



STE140NF20D

N-channel 200 V, 10 mΩ typ., 140 A STripFET™ II Power MOSFET
(with fast diode) in an ISOTOP package

Datasheet — production data

Features

Type	V _{DSS}	R _{DS(on)} max	I _D
STE140NF20D	200 V	< 0.012 Ω	140 A

- Exceptional dv/dt capability
- Low gate charge
- 100% avalanche tested

Applications

Switching applications

Description

This Power MOSFET is produced using STMicroelectronics' unique STripFET™ process, which is specifically designed to minimize input capacitance and gate charge. The device offers extremely fast switching performance thanks to the intrinsic fast body diode, making the device ideal for hard switching topologies.

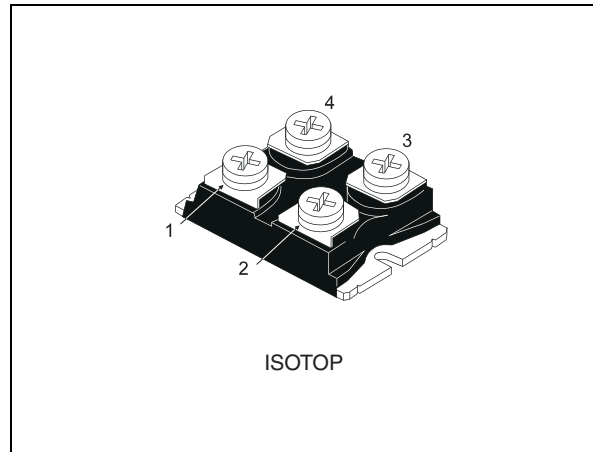


Figure 1. Internal schematic diagram

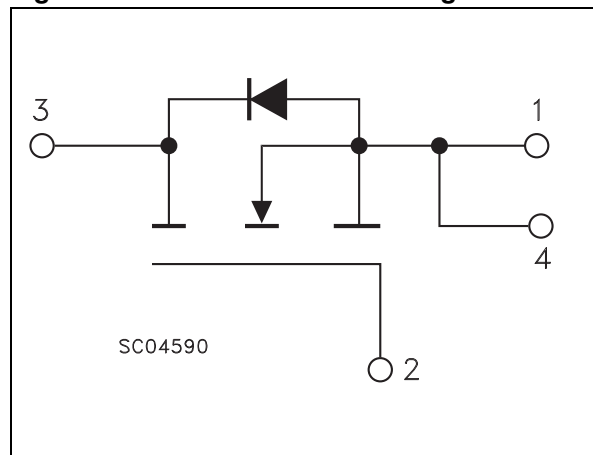


Table 1. Device summary

Order code	Marking	Package	Packaging
STE140NF20D	140NF20D	ISOTOP	Tube

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	200	V
V_{GS}	Gate-source voltage	± 20	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$	140	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	88	A
$I_{DM}^{(1)}$	Drain current (pulsed)	560	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	500	W
$I_{AR}^{(2)}$	Avalanche current, repetitive or not repetitive	140	A
$E_{AS}^{(3)}$	Single pulse avalanche energy	800	mJ
$dv/dt^{(4)}$	Peak diode recovery voltage slope	25	V/ns
V_{ISO}	Insulation withstand voltage (AC-RMS)	2500	V
T_J T_{stg}	Operating junction temperature Storage temperature	- 55 to 150	$^{\circ}\text{C}$

1. Pulse width limited by safe operating area
2. Pulse width limited by T_{jmax}
3. Strating $T_J = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$
4. $I_{SD} \leq 140\text{ A}$, $di/dt \leq 1000\text{ A}/\mu\text{s}$, $V_{DD} \leq 80\% V_{(BR)DSS}$

Table 3. Thermal resistance

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	0.25	$^{\circ}\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient	40	$^{\circ}\text{C}/\text{W}$

2 Electrical characteristics

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

Table 4. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0$	200			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 200\text{ V}$, $V_{DS} = 200\text{ V}$, $T_C = 125\text{ °C}$			10 100	μA μA
I_{GSS}	Gate body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 20\text{ V}$			± 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	$V_{GS} = 10\text{ V}$, $I_D = 70\text{ A}$		10	12	m Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$	-	11100	-	pF
C_{oss}	Output capacitance			2190		pF
C_{rss}	Reverse transfer capacitance			334		pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{DS} = 0\text{ to }160\text{ V}$, $V_{GS} = 0$,	-	1525	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related		-	1139	-	pF
R_g	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	1.4	-	Ω
Q_g	Total gate charge	$V_{DD} = 160\text{ V}$, $I_D = 140\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 16)	-	338	-	nC
Q_{gs}	Gate-source charge			47		nC
Q_{gd}	Gate-drain charge			183		nC

1. Time related 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}
2. Energy related is defined as a constant equivalent capacitance giving the same stored energy 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
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 100\text{ V}$, $I_D = 70\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 15)	-	232	-	ns
t_r	Rise time			218		ns
$t_{d(off)}$	Turn-off delay time			283		ns
t_f	Fall time			250		ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		140	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		560	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 140\text{ A}$, $V_{GS} = 0$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 140\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$	-	190		ns
Q_{rr}	Reverse recovery charge			1.4		nC
I_{RRM}	Reverse recovery current			14		A
t_{rr}	Reverse recovery time	$I_{SD} = 140\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$	-	257		ns
Q_{rr}	Reverse recovery charge			2.4		μC
I_{RRM}	Reverse recovery current			18		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

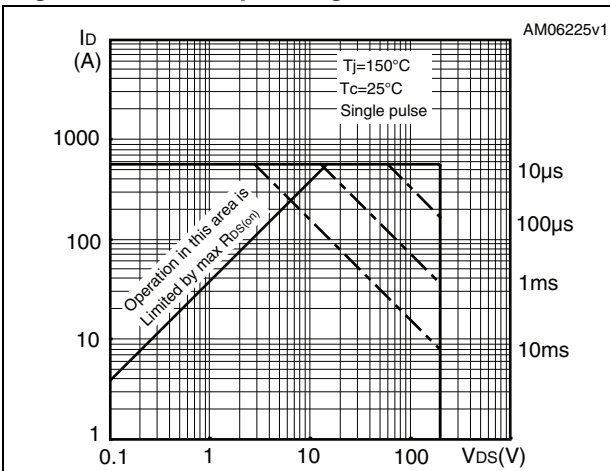


Figure 3. Thermal impedance

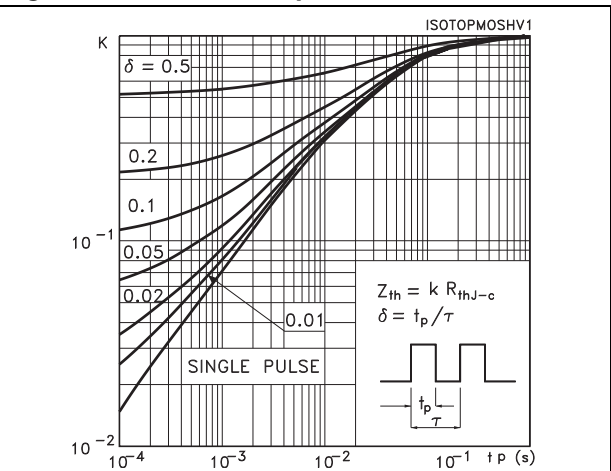


Figure 4. Output characteristics

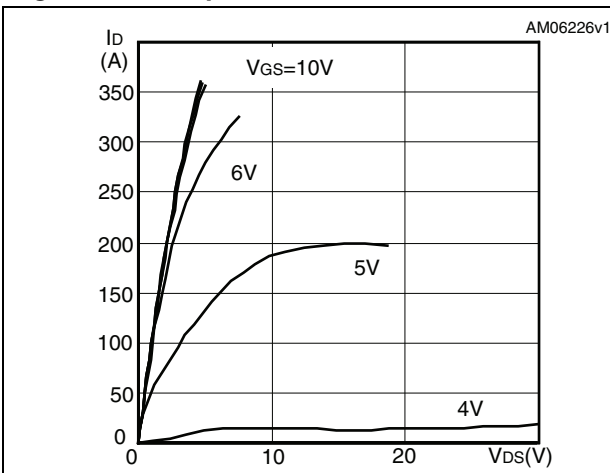


Figure 5. Transfer characteristics

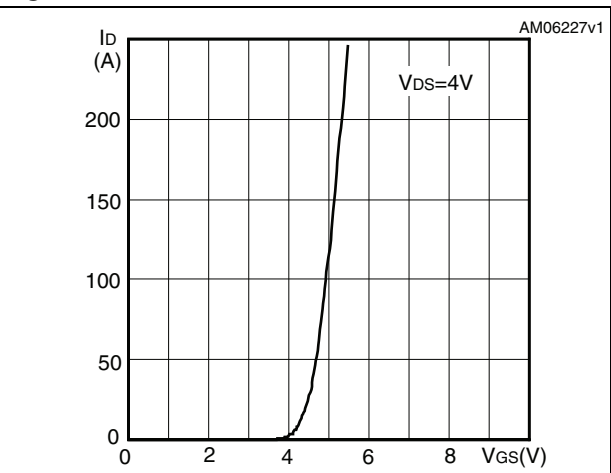


Figure 6. Gate charge vs gate-source voltage

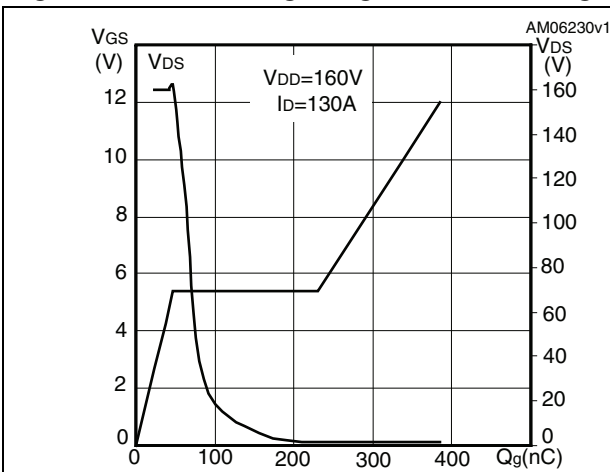


Figure 7. Static drain-source on-resistance

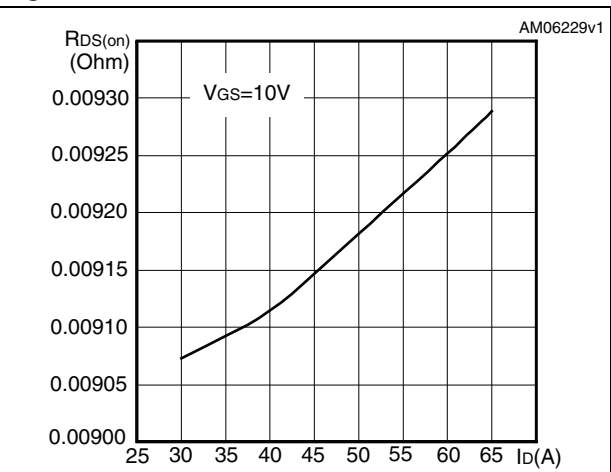


Figure 8. Capacitance variations

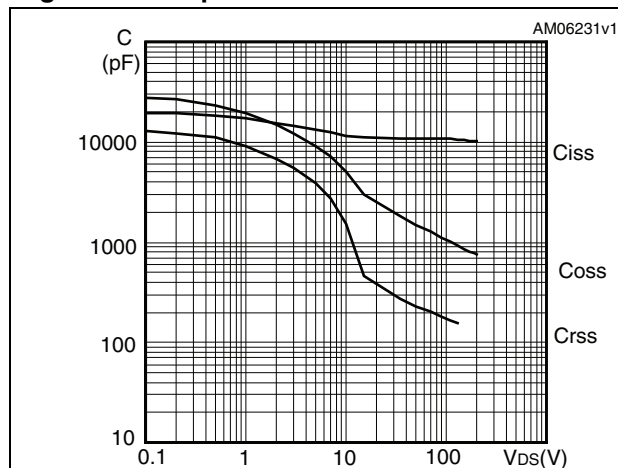


Figure 9. Output capacitance stored energy

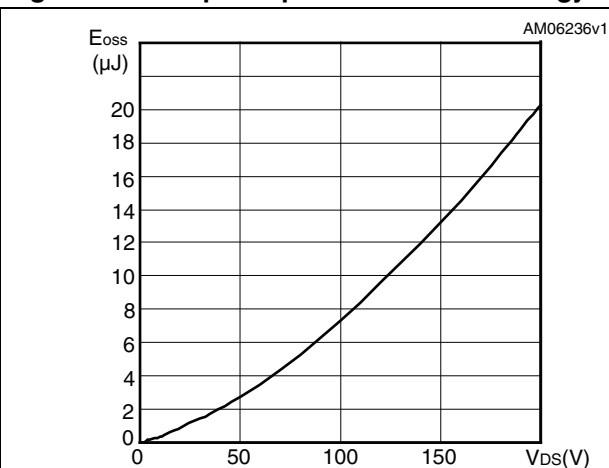


Figure 10. Normalized gate threshold voltage vs temperature

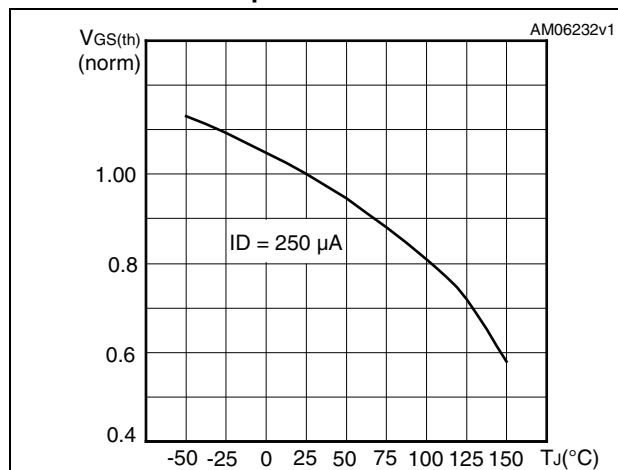


Figure 11. Normalized on resistance vs temperature

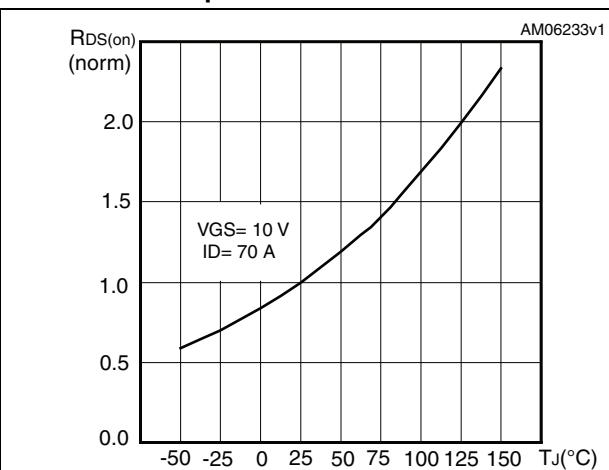


Figure 12. Source-drain diode forward characteristics

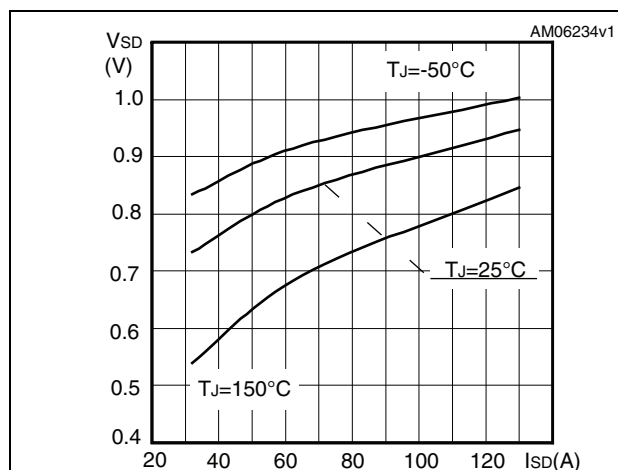
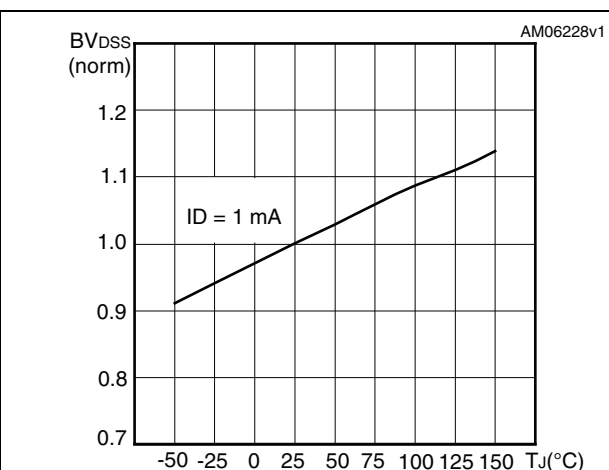
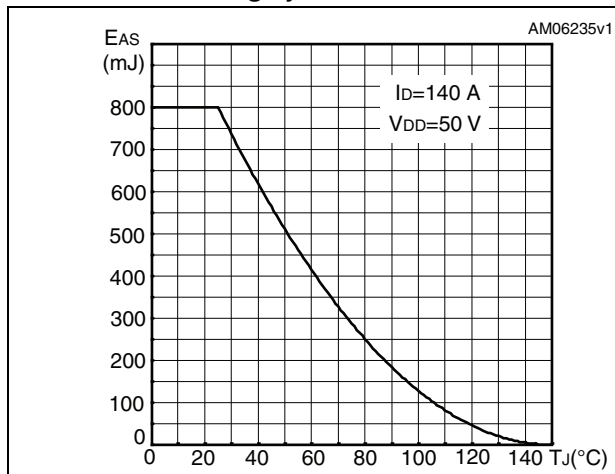
Figure 13. Normalized $B_{V_{DS}}$ vs temperature

Figure 14. Maximum avalanche energy vs starting T_J



3 Test circuits

Figure 15. Switching times test circuit for resistive load

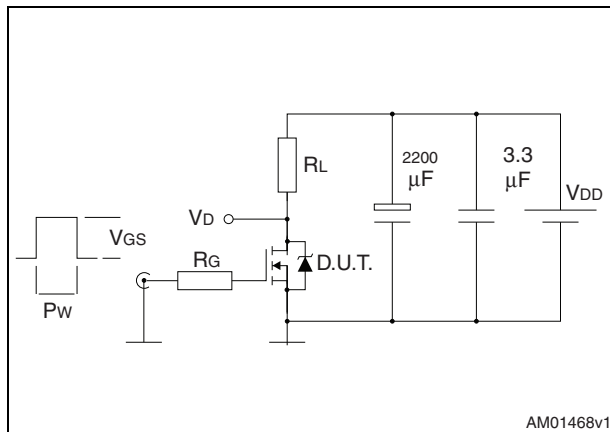


Figure 16. Gate charge test circuit

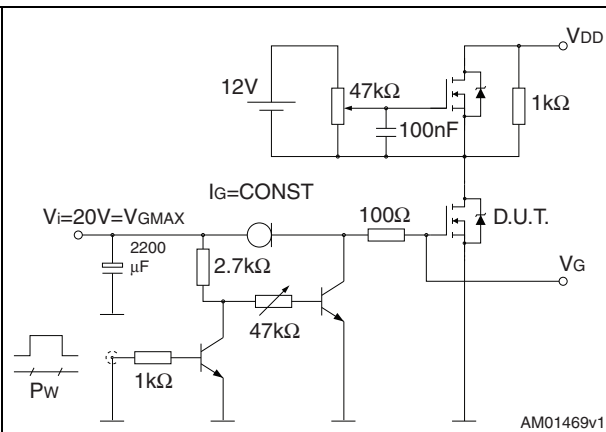


Figure 17. Test circuit for inductive load switching and diode recovery times

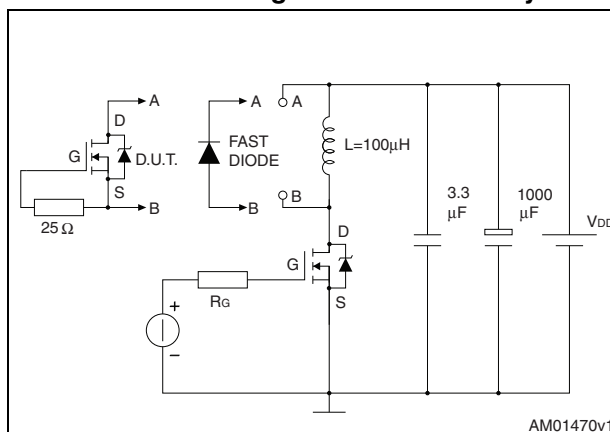


Figure 18. Unclamped inductive load test circuit

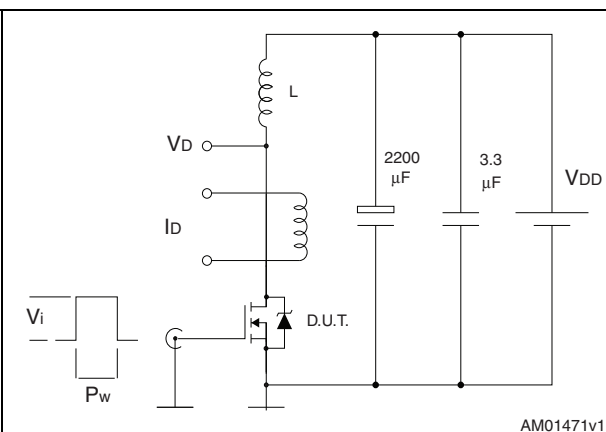


Figure 19. Unclamped inductive waveform

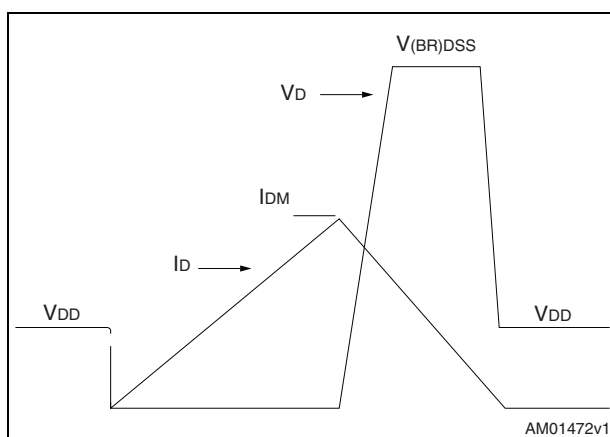
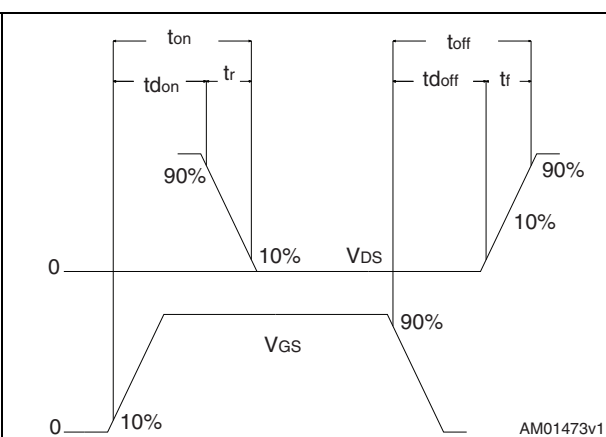


Figure 20. Switching time waveform



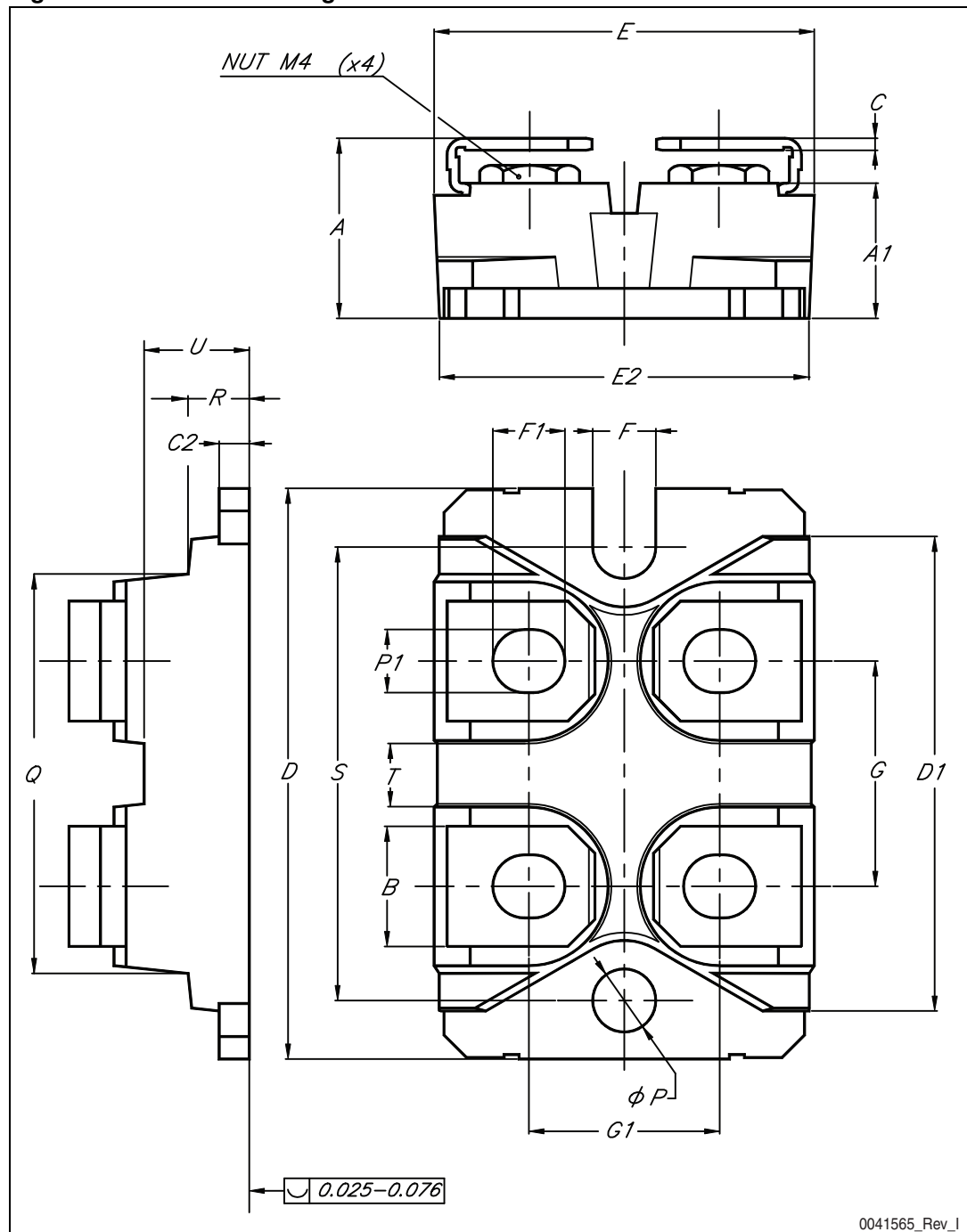
4 Package mechanical data

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. ISOTOP mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	11.76		12.19
A1	8.92		9.58
B	7.80		8.18
C	0.76		0.84
C2	1.98		2.13
D	38		38.20
D1	31.50		31.70
E	25.20		25.45
E2	24.59		25.07
G	14.91		15.09
G1	12.57		12.83
F	4.09		4.19
F1	4.67		4.93
φP	4.09		4.27
P1	4.06		4.32
Q	26.54		26.90
R	3.94		4.42
S	30.12		30.30
T	3.30		3.61
U	6.88		7.09

Figure 21. ISOTOP drawing



5 Revision history

Table 9. Document revision history

Date	Revision	Changes
27-Jan-2009	1	First release
18-Jan-2010	2	Document status promoted from preliminary data to datasheet.
01-Jul-2010	3	Inserted V_{ISO} parameter in Table 2: Absolute maximum ratings
17-Oct-2012	4	Updated: Figure 1, 5, 6, 10, 11, 13 . Updated: I_{SD} value in note 4 (below Table 2: Absolute maximum ratings). Updated: I_{DSS} and I_{GSS} values (test conditions) in Table 4: On/off states . Updated: Section 4: Package mechanical data . Minor text changes.

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