

N-channel 650 V, 0.014 Ω typ., 130 A, MDmesh™ V Power MOSFET in a ISOTOP package

Datasheet - preliminary data

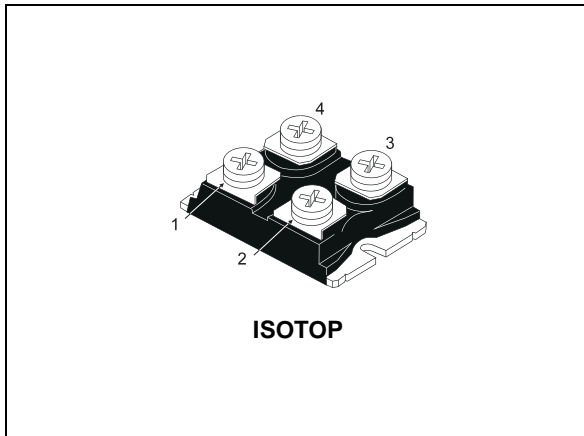
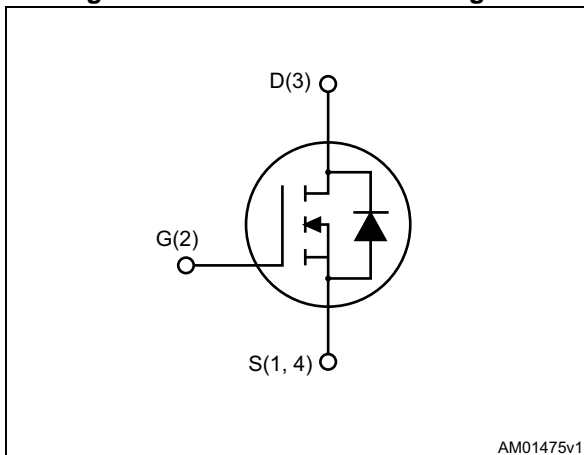


Figure 1. Internal schematic diagram



Features

Order code	$V_{DS} @ T_{jmax}$	$R_{DS(on)}$ max	I_D
STE139N65M5	710 V	0.017 W	130 A

- Very low $R_{DS(on)}$
- Higher V_{DSS} rating
- Higher dv/dt capability
- Excellent switching performance
- 100% avalanche tested

Applications

- Switching applications

Description

This device is an N-channel MDmesh™ V Power MOSFET based on an innovative proprietary vertical process technology, which is combined with STMicroelectronics' well-known PowerMESH™ horizontal layout structure. The resulting product has extremely low on-resistance, which is unmatched among silicon-based Power MOSFETs, making it especially suitable for applications which require superior power density and outstanding efficiency.

Table 1. Device summary

Order code	Marking	Packages	Packaging
STE139N65M5	139N65M5	ISOTOP	Tube

Contents

1	Electrical ratings	3
2	Electrical characteristics	4
2.1	Electrical characteristics (curves)	6
3	Test circuits	8
4	Package mechanical data	9
5	Revision history	12

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate- source voltage	± 25	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	130	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	78	A
$I_{DM}^{(1)}$	Drain current (pulsed)	520	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	672	W
I_{AR}	Max current during repetitive or single pulse avalanche (pulse width limited by T_{JMAX})	17	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{V}$)	2400	mJ
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
T_{stg}	Storage temperature	- 55 to 150	$^\circ\text{C}$
T_j	Max. operating junction temperature	150	$^\circ\text{C}$

1. Pulse width limited by safe operating area.
2. $I_{SD} \leq 130\text{ A}$, $di/dt = 400\text{ A}/\mu\text{s}$, $V_{DD} = 400\text{ V}$, $V_{DS(\text{peak})} < V_{(BR)DSS}$.

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	0.186	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	30	$^\circ\text{C}/\text{W}$

2 Electrical characteristics

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

Table 4. On /off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}, V_{GS} = 0$	650			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 650\text{ V}$ $V_{DS} = 650\text{ V}, T_C = 125\text{ °C}$			10 100	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	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on- resistance	$V_{GS} = 10\text{ V}, I_D = 65\text{ A}$		0.014	0.017	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}, f = 1\text{ MHz},$ $V_{GS} = 0$	-	15600	-	pF
C_{oss}	Output capacitance		-	365	-	pF
C_{riss}	Reverse transfer capacitance		-	9	-	pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{GS} = 0, V_{DS} = 0\text{ to }520\text{ V}$	-	1559	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related	$V_{GS} = 0, V_{DS} = 0\text{ to }520\text{ V}$	-	360	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz open drain}$	-	1.2	-	Ω
Q_g	Total gate charge	$V_{DD} = 520\text{ V}, I_D = 65\text{ A},$ $V_{GS} = 10\text{ V}$ (see Figure 15)	-	363	-	nC
Q_{gs}	Gate-source charge		-	88	-	nC
Q_{gd}	Gate-drain charge		-	164	-	nC

- $C_{o(tr)}$ is a constant capacitance value that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .
- $C_{o(er)}$ is a constant capacitance value that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(v)}$	Voltage delay time	$V_{DD} = 400\text{ V}$, $I_D = 80\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 16) (see Figure 19)	-	295	-	ns
$t_{r(v)}$	Voltage rise time		-	56	-	ns
$t_{f(i)}$	Current fall time		-	37	-	ns
$t_{c(off)}$	Crossing time		-	84	-	ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit	
I_{SD}	Source-drain current	$I_{SD} = 130\text{ A}$, $V_{GS} = 0$	-		130	A	
	Source-drain current (pulsed)				520	A	
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		520	A	
$V_{SD}^{(2)}$	Forward on voltage		-		1.5	V	
t_{rr}	Reverse recovery time		-	570		ns	
Q_{rr}	Reverse recovery charge		$I_{SD} = 130\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$ (see Figure 16)	-	15		μC
I_{RRM}	Reverse recovery current		-	53		A	
t_{rr}	Reverse recovery time		$I_{SD} = 130\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$	-	720		ns
Q_{rr}	Reverse recovery charge		$V_{DD} = 100\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 16)	-	24		μC
I_{RRM}	Reverse recovery current	(see Figure 16)	-	68		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

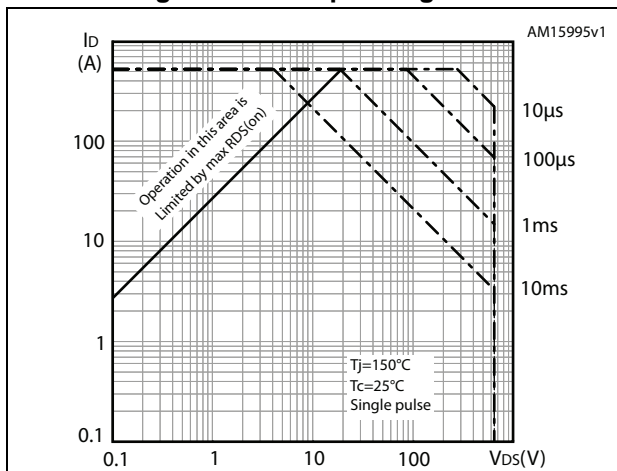


Figure 3. Thermal impedance

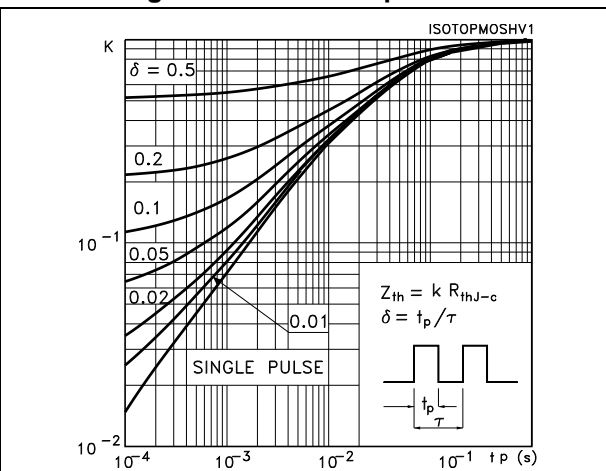


Figure 4. Output characteristics

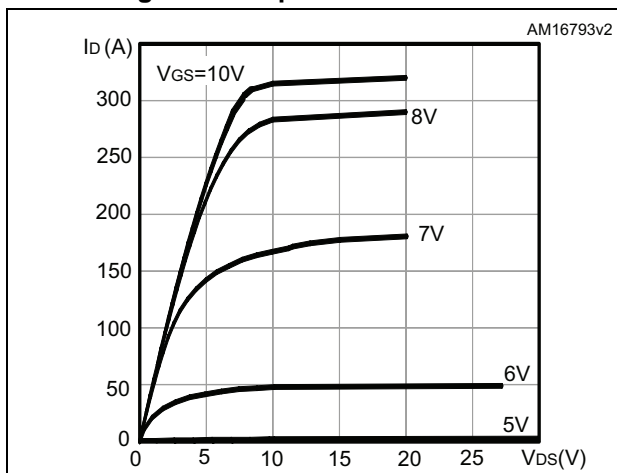


Figure 5. Transfer characteristics

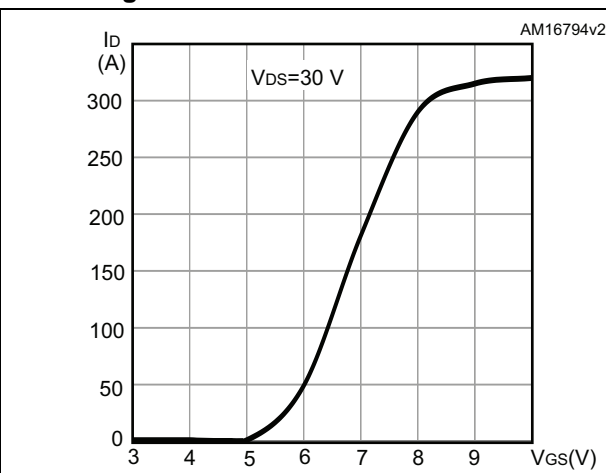


Figure 6. Normalized V_{DS} vs temperature

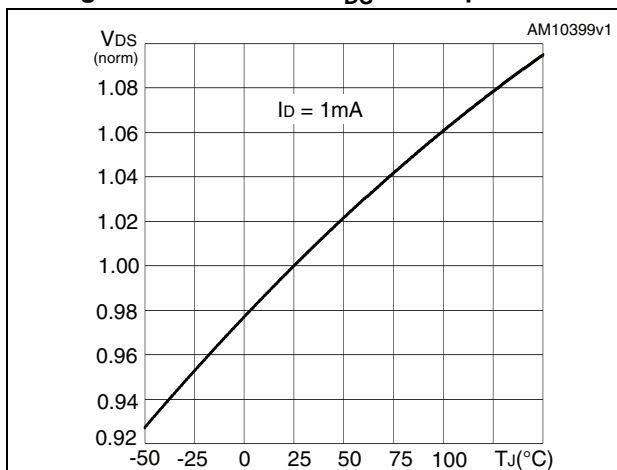


Figure 7. Static drain-source on-resistance

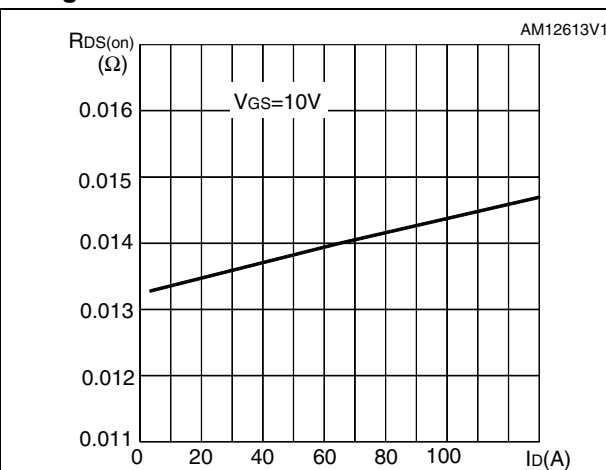


Figure 8. Gate charge vs gate-source voltage

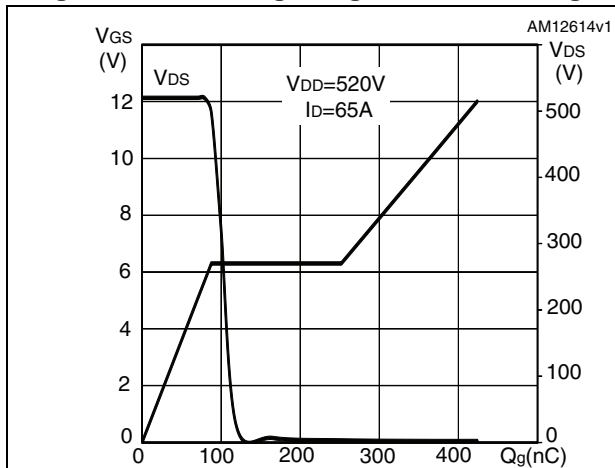


Figure 9. Capacitance variations

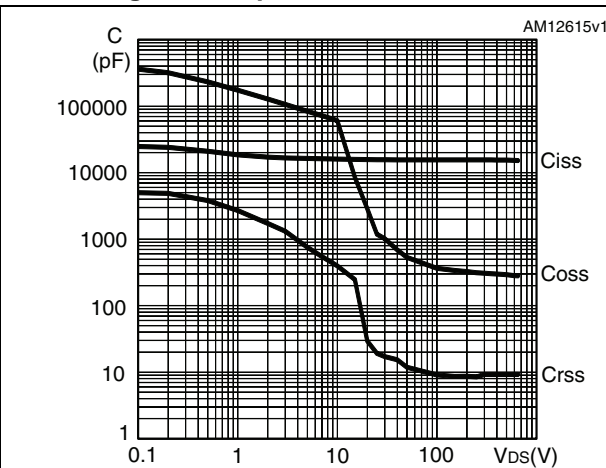


Figure 10. Normalized gate threshold voltage vs temperature

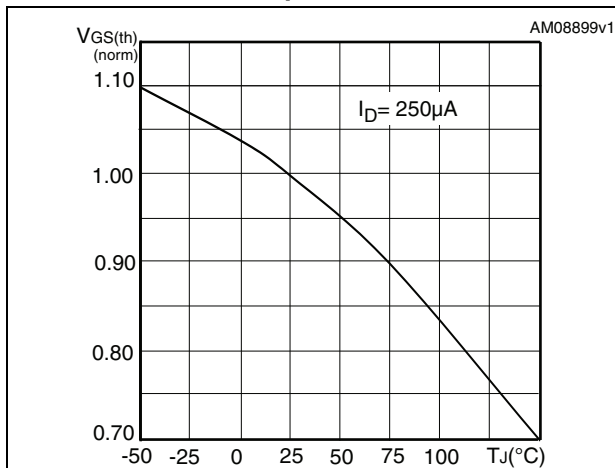


Figure 11. Normalized on-resistance vs temperature

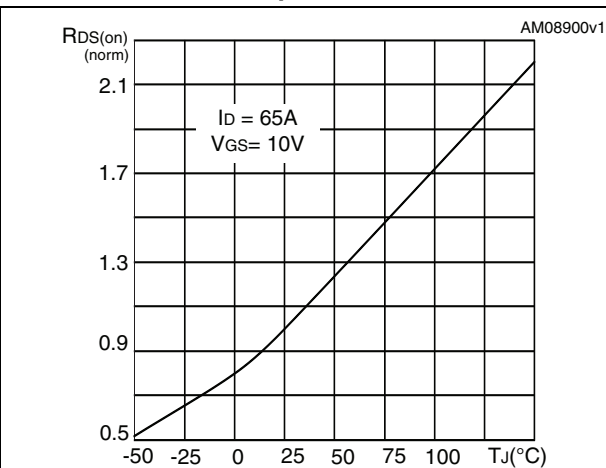


Figure 12. Output capacitance stored energy

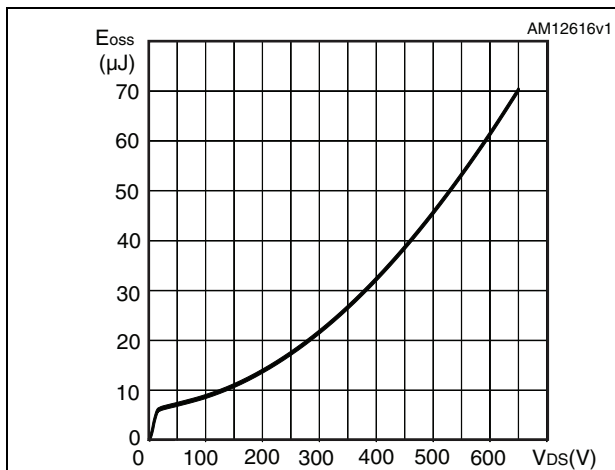
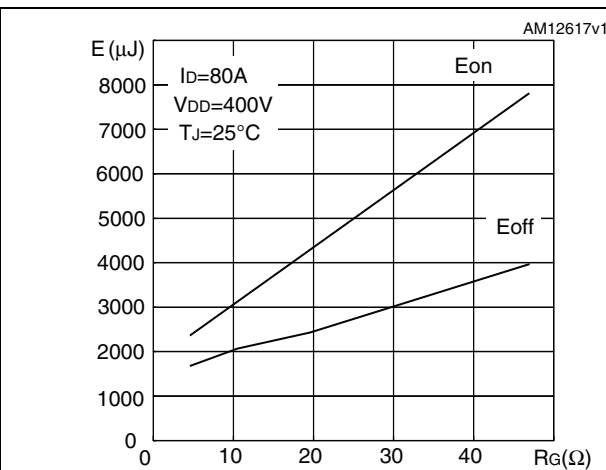


Figure 13. Switching losses vs gate resistance (1)



1. Eon including reverse recovery of a SiC diode.

3 Test circuits

Figure 14. Switching times test circuit for resistive load

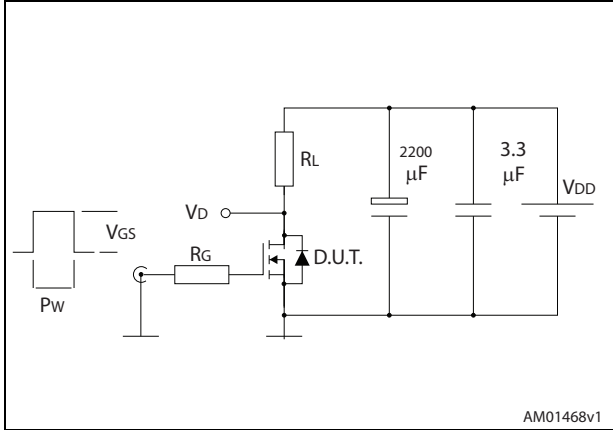


Figure 15. Gate charge test circuit

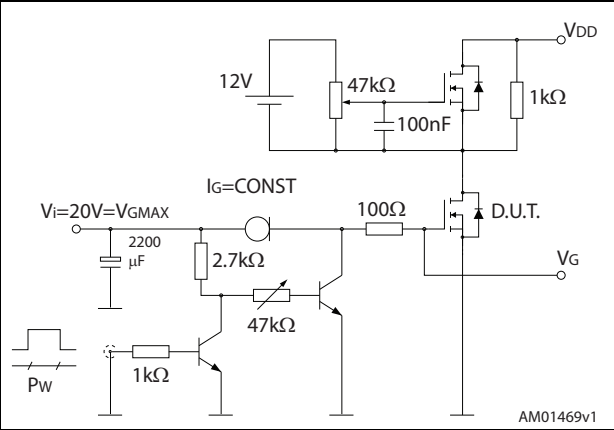


Figure 16. Test circuit for inductive load switching and diode recovery times

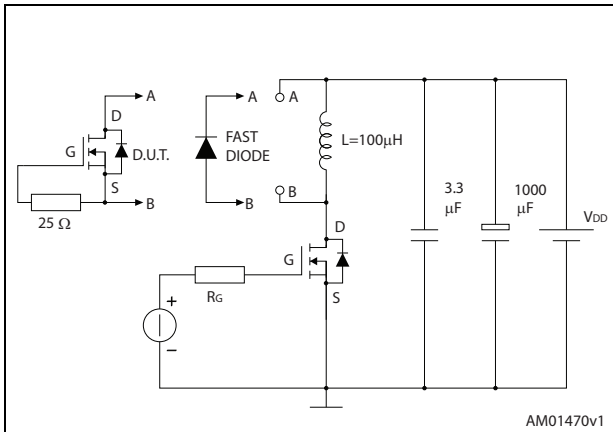


Figure 17. Unclamped inductive load test circuit

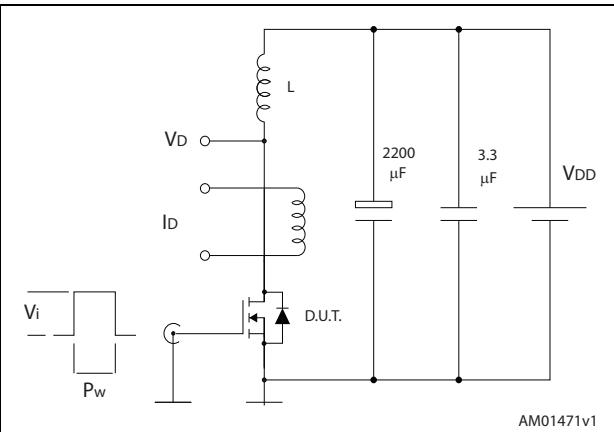


Figure 18. Unclamped inductive waveform

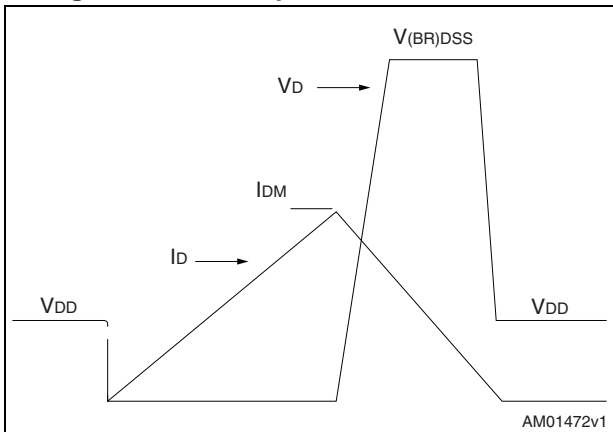
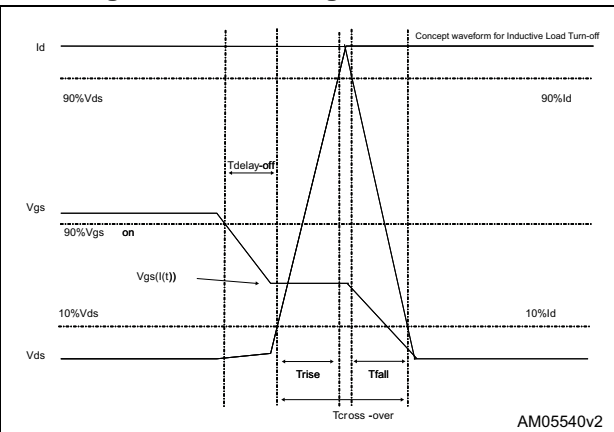


Figure 19. Switching time waveform



4 Package mechanical data

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Table 8. ISOTOP mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	11.80		12.20
A1	8.90		9.10
B	7.80		8.20
C	0.75		0.85
C2	1.95		2.05
D	37.80		38.20
D1	31.50		31.70
E	25.15		25.50
E1	23.85		24.15
E2		24.80	
G	14.90		15.10
G1	12.60		12.80
G2	3.50		4.30
F	4.10		4.30
F1	4.60		5
φP	4		4.30
P1	4		4.40
S	30.10		30.30

5 Revision history

Table 9. Document revision history

Date	Revision	Changes
13-Aug-2013	1	Initial release.

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