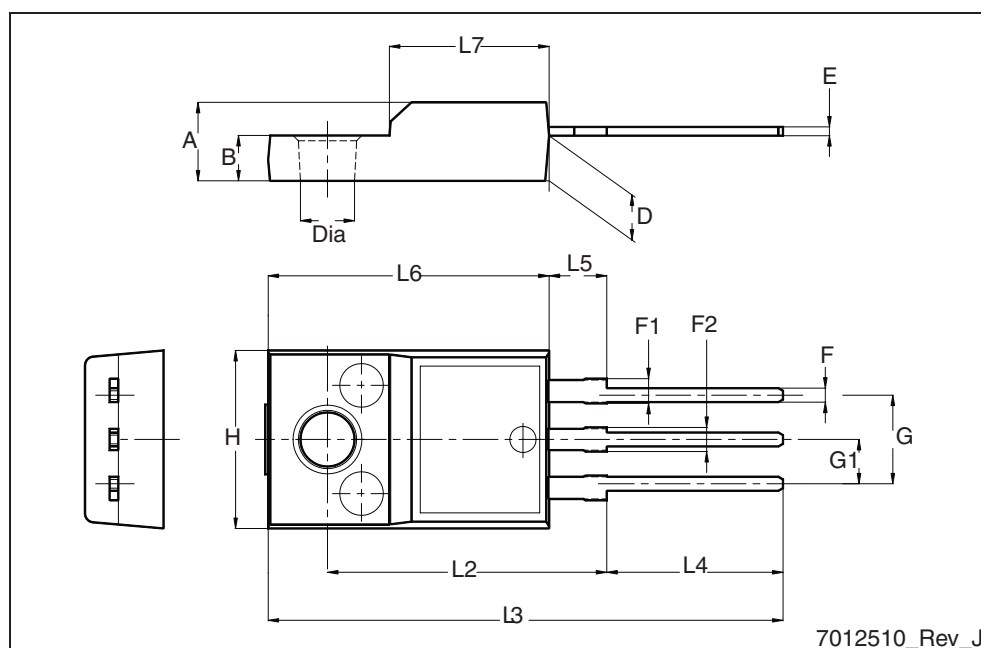
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Package mechanical data

STx8NM60ND

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		1.5
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

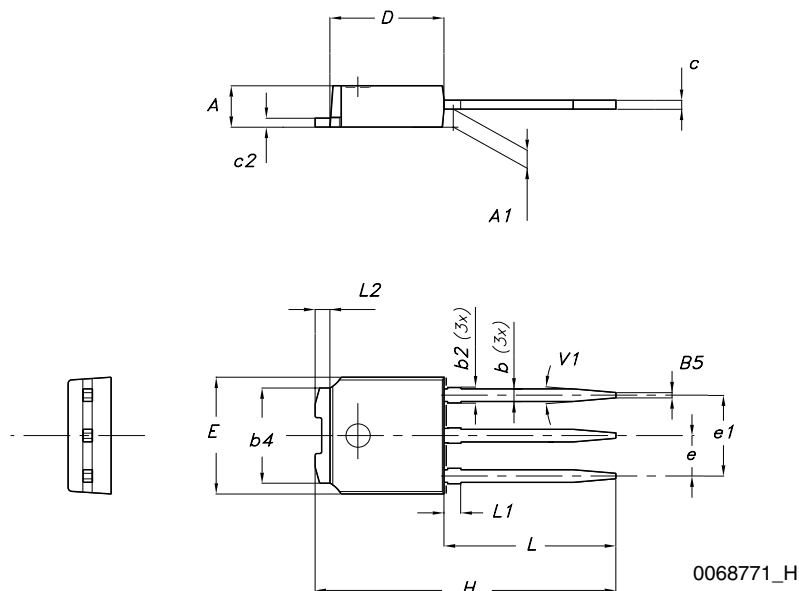


STx8NM60ND

Package mechanical data

TO-251 (IPAK) mechanical data

DIM.	mm.		
	min.	typ	max.
A	2.20		2.40
A1	0.90		1.10
b	0.64		0.90
b2			0.95
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
E	6.40		6.60
e		2.28	
e1	4.40		4.60
H		16.10	
L	9.00		9.40
(L1)	0.80		1.20
L2		0.80	
V1		10°	

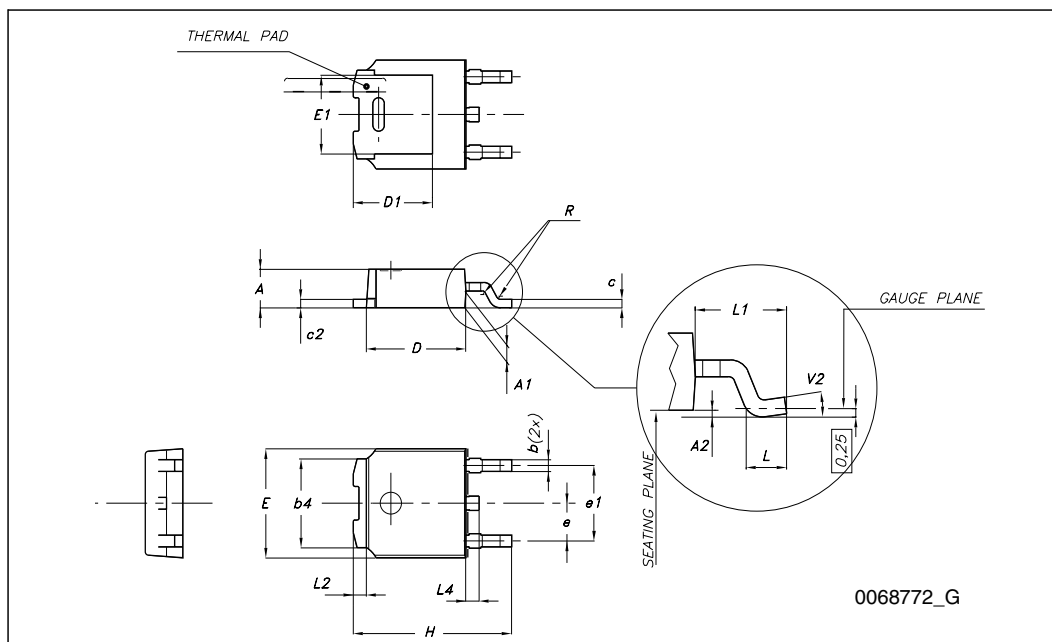


Package mechanical data

STx8NM60ND

TO-252 (DPAK) mechanical data

DIM.	mm.		
	min.	typ	max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1		
L1		2.80	
L2		0.80	
L4	0.60		1
R		0.20	
V2	0 °		8 °

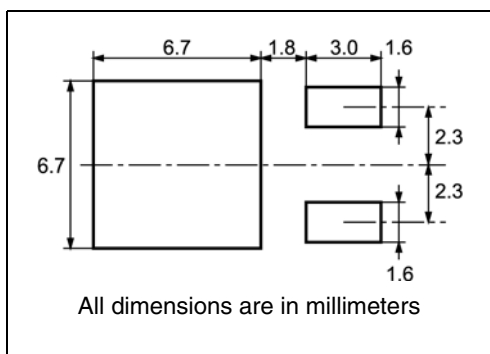


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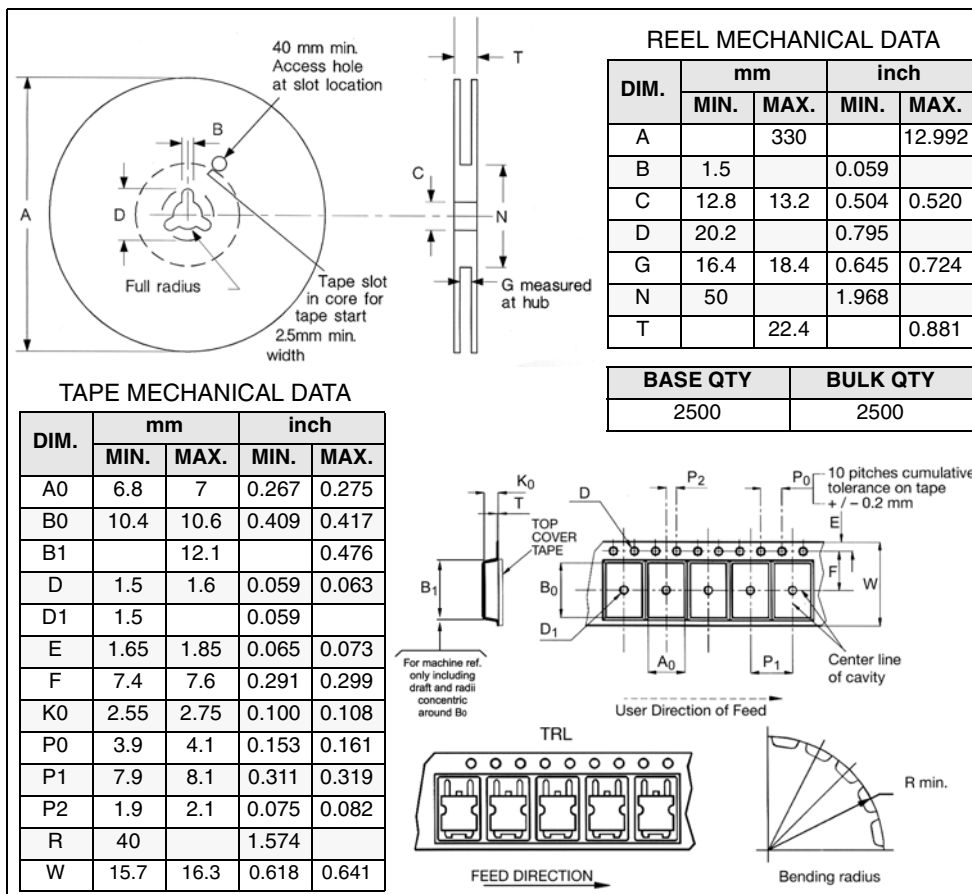
Packaging mechanical data

5 Packaging mechanical data

DPAK FOOTPRINT



TAPE AND REEL SHIPMENT



Revision history

STx8NM60ND

6 Revision history

Table 9. Document revision history

Date	Revision	Changes
09-Feb-2009	1	First release

STx8NM60ND

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