STE145N65M5

N-channel 650 V, 0.012 Ω typ., 143 A MDmesh™ M5 Power MOSFET in an ISOTOP package

Datasheet - production data

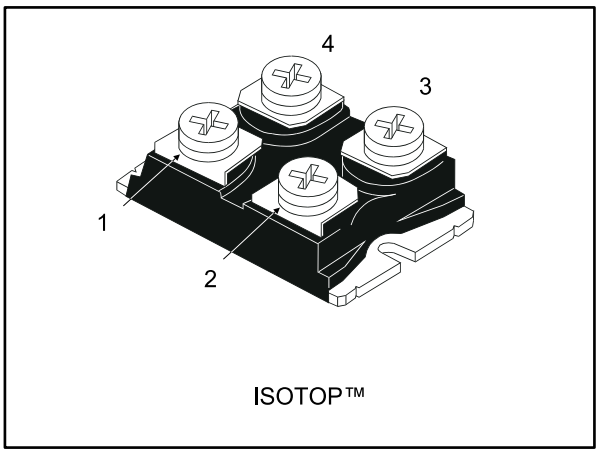
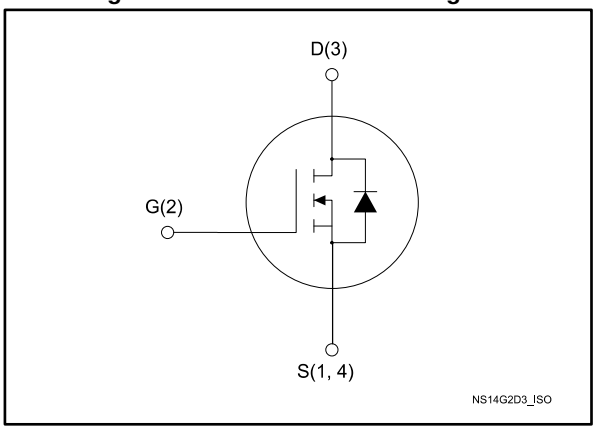


Figure 1: Internal schematic diagram



Features

Order code	V_{DS} @ T_{Jmax}	$R_{DS(on)}$ max.	I_D
STE145N65M5	710 V	0.015 Ω	143 A

- Extremely low $R_{DS(on)}$
- Low gate charge and input capacitance
- Excellent switching performance
- 100% avalanche tested

Applications

- Switching applications

Description

This device is an N-channel Power MOSFET based on the MDmesh™ M5 innovative vertical process technology combined with the well-known PowerMESH™ horizontal layout. The resulting product offers extremely low on-resistance, making it particularly suitable for applications requiring high power and superior efficiency.

Table 1: Device summary

Order code	Marking	Package	Packaging
STE145N65M5	145N65M5	ISOTOP	Tube

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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 °C	143	A
I_D	Drain current (continuous) at T_C = 100 °C	90	A
I_{DM} (1)	Drain current (pulsed)	572	A
P_{TOT}	Total dissipation at T_C = 25 °C	679	W
I_{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by Tj max)	12	A
E_{AS}	Single pulse avalanche energy (starting T_j = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	2420	mJ
dv/dt (2)	Peak diode recovery voltage slope	15	V/ns
V_{ISO}	Isolation withstand voltage applied between each pin and heatsink plate (AC voltage, t = 60 s)	2.5	kV
T_{stg}	Storage temperature	- 55 to 150	°C
T_j	Max. operating junction temperature	150	

Notes:

(1)Pulse width limited by safe operating area.

(2)I_{SD} ≤ 143 A, di/dt ≤ 400 A/µs; $V_{DS(peak)}$ < $V_{(BR)DSS}$, V_{DD} = 400 V.

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case max	0.184	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient max	30	°C/W

2 Electrical characteristics

T_C = 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	V_{GS} = 0 V, I_D = 1 mA	650			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 650 V			10	µA
		V_{GS} = 0 V, V_{DS} = 650 V, T_C = 125 °C			100	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = ±25 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 = 69 A		0.012	0.015	Ω

Table 5: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS}= 100 V, f = 1 MHz, V_{GS} = 0 V	-	18500	-	pF
C_{oss}	Output capacitance		-	413	-	pF
C_{rss}	Reverse transfer capacitance		-	11	-	pF
$C_{o(er)}$ (1)	Equivalent output capacitance energy related	V_{GS} = 0, V_{DS} = 0 to 520 V	-	415	-	pF
$C_{o(tr)}$ (2)	Equivalent output capacitance time related		-	1950	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, open drain	-	0.7	-	Ω
Q_g	Total gate charge	V_{DD} = 520 V, I_D = 69 A, V_{GS} = 10 V (see *Figure 15: "Test circuit for gate charge behavior"*)	-	414	-	nC
Q_{gs}	Gate-source charge		-	114	-	nC
Q_{gd}	Gate-drain charge		-	164	-	nC

Notes:

(1)$C_{o(er)}$ 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}

(2)$C_{o(tr)}$ 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
$t_{d(V)}$	Voltage delay time	V_{DD} = 400 V, I_D = 85 A R_G = 4.7 Ω, V_{GS} = 10 V (see *Figure 16: "Test circuit for inductive load switching and diode recovery times"* and *Figure 19: "Switching time waveform"*)	-	255	-	ns
$t_{r(V)}$	Voltage rise time		-	11	-	ns
$t_{f(i)}$	Current fall time		-	82	-	ns
$t_{C(off)}$	Crossing time		-	88	-	ns

Table 7: Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		143	A
I_{SDM}, (1)	Source-drain current (pulsed)		-		572	A
V_{SD} (2)	Forward on voltage	V_{GS} = 0 V, I_{SD} = 143 A	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 143 A, di/dt = 100 A/µs, V_{DD} = 100 V (see *Figure 16: "Test circuit for inductive load switching and diode recovery times"*)	-	568		ns
Q_{rr}	Reverse recovery charge		-	14.5		µC
I_{RRM}	Reverse recovery current		-	51		A
t_{rr}	Reverse recovery time	I_{SD} = 143 A, di/dt = 100 A/µs, V_{DD} = 100 V, T_j = 150 °C (see *Figure 16: "Test circuit for inductive load switching and diode recovery times"*)	-	728		ns
Q_{rr}	Reverse recovery charge		-	24.5		µC
I_{RRM}	Reverse recovery current		-	67		A

Notes:

(1)Pulse width is limited by safe operating area

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

2.2 Electrical characteristics (curves)

Figure 2: Safe operating area

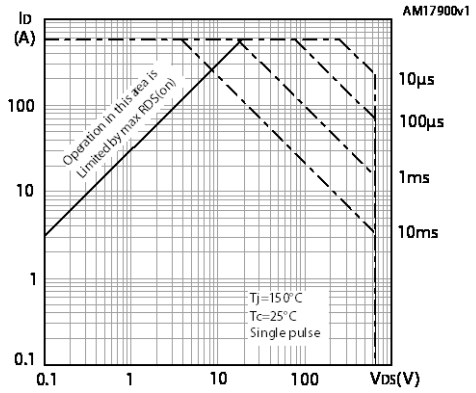


Figure 3: Thermal impedance

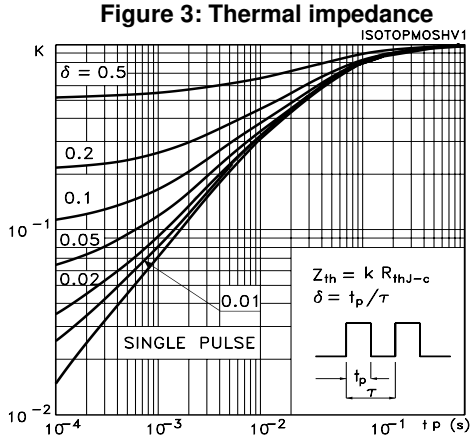


Figure 4: Output characteristics

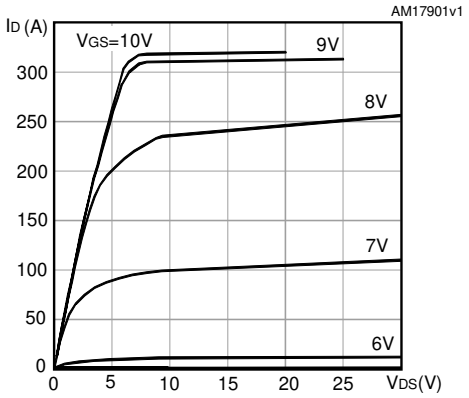


Figure 5: Transfer characteristics

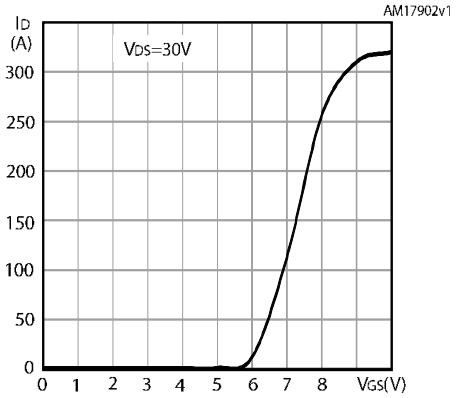


Figure 6: Gate charge vs gate-source voltage

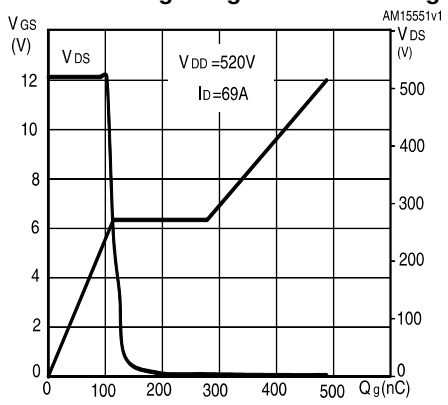


Figure 7: Static drain-source on-resistance

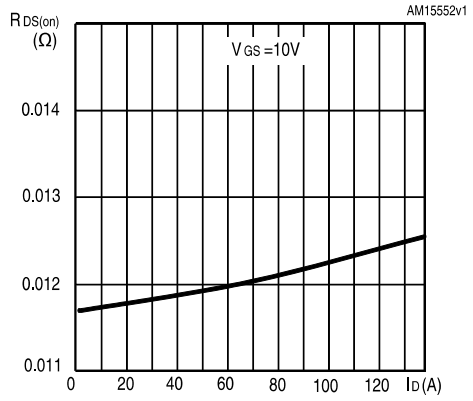


Figure 8: Capacitance variations

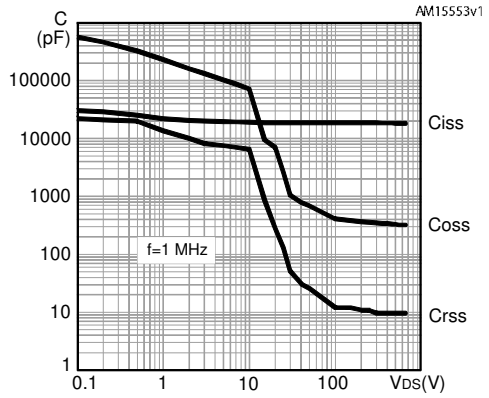


Figure 9: Normalized gate threshold voltage vs temperature

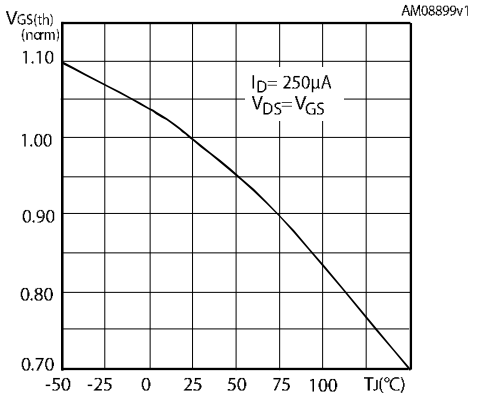


Figure 10: Normalized on-resistance vs temperature

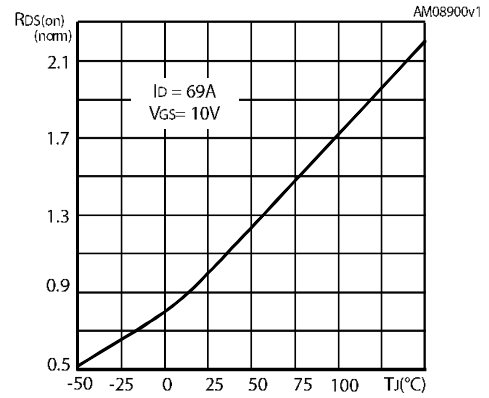


Figure 11: Normalized $V_{(BR)DSS}$ vs temperature

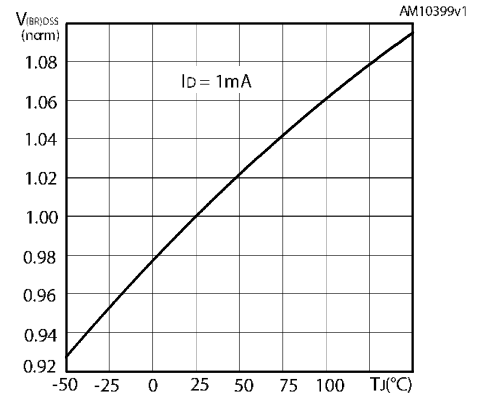


Figure 12: Output capacitance stored energy

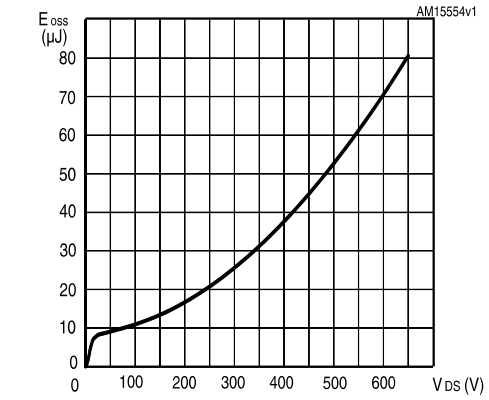
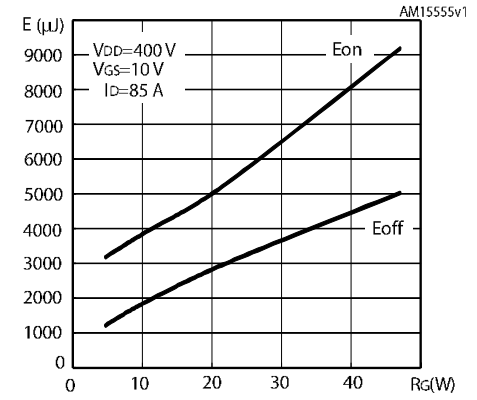


Figure 13: Switching losses vs gate resistance



The previous figure E_{on} includes reverse recovery of a SiC diode.

3 Test circuits

Figure 14: Test circuit for resistive load switching times

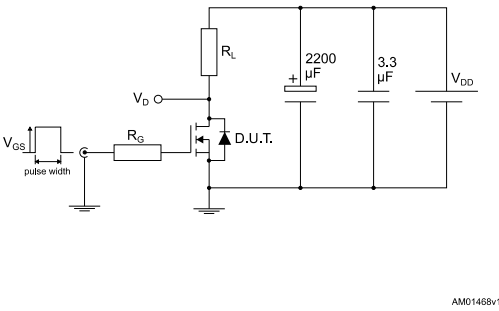


Figure 15: Test circuit for gate charge behavior

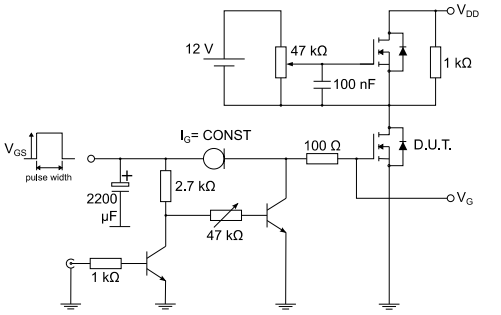


Figure 16: Test circuit for inductive load switching and diode recovery times

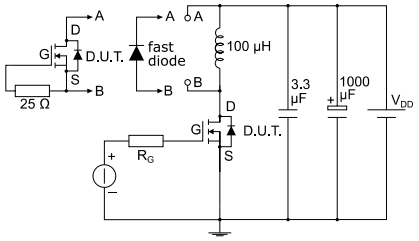


Figure 17: Unclamped inductive load test circuit

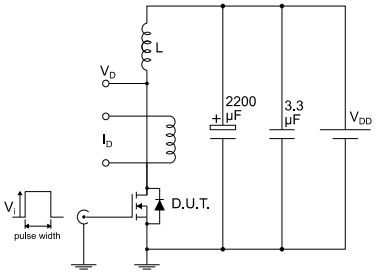


Figure 18: Unclamped inductive waveform

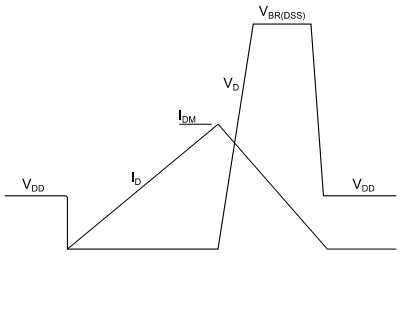
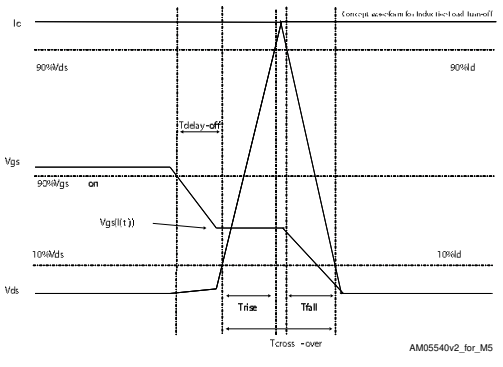


Figure 19: Switching time waveform



4 Package information

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.

4.1 ISOTOP package information

Figure 20: ISOTOP outline

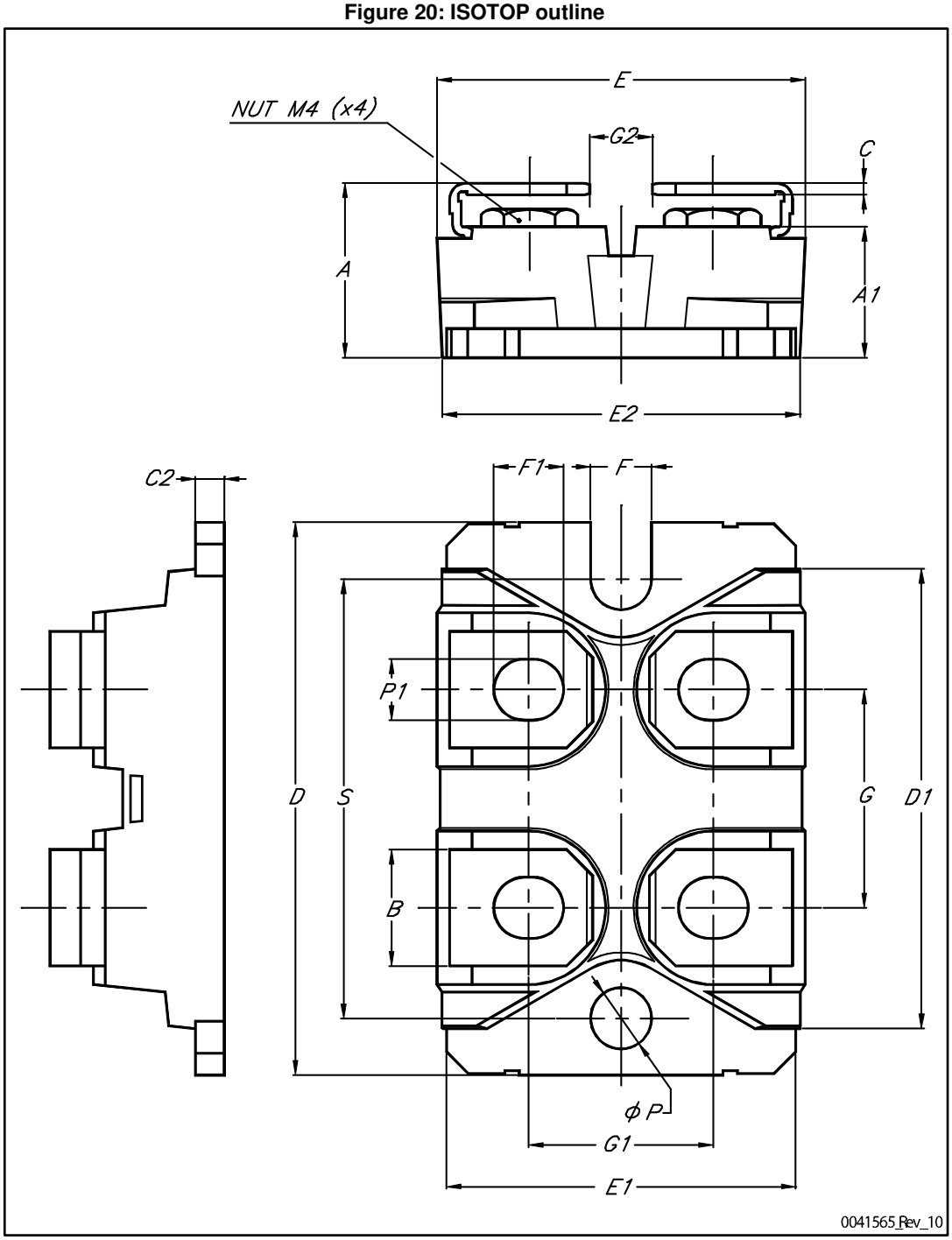


Table 8: ISOTOP mechanical data

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
ØP	4		4.30
P1	4		4.40
S	30.10		30.30

5 Revision history

Table 9: Document revision history

Date	Revision	Changes
18-Nov-2013	1	First release.
12-Nov-2015	2	Updated title, features and description on cover page. Document status promoted from preliminary to production data. Modified: *Table 2: "Absolute maximum ratings"* and *Figure 12: "Output capacitance stored energy"* Minor text changes.

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